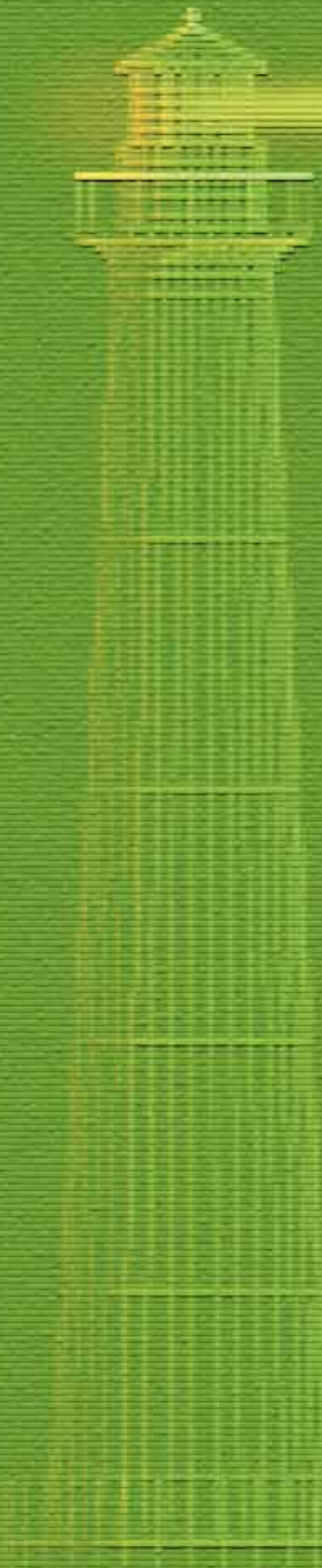
7th Global Symposium for Regulators (Dubai, 2007)

The Road to Next Generation Networks (NGN): Can regulators promote investment and achieve open access?

Discussion Papers

International Telecommunication Union



GSR 2007

DISCUSSION PAPER

NGN OVERVIEW

Comments are welcome and should be sent by 1 March 2007 to GSR07@itu.int

International Telecommunication Union

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NEXT GENERATION NETWORKS (NGN) REGULATION OVERVIEW

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*This paper has been prepared by **Dr. Tracy Cohen**[‡], Independent Communications Authority of South Africa (ICASA), as an input document for the 2007 Global Symposium for Regulators (GSR), organized by the Telecommunication Development Bureau (BDT). The views expressed in this paper are those of the author and do not necessarily reflect the opinions of the ITU or its membership. Comments are welcome and should be sent to gsr07@itu.int by 1 March 2007.*

The ICT sector once again stands on the cusp of a new era in technological development: the migration to fully Internet Protocol (IP) enabled networks and services or Next Generation Networks (NGN). NGNs are managed broadband networks that allow integrated data, voice and video services through the deployment of Internet Protocols. IP based networks will ultimately replace traditional circuit switched telecommunications networks (PSTN) and services and traditional fixed line carriers have begun to invest in and deploy IP based networks, usually as overlays of their existing networks which continue to offer traditional services. Due to the efficiencies and flexibility of IP technology, most new networks being established are also IP based. The ITU predicts that by 2008, at least 50 percent of all international minutes will be carried on IP networks and that many international carriers will have deployed all IP based networks. The OECD predicts that between 2002 and 2006, the market for NGN equipment will grow by 23 percent annually, with the optical switch market growing at 84 percent and the switching market by almost 12 percent.[1] While NGN migration is a gradual process, it is anticipated that in OECD countries, full fixed NGNs are expected to be in place by 2012 and mobile by 2020, enabling the full and true convergence of fixed and mobile, voice and data, data and video and the Information Technology (IT) and telecoms and broadcast sectors.[2] This means that the choice of technology used for infrastructure no longer has an impact on the kinds and variety of services that are delivered over that infrastructure. The advent of NGNs therefore heralds a shift from vertically to horizontally integrated networks, enabling unfettered, consistent and ubiquitous access for both users of these networks and competing service providers.[3] This presents many opportunities, challenges and innovative options and alternatives for the global ICT sector.

1 Introduction

The current circuit switched, telco regulatory model, with its oversight intensive approach to technical and economic regulation differs markedly from regulatory approaches to the packet based Internet, which is generally less subject to regulatory intervention. The two have evolved differently, requiring disparate approaches by regulators to new developments. In some cases, simply augmenting current practices is sufficient. For example, in countries where it is legal to offer Voice over IP services (VoIP), ensuring that VoIP operators have the right to interconnect to other operators and access to a national numbering plan. However, as NGNs combine the telco and the Internet model at a technical level, it will therefore require planning and foresight by regulators and policy makers at the legislative and policy level too, in order to ensure that regulatory frameworks are designed or augmented to facilitate NGN development and deployment.

This presents an opportunity for regulators and policy makers to analyze what impact their current regulatory framework has on innovation, investment and affordable access and to design frameworks for NGNs that ensure these goals are met, informed by their own domestic specific context. The NGN evolution thus presents another opportunity, heralded by technological innovation, to re-define regulatory ground rules in advance, audit and review approaches to regulation and policy that will seek to promote competition, investment and widespread end user access. Key regulatory questions emerge that need to be addressed. These include primarily whether an NGN regulatory framework should be regarded as a choice between two different regulatory approaches, or a hybrid system, or an entirely new model? For example, **West African** countries have agreed on a harmonized regulatory framework[4]. A new entrant in the fixed line space who may deploy a NGN network will certainly coexist with legacy networks that are sometimes analogous. In

this context the question of framework to be used is important, yet it remains unclear whether a new harmonized one or a hybrid one taking into account the diversity of coexisting networks would best facilitate for example, interconnection and tariffs regulation. Moreover, how should policy makers and regulators approach the migratory phase, while PSTNs, mobile networks, IP and NGN co-exist, without leading to a situation of different regulatory frameworks for different networks, leading to discriminatory regulatory treatment and fostering arbitrage? Is NGN an opportunity to lighten the regulatory burdens that were placed on PSTN operators, while at the same time cautiously moving toward *some* regulation of the Internet to protect the network and its users? It is an early phase in the regulatory history of NGNs and there exist more questions than answers to many of the challenges presented. This GSR Discussion Paper will highlight the main concerns that regulators and policy makers should begin to address as they decide if, when and how to approach aspects of regulating NGNs.

Box 1: What is Internet Protocol (IP)?

Traditionally, connections for voice communications using circuit switching require a physical path connecting the users at two ends of the network. That path must stay open until the communication session ends resulting in users having dedicated access to a direct connection. Over the Internet data (including voice) is delivered using the Internet Protocol. With this technology, the message is divided into packets containing both the sender's and receiver's IP addresses that identify them. Any packet is sent to a router that understands the destination address and forwards the packet to an adjacent router that in turn reads the destination address. This process will continue across the Internet until one router recognises the packet as belonging to within its immediate domain. That router then forwards the packet directly to where the address is specified. Since a message is divided into a number of packets, it can be sent by a different route across the Internet when necessary and the routes packets can take to the same destination may vary depending on the routing information available. In this way, IP networks allow communication flow without requiring the establishment of an end-to-end dedicated path.

These packets can also transmit voice information and as a result, a variety of platforms, including wireline and wireless communications standards and gaming systems, have evolved to include IP as a key component. For example, personal digital assistants (PDAs) have a capability to transmit voice and other data using IP technology. IP networks are currently used by a wide range of users from enterprise customers to residential VoIP subscribers. The most widely used version of IP today is Internet Protocol Version 4 (IPv4), but Internet Protocol Version 6 (IPv6) is already being deployed in many networks. IPv6 is expected to add a number of improvements to IPv4 in that the function of multicast is installed as a default which will ensure quality of service in telecommunications with a configuration where voice and image has a higher priority than data, in addition to significantly increasing the available address space.

Source: OECD (2006) and SearchMobileComputing.com

2 What do we mean by "Next Generation Networks"?

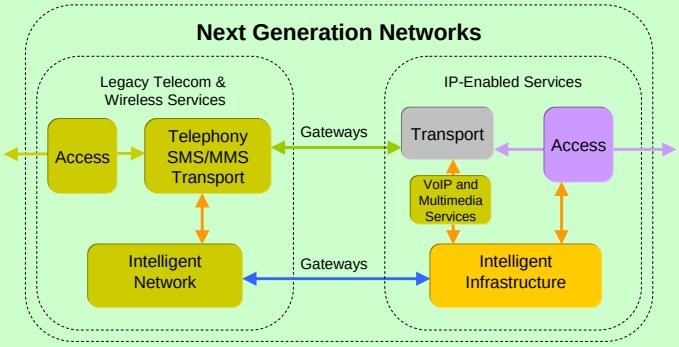
There are numerous views of what constitutes NGNs and different operators that have begun the process of migration or development refer to their networks differently: for example, Korea Telecom uses the name Broadband convergence Network (BcN) and British Telecom has named their NGN, "21CN". Deutsche Telekom calls their IP-based global network Telekom Global Network (TGN); NTT (Nipon Telegraph and Telephone) call their NGN Resonant Communication Network Architecture or RENA. There is however a tendency when using the term "NGN" for it to mean different things for companies and people using the term. For some, NGN simply means migration from the PSTN to an IP based network. For others, it is a more specific reference to, for example, international calling IP trunking, and/or IP in the local loop. Numerous vendors use the term NGN in their products and operators and providers setting out their vision refer to NGNs frequently for marketing and other purposes, but there is no reference to a single set of NGNs standards at this stage.

At a minimum, NGNs are generally packet-based, IP-based, multi-service networks.[5] Some definitions consider capacity for example, 20Mbps or more as definitive on the basis that such bandwidth would be the minimum required to support services that cannot be delivered using current broadband technologies.[6] At the broadest level, NGN's imply very fast access to and end to end IP based network.

NGNs can be developed using a number of technologies, including fibre, cable, fixed, mobile wireless, or further technology upgrades to the existing copper based networks. This heralds the shift from a "one

network-one service" approach, to a "one network–many services" one.[7] For operators NGNs are considered essential for strategically positioning networks to compete in the increasingly converged world of services and content where voice is no longer the sole source of revenue. While the Trends in Telecommunication 2007 chapter on NGN Technology will provide a detailed breakdown of the technical aspects of NGNs, an overview is offered here to set the context for understanding the regulatory, operational and financial issues that arise from NGN development.

Box 2: Legacy fixed and wireless networks and NGNs



Source: Anthony Rutkowski, Verisign

At a market level, NGNs are partially driven by the increased demand for ubiquitous, integrated data, voice and video, mobile and fixed broadband, alongside the increasing role of mobile services in the broadband domain. Demand and technological evolution has driven the inevitable convergence of IP based networks with traditional PSTNs and existing mobile networks. Operators and investors seek increased revenue and profitability, greater productivity and broader service offerings. These trends are facilitating the integration of separate and distinct mobile and fixed technologies (optimised for one service) to enable the seamless distribution of services over fixed and mobile broadband services and to create a unified IP-based multi-service network. Put simply, a NGN can be viewed as a "communication network that allows unfettered access to all communication products and services, irrespective of the service provider or network connection."[8]

At the technical level, NGN's are distinguished from legacy or traditional circuit switched networks in that all information is transmitted via packets, which are then labelled according to their type (data, voice, etc) and handled differently by traffic management equipment.

Box 3: ITU Definition of NGN

The ITU defines a **Next Generation Network** as a packet-based network able to provide services including telecommunication services and able to make use of multiple broadband, QoS-enabled transport technologies and in which service-related functions are independent from underlying transport-related technologies. It offers unfettered access by users to different service providers. It supports generalized mobility which will allow consistent and ubiquitous provision of services to users.

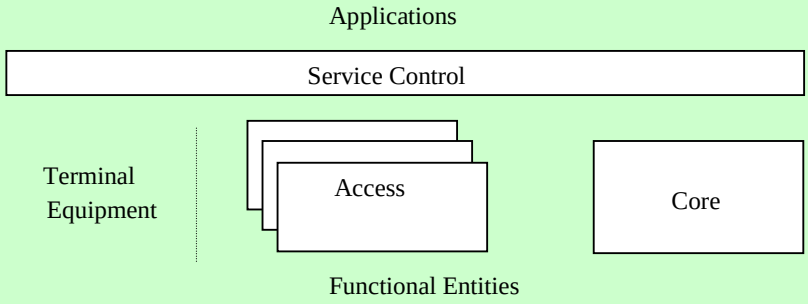
Source: ITU-T Recommendation Y.2001 (Study Group 13)

The above definition divides the NGN in two parts, namely the ***Core*** and the ***Access NGN***. The ***Core NGN*** is essentially the transport or backbone network, and uses digital technology to connect telephone calls and other network traffic more efficiently than traditional networks. **Access *NGNs*** involve an upgrading of the local loop to broadband, either through DSL technology or by deploying fibre into the loop for part, or all of the connection. Building a core NGN does not directly influence these access technologies.[9] At the core, providers need to upgrade the equipment in telephone exchanges (replacing switches, installing routers and VoIP equipment) but do not need to change existing wires and fibre in the ground."[10] This facilitates

converged technologies to carry multiple services (voice and data) over the *same* (horizontal) infrastructure and equipment, rather than using *separate* (vertical) equipment and/or infrastructure.[11]

In addition NGN's involve a *de-coupling or separation* between the transport (connectivity) portion of the network and the services that run on top of that transport. (see box below) By separating transport and service layers, a provider can enable a new service by defining it directly at the service layer without considering the transport layer – that is, service and transport layers are entirely independent, which has implications for competition and pricing.[12] Services may therefore be provided as *applications* on a NGN network.

Box 4: NGN - Core, Access, Services



The Next Generation Core: The next generation core network is a single converged fixed network, which can carry voice and data. The network technology of choice will be IP/MPLS and all traffic is transported as IP. This core network evolves from a complex environment of different boxes in today's core networks. The evolution to a next generation core network promises significant savings in the long run and a stable platform for converged services.

The Next Generation Access: The next generation access is a large digital bitpipe. The next generation access is service independent and allows multiple plays (TV broadcast, high speed internet access, telephony and others). There will not be a single platform to deliver next generation access. Platform competition is expected between copper lines, cable networks, mobile networks as well as wireless, satellite and fibre access.

The Next Generation Service Control: Today's service control is service specific. In a next generation network rapid service development and delivery is paramount. The next generation service control will provide a toolbox for operators, where converged service can be brought to market flexibly and quickly. Certain challenges arise regarding interoperability of services and service components.

Source: European Telecommunications Platform

Next Generation Networks then is a catch-all phrase for the infrastructure that will enable the advanced new services that mobile and fixed network operators have started to offer, while continuing to support existing services. They will also support fixed, mobile and nomadic users and have the ability to carry voice, data and multimedia – real time interactive services.[13] These networks enable a range of new service offerings in a multi-vendor environment, such as for example, Voice over IP.[14]

As factors like interoperability and quality of service (QoS) are critical, work is underway in numerous organizations concerned with standards to ensure that NGN evolution and migration is being carried out coherently and effectively. Already, there are various interoperability issues between different VoIP soft client providers, which if not addressed, will hold back the development of this service segment. Some of these standards organizations include the European Telecommunications Standards Institute (ETSI), specifically the Telecoms and Internet Converged Services and Protocols for Advanced Networks (TISPAN); the ITU Standardization Bureau (ITU-T), specifically the NGN Global Standards Initiative (NGN-GSI), the 3rd Generation Partnership Project (3GPP) and the Fixed Mobile Convergence Forum.[15] There are also many organizations such as for example, the European Regulators Group (ERG); European Conference of Postal and Telecommunications Administrations (CEPT); the ITU and the Organization for Economic Cooperation and Development (OECD) to name a few, which are currently engaged in policy and regulatory based research on IP and NGN networks, considering the types of regulatory principles and

implementation issues that they involve. Many projects are also taking place regionally, for example, in Europe, the GÉANT project (including all research and education networks in Europe) and the Task Force on Next Generation Networking (TF-NGN) were established for collective investigations and deployment of NGN in 2001; NGN FOG in Australia under the auspices of the NGN Ventures conference in the USA, UNF in Japan and the BcN Forum in Korea are also joint activities related to technology and service development.[16] As mentioned above however, while there are characteristics of NGNs and services, there is not as yet a single standard or reference point for benchmarking them. This is still evolving as work in these organizations is underway.

Table 1: Major Characteristics of NGN

All IP or packet-based networks (Migration from circuit based ISDN to packet based ISDN)
Separate application/services from the transport networks
Open networks
Converged or integrated broadband networks
Distribution of network intelligence

Source: OECD

Table 2: Comparison of telco networks and the Internet

Current telco networks – closed	**Telco NGN networks –closed**	**Internet – open**
• Circuit switched technology	• ATM/IP based technology	• IP based technology
• Intelligent network	• Less intelligent network	• Dumb network
• Dumb terminal	• More intelligent terminal	• Intelligent terminal
• User-user services centrally controlled by provider of transport service	• User-user services centrally controlled, with much greater scope for third party services.	• User-user services run by users themselves. No service creation - services and applications run from edge.
• No client-host services		• Client-host services run by independent hosts at edge
• Usage related charges and quality control	• Usage related charges and quality control	• No usage-related charges and little quality control. Gateways to telco networks have control and charging.
• Access control for users and interconnection	• Access control for users and interconnection	• Access control for users but otherwise open.
• Interconnection is service related and controlled	• Interconnection may occur at various levels. Above the IP level it is likely to be service related and controlled.	• Interconnection is open and only at IP level.
• Few/no third party services	• Few/no third party services	• Numerous third party services

Source: CEPT, 2003.

Box 5: What is a Next Generation Network?

The NGN is characterized by:

- Packet-based transfer
- Separation of control functions among bearer capabilities, call/session, and application/ service
- Decoupling of service provision from network, and provision of open interfaces
- Support for a wide range of services, applications and mechanisms based on service building blocks (including real time/ streaming/ non-real time services and multi-media)
- Broadband capabilities with end-to-end QoS and transparency
- Interworking with legacy networks via open interfaces
- Generalized mobility
- Unfettered access by users to different service providers
- A variety of identification schemes which can be resolved to IP addresses for the purposes of routing in IP networks
- Unified service characteristics for the same service as perceived by the user
- Converged services between Fixed and Mobile
- Independence of service-related functions from underlying transport technologies
- Compliant with all Regulatory requirements, for example concerning emergency communications and security/privacy, etc.

3 Differences between NGNs in developed and developing markets

While there are commonalities between NGNs evolving in highly developed ICT markets and NGNs in less developed markets, like many other aspects of the ICT sector in these markets, there are many differences affecting regulatory, financial and operational issues. The most obvious of which are linked to questions of access and affordability. Developed markets generally boast high levels of PSTN, mobile, Internet and broadband penetration, while less developed markets generally have low penetration indicators and the presence of more mobile than fixed line networks. It is trite, but worth restating that in order for consumers to begin to reap the benefits of NGN services, greater attention needs to be paid to creating competitive environments. This pertains to both traditional fixed and mobile voice, which with NGN-related standards such as SIP, will seamlessly interface with each other in a wider IP based environment.

Other major differences in the NGN evolutionary path between developed and developing countries will be the pace and manner NGN assumes. One similarity is that full NGN evolution takes time and will not occur rapidly, with predictions of 2012 -2020 as the period in which most operators in developed countries will see NGN migration come to fruition. Convergence is driving new demand for the *variety* of service offerings that can now be delivered and while so doing, is blurring pre-existing boundaries between fixed, mobile and data networks. This means that the end user can request a range of services, regardless of the access technology used. This requires a "meta-infrastructure" beyond the existing, subordinated networks – a core network for all the access networks.[17] It is envisaged that developed countries, with already existing and evolved fixed line networks (predominantly fibre based) will more easily leverage existing fixed line networks for core and access NGN development. For example, British Telecom began its PSTN evolution in 2005 by deploying Multi Service Access Node (MSAN) devices to its edge network. The replacement of circuit switches by SoftSwitches started in 2005 and it is anticipated that 50% of all BTs circuit switches will have been replaced by 2007. Verizon has also adopted the SoftSwitch technology to upgrade already existing circuit exchanges in its local networks.[18]

On the contrary, where fixed line network development is not as evolved and considering the prevalence of mobile networks in relation to fixed in developing countries, it is arguable that NGN in developing countries will more likely be leveraged off existing 2G mobile networks, suggesting that they will be wireless. This is made possible through the IP Multimedia Subsystem (IMS). Generally, the core NGN will tend to be a fixed network, with the possibility of interconnection with a mobile network. However, both fixed and mobile are converging towards a unique type of core NGN architecture for fixed and mobile networks: the IMS (IP Multimedia Subsystem). Most cellular mobile operators in **Africa** have 2G GSM networks. Some of these networks are being transformed into intermediary generation networks (2.5G) like GPRS (General Packet

Radio Service). Outside of countries like South Africa, who have fully fledged third generation mobile networks (3G), it is difficult to predict the pace at which such transformation will take place. In any case, the evolution of second generation networks into 3G through 2.5G constitutes multi-faceted challenges for operators in this constantly changing environment. In essence, this suggests that developing countries may have less existing infrastructure to leverage in the evolution to NGNs. While the NGN migration path is likely to differ between developed and developing countries, and within developed and developing countries themselves, this does not however mean that developing countries are going to have to build out fixed, fibre networks to achieve full NGN migration.

The salient driver behind this migration is to reduce the costs of building and operating a number of separate networks. As fixed line voice service revenue continues to decline, network evolution consolidating existing legacy equipment regardless of the infrastructure, is a priority issue for operators. This will enable operators to optimize network resources by carrying a variety of services on a converged multi-service IP network, and by using node devices with higher processing and service interfacing capabilities to optimize the network structure. This will in turn enable the cost-efficient provision of innovative services. It is important to note however that there is no "one size fits all" network solution that can apply to all operators, as each has its own network scale and topology. One view argues that operators with large scale networks tend to adopt the smooth migration policy to upgrade their networks seamlessly, while operators with small scale networks tend to build new IP networks and migrate current services to the new networks.[19]

More critically for policy makers and regulators is the question whether to regulate IP network development or allow an evolutionary approach for IP networks. And where a decision is taken to regulate rather than evolve, what aspects of NGN migration should be regulated? On the one hand, deployment requires significant capital investment and oversight by regulators to ensure that investments are protected. On the other hand, it can be argued that opening access to all market segments will induce appropriate risk assessed investment and result in competition which should then be accompanied by regulatory forbearance except in the case of market failure. In many developed countries, this goal has prompted a preceding discussion on the benefits of *ex post* (after the fact) versus *ex ante* (before the fact) regulation. Some countries, like Canada are starting to move towards a framework in which *ex post* regulation begins to play a bigger role than *ex ante* regulation based on verified complaints of significant market power (SMP). This would see greater reliance placed on a country's competition authority rather than the sector regulator.[20] However, these developments tend to reflect more mature telecommunications markets which have seen a longer or faster period of market liberalisation than is the case in most developing countries. Nontheless, an underlying remaining requirement for the development of competition, and a clear requirement of the combined WTO GATS Agreements, is a clear, transparent and non discriminatory *ex ante* framework to promote competition that at the same time, reflects the needs of convergence and integrated services.[21]

This has importance beyond the sector. It speaks of creating credible commitments for investment generally. *Ex ante* rules are put in place to ensure that a baseline of regulatory uniformity and certainty for local and foreign investors is established. In an international trade context, this need for a minimum standard stems from the concern that domestic regulatory choices and actions can operate as non-tariff barriers, thwarting market access gains at the international level. Predictable and clear features common to regulatory systems attempt to avoid this outcome by reducing uncertainty and the high transaction costs associated with commercial exchange.[22] With the growing importance placed on foreign investment in developing countries, a sound *ex ante* framework allows a country to signal to investors that the terms upon which they expend large capital outlays in sunk costs will remain fixed and sheltered from arbitrary exercise of political or administrative discretion.[23] It has been documented that an inverse correlation exists between credibility and uncertainty, "confirming that the more credible a government and its institutions, the less investor uncertainty exists".[24] The optimum outcome for a country seeking to attract capital for network development is to have its reform programme, and the commitments made pursuant to that plan – including its regulatory institutions and rules - perceived as credible. A transparent and certain *ex ante* framework operates to minimize transaction costs and changes in the "rules of the game" at a later stage.[25] Central to this are national regulatory authorities to ensure that barriers to entry and to the use of new technologies are also reduced.

3.1 Broadband Policy

From a policy and regulatory point of view, the development of NGNs and IP-based services in developing countries can generally be characterised as policy absence or failure, usually with respect to broadband policy, and regulatory lag, coupled with affordability concerns. It is important to note however that there is an emerging coexistence of IP networks licensed to deploy NGNs for example, and IP networks largely using the Internet, which operate in the absence of any license, selling voice services (often through prepaid cards) which may be perceived as detrimental to the voice revenue of licensed operators, specifically for international calls. Although many countries in Africa for example, prohibit Internet voice traffic diversion, regulators by and large are technically not able to effectively prevent this. While this may have some cost savings for consumers in the short term, it may also be perceived as having a negative effect on the liberalisation of these fixed line markets and the introduction of new licensed NGNs. Nonetheless, the very fact that new IP services can be run over NGNs, does not necessarily alter the economics of supply and demand. While there may be some savings from network topologies, the basic issues of cost, access and rollout continues to plague developing countries. Few of these countries have yet to develop coherent broadband policies to give effect to the technological and business realities of converging networks and services.

The pre-requisite for the efficient use of a NGN is network access with high bandwidth for the end user. As such, the development of NGNs and the regulatory and policy frameworks that enable their deployment are inextricably linked to a country's national broadband policy debate and should be seen as part of that dialogue. It is countries that have extensive broadband penetration and usage such as Denmark, Iceland and South Korea, in which NGN development is best able to flourish and where the critical mass necessary for the network effects associated with economic growth are most likely to be realised. Similarly, facilitative broadband policy frameworks in India, Pakistan and Malaysia are fuelling the growth of broadband making these markets also ideal candidates for consideration of NGN migration.

Defining broadband as any access at speeds from 256Kbps and above, the ITU has noted that Africa as a whole accounts for 0.1 percent of broadband subscribers worldwide, when considered by region. Asia, Europe and the Americas account for 99 percent of all broadband subscribers, the majority of which are located in North America, Western Europe and Asia.[26] The OECD Broadband Statistics for 2006 reflect this with the highest broadband penetration rate of 29.3 subscribers per 100 inhabitants recorded in Denmark. The strongest per-capita subscriber growth (adding more than 6 subscribers per 100 inhabitants) was recorded in Denmark, Australia, Norway, the Netherlands, Finland, Luxembourg, Sweden and the United Kingdom.[27] By contrast, most African countries have yet to launch high-speed Internet services at all, although a few like Morocco, offer broadband services of up to 20Mbps and Sonatel in Senegal has rolled out a "triple-play" service bundle offering voice, Internet access and television programming.[28] It is worth noting however that in developing countries, the prevalence of fraudulent smart cards allowing access to paid satellite television programs at significantly reduced rates potentially hinders the development of television access offers in the context of triple play.

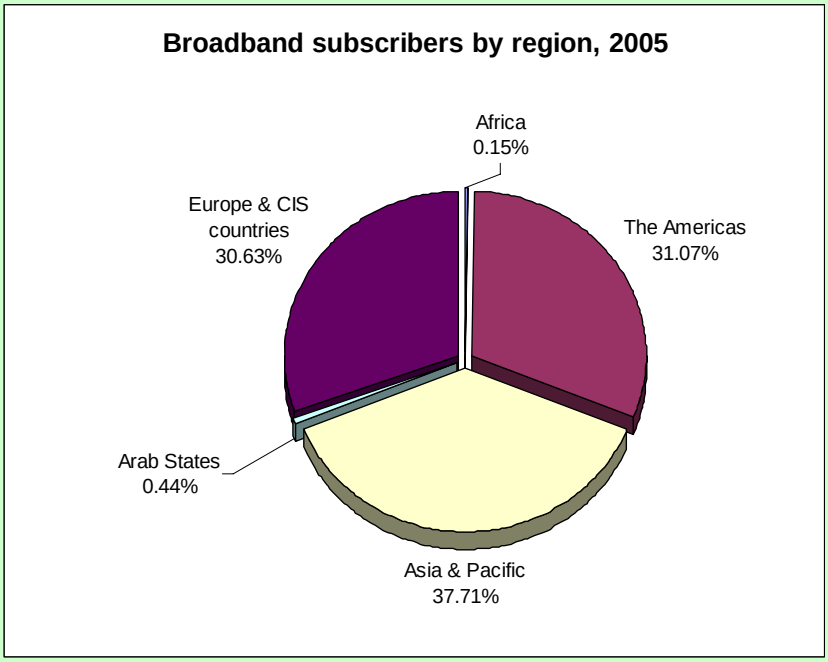
Where broadband development is occurring, it is usually led by the fixed line incumbent through DSL deployment, while still controlling access to its network for downstream competitors. The ResearchICTAfrica 2004 household study examined broadband usage across ten African countries and found it to be statistically insignificant. A similar 2005 study (although non representative) reflected a similar, negligible use of broadband services.[29] In many African countries, national penetration rates for fixed line remain exceptionally low, while high end mobile broadband services such as EDGE/GPRS, 3G and HSDPA where available, remain beyond the reach of the majority of the population. Without competition generally, prices in Africa and in developing countries generally, are magnitudes of scale higher than international benchmarks, which results in limited usage and undermines any of the economies of scale that would drive down prices.[30]

As such, structural market issues relating either to the continued monopoly of the incumbents in certain market segments or to their ability to leverage their dominance anti-competitively as a result of vertical integration across several market segments will need to be resolved to induce much needed private investment in broadband NGNs. Therefore, the issues affecting IP network and services development remain in many ways, the unaddressed "legacy" regulatory and competition issues from traditional PSTN regulation. The harmonization of regulation in different regions may however assist in addressing these legacy issues.

However, the lack of effective competition authorities (ex post regulation) in many countries may similarly serve to inhibit the attainment of this objective. Such institutional issues and where relevant, the benefits of harmonization for individual country's ICT development needs examined.

Like those countries that have been unable to develop their network extensively and are not constrained by protecting large legacy networks, those countries that have not proceeded with reform strategies and public commitments to investors and operators that may constrain them, have the potential to 'leapfrog' orthodox reform measures and adopt new strategies more appropriate to new, rapidly deployable, lower cost and higher efficiency networks. While the commercial value driver for broadband is a sound one, governments and regulators need to ensure that policy is in place to facilitate full broadband growth, outside of silo services, which are protected through legacy rate regimes, distorted interconnection frameworks and access restrictions. At this stage however, although legacy networks and NGNs will co-exist, it still remains an open question, informed by the context specific issues in each country as to whether this would be best achieved through the deployment of policy tailored for NGN development, or by developing NGN policy alongside the policy trajectory in place for legacy networks and operations.

Graph 1 : Broadband Subscribers by Region



Source: ITU World Telecommunication Indicators Database, 2005

3.2 Regulating Legacy Issues

While the advent of IP networks and services pose new challenges around the world for operators, regulators and policy makers, for the latter two, these challenges tend to comprise two parts: first, whether to legalise new services enabled by NGNs and where legalised, what aspects of these new services to regulate and whether those aspects which they seek to regulate can technically be enforced. Second and more fundamentally, to enable widespread development of IP networks and NGN services, regulators need to re-examine their roles and the degree of regulation required and its timing and sequencing.

Many of these challenges may emanate from an attempt to regulate new services in a legacy fashion, or legacy failure to regulate the dominance of incumbents or essential facilities that may inhibit the entrance of new services. This is particularly acute in developing countries where markets are just gradually opening up to competition. For example, with regard to VoIP, standards remain critical to ensuring innovation; service quality, interoperability and competitiveness. How can regulators best approach these goals? Should VoIP

services be regulated like traditional voice services?[31] Is consumer interest regulation required to ensure fair pricing and quality of service (QoS) or would this not be required if markets were more open and there was sufficient competition? Even if there was effective competition would numbering allocation; interconnection; emergency services; directory assistance, privacy and security require regulation?

Yet, despite the potential of VoIP to undercut the exorbitant prices of telecommunications, the regulatory framework in many countries does not recognise alternative voice service providers to incumbent operators. In most of Africa for example, this is often the result of the fact that such providers are not licensed, which is still a pre-condition to offering public services. How should the regulator approach this and other innovations, like IPTV or broadband wireless access networks? Traditionally, broadcasting has attracted a more interventionist regulatory approach than telecoms – at least with respect to content. Promotion of such content or protection of audiences is often closely linked to a country's language or cultural values. Questions emerge as to whether it is possible to regulate content in a converged "always-on", on-demand broadband world where content is no longer delivered solely through a single point to multi point broadcasting service? Are platform independent approaches to regulation possible? How is the public interest to be promoted in the context of this rapidly evolving IP enabled communications environment? Many of the questions that need to be addressed also proceed from the assumption that the development of NGNs will increasingly undermine rationales for asymmetrical approaches to regulation across sectors. Reforming and tailoring existing legal and regulatory regimes to this end should remain a regulatory priority.

4 NGN Deployment Drivers

Drawing from the points above regarding the pace and manner of NGN migration in developing and developed countries, it is important to highlight that there will also likely be several different migratory paths towards NGN. NGN deployment can essentially take place in two ways: in a gradual, phased-in manner on existing circuit switched networks seeking to upgrade to a fully IP-enabled architecture, or by building a fully IP-enabled network from the outset. For example, British Telecom has favoured a rapid shift to IP technology, while Deutsche Telekom has expressed its preference to adopt the overlay model, where old networks are only gradually replaced by new IP networks. Both plan to extend their services into other countries. The more gradual approach to NGN migration may include the upgrade only of the core network and replacement of routers and switches; then migrate to IP trunking, implement at the local loop level and then at the user level. The second stage of change is to introduce IMS or similar for multimedia service. And of course, many of these changes can also run in tandem with one another. For example, Telecom Egypt and Maroc Telecom are offering IP-TV but have not as yet implemented VoIP.

Other elements of gradual evolution suggest upgrading the core in urban centres first and then slowly rolling out upgrades to peri-urban centres and rural areas. It is also important to note that many countries have been using IP in their core networks for voice traffic for some time. This may prove to be sufficient in some cases, while others may choose to undertake a full scale NGN migration of all networks. While it is likely that NGN migration is an inevitable course for the ICT sector, some operators may choose not to migrate fully to a NGN, but either remain in an outdated circuit switched environment or opt for a less optimal performing IP network. One view is that in developing countries, the introduction of competition in the fixed network will force new entrants will deploy a Greenfield NGN network and drive incumbents toward a strategy of gradual NGN deployment in order to cope with the competition they will face from new entrants that may be able to offer rapidly new and innovative services through their new NGN. Within developed countries, where fixed line competition has been in place for some time, all operators face the same challenge of what strategy to adopt for migration that will best enable them to cope effectively with the challenges of competition.[32] While predictions are not easy to make at this stage, for regulators and policy makers, the critical point is that few countries will effect a rapid NGN deployment route which suggests that legacy networks will co-exist with NGNs and that consequently, legacy and NGN regulation may co-exist for a period of time. It is important that while these two systems co-exist any efforts at arbitrage, particularly with respect to interconnection and access by incumbent operators should be minimized

Already various traditional carriers, cable, mobile and fixed line operators, new entrants and Internet Service Providers (ISPs) are developing plans to migrate to a NGN. Whichever is the preferred approach both are created as a result of a coalescing of pressures or drivers on the ICT sector creating the latest innovation. Technological evolution lies at the core of these changes enabled by developments in IP technology and applications. Moreover, many legacy networks are reaching the end of their life cycles and require

replacement equipment. Other drivers include the *de facto* convergence of media, telecoms and IT, coupled with the worldwide success of mobile services and the resultant mobility, which in an IP environment, have changed the way in which consumers relate to their daily communication needs. For example, South Africa is capitalising on the developments in 3G and digital migration to ensure that when it hosts the 2010 football world cup, every mobile phone in the country will be enabled to received mobile television, while MMS services will continue to enable visitors from around the world to send photographic and video footage from stadiums around the country over their mobile phones.

Other operators that have begun to implement NGN plans include NTT in Japan which has announced plans to establish a high security, high speed and large capacity network and end-to-end connectivity. While this list is not exhaustive, Korea Telecom plan to have replaced their PSTN with an all IP based network by 2012. Similarly, Telekom Austria plans to do the same by 2009 and began its first installations in 2004. Bell Canada and Telus in Canada have also announced plans to implement NGN, along with Telecom Italia, Sprint and Qwest, the US company that claims to have completed a transcontinental domestic IP network. Shanghai Telecom and Chunghwa Telecom have been undertaking NGN deployment since 2003 and Combellga in Russia announced plans to enhance its existing voice network with IP based infrastructure. Ceský Telecom in the Czech Republic began to introduce NGN solutions in 2002.[33] In Asia, the incumbent operator in Vietnam and India are also known to have similar plans.

Box 6: Reported NGN Deployments Around the World

Africa: In 2006, Gateway Communications completed what it claims to be the continent's "first long-distance NGN" by deploying a VoIP solution to upgrade and expand its existing international long distance network. This has enabled Gateway Communications to link mobile networks cost-effectively across over 30 African countries throughout Africa and to connect with their European gateway network. With a next-generation network in place, Gateway Communications is able to use VoIP to deliver new IP services over a converged IP network. In 2005, Chinese telecoms manufacturer ZTE established a NGN based on an IP platform using CDMA2000 1x and EV-DO technology, but this was limited to Angola. Gateway spent conservatively USD 1.4 million on upgrading the network which will benefit subscribers of all major pan-African mobile carriers and some fixed line carriers by lowering the cost of calls and improving their quality. Veraz Networks Inc, a global provider of VoIP softswitches, media gateways and digital compression products provided the technology solution.

Chile: In July 2006, Chilean telecommunications and cable provider VTR, partnered with Cisco to deploy the Cisco CRS-1 Carrier Routing System, the core component of the Cisco IP Next-Generation Network (IP NGN) architecture, to facilitate the growth of triple play (data, voice and video) services over residential broadband connections. VTR was the first company in Chile to offer triple play services, and VTR is now the first telco in Latin America to deploy the Cisco CRS-1. VTR has more than 2.2 million residential subscribers, with 1.2 million digital cable TV subscribers, 300.000 Internet subscribers and 400.000 IP telephony subscribers. This deployment is part of an extensive network upgrade.

China: Jilin Mobile Communications (Jilin MCC) has deployed a mobile NGN solution to expand the operator's existing mobile network. The cornerstone of this mobile NGN solution is the Alcatel 5020 Spatial Atrium Softswitch, a multi-standard mobile call server controlling distributed media gateways. Its distributed architecture results in significant cost efficiency and greater simplicity in the design of Jilin MCC's network. It is anticipated that the upgrade increase Jilin MCC's network capacity by 30 % to serve up to 8 million subscribers covering cities in Jilin province, including Chuangchun, Jilin, Yanji, Siping, Songyuan, Liaoyun, Baicheng, Baishan and Tonghua.

France: France Telecom will start its PSTN to VoIP evolution in 2007 using two evolution modes: the first will be VOICE DSLAM devices that integrate VoIP gateway functions with traditional DSLAM. The VoIP gateway module under the control of the call server or Softswitch will convert POTS into VoIP voices. The second mode is to use RGW devices or IP phones that are controlled by the SoftSwitch to realise VoIP voice access directly at the subscriber side. France telecom will use an IMS-based NGN which will use a core controlling architecture for universal functions and integrated services.

Japan: In November 2004, the NTT Group announced its plans for building a next-generation network and developing ubiquitous broadband services. NTT plans to build an open next-generation network that a variety of players outside NTT Group can use to pioneer and develop a variety of services and business models. Services that will be offered include: broadband Internet access, IP telephony, multicast communication for video distribution, bi-directional video (data) communications, and Ethernet services.

Russia: In 2006, regional operator, JSC Sakhatelecom announced its NGN plans to offer its customers various NGN services such as IP Centrex, videoconferencing, virtual private networks and unified messaging, as well as enhanced Internet services. The company is partnering with Alcatel, some of whose other NGN projects include British telecom; the Asia Pacific Telecom Group (Taiwan) and Telecom Austria. Alcatel will provide the telco with its IP multimedia subsystem (IMS)-compliant NGN solution including the Alcatel 5020 Softswitch and Alcatel 7515 family of media gateways and its Optical Multi-Service Node (OMSN) systems and the Alcatel 7750 Service Router. Alcatel will also provide a state-of-the-art broadband access network based on its 7302 ISAM, a leading high-end IP broadband services access platform which includes a Voice Package that adds a voice over IP media gateway as well as legacy POTS and ISDN line cards to support a smooth migration to an NGN/IMS network.

Saudi Arabia: Rawabi Telecom and Software (RTS) have announced plans to deploy integrated VoIP offerings, IPTV and mobile service bundles. This will include voice over broadband telephony; enterprise VoIP trunking; IP conferencing; and wholesale VoIP interconnection. RTS will provide these services initially in the Kingdom of Saudi Arabia and then in throughout the United Arab Emirates, Bahrain, Oman, Qatar and Kuwait working closely with NexTone and Verscom to bring to market NGN services as the region's telecom sector undergoes deregulation.

Sudan: Canar Telecommunications Company, a national provider of fixed lines, data and Internet services, has launched its IP-based network, making it one of the first national operators in Africa to roll-out a Next Generation Network. Canar has announced the commercial launch of Sudan's first 3Gwireless broadband Internet services under the name "Canar Go".

Source: Mena Press, ITWeb, Hauwei, Sudan Tribune and company press releases.

4.1 End User Drivers

Consumer demand for NGN services is difficult to quantify currently where large uncertainty remains regarding the exact nature and scope of services. However, where affordability and access are not barriers to development, consumer demand for high end, innovative and evolving services as user patterns change is matched only by limitations on bandwidth. A sampling of currently available bandwidth offerings includes in Morocco, 20Mbps; the UK, 8Mbps and upwards; 24Mbps in France, and 100Mbps and rising in markets like Japan, South Korea, Hong Kong and Singapore, the latter having set 1Gbps as a target. It is expected that access networks in the future will provide bandwidth of up to 100Mbps for individual users and transmission rates in the gigabyte range for commercial customers. These high bandwidth offerings are all able to support multi-play options including broadband Internet, telephony, television and mobile services. In countries with high broadband penetration levels, evolved DSL platforms and increasing fibre to the home offerings, VoIP telephony and video calling has become the norm for end user communication.[34] Fixed line usage is declining for classical voice services, mobile services growth continues and broadband Internet deployment is showing rapid growth as well. As newer and more innovative services and applications become available, operators worldwide are seeking new solutions to adequately address demands being placed on them by consumers and technological developments. At the same time, consumer needs are also maturing with increased choice in offerings, reduced prices and discounted bundled products. Consumers are also seeking simplicity in billing and increased personalization with full mobility and increased quality of service.

For individual consumers, the demand for broadband to the home, offering on-demand multimedia services is increasing in countries that have the infrastructure to support such demand. As services and platforms converge, consumers also seek attractive pricing bundles for their combined voice, data and video needs, across both fixed and mobile networks. This is also fuelled by increases in local and cross border communications for personal and business purposes, including telecommuters who work from home or abroad, requiring high performance, widely available, secure voice and data services.[35]

Similarly, business enterprise users are seeking integrated voice, data and video services as well as ubiquitously available electronic communications services with high speeds and flexibility. While business users also seek flexible virtual private network (VPN) solutions, overall, commercial customers are demanding more innovative services and network intelligence – security, storage, application layer routing and adaptability – to support the trend in enterprise markets toward better integration of their networking and information systems. [36]

Table 3: NGN Major Drivers

Structural changes in telecoms markets	Decrease in PSTN subscribers and PSTN revenue
	Increased competition, privatization
	Market deregulation (e.g. LLU)
	Globalization
Changes in services and user needs	Rapid diffusion of broadband Internet
	VoIP
	Cellular, 3G, WLAN, Wi-Fi
	Digital TV
Technological evolution	Creating innovative, interoperable, scalable solutions in the IP environment
	Ipv6
	Digitalization
	Central Processing Unit (CPU) power and memory capacity, mass storgae
	Optics

Source: OECD

4.2 Operator Drivers

The main factors driving operators to migrate to NGNs include growing competition in newly liberalised markets and growing competition from new serves and innovations in competitive markets. Declining call revenues and the multiple different networks from which these services are currently being delivered are promoting operators to re-think their business models and convert to a fully IP based architecture. This will enable the search for new profit and revenue streams other than traditional voice which is now being offered by multiple service providers using VoIP technology.

These drivers emanate from a need to address the market demands from end users. It is the traditional fixed line carriers that have generally been the leaders in broadband Internet access using DSL technologies over copper wire. Increasingly, they are faced with pressure from competitors such as mobile operators, new VoIP providers, other wireless carriers and where relevant, cable TV networks which can now support bi-directional IP-based services. Traditional operator's business models and investment plans have had to be altered to address these challenges, including the development of business models for data and audio-visual content. With historically separate infrastructures for voice and data, convergence and growing competition has forced traditional carriers to start investing in common IP-based core infrastructures. While significant investment will initially be required to integrate a common IP-based network, there will be savings down the line for operators who can then reduce the costs of running different networks, while increasing the subscriber base and service offerings over time.

It is these savings from network topologies that have largely prompted the consideration of switching to IP neworks. In this way, operators will be investing a single network that can be used more efficiently for many different forms of traffic. IP network deployment costs also often come in smaller increments than those required for telco switching facilities and dedicated circuits. It is possible to add capacity incrementally in a manner that will realise return on investment more quickly than the traditional multi-million dollar telecom equipment investments, which require many years to produce the required return. Smaller investments can often be financed from cash flow rather than requiring major external borrowing. Moreover, some components for new NGNs are items that can be found in retail electronics outlets rather than being sold as an "integrated solution" by a manufacturer. And cost reduction is a major priority as operators increasingly face competition and revenue erosion in traditional services from other services and service providers. For example, there is significant growth in data services such as text messaging and MMS on many networks in Africa as these networks invest in greater data capacity. This is manifested in the decreasing voice minutes of use and ARPUs. Although potentially offset by increased volume, Vodacom for example reports a 15 percent reduction in ARPU as a result of the higher proportion of lower ARPU connections as the lower end of the market is penetrated.

These concerns remain even more pressing for fixed line operators whose major revenue source emanates from voice services.[37] In Europe, telcos have experienced ARPU reductions in fixed line services from 33.50 Euro in 1998 to less than 31Euro in 2005 in residential markets, while business revenues have declined from 78 Euro to 63 Euro per month. This raises pertinent questions regarding the need to invest in new NGNs, and also, about the capacity to do so in light of declining revenue.[38] A recent study on telecoms investment in EU countries bears this out: it was noted that in "absolute terms, investments by fixed telephony incumbents were eight times higher than those by new entrants in 2004, reflecting their larger size and need to maintain their networks.[39] In South Africa, a new round of capex is emerging from existing operators destined for investment in NGN and general upgrading of data networks to counter ARPU reductions and increase customer loyalty. For example, Telkom SA, the largest fixed line incumbent on the continent has announced plans to invest about one third of 30 billion ZAR (4.2 billion USD) in NGN investment for IPTV and high speed broadband services as it begins to face competition in fixed line services from the new entrant, Neotel, which commenced wholesale operations in August 2006.

In addition to anticipated greater revenues and profitability from the value added services associated with NGNs, operational efficiencies are expected primarily as a result of labour reorganization, greater productivity and savings from a common, consistent infrastructure. British Telecom for example, estimates approximately 1 billion GBP per year in savings. These efficiencies will allow operators flexibility within their cost base to reduce operational and capital expenditure, although actual figures are difficult to obtain from operators at this stage and it is also dependent to some extent on the pricing models to be offered.

Anticipated cost reductions include those associated with network element costs; network maintenance and outsourcing and other operating costs such as IT, property and power costs.[40]

4.3 Other Drivers

While operators seek increased revenue from more customers, reduced cost through harmonized networks and the ability and flexibility to introduce new services to market as a more rapid rate, there are other market and social benefits and public policy elements that underlie this business case. For example, as discussed in section 1.3 above, competition and infrastructure concerns are more prevalent than in developed countries with more mature markets. Existing incumbent operators tend to exercise significant control on the market by retaining access over key facilities such as undersea cables, VSATs and leased lines, which has the effect of higher prices in downstream markets. Where DSL access is available, it is costly and not widely rolled out. While more competitive elements are present in the mobile space, there is usually no opportunity for wholesale arrangements between operators for either voice or data, which combined, serves to distort the market from a price and quality perspective.[41]

NGNs provide an opportunity to address the affordability and access issues and can also greatly assist in the optimum utilization of Radio Spectrum.[42] A recent consultation document by the Telecommunications Regulatory Authority of India (TRAI) for example, estimated that 70 percent of mobile calls are originated and terminated inside fixed locations.[43] If NGN is implemented in end-to-end networks, in access and core, such in-building/fixed location mobile calls could be completed on fixed/broadband networks, resulting in cost savings and more efficient utilization of scarce resources like spectrum. The convergence capability of terminal equipment is also a major driver of NGN, such as dual-mode handsets for 2G mobile and Wi-Fi. Moreover, triple play offerings also have the potential to open up television as a delivery platform for a far wider range of rich, multimedia services, overcoming to some extent, the lack of installed, Internet-connected computers in developing countries.[44] However, while this may be a solution for the urban poor, it still will not address lack of Internet access for those in rural areas without electricity or digital television coverage.

In addition, in cases where there are no existing and operational legacy infrastructures to bind migration to NGN, operators can more readily invest in markets on the basis of the so-called “ladder of investment”, or incremental, phased investment approach. As such, deployment can also be undertaken on a regional basis at first, starting with the most densely populated areas, and expanding roll-out to other areas incrementally. Where existing infrastructure in developing countries is well developed, NGN migration may allow operators, subject to competition concerns, to leverage effects within their current subscriber or customer bases. Another driver prompting IP enabled network development comes from equipment manufacturers, who are said to be increasingly withdrawing support for circuit switches and forcing a move to IP technology adoption.[45] Investment in NGN is expected to boost the equipment manufacturing market considerably, including the customer premises equipment market. While wider public policy debates are important to NGN policy development, OFCOM has noted that it may be premature to try and answer these questions on the current level of NGN deployment to date.[46] Nonetheless, they remain pressing and require targeted policy direction by regulators and policy makers.

Box 7: BTs 21st Century Network

- **Name:** 21st Century Network (21CN) is BT terminology for its NGN.
- **Competitors:** Cable & Wireless, Thus and Easynet, but none on the same scale of BTs NGN.
- **Cost:** £10bn to implement, but will save £1bn per year to run that the 16 networks that preceded it as all IP applications will be able to run over the same converged NGN.
- **Completion date:** between 2007 and 2011.
- **Suppliers:** Fujitsu, Huawei, Alcatel, Cisco, Siemens, Lucent, Ciena and Ericsson.
- **Highlights:** self-service portal for businesses to buy or change services and bandwidth in real-time and potential cost savings.
- **Status of regulatory oversight:** Consultation phase

Source: ZDNet UK

4.4 Challenges for Operators and New Entrants

4.4.1 Operators

While the drivers for NGN development present opportunities for operators, their development is not without challenge. For example, while new technology supply options and economies may exist, there are still concerns as to the integrity and the cost of the newer generation of network equipment - including Wi-Fi and Wi-MAX – as part of an IP network roll-out. These new wireless technologies can and are being deployed both to create local loop access and for backbone links. Again, it is argued that this is being done more cheaply than traditional copper or fibre networks, which in turn can challenge the market dominance of the fixed line operators. However, it may be premature to do a cost comparison with other technologies as the potential cost savings using wireless technologies like WIMAX are not absolutely quantifiable at this stage although incumbents worldwide are both deploying these technologies and at the same time, are threatened by them.

Likewise, incumbent mobile operators that have invested considerable sums in 3G licences and need to earn a return on their investment over five to ten years, are also threatened by the potential of wireless-enabled VoIP services, which offer the potential for cheaper voice service. Users of 3G networks can now use mobile phones for example, to make Skype calls to other Skype subscribers at cheaper data rates. This will particularly affect the high-price international roaming business. This presents a recurring dilemma for the regulator with respect to its role in encouraging investment: should it protect the investment of the mobile operator and delay cost-saving innovations for consumers or should it allow wireless-enabled, mobile VoIP to flourish, which may have the effect of undercutting investment returns of the mobile operators? And these questions are particularly pertinent for regulators and policy-makers in developing countries where the choice is often between defending a government-owned telco incumbent (for financial and social reasons) and the distributive policy aspiration of making cheaper communications available to a wider number of people, particularly in rural areas.[47] And at an even more fundamental level, there is the issue of whether technically many limitations on such IP based service innovations, such as VoIP can be enforced.

Challenges for incumbent operators essentially arise out of a lack of certainty as to what exactly is required to develop multi-service platforms capable of supporting multi-media services, enabling separation between service and application creation and basic transport. The key question appears to be whether NGNs need to include all PSTN functionality or can develop separately and in parallel to the slow migration of the PSTN to IP. This is important because it determines the extent to which the NGN needs to take account of the special features of the PSTN, some of which are required by regulation. If the two will develop separately and in parallel, then the NGN will not need to embrace the PSTN, although both will be supported on the same underlying infrastructure.[48]

Other more basic challenges for telcos still exists once they have assessed the validity of an economic case for replacing circuit switched network with IP based infrastructure.[49] These include managing competition from the Internet for the carriage of new services. Also, decisions will have to be made as to the substitutability of circuit based and packet based voice from a consumer perspective, where latency and jitter still remain present. However, once quality and price decisions are made, it is clear that circuit switched networks are likely to start experiencing reduced traffic loads –with the exception of dial-up traffic - which will have implications for terminating traffic and revenues. This balance will need to be struck for many telcos whose top priority remains how they manage their debt situation, while transmission and switching costs decline, yet infrastructure costs remain high. On the other hand, it might be argued that computer-based systems for voice over the Internet are unlikely to reach the levels of reliability of the PSTN for a long time and many customers may choose to retain their traditional PSTN connections for use when the PC or LAN malfunctions, even when they use the Internet for most of their voice traffic.[50] The ability to enter into service level agreements however may ensure certain quality levels that alter this assertion. It may also be said that this is less relevant given the fact that the poor quality on many mobile networks, including dropped calls and interference, have accustomed users to quality levels that would never have been accepted on the fixed line network, although quality concerns are offset by by other benefits of mobile that are not possible with the traditional PSTN fixed networks.

Regardless, it is still unclear how telecommunications networks will develop at a technical level over the coming years but it is clear that IP migration and ultimate full NGN transition represent a logical commercial

development for all operators as they increase efficiency, facilitate service and pricing innovation and allow for lower backbone transmission costs. Companies like MCI, Cable and Wireless and Viatel already operate converged core networks.[51]

4.4.2 New Entrants

Challenges for new entrants also present themselves for consideration, possibly the largest of which is the degree and intensity of competition on and between layers. NGNs provide the opportunity for third parties and service providers to develop and provide value added customer services over the networks owned by other operators. As such, the separate transport, control and application layers also enable different operators to compete with each other in different layers. As these layers should be open, competition is fierce, providing great consumer welfare benefits and opportunities to innovative service providers. This could also be advantageous for rural service delivery.[52] However, a clear and fair, transparent and well implemented ex ante competition regime will have to be in place for new entrants to be guaranteed timely entry to the market. However, it is also important for regulators to guard against any market dominance effects by incumbents. There remains a risk that operators of core NGNs may deny access to potential competitors, in the same way in which access to the local loop was withheld as an anti-competitive technique in the PSTN. This concern sees expression in the so-called "walled garden" concern, namely, that provision of a closed or exclusive set of information services for certain subscribers to a network. The term is used to describe service offerings from interactive television providers or mobile phone companies which provide custom content and not just common carrier functions. One of the best known examples of this was America Online (AOL) who until the mid-1990s had revenue sharing agreements with only certain information providers in their subscriber only space.[53]

It is also difficult to accurately quantify at this stage, but there will be increased additional costs for compliance with specific consumer focused issues, such as QoS or security requirements for emergency services and lawful interception. These may serve to be prohibitive for smaller players. The experience for consumers will evolve in the coming years but some of the features becoming available in corporate networks will become more widely available if there is a viable consumer market. The major determining factors will be the access devices used and the access technologies. Mobile phones and the Internet already provide an early "NGN" experience for many users with services such as push-to-talk, Instant Messaging, two-way video and content (video, audio and text) streamed and broadcast to the user. There is always concern by providers that a rigid and inappropriate application of current regulations may limit the consumer benefits. One additional serious risk to new entrants, notwithstanding the access concerns, is that established telcos who have a large share of the Internet access market could degrade the quality of Internet access so that real-time services and applications do not work adequately over the Internet and therefore try to retain voice traffic on the PSTN for longer.[54] However, the use of clear Service Level Agreements could go someway to mitigating this risk.

4.5 Investment

Although long term savings are expected for operators, the initial migration will require considerable investment to support the uptake of new NGN services. This investment is already underway in various countries, varyingly in the core and access networks: in addition to BT and Deutsche Telekom, Illiad in France and NTT in Japan are deploying fibre to the home and AT&T and Verizon are investing in faster broadband access networks in the USA. There still exist many questions regarding the effect regulation will have on investment in NGNs as well as the exact characteristics of NGN investment and the implications of economies of scale and scope. Policy makers need to consider ways in which to create incentives for both incumbents and new entrants to invest in NGNs. OFCOM believes that it is not the regulator's role to provide operators with incentives to make particular investments, but rather that the regulator should ensure that the incentives for efficient investment are not distorted, particularly as a result of disproportionate regulation.[55] Questions emerge when the nexus between regulation and investment is brought to the fore. For example, where should regulation appropriately be targeted or applied? Should NGN investment with its voice, data and content oriented services still be considered as traditional PSTN and as such, remain subject to regulation. That is, should regulation be jointly applied to the 'traditional' voice and data aspects of the regulated entity or should it be uncoupled from its content role?

One argument is that in order to foster NGN-investment, regulation should be substantially reduced or eliminated, as NGNs should be seen as constituting a nascent (emerging) market characterised by innovation, rapid market growth and volatile market shares. Regulatory instruments that can be considered in this regard include regulatory or access holidays combined with a commitment to a reduction or elimination in *ex ante* regulation and sunset clauses or time limited forbearance, which suggest to investors that regulation is only interim and once the market adjusts, regulation will be withdrawn.[56] While this will be discussed further below with a discussion on SMP, it is difficult at this stage to know definitively whether less regulation will translate into more investment by incumbents and less investment by new market entrants, or vice versa, and in advance, to know when existing regulation should be withdrawn. This question cannot however be divorced from the usual need to regulate ex ante where SMP is present, to foster competition and the consumer interest.[57]

Incumbent carriers however may argue that IP-enabled NGNs particularly the deployment of high speed access networks (e.g. FTTx, VDSL), require massive investments and that national regulatory moratoria for incumbents are appropriate. Competitive providers will argue the opposite and suggest that regulators need to ask whether, in the absence of wholesale economic regulation, market dynamics will be sufficient to ensure a competitive environment? They remain concerned that without the immediate attention by regulators to NGNs, carriers will rapidly vertically integrate services and that bottlenecks will emerge particularly for the delivery of audiovisual content.[58] As OFCOM points out, traditional access network investments have already been amortised, and as these were considered competitive bottlenecks, most (EU) regulators required that access to other operators be provided on a cost basis. However, the new access networks are different and it is not a foregone conclusion that consumer demand will sufficiently address the risks associated with such investments. If regulators impose a traditional cost base policy with a standard return on investment that does not consider this risk and its effect on the cost of capital, operators have little incentive to invest. Succinctly put, if demand does not materialise, operators will bear the loss, and if it does materialise, regulation may prevent them from benefiting.[59] The USA, Germany, the European Commission and the Netherlands are all considering the degree and implications of different regulatory approaches. It is worth noting that the debate overall, regardless of its precise detail, militates strongly for any regulatory approach to NGNs to be focussed on being light touch and creating an environment conducive to investment.

5 Market Power Regulation

The telco and Internet regulatory models are as divergent as the separate networks and services they offer. They have different market structures and technical architectures. The regulatory requirements with respect to both differ. As noted earlier, the telco model has historically attracted more regulatory oversight and intervention than the Internet, whose decentralized nature has not required the same level of regulation. For example, there is little need to regulate market access and pricing with the Internet, yet with respect to both telcos and the Internet, regulators need to ensure consumer protection, security and a viable competitive environment, although the enforcement aspects on the two are different. In EU market terms, this situation has emerged largely due the fact that there is no designation of significant market power (SMP) on the Internet which has also precluded any need for traditional telco regulation like tariff regulation. With the advent of NGN migration and the possibility of numerous erstwhile separate networks and services operating off one network, it is arguable that this has the capacity to change. For example, PSTN and cable TV companies can evolve into vertically integrated enterprises that are also Internet backbones and leverage the market power associated with last mile facilities into their Internet role. Competition questions may thus emerge, which require an examination of whether NGN migration may serve to create vertically integrated operators with incentives to keep other players out? Or will NGNs create vertically integrated operators that see business opportunities in opening different layers of their network to a full range of service and applications providers and users?

This question sees some expression in the current US debate regarding “Net Neutrality”. This concept suggests that incumbents should not be allowed to determine how their networks are used by other operators, service providers or consumers. As “Net Neutrality” is underpinned by many well established principles of telecommunication regulation, such as mandatory interconnection and common carrier regulation, this remains critical in all countries where there are legacy telcos facing competition and liberalisation and thus responding to incentives to delay or block the entry of competitive operators. This is further complicated by widespread state equity (full or partial) in such incumbents, resulting in a conflict of interest between the

state as the agent responsible for policy formulation and the interests of its competitors and as the owner of the operator.

Box 8: Net Neutrality – A Primer

Net Neutrality is a simple principle of non-discrimination in network design. It requires that network service providers, such as telco and cable companies should not be permitted to dictate how those networks are used (not ban or block programmes; devices or favour carriage of traffic). It has its origins in the efforts by US broadband operators in the late 1990s, to impose contractual limits on the activities of their subscribers. Net Neutrality aims to secure the right of consumers to access any application, content or service, subject to certain exceptions, e.g. security purposes or specialized services like broadband video.

Underpinning Net Neutrality is the assumption that neutrality (non-discrimination) on a network, will promote evolutionary innovation of information technology. As such, a discriminatory network will distort markets that depend on the network and will deter future innovation and ultimately may slow economic growth. Those opposed to Net Neutrality (frequently traditional telcos and cable providers), argue that disallowing a network to discriminate against operators/services may affect future investment; may lead to congestion and poor network performance, and may attract more regulatory oversight than is warranted.

The debate is fuelled by the increased demand and use for high bandwidth applications, such as music and video; improvements in network technology, enabling cheaper broadband provision; government funded high speed networks and city wide wireless networks; increased home wireless network usage which enables sharing among neighbours and communities, reducing the revenue for providers, and high bandwidth video and audio telecommunications over the Internet, such as VoIP, which also threatens telco revenues. Net Neutrality has been adopted into legislation in various countries, notably those world leaders in broadband such as Japan, South Korea and the UK.

Source: Wikipedia

One of the clear additional new dimensions to the general ICT discourse on competition is that IP networks or NGNs both access and core, are going to have to compete with the open Internet (unrestricted access to content and services, as opposed to "walled gardens" or limited proprietary access) where the commercial arrangements are different to both legacy networks and the NGNs. OFCOM for example expects increased competition between NGN-based VoIP services and broadband-based VoIP services at the retail level. This may be accompanied by greater take-up of bundles comprising voice and broadband services. Many more end user services are available on the Internet and increasing rapidly, at zero marginal cost or lower cost than what a subscriber previously had to pay in terms of usage charges with fixed line telcos. The upfront costs remain, (a PC, Internet connection, subscription) although are declining globally, but the usage based model has been significantly altered by the Internet.

5.1 Regulating for Significant Market Power (SMP)

One of the key objectives of telecoms regulation is to ensure fair competition in the market. From a legislative perspective, while countries may approach this objective differently, common to all is the object of ensuring that dominance or market power on the part of operators is checked in the ICT sector through either ex ante (before the fact) or ex post (after the fact) competition promoting measures. This is usually done through a variety of procedures and mechanisms relevant to that country's legal and regulatory framework. The European Regulatory Framework for example requires that before any *ex ante* measures are imposed in a particular market, national regulatory authorities (NRA's) must define markets in accordance with accepted principles of competition law and such markets must, on the basis of various criteria, be considered susceptible to ex ante regulation. The starting point for the NRA's market analysis is the European Commission's Recommendation on relevant markets and the Guidelines on market analysis and assessment of significant market power (SMP) or dominance. Markets need to be defined according to national circumstances applicable in each member state, particularly the relevant geographic market, in accordance with the principles of competition law. For this to occur, it thus requires an evaluation, finding and assigning of significant market power (SMP) or dominant status to operators after a market analysis has taken place.[60] Once completed, such regulation may include proportionate pro competitive measures to counter potential competition problems. Increasingly, as markets evolve in developing countries, both regulators and operators alike are seeking more sound methodological approaches to imposing ex ante regulation. While some developing countries have adopted a variation of this model, the EU market approach

is not widely practiced in developing markets where insufficient levels of competition have not prompted a more rigourous treatment.

The constant evolution of technology and services requires that approaches to dominance and SMP be reviewed and monitored to ensure that the entry of new networks and services is not compromised by the market power certain operators may have in a given sector. In all countries, regulators and operators alike will have to be aware of the competition aspects of NGNs as they offer both positive and negative benefits. Certainly, concerns of SMP remain very valid as networks integrate. For example, voice, data and image convergence on IP networks allows users to combine these different forms of traffic and significantly expand the range of product and service offerings. Convergence also blurs the line between voice, data and television programming allowing operators to offer "triple-play" options that combines all three in a single service. Yet, this form of delivery has implications for competition as users increasingly seek a single provider and billing option. A single bill for all these services is undoubtedly convenient for consumers but the cost of each service is not transparent, making comparisons between services difficult for users.

Historically, a vertically-integrated incumbent carried traffic and offered services, usually from a monopoly position. In a more liberalised market, the same telco will sell international transmission to both external ISP customers and to its own ISP, leading inevitably to accusations of conflicts of interest. For VoIP service providers for example, the terms under which there is access to broadband therefore becomes a key question. As a result, many telcos have separated out their wholesale and retail functions in order to better understand the underlying cost structure of different parts of the business. Usually, this was prompted by regulators seeking to clarify terms of access to either the local loop or the network itself but sometimes by the companies themselves wanting answers to questions about costs of delivery.[61]

5.2 Emerging Markets

Following from the earlier discussion regarding the differences in approach between regulating the Internet and regulating traditional telcos, another reason the Internet has remained largely unregulated (outside of content regulation and domain name allocation) is for its "infant industry" or "emerging service" status: the fact that it was originally approached in many respects as a service for which the business case was unknown. The question of regulating for SMP in a NGN space is linked to whether NGN services can be defined as emerging markets or services.

It needs to be noted that the term "emerging markets" is usually used in the context of the European Union definition of markets, but for the purposes of this Paper refers to emerging services and networks as well. As many countries do not have the same framework for regulation as the EU, at the level of principle, it is possible to look to international trade practices with respect to "infant industry" protection to offer some guidance on how to approach these emerging markets and services.[62] This would signify that emerging market protection is warranted for operators offering new services that are untried and untested, without which such service offerings may have less chance to compete meaningfully with the established operators and other services in the market who have been operating longer and evolved efficiencies in production and delivery. It is however difficult to decide what can be classified as an emerging service in the ICT market generally within the continuous evolution of products and services across a horizontally integrated network.[63]

Drawing on the European regulatory model, the SMP *ex ante* approach can be very effective in current markets, but may have distorting effects in newly emerging markets, and as a result, the European Commission has cautioned against such an approach in these markets. Yet, the EU regulatory framework does not define what constitutes such a market or suggest where *ex* ante regulation is in fact appropriate. And as OFCOM points out, looking at the possible types of retail product offerings NGNs can deliver, it is also not clear what services might constitute a separate market.[64] Moreover, the discussion of when to regulate or forbear in emerging markets is somewhat tied to the existence of a regulatory framework that has a sophisticated and clear set of market definitions.[65] That said, the general principle of whether and how to regulate an emerging (product or geographical) market remains: namely, "how to attract investment in new multimedia platforms on which both emerging and well established services will run, without re-monopolization of established services."[66] More simply stated, the challenge is how to encourage investment in infrastructure in a manner that will ensure a return on that investment through the take up of services offered, while not unfairly protecting the dominant status of that operator in other services. This prompts an examination of whether these new services or markets should be targets of ex ante regulatory measures.

As no definition of an emerging market is supplied by the European Commission, OPTA has ventured a definition based on parameters drawn from the EU regulatory framework as a whole. OFTA views the absence of the information required to carry out the necessary market definition tests (in regard to demand, price, elasticity and entry behaviour) as determinative.[67] In that regard, OPTA suggests VoIP services; services based on next generation fixed access and core networks; service based on next generation mobile networks and fixed mobile integration services are unsuited to ex ante regulation and should be viewed as emerging markets. (See box below).

Box 9: Defining Emerging Markets

Category		*Characteristics of emerging markets*
VOIP Services	• PC client based (e.g. Skype) • Voice over broadband ("Double play") • VoIP through a NGN connection	1. New and uncertain markets; lack of information on their functioning, demand, pricing, etc. 2. Investment in new multimedia infrastructure; 3. Investments may generate new markets of bundled services, currently in separate markets; potential for substantial economies of scope; 4. Strong technology innovation with potential for increased functionality at reduced costs; 5. High investment risks.
Services from Next Generation Fixed access and core Networks	• ADSL2+ technology, VDSL, FTTP • Triple play	
Services from Next Generation Mobile Networks	• 3G W-CDMA and multimedia services	
Fixed Mobile integration services	• NGN core IP networks • Wireline and wireless access networks • Multiple radio interface devices e.g. WiFI, Bluetooth, GSM, W-CDMA	

Source: OPTA

Apart from its emerging service perception, an additional reason the Internet and its services have not been subject to regulation – and essentially treated as an emerging market in most jurisdictions - is due to its decentralized nature and open architecture which does not lend itself to easy regulation.[68] As such, the emerging market argument needs to be carefully parsed for it implications with respect to competition generally and the nature of the network on which the service is offered. It is not necessarily clear (and certainly in markets that lack a market definition framework) whether "services" or "networks" should be defined as "emerging" to qualify either for ex ante regulation or regulatory moratoria. Certainly from OPTA's perspective, ex ante regulation of services should be confined to only non-replicable assets used to provide the services.[69] Non-replicable assets are defined as those not commercially feasible to replicate in similar circumstances with no functional equivalent which can deliver comparable services. At the level of principle, the European Commission has cautioned that ex ante regulation in emerging markets "may unduly influence the competitive conditions taking shape within the new and emerging markets". Moreover, the Commission has suggested that it should not be a principle that the presence of market power should qualify that emerging market to ex ante regulation. While the Commission does not rule out such regulation completely, eager to ensure that it does not foreclose on competition in such markets, it cautions that if intervention is chosen, regulators should be fully able to justify their early entry into such markets as they retain the ability to intervene at a later stage as well.[70]

In this regard, also proposed by OPTA, is the question of regulatory holidays or moratoria comes to the fore. Regulatory holidays are a defined period of time in which investors can be confident that they will be fully rewarded for successful investment while the regulator can monitor competitive dynamics. While more at the level of principle than individual investors, the European Competitive Telecommunications Association (ECTA) has rejected claims that EU policy makers should grant a "NGN moratorium", in favour of a policy to boost investment confidence for the entire communications sector. That followed proposals from German politicians to grant a three-year regulatory moratorium on plans by the incumbent to upgrade its access

network, undermining competitors' current and future investment plans.[71] In arguing against the proposals, ECTA noted that markets with competition enjoy higher levels of innovation and recommend that policy makers maintain the pro-competitive approach that underpins the EU regulatory framework. The European Commission however, has spoken out against regulatory holidays on the basis that the effective implementation of a regulatory regime that promotes competition and open markets is the best driver of investment and innovation. Such regulation should only be phased out when competition is effective. The Commission has suggested that the mere installation of new access technologies or networks does not in itself change the access obligations required to foster competition and that any moratorium on regulation to "privileged the investment" of dominant players may simply serve to entrench their position compromising consumer benefit in the longer term.[72]

While the EC's position appears to be arguing against regulatory holidays for incumbents with market power, and not specifically against the idea of regulatory holidays as a concept, it is important to note that regulatory choices have to endure across technologies and over time. As convergence has started to occur and operators and service providers have entered new markets different from their traditional areas of service, new calls for regulation of services that have not been traditionally regulated, like the Internet, may well be heard as dominant operators begin to exert their market power derived from traditional services, into new services as well.[73] Regulators will have to be guided by the principle of balancing investment certainty with encouraging investment in, and take up of new services. This is a complex balancing act that while guided by best practice principles, is dependent on the specific legal and regulatory framework in each country, and the level of development and competition in each market.

A recent example of this issue, valid for its regulatory principles, is the recent Canadian Radio-television and Telecommunications Commission (CRTC) decision on VoIP.[74] Although not explicit, this decision to regulate VoIP services as local telephony services was taken with an emerging/nascent market angle and based on principles of technological neutrality, to ensure that incumbent operators did not dominate the VoIP space and that new entrants approach the market on an equal footing. The decision was later appealed to Cabinet and varied. (See box below)

Box 10: Canadian Approach to VoIP as an emerging market

In 2006, **Canada** lightened its regulation of certain VoIP services. In 2005, the CRTC denied a request from incumbent local exchange carriers (ILECs) to have certain forbearance rules applied to their VoIP offering. The determining factor in selection of the appropriate regulatory framework for VoIP services was not the technology used, but rather the nature of the services provided to customers. Although some VoIP services have distinct features, the CRTC found that they are marketed as, and intended for use as, a substitute to traditional telephone services. As such, the CRTC ruled that VoIP services, as a substitute of traditional telephone services, shall be subject to the existing regulatory regime applied to traditional local telephony. This effectively meant that incumbent phone companies like Bell Canada and Telus Corp., were subjected to the same regulatory requirements for their local VoIP services as they faced for their traditional telephone services. For example, the requirement to file tariffs, restrictions on marketing practices, service bundling and price floors. Competitive telephone service providers (including the cable companies like Rogers) were not subject to these economic requirements before the CRTC Decision and remain unaffected now.

On appeal to the Minister, following a reconsideration of the original CRTC decision by the regulator which confirmed the original decision, it was decided that there must be a distinction for different types of VoIP services for the purpose of economic regulation. Namely, "access dependent" (VoIP services which connect to customers making direct use of the service provider's own network, e.g. a cable company providing VoIP service over its own cable network) and "access independent" services (those which connect to customers using any high-speed internet connection and are therefore not tied to the service provider's network e.g. a phone company providing VoIP service to a customer through the customer's cable internet access). Access independent VoIP is accessible only to consumers who have a high-speed connection and must be accessed through the Internet. Access dependent VoIP is similar to traditional phone service, generating stronger arguments for applying the same regulatory regime. Conversely, access independent service has fewer similarities to traditional local telephony, the barriers to entry are lower, and therefore, the case for applying economic regulation is less convincing.

The appeal changes the CRTC's decision so that it forbears from the economic regulation of "access independent" VoIP services of incumbent telephone companies when offered in their incumbent territories. Such forbearance is justified on the grounds that access independent VoIP has lower barriers to entry and is a much less reasonable substitute for traditional wireline telephone service given quality of service issues and other distinguishing factors. When operating outside their incumbent territories, incumbent telephone companies are already deregulated to the same extent as new entrants. This does not however, vary the social and safety obligations imposed on VoIP service providers such as 911 emergency services, which were effectively applied to VoIP services under the CRTC's original decision.

Source: CRTC and the Canada Gazette, Vol. 140, No. 24 — 29 November 2006.

In response to the possibility that NGNs should be treated in a similar way to existing networks with an emphasis on regulating where SMP is found to exist and in particular where there are enduring bottlenecks – an approach supported by OFCOM - it is unlikely that the migration to NGN will eliminate SMP concerns in entirety.[75] Market power associated with last mile bottlenecks will continue to be a significant regulatory concern for the future. However, migration to IP based NGNs will also tend to put pressure on interconnection arrangements that are widely at variance with cost and competition in services and will expand opportunities to bypass inefficient interconnection arrangements through competitive infrastructure provisioning.[76]

As so many of the technical, financial and regulatory questions remain open ended, pertinent questions emerge as to whether the SMP EU model is capable of universal application. Few developing countries, although many are beggining to consider market segmenatation and definition for the purposes of regulation, have such evolved competition principles. Many of these countries simply apply these principles *ex post,* where they exist.

The principle of technological-neutrality with respect to user choice or functional equivalence across a full range of features is being adopted by some regulators to determine whether a service can be classified as an emerging market. The Australian Communications and Media Authority (ACMA) developed a matrix to assess whether current regulatory requirements apply to new services on NGNs.[77] For the foreseeable future, it may be prudent to adopt an approach that suggests that the body of best practice regulation with respect to

competition should prevail, unless there are compelling reasons to do otherwise. The European Telecommunications Platform advoctes that the correct regulatory approach should be based on technology and provider neutral criteria; on legal principles drawn from competition law; that economic regulation if required should focus on enduring bottlenecks; non-economic regulation should be light touch and should foster innovation and investment, providing legal and investment certainty. These principles should also avoid the fragmentation of markets and focus on services not on technology, seeking to balance harmonisation and innovation, and where relevant, should address the question of cross border services.[78]

Box 11: ETP Regulatory Principles

- Technology and provider neutral;
- Focus on services, not technology;
- Informed by legal principles drawn from competition law;
- Focus on enduring bottlenecks;
- Be light touch;
- Foster innovation and investment;
- Provide legal and investment certainty.
- Avoid fragmentation of markets;
- Balance harmonisation and innovation;
- Address the question of cross border services.

Source: European Telecommunications Platform, (06) 01, 17 January 2006.

6 NGN Regulatory Challenges

Next Generation Networks and services are still in an evolutionary phase and no country has as yet developed a specific regulatory framework for NGNs. However, regulators in various countries are currently considering the best way to facilitate regulation and create an investor friendly climate with sustainable business opportunities.[79] Some countries, notably the UK, India, Australia and Singapore amongst others, have begun detailed consultations on approach to NGN regulation to begin to address the significant regulatory challenges they present for the promotion of competition, interconnection, consumer protection, numbering, universal service and security concerns to name a few.[80] Many of these challenges arise from the obvious technical differences between circuit switched and packet switched networks as most of the current regulatory principles and practices worldwide are based on a circuit switched environment. While IP networks and services will offer consumers a greater degree of choice at lower costs, operators and service providers need to ensure that the technical and commercial aspects of service provision have been adequately addressed both in the interests of business and in the public interest. In rapidly changing and liberalizing telecoms environments, it is critical that regulation, where required, creates an enabling framework for the development of new services and sustainable business models.

Since IP services, such as VoIP are enabled by the existence of IP networks, it is imperative that regulators "get the framework right" for the regulation of these networks. Different policy choices applicable to different country's circumstances will dictate varying approaches to and pace of reform. However, the critical aspect is to ensure that clear rules are in place to facilitate NGN deployment, as without clear rules to forecast investment returns, fewer investments will be made. Applying traditional regulatory practices, developed for the circuit switched service provision model may be counter productive as many traditional regulatory requirements of NGNs are becoming increasingly less relevant and/or require modification.[81] At a minimum, getting the framework right suggests that the approach of treating different networks differently should be re-examined. This warrants a paradigm shift away from the assumption of distinct services running over separate networks and may also require regulators to reconsider their roles in light of a proposed distinction in roles between service provider; service platform provider (core network operator) and access network operator. This also requires a fundamental recognition of the convergence of telecommunications, broadcasting, media and IT and suggests a forward looking approach to regulation which envisages a single regulatory and unified licensing framework for all transmission networks and services.

It is suggested that the issues that have been identified to give a sufficient degree of certainty for efficient and effective market development, may not in all cases require new policy interventions or national regulatory intervention at all – some are capable of being left to self or industry regulation already in place.

Some policy interventions may simply require a degree of augmentation to the current regulatory process. However, others may require new and targeted policy decisions. As is the case generally with telecommunication reform, the sequencing and degree of reform is critical: the role of the regulator and the role of the market have to be carefully balanced. Regulation can bring certainty, but if it is premature or prescriptive, it can pre-empt the role of the market in determining the shape and form of competition. On the other hand, intervention that is too little regulation or which comes too late can result in foreclosure of competition. A balance needs to be carefully crafted between allowing nascent markets to develop without regulatory interference and ensuring that competitive forces can emerge in those new markets.[82]

It is imperative however to ensure that with planned migration to IP networks, already established competitive playing fields are likely to face some form of disruption, which should be the main regulatory concern. The view emanating from some countries that have embarked on consultative processes with regard to NGNs suggests that the central role of the regulator is to ensure that a level playing field amongst existing market players remains untouched and that given the innovative space in which NGNs are evolving, a light touch approach to regulation is appropriate. OFCOM's approach in this regard, is to attempt to balance greater industry involvement with greater certainty as to the application of ex ante competition rules.[83] The view from OFCOM's consultation in 2005 suggests that withdrawing regulation should not be hasty or before the impacts of next generation networking, on current and future products, is known.[84] While the GSR Discussion Paper on Creating an Enabling Environment will address the regulatory issues NGNs raise and other GSR Discussion papers deal with specific regulatory topics in detail, the following is a brief outline of the main issues for introductory purposes, in no specific order of importance:

Licensing: In the NGN context, countries increasingly recognize that service and technology specific licensing regimes restrict the way in which technology is used and can prevent operators from benefiting from economies of scope. Thus, many policy makers and regulators are reviewing the licensing and regulation of traditional markets structured around vertically integrated incumbents and developing horizontal licensing that better reflects the technical and logical separation of the core, access and service layers of NGNs. Where national policy has not yet matured organically, regulators and policy makers may consider classes and types of licences to be used and whether this will require a new set of licensing criteria and conditions to be developed, or whether existing ones will suffice. For example in India, the regulator has already recommended a single unified licence for all types of services and geographical locations, and also a category of class licence for all value added services.

Numbering: With the advent of IP based networks and the multiple service offerings (most notably, VoIP) new market players and VoIP providers must have access to numbering resources. At the same time, numbering, naming and/or addressing schemes will need to encompass legacy, transitional and NGN services and associated directory services will need to be developed. Regulators may have to review their numbering plans to ensure that it can support new resources while ensuring the interoperability of new and existing services. This may also necessitate a specific number allocation scheme to differentiate IP telephony from PSTN numbers.

Interconnection: The technologies and architecture of NGNs differ from the PSTN and results in new network topologies, associated costs and interconnection models. This presents challenges to the current interconnection regime in many countries where the new value paradigms in NGN architectures mean that new models may be needed for settlement of interconnect service provision. This is likely to lead to the development of new IP based interconnection arrangements that are service-based and capacity based, rather than based on minutes and miles, particularly for certain types of traffic (isochronous).[85] Regulatory and policy considerations include the impact of IP based networks (and traffic) on current interconnection arrangements; ensuring no discriminatory access behaviour; defining the parameters of interconnection in a multi-service environment and whether there will still be a need for mandated wholesale interconnection regimes, as well as a revision of the charging principles. For example, there is no Reference Interconnect Offer published as yet, the structure of which and the content of the interconnection agreement are also likely to see alteration. (See the GSR Discussion Paper on Access and Interconnection.)

Standards and Interoperability: Standardization is critical to ensure that there are no delays in the introduction of new services and providers in retail markets. For developing countries opening their fixed markets to competition, regulations ensuring the interface between legacy networks and NGNs are important as the new entrant is likely to be a full NGN operator. As a general rule of thumb, standards should be market driven, although regulatory oversight may be required to ensure transparency in standard setting procedures and other elements if no specific body is established in a country to address standardization, as is the case in the UK or France (e.g. comité d'interconnexion).

Spectrum*:* As many of the key spectrum assignments have already been made to incumbent operators for the provision of fixed, fixed-mobile and mobile services, policy makers and regulators have to ensure that legacy assignments do not hamper the introduction of new NGN operators and services. In many developing countries, numerous incumbents have delayed new entrant "last mile" and competitor access and consequently, competition by using the myriad issues involved in local loop unbundling and facilities leasing on a wholesale basis, while at the same time, building up their retail offerings in the same services. NGNs however, allow new entrants and other service providers to deploy alternative technologies like WiMAX facilitating high speed broadband Internet access over wireless connections. This should not be hampered by a lack of available spectrum for widespread deployment.

Universal Service and Access: As ICT penetration rates in developing countries still remain low and affordability and accessibility are key policy goals, current efforts to ensure universal access and service should not be abandoned or altered in a NGN environment. Rather, policy should be geared to utilize NGN migration as a means to further address accessibility deficits. The ongoing relevance of universal service obligations and levies remain a medium to long-term goal for NGN migration. At the same time, as service obligations can be costly to operators, the challenge remains to preserve the universal service objective, while fostering innovation in new networks and services. With more users switching to IP telephony, there are concerns that telco revenue loss could result in a subsequent loss in funding for Universal Access. This raises the questions as to whether VoIP providers should contribute to a national universal service or access fund; how to structure universal service contributions and to which technology or service should these attach?[86] (See the GSR Discussion Paper on Universal Access and Service.)

Consumer Protection*:* As is the case with PSTN services, NGN migration will continue to require adequate protections for consumers given the scale and complexity of the envisaged transition. The issues that will require attention include but are not limited to, quality of service; continued priority access to emergency services; the provision of location information; rights and presence management, number portability, operators' liability; privacy and security. Regulators around the world, such as OFCOM in the UK and TRAI in India, have started industry wide consultations of the consumer aspects of NGN migration to ensure that consumers are in no way adversely affected.[87] (See the GSR Discussion Paper on Consumer Protection and Quality of Service for NGNs.)

Box 12: Regulatory Consideration for NGN Migration

Licensing	Consider appropriate regime for classes and types of licences and licensing criteria, where licensing is required. There is a shift away from service and technology specific licensing towards horizontal licensing.
Numbering	To ensure access to numbering resources and ensure that numbering, naming and/or addressing schemes encompass legacy, transitional and NGN services and associated directory services.
Interconnection	Regulatory considerations include whether new interconnection models may be required; the impact of IP based networks and traffic on current interconnection arrangements; ensuring no discriminatory access behaviour; defining the parameters of interconnection in a multi-service environment and whether there will still be a need for mandated wholesale interconnection regimes, as well as a revision of the charging principles.
Standards and Interoperability	Regulatory considerations include mandating standards and interoperability between operators and new entrants to ensure no delays in the introduction of new services and providers in retail markets and to coordinate standardization activity where no specific body has been established.
Spectrum	The main regulatory consideration is ensuring equitable access to spectrum required by new NGN operators and services and ensuring that competition is not hampered through legacy spectrum assignments to incumbent operators for the provision of fixed, fixed-mobile and mobile services.
Universal Service	Affordability and accessibility are key policy goals that should not be abandoned or altered in a NGN environment. There is ongoing relevance to the structure of universal service obligations and levies for NGN migration, whilst ensuring that these are not onerous on operators such that they compromise innovation and infrastructure development. Regulatory questions include whether VoIP providers should contribute to a universal service fund; how to structure universal service contributions and to which technology or service these should attach.
Consumer Protection	Issues that require attention include but are not limited to, quality of service; priority access to emergency services; the provision of location information; rights and presence management, number portability, operators' liability; privacy and security. Regulators around the world have started industry wide consultations of the consumer aspects of NGN migration to ensure that consumers are in no way adversely affected.

Box 13: Spectrum Sharing in South Africa

Numerous new players are seeking to offer WiMAX services on a national scale. Other licensed operators, such as the Under-serviced Area Licensees and the new national fixed line entrant licenced in 2005, require access to the 800Mhz Band (822-830MHz- Channel 65) for the deployment of non broadcasting services (essentially, CDMA). The regulator, ICASA recently embarked on a public process to assess the viability of new operators sharing this band for non-broadcasting purposes, with the incumbents in the band. The key objectives of this exercise were to provide spectrum for greater choice of access and distribution technologies to users and advance competitiveness in the telecommunications industry. At the same time, the process was mindful of wanting to encourage innovative applications without causing harmful interference to other services co-existing in the same spectrum. At the conclusion of the process, ICASA ruled that it is feasible to share the 800Mhz band based on spatial/geographic separation. TRAI in India has proposed in its consultations on NGNs, the de-licensing of 5.1 – 5.3 GHz band for outdoor usage for broadband access and the identification of additional spectrum bands, which are underutilized for deployment of broadband services.

Source: ICASA

6.1 Consultation

The existing resource challenges for regulators around the world will intensify under a new regulatory regime required to effectively and efficiently regulate NGNs. Many of the existing personnel within regulatory bodies are accustomed to neat divisional lines between telecommunications, broadcasting and spectrum management. Convergence and the move to horizontal and unified licensing frameworks have presented enormous challenges for this silo organizational design. Even where human resource and financial

capacity constraints are less in issue, regulators have begun to consult widely with stakeholders on NGN migration to allay concerns for operators and service providers in terms of business models and operations and to ensure consumer protection. The importance of joint consultation cannot be overstated as this interaction is essential for evolving regulation that benefits the operators, consumers and the ICT sector as a whole. Most of the developed countries in more advanced stages of NGN development have considered or are setting up cross industry bodies comprising the major players to manage the transition and deliberate upon the issues pertaining to standards, interconnection timeframe, etc. in addition to organizing awareness and educational programmes for stakeholders. The Bangladesh Regulator (BTRC) organised a workshop to cover various issues pertaining to NGN for regulatory staff as well as service providers by inviting international experts.

In Singapore, the Infocomm Development Authority (IDA) is playing a role in promoting the formation of industry-led alliances, exchanges and marketplaces while collaborating with industry to deploy infrastructure for ubiquitous offerings. Potential industry alliances will be forged in the areas of inter-roaming, interoperability and interworking in a multi-operator, multiplatform environment. This enables the regulator to engage with the cutting edge of the industry, to better understand the changing capital and operating expenditure requirements, the technical challenge of various aspects of social and security regulation in the new environment and how best to avoid regulatory induced failure in this now critical sector of any modern economy. OFCOM has established “NGN Co.”, a NGN industry coordination committee. This body is tasked to manage key aspects of transition to NGNs. The responsibilities of this body include producing a reference interconnect architecture for NGN, setting out detailed transition plan and also a plan for communication to consumers, in addition to overseeing the transition. TRAI in India has already established “NGN eCo” (NGN Expert Committee) to take forward ongoing joint consultation with consumers, industry players and policy makers to enrich the regulatory process. Issues that are being deliberated upon by this committee include interconnection, QOS and licensing as well as migration timetable for NGN in the country. It is also emphasized that in addition to industry wide consultation of matters of mutual interest, joint consultation with other regulators is critical for evolving regulation that benefits the operators, consumers and society as a whole.

7 Recommendations

Although NGN development globally on average is still in its nascent phase, there are numerous recommendations for designing and implementing policy and regulation in a manner that will best facilitate NGN deployment and development. These are drawn from best practice principles of regulation applied to existing networks and services. However, many of these depend on various different assumptions about the state of competition in a country, the market structure, regulatory capacity and the like.

Moving forward from a regulatory perspective also requires a sober examination of what works for PSTN regulation that can be carried over to a NGN space, and what does not and should be left behind. We know for example that interconnection agreements, frameworks and current charging principles are likely to change. Moreover, we know that the principle of universal access and ensuring priority access for operators to emergency calling can never be compromised in a NGN environment. Regulatory oversight will continue to be applicable. But as the NGN transition takes on increasing IP functionalities more closely resembling elements of the Internet which has generally attracted less regulation, regulators and policy makers need to question the applicability of legacy regulatory frameworks, for example content rules and quotas in broadcasting. Will these be easily applicable beyond public broadcasters who may be governed under a different mandate? Should voice (including VoIP) be distinguished as a service still needing to be treated with a distinct set of policy, legislative and regulatory provisions? Will competitive market dynamics be sufficient to secure a competitive environment in the absence of wholesale regulation? What prospects remain for incumbents to further entrench their market position through vertical integration? Is it more urgent to rapidly address legacy competition issues to prevent entrenching already unfair advantages in the market? Is it just incumbents that might need regulatory oversight or new entrants as well, and if so, to what degree? Is there an increased role for stakeholders in guiding regulatory and policy outcomes? While numerous questions still remain unanswered and will no doubt be resolved as the NGN migration gathers pace, the following is an attempt to extract general principles to be considered:

- If they have not already done so, regulators and policy-makers can begin to consider the processes required to address IP based and full NGN transition. This may include research, training, consultations with the industry and the public.
- For those markets that have not reached mature levels of competition, regulators and policy makers can explore measures to facilitate competition and promote efficiency in telecoms operations to facilitate growth and bring about improvements in roll-out and services. For example, unbundling the local loop to avoid duplication in the access network.
- Regulators can encourage a competitive market based outcomes rather than regulatory intervention, which should be used to pre-empt and address market failure.
- Universal access policies will remain vital. However, strategies to achieve these need to move away from protection of existing networks to more competitive strategies where pent up demand can be met more efficiently by the market and obligations to address market failure spread among all players.
- Policy-makers and regulators, rather than promoting certain technologies through technology and service-specific licensing, can explore a move towards unified and technology neutral licensing.
- Consumer education and participation is critical and it is the regulators responsibility, in consultation with operators to educate consumers on benefits and risks of new services and technologies. This could be effectively communicated to consumers and enforced for operators through the publication of guidelines or codes of good practice.
- Voice communications are starting to migrate away from the PSTN and the migration onto the Internet will gather pace. Regulators need to ensure that the consumer focused and regulatory issues are addressed in advance.
- Policy should encourage the continued operation and maintenance of legacy circuit switched PSTN until users are successfully migrated to new networks and services.
- Policy should create reasonable certainty for the industry and investment.
- Where industry self regulation is feasible, the regulator may consider the establishment of a self-regulatory body representative of all stakeholders in a convergent industry, particularly in relation to development of standards.
- Where content concerns emerge, (e.g. advertising, objectionable content, fraudulent behaviour, etc) policy makers should consider appropriate content protection rules and institutions to enforce them depending on the particular circumstances and context in that particular country. Many of these are effectively managed through industry self regulation and codes of conduct.
- Where relevant, regulators should be ready to accelerate the type approval process for NGN devices and rapid deployment. A memorandum of understanding may be helpful, as is the case with regard to GSM.
- Policy makers should address the issues of security and access to emergency services for consumers.
- A roadmap should be developed to revisit laws and regulations (specifically addressing interconnection and access issues) on an ongoing basis to ensure their suitability for sound NGN development.

Box 14: Policy Challenges for NGN

- Addressing Significant Market Power (SMP) issues and promoting fair competition
- Maintaining and open and competitive market in infrastructure and services
- Encouraging innovation and long-term investment
- Removing barriers to the development of emerging markets;
- Ensuring proportionality of regulation, including forbearance;
- Ensuring technologically neutral regulatory framework, allowing market players freedom of choice;
- Ensuring the optimal balance in spectrum management
- Ensuring consumer protection and QoS

Source: OECD

Box 15: Regulatory Principles for NGNs

- Technology and provider neutrality – to promote investment and innovation
- Market driven, commercial imperative to drive investment and technology decisions
- Light touch regulation: reduce barriers to entry
- Consistent and transparent regulation
- Regulation of non economic goals to be proportionate
- Reduced or no limits on foreign ownership
- No restriction on licences within technical or spectrum constraints
- Withdraw from regulation at levels not required
- Develop varying regulatory solutions for different products
- Promote infrastructure investment
- Expand capacity for external connections (landing stations; satellite etc)
- Removal of bottlenecks to access by end users to telecom services
- Fair regulatory framework for interconnection
- Promote effective competition and protection of consumers interests
- Comply with WTO non discrimination requirements
- Regulate to foster market growth to satisfy user needs

Source: OFTA and OFCOM

8 Regulating NGN: the Future

While much is known and can be anticipated with respect to the regulation of NGNs, it is simply too early in their evolution to determine prescriptive and definitive principles and approach, beyond a light touch, facilitative regulatory stance. What is certain is that the NGN evolution is underway and promises to fundamentally alter the ICT landscape. It will bring opportunities for operators and benefits for consumers and will pose challenges for regulators and policy makers. Regulation in this regard is a true work in progress. There is much to be learned from those countries at more advanced levels of technological development and policy consultation. As is the case in all ICT developments, there will be world leaders in NGN development and regulation. Those countries that are at less developed stages will have the opportunity to benefit from the experiences, mistakes and gains experienced by other countries and these should be leveraged wherever possible. At a minimum, there is clear guiding value in the established principles of regulation that seek to foster competition and investment. In most cases, there is yet to be a convincing case to depart from these tried and tested principles. Where necessary, departure from these principles should be capable of justification and modelled to promote competition, investment certainty and consumer welfare.

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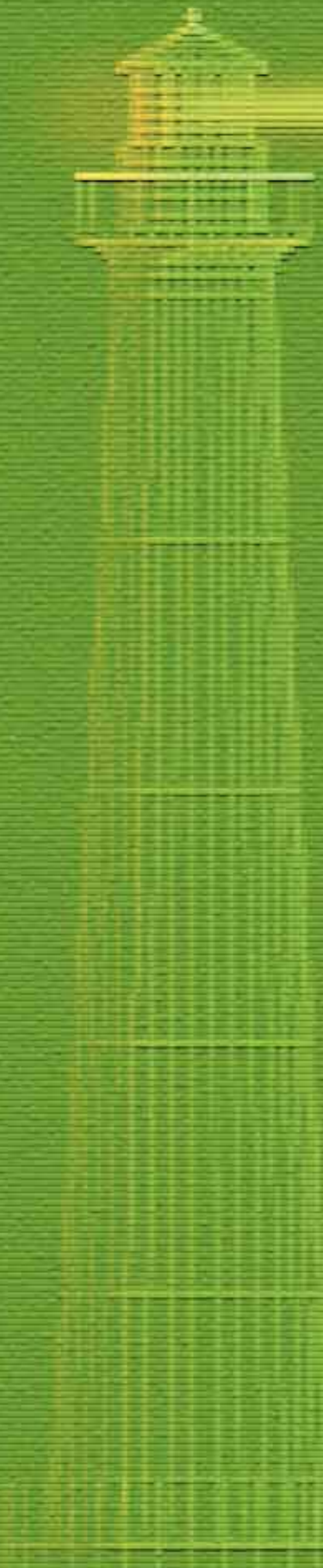
[87] Electronic Communications Committee (ECC) within the European Conference of Postal and Telecommunications Administrations (CEPT), "*Next Generation Network Developments and their Implications for the New Regulatory Regime*", ECC Report 27, Bornholm, October 2003.

International Telecommunication Union



GSR 2007

DISCUSSION PAPER

Fixed-Mobile Convergence

Comments are welcome and should be sent by 1 March 2007 to GSR07@itu.int

International Telecommunication Union

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FIXED-MOBILE CONVERGENCE

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GSR DISCUSSION PAPER
FIXED-MOBILE CONVERGENCE

*This paper has been prepared by **Ewan Sutherland**, 3wan@3wan.net, Telecommunication Policy Analyst, as an input document for the 2007 Global Symposium for Regulators (GSR), organized by the Telecommunication Development Bureau (BDT). The views expressed in this paper are those of the author and do not necessarily reflect the opinions of the ITU or its membership. Comments are welcome and should be sent to gsr07@itu.int by 1 March 2007.*

1 Introduction

Although termed the "mobile" service, cellular wireless handsets are often used for non-telecommunications functions and can more accurately be considered personal communications devices. They are used so frequently in fixed locations, primarily the home and the office, that some operators are offering special "home zone" tariffs while in others mobile competes direct with the limited range of Fixed Wireless Access (FWA).

While customers increasingly use a Radio Access Network (RAN) over short distances, most of the backhaul traffic is carried on core networks constructed with optic fibre cables. These offer a high capacity and low unit cost that present many advantages. In the many Small Island Developing States (SIDS) the use of satellite is unavoidable because there are no undersea cables, significantly increasing the costs. In much of Africa there is limited provision of undersea cable or access to those cables is controlled by a monopoly.

The strength of continuing innovation has required efforts to outline the patterns of technological development, for example, in the evolution of broadband access networks and services.[1,2] These attempts at forecasting indicate a future that will continue to change. The maps will have to be modified once they come into contact with consumers whose responses have proved to be so unpredictable.

Given the delays and uncertainties in the introduction of Third Generation (3G) mobile services, manufacturers have developed plans for the Long Term Evolution (LTE) to 3.5G and beyond.[3] These are intended to avoid a hiatus over the introduction of 4G and potentially highly unpopular demands to finance massive investments in new infrastructure. Yet in avoiding the term 4G it is left open for use by suppliers of alternative technologies seeking to gain a marketing advantage over 3G operators. On fixed networks, the terminology is the vaguer Next Generation Network (NGN) is used even though some of the technology is shared.[4]

IP Multimedia Sub-system (IMS) was originally devised for 3G networks then adopted by some manufacturers of fixed networks.[5] However, the evidence remains uncertain about how quickly it is being used on fixed networks and whether the two will be truly integrated.

In many developing countries and Least Developed Countries (LDCs) there are low fixed teledensities, with little prospect of further investment in traditional narrowband networks. Moreover vast numbers of people have access to neither a fixed nor to a mobile network. As a result Fixed Mobile Convergence (FMC), as conceived in the developed countries, is at best misleading and often meaningless. Nonetheless, there is progress towards convergence of voice and Internet access in developing countries, though with much greater emphasis on delivery of the services over wireless networks.

This chapter considers first the different classes of convergence. It then analyses the consumer markets and enterprise markets. The policies used for Fixed Mobile Convergence are then considered. Finally, conclusions are drawn.

2 Classes of convergence

While convergence is often thought of as fixed and mobile, it can take and often has taken other forms. For example, considerable attention has been given to the convergence of telecommunications and broadcasting.

A significant problem has been that the approaches taken by manufacturers and operators to convergence have often been to create "hype" around specific platforms and products in order to promote them to financial institutions, to policy-makers and to customers. For all that such propositions sound plausible at the time, the reality has invariably proved different because of the rapidity of change and the profusion of alternatives. Nonetheless, convergence has been an enduring aspiration for market players and something given serious attention in public policy.

Convergence has often been confused with substitution – notably in the claims that mobile was displacing fixed telecommunications. An extreme example is that some manufacturers of watches are concerned that the mobile phone, along with other electronic devices, is substituting for their more traditional products – fixed and mobile, analogue and digital.

Fixed and mobile telecommunications markets are both subject to regulation by the same laws and institutions, but with considerable differences in treatment. These arose from the presumption that the mobile "market" was competitive while fixed markets required regulated access regimes.

Elements of mobility or at least of portability were added to the fixed network with the use of cordless telephones. The Digital European Cordless Telephony (DECT) standard has been used extensively for networks in offices and factories and also in homes and gardens.[6] Gradually DECT is being replaced by multipurpose Wireless Fidelity (Wi-Fi) networks.

It is possible to have the convergence of many different RANs in a portable or handheld device including:

- Near Field Communications (NFC):
  - Ultra Wide Band (UWB)
  - Radio Frequency IDentification (RFID)
- Hot spots:
  - DECT
  - Wi-Fi
  - WiMAX
  - Orthogonal Frequency Division Multiplexing (OFDM)
- Cellular:
  - Global Standard for Mobile (GSM)
  - Code Division Multiple Access (CDMA)
- Broadcast:
  - Digital Audio Broadcasting (DAB)
  - Digital Multimedia Broadcasting (DMB)
  - Digital Video Broadcasting – Handheld (DVB-H)

A physical constraint on the inclusion of these in one device is the power each draws off the battery and consumer perceptions of how frequently they should be recharged. The dictates of fashion require the designs of handsets and thus batteries to be small and especially to be thin. A leading manufacturer recently announced a model only 6.5 mm thick. The battery must be shared with an array of other functions. The use of a Software Defined Radio (SDR) reduces the complexity of the electronics and thus the load on the battery.

There are also problems of space for the various antennae. Visible and protruding antennae were abandoned because they spoiled the design. The difficulties are being reduced by the use of Multiple Input Multiple Output (MIMO) aerials.

The availability of low cost chip-sets means that radio interfaces can be included in a wide range of devices, notably in consumer electronics. With a Wi-Fi chip a consumer electronic device can be connected to the network of the residence or of the car and from there, through a gateway, to the Internet. This allows control of the device from other locations. It also permits the provision of value-added services, such as remote diagnostics of the device, upgrades to software and control over the use of electricity.

Similar arguments apply to the use of RFID, where sharply falling costs allow the use of RFID tags on individual items. This has been termed the "Internet of things" as an extension to include inanimate objects.[7] It is argued to be the next "logical" step, after connecting people anytime, anywhere, to connect inanimate objects to a communication network. The use of RFID and sensors serves to extend the communication and monitoring potential of the Internet, as will the introduction of computing power in everyday items such as razors, shoes and packaging. It is far from clear what comes next, but one possibility is implants in humans and animals that connect directly to the Internet.

The use of RFID tags on individual products raises important questions of privacy.[8] For example, the ability of third parties to read the tags and by their location or proximity to a person or residence draw inferences that infringe on the private life of an individual.

The inclusion of an RFID tag and also an RFID sensor in a handheld device open the possibility of many additional services. Many Japanese handsets can already read two-dimensional barcodes, allowing a quick link to be made from an object to a web site with information about the object or a related service. This can be further extended with the ability to read RFID tags. With an embedded RFID tag in the handset it can be used as an electronic purse or a means of identification.

An obvious problem in service convergence arises where there are significant differences in unit costs of networks, or indeed in the type of units used to charge for access on different networks. If access is unlimited on fixed networks and billed per second or per kilobyte on mobile networks, then there will be a strong economic incentive to use the fixed network. Yet this appears to reflect real differences in the underlying costs.

It presents the problem for operators of having to advise customers of the differences or offer common pricing and to absorb the differences in cost.

What might be considered a technologically crude form of convergence is already available in many countries, with the appearance of offers and invoices that merely bundle services together as triple and, with the addition of mobile telephony, quadruple play. These have become a matter of the branding of the service and the use of a shared billing platform.

Such bundles of services and hardware can run far ahead of the technology and of corporate structures, provided there are flexible and competitive wholesale markets which allow operators to aggregate the various components into an interesting offer.

2.1 Mergers and acquisitions

Recognizing that convergence is taking place, some market players have moved to acquire companies in upstream, downstream or complementary markets.[9]

If a telecommunications operator sees that it will need content, then in might be tempted to acquire a broadcasting company or a games software house or a music label in order to secure its supply and to ensure that it will continue to make profits in the future.

One of the great fears of telecommunications companies and their boards is that they might be reduced to being a utility with no special status in financial markets, perceived merely as a bulk carrier of undifferentiated bits. It does not present the same level of difficulty for public policy objectives and may offer some advantages. However, there is a risk into which a couple of fixed operators have fallen of being

taken over by financial interests concerned only with “sweating the assets” with little apparent regard either for customers or regulation.

A constraint on acquisitions lies with the views of the financial markets, though these can change quite quickly. At one time they told fixed telecommunications operators to spin off their mobile network operators to maximize shareholder value. Later they were told to re-integrate mobile with fixed.

The financial markets are generally happy to approve operators seeking competitive advantage over rivals and new ways to distinguish themselves from competitors. At the same time, they consider that firms should “stick to their knitting”, that is to their core activities. Financial analysts and markets tend to see difficulties and heightened risks when telecommunications companies move into manufacturing or creative industries. Moreover, the failure of international alliances in the late 1990s ought to act as a reminder, from the recent past, that operators have made serious mistakes in assessing their ability to create value within their own industry. To cross borders into content generation raises much more serious issues about their ability to manage differences in organizational cultures and values.

Competition law, in the form of merger control, also plays an important role. There are extensive analyses and experiences from its application to vertical and horizontal mergers.[10], [11] Where there is a significant risk of the reduction of competition by the leveraging of power from one market into another, national competition authorities will be reluctant to permit acquisitions. They are likely to seek to block such mergers or to require commitments that ensure wholesale access to any essential facilities and key inputs.

2.2 The evolution of convergence

The reaction of consumers to devices and services that offer convergence is still emerging. Clearly, many innovations or combinations of elements will fail, because of lack of interest, poor value for money, concerns over privacy or the introduction of something even more innovative. This market filtering process is as inevitable as it is pitiless.

Convergence does not stand still rather it evolves or morphs under pressure from the upstream markets in the supply of chips and their application in innovative hardware and services. Market players try to respond to the changing views of the various groups of customers, whether consumers or business.

There is no reason to expect these changes to stop or even to slow down, given those underlying forces. At one time mobile was to substitute for fixed, then they were to converge, it is unclear what will come next.

3 Consumer markets

From the days of the black Bakelite telephone we have jumped to fast moving consumer goods and services. New models, devices and services appear with great rapidity, many lasting relatively short periods of time. What was once a rather staid state-provided utility has become part of a consumer market kept moving by technological innovations funded in part by venture capitalists.

Consumers have expressed clear preferences for brands in handsets and services, accessible from different platforms.[12] Leading search engine companies have recently entered into deals with mobile operators and handset manufacturers to make their services available on mobile handsets. On a mobile device searching takes on a complex challenge of having to consider location, which can be determined in many ways, and the profile of the user, since it is a personal device. Searches for video material also appear to require an element of personalization.

While the mobile network operators see an increased role for themselves in such value-added activities, customers appear to want the same brands regardless of the device or interface.

This section looks at the fusion of television and telephony, quadruple play, at telecommunications in motor cars and in homes, plus consideration of Web 2.0.[13]

3.1 Telephony and television

One of the earliest examples of convergence was based on the view that most homes in developed countries had both a telephone and television. This led to videotex systems with a modem into which the television could be plugged as a monitor.[14] The service came too soon, when most households still had only one television which other family members were reluctant to see diverted to this seemingly exotic service.

The most famous and successful example was the French Minitel system which generated enormous interest and traffic. It used a simple kiosk system that was later to be used by a Japanese mobile network operator to allow content providers to offer services with the operator billing customers on their behalf using a very simple set of fixed rates. However, Minitel used a dedicated terminal, rather than a television and adapter as had originally been envisaged.

An unanticipated example of convergence came with the use of Short Message Service (SMS) for voting and competitions on television shows, on both satellite and terrestrial networks.[15] This provided a means for viewers to participate in the shows making them more attractive. It also generated considerable revenues, since many of the numbers used were charged at premium prices. A committee of the United Kingdom House of Commons has recently proposed reclassifying some of these activities as gambling, being based on luck and not skill.[16]

The addition of SMS provides an early impression of how more interactive forms of television might develop.

Many newspapers and television stations have invited customers to submit their own photos and videos taken using mobile cameras. While the quality may be less than the usual standards, there is an immediacy and a sense of participation that adds considerable value.

While both fixed and mobile operators are experimenting with television, the approaches taken appear to be separate. On fixed networks operators are offering IP Television and Video On Demand (VOD), usually bundled with broadband Internet access.[17] The limitations and the costs of offering television on 3G networks, using Multimedia Broadcast Multicast Service (MBMS), have encouraged operators to try to obtain separate allocations of spectrum for mobile television using one of a number of technologies. This may also be a means of pre-empting competition from broadcasters offering mobile television. One result is that it pushes the convergence from the network into the handset, the billing and the commercial arrangements with broadcasters.

To date, there is limited evidence of operators creating seamless fixed and mobile television offers. Indeed some operators provide what might be considered competing offers with similar content on fixed and mobile. There remains enormous uncertainty about developments, for example, on the scaleability of television from the widescreen down to the mobile phone and from the full length movie down to the video clip.

3.2 Quadruple play

Convergence, of a sort, has arrived in the form of triple and quadruple play offers, spanning:

- television
- Internet access
- fixed telecommunications
- mobile telephony

The speed with which these have appeared and spread across the developed countries has been very rapid, and this is now extending into developing markets.

Operators have been reluctant to reduce prices below a level of between USD 25 and USD 40, so they switched to other forms of competition by increasing the speed and adding other services. Many previously

distinct elements, not least voice telephony, are being lost in a flat fee with discretionary spending on services and content.[18] However, the offers are usually limited to calls to fixed networks because of the high cost of wholesale mobile termination rates (MTRs). Some mobile operators have created similar bundles with unlimited calls to fixed networks.

Many operators are upgrading their infrastructure for 3G or 3.5G with services launched in almost all the developed and many developing countries. The OECD has reported that around 30 per cent of operators provided an option with an unlimited flat rate data services, though high prices had been a disincentive to faster uptake.[19]

The OECD argued for the introduction of Mobile Virtual Network Operators (MVNOs) in order to reduce entry barriers for specialized mobile data services and to generate competition. It suggested they would also play an important role especially in the context of fixed-mobile convergence. Unfortunately, the experiences have been very mixed and almost exclusively in developed countries.

It is open to question whether MVNOs would work in developing countries. There is, so far, little evidence of success that would encourage infrastructure owners to open their networks. There are no legal models in place to require access for MVNOs and this would be resisted by operators. The most obvious strategy for an MVNO would be to lower prices, putting unwelcome pressure on operators.

Offering broadband Internet access over cellular networks raises complex questions. An obvious difference from the fixed network is that there is no regulated or wholesale access, with a very small number of operators, rather than a range of Internet Service Providers (ISPs). Moreover, there is very limited prospect for further market entry. Mobile operators have shown much more interest in providing value added services than “raw” IP access.

While manufacturers claim 3G and 3.5G networks can provide very high speeds there is little evidence from the field to show what is being delivered. The level of infrastructure investment will constrain the extent to which multiple users can access the higher speeds. This is very different from the contention ratios on fixed networks.

A form of triple play has been delivered in Cape Verde combining cellular, fixed and digital television.[20] Another recent announcement in the Caribbean suggests developments in adding television over GPRS and 3G to voice and Internet access.[21] The questions which remain to be answered concern the experience delivered to the customer and the economics of meeting demand for the services.

A significant problem is delivering the bandwidth over a radio access network. While there is considerable hope placed in WiMAX, the delivery of low cost handsets and affordable networks has yet to be achieved on the scale needed to deliver a service equivalent to the multiple play offers described above.

3.3 Cars

The high level of competition in the automobile industry has led manufacturers to concentrate on Information and Communications Technologies (ICTs) as a way to add value to their products and supporting services. A car lacks the constraints of a mobile handset in terms of the available space and the source of power, allowing a much greater range of possibilities.[22]

Manufacturers have added Global Positioning Systems (GPS) with satellite navigation for drivers. GPS has also been used to discourage theft by warning of the ability to locate stolen vehicles. ICTs have been used to add value with services to improve vehicle maintenance, fuel efficiency, fault diagnosis and customer care. One leading manufacturer is advertising its full range of vehicles as being Bluetooth-enabled.

Mobile telephony has been integrated with cars through kits to supply power and hands-free operation to avoid the driver having to use the handset. In some cars there is an embedded phone with a supplementary Subscriber Identification Module (SIM) card using the same number, so that the car becomes the phone.

There is continuing controversy over the safety of telephony while driving, even without use of the handset. A growing number of countries have banned the use of handsets while driving with some evidence suggesting it is as dangerous as driving under the influence of alcohol.[23] However, many developing countries have been slow to adopt legislation to ban the use of telephone handsets while driving. Such regulations require to be technologically neutral, including cellular, satellite and FWA devices – especially the watching of videos.

The primary area of attention amongst automobile manufacturers is now In-Car Entertainment (ICE). For example, many vehicles in the North America are supplied with a satellite radio requiring customers to pay a small monthly charge for a service that offers one hundred channels of music and news. Increasingly, satellite video will be available to entertain the passengers. New ICT applications are also being developed to improve safety of the vehicle by reducing the risks of accidents.

Cars were the original place for mobile phones, given their size and power requirements. Today, they retain an important place, though with a much increased range of services.

3.4 Homes

With an increasing number of high-capacity broadband connections, that is 100 Megabits/second and more, especially with Fibre To The Home (FTTH), there is a potential market for sophisticated and powerful Home Gateways (HGs).[24] These would go far beyond an:

- IP router
- gateway to the Internet
- Wi-Fi and WiMAX transceivers
- storage capacity for video and audio
- heavily defended firewall

This would allow any device in the home to be connected to the Internet. Manufacturers of chips and electronics, plus service providers, are all positioned to fight out which will win in the market place.

A number of service providers and device manufacturers have already entered the market with innovative services. One company has developed a standalone device to allow the residential customer to stream any audio or video available in the home to the individual when elsewhere. Almost inevitably, this has been extended to other family members and sometimes beyond. Initially, this was only available for National Television System Committee (NTSC) video, but later extended to Phase Alternating Line (PAL) and even to High Definition (HD).[25] The software clients were initially for a conventional Personal Computer (PC) with a fixed broadband connection, but these have been extended to smaller devices, including mobile phones which have Internet access. It can even be accessed in planes equipped with Wi-Fi.

The manufacturers of Personal Video Recorders (PVR) have begun to incorporate a similar function, allowing customers to store and to stream video across the Internet.[26] This allows remote access to satellite or terrestrial broadcast television and also to DVDs and recorded programmes when out of the home.

This place-shifting, to complement the well-established time-shifting of Video Cassette Recorders, bypasses any offers or constraints of local operators and service providers. It may also bypass regulatory constraints and the geographical limits of any licensing of content.

Such consumer-led and almost anarchistic innovations can only be expected to multiply. Viral marketing and peer-to-peer are strong models that together have proved very successful.

3.5 Web 2.0

In picking up the pieces from the crash that followed the dot com bubble, the idea of Web 2.0 was floated by Tim O'Reilly and others.[27] It was to identify those elements of the new business models that might endure and thrive. Web 2.0 stressed the use of underlying databases and interfaces that were subject to constant new releases, some never emerging from a trial status. A problem here for developing countries is the traffic this generates in repeated downloads.

The most conspicuous success of Web 2.0 has been in the creation of the so-called "blogosphere" and other social-networking applications. It is estimated that there are already over twenty million people in China with their own weblogs. This is now being extended to video-logs, though mobile logs seem to be slower in taking off.

While there is considerable debate about Web 2.0 for the fixed Internet, this seems to be distinct from the initiatives of the cellular wireless operators who have their own vision.[28] While these are in conflict and the players have different economic incentives it seems unlikely there can be true convergence.

Instant Messaging (IM) has been available for over a decade on the fixed Internet. However, there have been problems of inter-working between the various systems. It is not merely the capability to exchange messages between individuals, it is also the availability of their status, whether they are free to communicate or busy or even off-line. Service providers do not want customers of their rivals to be able to see the availability status and "buddy lists" of their own customers, rather they want customers to use their system.

No government has yet forced the inter-working of instant messaging or equivalent systems. However, commitments were obtained in the approval of an acquisition of one messaging provider by another.[29] These were supposed to have ensured better inter-working, though the progress has been limited.

Some handset manufacturers and cellular wireless operators are offering conventional IM services on handsets. This is, in part, a response to the fear that the large revenues from SMS could disappear into cheaper and more competitive messaging services carried over IP networks. The business model tends to be a monthly subscription, rather than a payment for the data used. Some mobile networks are providing access to social networking, again for a monthly subscription.

Many VoIP services have capabilities based on IM, in that they show the status of friends and colleagues. It would require not merely interconnection, but a much richer range of inter-working to provide equivalent functionality. Similar characteristics can also be found in some Massively Multiplayer Online Role-Playing Games (MMORPG), though inter-working here could be very complicated.

There has been a rapid and widely discussed growth of social networking systems, with some high value acquisitions of firms. In some ways, these have only re-invented the idea of a personal web page, but with much easier software and convenient links into networks of friends. Following concerns about abuse and crimes, parental controls are being introduced.

A number of systems have developed which allow interaction in a three dimensional landscape and an artificial geography.[30] Here individuals participate as an avatar, which they can design and personalize.

While many of the applications are recreational there are also the beginnings of business applications.[31] A leading news agency was one of the first corporations to open a commercial presence in a social networking space, followed by others exploring the possibilities of using avatars in cyberspace for internal business processes and for engagement with customers.

The usual generational argument applies here, with younger users taking the lead. 2006 saw not only a rapid growth in social networking, but also an extension of the age and socio-demographic range, extending to older users, those over twenty-five. While mobile devices are used to create still and moving images to be uploaded across the fixed network to social networking sites, there are only the beginnings of Mobile Social networking Software (Mososo).

3.6 Device convergence

Manufacturers of handheld electronic devices have sought to add more features to attract customers in their highly competitive markets. For example, games consoles have seen the addition of Wi-Fi and audio, allowing them to become, in effect, telephones with client software for IM and VoIP.

There has been rapid progress in a range of countries to turn mobile handsets into banking instruments. With the addition of an RFID tag, the handset can be linked to the identity of the customer and used for debit and credit card payments. In least developed countries there are generally more mobile phones than bank accounts, with mobile telephony growing faster than banking. Thus it is an attractive option for network operators to try to boost their low Average Revenue Per User (ARPU).

However, it raises interesting issues concerning the interaction between banking and telecommunications regulators. Many banking regulators may require assistance to understand the implications of network economics and technologies.

Convergence in handsets, with platform-based competition, brings firms into competition that were once in separate markets. Despite a growing overlap in functionality, firms can expect that prices will initially increase and that profits will rise through increased value. Later, as substitution takes over and dominating any perception by consumers of an increase in value, it causes prices and profits to fall. Most of the factors influencing this are outside the control of even the larger firms, requiring them to be very careful in whether and how they deploy specific technologies, carefully evaluating whether they will gain a competitive advantage. Much of the benefits for the firm will be competed away, to the benefit of the consumer.[32]

A group of manufacturers and operators under the Fixed-Mobile Convergence Alliance (FMCA) is sharing experiences of convergence.[33] Its mission is to "abolish the distinction between fixed and mobile" irrespective of the underlying networks.

Manufacturers are currently developing dual GSM and Wi-Fi handsets. Some commentators believe they resemble the earlier combination of GSM and DECT from the 1990s which were not successful[34]. These earlier dual handsets were both late in hitting the market as well as being large and unattractive. The commercial logic of both dual-mode devices is the same, with an attempt to eliminate the need to carry two handsets. The renewed GSM-Wi-FI handset, however, uses much more sophisticated technology, with seamless transfer of calls between technologies, for example, in the use of Unlicensed Mobile Access (UMA).[35]

In the intervening years GSM has become much more commonplace and is more heavily used. There is also a strong incentive for operators, since the use of Wi-Fi for calls allows traffic to be moved onto the fixed network bypassing GSM networks and reducing costs. This may allow the operators to compete with providers of VoIP. However, for the customer the technology is largely irrelevant, with the interest being in flat rate pricing models.

Part of the logic of dual-mode phones for corporations is the potential cost savings made from around half of all business calls being made from cellphones while employees are at their desks. This preference on the part of customers is usually because the handset contains the numbers in an address book. The attraction for the corporation is to achieve the savings.

As ever, the appearance of the new handsets has been delayed. Consequently, what is missing has been the volumes of demand that will drive down the prices and trigger widespread adoption.

4 Corporate networks

The market to supply corporations with networks and network services is much less susceptible to the whims of fashion than consumer markets, the trends are stronger and more predictable. The high levels of expenditure are subject to rigorous tests such as Return On Investment (ROI) and Total Cost of Ownership (TCO).

Although FMC for corporations has been discussed for years, progress has proved limited and slow. Amongst the reasons for this are the high prices for the termination of calls on mobile networks in many countries, the very high cost of the cellular data service and the absence of Service Level Agreements (SLAs). While mobile network operators continue to stress substitution rather than convergence these issues will remain unresolved, causing corporations to look elsewhere for mobility or nomadicity, to Wi-Fi and DSL technologies.

This section considers fixed and then mobile business telecommunications, followed by enterprise applications and some conclusions.

4.1 Business communications services

The supply of Business Communication Services (BCS) is a highly competitive market and one that is close to being global. Market players provide good coverage in developed countries and in key emerging markets. In addition to global operators there are a few strong regional players and some virtual network operators. From these, enterprises are able to pick the "best of breed" suppliers, those that are best able to deliver their requirements, with a strong emphasis on reliability, security and cost, plus a good match on geographic coverage.[36]

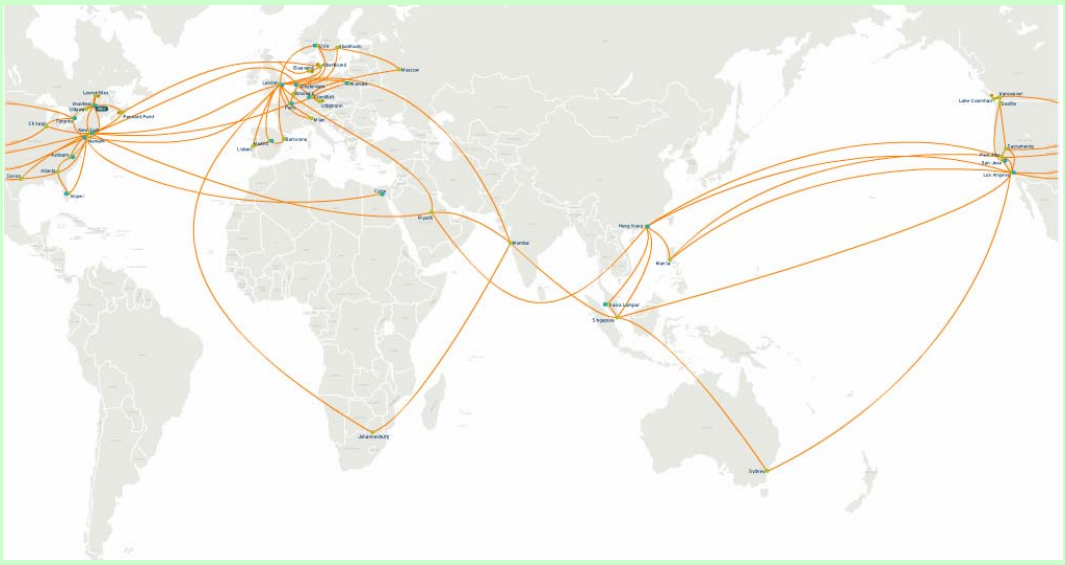
These requirements are specified in detail in the contracts and SLAs which set out not only technical parameters, but also penalties for failure to comply. Networks are required to have diverse routing to limit the effects of disasters and accidents, to ensure business continuity. A high quality of voice call is required, while very low latency is required for enterprise applications.

The supply of business communications services is weak in most of Africa and much of Central Asia, where there is limited demand and where wholesale access to infrastructure is limited. Even in rural areas of Europe and North America the global operators have problems in delivering services, being reliant on reselling infrastructure obtained from national incumbent operators. Nonetheless, the global and regional service providers will meet the requirements of a large customer regardless of the location, even if they are obliged to use unreliable infrastructure provided by a reluctant or less than fully cooperative local operator.

Videsh Sanchar Nigam Ltd (VSNL)

VSNL is the former state monopoly provider of international telecommunications in India. In 2002 the Tata Group acquired majority control of VSNL, with the Government of India remaining a significant shareholder. Established by Jamsetji Tata in the second half of the 19th century, the Tata Group has grown into the largest conglomerate in India. Through VSNL, the Tata Group acquired Teleglobe International Holdings Ltd for USD 239 million and Tyco Global Network for USD 130 million. These give VSNL the capability to collect traffic from many parts of the world in order to supply the call centres and business outsourcing centres run in India by the Tata Group (see Figure 1).

Figure 1 VSNL International Network



VSNL has a formidable partner in Tata Consulting Services (TCS). For the third quarter of the calendar year 2006 it reported quarter-on-quarter growth of over 9 per cent, the equivalent of almost 50 per cent annual growth, continuing a run of quite remarkable results (see Table 1).

Table 1 Revenues of Tata consultancy Services (INR millions)

	2004	***2005***	***2006***
Consultancy services	69,269	94,856	120,953
Sale of equipment & software licenses	6,868	10,381	8,468
Other revenues	896	1,158	3,034
Total revenues	**77,033**	**106,394**	**132,454**

Source: TCS annual reports, USA GAAP conventions. Year to 31 March.

Both voice and data are carried on Virtual Private Networks (VPNs), increasingly these are IP-VPNs using Multi-Protocol Label Switching (MPLS).[37] They offer corporations a low and declining unit cost for traffic. MPLS allows the network to be configured to carry many different types of traffic, ensuring that policies about the priorities for particular traffic are enforced.[38] In this way corporations can give an appropriate priority to voice and enterprise application software, while also allowing for video conferencing and messaging.

There remain significant barriers to the implementation of voice and data convergence for corporations (see Table 2). Work on these issues and the technical challenges will be sufficient to keep corporations busy for some time, after that they can look at integration of cellular wireless services.

Table 2 Significant and major barriers to converged IP networks[39]

	Global	*USA*	*Europe*	*Asia-Pacific*
Network security	58.2%	45.3%	61.5%	64.7%
Cost of implementation	55.6%	52.6%	53.7%	59.2%
Cost of new equipment/technology	54.0%	58.1%	47.4%	53.3%
Complexity of implementation	53.6%	46.6%	52.9%	58.3%
Disruption to business while migrating	50.4%	46.2%	50.7%	53.3%

Source: AT&T EIU survey of multinational corporations, June 2006.

The move to voice and data integration is encouraging corporations to outsource the supply of BCS. The scale of the conversion and the associated risks, together with the management of the merged network present an opportunity for MNCs to leave the business of self-supply. Behind this is the view of most enterprises that telecommunications is not a core function and therefore something that ought to be outsourced to third parties.

IP-VPNs present problems for corporations seeking to ensure positive regulatory compliance. Many countries continue to use regulations that are technologically obsolete and that make no mention of the types of networks and services currently in use. For example, the use of IP telephony and connections from an IP-VPN to the PSTN and the Internet may neither be legal nor illegal but left in a regulatory limbo.

4.2 Enterprise cellular services

Cellular mobile networks remain distinct and separate from fixed networks for multi-national corporations. The offers by the mobile operators are national in scope and they focus on voice and value-added services, rather than access to enterprise applications and integration with corporate fixed VPNs. Even combining numbering for mobile services with a corporate numbering plan can be very difficult.

The criticism of large corporate clients is that operators appear to have limited interest in their requirements and future plans. For example, it is almost impossible to obtain an SLA for mobile, something available on fixed networks for more than a decade. Such an SLA would be expected to specify the coverage, the data rates available, the limits of jitter and packet loss, in order that customers could ensure their various applications would work properly.

The mobile network operators make national offers and provide services country by country. Although a number of geographically extensive groups have developed footprints through acquisition and network construction, they continue to treat their customers as being national. Sometimes this is because the footprint is an incomplete patchwork. It is often aggravated by the lack of integration of national management teams.

The recent decisions by one of the largest GSM operators to withdraw from key markets makes clear its lack of interest in providing the seamless trans-national services sought by multi-national corporations. Instead it appears to be concentrating on growth in consumer markets.

The significance of trans-national offers varies greatly by continent because of differences in travel patterns. It is in Europe, with the high level of trans-national integration of the European Union and its single market that travel is the most intense and thus trans-national offers most important. By comparison, there are much lower levels of travel and therefore lesser concerns about roaming in Africa, Asia and Latin America. However, the overall arguments for continental contracts remain strong, in terms of a single point of contact, one interface to billing software and one supplier with whom to discuss future needs.

Over many years corporations have built up their use of roaming for voice, generally with very limited financial controls. Despite this, there are established patterns that are, after a fashion, allowed for in budgets. However, the prospect of adding to this large and entirely unpredictable bills for data roaming has caused

corporations to be extremely cautious in allowing employees to use data services. Instead, corporations have sought alternatives with more predictable spending patterns.

There are signs in Africa that operators are abandoning the practice of charging for international roaming. Two operators have abandoned voice roaming surcharges in East Africa, with one having dropped surcharges for GPRS on a much wider footprint.[40] It remains the approach of a tiny minority of network operators, aimed at consumers with limited spending power, rather than the needs of corporations.

While initial access to data application was by dial-up to dedicated numbers this was gradually widened to add access from broadband and Wi-Fi hot spots. In many corporations this is outsourced to third party suppliers able to ensure the widest possible access with simple and seamless access for end customers.

There are very few MVNOs aimed at enterprise customers because of the difficulties in obtaining the wholesale access from licensed operators.[41] One small West European MVNO offers a multi-country service, without roaming charges, in four and soon six countries in Western Europe.[42]

Given the lack of progress with cellular operators, corporations have found alternative solutions. Corporate mobility is now provided with a wide range of technologies, notably broadband access from homes and hotels, plus Wi-Fi hot spots where they are available, falling back on dial-up where there is nothing else available.

4.3 Mobile enterprise applications

One of the technologies that supports secure remote access from different networks is Session Initiation Protocol (SIP) which is now being deployed by corporations. In particular, it allows access to voice and instant messaging services and to enterprise software applications over DSL and Wi-Fi, and eventually WiMAX, with potentially significant cost savings.

The development of Mobile Enterprise Applications (MEA) or of mobile access to conventional enterprise applications has been very slow. In part this is due to the technical characteristics of the cellular networks which are very different from the fixed business networks, with problems of jitter and latency. Most efforts have tended to focus on support for applications that would boost sales.

One exception to this has been the introduction, from the late 1990s, of dedicated devices for electronic mail. Initially these operated on bi-directional pager networks, but were later moved to run on Internet Protocol over cellular networks. With a flat monthly fee they have been seen as both relatively affordable and a valuable personal productivity tool. However, the latter claim is unmeasured and open to doubt given the somewhat obsessive use made of the service by many executives, often well beyond conventional office hours. [43]

An area of increasing concern for corporations is the security of their fleets of mobile devices. This includes protection against viruses, trojans, worms, phishing attacks and the like. Increasingly corporations seek integrated solutions that ensure proper protection before a device connects to their network with a series of verifications that the device and the user should be connected and the privileges they should have while connected. Where a device is lost, corporations want to destroy the data remotely, even if it is encrypted. These challenges are quite different from their fixed networks and the solutions are not integrated.

There has been a string of disclosures of personal data in the United States from the loss or theft of portable devices. These have occurred across all sectors, including branches of government, universities, private sector companies and telecommunications operators. These emphasize the inadequacy of policies and security measures imposed on devices and users by these organizations.

Information systems directed by corporations towards their customers remain unconverged. For example, banks will offer notification of transactions by SMS, while allowing a much wider range of interactive facilities when the customer uses the fixed Internet. Some European railway companies allow customers to

make reservations using the Internet then present the SMS as their ticket. The two technologies are seen as distinct channels to the customer, with different economies and social characteristics.

Similarly, customer services are usually distinguished between fixed and mobile. There are different charges for customers, with few freephone or toll-free numbers on mobile networks. Mobile operators also use separate short code number ranges from the fixed networks.

4.4 Separate and different

The forces on the enterprise market in terms of demand and supply have resulted in quite different outcomes from retail or consumer markets. However, examples such as the slow adoption of weblogs and instant messaging indicate that businesses will, to some extent, follow the lead of consumer markets in applications.

Voice and data are converging on fixed networks, with high levels of assured quality. Mobile networks remain quite separate, with cellular wireless operators focused on national offers of voice services, with some messaging services. In particular, operators have been reluctant to offer affordable tariffs for data with SLAs. As a result corporations have had to achieve a significant degree of nomadic access with non-cellular solutions in the absence of offers of quadruple play.

5 Policy frameworks

While the scope of legislation and regulations invariably covers both fixed and mobile it does so in different and asymmetric ways. Ensuring the determination of location from which calls are being made to emergency services may be strictly enforced for VoIP operators in some countries, while mobile operators have been granted more time to resolve engineering issues.[44] Likewise, mobile operators may be relieved of directory service obligations that are imposed on fixed line operators. Often, the presumption has been that mobile was or would be more competitive than fixed, and would therefore require less regulation.

As a result, fixed operators have often sought to obtain the perceived privileges of mobile operators while they in turn resisted the imposition of “legacy” regulation. In time and after careful analyses the differences in the levels of competition have proved to be less than was once supposed, requiring the judicious imposition of some of the tried and tested regulatory measures on mobile operators, in order to resolve the market problems.[45]

This section considers numbers, relevant markets, the ubiquitous network society policy model, unified licensing, voice over Internet protocol and legacy regulation.

5.1 Numbers

The telephone numbers used for fixed and mobile networks have been kept separate in most countries, though these could easily have been combined. There are a few exceptions, such as North America and Hong Kong, China.

Number ranges have typically distinguished fixed or geographic numbers from mobile networks. While the number ranges for fixed networks indicated the location, mobile ranges have often identified particular operators. Indeed, many mobile operators prefer this because it allows them to use the number as part of the brand and assists their efforts to keep groups of customers on the same network by offering lower prices for on-net calls.

As tariff plans have gradually lost the distinction between local and long distance the value of a number as a geographic locator has become less important on fixed networks.

Where the Calling Party Pays (CPP) system is used, then the number ranges must be kept separate because of the considerable price differences in calls to fixed networks and to mobile networks. The numbers are

required to act as a warning about the price of the call. However, many number plans are too complex to be generally understood.

In many countries number portability has been introduced in order to increase consumer choice, to reduce switching costs and intensify competition. In countries with RPP it is possible to have portability between fixed and mobile. In the case of CPP it is much more problematic, since it is unlikely that the receiving party would want to pay the cost of the MTR on incoming calls. It would therefore be necessary to warn the caller that the call would be more expensive. This is generally considered a strong disincentive to its application.

A previous generation of national assignments of numbers for personal services failed. This was due to the rapid growth of second generation mobile, the inconvenience of having to update contact numbers for call forwarding in real time on a remote server and the high cost of the service.

5.2 Relevant markets

In approaches based on or using competition law, the unit of analysis is the relevant market. This has a much stricter definition than used in marketing, in policy formulation or in *ex ante* regulation.

The European Commission has undertaken a review of its Recommendation on the markets to be analysed by national regulatory authorities. This document has a complex history, emerging from *ad hoc* regulatory measures in the 1990s and brought together in the Framework Directive in 2002.[46] The markets were then analysed under competition law principles, then opened for comments by operators, before being adopted as a Recommendation in 2003.[47]

In mid-2006, the EC made its proposal to revise the list of markets.[48] It removed several retail markets, in order to concentrate on wholesale markets. It retained separate markets for call termination, access and call origination on fixed and mobile networks. It noted that:

> *In the initial Recommendation, a general division was made between services provided at fixed locations and those provided to non-fixed locations. Overwhelmingly, despite some moves towards converged offerings, this distinction remains valid.*[49]

Among the differences are that on fixed networks customers have the possibilities of broadband Internet access, can use carrier selection or pre-selection for outgoing calls, while mobile is purchased as a bundle or cluster of services without a choice of alternative operators for outbound calls.

A supporting report noted that previous attempts at narrowband integration had failed, but that renewed efforts were being made with dual-mode handsets. It also observed that convergence could be considered to comprise both integration and substitution.[50] Despite a forward-looking analysis, call origination on fixed and mobile were seen as remaining distinct markets.

While noting that operators planned to deploy Next Generation Networks (NGN), no account was taken by the EC of the possible changes. It was left to future revisions of the recommendation to consider the effects of NGN, perhaps in 2009. The basis for this was that while the technical developments were considered interesting, at the level of economic analysis the effects on markets could safely be ignored in the short term.

In the United States the recent acquisition by one large operator of another required approval for the transfer of the licences from the Federal Communications Commission (FCC). In doing so, the FCC accepted separate commitments on fixed and mobile services.[51] While broadband roll-out undertakings were made, these were to be provided by a mixture of ADSL and WiMAX. Likewise, the undertakings on network neutrality applied only to fixed networks and not to mobile, despite there being well-established offers of Internet access on mobile. The merger itself was approved by the Department of Justice in a consent decree which similarly kept the fixed and mobile apart.[52]

In 1997 and 1998 the incumbent operators in Belgium and Denmark, launched “duet” services on fixed and mobile networks offering one number, one voice mail service, one subscription, one bill and one point of

contact. Both were discussed in parliaments and investigations were made by the public authorities because of concerns that other operators were unable to match the offers based on control of essential facilities and cross subsidization. As the Danish telecommunications regulator (Telestyrelsen) admitted the case was "characterized by great complexity and an exceedingly intricate process".

The matter was raised in the Danish Parliament, the subject of a complaint by a competitor to Telestyrelsen, referred to the competition authority for an opinion and taken to the telecommunications appeals tribunal.[53] The matter was also raised in the Belgian Senate and the subject of a complaint to the telecommunications regulator, the Belgian Institute for Posts and Telecommunications (BIPT/IBPT).[54]

The view of Telestyrelsen was that competitors had access to a number of products from the incumbent operator that could be combined with their mobile offers, by the wholesale purchase of minutes or of subscriptions, plus the possibility of taking over the "raw" copper local loops of the customer. Minor changes were made to the interconnection agreements to ensure competitors had sufficient access. One mobile competitor argued that the incumbent should become a service provider on its network, in order to provide the duet service, rather than it merely reselling service of the incumbent operator. Service providers on the fixed network were in an even weaker position, with no access to the wireless networks.

In retrospect, there seems to have been limited demand for the duet service, with fixed mobile convergence not having proved very attractive to customers. This may have been because there is not always a one-to-one mapping of fixed and mobile phone lines, with many fixed lines being shared with colleagues (e.g., group pick-up) and with family members. The complexity of the regulatory processes clearly delayed speedy and decisive roll-out of the service.

In 2006, the Commission for Communications Regulation (ComReg) in Ireland noted potential offers of 'home-zone' services from mobile operators. These enabled mobile phone customers to make and receive calls on their mobile phones in or near their homes at fixed line prices. Given the expressions of interest ComReg conducted a consultation to ensure they are introduced in the way that best suited consumers.[55]

5.3 Ubiquitous network society

The policy model used by Japan and the Republic of Korea is the Ubiquitous Network Society (UNS).[56, 57] These policies were both developed by collaboration between government and industry, including manufacturers, operators and service providers. They have the extremely ambitious aim to ensure the provision of services on any device, any network, any time and anywhere. Unlike the frameworks used in most countries the stakeholders look at markets from semiconductors through the complete value chain to value added services provided to consumers. In both countries UNS is driven by the intention to export large volumes of equipment and the associated systems in order to drive economic growth and the creation of jobs – effectively part of industrial policy.

An important difference from the European and North American perspectives is that it encompasses the widespread provision and use of Radio Frequency IDentification (RFID) tags and Universal Sensor Networks (USN).[58] These are seen as providing manufacturing opportunities, through to value-added services for consumers. It raises interesting issues about privacy in order to reduce risks of rejection by consumers.

In the ubiquitous network society, operators are expected to provide:

- fibre to the home
- wireless cellular networks
- wireless broadband
- digital broadcasting

Consequently, the framework has to ensure competitive access for service providers across all of these networks. In particular it has to avoid operators leveraging power from one market to another. In some

respects the two governments have taken the easy option by ensuring that operators have opportunities to deploy all of these technologies, rather than having to develop access regulations.

The UNS framework is the most comprehensive set of policies created by any country. Moreover these are dynamic policies to allow for the introduction of new technologies and services as they become practicable, but before they are deployed. It is a long term evolution view of policy.

Some countries will be reluctant to adopt an approach that is clearly industrial policy. For many countries, the absence of large scale manufacturing and service industries may make the UNS approach inappropriate. It may also be difficult to conduct the same debate over policy, which would be dominated by network operators without the balancing manufacturing interests.

5.4 Unified licences

A small number of developing countries have created a policy of "unified licences".[59] It is an endeavor to create a "future proof" licensing regime, building on strengths and especially competition in mobile markets to reinvigorate fixed networks. It also helps to expand providers of broadband Internet access. In many countries the fixed network operators are moribund and the introduction of a second fixed network operator has proved a very difficult and unsatisfactory process.

In the case of India the unified access licensing policy proposed by the TRAI in November 2003 was intended to calm some of the controversy between the GSM and FWA operators.[60] The number of lines on FWA networks has already overtaken the number on the copper fixed network, though still lagging GSM customer numbers.

The conversion to unified licensing has also been used to simplify licensing procedures, to ensure flexibility and efficient use of resources. Licensing can also be made scaleable, allowing and encouraging smaller and more efficient operators to serve niche markets. The success of this approach in rural or remote areas remains to be seen.

In Nigeria the mobile network operators had a period when there was to be no further market entry.[61] This ended in 2005 with the Nigerian Communications Commission (NCC) moving to a system of unified licences. Within any geographical restrictions of their licences, the mobile and fixed wireless access operators were allowed and encouraged to compete with each other with restrictions on the types of services being lifted. Spectrum could be used for voice, data, Internet access and the like in particular, with no restrictions on handover between cells. These changes were subject to consultation with the operators.[62]

The objectives of the unified licensing policy were:

- encouragement of the growth of new applications and services
- simplification of existing licensing procedures to ease market entry
- flexibility for operators in addressing market and technological developments
- efficient utilization of network resources, so that individual networks could be used to provide a broad range of ICT services
- admitting a full range of operators, including micro-entrepreneurs

A unified service licence permits an operator to provide fixed telephony (wired and wireless), mobile, long distance and international services. In particular, mobile operators were allowed to offer fixed services and Internet access. A continuing constraint on the number of licences is the available spectrum and the affordability of network equipment and customer premises equipment.

Unified licensing leaves spectrum policy to be decided in ways that encourage competition and ensure market entry for new players. This requires caps on the amount of spectrum held by any one player, with mechanisms to reclaim unused or underused spectrum in order that it can be re-assigned. There remain

difficult questions about the number of players the market can or will support and whether gradually to increase the number or to admit too many and to exercise control by means of merger control.

5.5 Voice over Internet Protocol

While considerable progress has been made in the provision of Voice over Internet Protocol (VoIP) on fixed networks, the same cannot be said for cellular wireless networks. The mobile network operators have been very reluctant to admit this possibility and have often prohibited it in contracts with customers and taken technical measures to block access. For the present, there has been very little policy work on mobile VoIP.

There are two obvious threats to the revenues of mobile operators from IP-based services. One is a shift from SMS to IM, with a payment per month or per byte at a fraction of the price charged for an SMS. The other is a similar process with voice over IP on mobile or at least wireless networks. The cellular operators have been extremely reluctant to allow access by their customers to VoIP and there are no obvious legal obligations that require them to do so. A primary concern is that the low unit costs and flat rate pricing plans could do considerable damage to their revenues. In particular, their long tail of low spending and especially younger customers could jump to flat rate price plans leading to significant reductions in ARPU. While cellular operators are able to control their networks to block or to degrade such services, it forces market entrants to look to other networks such as Wi-Fi and WiMAX. However, the equipment for these is not yet widely available or affordable.

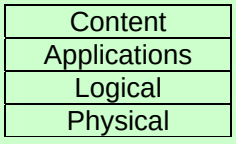
The other side of this potential collapse in revenues is that it would be much more affordable for customers and thus greatly widen the potential base of customers.

5.6 Legacy regulation

A number of countries have attempted to create convergence legislation, aimed a bringing together broadcasting and telecommunications. This invariably faces difficulties because of conflicting economic and political interests of the players and also the regulators.

Traditional regulation focuses on the type of network, and with convergence, the regulations often no longer fit the infrastructure. Instead, a layered model of regulation has been proposed, reflecting IP-network design, and policy makers in a range of countries have been encouraged to adopt it, especially by operators. In the United States it has been proposed as an alternative to the continuing exegesis of long-standing definitions of and distinctions between services.[63] Particularly in the more litigious jurisdictions, the uncertainty of the application of older legislation and case law presents opportunities for defensive plays in court, by operators seeking to delay or to disadvantage potential competitors.

Figure 2 Layered model of regulation



Some operators and service providers have survived and prospered in the gaps and holes in the legislative framework. Unintentionally, national and international frameworks can create regulatory niches that favor those players clever enough to devise a service that permits them to combine aggressive competition against incumbent service providers, but which qualifies them for arbitrary and anomalous loopholes. This can reduce or even exempt them from the costs and burdens of regulatory compliance and limitations in the market.[64]

Much of this debate has been characterized, especially by operators, in pejorative terms as “legacy” regulation, something unnecessary and inappropriate for Internet and mobile services. Such arguments have often relied more on political and economic assertions than on detailed proof of the competitiveness of the markets.

Where there are asymmetries in the burdens or opportunities created by legislation and regulation it creates the potential for artificial competitive advantages for certain firms. They will also seek to avoid certain classifications that create a bias toward more pervasive and costly regulatory burdens. Asymmetrical regulation has the potential to tilt the competitive playing field in favor of one category of stakeholder over others. Some operators have found ways to create arbitrage opportunities based on regulation in order to generate revenues and profits.

5.7 Converged regulation

The OECD has addressed the challenges in developing policies for effective regulation in this dynamic field.[65] It noted that audio-visual content was now accessible over all sorts of networks and devices, with national borders less effective as barriers. An international multi-platform environment was emerging with audio-visual content available anywhere, any time and in any way.

The United Kingdom merged its broadcasting and telecommunications regulators and added some competition law powers.[66] However, there is also a complex array of specialist independent regulatory bodies such as the ombudsman, premium content regulator and the advertising regulator. Malaysia also fused its broadcasting and telecommunications regulators into one body. This appears to remain some distance ahead of the industry, which is still far from converged.

In Germany, the convergence of regulators was based on networks, an approach intended to achieve economies of scale in economic regulation. The *Bundesnetzagentur* being given responsibility for electricity, gas, posts and telecommunications. Questions of moral regulation for content were left to the administrations in the *Länder*.[♣]

The issues involved, the very different cultural and legal traditions and the uncertainties have made it hard to create legislative and regulatory structures that are politically acceptable and sufficiently abstract in their principles to apply to all services.[67], [68] Expertise in economic regulation is not especially helpful and possibly unhelpful in the regulation of content. Issues concerning specific pieces of content can distract attention from longer term economic issues. The example of the potential overlap with banking regulation can hardly be solved by convergence.

Clearly all regulators need a sufficient understanding of the technologies and market trends. However, that does not require convergence of the regulatory bodies.

6 Conclusion

Convergence invariably sounds plausible but on closer examination has turned out to be inconstant, changing and often impossible to predict. There is no reason to expect these trends to stop or even to slow down.

The proponents of a new business model or a new technology expect to overwhelm existing players or to absorb all or a significant part of their revenues. Yet this has proved much tougher to achieve in practice or someone else has quickly appeared with an idea to steal their market. There has been no shortage of venture capital to fund market entry for disruptive players; the constraint has been on access to the networks. The forecasts of who would be the winners have constantly changed.

While strong demand exists for increased mobility in the provision of services, it is not always synonymous with cellular wireless networks. There is a range of user experiences on different devices with connections to

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[♣] Roughly translates as provinces.

the Internet. These offer degrees of mobility from fixed and residential through nomadic and to mobile and automobile networks.

Sometimes the mobile element is superfluous, or nomadicity is sufficient. Many people in LDCs can travel only on foot, by animal powered cart or, perhaps, by bus, so that seamless cell-to-cell mobility is hardly relevant. Equally, many business users are content with nomadic access to enterprise applications in offices, hotels and airports.

The ways in which people use services on networks are very different for cultural and economic reasons. Younger customers are playing an ever more important role in leading the market, notably in social networking, with parents and bosses following their examples.

The mass market for handsets and the enormous industry that supplies it have proved to be a continuing winner. They have engaged in considerable competition and shown themselves able to find a stream of new features that appeals, however briefly, to consumers. Yet while these are all portable many features are unconnected to a cellular network. The manufacturers have brand names known throughout the world. The recent collapse into bankruptcy of a formerly leading handset business proves the difficulties for those unable to keep pace with the leaders.[69] Yet there are more manufacturers willing to enter the market.

In developed countries fixed and mobile services continue to be treated separately in *ex post* economic analyses, a view supported by both competition authorities and telecommunications regulators. Conditions of demand and supply remain quite distinct. By contrast, some developing countries are moving towards *ex ante* convergence by the creation of service neutral or unified licences, a response to very different economic conditions. This latter approach may prove successful in bringing competition from mobile into fixed and could in time achieve convergence.

An example of the continuing distinctiveness of mobile is the attempt to boost .mobi, a global top level domain name created by mobile operators and manufacturers. This risks a repetition of WAP which after a being hyped disappeared from public view some years ago. Logically, web servers should be able to tailor content and services based on the device being used, without having to be addressed separately by the customer. Moreover, it means customers will have to type and to store different URLs on mobile and fixed devices, the antithesis of convergence. While the servers will know that the devices is mobile, they will have to work out the languages to be used and any geographical element to be used to tailor services.

For the moment, advertisers continue to view the fixed and mobile Internet in different ways and as different markets, with the mobile device seen as being personal. Given that many consumers cannot or will not pay for services, then advertising revenues are essential. While the demographics and responses of the two media are different, they will continue to be kept apart, attracting different revenue flows.

Corporate networks continue to add more flexibility in access, but with cellular wireless networks providing only one element of increased mobility. The requirements are too different from the consumer markets on which the mobile operators seem so fixed in their attention. There is not always a need for seamless mobility, nomadic access is often sufficient.

Tempting as NGN can seem, the implications for public policy remain nebulous and difficult to identify. On fixed networks it may be that IMS is adopted with the same rationale as on 3G, to facilitate the rapid introduction of services, with significantly increased control over access. Nonetheless, it appears that there will be two implementations of IMS in parallel. Given that there are almost no retail customers for NGN it is difficult to identify market problems that require resolution.

The challenge at the policy level is to allow the markets to flow and, where it is appropriate, to converge without taking sides. This means removing obstacles, promoting competition and protecting consumers all without prejudicing outcomes. Much as consumers and enterprises are enthusiastic about new devices and services, their appetite for convergence has been limited. Where there is demand, in multi-play, mobile and fixed become just channels in a mix that seems mostly to be about entertainment.

The concatenation of the terms fixed, mobile and convergence creates enormous vagueness, given the uncertainties of each term. In particular, the often highly misleading equation of mobile with cellular leads to unnecessary complications. Rather, there is a range of technologies that offer degrees of mobility, which meet a range of customer needs.

7 Abbreviations

2G	Second Generation
3G	Third Generation
3GSM	GSM plus UMTS
ADSL	Asymmetric Digital Subscriber Line
BCS	Business Communications Services
CDMA	Code Division Multiple Access
CPP	Calling Party Pays
DAB	Digital Audio Broadcast
DECT	Digital European Cordless Telephone
DMB	Digital Multimedia Broadcast
DSL	Digital Subscriber Line
DVB	Digital Video Broadcast
DVD	Digital Video Disc
EC	European Commission
ETSI	European Telecommunications Standardisation Institute
EU	European Union
FMC	Fixed Mobile Convergence
FTTC	Fibre to the Kerb
FTTH	Fibre to the Home
FTTP	Fibre to the Premises
FTTx	Fibre to the x (or anywhere)
FWA	Fixed Wireless Access
GPRS	General Packet Radio System
GPS	Global Positioning System
GSM	Groupe Speciale Mobile
GSM	Global Standard for Mobile communications
HD	High Definition
HG	Home Gateway
ICE	In Car Entertainment
ICT	Information and Communications Technologies
IEEE	Institute for Electrical and Electronic Engineers
IM	Instant Messaging
IMS	IP Multimedia Subsystem
IP	Internet Protocol
IP-VPN	Internet Protocol – Virtual Private Network
LTE	Long Term Evolution
MBMS	Multimedia Broadcast Multicast Service
MEA	Mobile Enterprise Application
MIMO	Multiple Input Multiple Output
MMORG	Massively Multi-user On-line Role-playing Games
MPLS	Multi-Protocol Label Switching
MoSoSo	Mobile Social networking Software
MVNO	Mobile Virtual Network Operator
NFC	Near Field Communications
NGN	Next Generation Network
NTSC	National Television System Committee
OECD	Organisation for Economic Cooperation and Development
OFCOM	Office of Communications (United Kingdom)

OFDM	Orthogonal Frequency Division Multiplexing
PAL	Phase Alternating Line
PC	Personal Computer
PTT	Push To Talk
PDA	Personal Digital Assistant
QoS	Quality of Service
RAN	Radio Access Network
RFID	Radio Frequency IDentification
RPP	Receiving Party Pays
ROI	Return on Investment
SECAM	Séquential Coleur à Mémoire
SDR	Software Defined Radio
SDSL	Symmetric Digital Subscriber Line
SIDS	Small Island Developing States
SIP	Session Initiation Protocol
SLA	Service Level Agreement
SIM	Subscriber Identification Module
SMS	Short Message Service
TCO	Total Cost of Ownership
UNS	Ubiquitous Network Society
USN	Universal Service Network
UWB	Ultra Wide Band
VDSL	Video Digital Subscriber Line
VPN	Virtual Private Network
VoD	Video on Demand
Wi-Fi	Wireless Fidelity

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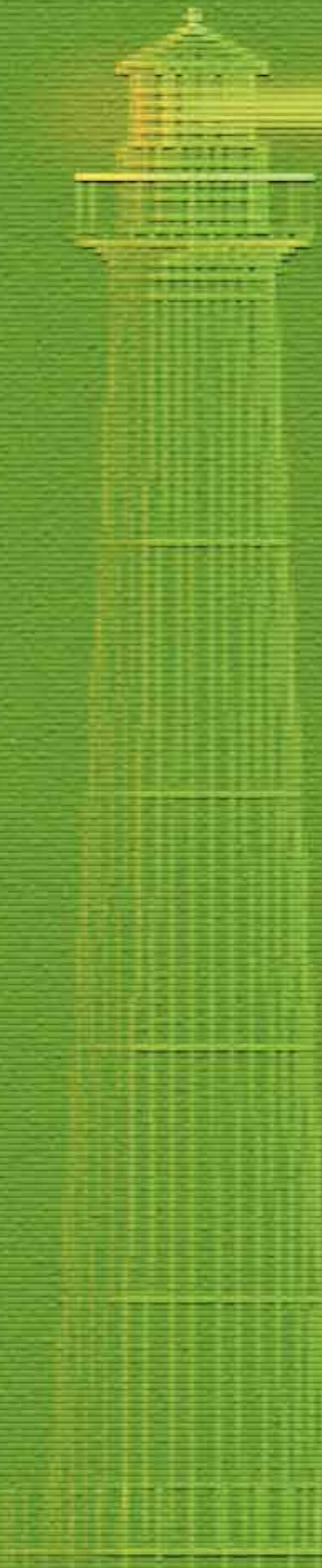

GSR 2007

DISCUSSION PAPER

NGN Interconnection and Access

Comments are welcome and should be sent by 1 March 2007 to GSR07@itu.int

International Telecommunication Union

GLOBAL SYMPOSIUM FOR REGULATORS

Dubai World Trade Center
Dubai, United Arab Emirates

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Work in progress, for discussion purposes

INTERCONNECTION ON AN IP-BASED NGN ENVIRONMENT

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WIK-CONSULT GMBH

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GSR DISCUSSION PAPER

INTERCONNECTION IN AN IP-BASED NGN ENVIRONMENT

*This paper has been prepared by **J. Scott Marcus**, WIK-CONSULT GmbH, as an input document for the 2007 Global Symposium for Regulators (GSR), organized by the Telecommunication Development Bureau (BDT). The views expressed in this paper are those of the author and do not necessarily reflect the opinions of the ITU or its membership. Comments are welcome and should be sent to gsr07@itu.int by 1 March 2007.*

1. Interconnection in an IP-based NGN environment

This chapter addresses interconnection and access in an IP-based NGN environment, from an economic, technical and regulatory perspective.

It is worth noting at the outset that this chapter deals with both *interconnection* and with *access*. These topics are so familiar to regulators that we often lump them together without clearly distinguishing them; moreover, the conventional definitions tend to be so turgid and technical as to shed little light on what is really meant.[1] Access and interconnection are related, but they are not the same thing. For our purposes, *interconnection* enables an operator to establish communications with the customers of another operator, while *access* enables an operator to utilize the facilities of another operator in the furtherance of its own business and in the service of its own customers.[2]

Regulation is frequently needed in support of access and of interconnection. Whether regulation is appropriate in a particular case depends on the specifics of the market in question, especially on the degree to which that market is competitive, and also on the ease with which the interconnection or the facilities in question can be bypassed or replicated.

A key question that this chapter considers is the degree to which regulation of access and interconnection will be necessary in the emerging world of the NGN. How does the emergence of NGN alter market power, and the ease of bypass and replication?

The chapter seeks to apply economic reasoning, drawing on the substantial economic analysis that has been done to date of the Public Switched Telephone Network (PSTN) and the Internet, and also on substantial practical experience with both systems. There is no corresponding base of theory or practice as yet for IP-based NGNs. To a first order, it is reasonable to assume that the economic forces driving NGN market players will be similar to those that today motivate their counterparts who run the networks that most resemble IP-based NGNs.

The chapter also considers the relative merits of different wholesale arrangements. Most of the world uses a system known as Calling Party's Network Pays (CPNP); however, a less widely used system known as Bill and Keep offers a number of advantages, particularly for countries where adoption of ICT services is already well advanced. The time of migration to an NGN is a natural time for a country to consider whether its wholesale interconnection arrangements could profitably evolve to Bill and Keep.

Section 5.1 briefly discusses the objectives and rationale for regulation. Section 5.2 considers technical constraints, while Section 5.3 explores specific challenges. Section 5.4 provides general background on the economic theory of interconnection, at wholesale and retail level, both for the Public Switched Telephone Network (PSTN) and for the Internet. Section 5.5 considers whether regulators will need to set prices in the world of the NGN, and at what level if so. Section 5.6 reviews studies and proceedings conducted by a number of regulatory bodies in developed and developing countries. Section 5.7 broadens the discussion to compare fixed access concerns to those of mobile (with particular consideration of the implications for developing countries). Section 5.8 briefly considers last mile access issues. Section 5.9 provides concluding observations.

1.1 Objectives of regulation

The broad societal objectives that the regulator seeks through interconnection arrangements are largely those that telecommunications regulators everywhere seek through all of their actions[3]: to make electronic

communication services available to all of their residents at reasonable cost. The regulator would be well advised to step back and, wherever possible, rely on competitive market mechanisms to do so; however, for a variety of reasons, certain regulatory interventions tend to be necessary in most if not all countries. This is just as true for the NGN as it is for traditional networks today.

1.1.1. Addressing potential barriers to competition

The most noteworthy rationale for intervention is to deal with barriers to competitive entry. Wired telecommunications were long thought to be a natural monopoly. Initially, wired telecommunications services were generally provided either by the government or by some government-sanctioned private monopoly provider. Today, most countries encourage competitors to enter the market. The historic incumbent provider has every incentive to seek to hinder the entry of these new competitors into the market.

Competitive entrants cannot hope to successfully offer a mass market service unless they can connect their own customers to the historic incumbent's customers. The incumbent is likely to be motivated to delay or deny this access, or to make access as expensive as possible in order to raise the new entrant's costs, and thus render the new entrant a less effective competitor. Indeed, attempts to withhold interconnection are among the most common techniques used by incumbents seeking to maintain their market power.

These actions could be viewed as an anticompetitive barrier to competitive entry; unfortunately, experience strongly suggests that the application of competition law alone is not enough to enable competitive entry.[4] Where market power is entrenched, it is necessary to impose regulations in advance (*ex ante*) in order to ensure that efficient competitors can successfully achieve market entry.

1.1.2. Consumer benefits

A regulator would seek to encourage, or at least not to impede, many other societal goals through interconnection policy, including:

- Price/performance of services
- Availability of useful and innovative services
- Prospects for informed consumer choice

Access and interconnection have often implied wholesale payments between operators at regulated rates. Regulatory imposition of payments always implies a risk of creating economic distortions that could impede investment. Consequently, regulators need to balance carefully their interventions, and avoid needless meddling.

1.2 Universal service / universal access

All countries seek to ensure that some minimum, crucial set of electronic communication services are available to all residents at reasonable cost. Different countries fund universal access in different ways. International and domestic interconnection charges (call termination fees) have played an important role in financing universal service in a number of countries. The migration to NGN is putting downward pressure on call termination fees, and may ultimately make current call termination arrangements unsustainable. Should that prove to be the case, how are such countries – especially developing countries – to finance universal service? To what extent, if any, is it necessary to subsidize universal access or universal service in the world of the NGN?

1.3 Communications as an enabler to overall growth and prosperity

ICTs have long been recognized as a key enabler of economic growth. The migration to Next Generation Networks is expected to make a wealth of interrelated services available to the public. The significance of ICTs to societal growth is likely to be even greater with tomorrow's networks than it is with today's.

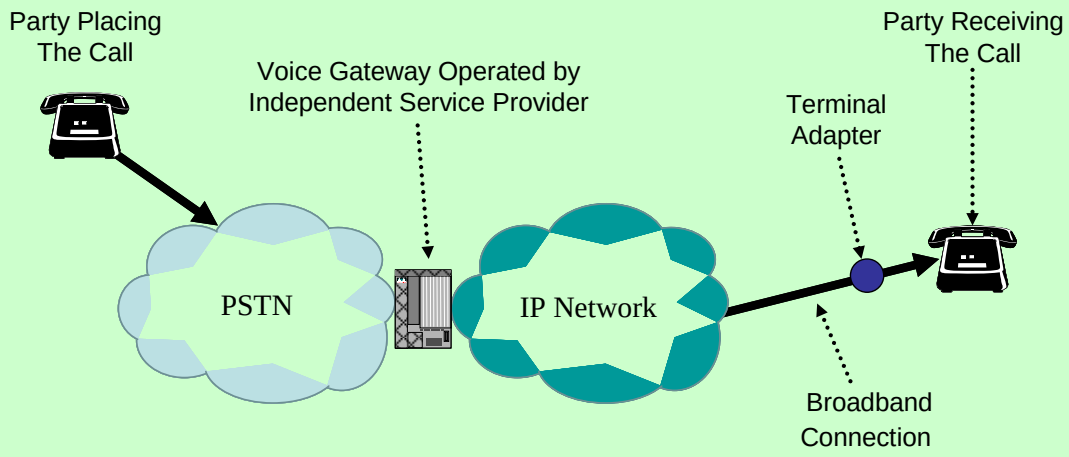
2 Technical constraints in the NGN world

A distinguishing characteristic of Next Generation Networks is the "…[d]ecoupling of service provision from network, and [the] provision of open interfaces."[5] This decoupling of *network* and *service* has profound implications for regulatory policy. Regulation of interconnection has implicitly depended on a close relationship between the network and the service. The standard mechanism for intercarrier compensation[6] depends on wholesale payments from the *service* provider originating a call to the *service* provider terminating the call in order to compensate (primarily) for the use of the *network* used to terminate the call. If the terminating service provider happens coincidentally to be the same as the terminating network provider, then the system could conceivably function much as it does today.

If, however, these are different corporate entities (as is explicitly envisioned in the definition of an NGN), then it is difficult to see how a system based solely on present paradigms could possibly function going forward. For example, the customer might have a contractual relationship with an NGN network operator to obtain broadband Internet network access, and a separate contractual relationship with a third party VoIP service provider (that does not operate a network of its own), but these two providers will not necessarily have a contractual relationship with one another.

Suppose, for example, that a caller on the traditional PSTN places a call to a customer of an independent VoIP service provider (such as Vonage), as shown in Figure 1 below. The party that receives the call typically has two separate contractual relationships (one with a broadband Internet access provider, the other with the VoIP service provider), and compensates each of these providers.[7] In addition, the VoIP service provider[8] could potentially receive a termination fee from the PSTN operator that originates the call.

Figure 1: A call from the PSTN to a customer of an independent VoIP service provider



The first challenge is that the independent VoIP provider has no network costs to speak of. More precisely, it has network costs that are very different from those of a normal fixed operator. Much of the cost of a traditional operator is associated with last mile facilities, especially the local loop. That cost is absent in this case – the broadband access plays a somewhat equivalent role, but the customer is already paying the broadband network provider for that access. The independent VoIP service provider is arranging for gateway services to translate the PSTN call to a VoIP call, and may possibly be providing the user with a terminal adapter to enable connection of a normal telephone to the Internet, but does not incur significant network costs.

In other words, an independent service provider that does not operate a network of its own is perhaps not the appropriate entity to receive compensation for network costs, and typically is under no obligation to transfer

termination fees to the network operator (in legal terms, this is an issue *privity of contract*[9] -- again, the service provider and the network provider do not necessarily have a contract with one another).

The second challenge is that no mechanism exists for the service provider to transfer those payments to the network operator, even if it chose to do so.

The third challenge has to do with the limited visibility that the service provider tends to have into the network operator's business, and vice versa. The TCP/IP protocol suite, upon which both the Internet and the NGN are based, intentionally *layers* protocols and hides information in order to simplify network design and evolution. In consequence, an independent VoIP provider is ill-equipped to measure network usage, and in the normal course of its business need not even be aware of the broadband service provider with which the customer has contracted. Conversely, the network provider can view the traffic that it carries as undifferentiated bits – it need not be aware of the nature of the traffic that it is carrying, unless that traffic requests special handling (that is, differentiated Quality of Service [QoS], a point addressed later in this chapter). Thus, the network operator is ill-equipped to account for the services that run over its network, and the service provider is ill-equipped to account for usage of the underlying networks.

The obvious way for the regulator to resolve these issues would be to determine that integrated entities that provide both the network and the voice telephony service should receive termination fees, while independent service providers should not. To do so would, however, inevitably beg the question: If termination fees are unnecessary in the case of an independent service provider, why should they be required for an integrated service provider (that is performing exactly the same function, and incurring costs that are no greater than those of the independent service provider)?

2.1 What can be measured, and what cannot?

In this discussion, we focus particularly on telephony arrangements since these are central to current interconnection payment arrangements. We assume that voice telephony in the NGN, like all traffic, will be carried over the IP protocol (i.e. it will be VoIP).

Billing in general, and call termination fees in particular, have usually depended on a few variables that in the past were relatively easy to determine:

- The duration of a call;
- The time of day and day of the week at which the call was placed;
- The physical location from which the call was placed, and the physical location of the party receiving the call;
- The identity of the network operator to which the party receiving the call is subscribed; and finally
- Where a mobile customer is placing or receiving a call at a location not served by his or her normal network operator, especially where the customer is roaming in a different country, then additional rules come into play.

The migration to NGN poses challenges in all of these areas, not only for wholesale termination payments between operators, but also for retail payments to the VoIP service provider. Some of these become difficult to determine, at least in certain instances; others no longer have a clear correlation with underlying costs.

2.1.1 Call duration and time of day

VoIP services in the world of the Internet or the NGN will typically be implemented using the *Session Initiation Protocol (SIP*). The SIP server initiating the call will unambiguously be aware of the time at which the voice session was initiated, and will in general also know the time at which the voice session ended. The VoIP service provider (which is not necessarily the same entity that is operating the network) will generally be the party operating the SIP server.

Similar considerations relate to determining the time of day, and the day of the week on which the call was initiated.

2.1.2 Source and destination location

Telephone numbers based on the ITU E.164 standard are associated with a country and, in the case of the fixed network, a permanent location. To the extent that the call is placed using telephone numbers, the source and destination could be viewed as being known to the VoIP service providers, which again are not necessarily the same as the corresponding network providers.

Even for the VoIP providers, the correspondence of telephone number to location does not mean what it once did. Nominally "fixed" VoIP services are often in practice *nomadic* – when a user changes location, the service can move with the user. This uncertainty as regards location poses a problem not only for billing, but also for identifying the location of a caller who seeks access to emergency services.[10]

Where the source or destination location are not associated with a conventional E.164 telephone number, additional challenges might be relevant. Any IP interaction will be associated with a source and desination IP address; however, these IP addresses are linked to the network's topology, not to the geographic location of the user.[11]

2.1.3 Origination or termination

At the retail level, it is common (but not universal) to bill the party that initiates the call, but not the party that receives the call (Calling Party Pays, or CPP). Analogously, it is common but not universal to oblige the network of the originating party to make a wholesale payment to the network of the party receiving the call, i.e. the terminating network (Calling Party's Network Pays, or CPNP). See "Economic background" later in this chapter.

In the PSTN, and under VoIP services that function similarly to the PSTN, the VoIP service provider will in general continue to be able to identify the party originating a call. It is, however, entirely possible that new VoIP services will emerge where it is not so clear which party has originated the call.

As a trivial example, consider the automated dialers that are available with many VoIP services. A program on the customer's PC completes the call by causing first the caller's phone to ring, then that of the recipient.[12] To the network, both parties are terminating a call, and neither is originating. It is often the case today that the party whose phone rings first could be viewed as the originator, but there is no inherent reason why this must invariably be so.

If there were an economic incentive to do so, it would be absolutely trivial for a VoIP service provider to reverse the apparent direction of a call. This exposure is reminiscent of the *refile* schemes that were popular a few years ago, when, for example, calls from Europe to America were far more expensive than calls from America to Europe. Predictably, whenever economic distortions are large enough to make bypass profitable, and where it is feasible and not unlawful (or where prohibitions are unenforceable), bypass will happen.

2.1.4 Resource consumption

As previously noted, the network operator is ill-equipped to account for activities and usage at the application level, e.g. at the VoIP level, except perhaps in cases where the same entity is in both roles; conversely, an independent VoIP provider is ill-equipped to account for network usage, and will not necessarily be able to even identify the networks that have been used to carry the VoIP provider's traffic.

3 Practical challenges

As the previous section hinted, a plethora of problems stand in the way of implementing a robust interconnection framework for IP-based NGNs, and of successfully operating such a framework were it to emerge.

3.1 Transaction costs

Establishing and maintaining an interconnection arrangement with another firm takes work. The technical effort can sometimes be substantial, depending on circumstances. What is often overlooked are the costs of administratively and contractually establishing IP interconnection arrangements.

Suppose there were 10,000 IP-based service providers, either Internet service providers (ISPs) or Next Generation Networks (NGNs). If each of them needed direct interconnection to all of the others, the sheer administrative overhead would be intractable. Each would need 9,999 interconnection agreements. In total, there nearly 50 million agreements.[13] Obviously, this is not what is done today.

In the Internet, it is common for an ISP to maintain not more than fifty *peering* interconnection arrangements, and to use between one and three *transit* relationships to reach all of the rest.[14] This number of interconnection agreements is burdensome but manageable.

Traditional PSTN telephone service providers that have not previously operated IP-based networks will need to create new IP-based interconnection agreements. Firms with existing IP-based interconnection agreements may wish to revise them to explicitly address the ability to carry traffic at a committed level of quality of service (QoS) superior to today's typical best-efforts basis. In both cases, transaction costs represent a barrier to enhancing the global network. In the case of QoS, transaction costs have historically played a large role on causing adoption to stall.

It is possible that transaction costs could be reduced, and the quality of agreements between network operators improved, if some standard agreement template were to be agreed. The GSM Association's *Standard Terms for International Roaming Agreements (STIRA)* illustrates both the benefits and the possible costs of such an approach. On the one hand, the STIRA has probably played a significant role in achieving ubiquitous global availability of roaming services (the ability to place and receive calls from one's mobile phone while traveling in an area that one's own mobile operator does not cover, such as a foreign country); on the other hand, aspects of the STIRA have arguably served to hinder competitive entry and to maintain high prices for global mobile roaming.[15]

3.2 Sensitivity of data

When an IP-based network is under heavy load, it responds by delaying or discarding traffic, rather than by blocking services altogether. For most purposes, this graceful degradation represents a strength of the IP design; however, it can be problematic for delay-sensitive traffic, and especially for real-time voice. IP-based operators who seek to provide their customers with high quality voice services to customers of other networks over an IP-based interconnection may in consequence wish to ensure that their interconnection partners are adhering to mutually agreed levels of Quality of Service (QoS). The desire to verify QoS compliance implies a need for measurement of IP-based interconnection that was not present in the PSTN.

Networks often provide *Service Level Agreements (SLAs)* to their customers. The service provider commits to deliver IP traffic at defined levels of delay and loss, and may offer financial compensation if it fails to meet its objectives. In practice, any financial guarantees typically have little relationship to the actual costs that poor performance might impose on the customer; however, it increases the customer's confidence that the service provider will meet the desired standard.

The service provider generally takes responsibility for any measurements of adherence to the SLA. More often than not, the customer does not have the tools or the knowledge to verify the service provider's measurements. Note, too, that there is no need to measure performance in the customer's network, since the customer is not making a QoS commitment to the service provider.

Where two interconnected networks are not customers of one another, measurement arrangements become much more complicated. Any attempt to measure rigorously whether two networks have adhered to their respective commitments to carry one another's traffic at agreed levels of QoS will need to somehow measure key performance metrics (such as average delay, variability of delay, and packet loss) across *both* networks. This tends to imply a need for instrumentation, either at the end user's premises or within both networks (or perhaps within *all* networks).

IP-based networks experience performance problems from time to time. Any network operator will be uncomfortable with permitting a competitor to place instruments within its network, since this makes those problems visible to the competitor and possible to the prospective customers for whose business both operators are competing. At the same time, neither network operator is likely to have full confidence in the other's measurements – neither will wish to make a payment to the other based solely on measurements that it cannot independently verify.

These problems have been discussed within industry from time to time, but never resolved. One solution that might possibly be workable would be for each network operator to deploy servers to a set of agreed-on cities for the sole purpose of responding to performance probes from the other (for example, various kinds of echo requests). This could perhaps be done on an experimental basis at first, in order to enable network operators to determine the degree to which measurements were stable and repeatable – essentially a confidence-building exercise.

An alternative would be for trusted third parties to operate measurement infrastructure in multiple networks. This would seem in principle to be an attractive solution; however, it is not at all clear who could serve as the trusted third party. For an organization to be accepted by service providers in this role, it would need to have both technical sophistication and impeccable impartiality and integrity.

Today, this entire constellation of issues could be viewed as an unsolved problem. It may be a contributory factor in the glacial deployment of QoS-capable IP-based interconnection among providers (see "Why so slow to emerge?" later in this chapter); on the other hand, in the absence of deployment of QoS-capable interconnection, there has been no impetus to solve it.

3.3 Minimizing fraud

If service providers were to implement usage-based charging, there might be a temptation on the part of one provider or both to synthetically generate traffic in order to be compensated for it.

In today's network, if a service provider were allowed to collect wholesale termination fees well in excess of cost, that service provider might well be tempted to offer favorable retail prices to free-of-charge call centers so as to stimulate calls to its network. Soliciting business that maximizes termination fees collected would in general tend to be viewed as a legitimate and permissible practice.

If the service provider were somehow to place a large number of calls to itself through a competitor's network, with the intent of collecting more wholesale termination revenue, that could reasonably be viewed as a fraudulent practice. Fortunately, this has not been a problem in the traditional network, possibly because it is not easy to do.

In an IP-based environment, it would be quite trivial to synthetically generate large volumes of traffic to or from a competitor's network. Some scenarios would be easy to detect, but others might be difficult. In practice, it might also be difficult to draw a bright line between appropriate and inappropriate practices. It is likely that complex judgment calls would be needed to distinguish between legitimate business practices that alter the traffic balance, versus improper attempts to defraud a competitor.

4 Economic background

This section provides background on the underlying economics of network interconnection, in order to motivate the discussion that follows. It attempts to present the economics of the PSTN and that of the Internet in an integrated way, and also to provide a consistent view of the various models that have emerged at the retail and at the wholesale levels. It also serves to introduce the economics vocabulary that will be used throughout the balance of the paper.

For the reasons already noted, the traditional models of interconnection practiced in most of the world cannot be effective in their present form in an IP-based NGN environment. Adaptation and evolution will be necessary. It is impossible to predict the exact shape of future arrangements; however, understanding the strengths and weaknesses of alternatives already being practiced, both in the Internet and in telephony in North America, is essential to a comprehensive understanding of the likely evolution of interconnection in an NGN world.

4.1 PSTN arrangements

The interconnection of traditional telecommunications networks has been extensively studied in the literature.[16] This section seeks to provide non-specialists with a non-technical but thorough grounding in the theory and the literature.[17]

Section 5.4.1.1 deals with arrangements at the retail level, while section 5.4.1.2 deals with arrangements at the wholesale level. Retail and wholesale arrangements are interrelated, but they are not the same thing. Retail and wholesale arrangements have implications for the speed with which consumers adopt the service, the prices that they pay, and their propensity to use the service once they have it. These implications are covered in section 5.4.1.3.

4.1.1 Retail level

Retail arrangements in the world of conventional telephony are, in a sense, familiar to anyone who uses a telephone. Nonetheless, it may be helpful to put them into a broader perspective, in order to provide a comparative context. Most of us live in a single country, and have only limited exposure to alternative arrangements.

In the following sections, we discuss the two main models in use today, the *Calling Party Pays (CPP*) system and the *flat rate* (or "*buckets of minutes*") system. Each of these systems has its advantages and its disadvantages, and each has its adherents and detractors. Both systems are in need of a major re-thinking as the world evolves to IP-based NGN arrangements.

4.1.1.1 Calling Party Pays (CPP)

In most countries, the party that originates (initiates) a call pays a fee for the call, usually as a function of the duration of the call in minutes, and often also as a function of the distance from the originator to the point at which the call terminates (is received). In these same countries, the party that receives the call typically is not charged. These arrangements are collectively referred to as Calling Party Pays (CPP).

CPP calling arrangements have long been the globally most common set of arrangements. They are extremely logical if one starts from the presumption that the party that originated a call presumably wanted the call to complete, and that the originating party can therefore be considered to be both the prime beneficiary and the cost-causer of the call.

Analogously, the receiving party has been thought of as a passive party, involuntarily receiving a call from the originator. Again, under this assumption it is natural to refrain from charging the receiving party.

More recently, a number of economists have challenged this view. These revisionist economists argue that "… both parties to a call – i.e., the calling party and the called party – generally benefit from a call, and therefore should share the cost of the call."[18] In this view, there is an inherent mirror-image relationship between calling and called party. There is no qualitative difference between placing a call and receiving a call, inasmuch as "it takes two to tango." If the call were of insufficient value, the party that receives the call could simply hang up – a principle referred to as *receiver sovereignty*.[19]

These observations have important implications going forward. They imply that prevailing CPP retail arrangements – which place the entire burden of cost on the calling party, and none on the receiving party – are economically inefficient to the extent that they represent a flawed mirror of the value of the call to the customer.

4.1.1.2 Flat rate / buckets of minutes

A few countries – notably, the United States and Canada – use different arrangements. For calls in the fixed telephone network, they historically employed CPP, but these days they primarily implement either flat rate plans or else the nearly equivalent "buckets of minutes" plans for both fixed and mobile telephones.[20]

With a flat rate plan, the subscriber pays a fixed fee per unit time for use of the telephone. Typically, there are no usage-based fees for normal domestic calls, but there tend to be additional per-minute charges for any calls for which the operator pays a significant charge at wholesale. Thus, flat rate plans for fixed telephones generally include per-minute charges for international calls.

Most mobile plans in the United States are in reality *banded* flat rate plans. Each band is flat rate, as long as the consumer places or receives fewer minutes per month than some maximum. Such plans typically include nominal per-minute charges for calls that exceed the agreed-on number, but in analyzing these plans it is important to remember that these per-minute charges are infrequently invoked. They tend to be high to the

point of being punitive. These high charges exist, not with the expectation that many customers will pay them, but rather in order to force consumers to upgrade to a higher band or tier of flat rate service (with a greater number of minutes of use allowed per month) when the time comes.

"Buckets of minutes" mobile plans in the United States generally include per-minute charges for placing[21] international calls, and also for international roaming (placing or receiving calls when traveling outside the United States). Some also include per-minute charges for domestic roaming (placing or receiving calls when traveling in parts of the United States where one's mobile operator does not have its own coverage). Mobile operators set these per-minute prices so as to provide a reasonable return in excess of their wholesale per-minute costs (including the termination fees that they pay for international calls).

Consumers appear to have a strong preference for flat rate retail pricing arrangements over usage-based pricing. Flat rate arrangements reduce or eliminate the uncertainty as to what the consumer will have to pay.

Customers tend to respond to flat rate plans by making extensive use of the service in question. In an economic sense, this is a normal and predictable *demand elasticity* response to a perceived marginal price of zero.

If the marginal usage-based cost to the provider were high, this high utilization might lead to inefficient use; however, communications services today are characterized to an ever-increasing degree by significant initial costs and low or very low usage-based marginal costs. Under these circumstances, flat rate plans can be efficient for both the consumer and the provider. The high utilization of the service that flat rate promotes should thus be viewed as a gain in consumer welfare.

Some economists have argued that pricing structures will tend to gravitate to flat rate whenever the marginal cost is low enough, and purchases frequent enough: "People react extremely negatively to price discrimination. They also dislike the bother of fine-grained pricing, and are willing to pay extra for simple prices, especially flat-rate ones. … [P]rice discrimination and fine grained pricing are likely to prevail for goods and services that are expensive and bought infrequently. For purchases that are inexpensive and made often, simple pricing is likely to prevail."[22] Experience in the United States strongly bears out the consumer preference for flat rate services.

In the absence of high wholesale per-minute costs, operators will tend to prefer flat rate plans as well, because flat rates provide greater revenue predictability and better reflects their real costs. Flat rate plans may also simplify customer care somewhat, to the extent that they reduce the frequency of billing disputes.

For example, the Digital One Rate service that AT&T Wireless introduced in 1998 provided a "bucket of minutes" across the United States. As long as the mobile customer used not more than some fixed (and possibly large) number of minutes of air time, the customer could place or receive calls to and from any point in the continental United States. The customer would incur no per-minute charges, no long distance charges, and no roaming charges.[23]

Digital One Rate proved to be immensely popular. The success of Digital One Rate effectively forced AT&T Wireless's mobile competitors to provide a competitive response; however, initially they were hampered by their lack of nationwide scale. The net result was a wave of consolidation, alliances and joint ventures that ultimately resulted in a nationwide market for mobile telephone services with multiple carriers, each offering nationwide plans with a large "bucket of minutes" for a flat monthly fee.

Today, flat rate plans are becoming increasingly prevalent in the United States for all forms of telephony.[24] As dominant local operators were permitted to offer long distance services, they typically offered flat rate plans with unlimited domestic long distance. IP telephony service providers commonly offer unlimited domestic calls at a flat rate.[25]

Analogously, when America Online introduced flat rate pricing of USD19.95 per month for Internet service in 1996, it resulted in an explosion of consumer adoption – so much so, that the company was hard-pressed to deploy new service quickly enough.

At the level of governmental policy, both the United States and the United Kingdom have implemented measures to enable consumers to avoid per-minute charges when using dial-up to access an ISP.[26] These measures are motivated by the same recognition that true usage-based incremental costs are low, and that the societal value and consumer welfare benefits of increased utilization of the Internet are probably substantial.

At this point, it is necessary to correct one of the common misconceptions about these payment arrangements. Years ago, many analysts assumed that U.S.-style retail arrangements would lead consumers to turn off their mobile phones for fear of having to pay for unwanted calls. Whatever merit that analysis might have had at that time, it is totally irrelevant to today's flat rate or "buckets of minutes" retail environment. The consumer perceives the marginal cost of placing or receiving a call as zero, and therefore has no incentive whatsoever to turn off his or her mobile telephone.

Flat rate plans are common in the United States, but much less common outside of North America, largely as a function of differences in the underlying wholesale interconnection arrangements. High wholesale per-minute costs tend to preclude flat rates. It is for this reason that flat rate plans in Europe usually exclude calls to mobile phones[27] – the high termination fees to these phones represent a wholesale cost that is too great to be ignored.

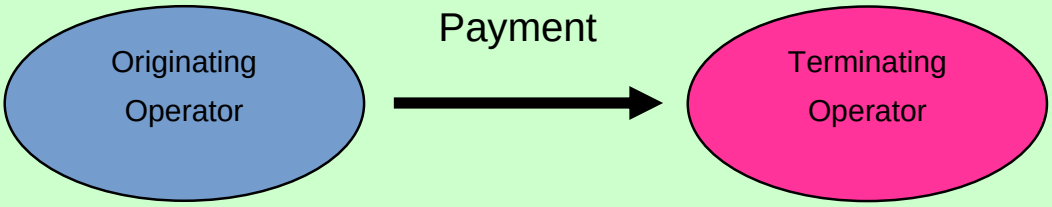
4.1.2 Wholesale level

Charging arrangements for the PSTN at the wholesale level mirror the arrangements at the retail level, but only loosely.

4.1.2.1 Calling Party's Network Pays (CPNP)

The most common arrangement by far is often referred to *Calling Party's Network Pays (CPNP*). In a CPNP regime, the call receiver's operator assesses some predefined charge per minute to the caller's operator for termination, as shown in Figure 2 below. The call receiver's operator pays nothing.[28]

Figure 2: Calling Party's Network Pays (CPNP) wholesale arrangements



Given that, under a pure CPP retail regime, the receiving party does not pay for the call at all at the retail level, the prevailing view has been that the calling party's network should compensate the receiving party's network (i.e. the terminating network) for its costs by means of a payment at the wholesale level. As networks evolve to NGNs, this underlying assumption is ripe for re-thinking for two primary reasons: (1) in an NGN world, it is increasingly easy to alter or manipulate the direction of call origination, as noted in the section on "Source and destination location"; and (2) economists have come to recognize that both parties, the originator and the receiver, benefit from the call, as explained in the section on "Calling Party Pays (CPP)" at the retail level.

4.1.2.2 "Bill and keep"

Bill and Keep, by contrast is a United States term of art that denotes the absence of a regulatory obligation to make payments at the wholesale level. Carriers could conceivably choose to voluntarily negotiate compensation arrangements at the wholesale level, but in general they are not motivated to do so.

Most countries use CPP at the retail level, and CPNP at the wholesale level. Indeed, wherever CPNP is practiced with relatively high per-minute termination fees (e.g. in excess of several cents per minute), the use of CPP at the retail level tends to follow as an economic consequence.

By contrast, only a few countries use Bill and Keep, and they tend to use it selectively. The United States, for example, is CPNP for calls to fixed incumbent operators,[29] but is effectively Bill and Keep for mobile-to-mobile calls and for calls from one non-incumbent fixed provider to another (or to a mobile operator).[30]

France used Bill and Keep for mobile-to-mobile calls until 2004, generally with satisfactory results.[31]

Singapore is particularly noteworthy. Singapore uses a U.S.-like system, with Bill and Keep for calls terminating on the mobile network, but CPNP for calls terminating on the fixed network. The termination fees for calls to the fixed incumbent are limited to 0.005 USD at peak hours, and to 0.003 USD at off-peak hours; termination fees between non-dominant operators are set by mutual agreement.

These wholesale arrangements have led to a retail market with high penetration, low retail prices, and very high utilization. Singapore has a competitive mobile market, with three operators offering 2G and 3G services. Retail arrangements for mobile services reflect per-minute prices (for calls placed or received, a system referred to as *Receiving Party Pays [RPP]*) of from 0.03 USD to 0.13 USD. Mobile penetration is 98%. Revenue per minute (for calls placed or received) for mobile operators is 0.08 USD, while the minutes of mobile use per month per subscriber is 313.[32] These results are among the best in the world, and are arguably superior, in terms of consumer welfare, to those of any European country.

There is some tendency in the literature to use the terms CPP and CPNP interchangeably, but this can lead to confusion. CPNP is a system of *wholesale* payments between operators. CPP, by contrast, relates to *retail* payments from end-users to their operators. CPP and CPNP are often found together, but not always. The wholesale arrangements do not invariably dictate the retail arrangements, nor vice versa. Bill and Keep wholesale arrangements make flat rate (or buckets) retail plans possible, but they do not preclude other arrangements at the retail level.

As has been previously noted, a very extensive literature exists on wholesale call termination arrangements in general.[33] A number of papers specifically address the relative merits of CPNP wholesale arrangements in comparison with Bill and Keep.[34]

4.1.3 Implications

This section considers that flow from these wholesale and retail arrangements. Of particular interest are:

- The termination monopoly – the tendency for operators (under CPNP, and in the absence of regulatory constraints) to set inefficient termination fees that are well in excess of cost;
- The impact that above-cost termination fees have on retail prices;
- The impact of retail price on consumer adoption and use of these services.

The following sub-sections begin with a brief summary of key findings, and then take up those issues in detail, in that order.

4.1.3.1 Key Findings

As a general rule, countries with CPNP systems tend to have higher retail prices and lower use of mobile service than those with Bill and Keep. Moreover, CPNP tends to subsidize the mobile network at the expense of the fixed network, at some risk of impacting or distorting the evolution of the fixed network (and thus of associated broadband services). For a country with mature ICT markets, Bill and Keep offers distinct advantages over CPNP.

For developing countries, the trade-offs between these two systems are more complex. Mobile operators respond to the higher profitability of their services by deploying rapidly and by offering incentives to new users. In effect, fixed telephone customers subsidize the mobile service. CPNP countries consequently tend to experience faster adoption of mobile services; however, they do not necessarily experience greater adoption of mobile services in the long term than in Bill and Keep countries.

This would seem to suggest that CPNP is appropriate for use in developing countries, but that CPNP should be withdrawn in favor of Bill and Keep once services are fully deployed.

This, however, implies a public policy quandary: once the subsidies associated with CPNP are in place, it is difficult or impossible to remove them. Several countries have transitioned from Bill and Keep to CPNP; no country has transitioned from CPNP to Bill and Keep.

The transition from PSTN to NGN represents a natural "watershed" event. Interconnection arrangements require massive re-thinking at that time in any event. For a country where ICT services are already close to full deployment and adoption, the point of transition to NGN would seem to be the natural point at which to consider whether a transition to Bill and Keep might be appropriate.

The following sections expand on these ideas.

4.1.3.2 Termination monopoly

CPNP termination leads to a problem that is known as the *termination monopoly*. When you attempt to place a call to someone, you may have a number of choices as to how to originate the call, but in general you have no control over how the call is to be terminated – in general, only a single operator is able to terminate calls to any given telephone number. This confers a special form of market power on the terminating operator – hence, the term termination monopoly.

The termination monopoly operates even in markets where competition for call origination is effective, and is by no means limited to large players that have market power on the call origination market. Economists speak of "… the *common fallacy that small players do not have market power and should therefore face no constraint on their termination charges*. … A network operator may have a small market share; yet it is still a monopolist on the calls received by its subscribers. Indeed, under the assumption that retail prices do not discriminate according to where the calls terminate, *the network has more market power, the smaller its market share*; whereas a big operator must account for the impact of its wholesale price on its call inflow through the sensitivity of its rivals' final prices to its wholesale price, a small network faces a very inelastic demand for termination and thus can impose higher mark-ups above the marginal cost of terminating calls."[35]

Consequently, and in the absence of regulation, operators will tend in general to set their termination prices well in excess of marginal cost, and at levels that are also well above those that are societally optimal.[36] In a CPNP environment, regulation of termination prices appears to represent the only viable alternative to inflated wholesale and retail prices.

The high termination fees can lead to large economic distortions where regulation is asymmetric. For example, the general practice in Europe prior to 2003 was to limit wired incumbent operators to termination fees based on marginal cost plus a reasonable return on capital; mobile operators, however, generally had unregulated termination rates. This resulted in European mobile termination rates that were an order of magnitude greater than fixed termination rates, and also led to very substantial subsidization of mobile services by customers of fixed service. A number of economists have argued that these transfer payments constitute an inappropriate subsidy from fixed to mobile services, and a massive economic distortion.[37]

The European Union can be said to generally subscribe to this analysis. Since 2003, the European regulatory framework for electronic communications has in effect treated the termination monopoly as an instance of Significant Market Power (SMP) that national regulators must deal with. In the absence of mitigating factors, all operators – large and small, fixed and mobile – will tend to be assumed to possess SMP. As a result, mobile termination prices have declined somewhat, and are likely to continue to do so in most if not all Member States of the European Union. Fixed-to-mobile termination rates in Europe averaged 0.156 USD as of October 2005,[38] somewhat higher than the global average of roughly 0.128 USD in March 2006.[39]

Under a Bill and Keep regime, the terminating monopoly problem does not arise. Interconnected operators generally have the opportunity under Bill and Keep to voluntarily negotiate interconnection prices other than zero; however, experience with mobile operators and with non-dominant wired operators (CLECs) in the United States, with mobile operators in France prior to 2004,[40] and with Internet backbones suggests that interconnection prices in the absence of a regulatory mandate will most often be voluntarily set to a price of zero.[41]

4.1.3.3 Linkage of CPNP to high retail prices

If traffic were balanced between two operators, and if they were to charge identical termination fees to one another, then there would be no net payment between them. This is true whether the termination fees are low or high. Since termination fees do not change net payments under these conditions, there may be a temptation to think that termination fees do not matter very much.

Economists refer to this as the *bill-and-keep fallacy*. "It is correct that a change in the access charge need not affect the (absence of) net payment between the operators, but the access charge affects each network's perceived marginal cost and therefore retail prices. It is, therefore, not neutral even if traffic is balanced."[42]

Each operator views its payments to other operators as a *real cost*. Other things being equal, operators will tend to be reluctant to offer service at a marginal price below their marginal cost. For on-net calls – calls from one subscriber of a network to another subscriber of the same network – operators can and often do offer lower prices that correspond to the operator's real costs, because they do not incur termination charges.[43] For off-net calls (calls to a subscriber of another network), however, it is unusual to see retail prices below a "high" wholesale call termination rate, even where termination payments are likely to net to zero.[44] This probably reflects the operators' understandable fear of adverse selection – if they set their retail price for off-net calls too low, they may attract too many of precisely those users whose calling patterns are such as to cause them to place more off-net calls, thus generating a net payment (an access deficit) to other operators.

To summarize, *high termination fees tend to lead to high retail prices for originating calls.* (Under CPP retail arrangements, there is generally no charge for calls that are received, whether termination fees are low or high.) In particular, high call termination rates preclude flat rate or "buckets of minutes" plans at the retail level. As we might expect, the higher marginal prices at the retail level tend to depress call origination – this is the well-known phenomenon of demand elasticity (or the price elasticity of demand). As the price of some good or service goes up, we will prefer to purchase less of it if we can.

An informal white paper of the United States FCC described these relationships succinctly:[45]

> *One source of inefficiency is that existing termination charges create an "artificial" per-minute cost structure for carriers that will tend to result in inefficient per-minute retail prices. In unregulated, competitive markets, such as the markets for [mobile telephony] services and Internet access services, retail pricing is moving away from per-minute charges and towards flat charges or two-part tariffs that guarantee a certain number of free minutes. This suggests that few costs are incurred on a per-minute basis, and that flat-rated pricing will lead to more efficient usage of the network. The existing reciprocal compensation scheme, which requires the calling party's network to pay usage sensitive termination charges to the called party's network, imposes an "artificial" per-minute cost structure on carriers which, if retail rates are unregulated, will likely be passed through to customers in the form of per-minute retail rates. Such usage sensitive rates thus would likely reduce usage of the network below efficient levels.*

The paper goes on to note that "…[t]he ISP market illustrates the importance of rate structure on usage. When AOL changed from usage sensitive rates to a flat charge for unlimited usage in late 1996 the number of customers and the usage per customer rose dramatically and other competitors soon followed. … Similarly, the introduction by [mobile operators] in the United States of pricing plans that include 'buckets' of minutes appear [sic] to have contributed significantly to the growth in wireless usage."

4.1.3.4 The linkage between retail price and usage

The relationship between termination fees, retail prices, and usage of the service by consumers can more readily be appreciated in regard to the mobile sector, since termination fees and in some cases retail prices are often regulated for fixed incumbents. The investment firm Merrill-Lynch provides an annual analysis of the mobile sector in a number of countries, and the U.S. FCC routinely quotes these figures in their annual reports on competition in the U.S. mobile industry.[46] Economists find it convenient to quote these figures, in part because they are readily available. This data is shown in Table 1. For this purpose, we can take the revenue per minute for all mobile operators in a country as being a reasonable proxy for mobile retail price, and a proxy that avoids the complexity of dealing with a plethora of different pricing plans and promotional offers. The minutes of use (in USD) include minutes of both origination and termination, whether charged or

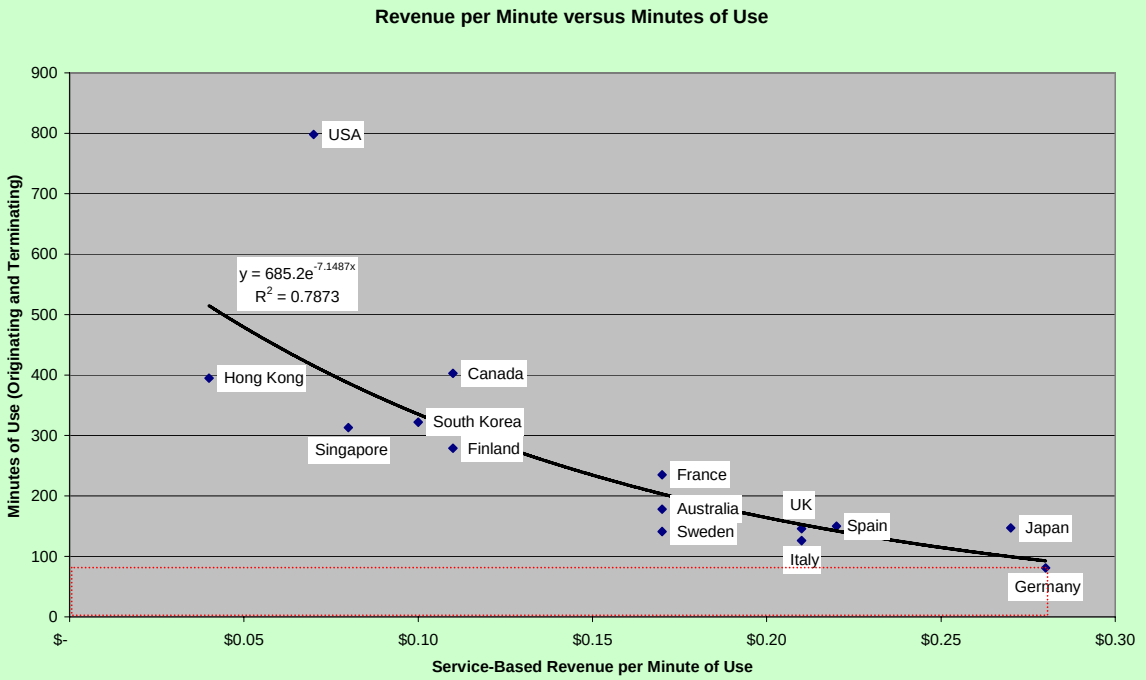
not. Based on this data, Figure 3 below depicts the relationship between service-based revenue per minute, minutes of use, and *Average Revenue per User (ARPU)* for a number of countries.

Table 1: Revenue per minute versus monthly minutes of use.

Country	Revenue per Minute	MOUs	ARPU
USA	00.07 USD	798	55.86 USD
Canada	00.11 USD	403	44.33 USD
Hong Kong	00.04 USD	395	15.80 USD
Singapore	00.08 USD	313	25.04 USD
UK	00.21 USD	146	30.66 USD
Germany	00.28 USD	81	22.68 USD
Italy	00.21 USD	126	26.46 USD
Sweden	00.17 USD	141	23.97 USD
France	00.17 USD	235	39.95 USD
Spain	00.22 USD	150	33.00 USD
Finland	00.11 USD	279	30.69 USD
Japan	00.27 USD	147	39.69 USD
South Korea	00.10 USD	322	32.20 USD
Australia	00.17 USD	178	30.26 USD

Note: Prices are expressed in USD. Revenues and ARPU are solely service-based.
Data Source: FCC, *Annual Report and Analysis of Competitive Market Conditions With Respect to Commercial Mobile Services, 11th Report (11th CMRS Competition Report*), September 2006, Table 12, based on *Interactive Global Wireless Matrix 4Q05*, Merrill Lynch, Telecom Services Research.

Figure 3: Minutes of use versus revenue per minute.



Data Source: FCC, *Annual Report and Analysis of Competitive Market Conditions With Respect to Commercial Mobile Services, 11th Report (11th CMRS Competition Report*), September 2006, Table 12, based on *Interactive Global Wireless Matrix 4Q05*, Merrill Lynch, Telecom Services Research.

The data clearly suggest that lower retail prices will tend to be associated with significantly higher utilization, expressed in minutes of use per month, and vice versa. The United States – with per-minute service-based revenues of just USD 0.07 per minute, but with a marginal price that many users perceive (somewhat inexactly) as zero[47] – experiences about ten times as much consumption, expressed in terms of minutes used per month (both originating and terminating), as a country like Germany, where average revenue per minute is about USD 0.28.

Bill and Keep arrangements tend to correlate with low service-based revenues per minute, and CPNP systems with high revenues per minute, but there are exceptions in both directions. Note, too, that low revenue per minute does not necessarily imply low gross revenues – monthly *Average Revenue per User (ARPU)* in the United States and Canada are the highest in this group (USD55.86 for the United States, USD 44.33 for Canada), despite low revenue per minute. Customers are willing to pay substantial monthly subscription fees for cost-effective "buckets of minutes" services.

Conversely, high revenue per minute does not necessarily correspond to high ARPU – in a country like Germany, with high service-based revenues of USD 0.28 per minute, monthly ARPU is low (USD 22.68, compared to USD 26.46 in Italy and USD 39.95 in France) because customers are reluctant to place calls at such high prices. In the graph above, ARPU is the area under the rectangle from the origin (the 0,0 point) to a point associated with a particular country. Germany is associated with a long, low rectangle which encloses very little space – hence, not much ARPU. Paradoxically, the graph above suggests that German operators could probably *increase* ARPU by *lowering* their prices. The resultant increase in usage would overwhelm the reduction in price per minute.

Results in India are particularly interesting. Termination fees for both fixed and mobile are limited to roughly 0.007 USD. This has led to some of the lowest retail rates in the world, roughly 0.02 USD of service-based revenue per minute. These low retail prices have in turn driven high usage of 350 minutes per month.[48] India has achieved this strong usage while simultaneously increasing mobile penetration enormously. India has

apparently found a "sweet spot" where both usage and the rate of penetration are experiencing healthy growth.

Strictly speaking, what is depicted is not demand elasticity – these are not the same customers, and the mobile services that they are using are not mutually substitutable, because they exist in different countries. But the data strongly suggest that demand is elastic, which is to say that a lower price will lead to notably higher utilization.

Bill and Keep arrangements make possible retail plans with flat or "bucketed" rates that are perceived as having zero marginal price, and that consequently generate heavy and efficient usage; however, these same plans tend to be associated with slower adoption of mobile services by consumers, as discussed in the next sub-section of this chapter. The more common CPP/CPNP arrangements generate effective subsidies to mobile operators. Portions of these subsidies are returned to consumers in the form of low or zero commitment periods, subsidies on handset purchase, and low or zero fixed (monthly) fees. CPP/CPNP systems also may be more hospitable to pre-paid arrangements than are Bill and Keep arrangements.

4.1.3.5 Linkage between CPNP arrangements and penetration

The low fixed fees and low monthly price associated with CPNP arrangements make it very easy for a consumer to procure a new mobile service. The consumer need make only a small initial investment and commitment. To the extent that the consumer intends primarily to receive calls, rather than to originate them, the total cost will remain low. Conversely, the operator benefits from termination fees in excess of marginal cost whenever the consumer receives calls.

Similarly, mobile operators under CPNP are highly motivated to offer pre-paid service with no monthly fee, once again in the hope of receiving termination fees well in excess of marginal cost.

These low monthly fees are usually accompanied by handset subsidies. Mobile operators provide handsets at prices well below cost, or else give them away outright. The low, subsidized initial price is a clear case of "giving away a razor in order to sell the blades".[49] These subsidies may, however, encourage subscribers to replace perfectly good handsets long before they become obsolete.

The combined effect is to encourage consumers in CPNP countries to initially adopt mobile service.[50] The disadvantage, however, is that per-minute usage prices well in excess of marginal cost discourage users from placing calls once they have the service.

Conversely, in Bill and Keep countries, prices track more closely to real costs. Handset subsidies are smaller. Customers have less incentive to initially acquire the service, but much greater incentive to use the service once they have acquired it.

In Europe, there is a growing sense that it is no longer necessary to subsidize the adoption of mobile services.[51] The European Union as a whole claims a 91% penetration of mobile phones, and a number of European countries claim penetration rates in excess of 100%.[52] One needs, however, to be cautious in interpreting these penetration numbers: Penetration rates are computed by dividing the number of subscriptions by the total population. Penetration rates in excess of 100% may reflect consumers who acquire multiple mobile services (multiple SIMs) simultaneously, or possibly consumers who stop using a pre-paid service but have no incentive to affirmatively terminate it. The need for multiple mobile services flows in part from high termination rates, and the desire to obtain cheaper on-net prices to other consumers who subscribe to different mobile networks. Many European countries report penetration well in excess of 100%, but in 2006, 20% of European households did not have a mobile phone at all, and in only three of the then 25 Member States of the European Union did more than 90% of households have a mobile phone.[53] Nonetheless, the bottom line is that mobile phone penetration in Europe is high to the point where there is no public policy basis for subsidizing further mobile penetration from the revenues of the fixed network.

One must be cautious in comparing penetration in CPNP countries versus that in Bill and Keep countries. Customary measurements tend to overstate mobile penetration rates for CPNP countries in comparison to those of Bill and Keep countries. Under CPNP, individual customers often subscribe to more than one service in order to get favorable on-net rates on more than one mobile operator's network. In the absence of monthly subscription fees, there is no disincentive to multiple subscriptions. These duplicate subscriptions provide little benefit to social welfare. In some senses, a more meaningful comparison of penetration would

compare the number of individuals with no mobile service at all. By this measure, the disparity in mobile penetration rates is much less than has been assumed in the literature to date.

Most experts have assumed that CPNP leads to greater adoption of mobile services than Bill and Keep. It may in fact lead to *faster* adoption, but it does not necessarily lead to *greater adoption in the long term*. Singapore, a Bill and Keep country, enjoys mobile penetration of 98%. Mobile phone penetration in the United States (currently at some 71%, and growing by about six points per year)[54] is probably only slightly behind the effective 80% penetration of Europe, once double-counting is taken into account, and is within a small number of years of equalling European levels. Canada, another Bill and Keep country, is following the same pattern but trailing by a few years.[55] Thus, countries that have buckets of minutes arrangements, based on Bill and Keep wholesale arrangements, may tend to experience slower take-up, but can in time achieve comparably high adoption rates to those of CPNP countries.

India's experience is particularly intriguing. In 2003, India introduced a CPNP regime but implemented unusually low fixed and mobile termination rates of just 0.007 USD per minute. The number of subscribers went from some 13 million at the beginning of 2003, to more than 100 million subscribers by the middle of 2006. This dramatic surge in penetration was not at the expense of usage, which nearly doubled over the same period.[56]

The cross subsidies from fixed to mobile that are inherent in high mobile termination rates may also have a tendency to slow the adoption of fixed telephone service.[57] To the extent that these CPNP cross subsidies slow deployment of the fixed network, they might have a negative impact on the deployment of wired broadband access services.[58] Whether this might be a concern will vary greatly depending on national circumstances.

4.1.3.6 CPNP versus Bill and Keep in developing countries?

In summary, what appears to be known is:

- Bill and Keep wholesale arrangements enable low or zero retail per-minute usage fees, but tend to lead to higher initial and fixed per-month retail charges;
- CPNP wholesale arrangements (coupled with high termination fees) tend conversely to preclude flat rate or buckets of minutes retail arrangements, leading instead to low initial and per-month fees but high per-minute retail charges;
- Countries with flat rate or banded "buckets of minutes" retail arrangements tend to experience high and efficient utilization, but may experience slower adoption of mobile services;
- Countries with conventional CPNP/CPP arrangements tend to experience lower utilization, but faster adoption of mobile services; and
- On the whole, CPNP arrangements seem to lead to larger economic distortions than Bill and Keep.

An obvious implication is that CPNP countries in which the market for mobile services is already mature or saturated should consider migrating to Bill and Keep arrangements. As a practical matter, however, it is very difficult to abandon the subsidies implicit in a CPNP environment once they are in place.

The migration to NGN represents a natural transition point at which interconnection arrangements must necessarily change in any case, and may represent a rare point in time at which a migration to Bill and Keep is worth considering. In Europe, it is the migration to NGNs that is prompting national regulators to reconsider the kind of interconnection arrangements that they might want going forward.

Conversely, developing countries seeking to foster the widespread initial adoption of mobile services might possibly prefer CPP/CPNP, even though they tend to embody distortions. CPNP arrangements may have additional advantages for developing countries:

- CPNP for international calls will tend to generate net monetary transfers in the direction of the less-developed country due to asymmetries in the number of calls placed, probably as a result in differences in the level of disposable income; and

- CPNP for domestic and international calls, implemented so as to reflect the higher costs that rural operators incur, may provide a means of supporting universal access or universal service.

Seen in this light, a key question remains: Will CPNP arrangements remain viable in light of the transition to NGN?

4.2 Internet arrangements

As with the analysis of the PSTN, it is helpful to distinguish between retail and wholesale arrangements. Section 5.4.2.1 discusses the retail level; section 5.4.2.2 discusses the wholesale level; and section 5.4.2.3 considers the implications for NGNs going forward.

The chapter focuses on experience with IP-based interconnection in the Internet rather than in NGNs, for the simple reason that there is no operational experience with interconnection of NGNs. At the same time, NGN operators will be subject to the same economic forces as their Internet counterparts, and can reasonably be expected to respond similarly.

4.2.1 Retail level

At a retail level, large enterprises purchase access on a somewhat different basis than do individual consumers (including small offices and home offices). In addition, pricing characteristics for individual consumers tend to be distinct for dial-up Internet access versus broadband.

4.2.1.1 Enterprise pricing

Internet access is most often sold to large enterprises on a flat rate basis, with a fixed monthly fee and no usage-based charges. The maximum traffic that the ISP will carry is nominally limited only by the size of the pipe to which the enterprise customer has subscribed, but may additionally be limited by the amount of capacity available in the ISP's overall network.

Enterprises have occasionally acquired Internet access on a usage basis, most often based on some approximation of their traffic during the busiest hour of the day. For example, some U.S. ISPs historically offered access based on the 95th percentile of traffic measurements taken every 15 minutes. For an ISP, a measure of near-peak traffic probably equates reasonably well to cost causation.

Alternatively, charges (especially for web hosting traffic) might reflect the total number of bytes of data transferred in the billing period.

If the customer's traffic increases in a pure flat rate arrangement, the ISP hopes to benefit in the longer term when the customer is obliged to procure more capacity.

4.2.1.2 Consumer dial-up Internet access

Dial-up Internet access should not be viewed as an NGN service; however, the operation of that side of the present market helps shed light on consumer preferences.

Historically, many dial-up ISPs charged consumers based on the number of hours for which the consumer was connected to the service. In many countries, the consumer also pays by the minute for the access over the telephone.

In the United States (and in a number of other countries, including the UK and Italy), telephone access to the ISP is typically available without per-minute charges. In addition, flat rate has been the norm for dial-up Internet in the U.S. since America Online first introduced its "all you can eat" plan in 1995. Countries where neither telephone access nor dial-up access to the ISP incur per-minute charges tend to experience much higher Internet usage, and customers clearly favor these flat rate arrangements.

4.2.1.3 Consumer broadband Internet access

Broadband Internet access is generally offered on a flat rate basis. The maximum amount of data that the user can send or receive is usually limited either by the physical capacity of the pipe to the consumer's home, or else by administrative controls.

The capacity upstream (from the consumer to the network) is often less than the capacity downstream (from the network to the consumer).This difference may reflect technical limitations, or the desire of the broadband ISP to charge a premium to customers who use the service to perform upstream-intensive operations such as web hosting, or both.

As with enterprise pricing, the consumer generally does pay a premium for slight increases in usage; however, the ISP hopes to benefit if the consumer's usage increases to the point where he or she needs a larger pipe.

4.2.2 Wholesale level

In this section, we consider the nature of interconnection arrangements among ISPs; the degree to which they are motivated to interconnect; and the similarities and differences, at an economic level, between PSTN interconnection and Internet interconnection.

4.2.2.1 Peering and Transit

The two most prevalent forms of interconnection at an Internet Protocol level between *Internet Service Providers (ISPs*) are *peering* and *transit*. For a definition of these terms, we turn to a publication of the Network Reliability and Interoperability Council (NRIC)[59], an industry advisory panel to the U.S. FCC:

> *Peering* is an agreement between ISPs to carry traffic for each other and for their respective customers. Peering does not include the obligation to carry traffic to third parties. Peering is usually a bilateral business and technical arrangement, where two providers agree to accept traffic from one another, and from one another's customers (and thus from their customers' customers). …
>
> *Transit* is an agreement where an ISP agrees to carry traffic on behalf of another ISP or end user. In most cases transit will include an obligation to carry traffic to third parties. Transit is usually a bilateral business and technical arrangement, where one provider (the transit provider) agrees to carry traffic to third parties on behalf of another provider or an end user (the customer). In most cases, the transit provider carries traffic to and from its other customers, and to and from every destination on the Internet, as part of the transit arrangement. In a transit agreement, the ISP often also provides ancillary services, such as Service Level Agreements, installation support, local telecom provisioning, and Network Operations Center (NOC) support.
>
> Peering thus offers a provider access only to a single provider's customers. Transit, by contrast, usually provides access at a predictable price to the entire Internet. … Historically, peering has often been done on a bill-and-keep basis, without cash payments. Peering where there is no explicit exchange of money between parties, and where each party supports part of the cost of the interconnect, … is typically used where both parties perceive a roughly equal exchange of value. Peering therefore is fundamentally a barter relationship.

In the literature, there is some tendency to assume that peering is invariably free, but this is not necessarily the case. Peering is a technical rather than an economic matter; the economic consequences then follow. Some years ago, about 10% of the peering relationships of GTE Internetworking (at the time one of the five largest Internet backbones in the world) involved payment. These payments were not a function of the relative sizes of the participants; rather, they were a reflection of traffic imbalance. For Internet backbones interconnected at multiple points by means of shortest exit routing, the traffic received from another network must on the average be carried further, and must therefore cost the Internet backbone service provider more, than the traffic sent to the other network.

4.2.2.2 To peer, or not to peer?

It is impractical for every ISP to directly peer with every other ISP.

How many ISPs are there? It is difficult to say. A few years ago, *Boardwatch Magazine* listed more than 7,000 ISPs in the United States alone. There are no reliable statistics today, but it is possible to estimate an upper limit. Any network that participates in the Internet's global routing system requires an Autonomous System Numbers (ASNs).[60] A tiny ISP might not need an ASN, but any ISP of any size will have multiple upstream service providers and will therefore require an ASN.[61] There are not more than 40,000 ASNs

currently assigned,[62] so there are not more than 40,000 ISPs of any size. In reality, there are probably far fewer.

Analogously, there is no unambiguous answer to the upper limit on the number of ISPs with which a peering relationship is technically feasible. It is reasonable to assume that technical constraints limit to a few hundred peering relationships at the maximum.

Technology poses constraints, but they are by no means the only constraints. The number of peering relationships is also limited by:

- The infrastructure costs of providing connections to each of a large number of peering partners; and
- The significant administrative costs associated with maintaining peering agreements with a large number of organizations.

For all of these reasons, the maximum number of peers that an organization could cost-effectively accommodate is less than the number of independent IP-based networks in the world by at least a factor of one hundred. These hierarchical arrangements contribute to efficiency. "[E]conomic analysis of Internet interconnection concludes that routing costs are lower in a hierarchy in which a relatively small number of core ISPs interconnect with each other to provide full routing service to themselves and to non-core ISPs."[63]

This is why the system that has evolved uses a combination of peering and transit relationships to connect to all Internet endpoints in the world. In practice, the Internet can be viewed as a very roughly hierarchical system, comprising (1) a very few large providers that are so richly interconnected as to have no need of a transit provider, and (2) a much larger number of providers who may selectively use peering with a more limited number of partners, and use one of more transit providers to reach the destinations that their peering relationships cannot.[64]

4.2.2.3 Incentives to interconnect

A body of economic theory that first appeared twenty years ago[65] analyzed incentives of firms to conform to standards when participating in markets characterized by strong network externalities. Economic analysis suggested that a firm that had a large or dominant customer base would not wish to adhere perfectly to open standards, because full adherence (and thus full interchangeability with competing products or services) would limit the ability of the dominant firm to exploit its market power. Some years later, it was recognized that substantially the same analysis applied to network interconnection.

The issue has come up in the context of a number of major mergers, and has been analyzed at length by a number of economists.[66] In a market for Internet backbone services characterized by strong network externality effects, if one backbone were to achieve a very large share of the customer base, it would have both the ability and the incentive to disadvantage its competitors. Conversely, as long as the largest backbone had not too large a share of the customer base, and as long as the disparity between the largest backbone and its nearest competitors were not too great, incentives to achieve excellent interconnection would predominate. "A simple bargaining model of peering arrangements suggests that so long as there is a sufficient number of core ISPs of roughly comparable size that compete vigorously for market share in order to maintain their bill-and-keep interconnection arrangements, the prices of transit and Internet service to end users will be close to cost."[67]

The thresholds at which these potential anticompetitive effects might dominate have not been rigorously determined. What can be said today is that Internet interconnectivity is near perfect, and that peering disputes are, in a relative sense, quite rare. It is reasonable, based on these indicia, to conclude that the global commercial Internet is operating well below the thresholds where this form of anticompetitive effects would predominate.

4.2.2.4 Linkages between PSTN interconnection theory and Internet interconnection theory

Interconnection in the world of the Internet evolved independently from interconnection in the PSTN. There is some tendency, due in part to differences of culture and orientation of the respective market participants, to assume that these are different worlds, with little or no commonality.

In fact, the economic models for intercarrier compensation in the two worlds are closely linked.[68] A key linkage between the economics of Internet backbone peering and the economics of PSTN interconnection has been identified:

> A key difference with this telecommunications literature is that in the latter there is a missing price: receivers do not pay for receiving calls … The operators' optimal usage price reflects their perceived marginal cost. … [T]he missing payment affects the backbones' perceived costs, and it reallocates costs between origination and reception. [69]

In other words, in PSTN interconnection under a CPNP regime, the "missing price" is the price that the call recipient would pay at retail. In an RPP system, there is no missing price, because the customer pays for both placing and receiving calls. Likewise, in a flat rate system, there is no issue of a missing price, because all of the usage charges (both for placing and receiving calls) are subsumed in the flat rate (e.g. monthly charge).

4.2.3 Implications

The interplay between peering and transit in IP-based networks yields a rich tapestry of interrelationships between and among Internet Service Providers (ISPs).

It is important to remember that peering and transit are not the same service. With peering, two ISPs agree to exchange traffic for their respective customers, but are not obliged to carry traffic for one another to third parties. With transit, one ISP agrees to carry traffic, usually to all destinations and usually for a fee, for another.

The complex dynamics of Internet play out quite differently than those of the traditional world of switched telephony. Notably, the implications of a refusal to peer in the Internet can be quite different from those of a refusal to interconnect in the PSTN. These differences have potentially important implications for future regulation, or lack of regulation, of interconnection among IP-based networks.

Like the rest of the chapter, this section draws experience from the Internet in order to reason about the future world of IP-based NGNs. There is no base of experience with IP-based interconnection of NGNs; however, it is reasonable to assume that the economics of IP-based interconnection that is visible in the Internet today will influence the NGN decision makers of tomorrow.

4.2.3.1 Relative desirability of peering versus transit

It is sometimes erroneously assumed that peering is inherently preferable to transit, because peering is often (but not always) "free". The reality is much more complex.

A handful of the largest and best-connected backbone ISPs have no need of a transit provider.[70] They are richly connected to one another, and can reach all destinations over their peering connections. To be in this position, an ISP needs to have dozens of peering relationships. If there are any gaps (that matter) in the ISP's peering coverage, the ISP will generally need to purchase transit from some other ISP that has coverage to those destinations. As a result, nearly all ISPs find it necessary to purchase some transit.

Suppose that two ISPs both have transit providers, and can therefore reach all destinations. When will they choose to peer? The answer is that they will view peering as an economic optimization – each will be motivated to peer if the cost of peering (considering capital, operating and transaction costs) is less than the cost reduction it obtains by avoiding sending this peering traffic to its transit provider. If both ISPs perceive a net reduction in cost, they will be motivated to implement the peering connection.

Nearly all ISPs find it necessary to purchase transit, and most find it cost-effective to supplement the transit with at least some peering.

If an ISP were to expand its peering relationships to the point where it no longer needed a transit relationship, would it save money by doing so? Not necessarily. In the few concrete cases where this has been accomplished, it has sometimes caused costs to *increase*, not to decrease. A transit customer benefits in many ways from the transit relationship. The transit customer has no obligation to carry traffic for the transit provider; moreover, the transit customer can expect the provider to deliver traffic over whichever of its multiple connections the customer prefers. If the transit customer "upgrades" to become a peer, it loses these benefits. The former transit customer will generally find it necessary to invest in circuits and equipment to

carry more traffic. In concrete instances, the increased costs of infrastructure have sometimes overwhelmed the savings from eliminating payments for transit service.

4.2.3.2 What happens when peering is denied?

Suppose an ISP (call it ISP A) refuses to peer with another (ISP B). What are the implications for both in terms of the likely arrangements that each will pursue, and the costs associated with each?

In most cases, the refusal to peer does *not* result in a connectivity breakdown. In declining to peer, ISP A typically reasons that ISP B's customers need to reach those of ISP A, and that ISP B will therefore find it necessary to make other arrangements.

The refusal to peer does not necessarily lead to more revenue for ISP A, nor does it necessarily reduce direct costs for ISP A. ISP B is by no means forced to become a customer of ISP A; it could instead use its arrangements as a transit customer *of any ISP* to reach ISP A (assuming that ISP A is generally reachable), and that is the more likely outcome.

Should ISP B choose to use its transit arrangements with some other ISP to route its traffic to ISP A rather than being able to do so over a peering connection to ISP A, doing so does not change the volume of traffic entering and leaving either network. To a first order, the volume of traffic is a function of customer demand, not of the way in which the networks are interconnected.[71] It does, however, change the location at which traffic enters and leaves each network, and to that extent potentially changes costs for both ISPs. The change in costs could be small, or they could be quite substantial.

5 Should interconnection prices be set in an NGN, and at what rates if so?

An important difference between PSTN interconnection and Internet interconnection is that the former had generally been subject to regulation, while the latter has generally not. Both systems seem to have led to generally satisfactory outcomes. What can we say about the differences between the two systems? Going forward, which system should be preferred?

In this section, we consider first the rationale for a regulated solution with interconnection obligations and established rates; then the arguments against interconnection obligations; and end with a quick summary.

The discussion that follows is largely in terms of termination fees based on minutes of use, because that is the way the debate has traditionally been framed, and is also the basis for most of the existing economic analysis; however, the analysis would not be very different if some other measure of traffic exchange were used.

5.1 Rationale *for* interconnection obligations

Interconnection obligations exist in the PSTN primarily to deal with market power imperfections that might otherwise motivate powerful, entrenched incumbents to refuse to interconnect on reasonable terms, thus inhibiting the entry of competitors. Interconnection has historically been a key locus for the exploitation of market power.

They exist secondarily as a means of limiting the degree to which CPNP wholesale payment arrangements might be set at levels well in excess of cost, thus harming consumer welfare.

5.1.1 Market power of incumbents

The most important reason for mandating interconnection in the PSTN is that, in the absence of regulation, large established incumbents would not be inclined to grant interconnection on reasonable terms. The discussion of "Incentives to interconnect" earlier in this chapter explains why: perfect interconnection would limit the ability of the incumbent, which has market power by virtue of the network effects associated with its large customer base, to exploit its market power. To the extent that a powerful incumbent were to provide perfect interconnection, it would undermine its competitive advantage.

Perhaps the first and best known example of this phenomenon was the refusal of the Bell System in the United States to interconnect with its long distance network with rivals. In the absence of interconnection to

the best and most richly connected long distance network, its competitors were not viable. Disputes with competitive entrants led to shareholder lawsuits and threats of a government antitrust investigation. The issue was ultimately resolved by limited commitments on AT&T's part to interconnect (the "Kingsbury Commitments").[72]

The dispute between Telecom New Zealand (TCNZ) and Clear represents a well known example in modern times. Reformist New Zealand attempted to avoid regulating interconnection in advance (*ex ante*), hoping that lightweight remedies based on after the fact (*ex post*) competition law would be sufficient to resolve problems. Unfortunately, it took six years to resolve the dispute on this basis, during which time New Zealand consumers were denied the potential benefits of competition. General dissatisfaction with this delay led New Zealand to implement a regulatory framework capable of dealing with interconnection issues on an *ex ante* basis.[73]

The migration to IP-based NGNs has the potential to open portions of the network up to competition, thus ameliorating these concerns. Unfortunately, that is not the end of the discussion. First, there is a strong likelihood that some forms of market power will remain, especially in regard to last-mile access (where it is unusual to find more than two significant facilities-based operators in any geographic area).[74] Second there is the risk that NGN might create opportunities for the exploitation of new bottlenecks. We return to these points shortly, in the "Changes in market power effects" section.

5.1.2 Termination monopoly

As previously noted, a CPNP system encourages operators to set termination prices at very high levels – levels that are in excess in many cases even of monopoly prices.

This is a problem that has been *created by regulation* – without a regulatory obligation to pay termination fees, the operators would tend either to mutually agree to much lower levels, or more likely to avoid them altogether. But it is also a problem that can be ameliorated by regulation. In Europe, concerted regulatory action has been effective in systematically moving both mobile and fixed termination fees to levels that are at least closer to usage-based marginal cost.[75]

5.1.3 Rate-setting

It is generally accepted that call termination fees should be set at levels that correspond as closely as possible to the forward-looking long run incremental costs of the operator that terminates the call.

This principle is simple enough to express, but actual computation poses a great many practical problems. We will provide only a brief sketch here, since these issues are well beyond the scope of this chapter and are in any case familiar to many readers:

- The operators understand their costs far better than does the regulator, and may be motivated to slant their reporting to the regulator.
- In computing a forward-looking cost, it is unclear whether the regulator should use a perfect, idealized network (which is perhaps unachievable in practice), the current network, or some blend of the two. To the extent that the rate reflects the current network, it may tend to reward bad design decisions.
- If termination fees are set too high, it might be difficult for competitors to achieve market entry. (The incumbent is not constrained by these rates in setting prices for on-net calls among its own subscribers.)

5.2 Rationale for *not* mandating interconnection

Bilateral negotiations for Internet interconnection have frequently led to satisfactory arrangements for all parties concerned.[76] In the United States, where mobile operators and non-dominant fixed operators are free to negotiate any rate they choose as long as it is symmetric, negotiations have led to very satisfactory arrangements for all parties concerned (and in most cases to an agreement to set termination fees to zero);[77] however, this has not always been the case in developing countries, where the historic incumbent often benefits from a huge size disparity in comparison with its smaller competitors.

These outcomes are best understood in terms of (1) the Coase Theorem, and (2) issues of market power.

IP-based NGNs differ somewhat from traditional networks in their technology, and in the associated value chain, as noted at the beginning of this chapter. A number of these differences tend either to undermine current interconnection arrangements, or to make them less relevant than they once were.

All things considered, it appears that:

- unregulated, Coasian Internet interconnection arrangements continue to work well today in most cases, but that
- regulators will nonetheless need to pay *more*, not less, attention to potential problems in regard to interconnection for some years to come.

5.2.1 Coase Theorem

The Nobel-prize-winning economist Ronald H. Coase has argued, most notably in a famous 1959 paper[78], that private parties could in many cases negotiate arrangements to reflect economic values far more accurately and effectively than regulators, provided that relevant property-like rights were sufficiently well defined. The key intuition here is that the operators themselves are in a better position to understand their costs, and the respective value to one another of interconnection, than are the regulators. The generally positive experience with Internet peering and with mobile operators in North America appears to bear this out.

In the United States, mobile operators (and non-dominant fixed operators) have generally been under no regulatory obligation to interconnect with one another; nonetheless, privately negotiated Coasian wholesale interconnection arrangements have worked well.[79] The sector has tended in practice to operate on a Bill and Keep basis.[80]

The parallels to Internet peering are striking. This experience reinforces the notion that the predicted economic outcome, in a market characterized by strong network externalities, a lack of market power, and no regulatory constraints, is (1) for good interconnectivity and interoperability, and (2) for Bill and Keep arrangements. Moreover, this experience reinforces the notion that these results flow from the underlying economics, and not from any unique technological property of the Internet.

There are also important differences. In the United States, the regulator does not set the termination fee (except for dominant wired incumbents), but fees must be symmetric.[81] Also, the FCC found it necessary to intervene to prevent local competitive operators (in American parlance, these are *Competitive Local Exchange Carriers*,or *CLECs*) from setting unreasonably high charges for completing calls from long distance providers. The problem was in part a consequence of the fact that the long distance operator was under a regulatory obligation to complete the call, but had no right to compensation from the local operator, while the CLEC had no significant constraints on the price that it could charge for completing the call. Additional regulation was needed to correct a regulatory asymmetry: the FCC imposed a rule preventing CLECs from charging a rate in excess of the (generally regulated) rate charged by the fixed incumbent (the *Incumbent Local Exchange Carrier*, or *ILEC*) in the same area.[82]

5.2.2 Changes in market power effects

If one party to a bilateral negotiation had significant market power, and the other lacked countervailing power, then one might expect that a Coasian negotiation might either break down or might arrive at an outcome that was not societally optimal. In general, this does not appear to be the case at present. To date, it has been widely if not universally recognized that Internet backbones do not possess significant market power.

The migration to IP-based NGNs is one of several interrelated trends[83] that have the potential to change this assumption in a number of ways. On the one hand, as wired incumbent telephone companies and, in some countries, cable companies evolve into vertically integrated enterprises that are also significant Internet backbones, it is entirely possible that they might leverage the market power associated with last mile facilities into their Internet role. Whether this is actually the case for a specific firm or a specific country would need to be evaluated based on market developments in that country, and also through the lens of that

country's regulatory and institutional arrangements. Some countries are well equipped to deal with market power; others are not.

At the same time, this form of market power may be mitigated by the emergence and deployment of technological alternatives. Broadband Internet over cable television already has some tendency to mitigate the market power of telephone incumbents. To the extent that broadband over powerline, broadband wireless and other alternatives achieve widespread deployment, they could go a long way to ameliorating or preventing the emergence of last mile market power.

5.2.2.1 Internet interconnection versus PSTN interconnection

Market power over interconnection manifests significantly differently for Internet service providers than for traditional PSTN-based operators. Institutional arrangements in the United States help shed light on the differences. In the United States, as in many countries, wired incumbents are subject to a range of regulatory obligations. Limited regulation of interconnection has also been necessary for mobile operators and CLECs in the United States, but not for ISPs. Why not?

Part of the answer is that these limited rules were necessary to correct for unforeseen consequences flowing from other regulations, including the interconnection obligation on long distance carriers. The other part is that it is the fundamental structure of interconnection in the Internet, with a mix of peering and transit, that largely obviates the need for regulation. This second point is relevant globally.

If a traditional incumbent PSTN carrier denies interconnection, its actions generally prevent a competitor from reaching the incumbent's customers. In the Internet, however, any provider can purchase transit in order to reach all Internet destinations. Therefore, when an ISP (call it ISP A) refuses to peer with a second ISP (ISP B), and in the absence of other bottlenecks, the second ISP can in general still access the customers of ISP A as long as one or both providers have a transit provider (see the section "What happens when peering is denied?" earlier in this chapter).

As long as the ISP that refuses peering (ISP A) offers peering to at least one or two ISPs who can access end-user customers at costs not very different from those of ISP A, the peer ISPs should be able to offer transit arrangements that include access to ISP A's customers at prices not very different from those of ISP A. From ISP B's perspective, this should be sufficient to enable it to compete effectively with ISP A, other things being equal.

These same considerations also limit the value to ISP A of denying peering. ISP A's denial of peering does not force ISP B to become a transit customer of ISP A; *ISP B can be or can become a transit customer of any ISP*, as long as ISP A is generally reachable at reasonable cost. Nor does ISP A's denial of peering necessarily reduce ISP A's network infrastructure expenses, because ISP B's traffic demands (and the demands of ISP A's customers to reach customers of ISP B) have not gone away – they simply enter ISP A's network at some other point, typically over some other peering interface.

This means that, as long as these markets remain reasonably competitive, ISP A should be making its decision on a rational business basis. It should be observing potential infrastructure savings from implementing peering with ISP B, considering its infrastructure costs and administrative costs to implement and maintain the peering, and agreeing to peer if the benefits exceed the costs, all things considered.

What if underlying markets are not competitive? What special challenges do regulators face in the event that a large ISP refuses to peer at reasonable cost with any of its domestic competitors? Section 5.5.3, "Market power of the incumbent", deals with this concern.

5.2.2.2 Independent service providers

The presence of independent third party providers of services such as Voice over IP (VoIP) may have some tendency to moderate market power, or to reduce the ability of incumbents with last mile market power to leverage that market power into upstream services markets.

Incumbents may attempt to restrict the activities in these party providers – by impacting, for example, the quality of service that their services receive. From a public policy perspective, it would be unfortunate were they to succeed. Third party services clearly enhance competition and consumer choice.

At present, it is not clear whether a degradation strategy would be effective. For DSL-based broadband services, all indications are that normal best-efforts services are good enough to enable competitive third party services; thus, incumbents would have only limited ability to discourage use of the service unless they were to intentionally cripple its performance, which could perhaps be viewed as an anticompetitive act. For cable-television-based broadband services, however, degradation might be a more significant concern. Many cable users share a common transmission link – significant delays are possible or likely, at least on occasion.

5.2.2.3 New loci of market power

As networks evolve to NGNs, there is a risk that new forms of market power might emerge. Historically, market power was often associated with physical bottlenecks, especially in connection with last mile access. In the future world of the NGN, it is entirely possible that new choke points will emerge in higher layers of the network, associated with logical control functions.

A study conducted for the European Commission[84] raised concerns over a variety of potential bottlenecks going forward; at the same time, it cautioned against an overly hasty attempt to apply regulation before problems have emerged. Their concerns included a range of network capabilities, call set-up capabilities, application program interfaces (APIs), various "walled garden" restrictions on access to content, and user identity and location information. For now, these should be viewed as potential threats, not as immediate problems requiring action today.

5.2.3 Changes in the value chain

Many IP-based services are available from traditional incumbents and also from independent third parties. Voice services, in particular, are available from third party service providers including Vonage, Skype, and SIPgate. IPTV providers are emerging. These independent services have already gained a following, and are likely to remain popular. Their presence in the marketplace provides clear procompetitive benefits.

Regulators will tend to view these changes as disruptive, and may be tempted to try to prevent their markets from developing in these directions. These independent services provide benefits, and should be embraced, not thwarted. Rather than attempting to suppress independent service providers, a regulator would be well advised to try to anticipate these changes, to support them, and to apply regulation only to the limited extent necessary to address likely competitive harms.

These independent service providers do not have networks of their own, and are ill-equipped to measure network usage. Conversely, network operators are ill-equipped to measure minutes of use from these third party providers.

Minutes of use are only weakly correlated with cost in an IP-based NGN. In addition, they will be difficult or impossible to measure consistently. In the not-too-distant future, it most likely will be impractical to continue to base termination fees on the duration of the call in minutes.

Does this mean that the entire system of termination fees will disappear? It very well might. But an alternative that is not absolutely precluded is that a system of access charges might emerge that reflects measurable and quantifiable aspects of the network provider's service that correlate better with the network operator's cost drivers – for example, some measure of average traffic volume and of traffic variability, possibly with a premium added on for traffic carried at better-than-best efforts quality of service.

5.2.4 Changes in retail price structure

The current CPNP system of call termination fees is largely a response to Calling Party Pays (CPP) retail pricing arrangements. Since the receiving party does not pay for the call, the CPNP termination fee compensates the terminating network operator for the use of its network.

With the disintegration of the traditional value chain, as discussed in the previous section, traditional providers will be subject to competition from independent providers of VoIP services (and other services as well, such as IPTV video). These new providers will have a very different cost structure from that of traditional service providers. All indications are that their usage-based costs are very low, and are roughly linear in the number of customers.[85] This will effectively set a ceiling on the prices that traditional providers

can charge for voice services – if they price substantially in excess of the costs of the independent providers, they will simply lose market share to them.

The migration to IP-based NGNs should alter the costs of the traditional operators such that their usage-based marginal costs are similar to those of their independent third party competitors. Large incumbents benefit from economies of scale and scope, but it is not clear that these benefits are compelling in regard to services such as VoIP. The most likely outcome would seem to be that the pricing structures offered by all market players will be generally similar, and will lead to retail pricing structures for voice services that are also similar. To the extent that traditional providers are viewed as offering superior service, they may be able to command a modest price premium commensurate with the perceived value of the difference.

Independent service providers incur minimal network expense.[86] Typically, their customers pay for their own broadband Internet access on a flat rate basis. The independent providers have one noteworthy per-call per-minute expense: the termination fees that they pay to traditional telephony service providers for terminating calls originated on the VoIP service. The pricing plans of providers such as Skype and Vonage are exactly what one would expect under those circumstances: They are flat rate and inexpensive for calls where the termination fees are low enough to ignore, but reflect per-minute fees somewhat in excess of the termination fee where the termination fee is larger (greater than roughly 0.02 USD per minute).

Given the competitive nature of the marketplace, it seems likely that traditional telecommunications firms will necessarily evolve to roughly the same flat rate pricing structure as their third party competitors as they migrate to IP-based NGNs, but perhaps with a slight premium for quality. The traditional providers will find it difficult to avoid tracking the contours of the cost structure of their competitors, particularly when that cost structure is roughly the same as the cost structure to which they themselves are subject.

Should this prove to be the case, then a key rationale for charging termination fees disappears. In a flat rate retail system, there is no pricing difference betweens calls placed and those received, nor between traffic sent and traffic received. Since there is no "missing charge" for calls that are received but not charged for, there is no need to correct for the missing charge with a termination fee.

5.2.5 Practical difficulties in allocating costs

As previously noted, it is difficult to determine the correct level for termination fees. The analysis is challenging and time-consuming, it is difficult to know how to properly interpret a forward-looking cost for a purely hypothetical network, and there are adverse consequences for errors.

One view from the United States is that true usage-based forward-looking marginal costs are closer to zero than they are to the levels at which call termination fees have traditionally been set. In this school of thought, setting fees to zero reduces errors at the same time that it simplifies the billing process between the operators.[87]

5.3 Special challenges for developing countries

All countries will tend to face significant challenges in dealing with entrenched incumbents, and in providing universal access or universal service to their citizens. Developing countries are likely to experience particular difficulties. The following sub-sections deal with market power and with universal access with a particular emphasis on developing countries.

5.3.1 Market power of the incumbent

An earlier study (prepared under ITU sponsorship, but not necessarily reflecting the views of the ITU) evaluated interconnection among IP-based NGNs in the context of developed countries, with an eye toward Europe.[88] That study concluded that IP-based NGNs were likely to interconnect even in the absence of an explicit interconnection obligation. The most likely form of interconnection would be peering, with no money changing hands (i.e. Bill and Keep). If that were indeed the case, then multiple service providers would be able to offer connectivity to one another's customers at reasonable prices through some combination of peering and transit. Under those assumptions, regulators would be well advised to pay primary attention to ensuring that markets for underlying components that competitive entrants would need in order to offer fully competitive services remain competitive – especially broadband and leased lines.

This is consistent with the notion that, wherever possible, the regulator should prefer the working of the competitive market. Ideally, the regulator should intervene only to the extent necessary to correct for market failures and deficiencies. Deferring to the competitive market eases the task of the regulator, and generally leads to more efficient outcomes for all.

The assumption that large IP-based NGNs operated by former national incumbents will voluntarily interconnect with other IP-based operators seems natural based on experience with the Internet, but it is by no means guaranteed. Historically, large Internet backbone ISPs have agreed to peer with some of their largest competitors, but that practice may in part reflect the decision of antitrust authorities to block worrisome aspects of mergers[89] that might have enabled a backbone to amass enough market power to find it profitable to have less-than-perfect interconnection with some competitors. It may also reflect the historical reality that the largest Internet backbones mostly derived from the U.S. long distance industry, a competitive segment, during a period when the local incumbents (the market segment that arguably possessed market power) were effectively precluded from offering Internet access services – it is by no means assured that the same outcome would emerge today.

There is also a notable counter-example – the Australian incumbent declined to peer with any of its domestic competitors. The Australian Competition and Consumer Commission (ACCC) ultimately forced Telstra to peer with domestic competitors in 1998.

Historically, regulators have been reluctant to regulate IP-based interconnection, and appropriately so. Most regulators lack authority to regulate IP-based interconnection. Going forward, as networks evolve to IP-based NGNs, at some point in time the only meaningful interconnection to the incumbent's network will be an IP-based interconnection. If the incumbent refuses to interconnect on reasonable terms, it seems clear that the regulator will need to have the tools and authority to enable it to respond effectively.

Circumstances may vary greatly from one country to the next, but it is quite possible that developing countries will face greater challenges than industrialized countries. The incumbent operator is more likely to be solidly entrenched. Moreover, the size disparity between the incumbent and its competitors is sometimes enormous, putting the latter at a great disadvantage.

Compounding these concerns, the legal and regulatory institutions associated with network interconnection in developing countries will in many cases be less mature than those in developed countries – not only for IP-based interconnection, but in many cases for traditional interconnection as well.

It is also worth noting that the prediction of the previous ITU-sponsored study was that *interconnection* would in many cases be implemented voluntarily. *Access* – to unbundled local loops, for example – is quite another matter. An established incumbent is unlikely to grant access to its facilities at favorable prices in the absence of regulatory pressure.

5.3.2 Universal access / universal service

Charges associated with interconnection are often used as a means of financing *universal service* – the availability of basic electronic communications to all, at affordable prices. *Universal service* refers to services delivered to the home; *universal access* refers instead to the closely related problem of delivering these services to public, shared facilities such as schools, libraries, post offices, or telecenters. For many developing nations, universal access represents a more appropriate and more readily achievable goal.

The transformation associated with migration to NGN places great stress on universal access and universal service institutions. The scope of universal service, the funding, and the very viability face enormous challenges going forward.[90]

Section 5.5.3.2.1 explains the rationale for universal service, in terms of network externalities, economic distortions, and consumer welfare. Section 5.5.3.2.2 explains the use of implicit interconnection-based subsidies within a developing country, while Section 5.5.3.2.3 explores subsidization mechanisms employed internationally. Section 5.5.3.2.4 expands on the implications for policy.

5.3.2.1 Network externalities, economic distortions, and consumer welfare

Markets characterized by strong *network externalities* (that is, markets where the benefits that a customer derives are strongly influenced by the number of other people using the same service, as is the case with a network) have a tendency to reach stable equilibrium at levels of service adoption that are much lower than those that are societally optimal.[91] Most countries have felt that voice telephone service was so important that the government should subsidize the service where necessary in order to ensure that the service is available to all, and even to those of limited means. In some cases, this has meant a commitment to universal access (e.g. availability in a nearby school, library or post office) rather than in the home.

Different countries generate these subsidies in different ways. Most economists would argue that it is best to take the funds from general revenues (i.e. overall taxation), because doing so ensures that the cost is spread as widely and as equitably as possible, and thus minimizes economic distortions; however, this is very rarely done in practice.

Some countries simply expect the incumbent local carrier to provide universal service, and to somehow extract enough profit from other customers to cover the cost. Still others provide an explicit universal service fund, with all providers of electronic communication services contributing.

The relevance of this discussion to interconnection arrangements is that intercarrier compensation is often used as an alternative, implicit means of generating the necessary subsidies.

5.3.2.2 Intercarrier compensation as a funding mechanism for ICT development

Domestically, access charges can provide a funding vehicle in the form of implicit subsidies. Network costs will tend to be greater in those areas that pose universal service challenges due to low teledensity or unfavorable geography. Some countries find it convenient to set access charges to higher levels in those areas in order to generate a net influx of money.

The World Bank has generally been supportive of the use of access charges as means of subsidizing telecoms deployment to rural or remote areas of developing countries.

At the same time, this technique is by no means limited to developing countries. It continues to generate implicit universal subsidies in a number of developed countries, including the United States. The U.S. has attempted to phase out these implicit subsidies for years, but they persist.

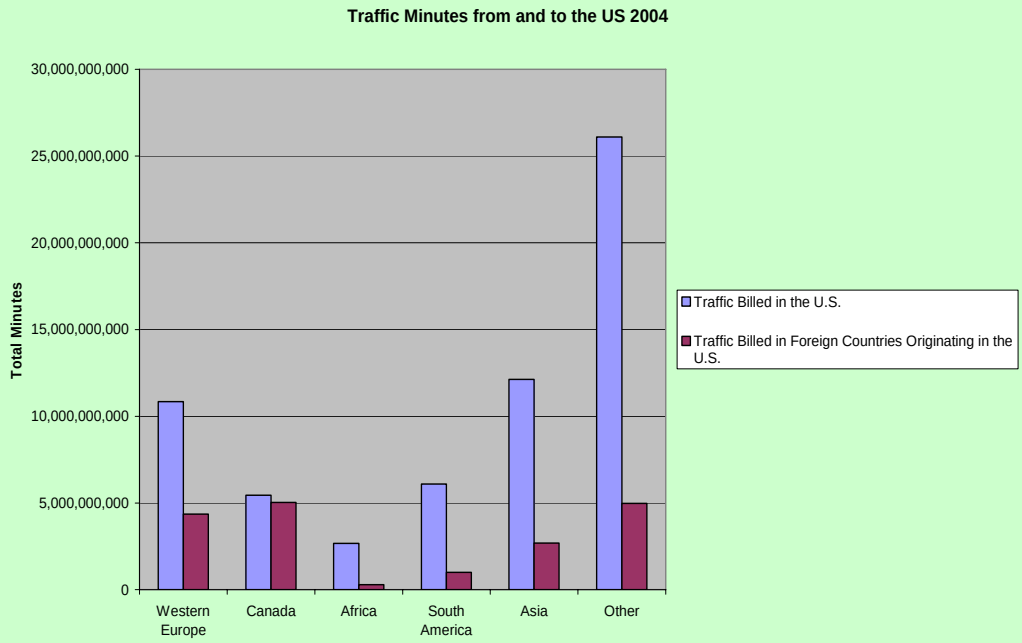
A number of concerns must be raised in connection with these subsidies. They represent an economic distortion. They are subtle, and not likely to be understood by the public – there can thus be a notable lack of transparency. And they can easily turn into "slush funds". It is for this reason that there has been a move away from the use of such subsidies towards other mechanisms. There are explored in the GSR Paper on Universal Access.

5.3.2.3 Traffic imbalance – the "Robin Hood" effect

As previously noted, PSTN interconnection fees for switched telephone calls in most countries are paid according to the Calling Party's Network Pays (CPNP) principle. It turns out that inhabitants of developed countries tend to place far more calls to inhabitants of developing countries than vice versa; consequently, these international termination fees (technically referred to as settlement fees) generate a net transfer of money from developed countries to developing countries.

Consider, for example, the number of messages and of minutes of use between the United States and (1) Western Europe, (2) Canada, (3) Africa, (4) South America, (5) Asia, and (6) everywhere else. Data from the U.S. FCC show a roughly balanced calling pattern with Canada, but a huge preponderance of calls placed from the United States to the other foreign countries.

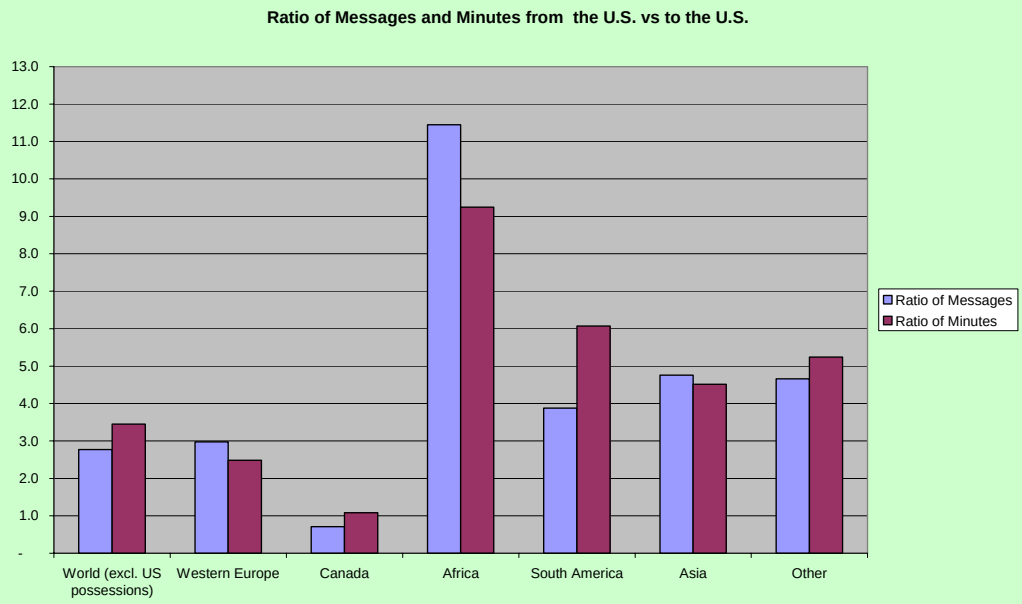
Figure 4: Traffic minutes between the U.S. and selected regions of the world.



Note: Author's figure prepared from 2004 FCC data

The next figure shows the ratio between traffic originated in the United States and traffic originated in a foreign country. This ratio is 1.1 for Canada, 2.5 for Western Europe, but 6.1 for South America and 9.2 for Africa. The disparity is thus far greater with developing countries. Most experts interpret these patterns as reflecting the tendency for residents of industrialized nations to have far more disposable income than those of developing nations.

Figure5:. The ratio between international traffic originated in the U.S. and traffic to the U.S. originated overseas (messages and minutes of use)



Source: FCC 2004

This asymmetry has the rather strange property of transferring money from richer countries to poorer ones. As such, one could draw a certain parallel to the mythical English folk hero Robin Hood, who robbed from the rich in order to give to the poor. The system functions as an inadvertent form of foreign aid.

Not surprisingly, developing countries have generally wanted to keep per-minute wholesale termination fees[92] at high levels, well in excess of real cost, in order to maximize the transfer of funds. Equally unsurprisingly, a number of developed countries, most notably the United States, have wanted to drive these payments down to levels approximating real termination costs.

In one recent incident, the government of Jamaica imposed a levy on international call termination payments, in order to explicitly generate subsidies to fund universal service.[93] The U.S. FCC complained, saying that "… universal service obligations must be administered in a transparent, non-discriminatory and competitively neutral manner, and that hidden subsidies in settlement rates and subsidies borne disproportionately by one service, in the case of settlement rates, by consumers from net payer countries, are not consistent with these principles and cannot be sustained in a competitive global market."[94]

The migration from today's world of the PSTN to tomorrow's world of the IP-based NGN probably implies that all of these implicit subsidy mechanisms will gradually either be explicitly phased out, or else will become irrelevant over time.

These termination payments are assuredly not an ideal subsidy mechanism; nonetheless, the fact remains that they have transferred funds to developing countries, and that portions of those funds may have served to fund telecoms development projects to remote or rural areas. The funding vehicle is likely to go away, but the development needs that it addressed, however imperfectly, will remain.

5.4 QoS

The ability to offer different levels of Quality of Service (QoS) has been seen as a key factor differentiating IP-based NGNs from the public Internet. It has long been recognized that tighter limits on network delay, and on variability of delay, would enable IP-based networks to deliver real-time bidirectional voice and video services more predictably and perhaps more reliably than the current best-efforts arrangements.

At the same time, the technical capabilities to deliver enhanced QoS have existed in the "public" Internet for at least a decade. Enhanced QoS is widely deployed within IP-based networks, but not *between* them. The reasons for this failure to deploy have little or nothing to do with technology, but rather flow from economic considerations. Given that the migration to IP-based NGNs does not intrinsically alter these economics, it is natural to ask whether deployment of differentiated QoS into IP-based NGNs will in fact be taken up without "help", and if not to wonder whether public policy initiatives should be considered. What sort of "help" might be beneficial?

In this section, we consider the economics of QoS; the technology of QoS; the reasons for its slow emergence between networks in the public Internet; the levels at which interconnection charges might be set; the implications of the network neutrality debate that has emerged in the United States; and finally whether it might be preferable to leave the economic arrangements to private arrangements (a "Coasian" approach) rather than attempting to regulate economic aspects of interconnection of IP-based NGNs.

5.4.1 General economic interpretation

It has long been recognized that providers of goods or services could potentially achieve some pricing power and profitability by distinguishing their goods and services, and by offering different qualities at different prices to different groups of customers. We experience this service and price differentiation every day. We drive into a gas station, and choose to purchase regular gasoline or premium. When we buy a ticket for a train or an airplane, we take it for granted that we may be offered first class and second class tickets, with a higher price for the former. To the extent that the amenities offered in first class have value to us, they increase our *surplus* (the difference between perceived benefits and cost), which in turn increases the price that we are willing to pay. The airline charges a higher price because it recognizes that those customers that value the amenities are willing to pay the higher price.

The basic notion of service differentiation is not new,[95] and the underlying economics have been well understood for many years.[96] Service differentiation recognizes that different consumers may have different needs and preferences, which translate in economic terms into a different *surplus* deriving from the purchase of one service versus another. Service providers can choose to offer tailored products that will be preferred only by certain consumers, or not.[97] In practice, they generally target their distinct offers at different *groups* of consumers (second order price discrimination) rather than targeting different *individual* consumers (first order price discrimination).

In some cases, price discrimination may be linked solely to the willingness of the customer to pay, and largely unrelated to underlying costs. When an airline offers cheaper tickets to passengers who are willing to stay overnight on Saturday, the lower price has nothing to do with the airline's costs; rather, it reflects the greater willingness to pay (lower elasticity of demand) of business travelers. Business travelers are able to pay more, but are in most cases unwilling to stay overnight outside of the Monday to Friday time frame.

Even though the benefits of service differentiation are obvious, it enjoys only mixed public acceptance in the context of industries that have historically provided common carriage. A long-standing tradition, particularly in England and in the United States, is that certain industries should serve the public indifferently. This indifference is taken to imply that price discrimination is not allowed. It is largely as a result of these attitudes that airline prices, for example, were regulated for many years.

Today, economists would generally agree that deregulation of the airline industry in the United States and elsewhere (which permitted the airlines to price discriminate) has provided greater consumer choice, and prices that are on the average lower than they would have been had the industry remained regulated.[98] Consumers have had to adjust to the fact that the person sitting in the adjacent seat may have paid a much higher, or a much lower price than they did; nonetheless, overall consumer welfare has improved.

The airline experience in the United States demonstrates both the opportunities and the risks associated with price discrimination. As the economist Alfred E. Kahn (both a proponent and a primary implementer of airline deregulation in the U.S.) has observed, competition on many air routes proved to be limited to only one or two carriers. "In such imperfect markets, the major carriers have become extremely sophisticated in practicing price discrimination, which has produced an enormously increased spread between discounted and average fares, on the one side, and full fares, on the other. While that development is almost certainly welfare-enhancing, on balance, it also raises the possibility of monopolistic exploitation of demand-inelastic

travelers."[99] In other words, those consumers with limited flexibility in their travel requirements could be charged a high premium with impunity. In markets with effective competition, service differentiation and associated price discrimination will tend to enhance consumer welfare. In markets characterized by significant market power, price discrimination could detract from consumer welfare.

Price discrimination is not invariably effective. It has been suggested that the propensity for Internet access to be priced at a flat rate is practically irresistible; however, this argument may be more persuasive in regard to prices paid by residential consumers than it is for prices paid at retail by large enterprises. "People react extremely negatively to price discrimination. They also dislike the bother of fine-grained pricing, and are willing to pay extra for simple prices, especially flat-rate ones. … Constraining architectures and pricing structures work against increased usage. … [P]rice discrimination and finegrained pricing are likely to prevail for goods and services that are expensive and bought infrequently. For purchases that are inexpensive and made often, simple pricing is likely to prevail. … Now the Internet already pervades society, and will be even more ubiquitous in the future, used round the clock in a variety of applications. Simplicity is likely to be key to acceptance. … Hence telecom service providers are likely to discover that the elaborate architectures they are dreaming of will work against their interests."[100]

In summary, price discrimination tends to enhance consumer welfare (to the extent that it works effectively, and in the absence of market power). An open question is whether markets in some countries are sufficiently competitive for this to be the case. We return to this point shortly, in the sub-section "QoS and network neutrality".

5.4.2 Technical background

The following sub-sections discuss the nature of application requirements, the basic technical characteristics of packet transmission in the Internet as they relate to variable delay, and the implications of differentiated QoS for billing, accounting, and Operational Support systems.

5.4.2.1 Applications delay requirements

What sort of performance does a user need from the network? This is a function of what the user is attempting to do.

For typical data applications – email, for example – the user may need the ability to send a fair amount of data, but a great deal of packet delay is acceptable. Even if packets were to take several seconds to get through the network – which is an extremely long time by the standards of today's networks – the user would receive his or her email and would likely be satisfied with the service.

For streaming video – one way transmission akin to watching television – the network needs to transmit a great deal of information, but can still tolerate some variation in delay, as long as the user will accept a second or two of delay when the transmission begins. This is so because the receiving system can *buffer* the video data. As long as individual packets are not delayed more than the original start-up delay, the buffer corrects for occasional slow-downs. Even occasional loss of data will not necessarily result in performance unacceptable to the user, as long as the receiving system is designed to try to smooth over the gap.

Two way real time voice is, however, much more demanding. Many tests over the years have found that, where delay exceeds about 150 milliseconds, people on both sides of the conversation are likely to start speaking at once (because neither knows that the other has already begun to speak). This phenomenon is familiar to those of us who have used satellite circuits for international telephone calls. One can still conduct a conversation, to be sure, but nobody would prefer such a conversation to one conducted with low delay.

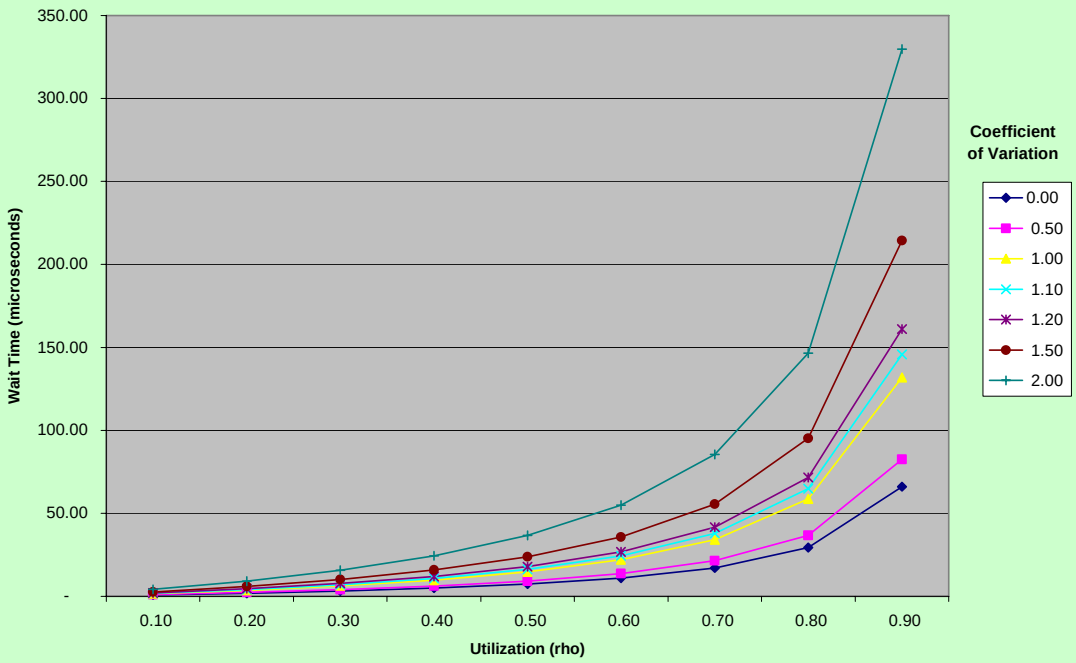
5.4.2.2 Delay in packet networks

It is natural to begin by asking the degree to which normal Internet traffic would meet demands for delay-sensitive traffic. The answer is, quite simply, that normal Internet traffic performs well enough nearly all of the time. This is the reason why services such as Skype and Vonage have customers – they work well enough today over the public Internet, with no special provisions taken to ensure quality of service.

This follows from basic queuing theory. Queuing theory is the branch of mathematics that deals with waiting lines – in this case, the waiting line to place a packet onto a high speed link between two routers in the core of the Internet.

The standard formulae for variable delay depend on how busy the transmission link is, how fast it is, how big the packets are and how variable in size. The standard analysis (which corresponds to a so-called M/G/1 queuing system) results in a family of curves, as shown in the figure below, where delay increases as the link becomes increasingly busy (moving toward the right of the graph). These particular curves reflect a 155 Mbps link, which is the *slowest* link that one is likely to find in the core of a high speed IP-based NGN. Variability in the length of the packets is reflected in the *coefficient of variation* of the packet length (and thus the service time), where a coefficient of variation of 0.0 denotes no variability at all, while a coefficient of variation of 1.0 reflects a nominal degree of variability corresponding to exponentially distributed packet lengths. A few years ago, a coefficient of variation of 1.2 was typical for Internet traffic.[101]

It is immediately obvious from the graphs that, even at exceedingly high loads of 90%, expected variable delay is less than 150 *microseconds* (where a microsecond is one millionth of a second). Given that our "budget" is in the range of 150 *milliseconds* (where a millisecond is one one-thousandth of a second) it is no surprise that IP traffic performs adequately most of the time – we could afford about 1,000 router hops, even under heavy load (as long as no link is truly saturated with traffic).



This does not mean that measures to better manage traffic are irrelevant. First, there is the risk that some link is completely saturated with traffic – a risk that cannot be completely avoided in light of the bursty nature of Internet traffic.[102] Second, there are the slower circuits at the edge of the network, especially shared media such as broadband based on cable television. And third, there is the matter of operation when the network is operation in a partially degraded mode due to the failure of some but not all components.

So the ability to provide QoS in a network has its place in a modern IP-based network. Still, the willingness of customers to pay a premium for a service that, most of the time and under most circumstances, provides no customer-visible benefits will surely be limited. This limited willingness to pay on the part of the customer naturally leads to limited willingness on the part of network operators to invest in making the capabilities available.

5.4.2.3 Technical solutions

In the early Nineties, the Internet Engineering Task Force (IETF) was active in evolving a series of relatively complex solutions under the rubric of the *Integrated Services Architecture*, as exemplified by the RSVP protocol. The common wisdom has been that these protocols were hopelessly complex.

In fact, at least one firm (BBN) had a working network based on RSVP. It was delivering services to real customers. It was a technical success but a commercial failure. It was eventually shut down, not due to technical problems, but rather because the company never found enough customers who were willing to pay much of a premium to use the RSVP-capable network.

Be that as it may, the IETF subsequently evolved a much simpler set of communications protocols in conjunction with *DiffServ* (for *Differentiated Services*). DiffServ enables hop-by-hop traffic management, where selected packets are marked as having requirements other than best efforts. It is up to each router, then, to do what it can to implement the desired transmission characteristics (or to decline to do so). Various techniques can then be used to ensure hop-by-hop performance, with *Multi-Protocol Label Switching (MPLS*) being perhaps the most common.

DiffServ provides a more limited service than RSVP in the sense that it assures performance only on a hop-by-hop basis, rather than end-to-end. Still, it can provide adequate overall assurance at a statistical level.

DiffServ and MPLS are trivial to implement within a network, and are in use in many large networks today. Nonetheless, there is no significant use *between* networks. The lack of deployment reflects economic and business factors rather than technical ones. We return to this point in a later section: “Why so slow to emerge?”

5.4.2.4 Implications for billing and accounting systems

The implications for Operational Support Systems (OSS) in support of differentiated QoS tend to be overlooked in most discussions. Technologists tend to focus more on the problem of getting the bits to move as they are supposed to move, and less on the problem of how to ensure that someone pays for those movements.

It has generally been assumed that a network operator would be willing to provide better-than-best-efforts quality only to the extent that either the end user or another network operator was willing to pay them a premium to do so. To the extent that this implies the need to account for QoS-capable traffic, it implies surprising complexity.

First, a pair of network operators would need to agree on how much QoS-relevant traffic each delivered to the other. Second, they would need to verify that each actually delivered the quality that it had committed to the other. Finally, each would need some tools to deter fraudulent use or “gaming” of the system. The first is trivial, the second and third are difficult. Finally, there would be the need to reconcile statistics, and to deal with discrepancies between the measurements of the parties.

Measuring traffic across a link would seem to be straightforward, and distinguishing among different marked classes of traffic is no harder. Capturing first-order statistics on traffic sent between the parties is straightforward. Even here, some prior agreements will be needed as regards what is being measured, and when – otherwise, there is the risk that network A has a slightly different view of the traffic delivered on the link from A to B than does network B, even though both are measuring (different ends of) the same link using substantially similar tools. And sampling intervals need to be mutually agreed, otherwise any measures of variability (quantiles, standard deviation) are likely to reach different conclusions due to the perverse effects of the Central Limit Theorem (if two sensors sample the same distribution, the one that is sampling at more frequent intervals will tend to see an apparently more lumpy distribution).

Reconciling data would be challenging. There is an old Dutch proverb: “Never go to sea with two compasses. Take one or three.” If the providers do not agree, whose statistics should govern? Is there scope here for a trusted intermediary, and if so who might that trusted third party be?

The challenges in verifying that the service was actually delivered are much more profound. In this case, network A needs to ensure that network B delivered the committed performance, and neither will want to rely on measurements provided by their respective end users. Network A thus needs performance statistics

about network B's network. Yet these networks are likely to be direct competitors for the same end users – network B is not about to let network A place sensors in its network. Both networks are likely to uncomfortable with providing internal performance data to one another.

It might be far simpler to bill, not for the use of the network, but rather for the services that benefit from differentiated QoS. Here, too, there are challenges – in an IP-based NGN, the service provider might not be the network provider. Moreover, it is quite possible, for reasons noted earlier, that services without QoS will compete successfully with services that are supported by QoS. It is not clear that network operators would be able to extract enough revenue from independent service providers to enable them to fund the differentiated services.

5.4.3 Why so slow to emerge?

Given that the technology of differentiated QoS is not particularly challenging, and given its widespread use *within* networks, why has it been so slow to achieve deployment *between and among* networks?

From an economic perspective, the basic answer is obvious: Had the benefits of deployment clearly exceeded the costs, it would have deployed. Thus, one might infer that either the perceived costs are too high, or the perceived benefits too low, or perhaps both.

Given that most users will be unable to notice the difference most of the time, there are indeed questions as to whether the perceived benefits are too low. In addition, a series of challenges related to *network externalities* and to *transaction costs* have inhibited deployment.

Many industries experience network externalities. A service may be most useful when a great many people use it (and not just because of economies of scale). This is true of telephone service, and also of the Internet. My telephone is worth more if there are a great many people whom I can call. My Internet connection is worth more when there are a great many people to whom I can send an email, and a great many websites to which I can connect.

Getting a new service launched in a sector dominated by network externalities can be challenging. In effect, the externalities of the old service keep pulling the industry back. It is difficult to get past the *initial adoption hump* in order to achieve critical mass.[103] The economist Geoff Rohlfs[104] has explained that different services got past the initial adoption hump in different ways. VCRs were initially purchased for time-shifting of television programs; only when enough consumers had purchased VCRs did a rental business emerge. CDs were successful because Matsushita and Phillips had commercial interests in both CD players and studios, and were thus motivated to ensure that both players and content were available.

Differentiated QoS *between and among networks* is subject to these network effects. The service has some value within a network. It might have great value if it were available to every destination on the Internet. If it were available to only two or three networks, then it is of limited value. Thus, the value of deployment might be significant to those networks that implement it later, but the initial benefit to the first two or three networks to deploy it is minimal.

At the same time, extending differentiated QoS to each additional network implies *transaction costs*. Agreements, monitoring tools, and coordination in general would need to be put in place. These costs might be roughly linear in the number of networks with which one network has agreements in place.

Thus, it is hard to get the process started, and it would be hard to get it to completion once it had been launched.

These concerns are not unique to differentiated QoS. A number of Internet capabilities are faced with similar economic challenges. The adoption of Internet Version 6 (IPv6, a new version of the Internet Protocol with a greatly expanded address range) and of DNSSEC (a security enhancement to the Domain Name System – the acronym alludes to *DNS SECurity*) have arguably been impacted by similar considerations.[105]

On the other hand, certain Internet capabilities have deployed effortlessly – for example, the worldwide web. In many cases, the successful capabilities benefit from the *end to end principle* – that is to say that they can be implemented independently by end-user organizations or consumers, without requiring coordination or for that matter any action at all on the part of the providers of the underlying IP-based network.

A common characteristic among the stalled capabilities is that, rather than being end to end features independent of the network, the stalled capabilities require concerted action and coordinated change to the core of the network. Regrettably, inter-provider QoS seems to clearly fit the profile of the stalled capabilities. Common characteristics among the slow-deploying capabilities include:

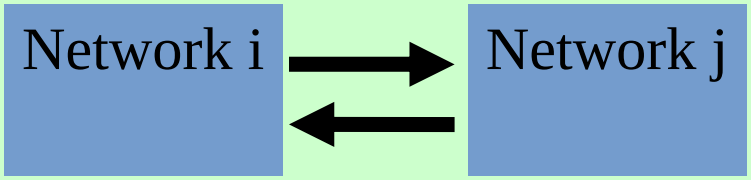
- Benefits that are in some sense insufficient: too limited, too difficult to quantify, too slow to appear, too difficult for the investing organizations to internalize.
- Limited benefits until the service is widely deployed.
- The need for coordination among a large number of organizations, leading to high economic transaction costs (the cost for a network or an end-user to adopt the service).

5.4.4 QoS and interconnection charges

In an unregulated environment, how would service providers (be they ISPs or NGNs) choose to set access charges for carrying one another's traffic at levels of quality other than the current best-efforts level of quality? It has widely been assumed that QoS between IP-based backbone ISPs would work only if the backbones compensated each other at a higher rate (i.e. with a higher access charge) for service of better quality.

Economists have modeled a pair of interconnected backbone ISPs (networks *i* and *j* in the figure below) serving a customer base of web sites (senders of traffic) and consumers (recipients of traffic). [106]

Figure 6: Traffic flows from network *i* to network *j*



In the absence of differentiated Quality of Service, backbone ISPs in a competitive market would tend to price to usage-based marginal cost. Profits in this scenario are nil – the backbones compete away their profits.[107] If, on the other hand, the backbones have market power (as a result of having designed their respective networks to inherently provide different levels of quality of service)[108], then profits can be positive – the network providers can make a profit.

In this latter scenario, if the ISPs face identical costs but distinct demands based on the differences in their quality of service, both will be motivated to price at an equilibrium price that maximizes their profits. At that point, an increase or decrease in either ISP's price would not further increase profits.[109]

In sum, the analysis at this level is consistent with the notion that a system where IP-based networks have the ability to offer a higher level of quality of service (for traffic delivered at higher cost and associated with higher access charges) could lead to an economically rational system that would tend to increase provider profits. As we show in the next sub-section, in a generally competitive market, this would tend to enhance consumer welfare.

5.4.5 QoS and network neutrality

In the United States, a recent debate has emerged over *network neutrality*. The arguments on both sides of this complex debate have arguably been somewhat misplaced, but it is worth noting that a number of experts have implicitly objected to price discrimination and to the use of technology to support the excludability that would make price discrimination effective.

The network neutrality debate emerged in the United States due to a "perfect storm" of three simultaneous market and regulatory changes:

1. The collapse of the wholesale market for broadband Internet access;
2. A series of mergers (Cingular/AT&T Wireless, SBC/AT&T, Verizon/MCI, and now AT&T/BellSouth) with insufficient conditions imposed; and
3. The overly hasty and ill-considered withdrawal of procompetitive regulation.[110]

These concerns about price discrimination appear to reflect excessive concentration in the U.S. market – regulatory experts are objecting to many practices that, in a healthy market, would be welfare-enhancing. In the U.S. context, these concerns are real; moreover, they cannot easily be fixed through regulation. The problems are too complex. Several U.S. FCC proceedings[111] suggest that the FCC lacks the necessary expertise to distinguish between welfare-enhancing service discrimination versus harmful anticompetitive acts. In any case, once markets have been allowed to deteriorate to this degree, no regulatory fix is likely to be satisfactory. The fox is already in the chicken house, the horse has already left the barn.

These network neutrality problems will not necessarily manifest themselves in other parts of the world, or at least not in exactly the same way. In Europe, for example, the underlying broadband markets are much more competitive than in the United States, in the sense that far more options are available to the average consumer; moreover, the regulatory system in Europe is likely to ensure that they remain competitive. Even in relatively concentrated European markets such as Germany, most consumers can choose among multiple broadband service providers (many of them service-based rather than facilities-based). As long as regulators continue to ensure competitive underlying markets, offers of different quality of service at different prices are likely to enhance consumer welfare rather than to detract from it.

5.4.6 A Coasian approach to QoS

As we have seen, Coasian arrangements (i.e. commercially negotiations) work well in a wide range of settings for interconnection agreements to convey best-efforts traffic. (In this sense, *best-efforts* connotes traffic for which the network exerts its best efforts to ensure that the traffic is delivered, but provides no ironclad guarantee that all traffic will be delivered. There may, of course, be *statistical* assurances as to the probability of delay or loss of data traffic.) What are the prospects that Coasian arrangements might work for traffic some fraction of which must be delivered with quality better than best-efforts?

Reasoning by analogy with current Coasian best-efforts arrangements, we might reasonably expect that each network would seek to be paid by its own customers, rather than seeking payment from either the consumer or the content provider customer of the other network. The charge to one's own customer for carrying better-than-best-efforts traffic would presumably be higher, on a unitized basis, than the charge for carrying best efforts traffic.

The *service* providers (of VoIP, for example) would likely charge their customers, and might also agree to charge one another. These payments between the services providers would then constitute a form of *micro-payment*.[112] In a competitive market, the *service* providers would tend to set these payments in such a way as to cover their costs, including their payments to the underlying *network* providers. A key insight from Laffont et. al. is that, where such micropayments exist, the access charge typically has no impact on traffic or on economic efficiency.[113]

This possibly simplistic analysis would seem to suggest that differentiated QoS might emerge spontaneously without any policy intervention on the part of governments. The seemingly intractable problems associated with access payments between service providers need not be dealt with at all – access charges could be set to zero, or simply ignored altogether. Unfortunately, this analysis begs the question: If it were that easy, why has it not already happened?

6 A sampling of regulatory analysis of NGN interconnection to date

This section briefly reviews a number of regulatory proceedings and studies that have considered the impact of IP-based interconnection. Many countries have looked at these issues.

Section 5.6.1 considers the overall approach of the European Union, which largely uses economic analysis to address market bottlenecks in a technologically neutral and reasonably future-proof way. Sections 5.6.2 and 5.6.3 consider recent developments in the UK and in Germany, which could be viewed as reflecting forward-looking thinking in the industrialized world. Section 5.6.4 and 5.6.5 briefly summarize recent proceedings in India and Saudi Arabia by way of showing emerging views in developing countries.

6.1 The European approach

Different countries will have developed different methodologies for addressing market power as it relates to access and interconnection. The approach that the European Union adopted in 2003 reflects a particularly forward-looking way to deal with migrations such as that to the NGN.

Under the European regulatory framework for electronic communications, regulators (1) clearly identify a set of relevant markets that could be of interest; (2) determine, using tools borrowed from competition law and economics, whether any firm or group of firms has Significant Market Power (SMP) on such a market; (3) applies a minimally adequate set of *ex ante* (in advance) remedies only to the firm or firms that possess SMP; and (4) removes any corresponding obligations that might have previously existed from firms that do not possess SMP. The framework is (insofar as practicable) technologically neutral – whether a service is delivered using a traditional network or an IP-based NGN is irrelevant. A relevant market is determined based on the service or services delivered to the user. The determination reflects consideration of the degree of substitutability with other services, consistent with competition law.

Properly implemented, a regulatory framework of this type enables a regulator to address such market power as may still exist in an NGN world, and also provides a natural and organic method for withdrawing regulation when it is no longer needed.[114]

6.2 The United Kingdom (U.K.)[115]

The use of the European regulatory framework simplifies the task of the regulator in addressing the challenges of the Next Generation Network, but by no means does it provide all of the answers. Ofcom, the national regulatory authority (NRA) for the UK, has been in the forefront in dealing with NGN migration challenges, largely as a result of the commitment of British Telecom (BT) to migrate rapidly to an NGN and to phase out the existing "traditional" PSTN network. These proceedings represent cutting edge thinking, and merit careful study by regulators.[116]

Among these Ofcom proceedings are:

- *Next Generation Networks – Future arrangements for access and interconnection* (First Consultation), 24 October 2004.
- *Next Generation Networks: Further consultation* (Further Consultation), 30 June 2005.
- *Final statements on the Strategic Review of Telecommunications, and undertakings in lieu of a reference under the Enterprise Act 2002* (Strategic Review), 22 September 2005.
- *Regulatory challenges posed by next generation access networks*, 23 November 2005.
- *Ofcom's approach to risk in the assessment of the cost of capital*, 26 January 2005 (updated 2 February).
- *Ofcom's approach to risk in the assessment of the cost of capital: Second consultation in relation to BT's equity beta*, 23 June 2005.
- *Ofcom's approach to risk in the assessment of the cost of capital: Final statement* (Final Statement), 18 August 2005.

- *Review of BT's network charge controls: Explanatory Statement and Notification of decisions on BT's SMP status and charge controls in narrowband wholesale markets*, 18 August 2005.

The Ofcom proceedings have considered a range of issues, including the degree to which regulatory remedies would continue to be needed going forward, the number of points of interconnection that would be required, the appropriate way to determine regulated costs and prices in an NGN environment. Many of these proceedings have concluded that it was simply too early to make a firm regulatory determination; consequently, they have tended to focus on putting clear and consistent *process* in place rather than making firm conclusions about the regulatory *outcome*.

At the same time, Ofcom has reached understandings with BT that establish a semi-independent subsidiary to provide those wholesale products that are closely associated with the local loop to the customer's premises, where BT is presumed to still possess market power.

Ofcom concluded early on that the migration to an NGN would not in and of itself eliminate BT's market power on the local loop any time soon. The subsidiary (*OpenReach*, referred to in some Ofcom documents as the *Access Services Division (ASD)*) is obliged to provide access products at wholesale to the competitors on the same basis on which it provides them to BT itself, a principle known as *Equivalence of Input*. Through these arrangements, Ofcom hopes to redirect critical obligations to a small number of services where barriers to competition are most likely to be durable, and by so doing to obviate the need for obligations on other services (higher level services) that use those lower level services as key piece parts.

6.2.1 New access products required

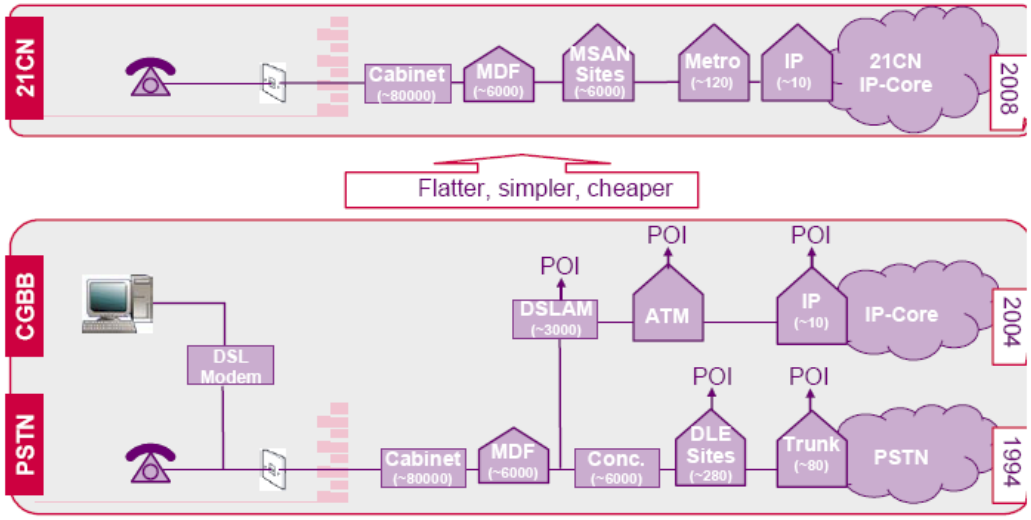
As regards existing SMP obligations, and specifically existing SMP interconnection offerings, Ofcom came to the unsurprising conclusion that those offerings would need to be maintained for some period of time. At the same time, they came to the equally unsurprising realization that new SMP interconnection offerings would be appropriate in the future. This necessarily implies some period of overlap:

> To enable business planning for alternative providers there initially needs to be continuity of existing SMP products (those products that BT is obliged to offer in markets where they have Significant Market Power), but we believe that this should only be for an interim period during which both legacy and next generation products are available. To ensure a timely move to next generation interconnect we propose that legacy products should be withdrawn once there is no longer reasonable demand or when next generation products provide an adequate replacement that providers are able to migrate to.[117]

6.2.2 Fewer access points

Ofcom recognized[118] that the new structure that BT envisioned for 21CN necessarily implied a flatter network with fewer points of interconnection. Today, BT has some 3,000 locations at which competitors can connect to the DSLAM, and some 280 Digital Loop Exchange (DLE) sites at which competitors can gain access to the voice network. In the 21CN as currently envisioned, interconnection will be possible only at the metro nodes, i.e. only at 100 – 120 sites.[119]

Figure 1. Comparison of existing BT voice and broadband networks with 21CN



Key:

PSTN	Public Switched Telephone Network	Conc	Concentrator
CGBB	Current generation broadband	DSLAM	DSL Access Module
21CN	BT's 21st Century Network	DLE	Digital Local Exchange
MDF	Main distribution frame	MSAN	Multi Service Access Node

This inevitably raised many questions. Alternative operators had invested significant sums to interconnect with BT at existing interconnect locations. Now, as a result of unilateral decisions set in motion by BT, many of those interconnect locations would no longer exist. How should the costs of these stranded assets be apportioned?

Ofcom found[120] "…that the key factors relevant to compensation arrangements for BT's 21CN migration are:

- the extent to which these changes are unilaterally decided by BT without industry agreement;
- the distribution of benefits that accrue from these changes;
- the remaining life of any legacy interconnect equipment employed at the time of the change;
- the extent to which new interconnect investments are made by communication providers after they have been made aware of forthcoming changes that would impact that investment; and
- the additional cost necessarily and directly incurred as a result of having to bring forward investment in new interconnect equipment.

6.2.3 Call termination in the traditional (narrowband) PSTN

Ofcom's analysis of *narrowband* (where narrowband refers to the existing PSTN, at bandwidths sufficient to carry a telephone call) call termination fees is particularly interesting, both for what is said and for what is not said. Ofcom must address an incumbent (BT) that is moving rapidly today, not merely to augment its network with NGN capabilities, but rather to replace its existing PSTN network altogether in just a few years with a new IP-based NGN known as the *21st Century Network (21CN)*. Driven by that need, they have developed a thoughtful analysis of how they might carry their existing narrowband arrangements forward during a transition period where the incumbent network is based partly on PSTN technology and services, and partly on those of the NGN.

Ofcom does not attempt the broader and more difficult task that is attempted in this chapter – determining whether the traditional PSTN model of interconnection will be appropriate going forward in a purely NGN world. In that sense, their analysis could be said to look back to the past, rather than forward to the future. Nonetheless, it contains valuable insights for regulators seeking to address the transition period from PSTN to NGN.

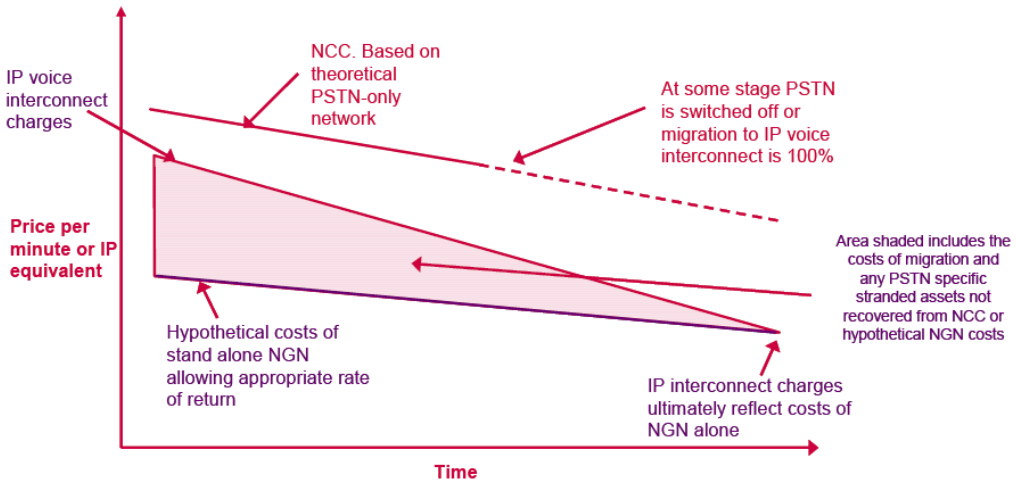
Ofcom recognized several interrelated factors of the current regulatory and market environment that could influence BT's profitability and that of its competitors, including:

- the higher risk to BT and its shareholders in implementing 21CN;
- the ultimately lower unit costs of operation for 21CN;
- the losses to competitors associated with stranded investments in interconnection facilities; and
- the cost to BT of simultaneously offering both old and new SMP offerings during the period of transition.

Ofcom has put forward the following over-arching view of the relationship between BT's risk, its initial capital expenditures in creating the 21CN, its lower overall unit costs once 21CN is fully operational and once legacy SMP offerings are no longer required in parallel, and the desired course for regulated rates for narrowband voice interconnection (and presumably to other regulated prices) as a result:

> *… IP voice interconnect charges would need to start above the costs of a hypothetical stand alone NGN, because to do otherwise would create an arbitrage opportunity where (for example) migration costs would not get recovered. However, these IP voice products could still be priced below [current] narrowband interconnect products to the extent they cost less to provide than [those current] interconnect products. Finally, at a point in the future, when all traffic is via IP voice interconnect, and all migration / PSTN costs had been recovered, IP interconnect pricing would end up reflecting the costs of the NGN allowing an appropriate rate of return.*[121]

Figure 5. 'Holistic' approach to narrowband voice interconnect cost recovery (illustrative only)



Source: Ofcom

This intriguing diagram represents a fascinating thought model, but it also raises many questions.

The upper line ("NCC. Based on theoretical PSTN-only network") reflects the expected trend for the regulated *Network Charge Control (NCC)* for BT's existing wholesale narrowband interconnect. It declines over time because BT's efficiency is presumed to improve over time. It is implicitly assumed that the efficiency of a network that is part PSTN and part NGN will improve no less quickly than BT's current PSTN network. In the event that the migration to NGN enables still greater efficiency gains, then BT reaps the benefit over the defined lifetime of these cost controls, which is 2005-2009 – the NCC level will not be revised other than in exceptional circumstances.[122]

The next line below, "IP voice interconnect charges", represents a future NCC for a new wholesale SMP product enabling interconnection to narrowband voice services. It is presumably some form of IP interconnection. Given that this interconnect offering is not yet defined, much less implemented, Ofcom has not attempted to set the level of these charges; however, the general notion is that they should be less than those of traditional voice interconnect charges, but still sufficiently in excess of incremental cost to enable BT to recover the cost of migration from the PSTN to the NGN.

The question of NCC levels during a period of coexistence between traditional interconnect and new IP-based interconnect is complex. To the extent that network costs are lower, the interconnect price for IP-based interconnect should be lower; however, maintaining different interconnection prices for the same service would tend to result in lower retail prices, and would thus tend to drive customers of the wholesale service to the new IP-based mode of interconnection. That could accelerate an already rapid transition.

6.2.4 Risk, the permissible rate of return, and the Weighted Average Cost of Capital (WACC)

Regulation must not interfere with the ability of service providers to make a reasonable return on reasonable investments. For a firm that is subject to regulation, this generally implies a need to compute the Return on Investment (ROI) that will be considered to be acceptable for regulatory purposes. Greater risks – as might be expected in connection with migration to the NGN – should be associated with greater expected returns.

Regulators typically determine an appropriate ROI by computing an appropriate Weighted Average Cost of Capital (WACC) for the firm. The Weighted Average Cost of Capital (WACC) can be computed using the *Capital Asset Pricing Mechanism (CAPM)*, a widely used and theoretically well grounded methodology for reflecting risk and its impact on the returns that shareholders should expect. A key component of the WACC under CAPM is the *beta*, which is a relative measure of the risk that is relevant to the specific firm.

Ofcom's analysis of the appropriate WACC for BT[123] provides a very lucid overview of the determination of a WACC for an incumbent provider that is on the verge of a rapid migration to an NGN. They chose to disaggregate BT's beta – instead of using a single beta for all of BT, they associated a somewhat lower beta with BT's relatively low risk local loop activities, and a somewhat higher beta with the rest of BT's activities. These different betas then led Ofcom to compute two different WACCs and thus to permit different levels of ROI for different parts of BT.

Ofcom considered various options, but they did not finally resolve the ROI that might be appropriate when BT migrates to an NGN (which BT intends to do on a very accelerated schedule). Ofcom has indicated that BT's risk might be slightly higher for next generation core networks, and significantly higher for next generation access networks, than for BT's current network. Ofcom might address this through further refinements to BT's beta; alternatively, they have raised the possibility of addressing these different levels of risk through a modeling mechanism known as *Real Options*[124].

6.2.5 The Equivalence of Input approach

Ofcom announced an agreement with BT in June 2005 that represents a significant departure from previous regulatory practice.[125] BT made legally enforceable commitments[126] to provide a range of access services to competitors on a nondiscriminatory *equivalence of input* basis. Ofcom defines *equivalence of input (EoI)* as "…a requirement for BT to make available the same [*Significant Market Power (SMP)*] products and services[127] to others as it makes available to itself, at the same price, and using the same systems and processes." EoI obligations would be applicable "… when the cost is proportionate, and in particular [to] all new wholesale SMP products, processes and systems, and therefore to all new SMP products delivered over 21CN."[128]

BT has agreed to make key wholesale offerings where it has previously been found to be dominant available to competitors *on an equivalence of input basis*. Most if not all of these offerings are, to be sure, available today in connection with *ex ante* remedies imposed in response to BT's market power. What the commitment implies is that these wholesale services must be delivered by BT's Access Services Division (Openreach) as of the committed dates using new order processes and new nondiscriminatory ordering systems.

This is an interesting and promising model for the regulatory community, to the extent that it implies an attempt to achieve regulatory aims, not by traditional regulatory means, but rather by an enforced but limited structural separation of the wired incumbent. The hope is that the incentives of the new Access Services Division will be such that day to day regulatory intervention will be unnecessary. It is too soon to say whether this approach will prove to be effective, but it merits careful study going forward.

6.3 Germany

The German BNetzA initiated a study group on the interconnection of IP-based networks, which issued its final report at the end of 2006. The report notes the importance of the separation of service and network, and the impact of the centralization of control functions.

As regards the number of interconnection points, the report concludes that it is not yet possible to predict what will happen, for both technical and business reasons. From a regulatory perspective, the number of interconnection points should insofar as possible be consistent with an efficient network architecture for the incumbent and also for competitors, and should seek to minimize stranded investments for all concerned.

IP-based networks have a clear focus on end-to-end quality. The report recognizes the value of providing different classes of service, and identifies four possible classes: real time service, streaming service, data service, and best efforts service. The questions associated with compensation for the higher costs of more demanding services are complex and interlinked. The report draws a useful distinction between VoIP services versus VoNGN (voice over Next Generation Networks), but recognizes that the marketplace should make the ultimate choice between the two.

Unit costs for NGNs will presumably be lower than for current networks; however, an immediate transition to these forward-looking costs could potentially be too disruptive to market participants. A glide path may be more appropriate, and may better reflect the transition period where the network comprises a mix of circuit-switched and NGN technologies. A single interconnection regime reflecting a "blended" cost structure may also serve to reduce the risk of arbitrage and bypass in comparison with an interconnection regime where PSTN interconnection is priced at a very different level from that of NGN interconnection. A unified interconnection regime is also likely to result in more appropriate market-based incentives for all concerned for a migration to NGN with an appropriate number of points of interconnection. The BNetzA will in any case need to undertake more detailed study of costs in an NGN environment.

The migration to NGN puts in sharp contrast the common practice of CPNP in the traditional switched network, versus the practices of Bill and Keep and of transit arrangements in the IP-based world. CPNP leads to the termination monopoly problem, which necessitates a regulatory correction; Bill and Keep eliminates the termination monopoly, and thereby reduces the need for regulation, since there is no need to set termination prices.

Bill and Keep would tend to reduce the incentive for operators to concentrate on groups of customers who receive more traffic, and may increase the tendency toward roughly comparable traffic among network providers, even when the providers are very different in size. These characteristics can enhance efficiency. At the same time, Bill and Keep might lead to the "hot potato" problem, which could result in underinvestment in network infrastructure.

A possible way to integrate these views would be to implement Bill and Keep in the concentration network, but CPNP on an *Element Based Charging (EBC[129])* basis in the core network.

The report provides a wealth of analysis, but does not reach firm conclusions as to the preferred long term interconnection regime (CPNP, Bill and Keep, or a hybrid of the two), nor as to likely time frame for transition from current to future arrangements.

6.4 India

The Indian TRAI issued a consultation paper[130] on NGNs early in 2006. The section on interconnection serves primarily to raise questions to stakeholders. The TRAI notes potential concerns that a dominant operator might refuse to offer new forms of interconnection to competitors, thereby disadvantaging them; and legacy services might be withdrawn or altered on short notice, to the detriment of competitors.

Among the questions that the TRAI poses are:

- Should independent VoIP providers who wish to terminate calls have interconnection rights?
- What interconnection services are appropriate going forward? Should NGN interconnection cover "… only [the NGN] Core, Core and Access or all three layers including Service?"
- Should interconnection charging continue to be based on time and distance, or should it immediately evolve to be based on capacity, quality, and class of service?
- What obligations, if any, should the incumbent have to continue to offer legacy interconnection products?
- How should the transition period to the NGN be handled?
- Given the complexity of interconnection issues, is a separate consultation dealing only with interconnection issues necessary?

6.5 Saudi Arabia

The Saudi Communications and Information Technology Commission (CITC) briefly considered IP-based interconnection as part of their 2006 review of the Reference Interconnection Offer of the Saudi Telecommunications Company (STC).[131] They note that "…IP traffic does not lend itself easily to per minute charging, and it is technically complex to separate one kind of traffic (e.g. voice) from another (e.g. http traffic) where many different types of traffic may be carried simultaneously across the same interconnection link. This raises issues about how service providers should charge for interconnection, and the issues are particularly complex when traffic has to be passed from a circuit-switched to an IP environment, or vice versa. The CITC believes that interconnection to NGNs will be an important issue in the Kingdom in future , and intends to begin a process of analysis and consultation to arrive at an optimal set of regulations for NGN interconnection within the Kingdom."

7 Access and Mobile Next Generation Networks

This section briefly addresses some concerns that are unique to mobile networks. As networks evolve into Next Generation Networks, fixed and mobile networks are likely to become increasingly interoperable and substitutable for one another. Nonetheless, important differences will remain, and will continue to require regulatory attention.

7.1 Is it appropriate that termination fees be higher for mobile networks?

Traditional economic theory has held that the termination fee should reflect the real marginal cost of terminating the traffic. To the extent that the mobile network entails greater cost than the fixed network, it is appropriate that the termination fee should be higher.[132]

Computing the appropriate termination fee is a complex specialist area. The operator should be able to recover not only usage-based marginal costs, but also a reasonable return on the capital invested. For a mobile service, a large part of that capital may have been invested in procuring spectrum at auction. The costs are generally based on some measure of long range forward-looking incremental cost for an idealized network. The rationale for the use of an idealized network is to avoid rewarding operators for poor design decisions.

Over time, the migration to NGNs is likely to provide competitive alternatives that will make the current interconnection arrangements unsustainable. For the moment, however, mobile operators seem to be more

tightly vertically integrated than their fixed counterparts. Independent third party providers of services such as VoIP have been less successful in cutting into the revenues of mobile operators. The current minutes-based arrangements might be sustainable somewhat longer in the mobile network than in the fixed network.

Regulators may be willing to migrate the fixed network to different interconnection arrangements (such as bill and keep) more quickly than the mobile network, in part because there is far less revenue involved. Mobile termination rates are many times as great as fixed.

Is there cause for concern if the regulators implement a mixed system, at least for some period of time? Perhaps not. Mixed systems are ungainly, but not impossible. France used Bill and Keep wholesale arrangements among mobile operators for many years, while using CPNP for calls to or from the fixed network. This system was ungainly, but in practice was unwieldy rather than unworkable.[133] Similarly, the United States has used Bill and Keep for years for mobile operators and for non-dominant fixed operators, but has used CPNP for calls to wired incumbents. The resultant system is hideously complex, but the practical results are surprisingly good. Singapore has achieved outstanding results with a U.S.-like mixed system that uses Bill and Keep for calls terminated by mobile operators, but regulated rates for calls terminated by the wired incumbent.

7.2 Mobile services versus WiFi services

One interesting competitive alternative to mobile telephony that is emerging is the use of WiFi in conjunction with VoIP. New handsets have recently emerged that operate as VoIP phones when WiFi is available, but as conventional mobile phones at all other times.

The original expectation was that people would use these phones to avoid high mobile charges when making calls from their own homes, but would use them primarily as conventional mobile phones when outside. A somewhat unexpected manifestation is that many WiFi hot spots are completely open and unsecured. A person walking down a big city street might very well be able to place a free VoIP/WiFi call by piggy-backing on a stranger's WiFi router.[134]

This introduces numerous practical and ethical questions. The person who owns the WiFi router probably will never notice that his service is being used, and suffers no significant degradation of service; nonetheless, he or she is arguably experiencing a microscopic theft of service. Should the practice be viewed as being acceptable, or objectionable?

Also, the owner of the router could easily eavesdrop on the conversation. Should this be a matter of concern?

7.3 Mobile Roaming

Mobile roaming is a complex market that is subject to many of the same defects as the mobile termination market. In the absence of regulation, prices have a tendency to be greatly in excess of real marginal cost.

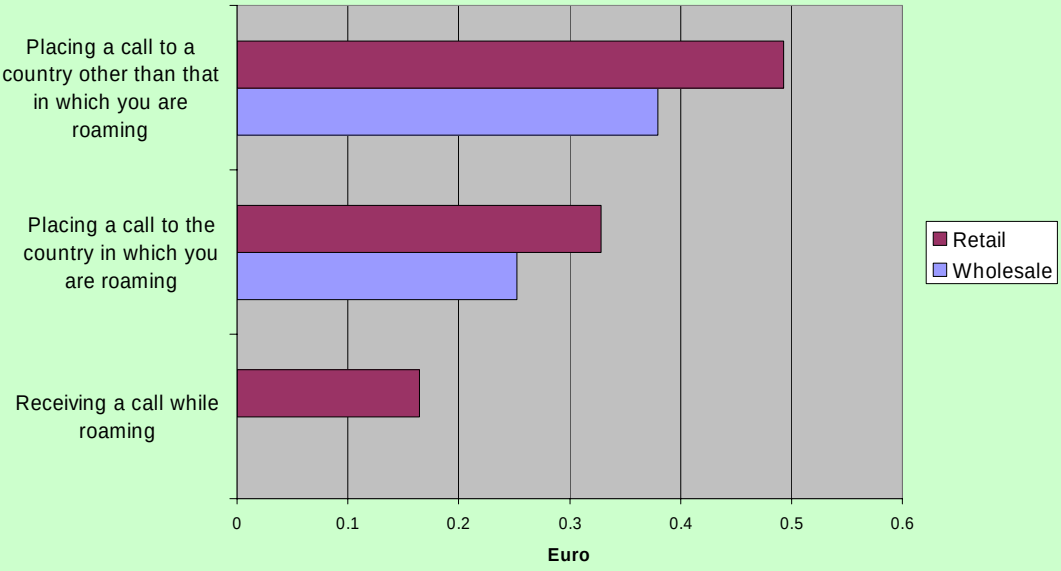
Mobile roaming consists of using one's mobile phone when one is outside of the service provider's service footprint. Roaming in a country where the service provider lacks a presence is *international mobile roaming.* Placing a call while roaming is *roaming out*; receiving a call while roaming is *roaming in*.

European regulators have become increasingly concerned over high roaming prices, both at wholesale and also at retail levels. Roaming out in Europe typically costs more than 1.00 EUR per minute, while roaming in often costs 0.50 EUR per minute. Real marginally costs are surely much less.

The European Commission has proposed a regulation to impose both wholesale and retail price caps on mobile roaming.[135] The imposition of retail price controls is a rather extreme measure, but is motivated in this case by the recognition that retail prices of mobile roaming have stubbornly refused to move very much over the past few years; moreover, since there is no wholesale price for roaming in, there is no serious prospect of addressing that aspect of the problem solely at the wholesale level.[136]

The Commission's proposed regulation would "peg" wholesale prices for mobile roaming to levels that are based on regulated mobile termination rates (MTRs). Based on the mobile termination rates that were in effect as of October 2005,[137] maximum wholesale and retail prices per minute would be as shown in Figure 7 below for wholesale and retail mobile roaming.

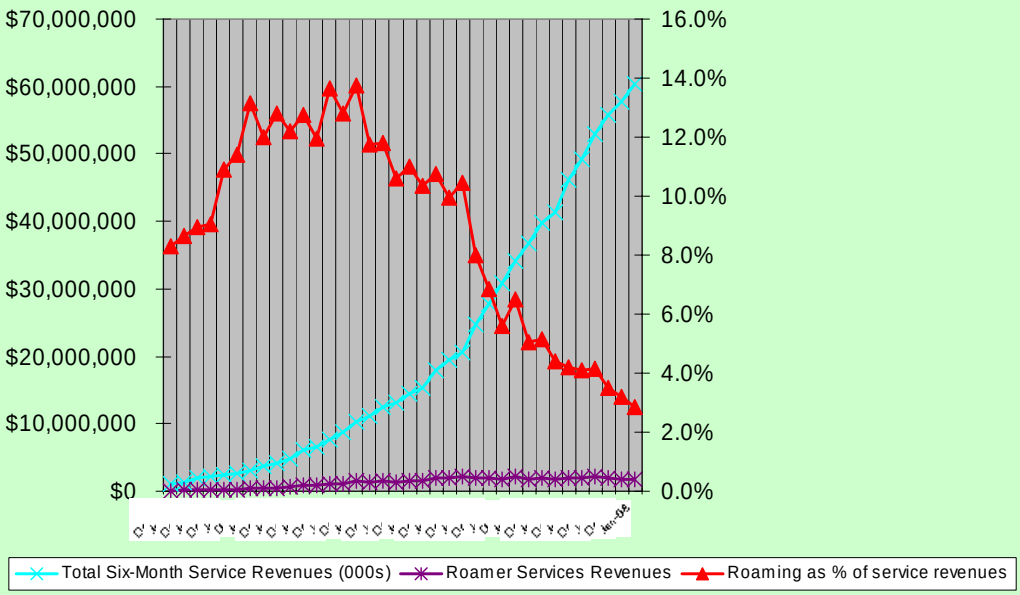
Figure 7: Maximum wholesale and retail prices for mobile roaming under the European Commission's proposed mobile roaming regulation



Source: European Commission

In the United States, domestic mobile roaming (within the U.S.) has been a problem of declining significance for many years. No regulation was necessary. Once AT&T Wireless offered a flat rate package with no domestic roaming charges, the industry moved quickly to transform itself. Mobile operators were effectively forced to become national in scope in order to compete, either through acquisitions or through partnerships. Mobile revenues in general have climbed steeply over the years, but mobile roaming revenues have been essentially flat and more recently have declined somewhat. As a percentage of total revenues, domestic roaming has declined from 13.8% in December of 1995 to 2.8% in June of 2006.[138]

Figure 8:. Domestic mobile roaming revenues in the U.S. in relation to total service revenues



Source: Cellular Telecommunications and Internet Association

Mobile roaming is proving to be a challenging problem; however, there is no particular reason to expect that the migration to IP-based NGNs will change the character of the problem very much.

8 Last Mile Access

Up to this point, this chapter has dealt primarily with network *interconnection*. The section deals primarily with *access*. For our purposes, *access* enables an operator to utilize the facilities of another operator in the furtherance of its own business and in the service of its own customers.

At the regulatory and policy level, access and interconnection have always been closely associated with questions of market power. It has been a general article of faith that governments must be prepared to intervene to address such abuses of market power as might exist.

Telecommunications networks were initially presumed to be natural monopolies, industries where initial costs were so high as to preclude competition between two providers in a single geographic area. In most countries, the government itself provided these services, usually through a Post, Telephone and Telegraphy (PTT) authority. In a few, notably including the United States and Canada, equivalent services were historically provided by highly regulated firms that were *de facto* monopolies with significant *de jure* privileges and protection.

With liberalization, services that were previously provided by the government have been privatized, and competitors have been encouraged to enter these markets. In most cases, the established incumbents have resisted competitive entry, either by price-based or by non-price-based discrimination.[139] This behavior is conditioned and shaped by legal and regulatory institutions in each country, but similar underlying economic factors tend to encourage similar incumbent behaviors in all countries.[140]

Once competition is established and effective, it is generally accepted that regulation should be withdrawn. At that point, market forces will channel service provider behavior more effectively than any regulator could hope to.

At the same time, it is important that regulation not be withdrawn before competition is effective. Reform-minded New Zealand attempted for many years to operate without a conventional sector-specific regulator.

In 2001, they gave it up as a bad job and implemented lightweight institutions approximating the function of a sector specific regulator. Interminable interconnection disputes were the primary reason.[141]

9 Concluding thoughts

As today's networks evolve into Next Generation Networks of tomorrow, much will change, but some things will remain the same.

- The character of competition may change, but competitive bottlenecks will continue to be of concern to regulators.
- The close link between the *service* and the *network* will be broken, but the regulatory interest in protecting consumer rights in connection with existing services and with their successors is likely to remain.

The time of transition to NGNs represents an appropriate point at which to reconsider the entire interconnection regime. The CPNP wholesale arrangements that are globally widespread today will be difficult or impossible to maintain without change going forward, for a variety of technical and practical reasons. Interconnection arrangements must evolve in any case, This is the appropriate time at which to reexamine the workings of the entire interconnection system.

A better trade-off between *adoption* and *use* of communication services is needed. CPNP has stimulated take-up of mobile services, but at the cost of substantially depressing the usage of mobile phones, and possibly also to the detriment of the fixed network.

In the longer term, arrangements reflecting withdrawal of a regulatory mandate for CPNP, akin to regulatory practice in North America (Bill and Keep) and in the Internet, may represent the most appropriate and most sustainable economic model. These systems are economically efficient; they encourage usage (albeit possibly at some cost in the speed of mobile penetration); they ease the task of the regulator, to the extent that regulatory rate-setting is not required; and they pose no conceptual or implementation difficulties in the world of the NGN.

Based on existing experience, Bill and Keep arrangements are likely to work well without a regulatory mandate to interconnect,[142] provided that key underlying markets are competitive, and provided that otherwise dominant operators are motivated (or possibly required) to interconnect on an IP basis to at least two or three significant domestic competitors. The regulator's task might be simplified in this scenario, but the regulator must nonetheless remain vigilant.

In the nearer term, CPNP systems with much lower termination fees than those typical today might represent a promising interim step. Experience in India suggests that CPNP arrangements with mobile termination fees less than 0.01 USD per minute can be compatible with both high usage and rapid adoption. By reducing the spread between CPNP and Bill and Keep, the regulator also greatly reduces the pain associated with a subsequent transition to Bill and Keep arrangements should such a transition prove necessary.

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[1] See, for example, Article 2 of the European Union's *Access and Interconnection Directive*: "(a) access means the making available of facilities and/or services, to another undertaking, under defined conditions, on either an exclusive or non-exclusive basis, for the purpose of providing electronic communications services. It covers inter alia: access to network elements and associated facilities, which may involve the connection of equipment, by fixed or non-fixed means (in particular this includes access to the local loop and to facilities and services necessary to provide services over the local loop), access to physical infrastructure including buildings, ducts and masts; access to relevant software systems including operational support systems, access to number translation or systems offering equivalent functionality, access to fixed and mobile networks, in particular for roaming, access to conditional access systems for digital television services; access to virtual network services; (b) 'interconnection' means the physical and logical linking of public communications networks used by the same or a different undertaking in order to allow the users of one undertaking to communicate with users of the same or another undertaking, or to access services provided by another undertaking. Services may be provided by the parties involved or other parties who have access to the network. Interconnection is a specific type of access implemented between public network operators …". *Directive 2002/19/EC of the European Parliament and of the Council of 7 March 2002 on access to, and interconnection of, electronic*

communications networks and associated facilities (Access Directive), Official Journal of the European Communities, L 108, April 24, 2002, Article 9.

[2] Access can be viewed as an inherently asymmetric relationship, in that one operator is providing access to another. Interconnection, by contrast, can be viewed as being a symmetric relationship between two operators.

[3] See, for example, Article 8 of the European Union's *Directive 2002/20/EC of the European Parliament and of the Council of 7 March 2002 on a common regulatory framework for electronic communications networks and services (Framework Directive)*, Official Journal of the European Communities, L 108, April 24, 2002.

[4] See, for instance, Haucap, Justus, and Marcus, "Why Regulate? Lessons from New Zealand", *IEEE Communications Magazine*, November 2005, available at http://www.comsoc.org/ci1/Public/2005/nov/ (click on "Regulatory and Policy").

[5] ITU's working definition reads, in part: "A Next Generation Network (NGN) is a packet-based network able to provide services including Telecommunication Services and able to make use of multiple broadband, QoS-enabled transport technologies and in which service-related functions are independent from underlying transport-related technologies. It offers unrestricted access by users to different service providers. It supports generalized mobility which will allow consistent and ubiquitous provision of services to users. …" See http://www.itu.int/ITU-T/studygroups/com13/ngn2004/working_definition.html..

[6] These wholesale payment arrangements most often follow the *Calling Party's Network Pays (CPNP)* principle, which is described later in this chapter.

[7] There may be a monetary payment; there may be an acceptance of advertising; or the customer may compensate the providers in some other way. In general, each service provider derives some quantifiable benefit from the customer.

[8] In practice, the termination is often implemented by a more-or-less traditional competitive fixed operator on behalf of the VoIP service provider.

[9] Cf. Wikipedia contributors, "Privity of contract," *Wikipedia, The Free Encyclopedia*, http://en.wikipedia.org/w/index.php?title=Privity_of_contract&oldid=90675807 (accessed December 10, 2006).: "The doctrine of privity in contract law provides that a contract cannot confer rights or impose obligations arising under it on any person or agent except the parties to it."

[10] See Marcus, J. Scott, "Voice over IP (VoIP) and Access to Emergency Services: A Comparison between the U.S. and the UK", *IEEE Communications Magazine*, August 2006, available at http://www.comsoc.org/livepubs/ci1/public/2006/aug/cireg.html.

[11] The migration of the Internet Protocol from IPv4 to IPv6 is not expected to change this.

[12] See, for instance, the description of Click2Call at http://www.vonage.com/features.php?feature=click_2_call. "You simply select a number from your contact list or anywhere on your computer, press the Hotkey or click the "Place Call" button - and we dial the number for you, instantly. Your Vonage phone rings first. When you pick it up it, it rings the number you clicked to call."

[13] For *n* providers, (*n* * (*n*-1)) / 2 agreements would be needed.

[14] Peering and transit are discussed later in this chapter, in section 5.4.2.2.1 "Peering and Transit".

[15] See, for instance, INTUG's submission to the European Regulators' Group (ERG), "International mobile roaming", June2005, available at: http://erg.eu.int/doc/publications/consult_wholesale_intl_roaming/wir_intug.htm.

[16] Many economists would view the authoritative sources as being Jean-Jacques Laffont, Patrick Rey and Jean Tirole, "Network Competition: I. Overview and Nondiscriminatory Pricing" (1998a), *RAND Journal of Economics*, 29:1-37; "Network Competition: II. Price Discrimination" (1998b), *RAND Journal of Economics*, 29:38-56; Armstrong, M. "Network Interconnection in Telecommunications." *Economic Journal*, Vol. 108 (1998), pp. 545–564 ; and Jean-Jacques Laffont and Jean Tirole, *Competition in Telecommunications*, MIT Press, (2001). I choose to draw primarily on Laffont and Tirole (2001).

[17] I should hasten to add that I myself am not formally trained as an economist.

[18] Patrick DeGraba, "Bill and Keep at the Central Office As the Efficient Interconnection Regime", U.S. FCC OSP Working Paper 33.

[19] Doh-Shin Jeon, Jean-Jacques Laffont, and Jean Tirole, "On the receiver pays principle", *RAND Journal of Economics* (2004).

[20] The United States is often referred to in the literature as a country that employs *Receiving Party Pays (RPP*), but this rather misses the point. RPP was never used for fixed services. Under RPP, the mobile subscriber pays for air time, whether originating or receiving a call. RPP plans may possibly still be available from some operators in the U.S., but their role in the U.S. mobile marketplace is small and is diminishing over time. Many mobile operators no longer bother to offer RPP subscription plans.

[21] Calls received from foreign countries are typically billed for air time at the same rates as domestic calls.

[22] Andrew Odlyzko, "The evolution of price discrimination in transportation and its implications for the Internet", *Review of Network Economics*, vol. 3, no. 3, September 2004, pp. 323-346, available at http://www.rnejournal.com/articles/odlyzko_RNE_sept_2004.pdf.

[23] Cf. FCC, *8th CMRS Competition Report*, §94: "AT&T Wireless's Digital One Rate ("DOR") plan, introduced in May 1998, is one notable example of an independent pricing action that altered the market and benefited consumers. Today all of the nationwide operators offer some version of DOR pricing plan which customers can purchase a bucket of MOUs to use on a nationwide or nearly nationwide network without incurring roaming or long distance charges." Several mobile operators offer a variant of this plan where there are no roaming charges as long as the customer is using that operator's facilities.

[24] Flat rate plans for fixed service are truly flat rate, whereas the mobile plans are generally constructed as if they were two part tariffs. The usage charges of the mobile plans are usually set to levels that must be seen in the context of the U.S. as unreasonably high (as much as 0.40 USD per Minute of Use). As previously noted, they are not so much intended to be used, as to punish consumers who purchase bundles that are too small. The common feature between the mobile plans and the newer truly flat rate plans is a movement away from meaningful usage charges.

[25] For example, Vonage offers unlimited calls to or from the U.S. and Canada (and also calls to fixed telephones in the UK, Ireland, France, Italy and Spain) for just $24.99 a month. See www.vonage.com.

[26] In the United States, by means of the Enhanced Service Provider (ESP) exemption; in the UK, by means of a system known as FRIACO.

[27] Mobile operators may, however, include *on-net* calls to mobile phones (calls to their own mobile customers). They do not pay a termination fee for these calls, and thus do not face a high marginal wholesale cost.

[28] This definition is adapted from Laffont and Tirole (2001), page 182.

[29] In the interest of brevity, we will gloss over the historically important distinction between access charges and reciprocal compensation in the United States. As the industry consolidates (with the disappearance of AT&T and MCI as independent long distance carriers), this distinction is somewhat less relevant than it once was. For a more detailed treatment of arrangements in the U.S., see Marcus, "Call Termination Fees: The U.S. in global perspective", presented at the 4th ZEW Conference on the Economics of Information and Communication Technologies, Mannheim, Germany, July 2004. Available at: ftp://ftp.zew.de/pub/zew-docs/div/IKT04/Paper_Marcus_Parallel_Session.pdf.

[30] In 2001, the FCC signaled its intent to migrate to a much broader implementation of Bill and Keep; however, this regulatory policy change has been stalled for years. See FCC, *In the Matter of developing a Unified Intercarrier Compensation Regime*, CC Docket 01-92, released April 27, 2001.

[31] The French ARCEP was obliged to end Bill and Keep arrangements because the European regulatory framework for electronic communications implemented in 2003 effectively prohibited operators from charging a different termination fee for mobile-to-mobile calls than for fixed-to-mobile calls. The mobile-to-mobile Bill and Keep arrangements had caused some minor anomalies, notably including relatively high use of so-called "SIM boxes" (a technological means of converting fixed-to-mobile calls into mobile-to-mobile), but were generally felt to have worked well.

[32] FCC, *Annual Report and Analysis of Competitive Market Conditions With Respect to Commercial Mobile Services, 11th Report (11th CMRS Competition Report*), September 2006, Table 12, based on *Interactive Global Wireless Matrix 4Q05*, Merrill Lynch, Telecom Services Research.

[33] See Laffont, Rey and Tirole (1998a) and (1998b); Armstrong (1998); Laffont and Tirole (2001), all op. cit. See also Cave et. al. (2004); de Bijl et. al. (2004); and Haucap and Dewenter (2004).

[34] See FCC OSP Working Paper 33: Patrick DeGraba, "Bill and Keep at the Central Office As the Efficient Interconnection Regime", and Working Paper 34: Jay M. Atkinson, Christopher C. Barnekov, "A Competitively Neutral Approach to Network Interconnection", both December 2000, both available at http://www.fcc.gov/osp/workingp.html; Stephen C. Littlechild, "Mobile Termination Charges: Calling Party Pays vs Receiving Party Pays", forthcoming, available at http://www.econ.cam.ac.uk/dae/repec/cam/pdf/cwpe0426.pdf; Robert W. Crandall and J. Gregory Sidak,

"Should Regulators Set Rates to Terminate Calls on Mobile Networks?", *Yale Journal on Regulation*, 2004; and Marcus (2004), op. cit.

[35] Laffont and Tirole, *Competition in Telecommunications* (2001), page 186. The italics are theirs. See also Haucap and Dewenter (2005).

[36] There are, of course, numerous exceptions and caveats to this statement. See chapter 5 of Laffont and Tirole (2001).

[37] See Martin Cave, Olivier Bomsel, Gilles Le Blanc, and Karl-Heinz Neumann, *How mobile termination charges shape the dynamics of the telecom sector*, July 9, 2003; Paul W.J. de Bijl, Gert Brunekreeft, Eric E.C. van Damme, Pierre Larouche, Natalya Shelkoplyas, Valter Sorana, *Interconnected networks*, December 2004; Littlechild (2006); and Marcus (2004).

[38] As of October 2005. European Commission, *11th Implementation Report* (December 2005). See also Marcus (2004).

[39] ITU, "Report of the meeting of Working Party 2/3 (Geneva, 19-27 June 2006)", COM3–R8–E, September 2006, page 12, paragraph 6.14.

[40] Laffont and Tirole (2001), page 190.

[41] Milgrom et. al. suggest that this is the economically predicted result for Internet backbones. See Paul Milgrom, Bridger Mitchell and Padmanabhan Srinagesh, "Competitive Effects of Internet Peering Policies", in The Internet Upheaval, Ingo Vogelsang and Benjamin Compaine (eds), Cambridge: MIT Press (2000): 175-195. At: http://www.stanford.edu/~milgrom/publishedarticles/TPRC%201999.internet%20peering.pdf.

[42] Laffont and Tirole, *Competition in Telecommunications* (2001).

[43] To understand the motivation for this, see Laffont and Tirole (2001) pages 201-202.

[44] An operator might choose to ignore a termination fee that constitutes only a small fraction of the total cost of the call. Termination fees set in the absence of regulation, however, are generally too high to ignore – they often represent the preponderance of the total cost of the call.

[45] Federal Communications Commission (FCC) Office of Strategic Planning and Policy Analysis (OSP) Working Paper 33: Patrick DeGraba, "Bill and Keep at the Central Office As the Efficient Interconnection Regime", December 2000, at 95, available at http://www.fcc.gov/osp/workingp.html.

[46] FCC, *Annual Report and Analysis of Competitive Market Conditions With Respect to Commercial Mobile Services, 10th Report (11th CMRS Competition Report*), September 2006, Table 12, based on *Interactive Global Wireless Matrix 4Q05*, Merrill Lynch, Telecom Services Research.

[47] As a consumer originates more calls, eventually he or she exceeds the number of minutes in the bucket, incurs exceedingly high charges, and is effectively forced to upgrade.

[48] Private communication, Indian TRAI.

[49] In analyzing European experience, Cave et. al. find that only a small portion of the subsidy is returned to the consumer.

[50] This section presents the traditional view. Some recent studies have challenged this view, including Haucap and Dewenter (2006) and Littlechild (2006).

[51] See, for example, Cave et. al.; Littlechild; Crandall and Sidak.

[52] European Commission, *11th Implementation Report*, page 43.

[53] Eurobarometer, *E-Communications Household Survey*, July 2006 (reflecting December 2005 – January 2006 survey data).

[54] FCC, *Annual Report and Analysis of Competitive Market Conditions With Respect to Commercial Mobile Services, 10th Report (11th CMRS Competition Report*), September 2006, paragraph 5.

[55] Whether the U.S. will achieve European levels of subscriptions per inhabitant is in fact doubtful; however, the U.S. is quite likely to achieve European levels in terms of the more meaningful measure of the fraction of households that have access to at least one mobile phone. As previously noted, Europeans are probably much more likely than Americans to have multiple mobile subscriptions at once.

[56] Private communication, Indian TRAI.

[57] See Olivier Bomsel, Martin Cave, Gilles Le Blanc and Karl-Heinz Neumann, How mobile termination charges shape the dynamics of the telecom sector, 9 July 2003, section 6.4,available at: http://www.med.govt.nz/upload/39184/06-appendix.pdf. The impact is difficult to analyze because many incumbents operate simultaneously in both the fixed and the mobile markets.

[58] Consider, for example, a country like Hungary. Mobile penetration is about 90%, and growing; fixed penetration is about 35%, and declining.

[59] Report of the NRIC V Interoperability Focus Group, "Service Provider Interconnection for Internet Protocol Best Effort Service", page 7, available at http://www.nric.org/fg/fg4/ISP_Interconnection.doc.

[60] An Autonomous System, as defined in the IETF's RFC 1930, is "… a connected group of one or more IP prefixes run by one or more network operators which has a SINGLE and CLEARLY DEFINED routing policy." A globally unique AS number must be assigned to every AS. These numbers are currently assigned from a 16 bit field, and thus constitute number from 1 to 65,535.

[61] Large organizations with more than one upstream ISP also require an ASN.

[62] A list of assigned ASNs appears at http://www.iana.org/assignments/as-numbers.

[63] Paul Milgrom, Bridger Mitchell and Padmanabhan Srinagesh, "Competitive Effects of Internet Peering Policies", in *The Internet Upheaval*, Ingo Vogelsang and Benjamin Compaine (eds), Cambridge: MIT Press (2000): 175-195. At: http://www.stanford.edu/~milgrom/publishedarticles/TPRC%201999.internet%20peering.pdf.

[64] A very innovative paper by Prof. Lixin Gao of the University of Amherst confirms this structure. See Gao, Lixin Gao, "On inferring autonomous system relationships in the Internet," in *Proc. IEEE Global Internet Symposium*, November 2000.The Internet is probably more richly interconnected today than was the case in 2000, but there is no reason to believe that these basic aspects have changed very much.

[65] See M. Katz and C. Shapiro (1985), "Network externalities, competition, and compatibility", *American Economic Review* 75, 424-440.; and J. Farrell and G. Saloner (1985), "Standardization, compatibility and innovation", *RAND Journal of Economics* 16, 70-83..

[66] Jacques Cremer, Patrick Rey, and Jean Tirole, "Connectivity in the Commercial Internet", May 1999.

[67] Paul Milgrom, Bridger Mitchell and Padmanabhan Srinagesh, "Competitive Effects of Internet Peering Policies", in The Internet Upheaval, Ingo Vogelsang and Benjamin Compaine (eds), Cambridge: MIT Press (2000): 175-195. At: http://www.stanford.edu/~milgrom/publishedarticles/TPRC%201999.internet%20peering.pdf.

[68] The definitive works on intercarrier compensation in the world of the PSTN are generally considered to be Armstrong, M. "Network Interconnection in Telecommunications." *Economic Journal*, Vol. 108 (1998), pp. 545–564; and Laffont, J.-J., Rey, P., And Tirole, J. "Network Competition: I. Overview and Nondiscriminatory Pricing." *RAND Journal of Economics*, Vol. 29 (1998a), pp. 1–37.

[69] Laffont, J.-J., Marcus, J.S., Rey, P., And Tirole, J., "Internet interconnection and the off-net-cost pricing principle", *RAND Journal of Economics*, Vol. 34, No. 2, Summer 2003, available at http://www.rje.org/abstracts/abstracts/2003/rje.sum03.Laffont.pdf. A shorter version of the paper appeared as "Internet Peering", *American Economics Review*, Volume 91, Number 2, May 2001.

[70] The absence of a significant transit relationship has in some contexts been used as a definition of a *backbone* ISP.

[71] To the extent that the different interconnections have different bandwidth and delay characteristics, this could have some impact on the total volume of data transferred. A user might not make a second request to a web site, for example, until the first request is complete.

[72] See "A Brief History: The Bell System", at http://www.corp.att.com/history/history3.html. See also Wikipedia contributors, "Kingsbury Commitment," *Wikipedia, The Free Encyclopedia*, http://en.wikipedia.org/w/index.php?title=Kingsbury_Commitment&oldid=60945357 (accessed December 17, 2006).

[73] See Justus Haucap and J. Scott Marcus, "Why Regulate? Lessons from New Zealand", *IEEE Communications Magazine*, November 2005, available at: http://www.comsoc.org/ci1/Public/2005/nov/ (click on "Regulatory and Policy").

[74] Ofcom has noted this problem in their many public consultations on NGN. Consider, for instance: "The core problem is in the fixed line market. 20 years of pro-competition regulation has led to some improvements for consumers. But years of intrusive regulation have not created the conditions for the sustainable competition necessary for long-term consumer benefit and which, in other countries, has spurred investment in next generation core and access networks.

Ofcom's overall approach, therefore, … has been to create a regulatory framework which seeks to encourage and incentivise sustainable, scale, infrastructure competition at the deepest extent possible. However, some assets in the network are either economically impossible or highly economically inefficient to try to replicate: the so-called enduring bottlenecks- mainly, though not exclusively, in the access part of the network. Without open and truly equivalent access to such assets, sustainable infrastructure based competition would be too risky and too easily frustrated." Available at: http://www.ofcom.org.uk/consult/condocs/telecoms_p2/statement/.

[75] European Commission, *11th Implementation Report*, COM(2006)68, 20 February 2006, Volume II, Annex 2, pages 30-36. Mobile termination fees for all operators have fallen from 0.2054 EUR per minute in July 2001 to 0.1279 EUR per minute in October 2005. Fixed interconnection fees have also fallen under pressure from regulators.

[76] This is not to suggest that all parties have been satisfied with the results. An ongoing dispute over International Charging Arrangements for Internet Service (ICAIS) has been simmering for some years now.

[77] See Marcus, "Call Termination Fees: The U.S. in global perspective", presented at the 4th ZEW Conference on the Economics of Information and Communication Technologies, Mannheim, Germany, July 2004. Available at: ftp://ftp.zew.de/pub/zew-docs/div/IKT04/Paper_Marcus_Parallel_Session.pdf. See also Patrick DeGraba, "Bill and Keep at the Central Office As the Efficient Interconnection Regime", op. cit.

[78] Coase, Ronald H., "The Federal Communications Commission", *Journal of Law and Economics*, Vol. 2, pages 1-40, (1959).

[79] Marcus, "Call Termination Fees: The U.S. in global perspective", op. cit.

[80] Retail pricing arrangements for mobile operators are completely unregulated, but operators and consumers have increasingly chosen flat rate (buckets of minutes) plans.

[81] Strictly speaking, this is true for *reciprocal compensation*, but not for *access charges*. The distinction will not be of interest to most readers. See Marcus (2004), op. cit.

[82] Marcus (2004), op. cit.

[83] Industry consolidation is another noteworthy contributory factor.

[84] Cullen and Devoteam, *Regulatory implications of the introduction of next generation networks and other new developments in electronic communications*, 16 May 2003.

[85] Verbal remarks of Thilo Salmon of SIPgate, at the WIK/BNetzA workshop on NGN and Emerging Markets, 5 December 2005, Koenigswinter, Germany.

[86] Their costs are not zero, however. They typically need a traditional switch, or a media gateway, to terminate calls placed to their subscribers. Alternatively, they may pay a traditional operator for providing this service. It is a cost in either case, but it is a small cost in comparison with that of traditional telephony network.

[87] It does not totally eliminate administrative expense, of course. Operators would typically continue to *monitor* traffic exchange, even if they do not explicitly *charge* for it. Having been in both positions, I would say that charging represents a vastly greater level of administrative complexity and of overhead.

[88] J. Scott Marcus, "Interconnection in an NGN Environment", a background paper commissioned for the ITU New Initiatives Programme workshop on "What rules for IP-enabled Next Generation Networks?" held on 23-24 March 2006 at ITU Headquarters, Geneva. Available at: http://www.itu.int/osg/spu/ngn/documents/Papers/Marcus-060323-Fin-v2.1.pdf . Also available as WIK Discussion Paper 274 (see http://www.wik.org/content_e/diskus/274.htm).

[89] Notably Worldcom/MCI and Worldcom/Sprint.

[90] See OECD, Patrick Swinburne, "Rethinking Universal Service for a Next Generation Network Environment", DSTI/ICCP/TISP(2005)5/FINAL, 18 April 2006.

[91] See Rohlfs, op. cit.

[92] Referred to in this context as *international settlement rates*.

[93] The author is not a neutral party in the matter. The author has an ongoing relationship with the Jamaican regulatory authority.

[94] FCC, *Modifying the Commission's Process to Avert Harm to U.S. Competition and U.S. Customers Caused by Anticompetitive Conduct*, IB Docket No. 05-254, Released: August 15, 2005.

[95] Andrew Odlyzko has written a number of insightful papers exploring the historical roots of price discrimination, and the relevance to the Internet. See Andrew Odlyzko, "The evolution of price discrimination in transportation and its implications for the Internet", Review of Network Economics, vol. 3, no. 3, September 2004, pp. 323-346, available at http://www.rnejournal.com/articles/odlyzko_RNE_sept_2004.pdf.

[96] See the classic paper by the Stanford University mathematician Harold Hotelling, "Stability in Competition", *The Economic Journal*, March 1929, pages 41-57. The Hotelling paper argues, in fact, the providers will tend to prefer to provide products very much like those of their competitors, even at the cost of leaving some demand only imperfectly satisfied.

[97] The Hotelling paper argues, in fact, the providers will tend to prefer to provide products very much like those of their competitors, even at the cost of leaving some demand only imperfectly satisfied.

[98] See, for example, Joskow, P., "Regulation and Deregulation after 25 Years: Lessons Learned for Research in Industrial Organization", 2004, pages 26-27, available at: http://econ-www.mit.edu/faculty/download_pdf.php?id=1005.

[99] Alfred E. Kahn, "Whom the Gods would Destroy, or How not to Deregulate", available at http://www.aei.brookings.edu/admin/authorpdfs/page.php?id=112.

[100] Andrew Odlyzko, "The evolution of price discrimination in transportation and its implications for the Internet", *Review of Network Economics*, vol. 3, no. 3, September 2004, pp. 323-346, available at http://www.rnejournal.com/articles/odlyzko_RNE_sept_2004.pdf, page 340.

[101] J. Scott Marcus, *Designing Wide Area Networks and Internetworks: A Practical Guide*, Addison Wesley, 1999.

[102] There has been a long and tiresome debate in the literature about the degree to which Internet traffic is *self-similar*. Suffice it to say that traffic patterns are not perfectly random, and that in consequence the risk of an occasionally saturated link is a bit higher than the standard equations would lead one to expect. The network design consequently needs to leave slightly more "headroom" than the basic mathematics would otherwise imply.

[103] Rohlfs notes that many new high technology services encounter difficulty in achieving sufficient penetration to get past an initial adoption hump. A certain number of end-users might take up a product or service based solely on its intrinsic value, but that number is likely to be far less than the number of end-users who would take up the service if everybody else did. The market can easily settle into equilibrium at a number of end-users that is far less than the level that would be societally optimal.

[104] Jeffrey H. Rohlfs, *Bandwagon Effects In High-Technology Industries* 3 (2001). Much of the discussion in this sub-section derives from Rohlfs's excellent book.

[105] See Marcus, "Evolving Core Capabilities of the Internet", *Journal on Telecommunications and High Technology Law*, 2004, available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=921903.

[106] Laffont, J.-J., Marcus, J.S., Rey, P., And Tirole, J., "Internet interconnection and the off-net-cost pricing principle", *RAND Journal of Economics*, Vol. 34, No. 2, Summer 2003, available at http://www.rje.org/abstracts/abstracts/2003/rje.sum03.Laffont.pdf. A shorter version of the paper appeared as "Internet Peering", *American Economics Review*, Volume 91, Number 2, May 2001, page 371.

[107] Ibid., page 374-376.

[108] This is, in a formal sense, a form of market power, but it is not a manifestation of the kind of market dominance that regulators generally seek to control, and it does not necessarily imply a loss of consumer welfare.

[109] Ibid., page 380-381.

[110] "Is the U.S. Dancing to a Different Drummer?" *Communications & Strategies*, no. 60, 4th quarter 2005. Available at: http://www.idate.fr/fic/revue_telech/132/CS60%20MARCUS.pdf. Also available in *intermedia* (the journal of the International Institute of Communications), vol. 34, no.3, July/August 2006.

[111] In the Madison River proceeding, the FCC levied a fine for conduct that arguably might have been objectionable, but without identifying any rule that was violated or any way in which Madison River could reasonably have known that they were in violation. In the "Broadband Policy Statement", they established lofty but ill-defined goals without clarifying their meaning or establishing an enforcement mechanism. Collectively, the rulings leave an ambiguous legacy.

[112] Laffont, J.-J., Marcus, J.S., Rey, P., And Tirole, J., "Internet interconnection and the off-net-cost pricing principle", *RAND Journal of Economics*, Vol. 34, No. 2, Summer 2003, op. cit., especially the discussion in section 6, "Micropayments and neutrality".

[113] Ibid.

[114] It must, however, be noted that a framework of this type requires some economic sophistication. Moreover, the effectiveness of implementation depends on institutional arrangements that enable economic tests to be applied impartially and transparently.

[115] The discussion of Ofcom's proceedings draws heavily on an earlier paper, "Framework for Interconnection of IP-Based Networks – Accounting Systems and Interconnection Regimes in the USA and the UK", a background paper prepared for the German Federal Network Agency's study group on a Framework for Interconnection of IP-Based Networks, 27 March 2006, available at: http://www.bundesnetzagentur.de/media/archive/6201.pdf.

[116] See also the final report of the German BNetzA's project group: *Rahmenbedingungen der Zusammenschaltung IP-basierter Netze*, 15 December 2006, available at http://www.bundesnetzagentur.de/media/archive/8370.pdf. For a developing country perspective on these interconnection issues,

[117] *Further Consultation*, section 1.11.

[118] *First consultation*, Figure 1.

[119] Ibid., section 2.9. Figure 1 of the *First Consultation* shows 120 sites; however, at the December 5, 2005 "NGN and Emerging Markets" workshop, hosted by WIK on behalf of BNetzA, BT CTO Matt Bross referred to 100 metro sites.

[120] *First Consultation*, section 1.13.

[121] *Further consultation*, section 3.10.

[122] It is generally recognized that regulators should refrain from frequent or arbitrary reductions in regulated rates, due to the risk of reducing the incentive for operators to invest in efficiency improvements . Cf. Laffont and Tirole, *Competition in Telecommunications*, 2001.

[123] *Ofcom's approach to risk in the assessment of the cost of capital: Final statement*, August 18, 2005.

[124] Ofcom defines a real option as "… the term given to a possibility to modify a project at a future point." It relates to "… the option for a firm that faces significant demand uncertainty to 'wait and see' how the demand or technology for a new product will evolve before making an investment."

[125] See http://www.ofcom.org.uk/media/news/2005/06/nr_20050623 and http://www.ofcom.org.uk/consult/condocs/telecoms_p2/statement/main.pdf. See also Ofcom's *Final statements on the Strategic Review of Telecommunications, and undertakings in lieu of a reference under the Enterprise Act 2002* (Strategic Review), 22 September 2005.

[126] BT offered undertakings in response to an implied threat by Ofcom to refer them to UK competition authorities. The undertakings are thus pursuant to competition law, and operate in a parallel and complementary fashion to Ofcom's *ex ante* sector-specific regulation. See http://www.ofcom.org.uk/consult/condocs/sec155/sec155.pdf. BT's commitments appear as Annex A to Ofcom's *Strategic Review*.

[127] An "SMP product or service" is a product or service that BT is obliged to provide as a regulatory remedy because Ofcom has found BT to have Significant Market Power, or SMP.

[128] *Further Consultation*, op. cit., section 1.21.

[129] In an element-based charging (EBC) charging system, termination fees reflect the long range incremental costs of the underlying network elements used in service provision, plus a surcharge that provides a reasonable return on the capital invested.

[130] See section 3.7 of the Indian TRAI's Consultation Paper No: 2/2006, *Consultation Paper on Issues Pertaining to Next Generation Networks (NGN)*, 12 January 2006.

[131] Saudi CITC, *Report on CITC's Review and Analysis of Saudi Telecommunications Company's Revised Reference Interconnection Offer Filed on 21/1/1427h*.

[132] Mobile termination rates are indeed higher. In Europe, the average (peak rate) mobile termination rate for all operators in October 2005 was 0.1296 EUR per minute, while the fixed termination rates for local level, single transit

and double transit were 0.0060 EUR, 0.0094 EUR, and 0.0139 EUR, respectively. Mobile termination rates are thus ten to twenty times higher.

[133] The French experienced considerable take-up of so-called "SIM boxes" that effectively converted calls that would otherwise have been fixed-to-mobile into mobile-to-mobile calls. In doing so, they bypassed CPNP wholesale charges and capitalized on cheaper mobile-to-mobile retail prices.

[134] See Matt Richtel, "The Air is Free, and So Are the Phone Calls That Borrow It", New York Times, 27 November 2006; and Glenn Fishman, "Marrying the Cellphone to Cheap Internet Calling",*New York Times*,14 December 2006.

[135] European Commission, *Proposal for a Regulation of the European Parliament and of the Council on roaming on public mobile networks within the Community and amending Directive 2002/21/EC on a common regulatory framework for electronic communications networks and services*, {SEC(2006) 925} and {SEC(2006) 926}, COM(2006) 382 final, 2006/0133 (COD), 12 July 2006; and *Commission Staff Working Paper: Impact Assessment of Policy Options in Relation to a Commission Proposal for a Regulation of the European Parliament and of the Council on Roaming on Public Mobile Networks within the Community*, {COM(2006) 382 final} {SEC(2006) 926}, SEC(2006) 925, 12 July 2006.

[136] See Ulrich Stumpf, "International Roaming: A Way Forward", presented at IBC's 9th Annual Conference "Communications and EC Competition Law", Brussels, 14-15 October 2004; and Ulrich Stumpf, "Prospects for improving competition in mobile roaming", presented at TPRC, Alexandria, VA, USA, 27-29 October 2001.

[137] European Commission, *11th Implementation Report* (December 2005). See also Marcus (2004).

[138] Data source: Cellular Telecommunications and Internet Association, *Semi-Annual Wireless Industry Survey* (see http://www.wow-com.com/industry/stats/surveys/).

[139] Including slow rolling, cost-price squeezes, and strategic litigation.

[140] In the absence of regulation, these behaviors can arise quickly and spontaneously. In the United States in the early 1900's, it was a refusal of AT&T to interconnect with competitors that led to the Kingbury Commitment of 1912, and ultimately to the regulation of telecommunications.

[141] Justus Haucap and J. Scott Marcus, "Why Regulate? Lessons from New Zealand", *IEEE Communications Magazine*, November 2005, available at: http://www.comsoc.org/ci1/Public/2005/nov/ (click on "Regulatory and Policy").

[142] The same claim cannot be made for *access*, as distinct from *interconnection*.

International Telecommunication Union

GSR 2007

DISCUSSION PAPER

NGN Enabling Environment

Comments are welcome and should be sent by 1 March 2007 to GSR07@itu.int

International Telecommunication Union

GLOBAL SYMPOSIUM FOR REGULATORS

Dubai World Trade Center
Dubai, United Arab Emirates

5-7 February 2007

Work in progress, for discussion purposes

ENABLING ENVIRONMENT

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ENABLING ENVIRONMENT

This paper has been prepared by Janet Hernandez, Telecommunication Management Group (TMG), as an input document for the 2007 Global Symposium for Regulators (GSR), organized by the Telecommunication Development Bureau (BDT). The views expressed in this paper are those of the author and do not necessarily reflect the opinions of the ITU or its membership. Comments are welcome and should be sent to gsr07@itu.int by 1 March 2007.

1 Introduction

Today, the lines between traditional telecommunications services are blurred due to convergence in the ICT sector. The move to NGN constitutes the latest step in the road to convergence of the ICT sector, as it will essentially enable consumers to receive a wide range of services, including upgraded versions of existing services (*e.g.*, faster broadband services), as well as new services, all over a single, all IP-based network.

NGNs are defined by the ITU-T as packet-based networks able to provide services including telecommunication services and able to make use of multiple broadband, QoS-enabled transport technologies and in which service-related functions are independent from underlying transport-related technologies. It offers unrestricted access by users to different service providers. It supports generalized mobility which will allow consistent and ubiquitous provision of services to users.[2]

For wireline providers, the transition to NGN, both at the access and core level,[3] is being driven by various factors.

- Competitive pressure from traditional cable television providers offering "triple play" (i.e., voice, video, and data services) – as well as pressure from other new market players such as alternative providers, local governments and power companies – and by their ability to offer television over Internet Protocol (IPTV) is pushing wireline providers towards NGN.
- Expected cost savings associated with the economies of scope deriving from the integration of existing networks is a key driver for core NGN migration.
- From the access network perspective, investing in NGNs is expected to reduce the on-going operational cost of the copper local access networks since they allow for eliminating local exchanges, and thereby directly linking customer premises with the data switching capabilities higher up in the network architecture.
- The consumers demand for an ever increasing "need for speed", particularly in developed markets, has been a main driver for operators to upgrade existing networks and, particularly for the deployment of FTTx access infrastructures. In Japan, for example, operators are providing commercial offering of 100 Mbps in response to consumer demand for higher speeds.

Thus far, the debate regarding the appropriate regulatory framework for the NGN environment focused to a large extent in developed economies, such as Australia, Japan, Singapore, the United States, and some EU Member states, notably the United Kingdom, Germany, and the Netherlands. In these countries, issues such as extending existing *ex ante* access obligations to NGNs, IP-interconnection, and the universal services implications of IP-based services, particularly voice, have been at the center of the regulator's agendas on NGNs. Some developing economies, such as India, have also initiated consultations and are promoting public awareness of NGNs through various regulatory processes and initiatives.

For regulators, migration to the NGN world can be characterized by the following elements:

- Traditional market boundaries have become increasingly blurred in the presence of IP-enabled services and fixed-mobile convergence.
- Regulatory frameworks which generally were designed for a traditional circuit switched environment may not be equipped to address an IP-based environment where multiple services can be offered over a single platform.
- Access providers and network operators must make intensive investments in upgrading and building new infrastructures and are looking for regulatory certainty.
- New potentials for bottleneck structures and market dominance in the telecommunications industry can emerge.[4]

1.1 Bridging the digital divide

The creation of enabling environments for NGN deployment will be closely linked with addressing and bridging the digital divide. Despite dramatic increases in penetration in many developing countries, particularly via mobile network deployment, major disparities still remain in the areas of Internet, broadband, and 3G mobile penetration.[5] Indeed, globally, Asia, Europe and the Americas represent no less than 99 per cent of all broadband subscribers, the majority of which are in the wealthier countries of North America, Western Europe and Asia. According to the 2006 Millennium Goals Report, in 2004, by the end of 2004 there was a large digital divide separating developed and developing regions regarding Internet use, as over half the population in developed regions had access to the Internet, compared to 7 per cent in developing regions and less than 1 per cent in the 50 least developed countries.[6]

As pointed out by the Romanian regulator in the Consultation to the 2007 Global Symposium of Regulators, the shift towards NGNs will not happen overnight and will be dependent on country-specific conditions.[7] Nevertheless, NGN is increasingly becoming an important issue for both developed and developing countries.[8] Migration towards all IP-based environments, the deployment of the necessary access infrastructure, and the ability to offer consumers higher speeds and newer applications is expected to become, as mobile telephony currently is, a major driver in bridging the digital divide between the information rich and information poor countries. However, the shift towards an NGN world also creates concern for regulators regarding the digital divide within their own jurisdictions as a consequence of the economics of NGN deployment, particularly access networks, which initially will cover only densely populated areas.

1.2 NGN deployment in developing countries

Service providers in developing countries are aware of cost-saving efficiencies associated with NGNs, and in countries such as Brazil, India, the United Arab Emirates, and Vietnam, they have already announced plans to migrate to core NGNs. Similarly, in countries such as Argentina, Bangladesh, Bulgaria, Brazil, the Cayman Islands, Pakistan, Vietnam and Venezuela providers have also engaged in FTTx projects. At this stage, however, such projects are mostly concentrated in highly populated, high income areas.

Developing countries have certain advantages in the migration process towards NGN, and should leverage these advantages to create proper enabling environments for this transition.

- Compared to more developed telecommunication markets, service providers in developing countries generally have less baggage of legacy products in their core networks (*e.g.*, ISDN, IP, ATM, FR, and SHDS). This makes it easier for them to migrate to all IP-based systems, thus leapfrogging technologies and going to core NGNs straightaway.
- In the case of access networks, limited deployment and penetration of copper networks in particular, and the reduction of the costs of fibre, can also facilitate "greenfield" deployment of FTTx projects. Thus, they also will be able to leapfrog access technologies, where economically viable, and go directly to NGN access infrastructure. Similarly, in certain countries the lack of adoption or implementation of complex access-based *ex ante* regulations can be viewed as an advantage as they are confronted with fewer regulatory burdens and commitments to consider and/or maintain.

1.3 Way Forward

Regulators must see NGN deployment in its proper dimensions -- as a continuation of their broadband and convergence policies. Robust policies that promote both of these crucial objectives is a prerequisite, and in many cases mixes with, creating an enabling environment that will open the way for the migration to the new NGN world.

As noted in the World Summit on the Information Society (WSIS) Action Plan, "(g)overnments should foster a supportive, transparent, pro-competitive and predictable policy, legal and regulatory framework, which provides the appropriate incentives to investment and community development in the Information Society." This is of paramount importance for facilitating NGN deployment.[9] Regulators must provide operators with regulatory certainty that will permit them to incur the risks associated with NGN deployment, particularly the high upfront investments required. However, regulators should keep in mind that their role is not to provide incentives to make particular investments, but to ensure that incentives for efficient investment are not distorted, particularly as a result of disproportionate regulation.[10] Thus, regulators must strive to strike the appropriate balance between these objectives as they advance to the new world of NGNs.

2 Role of the Regulator in Transitioning to and Facilitating an NGN Environment

With the emergence of NGNs, regulators are faced with the issue of deciding whether to implement an *ex post* regulatory model, or maintain *ex ante* regulation. *Ex ante* regulation refers to the process of establishing specific rules and requirements to prevent anti-competitive or otherwise undesirable market activity by operators before it occurs. *Ex post* regulation, which relies primarily on competition law, by contrast calls for establishing few or no specific rules in advance, but applying regulatory measures to remedy a market failure or anti-competitive situation.

In certain countries, regulators have required incumbent operators to provide their competitors with mandatory access (i.e., local loop unbundling, bitstream or wholesale access and/or resale) to their networks (see Box 1). Now with the transition to NGN, the new question is whether these new IP-based networks, which will require significant investments by the incumbent operators, should be subject to the same access obligations currently being imposed. In considering this issue, regulators are assessing the level of competition in their markets to determine if a shift towards an *ex post* model could sustain existing levels of competition and enhance consumer welfare. On the other hand, regulators also are faced with determining if investment in NGNs leads to the emergence of new services and markets that should be free from existing *ex ante* regulation.

Box 1: Mechanisms to Promote Access-Based Competition

1) **Unbundling of the local loop**: This mechanism has two modalities: full unbundling or shared access. **Full unbundling** allows the services-based operator seeking access from the facilities-based operator to have management control over the copper pairs connecting a subscriber to the facilities-based operator's main distribution frame (MDF). The services-based operator seeking access can provide both voice and data services on the facilities-based operator's network. **Shared access** refers to an arrangement where the services-based operator has access to either voice or data transmission over the facilities-based operator's network. The services-based operator leases part of the copper pair spectrum while the facilities-based operator maintains control of the copper pair.

2) **Bit stream (or wholesale) access**: This involves the facilities-based operator installing high-speed access links to its customers and opening these links to its competitors (i.e., services-based operators). In this case, the services-based operator seeking access has no management control over the physical line and is not permitted to add any equipment to the network.

3) **Total Service Resale**: This allows a services-based provider to purchase the facilities-based operator's service at a wholesale discount, rebrand the service, and resell it to the consumer, allowing the services-based provider to build a customer base and obtain a retail sales margin over the wholesale rate.

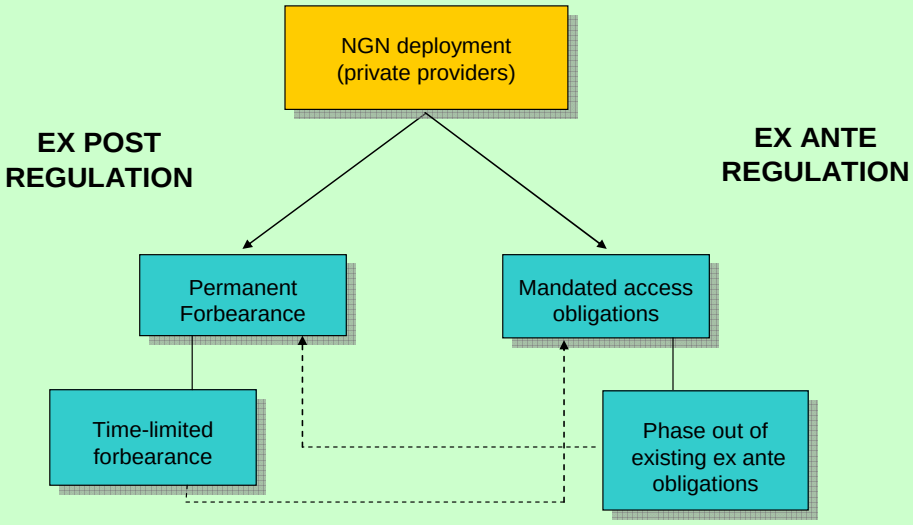
For example, in the EU, this debate has been particularly heated lately, where competition in retail electronic communications markets, specifically the broadband market, currently relies on mandatory wholesale access to carriers found to have significant market power (SMP). Under the EU regulatory framework, *ex ante* regulations that impose mandatory access to existing networks, however, must serve as an interim measure to ensure competition between services and options for the consumer until adequate infrastructure competition exists.[11] *Ex ante* regulation usually is imposed only after conducting a thorough market review under the EU Framework Directive. The process for market review is to define the relevant economic market(s), to assess competition in each market(s), in particular to assess whether any firms in that market have SMP, and to apply appropriate *ex ante* regulatory obligations for any firms found to have SMP. In addition, *ex ante* access and price regulation must be set up in such a way that it does not negatively influence investment incentives for market players and, if possible, promote companies to "ascend the investment ladder".[12]

Although in developing countries the regulatory issues related to migration to NGN may be at an earlier stage, regulators are also keenly aware of the relevance and regulatory concerns associated with the migration towards NGNs. We have seen much discussion and input related to NGN from contributions submitted by developing countries to the 2006 World Telecommunication Development Conference and the Telecommunications Forum at 2006 ITU Telecom World. Regulators such as TRAI of India, for example, have focused their effort on raising awareness of the benefits of NGNs for the market and consumers, as well as creating the necessary enabling environment for their deployment (*e.g.*, addressing issues such as licensing reform, and creating level playing field for competition). Most recently, numerous regulators have expressed their views and activities related to NGN in the Consultation to the Global Symposium for Regulators. For example, regulators in Costa Rica, Morocco, and Poland have indicated that they consider imposing access obligations to be a favorable mechanism to increase broadband penetration and future NGN take-up.[13]

2.1 Regulator's decision tree

With the transition to NGNs, regulators generally are faced with two primary options: extending current access obligations to the NGN world or permanently forbearing from doing so. However, some regulators have also opted to pursue transitional options towards either *ex ante* or *ex post* regulation by imposing forbearance in a time-limited manner or eliminating regulatory obligations in a phased-out fashion (Figure 1). These are extremely complex decisions, and there are advantages and disadvantages to each approach (Box 2).

Figure 1: Regulator's decision tree



In mature, access-intensive markets, where the regulatory environment has encouraged alternative/competitive providers over the past years to deploy their infrastructure to as many interconnection points as possible and allowed them to use incumbent's non-replicable assets from there to reach the end user, regulatory clarity is seen as vital. Without it, some argue that current and future investment as well as competition by alternative/competitive providers may be disrupted, as their investment decisions (e.g., on DSLAMs in an unbundled local loop (ULL) scenario) are highly dependent of the underlying dominant network provider's future plans. In the Netherlands, for example, OPTA has identified the lack of clarity and certainty regarding access alternatives in the wake of incumbent KPN's NGN migration as a factor for the lack of investment in DSL networks by alternative providers during the first semester of 2006.[14]

Because of this, rather than wait for regulatory intervention that may not suit their business interests, certain incumbent operators have taken a more pro-active stance and voluntarily agreed to certain measures regarding access to their proposed NGNs. For example, BT in the United Kingdom voluntarily agreed to allow third parties to access its NGN core network. Similarly, France Telecom,

has announced plans to allow rival operators to access its new FTTH systems to prevent regulatory intervention.

The appropriate course to pursue is dependent on country-specific conditions and the state of development of internal markets. However, regardless of what course a regulator pursues, it should keep in mind the need to create regulatory certainty for both incumbent and competing/alternative providers. Regulators must be mindful of the risks associated with NGN deployment so as not to stifle innovation. They must balance this goal with that of fostering robust, competitive markets. Although it is not necessarily the role of the regulator to protect investments made by competitive/alternative providers against market risks, in regulating NGNs it is important to consider the interests of existing competitive operators in ensuring the continued availability of and terms for current wholesale inputs to their products, during the lifetime of the assets in which they have invested. Similarly, suitable migration paths for existing infrastructure investments following the deployment of new technologies must be ensured.[15]

Box 2: Pros and cons of *Ex Post* and *Ex Ante* Regulatory Options

	Pros	Cons
Permanent forbearance	Avoids distorting investment incentives by eliminating price regulation as such regulation has the effect of capping positive returns of the NGN operator's investment, while leaving investors fully exposed should the investment be unsuccessful.	With the elimination of mandating an incumbent operator to offer competitors wholesale products, such products may not be available for competitors to purchase them. Thus, permanent forbearance may lead to markets where the only competition in future NGN services is between operators that own their own infrastructure to the end user's premises.
Time-limited forbearance or regulatory holiday	Delivers incentives to NGN operators of the future bottlenecks by offering them monopoly rents for a period of time, after which regulation would apply or be enforced to protect competition.	Creates uncertainty as the payback periods for NGN investments are long and time-limited forbearance (3 to 5 years) generally would not suffice to recoup them. In countries where access-based competition does exist, impact would likely exceed the forbearance period if NGN service competes with current services as current competitors would be severely affected in their ability to compete and it could take them many years to attain their current market standing.
Mandated access	Ensures continued progression of access-based competition models, allowing current competitors to use new NGN bottleneck facilities.	Incentives for efficient investment in NGN deployment may be distorted, and incumbent operators may abstain from committing to such deployment. Depending on the level of mandated network access, it may dampen competitors' incentives to invest in their own infrastructure.
Phase out of	As in the case of forbearance, it	Eliminating the requirement that

existing ex ante obligations	avoids distorting investment incentives; however, it allows the regulator more control over the process, as it is directed only at specific segments where inter-modal competition exists. If accompanied by the threat of reinstating *ex ante* regulation, it allows regulators to intervene where market forces cannot deliver effective inter-modal competition.	incumbent operators offer their competitors wholesale products runs the risk that such competition may not arise spontaneously. However, this may be remedied with the threat of *ex ante* regulation. As in the case of forbearance, the phasing out of existing *ex ante* regulations may lead to markets where the only competition in future NGN services is between operators that own their own infrastructure to the end user's premises.

Source: See Ofcom, Regulatory challenges posed by next generation access networks. Public discussion document. 23 November 2006, at p. 22-24.

2.2 Regulatory Checklist Regarding *Ex post* and *Ex ante* Regulation in an NGN Environment

In order to create enabling regulation for the transition towards an NGN environment, regulators are considering a variety of issues based on specific market conditions, particularly regarding how best to foster a competitive environment and what obstacles need to be addressed and remedied to sustain competition between incumbent operators and alternative/competitive providers.

Although there is no definitive list of issues and answers for regulators, particularly given the different market dynamics in each jurisdiction, the following is a checklist of issues (Box 3) that regulators should consider when deciding between opting for *ex post* or *ex ante* regulation as a means to usher in the transition to an NGN environment.

Box 3: Checklist of Issues Regarding *Ex Post* and *Ex Ante* Regulation

- Is there sufficient inter-modal competition?
- If so, is a phased-out policy needed to transition from an *ex ante* to an *ex post* regulatory environment?
- Is time-limited forbearance or a regulatory holiday necessary?
- Does a bottleneck situation need to be addressed?

2.2.1 *Is there sufficient inter-modal competition*?

In determining whether to impose *ex ante* regulation to NGN deployments, regulators are looking at whether sufficient inter-modal competition exists in the market (*i.e.*, if significant prospects exist for wide scale, competing end-to-end access infrastructure deployments that will provide competitive constraints to incumbent operators' ability to leverage any position of market power). If sufficient competition is found to exist, some regulators have opted to forbear from regulating NGNs. For example, regulators in the United States and Hong Kong, China have abstained from imposing access on FTTx deployments by incumbents (United States) or eliminated unbundled access obligations to incumbent's infrastructure altogether, albeit in a phased-out manner (Hong Kong, China). In both cases, regulators have relied on large scale deployment of competing networks (cable television in the United States and fibre in Hong Kong, China) and on inter-modal competition to keep incumbents in check, arguing that *ex post* competition law remedies would suffice to address any future problems that may arise.

Deciding whether to rely on inter-modal or intra-modal competition largely depends on the market structure and the policy objectives of the country. For example, in the United States, the regulator has acknowledged that unbundling can bring competition to markets faster than it might otherwise develop; however, it has decided that excessive network unbundling requirements tend to undermine the incentives of both incumbent/dominant providers and new entrants to invest in new facilities and deploy new technology. As such, and taking into account the levels of competition in the U.S. broadband market, the FCC has not imposed unbundled access obligations on FTTH infrastructure deployed to serve the U.S. mass market. (Box 4)

No clear-cut rule exists to determine at what stage of deployment sufficient competition exists. In the United Kingdom, Ofcom recently stated that the existence of cable TV networks that cover 45% of households is not evidence of sustainable, large scale end-to-end local access infrastructure competition in that country.[16] In Hong Kong, China, however, coverage of 53% of households by at least two access infrastructures was deemed sufficient to trigger forbearance of access regulations by OFTA.[17]

Box 4: Regulation of unbundled access to fibre loops in the United States

The Telecommunications Act of 1996[18] was designed, in part, to introduce competition into the local exchange market in the United States. Among the various requirements imposed to achieve this goal, few, if any, have spurred so much regulatory attention, industry effort, or litigation, as the requirement under section 251(c)(3). This provision requires incumbent local exchange carriers (ILEC) to make elements of their networks available on an unbundled basis to new entrants at cost-based rates.

Litigation associated with shaping current unbundled network elements (UNE) regulation in the United States has resulted in the ILECs narrowing the initial scope and reach of the FCC's UNE regulations.[19] In this context, one of the main drivers influencing the UNE regulatory landscape in the United States was, quite naturally, creating the right investment incentives to foster NGN roll-out, both by ILECs and new entrants. As a backdrop to this whole debate were the ILEC's arguments that initial FCC unbundling and sharing obligations, although innocuous to sunk investments (*i.e.*, legacy copper loops), dampened their incentives for new investment, such as DSL upgrades and fibre deployments.

The centerpiece of the FCC´s policy on unbundling of specific next generation access network elements for the provision of broadband services, particularly hybrid and fibre-to-the-home (FTTH) networks, is its *Triennial Review Order*. There, the FCC imposed clear limitations on unbundled access to NGN loops serving the mass market in the United States, declining to require incumbent LECs to provide unbundled access to their hybrid or FTTH loops for the provision of broadband services.[20] This decision was based on the FCC's recognition of robust broadband competition and increasing competition from inter-modal sources in the marketplace. FCC rules provide for the following with regard to next generation access infrastructure unbundling:

- For loops serving mass market customers, incumbent LECs need not unbundle either dark or lit fibre loops that extend to the customer's premises (FTTH loops) deployed in new build, or "greenfield," situations.[21]
- Where an FTTH loop is deployed in overbuild, or "brownfield," situations, incumbent LECs either must provide unbundled access to a 64 kbps transmission path over the fibre loop or unbundled access to a spare copper loop.[22]
- For hybrid copper/fibre loops, incumbent LECs need not unbundle the packet-switched capabilities of those loops, but must provide unbundled access to any TDM features, functions, and capabilities for requesting carriers seeking to provide broadband

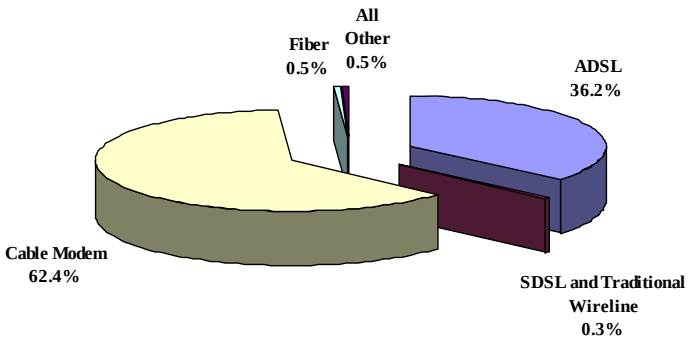
services.[23]

- When a requesting carrier seeks access to a hybrid loop to provide narrowband service, the incumbent LEC may provide either unbundled access to an entire hybrid loop capable of voice grade service using TDM technology or unbundled access to a spare copper loop.[24]

The FCC also has extended these rules to multiple dwelling units (MDUs) and concluded that FTTH rules apply to MDUs that are predominantly residential.[25]

Although cable modem continues to be the prevalent technology for delivery of advanced services in the United States, accounting for 62.4% of lines serving residential end users, with ADSL representing 36.2% and fibre 0.5% (Figure 2), the FCC's hands-off policy has clearly had a positive impact on FTTH line growth in the United States along with other factors, such as competitive pressure from cable television providers. Indeed, after the D.C. Circuit Court upheld the FCC rules in *USTA II*, fibre take-up and deployment has seen a year-to-year increase of over 540% (2004-2005) compared to an increase of only 32% and 74% in the previous two years respectively (2002-2004).[26]

Figure 2: U.S. Residential Advanced Services Lines by Technology as of December 31, 2005



Source: FCC, High-Speed Services for Internet Access: Status as of December 31, 2005

2.2.2 *If it is determined that sufficient competition exists, is a phase-out policy needed to transition from an ex ante to an ex post environment?*

If regulators find that sufficient competition exists, they may consider it necessary to eliminate certain regulatory obligations, but may opt to do so in a phased-out manner to avoid any major disruption in the marketplace. In Hong Kong, China, the regulator, OFTA, not only abstained from mandating access to fibre-based networks, but completely withdrew existing obligations from legacy, copper-based local loops. This was ordered in a phased-out manner and on a building-to-building basis and applies to buildings served by at least two competing self-built access networks (Box 5). Hong Kong China's policy, however, should be viewed in its proper context, mainly within the high urban concentration of its area where the entire population lives and works in less than 100,000 buildings and hence the costs associated with deploying overlapping access facilities to each customer's premise is significantly lower than in Europe or the United States.

Box 5: Elimination of Type II interconnection in Hong Kong, China

Hong Kong, China introduced unbundled access obligations, so called Type II interconnection, in 1995 with the objective of promoting the telecommunications industry, encouraging investment in networks, facilitating effective competition in the telecommunications market, and enhancing consumer choice.

In 2003, however, the government initiated a review of this policy, indicating that its continuation would only be justified "if the benefits from facilitating effective competition and enhancing consumer choice outweigh any potential detriment arising from dampening of incentives for investment in network infrastructure."[27]

In 2004, OFTA ordered withdrawal of Type II interconnection obligations subject to a phase-out period to be fully implemented by 30 June 2008.[28] The withdrawal would be implemented on a building-by-building basis and apply to buildings already connected to at least two self-built customer access networks; however, the withdrawal would be subject to a two-year transitional period to ensure no disruption of choice and service to consumers and a one-year "grandfather" period thereafter to protect the regulated interconnection terms (including charges) for lines connected before and during the transitional period. After the "grandfather" period, or 30 June 2008, whichever is earlier as the case may be, interconnection terms (including charges) should be subject to commercial negotiations between the carriers concerned.

OFTA indicated that liberalization had resulted in significant network roll-out by competitors, which at the time covered 53% of households in Hong Kong, China. Upon review of market conditions, it concluded, among other things, that:

- the absence of mandatory Type II interconnection was not necessarily found to be an impediment to market entry in areas with certain favorable conditions, nor was its availability necessarily a push towards reliance upon such a facility;[29]
- the availability of mandatory Type II interconnection may discourage investment in additional fibre-based alternative customer access networks to buildings, even if it is technically feasible and economically viable to do so.

OFTA, however, recognized the need to maintain the threat of *ex ante* regulation in such cases where facilities were determined to be non-replicable. Thus, under the "essential facilities" doctrine, OFTA reserved the authority to impose Type II interconnection after determining: (i) that the dominant operators' customer access network cannot be duplicated; and (ii) that refusal to allow access to that operators' customer access network will foreclose competition.[30]

Similarly, in France, as competitive conditions have evolved in the market and several operators are currently able to replicate SMP operator's resale services, the regulator is proposing that mandatory resale offerings are no longer needed and that *ex post* regulation is sufficient to maintain a competitive market with regards to wholesale broadband service resale.[31] France has followed the "investment ladder" policy in which wholesale broadband service offers are mandatory for SMP operators through different investment levels. Following the rationale of the proposed decision, if competition conditions in the market continue evolving, especially with the launch of NGN networks, ARCEP could continue phasing out other mandated wholesale broadband service obligations.

2.2.3 *Is time-limited forbearance or a regulatory holiday necessary?*

Prompted largely by requests from incumbent operators, certain regulators are considering whether to introduce time-limited forbearance policies, whereby the regulator commits to not mandate access to

NGNs, particularly their access component, for a pre-established period of time – say 3-5 years. After such period, regulation would either resume or begin to be enforced in such markets if dominance was determined via specific market analysis.[32]

This policy may significantly alter the existing competitive landscape in the communications sector, particularly in markets where access-based providers have made significant inroads into incumbents' market shares by benefiting from mandated wholesale access, specifically ULL and wholesale bitstream access. There is also a concern that regulatory holidays for NGNs, notably in instances where NGN services are a replacement for existing regulated broadband services, could hinder a competitors' ability to offer such services during the forbearance period. Moreover, this time lag might mean that it could take competitive/alternative providers several more years to recover, if at all, their current market position. From the incumbent's perspective, the length of the forbearance period might not be sufficient to recoup its investment. Hence, uncertainty over the impact of regulation on revenue streams after the forbearance period may impact a business case more than uncertainty in the early years.[33]

In 2005, TRAI proposed to the Government of India that to promote quick growth and create immediate competition in broadband services, nondiscriminatory ULL should be executed in a time bound manner for both shared unbundling and bitstream access. In order to address the possible disincentives this would bring about for new greenfield network deployments, TRAI proposed that new infrastructure (*i.e.*, infrastructure less than five years old) should not be unbundled. The Government of India, however, did not adopt TRAI's ULL recommendation.

In Germany, incumbent provider Deutsche Telekom (DT) has actively sought relief from extension of existing unbundling and wholesale obligations to its NGN infrastructure, strongly lobbying the German Government to award it "regulatory holidays" that it deems indispensable to recoup its investments. When the German regulator, BNetzA, initially agreed with DT, this created frictions with the EC, which expressed "serious doubts" regarding the exclusion of VDSL connections from the relevant market as defined by the regulator. Ultimately, the EC prevailed, and BNetzA imposed wholesale access obligations on DTs VDSL service (Box 6). However, DT remained firm in its objective and, as a consequence, the Government proposed, and the German Parliament approved, amendments to the Telecommunications Act that exempt "new and emerging markets" from regulation. In response the EC has indicated that it will sue to block the law granting DT the right to restrict a competitor's access to its fibre networks.[34]

Box 6: Bitstream access via VDSL infrastructure in Europe: the case of Germany

In August 2006, the regulator, BNetzA, imposed bitstream access obligations on all variants of incumbent DT's infrastructure, including ADSL2, ADSL2+, SDSL and VDSL.[35] This decision came after considerable controversy, as DT had vehemently opposed any *ex ante* regulation, instead seeking regulatory holidays and arguing that this was necessary to recoup investment costs incurred in updating its network to VDSL technology.[36] The EC strongly opposed this view from the outset, indicating in a recent letter to the German regulator that investment incurred by DT should be compensated, "*but cannot justify exclusion from the access obligation.*"[37]

The EC thus played a key role in this decision, as original draft measures notified by BNetzA on October 11, 2005 generally excluded bitstream access via VDSL connections from review of wholesale broadband access in Germany.[38] At the time, the German regulator argued that no

VDSL retail products were available, thus respective wholesale products could not be derived within the two-year period of the notified market analysis. The EC expressed serious doubts with BNetzA's determination, noting that at such time there was no indication that, within the timeframe of the forward looking assessment, VDSL retail products would differ substantially from those delivered over ADSL(2+) technology.[39]

Soon thereafter, BNetzA amended the notified draft measures to include bitstream access via VDSL connections within the wholesale bitstream access market,[40] and the EC withdrew its objections.[41] The EC emphasized that in case new retail services give rise to new derived wholesale markets – as they can not be provided over the existing wholesale products – then the corresponding new wholesale products should not be subject to inappropriate obligations. For this purpose, the EC further argued, the key is to establish lack of demand and supply-side substitutability before excluding the product from the market in question.[42] The EC argued that the costs incurred could not justify excluding DT's VDSL services from the access obligations. Investment costs to upgrade broadband networks to VDSL technology were to be recouped by setting appropriate access prices (including cost of capital).[43]

Thus, at the European level, the EC has been vehement in including NGN access infrastructure within the existing market definitions. The EC's position is that the use of more efficient technologies (such as FTTH) to provide currently regulated services does not alter the justification for regulation. Thus, if competitive conditions have not changed, the move to NGNs should not be seen as an opportunity to roll-back regulation on existing services.[44] In its recent Draft Recommendation, the EC emphasized the need to consider, on a case-by-case basis, the substitutability of services provided using the various access technologies (including FTTH and hybrid networks), thereby taking the principle of technology-neutral regulation as a starting point.[45]

2.2.4 *Is there a bottleneck situation that needs to be addressed?*

In some countries, such as the United Kingdom, Netherlands, United States, and Japan, among others, regulators have been initially faced with determining if NGNs, particularly access infrastructure (*i.e.*, FTTx networks), will become new enduring bottlenecks (*i.e.*, new non-replicable assets), and, if so, what regulatory policy should be adopted. This has become a particularly pressing issue for countries where competition has been based on mandated access (*e.g.*, ULL, wholesale bitstream, and resale) as they must determine the way forward and how, if at all, existing policies and regulations would be applied in the NGN world.

In the United Kingdom, Ofcom has acknowledged that the private sector is better suited to set the ground rules and standards to handle BT's migration towards an all IP-based core network -- 21st Century Network (21 CN). Nevertheless, Ofcom stepped in to usher the migration process, setting certain principles under which the transition would be conducted. (See Box 7). One of the priorities sought by Ofcom is that the deployment of BT's NGN does not foreclose competition, either by disrupting existing competitive businesses or preventing equality of access being provided in the future. In September 2005, BT agreed to undertakings to support these goals, including commitments to provide unbundled network access and other wholesale services, on an "equivalence of inputs" basis, and not to make design decisions that would foreclose specific product options without adequate consultation. [46]

The concept of "equivalence of inputs" is at the heart of Ofcom's efforts, and basically means that BT was compelled to take structural measures at the wholesale level to ensure the wholesale components and products it sells to itself are identical to those it sells to competitor providers. This policy is

precisely aimed at providing alternative/competitive providers with unbundled access to those elements of BT's network that represent enduring economic bottlenecks. Among these structural measures, BT effectively isolated elements including its local loop and the backhaul in a separate business unit (named Open Reach) that, although not structurally separated from BT, has been placed at arms length from the rest of the company.[47]

More recently, Ofcom has hinted at the need to establish mandatory access on future FTTx deployments in the United Kingdom, because they too might be seen as enduring economic bottlenecks. In this sense, Ofcom has indicated that it does not foresee widespread facilities-based competition in end-to-end wireline NGN access networks, and has invited comments on the way forward.[48]

Box 7: NGNs in the United Kingdom: Ofcom´s measures to ensure access to BT's 21 CN

Since 2005, BT has been heavily investing in its 21 CN project to replace all of its existing network platforms (PSTN, ISDN, IP, ATM, FR, SHDS, etc.) with a single unified IP platform. Starting in late November 2006, BT began to transfer the first customer lines to its 21 CN, a process expected to take several years to complete. Ofcom views this major change as the first instance in which the network of an incumbent operator accommodates competition from the outset.

Accordingly, Ofcom sees its role as ensuring that clarity exists as to the regulatory policy requirements necessary to support effective competition. However, it has indicated that it does not wish to become involved in the detailed design of BT's network. Because of this, Ofcom has emphasized industry-led processes to guide the transition. Ofcom has proposed the following key regulatory principles to guide its approach towards NGNs:

1. to promote competition at the deepest levels of infrastructure where it will be effective and sustainable;
2. to focus regulation to deliver equality of access beyond those levels;
3. as soon as competitive conditions allow, to withdraw from regulation at other levels;
4. to promote a favourable climate for efficient and timely investment and stimulate innovation, in particular by ensuring a consistent and transparent regulatory approach;
5. to accommodate varying regulatory solutions for different products and where appropriate, different geographies;
6. to create scope for market entry that could, over time, remove economic bottlenecks; and
7. in the wider communications value chain, unless there are enduring bottlenecks, adopt light-touch economic regulation based on competition law and the promotion of interoperability.

Ofcom views its challenge as establishing an appropriate balance between its role in providing regulatory certainty and the role of the market in determining the commercial outcome of NGN-based competition. For this purpose, it has recently undertaken two initiatives to deliver effective NGN-based competition:

- First, recognizing the need to provide greater certainty as to the nature of the *ex ante* competition regime associated with NGNs, Ofcom has proposed an approach to address the impact of IP-based convergence on existing market definitions, and on the associated significant market power (SMP) analysis and remedies.
- Second, Ofcom has also indicated the need to establish an industry body capable of providing a strong strategic vision for the access and interconnection arrangements required to support NGN-based competition.

In addition, Ofcom has recognized that a third line of work is required to consider consumer protection issues raised by the migration to NGNs.

Sources:
Ofcom, Next Generation Networks. Future arrangements for access and interconnection, Consultation 13 January 2005, available at www.ofcom.org.uk/consult/condocs/ngn/ngn.pdf
Ofcom, Next Generation Networks: Developing the regulatory framework, 7 March 2006, available at http://www.ofcom.org.uk/consult/condocs/nxgnfc/statement/ngnstatement.pdf

Similar issues are being addressed in the Netherlands, where the regulator, OPTA, has proposed the need for KPN, which is transitioning to an all-IP network, to offer a "fully fledged alternative" to its current access offers that guarantees connectivity between KPN and the networks of other providers in a way that adequately compensates for the modifications of current unbundled access offers.

In Japan, the country with the highest FTTH penetration in the world, the Ministry of Internal Affairs and Communications (MIC) has mandated access on fibre deployments by incumbents NTT East and NTT West. There, competitive pressure, particularly from electricity companies which have rolled-out their own infrastructure and aggressively engaged in price-based competition with incumbents, has been a major driver towards NGN migration and particularly for FTTH deployment.

In determining the appropriate regulatory framework for the migration to NGNs, regulators need to be aware of the delicate nature of their role in creating an enabling environment that balances both investment and competition incentives. If regulators opt for imposing access obligations, striking the right balance is key. If competitive/alternative providers perceive access prices to be high, they will be deterred from entry; while if such prices are perceived by the incumbent to be low, they might be deterred from deploying NGNs.

In fact, some regulators have been left "perplexed"[49] by the outcomes of their efforts to impose access on regulated prices to future NGN access facilities. Incumbents have reacted in different ways to such actions and not all have been willing to accept regulatory burdens on planned and yet to be deployed infrastructure. For example, disagreement with the ACCC over what the incumbent operator, Telstra, could charge rivals for access precipitated Telstra's unilateral decision, in August of 2006, to withdraw its plans to deploy a FTTN wireline network altogether. This project, proposed in late 2005, was initially slated to cover five major Australian cities, and then expand to the rest of the country.

3 Modifying the Legal and Regulatory Framework to Transition to an NGN World

Migration towards NGNs is a further step in the convergence of the ICT sector. As such, regulators will be faced with many of the same convergence-related issues they have been confronting to date, as well as with new NGN-specific concerns (*e.g.*, numbering, interconnection, universal service/access, etc.) The following checklist highlights a set of issues that regulators should consider when discussing possible changes to existing regulatory frameworks to facilitate NGN deployment. (Box 8)

Box 8: Checklist of issues regulators should consider for enabling NGN deployment

- Does the regulatory framework present any market entry barriers? Does it support full competition in the market and service providers to offer multiple services? Are there any services (*e.g.*, subscription television) restricted to a number of service providers?
- Does the current licensing framework facilitate the provision of different services over

different platforms (*i.e.*, technology neutrality)?
- Are VoIP and other IP-based services allowed? If so, are they regulated in equal conditions than traditional services or does IP-specific regulation exist?
- What are the regulatory policies for these new technologies and services with regard to numbering, spectrum, interconnection, universal service, and rights of ways and shared deployment?
- Does the regulatory framework promote diversification of access networks?
- Are institutional and structural changes of the regulatory authority required to address an NGN environment?
- Does the regulatory framework encourage and facilitate public (municipal) initiatives?

3.1 Market Barriers

In order to foster NGN deployment, regulators should look at their regulatory framework and seek to eliminate market entry barriers that may prevent or hinder new entrants from participating in the market. These restrictions may relate to exclusivity rights granted to an incumbent operator that outright bar entry, cross-ownership restrictions, excessively burdensome licensing and other requirements, and foreign investment restrictions. For example, in the United States, telecommunications operators have been deploying FTTx due to competitive pressure from traditional cable television providers that are offering triple play bundles. However, in some instances, they have encountered delays from local franchise authorities and been subject to unreasonable compensation requests to obtain the needed franchise to begin offering video services. Recently, the FCC has adopted rules that prohibit local franchise authorities from unreasonably refusing to award competitive franchises for the provision of cable services.[50]

In other countries, governments have sought to eliminate restrictions that prevented operators from offering certain services. For example, in Mexico, the Secretariat of Communications and Transport (SCT) issued a Convergence Agreement on 3 October 2006 eliminating existing restrictions preventing fixed telephony operators and subscription television operators (mostly cable operators, but also satellite television and MMDS operators) from entering each other's market and restricting their ability to offer triple play offerings. In order to avoid cross-subsidization, operators must implement accounts separation for fixed telephony and subscription television services. With the issuance of the Convergence Agreement, the incumbent operator, Telmex, now may offer cable services with certain restrictions and cable operators may use their network to provide local fixed telephony services (previously the SCT only permitted cable operators to indirectly provide local fixed telephony through a licensed fixed telephony operator).

3.2 Licensing

Licensing in the context of liberalized and convergent markets is increasingly seen as means of gate-keeping to control entry and, to some degree, as a tool for imposing regulatory obligations and ensuring implementation of policy objectives. Licensing regimes are thus required to evolve alongside markets and technologies to guarantee that they remain effective and beneficial for sector development. By remaining static in the context of convergence and NGN migration, licensing frameworks can become an obstacle to development in several ways:

- Preserving unnecessary, onerous and complicated licensing requirements can act as a barrier to market entry and hinder competition.

- Requiring operators seeking to offer multiple-service offers to obtain multiple licenses often with different fees, requirements, and geographic scope (i.e., national versus local or regional licenses) can limit competition and impede the deployment of new services to consumers.
- Maintaining outdated and irrelevant licensing classifications can hinder technological advancement and service development.
- Licensing classifications based on specific types of technologies can act as artificial barriers to the introduction of alternative new technologies.[51]

To avoid these pitfalls, licensing frameworks should be flexible and technology neutral. This was recognized by numerous regulators that submitted papers in the Consultation to the Global Symposium for Regulators. For example, Costa Rica, Jordan, Pakistan, Thailand, and Tunisia, noted that flexibility in licensing and allowing providers to offer multiple services is an important step to attract investment in NGNs.[52] In addition, Lithuania and Morocco emphasized the importance of a technology neutrality approach to address licensing in the transition towards NGN.[53] These attributes are vital for the transition towards an NGN world, characterized by the decoupling of service/application layer from the underlying infrastructure. This means that a service/application provider may have no relationship with the infrastructure provider and the carriage service provider and can be geographically separated from its customers. Similarly, in the NGN world all services/applications will constitute IP-based data packet transmissions, and hence will not fit in the traditional end-service categories with their corresponding specific licensing regimes.

Because of this, governments are reforming their licensing frameworks to allow for NGN service development and permit such operators to provide multiple services over the same infrastructure/network. For example, in Malaysia, the licensing framework was modified from a system of 31 different types of licenses to four technology-neutral licenses. Uganda also developed a new streamlined technology-neutral licensing regime that was implemented in January 2007. Under the regime, there are three categories of licences: (i) public service provider licence; (ii) capacity provider licence; (iii) special permission to construct; and (iv) general licence (see Box 9).[54]

Box 9: Uganda: New Licensing Regime

Type of License	Services Covered Under License
Public Service Provider Licence	**Category 1: Public Voice and Data** - Cellular, Fixed voice, GMPCS, Internet access (including IP telephony + Virtual Private Networks), Internet exchange services, Virtual Private Networks (VPNs) that are NOT provided over the Internet
	Category 2: Capacity Resale - (local and international), calling cards
Capacity Provider Licence	**Category 1:** Licensees already permitted to install infrastructure of the type they have already invested in, for example Internet Access Providers with wireless networks
	Category 2: Persons whose core business is not in telecommunications but who possess private communications facilities with surplus capacity and wish to resale this to third parties
	Category 3: New entrants in the Internet Access market operating their networks using the Industrial, Scientific and Medical frequency (ISM) band,

	e.g., 2.4GHz and 5.7GHz band
Special Permission to Construct	
General Licence	**Category 1**: Public Pay Communication Services (e.g., Internet Café, Payphones, telephone bureaus etc) **Category 2**: Private Networks

Source: Uganda Communications Commission, available at: http://www.ucc.co.ug/licensing/default.php

In addition, many governments are shifting to a unified authorization system, including Peru, Tanzania, and Nigeria, as well as the EU member states. Under the new Converged Licensing Framework, for example, the Tanzania Communications Regulatory Authority has recently issued a new type of licence that will allow licensees to provide a host of services, including payphone, Internet access, videoconferencing, voice, data, VoIP, and calling card services. Similarly, in 2005, Morocco issued technology neutral, unified licenses called "new generation licenses" that allow licensees to offer all fixed telecommunications services (i.e., voice, video and data), and to deploy the necessary wireline and wireless public networks.[55]

Other countries, where comprehensive licensing reform efforts have been unsuccessful, have opted to introduce specific reforms within their general legal framework designed to address the issues posed by IP-based services and their combined offer. This is the case of the recent draft "Regulation on Convergence" issued by the Ministry of Communications of Colombia, which proposes to licence all IP-based services and applications (*e.g.*, voice, video, data, etc) provided over any type of network as value added services.(Box 10)

Box 10: All IP-based service licensing reform in Colombia

Colombia's general telecommunications framework was adopted in the late 1980s and early 1990s and heavily relies on the traditional service-specific regulatory approach. Telecommunications services are grouped into: (i) basic services, which include both fixed and mobile telephony; (ii) broadcasting services; (iii) telematic services; (iv) value-added services; (v) auxiliary services; and (vi) special services.[56] In addition, specific laws regulating both fixed local switched telephony and cellular and Personal Communications Services (PCS) were passed in 1993 and 2000, creating service-specific frameworks for such services.[57]

This regulatory framework proved inflexible to address technological developments, particularly the emergence of IP-based services in Colombia. Thus, the Ministry of Communications initiated a consultation proceeding on a "Regulation on Convergence" which, among other things, such as a proposal to create a unified licence, expressly provides that IP-based services will be considered "value added" services under the existing regulations.[58]

Governments also are reducing the administrative burdens to obtain a licence by introducing registrations, notifications, and in certain instances, deregulation. For example, in the EU, operators seeking to offer services only need to file a notification with the national regulator listing the services

they seek to provide. Similarly, in Japan, all authorizations are conducted through a registration or notification process. If the operations involve a network of a large size or scale, a registration must be filed that requires approval by the regulator; but in all other instances, only a notification is necessary. In certain countries, the regulator has opted not to impose any authorization requirements for particular services. For example, in the United States, VoIP providers are not subject to any licensing requirements; however, they are subject to regulatory obligations if they are interconnected VoIP providers (see section C below).

3.3 VoIP specific regulation in an NGN world

Regulators are assessing the need to issue VoIP specific regulations and if this will facilitate the migration towards a NGN world, where IP-based applications, which include, but are not limited to voice, all coexist in the same decoupled applications layer of the network. In the last few years, voice has spearheaded the uptake of IP-based applications and services and is expected that this trend will continue at least for the foreseeable future. The erosion of traditional voice revenues of incumbent providers as a consequence of higher efficiency and lower costs of VoIP services has been one of the drivers of NGN migration plans and deployment by incumbent providers themselves around the world. VoIP is thus ceasing to be seen as a new disruptive technology in the marketplace as it penetrates the mainstream voice market. Moreover, whereas in certain countries VoIP services were generally exempt from most, if not all, regulatory obligations imposed on traditional voice providers (e.g., access to emergency service and universal service contributions), regulators are beginning to issue specific rules to accommodate VoIP's distinct functionalities (e.g., nomadicity of service).

In certain instances, regulation, or the lack thereof, has limited or hindered the development of VoIP. In Chile, for example, the lack of clarity on the regulatory treatment of VoIP services led the incumbent operator to block such services over broadband connections. Ultimately this triggered the intervention of the Competition Tribunal, which ordered such practices to be ceased.[59] In addition, the regulator, SUBTEL, has initiated a consultation on a draft VoIP regulation which, among other things, expressly classifies VoIP services as public telecommunications services and requires interested parties to secure the relevant concession. This move is intended to create legal certainty for the provision of VoIP services as a means to foster their deployment in the market place.[60]

In the United States, similar actions by an incumbent also prompted FCC action requiring it to cease blocking VoIP service over its network.[61] However, the FCC has yet to classify VoIP service as a telecommunications service or information service or to adopt general regulations for VoIP. Nevertheless, the FCC has changed its deregulatory approach towards these services, imposing obligations to accommodate legal wiretaps, contribute to universal service funding and provide emergency calls on interconnected VoIP providers (i.e., those that allow calls to or from traditional telephone lines/numbers).[62] In addition, the Commission recognized that in the transition to a broadband telecommunications market, it was duty-bound to preserve and promote the vibrant and open character of the Internet, fostering the creation, adoption and use of Internet broadband content, applications, services and attachments, and to ensure that consumers benefit from the innovation that comes from competition. As such, the FCC issued a set of network neutrality principles to guide its ongoing policymaking activities. In this sense, to encourage broadband deployment and preserve and promote the open and interconnected nature of the public Internet, consumers are entitled to:

- Access the lawful Internet content of their choice.
- Run applications and use services of their choice, subject to the needs of law enforcement.
- Connect their choice of legal devices that do not harm the network.

- Competition among network providers, application and service providers, and content providers.[63]

Regulators are realizing that traditional PSTN-oriented voice regulation does not always work for IP-based services and are increasingly finding the need to adopt specific VoIP regulations in light of the increasing role that the service is playing in the current telecommunications market. Clarity on the regulatory framework applicable to VoIP is generally seen by service providers as the first step towards a clear regulatory picture for NGN policy.

3.4 Numbering [64]

Numbering policies and regulations were originally developed to address traditional voice telephony services. As a result, numbering plans established different ranges for voice services and geographic areas (for fixed services). This differentiation had a twofold function: (i) informing end users of the charges of the calls and (ii) maintaining the interconnection cost structure based on services (i.e., mobile voice service vis-à-vis fixed voice service) and distance. Since this allowed subscribers to be reached by a unique combination of digits, numbering became an essential resource for telecommunications networks operators. However, with the advent of convergence and the migration towards IP-based NGN services, regulators are finding that modifications to such policies and regulations are necessary.

The increasing use of VoIP services has raised questions among regulators as to whether numbering resources should be assigned for VoIP and whether traditional telephone service operator obligations should be imposed on VoIP providers. Regulators have adopted a variety of solutions, ranging from allowing VoIP providers to use geographic numbers - provided they offer service under the traditional voice service regime, with the relevant obligations – to creating specific numbering ranges for VoIP - that take into account the special characteristics of the service, most notably its nomadic use. Some countries, such as Japan, Spain, and the United Kingdom, have combined both measures, and grant geographic numbers to VoIP providers if they operate under the traditional voice service regime, and specific number ranges if VoIP providers operate under the "information service" regime.

The ENUM initiative on electronic numbering is a further step in the process of numbering reform and seeks to address the shift from PSTN to all-IP networks, allowing for protocols that convert a telephone number from one world to the other.[65] This initiative establishes the possibility of introducing a fully neutral approach to numbering, simplifying numbering regulations, and addressing complexities resulting from all-IP environments. Essentially, by translating a PSTN number to an IP address, ENUM would make it easier to contact people through electronic means (*e.g.*, by linking the users' email, telephone number, fax and instant messenger address to a single number).

ENUM developments may potentially define the future direction of numbering policies. In addition, it may address some of the transparency concerns with VoIP, due to the mapping of PSTN numbers to "uniform resource locators" (URLs). ITU-T Study Group 2 and the Internet Architecture Board are working together in the implementation of ENUM. An interim procedure to administer the delegation of ENUM resources has been approved by the ITU-T Study Group 2.[66] User ENUM is currently in commercial operation in countries such as Austria, Poland, Romania, Germany, Netherlands, and Finland. Other countries including Australia, China, Japan, Republic of Korea, Sweden, and the United States have started ENUM trials.[67] Other regulators, such as the ANRT of Morocco, agree that access to NGN services by means of a unique identifier would be more efficient than the current mechanism; however, they question the maturity of existing alternatives to accomplish this in the near future. [68]

In addition, as NGNs will allow for ubiquitous communications both in fixed and mobile settings, addressing issues such as fixed to mobile convergence and inter-modal number portability is also relevant for regulators to enable the transition to NGNs. Number portability, the ability of a consumer to maintain the same telephone number when changing service providers, may be inter-modal (e.g., porting a number from a fixed to a mobile network or vice versa) or restricted to one type of network. For example, the United States has included geographically restricted inter-modal portability, meaning that a consumer may port among different types of networks within a limited geographical area. In Argentina, the telecommunications law allows inter-modal portability to be implemented by the regulator although it has not been adopted yet. Hong Kong, China and Japan are currently discussing whether to introduce inter-modality portability to address fixed to mobile convergence, and number portability potentially could be expanded to other services, such as VoIP.

3.5 Spectrum

As currently envisaged, NGNs are expected to deliver not only multiple services/applications over a single IP-based platform at higher data rates, but to allow for general mobility to accommodate the consistent and ubiquitous provision of such services/applications to end users. As such, the ITU-R has been working toward defining the framework and overall objectives of the future development of IMT-2000 and systems beyond IMT-2000 for radio access networks.[69] The World Radiocommunications Conference of 2007 is expected to address future spectrum requirements for such systems.[70]

Systems beyond IMT-2000 are of particular interest for future NGN deployment supporting mobile applications. These systems may require new wireless access technologies, some of which are expected to be developed around the year 2010. It is anticipated that these technologies will be capable of supporting high data rates with high mobility - with target peak data rates of up to approximately 100 Mbit/s for high mobility (e.g. mobile access) and up to approximately 1 Gbit/s for low mobility (e.g., nomadic/local wireless access). In some countries, these technologies could be widely deployed around the year 2015.

Regulators should closely monitor the roll-out of technologies supporting systems beyond IMT-2000, and the developments of their internal mobile and broadband markets in order to make any necessary policy decisions to enable the future deployment of systems that will accommodate the seamless transition between fixed and mobile settings in an NGN environment.

3.6 Interconnection

The introduction of NGNs is challenging existing interconnection regulations that were designed primarily for PSTN networks and voice services. Traditionally, interconnection charges have been based on time and distance and follow the hierarchical structure of PSTN networks because these elements represented the cost structure of PSTN networks. However, NGNs are based on IP-architectures and allow the separation of functional levels of the network. This means that time and distance are irrelevant for NGNs' cost structure and access and service are no longer tied to one network. As a result, charges tend to be flat fees and service providers (e.g., VoIP and IPTV providers) will be able to offer their services to end users without owning a network to access them.

Numerous regulators currently are evaluating how to migrate to the NGN environment with minimum distortions for the market, while at the same time preventing any disruptions to competition. Among the issues of concern raised in some countries are maintaining the any-to-any interconnection principle

(i.e., ensuring end-to-end connectivity), defining different interconnection levels (i.e., access level and service level), ensuring non-discrimination among operators using NGN technical capabilities (e.g., quality of service and traffic prioritization), managing the impact caused by the reduction of interconnection points of the dominant operator's network, and defining charging principles under NGN cost structures (e.g., bill and keep, capacity-based or service-based charges).

Some regulators have introduced reforms into their interconnection regulatory frameworks to address the new IP and NGN environment. For instance, in the United Kingdom, Ofcom introduced the concept of "equivalence of inputs" for NGNs, which requires that when the cost is proportionate, the significant market power operator (i.e., BT) must make available to other operators at a wholesale level the same products and services it makes available to itself at the same price and using the same systems and processes. In other jurisdictions, such as Spain or Colombia, regulators have introduced capacity-based interconnection, which if not conceived initially for NGNs, addresses the cost structures derived from the IP-architecture environment. NGN interconnection issues are further discussed in the Global Symposium for Regulator's discussion paper on Interconnection.

3.7 Universal Service and Access

The transition towards NGNs also will challenge universal service and access[71] policies in various ways (e.g., sources of funding and the scope of obligations). As originally conceived, universal service was an obligation imposed on the monopoly telephony operator requiring operators to expand coverage to provide voice services in remote and underserved areas. PSTN operators typically cross-subsidized the cost of their universal service obligations with revenues derived from other services. With the introduction of competition and new technologies, regulators substituted this implicit cross-subsidization with a requirement that all or some operators contribute a percentage of their revenues to a universal service fund. However, the scope of such obligations remained focused primarily on voice services. The general objectives of universal service and access, which are expected to be maintained in the near future and onto the NGN world, are to provide for availability, affordability, and accessibility of services.[72]

The transition towards NGNs will be uneven from a geographical standpoint, since operators will likely deploy them, at least initially, in a country's more profitable areas. This trend is being seen with fibre deployment both in developed and developing countries, and will threaten to broaden the digital divide within countries, which already is causing concern for regulators in countries such as Japan and the United Kingdom. As such, universal service and access policies may need to be modified to address these asymmetries.

Moreover, the move towards NGNs will imply that voice traffic will migrate to IP networks hence threatening universal service and access funding models. Currently, many universal services funds are maintained by PSTN revenues from voice service. Regulators must determine whether IP-based services, notably VoIP, should be subject to universal service obligations. Most countries have not imposed universal service obligations on service operators using new technologies due to concerns that such obligations would inhibit the development of these players and their services. This trend, however, seems to be shifting as more traffic moves from PSTN networks to IP-based networks. Some developing countries that allow VoIP, including Mauritius, the Czech Republic, the Slovak Republic, and Venezuela, are subjecting VoIP operators to the universal service contribution regime. In the United States, the FCC has extended universal service contributions to interconnected VoIP providers although it has not formally classified the service as a "telecommunications service". In South Africa,

VoIP providers that offer service by virtue of their VANS licence must contribute to the universal service fund as a general telecommunications licence holder.

Similarly, as IP-based technologies proliferate, universal service and access policies in many countries have seen a shift to include both narrowband, and even broadband, within the scope of universal service obligations. For example, of the 93 countries that responded to the ITU's 2005 regulatory survey, 27 included narrowband Internet service in the universal service definition and 11 included high-speed Internet.[73] In the EU, form example, under the Universal Service Directive designated providers must provide "functional Internet access." This has been understood by regulators to mean narrowband connections. However, given the limited development of broadband markets in certain countries, some regulators have dismissed the current need to expand universal service/access obligations to broadband connections because it is not yet considered an essential service of social importance.[74]

3.8 Rights of way and shared deployment

One of the most significant costs associated with NGN deployment relates to excavating the necessary conduits and laying down the fiber for the access part of the network. This entails actual building costs (i.e., civil engineering costs) and generally requires securing numerous additional permits (e.g., building and digging permits and environmental permits). Thus, simplification of requirements, shared use of ducts and poles, as well as other possible solutions that reduce operator's costs are relevant steps in creating an enabling environment for NGNs.

Recognizing the constraints that some operators face in deploying networks, some regulators have sought to simplify the procedural requirements to secure rights of way in order to facilitate the roll-out of next generation access networks. In Japan, for example, the MIC plans to revise the "Guidelines for the Use of Infrastructure such as Telegraph Poles and Conduits Owned by Public Utilities" to facilitate and promote competitive carriers initiatives' to install their own FTTx network. These simplified procedures are expected to be in force in 2007.[75] In France, competitive broadband provider Illiad has announced FTTH deployments in Paris using municipally-owned ducts and sewers. Similar initiatives have been taken in the United States, where the government has issued recommendations to streamline procedures for granting "rights-of way" across federal lands in order to remove one barrier to deploying broadband technology.

In the Netherlands, OPTA has taken a different approach to reducing operator's costs associated with deployment, proposing the joint construction of fibre optic infrastructure by the incumbent and interested competitors. The proposal is that each party would lay their respective ducts into a gulley that has been jointly dug, hence reducing the digging costs. In addition, OPTA is considering imposing other possible arrangements, such as requiring operators to include an empty duct as standard procedure in any digging activities in order to sell it to third parties interested in deploying their own infrastructure.

3.9 Promotion of Diversification of Access Networks

Promoting diversification of access networks, such as wireless and cable television networks, also is a policy option being explored by regulators in developed and developing countries as a strategy to promote infrastructure deployment and increase broadband penetration and competition. In particular, the use of wireless technologies, allow for significant cost reduction in network deployment, hence facilitating broadband service provision as an initial step towards NGN deployment.

Thus, in Japan, the MIC has committed to actively promote the introduction of new wireless access technologies, such as high-speed wireless LAN systems in the 5GHz band and BWA systems using the 2.5 GHz band.[76] For the ANRT of Morocco, for example, encouraging the diversification of access networks, such as wireless systems, is seen as an initial step on the road to FTTx deployments.[77] In addition, India's TRAI has recommended regulatory measures directed at delicensing spectrum in the 5.1 GHz and 5.3 GHz bands and to earmark additional spectrum bands that are not in high usage for deployment of BWA networks.[78] Similarly, countries such as France, Germany, Portugal, Norway and the United States have granted BWA licences in the 3.5 GHz band, a trend also adopted in transitioning economies such as Bulgaria, Colombia, Ecuador, Honduras, and Jordan.

3.10 Institutional and Organizational Changes

There are three primary institutional designs for regulatory authorities with responsibility over the communications sector. The most prevalent model is the single-sector regulator whose sole function is to regulate the telecommunications sector (e.g., regulators in Botswana, Spain, and Peru). In addition, numerous regulators are multi-sector regulators with responsibility over various industry sectors typically considered to be public utilities (e.g., telecommunications, water, electricity and transportation), such as the regulators in Jamaica, Costa Rica, Germany, Latvia, and Panama.

In recent years, there has been an increase in converged regulators with responsibility over broadcasting, telecommunications, and information technology, commonly referred to as converged regulators. Today, such regulators are found in most EU countries, including Finland, Italy, and United Kingdom, as well as in Australia, Hong Kong China, Malawi, Malaysia, South Africa, and Tanzania. This trend is occurring because governments consider that these types of structures are better equipped to address convergent environments where different services are offered over the same platform. For the same reasons, this move will also benefit the transition to NGNs.

However, the term converged regulator is used broadly and defined in many different ways. For some, a converged regulator is a regulator with responsibility over all communications, including telecommunications, broadcasting, and information technology, as well as radio spectrum, such as the U.S. Federal Communications Commission which has had responsibility over these industries since its inception. In the United Kingdom and Australia, the regulator has these responsibilities as well, but as a result of certain institutional changes where the governments opted to combine responsibility over these industries under one umbrella agency. For example, in 2002, the UK government established Ofcom by merging five regulatory bodies into one, the Independent Television Commission, the Broadcasting Standards Commission, the Office of Telecommunications, the Radio Authority, and the Radiocommunications Agency. In 2005, the Australian Communications Authority and the Australian Broadcasting Authority were merged to form the Australian Communications and Media Authority which has responsibility over telecommunications, broadcasting, radiocommunications, and online content. In Hong Kong, China, the government has proposed to merge the Broadcasting Authority and Telecommunications Authority into a unified regulator called the Communications Authority through a comprehensive Communications Bill.[79]

Governments have identified various reasons for moving to a single regulator with responsibility over various industry sectors. By shifting regulatory responsibilities regarding the communications sector into one government agency, stakeholders have a one-stop-shop for resolving regulatory issues, resulting in greater consistency in regulatory approach and practice. In addition, certain operational efficiencies should result and greater resources may be available since the single regulator now has a

larger pool of experts with different expertise all under one roof that it could tap to deal with a wide variety of issues. Furthermore, less overlap and turf battles between government agencies would be the natural result of a single regulator. Operators find it easier to have to comply with only one regulatory authority and to address their issues in one place. Another benefit of having a converged regulator is that it better reflects the marketplace given that operators now offer triple and quadruple play offerings.

When considering whether to introduce an institutional or organizational change to facilitate NGN development, governments should assess the objectives that they are trying to achieve and then think about what functions are best placed under the converged regulator. In other words, will the regulator have responsibility over technical regulation and standards, spectrum management, licensing, consumer protection, economic regulation, and competition law enforcement? For example, in certain countries, the regulator has responsibility over broadcasting and telecommunications but may not have authority over consumer protection and competition issues which is the responsibility of other authorities, such as with CONATEL of Venezuela. Similarly, in Canada, spectrum matters are addressed by Industry Canada rather than by the Canadian Radio-television and Telecommunications Commission. In other instances, responsibility over broadcasting content may reside with a separate regulatory authority. In Singapore, IDA has responsibility over telecommunications and information technology matters, but the Media Development Authority licences over-the-air television and regulates content.

In addition, governments also need to consider the relationship between the telecommunications, broadcasting, and competition laws. Should the regulator have any responsibility over competition issues? Different countries take distinct approaches. In Australia, for example, the communications regulator has no authority over competition issues whereas in the United Kingdom, Ofcom has jurisdiction concurrently with the Office of Fair Trading. The issue of whether it will generally be subordinate to the competition authority with regard to telecommunications and broadcasting issues that include a competition element is important. For example, in Singapore, the regulator only has authority to the extent that such responsibility has not been granted to the Competition Commission. If the jurisdiction and responsibilities of these two authorities are not appropriately balanced, certain inefficiencies and jurisdictional debates may ensue.

3.11 Public (municipal) initiatives

Another route taken by certain governments, particularly by local governments, involves direct deployment and backing of next generation access and core network deployments via public/private partnerships. Municipally-sponsored FTTH projects are springing up across Europe, the United States, and Asia, with the goal of providing competing infrastructures that grant open access to competitive/alternative broadband service providers. Even some national regulators, such as Singapore's IDA with its Next Generation National Infocomm Infrastructure (Next Gen NII) project, are also getting involved in this type of initiatives (Box 11). In Amsterdam, for example, expected competition from Citynet, a municipal project, has prompted incumbent KPN's deployment of FTTH.[80]

Box 11: Singapore's Next Generation National Infocomm Infrastructure (Next Gen NII)

Announced by Singapore's Prime Minister in February 2006, the Next Gen NII, which comprises complementary wired and wireless networks, is intended to be Singapore's new digital super-highway for super-connectivity. The wired broadband network or Next Generation National Broadband Network (Next Gen NBN) will deliver ultra-high broadband symmetric speeds of 1Gbps and above, to all homes, offices and schools, while the Wireless Broadband Network (WBN) will offer pervasive connectivity around Singapore.

Next Gen NBN

The Next Gen NBN is envisaged as a carrier-neutral, totally-wired network. IDA has proposed this to be an open platform which supports multiple service providers in delivering multiple services to homes and offices. IDA expects the private sector to build, own and operate the NBN. However, IDA´s proposal calls for structural separation of the Operating Company[81] and the retail service providers (RSPs) to ensure that all RSPs are treated on an equitable basis in terms of pricing and contractual arrangements for equivalent services and volumes. The Government has indicated that will provide some funding to kick-start the project and to ensure that this ultra high-speed broadband service will be viable, affordable and sustainable for the longer term. The process to deploy the NBN was initiated with a Request-For-Concept (RFC) in March 2006, with a Request-For-Proposal (RFP) process taking place between June-December 2006. By early-2007, NBN will be awarded to private sector partner. The appointed operator is expected to complete at least 50 percent rollout within 3 years from the award, and to complete the project within 5 years.

WBN

To complement NBN, the government will first work with the private sector to accelerate the deployment of the WBN in key "catchment" areas (*i.e.*, places of interests, central business district, and town centers in the heartlands) and to offer wireless access at highly affordable rates under a Wireless Broadband Market Development (WBMD) Call-For-Collaboration (CFC). On October 10, 2006, IDA selected Cell Network Pte Ltd, QMAX Communications Pte Ltd and Singapore Telecommunications Ltd, for the CFC. These three operators are expected to launch initial commercial services of a wireless broadband network by January 2007 and to complete the project by year-end 2008.

Sources: IDA, Fact sheet: Next Generation National Infocomm Infrastructure, available at http://www.itu.int/osg/spu/ngn/documents/NGNII-Factsheet-060303-Singapore.pdf; IDA, Summary of Responses of Request-For-Concept for Next Generation National Broadband Network, August 15, 2006, available at http://www.ida.gov.sg/idaweb/doc/download/I3757/Summary_of_RFC_Responses.pdf; IDA, Wireless Broadband Market Development Call for Collaboration (CFC) home page, available at http://www.ida.gov.sg/idaweb/marketing/infopage.jsp?infopagecategory=factsheet:wireless&versionid=1&infopageid=I3764.

A key element of this trend is creating open access networks that will allow non-discriminatory access by multiple service providers to NGNs. However, not all municipal projects are open access networks. In the United States 32 municipality-led projects have been deployed, either directly or via municipally owned utility companies, but these networks are not generally designed as open networks.[82] An interesting exception is that of the Utah Telecommunication Open Infrastructure Agency (UTOPIA), a planned FTTH open infrastructure network (Box 12).

Box 12: UTOPIA: Open access municipal FTTH in the United States

UTOPIA was originally formed in 2002 by fourteen cities in the State of Utah located in the western United States. UTOPIA´s mission is to build and maintain a FTTH open infrastructure network. The project is funded by the sale of bonds which are guaranteed by 11 of the cities involved in the project. In 2004, 85$ million in bonds were sold to fund the first phase of construction (*i.e.*, laying down fibre for the six southern cities). The project is currently in its second phase, which involves rolling-out fibre in the five northern UTOPIA cities. To repay these bonds, UTOPIA will collect a wholesale fee from service provider based on the type of services the customer takes. If such revenues prove to be insufficient, however, the 11 guarantor cities will be required to honor UTOPIA´s bond commitments with monies levied form sales taxes which local referendums authorize them to collect. Currently, several small service providers such as MSTAR, Veracity Communications and X-Mission Internet, as well as large providers like AT&T, are offering voice, broadband and television services via UTOPIA'S network.

Sources: www.utopianet.org; Steve Cherry, A Broadband Utopia Continued, IEEE Spectrum Online, May 2006, available at http://www.spectrum.ieee.org/may06/3434/3

A concern expressed about municipal projects is that poorly targeted schemes may potentially result in considerable harm, particularly if the public intervention distorts commercial companies' incentives for efficient investment.[83] In many cases, governments must adopt legislation or regulations must be implemented to determine the scope of such projects, particularly so as to not affect private parties' incentives to invest. For example, in France (see Box 13), the Netherlands, and the United States, legislation was necessary for municipal projects to materialize. [84]

In addition, municipal project may face challenges from incumbent providers. In the United States, for example, incumbent providers have consistently used the courts and state legislatures to block municipal broadband projects, particularly those related to WiFi deployments.[85] At present, 14 states have enacted some sort of legislation restricting municipalities from offering telecommunications services, half of which apply to broadband.

Box 13: Enabling local governments to deploy next generation access networks in France

In June 2004, France amended the Territorial Collectivities Code[86] to expand municipalities' authority to promote and roll-out telecommunications infrastructure within their jurisdictions. Local governments now are allowed to deploy networks that they may operate themselves (i.e., acting as carrier's carrier) or outsource to private operators. In addition, municipalities are exceptionally entitled to serve end users directly under very specific circumstances.[87]

Municipalities must publish their projects to roll-out infrastructure in the official journal two months before starting operations and must also inform the regulator, ARCEP, of their projects. Local governments must adhere to principles of transparency, non-discrimination, and proportionality in their telecommunications activities. In addition, they must establish account separation for activities involving the telecommunications network.

In early 2006, ARCEP reported that French municipalities had shown interest in 1,480 municipal telecommunications networks projects, 380 of which foresaw the deployment of fibre optic networks, either FTTH or FTTC.[88]

4 Facilitating the Transition to a Pre-NGN and NGN World

It is important for governments to build in mechanisms for collaboration among regulators, policy makers and industry as they grapple with how best to address the transition to an NGN environment. Regulators in Costa Rica, the United Kingdom, and Lithuania have recognized that they should play a supervisory role rather than attempt to manage the migration to NGNs, as industry stakeholders, which better understand the requirements and possibilities of NGNs, are more likely to develop better solutions than regulators. The goal of such collaboration is to ensure that the regulatory framework is not so restrictive that it thwarts investment in NGN, and at the same time does not act too late to encourage competition. The involvement of stakeholders in the regulatory process can take a number of forms, including a consultative process, hearings, seminars, forums, community meetings, as well as establishing technology expert groups and industry-led groups.

Involving stakeholders in the regulatory process is an essential part of a regulator's decision-making process and provides abundant benefits. It enhances confidence in the regulator by providing

stakeholders an opportunity to voice their opinions on a regulatory issue, although the regulator may not ultimately agree with their position. It also increases consensus and support for regulatory decisions since the stakeholders have had an opportunity to participate in the process. Moreover, it provides an opportunity for stakeholders to provide input on the regulator's plan of action and allows for feedback from stakeholders with valuable insights into the sector given their day-to-day operations in the industry. Finally, obtaining input from stakeholders reinforces regulatory autonomy and accountability since it demonstrates to stakeholders that the regulator has decision-making power in the regulatory process.

4.1 Consultative Processes

Many countries have undertaken policy and regulatory initiatives related to NGN, IP-related issues, and convergence, including Australia, Germany, India, Japan, Mexico, Netherlands, Singapore, and the United Kingdom.

For example, in January 2006, TRAI of India issued a consultation paper seeking comments from stakeholders on NGN-related issues, such as the relevance and timing for transition to NGN, regulatory and technical issues, and migration-related requirements. In addition, it conducted Open House Discussions in the cities of Bangalore and Delhi to seek views of consumer organizations and other stakeholders. As a result, TRAI issued its recommendations in a document published in March of 2006, addressing among other issues, the need to enhance cross-industry and regulator collaboration in the transition towards NGNs.[89]

During May-June 2006, OPTA of the Netherlands sought comments from stakeholders regarding regulatory issues surrounding KPN's plans to migrate to NGN, an operation called All-IP by KPN.[90] In particular, the consultation was focused on "the relationship between All-IP and KPN's existing obligation to offer unbundled access to its access network." In October 2006, OPTA issued an All-IP Position Paper to inform and consult stakeholders about the policies it was proposing to adopt and the follow-up activities it was planning to undertake.[91]

In addition, some countries have also initiated less formal consultation processes. Ofcom, for example, issued a public discussion document in November 2006 entitled "Regulatory challenges posed by next generation access networks," in which it indicated its interest in obtaining stakeholders views and opinions. Although it did not initiate a formal consultation process, Ofcom indicated its interest in receiving written views from third parties to promote public discussion on the way forward regarding next generation access network deployment and regulation. In addition, Ofcom noted its intention to organize several seminars in 2007 to meet with stakeholders and discuss the issues presented by next generation access.

4.2 Public Awareness Campaigns

For some regulators, one of the first steps to addressing the transition to NGN has been to provide greater awareness about the issues related to NGNs and how they will impact the industry and consumers. For example, after conducting its consultation process, India's TRAI issued final recommendations that focused on the need to increase awareness about various aspects of NGN.[92] Among its recommendations were that (i) the government should arrange to organize some interactive workshops/seminars; (ii) a cross industry joint consultative group consisting of Telecom Engineering Centre (TEC) (the standards-setting organization in India), service providers, technical institutions, and vendors should be established to analyze NGN standards and their customization for national

requirement; (iii) TRAI should conduct a detailed consultation with stakeholders on the interconnection issues and QoS regulation for NGN; and (iv) an expert committee should be established.

In Australia, the regulator also has been keen about the importance of public awareness. In its VoIP Report, the ACMA included various recommendations regarding its obligations to promote consumer awareness regarding VoIP. In particular, ACMA decided to promote consumer awareness through toolkits and facts sheets about the differences between VoIP services and traditional circuit-switched telephony services and ways consumers can influence the performance of their VoIP service. In addition, providers were required to disclose to consumers the characteristics and limitations of any VoIP service they purchase in comparison to traditional circuit-switched telephony services.

4.3 Industry and Consultative Bodies

Various countries are establishing industry groups or expert groups to address the transition to NGN. These groups may be ad hoc or an existing consultative body comprised of several government agencies, industry representatives, and other interested parties. The role and functions of these consultative bodies vary, but they generally issue recommendations to the government addressing the need for changes in convergence legislation and/or regulation. The expectation is that such groups will benefit all stakeholders in the transition of the telecommunications industry to NGNs and will help to ensure a smooth transition for both industry and end-users. These consultative bodies are a valuable tool that provide a way to constantly review and monitor the transition to NGN, as well as the effects of convergence, and can provide first-hand contact with industry and other parties that deal with these issues directly.

For example, in the United Kingdom, Ofcom has established NGNuk, an independent NGN industry body, in order to create an improved framework for industry involvement (see Box 14). In addition, Australia has several consultative forums for the communications sector. For example, the Australian Communications Industry Forum (ACIF) implements and manages industry self-regulation. As part of its activities, it established the (NGN) Future Operations Group (NGN FOG) to discuss and analyze issues relating to NGN implementation. Similarly, in Mexico recently established a Convergence Committee comprised of the regulator, COFETEL, service providers, and industry experts. Recently, the regulator in India, TRAI, announced its intent to establish "NGN eCo" (NGN Expert Committee) to facilitate joint consultation between the regulator and consumers, industry players and policy makers. The Committee will address issues such as interconnection, QoS, awareness building and the migration timetable for NGN.

Some consultative groups are much larger in scope, such as in Japan, where the government recognized the importance of promoting industry-academia-government collaboration and established the Next Generation IP Network Promotion Forum in December 2005. The Forum consists of 211 members including universities, telecommunications carriers, manufacturers, and application production companies, led by the National Institute of Information and Communications Technology.

Moreover, in certain countries, the regulators have established expert groups to assist them with the preparation of reports and studies that are used as part of the consultation process. For example, in October 2005, the MIC in Japan established the "Study Group on a Framework for Competition Rules to Address the transition to IP-Based Networks" to address the migration towards NGNs and its regulatory implications. This group issued a report with a set of recommendations and principles to guide competition policies in the NGN world. The MIC adopted these recommendations and

formulated a road map for developing fair competition rules shortly after 2010 to further promote competition in telecommunications markets and secure user benefits.

Similarly, in Germany, the regulator created a Project Group, consisting of high-level telecommunications experts led by the head of the regulatory authority, to assist it with developing a report on the appropriate interconnection framework for IP-based networks. The Project Group's mandate was to act in an advisory capacity and not to make any legally binding decisions. The regulator subsequently initiated consultation with results expected in 2007. In addition to preparing the report, the Project Group's experts have given presentations that are accessible on the regulator's website, and the regulator has commissioned experts to prepare various studies.

Box 14: NGNuk: Background, justification, goals and current developments

In June 2005 Ofcom published a consultation entitled "Next Generation Networks: Further Consultation",[93] which proposed a series of policy principles and processes to support the development of NGNs in the United Kingdom. Ofcom's position is that it is inappropriate for it to manage the migration to NGN and that this is best left to BT and alternative providers which understand the requirements and possibilities of NGNs and therefore are likely to develop better solutions than Ofcom. Because of this, Ofcom instead sought to ensure that suitable industry-led processes were established and empowered to successfully implement this change in line with the policy principles proposed by Ofcom.

Figure 3. Ofcom's role in the move to NGNs

What	How
Help to identify and clarify potential regulatory issues early on	Consultation and ongoing dialogue with stakeholders
Establish clear governing policy rules to support NGN-based competition	Consultation and subsequent statement in conjunction with UK Enterprise Act consultation/Statement on Undertakings
Establish policy framework for consumer protection and information	Consultation and subsequent work on communication plan
Ensure appropriate industry-led processes are established	Consultation and ongoing discussions With stakeholders
Ensure industry-led processes stay on Track	Ongoing informal monitoring and dialogue With BT and other providers
Resolution of competition issues when industry processes fail	Formal market reviews and ex post competition powers as required
Updating ex ante regulatory framework to take account of NGNs	Ongoing programme of market reviews (e.g., updating market definitions, remedies and de-regulating as appropriate)

Source: Ofcom, Next Generation Networks: Further Consultation, at p. 10.

Ofcom proposed establishing an industry body to coordinate the UK telecommunications industry's transition to NGN core networks and engaged consultants to develop a more detailed proposal regarding the purpose and scope of the industry body, as well as the mechanics of its operation (*i.e.*, its membership, governance, funding, etc).[94] On this basis, in its report entitled "Next Generation Networks: Developing the regulatory framework"[95], Ofcom announced plans to establish NGNuk as an independent NGN industry body, with the purpose of creating an improved framework for industry engagement and focusing on three primary issues: IP

interconnect architecture; IP interconnect commercial model; and network intelligence interoperability.[96]

The role of the proposed body is not to provide a substitute for Ofcom's regulatory functions, but to ensure that there is a clear commercial vision led by industry for competition based on interconnected NGNs. This, Ofcom has argued, would allow for regulation to follow the market rather than lead it.[97]

NGNuk began its start-up phase on 1 April 2006 and its Constitution was agreed upon and signed on August 16 2006.[98] Following Ofcom's clear intention, the Executive NGNuk's members consist of electronic communications network providers with a demonstrable, substantial, network investment (whether existing or committed) in NGNs in the United Kingdom, with the clear intent to interconnect with other NGNs. Participating members reflect the wide range of NGN stakeholders with a bona fide and demonstrable intention to interconnect, use, or invest in NGNs in the United Kingdom.[99]

4.4 International Forums

International organizations such as the ITU, *info*Dev, INTUG, and OECD, as well as regional organizations and industry associations, such as APEC, APT, CITEL, CEPT, EU, ECTA, ETNO, and ETP are involved in NGN policy and regulatory initiatives through workshops, seminars, conferences, consultations, reports, and study groups. For example, the ITU has created the Next Generation Networks Global Standards Initiative (NGN-GSI) which focuses on developing the detailed standards necessary for NGN deployment to give service providers the means to offer the wide range of services expected to be delivered by NGNs. In collaboration with other bodies, NGN-GSI aims to harmonize different approaches to NGN architecture worldwide. In addition, it has established the NGN Focus Group under the banner of the NGN-GSI. Moreover, a number of ITU-T Study Groups are addressing questions related to NGN migration issues, particularly Study Group 1, as well as Study Groups 11, 12, 13, 15, 16 and 19. Similarly, the ITU Development Sector (ITU-D), is also focusing on NGNs through its programmes and study groups, in furtherance of the recent decisions of the World Telecommunication Development Conference.

Regulators should monitor these international developments regarding NGN-related issues, such as IP-interconnection, standardization, and numbering and, to the extent possible, should participate by attending meetings and providing input and comments into the process. Coordination and interaction with other regulators and entities that are confronting similar NGN transition issues are a useful tool and resource that should be fully utilized.

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[1] *See* ICT Regulation Toolkit, *info*Dev/ITU, available at http://www.ictregulationtoolkit.org/section/legal_regulation/impact_of_convergence/4_3_modifications_to_telecommunications_legislation_to_address_convergence/4_3_4_interconnection/.

[2] ITU-T Recommendation Y.2001.

[3] NGNs are composed of an access component and a core component. The access component of NGNs (or Next Generation access network), constitutes the evolution of existing access or distribution networks (local loops) with the deployment of new high-speed technologies, particularly fibre into the local loop. The core component constitutes the integration or convergence of existing backbone infrastructure (e.g. ATM, frame relay, X.25, ISDN, etc.) towards an integrated IP-based network, allowing for multiple service/applications capabilities and differentiated quality of service.

[4] See also Wey, Christian, Pio Baake and Sven Heitzler, Ruling the New and Emerging Markets in the Telecommunication Sector. Challenges: The Emergence of Next Generation Networks, ITU, 15 April 2006, available at http://www.itu.int/osg/spu/ngn/documents/Papers/Wey-060323-Prem-v1.1.pdf

[5] According to the 2006 Millennium Goals Report, in 2004, Africa added some 15 million new mobile phone subscribers. This figure is equivalent to the total number of fixed and mobile telephone subscribers on the continent in 1996. See UN, Millennium Development Goals Report 2006, at p. 25. Available at http://unstats.un.org/unsd/mdg/Resources/Static/Products/Progress2006/MDGReport2006.pdf

[6] *Id*.

[7] *See* Contribution of the National Regulatory for Communications Authority of Romania (ANRC) on the Economic and Regulatory Aspects Regarding the Migration to Next Generation Networks, available at http://www.itu.int/ITU-D/treg/Events/Seminars/GSR/GSR07/contributions/rom.pdf.

[8] *See* Keynote Speech by Mr. M H Au, Director-General, Office of the Telecommunications Authority, Hong Kong , People's Republic of China in the Session on "Next Generation Networks for Development: The Enabling Environment" on 7 December 2006, in the Telecommunications Development Symposium, ITU TELECOM WORLD 2006. Available at http://www.ofta.gov.hk/en/speech-presentation/2006/20061207.pdf

[9] *See* WSIS, Plan of Action. Document WSIS-03/GENEVA/DOC/5-E, 12 December 2003, Action Line C6. Available at http://www.itu.int/wsis/docs/geneva/official/poa.html#c6

[10] Ofcom, Regulatory challenges posed by next generation access networks. Public discussion document. 23 November 2006, at p. 16.

[11] Explanation to the recommendation of the European Commission of 11 February 2003 regarding relevant product and service market, Official Journal of the EC 203, L114/45, page 29.

[12] The investment ladder, or 'ladder of investment' is a theoretical concept based on the notion that competitors will roll out their networks gradually, first by simply reselling, then by purchasing wholesale broadband access, then acquiring unbundled access to the local loop, and finally deploying end user connections.

[13] *See* regulator's contributions to the 2007 Global Symposium for Regulators available at http://www.itu.int/ITU-D/treg/Events/Seminars/GSR/GSR07/consultation.html

[14] OPTA, KPN's Next Generation Network: All-IP. Position Paper, 3 October 2006 (OPTA/BO/2006/202771), at p. 8.

[15] Ofcom, Regulatory challenges posed by next generation access networks. Public discussion document. 23 November 2006, at p. 3.

[16] Ofcom, Regulatory challenges posed by next generation access networks. Public discussion document. 23 November 2006, at p. 22.

[17] OFTA, Review of Type II Interconnection Policy, July 2004, at p. 4.

[18] Telecommunications Act of 1996, Pub. L. No. 104-104, 110 Stat. 56. The 1996 Act amended the Communications Act of 1934, 47 U.S.C. § 151 *et seq.*

[19] Hence, we will not address it in depth here. For a complete account see FCC, In the Matter of *Unbundled Access to Network Elements; Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers*, WC Docket No. 04-313 and CC Docket No. 01-338, Order on Remand 18 FCC Rcd 16978, 17145, para. 6-19 (2005) (*Triennial Remand Order*).

[20] *Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers; Implementation of the Local Competition Provisions of the Telecommunications Act of 1996; Deployment of Wireline Services Offering Advanced Telecommunications Capability*, CC Docket Nos. 01-338, 96-98, 98-147, Report and Order and Order on Remand and Further Notice of Proposed Rulemaking, 18 FCC Rcd 16978, 17145, para. 200, 288 (2003) (*Triennial Review Order*). These rules were later upheld by the D.C. Circuit on March 2, 2004, in *USTA II* (359 F.3d at 564-76).

[21] Id. para. 275. "Greenfield" markets are those "which require entirely new construction of local loops (in addition to the deployment of the necessary switching and other network equipment) to serve new residential communities." Id. para. 227.

[22] Id. paras. 276-77. Overbuild or "brownfield" deployment refers to the situation in which "an incumbent LEC constructs fibre transmission facilities parallel to or in replacement of its existing copper plant." Id. para. 276.

[23] Id. paras. 288-89.

[24] Id. para. 296.

[25] *Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers; Implementation of the Local Competition Provisions of the Telecommunications Act of 1996; Deployment of Wireline Services Offering Advanced Telecommunications Capability* CC Docket Nos. 01-338, 96-98, 98-147, Order on Reconsideration, 18 FCC Rcd 16978, 17145, para. 4 (2004) (*Order on Reconsideration*).

[26] *See* FCC, High-Speed Services for Internet Access: Status as of December 31, 2005. July 2006. Available at http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-266596A1.pdf.

[27] OFTA, Review of Type II Interconnection Policy, July 2004, at p. 5. Available at http://www.ofta.gov.hk/en/report-paper-guide/paper/information/info20040706.pdf

[28] OFTA, supra note 22 at p. 5.

[29] In Hong Kong, China, Type II interconnection was only granted to the three new entrants in 1995, namely Hutchison Global Communications Limited (HGC), Wharf T&T Limited (Wharf T&T) and New World Telecommunications Limited (NWT), with the incumbent, PCCW-HKT Telephone Limited (PCCW-HKT), being forced to provide interconnection. Other competitors which entered the market starting from 2003, notably Hong Kong Broadband Network (HKBN), was not eligible for mandatory Type II interconnection and was required to build its network outright. In addition, OFTA observed that HGC was also building its fibre optic network steadily and was operating quite independent of the availability of mandatory Type II interconnection. Meanwhile, NWT and Wharf T&T relied more on Type II interconnection to roll-out their own services.

[30] OFTA, supra note 22 at p. 5.

[31] ARCEP, Notification a la Commission européenne du projet de décision proposant la levée de la régulation du marché des offres de gros d'accès large bande livrées au niveau national (December 2006) available at http://www.arcep.fr/uploads/tx_gspublication/proj-dec-12bis-comue-dec2006.pdf.

[32] *See* TRAI, Recommendations pertaining to Local Loop Unbundling at para 3.4.2.13 to 3.4.2.22.

See Ministry of Communications and Information Technology, Broadband Policy 2004. Available at http://www.dotindia.com/ntp/broadbandpolicy2004.htm. Also *see* TRAI, Letter to the Secretary of the Department of Telecommunications, Ministry of Communication and Information Technology, in re Broadband Policy 2004 - targets and achievement, F.No.2-2/2004-CN, November 3, 2005, Annex "A". Available at http://www.trai.gov.in/trai/upload/Recommendations/5/letter3nov05.pdf.

[33] Ofcom, Regulatory challenges posed by next generation access networks. Public discussion document. 23 November 2006, at p. 23.

[34] Statement from Martin Selmayr, spokesman for EU commissioner Viviane Reding, in German Parliament approves rules banning rivals from Deutsche Telekom's new network, International Herald Tribune, available at http://www.iht.com/articles/2006/12/15/business/telekom.php.

[35] *See* EC, letter of 21 August 2006, Case DE/2006/0457: Remedies relating to the Market for IP bitstream access with handover at IP level at different places in the network hierarchy, including HFC broadband access with handover at IP level. Comments pursuant to Article 7(3) of Directive 2002/21/EC (Framework Directive).

[36] VDSL access is generally offered over so-called "hybrid local loops" between the main distribution frame and the customer's premises. Hybrid local loops are lines partially consisting of fibre optic, either from the main distribution frame to the remote concentrator or to the street cabinet, whereas the part of the local loop leading into the premises of the end-user consists of copper.

[37] EC, *supra* note 1, at 4. (EC, letter of 21 August 2006).

[38] *See* EC, letter of 11 November 2005, Case DE/2005/0262: Wholesale Broadband Access. Opening Phase II investigation pursuant to Article 7 (4) of Directive 2002/21/EC (Framework Directive).

[39] EC, *supra* note 4, at 5. (EC, letter of 11 November 2005).

[40] *See* EC letter of 23 December 2005, Case DE/2005/0262: Wholesale Broadband Access in Germany. Withdrawal of serious doubts, at 4.

[41] *Id.* at 4.

[42] *Id.* at 5. However, in a more recent letter to the BNetzA, the Commission all but eliminated this possibility - with regards to VDSL - indicating that *"the question about the substitutability between bitstream access to VDSL connections and other forms of bitstream access should be answered positively from the outset."* EC, *supra* note 1, at 4. (EC, letter of 21 August 2006).

[43] *Id.*, at 4.

[44] *See* EC, Commission Staff Working Document. Public Consultation on a Draft Commission Recommendation on Relevant Product and Service Markets within the electronic communications sector susceptible to *ex ante* regulation in accordance with Directive 2002/21/EC of the European Parliament and of the Council on a common regulatory framework for electronic communication networks and services (Second edition), 28 June 2006, SEC(2006) 837, at p. 16. (Draft Recommendation)

[45] EC, supra note 38, at p. 28.

[46] *See* OFCOM, Final statements on the Strategic Review of Telecommunications, and undertakings in lieu of a reference under the Enterprise Act 2002, 22 September 2005, available at http://www.ofcom.org.uk/consult/condocs/statement_tsr/statement.pdf.

[47] See www.openreach.co.uk/orpg/home/home.do.

[48] Ofcom, Regulatory challenges posed by next generation access networks. Public discussion document. 23 November 2006.

[49] *See* ACCC 'perplexed' by Telstra decision on fibre-to-the-node investment, Press release, 7th August 2006. Available at: http://www.accc.gov.au/content/index.phtml/itemId/757949.

[50] FCC Adopts Rules to Ensure Reasonable Franchising Process for New Video Market Entrants. December 20, 2006. Available at http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-269111A1.pdf.

[51] *See also* Dale N. Hatfield and Eric Lie, *Why Licence?*, in Trends in Telecommunication Reform 2004/2005: Licencing in an Era of Convergence. ITU. P. 28.

[52] *See* regulator's contribution to the 2007 Global Symposium for Regulators available at http://www.itu.int/ITU-D/treg/Events/Seminars/GSR/GSR07/consultation.html.

[53] See ANRT, Response to the consultation in preparation for the 2007 Global Symposium for Regulators, available at http://www.itu.int/ITU-D/treg/Events/Seminars/GSR/GSR07/contributions/mrc.pdf

[54] Uganda Communications Commission, available at: http://www.ucc.co.ug/licensing/default.php.

[55] *See* Cahier des Charges de la licence nouvelle génération attribuée à Médi Telecom S.A. pour l'établissement et l'exploitation de réseaux publics de télécommunications au Royaume du Maroc, avalable at http://www.anrt.net.ma/fr/

[56] Article 27 of Decree-Law 1900 of August 19, 1990.

[57] *See* Law No. 142 of 1994 on Public Domiciliary Services (establishing the service categories of local and long distance basic public switched telephony); Law No. 37 of 1993, as amended (regulating mobile ceULLlar telephony services) and Law No. 555 of 2000 (regulating Personal Communications Services).

[58] Article 8 of the draft Regulation on Convergence.

[59] See Competition Tribunal, Decision Nº 45/2006 of 26 October 2006, available at http://www.tdlc.cl/db_images/sentencias/45411f978d854_Sentencia-45-2006.pdf.

[60] Available at http://www.subtel.cl/servlet/page?_pageid=58&_dad=portal30&_schema=PORTAL30.

[61] *Madison River Communications, LLC and affiliated companies* File No. EB-05-IH-0110, Order (2005). Available at http://hraunfoss.fcc.gov/edocs_public/attachmatch/DA-05-543A2.pdf.

[62] There is currently an ongoing proceeding regarding IP-Enabled services in order to determine what rules will apply to these services. *See* In the Matter of IP-Enabled Services, WC Docket No. 04-36.

[63] *Appropriate Framework for Broadband Access to the Internet over Wireline Facilities; Review of Regulatory Requirements for Incumbent LEC Broadband Telecommunications Services; Computer III Further Remand Proceedings: Bell Operating Company Provision of Enhanced Services; 1998 Biennial Regulatory Review – Review of Computer III and ONA Safeguards and Requirements; Inquiry Concerning High-Speed Access to the Internet Over Cable and Other Facilities; Internet Over Cable Declaratory Ruling; Appropriate Regulatory Treatment for Broadband Access to the Internet Over Cable Facilities* CC Docket Nos. 02-33, 01-337, 95-20, 98-10, GN Docket No. 00-185, CS Docket No. 02-52, Policy Statement, 18 FCC Rcd 16978, 17145, para. 4 (2005). Available at http://www.cdt.org/speech/net-neutrality/20050923fcc-appropriate-framework-nprm.pdf.

[64] *See* ICT Regulation Toolkit, *info*Dev/ITU, available at http://www.ictregulationtoolkit.org/section/legal_regulation/impact_of_convergence/4_3_modifications_to_telecommunications_legislation_to_address_convergence/4_3_4_interconnection/.

[65] ENUM resulted from the work of the ITU's Internet Engineering Task Force's (IETF's) Telephone Number Mapping working group. The working group was assigned with the task of defining a Domain Name System (DNS)-based architecture and protocols to map a PSTN telephone number to a Uniform Resource Locator (URL) through which a recipient could be contacted. For further details, see ITU-T Resolution 49, *available at* http://www.itu.int/dms_pub/itu-t/opb/res/T-RES-T.49-2004-PDF-E.pdf.

[66] *See* http://itu.int/ITU-T/inr/enum/procedures.html and http://www.itu.int/ITU-T/inr/enum/procedures-02.html.

[67] *See* http://www.itu.int/osg/spu/presentations/2004/enum-country-experiences-ftra-uganda-rs.pdf. For an example of an ENUM trial, *see also* http://www.enum.org/.

[68] *See* ANRT, Response to the consultation in preparation for the 2007 Global Symposium for Regulators, available at http://www.itu.int/ITU-D/treg/Events/Seminars/GSR/GSR07/contributions/mrc.pdf

[69] *See* Recommendation ITU-R M.1645.

[70] See Resolution 802 (WRC-03), resolves 1.4 (also referred to as Agenda item 1.4).

[71] "Although the terms "universal service" and "universal access" are closely related and are sometimes used interchangeably, they have different meanings. Universal service refers to the provision of telecommunications services to all households within a country, including those in rural and remote (high cost) locations. Universal access policies seek to increase access to telecommunications services on a shared basis, such as on a community or village-wide level. Universal access programs typically promote the installation of public payphones or public call offices in rural and remote villages or low-income urban areas with the aim of providing a basic and initial connection to the telecommunications network. While universal service may be a realistic policy objective in developed countries, universal access is a more feasible practical goal in many developing countries." Patrick Xavier, *What rules for universal service in an IP-enabled NGN environment?* ITU, April 15, 2006, p.4. Available at http://www.itu.int/osg/spu/ngn/documents/Papers/Xavier-060323-Fin-v1.pdf.

[72] Availability implies that the level and quality of service (including reliability) is the same wherever a person lives or works, so that residing in a high cost rural or remote area does not affect a person's ability to access communication services. Affordability is referred to the fact that maintaining and using the service does not place an unreasonable burden on consumers, particularly on vulnerable disadvantaged consumers. Accessibility means that people with disability can use the service. See Xavier, supra note 60 at p. 5.

[73] World Telecommunication Regulatory Database 2005.

[74] See Xavier, supra note 60, p. 8; Ofcom, *Review of the Universal Service Obligation," 10 January 2005. Available at http://www.ofcom.gov.org.uk.*

[75] *See* MIC, New Competition Promotion Program 2010, 19 September 2006, at. p. 2, available at http://www.soumu.go.jp/joho_tsusin/eng/pdf/060928_1.pdf.

[76] MIC, New Competition Promotion Program 2010, 19 September 2006, at. p. 3, available at http://www.soumu.go.jp/joho_tsusin/eng/pdf/060928_1.pdf.

[77] *See* ANRT, Response to the consultation in preparation for the 2007 Global Symposium for Regulators, available at http://www.itu.int/ITU-D/treg/Events/Seminars/GSR/GSR07/contributions/mrc.pdf

[78] TRAI, Recommendations on Issues Pertaining to Next Generation Networks (NGN), 20 March 2006, at p. 14. Available at http://www.trai.gov.in/trai/upload/Recommendations/47/recom20mar06.pdf.

[79] Consultation on the Establishment of a Communications Authority, Communications and Technology Branch, Commerce, Industry and Technology Bureau, March 2006.

[80] *See* www.citynet.nl.

[81] The Operating Company will be responsible for running the Network, providing bandwidth connectivity on a wholesale basis to RSPs that would compete with each other providing services to end-users.

[82] *See* Telecommunications Industry Association (TIA) and FTTH Council, U.S. Optical Fibre Communities – 2006, available at http://www.ftthcouncil.org/documents/959055.pdf. It is worth noting that there has been considerable increase in the number of communities served with FTTH in the United States during the past years. Data from 2005-2006 shows an increase of more than 135% on a year-to-year comparison, as the number of communities served in May of 2005 was 398. *See* Telecommunications Industry Association (TIA) and FTTH Council, U.S. Optical Fibre Communities – 2005, available at http://ftthcouncil.org/documents/213284.pdf.

[83] Ofcom, Regulatory challenges posed by next generation access networks. Public discussion document. 23 November 2006, at p. 19.

[84] *See* Randal C. Picker, *Who Should Regulate Entry into IPTV and Municipal Wireless?* John M. Olin Law & Economics Working Paper No. 308, University of Chicago Law School, September, 2006. Available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=931495.

[85] For a recent reference to the legal landscape of municipal WiFi in the United States, *see* Federal trade Commission, Municipal Provision of Wireless Internet, Staff Report, September, 2006. Available at http://www.ftc.gov/os/2006/10/V060021municipalprovwirelessinternet.pdf.

[86] Code General de Collectivités Territoriales. Article L 1425.1, introduced by the Loi nº 2004-575 du 21 juin 2004 pour la confiance dans l'économie numérique.

[87] Municipalities can only serve end users directly if it is confirmed that private initiatives are insufficient to meet end user demand in their jurisdictions. To this end, local governments must conduct public offerings to enlist private operators that meet this demand. Only if this process is unsuccessful (*i.e.*, no private parties come forward to meet demand), and after duly notifying the French regulator, ARCEP, may local governments engage in the provision of end user services.

[88] Equipement des zones d'activité en infrastructures de télécommunications a haut et très haut débit. Guide pour les aménageurs et pour les collectivités. ARCEP. P. 14.

[89] *See* TRAI, supra note 66.

[90] Issue Paper KPN's Next Generation Network: All-IP dated 22 May 2006, reference: OPTA/BO/2006/201599.

[91] Position Paper KPN's Next Generation Network: All-IP dated 3 October 2006, reference: OPTA/BO/2006/202771.

[92] TRAI Recommendations, March 2006.

[93] Issued June 30, 2005.

[94] Spectrum Strategy Consultants, Ofcom. Scoping an NGN industry body. December 9, 2005. Available at http://www.ofcom.org.uk/consult/condocs/nxgnfc/ngn/.

[95] Issued March 7, 2006. Available at: http://www.ofcom.org.uk/consult/condocs/nxgnfc/statement/ngnstatement.pdf

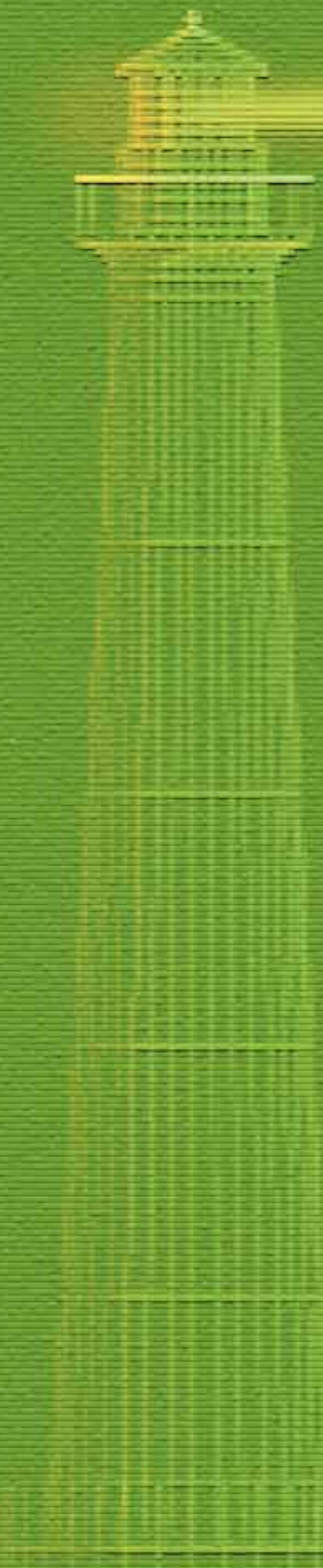
[96] *Id.* at p. 8-9.

[97] *Id.* at p. 9.

[98] *See* NGNuk Constitution, available at: http://www.ngnuk.org.uk/docs/NGNuk_constitution_060816.pdf.

[99] *Id.* Sections 3.3.3 and 3.4.1.

International Telecommunication Union



GSR 2007

DISCUSSION PAPER

Quality of Service and Consumer Protection in an NGN World

Comments are welcome and should be sent by 1 March 2007 to GSR07@itu.int

ITU International Telecommunication Union

GLOBAL SYMPOSIUM FOR REGULATORS

Dubai World Trade Center
Dubai, United Arab Emirates

5-7 February 2007

Work in progress, for discussion purposes

CONSUMER PROTECTION AND QUALITY OF SERVICE (QoS), INCLUDING NETWORK NEUTRALITY AND CYBER-SECURITY ISSUES

PREPARED BY ROSALIND STEVENS-STROHMANN, CONSUMER POLICY MANAGER
OFCOM

COMMENTS ARE WELCOME AND SHOULD BE SENT BY 1 MARCH 2007 TO
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GSR DISCUSSION PAPER

CONSUMER PROTECTION AND QUALITY OF SERVICE (QOS), INCLUDING NETWORK NEUTRALITY AND CYBER-SECURITY ISSUES

This paper has been prepared Rosalind Stevens-Strohmann[1], Consumer Policy Manager, OFCOM, as an input document for the 2007 Global Symposium for Regulators (GSR), organized by the Telecommunication Development Bureau (BDT). The views expressed in this paper are those of the author and do not necessarily reflect the opinions of the ITU or its membership. Comments are welcome and should be sent to gsr07@itu.int by 1 March 2007.

1 Introduction

The deployment of Next Generation Networks (NGN, using IP connectivity to support fixed, wireless and mobile voice, video, data, and broadcast TV services, provides new opportunities to increasing consumer choice. It also raises new challenges for Quality of Service (QoS) and for consumer protection.

Consumers have certain expectations of the quality of their communication service, primarily based on their past experience of the well established PSTN voice quality. However the increasing amount of choice of products available to them through NGN may well alter their perceptions of and satisfaction with the overall QoS provided.

In order to take full advantage of the choices on offer, consumers need to be equipped with the necessary skills and information to make fully informed purchasing decisions. They need access to comparable, reliable and independent information about price, quality and service features to empower them to switch with confidence.

The level of regulatory intervention required will depend in part on the structure of the market concerned and the commercial incentives for service providers. Where there is effective competition and commercial incentives for service providers the focus is likely to remain on consumer empowerment, enforced where necessary through transparency requirements. Where competition or commercial incentives are weak, regulators (NRA) may need to take a more interventionist approach, for example through setting and monitoring minimum QoS standards that are appropriate to the NGN environment.

Even the most well informed consumer may still need protection against threats to cyber security, such as identity theft by phishing, malicious virus dissemination via SPAM, the transmission of harmful content, etc. It is probably too early to predict whether these problems will be exacerbated by the deployment of NGN. For example, whereas the increasing sophistication of core NGNs has the potential to improve authentication and tracking procedures, this does not rule out the emergence of new scams and security threats. This chapter also describes the current cyber security issues and considers the options currently available for combating them.

2 Quality of service

2.1 Current QoS practices

From a consumer experience perspective, the regulatory approach to QoS for established PSTN networks is two dimensional[1]:

[1] The author is a Consumer Policy Manager at the Office of Communications (Ofcom). Although she has sought the opinions of her colleagues and referred extensively to Ofcom policy documents when writing this chapter, the opinions expressed are her own and do not necessarily represent Ofcom's views.

- Enforcement approach: whereby the NRA defines the QoS parameters and benchmark standards with which operators must comply.
- Encouragement approach: whereby the NRA relies on competition and publicity to empower consumers to make informed choices and switch providers.

In practice, NRAs are likely to adopt a mixture of the two. Within the European Union, the regulatory framework for QoS reporting is part of consumer protection legislation enacted through the Universal Services Directive.[2] The QoS requirements allow individual NRAs both flexibility and discretion as to whether to impose minimum quality of service standards and the parameters to be measured. This is important as the measures likely to be of most interest consumers are constantly evolving. For example, Annex III of the EU Universal Services Directive[3] did not include a parameter measuring delay before getting a dial tone, as this was no longer considered relevant to digital networks.

Box 1: The evolution of QoS monitoring in the EU

Annex III of the EU Universal Services Directive sets out the quality of service parameters, definitions and measurement methods to be used by NRAs to monitor the performance of designated undertakings with universal service obligations. NRAs may also require all providers of publicly available electronic communications services (PATS) to publish comparable QoS performance indicators for end-users, using Annex III parameters where appropriate.

Annex III Quality of service parameters: in accordance with ETSI EG 201 769-1 version 1.1.1 (April 2000) definition and measurement method.

Supply time for initial connection
Fault rate per access line
Fault repair time
Unsuccessful call ratio*
Call set up time*
Response times for operator services
Response times for directory enquiry services
Proportion of coin and card operated public pay-telephones in working order
Bill correctness complaints

* *Member States may decide not to require that up-to-date information concerning the performance for these two parameters be kept, if evidence is available to show that performance in these two areas is satisfactory.*

In the United Kingdom, for example, Ofcom has directed fixed voice providers to publish QoS parameters covering supply times; fault rates and fault repair; complaints resolution and upheld billing complaints[4]. Ofcom does not set or monitor benchmark standards for the parameters. Instead the results are published on an independent website (www.topcomm.org.uk) which enables consumers to compare QoS across providers and empowers them to switch if dissatisfied. The mobile operators are not directed to publish QoS information but are encouraged to do so. Comparable, independent information on mobile network voice call quality is updated fortnightly on an independent website (www.topnetuk.org). All of the measures are subject to review, with a view to extending the initiatives to include, for example, broadband QoS and mobile customer service.

Beyond the European Framework, NRAs have developed and employed a wide range of service indicators to meet the requirements of different markets[5]. In India for example, the TRAI requires operators to provide information about several categories of QoS indicators, covering[6]:

- Development eg telephony and payphone penetration, or growth in access lines;
- Network performance eg call completion rates;
- Customer service, including quantitative and qualitative aspects.

As well as requiring both fixed and mobile operators to publish the indicators on a quarterly basis, TRAI sets performance targets, which are reviewed annually with a view to encouraging improvements in standards[7].

Many countries continue to prescribe minimum standards for basic telephony services. In Brazil, for example, there are 36 different indicators and all licensed operators must comply with minimum QoS standards. Fines remain the most common way to enforce compliance. In Brazil, the NRA may impose a fine of up to USD $40 million for failure to comply.

In some countries the minimum QoS standards may be linked to price cap regulation. For example in the U.S. a QoS variable "Q" is included in the price cap formula. A similar approach has been adopted by the Colombian regulator. If service quality erodes, this will be reflected in lower prices for consumers, whereas if quality improves higher prices may be allowed. The NRAs are likely to consider imposing minimum QoS standards should quality fall to an unacceptable level.

Box 2: ITU QoS Indicators

The ITU includes QoS indicators for up to 206 economies it its annual World Telecommunication Report. It has also established a set of measures, which are published in the ITU Telecommunication Indicators Handbook[8]. These include:

- The length of waiting lists for main lines
- The percentage of telephone service faults cleared by the next working day.
- The percentage of failed calls.
- The number of telephone main line faults.
- The percentage of calls for operator service answered within 15 seconds.
- The number of complaints per 1,000 bills.

The customer satisfaction rate.

This chapter focuses on the "encouragement" approach which Ofcom has taken. This is because in order for QoS initiatives to be meaningful to consumers the information must keep pace with changing technological and market developments. The communication providers are best placed to provide the relevant QoS indicators in a timely fashion.

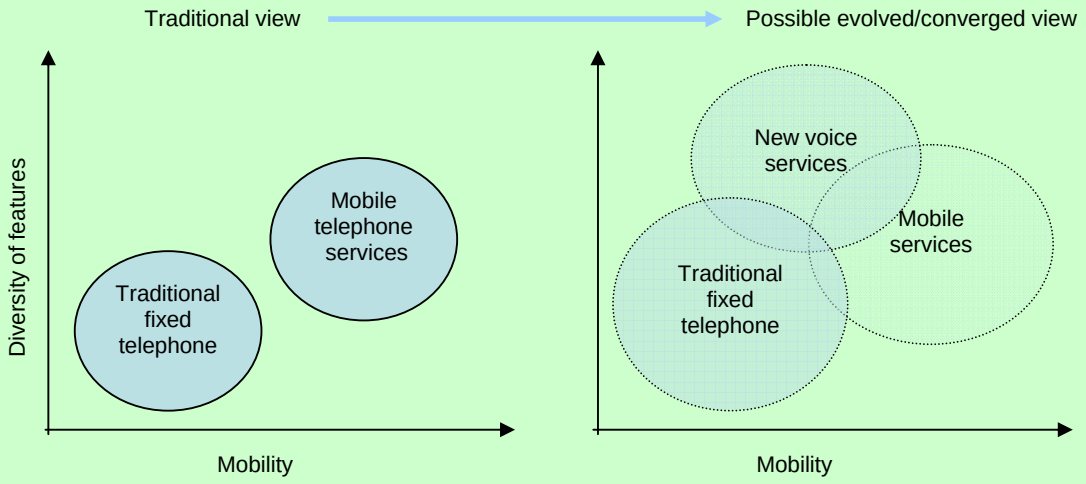
However, the ability to provide meaningful data does not necessarily mean that communication providers will be willing to provide it without regulatory intervention. As competition increases, there are clear incentives for providers with a high quality of service to produce and promote timely and accessible QoS information for consumers. Conversely there is no economic incentive for those providers offering a low quality of service to do the same[9]. In the United Kingdom, this issue is addressed by targeting enforcement action on a provider which fails to comply with the QoS Direction. A company that fails to publish QoS information as prescribed risks a fine of up to 10% of turnover.

For those readers who wish to learn more about various enforcement approaches taken on more global scale, there are a number of detailed studies, together with further information about QoS parameters, benchmarks and measurements[10]. There is also a comprehensive ITU website available, the Global Regulators Exchange (www.itu.int/grex), where NRAs exchange information about their practices with regard to setting parameters, measuring compliance and handling enforcement.

2.2 Quality of Service: Issues for NGN

NGNs support a converged communication framework using internet protocol (IP) based packet technologies on top of various transport technologies eg cable television (CATV), wireless and mobile technologies, etc. This facilitates the provision of multiple services to consumers, including voice, data and multimedia. The associated disaggregation of the service or application layer from the transport layer reduces the barriers for consumers wishing to access services provided by competing service providers.

Fig. 1: Evolution and convergence of new voice services



Source: Robert Milne (Antelope Consulting)

There are a number of QoS-related aspects that need to be addressed as NGN is deployed. These include:

- Service disruption during the migration from PSTN to NGN.
- Management of end-to-end voice quality of service.
- Access to emergency services and emergency call location.
- Number portability.
- Feasibility of alternative text relay services.
- Differentiation of QoS.
- Network integrity.
- Network security.

From a customer perspective, quality of service may relate to the communication service itself eg voice quality, picture quality, delay, speed, etc. It may also describe the quality of customer experience when interacting with the communication provider eg whether the bills received are accurate, how quickly a service is provided, how likely it is that there will be a fault with the service and how long the provider takes to repair it, how long it takes the call centre staff to answer the telephone and how helpful they are, etc. To avoid disappointment and complaints later on, customers need to be aware of the service levels they can expect before signing a contract for a product or service. This is especially important where a bundle of services is provided under the same contract.

However in order to identify the parameters most likely to satisfy and/or improve the customer experience, a technical perspective is required. In relation to NGN, it may be useful to differentiate between real-time interactive services, eg voice and video telephony; real-time non-interactive services, eg television transmission; and near real-time interactive services, eg instant messaging. For voice telephony it will always be important to control delay, jitter, error rate and packet loss, otherwise the consumer experience is likely to suffer. This is also true for video telephony, which also demands a higher guaranteed bandwidth to maintain a certain quality of service. Delay is less important for delivering quality in “streaming” services like television and for instant messaging only a minimum level of service quality across the parameters is needed to satisfy consumers.

2.3 Migration from PSTN to NGN

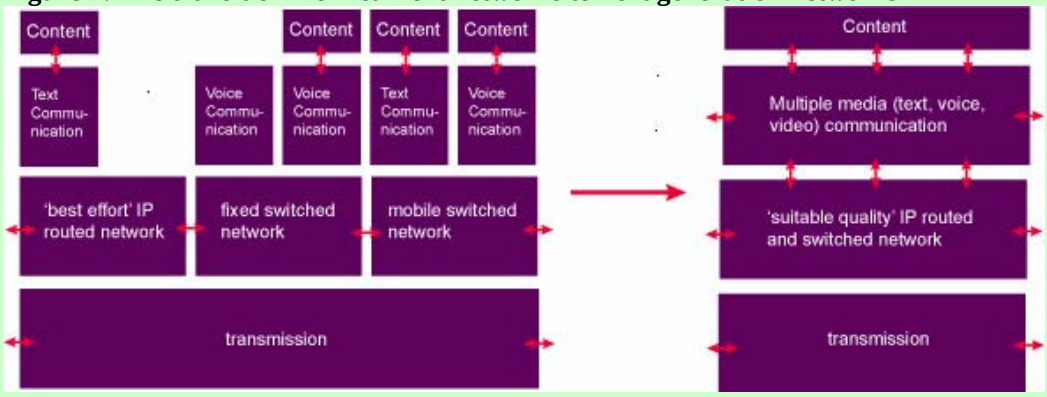
A key consideration for NRAs is to ensure that consumers do not suffer any loss or degradation of service during the migration to an NGN. It is also essential that consumers are fully informed about the transition and know what to expect. In the United Kingdom, BT recently began rolling out its 21CN network on an area by area basis. It has launched a special consumer information website, http://www.switchedonuk.org/home/, which helps consumers find out when the migration in their area is likely to happen, and how it is likely to affect them.

2.4 Management of end-to-end Voice QoS

The voice planning process in traditional telephony, whilst complex, is relatively straightforward. Environment, transmission, switching and voice communication services are provided by dedicated networks. It is possible to ensure voice quality by allocating dedicated bandwidth for the duration of each call.

In the NGN environment, a single network supports multiple service types (as illustrated in Figure 2 below). In order for NGNs to achieve the same grade voice quality, there needs to be either a system of network protocol prioritization or allocation of additional capacity. If not, voice calls may fail due to lengthy queuing delays, which happen during periods of congestion.

Figure 2: The transition from current networks to next generation networks



Source: Robert Milne (Antelope Consulting)

The emergence of NGNs is already driving much of the change in the way voice services are delivered. For example, whereas some of the new voice services such as Voice over IP (VoIP) have the potential to 'look and feel' like traditional telephone services, they may not be able to deliver over the Internet the same features or standards consumers have come to expect from a PSTN-grade voice service

The reliability and performance of a VoIP service depends on a number of elements. VoIP traffic will typically include signalling and media data, which take diverse routes through an IP network. For example, for a VoIP service running over an xDSL network, reliability will be affected by the quality and reliability of the PC, software and adaptor; the local access; the broadband access network (including the Digital subscriber line access multiplexer (DSLAM), Asynchronous transfer mode (ATM) and IP network); the core IP network and Internet peering arrangements; the service and application layers (e.g. home subscriber server, call server and media gateways) and interconnection into other networks.

A VoIP provider can only guarantee technical QoS standards to the extent that it is possible to control the end-to-end parameters of the network employed. In respect of the service/application and network layers there are a number of steps a VoIP service provider (including those offering nomadic services) can take in respect of those elements over which they have control:

- Engineer the VoIP service to minimise latency (which is the consumer's experience of network delay) and specify minimum requirements for use of the service, e.g., bandwidth and traffic control[11]. (However if the public Internet is used, the QoS is not guaranteed and the user experience will be variable.)

- Make the VoIP traffic a priority in terms of QoS within an IP network in accordance with an agreed DiffServ or IntServ class of service scheme which is then used between interconnected Ipv4 networks and may be maintained both in IP headers (precedence bits) and interconnected MPLS networks (EXP bits)[12].

- Design their networks to minimise routing hops, providing sufficient redundancy including call servers, gateways and network capacity, to deal with any throughput issues during re-routing or congestion

- Proactively manage any customer premise equipment (CPE) to dynamically alter the properties, such as packet and/or window size[13], to maximise throughput for voice traffic in response to observed network performance.

- Implement deep packet inspection to identify and prioritise voice traffic in those parts of the network over which it has control.

- Implement home subscriber server, gateways and call servers close to significant sources and sinks of traffic to other networks.

- In the case of an xDSL service, use the associated PSTN line for emergency access to ensure that in the event of power failure emergency calls would be routed to the associated PSTN line by use of software or control in the CPE/broadband adaptor.

The distinctions between mobile and fixed services are also likely to become harder to draw in future as new services start to offer some form of mobility and enhanced functionality. For example, in the UK there are already packages available that combine VoIP, mobile search, instant messaging and online auction services with mobile access to home TV content and to music, video and other digital content on users' home PCs.

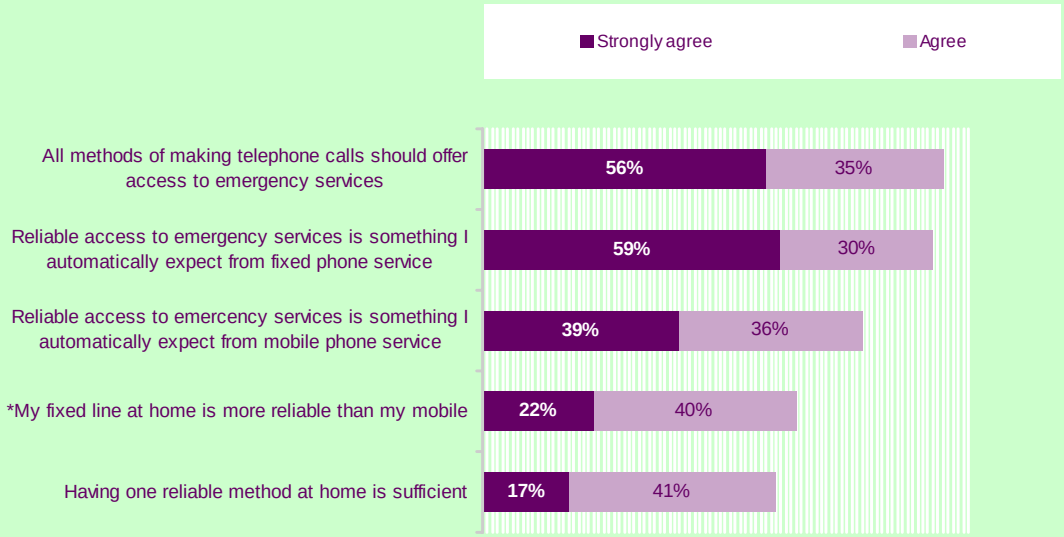
These trends are likely to affect both the type and quality of the services offered in the market. For example, with some routine Internet activities such as web browsing and email all that is normally required is sufficient bandwidth. The IP-protocol should not as rule experience any difficulty with delay, jitter etc. However as consumers demand more interactive functions such as conversations and video-conferencing, a low level of end-to-end delay and jitter, low packet loss, and a guaranteed bandwidth are all needed to ensure standards are maintained.

2.5 Access to emergency services and provision of emergency location information

Whereas traditional PSTN networks are normally line powered, VoIP services are dependent on mains power for their terminal equipment. Some VoIP services may not offer any access to emergency calls or reliability of the access may be affected by a power cut or power failure, or through failure of a broadband connection.

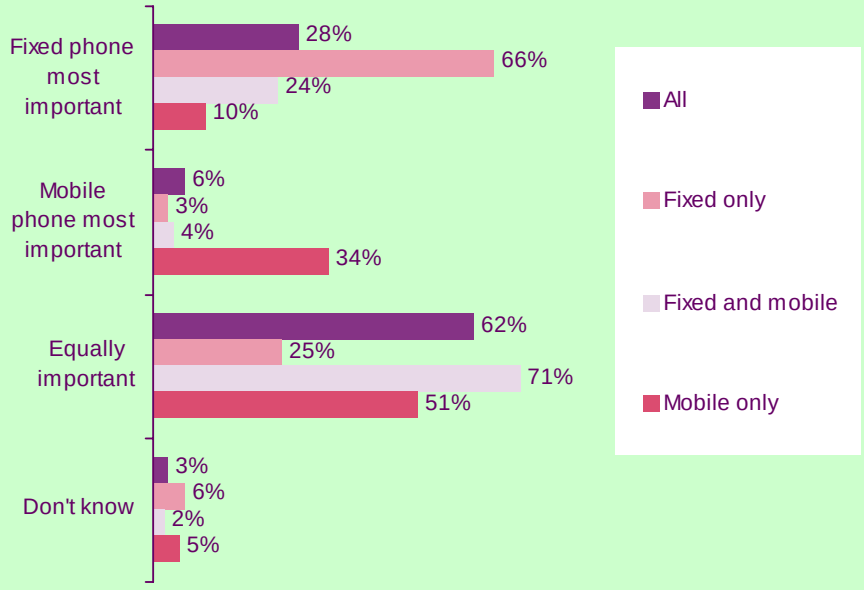
As figures 3 and 4 below illustrate, consumer expectations do not seem to accord with the actual situation, with most expecting access to emergency services through their fixed line phone service.

Fig 3: Consumer attitudes towards accessing emergency services



Source: Ofcom survey UK residents 2006
Base: Adults aged 15+, (Base: 883), with a fixed line at home who also personally use a mobile

Fig 4: Most important device in home for reliable access to emergency services



Source: Ofcom survey conducted by NOP World Base: GB adults aged 15+, May '2004 (Base: 883)[14]

There have been a number of significant changes in the regulatory arena and wider policy debate in relation to VoIP services. For instance, following high profile incidents in the US in 2005, the FCC changed its relatively liberal regulatory environment to one where VoIP services that interconnect with the PSTN (that is, that allow calls to or from traditional telephone lines/numbers) must provide access to emergency services, in line with the requirements that apply to incumbents[15].

The EU Regulatory Framework[16] requires Member States to put in place arrangements to ensure that calls to emergency services are adequately answered and handled. Caller location information should also be made

available to emergency services operators.

The obligation to provide access to emergency services applies to providers of publicly available telephone services ("PATS"), namely if, and only if, all of the following core elements are satisfied:

- The service is 'available to the public';
- 'for originating and receiving national and international calls and access to emergency services';
- 'through a number or numbers in a national or international telephone numbering plan'.

This situation creates a number of inter-linked potential challenges in relation to the regulation of VoIP services.

First, certain PATS obligations eg the requirement to provide uninterrupted access to the emergency services, could impose a burden on VoIP service providers who want to offer PATS services, in that it could discourage market entry and thus service innovation.

Second, the potentially high regulatory burden of meeting certain PATS obligations could create a disincentive for providers to offer access to emergency services, even on a 'best efforts' basis. This disincentive arises since, by not offering emergency access, a VoIP service would not constitute PATS. This raises concerns in relation to consumer protection, particularly where the VoIP service is the only one available to the household.

Third, relates to the provision of consumer information. Both PATS and non-PATS VoIP services may differ from traditional PSTN voice services, eg in terms of availability of emergency access and the reliability of the QoS. This means there is a risk that consumers are insufficiently informed and protected.

Given the wide diversity in regulatory approaches across the EU, the focus has been on consumer information requirements to ensure consumers can make informed choices. This approach is set out in a common statement on VoIP, published by the European Regulators' Group (ERG) in 2005[17] and in a recent report on VoIP and consumer issues.[18]

In the United Kingdom, Ofcom has consulted on a number of proposals[19] designed to encourage providers of VoIP services to help maintain a high level of good quality access to emergency services. The proposals for consideration include:

- a regulatory requirement on all providers of voice public electronic communication services (PECS) to offer access;
- setting more stringent network integrity requirements eg requiring battery back up;
- modifying the consumer information requirements to ensure consumers are aware of the impact of non-availability of access.

Emergency location information is also important to emergency services as the information is used to dispatch and monitor relevant emergency assistance. In the PSTN network a termination point is matched with a caller's location, which can be identified from the caller line identification (CLI). For VoIP providers who do not use or assign an E.164 number (see below) as a user identifier, this is no longer feasible. Industry is therefore being encouraged to develop solutions to overcome any technical limitations to the provision of location information and adequate routing of emergency calls.

The ERG has acknowledged that in future it may be necessary to update emergency service centres and emergency services to accommodate VoIP and other means of communication eg through a SIP address for emergency calls, an SMS number (112) for emergency SMS messages, an e-mail address for emergency messages, etc. Further requirements will be discussed once the technology and standards have matured.

2.6 Number portability

Number portability plays an important role in the promotion of competition and benefits consumers by removing the cost and inconvenience of having to change telephone numbers when switching providers.

The central issue in number portability is how communication providers route calls and messages to numbers that have been ported. In order to route calls correctly, providers need to know the location of the destination number, based on a number range analysis.

Although the regulation of number portability has not changed materially over the past decade, there have been major changes both in the nature of competition and in the way in which services are provided. In particular, there has been increased convergence between services that have traditionally been regarded as "fixed" and "mobile" services, and a rise in the number of services using VoIP. Concerning the latter, according to the EU Universal Services Directive, only subscribers of publicly available telephone services (PATS) have the right to number portability. This may lead to restrictions for the availability of number portability in VoIP services.

Increasingly therefore the distinction between the geographic location of a fixed number and between fixed and mobile numbers is being eroded and the deployment of NGN architectures will further erode the association of area number codes with a fixed location.

Many NRAs have already established a technology neutral numbering plan to allow for technological innovations and number portability, in accordance with the ITU-T E.164 recommended international public telecommunication numbering plan. At present E-164 is still required for the origination and receiving of VoIP calls from traditional voice services and is likely to remain important for VoIP services in the foreseeable future. Moving forward it may prove necessary to modify numbering plans and open up new number ranges, for example, to distinguish between general purpose, nomadic and ENUM-based services[20].

In the United Kingdom, Ofcom is considering the implementation of number portability within the context of the development of NGNs in UK[21]. The present analysis seems to favour transition of the current onward routing solution for routing of calls to ported numbers to an all-call query of a common database of numbers ("ACQ/CDB") solution, both for fixed networks in transition to NGN and or mobile networks. Implementation would require timely agreement by industry of technical standards as well as the commercial framework for design, build and in-life management of the database

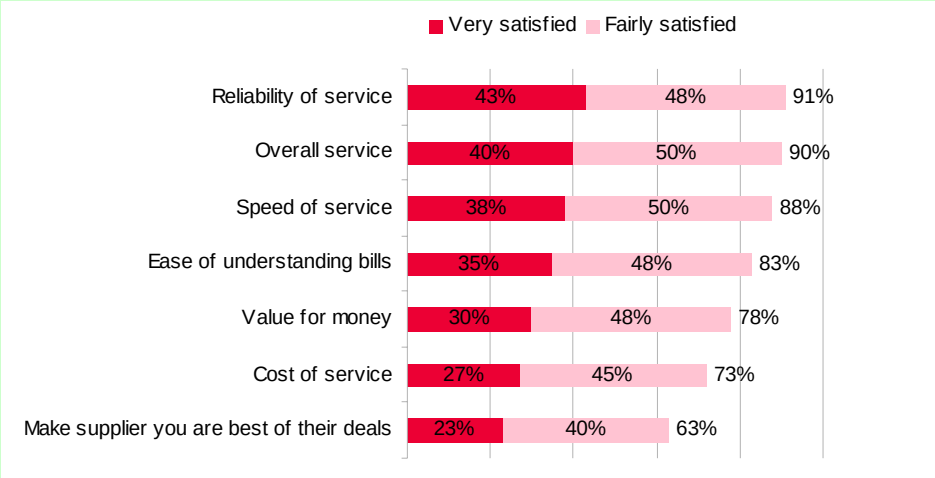
2.7 Feasibility of alternative text relay services

For people with disabilities, the deployment of IP based technologies may present new difficulties. For example, some text phone services may not work on a VoIP connection or may fail mid-conversation. Hearing aid wearers may experience feedback when using a VoIP phone or find that their hearing aid is incompatible. In the longer term however there is plenty of potential for VoIP to make telephone communication easier for people with a hearing loss, because with VoIP there is the theoretical possibility of transmitting frequency ranges that are more readily heard by individuals with a hearing loss.

2.8 QoS: What matters for consumers?

Consumers have certain expectations about the quality of service of a communication services, based on previous experience of the well-established PSTN, mobile and Internet services. Consumers are highly unlikely to consider QoS from a technical perspective. Rather, they tend to focus on customer-related aspects of the service they receive from providers eg reliability, speed, etc. This is illustrated in Figure 5 below, which shows the results of an independent consumer survey undertaken for Ofcom, in which consumers are asked to express their satisfaction with different elements of their internet service.\

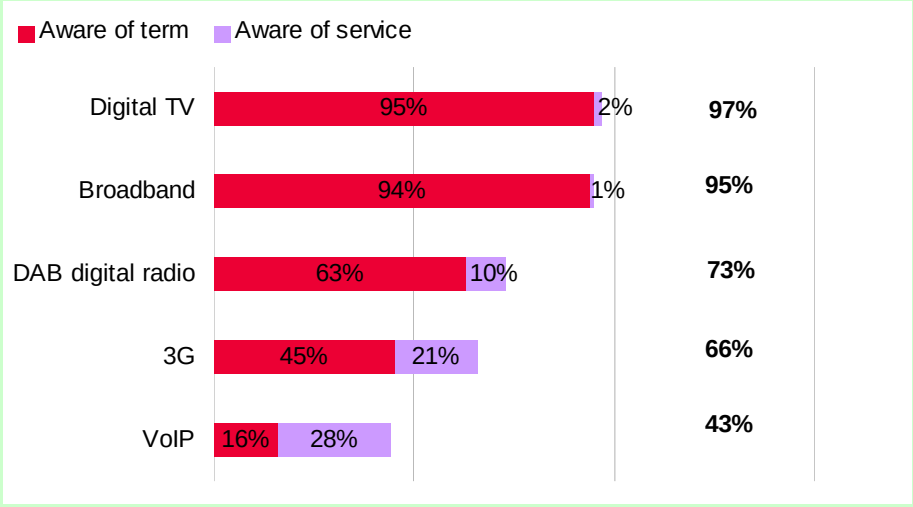
Fig 5: Satisfaction with internet service providers



Source: Ofcom Communications Tracking Survey Q3 2006. Base: All adults with the internet at home n=1116

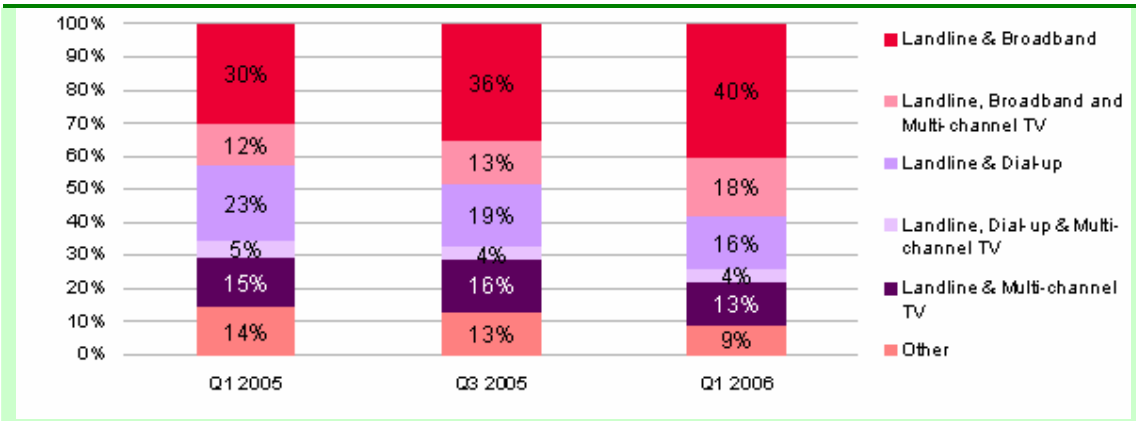
Independent research commissioned by Ofcom during 2006 found that UK consumer awareness of the products and services available through new technologies is high, and take up is increasing. The starting point for comparison is a high level of overall satisfaction with fixed and mobile services. Increasingly consumers are buying a bundle of services from one provider and they are likely to expect, at least initially, a similar quality of service for each element of the bundle.

Fig 6: Awareness of technology and the services this technology makes available



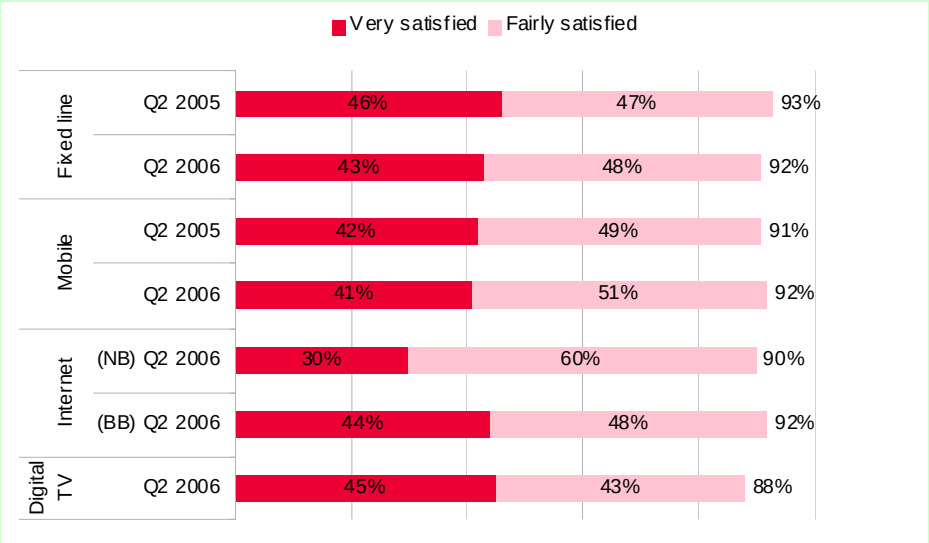
Source: Ofcom Consumer Panel survey, conducted by Saville Rossiter-base during October-November 2005. Base 2689 UK adults

Figure 7: Trend in purchasing multiple communications services from a single supplier



Source: Ofcom Communications Tracking Survey, conduced by IPSOS-MORI Bases Q1 2005(640), Q3 2005 (681) and Q1 2006 (686) UK adults who bundle at least two services

Fig. 8: Satisfaction with overall services over time

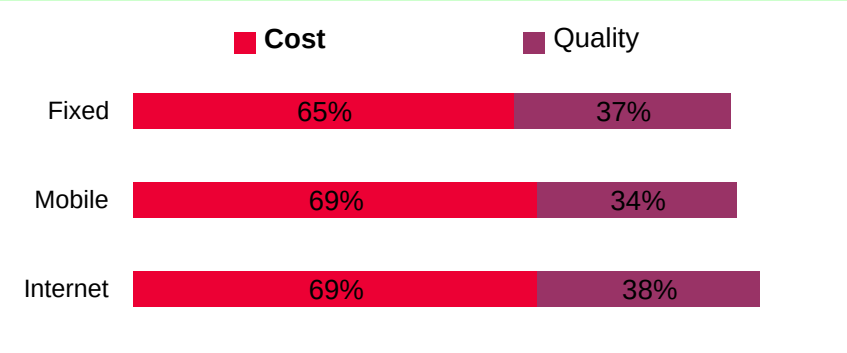


Source: Ofcom Communications Tracking survey, conducted by Ipsos- MORI Q2 2005 and Q2 2006 Bases: UK adults 2439. Don't knows have been excluded.

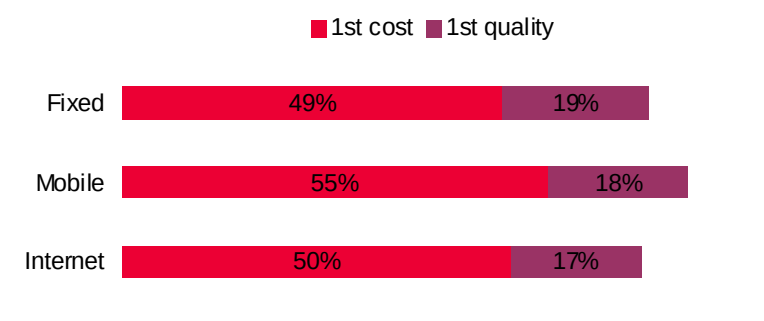
Quality of service is consistently mentioned by consumers as the most important factor after price when choosing a new supplier. However, around a third of consumers find it difficult to make quality of service comparisons, with only 43% of fixed line customers and 51% of mobile customers finding it easy. Most consumers say they find it easier to compare costs than to compare quality of service.

Figure 9: Importance placed on cost and quality when choosing a new supplier

Total mentions of cost and quality



Most important aspect



Source: Ofcom Strategic Review of Telecommunications., Research Annex. Base: 1586 UK fixed decision makers, 1303 mobile decision makers, 715 Internet decision makers, May-June 2004, MORI

The deployment of NGN adds a new dimension and increased complexity to the consumer purchasing decision and satisfaction levels, namely choice of services available and the differential quality of service they may experience. Consumers are increasingly likely to have experienced degraded quality or loss of service eg on international calls over satellite and/or Digital Circuit Multiplication Equipment (DCME) compression, mobile to mobile calls with low signal strength and "free" VoIP services. These may alter their perception of and satisfaction with the overall QoS provided.

Some consumers may demand a higher quality of service than they currently experience, which could be provided, for example, through wide-band speech [22], or expect the same level of service from a different technology, for example IPTV.

Consumer may be prepared to pay more for faster Internet speeds and access to new content and applications. In turn, this may lead to a more transparent quality of service-related pricing mechanisms, provided consumers demand the relevant QoS information needed to differentiate between the products and services on offer. What is not clear is whether consumers will be prepared to "trade" quality for the more choice of products, services and features.

The challenge for regulators going forward will be to ensure that consumers have access to transparent, comparable, reliable and up to date price and quality of service information that helps them to make increasingly complex choices and the potential for differential product and service offerings. Such initiatives are most likely to succeed if provided through independent, industry led initiatives as these are more flexible and capable of keeping pace with the dynamics of the marketplace.
In order to achieve this it is essential that consumers are aware of the availability and importance of comparative QoS indicators. Ofcom is considering various ways to achieve this objective. For example, in

December 2006, Ofcom launched its consumer advice portal http://www.ofcom.org.uk/consumeradvice/. This provides advice on the most useful questions asked by consumers and is designed to help them choose the best product and service for them. The portal includes links to price and QoS comparator sites.

3 Net neutrality

The expression "net neutrality" usually refers to the debate around whether there should be an overarching principle of non-discrimination regarding different forms of internet traffic carried across networks. At the extreme this would imply:

- No prioritisation of applications or one application provider's traffic over another.
- No deliberate degradation of applications or an application provider's traffic.
- No charging application providers for a higher quality of service.
- No deliberate blocking of any one application or an application provider's traffic.

The debate originated in the U.S. triggered by changes made to the way in which broadband networks were regulated, namely as information services and not telecommunication services. This has led to an increase of market power at the retail ISP level.

Those in favour of net neutrality argue that to date the Internet has treated different types of traffic equally and has been free. However, the Internet has never really been neutral. Operators, content providers and consumers all have to make payment to access content in various ways. A number of business models have evolved which require inter-operator payments for the delivery of content to end customers. Examples include content provider payments to backbone network providers to host content, either with or without quality of service level agreements (SLA's) or with or without content caching close to the customer.

Box 3: Service Level Agreements (SLAs)

An SLA provides a way of quantifying service definitions by specifying what the end user wants and what the provider is committed to provide. The definitions vary at business, application or network level.
Business SLAs typically cover pricing and contract terms.
Application level SLAs relate to server availability (eg 99% during working hours)
Network SLAs relates to service level specifications such as throughput, latency, packet loss[23].

The net neutrality debate is most typically argued from a supply-side perspective ie whether network operators should be allowed to block, or charge for prioritizing and application provider's traffic. However there is clearly a consumer dimension to net neutrality. Customers have always paid differential amounts for different quality of service from service providers. This can take the form of higher prices for higher bandwidth services, guaranteed quality of service, greater usage caps or managed services. The prioritisation of different types of traffic has clear benefits for consumers. For example, it allows them to pay to access products that are more tailored to their individual needs. They are also likely to benefit from improved network efficiency. If all applications were delivered at a uniform level of service, irrespective of the application's tolerance to say, jitter and delay, all consumers would be paying for QoS requirements that are only relevant for some of the services.

In reality, net neutrality is best thought of as a continuum, with a range of approaches that network operators may adopt to prioritise certain types of traffic and/or traffic from particular providers. It is relevant to QoS because of the potential to change the nature of delivery of traffic from a "best efforts" basis to one of prioritisation according to certain criteria.

The current interest in the topic arises for a number of reasons:

- The majority of internet access in developed economies is now through broadband, mainly priced with flat rate tariffs.

- The availability and increasing popularity of heavy usage applications, such as HDTV, has generated a rapid increase in the volume of traffic on the Internet, which had led to substantial congestion in some parts.
- Some applications are more time sensitive than others eg VoIP services, as compared to music downloads.
- Network routers are more intelligent and therefore capable of identifying and prioritising the packets associated with different applications.

The debate is most controversial where it relates to differentiation between application providers. For example, network operators in the US have argued that they need to be able to charge application providers for high priority traffic in order to support the business case for investment in higher capacity networks that such applications require. The counter argument by those who favour net neutrality is that end users have already paid the operators for access such that prioritisation by the ISPs effectively constitutes charging twice for the same network.

Innovation is also a key consideration. Those who favour net neutrality would argue that some of the most innovative internet applications have been developed through start-up companies who would be either unwilling or unable to pay ISPs to allow end users to access their applications at the required quality of service. If they were made to do so, innovation would effectively cease. Network operators, on the other hand, argue that differential QoS may increase the scope for product and service innovation as it allows new emerging products and services to be supported through prioritisation.

In essence the issue of net neutrality is all about the future of commercial relationships, payment flows and access to markets. Concerns about net neutrality are greatest where an operator with SMP in the relevant market undertakes to prioritize delivery of its own services over those of its competitors for anti-competitive purposes.

Under the European Framework, most incumbents have requirements to unbundle and/or offer wholesale broadband access, facilitating competition in the retail broadband market. The EU's position on net neutrality is that the EU is not at risk of problems in the same way as in the U.S. Provided that an operator with SMP does not discriminate between customers in similar circumstances, the EU does not object in principle to operators offering different services to different customer groups. Where discriminatory behaviour by an operator with SMP is demonstrated to be anti-competitive there are sufficient powers available under the Framework Directive and competition law to deal with any arising issues.

In relation to consumers, the European Commission is concerned that some operators may degrade the QoS of some services offered to consumers (eg "free" broadband) to unacceptably low levels. In its Review of the EU Framework, it makes proposals for amendments that would allow NRAs to mandate a common set of minimum QoS standards for network transmission services. The proposed standards would apply across the EU to all operators, not just those with SMP.

The UK's favoured approach is not to impose uniform minimum QoS standards but to agree a fully transparent set of service level definitions which allow for the ready comparison of services from different providers. Whether or not SMP is an issue, it is essential that service levels and traffic prioritisation, degradation or blocking policies applied by the ISP are fully transparent to operators and consumers. This approach is equally valid where the level of competition in the retail market is weak or non-existent.

There are therefore a number of possible remedies that NRAs may apply as an alternative (or possibly in addition to) net neutrality rules. These could include, for example, obligations to supply, charge caps, minimum quality of service standards and mandating ISPs to provide consumers with information as to whether they block access to certain ports or websites.

3.1 Reducing barriers to consumer switching

For those operators without SMP in the relevant market, the efficient working of a competitive market should address the risks posed to consumers from non-network neutral approaches. An effectively competitive market at the retail level, with relatively low barriers to entry, means that customers have a range of choice in their ISP.

Therefore, if a single operator without SMP were to introduce charging for the delivery of third party content services, or to block specific services, consumers would be able to move supplier. This reduces the incentives for operators to charge consumers excessively high prices or block specific services.

In order for this to function effectively:

- Consumers need to be well-informed and have accurate, comparable and easy to understand information about the nature, price and quality of services as well as complete and accurate information about the transfer process, at the point of purchase.
- There must be no artificial barriers to consumer empowerment, reducing their ability to switch service providers e.g. where a process is not seamless and subjects consumers to a level of unnecessary hassle.
- The migration process from one service provider to another must not unduly influence consumers' decision to switch service provider e.g. where the process is unpredictable and unreliable this may be a factor in stopping consumers engaging in the competitive process.

If this is not the case, then there may be a role for regulatory intervention to protect consumer interests. However, any intervention would be best focused on addressing the lack of consumer information, empowerment or migration processes. Addressing any issues within these three areas would then allow the efficient working of the market and consumer choice.

However, for this to be an effective constraint of the potential for consumer harm, it is essential that there are no unnecessary barriers to switching and that migration processes are efficient and of a high quality. Customers must be able to switch seamlessly between providers and/or products regardless of the nature of the service migration or the underlying technologies involved. This becomes more critical of an issue as more consumers increasingly look to 'bundle' their products and services together.

Competition will only be effective if consumers are confident in the switching and transfer process. Where this is not the case, customers will be unwilling to engage effectively in the competitive process. In order for this to be achieved, there are a number of characteristics that need to be met:

- The customer should control the process and be well-informed throughout
- Where possible, a consistent approach should be used across products and/or services – to make switching easier for customers and competitive providers.
- The customer should be subject to minimal hassle;
- The switching process should be predictable and reliable.
- There should be adequate opportunity for the customer to change their mind.
- The switchover period should be as quick as possible (albeit will need to ensure adequate protection from the risks of mis-selling/slamming).
- There should be minimal customer disruption, including no interruption to service.
- Consumers should be protected against dishonest sales and marketing activity.
- Consumers should have access to essential information including the identity of the company, its address, telephone, fax and e-mail contact details, as appropriate.
- The description of the services to be provided should be sufficient to enable the customer to understand the option that they have chosen, and how it works.
- Consumers should have access to information about the major contractual elements of the service, including the cost of any standing charges, the payment terms, line rental, key call types and details of "protected or special support" arrangements.

- Consumers should understand what the impact of switching will be upon services currently being used, including a clear understanding of which services will be affected/unaffected.
- Consumers should be informed about the arrangements for the provision of the service, including the order process and, as accurately as possible, the likely date of provision. Where there may be significant delay in the likely date of provision, the customer should be informed:
    - the existence of a right of cancellation and the process for exercising it;
    - the period for which the charges remain valid; and
    - the minimum period of contract and minimum contract charges, if any.

In addition it is essential that competition in retail markets is supported by ensuring that switching costs are kept to the minimum necessary. This objective is dependent on many factors. These include the following:

- avoiding 'unnecessary' switching barriers for customers;
- ensuring that providers, including prospective new entrants, can access efficient, symmetrical and high quality migration processes to support migration of customers, through efficient back office operations; and
- avoiding distortion to the competitive process through preventing unfair behaviour by providers during the transfer process.

4 Consumer Protection and cyber security

Over the past decade, the internet has grown to become a central part of the cultural and economic life of many people around the world. The internet is a powerful platform for the distribution of services to their intended audiences. It spans the world and connects a global audience with a globally provided set of content and services. The internet's flexibility means it has been an engine for innovation, enabling the development of new businesses and new business models, new content and new communications services; and its openness has allowed operators of every scale, from multinationals to individuals, to create and offer content and services as well as benefit from them. Alongside global reach, openness and flexibility, many observers attribute the success and importance of the internet to the limited extent of internet service regulation.

The international nature of the internet has generated new opportunities for consumers but it has also put them within easier reach of those seeking to take advantage of them. The internet has given rise to many new types of crime – for example, identity theft by phishing, malicious virus dissemination via SPAM, and online grooming of children. It has also made it easier for criminals to circumvent the law by taking advantage of the impersonal nature of the internet to misrepresent or disguise their true identity. With the advent of NGN and its potential for higher speeds of connectivity, the Internet is likely to play a much greater role in citizens' lives, increasing the potential for harm.

In response to both the growing role the internet plays in delivering services to consumers and the risks it exposes them to, there has been an immense amount of activity at national and international levels in developing legislative and regulatory frameworks to deal with internet-specific issues. While some of these efforts have sought to achieve international cooperation and harmonisation of laws, many have also been tailored to suit the particular circumstances, and cultural and political norms of local markets.

Box 4: Stemming the tide of international spam

ITU 2004 Global Symposium for Regulators (GSR): proposals for a multi-pronged approach for dealing with spam:

- Anti-spam legislation eg US 2003 CAN-SPAM Act
- Enforceable codes of conduct for ISPs
- Voluntary codes of conduct approved by NRAs
- End-user initiatives eg spam filters

Box 5: ITU Thematic Workshop of Countering Spam 2004: proposals for a five-part approach combining

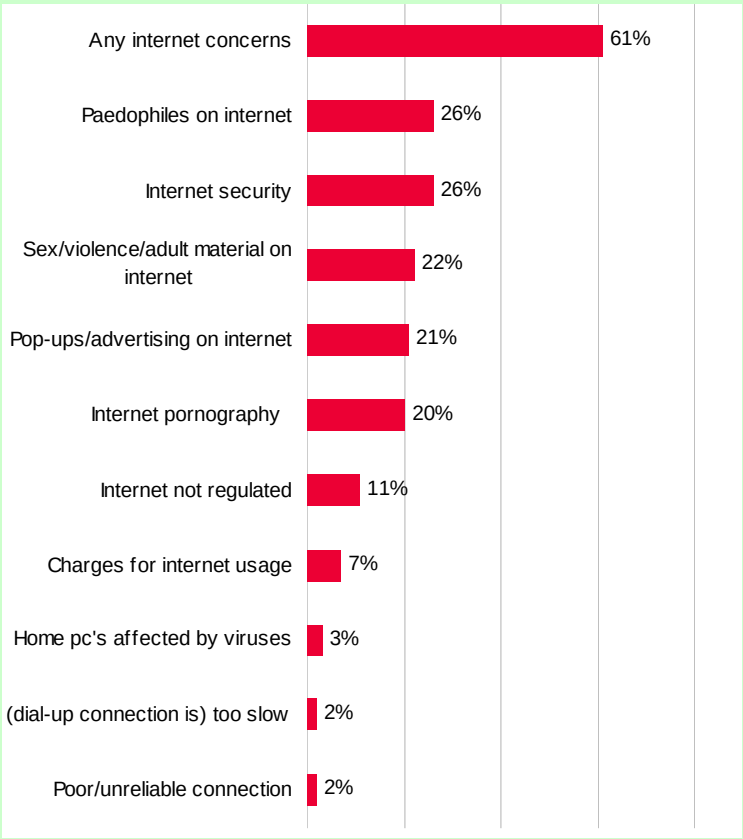
- Strong-enforceable legislation.
- Continued development of technical measures.
- Establishment of meaningful industry partnerships, especially among ISPs, mobile carriers and direct marketing associations.
- Consumer and industry education about anti-spam measures and Internet security practices;
- International co-operation among government, industry, consumer, business and anti-spam groups for a global and co-ordinated approach to the problem.

Independent research undertaken for the UK regulator has identified a number of internet security issues that cause concern for consumers. These include:

- access to personal data
- scams and fraud
- Internet spam
- children and the internet
- inappropriate/harmful content
- unauthorised access to personal data, which may or may not be malicious

The results of the survey are illustrated in Figure 10 below. Security and content are common themes.

Figure 10: Spontaneous concerns about Internet services



Source: Ad hoc survey conducted by BMRB on behalf of Ofcom, during August 2006 Base 612 UK adults using Internet at home

Despite an increasing number of national and international laws and agreements, internet-related issues remain a serious and growing concern. For example, the Information Commissioner's Office, the regulator charged with oversight of data protection regulation in the UK, received over 19,000 data protection complaints from the general public in 2004[24]. Phishing incidents are becoming increasingly common. Globally, the Anti Phishing Working Group reported 16,882 unique attacks in November 2005, up from 8,975 unique attacks launched in November 2004[25]. BT reported in December 2005 that its "cleanfeed" technology blocks an average of 45,000 attempted hits onto illegal child pornography sites each day[26].

The attempts to translate traditional direct regulatory structures onto the internet have for the main part been ineffective at achieving their desired goals. Where action has been effective, both nationally and internationally, it has often involved co- or self-regulatory measures developed with participation from the industry.

The Internet Watch Foundation (IWF) in the UK is one such example of self-regulation. The IWF operates a hotline for reporting illegal content on the internet. Once content is ascertained by the IWF to be illegal, it issues take-down notices to hosting service providers, when these are based in the UK. Additionally, it supplies ISPs with details of websites containing internationally hosted illegal content, and of online user groups dedicated to disseminating illegal and offensive material. Most UK ISPs have already voluntarily agreed to block those sites and user groups. The IWF has been a successful self-regulatory strategy – in 2005, only 0.4% of potentially illegal child abuse images reported to the IWF were hosted in the UK[27]. However, the international problem remains.

At international level, industry-led measures have played a significant part in increasing consumer confidence in e-commerce and hence making the internet a more secure place for commercial transactions. For example, data encryption through the https protocol[28] has been widely adopted by online banking and commercial sites, although there remains a need for on-going investments to ensure adequate levels of security. Furthermore, significant efforts have been invested by the industry in marketing its benefits to consumers – today, for example, the padlock symbol is displayed on many browser windows. Though further efforts are needed to ensure that the padlock symbol guarantees adequate levels of consumer protection, its use by e-traders can serve to give consumers the peace of mind necessary to decide to engage in e-commerce.

Within the context of NGN, the problems to be addressed are likely to be similar to those that already exist for Internet service, for example:

- Misuse of NGN that causes harm to consumers, for example 'SPAM over Internet telephony' (SPIT).
- Potential for fraud and identity theft.
- Privacy concerns and potential for misuse of personal information (eg through the greater personalisation capability provided by NGN.

To protect the integrity of the network, operators need to take account of potential security threats at every level of their network infrastructure as well as at the customer level e.g., laptops, personal digital assistants and mobile phones. High quality and network security management is therefore likely to become an increasingly important aspect of brand reputation and the associated customer satisfaction.

Box 6: Effects of spam in developing countries

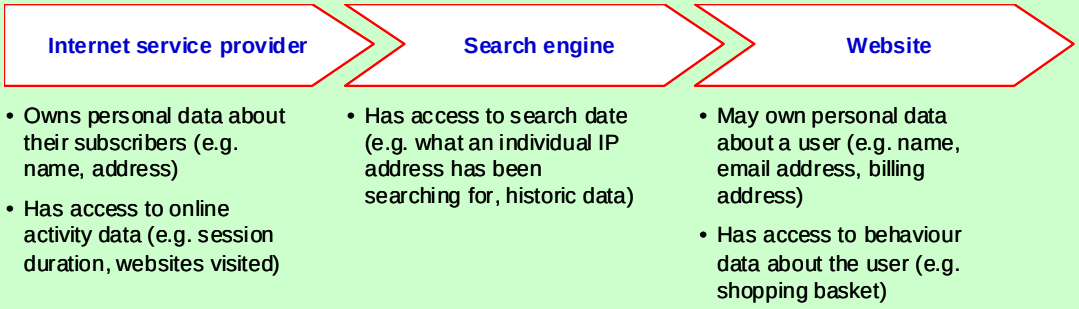
Spam is arguably a bigger problem in developing countries, many of whom do not yet have anti-spam laws. For those that do, many do not have the resources to enforce them, although the law may still be useful in providing the basis for regional and multinational enforcement. The impact of spam may also be more costly where ISPs are frequently deluged by spikes in spam that lead to network slowdowns and breakdowns. Moreover many people send e-mails from shared Internet connections and equipment, such as cybercafés or other public access centres. These services normally rely on hosted e-mail services with limits on in-box sizes. Accessing e-mail become too expensive if per-minute charges to cybercafé owners are consumed by cleaning spam from their inboxes.

Source: John G Palfrey, *Trends in Telecommunication Reform, 2006*, chapter 7

4.1 Protection of personal data and monitoring of users' online activities

There are many ways in which an internet user provides personal data, as illustrated in one example below.

Figure 11: Data collection and retention across an example internet lifecycle



There has been increasing concern about how aware consumers actually are about the disclosure of their data online, especially when data is collected unknowingly. For example, a common method by which personal data can be collected from an individual without their knowledge is through the use of 'spy ware' - software installed on an individual's computer which covertly transmits information about the user's activities to a remote host.

There is no conclusive definition of the term spyware, although for the purposes of this report we define spyware as comprising of two types: 'malware' and 'adware'. Malware includes viruses, worms and trojans and its defining characteristic is that it is intended to cause harm to the computer or be otherwise used for criminal purposes.

Adware is distinct from malware in that it does not have a malicious intent, but rather is designed to enhance the effectiveness of advertising targeted at the user or otherwise provide marketing information to a third party. Examples of this are applications that facilitate pop-up browser windows, redirect browser home pages and add favourite sites to browser lists. In addition, data tags referred to as cookies can be used by websites to identify users. On their first visit to a specific website, users may have a cookie downloaded onto their computer, which allows the website to recognise that user and their preferences when they return.
However, in the majority of cases users are not aware a) what spyware is and b) that it has been installed on their computer, creating potential privacy issues as personal data about them is being collected and distributed without their knowledge. The user's ability to manage these issues happens at the local level ie dependent on their choice of browser technology and/or the configuration of their browser. This example demonstrates the importance of promoting media literacy.

Users who rely on cybercafés for internet access should in principle be able to rely on security procedures being in place to deal with key loggers, filters and data theft. However this may be open to compromise and NRAs need to take a pragmatic approach eg by providing information and guidance.

When considering the protection of personal information, the starting point for most analyses lies with rights to privacy. The right to privacy is a basic human right enshrined in the 1948 United Nation's Universal Declaration of Human Rights and the 1981 European Convention on Human Rights (Article 8). Since the 1970s, many developed countries have responded to concerns about privacy risks arising from the collection and use of personal data by relying on "fair information principles" to govern the appropriate use of personal data. For example, such principles were laid out in the 1981 European Convention for the Protection of Individuals with regard to Automatic Processing of Personal Data, following the development of the OECD's Guidelines on the Protection of Privacy and Transborder Flows of Personal Data in 1980.

According to these principles, personal data can be collected lawfully for specific and limited purposes only, and can be stored only for as long as necessary to fulfil the purpose. Data must be accurate and adequate for the intended purposes, and individuals have a right of access to and correction of their personal data. The Convention also established special protection for data of sensitive nature, such as, for example, data on the individual's religious and political beliefs or medical records. Many of these principles have been formally adopted through data protection legislation.

4.2 International framework

The growth of the internet has exacerbated many issues concerning the protection of personal data, particularly across national borders. In response, the EU and APEC (Asia Pacific Economic Cooperation) have developed agreements to harmonize their Members' approach to legislation regarding internet data protection. Of the international organisations developing data protection laws relating to the internet, the EU has been the most active, developing both legislative instruments and guidance that aim to protect data and underpin the free flow of goods and services within the EU.

There are three EU directives that relate to the protection of personal data. The first is the Directive of 24 October 1995 on the Protection of Individuals with Regard to the Processing of Personal Data and on the Free Movement of such Data. The 1995 Directive lays out six conditions of legitimate date processing one

which is unambiguous consent before data may be collected, with limited exceptional cases, for example, if it is in the vital interests of the subject, to ensure legal compliance, or in the interests of national security. The 1995 Directive prohibits the collection of specific types of data (e.g. race, ethnicity, religious beliefs, political opinions, health), unless under exceptional circumstances, and requires those collecting, processing and retaining data to institute technical and organisational security measures to protect the data.

The second is the Directive 97/66/EC of 15/12/1997 concerning the Processing of Personal Data and the Protection of Privacy in the Telecommunications Sector. The 1997 Directive aims to harmonize and provide an equivalent level of privacy and data protection as provided by the 1995 Directive but specifically within the telecommunications environment. It includes responsibilities on telecoms providers to maintain security of the network and traffic/billing data, and the right of individuals not to appear in publicised directories.

The third is the Directive of 12 July 2002 Concerning the Processing of Personal Data and the Protection of Privacy in the Electronic Communications Sector. The 2002 Directive updates and replaces the 1997 Directive (97/66/EC) and deals specifically with internet related issues. It includes the legal protection of new internet data, such as traffic data (e.g. routing information, session duration) and focuses on the confidentiality of electronic communications, data retention of users' online activities, spamming and inclusion of personal data in public directories.

Other international agreements include the 1981 Council of Europe Convention for the Protection of Individuals with regard to Automatic Processing of Personal Data, 28/01/1981 . The 1981 Convention aims to strengthen the legal protection of individuals with regard to automatic processing of personal information relating to them. It includes basic provisions requiring the lawful collection of data, secure and confidential retention of data, maintenance of accurate data and the right to access data by the subject, effectively harmonising signing Member States' legislation. It also includes provisions on the cross-border flow of data and international collaboration in the implementation of the treaty. The convention has been ratified by 35 Council of Europe Member States.

The OECD has published guidelines, signed by 30 OECD Member States, setting out data protection and privacy principles to be observed by signing States. These include limits on how personal data is collected and used and requirements on signatories to secure information flows across borders and cooperate in areas related to data protection. The OECD continues to be active in this field, especially through the work of its Working Party on Information Security and Privacy.

Finally, the Asian-Pacific Economic Cooperation (APEC) Privacy Framework promotes a consistent approach to information privacy protection across APEC member economies, including the development of appropriate privacy protections for personal information, and the prevention of unnecessary barriers to information flows.

4.3 Inappropriate content and consumer protection

The definition of what constitutes inappropriate content varies by country and even region. Whilst in one country certain types of content are deemed perfectly legal and acceptable for consumption, in others, production or consumption of the same content may be frowned upon or even be a criminal offence. These variations in attitudes occur for many reasons, including local political, cultural and religious differences, and result in different stances on how best to tackle the distribution of what is considered inappropriate content within each individual territory.

There are, however, certain types of content for which there exists a widespread consensus amongst different countries of what is deemed to be "decent" or "legal". The best example of such content where there is a general consensus is child pornography. In such cases, a cross-border approach to tackling the distribution of such content is possible. For other types of content, national differences in attitudes make it difficult to achieve cross-border cooperation, forcing national markets to adopt solutions tailored to their specific circumstances and prevailing cultural norms.

The extent and nature of international and national legislation and regulation differ across content types, with certain types of content being targeted more actively than others. Broadly speaking, inappropriate content can cover the following types of content:

- Child pornography.
- Content and communications which facilitate acts of terrorism.
- Racist or xenophobic material or material which incites racism or xenophobia.
- Other content (includes adult pornography, violent material, defamatory content and other content which may be deemed to be illegal or inappropriate under a nation's laws).

4.3.1 *Inappropriate content*

Child pornography is the clearest example of content that is considered not only inappropriate but also illegal in most countries. At an international level, both the Council of Europe and the United Nations have taken action against dissemination of child pornography, and have encouraged collaboration between nations in combating the problem.

The 2000 UN Optional Protocol to the Convention on the Rights of the Child on the Sale of Children, Child Prostitution and Child Pornography, mandates signing parties to prohibit the sale of children, child prostitution and child pornography within their nation's law, including via the internet. It also provides a framework for increased international cooperation in prosecuting perpetrators in these areas. The Protocol has entered into force following 12 ratifications by signing nations.

The 2001 European Convention of Cybercrime mandates signing parties to prohibit the production, distribution and buying of child pornography over the internet. It was the first international treaty to criminalise offending behaviour directed against computer systems, networks or data in addition to content related crimes such as child pornography. The Convention creates a legislative framework for investigating and prosecuting violations of law with respect to child pornography, and mandates cooperation between national agencies in combating child pornography. It entered into force in July 2004 following 5 ratifications. To date, it has been signed by 38 countries and ratified by 12 countries, though not including the UK.

The substantive criminal law measures of the European Convention of Cybercrime include offences on:

- Intentional illegal access of computer systems
- Intentional illegal interception of non-public transmissions of computer data
- Intentional interference with computer data including deletion or alteration
- Intentional interference with a computer system.

Additionally, the Convention includes crimes such as computer related forgery and fraud, and content related offences such as child pornography. Offences related to infringements of copyright and related rights are also included within the Convention.

Attempts to encourage international collaboration for other types of inappropriate content have proved problematic due to national differences in the definition of what is inappropriate. For example, the committee drafting the Cybercrime Convention discussed the possibility of including content related offences other than child pornography (Article 9) within the Convention, for example, the online distribution of racist propaganda. However, the committee could not reach consensus on the inclusion of additional offences within the Convention. Instead, it was recommended that additional protocol to the Convention be developed under the title "Broadening the scope of the convention to include new forms of offence".

The Additional Protocol concerning the Criminalisation of Acts of a Racist and Xenophobic Nature Committed through Computer Systems aims to harmonize substantive criminal law in the fight against racism and xenophobia on the internet and, to improve international co-operation in this area. Following five

ratifications, it came into force on 1 March 2006. Importantly, however, the UK and the US are currently not signatories to the Additional Protocol.

Though the US had signed the original convention which focused on child pornography, it has not signed the Additional Protocol on the grounds that the Protocol restricts an individual's right to free speech. The First Amendment of the US Constitution guarantees an individual's right to free speech and is broader in scope than the equivalent Article 10 of the European Convention of Human Rights. The First Amendment states that 'Congress shall make no law respecting an establishment of religion, or prohibiting the free exercise thereof; or abridging the freedom of speech, or of the press; or the right of the people peaceably to assemble, and to petition the government for a redress of grievances'.

Such differences in national opinion compromise the effectiveness of the treaty. Websites containing offensive content, in this instance racist or xenophobic content, can relocate their hosting to a country which is not a signatory to the treaty thereby avoiding legal sanctions.

4.4 Online advertising

For inappropriate advertising practices on the internet, there is a European coordination manifested through the EU's Television without Frontiers Directive (TWF) and the European Advertising Standards Alliance (EASA).

The EU's Television without Frontiers Directive was first written into EU law in 1989. Since then it has been subject to a number of amendments with a substantive review of the legislation currently underway. The Directive seeks to harmonize Member States' legislation across all aspects of the production and distribution of audiovisual media, including advertising.

When the legislation was first established, it was primarily aimed at linear audiovisual content, that is, transmission of broadcast television via a terrestrial, satellite or cable network. The current review of the Directive seeks to address the increasing role of the internet as a platform for the delivery of audiovisual services. The new Directive has not yet been finalised.

Under the proposed new Directive, the regulations would not apply to:

- Internet services whose primary objective is not the provision of audiovisual services (e.g. contains an audiovisual content clip which is ancillary to the main purpose of the site);
- Electronic versions of newspapers or magazines;
- Private correspondence (e.g. e-mail).

The European Advertising Standards Alliance does not have a Code of Conduct which members agree to comply to. Instead, it works as a forum and lobby group for self-regulatory entities from across Europe and other member countries, and industry players such as advertising federations. Since 1992 it has also had a role in handling and resolving cross-border complaints concerning advertising content and standards between members. Its remit extends into the internet space.

It is important, however, to bear in mind that ways to misuse personal information are constantly evolving. One of the key challenges for government, regulators, enforcers and industry lies in responding swiftly and effectively to new forms of abuse.

5 Conclusions

Next generation networks offer the possibility of delivering real benefits to citizens and consumers in terms of innovative new services and greater choice. However the convergence of different services onto a single network raises important issues around quality of service, consumer awareness and consumer protection.

For example whereas new voice services may seem at first sight to consumers to be identical to traditional voice services, they may not be able to deliver certain features, such as access to emergency services, that consumers have in the past taken for granted. With the growing trend towards bundled products, with new content and applications, consumers may or may not be prepared to accept differential service standards. They are likely to become more aware of the importance of quality of service when choosing a supplier and demand more information which allows them to differentiate between the products and services on offer.

Network neutrality implies there should be minimal differentiation in the traffic management and prioritisation of delivery of services to the consumer. However, provided consumers are well informed and there are no barriers to switching, discrimination between product offerings need not be detrimental and may even increase consumer benefits.

The internet's flexibility makes it an engine for innovation. With the advent of NGN it is likely to play a much greater role in citizens' lives. In relation to cyber security, high quality and network security management will be essential to protect brand reputation and protect consumers from harm.

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[1] See Milne, Claire, *Telecom Reform: Principles, Policies and Regulatory Practices*, (Chapter 14 -Regulating Quality of Service, http://lirne.net/2003/resources/tr/chapter14.pdf

[2] Directive 2002/22/EC of the European Parliament and of the Council, 7 March 2002, on universal service and users' rights relating to electronic communications and services (Universal Service Directive) Annex III, pL108/72.

[3] Directive 2002/22/EC of the European Parliament and of the Council of 7 March 2002 on universal service and users' rights relating to the electronic communications networks and services (Universal Services Directive)

[4] http://www.ofcom.org.uk/consult/condocs/qualitystate/statement/

[5] As discussed by Intven, Hans and Miedema , Theresa in *Trends in Telecommunication Reform 2002, chapter 5, Specific Regulatory Function*

[7] For a full discussion of monitoring of QoS standards in India see Milne, Robert, ICT *Quality of Service Regulation: Practices and Proposals. Background Paper*, ITU Global Seminar on Quality of Service and Consumer Protection, Geneva, September 2006

[8] ITU, Telecommunications Indicators Handbook, on line : http://www.itu.int/ITU-D/ict/publications/world/material/handbook.html

[9] See discussion in *Ofcom's Consumer Policy: A consultation*, 8 February 2006 http://www.ofcom.org.uk/consult/condocs/ocp/

[10] See for example, ITU Trends in Telecommunications Reform, 2002; the ITU-T 2004 Handbook on QoS and Network Performance. http://web/pub/T-HDB-QOS.02-2004/en and Milne, Robert, Antelope Consulting, United Kingdom (rem@antelope.org.uk), *ICT Quality of Service Regulation: Practices and Proposals, Background Paper*, ITU, Global Seminar on Quality of Service and Consumer Protection, Geneva, Switzerland, 31 August – 1 September 2006; and Oodan, A.P., Ward, K.E. and Mullee, A. W., *Quality of service in telecommunications.* IEE Telecoms Series No. 39, London, 1997. (especially chapters 14, 15 and 16) http://www.iee.org/Publish/Books/TeleComm/Te039c.cfm#8Customers

[11] The ITU-T Recommendation G.114 (5) establishes a number of time constraints on one-way latency. The upper bound is 150 ms for one way traffic. VoIP calls must achieve the 150 ms bond to successfully emulate the QoS experienced in traditional voice services. This time constraint leaves very little margin for error in packet delivery.

[12] Diffserv and Intserv are methods for controlling priority of Internet protocol packets by encoding priority into some digits reserved for this purpose in each packet. Some routers are able to recognise this information and route the packets with priority over other packets when network nodes are congested. EXP is a similar concept used in networks employing MPLS to provide QoS differentiation between different services).

[13] Window size is a parameter specific to flow control in Transport Control Protocol (TCP), commonly used to transport non real time data reliably over the Internet

[14] http://www.ofcom.org.uk/consult/condocs/new_voice/anew_voice/nvs.pdf

[15] http://ftp.fcc.gov.uk/cgb/voip911order.pdf

[16] Universal Service Directive, Article 26

[17] http://erg.eu.int/doc/publications/erg0512_voip_common_statement.pdf

[18] http://erg.eu.int/doc/publications/erg_06_39_report_voip_cons_aspects.pdf

[19] Ofcom consultation, *Regulation of VoIP Services*, 22 February 2006

[20] ENUM is a standard for converting an ordinary telephone number into a domain name, which can then be converted

into an IP address for use by an NGN or VoIP system to route a telephone call.
[21] see Ofcom, *Review of General Condition 198 – Number Portability*, 16 November 2006
[22] In digital networks (NGN or otherwise) speech is encoded into a digital representation. The most commonly used standard for doing this is known as G.711, which encodes telephone speech at 64,000 digits per second (or bits per second). Wide-band speech is encoded at a higher rate, say 96,000 bits per second for example, to provide better speech quality.
[23] See Chieng, Marshall,Ho and Parr, Agent-Enhanced Dynamic Service Level Agreement in future network environments,
[24] Information Commissioner's Office
[25] Anti-Phishing Working Group Phishing Activity Trends Report, November 2005

[26] [26]BT. See http://www.btplc.com/societyandenvironment/news/showarticle.cfm?articleid=2ab29f02-bd0c-4e0a-952f-60fef2500246
[27] Internet Watch Foundation
[28] HyperText Transfer Protocol (https) is a secure version of HTTP which uses certificates and encryption when sending data to prevent unauthorised interception and receipt of data. It is used for credit card payments and entry of sensitive personal or financial data.

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International Telecommunication Union

GSR 2007

DISCUSSION PAPER

NGN and Universal Access

Comments are welcome and should be sent by 1 March 2007 to GSR07@itu.int

ITU International Telecommunication Union

GLOBAL SYMPOSIUM FOR REGULATORS

Dubai World Trade Center
Dubai, United Arab Emirates

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Work in progress, for discussion purposes

NEXT GENERATION NETWORKS AND UNIVERSAL ACCESS THE CHALLENGES AHEAD

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NEXT GENERATION NETWORKS AND UNIVERSAL ACCESS

THE CHALLENGES AHEAD

*This paper has been prepared **Eric Lie**, Telecommunication Consultant (eric.lie@gmail.com), as an input document for the 2007 Global Symposium for Regulators (GSR), organized by the Telecommunication Development Bureau (BDT). The views expressed in this paper are those of the author and do not necessarily reflect the opinions of the ITU or its membership. Comments are welcome and should be sent to gsr07@itu.int by 1 March 2007.*

1 Introduction

In 2003, signatories to the Plan of Action of the World Summit on the Information Society (WSIS) set themselves a number of Information Communication Technologies (ICT) access and connectivity targets.[1] Nine years away from the deadline of 2015, voice penetration rates have been given a boost by the doubling of mobile subscribers numbers over just the past few years. At the end of 2005, ITU indicators showed that global telephone penetration rates (fixed and mobile) were at 52 percent. While enjoying similar levels of growth, Internet usage currently extends only to around 16 percent of the world's population. If all the WSIS access and connectivity targets are to be met by 2015, countries, both developed and developing, will have to focus on reviewing and renewing their policies and regulations that support universal access[2].

A reconsideration of universal access in the present is timely also from another perspective. In recent years, a growing number of operators have embarked on a transition from traditional circuit switched networks to Next-Generation Networks (NGN). NGN offers end-users access through a variety of networks, and because they are based on IP technology, they rely on much cheaper bandwidth and make available a wide range of services more easily.

However, is a discussion on universal access and NGN premature? Admittedly, no major operator has yet completed its transition to an end-to-end NGN. Even for the most advanced, the replacement of existing circuit-switched networks with NGN is expected to be completed no earlier than 2010. While the transition from circuit-switched to NGN is not complete, ICT markets are already feeling the impact of this migration in terms of service offerings, traffic flow and revenue. This can be most clearly seen in the increasing amounts of voice traffic that are being routed through IP networks and its accompanying effect on prices. In turn, these changes have already begun to force a rethinking of ICT policy and regulation in many countries.

On the one hand, the deployment of NGN promises to benefit universal access efforts in the form of cheap voice services and affordable access technologies. On the other, it also brings along with it a number of significant challenges that include the erosion of the revenue base used to fund universal access programmes, and, more alarmingly, the possibility of an even widening digital divide stemming from an uneven distribution of NGN related benefits.

Section 2 of this chapter looks at some of the different NGN related technologies and the role they play in expanding ICT access. Section 3 takes a look at the role sector reform plays in expanding ICT access, especially in the areas of licensing, spectrum management, interconnection, VoIP regulation, quality of service and price regulation. Only in the event that universal access goals remain unmet after such sector reform measures are implemented should universal access funding be considered by regulators. Sections 4 to 6 look at some of the issues that are raised when universal access funding becomes necessary. These include:

- How should the scope of universal access be defined?
  - In an NGN environment where infrastructure is decoupled from services, what should universal access funding support?
  - Should broadband be included in a universal access definition?
- Where funding is required, how should funds used to support universal access be collected?
- How should funds for universal access be distributed?
  - How should needs be identified - top down or bottom up?
  - What role do not-for-profit organizations play?

- How should funding be distributed (e.g. micro-finance)?

2 Universal Access and NGN technology

Simply put, the transition to NGN involves the replacement of legacy PSTN equipment by packet-based technology in the core of the network. This allows for a more defined separation between the transport portion of the network and the services (e.g. voice, data and video) that run on top of that transport. (See Box 1.)

Box 1: What are Next Generation Networks?

A Next Generation Network is defined by the ITU as "a packet-based network able to provide telecommunication services and able to make use of multiple broadband, QoS-enabled transport technologies and in which service-related functions are independent from underlying transport-related technologies. It enables unfettered access for users to networks and to competing service providers and/or services of their choice. It supports generalized mobility that will allow consistent and ubiquitous provision of services to users."

Source: ITU-T Recommendation Y.2001

The technological innovations associated with the transition to NGN have already started to transform the way universal access is being extended to rural and remote areas in both developed and developing countries. To a large extent, this transformation is fuelled by the introduction of new wireless technologies such a Wi-Fi and Broadband Wireless Access (BWA) that have dramatically reduced the price of infrastructure deployment. Affordability and availability have also been given a further boost by the introduction of new services and applications, such as VoIP, that have been designed to run over these networks.

2.1 Infrastructure

Despite the remarkable success of mobile technology in providing access to voice services, many internet services still depend on fixed line based networks for connections to end users. While this fact may have led to the mandatory use of fixed-line infrastructure as part of a universal access obligation or programme in a number of countries in the past, it is important to note that this situation is rapidly changing. Wireless technologies such as Wi-Fi and BWA in particular have been singled out for their ease of installation and their ability to provide affordable access in rural and remote areas. Coupled with backhaul delivered through very small aperture terminals (VSAT), even the most remote villages can be connected, albeit with limited and expensive bandwidth.

Advances in mobile technology, especially 3G and 3.5G technologies, have also made mobile networks a viable platform to deliver services beyond voice, especially where coverage has to be extended over a wide area. Advances in mobile technology that have added increasing amounts of capacity have further contributed to the narrowing of the gap between wireless and fixed line technologies.

2.1.1 Wi-FI

Wi-Fi (wireless fidelity) refers to wireless local area networks that use one of several standards in the same "family" of 802.11 standards. Due to its affordability, scalability and versatility, its popularity has spread to rural and urban areas in developed and developing countries alike.

Using mesh network architecture[3], Wi-Fi networks can be scaled to match coverage area and the terrain of the target population. Coupled with solar powered generators, such networks have proven to be sufficiently robust to withstand deployment in the most isolated areas of the world. (See Box 2)

Box 2: Mesh Networking in the Amazon basin

Yachana in the Amazonian region of Ecuador, is located 2.5 hours by motorized canoe from the nearest small city. There, the Foundation for Integrated Education and Development (Funedesin), a non-governmental organization (NGO) dedicated to community development, has deployed a wireless mesh network to connect a school to an ecotourism centre and a bioscience centre.

The different sites are between 1.5 km and 5 km apart and the Wi-Fi mesh is connected to the internet via a VSAT link. All power for the meshboxes and laptops is provided using solar panels. VoIP is used to provide voice services within the network and to link users to the PSTN through Skype.

Supported by the revenue it gains through 2,000 annual visits from ecological tourists, Funedesin is setting up a college nearby to train others in the art of mesh networking, with support from its equipment provider LocustWorld.

Source: Funedesin at http://www.funedesin.org

Used as a point-to-point link, Wi-Fi can also be used as backhaul with line-of-sight ranges that reach up to 20km. In rural areas, where the risk of interference is low, increased power could be used to boost the signal to extend the range. For example, an agricultural community in Chancay-Huaral in Peru uses a backbone of 12 Wi-Fi links, the longest of which stretches over 10km. This network covers the entire 220km^2 valley and connects 14 telecentres that serve the 6,000 farmers who initiated and partially funded the project. Installation costs for the towers and radio equipment was around US$1,500 per site.[4]

The increasing use of Wi-Fi networks to extend coverage in rural areas with minimal capital has also been emulated in urban environments, albeit on a larger scale. Citywide Wi-Fi networks, which are constructed and managed by governments alone or in partnership with private operators, have become increasingly popular over the past few years. Small countries such as Singapore as well as large cities, such as Sydney, Philadelphia and San Francisco, have started to deploy ubiquitous Wi-Fi coverage within their borders. The majority of these initiatives are public-private sector partnerships that are non-profit in nature. While such initiatives do not strictly fall under universal access programmes, they nevertheless demonstrate the ability of new wireless technologies to make high speed Internet access an affordable and available proposition to the inhabitants of large urban centres. (See Box 3)

Box 3: Surfing for free in Singapore

From the beginning of 2007, Singaporeans will enjoy free wireless connectivity at up to 512 kbps speeds almost everywhere for at least two years under the regulator's 'Wireless@SG' programme.

Run by three private local wireless operators, the programme intends to increase the number of public Wi-Fi 'hotspots' from 900 to about 5,000 effectively covering most of the small island state. This two-year free offering with unlimited usage is extended to all residents and visitors in Singapore, including tourists and business travellers. Users do not have to be existing subscribers of these operators to enjoy the free service. The commercial model of the programme will be reviewed after the two year period of free access.

The three operators are expected to invest around SGD 100 million (USD 65 million) to extend the network over the next two years. IDA, the Singapore regulator, is expected to defray around SGD 30 million (USD 19 million) of the cost.

Source: Infocomm Development Authority of Singapore (IDA) at http://www.ida.gov.sg

While Wi-Fi access equipment is affordable and readily available to end-users, the deployment, operation and maintenance of such large citywide networks require a significant capital expenditure. The United States city of Philadelphia, for example, estimates it will spend USD 10 million to build and maintain its network over the next several years while the city of San Francisco plans to spend USD 15 million over the next decade.[5] In total, network providers and local governments building their own networks are expected to spend USD 235 million to build and operate citywide networks in 2006 alone. By 2010, it is estimated that more than USD 3 billion will spent on these networks.[6] Many of these networks, however, have not yet been

deployed and remain only in the planning phase. Such delays have led to a number of innovative "bottom-up" approaches aimed at achieving ubiquitous high-speed Internet access on a citywide basis. (see Box 4)

2.1.2 Power Line Communications (PLC)

Power Line Communications (PLC) or Broadband over Power Lines (BPL) is a term describing several different systems for using electrical power distribution wires for the simultaneous distribution of data. Plugging in a PLC modem into any power outlet in an equipped building will allow high-speed Internet access. While not a wireless technology, PLC offers a number of benefits relative to regular fixed line connections such as cable or DSL. In many countries, electrical infrastructure is usually more extensive than fixed line telecommunications infrastructure, making it suitable for expanding coverage. Moreover, PLC offers higher speeds over its networks than what is now commonly available through cable or DSL.

Box 4: Grassroots Wi-FI

Spanish start-up FON is giving away Wi-Fi routers loaded with software that allows broadband subscribers to share their Internet connections with Wi-Fi users throughout their communities. FON's package allows broadband subscribers to split their internet connection so that it offers a secure connection indoors and an open connection to people outside the home. Its self designed La Fonera router uses standard 802.11g technology and was designed for easy installation. Users simply plug the device into their existing broadband modem to convert it into a FON access point. Once users have registered, they become part of the FON community, which allows them free access to any FON hot spot in the world. Non-FON members can also access the network, but they must pay USD 1 or USD 2 for 24 hours of access. This small fee is how FON generates revenue.

Currently, about 112,000 La Fonera and FON-enabled routers have been registered with the company. To help spur adoption it's been offering the routers on its Web site for USD 5 apiece. It offers routers for free in cities such as San Francisco and in New York.

There are, however, certain issues that remain unresolved. Many Internet service providers consider the concept a violation of their customer contracts. Interference in densely populated areas also remains a big problem while the viability of the network is dependant on individuals that keep their routers turned on.

Source: CNET, Taking Wi-Fi power to the people, Oct 2006, at http://news.com.com/Taking+Wi-Fi+power+to+the+people+-+page+2/2100-7351_3-6130059-2.html

As a communications network, PLC is understandably more useful in countries with high electricity penetration rates. With rural and remote communities in many parts of the world still relying on independent generators to provide electricity, the use of PLC may be limited in the context of universal access. One possible alternative is to use PLC as backhaul for wireless communications. By hanging Wi-Fi access points, Broadband Wireless Access (BWA) points or mobile phone base stations on utility poles or towers, for example, end-users within a wider range could connect to PLC networks.

As a technology, however, PLC is still in an early stage of adoption with limited deployments on a significant scale. Trials are still ongoing in many developed countries with a focus on an eventual deployment first in urban areas. Nevertheless, there have been rare instances of PLC trial deployments in rural areas. In January 2006, in the rural locality of Band, Romania, a PLC trial was introduced by the Ministry of Communications and Information Technology. The network offers voice service and broadband Internet access for around USD 10 per month. The technology was introduced initially to 50 households. If successful, the project will be extended to other rural areas throughout Romania.[7]

2.1.3 Second and Third Generation cellular mobile systems

Second generation (2G) mobile technology is regarded as mature technology for the delivery of voice services. Unfortunately, however, data transfer speeds on 2G and 2.5G networks remain significantly slower than that available through fixed line networks. The high cost of greenfield installation also acts as a further deterrent to its adoption as a universal access solution for rural services beyond the urban fringe.

Nevertheless, in many parts of the world, mobile network coverage typically reaches areas far beyond that covered by fixed line infrastructure. As such, a large proportion of the population stands to benefit from an upgrading of the existing networks to provide faster data speeds. In some cases, an upgrade from 2G to 2.5G, Third Generation (3G), or 3.5G systems can be a cost effective way of extending high-speed Internet coverage as a main component of a mobile network's capital cost is the installation of towers and base stations. An upgrade from 2G to 2.5G, for example, typically involves changes in the hardware subsystems of certain base stations, a software upgrade and, in some cases, the addition of new base stations. Furthermore, the cost of adding new subscribers and capacity is distributed among all users on the network.

The introduction of 3G CDMA450 technology, in particular, has rekindled interest in the use of mobile technology to provide universal access. By transmitting at a lower frequency the technology allows for large cell sizes. In turn this allows reductions in installation costs as fewer base stations are required to cover the target area. As a 3G technology, it also supports the transmission of high-speed data with speeds reaching up to 2.4Mbps. A number of countries have already deployed CDMA450 as part of their universal access programmes.[8] (See Box 6 below)

2.1.4 Broadband Wireless Access (BWA)

Broadband wireless access is a technology aimed at providing high-speed wireless access over a wide area. It typically supports data rates faster than 1.5 Mbps at ranges that can go up to 30km. Currently, the most widely used technologies are Local Multipoint Distribution Service (LMDS) and Multichannel Multipoint Distribution Service (MMDS).[9] WiMAX technology, built on the IEEE 802.16 standard, is expected to be the eventual BWA platform of choice as deployments pick up speed over the next few years.[10]

In general, BWA systems show considerable promise in delivering cost effective voice and high-speed services to both urban and rural areas in developing countries. For example, Ghana and Pakistan plan ambitious rollouts of WiMAX networks that are expected to provide nationwide coverage progressively.[11] The growing availability of interoperable WiMAX equipment is expected to reduce the cost of BWA deployment in a similar way the Wi-Fi standard has resulted in large reductions in equipment prices. (see Box 5)

2.2 Applications and Services

The ability of NGN to deliver a suite of services and applications over a single network is expected to result in direct cost-savings to end-users. As importantly, it opens up the possibility of rural operators to tap into demand for services that go beyond just voice telephony, such as Internet Protocol Television (IPTV). The commercial sustainability of most universal access programmes depend on aggregating demand of the target population in order to meet the cost of network deployment and operation. As services can be provided over NGN for marginally incremental costs, the cost of NGN deployment and operation can be more easily offset by the larger demand each additional service generates. The marketing of service bundles facilitated by NGN, such as triple-play[12], would offer households in rural and remote markets both greater incentives to subscribe and better value for their money. Even in the absence of NGN, the cost of operation of many commercial and non-commercial telecentres is often offset by the provision of a wide range of commercial activities including Internet services, international calling, voice mailboxes as well as non-telecommunications services such as post office, photocopying, faxing, etc. In some cases telecentres already act as full business centers, adding to their profitability and social utility.

Box 5: BWA in Sierra Leone

In Sierra Leone, Omniglobe, a network solutions provider, and Limeline, a local operator, installed a satellite hub and pre-WiMAX BWA system with 6 wireless access points providing coverage to the population living within a radius of 5 to 10 km of the antenna. With each base station capable of supporting a maximum of 250 subscribers, the configuration supports up to 1,200 subscribers in the coverage area. The configuration is easily scalable with additional equipment easily added on.

The cost for equipment, installation and training for such a typical system supporting between 250 to 1,500 subscribers including satellite antenna, satellite terminal, wireless base stations and antennas lies between USD 18,000 and USD 40,000. (excluding the antenna structures, customs duties, shipping, taxes and travel for one engineer). The Consumer Premises Equipment (CPE) cost about USD 400 each. The overall capital cost for a 250 subscriber system is about USD 480 per subscriber.

Limeline's operating costs consist of: (i) bandwidth capacity purchased from Omniglobe with prices in the order of USD 2,000 to USD 4,000 per 2 Mbps downlink / 512 Kbps uplink speed capacity; (ii) remote technical support, (iii) salaries, employee benefits, administration and selling costs; (iv) licence and other fees; and (v) Ominglobe's share of monthly revenues.

Installation took only 8 to 10 weeks from the moment the contract was signed to when it was launched. Limeline charges USD 195 per month for its basic service offering 1Mbs download and 512kbps upload.

Source: Peter A. Stern, David N. Townsend and Robert Stephens, New Models for Universal Access to Telecommunications Services in Latin America, Regulatel and World Bank, Nov 2006; Omniglobe at http://www.omniglobe.net and Limeline at http://www.limeline.sl/

There is some evidence to support the idea that there exists a high demand for television content in developing markets. In developing countries, the penetration rate of television sets is often higher than fixed line penetration. For example, in India the number of cable TV subscriber lines far outnumbers that of fixed-line telephones. Globally, the overwhelming popularity of television ownership and cable TV subscribership indicates the ability of many rural populations to pay for services that they demand. As such, the bundling of ICT services with television programming may act as a stimulus to demand and as an attractive value proposition to populations in rural areas (see Box 6)

Box 6: Service Bundling in the Andes

In June 2006, Peruvian rural operator Valtron became the first commercial CDMA450 network operator in Latin America. Operating under the name, Televias de Huarochirí, Valtron will supply a comprehensive suite of 5 services that covers fixed, mobile, public telephone, Internet access and cable TV services to 127 low income towns in the Andean mountain province of Huarochirí.

Valtron was established with a grant awarded by the Fondo de Inversión en Telecomunicaciones (FITEL), the Peruvian regulator OSIPTEL's universal services fund. The 10-year project has a goal of reaching 38,000 direct subscribers and 59,000 indirect subscribers by the end of that period. Televias de Huarochirí's initial network will cover seven of its 32 districts and support 5,000 lines. Ultimately, Valtron's capacity will reach 400,000 lines and cover 32 districts.

Source: Fondo de Inversión en Telecomunicaciones (FITEL) at http://www.fitel.gob.pe/contenido.php?ID=48&tipo=H&pagina=contenidos/PPT/Valtron/Valtron.html.

With the deployment of NGN in rural areas, the provision of IPTV presents itself as a possible add-on service. IPTV refers to a system where a digital television service is delivered using IP over a network. IPTV uses standard networking protocols and is typically delivered over broadband Internet connections to households equiped with IPTV set-top boxes.[13]

The feasibility of deploying an IPTV service in a rural area is currently limited due to the bandwidth intensive nature of the service and the high cost and complexity of IPTV equipment. The scarcity of backhaul in a rural network is likely to act as a bottleneck to the delivery of IPTV services. The delivery of a standard definition television (SDTV) channel using MPEG2, which is a common standard for digital television, requires around 4 Mbps per channel. An IPTV service offering around 50 channels would require

the network to support 200 Mbps in total, a requirement that would be easily met by an urban network but not by a rural or remote one, especially where VSAT backhaul is used. Similarly, last mile bandwidth requirements are also high with many existing IPTV implementations requiring at least 10Mbps in bandwidth to the home.

Currently, most IPTV solutions are relatively new. Equipment prices are high and devices supplied by different vendors are not yet interoperable. Eventually, advances in technology and improving economies of scale will allow IPTV to overcome most of these obstacles. However, it is unlikely that it would be suitable for deployment in rural and remote areas in the immediate future.

3 Sector Reform

The transition to NGN is a timely catalyst for regulators to review and rethink the mechanisms that they rely on to reach their universal access goals. Such a review should focus, first and foremost, on the sector reform process which allows market forces to play a greater role in achieving universal access.

While universal access funding programmes play a large role in bringing ICT services to the "socially excluded", they are no substitute for continuing sector reform. Liberalization and competition have brought far greater benefits over the past few years than decades of universal access efforts channeled through incumbents. As such, regulators and policy makers have to look at other areas of regulation that play a vital role in supporting the expansion of ICT access. The need to look at policy and regulation holistically is even more urgent today as the transition to NGN brings about profound changes in ICT markets. Such an approach should take into consideration the areas of spectrum management, licensing, interconnection, VoIP regulation, quality of service and price regulation which are discussed below.

3.1 Spectrum Management

3.1.1 Providing Licence-free Spectrum Use

The growing popularity of mobile services and the introduction of new wireless technologies has increased the demand for spectrum dramatically over the past few years. As a result, countries are looking at new ways to manage spectrum use more efficiently. As part of this effort, increasing amounts of spectrum are being allocated to license free use worldwide in order to exploit the potential of technologies such as Wi-Fi and WiMAX to propel the rapid expansion of affordable high-speed access in both rural and urban areas.

Not all countries have embraced the idea of allocating spectrum to licence free uses for a variety of reasons such as fear of revenue loss or potential congestion. These fears, however, do not appear significant when compared against the potential of these technologies to provide cheaper and more accessible broadband access. Potential revenue loss from forgoing licensing fees would be offset by substantial savings in terms of disbursements of subsidies for universal access. Alternatives such as the levying of a small fee attached to the cost of purchasing equipment that are used in unlicensed spectrum, such as Wi-Fi routers, could obviate the need for a licence to operate in a particular frequency band while still providing revenue to the government.

3.1.2 Issuing Rural Spectrum licences

As a general principle, regulations should reflect market differences in urban and rural areas. In rural areas, spectrum is available in more abundance than in urban areas. With spectrum congestion being less of a concern in rural areas, spectrum licences should be awarded more cheaply or even licence free in certain bands. This would substantially reduce the cost of wireless network deployment in rural areas.

In many countries, current spectrum management practices leave many rural providers with mediocre spectrum while frequencies that have far better propagation characteristics remain idle because they are allocated to urban centers that are located far away. Such situations clearly reflect the shortcomings of a uniform spectrum management approach and the need for spectrum managers to recognize rural - urban differences. In practice, pilot testing for such a spectrum management approach could take place initially in specially designated "white spaces" in rural areas. In some countries, these could be within frequencies currently allocated to television broadcasting but be completely outside any existing broadcast contour.[14]

3.2 Licensing

Burdensome licensing requirements like high licensing fees are significant barriers to investment, particularly for small operators and those intending to invest in rural areas where margins are smaller. A simplification of the licensing process and a reduction in licence fees for operators providing services in rural areas would alleviate some of the obstacles rural providers already face. In practice, regulators could designate specific areas where operators would face minimal regulation beyond obtaining authorization and ensuring against interference with other users.

Where licensing requirements have already been eased, regulators and policy makers can consider further licence related incentives to encourage market entry into rural and remote areas. Obligations to provide services in rural areas, for example, can be bundled with licences to provide services in more lucrative markets. For example, in Uganda, 154 underserved counties were packaged into three separate "Universal Access Regions" for licensing purposes. Each Universal Access Region bundled together a mix of counties with different levels of market potential.[15]

3.3 Interconnection

A number of experts have made strong arguments for having asymmetric interconnection charges for rural areas. With interconnection rates moving towards being cost based, higher termination rates for calls originating in urban areas and terminating on rural networks would be justified because it costs more to construct, operate and maintain networks in rural areas. Higher termination rates would then be accompanied by higher tariffs on such calls. The fact that income generated by rural operators tends to come mainly from termination rates levied on incoming calls increases the appeal of mandating asymmetric interconnection rates. Chile, for example, allows cost-related asymmetrical interconnection rates. In 2002, the largest Chilean rural operator derived 60 percent of its total revenues from its positive interconnect balance with urban operators, allowing it to recover costs and develop the significant business opportunity from incoming calls. As a practical first step to implementing asymmetrical termination rates, regulators could use rate approximations pending further refinement as further studies are done.[16]

The increasing popularity of mobile services, however, has made it increasingly difficult to designate operators and end-users as being purely rural or urban. This complicates the levying of asymmetric interconnection charges. The transition to NGN, will further limit the benefits of adopting such an asymmetric system as interconnection for IP networks relies on peering and transit arrangements that remain largely unregulated. In an NGN environment, small rural ISPs are more likely to have to pay national ISPs transit charges to obtain connectivity to the internet as they are unlikely to have a large enough traffic volume and subscriber base to qualify for peering.[17]

3.4 VoIP

VoIP has become increasingly popular, particularly for long distance and international calling where calling prices on the PSTN are high. For a variety of reasons, a significant, although decreasing, number of countries have banned or restricted the use of VoIP for reasons that typically include the fact that it deprives incumbent operators of revenues that could otherwise support the expansion of universal access. In Panama, for example, a hefty 12% tax is levied on VoIP calls.

While this is true, lifting restrictions on the provision and use of VoIP, particularly for rural operations, would support universal access goals directly. Firstly, VoIP services provided through telecentres or internet cafes make long distance and international calls more affordable and secondly, its revenue supports the operation of high-speed access in these centres. One of the factors contributing to Peru's "Cabinas Publicas", which were discussed earlier, has been the fact that they are allowed to use VoIP.

While the application of technology neutrality may eventually entail the levying of universal fund contributions on VoIP operators, these contributions should not be set at punitive levels but at levels comparable to those paid by operators of other technologies.

3.5 Quality of Service

Regulations concerning quality of service may not recognize that it may not always be possible to guarantee the same quality of service in rural as in urban areas. Equipment may be subject to more wear and tear in

rural and remote areas and technical assistance might not be easily available to repair faulty equipment as promptly as in urban areas. Furthermore, where VoIP services are provided in rural areas over wireless and satellite technologies, quality or service may be even more difficult to maintain given possible interruptions in terms of power supply and connectivity.

In this context, strict quality of service requirements may be an impediment to investment in rural networks. Operators may be daunted by high quality of service requirements or they may have to spend considerably more in order to meet quality of service requirements. Given the limitations rural operators face, regulators should look into whether more flexibility can be built into quality of service standards in rural areas.

3.6 Price Regulation

Irrespective of the transition to NGN, rate rebalancing should remain a priority for regulators in their efforts to achieve universal access goals. Allowing incumbents to continue cross-subsidies for rural services, precludes new entrants from entering those markets and in effect compels them to "cream skim" in urban areas. Mandating below cost prices in rural areas also effectively discourages new market entrants without sources of cross-subsidy from entering rural areas.

The lowering of international and domestic long distance prices through VoIP will inevitably increase the level of cross subsidies necessary to maintain below cost prices in rural areas. In turn, this will render the provision of such services more unattractive even to operators with sources of cross-subsidy. A policy of rate rebalancing should be pursued to make prices more reflective of costs, allowing higher prices to reflect higher costs of service to rural areas. This will make rural markets more attractive to operators. Many low-income users have demonstrated a willingness to pay for services they require. For example, although mobile services tend to be more expensive than fixed line services, the use of pay as you go charging (e.g. pre-paid) have proven to be very popular. If necessary, higher end-user costs in rural areas may also be mitigated by transparent subsidies that do not distort the market.

4 The Scope of Universal Access in an NGN Environment

In the vast majority of countries, however, there will inevitably be segments of the population that will be inadequately served by market forces, regardless of the sector reform efforts taken. In these situations, the government intervenes directly to promote universal access, usually in the form of funding or mandatory obligations.

While there is a common understanding of the objectives that underlie such universal access frameworks, there is no single definition of what commitments they include. Beyond the generic goals of promoting "availability, affordability and accessibility" to ICT services, universal access definitions vary from country to country in terms of the ICT services to which these goals should apply.

For example, in the European Union, member states are required to ensure that a set of basic telecommunication services would always be available at a determined quality and an affordable price. This set includes the following rights[18]:

- Connection to the public telephone network at a fixed location
- Access to publicly available telephone services
- Availability of a directory information service
- Availability of public pay telephones
- Facilities for disabled users and those with special social needs.

Connections to the public telephone network at a fixed location should be capable of supporting speech and data communications at rates sufficient for access to online services such as those provided via the public Internet. No minimum data rate is mandated in the directive in order to allow member states the flexibility to determine what technology choice suits the particular member state best.

In contrast, in India the obligation extends to the following services that its Universal Service Obligation Fund supports[19]:

- Installation, operation and maintenance of the Village Public Telephones in each revenue village in India[20]
- Provision of additional rural community phones after achieving the target of one Village Public Telephone in every revenue village
- Upgrades of Public Telephone to Public Tele Information Centers with data transmission facilities in villages with populations exceeding 2000
- Phased Installation of High Speed Public Telecom Information Centers in villages with populations exceeding 2000
- Provision of household telephones in rural and remote areas according to targets that may be determined by the Central Government

Differences in individual and shared access aside, the two examples above show that there is a clear recognition of the importance of catering to voice as well as data services. The inclusion of data services as part of universal access definitions itself is a relatively new trend in most countries, both developed and developing. In the EU, for example, access to narrowband services was only added to the definition of universal service in 2002.

With the transition to NGN technology, both voice and high-speed data services will be delivered using only one transmission platform. While this supports universal access efforts that focus on providing both voice and data services, the technical characteristics of NGN may require countries to rethink how universal access is defined.

4.1 Separating service and transport

NGN's architecture rests on the separation of the network into different layers. This allows for decoupling the network's transport and service layers. As such, whenever a provider wants to enable a new service, it can do so by introducing it directly at the service layer without considering the transport layer. As services are independent of transport, one provider can easily supply services while a different provider supplies the infrastructure. This is common, for example, in the case of VoIP where a service provider (e.g. Skype, Vonage, etc.) provides the voice service and a carrier (e.g. BT, SingTel, etc.) provides the infrastructure. Such a separation allows customers much greater choice in the selection of service providers.

This raises the issue as to whether universal access funding programmes should apply only to infrastructure access or whether they should apply also to access to services. The argument that the scope of universal access funding programmes should eventually only extend to access to infrastructure is conceptually sound. The installation and maintenance of physical infrastructure is the largest cost factor in providing service in rural and remote areas. Services can typically be provided on top of this at marginal cost. Furthermore, the provision of services itself is geographically agnostic. End-users in rural and remote areas will by and large pay the same amount for the same services as end-users in urban areas. In this way, rural populations will be able to enjoy the same benefits of competition and scale that urban populations already enjoy for services. For example, an end-user in a rural location pays the same rates for a VoIP service like Skype as an end-user in an urban area.

The question of whether access to infrastructure can be practically decoupled from access to services in a universal access programme, however, will depend on the extent the two have been decoupled in commercial markets and how available and affordable independently provided services are. Currently, operators of transport networks enjoy significant advantages. They tend to be the default providers of the services that flow through their networks, particularly in the case of voice. Added to that, they are also usually in the best position to offer service bundles of voice, data and video. Regulators will have to grapple first with the competition policy issues that arise from the present market realities as well as deal with concerns over network neutrality before a similar policy can be introduced for universal access. In its submission to the EU consultation on universal service, for example, Ofcom noted that while there could be a case for separating the two elements for purposes of universal service, more studies would have to be done on the availability and affordability of services when decoupled from access to infrastructure.[21]

4.2 Technology Neutrality

As early as a decade ago, the definition of universal access extended only to fixed line infrastructure in the absence of other practical alternatives. However, as highlighted in section 2 above, this no longer appears to be the case. Access to a full range of ICT services can be provided over a wide variety of means, both wireless and fixed. With NGN, the type of technology used for infrastructure no longer impacts the kind of services that are delivered through it. As a result the choice of technology used to deploy infrastructure ultimately depends on the particular circumstances and needs of the target population.

Faced with a wide range of infrastructure possibilities, regulators have to devise guidelines that promote the deployment of the best possible infrastructure solution for each particular universal access target area identified in a universal access plan.[22] Instead of mandating a single infrastructure technology, the setting of minimum performance criteria that support a given range of services would allow universal access providers to propose or select the most cost effective technology from all the options available. (See Box 7.)

With an ever-increasing range of interoperable telecommunications infrastructure options available to choose from, restricting support to just one option or a single category of options appears increasingly unwise. In commercial markets, competition between different infrastructure platforms that supply the same services has led to greater availability, affordability and accessibility for the consumer. The same improvements can be expected when similarly applied to universal access programmes.

Box 7: Access Technologies and Universal Access in Malaysia

Under the Universal Service Programme (USP) implemented by Malaysia's regulator the MCMC, universal service providers are selected via a tender process where interested parties submit bids based on specifications laid out by the regulator. A remarkable amount of flexibility is given to the bidder in terms of technology used. Tender specifications are usually generic, specifying mainly the number of lines required and the type (residential or payphones). Bidders are allowed to propose the technology to be used, a suitable timeframe for network deployment as well as the target sites within a given district.

In practice, solutions ranging from the provision of mobile satellite phones to the deployment of CDMA wireless local loop networks were employed in different locations throughout the country. This large flexibility given to industry has been seen as a key contributor to the rapid pace of implementation of the USP programme.

Source: Eric Lie, "Building Digital Bridges: The Case of Malaysia", ITU, Sep 2004 available at http://www.itu.int/osg/spu/ni/digitalbridges/docs/casestudies/malaysia-rv3.pdf

4.3 Data

The need for some form of access to the internet whether it is on an individual basis, like in the member states of the EU, or on a shared basis, like in India, has become an integral element of universal access programmes in most countries, both developing and developed. While the transmission speeds mandated by such programmes are mostly narrowband, the present transition to NGN raises questions regarding the adequacy of existing requirements.

4.3.1 Should broadband be part of Universal Access?

The question of whether access to broadband should be included in the scope of universal access obligations assumes greater importance as the transition to NGN continues apace. NGN services such as high-quality VoIP and streaming video can only be delivered through broadband networks.

Although broadband penetration rates have been rising on a global basis, the deployment of such networks has been uneven with broadband network expansion taking place primarily in urban areas. As a result, exclusion from the benefits of broadband based services has become a concern for many countries.

Such concerns have led a small number of developed countries to contemplate mandating broadband access for all individual households as part of a universal access obligation in order to avoid "social exclusion" on the part of those who do not have such access. (See box 8)

Box 8: Broadband Switzerland

In September 2006, the Swiss Federal Council adapted the content of its universal service order to mandate, among other things, the provision of broadband access to the entire population of Switzerland from 1 January 2008.

Under this order, the connections currently available as part of universal service were supplemented by new connections permitting internet access at a minimum transmission rate of 600kbps (down) and 100kbps (up). In order to minimize the cost of including broadband access for universal service, however, it is envisaged that in exceptional cases the future universal service provider could reduce the transmission rate.

An upper price limit of CHF 69 (USD 55) per month was set for this service which includes not only the broadband connection but also a voice channel, a telephone number and an entry in the public telephone directory. The upper price limit will be re-examined in 2010 in order to take account of developments in the broadband connection market.

A public call for tenders was launched in October 2006 for the award of a universal service licence which will enter into force on 1 January 2008. Reults of the tender will be available in June 2007.

Source: Federal office of Communications (OFCOM), Switzerland at
http://www.bakom.ch/dokumentation/medieninformationen/00471/index.html?lang=en&msg-id=7308

While there are obvious benefits associated with the expansion of broadband access, is it nevertheless necessary to include broadband access as part of the universal access obligation now? A review of current trends indicates, however, that there does not seem to be a persuasive case for including broadband as a universal service at the present time.[23] While there is little doubt that there are potential benefits from expanding high-bandwidth broadband penetration, broadband is not yet so pervasive that those without broadband access can be considered to be "socially excluded". This view is supported by limited broadband take up, the risk of stifling competitive entry into the broadband market and the views of some regulators on that question.[24]

Indeed a comparison between broadband penetration rates on a global basis would indicate that broadband access has not reached the level of ubiquity where those who do not have access could be considered as "socially excluded". As of the end of 2005, only 3.3 inhabitants per 100 had access to broadband on a global basis. Even in leading broadband countries such as Korea (Rep.), broadband penetration rates have only just exceeded a quarter of the population. (See Figure 1.)

Figure 1: Broadband Market Data

Top 20 economies (ranked by total subscriber numbers) as at 31 December 2005

Total fixed broadband subscribers, penetration rate, broadband as a percentage of all internet subscribers and price per 100 kbit/s in USD.

Economy	Total fixed broadband Subscribers (000s)	Penetration (per 100 Inhabitants)	As % of Internet subscribers	Price in USD per 100 kbit/s
1. United States	49'391.1	16.6	73.9	$0.49
2. China	37'504.0	2.9	51.2	$1.43
3. Japan	22'365.1	17.5	66.0	$0.07
4. Korea (Rep.)	12'190.7	25.2	100.0	$0.08
5. Germany	10'686.6	12.9	53.4	$0.51
6. United Kingdom	9'539.9	16.0	63.1	$0.63
7. France	9'465.6	15.6	75.3	$0.36
8. Italy	6'820.0	11.7	38.5	$0.30
9. Canada	6'706.7	20.8	90.1	$1.01
10. Spain	4'994.3	11.7	90.0	$4.84
11. Taiwan, China	4'602.2	20.1	61.2	$0.18
12. Netherlands	4'100.0	25.2	58.6	$0.14
13. Brazil	3'304.0	1.8	41.8	$1.08
14. Mexico	2'304.5	2.2	58.0	$6.25
15. Australia	2'102.9	10.4	35.2	$3.45
16. Belgium	1'974.8	19.1	90.3	$1.21
17. Sweden	1'838.0	20.3	55.8	$0.23
18. Switzerland	1'725.4	23.1	71.6	$1.58
19. Hong Kong, China	1'659.1	23.6	62.8	$0.83
20. Turkey	1'589.8	2.2	70.6	$10.52
WORLD	215'477.7	3.3	56.2	$72.20

Note: «Broadband» is ≧ 256 kbit/s in one or both directions

Source: ITU World Telecommunications Indicators Database

If it is not appropriate for broadband to be included in universal access obligations now, the question then arises as to when or if regulators should move away from just promoting broadband access towards making broadband access obligatory. In this respect, a set of guidelines based on the approaches taken in Australia, the United States could be followed when a regulator wants to consider whether broadband should be part of a universal service obligation. (See Box 9.):

Box 9: Rules for systematically considering whether broadband should be a USO

1. Consideration of whether broadband is an essential service of significant 'social importance'
2. Estimation of the degree of expected market penetration of broadband service
3. Assessment of the nature and extent to which broadband will not be made available by the market and why
4. Identification and specification of objectives and desired outcomes clearly and specifically
5. Assessment of the extent to which market demand and delivery can/will meet the specified objectives.
6. Consideration of the social and economic disadvantages incurred by those without access to broadband if there is no government intervention in this expected market situation.
7. Estimation of the costs of intervention to widen broadband deployment through the use of the USO mechanism
8. Estimation of the costs of intervention through the use of the USO mechanism compared against the use of other approaches to establish that the USO mechanism is superior.
9. Establishment that the benefits of intervention through the USO exceed the costs of doing so, taking into account the incidence of such benefits and costs (especially those on unsubsidised telecommunications/Internet/broadband Internet customers); and of effects on other communications and broader policy objectives. (Intervention should only occur where overall benefits persuasively outweigh overall costs and where a substantial increase in the level of USO expenditure would not result.)

Source: Xavier, Patrick, "What Rules for Universal Service in an NGN Environment", ITU, Apr 2006 available at www.itu.int/osg/spu/ngn/documents/Papers/Xavier-060323-Fin-v1.pdf

4.3.2 Backbone and Backhaul Infrastructure

While the problem of providing affordable last-mile access has been alleviated by cost-effective technologies such as Wi-Fi, the expansion of networks into rural and remote areas has been limited by the lack of affordable backhaul and backbone infrastructure. Isolated sites typically rely on expensive satellite backhaul through very small aperture terminals (VSAT) stations.

At present, most universal access programmes have focused more on increasing last-mile access and have not devoted sufficient resources or incentives to support the deployment of more backhaul and backbone infrastructure to support greater last-mile access. While this asymmetry allows for a faster expansion of voice and narrowband data services, the lack of backbone and backhaul infrastructure threatens to act as a severe bottleneck especially with the introduction of more bandwidth hungry applications that ride on NGN.

Aside from funding backbone and backhaul from universal access funds, there remains considerable scope for governments to encourage the deployment of such infrastructure. Governments can leverage on the nationwide reach of infrastructure providers such as railways, highway operators and utility companies by encouraging them to enter into the market for backbone and backhaul services on an open access basis. These companies usually enjoy nationwide customer penetration and extensive communication infrastructure. Electricity utilities, for example, have internal needs for data communications within their power networks. These companies often have extensive networks of fibre-optic cables within the power grid to enable communications between electrical sub-stations. Once fibre is installed in the power grid, the excess capacity can be used to accommodate other rural users in the service area. Most of the cost of laying the fibre can be justified through savings achieved from more efficient electricity distribution. As a result, the incremental cost of opening up the network for backbone or backhaul access is minimized. By leveraging the existing telecommunication infrastructure between their installations, power companies in countries such as Iceland and Japan have already entered the ISP market. In Iceland the Reykjavik Power Company has established a data transmission network over its power grid that connects its power transformer stations

around the capital. Supplemented by fibre and fixed-wireless access, the company is able to offer broadband services to its customers.[25]

The power network, however, is not the only public infrastructure network to be leveraged on to expand access. In developing countries in particular, infrastructure networks such as railways and highways can be used as an alternative. India provides a good example of the use of its railway network to extend internet access to its rural areas. (See Box 10)

Box 10: India's Railway Backbone

In December 1988, the first fibre optic cable system was commissioned on Indian Railways over a distance of 60kms. Over the next few years, the network was slowly expanded. In September 2000, the RailTel Corporation of India Limited, a public sector company under the Ministry of Indian Railways, was formed to deploy fibre optic cables over the entire Indian Railways system to meet railway requirements as well as for the commercial sale of surplus capacity.

Railway communications typically require bandwidth to be available at each railway station for the operation of railway switches and junctions and for communications. As only 2 to 8 Mbps is required for this purpose out of the 155 Mbps the network supports, the remaining capacity can be used for other purposes such as backhaul services for rural and remote areas.

RailTel currently offers a number of services including the provision of leased lines and facilities such as tower space, as well as national long distance voice services. The company is also in the process of establishing broadband internet kiosks at railway stations while also deploying wireless broadband networks to provide broadband voice and data services to ISPs serving towns and cities astride its network of railways across India.

Source: RailTel Corporation of India at http://www.railtelindia.com/

4.3.3 Capacity Building and Content Support

Currently, most universal access programmes that focus on providing access to the internet in rural areas concentrate exclusively on the rollout of infrastructure. Community internet centers, however, have enjoyed at best mixed success in the countries where they have been deployed. Studies show that the most successful community internet centre programmes are those that are linked from their inception to a wide variety of capacity building and support programmes that are implemented with other government entities, local communities, businesses and NGOs.[26] The success of universal access programmes depends as much upon the availability and quality of the content and applications available as well as upon the level of training of its users, operators, service providers as upon the availability and affordability of infrastructure access. In Malaysia, for example, the regulator's Community Communications Development Programme (CCDP), which established semi-rural areas with broadband internet centers, was accompanied by a support programme aimed at encouraging capacity building and public outreach. Under the programme, centre operators are expected to act as promoters of broadband services, particularly by encouraging members of the community to establish a web presence on the Internet for purposes such as the marketing of local products and attractions (e.g. handicrafts and local tourist sites). Having been technically trained, operators are also expected to give users basic courses on subjects such as e-mail, web surfing and word processing.[27]

Equally important, suitable content and applications for the target populations should also be developed alongside infrastructure based programmes. These typically include eGovernment, telemedicine and teleeducation services. As a complement, universal access programmes should also support applications and content that highlight innovative uses of ICTs and multimedia applications, which can generate increased demand and economic benefits for local communities. Such services that can generate grassroots appeal could include, for example, local human interest content (news, entertainment, public affairs) transmitted via web based streaming audio or video; instructional and informational software applications for small businesses, farmers, families and other interest groups; and on-line forums to encourage the exchange of local or indigenous cultural heritage. Interactive multimedia services such as IPTV assume an even greater role in the dissemination of information and education in areas where illiteracy is prevalent. The Open Knowledge Network (OKN), run by the NGO One World, is one such example of an initiative aimed at supporting the creation and exchange of local content in developing countries through the use of ICT

solutions. Using the OKN system, individuals in developing countries in Africa, Asia and Latin America are able to create digital content in their own language, which is then exchanged with others through networks of existing community access points.[28]

With the increased number of services and applications NGN networks are expected to support, such as IPTV, capacity building and content support programmes are expected to play an increasing role in making ICT access beneficial and meaningful to these populations.

4.4 Voice

4.4.1 Mobile Voice

NGN aside, it is useful to remember that in most parts of the developing world, the overwhelming success of mobile technology means that mobile services are the de facto option for universal access to voice services. Due to its availability, affordability and convenience, it has exceeded in less than a decade the impact fixed-line phones achieved in a century.

At the end of 2005, 33.5 percent of the world's population subscribed to mobile services.[29] Already, it is estimated that mobile coverage extends to 80 percent of the world's population.[30] This remaining unserved segment of the population is likely to be disadvantaged in terms of geographic isolation, with its associated high cost of providing backbone and local transmission facilities.

Universal access programmes that are concerned with voice services should bear in mind these market realities and avoid investing scarce resources on alternative network deployments where mobile services can or are expected to serve the market without subsidy.

4.4.2 VoIP

Whether a fixed line network or a mobile network is used, the transition to NGN is expected to be accompanied by the increasing use of VoIP for voice. In the context of universal access, the migration to VoIP raises a number of issues that revolve around its quality of service (QoS) and access to emergency services. Currently, VoIP calls differ in terms of quality and reliability from voice over the PSTN as the former is more susceptible to Internet related technical problems and, in the case of fixed line VoIP, reliant on electrical power supply for calls. VoIP services also do not normally include free calls to emergency numbers, the automatic rerouting of emergency calls to the nearest emergency call centers nor caller identification.

These VoIP shortcomings relative to voice over the PSTN have led regulators to introduce a variety of different measures regulating the provision of VoIP. For example, in Canada the Canadian Radio-Television and Telecommunications Commission (CRTC) mandated VoIP providers to offer emergency 911 services. In addition, they were obliged to notify customers about limitations to their services.

Mandating VoIP to have the same quality of service and emergency related features as voice over the PSTN, however, increases the cost of providing that service. Given that VoIP's affordability is its major appeal, light-handed regulatory measures may be more suitable to strike a balance between meeting consumer expectations and lowering costs. (See Box 11.)

Box 11: The VoIP Framework in Singapore

In June 2005, the Singapore regulator, IDA, introduced a regulatory framework that included minimal obligations to encourage provision and adoption of VoIP services. Two sets of numbering ranges were assigned to VoIP services for this purpose.

Under the framework, operators providing VoIP services using level '3' numbers, are not required to provide number portability, emergency service connection, directory enquiry and printed directory services, or conform to QoS levels set by IDA. Operators, however, are obliged to keep their subscribers informed of any service limitations, for example, as to whether their service allows access to emergency services and whether it meets the minimum QoS levels set by IDA for local fixed-line services.

Facilities-based operators may use level "6" numbers, the number range currently reserved for fixed-line PSTN voice services, for VoIP services if they can provide number portability; connection to emergency services; directory enquiry and printed directory services; and, ensure QoS levels that are currently required for local fixed-line services.

Source: Infocomm Development Authority of Singapore (IDA) available at http://www.ida.gov.sg/News%20and%20Events/20050706170936.aspx?getPagetype=20

5 The Implications of NGN on Universal Access Funding

The funding base for universal access programmes has been under constant pressure over recent years due to a number of factors that have eroded traditional sources of revenue. Revenues from international and domestic long distance services, have been declining rapidly over the past few years as a result of a combination of factors, such as increased competition, the circumvention of the international accounting rate system and an increase in the use of VoIP. Added to this, mobile phone services have spread dramatically, allowing subscribers to avoid paying high domestic long distance charges. On a smaller scale, cable television systems and internet service providers have also started to offer VoIP services in many countries with rate plans that charge a flat rate for voice services or bundle free voice services with broadband access. The transition to NGN will inevitably lead to further falls in voice related revenues with analysts predicting an acceleration in the migration of voice traffic to VoIP and private corporate networks.

The problem of revenue erosion has been particularly acute for incumbent fixed line operators in developing countries where falling voice revenues, resulting largely from falls in international and long-distance revenues, have not been matched by a growth in internet usage through services such as broadband that have been giving fixed line operators in developed countries new revenue streams.

Fortunately, most developing countries that have implemented universal access programmes over the past few years have favored the creation of a central fund to support their universal access goals. Countries that have set up universal access funds have been more insulated from the effects of fixed-line revenue erosion, particularly if their funds rely on funding from general taxation revenues or from a wide and diverse operator base.

To cushion against the effect of unpredictable revenues resulting from a transition to NGNs, contributions to universal access funds should come from as broad an economic base as possible. Options for diversification include funding from general taxation revenues, specific taxes levied on end-users and from expanding the categories of operators that contribute to the fund. Revenues generated through the levying of spectrum and licensing fees as well as proceeds from the privatization of public owned operators can also form part of the funding base of a universal access fund.

5.1 General taxation revenue

In a general taxation system, the government allocates a certain percentage of the national budget to meet the cost of providing services. In many countries, this system is used to fund schemes to provide gas, electricity and water. While less prevalent, a number of countries also rely on general taxation revenue to fund their universal access programmes. Chile, for example, receives its universal access funding from the State Consolidated Revenue Fund. A universal access fund financed in part or in whole from general taxation revenue ensures a measure of security and consistency that permits long term planning for universal access

programmes. It also guarantees that the burden of providing communication services is distributed evenly across all sectors of the economy that benefit from wider ICT access. Some operators have also argued that general taxation makes sense where governments have decided that ICT is key to general socio-economic development.

5.2 Tax on End-users

Another alternative that has been proposed is the charging of an explicit tax on telephone service subscribers. In this system the operator collects and submits proceeds from this tax to the universal access fund. Depending on the user base, a relatively small levy on each subscription could generate a large sum of money.[31]

Nevertheless, for such a system to remain equitable in an NGN environment, it must necessarily extend to all users of ICT services. Users of VoIP, which does not require a subscription to a telephone service, may evade such taxes if internet access is not treated similarly.

5.3 Tax on Operators

Currently, many universal access funds rely on financing derived from taxes imposed directly on operator revenues. In many cases, this tax only applies to large fixed-line and mobile operators. ISPs and smaller service-based operators relying on resale are largely exempt from such contributions because of their small revenues or as part of government policy to leave internet related services largely untaxed and unregulated to promote their expansion. For example, in Malaysia only licensees that generate revenues above MYR 2 million (USD 560,000) from designated services are subject to mandatory contributions to the universal access fund.

This, however, appears to be evolving. Following increasing usage of VoIP, some countries have extended taxes to include VoIP providers and ISPs in an effort to mitigate the effects of revenue erosion suffered by PSTN voice operators and ensure a more consistent treatment of all voice operators, VoIP and PSTN alike. (See Box 12.)

Box 12: FCC approves new Internet phone taxes

In June 2006, the FCC voted unanimously to require taxes on all voice over Internet Protocol services that connect to the public-switched phone network. The tax revenue will be used by the Universal Service Fund, which subsidizes phone service in rural and low-income areas. Wireless, wireline, payphone, and DSL providers already contribute to the fund.

The taxes approved by the FCC will apply to companies such as VoIP provider Vonage but not to peer-to-peer services, such as those offered by Skype, in which connections are made entirely over the Internet.

Source: Federal Communications Commission (FCC) available at
http://news.com.com/FCC+approves+new+Internet+phone+taxes/2100-7352_3-6086437.html

6 The Distribution of Universal Access Support and Funds

As discussed in the preceding sections, the transition to NGN has opened up new possibilities in the context of universal access. As a result, the distribution of universal access support should be reconsidered in order to maximize the potential offered by NGN in meeting universal access goals.

The general question of how universal access support should be distributed encompasses a number of more specific questions: Who should be supported? (e.g. end-users, small operators, the incumbent, NGOs, etc.), What form should the support take (e.g. subsidies, loans, venture capital, etc.) and How should universal access providers be selected? (e.g. incumbent, auction, tender, etc.). While no one answer will prove to be the most ideal, it is nevertheless good practice to consider all the available options. Ultimately, what may be the most effective option could be a diversified approach to the allocation of universal access support over a range of actors and activities.

6.1 A top down vs. a bottom up approach

Early phases of universal access programmes are often undertaken on a large scale with supply-driven objectives that are measured in terms of infrastructure deployment on a national level (e.g. one public phone per village). In the past, traditional top-down, supply-driven approaches were typically adopted for large scale universal access projects. In such a scenario, a single provider - usually the incumbent - is selected to provide a standard set of services, using a narrow set of technologies, over a wide geographical area. The benefit of such an approach lies in the economies of scale a single provider can harness to achieve savings in cost. Taking a standardized approach over a wide area allows equipment to be purchased in bulk and for costs to be spread over a wider subscription base.

The introduction of NGN related technologies, such as BWA and Wi-Fi, however, has challenged this premise. NGN has substantially reduced economies of scale in both the infrastructure segment (as a result of cost-effective new wireless technologies) as well as in the service segment (e.g. VoIP). This opens up the field to a wider range of small or local providers to expand universal access from a bottom-up, demand driven angle.

A number of recent studies show that projects which originate from the communities that will be benefiting from the services to be provided or from the entrepreneurs that will be taking risks rather than those designed by bureaucrats have shown more promise. For example, studies by the International Institute for Communications and Development (IICD), a Dutch NGO involved in Bolivia and Ecuador, indicate that it is possible to implement small-scale universal access projects in rural areas.[32] The studies show that there is demand from farmers, small businesses, education institutions and local government.

As a result, more regulators have established programmes that encourage smaller operators and venture oriented companies that are closer to the target communities to participate in universal access projects. Since 2004, for example, small operators in Peru could request for subsidies for their self-initiated projects.

In cases where large-scale projects must still be undertaken, top-down approaches can still be used. However, these should be combined with a bottom-up approach to identifying requirements such as proposals delivered by communities, towns and municipalities.

6.1.1 Competition for Universal Access Delivery

Where a top-down solution is used in universal access projects, competitive methods of selecting a universal access provider should be considered. In such a system, potential universal access providers would bid through an auction, tender or other competitive selection process to provide specific types of services at specified levels of quality, scalability, upgradability and price. The winner would be the operator that requires the least amount of subsidies or funding to meet those requirements. Requirements should be kept to the barest minimum to allow potential providers the flexibility to propose the most efficient solutions. (See Box 7 above).

Such an approach is advisable for a number of reasons: Firstly, with economies of scale more easily attainable, incumbents should no longer be viewed as being the most ideal provider of universal access. Secondly, technological innovation has led to a wide range of access and service options to choose from. Given their limited resources, regulators and policy makers may not possess the same level of information and familiarity concerning the viability of these options as commercial providers. Allowing providers to propose solutions that they feel are the most cost-effective may result in greater cost savings as a result.

To ensure that winning providers would have incentives to keep investing and remain responsive to changing technologies and market conditions, a new competitive selection process might be held every 5 to 10 years, with the original winner facing the potential of being replaced.

6.1.2 The Role of Not for Profit Private Initiatives

The increasing ease with which small-scale universal access projects can be launched has also catalyzed the entry of non-traditional actors onto the universal access scene. These entities engage in activities from funding support to infrastructure deployment and service provision. As a common denominator, however, they have tended to focus on small-scale projects that are initiated closely with local communities or enterprises.

For example, Red Cientifica Peruana (RCP) in Peru started life in 1993 as nonprofit company set up with one computer and three modems. To date, its co-operative, self-sustaining model has inspired the setting up of more than 30,000 "cabinas publicas" or booths with computers across Peru, accounting for the bulk of the country's Internet use.[33]

Beyond the deployment of infrastructure and services, a small but growing number of not-for-profit organizations have emerged to focus on supporting local small-scale projects in developing countries. For example, an innovative funding mechanism intended to fill the "financing gap" for entrepreneurs who are unable to find capital was established recently in South Africa. (See Box 13.)

Box 13: Funding Support through Enablis

Enablis Entrepreneurial Network's is a not for profit, membership based organisation that supports individuals who adopt ICT as a significant enabler for social and economical development in the developing world. It has the support of private sector companies and the Canadian Government's Fund for Africa.

At present, it offers its members access to a ZAR 50 million (USD 65 million) fund, which provides a 90% loan guarantee exclusively to Enablis members in South Africa. This fund allows entrepreneurs with approved viable and sustainable business plans to obtain risk funding under favourable terms. Loan amounts are available in the ZAR 100,000 to ZAR 2.5 million range.

The model Enablis uses relies on its closeness to the borrower to ensure loan repayment. Relationships with members are fostered by the capacity building services and coaching Enablis offers. In addition to supporting borrowers with networking mentoring and coaching support, Enablis also provides support through an e-advantage seminar programme and e-circle peer-to-peer support programme and an e-finance risk capital programme.

Source: Enablis at http://www.enablis.org

6.2 Types of Funding Support

Before the wave of liberalization swept global ICT markets, universal access funding support was typically directed towards compensating the incumbent for maintaining high cost networks through the payment of an "access deficit charge" or through one off grants that supported the large scale roll-out of infrastructure. The entry of competition and the introduction of cost-effective access technologies, however, have introduced a wider range of operators that could benefit from universal access funding support.

6.2.1 Micro financing

The introduction of micro credit in the ICT sector has been a relatively recent phenomenon although it has been used in other sectors, such as agriculture, with considerable success. Micro credit fills a funding gap that allows individuals and small enterprises to obtain financing which would otherwise be denied to them by the traditional banking system for want of adequate returns and for high transaction costs. A loan of a few thousand dollars would already allow the setting up of a small internet booth equipped with a computer and Wi-Fi access. Money pooled may even support the rollout of a small mesh network in a rural community on the urban fringe.

Restructuring of universal access funds where a portion can be used for micro-financing operations including loans, grants, equity participation in projects run by small local entrepreneurs, local authorities and not-for-profit organizations could trigger the beginning of a grassroots movement to expand ICT access. This was the logic behind the partnership forged between the ITU and Grameen under the "ICT Empowerment Network" initiative in December 2006.[34]

6.2.2 Targeted End User Programmes

In a number of developed countries, universal access funds have been used to assist end-users directly through programmes that specifically target certain groups such as low-income households, the elderly and the disabled. Programmes range from the provision of subsidies to the mandating of special tariffs for certain target groups. For example, the Low Income Program in the United States reduces the cost of initiating a

new telephone service as well as reduces monthly charges for basic telephone service. This programme forms part of the country's Universal Service Fund's activities.[35]

The benefit of targeted subsidies rests on its transparency and on its ability to target specific "excluded" end-users with assistance. When applied in areas where a selection of access technologies and services is available, a suitably designed end-user programme would also allow such end-users to select the particular solutions that they require. For example, end-users benefiting from such a programme would have the choice of using their subsidies for a mobile phone or a fixed line phone, for voice or internet services.

It should be noted, however, that most end user subsidy programmes are implemented in areas where commercially provided services are already available and not in rural and remote areas which do not yet have ICT access. Nevertheless, there appears to be some merit in considering the introduction of an end-user subsidy programme even in unserved populations. Government assurances of the establishment of such programmes once services are introduced may increase the commercial viability of service provision in these areas provided an adequate mechanism is put in place to ensure that such assistance is used for ICT services and not for other purposes.

7 Conclusion

The transformation brought about to ICT markets as a result of the ongoing transition to NGN has led to a reconsideration of all areas of ICT policy and regulation. In the context of universal access, this paper has highlighted both the opportunities and the challenges this transition brings.

In deciding between the different options available for regulators and policy makers to take, it should be recalled that the transition to NGN is ongoing with markets still having to adjust to on going changes. With future developments being hard to predict, greater reliance in general should be placed on market forces in the provision of universal access. A systematic review of a country's universal access policies should first and foremost include a revision of its sector policies and regulations concerning licensing, spectrum management, interconnection, VoIP and price regulation with a view towards lowering barriers to market entry in rural and remote areas.

Intervention by regulators and policy makers in the form of universal access funding should only be attempted where there has been a clear failure of market forces in meeting universal access goals and when sufficient time for deliberation has passed. In such an event, a number of considerations are recommended. Given the changes the transition to NGN entails, the principle of technology neutrality should be adopted to ensure sufficient flexibility to employ the most effective and practical technology solutions that NGN allows. The separation of infrastructure from services which NGN heralds will also need to be considered when policy makers and regulators decide on what aspects of universal access they should fund. During that process, attention should also be paid to backbone and backhaul infrastructure deployment, capacity building and local content development.

In the distribution of universal access funds, policy makers and regulators should also take advantage of the reduction in economies of scale brought about by NGN related technologies in the provision of infrastructure and services. Innovative grassroots funding mechanisms such as micro-financing would allow a new set of actors such as small businesses, civil society and even individuals to play a larger role in bringing about universal access, thereby reducing the dependence on incumbent operators. In this respect, the transition to NGN can be regarded as a catalyst which allows the pursuit of universal access to become more of a universal endeavor.

[1] The following targets were set, to be achieved by 2015, with special attention to be paid to the needs of developing countries.

- to connect villages with ICTs and establish community access points;
- to connect universities, colleges, secondary schools and primary schools with ICTs;
- to connect scientific and research centres with ICTs;
- to connect public libraries, cultural centres, museums, post offices and archives with ICTs;
- to connect health centres and hospitals with ICTs;
- to connect all local and central government departments and establish websites and email addresses;
- to adapt all primary and secondary school curricula to meet the challenges of the Information Society, taking into account national circumstances;
- to ensure that all of the world's population have access to television and radio services;
- to encourage the development of content and to put in place technical conditions in order to facilitate the presence and use of all world languages on the Internet;
- to ensure that more than half the world's inhabitants have access to ICTs within their reach.

[2] A Definition of Universal Service

Universal Service policies generally focus on promoting or maintaining "universal" availability of connections by individual households to public network facilities and services at affordable prices.

Universal Access generally refers to a situation where every person has a reasonable means of access to a publicly available network facilities and services. Universal Access is typically provided through pay telephones, community telecentres, community Internet access terminals and similar means.

While Universal Service and Universal Access policies can be quite different, the concepts are closely related. In some cases, the two terms are used interchangeably. For simplicity, the term universal access in this paper will refer to both Universal Service and Universal Access.

[3] Mesh networks are networks formed out of a number of access points that can automatically form connections with other nodes within range, and reroute traffic if a node drops offline. This allows the network to be self-organizing, making it extremely robust. Mesh networks using Wi-Fi usually can be set up in a matter of days and at a cost significantly below that of a similar wireline network.

[4] See http://www.huaral.org/ for more information.

[5] For more information see, for example, http://www.wirelessphiladelphia.org/

[6] MuniWireless, "More Than $3 Billion Will Be Spent On Public Wi-Fi By U.S. Municipalities During Next Four Years" Oct 2006 at http://muniwireless.com/municipal/1431

[7] For more information, see http://www.jurnalul.ro/articol_45928/broad_band_internet_via_power_sockets_in_rural_romania.html

[8] See http://www.450world.org/ for further information.

[9] **LMDS** is a technology that uses microwave signals operating between the 26GHz and 29GHz bands. It is a point-to-multipoint service, allowing access by multiple parties. Links up to 8 km from the base station are possible, but distance is typically limited to around 2km due to weather and terrain. Download speeds vary according to the number of users served but can attain more than 500mbps. **MMDS** uses microwave frequencies between the 2 GHz to 3 GHz bands. It is a point-to-multipoint service and has a range of up to 25kms with line of sight. Typical download speeds offered go up to 3Mbps.

[10] WiMAX is a standards-based technology that will operate in the 3.5 GHz, 2.3/2.5 GHz, or 5 GHz bands, depending on local spectrum allocations. It uses interference mitigation technologies that make it suitable for use in unlicensed frequencies. Its typical transmission radius ranges from three to 10 kilometers and can be expected to deliver capacity of up to 40 Mbps per channel, for fixed and portable access applications.

[11] See http://voipforsmb.tmcnet.com/news/2006/05/23/110235.htm and http://www.ghana.com.gh/ncs.html respectively for more information.

[12] Triple Play refers to the commercial bundling of IPTV, VoIP and Internet access.

[13] For more information on IPTV technology see ITU's website on the technology at http://www.itu.int/ITU-T/IPTV/ and a presentation by Reza Tadayoni, CICT, Technical University of Denmark at http://www.itu.int/ITU-D/treg/Events/Seminars/2006/ceotraining/documents/3Dec_Session%20A_2_IPTV.pdf

[14] Entman, Robert, "Policy Issues for Telecommunications Reform Reports of the 2005 Aspen Institute Conferences on Telecommunications and Spectrum Policy", Feb 2006 available at www.aspeninstitute.org/atf/cf/%7BDEB6F227-659B-4EC8-8F84-8DF23CA704F5%7D/2005TelecomReportText.pdf

[15] For more information see "Licensing in the Era of Liberalization and Convergence: The Case Study of the Republic of Uganda, 2004", ITU available at http://www.itu.int/ITU-D/treg/Case_Studies/Index.html

[16] Andrew Dymond, Telecommunications Challenges in Developing Countries, Asymmetric Interconnection Charges for Rural Areas, World Bank Working Paper No. 27, 2004

[17] To some extent, the challenges facing small rural ISPs are similar to those faced by developing country ISPs such as limited market size and geographic isolation. Some of the solutions proposed to such as demand aggregation can be used effectively in both situations. Please see the 2007 ITU GSR Discussion Paper on International Interconnection, NGN and Development for more information.

[18] Directive 2002/22/EC of The European Parliament and of the Council of 7 March 2002 on universal service and users' rights relating to electronic communications networks and services (Universal Service Directive)

[19] See http://www.dot.gov.in/uso/usoindex.htm for more details.

[20] A revenue village is an administrative unit comprising of an agglomeration of habitations which has a definite boundary.

[21] Ofcom's response to the European Commission's "On the Review of the Scope of Universal Service in Accordance with Article 15 of Directive 2002/22/EC" 24 May 2005, COM (2005) 203, 24 May 2005

[22] A target area can be defined in a number of ways. This could include specific villages that do not have any telecommunications services to entire regions that have teledensities below the national average.

[23] See Xavier, Patrick, "What Rules for Universal Service in an NGN Environment", ITU, Apr 2006 available at www.itu.int/osg/spu/ngn/documents/Papers/Xavier-060323-Fin-v1.pdf

[24] For example, Ofcom undertook a preliminary review of the case for extending USOs to include broadband and concluded that: "…as yet, the efficiency case for a broadband USO is not compelling" due to the "…still limited take-up, the dangers of distorting the market (through non-technology neutral intervention at an early stage of market development), the lack of convincing efficiency or social policy arguments for universal broadband access and the number of existing private and public broadband initiatives" - Ofcom's response to the European Commission's "On the Review of the Scope of Universal Service in Accordance with Article 15 of Directive 2002/22/EC" 24 May 2005, COM (2005) 203, 24 May 2005.

[25] Srivastava, L. "Promoting Broadband - The Case of Iceland", Apr 2003, ITU available at http://www.itu.int/osg/spu/ni/promotebroadband/casestudies/iceland.pdf

[26] Peter A. Stern, David N. Townsend and Robert Stephens, New Models for Universal Access to Telecommunications Services in Latin America, Regulatel and World Bank, Nov 2006

[27] Eric Lie, "Building Digital Bridges: The Case of Malaysia", ITU, Sep 2004 available at http://www.itu.int/osg/spu/ni/digitalbridges/docs/casestudies/malaysia-rv3.pdf

[28] For more information, see http://www.openknowledge.net/

[29] ITU World Telecommunication Indicators Database

[30] ITU World Telecommunication Indicators Database

[31] Supra note 26

[32] Joitske Hulsebosch, Bénédicte Marcilly, Loeki Schaeffers, "Uniting Through Networks", Nov 2006 available at http://www.iicd.org/articles/uniting-through-networks

[33] See http://www.rcp.net.pe/ for more information.

[34] For more information, see http://www.itu.int/newsarchive/press_releases/2006/35.html

[35] See http://www.usac.org for more information.

International Telecommunication Union

GSR 2007

DISCUSSION PAPER

International Internet Interconnection

Comments are welcome and should be sent by 1 March 2007 to GSR07@itu.int

International Telecommunication Union

GLOBAL SYMPOSIUM FOR REGULATORS

Dubai World Trade Center
Dubai, United Arab Emirates

5-7 February 2007

Work in progress, for discussion purposes

INTERNATIONAL INTERNET INTERCONNECTION NEXT GENERATION NETWORKS AND DEVELOPMENT

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TELECOMMUNICATION CONSULTANT

COMMENTS ARE WELCOME AND SHOULD BE SENT BY 1 MARCH 2007 TO
gsr07@itu.int

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GSR DISCUSSION PAPER

INTERNATIONAL INTERNET INTERCONNECTION

NEXT GENERATION NETWORKS AND DEVELOPMENT

*This paper has been prepared **Eric Lie**, Telecommunication Consultant (eric.lie@gmail.com), as an input document for the 2007 Global Symposium for Regulators (GSR), organized by the Telecommunication Development Bureau (BDT). The views expressed in this paper are those of the author and do not necessarily reflect the opinions of the ITU or its membership. Comments are welcome and should be sent to gsr07@itu.int by 1 March 2007.*

1 Introduction

The subject of international interconnection has been dominated for some time by issues related to the accounting rate system and the cost of international internet connectivity. While these issues have been with us for some period of time, a greater sense of urgency to resolve them has been brought about by the accelerating transition from PSTN to NGN networks. This transition is expected to lead to further declines in the amount of PSTN traffic that goes through the accounting rate system, lowering the already reduced amounts of foreign exchange developing countries receive through settlement payments. At the same time, this transition is also expected to place a greater burden on developing countries in the form of costs related to international internet connectivity. For a variety of reasons, developing countries have had to bear high costs for international connectivity to the internet. These costs are expected to increase as more traffic migrates to NGNs.

This paper discusses some of the current trends in international interconnection as well as the implications international interconnection practices have on telecommunications development. Section 2 describes the charging arrangements related to international PSTN connection and international IP connection. It also discusses some of the international traffic trends that have had an effect on these arrangements. Section 3 considers the impact of international interconnection practices on telecommunications development, focusing in particular on the effects of the declining accounting rate system and the high cost of international internet connectivity on developing countries. The chapter also makes some suggestions as to how some of these challenges can be addressed.

2 Trends in International Interconnection

2.1 International Interconnection on the Public Switched Telecommunications Network (PSTN)

2.1.1 *The Accounting Rate System* [1]

The accounting rate system is a series of arrangements between national operators in which they jointly provide international calls and divide the revenues from such calls between them. It was developed as a way to allocate revenue for international telephone services and to cover the costs of international transmission, the international gateway and call termination. The system provides a set of agreed prices or "accounting rates" for the interconnection of international calls. The originating carrier charges the customer making the call a retail rate, and is charged generally half the accounting rate by the terminating carrier for the termination of the international call. Under this system, there is a joint provision of service, each carrier providing service to an imaginary halfway point on the international circuit (half circuit). It should be noted, however that accounting rates do not necessarily reflect costs.

The accounting rate system is set out in the *International Telecommunication Regulations (ITRs)*, an international treaty administered by the International Telecommunication Union (ITU). The ITRs are complemented by "D-series" Recommendations, which are the work of Study Group 3 of the ITU Telecommunication Standardization Sector (ITU-T).[2]

The accounting rate system contains a number of different methodologies, but the most common system of remuneration has been the "accounting rate revenue division procedure". Under this system, a net settlement payment is made on the basis of excess traffic minutes, multiplied by half the accounting rate. This amount is usually paid in United States Dollars (USD) or Special Drawing Rights (SDR)[3]. If traffic flows along a route are balanced, the accounting rate system does not generate significant cash flows. However, for many less-developed countries, traffic on international routes is unbalanced as more calls are terminated in these countries than originate from them. As a result, the accounting rate system has produced considerable revenue inflows to many developing countries.

During the 1990s, net settlement payments grew extremely large as traffic flows become less balanced. During the period between 1993 and 1998, the ITU estimated that net flows of settlement payments from developed to developing countries amounted to some USD 40 billion. However, an increasing volume of traffic now passes outside the accounting rate system (e.g. via VoIP), or is routed in such a way as to exploit the least-cost route between two end-points, which is not necessarily the most direct one. Participants in ITU-T Study Group 3 have estimated that developing countries may now pay USD 3 billion to developed countries.

2.1.2 *Decline of the Accounting Rate System*

The accounting rate system has come under sustained pressure for more than a decade. The wave of telecommunications sector liberalization that started in the late 1990s led to the entry of new competitive carriers into both the international and domestic telecommunications market of many countries. The presence of these competitive carriers made it possible for carriers in other countries to deal with more than one correspondent in the delivery of international calls, opening the gates to different arrangements in search of lower prices. In some cases, foreign carriers entered into domestic markets to interconnect directly with local operators.

Arbitrage opportunities from the uneven pace of liberalization on a global basis allowed carriers to offer customers prices that were well below international accounting rates even for calls to countries without liberalized telecommunications markets.

At the same time, the system also came under increased regulatory pressure. In 1997, the United States Federal Communications Commission (FCC) acted to reduce accounting rates by prohibiting US-based carriers from paying rates above certain benchmark levels. (See Box 1)

Box 1: FCC intervention in international accounting rates

In 1997, the FCC established its benchmarks policy with the goal of reducing above-cost settlement rates paid by US carriers to foreign carriers for the termination of international traffic. The benchmarks policy requires US carriers to negotiate settlement rates at or below benchmark levels set by the Commission in its 1997 Benchmarks Order. The *Benchmarks Order* divided countries into four groups based upon economic development levels as determined by information from ITU and the World Bank.

Currently, more than 95 percent of U.S. outbound international minutes are reported by US carriers to be in compliance with the prescribed benchmark rates. The Commission's Benchmarks Policy has contributed to a decline in international settlement rates. FCC staff estimate US consumer savings of up to $38 billion due to the decline in settlement rates from 1997 through 2002.

Source: FCC at http://www.fcc.gov/ib/pd/pf/account.html

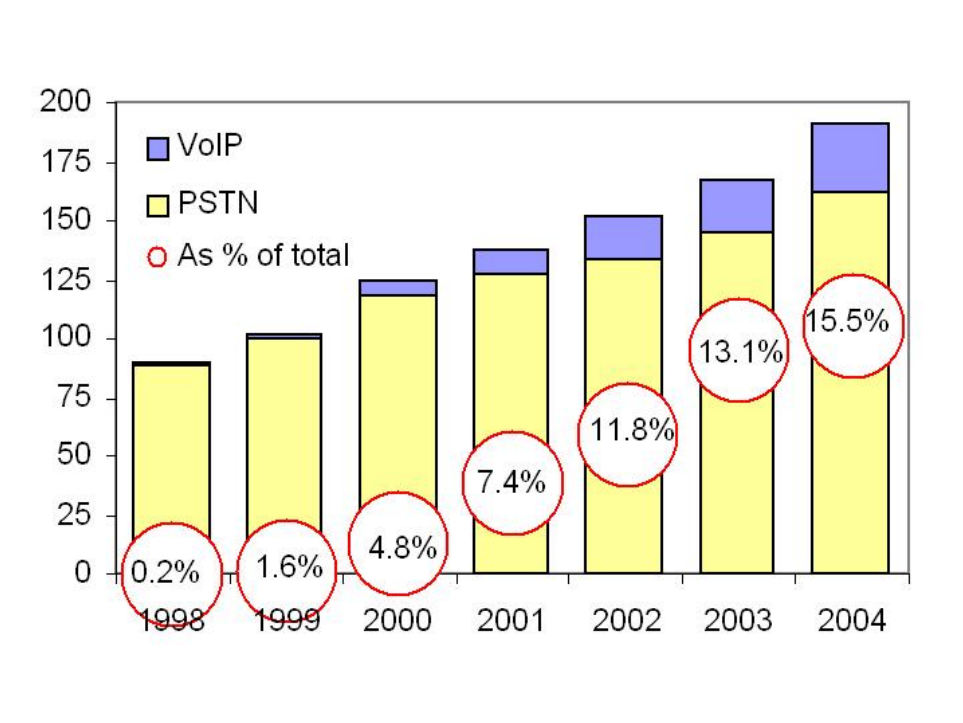
The increasing use of VoIP, which bypasses the international accounting rate system, has further undermined the system's relevance. While VoIP traffic still accounts for only a modest share of international voice traffic, that amount is expected to rise exponentially as more carriers transition to end-to-end NGN. (See Figure 1.)

The accounting rate system has now been largely replaced by directly negotiated rates to terminate traffic, in some cases with long-term contracts, in other cases on a short-term or spot basis. Electronic exchanges like Arbinet and VPF, have emerged that enable trading of international voice, data, and mobile capacity. In most cases the prices for terminating traffic around the world at such exchanges are significantly lower than even those prescribed by the FCC's benchmark rates.[4] Studies conducted by the ITU indicate that on a global basis

settlement rates have fallen consistently. Since 1998, the rate of reduction has accelerated to more than 20 per cent year on year. In SDR, average settlement rates were 1.06 in 1998, 0.258 in 2001, 0.229 in 2002, 0.195 in 2003, 0.125 in 2004, 0.088 in 2005 and 0.071 in 2006.[5] The accounting rate system still exists, but in a far more modest scale than a decade ago. The ITU estimates that only 20 percent of international traffic still uses the accounting rate system. This percentage is predominantly made up of traffic originating and terminating in developing countries. No developed countries exchange traffic with other developed countries using the accounting rate system.

The combined effect of all these trends has contributed to a general decline in the volume of international voice traffic over the PSTN, its retail price and consequently the revenue it generates for carriers. (See Figure 2.)

Figure 1: International Voice Traffic
in billions of minutes



Source: ITU World Telecommunication Indicators Database

Although this decline has been felt globally, its effects have been more pronounced in developing countries. Some of the effects that present themselves in the context of telecommunications development are discussed in Chapter 3.

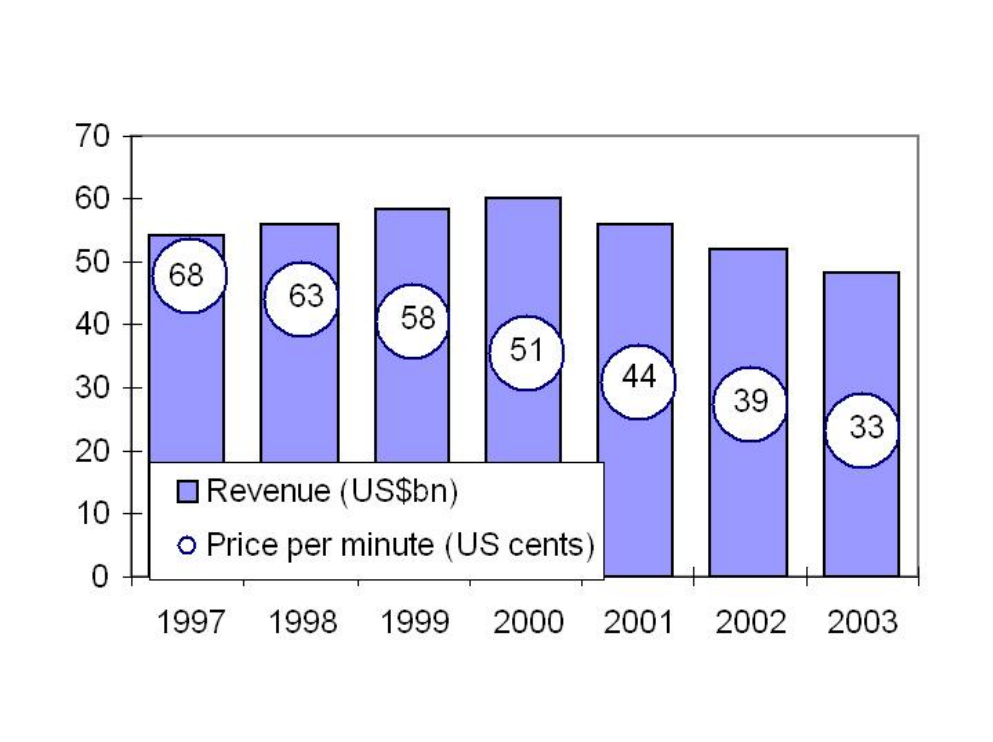
2.1.3 *International Efforts at Reforming the Accounting Rate System* [6]

In order to adapt the accounting rate system to the evolving global telecommunication environment, Study Group 3 of the ITU-T started an overall review of the accounting rate system as early as 1991. Work on accounting rates concentrated on:

- developing general principles and guidelines for the establishment of accounting rates;
- determining cost components to be included in the telephone accounting rates;
- developing appropriate costing methodologies; and
- establishing a transition period to avoid drastic changes, particularly for developing countries.

Based on these objectives, Study Group 3 developed ITU-T Recommendation D.140, which was subsequently adopted in 1992. It recommended cost-orientation, publication and the periodical review of accounting rates, specifying the cost elements to be taken into account. In December 1998, Study Group 3 approved a revision to ITU-T Recommendation D.150, agreeing on three new procedures for remunerating the party that terminates international traffic. The first, the termination charge procedure, allows governments or operators to establish a single charge for terminating traffic in their country, provided the charge meets certain multilaterally agreed criteria. The second, the settlement rate procedure, allows negotiation of cost-orientated and asymmetric settlement rates. The third procedure, between countries that have introduced liberalization, allows any other bilaterally negotiated commercial arrangement.

Figure 2: International Voice Traffic Trends
Revenue (USD billion) and price per minute (US cents)



Source: ITU World Telecommunication Indicators Database

In 1998, ITU-T Study Group 3 also agreed to establish a Focus Group in order to study a possible scheduled reduction of accounting rates. The Focus Group proposes “target rates” for countries in different teledensity bands on a periodic basis. Currently, ITU-T Study Group 3 also continues to study the adaptation of its recommendations to the changing market environment mainly through the periodic collection of data and its analysis.

To a large extent ongoing work by Study Group 3 concentrates on refining the costing methodologies and settlement procedures that are based on its current recommendations. Recently, however, focus has shifted towards an examination and analysis of mobile termination rates for international calls.

The topic of accounting rate reform has also been the subject of discussion at the World Trade Organisation (WTO) for some time. Most favored nation (MFN) status was not applied to accounting rates and no consensus on accounting rates was reached when its Members concluded negotiations on the General Agreement on Trade in Services (GATS) in 1994 largely because not all countries had embraced telecommunications market liberalization to the same extent at that point in time. Negotiations on how principles, such as non-discriminatory pricing, may apply to measures related to the accounting rates system have remained inconclusive while proposals that participants address these issues by scheduling market

access commitments on "termination services" have not so far been found acceptable. With less traffic flowing through the accounting rate system, the issue has become less controversial. Nevertheless, the secretariats of the ITU and the WTO continue to collaborate closely on ongoing reform efforts.

2.2 International Internet Interconnection

2.2.1 *Charging Arrangements for International Internet Interconnection*

2.2.1.1 IP Peering and Transit

Unlike in the PSTN world, where the costs of international calls are shared between operators, Internet Service Providers (ISPs) exchange IP traffic in two principal ways common to both international and domestic markets: peering and transit. (See Box 2.)

Box 2: Peering and Transit

Peering, also known as "Sender Keep All" or "Bill and Keep" is a zero compensation arrangement by which two ISPs agree to exchange traffic at no charge. This kind of arrangement makes sense where the two ISPs have roughly the same characteristics and traffic volumes, such that net financial burden from traffic flows between them is likely to be small.

The process by which an ISP qualifies for peering remains private. ISPs negotiate terms and conditions privately. They only rarely publicly disclose the criteria they use to qualify for peering. However, several Tier-2 ISPs have posted general qualifications for agreements to peer on their web sites. These conditions emphasize network coverage, volume of traffic, and 24 hour a day network maintenance capability. These criteria are probably more liberal than a Tier-1 ISP would require.

Transit is an arrangement in which larger ISPs sell access to their networks, their customers, and other ISP networks with which they had negotiated access agreements.

Under a transit arrangement, the sender pays the full cost of interconnection. Transit charges are set by commercial negotiation, and are generally not disclosed.

Internet transit access arrangements provide a much greater geographical access than telecommunications transit arrangements. In telecommunications, transit arrangements typically secure an indirect link to one carrier in one location (primarily because a small carrier is unable to secure a direct link). Internet transit arrangements typically provide access to a vast array of networks, not limited to one country.

At the extreme, one Internet transit payment arrangement with one major Tier-1 ISP can provide a small, remote ISP with access to the Rest of the World. This is because the Tier-1 ISP has ubiquitous access and so can provide extensive routing opportunities.

Source: ITU-InfoDev ICT Toolkit available at http://icttoolkit.infodev.org

The question of whether two ISPs enter into a peering arrangement, as opposed to a transit arrangement, depends largely on whether there is a balance of contributions and benefits between the two parties. Unlike the PSTN system, the determination of such a balance is more broadly based than just a measurement of traffic volume. Balance takes into account not only on a comparison of traffic volume but also factors such as customer base (customer loyalty, size of customer base, customer demographics), the range of ancillary services offered, the quality of onward connectivity and the technology used.

Traffic volume alone is never used as the only metric for determining the relative contributions to the cost of the connectivity between two ISPs. Such measurements are prone to abuse and misinterpretation. Moreover, the resources involved in measuring traffic are considerable with precise measurements difficult to obtain and results subject to debate. Nevertheless, traffic balance still represents one important factor into the calculation of balance for purposes of peering.

In many cases, even when peering arrangements are available, some ISPs may choose to pay for transit for a number of reasons. For many countries, the incremental cost of using high capacity links to the US together with the lower transit fees paid to US ISPs for global connectivity is in most cases less than the cost of

establishing separate routes to individual ISPs in different countries for purposes of peering, especially when the volume of traffic exchanged is low. There are also costs and other resources involved in negotiating peering arrangements with different parties. Peering requires routers and other related equipment which are installed at peering points. The more peers, the more equipment is required, and the higher the capital expenditure. As a result, in practice many ISPs have adopted a hybrid approach to interconnection - peering with a number of ISPs and paying for transit from one or more ISPs in order to have access to the backbone of the transit supplier as well as the peering partners of the transit supplier.

2.2.1.2 International VoIP Interconnection

On a technical level, there is no fundamental difference between the exchange of Voice over Internet Protocol (VoIP) packets and the packets of any other IP based service like email or IPTV. As a result, VoIP traffic is generally exchanged on the same basis as other forms of IP based traffic.

As opposed to IP based services such as email, however, VoIP interconnection with the PSTN remains a necessity as the vast majority of telecommunications users are still reliant on the latter. In most cases, major international VoIP service providers such as Skype or Yahoo terminate traffic on the PSTN through termination agreements with telecommunications operators who terminate traffic on their own network or through their termination agreements with a range of national operators. Not unlike commercial practices on the PSTN, VoIP service providers typically shop around for the best terms and conditions for international termination. Currently, VoIP service providers do not receive any compensation from PSTN service providers for terminating calls that originate on the PSTN. This may change as the balance between PSTN users and VoIP users shifts.

It is worthwhile noting that in recent years, VoIP service providers have started to enter into their own specific peering arrangements with other VoIP service providers. [7] While the essential aim of these arrangements is to reduce costs through settlement free peering, such arrangements also have the potential to guarantee or improve service quality. As NGN technologies like Multi-Protocol Label Switching (MPLS) gain in popularity as a means to mark certain packets as having delivery requirements other than the "best effort" standard of the public Internet, VoIP service providers that interconnect directly with other VoIP service providers can guarantee a certain level of end-to-end service quality for their services.

2.2.1.3 New Models for International Internet Interconnection

NGN's ability to provide different levels of quality for different IP-based services, however, has led a number of network operators to question the sufficiency of the current international interconnection regime when it comes to the delivery of traffic that requires more than "best efforts".[8] They advocate the establishment of an interconnection regime that would reflect the best of the PSTN and IP worlds in terms of the assurances of security and quality of the former and the cost-effective performance and flexibility of the latter.

As NGN deployment continues, operators owning network infrastructure have advocated the use of service control and application layers to distinguish specific high quality and secure services provided to their customers (such as VoIP or online games), from other services (such as emails or world-wide-web browsing) or from services destined for the customers of a different service provider. This would allow these operators to charge their consumers or service providers using their networks different prices that correspond to the level of quality and security demanded.

To some degree, the decoupling of service provision from the network made possible by NGN has also contributed to network operator dissatisfaction with the current interconnection regime. With service providers receiving larger shares of end-user generated revenues, network operators fear that they will eventually be reduced to just conduits through which more profitable services will flow. As a result, network operators seek to recover some of the perceived difference through differentiated charging for interconnection and/or by entering the downstream service provision market themselves.

In the US, these issues form part of a wider debate on "net neutrality".[9] While the term "net neutrality" has no precise definition, advocates of "net neutrality" generally argue that all network application needs should be met equitably. Any particular internet host, protocol, or application should not receive preferential treatment, except to ensure the correct operation of the network or protocol. In the US, attempts by network operators to introduce differentiated charging has provoked strong protest from service and content providers

without networks, such as Skype, Vonage and Google, who fear that such differentiation could lead to increased interconnection costs as well as anti-competitive behavior, in particular discrimination, when network providers enter into the same downstream service markets.[10]

While this issue is still largely localized to the US, it will inevitably enter into the international market as more network operators seek to provide services with quality and security assurances internationally. Already a number of large network operators such as NTT, BT and France Telecom have indicated that provided certain requirements are met, they would be prepared to open service and control application layers to selected international interconnecting partners in order to allow end-to-end quality of service and security guarantees.[11] Agreements such as these give rise to concerns from operators who may not carry the same weight as these incumbents. In the absence of countervailing influences, the international internet market risks a return to the questionable competitive environment of the late 1990s where market concentration in the hands of a Tier-1 ISPs led to high prices for international internet connectivity.

In order to prevent an unconsidered de facto determination of international NGN interconnection norms, it remains imperative for stakeholders in the market, from regulators to service providers, to take an active interest in the ongoing debate. Although international debate on "net neutrality" has not taken place on the same scale as in the US, international fora such as the ITU, APEC, and the OECD are currently examining the issue. For example, during the 33rd meeting of the APEC Telecommunications and Information Working Group (APEC TEL) in April 2005, the topic of "net neutrality" was raised at the regulatory roundtable for discussion.

2.2.2 *Market Developments in International Internet Connectivity*

2.2.2.1 A US-centric Internet

Historically, the internet started in the United States. When the internet was commercialized in the early 1990s, non-US participants had to connect to the US for access to content and for international delivery.[12]

Although internet usage spread globally towards the late 1990s, the US continued to host the bulk of the internet's major content providers. The vast majority of traffic is made up of file transfers, web browsing and multimedia downloads - uses that are driven by the need to access content. Given the concentration of content in the US, the vast majority of international links led to the US. In 1998, for example, in Europe, the maximum link between any two countries was under 450 Mbps, while U.S.-bound bandwidth was over 3.5 Gbps. In Asia, no two countries shared links of over 155 Mbps, while capacity to the US was around 2 Gbps. Around 75 percent of traffic originating from Europe and Asia went first to the US with a portion being routed back to the region.

For ISPs outside the US, international internet connectivity involved paying for the cost of the transmission link to the US as well as the cost of delivery within the US. In the 1990s, these backbone services were mostly bundled and sold by International Backbone Providers (IBPs), in particular Tier-1 ISPs with little price flexibility. Non-US ISPs were required to pay the entire cost of the transmission link (full circuit) to the US despite the fact that traffic flowed in both directions. In 1993, for example, the price of capacity from Australia was over USD100 000 per Mbps per month. Transit within the US also had to be purchased by non-US ISPs while Tier-1 ISPs enjoyed settlement free peering amongst themselves. Private peering with Tier1 ISPs was the goal for most non-US ISPs to reduce delivery costs. However requirements for peering were extremely onerous, necessitating multiple high-speed connections distributed throughout North America. Even when requirements were met, private peering with non-US parties took place only at US nodes and not at a notional mid-point between the two countries. As a result non-US ISPs had to continue to purchase transmission to the US at a high cost.

2.2.2.2 Increasing Competition

To a large extent the internet still remains US centric. With abundant capacity still leading to and from the US, it still remains more cost effective to deliver traffic to other countries via the US in many cases. Almost all of the top Tier-1 ISPs are headquartered in the US.

In recent years, however, a number of changes to the internet landscape have led to a sharp decline in the cost of international internet connectivity. A major factor has been the new found popularity of public peering at public Network Access Points (NAPs) or Internet Exchange Points (IXPs) where Tier-2 ISPs inside and outside the US could peer with each other.[13] This provided a viable alternative to transit services

obtained from Tier-1 ISPs. At the same time, competition for the provision of delivery in the US increased as the number of Tier-1 ISPs rose. From around three in 1996 there are currently nine ISPs commonly recognized as Tier-1: AOL Transit Data Network (ATDN), AT&T, Global Crossing (GX), Level 3, Verizon Business (formerly UUNET), NTT Communications (formerly Verio), Qwest, SAVVIS and Sprint Nextel Corporation. As a result, it became increasingly common for ISPs purchasing transit to have agreements with more than one Tier-1 ISP. Through multihoming, ISPs purchasing transit are able to direct their traffic through the Tier-1 providers that offer them the best deals.[14]

The construction boom in high capacity fiber optic cables has also greatly reduced international transmission costs. More importantly, fiber optic cables were deployed more evenly across the globe. Although the largest capacity increases were on East-West routes across the Atlantic and the Pacific, fibre optic submarine cables also became available between Asia and Europe via the Middle East, between South America and North America as well as along the West Coast of Africa to Europe. (See Figure 3) Some of these new cable systems are described in Section 3 below. The more even distribution of high capacity fiber optic cables both lowers transmission costs in the countries located along these routes as well as increases the potential for regional traffic exchange.

Figure 3: Submarine Cable Map, 2007

Source: TeleGeography research

As a result of these competitive pressures, transit prices have fallen sharply in recent years. For example, studies by Telegeography indicate that since 1993 the monthly price of a 155 Mbps port in New York City has fallen from USD 101 per Mbps in the second quarter of 2003 to USD 29 per Mbps in the second quarter of 2006, while the price of a comparable port in Hong Kong, China has fallen from USD 204 per month in

Q2 2003 to USD 69 per month in Q2 2006.[15] In some countries, falls in the cost of international internet connectivity have led to remarkable cost savings by ISPs. For example, in Australia, the international component represented 50 to 70 percent of ISP costs in the early 1990s. In 2004, this percentage fell to 5 to 15 percent of total wholesale costs.[16]

Although global prices for international internet connectivity have fallen steadily for a sustained period of time, a number of developing countries nevertheless continue to labour under the burden of crippling costs for international internet connectivity for a number of reasons such as geographic isolation and continued monopoly in the sector. These issues are discussed in the Section 3.

2.2.3 *Regulation and Reform in International Internet Connectivity*

While the backbone market for international internet connectivity has shown the effects of increased competition, recent trends towards consolidation still gives rise to competition concerns. Although regulatory intervention has been relatively restrained in the area of international internet connectivity, regulators in the US have remained watchful over possible anti-competitive behavior and the risks of market concentration in the backbone segment of the US market. In the US, for example, the market for "Tier-1" or national Internet backbone services was described by the US Department of Justice as "highly concentrated" in its filing against the WorldCom/Sprint merger in 2000. In particular, its filings cited concerns over the 53 percent control the merged entity would have over internet traffic in the US and the increased potential such an entity would have to raise prices and lower service quality[17].

Nevertheless, in the absence of an international competition policy framework, the potential for market concentration and abuse at the Tier-1 segment remains an area of significant concern to developing countries. Apart from sporadic, unilateral intervention from the US and possibly the EU, there are currently no international competition safeguards to prevent Tier-1 ISPs from exercising their market power to shift greater infrastructure and operation costs to the smaller ISPs in developing countries. As a result, there has been growing pressure at the international level for some form of oversight on the subject of international internet connectivity.

Since 1998, the ITU has studied the issue of charging arrangements for international internet connectivity. The objectives of ITU-T Study Group 3 at that time were to identify the differences between internet and the PSTN costing models. Members of ITU-T Study Group 3 agreed then that it was inappropriate to apply the existing PSTN costing model but disagreements persisted regarding whether the existing transit model resulted in equitable cost compensation between providers.

In June 2000, ITU-T Study Group 3 attempted to gain global agreement on a draft recommendation made by the Regional Tariff Groups to set out the principle for negotiating agreements to transmit international internet traffic that included the possible need for compensation between the providers carrying the traffic. However, this failed due to the resistance of a few developed countries and major ISPs who saw in the proposal an attempt to impose on the Internet a traffic-based settlement system similar to that of the PSTN which would preclude their freedom to negotiate interconnection agreements on their own terms. This was contrasted with the position of the majority of developing countries and Australia who believed that the principles of non-discrimination, cost-orientation and transparency should also apply to international interconnection. As importantly, they sought recognition for the possible need for compensation between the providers carrying the traffic because under the arrangements in place non-US ISPs were required to pay the full cost of transmission to the US regardless of the direction of traffic flow (full-circuit cost). At the time, it was estimated that non-US ISPs were subsidizing US Tier-1 ISPs up to USD 5 billion per year.

Given the lack of consensus, the Chairman of ITU-T Study Group 3 decided to submit the draft Recommendation directly to the Sector's governing body, the World Telecommunication Standardization Assembly (WTSA) where it was adopted with reservations taken by the US and Greece, and labeled as Recommendation D.50. (See Box 3)

In parallel, members of the Asia-Pacific Economic Cooperation (APEC) group also conducted discussions on the charging issue. This culminated in the adoption of the APEC Principles on International Charging Arrangements for Internet Services at the 4th APEC Ministerial Meeting on Telecommunications and the Information Industry in May 2000. (See Box 4.)

Box 3: Recommendation D.50

It is recommended that administrations involved in the provision of international Internet connections negotiate and agree to bilateral commercial arrangements enabling direct international Internet connections that take into account the possible need for compensation between them for the value of elements such as traffic flow, number of routes, geographical coverage and cost of international transmission among others.

Source: ITU

During the same period, Australia, Mexico and Columbia also raised the issue at the WTO. A proposal was made to give WTO members a role in promoting fair competition in International Internet Charging Arrangements in cases where there are dominant players or de facto monopolies. Australia proposed that 'internet delivery' be recognized as a basic telecom service ('packet-switched data transmission services'), making it subject to the basic telecom reference paper.

Following the adoption of ITU Recommendation D.50 at the WTSA, the assembly decided that there was a need for on-going studies on the issue. In the subsequent Study Period 2000-2004, ITU-T Study Group 3 continued to study the technical and economic developments related to international internet connectivity and it considered the need to provide further guidance on the general principles. Accordingly, in June 2004, ITU-T Study Group 3 adopted an annex to Recommendation D.50 which contained additional guidelines relevant to bilateral commercial agreements on the issue. ITU-T Study Group 3 also encouraged the international donor community to address the high cost of international internet connectivity for the least developed countries by supporting efforts such as regional traffic aggregation and capacity building. In the new Study Period 2005-2008, ITU-T Study Group 3 continues to study internet traffic flow methodologies for use in commercial agreements and the efficiency and cost of Internet connectivity around the world.[18]

Recently, debate on the issue of charging for international internet interconnection has been subsumed under the context of internet governance which was discussed during the first phase of the World Summit on the Information Society (WSIS), which was held in Geneva in December 2003. Its Plan of Action called for the reduction of interconnection costs through the creation of regional backbones and IXPs, and for Internet transit and interconnection costs to be "oriented towards objective, transparent and non-discriminatory parameters".[19] The Summit also requested the Secretary-General of the United Nations to create a Working Group on Internet Governance (WGIG) to work on the different issues concerning internet governance.

Box 4: APEC Principles on International Charging Arrangements for Internet Services

Internet connectivity is an essential element of the global information infrastructure that should be encouraged to strengthen the Asia-Pacific Information Infrastructure.

Governments need not intervene in private business agreements on International Charging Agreements for Internet Services achieved in a competitive environment, but where there are dominant players or de facto monopolies, governments must play a role in promoting fair competition.

Internet charging arrangements between providers of network services should be commercially negotiated and, among other issues, reflect:

- The contribution of each network to the communication;
- The use by each party of the interconnected network resources; and
- The end-to-end costs of international transport link capacity.

Source: APEC Principles on International Charging Arrangements for Internet Services available at: http://www.apec.org/apec/ministerial_statements/sectoral_ministerial/telecommunications/2000/annex_b.html

The WGIG presented a final report for consideration during the second phase of the WSIS, which included a number of recommendations on the issue of international interconnection charging. These recommendations were adopted by the second phase of the WSIS held in Tunis in November 2005 as part of the WSIS Agenda for the Information Society. (See Box 5)

Box 5: WSIS Agenda for the Information Society

Paragraph 50.

We acknowledge that there are concerns, particularly amongst developing countries, that the charges for international Internet connectivity should be better balanced to enhance access. **We therefore call for** the development of strategies for increasing affordable global connectivity, thereby facilitating improved and equitable access for all, by:

a. Promoting Internet transit and interconnection costs that are commercially negotiated in a competitive environment and that should be oriented towards objective, transparent and non-discriminatory parameters, taking into account ongoing work on this subject.

b. Setting up regional high-speed Internet backbone networks and the creation of national, sub-regional and regional Internet Exchange Points (IXPs).

c. Recommending donor programmes and developmental financing mechanisms to consider the need to provide funding for initiatives that advance connectivity, IXPs and local content for developing countries.

d. Encouraging ITU to continue the study of the question of International Internet Connectivity (IIC) as a matter of urgency, and to periodically provide output for consideration and possible implementation. We also encourage other relevant institutions to address this issue.

e. Promoting the development and growth of low-cost terminal equipment, such as individual and collective user devices, especially for use in developing countries.

f. Encouraging Internet Service Providers (ISPs) and other parties in the commercial negotiations to adopt practices towards attainment of fair and balanced interconnectivity costs.

g. Encouraging relevant parties to commercially negotiate reduced interconnection costs for Least Developed Countries (LDCs), taking into account the special constraints of LDCs.

Source: WSIS Agenda for the Information Society, Tunis, 2005 available at http://www.itu.int/wsis

To a large extent, the text of the Agenda echoes the declarations and recommendations made by APEC and the ITU on this issue. Although further study in this area is ongoing in ITU-T Study Group 3 at the moment, it appears likely that there will be no fundamental shift away from the principle of commercially negotiated internet transit and interconnection agreements towards the regulation of international internet interconnection practices for some time to come. Focus instead has shifted to the promotion and support of initiatives aimed at establishing regional high-speed backbone networks and IXPs. Some of these initiatives are described in the following chapter.

3 International Interconnection and Development: Between *Scylla* and *Charybdis*

Like the ancient mariners in Greek mythology seeking to avoid the two monsters Scylla and Charybdis[20] that line two sides of a narrow strait, developing countries find themselves navigating between the loss of international accounting rate revenue and the often high costs they bear for international internet connectivity. Current practices in charging for international interconnection and recent patterns in international PSTN and IP traffic play a large role in shaping the development telecommunications markets in developing countries. These factors impact the revenues carriers earn, the prices end-users pay and the availability of ICT access in the country in general. With more international traffic expected to migrate from the PSTN to NGN as the latter's deployment continues apace, many carriers in developing countries are caught between two trends: falling revenues from international voice services and high international internet

connectivity costs. It thus becomes increasingly important to ensure that developing countries are not penalized or left behind in the process.

The first part of this section looks at the effect of the decline in international call revenues from the PSTN on telecommunications development and some possible measures that can be taken to mitigate its effects. The second part of this chapter looks at the challenges developing countries face in relation to high international interconnection charges and some of the efforts that have been made to meet those challenges.

3.1 ICT Development and the Accounting Rate System

Under the accounting rate system, there was typically more international traffic flowing into developing countries than flowing out. For the most part, this was due to the fact that subscribers living in developed countries had more income and could thus afford to call their friends and relatives who lived in developing countries. Developing countries with large populations working abroad typically benefited from the accounting rate system.

During the heyday of the accounting rate system, income from settlement rates provided carriers in developing countries with the bulk of their revenue. In 1997, for example, in Africa, US settlement payments accounted for more than 80 percent of total telecommunications net incomes.

Since then, however, statistics from the FCC on international payments to foreign carriers indicate that settlement payments from the US have been reduced by more than three quarters. Currently, the average settlement rate paid by US carriers is only $1/15^{th}$ of what it was in 1998.This trend of falling settlement payments and the resulting decline in revenues has given rise to concerns regarding telecommunications infrastructure investment in developing countries. To some extent, revenue earned through settlement payments were used by many developing countries to fund universal service initiatives aimed at expanding telecommunications access.

Nevertheless, the correlation between revenues earned from settlement payments and telecommunications development has been put into question by a number of studies. With the introduction of its 1997 benchmark policy, the International Bureau of the FCC conducted a study to determine the impact of international settlement on telecommunications network build out in a number of countries. The study concluded that there was not a statistically significant relationship between the two elements.[21]

Taken as a whole, the benefits realized from maintaining the accounting rate system are likely to be outweighed by the monopoly regulation required to enforce this system. In the 2006 OECD paper on Internet Traffic Exchange: Market Developments and Measurement of Growth, the examples of Bangladesh, Sri Lanka and Nigeria were highlighted. These countries experienced decreasing settlements payments at the same time as unprecedented growth in access to telecommunication services, largely as the result of sector liberalization and competition.[22] For example, between 1995 and 2004, Sri Lanka's teledensity (fixed plus mobile) increased from 1.4 per 100 inhabitants to 16.6 per 100 inhabitants following the introduction of competition in fixed services in 1996 and the licensing of four cellular providers during the same period. Sri Lanka's growth also coincided with declining net settlement payments. Net incoming settlement payments from the United States fell from USD 42 per subscriber line in 1996 to USD 4 per subscriber line in 2003.

Despite the global decline in settlement rates, a number of developing countries still manage to continue to charge high rates through tight control of the international gateway. Although the decline in settlement payments can be slowed, this course of action carries significant risks in terms of the long term development of the telecommunications market in these countries. International call rates for end users in these markets typically remain high, as do internet prices.

In many developed country markets, increased demand for internet access through dial-up and broadband have generally supplanted operator revenues previously earned from settlement payments and high international call rates. While this success story has been duplicated by many developing countries, as the examples of some Asian and Eastern European countries have shown, this has largely not been the case in the least developed countries (LDCs). In these countries the cost of internet access remains prohibitively high due to a combination of factors ranging from the high cost of international internet connectivity to the lack of competition in the sector. As a result, usage volumes typically remain low, preventing operators from generating significant amounts of revenue from such services. In such cases, however, the answer does not lie in maintaining subsidies through settlement payments, which perpetuate market inefficiencies, but in the

development of alternative sources of revenue, such as internet access, by making ICT services more affordable and available.

Admittedly, LDCs face substantial hurdles in pursuing such a path, the high cost of international internet connectivity being one such obstacle. Nevertheless, domestic reform efforts and international support in terms of funding and expertise will reap greater returns by concentrating on removing these obstacles instead of focusing on maintaining an accounting rate system that was not conceived as a development tool.

3.2 ICT Development and International Internet Connectivity

Nearly every country today is experiencing rapidly growing demand for Internet connectivity, with ISPs offering faster local connections and users requiring greater volumes and more bandwidth-intensive types of Internet services. This growth places ever-increasing burdens on the transmission capabilities of developing country ISPs, which must struggle to upgrade obsolete equipment and secure greater amounts of international internet bandwidth to keep pace. In many cases, ISPs in developing countries use their transmission lines at 100% of capacity, resulting in dropped transmission of packets of data and a resulting compounded latency for completing Internet transactions.

Although the average price for international internet bandwidth has fallen dramatically over the past few years, a number of developing countries still labor under bandwidth costs that can be up to 100 times higher than in developed countries.[23] In most developing countries, studies indicate that around 20 to 35 percent of costs ISPs incur come from international internet connectivity. This percentage is usually far higher for LDCs and small island and landlocked states.[24]

Developing countries typically suffer from a combination of institutional and structural factors that lead to high bandwidth costs. These typically include low income levels that limit investment in ICT infrastructure, small markets that preclude economies of scale and lower unit costs, geographical isolation that entails the use of expensive satellite connectivity and monopolistic ICT markets that prevent competitive pressures from reducing costs. These factors are often exacerbated by poor traffic routing that often entails unnecessary international segments, such as the transiting of emails from the user of one ISP in the country via developed countries to send an email to the user of another ISP in the same country.[25]

In response, a wide range of international, regional and domestic measures have been deployed in recent years to meet these challenges. These range from domestic reforms that encourage competition to international efforts to support infrastructure expansion.

3.2.1 *Expanding International Internet Infrastructure*

Ensuring the availability of abundant international capacity is usually a good starting point in the pursuit of lower costs for international internet connectivity. In this respect, fiber optic cables have been long regarded as the medium of choice for routes that transport significant amounts of traffic. In general, countries that connect directly to international fiber optic cable routes tend to enjoy lower access prices as opposed to countries still reliant on satellite links for international connectivity. (See Box 6)

In its “Halfway Proposition” the African ISP Association (AfrISPA) also warns that while satellite communications in general and VSAT in particular have been promoted as a viable means of obtaining international internet connectivity, the cost of satellite capacity remains significantly higher than that of fiber optic cables. It also adds that “another danger also lies in the fact that when VSAT operators take traffic directly from end users in Africa to an International Backbone Provider’s (IBP) network they are actually "de-aggregating" traffic and compounding the problem”.[26]

Unsurprisingly, the number of undersea cables and the amount of capacity that has been added since the early 1990s has increased markedly on a global basis. Although growth has been concentrated on East-West routes in the Northern Hemisphere across the Atlantic and Pacific, high capacity cables have also been increasingly deployed along North-South routes like the SAT-3/WASC cable that connects the countries along the West Coast of Africa. Currently, deployment of the East African Submarine Cable System (EASsy), which will connect countries along the East Coat of Africa, is underway, filling in a large gap in the global undersea cable network.

Box 6: From Satellite to Cable in Nepal

According to announcements by Nepal Telecom (NT), the cost of internet access for end-users in Nepal is expected to drop by as much as 65 percent in 2007.

This saving has been attributed to the availability of cheaper international bandwidth made available through the East-West optical fibre link operated by the state owned Indian telecom company, BSNL. At the end of 2006, BSNL agreed to supply NT symmetric bandwidth as a cost of USD1800 per Mbps compared to the USD7400 being charged by international vendors that use satellite to make the transfer. NT will procure symmetric bandwidth of 8 mbps in the initial phase using optical fibre links at Biratnagar and Birgunj, which will later be increased to 155 Mbps.

Currently, the monthly price of a 64 Kbps leased line from NT is fixed at NPR18 000, while the monthly price of unlimited and dedicated internet access of 128 Kbps through ISDN dialup is fixed at NPR13600. These prices are expected to go down to as low as NPR6 000 and NPR4 500 respectively.

Source: eKantipur.com available at http://www.kantipuronline.com/kolnews.php?nid=93747

As demand for internet access increases and as ICT markets in larger developing countries grow, more developing countries have started to invest more in expanding their international internet connectivity. Indian telecommunications operators, in particular, have been particularly active in purchasing and building international internet infrastructure. Cable projects that have been bought, commissioned or constructed include SEA-ME-WE-4, which links countries from South East Asia all the way through to Western Europe, SAFE, which connects South Africa, Reunion, Mauritius, India and Malaysia, the Tata Indicom Cable which links the Indian city of Chennai to Singapore and the Bharat Lanka Cable which connects Sri Lanka to India. In December 2006, Reliance Communications announced that it would build the world's largest IP submarine cable network. Dubbed the FLAG Next Generation Network (NGN), the system would ultimately cover 60 countries and span over 115,000 km by December 2009.[27]

This proliferation has not been confined to developing countries in Asia. Kenya, a country that currently has no direct connections to international fibre optic links, is suddenly poised to reap the benefits of three. By November 2007, construction is expected to be completed on the East African Marine System (Teams) project, a fibre link from Mombasa to Fujairah in the UAE in which the Kenya Government will have a 40 per cent holding. At around the same time, Kenya Data Networks (KDN) has entered into a contract with Flag Telecom to construct a fibre optic link that would connect Mombasa, Nairobi and Busia in Kenya to an undersea junction in the waters of Yemen. KDN expects it to be operational in the first quarter of 2008. Telkom Kenya and KDN are also members of the EASsy consortium that, although dogged by controversy, is nevertheless still expected to become operational sometime in 2008.

Despite the growing appeal of high-capacity undersea cable projects, governments and operators in developing countries have to consider the commercial and political challenges that often accompany such projects. For example, despite the obvious need for the EASsy undersea cable, disputes over pricing, access and governance has led to extended delays in its deployment and increasing doubts as to its eventual utility as a tool to reduce the cost of international internet access in that part of Africa. (See Box 7)

Despite the difficulties it faces, the EASsy project will nevertheless serve as a reference point for cable system projects that involve multiple stakeholders: governments, operators and development funding institutions (DFIs). Given the significant costs involved in deploying such infrastructure, it may be worthwhile to examine the use of similar models to overcome investment hurdles in other developing countries, especially small island or landlocked LDCs, that still reply on expensive satellite links for international internet connectivity.

Box 7: Not so EASsy

The EASSy project was first proposed at the first East African Business Summit convened in Nairobi in November 2002. As the East African region was exclusively reliant on satellite links for communications, it was felt that the construction of a 9 900 km fibre optic system linking Mtunzini in South Africa to Port Sudan in Sudan was necessary to improve connectivity. Landing points would be located at Mtunzini (South Africa), Maputo (Mozambique), Toliary (Madagascar), Dar es Salaam (Tanzania), Mombasa (Kenya), Mogadishu (Somalia), Djibouti (Republic of Djibouti) and Port Sudan (Sudan). It was envisaged in 2002 that EASSy would cost USD 300 million and would be completed by June 2005. A number of difficulties, however, caused significant delays in the projects implementation.

Negotiations have been complicated with three sets of parties involved: the EASSy Consortium members, who are mainly incumbent operators, development funding institutions (DFIs), such as the World Bank, and the Governments of the countries affected. Debate has focused largely on the access model upon which the cable system would be used. It has been the view of the World Bank, as well as some government stakeholders, that EASSy would deliver better value to its users if it was built and run along the Open Access model, whereby non-investors in the system would be able to access capacity at rates comparable to those which investors in the system pay. EASsy Consortium members, however, exhibited a distinct preference for ownership and control over the cable system to remain closed to them, allowing them to charge those that wish to access it a cost-plus-premium fee.

While there is now broad agreement over the use of an Open Access model, the details of its application are still being discussed. In addition, issues of pricing, participation and governance still remain. In the area of pricing, the high level of debt necessary for the financing of the cable system has led to concerns that eventual prices for access are likely to be high with a higher than expected range of USD 1,500-USD 1,700 per Mbps likely. On governance, there is also some confusion over the question of who will be represented on the board of EASsy's Special Projects Vehicle (SPV). Suspicion still remains in the private sector that governments will get involved in what was essentially supposed to be a commercially run and private sector led initiative.

Source: Balancing Act available at http://www.balancingact-africa.com

At this point, may be useful to recall the role the International Telecommunications Satellite Consortium (INTELSAT) played in the growth of global communications in the 1960s and 1970s.[28] Formed in 1964 by governments and operators, it assures telecommunications connectivity for all countries across the globe until the present (currently through the International Telecommunications Satellite Organisation (ITSO)). While there may not be the need for such an initiative now given the resources available to the private sector to deploy fiber optic cables, there may nevertheless still be scope for the organization to provide development-funding assistance targeted particularly at supporting infrastructure deployment for small island or landlocked LDCs either through informal cooperation between DFIs or even through a global connectivity fund specially set up for the purpose.

3.2.2 *The Role of Sector Reform*

The problems afflicting developing economies have been the subject of research in a number of ITU Internet Case Studies.[29] In most cases, the lack of competition in domestic ICT markets often makes it difficult for developing countries to benefit fully from the drop in prices and increase in capacity in the global market for international internet connectivity. For many African countries, for example, the international gateway and international leased line services remain in the hands of monopolies with no competition on rates, while a lack of trust between ISPs had resulted in a shortfall of national and regional IXPs. Consequently, prices remain artificially high.

The availability of capacity between countries can translate into cheaper prices only where there is effective competition for the provision of access to those facilities. Case examples highlighted by the OECD (2006) illustrate this point. A fiber optic SAFE cable provides transmission capacity between South Africa and Mauritius, however, at the end of 2004 a 1 Mbps connection to Europe cost an ISP in Mauritius USD 5,000 per month with global transit included in this price. To purchase the same amount of capacity between

Mauritius and South Africa, at the same date, with no peering or transit included, cost USD 11,500 per month. As a result, because of such monopolistic pricing practices the two geographical neighbors, benefiting from a state of the art fiber optic cable operating between them, continue to exchange internet traffic via North America and Europe.

The failure of the SAT-3/WASC cable to lead to competitive pricing because of monopolistic pricing has also been stark. Even though the high capacity fiber optic cable connects Senegal, Cote d'Ivoire, Ghana, Benin, Nigeria, Cameroon, Gabon, Angola and South Africa, in all these countries for which trace routes were available, ISPs exchanged traffic via Europe or North America and in some cases both of these continents.

In such cases, international capacity is typically owned or controlled by the incumbent, either through regulations or business practices that restrict competition. For example, the incumbent operators that belong to the SAT3/SAFE consortium have monopoly access to that capacity. Although the first phase of the fiber cable in connection with SAT3/WASC project was completed in 2002, the investors in that cable enjoy a legal monopoly over it until June 2007.

Ultimately, the price reductions that can be passed on to the domestic market depend on the level of competition. Members of a cable consortium may sign non-compete clauses preventing them from offering access to the cable facility at competitive rates while local ISPs may still be forced to buy international leased circuits and international internet connectivity from the incumbent at prices far above cost.

Experience shows that the liberalization of the international facilities market has resulted in competitive prices for international connectivity in many developed and developing countries.[30] This eventually results in increased competition, greater infrastructure investment and lower end-user prices. For example, in India, liberalization in the international facilities market has led to an expansion of international connectivity and a corresponding decrease in prices. There the average cost of international capacity on various routes fell between 60 percent to 90 percent, depending on capacity purchased, in the period between 2000 and 2005. As was highlighted in the preceding section, international capacity to India also expanded sharply following liberalization. This has enabled India to strengthen its position in the provision of call centers and other back office services.

In countries where satellite links play a large role in providing international internet connectivity, the liberalization of VSAT markets and the lowering of licensing requirements, especially licensing fees, can also reduce the high costs of accessing international internet connectivity. In Nepal, for example, prices dropped to the lowest in the region when the country liberalized its VSAT market in 2000.

Apart from competition in terms of access to international facilities, it is also necessary for regulators in developing countries to ensure that there is a competitive environment in the rest of the domestic ICT market. As was noted above, the cost of international capacity is only one component of the costs that make up end-user prices. Telecommunications access costs and ISP costs usually account for a far greater share of end-user prices. These can typically be lowered by facilitating increased competition in the domestic internet access segment of the market.

Licensing requirements for ISPs can be lowered or simplified to allow easier entry into the market. Countries requiring formal regulatory approval for ISPs tend to have fewer Internet users and hosts than countries that do not require such approval.[31] At the same time spectrum management policies can be re-tooled to foster the use of new wireless technologies that decrease the cost of infrastructure deployment. Regulators also need to pay particular attention to interconnection and interconnection related issues, such as unbundling and the market for domestic leased-lines. In order for effective competition to be established, new entrants also need to interconnect with the incumbent's network quickly at cost-oriented prices. In the migration to NGN networks, issues such as quality of service and non-discriminatory access to content become increasingly important.

3.2.3 *Facilitating Regional Traffic Aggregation and Exchange*

In negotiations involving the purchase of transit for international internet connectivity, lower prices and better conditions are usually available to ISPs who purchase capacity in large volumes. ISPs in developing countries typically generate low amounts of traffic, precluding them from such opportunities as well as from possibilities for peering. In the absence of local and regional infrastructure for the exchange of internet

traffic, developing country ISPs often have to pay for international transit to deliver local and regional traffic, an effect described as “tromboning”. As a result additional costs are incurred and transmission latency is increased.

3.2.3.1 The role of IXPs

The development of regional and local Internet Exchange Points (IXPs) has been strongly advocated as a good way to aggregate traffic and facilitates traffic exchange in order to reduce international internet connectivity costs and bring about service improvement.

An IXP is a shared switching facility that allows ISPs to exchange internet traffic with each other. It uses a centralized hub and spoke network typology that allows ISPs to hand off traffic directly to other connecting ISPs, and to aggregate traffic for long haul transmission. IXPs also offer traffic switching and routing flexibility allowing IXPs to manage traffic more efficiently. For example, for African ISPs “tromboning” adds 200 to 900 milliseconds to each transmission. This degree of latency is a major obstacle to the introduction of new services such as VoIP, IPTV, streaming audio and video, video-conferencing, telemedicine and teleeducation. With a local IXP in place, adjacent ISPs can route traffic to each other’s networks in 5 to 20 milliseconds. IXPs also allow outbound traffic to be aggregated at the regional level. This lowers the ratio of outbound traffic to inbound traffic allowing developing country ISPs to negotiate for better rates for international transit or to even negotiate for peering. Given sufficient traffic aggregation, Internet Backbone Providers (IBPs) may be drawn to establish points of presence at such regional traffic aggregation points. This improves the quality of international connectivity and shifts a greater burden of international transit costs to the IBPs.

In the 1990s, ISPs in countries in Asia faced high costs for international internet connectivity from high transit charges exacerbated by “tromboning” via the US. Towards the end of the millennium, Asian ISPs started to establish local and regional IXPs to facilitate peering. As much of the traffic was local in many Asian countries, largely due to language reasons, local peering resulted in an increase in international connectivity quality and a lowering of prices. In the process, IBPs realised that in order to maintain similar levels of quality and compete for business, they had to establish points-of-presence at local or regional peering points in Asia, lowering costs even further for Asian ISPs.

The benefits of local and regional traffic aggregation and exchange have been similarly recognized by African ISPs in their “Halfway Proposition”. The Halfway Proposition is a strategy that borrows from the experience of Asia and adapts it into a realistic strategy for Africa. It aims to “articulate the root causes of high connectivity costs in Africa and to map out a strategy of how to tackle the problem”. (See Box 8)

3.2.3.2 Challenges Faced by IXPs

While the benefits of local and regional traffic aggregation and exchange are clear, there are nevertheless significant obstacles that stand in the way of establishing and operating IXPs in developing countries.

Most of the effort in establishing an IXP is in building the necessary support. It requires extensive coordination between different stakeholders which usually include the incumbent operator, other ISPs and the regulator.[32]

There is often strong resistance to IXPs on the part of monopoly or incumbent operators. They often view IXPs as a threat to their market dominance and as an avenue through which competing services such as VoIP can be introduced. From the experience of establishing IXPs in developed countries, incumbents typically oppose the establishment of IXPs by controlling basic telecommunications infrastructure in such a way that independent ISPs are unable to compete. For example monopolistic ownership arrangements surrounding the present SAT-3/WASC cable prevents cost effective access to an IXP. As a result, instead of using fibre optic cables, where available, AfrISPA members use satellite networks to provide some direct connectivity between African IXPs.[33]

Box 8: The Halfway Proposition

In October 2002, the African Internet Service Providers Association (AfrISPA) presented its "Halfway Proposition" to the Conference of African Ministers of Finance, Planning and Economic Development that was held in Johannesburg, South Africa.

The Proposition notes that the current burden of international Internet connectivity is unfairly placed on countries in Africa and that the existence of reverse subsidies amounting between USD 250 and 500 million per year is the single largest factor contributing to high bandwidth costs.

Instead of pursuing an accounting rate solution to the problem, the Proposition advocates a self-help, private-sector led strategy. This strategy is driven by two underlying philosophies that focus on the aggregation of traffic within Africa and the creation of "Digital Arteries" that would carry traffic more efficiently both regionally and internationally. As part of the strategy, the Proposition argues for the creation of national and regional IXPs and the deployment of high capacity Fibre Optic Digital cables in and out of the continent

The Proposition also identifies the necessary partners and their roles in the implementation of the strategy. ISPs in AfrISPA would cooperate in establishing National IXPs, African governments and regulators would ensure the removal of regulatory obstacles, and organisations like the New Partnership for Africa's Development (NEPAD), the African Telecommunications Union and the African Union would promote the need for regulators and policy makers to pursue policies that will facilitate the objectives of the Halfway Proposition. Finally, G8 donor governments were called on to provide grant funding in support of the proposition.

Source: AfrISPA available at http://www.afrispa.org/Initiatives.htm

Official governmental and regulatory support for the establishment of IXPs is an important prerequisite to success. However, in the initial phases of telecommunications development, governments or regulators in developing countries often side with the monopoly or incumbent operator. Developing countries are often so heavily dependent on revenues from the monopoly or incumbent operator that they are often reluctant to sanction activities which might erode revenues and threaten telecommunications development goals. Often, unfamiliarity with the technical and economic aspects of IXPs also causes regulators in developing countries to take a slow and cautious approach to their establishment. (See Box 9)

In some cases, there can also be resistance from the competitive ISPs themselves. Established ISPs secure in their market position usually fear the effects of making connectivity cheaper for their competitors. As such, competing ISPs must be made to understand that an IXP will not tilt the competitive playing field in favor certain ISPs. In addition, ISPs in adjacent countries must be made to understand the value of routing their traffic to the IXP, rather than attempting to develop their own facility.

Success in establishing an IXP, however, is no guarantee of operational success. Challenges faced in establishing an IXP often continue far into the future. Monopolistic practices of incumbent operators often frustrate cost-effective connection to IXPs while ISPs in competition with each other often lack sufficient trust to cooperate effectively. The OECD (2006) report highlights the plight of India where although four IXPs exist, they are underutilized for a number of reasons.[34] In mid-2005, about 30 of India's approximately 180 ISPs connected to the IXPs. Some Indian ISPs still exchange traffic on the West Coast of the US via IBPs despite the availability of domestic IXPs. The lack of trust and cooperation among competitors has been highlighted as a particular stumbling block to the use of IXPs in India. In India, ISPs operating at multiple locations across the country refrain from announcing all their routes as they believe others may enjoy a "free ride" on their backbone. At the same time, access to domestic leased lines is expensive for small ISPs when compared to transit. Without direct connections to the IXPs two relatively small ISPs, who are customers of the same upstream provider, may not be permitted to peer.

Box 9: Establishing an IXP in Kenya

The experience of the Kenyan ISPs in attempting to organize and launch an IXP provides a good example of the practical barriers that confront the establishment of IXPs in Africa.

Prior to Kenya's, there was no IXP on the African continent outside South Africa. In early 2000, TESPOK, the association of Kenya's competitive ISPs began to organize a neutral, non-profit IXP for its members. After nearly a year of preparatory work the KIXP, located in Nairobi, was launched in late November 2000.

Fearing the loss of a significant portion of its international leased-line revenue, Telkom Kenya filed a complaint with the Communications Commission of Kenya (CCK) arguing that the KIXP violated its exclusive monopoly on the carriage of international traffic. Within two weeks, the CCK concluded that the KIXP required a license, and ordered that it be shut down as an illegal telecommunications facility. In response to the CCK's closure order, the Kenyan ISPs argued that the KIXP was a closed user group, and therefore would be legal under the Kenyan Telecommunications Act. Also, they noted that the local exchange of domestic Internet traffic does not contravene Telkom Kenya's international monopoly, as all international traffic would continue to flow over its international links.

After nearly a year of intensive efforts, including public pressure, threats of litigation, and private diplomacy, TESPOK finally received the approval of CCK in the form of a license, granted in November 2001. The CCK's licensing order represented a turn-around in its thinking, stating: "An IXP is not an international gateway but a peering facility that enables ISPs to exchange local traffic. The Internet is expanding very fast and since Telkom Kenya has demonstrated that it has some apparently insurmountable difficulty in rolling out Internet facilities, it would be in the best interest of the market to allow other companies to offer IXP services in the country." In February 2002, TESPOK re-launched KIXP.

Source: Andrew McLaughlin, “Internet Exchange Points Their Importance to Development of the Internet and Strategies for their Deployment – The African Example”, May 2004, Global Internet Policy Initiative

As the history of IXPs in developed countries illustrate, many of these challenges can be eventually overcome by improving facilities based competition. Nevertheless, to overcome ISP mistrust and suspicion, IXPs will need to continue to dedicate sufficient resources to outreach and promotion in order to educate competing ISPs as to the benefits of traffic aggregation and exchange.

4 Conclusion

For some time, developing countries have found themselves to be caught in the middle of two trends: the decline of the accounting rate system and the growth in demand for international internet connectivity. Although these trends were established long before NGNs were discussed, the ongoing transition to NGN networks is likely to accelerate the effects felt by developing countries as a result of these trends.

While the decline of the accounting rate system appears unstoppable, development concerns over its demise can be addressed by increased international support and concerted domestic sector reform aimed directly at making access to ICT services more affordable and available. A large part of this effort must be directed at lowering the high cost of international internet connectivity faced by many developing countries.

In order to ensure affordable international internet connectivity prices for developing countries, ongoing international efforts to ensure a competitive international market for internet connectivity must continue. At the same time, local and regional traffic aggregation and exchange initiatives require continued multi-stakeholder support. More importantly, domestic sector reform efforts have to ensure that bottlenecks do not arise from monopolistic practices in the local market.

However, in some developing countries, particularly small island and landlocked ones, domestic and regional efforts alone are often insufficient to overcome structural problems related to geography and market size. In such situations, the international donor community has an important role to play in complementing sector reform efforts by providing funding support for infrastructure and capacity building projects. Only

through such a multi-pronged holistic approach can development issues related to international interconnection be successfully addressed.

[1] More information describing the international Accounting Rate System is available on the ICT Regulation Toolkit at http://www.ictregulationtoolkit.org/en/Section.2145.html

[2] Available at http://www.itu.int/ITU-T/itr/ and http://www.itu.int/pub/R-REC/en

[3] An SDR is a value based on a basket of key international currencies. See http://www.imf.org/external/np/exr/facts/sdr.htm

[4] See, for example, Arbinet at http://www.arbinet.com/

[5] See Report of the meeting of Working Party 2/3 (Geneva, 19-27 June 2006) available at http://www.itu.int/ITU-T/studygroups/com03/index.asp

[6] The history of accounting rate system reform at the ITU is available at http://www.itu.int/ITU-T/studygroups/com03/accounting-rate/index.html

[7] See for example Global Crossing and Stealth VPF announced at http://www.voip-news.com/news/global-crossing-voip-peering-102306/

[8] Best effort refers to a network service that attempts to deliver messages to their intended destinations but which does not provide any special features that retransmit corrupted or lost packets. Thus, there are no guarantees regarding delivery.

[9] For more information on the net neutrality debate in the US, see http://news.com.com/2009-1028_3-6055133.html

[10] For more information see http://www.savetheinternet.com/

[11] See Total Telecom Via Thomson Dialog News Edge, No Signal, Sep 2006, available at http://voipservices.tmcnet.com/news/2006/09/01/101500.htm

[12] See, for example, http://www.isoc.org/internet/history/brief.shtml for a brief history of the Internet.

[13] Tier 2 ISPs have networks with a limited geographical coverage. They buy capacity from Tier 1 ISPs to carry traffic outside their network coverage area.

[14] "Multihoming" refers to a computer host that has multiple IP addresses that are connected to different networks. Addresses with different prefixes can be used to force traffic to be routed through different providers.

[15] Global Internet Geography 2007 available at http://www.telegeography.com

[16] John Hibbard, John de Ridder , Dr George R. Barker and Professor Rob Frieden, "International Internet Connectivity and its Impact on Australia, Final Report on an Investigation for the Department of Communication Information Technology and the Arts", May 2004, Canberra, Australia

[17] US v. WorldCom and Sprint Corp. available at http://www.usdoj.gov/atr/cases/f5000/5051.htm

[18] SG 3 has established two closely-linked Rapporteur's Groups to study this area in depth. Firstly, SG 3 has established the Internet Traffic Flow Multi Factors Rapporteur's Group ("TFMF"). The TFMF Group is studying the aspects of Traffic Flow Methodology inclusive of Multiple Factors that come into play when such analysis is performed. Closely linked with the work of the TFMF group is the second Rapporteur's Group addressing this area of World Access and the Internet. Study Group 3 currently has the continuation of the original Rapporteur's Group on International Internet Connectivity ("IIC"). The IIC Group is now tasked to conduct further studies on the relevant technical and economic developments. ITU-T regional tariff groups (Africa, Asia and Oceania, Latin America and the Caribbean regions) are also deeply involved in the study of International Internet Connectivity

[19] See paragraphs 9 j) and k of the WSIS Plan of Action available at http://www.itu.int/wsis

[20] In Greek mythology, Charybdis was a sea monster, taking the form of a monstrous mouth. She lies on one side of a narrow channel of water. On the other side of the strait was Scylla, another sea-monster. Sailors attempting to avoid Charybdis will pass too close to Scylla and vice versa. The phrase *between Scylla and Charybdis* has come to mean being in a state where one is between two dangers and moving away from one will cause you to be in danger of the other.

[21] Cowhey P., FCC benchmarks and the reform of the international telecommunications market, Dec 1998, Telecommunications Policy Volume 22, Number 11.

[22] Paltridge S., Internet Traffic Exchange: Market Developments and Measurement Of Growth, OECD, Apr 2006, available at http://www.oecd.org/dataoecd/25/54/36462170.pdf

[23] International Development Research Center of Canada (IDRC), Open and Closed Skies: Satellite Access in Africa, 2004, available at http://www.gvf.org/database/regulatoryDB/africaskiesindex.cfm

[24] Antelope Consulting, DFID Internet Costs Study. The Costs of Internet Access in Developing Countries: Overview Report, 2001, available at http://www.antelope.org.uk/internet_costs.htm#internet_costs

[25] See, for example, ITU-IDRC Via Africa, creating local and regional IXPs to save money and bandwidth, 2004 at *http://www.itu.int/ITU-D/treg/publications/AfricaIXPRep.pdf*

[26] AfrISPA, "Halfway Proposition" available at http://www.afrispa.org/Initiatives.htm

[27] For more information, see http://www.flagtelecom.com/index.cfm?channel=4328&NewsID=27318

[28] See http://ww2.intelsat.com/aboutus/index.aspx for more information.

[29] See http://www.itu.int/ITU-D/ict/cs/

[30] See, for example, OECD, Internet Traffic Exchange and the Development of End to End International Telecommunication Competition, March 2002 available at http://www.oecd.org/dataoecd/47/20/2074136.pdf

[31] See ITU Trends in Telecommunication 2004: Licensing in the Era of Convergence

[32] Supra Note 25.

[33] AfriISPA, .Africa Online and Transtel Selected as Regional Carriers by AfrISPA., Press release, 7 April 2005 available at http://www.afrispa.org/NewsDetail.asp?ItemID=9

[34] Supra note 22.