8th Global Symposium for Regulators (Pattaya, 2008)

Six Degrees of Sharing: Innovative Infrastructure Sharing and Open Access Strategies to Promote Affordable Access for All

Discussion Papers

International Telecommunication Union

GSR 2008

Discussion Paper

Comments are welcome and should be sent by 13 April 2008 to GSR08@itu.int

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WHAT DO WE MEAN BY 6 DEGREES OF SHARING?

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The views expressed in this discussion paper are those of the author and do not necessarily reflect the opinions and official positions of ITU or of its Membership.

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Table of Contents

page

1 ...... What do we mean by 6 degrees of sharing? 3
2 ...... Why sharing, why now? 3
3 ...... Passive and active infrastructure sharing 5
4 ...... Does sharing mean selling less equipment or reducing competition? 6
5 ...... Common approaches depend on political will 8
6 ...... A broad perspective on sharing 8
7 ...... The GSR Discussion Papers 9

Figures

Figure 1:Growth in fixed lines, mobile cellular subscribers and Internet users worldwide, in billions, 1996-2006 4
Figure 2: Growth in cellular mobile and broadband subscribers 5

1 WHAT DO WE MEAN BY 6 DEGREES OF SHARING?

The title of this year's Global Symposium for Regulators (GSR) was inspired by the theory 'six degrees of separation', which argues that all people in the world can be *connected* through no more than five intermediaries. This name was in turn used by Professor Martin Cave as the title for his seminal article on functional separation[1]. This year's GSR will explore a range of regulatory and policy sharing measures that both developed and developing countries can implement to ensure that all people on earth are *connected* to ICT networks offering affordable broadband services. The sharing options to be explored can be used alone or in combination, mixing and matching regulatory initiatives to achieve desired policy objectives.

The GSR will examine passive and active sharing in both mobile and fibre backbone networks, sharing international gateways and submarine cable landing stations, functional separation of legacy fixed line networks, spectrum sharing to promote broadband wireless access technologies, end-user sharing devices and applications, international mobile roaming regulation as a form of regulatory sharing or harmonization, and trends in IPTV and mobile TV regulation, addressing new regulatory challenges when content and carriage share the same network.

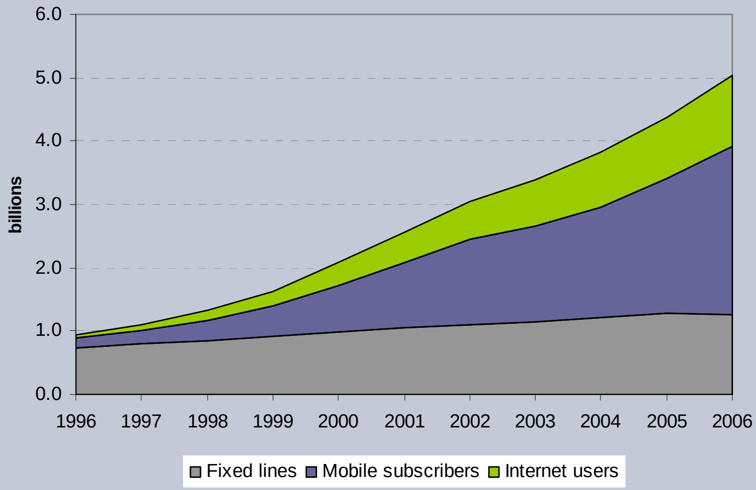
2 WHY SHARING, WHY NOW?

The single biggest reason to adopt sharing is to lower the cost of deploying broadband networks to achieve widespread and affordable access. Developing countries can harness the technological, market and regulatory developments that have fostered access to mobile services to promote widespread and affordable access not only to voice, but to broadband services as well, reaching those un-served or under-served today. For developed countries, infrastructure sharing promises to play an important role in the move to FTTx access as well as to reduce the environmental impact of ICT network deployment. In short, both developed and developing countries share the goal of further network deployment and development.

But this goal costs real money. Deploying mobile base stations or fibre backbone networks to reach rural areas may be uneconomic if each company builds its own network. Likewise, laying fibre to every home, building or street cabinet may be unattainable where operators act alone. Companies can, however, share some infrastructure but compete on services. Provided an effective legal and regulatory framework and the right incentives, the critical factor in creating new, affordable broadband access and backbone networks will be government will.

Initially, many developing countries sought to expand their telecommunication networks by extending exclusivity periods granted to incumbent state-owned fixed-line operators in exchange for geographical and population coverage commitments. Few of these strategies were successful. Countries then moved cautiously to liberalize their ICT networks in an effort to encourage investment in ICT networks to connect more end-users. In most developing countries, such initial liberalization strategies resulted in unexpectedly high levels of growth in the mobile sector. At first, the results were confined to urban areas, but today increasing levels of mobile population coverage have been attained in most developing countries, at least in terms of numbers of people who live within a mobile signal – although not necessarily those that actually access the signal. In the Asia Pacific region, for example, 74 per cent of the population is currently covered by a mobile signal.

Figure 1:Growth in fixed lines, mobile cellular subscribers and Internet users worldwide, in billions, 1996-2006

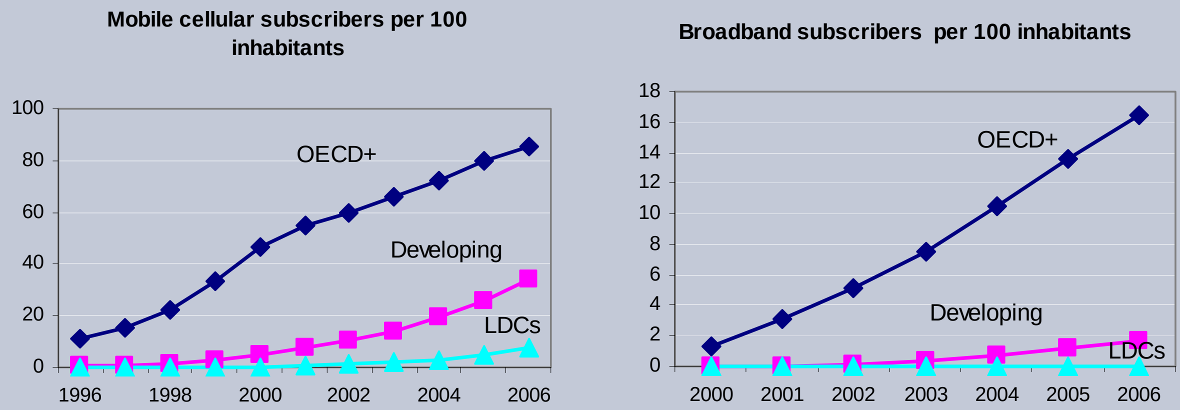


Source: ITU World Telecommunications/ICT Indicators Database

The major challenge for many developing countries is to build on the success of current mobile deployment to both increase levels of voice penetration and coverage while encouraging second generation mobile operators to migrate to broadband wireless systems as well as to promote fixed line broadband (ADSL, Cable TV, Broadband over Power Lines, FTTx, etc.) where economically viable. In addition, it is critical for developing countries to create national fibre backbones to provide backhaul services, especially where satellite connections remain too costly and microwave technology lacks the capacity required for broadband services and applications. Developing countries can leverage the decline in the price of optical fibre technology and adopt open access policies to meet this goal. Further, it is essential that developing countries adopt measures to lower the cost of access to international Internet connectivity, i.e. by promoting competitive and non-discriminatory access to international submarine cable and satellite networks. Further, a number of countries have established universal access strategies to connect the unconnected. Such universal access strategies equally have obtained mixed results. Where successful, smart subsidies have been provided, under a competitive framework, and granted to roll out networks in rural areas. In many countries, however, there is room for improvement both in modalities and implementation, in particular disbursement of funds and adapting policies for the broadband era.

The combination of these factors has given rise to the need for new regulatory strategies. Fortunately, many developing countries have reached the end of exclusivity periods allowing them to adopt a new wave of regulatory reforms to meet the objectives established by the World Summit on the Information Society (WSIS) and the Millennium Development Goals (MDGs). This second wave of regulatory reform, based on sharing, promises to unleash an array of new opportunities for business, government and consumers alike, as ICTs are increasingly relied upon as a tool for economic and social development.

Figure 2: Growth in cellular mobile and broadband subscribers



Source: ITU

Sharing does not mean abandoning market liberalization and universal access practices. On the contrary, further market liberalization is required, e.g. in the international gateway and to allow a new range of market players to meet the pent-up demand for broadband services. Universal access practices also can be refined and improved. All sharing practices, and infrastructure sharing in particular, in fact, are part and parcel of a competitive regulatory framework. Infrastructure sharing regulations, whether mandatory or optional, are usually included in a country's interconnection framework, although they are occasionally contained in operators' licensing agreements. The themes explored in the 8th annual GSR adapt for developing country markets those infrastructure sharing practices that have been implemented in a handful of developing countries, and which are more widely used in developed countries. What is new and innovative is their application and adaptation to meet the needs of developing countries. What is the same is that they use time-tested pro-competition tools, such as the regulation of essential or bottleneck facilities, transparency, and the promotion of collocation and interconnection.

Sharing options are also being closely examined among regulators in developed countries. Because they are now facing the difficult task of encouraging efficient deployment of next-generation networks (NGN) to meet bandwidth-hungry consumers' needs while maintaining a pro-competitive environment that fosters the emergence of new innovative players.

In a nutshell, infrastructure sharing promises to reduce network deployment costs, making rollout more affordable in areas that are not connected to any network today or which have access only to 2G mobile services. The idea is to examine critically where there is an absence of a working market to ensure that market forces are fully able to work to meet the WSIS targets.

3 PASSIVE AND ACTIVE INFRASTRUCTURE SHARING

Infrastructure sharing takes two main forms, passive and active. Passive infrastructure sharing involves operators sharing the non-electrical, civil engineering elements of telecommunications networks. This might include rights of way/easements, ducts, pylons, masts, trenches, towers, poles, equipment rooms and their related power supply, air conditioning, and security. There are, of course, different civil engineering elements dependent on the kind of network. Mobile networks require tower sites, while fibre backhaul and backbone networks require rights of way for fibre cables to be deployed either on poles or in trenches. International gateway facilities, such as submarine cable landing stations, can be opened for collocation and connection services so that competitive operators can directly compete in the international services market.

Active infrastructure sharing involves operators sharing the active network elements or the intelligence in the network, e.g., base stations and Node Bs for mobile networks and access node switches and management systems for fibre networks. Many countries have restricted active infrastructure sharing out of concern that it could enable anti-competitive conduct, such as collusion on prices or service offerings eliminating consumer choice. These concerns remain valid, but have to be balanced with advances in technology and applications that enable service providers to distinguish their offerings. In addition, for some remote and hard to reach areas, having fewer consumer choices can be balanced against the choice of having no services at all, to at least allow active infrastructure sharing for a limited time until demand for ICT services grow to support multiple network operators.

Regulators and policy makers may elect to adopt only one kind of infrastructure sharing, or they can use many options simultaneously. Some regulatory frameworks today may authorize passive infrastructure sharing, while prohibiting active infrastructure sharing. Some may simply have not addressed the issue, neither explicitly authorizing nor prohibiting infrastructure sharing. This give rise to a number of policy decisions. Should regulators and policy makers now move to more actively encourage passive infrastructure sharing, e.g. where it is now merely allowed but not promoted? This could include a variety of incentives, ranging from tax benefits to low licensing fees, to providing subsidies from universal access or other government funds to defray civil engineering costs. Where regulatory frameworks do not include passive infrastructure sharing provisions, should they now be added? Is the time ripe to review policies that prohibit active infrastructure sharing, carefully weighing concerns about anti-competitive behavior? In addition, are new models of infrastructure sharing required for new technologies, such as fibre backhaul and backbone and IMT services?

Infrastructure sharing can also be examined as a range of options or degrees on a scale of the regulatory intervention required. Interconnection and local loop unbundling can both be considered as forms of infrastructure sharing, with interconnection being less interventionist than local loop unbundling. Functional and even structural separation of networks can be seen as an extreme end of the infrastructure sharing spectrum. More widely used tools, such as accounting separation and mandating access to bottleneck facilities, may be less intrusive ways of achieving similar goals.

Likewise, some sharing options can be considered flip sides of the same coin. Functional separation forces legacy operators to open their networks to downstream competitors. When sharing is incorporated into an open access model to encourage market entry by Greenfield players who do not compete in the downstream market, resistance to forced sharing is replaced by the incentive to provide capacity to as many downstream service providers as possible.

Some widely used infrastructure sharing practices, such as mobile site sharing, were designed to address environmental and local planning constraints. The trick is to see how some of these practices could be modified for developing countries to promote deployment of Greenfield networks where none currently exist. Ancillary goals, such as protecting the environment, may also be served. Other initiatives are those currently being pioneered in a handful of developing countries specifically to promote ICT network rollout in rural areas. India is one of the leaders promoting mobile tower sharing. India is granting subsidies from its universal service fund to encourage network rollout to rural areas where towers are shared by at least three competitive operators. Such inspiring new practices lay at the heart of this year's GSR discussions, and could be adapted and adopted throughout the developing world in order to meet the WSIS objectives of connecting all the world's peoples to ICT by 2015.

4 DOES SHARING MEAN SELLING LESS EQUIPMENT OR REDUCING COMPETITION?

Equipment manufacturers may be concerned by discussions about infrastructure sharing. They seek to sell as much ICT equipment as possible. Here, it is important that the goal of this year's GSR discussions be well understood. It is not to limit the number of market players by putting infrastructure back in the hands of monopoly providers which have demonstrated their past failure to invest in equipment and plant. Rather the goal is to use infrastructure sharing together with existing tools and mechanisms, such as universal access strategies, within a competitive regulatory framework. Although infrastructure sharing policies could leverage the role played by current market players, e.g. by encouraging them to roll out to rural areas or upgrade their existing networks, sharing can also create new players eager to invest in equipment, such as tower companies or Greenfield fibre network companies. Such Greenfield providers may not even compete for end user customers. Instead they would serve a full range of end-user service providers that do, including those seeking to provide mobile broadband services or resell dark fibre, provide services to small communities, or provide backhaul to mobile networks upgrading to broadband. Infrastructure sharing can be embraced as a tool that could unleash a new wave of network deployment and upgrades, resulting in new equipment sales. The whole idea is to use sharing strategies to encourage new networks to expand to those areas that are completely un-served or which currently are served by only the most basic of telecommunication services – at least until markets develop to the point where they can support facilities-based competition.

In a way, infrastructure sharing is part of the "Market Efficiency Gap" analysis, the universal access theory that has extolled policy makers and regulators to use market forces and remove regulatory hurdles which impede universal access goals. By lifting licensing restrictions that artificially limit the number of market players developing countries are enabled to attract new investors to reach those that are un-served. Likewise, regulatory impediments to ICT development such as high license fees, unfair interconnection terms and conditions or inadequate spectrum allocations all can hinder attainment of universal access goals. Past editions of ITU *Trends in Telecommunication Reform* and GSR Discussion Papers have explored key regulatory issues such as interconnection, universal access and licensing of domestic service provision. These issues make up the first wave of regulatory reform and have been vital to growing the information and communication technology (ICT) sector in developing countries. The 2008 GSR will address a second wave of regulatory reforms to promote widespread, affordable broadband access under the umbrella "six degrees of sharing".

While progress has been made, as is evident in the mobile boom, it is also clear that many developing countries still have significant gains they can realize by pushing the market gap envelope even further. By doing so, they can focus only on the "True Access Gap" where subsidies are needed to encourage private players to serve remote and rural areas, as well as the affordability gap. In some cases, like in India, not only can infrastructure sharing mechanisms be used to reduce Capex and Opex, but they can be used together with universal access funds to subsidize initial capital expenditures, e.g. for mobile tower site sharing, to attract investment while promoting competition.

There is also a concern that the investment case simply cannot be made to reach rural areas even if using new infrastructure sharing options such as open access. Of course, only time will tell if this concern is merited. Affordability for Internet access, for example, whether in urban or rural areas, will depend, in large part, on the cost of international access. Promoting open access to submarine cable landing stations, such as in Singapore, has reduced international access costs by 95 per cent.

In addition, the investment case may also largely depend on how flexible national policy making becomes. For example, can open access providers which deploy their networks to the remotest of rural areas – serving a small population of impoverished users – really expect a return on their investments? At first glance, this does not sound very likely. However, if instead of encouraging a new Greenfield fibre backbone operator to expand its network to meet every town, village and hamlet such fibre backbone operators could snake their fibre strands through the ducts and rights of way of existing roads, railways, pipelines and other non-telecom infrastructure in the country, where these exist, the level of capital expenditure can be reduced. Alternatively, if other infrastructure providers have already laid their own fibre, they too can become open access providers selling fibre capacity to local communities along their routes who can simply lay the needed fibre from their locality and splice into the existing network. Or all of these players can join forces to create new joint ventures or co-operatives that can serve the entire nation, perhaps even receiving initial government funding. But this requires planning by all major infrastructure projects in a country to require access to ducts, provision of dark fibre and access points so smaller players can connect to the backbone. It also requires greater flexibility in many of the legal and regulatory frameworks that currently exist.

5 COMMON APPROACHES DEPEND ON POLITICAL WILL

Participants in this year's GSR can expect to hear some common approaches. Whether for mobile, fibre or international gateway facilities, such as submarine cable landing stations, a couple of key practices are common. These include providing collocation space and connection services and sharing information (e.g. publicizing the location of mobile sites that can be shared, who controls rights of way or when access to rights of way are expected to be dug up so others can lay their fibre equipment). Other common approaches include site sharing, the provision of power and air conditioning, access to collocation space for maintenance and providing connections at guaranteed levels of quality of service. These provisions can be included in reference interconnection offers.

Infrastructure sharing also involves common principles, such as neutrality, transparency, non discrimination, fair prices, provisioning on a first-come, first-served basis and timely responses to requests for sharing, fair competition, essential facilities doctrine, and speedy dispute resolution.

Again, all of these are well-tested principles and practices. There is an enormous body of regulatory experience and practice on which developing countries can build and develop their regulatory framework to incorporate these practices. Due to increased transparency among regulators, many of these practices and principles are freely available on regulators' website, and can be used by those developing their own frameworks.

Some of the newer areas involve sharing of active network elements. Many of the GSR Discussion Papers identify active infrastructure sharing practices regulators could use, while cautioning about their impact on competition and consumer choice. Of course, these practices can be expected to continue to develop over time, given advances in technology and business practices as increased intelligence either in the core or the end of the network permits service providers increasingly to differentiate their service offers. Regulators can continue to share with each other these developments as they occur.

One of the keys to promoting infrastructure sharing and its benefits, however, is a clear policy decision to promote greater competition to foster widespread network deployment through the adoption of infrastructure sharing and open access. Once political will for such measures is articulated, regulators can then move to establish clear regulatory frameworks for implementation. It is hoped that this series of discussion papers will not only address how to achieve sharing, but why sharing is so important on a policy level.

6 A BROAD PERSPECTIVE ON SHARING

In a way, many regulatory tools and practices can be viewed as sharing. That is why this year's GSR will address not only active and passive infrastructure sharing, under the umbrella theme of Six Degrees of Sharing, but also includes business sharing, end-user sharing, regulatory sharing and sharing where the same network provides both content and carriage. The business sharing discussions will focus on whether the growing trend toward functional separation makes sense for developing countries. The mobile sharing discussions will examine passive and active infrastructure sharing as well as the challenges and opportunities of national roaming, which can be seen as another form of business sharing. The GSR will further explore how other forms of sharing, such as spectrum sharing and the sharing of end user devices and developing innovative broadband applications for developing country users, can impact accessibility and affordability of ICT services. The regulatory sharing discussions will focus on international mobile roaming rate regulation, which has captured the attention of regional regulatory associations, many of which now seek to harmonize their approach to international mobile roaming.

The rise of broadband networks means the rise of new applications and services, like IPTV and mobile broadcasting. This gives rise to the need for regulatory frameworks designed for an ICT environment in which multiple services – including content and audio-visual services – share a single network. Where the legacy telecommunications network *is* this single network, and is currently regulated only for telecommunication services, there is need for telecommunication regulators to begin addressing new issues such as protection of minors and intellectual property rights, especially as IPTV, mobile TV and other content services become more readily available. These issues will be taken up in the session on regulatory sharing, along with the move to harmonization by regional regulatory associations.

7 THE GSR DISCUSSION PAPERS

There will be 10 GSR Discussion Papers:

- What do we mean by 6 Degrees of Sharing?
- Mobile Sharing
- Extending Open Access to National Fibre Backbones in Developing Countries
- Breaking Up is Hard to Do: The Emergence of Functional Separation as a Regulatory Remedy
- Spectrum Sharing
- WRC-07 Results and Impact on Terrestrial Broadband Wireless Access Systems
- End-User Sharing
- IPTV and Mobile TV: New Challenges for Regulators
- International Mobile Roaming Regulation – An Incentive for Cooperation.
- International Gateway Liberalization: the Singapore experience

[1] Professor Cave used the name for his 2006 article, "Six Degrees of Separation – Operational Separation as a Remedy in European Telecommunication Regulation," analyzing the recent trend in some European countries to functionally separate the access business of their legacy fixed line operator from its retail business. Professor Cave's paper explored the functional separation trend under a "ladder of investment" approach, where six different functional separation approaches were presented as options, only one of which could be adopted or implemented at a time as competitors move up the ladder of investment. The organizers of the 8th GSR wish to thank Professor Cave for inspiring the theme of this year's global gathering of regulators.

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EXTENDING OPEN ACCESS TO NATIONAL FIBRE BACKBONES IN DEVELOPING COUNTRIES

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February 2008

The views expressed in this discussion paper are those of the author and do not necessarily reflect the opinions and official positions of ITU or of its Membership.

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Table of Contents

page

Introduction 5
1 ...... The Importance of National Fibre Backbones For Developing Countries 7
2 ...... Issues addressed by Sharing National Infrastructure 9
2.1. Bottleneck Facilities 9
2.2. Addressing un-serviced or under-serviced areas 10
2.3. Role of Government 11
2.4. Country Examples 12
2.5. Regulatory issues 12
3 ...... Ways of Sharing National Infrastructure 14
3.1 Sharing Passive infrastructure for national transmission 14
3.1.1 Obtaining Rights of Way 15
3.1.2 Ducts, Poles and Power Supply 16
3.1.3 Fibre Capacity and Splicing 17
3.2 Active infrastructure at the national level 17
3.3 Using national infrastructure sharing as part of a wider broadband strategy 19
3.3.1 Creating conditions for entry by Greenfield backbone providers 19
4 ...... Approaches for national infrastructure sharing: Current models 21
4.1. Sweden: Stokab (Stockholm) 21
4.2. Ireland: SERPANT (South-East Regional Public Access Network of Telecommunications) 22
4.3. United States: Mid-Atlantic Broadband Co-operative (Virginia) 24
4.4. Other 26
5 ...... Policy and Regulatory issues 26
5.1. Contextualizing the regulatory debate 27
5.2. Balancing Competition and Investment 28
5.3. Regulatory and Policy Imperatives of infrastructure sharing 29
5.4. Implementation Considerations 31
5.5. Unbundling as a form of infrastructure sharing 33
6 ...... Best Practices for National Infrastructure Sharing 35
7 ...... Conclusion 36
References 37

Tables

Table 1: Layered network elements 14
Table 2: Key elements of passive infrastructure for fibre networks 15
Table 3: Key elements of active infrastructure 17
Table 4: Barriers to entry: the ladder of investment for Broadband 28

Boxes

Box 1: What is Open Access? 6
Box 2: Fast facts on Broadband in the OECD 8
Box 3: Sharing with non-telecoms infrastructure operators 13

Box 2: Virginia Mid-Atlantic Broadband Co-operative (MBC) 25
Box 4: Infrastructure sharing in India: an imperative for sustained telecom growth................. 34

FIGURES

Figure 1: Broadband in the OECD and selected Developing Countries 7
Figure 2: Multi-Media Service Access Points.. 24
Figure 3: Policy Challenge – balancing open access and exclusivity...................................... 30

INTRODUCTION

Many developing countries have either begun or are about to begin deploying a range of technologies that will offer broadband access at a local level. These technologies include among others WCDMA, HSDPA and WiMAX. As a result of continued technological development and increasing deployment, prices for communications services to users in developing countries are decreasing and the numbers of users and amounts of usage are gradually increasing. As demand escalates, one or more operators (and in some cases, national government) will ultimately see a need to offer or build out a national fibre network. As this is an extremely capital intensive initiative, the likelihood is that there will only be one or two operators, at least initially, one of whom covers just the main urban markets of the country involved.

A critical aspect of promoting wider broadband use is ensuring that national fibre infrastructure is affordable. This is important to encourage the "critical mass" of users and the services and applications that they might use. This critical mass is facilitated through economies of scale which allow for lower costs and therefore affordable pricing and subsequent take-up of services. Whilst competition at the international level has often driven down the price of bandwidth, national bandwidth prices in developing countries are set by one or two providers and as a result, often remain high.

Policy-makers and regulators globally need to develop policies that constantly seek to create the right incentives and conditions for competition. However, in the developing country context the imperative is on how to accelerate the growth of a critical mass of users and getting national wholesale costs and delivery right is a crucial task.

Increasingly, the sharing of infrastructure by telecommunication operators based on a model of open access is one such option attracting greater policy attention. While liberalized markets already have numerous models of infrastructure sharing, such as co-location, national roaming, local loop unbundling, other forms of sharing are also starting to emerge that involve sharing the passive and active elements of the network. Once incumbent operators perceive their value as revenue generating opportunities, these innovative arrangements also facilitate the development of new entrants and service providers. However, effective and enabling regulation and policy are critical to facilitate such arrangements.

This type of regulation and policy must address two broad issues which are often viewed as the stumbling blocks to speedy roll-out of national infrastructure: first, regulation needs to address problems emanating from access to bottleneck facilities, namely, where a single dominant infrastructure operator provides or leases facilities. A typical remedy in this regard would include for example, regulations on access to essential facilities. The second issue that policy and regulation needs to address is the situation where none of the existing market players are investing in rolling out high-capacity infrastructure to un-serviced or under-serviced areas.

This paper examines the concept of infrastructure sharing on the basis of "open access" and its implications for developing countries. In economic terms, "open access" allows multiple downstream competitors to share a bottleneck facility that is a critical input for the services that are provided. In most cases, the bottleneck facility is owned by one of the firms that also compete in the downstream market. The access is open if it is sufficiently non-discriminatory that all competitors can access the bottleneck facility at the same cost and level of quality. This ensures that if the bottleneck provider competes downstream, that it cannot discriminate against its competitors and realize a significant competitive advantage by virtue of its ownership of the facility.[1]

This paper also examines infrastructure sharing on the basis of open access where the owner of the bottleneck facility does not compete in the downstream market, but rather serves those who do. Where the bottleneck facility owner is a commercial entity, it will depend on the commercial strategy it has chosen. If it has decided to sell relatively low volumes of capacity at the highest price it can obtain, it will need to be persuaded that the market is enlarged through a different strategy that involves sharing: monopoly status tends to encourage this commercial approach. If it accepts that higher volumes will be sold if offered at lower prices, it has an incentive to share and may only need to be convinced to do this more effectively and fairly.

The paper will examine the parameters of open access in a concrete manner, moving beyond broad principles such as, "technological neutrality" and "non-discrimination" to explain what is at stake technically, and on a regulatory level, in connecting a wide range of different service providers to fibre networks. The paper will also identify instances where the sharing of national infrastructure has occurred and what can be learned from the experience. The paper is structured as follows:

Section one outlines the importance of broadband access for developing countries and sketches the challenging questions it raises in policy and regulatory terms.

Section two examines two critical regulatory issues - bottleneck facilities and un-serviced or under-serviced areas - that policy and regulation relating to national infrastructure might address in the developing country context.

Section three examines the different ways of sharing national infrastructure based on a layer analysis. This section considers the differentiation between passive and active infrastructure and how this distinction has affected attitudes to what parts of national infrastructure might be shared.

Section four examines model approaches to national infrastructure based upon looking at different examples of infrastructure sharing from Europe, the United States and elsewhere. These examples are used to identify the challenges different examples raise for developing countries and the best practices that can be derived from these operating examples.

Section five deals with a number of policy and regulatory issues that national regulators and policy makers need to consider and address for the implementation of national infrastructure sharing.

Section six concludes with proposed "best practice" from the perspectives of the different stakeholders that are affected.

Box 1: What is Open Access?

Open Access means the creation of competition in all layers of the network allowing a wide variety of physical networks and applications to interact in an open architecture. Simply put, anyone can connect to anyone in a technology-neutral framework that encourages innovative, low-cost delivery to users. It encourages market entry from smaller, local companies and seeks to prevent any single entity from becoming dominant. Open access requires transparency to ensure fair trading within and between the layers based on clear, comparative information on market prices and services.

Source: Infodev, 2005

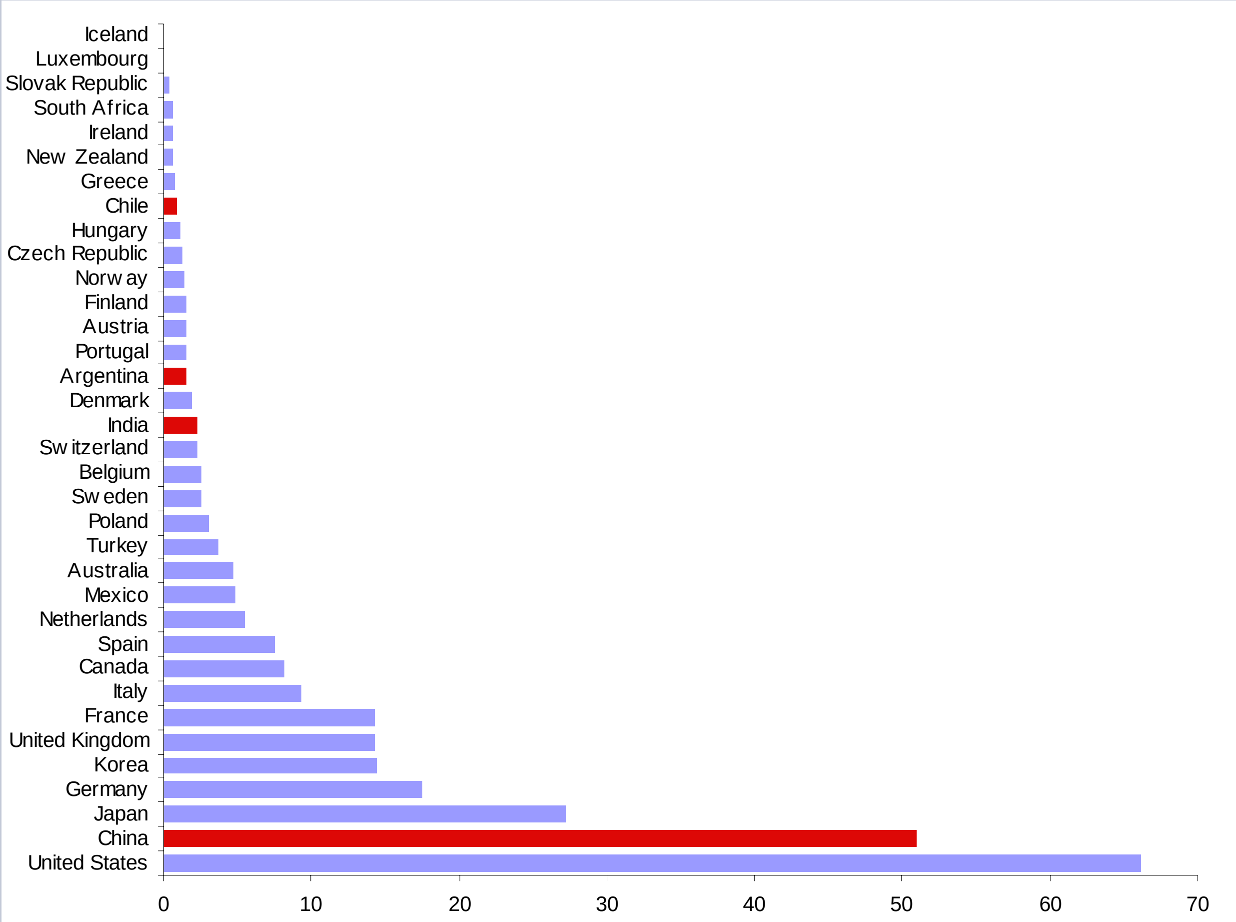
It should however be noted that it is very early days in the development of fibre backbone sharing models. There are very few existing operations of this nature and where they do exist, their development is recent. As such, this paper attempts to identify various different options based on the current knowledge and experience available. As this is a new area of regulation and commerce, government and regulators will continue to develop different practices and experiences and share those with one another as each country seeks in its own way, shaped by its domestic policy and objectives, to ensure the best approach for its needs.

1 THE IMPORTANCE OF NATIONAL FIBRE BACKBONES FOR DEVELOPING COUNTRIES

The economies of developed countries are increasingly reliant on widespread access to broadband services and applications. These are no longer just a means of communication through traditional applications such as e-mail or newer applications such as Skype or a trading channel, such as Amazon. Broadband services and the infrastructure on which they depend have become recognized as an essential input to business, education, healthcare and participation as a citizen in the information economy. These services have even been recognized as a media in their own right. The growing scale of online media use can be judged by the fact that online advertising for example will shortly exceed its television sector equivalent in a number of developed countries.[2] As will be shown in the case studies discussed later, a developed broadband infrastructure is an important attraction for the location of business and company operations and a pre-requisite for increased investment.

The Organization of Economic Cooperation and Development (OECD) countries, in many instances, have not only achieved ubiquitous access to basic Internet services, but are also succeeding in achieving high penetration rates for broadband access, which in turn facilitates more complex and effective services provision and delivery models for both government and the private sector.

Figure 1: Broadband in the OECD and selected Developing Countries



Note: Total Broadband Subscriber, by country, millions, June 2007

Note: ITU data to December 2006 in Red, compared OECD data of June 2007

Source: ITU, OECD and Regional Dialogue on the Information Society, 2007

In economic terms, arguably having access to a national broadband fibre network upon which services and applications can be built is as important a priority as building an effective national transport network. Given the central role that ICTs play in the information economy, many argue that broadband access is a similar "public good" to roads and railways and evidences strong positive externalities as a result of their existence. Without this kind of access, developing countries run the risk of enlarging the so called "digital divide" and becoming second or third class nations within the global order. Having this kind of competitively priced national broadband access becomes one more criteria of global competitiveness.

Although there are enormous obstacles to implementation in some developing countries, broadband access also offers these countries the potential for delivering government services more effectively and at a lower cost and of addressing poverty through minimizing the rural-urban divide so common to developing countries. A broadband infrastructure can, for example, better enable the economic participation of persons living outside major cities and urban centres by relocating "back-office" jobs to rural and less well-off towns and cities and attracting work outsourced from developed countries.

Box 2: Fast facts on Broadband in the OECD

- 221 million – the number of broadband subscribers in the OECD.
- 8 per cent of all broadband connections in the OECD are Fibre-to-the-home (FTTH) and Fibre-to-the-building (FTTB)
- Fibre connections account for 36 per cent of all Japanese broadband subscriptions and 31 per cent in Korea.
- 66.2 million – the number of subscribers in the United States, the largest broadband market in the OECD
- 49 USD - the average price of a month broadband subscription in the OECD
- 51 USD – the average price of fibre to the home/building (Fibre connections are nearly 5 times less expensive per Mbit/s than DSL, cable or wireless)
- 13.7 Mbit/s -the average advertised download speed in the OECD
- 1 Gbit/s – the fastest residential download speed available in the OECD (in Japan)
- 77.1 Mbit/s – average FTTH advertised download speeds in the OECD (much higher than DSL (9.0 Mbit/s), cable (8.6 Mbit/s) or fixed wireless (1.8 Mbit/s))
- 20 of the 30 OECD countries impose explicit bit/data caps on broadband connections
- 0 - bitcaps among surveyed firms in Finland, France, Germany, Italy, Japan, Korea, the Netherlands, Norway, Sweden and the United States

Source: OECD, 2007.

Sharing infrastructure is one strategy for achieving a national broadband infrastructure more quickly than through simply letting the market take its course. For the development of national infrastructure of this kind in developing countries is often blighted by a recurring "chicken-and-egg" problem: without this kind of access, there will not be a "critical mass" of users and without the users, the social and economic impacts that national broadband access might deliver will not be felt.

2 ISSUES ADDRESSED BY SHARING NATIONAL INFRASTRUCTURE

As operators seek to expand and grow their businesses into new areas and markets, infrastructure costs represent the highest portion of the capital required. In the light of an often-expressed desire to create high-capacity, national infrastructure, developing country policy-makers and regulators are seeking to speed up roll-out on the basis that if the infrastructure can be delivered quickly, it will help enhance a favorable economic growth trajectory.

Encouraging the build-out of national infrastructure can help all key stakeholders – whether in the public or private sector – address two broad issues that often hamper speedy roll-out: first, where a single dominant infrastructure operator can be seen as controlling “bottleneck facilities”; and second, where none of the market players are investing in rolling out high-capacity infrastructure to un-serviced or under-serviced areas. Both of these issues may be present in the same country and are often linked to the way infrastructure was delivered in the past.

2.1. Bottleneck Facilities

In the case of “bottleneck facilities”, usually the operator itself questions the commercial rationale for providing to others access to key infrastructure and has an unfair advantage over its competitors at all levels, but particularly in downstream markets, due to its ownership of key infrastructure elements. Most commonly, this is experienced in the price advantages that a vertically-integrated operator can give itself unless otherwise constrained: it is both its own customer and competes with the other customers it supplies. In these circumstances, the dominant infrastructure operator becomes the obstacle to both the development of new infrastructure and more generally, the expansion of competitors and market growth. The “bottleneck facilities” problem is the most fundamental of all interconnection problems as it can prevent equitable sharing of a dominant infrastructure network.

Historically, ownership of “bottleneck facilities” was in the hands of the former Government-owned operator but this pattern is changing, particularly in developing countries. In a number of instances, e.g. Africa’s mobile providers, whether privately owner or related to the state-owned fixed line operators, are setting out to become vertically integrated network and service providers and thus through increased market share may well become the dominant infrastructure providers. Therefore the issue is not how a particular category of operators (fixed or mobile) behaves but more about market power and how it is exercised. In any event, as countries increasingly try to capitalize on the gains of convergence, licensing regimes are being revised to reflect unified service and technological neutrality.

To address the obstacles caused by “bottleneck facilities”, regulators have had to look at how best to make a clear separation of retail and wholesale functions. Increasingly governments have become insistent that the infrastructure (network) business is as operationally separate as possible to allow completely transparent trading between the wholesale and retail sides of the business. Faced on this basis with several options by the UK regulator Ofcom, BT chose to set up a significantly more separate network company called BT OpenReach. According to its Group Chairman Sir Christopher Bland the company has two responsibilities: “…to keep the access network infrastructure healthy and to make sure that it is made available fairly and equally to all Communications Providers - leaving industry free to compete on equal terms” [3] (emphasis added).

Indeed agreeing what was needed to keep the access network infrastructure healthy formed part of its agreement with the regulator. It was allowed to have a 10 per cent investment return on Open Reach’s network assets as part of agreeing to a greater degree of structural separation. However in January 2007, BT was arguing that it has not managed to achieve anything like this level and Ofcom noted that it was “aware of BT’s concerns with respect to revenue and profit level in the future". So setting the terms for overall access to a dominant infrastructure network will almost certainly involve some level of agreement over rate of return.

In the case of South Africa, the Government has taken three initiatives to address what might be described as "bottleneck facilities" issues. First, it has mandated an "essential facilities" framework that opens up key elements of national and international infrastructure (see section 5 below for details). Second, it has chosen to create a new, state-owned company called "Infraco" that will operate the national fibre network assets of two state corporations, Eskom (the power utility) and Transtel (the telecommunications arm of the national railway company). In this particular case, however, the infrastructure will be leased to Neotel, the second fixed line operator on a limited term exclusive basis, at a lower, utility rate of return. Neotel in turn can on-sell capacity on Infraco to all other service providers and operators who want to buy it. Infraco is a Government-initiated private-public partnership in response to the issues raised above, particularly the impact of high, national wholesale rates on retail broadband prices. One argument to the contrary however is that this initiative, although well intentioned, has squeezed out private investment by removing any incentive for private capital to be committed to a network infrastructure project of this nature. Finally, the government has announced plans to build a 4.7 billion Rand undersea cable around the west coast of Africa to alleviate the bottleneck caused by the exclusivity arrangements between consortium partners on SAT-3 and the arguments that the cable has reached near full capacity.

With a similar desire to speed things up and make access affordable at a local level, Knysna municipality in South Africa decided to create its own Wi-Fi coverage area to provide voice and data for its 50,000 citizens because it believed that it was only by doing it itself that it would be affordable. There are also a considerable number of other municipalities in South Africa that have tendered for "muni" networks and they are all moving towards some form of "self-provisioning" of facilities in doing so, often through a public-private partnership with existing value-added service providers and ISP's. Provided a framework is in place to enable it, the infrastructure created can be shared by any service provider on agreed terms.

If licensing is required and where the framework does not immediately allow for it, governments and regulators many have to create general authorizations or augment their licensing frameworks to enable backhaul and backbone providers. In the case of Infraco, the South African government had to promulgate legislation to create the legal entity and amend existing sector legislation to enable its licensing.[4] The TRA in Lebanon has expressed its intention to encourage infrastructure sharing through the licensing process by allowing infrastructure sharing to facilitate the fulfillment of roll-out obligations, for example for future broadband access. Similarly, Lebanon's draft mobile licences permit the licensees to construct, maintain and operate mobile networks "whether alone or with other providers".[5]

2.2. Addressing un-serviced or under-serviced areas

In the case of un-serviced or under-serviced areas, the policy intention is usually aimed at creating a greater "critical mass" of users by encouraging the roll-out of high-capacity, national infrastructure to a wider range of places than the market alone might initially sustain. In essence, this argument for sharing national infrastructure is that two or more operators sharing (and paying for access to) a common infrastructure will help finance a wider roll-out, whereas traffic from a single operator would not make the same level of routes sustainable. Although there are considerable variations between developing countries, in Africa, only less than 4 per cent of the population on average currently has access to fixed line services, let alone high-capacity infrastructure.[6] Furthermore, in some countries national backhaul is largely handled by satellite with all the negative financial consequences for those countries' balance of payments.

After liberalization, it has become clear that whilst the new private sector providers have invested heavily in new networks that have covered an increasing percentage of the population, the capacity of these networks are often modest as many only handle voice services. For example, mobile cellular networks currently cover, on average, 67 per cent of the population in Africa and 74 per cent in Asia-Pacific, although this may rise to up to 80 per cent over the next 2-3 years. With the steady upgrade in many markets to 2.5G and 3G, national backbone requirements are rapidly increasing the world over. For example, in many African countries, national and international network requirements have doubled or tripled over the last three years and look set to keep increasing, if not at quite such a rapid pace. It is not clear whether existing microwave and satellite networks will keep pace with this growing demand.

2.3. Role of Government

Government has a key role to play in facilitating the most effective use of infrastructure assets and in identifying those parts of the country where there are gaps and getting coverage extended to them. In a very direct sense, Government will often be a significant customer and it can facilitate the key "anchor tenant" that will make a marginal location worth investing in: for example, a remote border town might connect its customs post, local government centre and school.

The facilitating role of Government can help overcome the reasons why sharing is not occurring. Cost is a compelling pragmatic reason for sharing national infrastructure but it is not always a sufficient reason by itself. During a panel in an African regulators forum last year, two major operators made it clear that they felt it was Government's responsibility to provide a particular element of infrastructure they were not providing. It happened to be cross-border links but their arguments could as easily apply to national fibre infrastructure. Also there is often insufficient trust between operators to look at how they might share national infrastructure: their experience has often been of poor delivery from the historically dominant infrastructure provider and they do not believe that this can be avoided except by them each providing for themselves.

However, notwithstanding these very real concerns from the operators, the financial prize remains considerable. The passive component of the network is estimated to constitute 40 per cent and the active component constitutes 60 per cent of the total capital cost of a network. However, fluctuations in property, steel and cement prices also affect the capital cost of passive infrastructure relative to active infrastructure which is currently declining due to price reductions of electronic components. Site acquisition and preparation costs account for approximately 20 per cent of capital costs for networks and the cost of setting up towers in rural areas tends to be approximately 30-40 per cent higher than in urban areas, given that these towers generally have to be ground-based and consume more materials. Estimates suggest that cost per kilometer of laying fibre overland are approximately USD 15 000 - 17 000 if the cable is buried directly at 1.2m depth. The price increases considerably where the cable is being laid in hard rock, and it decreases slightly when doing so in loose sand. If however the fibre is strung in urban areas on poles, the amount per kilometer is closer to USD2000/km but the maintenance cost will be much higher. It is estimated in one study that after ten years, both methods amount to approximately the same cost.[7]

Analysts examining the Middle East and North Africa (MENA) have suggested that telecommunication operators in the region will increasingly use infrastructure sharing as a strategy for new revenue generation and cost optimization as infrastructure sharing can help reduce capital expenditure components by as much as 40 per cent.[8] In the liberalized market in the MENA region for example, Bahrain, Egypt, Morocco and Saudi Arabia, growth and success rely extensively on sharing the incumbent's local loop, given the difficulty of rolling-out competing access networks. Market reports indicate that since local loop unbundling was enforced in Morocco earlier this year, the broadband market grew 19 per cent in a period of 6 months.[9] So although local loop unbundling is a regulatory remedy, it is clear that the strategic impact of overcoming bottlenecks in infrastructure is market growth.

2.4. Country Examples

The desire to create a more far-reaching national infrastructure has been the motivation of several African Governments in creating national infrastructure companies. The previous Kenyan Government prepared a plan to build a fibre network designed to cover the whole country. It envisaged that this network would either be run on contract by a private sector provider or by the former incumbent Telkom Kenya, under clearly agreed terms. A similar approach has been adopted in Uganda. In the case of the latter, the proposed network was amended to take into account fibre already laid down by existing providers MTN and utl. However, in both cases the government's proposals were presented as a way of offering a wider range of coverage and bringing national network costs down.

In India, the government has an ambitious plan to use the Universal Service Obligation Fund to roll-out free broadband connectivity at a speed of 2 MB per second across the country by 2009 in order to boost economic activity in the country.[10] The Department of Telecoms will seek to break the oligopoly of existing national and international long distance players in a bid to create infrastructure competition in the sector. According to a Department of Telecoms spokesperson, "India has only a handful of NLD/ILD operators while small countries such as Singapore and Taiwan have over 30 and 60 long distance operators respectively". Thus, however one judges the plans themselves, there is clearly an issue of infrastructure competition arising out of the existence of "bottleneck facilities".

Encouraging sharing of infrastructure at the national level by regulators can mean that the private sector becomes convinced enough to separate out its wholesale function or operate a separate passive infrastructure company. In February 2008, India's Reliance Infratel was floated as a separate company to manage the carrier's passive network infrastructure -- land, towers, generators, and power supply elements of the mobile network -- and will handle all new roll-out and network sharing deals with other operators. Although focused on mobile tower sharing, there is no reason why an operator should not create a similar company to manage the passive elements of a national infrastructure, particularly for example, the rights of way, ducts, and dark fibre needed for a fibre backbone or other backhaul network infrastructure.

2.5. Regulatory issues

From the above discussion, it is also clear that questions do however emerge regarding whether the roll out of such entities is an appropriate form of government spending? Should these networks run "at cost" as is currently being proposed and if so, on what basis? Because these organizations are not yet operating it is unclear what "at cost" will include, for example, whether it will allow capital replacement and maintenance: if not, the Government provider clearly will have an unfair advantage in the market. Therefore, it is important that regulators and policy-makers ensure that these kinds of initiatives do not have the kinds of unfair advantages that all too-often the dominant infrastructure operator was granted in the past.

Requiring existing or legacy operators to separate its wholesale function or operate a separate passive infrastructure company is not the only option. As described in Section 3 below, it is possible for regulators to authorize - or even promote - entry to an entirely new kind of business, one designed to serve as a backbone on which ride a full range of service providers, including local government entities seeking broadband access, small rural operators, and even major players looking to upgrade their microwave backhaul links to fibre. The regulatory issues here relate less to providing fair access to bottleneck facilities as these entities have incentives to provide access to their facilities: the issues relate rather to the cost of that access and ensuring the regulatory framework will allow them to enter and compete in the market, and that regulatory costs and hurdles are reduced to ensure that they can provide affordable access to their customers.

As each country is different, with divergent levels of market development and regulation, it remains difficult to list all the regulatory issues that might arise from allowing new styled infrastructure players into the market. Moreover, in some cases this may be a *legacy provider* providing backhaul and in others, a new entrant or *"greenfield licence".* There also remains the possibility of a *hybrid option* where the legacy operators are just one of many partners or investors in a joint venture or cooperative that provides backbone service. Provided the framework allowed for it, this situation might arise where (fibre) infrastructure exists which is not used for telecommunications services, such as power and transport networks, but which may offer rights of way that may be used by operators and service providers. The regulatory issues that might apply would differ according to which of these options were chosen, however, at a general level, government and regulators would have to concern themselves with the following:

- Facilitating the legal creation of these entities, be they cooperatives, joint ventures, or other;
- Enabling, where necessary, the licensing/authorization of these entities;
- The type and size of the licence fee required to ensure that licence fees do not act as a disincentive to investment and also allow for a rate of return;
- Whether spectrum will be required and if so, its assignment;
- Whether universal service obligations would attach to these licences;
- In the case of legacy providers, whether any form of price regulation is applied, and on what basis;
- Monitoring and investigation of anti-competitive complaints;
- An appropriate access regime

Box 3: Sharing with non-telecoms infrastructure operators

Cost-sharing infrastructure deals are often made because the infrastructure is being built for another reason and the cost of adding more capacity is marginal. This is particularly true for fibre networks used to manage diverse operations such as oil pipelines, power transmission and railways. Each requires its own fibre for management purposes but it is relatively easy to add fibre strands, either before or after construction. The resulting additional capacity can then be shared either by the operating company setting up its own wholesale fibre capacity sales operation or through it selling the right to sell the capacity to an independent organisation. In Africa, there are several examples of where this has occurred including: the Cameroon-Chad oil pipeline (known as the Doba-Kribi pipeline), Kenya Power and Light and Tanzania's TANESCO. In the case of the oil pipeline, 12 out of the 18 fibre cables installed will be available for use by telecommunications operators. Arrangements of this kind clearly cut the cost of building network infrastructure.

Source: Shared Infrastructure, paper for ITU Africa regional conference, Nairobi, 2007

3 WAYS OF SHARING NATIONAL INFRASTRUCTURE

In order to facilitate and ensure the sharing of national infrastructure, a variety of decisions need to be made at a number of different levels. Clearly it is important to know which of the technical elements in a national network can be shared and how this might be achieved. It is also worth noting that not all of the technical elements can be seen in the same light: terms like « passive » and « active » infrastructure, provide useful ways of approaching the different parts of the process of sharing (see Table 1 below). Moreover, simply addressing the technical elements alone does not effectively address "bigger picture" issues. Regulators need to create accepted frameworks for sharing national infrastructure based on the elements described below.

The easiest shorthand definitions of passive and active infrastructure are as follows:

- ***Passive infrastructure*** covers all the non-electrical or civil engineering elements of national infrastructure like physical sites and ducts, although it does include power supply.
- ***Active infrastructure*** covers all the electrical elements of national infrastructure like lit fibre, access node switches and broadband remote access servers[11]. However, as will become apparent in Section 3.3, the more difficult decisions about sharing are where they impinge upon the value-producing core of the infrastructure provider's business.

Sharing national fibre infrastructure involves essentially three key layers shown in the table below. The key elements shown on the right-hand side of the table summarize those items of equipment and software items that can be shared. Each layer has a set of functional rules that allows it to interface with the other layer and for information to flow over the network. In commercial terms, these technical elements are combined with considerations of "Reach" (the geographic scope of providers) and "Type of Customer" (wholesale or retail).

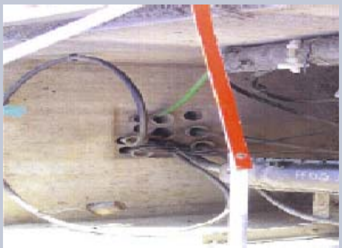
Table 1: Layered network elements

Layer	Description	Key Elements
Layer 1	Physical	Ducts, poles, dark fibre, RF channels
Layer 2	Transport	ATM PVC, Ethernet VLANs
Layer 3	Services	VPNs

Source: Authors

3.1 Sharing Passive infrastructure for national transmission

The table below lists the key elements of passive infrastructure that might be shared at the national level. Because a national backbone – whether fibre or microwave – will be used by all carriers, there is inevitably some overlap with the GSR Discussion Paper on mobile sharing. High-capacity networks in developing countries will inevitably be made up of a mixture of fibre and microwave transmission: however, the detail of the shared elements for microwave is to be found in the mobile sharing paper.

Table 2: Key elements of passive infrastructure for fibre networks	
Passive Infrastructure Sharing (Non-electronic components) Trenches (right) and Ducts (left)  	Cables Ducts Splitters Shelters Generators Air-conditioning equipment Diesel electric generator Battery Electrical supply Technical premises Easements, ducts and pylons
Note: This is a non-exhaustive list including inter-modal network elements. *Source:* Jim Forster, ITU and ARCEP[12]	

Access to the physical ducts or masts (in the case of power transmission lines) and rights of way are key potential passive elements in encouraging the roll-out of national fibre infrastructure through sharing. This has two aspects, one of cost and the other affecting speed of action. National governments, municipalities and state-owned enterprises frequently charge considerable sums of money for rights of way which allow operators to carry out physical trenching of ducts (see picture above).

3.1.1 Obtaining Rights of Way

There are a number of issues that need to be addressed. At a practical level, it is possible but not desirable that every operator creates their own physical duct. Time taken in ploughing up roads to achieve this would add significantly to the chaos and disruption of the process, particularly in urban areas. But also if each operator has to buy rights of way separately, these costs will need to be passed on to consumers, thus adding to the costs of wholesale distribution. Often, the actual laying of the cable may represent only a relatively small part of the overall costs of deploying a fibre network but obtaining the rights of way adds considerable costs.

The ownership of rights of way is complicated and the legal provisions covering them vary from country to country. Furthermore, their ownership is often spread between a bewildering array of bodies including private parties, national agencies like railway companies and local organizations like municipalities or local/district authorities. These bodies often apply very different rules and procedures to obtaining them. The processes for obtaining these rights may be very slow and not always subject to clear procedures. This creates a lack of transparency for potential investors and has the overall effect of slowing down plans that might otherwise be implemented relatively quickly.

There are several ways that will help overcome the barriers to implementation raised by these circumstances and they both involve the sharing of physical ducts. The Government at a national level can persuade or insist that those bodies that have ownership of rights of way give them for a purely nominal charge on the basis that the operator who develops the physical ducts installs additional dark fibre capacity that can be lit when requested by other operators.

Government (or indeed local government) could in addition, or in the alternative, ask for fibre capacity in exchange for the agreed value of the rights of way. So for example, as the case study from rural Virginia in the United States (see Section 4.3 below) shows, the local operator MBC gave 2 fibre strands to each of the local authority bodies which they could use for their own purposes. A rural municipality in a developed country might use this capacity to connect up its offices, schools and health care facilities.

Government at the national level can effectively do two things. First, it can simplify the ground rules for obtaining rights of way and in so doing, it can insist that the resulting physical ducts are shared by operators. Second, government can lower or prescribe the cost of the rights of way themselves as they constitute a significant part of the cost of creating national infrastructure. Lower entry costs combined with easier access to rights of way may encourage operators to consider laying fibre on routes that were previously considered uneconomic.

Regulators may not have the powers to achieve these things but they can bring them to the attention of Government and highlight the importance of them being adequately addressed. Indeed different sector regulators can use their respective power over different sectors of the economy to ensure that there are common ground rules for obtaining rights of way.

3.1.2 Ducts, Poles and Power Supply

In the face of growing conflicts resulting from demands for shared infrastructure and its impact on the growth of the national backbone, Brazil's three regulatory agencies for telecommunications, electricity and oil decided in 1999 to specify a common regulatory framework for the sharing of infrastructure. For these regulators, the infrastructure elements that needed to be shared were rights of way on private property; towers and cable channels; co-axial cables and fibres in the physical ducts or on power masts.

The same framework approach was adopted in Cameroon but in this instance, covering operators of telecommunications, television, electricity and railways under the leadership of the Cameroon Telecoms Regulator (ART) that signed an outline agreement with the operators[13]. The Nigerian Communications Commission (NCC) has also stipulated the main ways of co-locating and sharing infrastructure, adding to these elements masts, pylons, trenches, energy sources and technical locations in buildings[14]. The French regulator, ARCEP considers France Telecom's ducts to be an essential facility and the operator in a voluntary move prepared a standardized duct offer by the end of 2007, already commercially offered and to be made publicly available soon[15]. SingTel's Reference Interconnection Offer includes the terms and conditions under which SingTel will provide a requesting party with use of building lead-in ducts.[16] The newly established Telecommunications Regulatory Authority (TRA) in Lebanon has indicated its intention to promote infrastructure sharing as part of a holistic approach to telecom reform. TRA has stated its intention to promote passive infrastructure sharing of towers, masts, ducts and conduits in areas where it is not economically sustainable for multiple operators to build infrastructure and where environmental and social concerns are particularly important.[17]

The West African community adopted a regional regulatory approach to harmonizing the ICT sector that encourages infrastructure sharing. In January 2007, the Economic Community of West African States (ECOWAS) Heads of States and Governments adopted the Supplementary Acts that cover ICT policy, the legal regime, interconnection, numbering, spectrum management and universal access. The Act on Access and Interconnection in respect of ICT sector stipulates in Article 10 point 2 that "National Regulatory Authorities shall encourage infrastructure sharing between incumbents and new entrants concerning in particular posts, ducts and elevated points to be made available mutually on a commercial basis, in particular where there is limited access to such resources through natural or structural obstacles"[18].

The EU Framework Directive (2002/21/EC) has a specific article (12) on "Co-location and facilities sharing". Under this article, EU Member States can go as far as imposing facilities sharing where undertakings have the right to install facilities "on, over, or under" public or private property. Recital 23 of the same Directive explicitly mentions ducting as an object of facilities sharing.

The physical home of the cabling – whether in ducts or physical sheaths – is a key part of achieving a shared national network. Physical ducts are often scarce, under-utilized and have long pay-back periods. Opening up access to them in a variety of different ways creates incentives for sharing between operators and helps ensure maximum use of these relatively scarce resources.

3.1.3 Fibre Capacity and Splicing

Once access to the physical ducts or power transmission masts is opened, operators wanting national network capacity between different physical points then have a choice of investing in their own dark fibre or buying on a monthly or annual lease or indefeasible rights of use (IRU) basis (10-20 years) access to fibre routes. Lateral and mid-span splices can be offered, giving greater flexibility. In this circumstance, operators would provide their own equipment to connect to the network capacity they have bought and would need to be assured that there was sufficient space to accommodate potential network users. However, since IP network access equipment is of relatively modest proportions, physical space is hardly an issue.

3.2 Active infrastructure at the national level

Sharing active infrastructure is a much more contested ground as it goes to the heart of the value-producing elements of a business. The examples given below demonstrate the breadth of active infrastructure elements that might be included and the examples that follow demonstrate that whilst much is technically possible, operators will inevitably raise objections.

Table 3: Key elements of active infrastructure

Active Infrastructure Sharing (Electronic components)	Optical network unit (ONU) Access node switches Management systems Broadband Access Remote Server (BRAS) Coarse or dense division multiplexing Software (core network systems like billing)

Source: Authors

At layer two, the transport layer, the shared infrastructure operator can provide a wholesale, point-to-point fibre service to providers who can then use it to provide services across layer three - the services layer - of the network. In this case, each service provider and its associated customers are assigned to a separate Virtual Local Area Network or if the provider is using Asynchronous Transfer Mode (ATM), using separately assigned Permanent Virtual Circuits. Technical and service characteristics may vary depending on the network architecture but there is no insurmountable obstacle to sharing in this layer.

For video delivery (IP-TV and Video-On-Demand), IP networks will also be easily accessible on the basis described above but there may be issues about provisioning the necessary capacity to deliver this kind of service. However, thus far, video is far harder to deliver on a Passive Optical Network, although it can be done using a video overlay. Although possible, we were unable to find implemented examples of video delivery on a Passive Optical Network (PON), using this kind of overlay. Since PONs networks are sometimes presented by vendors as a way of an operator retaining control over the core network, there may be an understandable but perhaps unwarranted suspicion that the difficulty of creating shared services is intentional. Not having such an overlay on an IP network can save electro-optical costs but raises transport and switching costs. In summary, whilst there are some technical issues that affect the ways in which sharing might be conducted, the main issues remain policy and regulatory in nature.

Once there is a widespread fibre network, the question immediately arises as to how that capacity will be delivered to the customer's premises, whether a home or an office. To encourage speed of roll-out it may be useful to encourage the infrastructure operator to provide what has been termed a "fibre management point": in effect, this will allow competitive service providers to take the fibre capacity offered and deliver it locally. Where and how these are provisioned will depend on the density of users, the geographic characteristics of the neighborhood and the level of market development.

At a slightly more complex level, providers can each transmit on their own wavelength using either Coarse or Dense Wave Division Multiplexing over long national or international routes. A number of providers can be supported and in effect, each would be operating its own network over which it could make its own commercial decisions. With this approach, providers would treat their capacity a component of their own network and provision it accordingly. However, as far as we are aware, this separate shared network approach has only been used thus far for international cables.

Whilst the discussion about sharing active elements raised by MVNOs is beyond the scope of this paper, and is addressed in the GSR Discussion Paper on Mobile Sharing, it does clearly illustrate that active elements of infrastructure can and will be shared because of either commercial or regulatory imperatives. The MVNOs (sometimes referred to as 'thick' as opposed to 'thin') that are investing in their operations at a significant level share the following elements: the UMTS Terrestrial Radio Access Network (UTRAN), the gateway core and the core network itself. Within the core network sharing extends to Mobile Switching Centres (MSCs), U-MSCs, Serving GPRS Support Nodes (SGSNs) and GPRS Gateway Service Modes (GGSNs). Although the figures are contested, it is claimed that UTRAN sharing alone may offer 20 per cent operating savings. Indeed, the way that mobile operators outsource network operations and management demonstrates how different elements of the business can be operated by another party.

The primary barriers from a commercial point of view to this type of sharing are issues of "commercial confidentiality". Mobile operators who agree to share (or are forced to do so by regulation) run the danger that competitive operators might learn too much about their operation. From the operators' point of view, these are concerns addressed if it chooses the MVNO (rather than having it imposed) as it can align its own strategy with the MVNO. There are also issues about aligning equipment buying and interoperability. Both of these issues are more easily overcome if the services are offered by a neutral partner carrier. Or as is the case in Tanzania, an equipment vendor offers managed network services to operators on network rolled out in what otherwise might be marginal rural areas.[19]

There is also a wider issue already raised in section 2 above pertaining to when mobile operators becomes the dominant infrastructure providers. This has already happened in some African countries where there has been civil war as the damage has largely removed the presence of the historic operator. But in other countries such as Nigeria, mobile operators are making major infrastructure investments and are likely to become dominant infrastructure operators. It is worth noting that active sharing of fibre networks is likely to raise similar issues as have been raised by active mobile sharing. These include for example, concerns about consumer choice; commercial confidentiality and whether access should be mandated or merely authorized. After much (sometimes heated) discussion, there is in most African countries an interconnection agreement of some kind governing both pricing and access to the historic operator's national network. In many countries, the presence of Interconnection guidelines published by the government or regulator may also assist. In terms of national infrastructure sharing, the question is whether these same access rules apply to mobile operators if they become dominant network infrastructure providers? It is worth noting that where the backbone provider is not however competing at the retail level, concerns about consumer choice, prices and commercial confidentiality and whether these have to be mandated are less likely to present themselves. The GSR Discussion Paper on "Mobile Sharing" more appropriately examines these issues in some detail.

3.3 Using national infrastructure sharing as part of a wider broadband strategy

For the Government and regulators, national infrastructure sharing provides a number of levers that can be used to overcome barriers and speed up implementation. It cannot be said too often that different circumstances will require different approaches and that a light approach using persuasion is nearly always preferable to those requiring things to be imposed. However, it has to be acknowledged that there will times when the intransigence of major stakeholders can only be addressed by clear legislation or regulatory frameworks.

Different approaches respond to different market dynamics. If there are numerous existing or potential players wanting to roll-out a network, then a facilitating agency offering passive infrastructure assets like rights of way and Government land for sites will most likely succeed. However, if there were an appetite among operators to take advantage of it, the encouragement to share passive infrastructure could itself simply be a passive policy mechanism.

In developing countries the main challenge apart from implementing access is where there is no commercial appetite to address under-serviced areas where roll-out does not necessarily make commercial sense. In the absence of interested market players, the government might need to take the primary risk by encouraging investment in a wider national network and devising a fair and efficient mechanism to share this resource with existing market players. The issue for Government and regulators is whether they seek to duplicate elements of already existing networks or seek to “fill-in” gaps in already existing networks. The latter might easily be seen as a task for a Universal Access Fund but experience in some regions, e.g. Africa, has shown that these mechanisms do not produce speedy results in terms of national network roll-out to un-served and under-served areas.

It is however important to note that in markets where full liberalization has yet to occur, the slow progress at infrastructure investment should not be interpreted as a lack of willingness on the part of the private sector to invest. In some cases, restrictive policy and regulatory environments simply do not allow for that commercial evaluation to mature into investment and government may think that the private sector is not willing to take the network investment risk. As the Chairperson of the South African Competition Tribunal has noted, “The country's access deficit [the lack of broadband connectivity] was not due to market forces not working, but due to the fact that we have not had a working market. If there is one market that responds to market incentives, it is the telecoms market”.[20]

3.3.1 Creating conditions for entry by Greenfield backbone providers

Given the competing demands on government funds for equally important services such as healthcare, water, sanitation, electricity and education for example, government might not wish to take the sole responsibility for national infrastructure roll-out but might rather create the conditions for the private sector to do so, or encourage both operator and user representation in a joint venture vehicle that might be operated by an independent private contractor.

On this basis, government might also wish to encourage a wider range of partners to participate in the national infrastructure building task. Under the right access terms, there is no reason why private sector partners might not play a role. There is also a need for bodies like universities (through national research and education networks (NRENs) to participate, both as representing the user voice and by buying bandwidth to encourage wider online access for students. Having user voices in the governance of shared infrastructure projects ensures a universal focus on the overall objective of cost-effective delivery of bandwidth to end-users. The customers and participants in such a joint venture vehicle might include: existing national operators (fixed and mobile), ISPs, large-scale corporate customers (like banks), government funded services like public universities, hospitals and clinics and government departments. Depending of the state of development in the market, access can be offered to users in just layer one or both layers one and two as described in section 3.1 above.

Few governments have a convincing history in running “public interest” enterprises that have to operate in a commercially effective way. It is not impossible to achieve but it requires considerable skill and political subtlety and even in countries where these are available, it is not always successful. Nevertheless, it is perfectly possible for a government to grant a private sector company the contract to run some part of a shared infrastructure network on its behalf. The example of the Knysna municipal network in South Africa cited above is one where a municipality has contracted a private enterprise to provide the service. Another example at a national level is South Africa’s broadband network provider Infraco mentioned above, although it has yet to demonstrate its operating credentials. And an example at a regional basis is the Mid-Atlantic Broadband Co-operative in the United States described in Section 4.3 below.

Sharing infrastructure in a liberalized market can provide the dynamic for the roll-out of costly national infrastructure, whilst simultaneously allowing operators to compete fiercely in other layers in the market. Infrastructure sharing can be an additional tool for policy makers and regulators where Greenfield fibre backbone providers compete in the same market as existing network operators and service providers. These new Greenfield providers may be merely authorized to enter the market or actively encouraged through tax incentives and the creation of joint-venture or co-operative vehicles in which certain government players are also partners (or not). In other words, policy makers and regulators can encourage any and all potential backbone providers to enter the market rather than limiting market entry to one or two.

Where market entry is limited, policy makers and regulators then have to address other issues and decide on a long-term basis whether infrastructure sharing is a tactic or a strategy for achieving policy goals. If sharing infrastructure is used tactically, a country may reach the point where a national infrastructure is more or less in place and it might be advantageous to create a level of infrastructure competition again. For example, it may be useful to have competing infrastructure providers on key routes between cities. This approach then allows some price competition and might open up additional capacity more quickly than a single or shared infrastructure approach might do. Where market entry is open to all and competition is effective, many of these issues evaporate.

Ultimately, the requirement for sharing is a strategic need, for it allows government or the regulator to continue to intervene to ensure that consumer welfare and the positive externalities that flow from national infrastructure are protected. But whether one approaches the question either as a tactical or strategic issue, where market entry is limited it becomes necessary for the regulatory framework to contain the ability to impose sharing on those who control essential facilities and mandate the terms and conditions on which it should occur, as well as have the monitoring and enforcement mechanisms required to implement that framework.

However, in either instance two key questions arise: first, whether the creation of shared infrastructure services promotes competition and lowers prices for consumers and second, whether such arrangements serve to encourage other operators to continue to make technical innovations that lower cost and improve services? While the first question is likely to be answered in the affirmative and the latter question is slightly more complex to pronounce on definitively, both questions are directly linked to the type and quality of the access regime the policy-makers or regulators will conceive and implement in the pursuit of these objectives. This will be discussed more closely in section 5 below, following an examination of the models for infrastructure sharing that have to date been implemented. However, these two questions should not be viewed as separate inquiries. The fundamental question that emerges is whether there is competition and if so, whether it is effective?

4 APPROACHES FOR NATIONAL INFRASTRUCTURE SHARING: CURRENT MODELS

The examples listed below are all drawn from developed countries and have all been chosen because they have been in operation for some time, enabling certain lessons to be gleaned. In addition, each of the examples discussed has been funded from public funds but has been run privately.

Two of the examples (SERPANT in south-east Ireland and Mid-Atlantic Broadband Co-operative in Virginia, United States) focus on rolling out broadband networks to relatively large under-serviced areas in their respective countries.

SERPANT in Ireland was built as part of a nationally devised broadband strategy, whereas Stokab in Sweden started its work in the national capital Stockholm and extended its role and reach over time.

Although the three examples have had both social purposes and impact, the main strategic focus of each has been a desire to encourage economic development in their respective areas or country with broadband access as an incentive to help existing companies and to attract new investors.

Financially, each organization was tasked to be self-sustaining and has met this challenge over the period each has existed. None of the organizations is profit-distributing in the way that shareholders in a company receive dividends. However, MBC in Virginia does return the equivalent of profits (funds over and above its operating requirements in a given year) to participating operators using the term "capital credits".

Also in each of the examples, public funding has been used to lower the required return needed to operate a network of this kind and thus lowered the barrier for market entry to potential service providers.

Finally, this paper also provides a number of examples of publicly-initiated fibre backbone projects at a local and national level. These illustrate some of the knotty competition issues that are involved in launching projects of this nature. Many of these projects have been designed to create an incentive for what is seen as the next generation of broadband access upgrade, Fibre-To-The-Home (FTTH).

4.1. Sweden: Stokab (Stockholm)

Stokab was founded in 1994 and is owned by Stockholms Stadshus AB, which is in turn owned by the City of Stockholm. In its own words, it was established "to promote economic growth and thereby stimulate the telecom market and ICT development in the Stockholm region, particularly in the City of Stockholm".[21]

The impetus for its launch was a Government Bill called 'From an IT policy for society to a policy for an IT society' that set the objective for the country of achieving '[a] sustainable information society for all'.[22]

In practical terms, Stokab initially filled the gap left by the historic incumbent's refusal to provide fibre capacity after liberalization. However, a strategic decision taken that Stokab would only offer the market the fibre-optic infrastructure ("dark fibre"), the asset that is most difficult to replicate and leave services and innovation, using the fibre, to the new telecommunications companies. This decision was a key guiding principle of the company.

Stokab's core tasks are to build, operate and maintain the fibre optic communication network in the Stockholm region and to lease fibre optic connections. The company is competition-neutral and provides a network that is open to all players on equal terms. Stokab cooperates to facilitate the rollout of infrastructure for wireless communication and drives development of the broadband market in the Stockholm region.

This formal description rather understates the key strategic role it has played across Sweden by co-operating with both private and public network operators to ensure infrastructure development on an open access basis. Once established, the company expanded the network into 27 surrounding municipalities. It has also co-operated with Nordic and Baltic neighbors on fibre links, enabling the city to become a regional ICT hub. The company also operates the City of Stockholm's internal networks to serve both administrative purposes and for other public services in the areas of education, child care, recreation and culture. The City of Stockholm sees Stokab as providing a "public service on commercial terms".

Stokab commenced its network roll-out in 1994, initially concentrating on the central commercial districts before extending to all commercial areas. There is now network through the City's area and beyond to Uppsala, parts of the archipelago, to some of the municipalities in the Mälar region via Mälarringen and also to Gotland. It has worked with both public and private housing developers and utility companies to ensure that all new housing is fitted with fibre access.[23] Its network now has 5,600 kilometres of cable.

After commercial areas, fibre grew out into residential areas, first into multi-dwelling houses, where the service operator typically provided a basement router, and then into central points in single family house areas, where it fed wireless and other access points. These access points were also provided by other service providers and real estate developers. It is interesting to note how it also tied in with local roll-outs made by others. In one suburban municipality of around 17,000 single family homes, the local electricity distributor added fibre on an open access basis to every house on their grid.

Competition soon offered positive welfare gains for consumers. Large commercial customers like banks had more negotiating powers than consumers, once they were given a choice. Stokab's roll-out was a mixture of guessing where demand might be and anticipating it through a Master Plan. With a fibre backbone over the entire area, the question came up after a few years how several providers could provide wireless access in competition with one another. However, as spectrum allocation was based upon an old model, Stokab applied for, and received a slot for broadband wireless spectrum which it opened to SME providers in the more rural part of its area. Progress with this initiative has been stalled partly for internal reasons but also because products like Wi-MAX still have teething problems and remain an unproven technology, particularly in the face of limited spectrum availability. Furthermore ADSL is now available as an unbundled service and this lowers the entry cost for any contender wanting to build market share.

4.2. Ireland: SERPANT (South-East Regional Public Access Network of Telecommunications)

The SERPANT Broadband Project came out of a national broadband strategy[24] devised by the Irish Department of Communications, Marine and Natural Resources in 2004.

At the time, then Minister, Dermot Ahern stated that he had "secured government funding until 2007 which will deliver broadband to over 350,000 people who simply cannot get it at present."[25] The initiative targeted 88 towns with populations between 1,500-17,000 but mostly at the lower end of that population range. At the time, Ahern said the purpose of the initiative was to defend and develop Ireland's global competitiveness:" Ireland has to maintain its premier position as a supplier of digital goods and services to a global market. High-speed, low cost broadband helps ensure this."

Under the same nationwide broadband initiative, the Ministry offered 40 per cent of costs to rural communities who wanted to set up Group Broadband schemes and also set up Esat (BT Ireland) to provide high-speed backhaul links to regional providers embarking on initiatives like SERPANT. Nationally, the Ministry allocated 140 million Euros over a three year period, a significant part of which came from the European Union as part of Ireland's National Development Plan 2000-2006. In broad terms, the European Union funds are designed to benefit those areas that have not developed as well economically as other parts of the country.

In the case of SERPANT, primary responsibility was taken by a regional public authority, the South-East Regional Authority which covers the various local authority areas. As in the Stockholm example, SERPANT was set to fill a gap left by the failure of the private sector to roll-out broadband to these areas. The South East Regional Authority noted at its launch that "This move towards public ownership and provision of broadband telecommunications infrastructure is a new departure for regional and local authorities in Ireland and it represents a strategy to fill the gap in service provision that the private sector has hitherto failed to achieve". The proposed 26 metropolitan broadband rings seen as "major drivers of inward investment and cheaper communications links".

After a competitive bidding process, a local company, E-Net, was awarded a 15 year concession agreement to run the MANs constructed throughout the state. In formal terms, the role of e-Net is to operate, manage and promote the Government-owned metropolitan area networks that were built under the e-commerce measure of the National Development Plan. The network was built at a total cost of 18 million Euros and there is provision to extend the network beyond the local authority areas to a larger catchment area of customers.

A duct and optic fibre network passes as many businesses, government buildings, educational establishments and industry locations as possible. E-Net installs service connections between the main network and the customer premises. Spur routes have been provided for connectivity to certain key customers like major hospitals where a ring configuration could not be economically justified at the time. As elsewhere, the idea is to reduce the infrastructural investment costs that each service provider has to secure before being able to start offering broadband services to customers.

E-Net thus operates as a wholesaler of access to the metropolitan area networks and offers a full suite of products including ducting, sub-ducting, dark fibre, high level managed capacity, collocation facilities and relevant auxiliary services. It claims to offer pricing that is comparable with the cheapest available internationally.

Minister Ahern noted that the contract awarded to E-Net balanced public and private purposes, with the local authorities responsible for the capital risk and E-Net for the operational risks. He noted that "the contact strikes a balance between the more commercial objectives of the management company and the longer-term economic development objectives of the government and the local authorities." [26]

E-Net is headed by property developer Michael Tiernan of Tiernan Properties and funded by ACT Venture Capital, Anglo Irish Bank, Bank of Ireland and private equity. It has attracted industry expertise both at management and Board level from a range of companies.

4.3. United States: Mid-Atlantic Broadband Co-operative (Virginia)

Mid-Atlantic Broadband Co-operative (MBC) covers an area of rural south Virginia and was set up in 2000 in response to a range of problems caused by changes in the global economy. Entire industries such as tobacco, farming, textiles, furniture and more broadly manufacturing in general were disappearing, leading to thousands of job losses. The workforce had low education levels and old skills that were no longer required. Due to its geographic location, there were no competitive telecommunications carriers and services were expensive. Moreover, the existing carriers had no plans to roll out widespread broadband access in the region.

The idea for MBC was part of a broader economic development response to these circumstances and brought together business leaders, local university Virginia Tech and the Virginia Tobacco Commission.[27] This broader strategy aimed to transform the regional economy by creating a unique competitive advantage. The solution was a development strategy with four key pillars that were to build: an open access telecommunications infrastructure; human infrastructure; the conditions for innovation and regional development capacity.

The initial hurdle to overcome was how to get 20 counties and four cities, each with their own agendas, ideas and different levels of knowledge of telecommunications to work together. Each of these organizations had to be convinced that it would be better and more cost-effective to build a single network rather than patch together both the funding and construction required.

Eventually a single entity – Mid Atlantic Broadband Co-operative – was set up to manage the project, oversee construction and provide the same infrastructure and network connections for each County and City. Total funding of USD48 million came from the Virginia Tobacco Commission (USD42 million) and the Federal Government (USD6 million). These grant dollars were used to offset the debt service payments on the capital costs thus making it easier to deliver a cost-effective service.

Figure 2: Multi-Media Service Access Points

- Collocation
- Connection
- 24-hour access
- Security
- QoS

Source: Mid-Atlantic Broadband Co-operative

The network was designed to connect all business and technology parks, even including some that were not yet occupied as an incentive for inward location to the area. MBC operates solely as a wholesale carrier and offers backbone services that anyone can use including existing carriers like

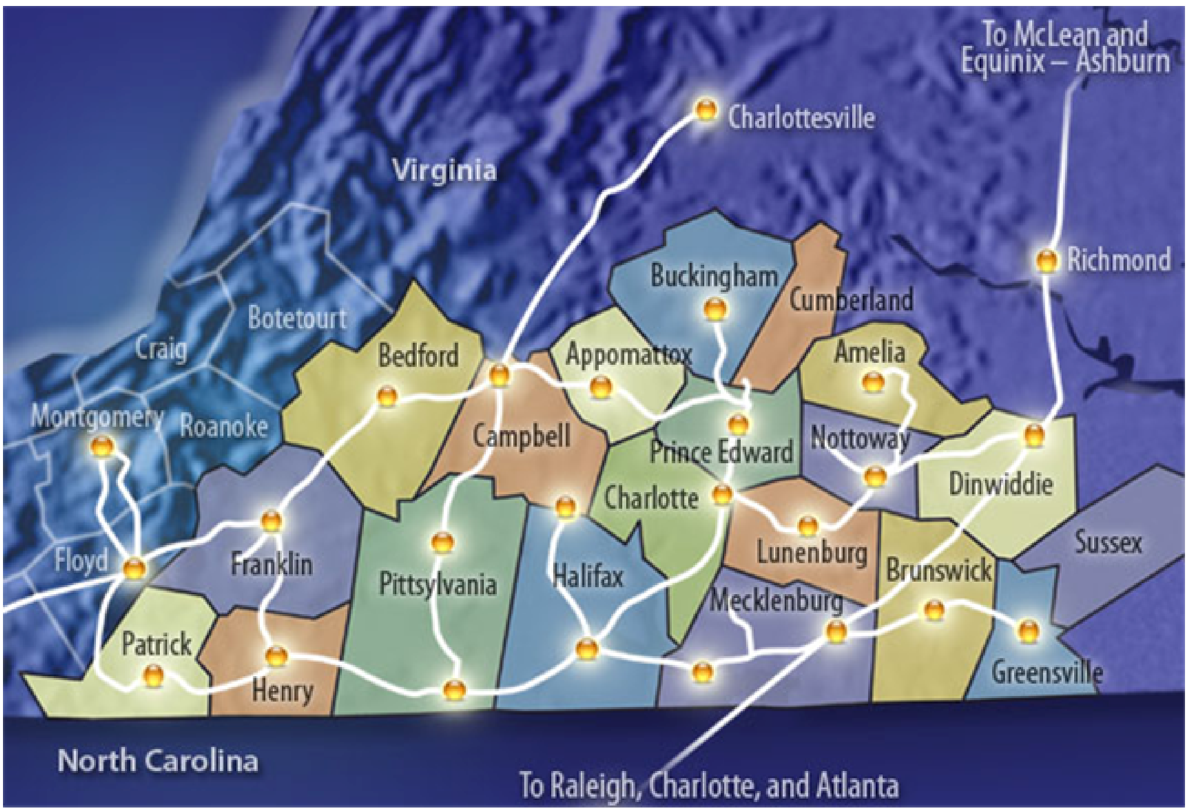
Verizon and Sprint. It offers dark fibre and also transport services in layers 1 (physical) and 2 (transport). Its philosophy is to make it easier for other service operators to serve the end user. MBC has laid over 1,100 kms of fibre and has 20 nodes that it calls Multi-Media Service Access Points (see Figure 2) with OC-48 and OC-192 backbone rings. Any service provider can sign a collocation agreement and put their equipment into one of its MSAPs. The agreement gives them 24 hour key card access and if the provider requires it, the equipment within the facility can also be located in lockable cabinets. All MSAPs are monitored remotely by cameras.

In return for obtaining rights of way, MBC gave 2 fibre strands to each of the local authority bodies which they could use for their own purposes, including for example, traffic sensor services. Overall it gave 12 strands of fibre for public sector use. In order to connect its network nationally and internationally, MBC has links to Tier one data locations, including Equinix in Ashburn, near to the capital Washington DC. It is also able to arrange cost-effective international transit for its users.

In the United States, there are several companies that provide towers for mobile providers to rent, again another pragmatic form of sharing. However, in this instance MBC has erected towers, which are connected to its fibre backbone, to create the incentive for mobile providers and wireless ISPs to supply both voice and broadband services, since its charges are much lower than competing tower companies.

Telecommunications companies join MBC as co-operative members and it provides open-access to its network, regardless of carrier, needs or competitive position. Member companies share in profitability of MBC through what are called Capital Credits at the end of each year. In effect, Capital Credits are a way of allowing for profit redistribution with a co-operative structure.

Box 2: Virginia Mid-Atlantic Broadband Co-operative (MBC)
Southside Virginia Coverage



Source: www.mbc-va.com/networkCVA.php

4.4. Other

Europe has a considerable number of FTTH projects initiated by local authorities. One of the largest of these initiatives is the City of Amsterdam and because of initial doubts stemming from the viability of the business plan and certain pre-investments carried out by the City of Amsterdam, the European Commission opened a formal investigation in December 2006. However, a year later the Commission concluded that the City of Amsterdam is participating in the project on the same terms as a would-be market investor. Therefore the Commission concluded that no state aid was involved.

Together with other shareholders, Amsterdam is investing in a company building a "fibre-to-the-home" broadband access network connecting 37,000 households in Amsterdam. The total equity investment in the project is 18 million euro. The Amsterdam municipality owns one third of the shares, two private investors, ING Real Estate and Reggefibre together own another third, while five housing corporations own the remaining third. The wholesale operator of the new fibre network was selected through a tender procedure and will provide open, non-discriminatory access to retail operators which offer TV, broadband and telephony services. Under EU state aid rules, investments by public authorities in companies carrying out economic activities can be considered outside of the state aid rules, if they are made on terms that a private investor operating under market conditions would have accepted (the market economy investor principle).

The European Commission has assessed over 30 public support measures for broadband services and networks under the state aid rules. If public intervention is well-justified because the market alone would not have provided the subsidized service, such as in rural areas with a low population density and no broadband coverage, state aid is generally considered to be justified. The Commission is more cautious when public authorities grant support in metropolitan areas, such as Amsterdam, where commercial broadband services are already available at competitive conditions. Such aid may crowd out existing and future investments by market players. However, in the case at hand, no state aid is involved, as the City of Amsterdam is acting like a market investor.

The City of Amsterdam is but one of many FTTH initiatives, including those that are being promoted by municipalities and power utilities in Europe. According to a presentation by an FTTH Council Europe Board Member, in June 2006 there were 84 projects being promoted by municipalities and power utilities, including the City of Vienna; Reykjavik Energy; Almere in the Netherlands and Vasteras in Sweden.[28]

5 POLICY AND REGULATORY ISSUES

The preceding sections of this paper have made numerous references to the enabling role of policy and regulation in the sharing of national infrastructure. At its simplest, this role is no different from the role played by policy and regulation in mandating any form of access regime, whether it is for interconnection, enabling facilities leasing or regulating access and pricing to essential facilities, or unbundling the local loop. Moreover, not only is the role unchanged, but the very tools with which to implement policy on infrastructure sharing are at the disposal of government and policy-makers and form part of any essential tool-kit on effective regulation.

Like all utility sectors, telecommunications access networks have historically had naturally high barriers to entry. The main barrier to entry was the cost of infrastructure provision. Laying down copper cable to individual households was a tremendously expensive undertaking. In most developing countries, the private sector did not have sufficient resources to meet the investment requirements of building telecommunications infrastructure. As a result, key infrastructure was either directly paid for by government (via state owned companies) or by private monopolies that were given a guaranteed rate of return and exclusivity conditions in order to repay their initial investment. Even then, the goal of providing household access to telecommunications was rarely met. In the last few decades, however, technology has evolved and prices have reduced such that there are more operators willing to take the risk of building their own infrastructure, enabling telecommunications services to be provided on a competitive basis.

This has taken different forms. In the United States, for example, facilities-based competition was possible, even in the access market, since cable TV networks were widely deployed and could be cost-effectively upgraded to provide broadband services. In Europe, however, a second access network was not widely deployed. Europe, therefore, promoted a service-based competition framework mandating local loop unbundling to spark broadband access networks, in the form of DSL upgrades to the legacy copper networks.

What is not clear at this point in time is whether costs for fibre backbone networks in developing countries can be significantly lowered, through infrastructure sharing and other mechanisms, to foster facilities-based competition, or whether costs will remain too high relative to likely returns on investment, such that they can only be provided on a service-based competitive framework. Realistically, the answer may be very different for rural than urban areas. Will lifting regulatory restrictions to market entry by potential fibre backbone providers open the door to multiple backbone and backhaul providers (e.g., enabling entry by small or regional backhaul providers)? Or is the developing country fibre backbone market more likely to mirror the European broadband access market, requiring regulatory intervention to mandate its development? Only if both options are available will the answers to these questions ever be known.

Where key infrastructure remains difficult or expensive to build, and can, once regulatory burdens are lifted, be provided by a single or limited number of operators and cannot be easily duplicated either environmentally, technically or economically, such infrastructure is termed « essential facilities ». Since essential facilities are the backbone of a telecoms network, providing cheap access has immediate beneficial effects on the competitiveness of the sector and results in lowered pricing and increased penetration. Infrastructure sharing as a regulatory tool to address bottlenecks, limits the need for new entrants to duplicate networks and by so doing, facilitates more rapid deployment and optimizes investment by gearing it towards underserved areas, product innovation and improved customer services.[29]

5.1. Contextualizing the regulatory debate

In essence then, the regulatory conversation necessary on infrastructure sharing reflect the many conversations underway at national regulatory bodies in the form of policy discussions and consultations on various forms of access and pricing issues necessary to facilitate market entry, growth and further liberalization. Infrastructure sharing can also be viewed in the broader context of the increasing trend towards open access models which has been gaining momentum over the past few years. For the reasons associated with costs, replicability of assets, access to land, speed of market entry and the like, the generally supported view is that the concept of open access is vital to competition. As it has been noted, "underlying most of regulatory economics is the existence of problems associated with lack of competitive entry. It is this which makes markets fail or succeed."[30] (see Box 1). As the trend towards open access gains momentum, it is clear that the technology exists to achieve national policy objectives but its successful deployment is subject to an enabling policy and regulatory environment being established and implemented.

Policy-makers and regulators need to carefully consider the policy dimensions, implementation challenges and monitoring and enforcement issues associated with ensuring competitive entry in their national markets. This is even more acute in some developing countries where competition is just commencing in the market and numerous challenges persist for service delivery from difficult geographies for ubiquitous wireless coverage, as well as difficult terrain for fibre construction. The possibilities created by the different modes of infrastructure sharing offer governments and regulators an opportunity to speed up competitive entry in their markets by reducing the capital costs of operators generally associated with network investments. With reduced entry costs and faster speed of access, comes more incentive for new entrants to invest in new markets. While there are clear benefits to giving fair access to essential facilities, the difficulty for government and regulators lies in implementing a fair access regime.

5.2. Balancing Competition and Investment

While the regulatory concern is essentially one of "access", there is also a bigger policy debate that frames the regulatory response. At the heart of all access discussions lies a challenge for government and regulators to balance two complementary, yet often competing policy objectives: on the one hand, increased competition will facilitate better quality, more diverse services and better prices, and on the other hand, a favorable investment climate for those operators who have already committed significant capital expenditure is required and this must also ensure an opportunity to secure investment returns. While strong competition might be viewed by some as an inhibitor of investment, competition and investment are in fact, inextricably linked as the right investments also ensure that services and innovation evolve, which would not be the case where there is no competition. It is now widely accepted that the most effective mechanism to achieve affordable pricing and high penetration levels in any given market, is competition.[31]

Table 4: Barriers to entry: the ladder of investment for Broadband

A hierarchy of infrastructure assets can be developed based on the ease of replication of each asset. The aim of this hierarchy is to pitch regulatory intervention at the appropriate stage of infrastructure development and to create incentives that encourage operators to move up the hierarchy towards assets that are more difficult to replicate. A dynamic approach to regulation is needed as demand changes and costs vary according to innovation. This requires practical principles according to which levels of replication can be determined as well as a phased approach to implementing regulatory interventions and identifying at what rung in the ladder the most appropriate interventions will be. A balanced regulatory approach to access is necessary in order to ensure that the benefits of competition and innovation are available to consumers.

Local Loop	Least replicable by an identical asset network, particularly in countries that lack cable access	**Hardest (non-replicable)** ↑
DSLAMs	Competitive suppliers renting loops have to install DSLAMs and collocate in the incumbent's exchange. Feasibility and ease is controversial. Cost modeling suggests a minimum efficient scale, high in relation to the number of broadband subscribers on any exchange. Scope for replication will vary within different countries	
Backhaul	Replication heavily dependent on geography	Relative ranking of ease of replicability
IP Network	High degree of replicability as network operators are able to attract more traffic or a more central location	
Retailing	Not susceptible to cost modeling in the same way as network service supply. Price regulation to leverage arbitrage to embark on the "ladder" will have no value for infrastructure competition	↓ **Easiest (Replicable)**

Source: Cave, *Telecommunications Policy, 2006*

This however, requires a clear policy from government evidencing political will to bring about the conditions required for competition to thrive. In many cases within the telecommunications sector, this does not even require that positive actions be taken to stimulate competition, but rather, that existing legislative and regulatory barriers to more effective competition, simply be removed. Invariably, underlying many of these barriers are problems associated with the "incumbent legacy". It is generally understood that due to the difficulty of duplicating infrastructure, new entrants are disadvantaged by not having access to infrastructure that was paid for some time ago under monopoly conditions. Incumbents have an incentive not to give fair access to infrastructure in order to protect their own revenues and the inefficiencies associated with being a former monopoly. Providing access at fair prices (usually some form of cost based provision) allows for innovation by new entrants, particularly in service provision. Since essential facilities are the backbone of a telecoms network, providing cheap access has immediate beneficial effects on the competitiveness of the sector and results in lowered pricing and increased penetration. Discriminatory practices by incumbent operators that prevent competition, usually by frustrating wholesale access to bottleneck facilities, have to be curtailed. The open access model is gaining momentum as a potential solution to the problem of ensuring that new entrants are able to enter a market that exhibits high structural barriers to entry.

While there are some generally agreed upon principles for approaching these challenges, there is no simple choice between open access (competition) and exclusive access (investment returns) and a balance between the two options thus needs to be carefully constructed. Striking the right balance requires the government and the regulator to take a dynamic approach to market analysis in order to make decisions appropriate to the level of both competition and investment in that particular market. A static approach, or where the regulator lacks the resources to dynamically monitor the market, increases the risk of adopting the extreme of either open or exclusive access which could result in a stultifying investment climate: either the incumbent sees no reason to invest in new infrastructure, or new entrants see no reason to risk investment in infrastructure to which they already have guaranteed access.

This paper advocates a middle path by suggesting a dynamic balance of policy objectives against the needs of the market. It also requires that the role of the government as player and referee needs to be carefully examined. Implicit in this is recognition by the policy-maker or regulator that while an impartial referee in theory, it is also a player and stakeholder in the sector and that its regulations or access regime (or lack thereof) have an impact on investment decisions by the market.[32]

5.3. Regulatory and Policy Imperatives of infrastructure sharing

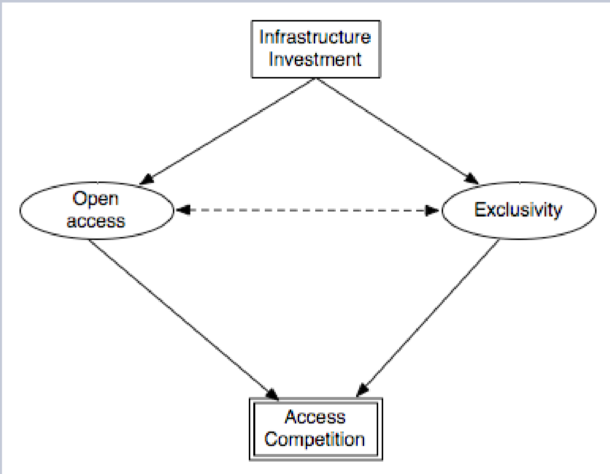
While there is variation within and between countries at different levels of development, the general regulatory/policy imperatives are the following:

Investment Incentives– The key challenge to be addressed here is how the regulator or policy-maker ensures that there are adequate incentives within the regulatory framework for operators to invest and continue to invest in infrastructure. This means that conditions must be created wherein infrastructure that is not easily replicable is still being rolled out. At the same time, it will require that access to this infrastructure exists. As a result there is an inevitable tension between the equally important policy objectives of open access and investment. Open access must entail some loss of return for the owner of the infrastructure if prices are regulated.

Open Access – Along with the principle of non-discrimination, open access is important because it lowers the barriers to entry of new entrants. The key problem is to provide competition at all (or most) levels of access because this has direct benefits in terms of innovation, specifically new technologies being introduced into the market, lower prices and wider penetration. In this regard, as access can be given at any of the layers discussed in Table 1, above, regulators need to ensure that if licensing is required, there is a regime in place that is capable of addressing access at any of these levels.

Open access thus becomes a tool with which to create infrastructure investment and facilitate new entrants and competition. However, as noted earlier, the overall challenge becomes one of guarding against abuse of the regulatory tool (open access) and if too much access is given to new entrants, the result can in effect be the same as when there is exclusivity on infrastructure access – namely, that there is little or no investment in infrastructure. An example of this is the market in the United States between 1996 and 2002. The reason that there was so little investment in (local loop) infrastructure by new entrants was that they could not supply infrastructure at the regulated prices – the prices were far too cheap, thereby acting as a disincentive to investment.

Figure 3: Policy Challenge – balancing open access and exclusivity



In the above diagram, the dotted line between open access and exclusivity represents that tension between the two options available to regulators or policy-makers. The traditional approach has been to provide the incumbent with an exclusivity period, during which it is obligated to rollout infrastructure. In nearly every case this policy has failed. However, there is also no point in a regulatory policy that allows the other extreme of providing access that acts as a disincentive to investment. As such, a regulator must adopt a dynamic approach that takes changing cost factors, technological innovation and the stage of competition at each level of access into account.

Regulatory Tools - The key challenge is not to reinvent the wheel. Governments, policy-makers and regulators in the telecommunications sector have been grappling with access regimes for the last two decades as deregulation and liberalization trends have increased. The means with which to effect this are all within current practices and processes underway. As discussed above, these include interconnection rules on access, pricing and dispute resolution; access rules for local loop unbundling and mandating access to bottleneck or essential facilities. There are some clear principles that may be followed: There should be a clear link to the definition of essential facilities - where are the bottlenecks and is it possible to provide alternative infrastructure at this point? In other words, is the specific infrastructure economically, environmentally or technically duplicable? One of the most commonly cited examples of essential facilities is the local loop. The conclusion in nearly all countries at this point in time is that it is not possible to duplicate this infrastructure and therefore it should be declared an essential facility. Because of the historical role that governments have played in providing essential facilities, a political commitment to lowering the barriers to entry (and therefore allowing access by new entrants) is also vital.

5.4. Implementation Considerations

To move the debate on implementation beyond the broad principles of non-discrimination, regulators need to identify and remove any technical constraints to infrastructure sharing. The following principles are of importance:

Commercial Imperative: Arrangements for the sharing of infrastructure between operators should be guided and shaped by an enabling regulatory and policy framework but as far as possible, allow for commercial negotiation. Sharing arrangements should be made on the basis of access-seeker arrangement but general agreement principles and time limits should be specified for concluding agreements on the sharing of infrastructure. In India, TRAI has required that service providers announce a program of passive infrastructure sharing on the existing infrastructure (where feasible) and for future investment while setting up mobile towers. TRAI also requires that sharing should be offered to other service providers on first come first serve basis subject to commercial agreements. Policy makers/regulators might also simply list and identify critical infrastructure sites without any further policy intervention.

Non-discrimination and Transparency: discrimination can take the form of price discrimination, (where the incumbent prices access for competitors in a manner which precludes competition with the incumbent) and non-price discrimination, (access terms and conditions which are less favorable than those it provides to itself or subsidiaries). Ensuring non-discrimination and transparency in access terms and pricing is a core function of regulatory interventions. This means that new entrants and service providers should have access to the full range of co-location and connection services, possibly if necessary, at a regulated price. The key point is to provide access to the network at different levels. Open access is not an all or nothing concept. There are gradations of implementation and the innovative ways that LLU (as a form of infrastructure sharing) has been implemented show a clear glide path towards higher levels of open access. Therefore, the technical constraints are generally more complex the more difficult the level of duplication is. In its recommendations on infrastructure sharing, TRAI has not mandated how passive infrastructure sharing should take place, but has required that the entire process should be transparent and non-discriminatory. Licensees must publish on their websites the details of existing as well as future infrastructure installations available for sharing by other service providers.[33]

Technical Feasibility: Access at different layers in the network raises issues of technical compliance and feasibility. All too often regulators must decide on interconnection disputes that have at their root, contestation over technical feasibility. Some of these claims are not without merit and in such cases, policy intervention may not yield the desired results. In the mobile market for example, much of the present infrastructure was created for utilization by specific operators themselves. Many towers erected in the initial stages of network roll-out were not designed with the possibility in mind of sharing with other operators. In the design of fibre networks, there is a view that PON networks (point to multipoint) for example, are not really designed for sharing, most particularly video (See Section3.1 above on technical sharing). Vendors often seek to push the roll-out of these networks in developing countries so that they can re-assert their control over the infrastructure network and in so doing, go back to making high margins. However, the imperative of open access means that anyone can connect to anyone in a technology-neutral framework at any level within the network.[34] Regulators thus need to guard against denial of access arguments on the basis of technological non-feasibility as a tactic to inhibit competition. Where there is merit to arguments of technological feasibility, those countries which have yet to deploy fibre networks should ensure that policy requires deployment of networks which are capable of open access. Moreover, the examples included in this paper demonstrate that open access of fibre networks is not only feasible, but is already being done.

Pricing: There are different forms of pricing options that can be explored and some type of cost based metric is considered best practice. This will vary from country to country but requires significant resources from regulators to ensure that it is implemented correctly. It may also be prudent to explore an option pricing approach which means that prices for the use of infrastructure start low to give new entrants a leg up initially, but over a period of time become progressively more expensive. The incentive here is ultimately for the new entrant to build its own infrastructure in those parts of the network that are replicable rather than having to pay higher and higher prices. It is however critical that any pricing methodology allow for a reasonable rate of return to ensure continued maintenance of the infrastructure – there is no point to mandating pricing below the cost of provision.

Competition Policy: Dominance or Significant Market Power (SMP): Policy to achieve development in the telecommunications sector and in the promotion of competition can be developed based on the lessons – both positive and negative – of countries at different stages in the process. The policy chosen will depend on the level of market maturity and the degree of liberalization. A comprehensive framework for managing anti-competitive conduct will however be required to ensure no abuse of market power or dominance where the owner of the infrastructure also competes downstream with other service providers in the same market. Such policy should incorporate an implicit understanding that regulatory or policy intervention is usually only mandated where there is a presence of SMP and an abuse of dominance in that market. The standard metrics for best practice regulation, including proportionality, narrow application and targeted interventions should apply equally with respect to managing competition issues arising from the sharing of infrastructure as they do with regard to other areas of price, access and competition regulation.

Enforcement: In line with the above, no policy can however, be effectively achieved without a sound enforcement framework in which complaints can be brought and disputes resolved with respect to the policy to share national infrastructure. Prescribing the form such enforcement should take on a universal basis is not possible as each country has its own institutional endowments and legal frameworks which may differ. The common thread however is a solid and effective mechanism for complaints handling and enforcement of policy with sanctions for violation sufficient to create incentives to comply.

Incentive Creation: Markets respond well to commercial incentives. One policy consideration is the creation of a financial incentive scheme for operators to make it commercially beneficial to share infrastructure. In the functional separation context, BT’s allowable 10 per cent investment return on network assets is an example. Other such incentives could include for example, regulatory exemptions; financial subsidies; reduced charges from civic or local authorities for installation of infrastructure where applicable; reduction in taxes and levies when a site is shared by service providers; a subsidy scheme or reduction in license fees. Regulators could also consider the award of more spectrum to operators sharing infrastructure. It could however be argued that there is no need for any financial incentive to be created by the policy-maker/regulator for infrastructure sharing as the very fact that it would result in reduction of Capex and Opex for all concerned parties will serve to encourage the sharing arrangements.

Role of Government: In the promotion of an open access model, the government needs to take a firm policy position on its role in the sector. Historically, in most developing countries, there is a legacy of state ownership in incumbents and a current practice of some form of equity retention even where liberalization policy is being implemented. While seeking to ensure consumer welfare and access, the government needs to decide if its role is to promote innovation, affordable pricing and high penetration, or to act as an economic stimulant in the form of active involvement (and ownership) in the sector? Evidence however, tends to warn against state involvement in the sector as both a market player and policy maker.

5.5. Unbundling as a form of infrastructure sharing

Unbundling of the local loop (LLU) specifically is an alternative way in which some the goals of infrastructure sharing – as a form of sharing- can be achieved. There are various ways in which to unbundle the local loop. These include full unbundling;[35] line sharing[36] and bit stream access.[37] The European Commission Regulation on Local Loop Unbundling (EC/2887/2000) came into force on 2 January 2001. This requires incumbent operators throughout Europe to offer unbundled access to their local loops on reasonable request. The Regulation also requires the incumbents to offer shared access and sub-loop unbundling or bit stream access.[38] Various developing countries such as South Africa, are examining the option of LLU to increase competition in their markets and countries like Morocco are already seeing significant gains as a result of this process.

The choice of model or combination thereof will be informed by different market circumstances and objectives. There is no reason why the same range of unbundled products offered on copper networks (raw copper, bit stream, line sharing, etc) would not apply in a fibre environment although there may however be slightly different considerations that arise from the much higher bandwidth capabilities. Moreover, if the fibre is located within a next-generation network (NGN) access network, with new intelligence and guaranteed quality of service built in, there are software/intelligence unbundling solutions that might be explored in addition to access to the physical network elements. These solutions would form the initial part of access until there were competitive options available to resellers. The argument that duplication is economically inefficient has been removed by the fact that allowing entry (and exit) from the market under competitive conditions means that the decision to invest is made by the firm and not by the regulator or by government. In essence, the point is to allow the “invisible hand” of the market to act by creating a level playing field and removing structural barriers to entry, particularly those created by the incumbents.

With respect to fibre backhaul in developing countries for broadband wireless networks in rural and urban areas, it does seem evident that some backhaul is replicable, dependent upon geographical and population density variables. This might include the regulator implementing the principles of a standard interconnection access regime as interconnection issues would remain pertinent.

The major regulatory limitations remain the challenge of harnessing and maintaining the resources to monitor the stage of competition in each level of infrastructure access but as a template approach, the issues the government and regulators might consider addressing by way of agreement principles for the terms and conditions of access/sharing, include:

- *Non-discrimination* among similar requests and no more favorable treatment for affiliates of the network operator
- *Quality of Service:* seamless transmission of any communications and testing and maintenance, fault reporting, service level disputes, system protection and safety measures
- *Service level agreements* that also provide reasonable remedies and penalties for any failure to meet those service levels
- *Standardization* with all relevant standards of the ITU and other technical standards
- *Confidentiality* of customer information
- *Transparency* such that charges for network elements are sufficiently unbundled and in line with any pricing methodology specified by the regulator
- *Billing and settlement* procedures and means of settling disputes
- *Charges* and mechanisms for the review of component charges
- *Enforcement* provisions and offences and penalties for contravention
- *Dispute resolution* procedures

Box 4: Infrastructure sharing in India: an imperative for sustained telecom growth

TRAI, the regulator in India, has sought to foster cooperative efforts amongst operators in India by making recommendations regarding passive and active infrastructure sharing and backhaul to enable further growth in mobile services, particularly in rural and remote areas. These recommendations follow a public consultation process. Given the significant costs of infrastructure investment, TRAI has acknowledged the need to optimally utilize available resources while ensuring competition and availability of services at affordable prices. TRAI has noted that infrastructure sharing can reduce costs and leverage roll-out of services more cheaply and quickly. It can enable more rapid coverage in the start up phase and in the longer term more cost effective coverage in un-serviced areas. TRAI has noted that regulatory interventions should only follow other policy initiatives including financial incentives. TRAI's policy recommendations include the following:

- Passive infrastructure sharing be subject to financial incentives – all licensees in any service areas will qualify for financial subvention schemes meant for rural areas;
- Tax exemptions of earnings from infrastructure sharing could be considered;
- Terms of sharing to be decided by commercial agreement between service providers but TRAI has reserved the option of prescribing a standard commercial agreement format in the future;
- A Joint Working Group will be established with representatives of operators, service providers, municipalities, local authorities and the Military Land control wing to assist in the resolution of disputes;
- Critical infrastructure sites will be identified;
- License conditions will be amended to allow active infrastructure sharing limited to antenna, feeder cable, Node B, Radio Access Network and transmission systems;
- To allow service providers to share their backhaul from the Base Tran receiver Station (BTS) to the Base Station Controller (BSC) as optical fibre in urban area is mostly available but it is not being optimally utilized;
- Sharing is permitted on optical fibre as well as radio at certain nodes;
- No sharing of spectrum at the access network has been recommended;
- Explore alternative, non-conventional energy sources to address critical power availability concerns.

Mindful of this tension between mandating access and encouraging ongoing investment, TRAI has attempted to ensure that such initiatives do not impact the competition in the market and in no way reduce the growth of wireless services in the country.

Source: TRAI, 2007

Whether sharing is used as a time-limited tactic or a long term strategy, it is necessary for regulators to have powers to impose the sharing of infrastructure in certain circumstances. As a paper from the French regulator ARCEP makes clear, this power will allow regulators[39]:

- To reduce interconnection conflicts between operators and oblige them to co-operate
- For both new entrants and small operators, it allows them to compete on a level playing field as quickly as possible
- It lowers one of the key barriers to market entry and thus significantly increases the opportunities for competition
- To encourage the growth of new service offers.

6 BEST PRACTICES FOR NATIONAL INFRASTRUCTURE SHARING

Given the multiple ways in which infrastructure sharing can be undertaken and how varying levels of market maturity and investment imperatives will affect these decisions, it is difficult to give a template "best practice" for implementation. In addition, in some countries, the regulatory functions rest with the policy makers, in which case the principles outlined below can be adapted to the entity responsible for implementation. Some guidance may be offered as a starting point as follows:

National policy-makers need to:

- Decide on the direction of the market and impose enabling laws and regulations that can facilitate the build out of national infrastructure. This could include revising licensing and authorization policies to enable joint ventures and cooperatives and other non downstream market players that offer open access;
- Co-ordinate with other government departments to ensure that where possible, a country's infrastructure (for non telecoms purposes), is leveraged to facilitate telecommunications network deployment;
- Design policy to speed up increased infrastructure investment.
- Reflect the political will to enable change through clear, directed, proportional regulation that will bring about the desired outcomes;
- Where there is an absence of market players, design incentives that will direct investment into infrastructure in under-served and non-served areas through for example, tax exemptions or rebates;
- Consider policy that will separate retail and wholesale functions within national infrastructure providers;
- Act as a clearinghouse for rights of way approval.

Local Government bodies need to:

- Where responsible for rights of way, assist operators with facilitating rights of ways and access to ducts and poles;
- Set up a clearing point for rights of way if multiple agencies are responsible for rights of way at different parts of the network;
- Provide information such as site surveys and geographic information systems for public land;
- Speed up the processes for granting rights of way;
- Reduce the costs to operators for obtaining rights of way;

Regulators need to:

- Where access regimes do not currently allow for sharing, embark upon consultation processes to assess the market and where intervention would be most appropriate, directed and proportional;
- Implement licensing/authorization frameworks to allow open access providers and create incentives for those who have spare capacity on their networks to share that capacity;
- Design regulatory interventions that are based on the technical reality of access at multiple levels of the network;
- Create incentives to promote infrastructure sharing on commercial terms;
- Improve transparency requirements for operators to publish relevant information for infrastructure sharing;

- Decide whether to approve or require publication of reference sharing offers covering issues such as provision of collocation space and connection services, power supply, air conditioning, access to collocation facilities for maintenance, etc.;
- Establish where bottleneck facilities are and whether it is economically, technically or environmentally possible to duplicate such facilities;
- Where necessary, establish the cost methodology (cost plus a fair rate of return) upon which access is going to be mandated;
- Where the regulator is not responsible for rights of way, establish who is responsible and assist operators coordinate the complexities associated with dealing with multiple agencies; Establish sound monitoring and enforcement for implementing infrastructure sharing, including speedy dispute resolution among operators;
- Require the publication of reference interconnection offers (RIO's) or similar instruments by operators with significant market power that specify the terms of access; sub-licensing if necessary; charges, billing, dispute resolution, etc.;
- Use competitive bidding processes or auctions when authorizing municipal or backhaul providers;
- Coordinate the trenching and ducting works between operators and service providers. And provide mechanisms for monitoring duct upgrading to ensure that service providers remove obsolete cabling to allow the introduction of third-party fibre;.
- Publish a list and identify critical infrastructure sites (with or without any further policy intervention, as the case may be);
- Establish a Dispute Resolution mechanism for addressing disputes that might arise.

Industry players need to:

- Assess the business case for sharing, rather than duplicating infrastructure;
- Move away from the assumption that excluding access to network elements is the only way to secure revenue;
- Co-operate with regulatory/policy processes;
- Improve transparency and publish on their websites the details of existing as well as future infrastructure installations available for sharing by other service providers;
- Implement regulatory coordination of trenching and ducting works between operators and service providers and those of other utilities.

7 CONCLUSION

This Discussion Paper has attempted to highlight the key issues involved in extending open access to national fibre backbones with a focus on developing countries. There are relatively few cases globally where this is currently occurring. As such, few examples suggest of definitive statements at this time, but all – even at early stages of their operation - offer some lessons for countries seeking to adopt an open access model to national infrastructure sharing. While the paper has advocated a technology neutral approach, there are however, distinctions relating to the sharing of fixed line and wireless networks due to their physical differences. Many countries may have legacy networks that can be upgraded to support broadband, whether cable TV, microwave or copper. Yet, many other countries might not have any legacy networks which are capable of upgrading for this important policy goal. Numerous developing countries now seek to pursue an ICT development agenda that will leverage their existing legacy wireless access networks by upgrading to some kind of 3G, BWA or 4G technology, which will also require upgrades to the backhaul and backbone networks.

Provided the framework is correct and the right incentives are established, there is a great leapfrogging opportunity for developing countries to enable the deployment of national fibre networks. The paper has also stressed that most of the regulatory and policy tools required are already available and need minor augmentation and adaptation. The paper has attempted to highlight these tools and draw some lessons for their "best practice" implementation. This paper is however ambitious in scope and content as it attempts to cover various scenarios in which national fibre sharing may occur, from the legal entity to the regulatory remedy. It has been noted however, that the most critical factor identified is the political will within government and regulators to enable the sharing of national fibre. With this secured, the implementation of law and policy that will give effect to these goals will be simpler, more efficient and effective.

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[2] The latest forecast suggests that this will occur in many developed countries in 2008. See "Burgeoning online advertising spend will pass TV next year", The Independent (London), 4 January 2008.

[3] Telco 2.0 www.telco2.net/blog/2007/09/making_structural_separation_w.html

[4] Infraco has been established through an Act of Parliament and by way of an amendment to the sector legislation with the stated aim of empowering government to make strategic interventions on infrastructure investments whenever it deems it necessary. By doing so, government intends to enable itself to initiate government intervention to ensure strategic ICT infrastructure investment and thereby more easily be able to address the challenges of reducing the cost to communicate by providing infrastructure to other operators at wholesale rates; improve on government service delivery and support the country's economic policy; link Nepad/Broadband with Africa/Latin America and Europe and provide the much needed bandwidth for strategic projects and consumers in general

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[26] Ibid.

[27] The Tobacco Indemnification and Community Revitalization Commission is its full title and it redistributes money to the local authorities in its area that is given by the tobacco companies as a result of Court action over the dangers of tobacco products.

[28] Presentation by Ramil Houbby, Board Member of FTTH Council Europe at the One Optical Network Europe Conference, 24-25 September, Cannes, France

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[30] Martin Cave, Encouraging infrastructure competition via the ladder of investment. Telecommunications Policy 30 (2006) at p. 226.

[31] "A commonsense appraisal of real-life experience – the comparison of productivity growth in countries with and without competitive market systems; Microsoft's efforts to use its dominance of the PC operating systems market to deny potential competitors access to related markets and to venture capital; the rapid introduction of new electric generating technologies when competition was opened up in the electricity market; the innovative services offered

by the airline industry when competition replaced regulation; the flood of innovations when the monopolies of BT in Britain and AT&T in America were successfully challenged – all suggest that competition means a fiercer gale of creative destruction of old technologies than does the cosier world of cartels and monopoly". See, I. Stelzer, "Creating an environment for rapid innovation" in Richards, E. Foster, R and Kiedrowski, T. 2007. Communications, the next decade. OFCOM, p.143.

[32] Academics at MIT have noted this concern as follows: The choice of layer in the network architecture for unbundling has important implications for allocation of costs and responsibilities between the bottleneck provider (in this case, a municipality) and the service providers, and for the range of services that can be offered by providers and the type of choice experienced by end-users. "While Layer 3 unbundling appears to support the most dynamic range of customer choice and flexible service-level competition, it also requires the municipality to become a full-fledged facilities-based provider of finished wholesale telecommunications services and limits the scope of facilities-based competition. Unbundling at lower layers reduces the municipalities' investment and role, and expands options for facilities-based competition for those elements of the local infrastructure that are not "bottleneck" facilities. Identifying where the bottleneck is likely to be in a world of changing technologies, market demand, and industry structure is difficult and uncertain, which helps explain the diversity of approaches." See, Lehr, W., Serbu, M., & Gillett, S. (2004) Broadband Open Access: Lessons from Municipal Network Case Studies", at http://itc.mit.edu/itel/docs/2004/Broadband_Open_Access.pdf

[33] However, indiscriminate non-discrimination might in the long run be as damaging as exclusive/proprietary arrangements. In this instance, there must be a regulatory requirement for technical feasibility and some reference to economic viability as a threshold for mandating access. This does however require careful implementation to avoid tactics by incumbents to keep new entrants out on the basis that sharing is technically not feasible or economically not viable.

[34] Infodev, 2005. Open Access Models: Options for Improving Backbone Access in Developing Countries (with a Focus on Sub-Saharan Africa).

[35] This method assigns the entire copper local loop to the leasing operator. New entrants will then install their own broadband equipment and collocate which would require the new entrants to place all the equipment in the incumbent's premises or outside the incumbent's premises depending on which collocation model is most appropriate.

[36] Line sharing is where the incumbent and other licensed operator share the same line. From the MDF the wires are connected to a splitter (which separates the frequencies for voice telephony and those for higher bandwidth services). The incumbent provides voice telephony over the lower frequency portion of the line, while another operator provides DSL services over the high frequency portion of the same line.

[37] This provides access to the bit stream on the network side of the DSLAM. In the case of copper circuit unbundled access the DSLAM connected to the unbundled circuit is always installed and operated by the new entrant. In the case of bit stream access, the DSLAM is installed and operated by the incumbent who also configures the DSLAM and sets up the required technical parameters (speed and quality of service (QoS) attributes) of each user's DSL access link. The output of the DSLAMs on the network side is configured as an Asynchronous Transfer Mode (ATM) transmission system.

[38] See http://europa.eu.int/eur-lex/en/lif/dat/2000/en_300R2887.html

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TABLE OF CONTENTS

page

1....... Background and Introduction 5
1.1 What Is An International Gateway (IGW)? 5
1.2 Importance of International Gateway Liberalization in Singapore 5
2....... Submarine Cable Systems 5
2.1 Growth in International Traffic 6
3....... Regulating IGWs in Singapore 7
3.1 Dominant Licensee's Reference Interconnection Offer (RIO) 7
4....... Access to SCLS 8
4.1 Mandating Collocation 8
4.2 Mandating Connection Services and Price Regulation 9
4.3 Enable Unrestricted Access in SCLS 9
5....... Submarine Cable Landing Coordination in Singapore 10
5.1 Landing Process and Coordination in Singapore 10
6....... Impact on Dominant Licensee and Consumers 10
7....... Challenges & Lessons 11
Annex A: Details of SCLS Collocation in the RIO 12

BOXES

Box 1: IDA's Regulatory / Policy Making Methodology 7
Box 2: Collocation Details in Dominant Licensee's RIO 8

FIGURES

Figure 1: Schematic of Submarine Cable System 6

1 BACKGROUND AND INTRODUCTION

Today, a nation's information backbone is predominantly made up of fibre optic cables, and is usually linked to other nations in other regions by a complicated web of cable networks. These networks are essential to the health of the domestic and global economy.

1.1 What Is An International Gateway (IGW)?

An International Gateway is defined as any facility through which international telecommunications traffic is sent and received. IGWs are potential bottlenecks in any nation's telecommunications market as they can restrict international traffic flows and maintain artificially high prices. Most international traffic goes through submarine cable systems, which will be the focus of this paper. Another important form of IGW, particularly for land-locked countries, is satellite communications.

1.2 Importance of International Gateway Liberalization in Singapore

Over the years, voice and data transmissions via submarine cables had traditionally been seen as a natural monopoly of incumbent operators, due to the high costs of investment and maintenance. However, with the arrival of the Internet and an explosion in the need to transmit voice and data, demand for capacity and interconnection has grown exponentially. A nation's ability to fully participate in the global Information Society may be impeded due to the high costs of Internet access or international communications.

In Singapore, the decision to introduce competition in the local and international telecommunications market was influenced by two main factors. First, rapid technological advancement had greatly reduced infrastructural costs and hence, the natural monopoly argument no longer held true. Second, a monopoly provider would not have sufficient incentives to provide the increasingly diverse and sophisticated demand for telecom services to support Singapore's aim to be a global economic and communication centre. Telecom liberalization was thus necessary to enable competition, increase consumers' choice and stimulate greater market efficiencies. Ensuring effective competition in the international telecom market is a key consideration of the Infocomm Development Authority's (IDA) objective in enhancing Singapore's economic competitiveness.

2 SUBMARINE CABLE SYSTEMS

A submarine cable system comprises 4 main portions (a) the wet side[1]; (b) the beach manhole[2]; (c) the backhaul[3] and (d) The Submarine Cable Landing Station (SCLS)[4]. Note the collocation spaces and connection services inside the SCLS which we shall discuss later.

Please see Figure 1 for a schematic of a Submarine Cable System.

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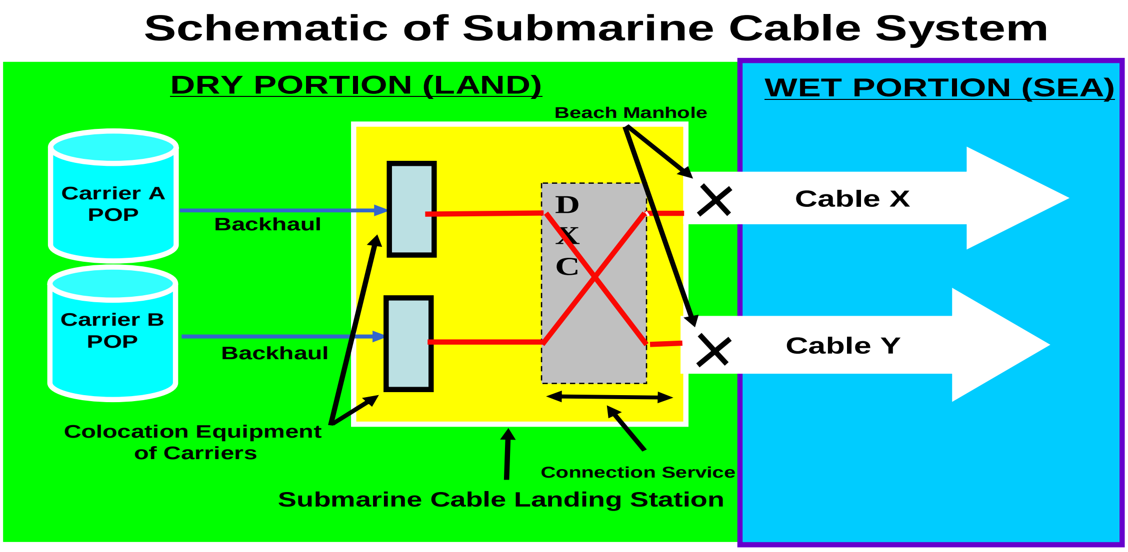
[1] Which refers to the portion of cable which is under the sea

[2] Where the cable emerges from the sea to land

[3] Backhaul refers to high capacity circuits that connect an SCLS to another terminating point (e.g. an operator's telecoms exchange) within the same country. From this terminating point, voice or data can be distributed to smaller capacity circuits over a network. Telecoms operators who have built backhaul facilities to the SCLS are licensed as Facilities-Based Operators (FBOs)

[4] A submarine cable landing station houses all terminal equipment; including lasers, multiplexers and power supply that takes the optical signals from the Cable and passes it on to a terrestrial system.

Figure 1: Schematic of Submarine Cable System



Note: DXC or Digital Cross Connect is a switching system that routes signals among multiple paths or different operators' circuits in this case.

2.1 Growth in International Traffic

With advances in optical fibre technologies, the cost of building and maintaining submarine cables has fallen. This resulted in a growing number of submarine cable networks worldwide. The Trans-Atlantic route is no longer the only well-served route. In addition, the Pacific routes and routes through the Middle East are growing rapidly. In fact, some countries now have international capacity measured not in gigabits per second but in terabits per second.

Liberalisation also made it possible for new operators to construct their own cable systems instead of being forced to join a consortium of various national operators and having to pay a high entrance fee. The first such cable was PTAT-1, which crossed the North Atlantic Ocean in 1989, linking New Jersey, Bermuda, Ireland and the UK. It effectively broke the joint monopoly of AT&T and British Telecom.[5]

For developing countries, the emergence of Next-Generation Networks (NGN), coupled with the increasing demand for international Internet connectivity means an even more urgent need to accelerate their efforts to connect. The WSIS[6] Agenda for the Information Society in 2005 urged the development of strategies that enable affordable global connectivity and facilitate equitable access to all.

[5] The PTAT-1 was shut down in 2004 as being no longer viable, because prices of other trans-Atlantic cables fell significantly.

[6] World Summit on the Information Society (WSIS), Tunis 2005, www.itu.int/wsis

3 REGULATING IGWS IN SINGAPORE

One of the most important drivers of increased international bandwidth capacity is long-term, sustainable and effective competition in the international telecommunication services market. In 2000, IDA fully liberalised its telecoms sector and at the same time revamped its regulatory framework. By September 2000, the IDA created the Code of Practice for Competition in the Provision of Telecommunication Services (The Code) which establishes a clear regulatory framework to help foster competition in Singapore. IDA also evolved a regulatory/policymaking methodology as a systematic means to achieve policy outcomes and address regulatory challenges (See Box 1).

Box 1: IDA's Regulatory / Policy Making Methodology

1. Determine the desired policy/regulatory outcomes
2. Apply IDA's Regulatory Principles throughout the process
   - ☑ Rely on market forces, wherever possible
   - ☑ Promote effective and sustainable competition
   - ☑ Promote facilities-based competition, wherever possible
   - ☑ Regulate in proportionate manner
   - ☑ Be technology neutral
   - ☑ Be transparent
   - ☑ Be timely in implementation and enforcement
3. Consult interested parties/stakeholders (including research on domestic and international practices)
4. Address concerns and analyze findings
5. Make preliminary recommendations
6. Advise interested parties on preliminary recommendations
7. Make decision, explain the reasons behind the decision (and address industry's requests for reconsideration and appeal, if any)
8. Implement decision (ensure legislation, enough resources, training)
9. Monitor that policy/regulatory objectives are being met. If not, take corrective action
10. Review overall decision after 2-4 years

The important first step is to determine the desired regulatory/policy outcomes. In this case, Singapore's desired outcomes in regulating IGWs are: Firstly, to create a vibrant international market in Singapore, with multiple players in the market. Secondly, to substantially increase Singapore's international bandwidth capacity. Thirdly, to ensure significant drops in the costs of international communications.

3.1 Dominant Licensee's Reference Interconnection Offer (RIO)

The next step is to require the Dominant Licensee to provide a Reference Interconnection Offer to its competitors. The RIO is essentially a model interconnection contract that facilitates rapid access and interconnection with the Dominant Licensee. The RIO covers, amongst others, a range of interconnection issues, including domestic interconnection, unbundled network elements, collocation and infrastructure sharing.

The RIO is important because it sets out in a transparent, efficient and non-discriminatory manner, regulator-approved prices, terms and conditions for other operators to interconnect, collocate and access the Dominant Licensee's SCLS. In Singapore, the RIO becomes a critical instrument in which to facilitate rapid adoption of reasonable interconnection agreements between the Dominant Licensee and other operators, which in turn, reduces the timeframe for interconnection negotiations, expedites market entry and promotes effective and sustainable competition.

Full texts of SingTel's Reference Interconnection Offer (RIO) can be found at: www.ida.gov.sg/Policies%20and%20Regulation/20060602171047.aspx

4 ACCESS TO SCLS

A key component of full liberalization is to encourage the landing of multiple submarine cable systems, with operators being able to access and backhaul their capacity on these cable systems effectively and efficiently for the provision of international telecommunications services. Singapore now has two operators who have four SCLSs between them.

In practice, most of the submarine cable systems that land in Singapore do so in the Dominant Licensee's SCLS. Operators that compete with the Dominant Licensee to provide international telecommunication services usually need access to the Dominant Licensee's SCLS to connect to their own submarine cable capacity, and to backhaul this capacity to their own exchange.

4.1 Mandating Collocation

As part of the full liberalization, IDA required that collocation[7] should be mandated at the Dominant Licensee's SCLS, at cost-based rates. This allowed operators providing international services direct and more efficient access to submarine cable capacity that land at the SCLSs and backhaul the capacity to their own exchange. This requirement was put into the Dominant Licensee's RIO that was approved in 2001. See Box 3 for collocation details, and Annex A for collocation charges.

Box 2: Collocation Details in Dominant Licensee's RIO

- Requesting Licensee can request up to a maximum of 10 square meters of collocation space at cost-based rates of about US$2000 per square meter per year
- Requesting Licensee may request for collocation space using a request form that is included in the RIO. Dominant Licensee will process and respond within 3 business days
- Dominant Licensee will undertake preliminary site survey and joint site survey within 15 business days
- Dominant Licensee will finish site preparation work within 25 business days, at rates stated in the RIO
- If Dominant Licensee fails to meet Service Level Guarantees stated above, rebates will be given to Requesting Licensee (rates stated in the RIO)
- RIO indicates detailed requirements that Dominant Licensee will provide eg at least 13 amps of power per collocation space, and earthing standard of 1 ohm
- RIO includes procedures to allow Requesting Licensee to maintain and repair their equipment. Upon request, Dominant Licensee will provide an escort for the Requesting Licensee within 24 hours, at reasonable rates stated in the RIO. (within 1 hour for emergencies)

[7] Collocation refers to the lease of space at the SCLS, incumbent's facilities, such as an exchange or to house transmission equipment.

Mandating collocation in the SCLS is a significant step in facilitating competition in the provision of international services. As a result of IDA's mandating collocation at the SCLS, operators are able to access and backhaul their own submarine cable capacity. In addition, competition in the backhaul services market was introduced, thereby bringing down the prices of backhaul in Singapore and international services. Notwithstanding, IDA noted that mandating collocation alone is insufficient to achieve the objectives of liberalization, because other bottlenecks, like Connection Services, had to be similarly addressed.

4.2 Mandating Connection Services and Price Regulation

An operator who has collocated equipment in the Dominant Licensee's SCLS must connect its national network to a submarine cable system. In order to do so, the Dominant Licensee must provide "Connection Services" to the operator. In 2000, while IDA mandated collocation, IDA had allowed Connection Services to remain as a service to be commercially-negotiated. It had also found that this was usually not a mandatory interconnection service in other regimes such as Japan or US.

Nevertheless after some industry feedback, IDA reviewed Connection Services and assessed that such services would constitute a clear bottleneck service. Essentially, IDA had three concerns. The first concern was that the Dominant Licensee could set its connection services rates unreasonably high because the other licensees have no other viable alternatives. Secondly, the Dominant Licensee could offer unreasonable terms and conditions which would further delay the ability of competing licensees to access and backhaul its own capacity. The third of IDA's concerns was the potential impact on Singapore's attractiveness as an international communications hub. In our review, IDA had found that the costs of accessing submarine cable capacity in other countries like Japan, the United States and Australia were much lower, for similar connection services. The high costs for connection services may cause licensees to reconsider lighting up their cable capacity in Singapore and instead they may choose to activate the capacity in other markets where the prices were more in-line with costs.

IDA thus amended the Code in 2002 to designate Connection Services as a mandatory service under the Code and required the Dominant Licensee to provide Connection Services under the RIO at prices that are cost-based and determined by IDA using forward looking economic costs and long run average incremental cost (FLEC/LRAIC)[8] methodology.

Connection Service charges have fallen by more than 90 per cent since the measure came into effect in 2002. See Annex B for Connection Service charges and Service Level Guarantees.

4.3 Enable Unrestricted Access in SCLS

Even with mandatory Connection Services, more work needed to be done.

Prior to 2004, if an operator owned international capacity on a submarine cable system landing at SingTel's SCLS, it can access such capacity to offer services to businesses or third parties. However, this operator cannot access capacity that it does not own in other submarine cable systems that land at the same station. Neither can they access capacity on behalf of a third party,

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[8] FLEC refers to the prospective costs an operator would incur in producing a service, using most efficient technology and best practices. This cost standard favors the prospective rather than historical basis for costs; economic rather than accounting measures of cost; and costs based on most efficient technology rather than embedded technology. To the Dominant Licensee operators, FLEC would incentivize them to be more efficient since they will only be compensated as such. To the new operators, FLEC would assist them in their build vs buy decisions, since it will be reflective of the costs they will be incurring if they were to construct their own facilities. If charges were priced below FLEC, new operators will not invest in additional infrastructure, but "free-ride" on Dominant Licensee operators' network. However, if charges were priced above FLEC, new operators may construct too much of their own facilities, resulting in unnecessary duplication and uneconomic bypass of Dominant Licensee operators' facilities. LRAIC consists of all variable costs and those fixed costs that are directly attributable to the provision of an additional unit of a service, and the share of indirect costs that are discernibly caused by such provision.

who owns capacity in these other cable systems, but lacks the necessary backhaul infrastructure for connection between the SCLS and its exchange premises.

It is evident that the restrictions on access in SCLS are increasingly inappropriate in today's market environment and will unnecessarily restrict operators from connection and/or transiting more submarine cable traffic through Singapore, thereby limiting effective competition in the telecommunications market.

In 2004, taking into account the changes in the market, IDA reviewed the regulatory framework for access to SCLS and made the following change. From 2004, operators can access capacity that is owned, or leased on a long term basis, on any submarine cable at the SCLS. Furthermore, these operators can also access capacity that is owned or leased by third parties, in order to offer them backhaul and transit services. IDA's decision provides greater flexibility and choice to operators in accessing, backhauling and transiting submarine cable capacity.

More details in:
http://www.ida.gov.sg/News%20and%20Events/20050712175459.aspx?getPagetype=20

5 Submarine Cable Landing Coordination in Singapore

Apart from regulation, IDA also aims to facilitate submarine cable landing in Singapore. The nature of the submarine landing requires use/access of several government controlled resources, operators usually need to seek approval from more than one governmental agency for example, the port authorities, utilities authorities, land control authorities etc. Hence, as with most regimes, operators need to face multi-governmental agencies in order to land submarine cables. In Singapore, the wet side, or sea approach, is under the purview of the Maritime & Port Authority of Singapore ("MPA") while approval on the land portion is under the purview of several agencies with the lead agencies for land usage being the Urban Redevelopment Authority ("URA") and the Singapore Land Authority ("SLA").

5.1 Landing Process and Coordination in Singapore

When an interested licensee intends to land a cable in Singapore, IDA facilitates the process as a "one-stop-shop" for the licensee to interface with all the necessary government agencies. The process involves guiding the licensee on the steps and processes necessary to land the cable as well as to reduce time and administrative hassle that may arise.

As there are multiple agencies involved in the clearance for the landing of a submarine cable system, IDA takes on the role to coordinate any issues that may arise from the licensee's application. Depending on the complexity of the landing of a submarine cable, the time taken for obtaining approval from the various government agencies may be between 2 to 6 months.
The most obvious benefit of having a "one-stop shop" concept is the convenience accorded to operators who wishes to land submarine cables in Singapore.

6 Impact on Dominant Licensee and Consumers

Faced with competition and a loss of monopoly in the Singapore market, the Dominant Licensee was forced to adopt a new business strategy to grow and internationalize. As a commercial entity that was accountable to its shareholders and that would eventually be subjected to competition, the Dominant Licensee was also forced to revamp and improve its operational efficiency, which led to lower tariffs and improved services for business and retail customers. Compared to 10 years ago, the Dominant Licensee's overall global revenues are three times more than pre-liberalization days.

With effective competition at the IGW, more players entered the international market. International Direct Dialling (IDD) rates had fallen more than 90 per cent since 2000 and there are today, more than 900 service providers in Singapore (more than 70 are ISPs). International private leased circuit rates had fallen by a staggering 95 per cent. In 2007, the mobile phone penetration rate stands at 116 per cent, while broadband penetration rates per household had hit 77 per cent.

7 Challenges & Lessons

Because Singapore is a small island of 4.6 million people, it had to be bold in formulating a highly effective competition management framework for international gateways. We had to learn from international best practices because Singapore in the year 2000 did not have a general competition law or a relevant history of competition policy that could be applied. Plans for full liberalization had also been accelerated (from 2007 to 2000) and IDA urgently needed to put rules in place to encourage new players to enter the sector.

The international gateway liberalization experience specifically has been a long learning process with many iterations. There were many potential bottlenecks that the regulator did not foresee. The regulator has to be vigilant in order to keep the nascent IGW competition alive.

Because of the many issues that demand attention in a regulatory decision, it is of utmost importance that there are clear policy objectives, firm regulatory principles and a consultative rulemaking methodology to ensure that regulation is prescribed and implemented in a consistent, optimal manner. At the same time, regulation should not be for regulation's sake. In this light, the dual hat of IDA as a regulator and development agency is advantageous in ensuring that regulation is prescribed with a developmental mindset in order to achieve certain policy/regulatory outcomes.

Lastly, the authority to require a RIO and to mandate collocation already exist in many countries. Therefore most countries already have the tools to address the issue of access to an SCLS that is deemed to be a bottleneck.

In conclusion, it is important to note that as different economies have different socio-economic landscapes and national economic goals, there is no standard regulatory blueprint for every regime. We hope our experience will provide some helpful learning points for you.

More details can be found at www.ida.gov.sg or contact the author at muhd_hanafiah@ida.gov.sg

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ANNEX A: DETAILS OF SCLS COLLOCATION IN THE RIO

RATES/CHARGES

8.2 Charges

8.2.1 The Charges are as follows:

TABLE 1 - COMMON CHARGES FOR CO-LOCATION AT:

POI/POA/ SUBMARINE CABLE LANDING STATION

DESCRIPTION	CHARGES (S$)
Ordering And Provisioning	
Per order[30]	$ 39.27
Per order (applicable where the application is rejected by SingTel pursuant to clause 3.3 of Schedules 8A, 8B and 8D)	$ 14.21
Project Study (per Co-location Site)	$ 1,517.47
Modified Co-Location Equipment	
Per Request	on a case-by-case basis
Site Preparation & Installation	
Site Preparation Work –for M&E works etc	on a case-by-case basis
Fire Safety Bureau Charges (where applicable)	on a case-by-case basis
Building & Construction Authority Charges (where applicable)	on a case-by-case basis
Construction of Connection Duct – 1 metre of 110mm diameter Connection Duct	$ 1,011.41
Road Opening Application Fee (where applicable)	$ 75.90
Installation of Optical Fibre	on a case-by-case basis
Provision, installation and termination of Transmission Tie Cables, Power and Earth comms cables	on a case-by-case basis

[30] This charge will not apply where the order is rejected pursuant to clause 3.3 of Schedules 8A, 8B or 8D.

DESCRIPTION	CHARGES (S$)
Provision, installation and termination of Tie Cables for IRS Tail Circuit Service (n x 64 kbps, 2 Mbps, 45 Mbps and 155 Mbps)	on a case-by-case basis
Recurrent Charges (paid quarterly)	
Co-location Space (minimum of 1 square metre to maximum of 10 square metre) per square metre per year (where the Requesting Licensee also leases Roof Space under Schedule 5C)	$ 3,034.35
Co-location Space (minimum of 1 square metre to maximum of 10 square metre) per square metre per year (where the Requesting License leases only Co-location Space under Schedules 8A, 8B and 8D)	$ 3,337.79
Power (minimum of 13 fused amp for AC and minimum of 20 fused amp for DC) per fused amp per year	$ 286.09
Lead-in Ducts (per duct metre per year)	
Central Business District	$ 4.28
Non-Central Business District	$ 4.17
Lead-in Manholes (per duct bore per year)	
Central Business District	$ 50.25
Non-Central Business District	$ 48.18

DESCRIPTION	CHARGES (S$)
Manpower Cost	
Supervision of work during installation, Site Inspection, Final Inspection, Escort Service for Physical Access	
During Office Hours (Minimum 2 hrs) – per hour	$ 46.42
After Office Hours (Minimum 2 hrs) – per hour	$ 69.63
After Office Hours (Minimum 4 hrs if recalled from home) – per hour	$ 69.63
Saturday (Minimum 4 hrs) – per hour	$ 69.63
Sunday (requiring < 4 hrs) – per activation	$ 408.50
Sunday (requiring > = 4 hrs) – per activation	$ 816.99
Public Holiday – per activation	$ 742.72
For all recalls/activations, the Requesting Licensee shall reimburse SingTel for its staff's reasonable transportation claim	
Physical Access/Emergency Physical Access	
Per Request	$ 12.53
Updating Master List	
Administrative Fee (per form)	$ 12.53
Termination Charges	
Per Termination Request including recovery of Equipment, Cable Trays, M&E works (where applicable) upon termination of Co-location.	on a case-by-case basis
Reconnection Charges	
Per Reconnection Request[31] (per Co-location Site)	on a case-by-case basis
SingTel Exchange Related Information	
Application Fee per application	$ 12.53
Address of SingTel Exchange Building and diagram of network boundary per SingTel Exchange	$ 58.83

[31] These charges shall apply in the event of the lifting of suspension of this RIO Agreement or Schedules 8A, 8B or 8D.

SERVICE LEVEL GUARANTEES FOR COLLOCATION

1. REBATES FOR CO-LOCATION REQUEST TIMEFRAMES

Missed notification timeframe as to whether Co-Location Request is accepted or rejected (clause 3.3) by:	Rebate
1-30 Calendar Days	Number of days of delay x weekly recurring Charge
More than 30 Calendar Days	30 x weekly recurring Charge

Missed notification timeframe as to response to Co-Location Request following detailed processing (clause 3.5) by:	Rebate
1-30 Calendar Days	Number of days of delay x weekly recurring Charge
More than 30 Calendar Days	30 x weekly recurring Charge

2. REBATES FOR PROJECT STUDY TIMEFRAMES

Missed timeframe for completion of Project Study (clause 4.1) by:	Rebate
1-30 Calendar Days	Number of days of delay x weekly recurring Charge
More than 30 Calendar Days	30 x weekly recurring Charge

3. REBATES FOR SITE PREPARATION WORK

Missed timeframe for completion of Site Preparation Work (clause 5.1) by:	Rebate
1-30 Calendar Days	Number of days of delay x weekly recurring Charge
More than 30 Calendar Days	30 x weekly recurring Charge

ANNEX B: DETAILS OF "CONNECTION SERVICES" IN THE RIO

RATES/CHARGES

SCHEDULE 4B – SUBMARINE CABLE CONNECTION SERVICE

4.3 General

4.3.1 The Requesting Licensee shall be liable to pay and shall pay SingTel the relevant Charges for the Connection Service as provided in Schedule 4B. A link is referred to as a fibre pair or co-axial cable pair.

4.3.2 Application Charge

The Requesting Licensee shall pay to SingTel the Application Charge for processing each Request for Connection Service (including all requests that are rejected). The Application Charge shall be applied if the Request for Connection Service is not approved by SingTel or prematurely cancelled or terminated by the Requesting Licensee.

4.3.3 Activation Charge

The Requesting Licensee shall pay to SingTel a one-time Activation Charge for each link activation (for service or protection links) or each capacity activation or each concurrent link/capacity activation.

4.3.4 Deactivation Charge

The Requesting Licensee shall pay to SingTel a one-time Deactivation Charge for each link deactivation (for service or protection links) or each capacity deactivation or each concurrent link/capacity deactivation.

4.3.5 Annual Charge for Group A Cable Systems

The Requesting Licensee shall pay to SingTel the recurring Annual Charge for the use of each link activated (for service or protection links).

4.3.6 Annual Charge for Group B Cable Systems

The Requesting Licensee shall pay to SingTel the recurring Annual Charge for the use of each STM-1 (or VC4) Input Port capacity. Additionally, the Requesting Licensee shall pay the recurring Annual Charge for the use of each

Schedule 9 – Charges Page 26

STM-1 (or VC4) Output Port capacity or the lower rate output port capacity such as VC3 or VC12 capacity.

4.4 Charges

Charges payable by the Requesting Licensee for the Submarine Cable Connection Services are as follows:

DESCRIPTION	CHARGES (S$)
Application Charge per Request	
- Link Activation	$ 424.32
- Capacity Activation	$ 424.32
- Link and Capacity Activation	$ 578.90
- Link Deactivation	$ 424.32
- Capacity Deactivation	$ 424.32
- Link and Capacity Deactivation	$ 578.90
Activation Charge	
- Link Activation per link activated (for each service or protection link)	$ 2,672.00
- Capacity Activation per capacity activated	$ 2,186.18
- Link and Capacity Activation per link and capacity activated	$ 4,372.36
Deactivation Charge	
- Link Deactivation per link deactivated (for each service or protection link)	$ 971.36
- Capacity Deactivation per capacity deactivated	$ 817.06
- Link and Capacity Deactivation per link and capacity deactivated	$ 1,788.69
Annual Charge for Group A Cable Systems	
- Per link activated (for each service or protection link)	$ 750.98

DESCRIPTION	CHARGES (S$)
Annual Charge for Group B Cable Systems	
- STM1 or VC4 (per Input Port)	$ 8,739.29
- STM1 or VC4 (per Output Port)	$ 8,739.29
- VC3 (per Output Port)	$ 4,369.65
- VC12 (per Output Port)	$ 208.08

FAULT RESOLUTION

8.5 Target Response Times

The target response time for attendance to an alarm or reported fault will depend on the time of its occurrence as contained in Table 1 below. "Office Hours" is defined as 8am to 5pm for Mondays to Fridays (except Public Holidays). The whole of Saturday, Sunday and any Public Holiday and the hours outside the Office Hours are referred to as "After Office Hours".

Fault Type	Response Time	
	During Office Hours	**After Office Hours**
Service Affecting	within one (1) hour of receipt of notification	within two (2) hours of receipt of notification
Non-Service Affecting	within two (2) hours of receipt of notification	within next Business Day of receipt of notification

Table 1 - Target Response Time

SERVICE LEVEL GUARANTEES FOR FAULT RESOLUTION

3. (A) FAULT REPAIR QOS STANDARDS (FOR NON-SERVICE AFFECTING FAULTS)

Missed timeframe for fault rectification by:	Rebate
(i) 24 – 48 hours	weekly recurring Charge
(ii) 48 –72 hours	2 x weekly recurring Charge
(iii) More than 72 hours	3 x weekly recurring Charge

(B) FAULT REPAIR QOS STANDARDS (FOR SERVICE AFFECTING FAULTS)

Missed timeframe for fault rectification by:	Rebate
(i) 6 – 12 hours	weekly recurring Charge
(ii) 12 – 24 hours	2 x weekly recurring Charge
(iii) More than 24 hours	3 x weekly recurring Charge

International Telecommunication Union

GSR 2008

Discussion Paper

Comments are welcome and should be sent by 13 April 2008 to GSR08@itu.int

International Telecommunication Union

INTERNATIONAL TELECOMMUNICATION UNION

8th Global Symposium for Regulators

Pattaya, Thailand, 11-13 March 2008

Work in progress, for discussion purposes

BREAKING UP IS HARD TO DO: THE EMERGENCE OF FUNCTIONAL SEPARATION AS A REGULATORY REMEDY

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February 2008

The views expressed in this discussion paper are those of the author and do not necessarily reflect the opinions and official positions of ITU or of its Membership.

COMMENTS ARE WELCOME AND SHOULD BE SENT BY 13 APRIL 2008 TO

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TABLE OF CONTENTS

page

1 ...... Introduction 3
2 ...... Meaning of functional separation 3
3 ...... Reason for requiring functional separation 4
- 3.1 Discrimination by the incumbent 4
- 3.2 Relaxation of other regulation 6

4 ...... Current methods to limit discriminatory behavior 6
- 4.1 Wholesale price control 6
- 4.2 Accounting separation 6
- 4.3 Non-discrimination rules 7
- 4.4 Ex-post competition law 8

5 ...... Key features of functional separation 8
- 5.1 Virtual separation 8
- 5.2 Equivalence requirements 9
- 5.3 Monitoring and enforcement 9

6 ...... Case studies 10
- 6.1 European Union 10
- 6.2 United Kingdom 10
- 6.3 New Zealand 11
- 6.4 Italy 11
- 6.5 Sweden 12
- 6.6 Ireland 12
- 6.7 Australia 12
- 6.8 France 13
- 6.9 Poland 13
- 6.10 Mongolia 13

7 ...... Common ground on functional separation 13
- 7.1 Costs of implementing functional separation 14
- 7.2 Functional separation not likely to be reversible 14
- 7.3 A drastic remedy 14
- 7.4 Continuing regulatory control 15

8 ...... Areas of debate on functional separation 15
- 8.1 Impact on investment incentives 15
- 8.2 Transition to fibre-based next-generation access networks 16
- 8.3 Difficulty in achieving stability in the asset base 16
- 8.4 Service quality 17

9 ...... Application of functional separation in developing countries 17
- 9.1 Promotion of broadband 17
- 9.2 The discrimination problem 19
- 9.3 Investment incentives 19
- 9.4 Institutional capabilities 19
- 9.5 Impact if subsequent privatization 20
- 9.6 Conclusion on applicability of functional separation to developing countries 20

10 .... Alternatives to functional separation 20
- 10.1 Enhanced non-discrimination rules 20

10.2 Accounting separation 21
10.3 Competition law capabilities 21
10.4 Using elements of functional separation 21
10.5 Separation of the entire network 22
11 .... Conclusion 22

FIGURES

Figure 1: Basic network structure 4
Figure 2: Fixed-line and fixed-line broadband penetration worldwide, 1996-2006 18

1 INTRODUCTION

There has been a tremendous amount of interest around the world recently in functional separation as a regulatory remedy in the telecommunications sector. Functional separation is one of the most drastic regulatory remedies that are available in a regulator's arsenal, with enormous implications for the incumbent, and also for the regulator in charge of its implementation and enforcement. It is also perhaps the most potent regulatory remedy under discussion in the set of 2008 GSR Discussion Papers.

The primary reason that has been given for considering functional separation is that existing regulatory remedies have failed to deal adequately with anti-competitive discriminatory behavior by incumbents. In particular, the concern has arisen in relation to competitor access to fixed line bottleneck assets to provide broadband services.

This paper will:

- consider the reasons given for implementing functional separation and the current remedies that are available in certain countries to address discriminatory behaviour;
- look at the key features of functional separation and examine case studies from countries that have implemented, or are considering implementing, functional separation;
- examine the arguments that are flowing around functional separation, including the common ground that exists and the major issues being debated; and
- consider the application of functional separation in a developing country context and look at some alternatives to implementation of functional separation.

2 MEANING OF FUNCTIONAL SEPARATION

But first, it is necessary to put forward a basic definition for the term "functional separation", sometimes also known as operational separation. In this paper, the term applies to the fixed line business of incumbent operators[1] and means:

- the establishment of a new business division, which is kept separate from the incumbent's other business operations;
- this separate business division providing wholesale access to the incumbent's non-replicable (or bottleneck) assets, which are required by competitors in order to compete with the incumbent in downstream retail markets; and
- the separate access services division being required to supply wholesale access to competitors, and the incumbent's own retail divisions, on a non-discriminatory basis.

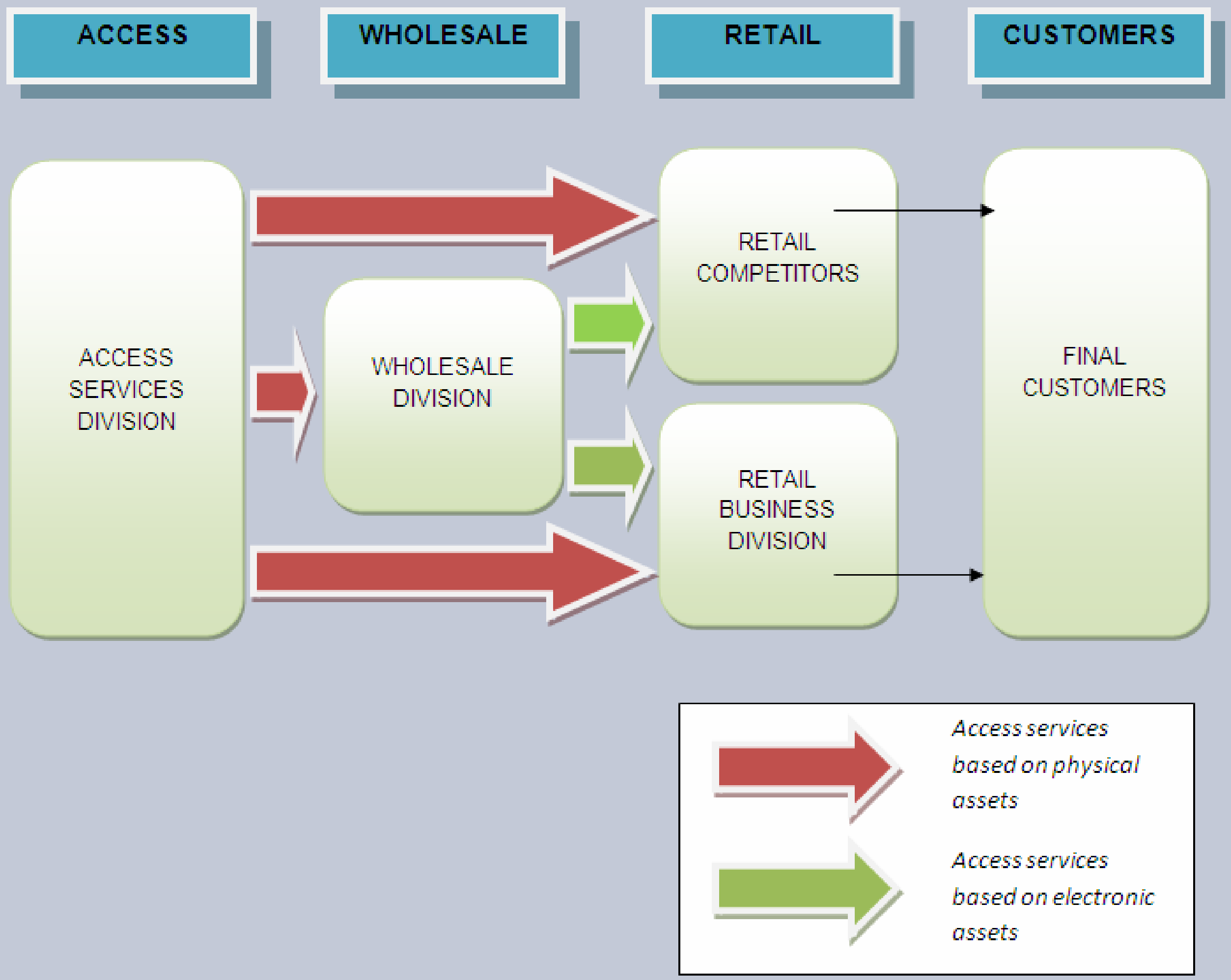
Often this structure is complemented by the establishment of a separate wholesale services division. This wholesale services division would also acquire access to the bottleneck assets from the access services division and create wholesale products, which can then be sold to competitors and the incumbent's own retail divisions on a non-discriminatory basis.

The access services division would provide access based on the physical assets under its control (e.g., local loop unbundling), to which the competitors and the incumbent's retail divisions can then add their own electronics to produce a retail service (e.g., broadband access).

The wholesale services division may also acquire access to the physical assets from the access services division and add its own electronics to produce a service (e.g., bitstream access) that can be resold by competitors and the incumbent's retail divisions.

This relationship between these various divisions of the incumbent, and competitors, is shown in the following diagram.

Figure 1: Basic network structure[2]



Source:

3 REASON FOR REQUIRING FUNCTIONAL SEPARATION

3.1 Discrimination by the incumbent

Regulators are concerned about discriminatory behavior by incumbents in providing wholesale access to bottleneck assets. This behavior can be difficult to identify and can be damaging to competitors seeking access to these assets.

- Discriminatory behavior is difficult to identify because there normally isn't any "smoking gun".
- Discriminatory behavior is seen as damaging because it causes delay and uncertainty on the part of the competitor, and a sense of impotence or lack of confidence in the

regulator in being able to combat the discriminatory behavior. This in turn may lead to under-investment or delayed investment by the competitor.

Incumbents, and their management, are considered to have both the incentive and the ability to discriminate and therefore to frustrate competition[3]. There has been some evidence of this type of discriminatory behavior in some countries[4].

Economic theory holds that exclusionary discrimination (i.e., behavior that is designed to limit a competitor's ability to compete in downstream markets) is definitely harmful. Downstream competition is hindered, leading to increased prices and a lessening of the quality of services.

It is the vertical integration of the incumbent that gives rise to discrimination concerns, and it is this vertical integration that functional separation seeks to address.

Discrimination can take two basic forms:

- price discrimination, where the incumbent prices access for competitors at a level which makes it difficult to compete with the incumbent, even for an efficient competitor; and
- non-price discrimination, where through the implementation of access terms, the incumbent provides access to its competitors on a less favorable basis than it provides that access to itself.

Examples of price discrimination include:

- cross subsidies between products where the incumbent has market power and products where the incumbent does not have market power;
- vertical price squeeze between the incumbent's retail price and the wholesale access price; and
- using the relative price of different wholesale products to mould the type of competition that the incumbent faces (e.g., reducing the wholesale price of bitstream relative to local loop unbundling prices to discourage local loop unbundling-based access by competitors).

Examples of non-price discrimination include[5]:

- undue delay in processing competitor's orders for access;
- providing greater levels of information about access products to the retail parts of the incumbent's business, than provided to the competitor;
- preferring the incumbent itself when developing the network or the means of access to the bottleneck assets;
- providing information on competitors' plans for access, received by the incumbent's wholesale group on a confidential basis, to the retail parts of the incumbent's business; and
- providing access to a competitor at a lower quality of service than it provides that access to itself.

David Currie, the Chairman of Ofcom, spoke recently on the harmful effects of discriminatory behavior[6]:

> "It does not even require active non-price discrimination. All that is needed is for the incumbent not to try their hardest to achieve reliability, timeliness and predictability to disrupt significantly the launch by competitors of a rival retail proposition. A significant mismatch between the promise of a marketing campaign and consumers' actual experience of waiting weeks or even months to get what is promised can do significant and lasting damage to a competitor's market entry."

3.2 Relaxation of other regulation

Another reason for implementing functional separation, which is not clearly articulated in the general discussion of the topic, is that it can lead to a relaxation of other forms of regulation of the incumbent's activities. An example is retail price controls, which may be present in addition to regulation of access to bottleneck facilities.

In the United Kingdom, Ofcom was motivated to lift BT's retail price controls, as well as lifting or relaxing other regulated services, after functional separation. It represents an "upside" for the incumbent, when otherwise faced with the perceived "downside" of functional separation.

4 CURRENT METHODS TO LIMIT DISCRIMINATORY BEHAVIOR

4.1 Wholesale price control

In most countries in the world where competition has emerged, the regulator has sought to control the prices that incumbents charge for access to bottleneck assets. Typically, this is on the basis of cost-based charges, which attempt to mimic the charges that would apply if there was a competitive market for access to those assets.

If properly implemented, cost-based pricing will effectively resolve some price discriminatory behavior, such as vertical price squeeze.

However, cost-based pricing is very difficult and very costly to apply in practice, even for the most well-resourced regulator.

4.2 Accounting separation

Another remedy to address price discrimination is accounting separation[7]:

- this means providing separate financial reporting for the incumbent's line of business that provides wholesale access to the bottleneck assets and for the competitive parts of the incumbent's business;
- it identifies internal transfer prices within the incumbent;
- it is designed to ensure parity of access pricing between that paid by the competitor and the notional accounting price paid by the incumbent;
- accounting separation can assist in identifying excessive returns made by the part of the incumbent's business that provides wholesale access to the bottleneck assets;
- it can identify vertical price squeeze by lower returns/losses in the competitive part of the incumbent's business; and
- it can increase the validity of accounting data, and provide a more robust data-set, in regulatory proceedings.

Accounting separation is relatively common and is regarded as an effective tool to address price discrimination[8].

However, accounting separation does not escape criticism as a regulatory instrument:

- the complex and subjective allocations of costs and revenues between the different parts of the incumbent's business can make it difficult for the regulator to monitor and check the accounting information;
- the amount of time required by the regulator to process and interpret the accounting information provided, means that discrimination may have occurred, but remain undetected for long periods; and
- the lack of power that regulators may have to gather data or require incumbents to report.

4.3 Non-discrimination rules

Most countries will have rules in place that require non-discriminatory treatment of competitors by incumbents when it comes to granting access to bottleneck assets. These rules can be broad and general in scope, supplemented by more specific and detailed rules to deal with particular situations.

For example, in the European Union regulatory framework, guidance is provided to national regulatory authorities in relation to obligations of non-discrimination[9]:

> "Obligations of non-discrimination shall ensure, in particular, that the operator applies equivalent conditions in equivalent circumstances to other undertakings providing equivalent services, and provides services and information to others under the same conditions and of the same quality as it provides for its own services, or those of its subsidiaries or partners."

Several weaknesses have been identified with non-discrimination rules as a means of dealing with discriminatory behavior:

- it can be difficult for the regulator, or competitors, to identify when there has been a breach of these rules – have the rules been bent, or broken? It can also be difficult for the incumbent to identify when it has been in breach;
- there will normally be a time lag between when the discriminatory behavior has occurred, and when it is investigated and resolved, which can be enough time to cause damage to the competitor concerned;
- without careful drafting, there is a risk that the rules will be ambiguous, presenting opportunities for the incumbent to continue discriminating; and
- some regulated services are not used by the incumbent, such as interconnection circuits, and therefore prohibitions on discriminatory behavior may be difficult to apply in these circumstances.

The first two of these are also weaknesses of ex-post competition law remedies, as referred to below.

The regulator will require meaningful enforcement and investigatory powers to supplement the non-discrimination rules. The regulator will also require sufficient funding and resources to make full use of these enforcement and investigatory powers.

4.4 Ex-post competition law

Ex-post competition law remedies are also available to control anti-competitive forms of discriminatory behavior.

However, these remedies have also been criticized as being problematic as a means to control discriminatory behavior. For the same sorts of reasons as non-discrimination rules are criticized, the ex-post application of competition law remedies means the behavior will have occurred, potentially some considerable time after the abuse has taken place. They can be complex to enforce, as well as being uncertain, costly and time-consuming to pursue.

Having said that, competition law is well equipped to deal with discriminatory behavior and the principles derived from decisions of the courts and national competition authorities can be applied in dealing with abusive discrimination.

5 KEY FEATURES OF FUNCTIONAL SEPARATION

The whole point of functional separation is to reduce the incentive and ability of an incumbent to engage in discriminatory behavior when it comes to access to bottleneck assets. The very reason for considering functional separation arises out of the misgivings that the current methods to control discriminatory behavior may not be fully effective.

The three key features of functional separation are:

- the "virtual" separation of the incumbent's business;
- the "equivalence" or "equivalence of inputs" (EoI) obligation; and
- monitoring of the incumbent, to ensure compliance with the separation and equivalence obligations, and effective enforcement.

5.1 Virtual separation

The important thing to note about functional separation is that it is a "virtual" separation of the incumbent's business. That is, the incumbent remains intact, both from a legal and an ownership perspective, but is required to restructure itself into distinct divisions.

The critical parts of a functional separation are that the business division that provides access services to bottleneck assets is separate and distinct from downstream retail business divisions and also the wholesale division.

By separating these divisions, the incentive and ability of an incumbent to engage in discriminatory behavior is blunted. This new institutional framework means that discriminatory behavior will be much more difficult for the incumbent to achieve, and easier for the regulator and competitors to identify, which should deter the behavior in the first place.

By being a "virtual" separation, separate subsidiaries are not required and ownership is retained by the existing shareholders. This preserves a number of the benefits of vertical integration for the incumbent (see the discussion of investment incentives below).

To that extent, functional separation can be distinguished from the sort of structural or ownership separation that has occurred in the energy sector in a number of countries. In these countries, the distribution and transmission networks (the equivalent bottleneck assets) have been placed in separate ownership to the theoretically competitive upstream generation assets and downstream retail assets. Structural or ownership separation is rarely used in the telecommunications sector, although examples can be found (notably) in the United States, and also in some developing countries such as Mongolia (see case study below).

Because the separation is “virtual”, various mechanisms are required under functional separation to simulate a distinct and independent business unit. Procedural barriers (or Chinese Walls) are erected, with rules designed to enhance their impermeability.

Various measures may be used to ensure that the management and staff of the division that controls the bottleneck assets are kept independent and separate from the management and staff of the downstream divisions. Their remuneration incentives may be linked to the performance of the division of which they are a part; they may be kept physically separate and operate under a distinct brand (e.g., Openreach in the United Kingdom and Chorus in New Zealand).

5.2 Equivalence requirements

While the virtual separation puts in place the institutional framework for functional separation that blunts the opportunities for discriminatory behavior, this will normally be further enhanced by requirements on the access services division to treat competitors in an equivalent fashion to how it treats its own downstream divisions.

In the United Kingdom and in New Zealand, functional separation has required equivalence of inputs. This means the equivalent wholesale products and services are provided to downstream divisions of the incumbent, and to competitors:

- on the same timescales and terms and conditions (including price and service levels);
- with the same service, system and process reliability and performance;
- with the same commercial information provided; and
- by means of the same systems and processes.

Ofcom uses the expression “equivalence of outputs”, which describes the first three of these requirements, but where the systems and processes used by competitors will be approximations of the systems or processes used by the incumbent’s retail activities (rather than identical systems and processes).

This last requirement for full systems and process equivalence is perhaps the most burdensome element of the equivalence requirement on the incumbent, which will have systems and processes that are integrated with various parts of its business that fall outside the access services division[10]. Given this, full systems equivalence may not be justified for access services with a short lifetime (e.g., services based on a technology that is being phased out), which are intended to be replaced over time by more advanced access services.

Equivalence of information will help overcome the information asymmetries that exist between the incumbent and competitors, but also between the incumbent and the regulator.

Although equivalence is the general principle that underlies functional separation, there will typically be exceptions that apply to equivalence, where it is necessary for the efficient operation of the incumbent. The exact definition of these exceptions in the separation plan will be a critical factor in the success of functional separation as a remedy.

5.3 Monitoring and enforcement

Functional separation involves a series of promises by the incumbent. There must be effective monitoring and enforcement of these promises by the regulator (or a proxy, such as an independent oversight group); otherwise there is a significant risk that they will not be complied with.

An independent oversight group may be established to monitor compliance by the incumbent with its separation and equivalence obligations. These sorts of groups have been established in the United Kingdom and in New Zealand[11]. Success of this independent oversight requires mandatory reporting and information flows to the oversight group from the separated divisions and strong powers of investigation to assess potential non-compliance.

Another key feature that facilitates monitoring is whistleblower protections, which can be a powerful disincentive to incumbents in seeking to avoid the functional separation requirements.

Effective enforcement powers by the regulator or the government are also a prerequisite to effective functional separation. The ability to cancel a licence for flagrant breach of separation requirements may be required as an ultimate deterrent.

6 CASE STUDIES

6.1 European Union

In November 2007, the European Commission (**EC**) announced a series of proposals to amend the existing electronic communications framework, that provides the ground rules for how telecommunications is regulated throughout the European Union. Among these proposals is an amendment to the Access Directive, to allow national regulatory authorities (**NRAs**) to order functional separation as a remedy.[12] This is intended to be used as a last resort, and the NRA must seek prior approval from the EC. In seeking approval, the NRA must demonstrate that the competitive problem has not been, and cannot be, resolved through other means. The NRA must also undertake a detailed cost-benefit analysis. The reason for the requirement for the EC to give permission lies in the extremity of the remedy. As functional separation is such a drastic move, the EC wishes to ensure harmony between the Member States. This desire for harmony must be balanced with individual circumstances – hence the country-specific cost-benefit analysis.

The proposal also allows for the acceptance of voluntary separation plans. It mandates disclosure by the telecommunications operator to the NRA of any voluntary separation plans and a subsequent market analysis by the NRA. The NRA may then impose obligations on the operator. These voluntary arrangements are not reliant on the European Union framework, but Member States may not act contrary to the framework.[13] In addition, the mandatory nature of the disclosure and analysis increases the NRA's involvement in the separation process.

The proposals (of which functional separation is only a part) are being debated throughout the European Union at the moment. Most commentators believe the proposals will be watered down before being put to the European Parliament and the Council of Ministers for endorsement, although any watering down might not be material in the case of the functional separation proposal. The changes are expected to become law before the end of 2009 and take effect in 2010.

6.2 United Kingdom

On 22 September 2005, Ofcom published a statement setting out its conclusions from its Strategic Review of Telecommunications and accepting more than 230 undertakings offered by British Telecommunications plc (**BT**) in lieu of a reference under Part 4 of the Enterprise Act 2002 (the **Undertakings**). The Undertakings given by BT have been subject to extensive interest around the world and formed the basis of the functional separation model adopted in New Zealand and the model discussed in this paper.

It is important to note that the Undertakings were a result of an agreement with Ofcom, following negotiations with BT being under pressure with the potential threat of a reference to the Competition Commission under the Enterprise Act. BT became an active supporter of the Undertakings in the negotiation process.

The key features of the Undertakings are:

- the establishment of a new and operationally separate business division, called Openreach. The division is staffed by BT employees who were previously responsible for the operation and development of BT's local access networks and with senior managers who are incentivized solely on the objectives of Openreach, rather than the objectives of BT Group plc;
- working to achieve equality of access, where Openreach is required to support all communication providers' activities (including BT Retail's) on an equivalent basis. Accordingly, it is intended that BT's competitors benefit from the same wholesale products, prices and processes as BT itself; and
- creating an Equality of Access Board that monitors BT's compliance with the Undertakings.

As part of the Undertakings, Ofcom has the power to issue directions to BT to remedy any breaches. Ofcom can bring an action in the High Court if BT breaches the Undertakings.

6.3 New Zealand

Functional separation is well underway in New Zealand. An Act was passed in 2006 requiring functional separation of Telecom New Zealand.[14] Following an investigation and determination by the Minister of Communications that it should be split into three divisions – retail, wholesale and access network – Telecom New Zealand submitted a plan for separation to the Minister. The separation process formally begins on 31 March 2008, and is expected to finish by 2012.

Through the separation, the Minister hopes to improve competition in the telecommunications market through a non-discriminatory retail market, with the end result being improved choice and lower prices for consumers. Each of Telecom's separated divisions must operate at arm's length from each other, and cannot give preference to a Telecom division over a competitor.

6.4 Italy

Italy was one of the first countries in the world to go down a separation path. In 2002, the Italian telecommunications regulator, Agcom, released a decision[15] introducing the concept of "administrative separation". The aim of this separation was to allow non-discriminatory access to the network services offered by the dominant operator, Telecom Italia.

Telecom Italia's response to this decision resulted in the establishment of several separate commercial units, TI Retail and TI Wholesale. TI Wholesale provides services to competitors. Both TI Retail and TI Wholesale are served by TI Field Services and TI Technology on a non-discriminatory basis. Telecom Italia introduced a number of safeguards to enforce the separation of these units. These include annual audits by an independent examiner, separate information systems with individual password levels, and a code of practice.

This regime has some differences, as compared to functional separation discussed in this paper. The key difference lies in the treatment of the access services division[16]. Under the Italian model, the core network and access services are both within the same division. In other words, this separated division includes both replicable and non-replicable assets.

More recently, there have been moves towards a more heavy-handed model. A public discussion document was published by Agcom and the Italian Ministry of Communications in May 2007[17] in relation to functional separation, along with a proposed supplement to the Italian Electronic Communications Code that would allow Agcom to impose functional separation on an operator with significant market power as a last resort in the event of all other forms of regulation being unsuitable.

In February 2008, and in an apparent attempt to appease Agcom, Telecom Italia announced that it would establish a new unit, to be called Open Access. The new unit would be completely autonomous and separate from Telecom Italia's other commercial operations. It will form part of a new division called Technology and Operations. Apart from Open Access, the new division will also have a network branch to design and build a modern network, an information technology branch and a technical infrastructures branch for real estate, plants and facilities management. Telecom Italia said it plans to spend the next year fully implementing the creation of the new unit. Agcom has been reported to have reacted positively to this development.

6.5 Sweden

The National Post and Telecom Agency in Sweden has recommended the creation of a new regulatory tool to allow regulators to impose both functional separation and structural separation[18]. At a minimum, the recommendation provides that the separated unit should comprise LLU and ancillary assets, and would include fibre access networks.

The agency advocates that the functionally separate unit should be its own legal entity, as a limited liability company. They go on to say that "the commitment to introduce functional separation should aim to expedite the introduction of the LLU market and its closely related markets".

This recommendation is in response to the perceived shortcomings of existing regulation to control a number of competition issues arising from TeliaSonera's actions. These problems were summarized in the recommendation report[19] as relating to information asymmetry and the protracted nature of legal proceedings as a remedy.

6.6 Ireland

Eircom is currently undertaking discussions with the Irish regulator, ComReg, on a voluntary separation[20]. Eircom's proposal, which is still in the formative stages, would lead to a full legal separation between the retail and network divisions, with Eircom's retail customer base and mobile phone unit being sold off.

If accepted by ComReg, this will be one of the first full structural separations undertaken anywhere in the world (at least since the separation of AT&T in the United States). It is noteworthy that the split is being driven by Eircom, rather than the regulator. While Eircom does not need Comreg's permission to go ahead with the proposed separation, it does rely on ComReg for pricing certainty and stability. Eircom believes that this voluntary sale is the best way to retain shareholder value.[21] It has also been argued that this is an example of the "strategic hypothesis", which says that the increased competition from separation leads to an expansion of the wholesale division. The profits from this expansion may then be greater than if the wholesale division had remained integrated.[22]

6.7 Australia

Telstra, the incumbent telecommunications provider in Australia, has recently undergone a functional separation[23]. This separation led to autonomous retail, wholesale and network units. This autonomy includes a separation of personnel and premises.

The purpose of this separation was stated in the Explanatory Memorandum to the separating Act:[24]

The aim of operational separation is to promote the principles of transparency and equivalence in relation to the supply by Telstra of wholesale and retail services.

The Australian version is separation "lite".

Telstra's separation plan, which was accepted by the Minister in June 2006, involves the separated wholesale division providing products to competitors exclusively, while the equivalent products are provided to the retail divisions within the fully integrated framework.

This variation of functional separation contrasts with the other models discussed in this paper, where equivalence goes further and requires the retail divisions of the incumbent to access services from the access services division and the wholesale division on an equivalent basis to competitors.

In contrast to some other countries, the Government's role in the separation process focused on the Minister, rather than the regulator. The regulator's role is limited to monitoring and reporting on Telstra's compliance with the functional separation plan once in place.

6.8 France

ARCEP imposed accounting separation on France Télécom in 1996, when the telecommunications sector was opened up to competition, and renewed this form of separation in 2006[25]. This accounting separation requires France Télécom to treat its separate divisions individually in its accounts, and to create equivalence between its retail arm and alternative operators in relation to wholesale services.

The regulator has been unwilling to expand this accounting separation to functional separation. This reluctance is based on concerns over the difficulties involved in imposing functional separation. The consequences of these difficulties include increased network costs imposed on all operators by the newly separated access services division, the loss of incentives to invest, the long-term nature of functional separation in a fast-moving market and difficulties in setting the boundaries of the separated divisions[26].

ARCEP did acknowledge the potential benefits of functional separation, such as reducing incentives for one division to assist another division, increasing transparency and resolving information asymmetry concerns. However, ARCEP held that, in comparing the costs and benefits as opposed to other regulatory tools, functional separation was unlikely to be an "effective and proportionate measure"[27].

6.9 Poland

The Polish regulator (**UKE**) is proposing to commence functional separation of the incumbent operator (**TP SA**) into two companies, one managing the infrastructure and one providing the telecommunications services. However, there appear to be mixed views on when this is expected to take place. Some observers expect a decision from UKE by June 2008, with the entire process completed by the end of 2010[28]. Others expect UKE to wait until the outcome of the European Commission's proposals regarding functional separation is known. TP SA does not currently accept the legality of functional separation, and has indicated that it is likely to challenge UKE in the courts if there is any attempt to enforce functional separation.

6.10 Mongolia

In 2007, the Mongolian regulator went beyond functional separation and imposed compulsory legal and ownership separation on the incumbent. Under the terms of the separation, the incumbent's local loop, as well as microwave and fibre transmissions, has been legally vested in public ownership. The partially privatized incumbent, Mongolia Telecom, now owns and operates the retail and wholesale division.

7 COMMON GROUND ON FUNCTIONAL SEPARATION

There is considerable debate internationally over the use of functional separation as a regulatory remedy.

It is useful to try and identify the areas where there is some general agreement, or common ground, among the participants in the debate:

- functional separation is expensive and time-consuming for the incumbent to put in place;
- once implemented, functional separation is probably not capable of reversal;
- functional separation is a drastic remedy, which many believe is appropriate only where other regulatory remedies have proven to be insufficient to deal effectively with the discriminatory behavior; and
- functional separation will not remove the need for continuing regulatory control over the access services division.

Surprisingly, there also seems to be little debate over the critical fact that, once properly implemented with suitable monitoring and enforcement, functional separation will be largely effective at controlling discriminatory behavior by the incumbent. This will lead to more vigorous downstream competition, with consequent welfare gains.

7.1 Costs of implementing functional separation

The costs to the incumbent of implementing functional separation can be significant[29].

There are the direct costs, which include:

- the additional staff and advisor costs involved in reorganizing the incumbent into separate divisions; and
- the additional computer systems that may be required to ensure equivalence.

The ongoing costs can also be significant, as a certain duplication of employees will be required to ensure independent and stand-alone divisions.

There are also the indirect costs that arise as a result of diversion of management resources to achieve separation and the loss of some of the previous synergies that the incumbent enjoyed as a result of full vertical integration (see the discussion on investment incentives below).

Given these direct and indirect costs, it may be the case that regulators will need to consider an increase in the incumbent's charges for access to the bottleneck assets, as compared to the levels of those charges prior to the separation.

The timescale for implementation of functional separation can be measured in years. In New Zealand, Telecom considers it will take the best part of four years to fully roll-out functional separation.

7.2 Functional separation not likely to be reversible

Once a company has gone through functional separation, it is unlikely that it will ever be able to return to its previous, fully vertically-integrated state. However, if the appropriate powers are granted, it will be possible to reset the boundaries for the assets controlled by the access services division (see the discussion on stability of the asset base below).

7.3 A drastic remedy

In the scale of regulatory remedies, functional separation is right up towards the top end.

Only structural or ownership separation, or licence revocation, would be more heavy-handed regulatory remedies.

7.4 Continuing regulatory control

Although functional separation should lead to some deregulation of the incumbent, the new division that holds the bottleneck assets will still require regulatory control. Its prices for access products and services will need to be controlled, as well as quality and availability of services.

As an alternative to cost-based price regulation, it may be possible to consider the introduction of utilities-style regulation, such as a regulated rate of return on the asset base of the access services division (the rate of return, and value of the asset base, being determined by the regulator). The rate of return, and value of the asset base, could be reset periodically (say, every 3 to 5 years), with agreed efficiency and capital expenditure targets. This style of regulation is employed in many countries for controlling the prices and revenues of electricity and gas distribution networks.

8 AREAS OF DEBATE ON FUNCTIONAL SEPARATION

The debate on functional separation has tended to focus on two issues:

- whether the benefits of functional separation outweigh the costs (not only in terms of directly attributable costs, but also any adverse effect on incumbent and competitor investment); and
- whether the existing remedies, or potential enhancements to the existing remedies, are sufficient to control discriminatory behavior.

8.1 Impact on investment incentives

In the United Kingdom, BT's undertakings provide that "any investment decisions shall be considered solely on their own merits and should not take into consideration the potential impact on other products"[30].

A vertically-integrated company without functional separation is more conducive to investment than a vertically-integrated company with functional separation. This is because coordination is optimally required among different vertical segments of the company in order to make an investment.

An example is where access investment (bottleneck) needs to complement backhaul investment (competitive). This is more difficult to achieve when the company is functionally separated, than when it is fully vertically-integrated.

It will also be more difficult for the retail division to communicate demand signals to the access services division or the wholesale division, or for the wholesale division to communicate demand signals to the access services division. This communication will be particularly important with significant new investments such as next-generation access networks, where much of the risk comes from the considerable demand uncertainties, which the customer-facing divisions will be most knowledgeable about.

Although difficult to quantify, this increased difficulty in coordination can lead to a reduction in investment incentives for a functionally separated company to invest in new infrastructure. In the case of new wholesale products, the incumbent may be reluctant to invest in product development if it had to share the benefits of any innovation with its downstream competitors.

Another dimension of the investment incentives concern is that the access services division would behave as a virtual monopoly removed from competitive pressure. The concern is that this division will not have strong incentives to make the investments required by the retail market.

This coordination concern may be overstated. After all, the incumbent remains vertically-integrated after functional separation. The main board of directors of the incumbent will be charged with investment decisions, and they oversee the entire functionally separated organization.

Indeed, some argue that the incumbent's incentives are enhanced as it reduces the incumbent's risk of future harsh remedial actions by the regulator, which allows the incumbent to invest and innovate with greater freedom. It can allow the incumbent to effectively "ring fence" the regulated part of its business, and enable the other parts of the business to be operated like an entrepreneurial competitive telco.

Another view on investment incentives is that competitors must also be considered, and functional separation will give them greater confidence (because of the reduced risk of discriminatory behavior) to invest and innovate. The counter-argument to that is that the incentives of competitors to invest and innovate are in fact dampened, as competitors will be content to rely on the incumbent for inputs based on the stronger equivalence obligations, rather than to invest in their own infrastructure.

8.2 Transition to fibre-based next-generation access networks

In developed countries, copper local loop access networks are increasingly being replaced by next-generation access networks (fibre-based or wireless), particularly in urban areas.

There is a concern that, just as the copper local loop access network was an enduring bottleneck, fibre-based next-generation access networks may also become enduring bottlenecks, at least in some parts of the country. The European Regulators Group, in its opinion on functional separation in October 2007[31], identified that "next-generation access investments are likely to reinforce the importance of scale and scope economies…potentially leading to an enduring economic bottleneck".

In fact, there is a view that, if a functionally separate access services division does invest in a widespread new fibre-based next-generation access network, it will pre-empt any potential new investment in this sort of network by other investors (be they competitors, financial investors or potentially governments). This would mean the creation of a new next-generation access network monopoly, using the functional separation model.

The approach taken in the United Kingdom and New Zealand is for the access services division to be responsible for new investment by the incumbent in fibre-based next-generation access networks. This is an attempt to "future proof" the access services division, in case the regulator determines that fibre-based next-generation access networks are non-replicable and that access is required to compete. In that event, competitors will be able to access those networks on an equivalence basis.

The debate over the whole issue of whether, and if so how, to regulate this new infrastructure is at an early stage in most developed countries.

8.3 Difficulty in achieving stability in the asset base

The intention is that the access services division contains the bottleneck network assets. Today, this list comprises the copper local loop access network, but also sometimes some backhaul assets (where those assets are considered non-replicable). As discussed above, it may be advisable to ensure that investment by the incumbent in fibre-based next-generation access networks is included in the asset base to allow a competing fibre-based network to be established.

However, it is true to say that, given the pace of technological change within the telecommunications industry, particularly in wireless, today's bottleneck assets may well not be the bottleneck assets of tomorrow. Or alternatively, technological change may mean that assets cease to be bottleneck assets in some parts of the country, but remain bottleneck assets in other parts of the country. This can make it difficult to set the boundaries of the assets to be controlled by the access services division.

Flexibility will be required to remove, and add, assets from the access services division as markets develop over time, potentially on a geographic basis. This means that the demarcation point of which assets should be a part of the access services division is likely to be subject to fairly regular review.

Some view this ability to change the asset base as being inconsistent with a long-term and irreversible remedy such as functional separation[32].

8.4 Service quality

There were concerns following the establishment of Openreach in the United Kingdom that the quality of certain access services was diminishing, with the fear that the equivalence requirement may in fact cause a general "leveling down" of quality, rather than a "leveling up".

The theory goes that access services division will remain, and will be perhaps entrenched as, a monopoly provider of access and monopoly providers may not have strong incentives to maintain and improve service quality to their customers. The early evidence coming out of the United Kingdom may confirm this.

Although evidence collected by Ofcom appears to suggest that these concerns have abated in the United Kingdom, it may still become an issue in other jurisdictions implementing functional separation and may mean that quality of service issues will need to be carefully dealt with through the separation process.

9 APPLICATION OF FUNCTIONAL SEPARATION IN DEVELOPING COUNTRIES

A cautious approach is advocated in this paper for any developing country considering functional separation.

When considering the applicability of functional separation as a remedy in a developing country, several factors should be taken into account by policy makers and regulators:

➢ Whether the discrimination problem that functional separation is designed to address is present to the same extent as in developed countries.
➢ Whether the regulatory infrastructure necessary to create and maintain functional separation is present.
➢ Whether existing remedies may be adequate, in the circumstances.

Before examining those issues, we look more closely at the context in which functional separation has arisen in developed countries[33].

9.1 Promotion of broadband

In the developed countries referred to above that have implemented, or are actively considering, functional separation to date, it is apparent that functional separation is regarded as an important tool to promote the rapid development of broadband services. In particular, broadband services over fixed access network infrastructure.

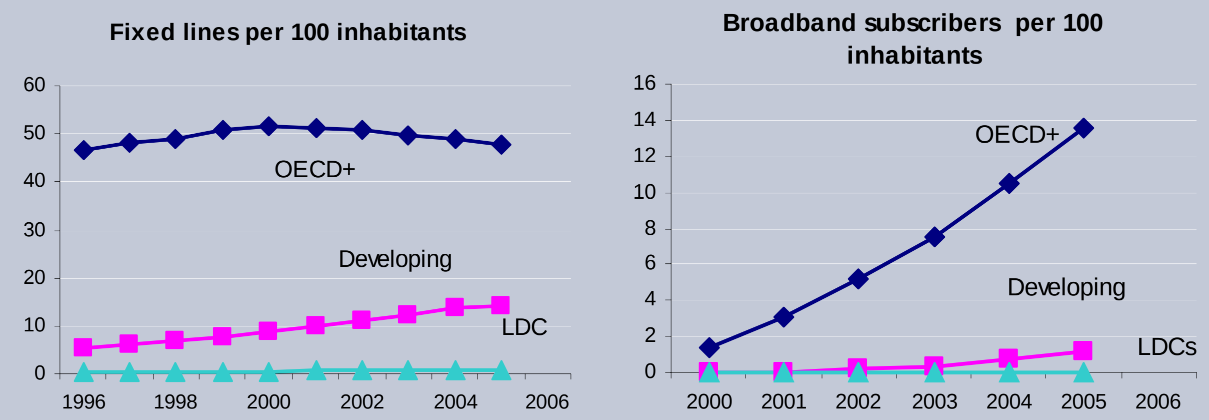
Increasing broadband network deployment is important to all countries. Broadband is seen as a critical enabler of economic and social development throughout the world.

However, when comparing developed and developing countries, and the likely development of broadband networks over the short to medium term, the developed countries are primarily relying on fixed access network infrastructure as the basis of their broadband networks, and developing countries may be more likely to primarily rely on wireless access network infrastructure.

Perhaps the main reason for this difference is the high levels of fixed access network infrastructure penetration in developed countries (on which broadband networks are normally based), but relatively low levels of fixed access network infrastructure penetration in developing countries.

The following graph shows the number of fixed lines per 100 inhabitants in OECD countries, as compared to developing and lesser developing countries[34]:

Figure 2: Fixed-line and fixed-line broadband penetration worldwide, 1996-2006



Source: ITU World Telecommunication/ICT Indicators Database

An additional factor that may explain the difference between developed and developing countries is that, where there is fixed access network infrastructure in developing countries, it may not be of sufficient quality to support reliable broadband services.

In fact, this presents an excellent opportunity for broadband competition in developing countries. There is the potential for a number of competitors to provide widespread and affordable wireless broadband access in developing countries, without the need for access to fixed line bottleneck infrastructure from the incumbent.

In some parts of developing countries, it may even be economic to deploy new fibre networks and simply leap-frog the stage of copper local loop-based broadband. In some cases, such a fibre network may be deployed with minimal requirement for access to any incumbent local loop infrastructure, although access to ducts and rights of way could facilitate such fibre rollout, as addressed in the GSR Discussion Paper on Extending Open Access to National Fibre Backbones in Developing Countries.

9.2 The discrimination problem

This then gives rise to the question of whether the discrimination problem, identified as the primary reason for implementing functional separation in the countries referred to above, is such a problem in most developing countries.

At least with the first generation of regulated services (e.g., interconnection), discrimination may not be such a major problem. Interconnection has its own set of issues, particularly around connection in the first place and interconnection pricing. However, once the parties have connected up their networks, by and large it is not the type of service that creates strong incentives for discriminatory behavior.

Nor is interconnection a service that fits all that well with the concept of equivalence, as the incumbent does not provide interconnection to itself. In the New Zealand model, interconnection services are not required to be provisioned by either the access services division or the wholesale division.

It is primarily where there is a requirement for deeper forms of access that the opportunities for discriminatory behavior present themselves. Local loop unbundling is a classic case, where it is necessary for the incumbent to switch its customer's local loops to the access seeker, at the same time as the incumbent is competing fiercely to provide new broadband services to that customer over that loop. In these circumstances, the incentives for discriminatory behavior on the part of the incumbent are very strong.

9.3 Investment incentives

In developed countries where functional separation is being considered, or is being implemented, there is a concern that the existing environment was not conducive to infrastructure investment by competitors, because of the damaging effect of the incumbent's discriminatory behavior in providing access to bottleneck assets.

However, this may not be such a strong factor in developing countries. It is likely that the driving factor that will incentivize greater investment by competitors and incumbents in broadband infrastructure in developing countries will be competition from other infrastructure investors.

9.4 Institutional capabilities

Any regulation that is designed to address discriminatory behavior can be complex and institutionally demanding for the government or regulator to develop and implement.

However, this is particularly the case with functional separation. Functional separation appears on its face to be a relatively straightforward thing to achieve. In practice, it is anything but straightforward.

In New Zealand, Telecom's current draft separation plan[35] is over 130 pages long, dense with arcane legal language, with subtle nuance upon subtle nuance. The devil is most certainly in the detail when it comes to the development and implementation of the functional separation requirements.

It will be very difficult to develop functional separation requirements without extensive input from the incumbent. This is because these requirements cannot be developed without a high degree of knowledge about the incumbent's business and its products, which only the incumbent will possess. When you get extensive input from the incumbent, this will also mean extensive negotiation. Normally, incumbents will be much better equipped to deal with this sort of situation than regulators and governments. If the regulator or the government is out-gunned in this encounter, the result will be a sub-standard and ineffective separation.

Strong institutional capabilities are also required by the regulator or the government to monitor and enforce the obligations. Skilled and expert regulatory staff are required that can identify and require compliance with complex obligations, particularly involving compliance with behavioral obligations which are an inherent part of functional separation. Big calls may need to be made against the incumbent to enforce compliance, which requires staff with considerable experience and expertise. Constant vigilance is required.

If these institutional capabilities are not present, or cannot be brought in or developed in the time period for implementation of functional separation, this alone may be a reason to avoid functional separation as a remedy and consider the other options discussed in this paper.

9.5 Impact if subsequent privatization

In developing countries where the incumbent has not gone through a privatization process, it should be noted that functional separation is likely to negatively impact on the value of the incumbent in the eyes of the investment community, potentially materially. On the other hand, a government may consider that it will be easier to develop and implement a functional separation while the incumbent is still in public ownership.

9.6 Conclusion on applicability of functional separation to developing countries

It is uncertain whether the remedy of functional separation is advisable in many developing countries. A cautious approach is recommended.

The main reason for requiring functional separation in developed countries may not arise in the case of most developing countries. The access network bottleneck that is the root of most of the regulatory problems in developed countries may not be a big problem and discriminatory behavior that is so pernicious with local loop unbundling may not be such an issue either.

Also, not every developing country will have the institutional capabilities to efficiently design, implement, monitor and enforce functional separation obligations.

10 ALTERNATIVES TO FUNCTIONAL SEPARATION

There may be alternatives to functional separation that help to address the problem of discriminatory behavior in developing countries. This section of the paper considers ways in which existing regulatory instruments may be improved or enhanced, to reduce some of the weaknesses discussed earlier in this paper. It also looks at whether some of the aspects of functional separation may be selectively adopted, and whether "whole network" separation could be considered.

10.1 Enhanced non-discrimination rules

A stronger focus on creating clear rules to ensure an equivalent treatment between an incumbent and its competitors when dealing with access to bottleneck facilities, and more intensive monitoring and enforcement of these rules, can be considered.

The rules could include examples of behavior that is prima facie regarded as discriminatory, which must be ceased immediately. Or, the regulator could issue "cease and desist" orders where the regulator is satisfied that there is sufficient evidence of a prima facie breach of the rules.

This would stop the behavior and place the burden of proving that the behavior is not discriminatory on the incumbent.

It would be less demanding on the regulator to implement, but may have the effect of preventing behavior that, upon further analysis, is not discriminatory.

However, the process could be supplemented by the ability to seek an authorization, where the incumbent may obtain the regulator's approval in advance for a particular behavior if it can demonstrate that the behavior is not discriminatory.

Breach of the enhanced rules may result in significant penalties as deterrence.

- There could be higher penalties again in the case of repeated breach.
- Firm managers could be subject to penalties (with no ability for the incumbent to compensate the managers for their behavior).
- Incumbents that are found to be in breach of the rules could be required to pay compensation to harmed competitors.

Non-discrimination rules may be supplemented by appropriate service level agreements and service level guarantees in areas where there is a risk of discrimination. Service levels would need to be measurable and subject to meaningful penalties to be fully effective.

10.2 Accounting separation

To the extent that it has not been implemented already, accounting separation will likely deal with many of the problems of price discrimination. Accounting separation is nowhere near as complex and burdensome to implement and maintain as functional separation.

10.3 Competition law capabilities

Although it would not entirely deal with the shortcomings identified above in relation to competition law remedies, the beefing up of resources involved in ex-post competition law monitoring and enforcement, and potentially an increase in penalties, is likely to be at least partially effective in deterring anti-competitive discriminatory behavior. "Cease and desist" orders could also be used in the case of prima facie breach, as discussed above in relation to enhanced non-discrimination rules.

Competition law offers a range of alternatives for dealing with anti-competitive behavior, of the type that arises with discrimination. In some countries, these remedies can go as far as requiring separation. A credible threat of competition law remedies will have a deterrent effect on incentives on incumbents to behave badly.

A strengthening of the competition law capabilities in government is also likely to be of benefit to other parts of the economy where anti-competitive behavior arises.

10.4 Using elements of functional separation

It may be possible to design a regime where elements of functional separation can be used to provide some of the benefits of a full functional separation, in conjunction with enhanced non-discrimination rules and accounting separation.

For example:

- requiring the establishment of a code of conduct for incumbent employees, including:
- statements of duties and roles of management;
- commitments to serve wholesale customers equitably; and

- clear rules on information sharing and use of Chinese Walls;
- creating a program of incentives for management involved with bottleneck assets that reward certain types of non-discriminatory behavior;
- where the incumbent wishes to introduce a new retail product or service in areas where it has dominance, then the incumbent must satisfy the regulator that it has provided an equivalent wholesale service before the new retail service can be provided; and
- the use of an independent oversight group to investigate and report on allegations of breach of non-discrimination rules and code of conduct.

10.5 Separation of the entire network

In some countries, such as the earlier iterations of separation in Italy, the model involves a separation of the entire network assets (not just the bottleneck assets) from the retail units of the incumbent. An advantage of this is that it will probably be simpler to implement than the other forms of functional separation referred to above.

However, the equivalence rules that would apply to such a "netco" would be potentially more difficult to define, as equivalence would not normally be required for those non-bottleneck assets which can be replicated by competitors.

11 CONCLUSION

Functional separation is a recent response by regulators and governments to the serious problem of anti-competitive discriminatory behavior by incumbents, and the concern that existing rules and remedies are inadequate to deal with the problem. It has so far been limited mainly to a small community of developed countries, although it appears to be gaining traction in a number of other countries around the world.

It represents a leap in potency from today's rules and remedies to deal with discriminatory behavior and can rightly be described as a drastic response. It is also relatively untested.

Even the European Commission, which has supported the move to functional separation, has taken a cautious approach, recognizing that it should not be considered unless:

- it can be demonstrated that the competitive problem has not been, and cannot be, resolved through other means; and
- a detailed cost-benefit analysis has been conducted.
- Likewise, developing countries may wish to take a cautious approach if considering functional separation.
- At this stage, it has not appear that the discrimination problem, identified as the main reason for introducing functional separation in developed countries, is a critical issue facing most developing countries.
- The issues and challenges that developing countries face with telecommunications regulatory policy are perhaps different in nature and extent as compared to developed countries. For example, the access bottleneck that bedevils regulatory policy in developed countries may not be so important in developing countries. In developing countries, the mobile and wireless sectors have, to date, been the primary arenas for competition, and bottlenecks are not a major feature of those sectors.

Other alternatives identified in this paper can be considered before going down a functional separation path. Well designed rules and remedies, tailored to the needs of the particular developing country, may well resolve most discrimination problems.

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1 The expression “incumbent operators’ is used throughout the paper. However, non-incumbent operators with significant market power may also be considered candidates for functional separation.

2 The image is adapted from a presentation by Andrea Gavosto: Functional Separation: the Italian debate (Le Chatelain All Suite Hotel, Bruxelles, October 17 2007).

3 This is the case even where a separate wholesale division is established by the incumbent, with a dedicated management team (the most basic form of separation after accounting separation)

4 Ofcom Notice under Section 155(1) of the Enterprise Act 2002 (30 June 2005) <www.ofcom.org.uk/consult/condocs/sec155/sec155.pdf>.

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6 David Currie LBS Global Communications Consortium Conference – Regulation, investment and the consumer interest, 12 November 2007

7 European Regulators Group ERG Opinion on Proposed Changes to Commission Regulation of 1998 on Accounting separation and cost accounting ERG (04) 15rev1 <www.erg.eu.int/doc/publications/erg_0415rev1_caas_opinion.pdf>.

8 Hogan & Hartson and Analysys Preparing the Next Steps in Regulation of Electronic Communications – a contribution to the review of the electronic communications regulatory framework (July 2006).

9 Directive 2002/19/EC, Article 10, Paragraph 2

10 A logical separation of ordering and provisioning systems may be capable of being achieved prior to a physical separation, and EoI may require the logical separation to take place before moving to physical separation over time.

11 This task could be fulfilled by the regulator, but it is clear that some form of effective oversight and monitoring is required in order for functional separation to be effective.

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MOBILE SHARING

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February 2008

COMMENTS ARE WELCOME AND SHOULD BE SENT BY 13 APRIL 2008 TO

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TABLE OF CONTENTS

page

1 ...... Introduction 3
2 ...... Passive Mobile Sharing 4
- 2.1 Site sharing 4
- 2.2 Policy reasons for encouraging passive mobile sharing 5
  - 2.2.1 Environmental and public health considerations 5
  - 2.2.2 Facilitate rollout 6
  - 2.2.3 Technology upgrade: from 2G to 3G 6
- 2.3 Competitive aspects of site sharing arrangements 7
- 2.4 Regulatory measures to promote passive mobile sharing 7
  - 2.4.1 Mandatory vs. optional sharing 7
  - 2.4.2 Dispute settlement mechanisms 10
  - 2.4.3 Authorization and licensing conditions: the role of local authorities 10
- 2.5 Ownership and other structural aspects 11
- 2.6 Financial incentives for passive sharing 12

3 ...... Active Mobile Sharing 13
- 3.1 Options for active mobile sharing 13
  - 3.1.1 Extended site-sharing (including antenna sharing) 15
  - 3.1.2 Sharing of radio access network 15
  - 3.1.3 Core network sharing 17
  - 3.1.4 Backhaul sharing 19
- 3.2 Competitive impact of active mobile sharing 19
- 3.3 Functional separation of mobile networks 22

4 ...... Concrete examples and policies adopted 23
- 4.1 European Union 23
- 4.2 United States 24
- 4.3 Canada 24
- 4.4 Brazil 24
- 4.5 India 25
- 4.6 Malaysia 25
- 4.7 Jordan 25

5 ...... Conclusions and best practices 26
- 5.1 Conclusions 26
- 5.2 Best practices 26

TABLES

Table 1: Standard terms and conditions in site sharing agreements 9

FIGURES

Figure 1: Passive mobile sharing: options available in site sharing 4
Figure 2: Lamppost style mast 5
Figure 3: 3G mobile network e 14
Figure 4: Sharing elements of the radio access network: rack sharing 15
Figure 5: Sharing elements of the radio access network: full ran sharing 16
Figure 6: Functionally separated RNC 17

1 INTRODUCTION

The present paper aims to describe the various options available for governments and regulators in connection with the sharing of mobile telecommunication networks in developing countries.

Mobile telecommunication services have shown an impressive take up in the last decade. In particular in developing countries, mobile telephony has played a vital role in making telephony services available to a part of the population that did not have access to such services previously. However, there is still a lot to be done to enhance competition in the mobile sector and for increasing the penetration of mobile services, in particular in rural areas in developing countries. The roll-out of mobile networks requires high sunk investments and the need to recover those by charging high fees for mobile services. This often makes mobile services less affordable and may discourage operators to innovate and migrate to new technologies. It may also cause licensed mobile operators to try to block the entry of new operators in the market. In addition, it may be too costly for single operators to roll out mobile networks in rural and less populated areas, resulting in the exclusion of a part of the population or a certain region from access to mobile telecommunication services.

Mobile infrastructure sharing is an alternative for lowering the cost of network deployment, especially in rural and less populated or marginalized areas. Mobile infrastructure sharing may also stimulate the migration to new technologies and the deployment of mobile broadband, which is increasingly seen as a viable means of making broadband services accessible for a larger part of the world population. Mobile sharing may also enhance competition between mobile operators and service providers, at least where certain safeguards are used, without which concerns of anti-competitive behavior could arise. Accordingly, policy makers and regulators are examining the role that mobile network sharing can play in increasing access to information and communication technologies (ICTs), generating economic growth, improving quality of life and helping developing and developed countries to meet the objectives established by the World Summit on the Information Society (WSIS) and the Millennium Development Goals established by the United Nations.

There are a variety of options that may be considered by regulators when assessing the viability of mobile sharing. Those options range from the sharing of towers and other building facilities to sharing an entire mobile network. This paper identifies a number of options, dividing them into two basic categories: (i) passive sharing and (ii) active sharing. Passive sharing refers to the sharing of space in passive infrastructure, such as building premises, sites and masts. Passive sharing is typically a moderate form of network sharing, where there are still separate networks that simply share physical space. Active sharing is a more intensive type of sharing, where operators share elements of the active layer of a mobile network, such as antennas, radio nodes, node controllers, backhaul and backbone transmission, as well as elements of the core network (such as switches). Active sharing includes mobile roaming, which may probably be considered as the most far reaching option for sharing infrastructure, since one operator would make use of another operator’s network in a certain geographical area where it has no coverage or no infrastructure. Active mobile sharing also has a number of risks, the biggest one being the limitation of the ability of operators to distinguish their service offerings from one another where the elements which determine network quality and transmission rates are identical.

Governments and regulators are faced with a number of dilemmas when dealing with mobile sharing. Network sharing arrangements may have an impact on the ability of operators to compete and differentiate themselves based on network quality. In addition, obligations relating to network sharing may influence the willingness of operators to make efficient investments in infrastructure and innovative services. This paper identifies the different forms of mobile sharing and discusses various regulatory issues involved in each of the options. The paper also deals with backhaul sharing, which is the sharing of transmission from the radio node to the node controller prior to entering into the core network. Backhaul sharing may be necessary in certain cases, in particular when operators have difficulties in rolling out transmission links to their radio nodes. Finally, this paper identifies a number of best practices for governments and regulators.

2 PASSIVE MOBILE SHARING

2.1 Site sharing

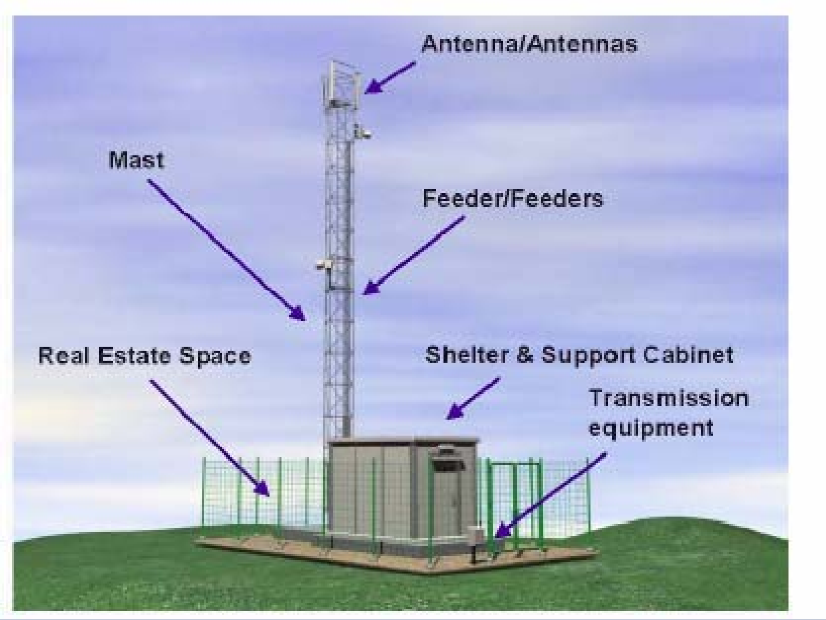
This section identifies the options available for mobile operators that wish to share passive elements in their radio access network.[1]

For the purpose of this chapter, the passive elements of a mobile telecommunications network are considered to be the physical components of the radio access network that may not necessarily have to be managed or controlled by the operator after their installation. Instead, these components could be shared among operators and provided either by one operator or a business entity designed to provide such components, such as a tower company. The passive infrastructure in a mobile network is composed mainly of:

- Electrical or fiber optic cables;
- Masts and pylons;
- Physical space on the ground, towers, roof tops and other premises;
- Shelter and support cabinets, containing power supply, air conditioning, alarm installation and other passive equipment.

The assembly of passive equipment in one structure for mobile telecommunications is generally referred to as a "site". Therefore, the form of cooperation where one or more operators agree to put their equipment on the same structure such as a tower, a roof-top or a mast fixed on the ground, will be referred to as "site sharing" or "collocation".

Figure 1: Passive mobile sharing: options available in site sharing



Source: Telecom Regulatory Authority of India (TRAI), Recommendations on Infrastructure Sharing

In site sharing arrangements, operators may share several elements of the passive infrastructure needed to provide mobile services. Operators may share space on the ground or on a tower or roof top. Depending on the location, operators may place their antennas directly on the structure (water tower or roof-top) or share a mast. Secondly, operators may share technical facilities available on the site such as power supply and air conditioning (generally integrated in a site support cabinet, or SSC) and feeders. Antennas and transmission equipment may also be shared, but are considered to be part of the active (or transmission) infrastructure and will be dealt with in the next section.

Site sharing is often welcomed by operators because of its cost effective aspects. Putting up new sites may be a very costly (i.e., capital intensive as well as operationally expensive) and cumbersome operation for operators, not in the least because of the environmental aspects involved (see below).

2.2 Policy reasons for encouraging passive mobile sharing

2.2.1 Environmental and public health considerations

Mast and antennas for wireless communication are generally considered to have a negative impact on the landscape. Local communities may object to the construction of new sites in their vicinities, because of the visual impact or because of other inconvenience caused, such as interference with electronic equipment (such as television and radio).

Public exposure to electromagnetic fields around masts and antennas may also raise public health concerns, when communities worry about the health effects of exposure to such radiofrequency fields.[2] Site sharing may be beneficial to limit such concerns and negative effects since it limits the number of necessary sites in order to achieve the required coverage.[3]

Another beneficial aspect of site sharing is the level of energy that can be saved if operators share electricity resources such as feeders and power supply, the latter of which is often a major concern in developing countries.[4]

While site sharing reduces the number of sites marking the landscape, it can also have adverse impacts. Mast sharing means that there will be more than one set of antennas and other telecommunication equipment on a mast. Antennas generally have to be separated from each other by a minimum distance in order to avoid interference. For this reason, mast sharing usually requires taller masts, more robust and visually intrusive. Local planning authorities and communities may prefer several smaller masts rather than a larger one. More discrete structures (such as a lamppost style mast, see Figure 2) reduce visual intrusion, but cannot support antennas of more than one operator.

Figure 2: Lamppost style mast

Source : http://dras-photos.fotopic.net/c976876.html

2.2.2 Facilitate rollout

There are significant costs involved with civil engineering activities when the number of building sites is relatively high as compared to other individual elements of a mobile network. Operators also encounter practical difficulties in acquiring and commissioning adequate sites, obtaining the appropriate regulatory licenses and overcoming other obstacles, such as public concerns about the presence of mobile masts.

Site sharing allows operators to reduce capital and operating expenditure by reducing their investments in passive network infrastructure and in network operating costs. It may also be a way of overcoming planning and other regulatory restrictions and to meet environmental concerns. Accordingly, site sharing may serve as an encouragement for rolling out networks in a faster and more affordable way. Site sharing may facilitate rollout, bringing more wireless services to low populated and rural areas. Because of the cost saving aspects, site sharing may also contribute to making wireless services more affordable.

2.2.3 Technology upgrade: from 2G to 3G

Infrastructure sharing may be an effective option for upgrading second generation (2G) mobile services to third generation (3G) mobile communications and broadband wireless access technologies.

Operators that provide 2G mobile services may upgrade to 3G by collocating the required 3G equipment on their existing towers and masts. This may be a very cost effective option for operators, even if building a 3G mobile network would require a significantly larger number of sites. In the European Union, many 2G networks were deployed providing services in the 900 MHz spectrum band while 3G licenses were assigned in the 1900-2000 MHz band. Rolling out mobile networks in the 1900-2100 MHz-band requires a significantly higher number of sites than rolling out a mobile network in the 900 MHz band. The 900 MHz operators must erect a large number of towers in migrating to 3G, reducing their ability to realize savings by co-locating 3G equipment on 2G sites. However, those 2G operators running their network in the 1800 MHz-band are well positioned to co-locate 3G equipment on their existing 2G infrastructure and to enjoy significant savings as a result.

In countries with largely developed 2G networks, the collocation of 3G equipment on 2G infrastructure may provide a substantial advantage to incumbent 2G operators compared to new entrant 3G operators.[5] Therefore, regulators may consider imposing non-discriminatory infrastructure sharing on existing 2G operators, requiring those to provide access to their facilities to new 3G operators under the same conditions as they provide to their own business. If new entrant 3G operators are not provided access under these conditions, they may not have a fair chance of competing on the 3G market with incumbent 2G operators. Other countries may be faced with this issue when 3G services are upgraded to 3.5 or 4G mobile services -- especially where 2G infrastructure has been deployed later and 3G infrastructure is intended to be used as a predominant type of technology for mobile services[6]. When dealing with this situation, regulators will wish to consider whether the existing infrastructure of incumbent operators would actually support more infrastructure than its own 2G and 3G equipment. There may be situations where the space available in the existing infrastructure may be exhausted.[7]

Infrastructure sharing may also be an alternative for other wireless broadband technologies, such as WiMax. WiMax was created as a broadband technology for metropolitan areas, to be a substitute for fixed broadband technologies such as cable, DSL and fiber. WiMax is also suitable as a technology for mobile telephony, although handsets suitable for WiMax are not yet widely available. There is currently a lot of uncertainty about the development of WiMax technology and the availability of equipment suitable for WiMax. However, once the technology is more developed and widespread, collocation of WiMax equipment in towers or masts used for other wireless services, such as 2G or 3G mobile, radio and television transmission, may be a serious alternative for increasing the availability and affordability of wireless broadband services. The economical benefits of collocating WiMax equipment in sites used for 2G (GSM) and 3G (UMTS) mobile services will depend generally on the operating frequencies used for Wimax, GSM and UMTS.

Wimax is primarily used in frequencies in the 2.6 GHz and the 3.4 GHz range, operating at a significantly higher frequency than 2G GSM (900 MHz and 1800/1900 MHz) and 3G UMTS (2100 MHz). In general, a WiMax cell would have significantly larger range (1.5 to 2 km) than a GSM or UMTS (0.4 to 0.7 km) range in a comparable urban environment. Accordingly, WiMax operators may achieve rather high savings by sharing infrastructure with GSM and UMTS operators. The shared infrastructure may include cables, cabinets, steel construction, antenna pole and battery back-up units.

2.3 Competitive aspects of site sharing arrangements

There are several types of site sharing agreements that may be contemplated by operators. Such agreements may be unilateral (one operator agrees to provide access to its facilities to another operator), bilateral (two operators agree to provide mutual access to facilities) or multilateral (several operators agree on the terms on which they will provide access to facilities to each other). In addition, such agreements may concern one individual site or be a framework agreement for several sites or for all of the sites in a certain geographical region.

Bilateral agreements for regional site sharing may be particularly interesting for operators from an economical point of view. Operators agree to use each other's passive infrastructure in certain regions, to avoid having to build new masts or sites where they agree to site share. This enables operators to offer service coverage in a larger geographical area, which is particularly attractive for operators subject to geographical coverage obligations. Regional site sharing allows operators to save a considerable amount of capital and operating expenditures and is an alternative for national roaming arrangements.[8] Regulators should also be careful in order to avoid collusion between operators, especially in highly concentrated markets and where incumbent or dominant operators are involved in bilateral sharing agreements.

Most site sharing agreements do not restrict competition between operators. Site sharing arrangements generally allow operators to keep independent control of their respective networks and services. As a result, site sharing agreements generally do not lead to the harmonization of networks making the service offerings and prices charged by the site sharing operators indistinguishable. Full competition is assured where operators retain independent control over their radio planning and the freedom to add sites, including non-shared sites. In that way, operators are free to increase their network capacity and coverage. Better coverage and capacity may be a competitive parameter, as operators may be able to distinguish themselves based on network quality and transmission capacity. It is also important that site sharing agreements do not contain exclusivity clauses, prohibiting operators from concluding similar agreements with third parties.. Site sharing arrangements that fulfill these conditions are not likely to restrict competition between operators.[9] In fact, site sharing agreements may have a positive impact on competition, since the savings achieved may be passed on to consumers, increasing quality of service and decreasing price.

Finally, it is important to ensure that exchange of information between site-sharing competitors is limited to information strictly necessary for this purpose, such as technical information and location data for individual sites. Additional exchange of confidential information should be avoided.

2.4 Regulatory measures to promote passive mobile sharing

2.4.1 Mandatory vs. optional sharing

In order to speed deployment of mobile networks to rural areas, policy makers and regulators may consider adopting regulatory measures to promote site sharing. These could include options to stimulate, but not require, site sharing as well as adopting mandatory site sharing options.

Mandatory sharing

Policy makers may choose to make site sharing mandatory for companies operating a mobile network. In countries where site sharing is mandatory, operators are generally required to allow third parties to share their facilities upon request. In this case, there are several measures that can be imposed by governments or regulators. Such measures may vary in the degree that they intervene in the freedom of operators to negotiate site sharing agreements independently.

- **Policy objectives**: The first step policy makers or regulators will take is to determine the policy objective to be achieved in requiring site sharing. This will include geographic and population coverage objectives, environmental concerns and the promotion of competition.
- **Determining facilities subject to sharing**: The next step is determining what kind of facilities will be subject to mandatory site sharing. For example, should site sharing only be imposed for masts and pylons, or also for roof tops and other buildings (such as water towers)? Another possibility is to impose mandatory sharing only in such areas where alternative sites are not available or where regulatory restrictions apply, limiting the ability of operators to construct sites, affecting coverage and quality of mobile services.[10] Such critical infrastructure sites[11] may be pre-defined by the competent authorities in a transparent, predictable and expeditious way. Once those sites have been identified, operators should only be granted permission to set up a mast or tower if they agree to share the site with other service providers.[12] Regulators will also wish to take into account that certain facilities may not have been designed to support site sharing or that the space on facilities may be exhausted due to the use made by the facility owner.
- **Tariffs and other terms and conditions**: regulators may choose to set the price to be paid for sharing facilities or to impose a price when operators do not reach an agreement. The price of sharing may have an important impact on the willingness of operators to roll out their infrastructure. Operators may be reluctant to roll out infrastructure if they know they will be obliged to provide access to competitors at cost-oriented levels. Certain operators may be inclined to deny access to other operators despite the availability of space for site sharing on their own infrastructure. Those operators may argue that they need to reserve space for their own use, because the space will be necessary in the future in order to improve capacity on their networks. Regulators may also consider setting up other access conditions, such as the time that operators would be allowed to reserve space on their infrastructure for their own use.
- **Information supply**: operators requiring site sharing must have access to technical information relating to the sites, including site coordinates and certain technical specifications. It is important to establish whether operators should provide coordinates of all sites, or only of those sites that those operators consider adequate for site sharing.[13]
- **Time limits**: regulators may also consider imposing time limits for providing the relevant information and for negotiating agreements. A time limit of thirty days for negotiation between the first request and the time when actual access is provided is often considered reasonable in many developed countries, such as the UK. Other countries may choose a longer period, for example of sixty days, in order to take account of administrative and other difficulties that operators may encounter when negotiating site sharing agreements.[14]

In all cases, the existence of pre-determined, clear **policy objectives** is crucial. Regulators can be guided by those policy objectives when setting up rules for mandatory or optional site sharing. For example, if the principle policy objective is to reduce visual intrusion and environmental interference, regulators may choose only to impose site sharing for those facilities that are more intrusive, such as towers and pylons and not for roof tops. On the other hand, if the policy objective is to promote roll out, regulators may choose to impose site sharing for all facilities, including roof tops[15] and water towers.[16] Regulators can also take policy objectives into account when setting tariffs and other terms and conditions.

Optional sharing

Policy objectives also play an important role when deciding whether site sharing should be mandatory or optional. When the policy is aimed at stimulating operators to invest in the roll out of their own infrastructure,[17] optional sharing may be applied. In many cases, operators may voluntarily opt for site sharing, in order to reduce costs. Regulators that wish to be less interventionist may take measures to stimulate site sharing, without mandating it. Regulators may consider the following measures for stimulating site sharing arrangements:

- Model agreements: regulators may draw up model agreements for site-sharing, including standard terms and conditions to be applied by operators that wish to site share. Regulators may choose to provide suggestions for standard terms and conditions, but to leave material provisions (such as tariffs) to operators. In general site sharing agreements should include the following standard clauses:

Table 1: Standard terms and conditions in site sharing agreements

	Standard terms and conditions in site sharing agreements
1	Objective of the agreement
2	Obligations of both parties
3	Term of the agreement
4	Applicable tariffs
5	Billing conditions
6	Service description
7	Implementation and coordination
8	Access to facilities and cooperation
9	Operations and maintenance
10	Subletting conditions (such as no subletting without the consent of the facility owner)
11	Term and termination
12	Penalties
13	Liability
14	Confidentiality
15	Representations and warranties
16	Amendments to agreement
17	Force Majeure
18	Governing Law and jurisdiction

Source : Author

- **Stimulate self-regulation**: the setting up of self-regulating bodies is a common practice in many countries. Self-regulating bodies (such as associations of operators) play an important role in stimulating site sharing by establishing uniform conditions for site sharing, for redevelopment of existing sites for site sharing and for joint development of new sites.[18] Such bodies may also be an important factor in the communication between local authorities and operators, in order to address concerns of the population about the installation of masts and antennas in their communities.
- **Guidance on types of sharing allowed**: operators may contemplate site sharing arrangements between themselves, for example regional sharing as discussed above.

Regulators can provide clear guidance to operators on the type of arrangements that are allowed under the applicable laws and regulations. It is very important for operators that contemplate these kinds of arrangements, to have legal certainty about the status of their plans. Regulators can provide this legal certainty, e.g. by publishing guidelines on the subject.

- **Encourage sharing on government-owned facilities**: many towers, masts and other facilities that can be used for wireless transmission are often owned by government authorities or government owned companies. Site sharing on such facilities could be encouraged. This will be further addressed in Section 2.5.
- **Financial incentives for sharing**: regulators may also consider several ways to encourage site sharing by providing financial incentives. This will be further addressed in Section 2.6.

2.4.2 Dispute settlement mechanisms

Whether governments choose mandatory or optional sharing, efficient dispute settlement mechanisms for the resolution of disputes in connection with site sharing should be put in place. The dispute resolution body should be composed of individuals with expertise in the field, who understand the technical and legal issues involved.

Dispute resolution bodies should have sufficient powers to take the necessary action in order to make site sharing possible. Such bodies should be able to impose interim measures in urgent cases, for example when new entrants depend on site sharing for rolling out their networks and entering the market.

In principle, dispute resolution bodies should be independent and have no connections with operators or other interested parties. Dispute resolution bodies could be formed by members of national regulatory authorities. It is natural that national regulatory authorities be guided by their objectives when settling disputes between operators, such as promoting market entry. Independent courts, however, should be able to review the decisions of regulatory authorities in an efficient and expeditious way. The ability to effectively promote site sharing and its important policy objectives, however, will suffer where decisions can be too easily appealed, and even suspended during appeal.

2.4.3 Authorization and licensing conditions: the role of local authorities

The possibility of constructing sites in certain areas may be limited due to regulatory restrictions. In most countries, the installation of masts and towers for wireless communications will be dealt with by local authorities, such as municipalities and townships. Local authorities often require a permit or authorization for the construction of a mobile mast.

Local authorities may take part in promoting site sharing, e.g. by requiring new masts or towers to be designed and engineered in order to accommodate more than one operator. Local authorities may also require operators to place their equipment on existing masts, unless this is not possible for technical reasons.

In order to be successful in the promotion of site sharing, it is crucial that local authorities work closely with operators and their representatives. Disputes between operators and local authorities are harmful for the roll out of networks and increase concern by communities, which may often be unfounded and unnecessary. Associations of operators may be an important factor in establishing a dialogue between local communities and operators, increasing awareness about the presence and the location of masts in their communities and the possible health or environmental effects of those masts. Such associations may also develop, in cooperation with local communities, common guidelines for the installation of new sites or new equipment on existing sites. This will increase local participation, improve the availability of information and create legal certainty for operators willing to roll out their networks.[19]

It is also possible that central or national authorities develop rules or guidelines to be followed by local authorities when addressing the authorization of site construction in their communities. For example, regulators could develop standard conditions for the authorization of the construction of towers or masts, to be applied in rural or less populated areas by local authorities, after evaluating the local environmental and other concerns.

2.5 Ownership and other structural aspects

Telecommunication operators that own towers, masts or other infrastructure may have incentives to prevent competitors from placing their equipment on their towers or masts. However, entities known as tower companies have every incentive to sell their services to as many telecommunication service providers as possible.

Where operators' towers or masts are to be considered as non-replicable and as a vital resource for wireless transmission, government authorities may consider ordering structural separation of those towers and masts as a separate entity. This new entity should have an obligation to allow all operators on its towers on a non-discriminatory basis.[20] Recently, the European Commission has introduced the concept of functional separation of telecommunications networks, as a remedy to be imposed in order to promote competition on the market.[21] The concept of functional separation of mobile networks will be addressed in Section 3.3.

Government intervention is not always necessary to separate the tower infrastructure from other activities of a mobile operator. Operators may contemplate outsourcing their tower operations to a tower company, which may be an interesting option from a business perspective. Operators may transfer the ownership of towers, masts and other passive equipment to an independent company, the so-called 'tower company'. The tower company would own the towers and masts (or possibly the whole site) and provide a variety of services to the outsourcing operator, such as (i) radio and transmission planning (ii) site acquisition (iii) site construction and equipment installation and (iv) site maintenance. Outsourcing deals may create considerable financial savings for operators and allow operators to focus on their core business, which is providing wireless services to their customers. Outsourcing of site infrastructure has been particularly successful in North America and is considered to be one of the key enablers of the roll out of mobile networks in the United States.[22] Although it is not as developed as in the United States, the concept of tower companies is becoming more common in Europe.[23] Government authorities may contribute for the roll out of wireless networks, by promoting and authorizing tower companies to sell their services to mobile operators.[24]

Government authorities may also promote multiple use of towers and other structures by making their own infrastructure available for wireless transmission. In many countries, infrastructure which may be used for the installation of wireless equipment is owned by government authorities or is the property of government owned companies.[25] Government authorities may promote the roll out of wireless networks, by offering this infrastructure for the installation of equipment by multiple operators. In particular, electricity companies,[26] as well as railway and highway companies, often own infrastructure that can be used for wireless transmission. Government authorities can contribute, by making this infrastructure available whenever possible and by promoting multiple usage of this infrastructure by operators.

Other issues that may be addressed by governments relate to the ownership of the towers and masts and of equipment placed on such towers. In certain jurisdictions, especially those governed by the civil law system, towers and masts that are installed on a long term basis on land or buildings, may be deemed to be owned by the land or building owner by way of "*accession*". Accession is a legal concept governing the acquisition of property of objects that have a close connection with or dependence on another object. According to this concept, the owner of a principal object (the land) may acquire property of the accessory (the tower or mast). Operators may have to take very costly and cumbersome measures to avoid losing the property of their infrastructure, such as establishing rights of "superficies" for each of their towers or masts.[27] Government authorities may contribute to avoiding uncertainty about ownership issues, by promulgating laws and regulations excluding acquisition of telecommunications equipment installed on land, buildings, towers and masts by way of accession.

In addition to ownership issues, lease agreements between operators and real estate owners should facilitate site sharing. Preferably, such agreements should not contain exclusivity clauses. In addition, lease agreements should allow other operators to place their equipment on the site, without requiring further consent of the real estate owner. Government authorities may help by making information available to real estate owners about the benefits of site sharing as well as their rights and obligations when contracting with operators. Government authorities or self-regulating bodies may also provide standard documentation (such as model lease agreements), which would facilitate negotiations between operators and real estate owners.

2.6 Financial incentives for passive sharing

There are several measures that may be considered by government authorities in order to provide financial incentives to encourage operators to share sites.

Depending on the taxation and licensing system applicable in a certain jurisdiction, authorities may consider exempting earnings from sale and lease of passive infrastructure for site sharing from certain taxes and levies, whether or not in connection with the applicable licenses. However, in the absence of structural or functional separation of these activities from other segments of the telecom business, it may be difficult to segregate revenue arising from those activities from other revenues. This may be resolved by providing a report by an independent auditor or by providing a statement of those incomes on which the authorities could rely.

In addition, charges levied by local authorities for the installation of masts and towers in their towns or villages may be reduced in cases where the infrastructure is shared with other operators. Local authorities may consider exempting operators from those charges or limiting those charges to recovering administrative costs. Local authorities should consider at least reducing those charges in cases where the site is shared.[28] Local communities that wish to promote the deployment of wireless telecommunications or broadband may consider leasing space or buildings for mast sites for a reduced price in order to reduce the cost of deployment, making the service available and more affordable for the local community. Local communities that provide such subsidies may require operators to provide a minimum level of service or to provide wireless broadband services to the community, e.g. at minimum speed levels. In addition to installing radio equipment for wireless transmission, operators can also be required to install sufficient backhaul facilities, which will allow the required broadband speed to be provided.

Government authorities may also consider making a distinction between site sharing in urban areas and site sharing in rural or remote areas. Rolling out a mobile network in rural or remote areas, where population density is much lower than in urban areas is usually very costly for operators because of low traffic volume.[29] Financial incentives for site sharing in rural areas may help bring wireless services to the population in those areas. In countries where the population depends on wireless technologies to have access to telephony services, authorities may contemplate using universal services funds to provide financial incentives for the roll out of shared infrastructure. This is the case in India, where the government has established a subsidy support scheme for shared passive wireless infrastructure in rural areas with a target to set up about 18,000 towers by 2010 and to increase sharing in urban areas to 70 per cent by 2010.[30] The Indian example is further dealt with in Section 4.

Subsidized infrastructure could be used initially for mobile telephony, but may be subsequently used to provide wireless broadband services. If subsidies are provided as loans to operators, government authorities may require some form of security for payment of the loan, such as a mortgage or pledge on the towers and mast or other equipment. If the subsidies are not paid back, the government may acquire the towers and mast and outsource them to a tower company (see Section 2.5).

Of course, governments will wish to examine carefully whether providing subsidies for wireless deployment in rural or urban areas is an adequate measure in order to stimulate the roll out of wireless networks. Sharing arrangements will often reduce costs and make wireless deployment in the respective areas viable. Moreover, the price of site leases in rural areas may be extremely low, especially if compared to site leases in major urban areas. Governments can therefore seek to analyze the cost of site deployment in rural areas before deciding on a subsidy scheme. Governments can consider the costs of site deployment and analyze what type of subsidy scheme would be adequate for achieving the goals stipulated by them. Governments may also decide to use pro-competitive subsidy schemes, such as minimum subsidy auctions. These methods will reduce the amount of subsidies given, while helping operators to deploy services in rural or less populated areas. Depending on the costs of site deployment, other kinds of commercial agreements between operators (such as national roaming) may resolve coverage problems in rural or remote areas, without the necessity for subsidies. Policy makers can balance concerns about the costs of subsidies against possible negative effects of roaming agreements, such as anti-competitive effects.[31] Alternatively, relaxing regulatory requirements may often be sufficient for promoting deployment in certain areas, without the need for subsidies. Governments may decide that providing subsidies is necessary when the installation of passive infrastructure is a main bottleneck for providing wireless services in a certain region.[32]

3 ACTIVE MOBILE SHARING

3.1 Options for active mobile sharing

In addition to sharing passive infrastructure, operators may also share active elements of their wireless networks. The "active elements" of a wireless network are those elements that can be managed by operators, such as antennas, antenna systems, transmission systems, channel elements and others. Operators may share those elements and keep using different parts of the spectrum assigned to them. Although active infrastructure sharing is more complex, it is technically possible and equipment manufacturers can supply packages which have expressly been designed for active mobile sharing. This section will describe a number of options available for active mobile sharing. Most of the examples used in this section are based on sharing of a 3G network for mobile telecommunications, but could be applied for broadband wireless or 2G networks.[33]

Active mobile sharing may not be permitted under the licensing regime in certain countries.[34] Other national authorities may allow active sharing only subject to strict conditions. Those restrictions are generally based on the idea that competing operators should utilize their own infrastructure independently. However, there are indications that many authorities are reconsidering this,[35] as operators increasingly compete based on the quality of their services and not on the features of their networks. The competitive aspects of active infrastructure sharing will be dealt with in Section 3.2.

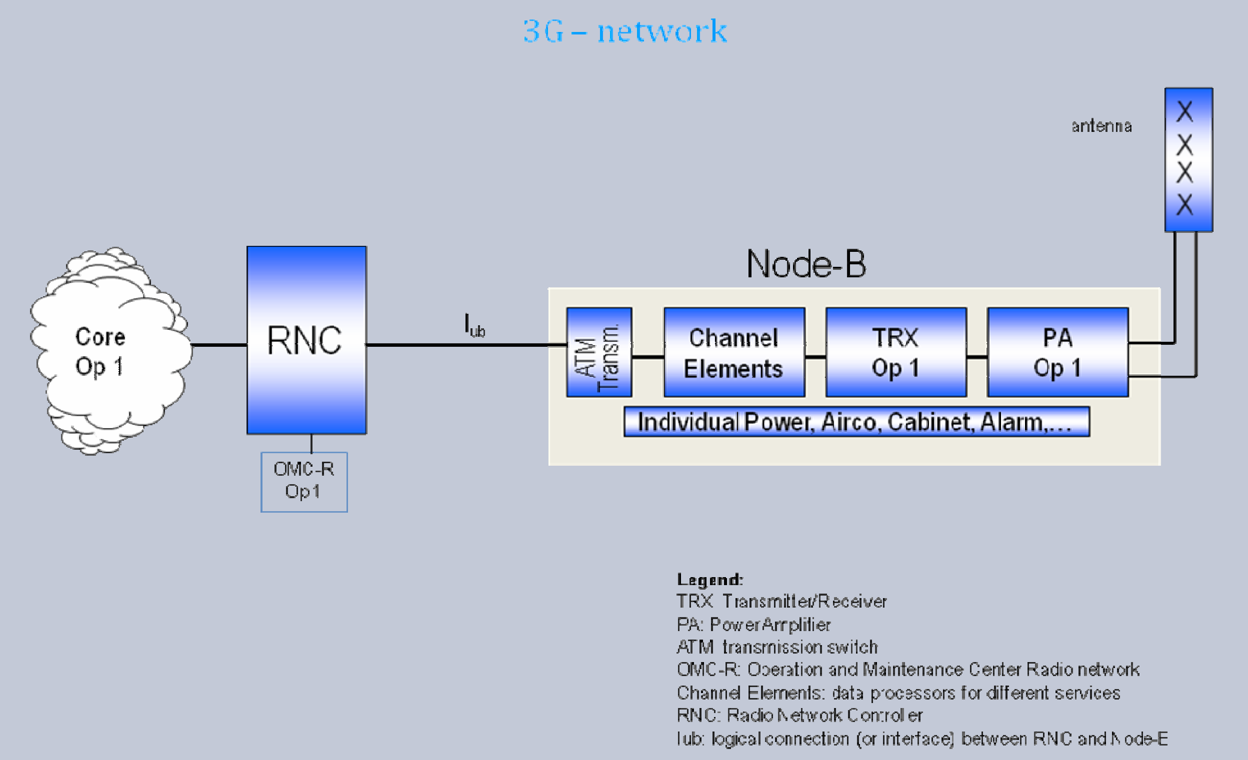
This section will elaborate on the different options available for operators that wish to share their 3G mobile networks. This information is also relevant for sharing of networks based on other technologies, since their basic configuration is similar. The following figure provides a graphical overview of the elements of a 3G mobile network that could be shared.

There are several elements of a 3G mobile network that may be share among operators:

- **Node-B:** is a term used in 3G mobile networks to denote the base station which is placed next to an antenna. The Node-B contains a number of devices that are necessary to control the transmission and reception of signals, such as: power amplifier, power supply, air conditioning, support cabinet, alarm installation, transmission switch (which, in case of UMTS is based on ATM-technology) and the TRX. The **TRX** (or transceiver) is a device which contains both a transmitter and a receiver and is responsible for sending and receiving signals at the frequency assigned to the operators concerned. The TRX is a very important device, since it enables communications with mobile handsets.

➢ **RNC** (Radio Network Controller): is responsible for the control of the Node-B. One RNC is usually connected to several Node-Bs (100 to 200). The RNC performs several important functions in a mobile radio access network, such as traffic and mobility management. The RNC tracks where the subscribers of a mobile network are located and assigns them to the base station closest to them. The RNC also controls the so-called handover between cells. If the subscribers are moving from place to place, they also have to change from cell to cell in order to avoid interruption of the call. The RNC is responsible for the coordination between the cells and for transferring an ongoing call from one cell to the other.

Figure 3: 3G mobile network



Source : Author

➢ **Core network**: is the intelligent part of the network. It includes the mobile switching centers (MSC's). In modern mobile network architecture, the MSC is physically split into a Mobile Gateway (MG) and a Mobile Switching Server (MSS). The MG switches the traffic to and from the radio network and from external networks (PSTN and other mobile operators). The MSS controls the traffic and customer services. In addition to the switching and control components the core network contains several databases, such as the subscriber data base or HLR (Home Location Register). The HLR is responsible for identifying the subscribers that are authorized to use the mobile network. Another element of the core network is the Operations & Maintenance Center (OMC). Part of the OMC controls the radio network components, such as the RNCs and Node-Bs, and is responsible for traffic management on the network. In more intensive network sharing agreements (such as full RAN Sharing, see below), parties may have to share the OMC. This may raise competitive concerns, because operators would be able to access information relating to traffic and volume. Regulators may require operators to create an independent OMC to ensure information separation from the sharing parties. This would also allow independent network optimization ensuring competitive differentiation. Because of these regulatory requirements, OMC may be one of the elements that should not be shared by operators.

3.1.1 Extended site-sharing (including antenna sharing)

Extended site sharing is where operators share not only the passive elements of a site, but also active equipment such as antennas, combiners and transmission links. In extended site sharing arrangements, operators may also share the TRX (transmitter and receiver). This will demand that the parties share the spectrum too. Although, spectrum sharing is technically possible (see the GSR paper on spectrum sharing) it may raise regulatory challenges, in particular because of rules dealing with spectrum optimization.[36]

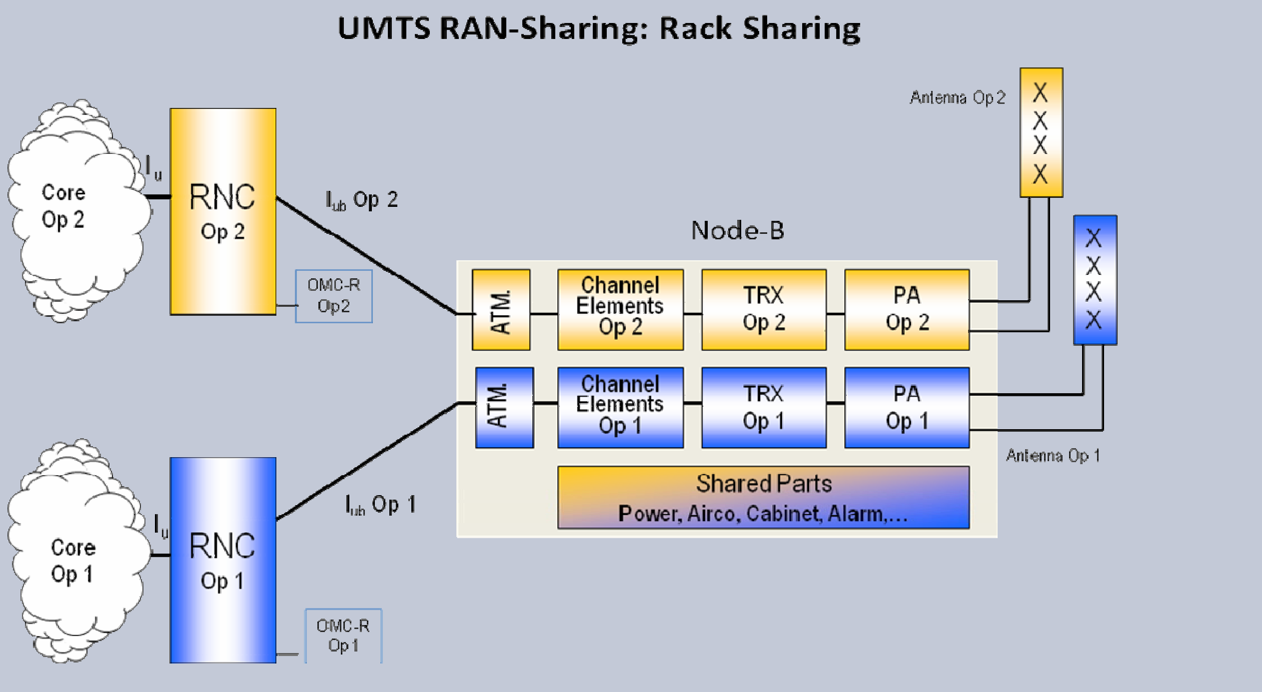
This option may increase capital and operating savings by operators as compared to simple site sharing. However, the amount of additional savings may be limited, since the additional costs of antennas and transmission equipment are relatively small. While it is technically possible for operators using different sets of frequencies to share an antenna, this option involves a number of technical challenges. It may not be recommended when radio optimization strategies are not aligned between operators. While an antenna can be shared, it is usually directed to a certain position, which is based on the operator's own radio optimization strategy. The optimization strategy of the sharing operator may require it to change the position of the antenna, which may be difficult or impossible when the antenna is shared.[37]

3.1.2 Sharing of radio access network

- **Rack sharing**: in addition to sharing the elements shared in the extended site–sharing option, operators install their individual active equipment in a shared cabinet or rack (i.e. the housing frame encompassing the electronic and other hardware). Other elements such as channel elements, TRXs and power amplifiers remain physically separated, as well as the transmission networks and other elements of the radio access, such as the RNCs. Power supply, air-conditioning, ancillary cabinet and alarm installations can be shared.[38] Depending on the actual situation, rack sharing may provide up to 5 per cent capital expenditure saving for an operator per Node-B. If battery back-up is used and is shared in a rack sharing situation, rack sharing may provide between 10 per cent and 0 per cent savings in capital expenditure. Figure 4 graphically illustrates this option:

Figure 4: Sharing elements of the radio access network: rack sharing

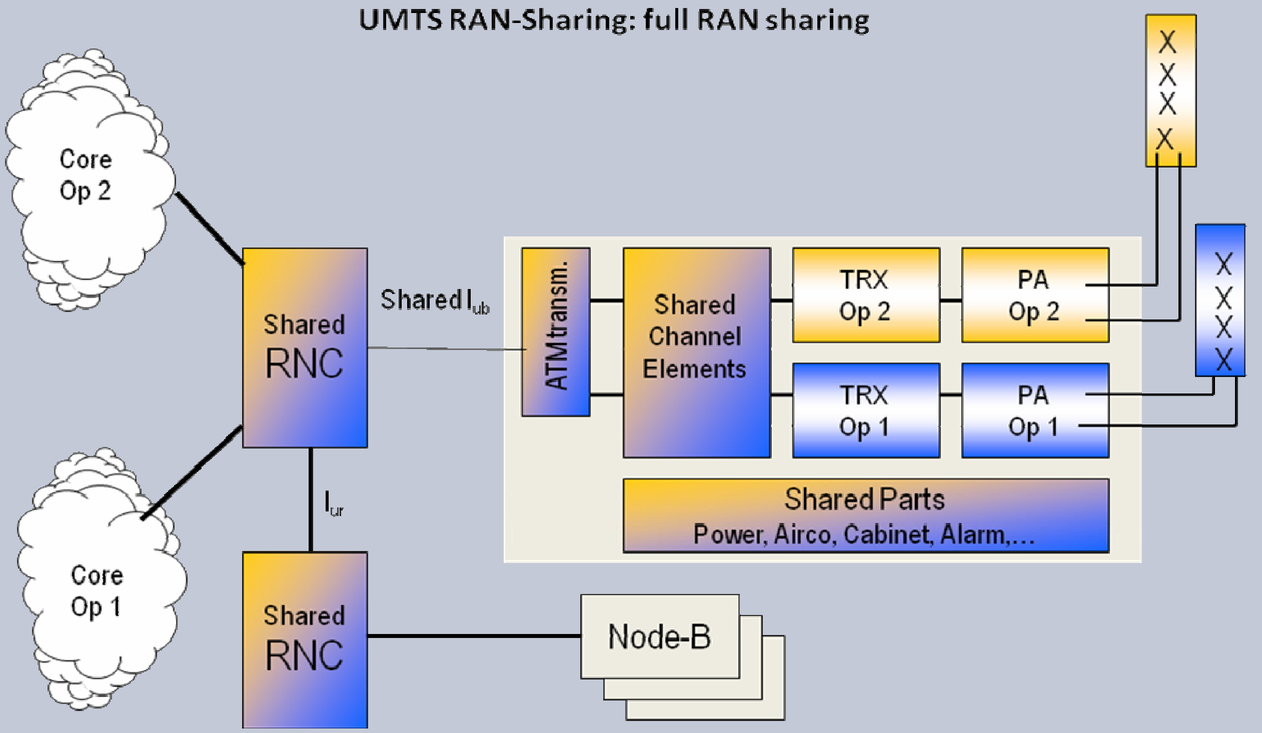
(i.e. physical frame housing electronics and other equipment and ancillary elements such as power supply, air-conditioning, battery back-up, alarm installation and other)



Source : Author

- **Full RAN sharing**: In addition to the elements shared under the previous options, operators have the option to share all the elements of the Node-B. In case independent frequency control needs to be in place, the TRX (transmitter/receiver) and the power amplifier (PA) should remain independent allowing for radiation at each operator's assigned frequency range. When the spectrum can be shared, operators may also share the TRX and the PA.

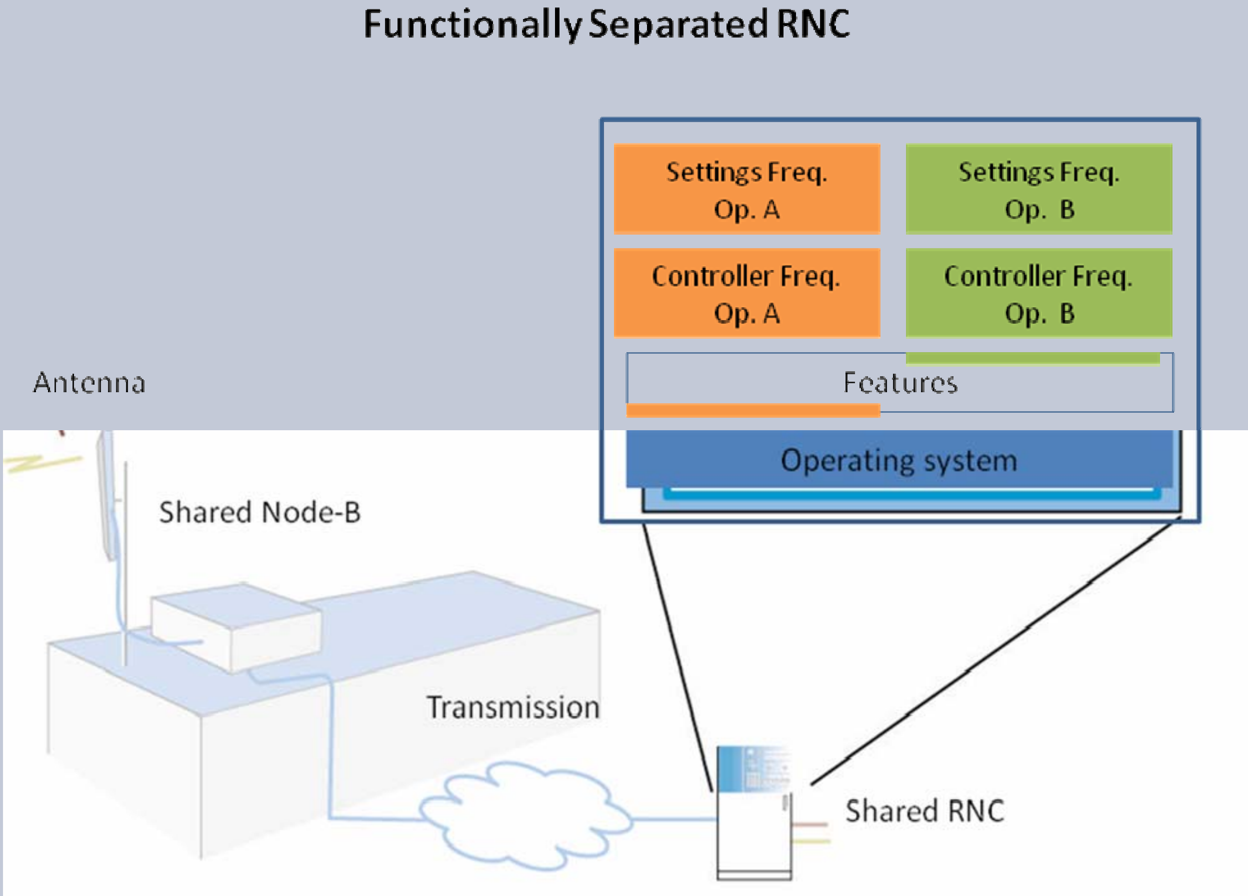
Figure 5: Sharing elements of the radio access network: full ran sharing



Source : Author

In the case of full RAN sharing, regulatory authorities may require the shared elements to be functionally separated. According to these authorities, operators should retain independent control of all the parameters that are determinant for the quality of the network.[39] This implies that the communication between the RNC and the Node-B has to be under the independent control of one operator as far as its service is concerned. This communication may take place using the same cables and connections, but must be logically separated. Operators should be able to control, in an independent way, all the parameters that determine the quality of the network, such as coverage, speed and the handover parameters. In addition, operations, maintenance and network control should be separated. Those elements may be under individual control by each operator or under joint control of an independent third party that operates the shared network on behalf of the sharing parties, also introducing Chinese walls between the sharing operators to enforce functional separation. This independent third party may be a joint venture between the sharing parties or and outsourced service provider. The following figure illustrates a functionally separated RNC, which may be necessary due to regulatory requirements.

Figure 6: Functionally separated RNC



Source : *Author*

3.1.3 Core network sharing

Sharing of the core network is technically possible. However, the core network performs several functionalities that are essential for the performance of an operator's service, such as the billing system. The core network also contains a large amount of confidential information concerning the operator's business. Accordingly, it may be complicated for competing operators to share a core network. However, there are other varieties of sharing according to which operators may use the same core network to provide their services, such as national roaming, or through an MVNO-construction. In addition, with the emergence of so-called next-generation core networks in which the switching and the control and service functionality is physically separated, network sharing may move into the domain of core network switching while enabling service differentiation and confidentiality.

National roaming

National roaming refers to the situation whereby operators agree to cover different parts of a country with their own networks and to use each other's network to provide services in the areas where they have no coverage. Such arrangements usually provide for the assignment of certain parts of the country to operator A and other parts to operator B, C or D. Operators then allow each other to use their networks (including the core network) in the areas where they have built their respective networks. There are several options for the geographic division of a country for the purpose of national roaming. A common alternative is to assign a number of cities (and the areas around them) to different operators. Another alternative is to assign a larger geographical region (such as a state or province) to a certain operator.

Operators normally pay a wholesale roaming charge (usually a charge per minute of use) in order to use each other's networks. National roaming is generally simpler and less costly to manage than active infrastructure sharing. However, national roaming may lead to a greater degree of uniformity at the retail level between operators. The roaming operator will rely, for all network matters, on the choices made by the visited operators. Although the visited operator will have the possibility to define and set the Quality of Service (QoS) to the roaming party, in most instances the roaming operator will demand the best QoS and is likely to get it because of the reciprocal character of most national roaming agreements. Therefore, in the roaming areas, the roaming operator will not be able to distinguish itself from the visited operator as far as coverage, quality and transmission speeds are concerned. In addition, price competition may be restricted since the retail tariffs charged by the roaming operator will be determined, to a large extent, on the basis of the wholesale charges charged by the visited operator.

Despite the concerns expressed above, national roaming may be an effective means for operators to provide coverage in rural or remote areas. In those cases, all operators roll out their networks in urban areas, but allow each other to use their networks in rural areas. In certain cases, national roaming may be the only alternative to bring coverage to a certain area. In any event, national roaming is very likely to make services available and more affordable in areas that would otherwise only be at a very high price or not covered at all.[40]

Wholesale mobile access: MVNO-model

MVNOs (Mobile Virtual Network Operators) offer mobile telecom services to customers by reselling wholesale minutes that they have purchased from an existing infrastructure owner (a mobile network operator, or MNO). Most MVNOs have their own core network (including a billing and identification system) and only require access to the mobile operator's radio access network. MVNOs avoid the need to own and operate their own end-to-end mobile radio access networks. Others, the so-called Service Providers, do not have a core network and simply buy and resell minutes to their end-users. The number of MVNOs in Europe has increased substantially since 2002-2003. Many well known consumer brands (such as Virgin and Tesco in the UK) have launched services. However, the degree of success of MVNOs and the business models adopted by them vary considerably from case to case and from country to country.[41] In the UK, there are a number of successful MVNO's, the largest one being Virgin Mobile, with over 4 million subscribers in 2006.[42] In the Netherlands, there are approximately 50 MVNOs and other service providers without a network that are active in the market. Together MVNO's and service providers reach a market share of approximately 17 per cent of the Dutch market, with Debitel and Tele 2 being the largest ones.[43] Recently a new concept called MVNE (mobile virtual network enabler) has been introduced in certain European countries. An MVNE does not have a relationship with the end-user, but provides administration, operation as well as infrastructure services to MVNOs or service providers.

Although the presence of MVNOs may boost competition in certain markets, it is not a solution in markets where mobile networks have not been widely rolled out. MVNOs depend on the existence of previously deployed networks in order to provide their services. However, when operators do not utilize their full capacity, providing access to MVNOs may be a good alternative to bring more affordable services to the market. In some countries, MVNO access has been imposed by regulators.[44] Regulating MVNO access involves introducing a number of regulatory measures concerning, among others: the type of access, pricing, transparency and non-discrimination. In many countries where MVNO access has been introduced successfully, operators have entered into MVNO agreements on a voluntary, non-mandatory basis. Entering into MVNO agreements may be commercially interesting when operators have spare capacity on their networks. Operators have an incentive to make this spare capacity available for alternative operators and boost their revenues. New entrants, possibly with a strong brand,[45] may want to enter the mobile market. Accordingly, regulators may consider facilitating the entry of MVNOs, whether or not through regulated access, in order to boost competition and affordability of services.

3.1.4 Backhaul sharing

In certain rural or remote areas, backhaul may be a bottleneck facility. In areas where mobile traffic is low, the full capacity of backhaul is not used and may be shared by operators. Accordingly, in areas with no capacity problem, when passive or active infrastructure is shared on a tower or roof top, backhaul may also be shared by operators. Backhaul sharing is possible, either where operators use fibre cables or microwave links as backhaul. Although it is technically possible to share backhaul facilities, regulatory or licensing conditions may preclude operators from sharing backhaul facilities, especially when radio waves (such as microwaves) are used as backhaul, which is the case in most rural or remote areas.[46] When backhaul radio facilities cannot be shared, operators have to install separate antennas on the towers in addition to the antennas used to communicate with the handsets. This increases the weight of the antenna on the tower, requiring higher and heavier towers, increasing the cost of construction and visual intrusion. Therefore, it may be more practical to share fibre and limit the sharing of radio backhaul facilities to low traffic regions. In addition, regulators and policy makers intending to foster wireless broadband deployment may wish to encourage mobile operators to replace microwave links with fibre links to carry broadband traffic.[47]

3.2 Competitive impact of active mobile sharing

When government authorities take a decision regarding the number of licenses or authorizations to be issued for mobile services, they usually consider the level of competition that they wish to achieve. Many government authorities intend to create the maximum level of competition between all market players.

Sharing of active mobile equipment may raise concerns by public authorities (such as regulators and competition authorities) about restricting competition between the sharing operators. Sharing active network infrastructure usually leads to operators offering similar network coverage, quality and transmission speeds. Regulatory authorities may be concerned that this would lead to a greater uniformity of conditions, restricting the ability of operators to differentiate themselves at the retail level. Regulators may also be concerned that network sharing would lead to uniformity of tariffs, since the wholesale price paid by operators may determine the tariffs charged at the retail level. In addition, regulators may be concerned that sharing arrangements may lead to collusion as operators exchange confidential information, increasing the predictability of commercial behavior by operators and restricting competition. For example, the UK regulator Ofcom has adopted a reluctant approach towards network sharing so far:

> Network sharing could also have undesirable consequences for competition. For example, MNOs could collaborate on network development and gain information about each other’s costs and plans which may have a chilling effect on competition in the retail market. Dynamic efficiency may also be lower with fewer networks able to provide high quality mobile broadband services. End-to-end competition, i.e. at both the network and service level could lead to greater innovation, which could bring significant benefits for consumers. We note that the competition concerns would be amplified if the 900 MHz operators were themselves to decide to share a single UMTS 900 network in response to the actions of their competitors.
>
> While it is difficult to quantify the potential impact of these effects, Ofcom’s initial view is that there is a significant risk that both competitive intensity and innovation in mobile broadband services would be weakened, with potentially serious impacts on consumer welfare. [48]

3G sharing agreements between T-Mobile and O2

Many European mobile operators have contemplated national roaming agreements following the 3G auctions between 2000 and 2001. However, 3G mobile sharing got off to a slow start in the EU as a result of delays caused by legal uncertainty as to the regulatory status of sharing agreements. The European Commission set the standard for what was permitted under EU regulatory law when it assessed the network sharing agreements for 3G mobile communications between operators T-Mobile and O2 in Germany[49] and in the UK[50]. National regulators in EU countries generally followed the Commission's approach when assessing 3G sharing arrangements in their own jurisdictions. As a result of the Commission's approach, operators' liberty to enter into network sharing agreements was restricted. As discussed below, the Commission's decision was later successfully appealed before the European Court of First Instance, which opened the way for new sharing arrangements in the EU. However, because of this early restriction, there is not much practical experience of 3G mobile sharing at this time.[51]

In Germany, the parties agreed that O2 would roam on T-Mobile's network (but not vice versa) within the area corresponding to O2's coverage obligation for a period of 6 years (between 1 January 2003 and 31 December 2008). The parties agreed that in certain areas, roaming would be phased out according to a certain timetable. Outside the areas falling under the coverage obligation, the parties agreed to provide each other national roaming on a reciprocal basis. O2 committed to purchase a minimum volume of such roaming services from T-Mobile. T-Mobile was not under an obligation to buy roaming services from O2. The agreement also contained the possibility of RAN sharing (sharing of Nodes B and RNCs) if the parties would consider it feasible in the future. Since the parties did not conclude any further agreement on RAN sharing, the Commission only assessed the aspects involving national roaming.

When assessing these agreements from a competitive point of view, the European Commission took the view that national roaming agreements by definition restrict competition. The Commission considered that national roaming would affect key competition parameters, such as coverage, call quality and transmission rates. According to the Commission, the roaming operators would be restricted by the coverage, network quality and transmission rates available to it on the visited network, which were a function of the commercial choices made by the visited operator. The visiting operator would be restricted in the nature of the services that it could provide to its end-users, because the types of services available were determined to a large extent by the transmission speeds available. In addition, the Commission deemed that the timing of the introduction of a particular service would be determined by the moment when certain transmission speeds would be available.

Finally, the Commission was concerned that the wholesale charge arrangements made would lead to coordination on retail price levels. For voice communication, the roaming operator would be charged a per-minute rate, based on termination rates and for data services according to a retail-minus pricing model. According to the Commission, O2 would be restrained in its ability to determine its own retail price by the wholesale charges paid to T-Mobile.

However, the Commission believed that the agreement satisfied the conditions necessary to receive an exemption of the prohibition to conclude restrictive agreements, because of its benefits to consumers.[52] According to the Commission, the agreement would contribute to improving coverage, quality and transmission rates, promoting economic progress. The benefits of the agreement were likely to be passed on to consumers, since consumers would benefit from a greater range of new and technically advanced 3G services, making price competition more likely. The restrictions agreed were essential for the achievement of the respective benefits and the agreement would not lead to elimination of competition in the market. Accordingly, the Commission granted an exemption but only for such time as was justified to promote competition during the initial roll-out phase of the network and to promote the commercial launch and take-up of 3G services. Depending on the area concerned, the parties received an exemption for periods of 4, 5 or 6 years.

The agreement between T-Mobile and O2 relating to the UK contained similar provisions about site sharing and national roaming. This agreement involved the allocation of a number of UK cities to each party, in which they would roll out their network. Operators would provide each other national roaming in the cities where they did not have coverage. The Commission took an opinion similar to its opinion in the German case, granting an exemption for periods of 5 and 6 years.

T-Mobile and O2 appealed against the Commission's decision before the European Court of First Instance (CFI). The CFI found in favor of T-Mobile and O2, considering that the Commission had wrongly concluded that national roaming agreements were restrictive of competition by their very nature.[53] According to the CFI, the Commission had failed to carry out an objective analysis of the impact of the agreement on the competitive situation. The CFI criticized the Commission for not presenting concrete evidence of the restrictive effects of the agreement:

> A fortiori, the Commission has failed to show that the agreement seeks to slow down, if not to limit, the roll-out of the applicant's network, as it submits in its pleadings. The letters submitted during the proceedings by the defendant […] show on the contrary that the agreement seeks to enable the applicant to roll out its 3G network in a profitable way in accordance with the requirements imposed by its license in terms of the timetable and coverage.
>
> In the present case, it cannot therefore be ruled out that a roaming agreement of the type concluded between T-Mobile and O2, instead of restricting competition between network operators, is, on the contrary, capable of enabling, in certain circumstances, the smallest operator to compete with the major players, such as in this case T-Mobile but also Vodafone on the retail market, or even dominant operators, as T-Mobile is on the wholesale market.54 (emphasis added)

The CFI also rejected the Commission's view on the impact of the agreement on price competition:

> As regards, first, the impact of wholesale prices paid to T-Mobile on the wholesale and retail prices charged by O2, the applicant is, from that point of view, in a situation analogous to that of any undertaking vis-à-vis its suppliers. O2 and moreover T-Mobile both depend upstream on the prices charged to them by suppliers of goods and services which they use and may be led to pass on those costs to their customers. In addition, the price dependence alleged has not been demonstrated. […] Moreover, in response to the questions put by the Court of First Instance, referred to in paragraph 36 above, concerning O2's price structure, the applicant has supplied information from which it is apparent that, by means of different types of products and services, a variety of subscription packages and pricing formulae combining many variables, it attempts to differentiate itself from T-Mobile.[55]

This decision by the CFI may serve as a reference for regulators and other policy makers in developing countries when they seek to balance anti-competitive concerns with the objective of deploying networks in a quick and efficient way. Firstly, regulators may wish to make an objective assessment of the implications of national roaming for the competitive situation on the market. As indicated by the CFI, national roaming (and, by consequence, other types of network sharing) may actually increase competition because it enables operators to compete in areas where they would otherwise have no coverage. Before reaching a conclusion, competition and regulatory authorities must assess the competitive situation in the absence of the network sharing agreement. Such agreements may lead to a situation that is more competitive than the situation where such agreements do not exist.[56]

Regulators will aim to ensure that all operators comply with the applicable regulatory obligations, including coverage. Availability of service with minimum quality levels is the least that the consumer should expect to receive. Whether or not the service is available should not be a key competitive parameter but rather a basic requirement. Network sharing agreements may help operators to make the service available and leave operators to compete on more important parameters from a consumer perspective, such as brand, price and customer service. This applies in particular to rural and remote areas. Authorities may also wish to distinguish between urban and rural areas when judging network sharing agreements.[57] In particular, authorities that have anti-competitive concerns may choose to limit sharing for a period of time until operators have acquired a substantial customer base in rural areas in order to satisfy their business case. Subsequently, operators may be required to deploy their own network.

Regulators will seek to have a thorough awareness of the competitive situation of the market, when judging network sharing agreements. Such agreements should not affect important competition parameters, such as price and service packages. Cooperating operators should not be allowed to exchange commercially sensitive information that may influence their future competitive behavior.

Where regulators impose conditions or limitations (such as requiring part of the infrastructure to be functionally separate), regulators may wish to impose only those obligations that are strictly necessary in order to preserve a situation of sustainable competition in the market.

3.3 Functional separation of mobile networks

The ultimate remedy that authorities may impose in order to insure competition in the telecommunications market is to require a vertically integrated operator to separate its infrastructure services (passive and active network elements) from its services. This can be done in two ways: (i) structural separation or (ii) functional separation.

The term "structural separation" refers to the situation whereby the ownership of and control over network elements on the one hand and service activities on the other belong to different entities. This is similar to the situation described above, whereby an operator outsources its towers and masts to an independent company (see Section 2.5.). In the case of structural separation, the operator would outsource its whole network and network activities to a different company and would concentrate on providing services to its customers. In the case of functional separation the operator establishes operationally separate business entities, but there is no change in the ownership situation.

The European Commission has proposed to introduce functional separation as a new remedy under the European regulatory framework for the electronic communications sector, in particular for legacy fixed line networks being upgraded to next-generation access networks.[58] The Commission sees functional separation as an instrument necessary to ensure fair competition in markets dominated by one operator. Functional separation should allow network access to new entrants and the incumbent's own retail division on the same terms with the purpose of giving new entrants a fair chance to build services using the incumbent's existing infrastructure.[59] Functional separation should reduce the incentive of dominant network operators to discriminate between third parties and its own retail activities, making it easier for compliance with non-discrimination obligations to be verified and enforced. The Commission proposes to apply functional separation only in exceptional cases, where there has been persistent failure to achieve effective non-discrimination and where there is little or no prospect of competition between several infrastructure providers within a reasonable timeframe.[60]

Functional separation may not be a very appropriate measure to introduce in the mobile sector. The mobile sector is generally characterized by competition between different infrastructure providers. Government authorities usually issue several licenses (at least two or three) for mobile operators to compete in a given market, building their own infrastructure and providing their own services. Functional separation may be more appropriate for fixed markets in developed countries with a legacy network (usually built under monopoly by state owned companies), where new entrants have not had a chance to compete with the incumbent on the same terms.[61] However, functional separation could be used in areas where mobile operators do not have commercial incentives to roll out their networks or to upgrade their networks to wireless broadband, such as in rural or remote areas given adequate regulatory capacity to calculate access costs and effective dispute resolution mechanisms. Given however that functional separation is a new and drastic measure, regulators in developing countries may wish to focus on more practical alternatives such as open access to passive mobile infrastructure based on the tower company model.

How might functional separation work to bring affordable services to rural areas? Government authorities could consider issuing only one license for building a wireless network in certain rural or remote areas, with the condition that the licensed operator would functionally separate its network from its service activities and would provide access to its own retail activities and to competing service providers on a non-discriminatory basis. This kind of functional separation may be interesting for operators from an economic point of view. The wholesale activities of the functionally separated network division may be very profitable, especially when there is a large interest on the part of service providers to purchase access.[62] Before imposing functional separation, however, authorities must take into account the effect of functional separation on investment in infrastructure. The network operator must have an incentive to innovate and to invest in new technologies in order to upgrade its network. Usually, new technologies are developed from a *services* point of view, in order to make faster and innovative services available to the end-user. If the network operator does not have a direct relationship with the end-user, it may have no incentives to make its network adequate for providing new services. For this reason, functional separation should not prevent appropriate coordination mechanisms between the network and the services division of the operator. The network division should take account of the interests of the service division and vice versa. This way, the network division should have an interest in investing in its network in order to make it adequate for providing new services. This is the reason why functional separation is probably more appropriate than structural separation in the telecommunications sector.

Functional separation may, in theory, be an efficient way of promoting the roll out of wireless networks in developing countries, especially in those countries with a high percentage of rural and remote areas that are less interesting for operators. However, government authorities in developing countries should bear in mind that introducing functional separation requires a number of complex regulatory measures, such as determining the type and price of access charges. Promoting extensive roll out of network and affordable access requires the network operator to charge cost-oriented tariffs to service providers. On the other hand, the network operator should have sufficient incentives and receive enough income to invest in its network. Setting the right price of access, taking account of all these factors, is a complex task that requires a large amount of expertise by regulatory authorities or their consultants. This kind of expertise may be lacking in certain countries that have just begun developing their telecommunications policies. In addition, introducing such far reaching measures requires a fast and efficient judicial system. Operators are expected to appeal against such measures because of the high interests involved and the large amount of investments usually made by operators when entering a new market. Imposing complex regulatory measures may not be a good solution when judicial systems do not work quickly, or allow regulatory measures to be suspended for a long time.

4 CONCRETE EXAMPLES AND POLICIES ADOPTED

4.1 European Union

Most European countries allow and promote passive infrastructure sharing between mobile operators. Many European operators have also contemplated agreements for sharing active infrastructure for 3G mobile services, but such agreements have been subject to conditions imposed by regulatory authorities in order to promote competition between networks (see above, the examples of T-Mobile and O2, described in Section 3.2). Some operators have implemented infrastructure sharing agreements, but have closed down the shared operations, apparently because the business case for implementing the agreement under the conditions imposed by the regulatory authorities was not satisfactory.[63]

More recently, new network sharing agreements for 2G and 3G infrastructure have been announced, such as the agreement between Orange and Vodafone to share 2G and 3G infrastructure in the UK and in Spain. In February 2007, Orange UK and Vodafone UK have announced their intention to share their radio access networks (RANs) for 2G and 3G mobile services. The two RANs (including masts, antennas, sites, support cabinets and power supply, as well as BTSs and Node Bs and RNCs) would be combined over a number of years, exploring opportunities as technical solutions become available. The proposal would allow both companies to continue managing their own traffic independently, retaining full responsibility for the quality of the service and remaining competitors at wholesale and retail level.[64] According to public statements made by Vodafone, it expected the UK sharing agreement to reduce capital and operating costs by 20-30 per cent across both its 2G and 3G networks.[65]

Orange and Vodafone also agreed to share their 3G RANs in rural areas in Spain. The agreement is said to relate to towns with fewer than 25,000 people in 19 provinces across the country. The network sharing arrangement would allow operators to reduce the number of sites by around 40 per cent, increasing the number of shared base stations to 1,500 by the end of 2007 and to 5,000 within four years.[66]

In December 2007, T-Mobile UK and 3UK announced their intention to share their 3G networks.[67] T-Mobile and 3 will combine their radio access networks. T-Mobile and 3 will make use of the so-called Multi Operator RAN (MO-RAN),[68] which enables the sharing partners to share all site equipment with exception of both parties' TRXs, which will remain independent since the parties will not share spectrum. Accordingly, each Node-B will have two sets of TRXs (one using T-Mobile's frequency and another one using 3's frequency). The parties will also share feeders, antennas, ancillary and transmission equipment. The RNC is also shared in the MO-RAN construction. According to the parties, this construction enables the parties to retain responsibility for the delivery of services to their respective customers and to remain full competitors on the market. Although antennas are shared, parties maintain flexibility to control their own radio optimization allowing for coverage differentiation. Although the RNC is also shared, the architecture developed by the equipment supplier reportedly allows for service differentiation.[69]

It is not clear whether all agreements mentioned above have been implemented successfully. However, it seems that after the decision of the CFI (see Section 2.5 above) European regulators have less space to impose restrictions on network sharing agreements based on competitive concerns. In any event, it seems that both agreements, given technical developments and availability of new equipment promoting network sharing, would allow both operators to control important parameters independently and remain full competitors in all aspects.

Now that the EC's restrictions on national roaming have been lifted, it will be interesting to watch if more 3G sharing agreements are implemented going forward.

4.2 United States

Other countries have adopted a slightly more liberal approach to infrastructure sharing than the European Member States. The United States federal regulator FCC has assessed a number of individual cases relating to infrastructure sharing, such as the joint venture between AT&T Wireless and Cingular for GPRS and Edge services.[70]In general, the US approach has been not to intervene in voluntary infrastructure sharing arrangements.

4.3 Canada

In Canada, the government has recently announced a new policy framework for the auction of advance wireless services (AWS) radio spectrum in the 2GHz band.[71] The government has decided to reserve part of the newly auctioned spectrum to new entrants and to mandate network sharing as a means of promoting market entry. The new policy framework will require incumbents to provide "out-of-territory" roaming for licensees seeking to operate outside of their licensed territory for at least 10 years. It will also require incumbents to provide "in-territory roaming" to new entrants inside the new entrant's licensed territory for a period of five years, with the intention of facilitating market entry by those new entrants. The new framework also includes mandatory sharing of antenna towers and sites and the prohibition of most exclusive site sharing arrangements.

4.4 Brazil

In the beginning of 2008, the Brazilian government issued 44 licenses for the provision of 3G mobile services in the whole national territory. The country was divided in 11 licensing areas. In each area, four operators were licensed to provide 3G mobile services. Regulator ANATEL took several measures to ensure that communities with fewer than 30,000 inhabitants (a large percentage of all Brazilian municipalities) would receive wireless broadband coverage.[72] In each licensed area, the total of the municipalities with fewer than 30,000 inhabitants was divided in four parts. Each part was allocated to one of the four licensed operators. This operator is required to roll out its network and provide coverage in the assigned area (which corresponds to 25 per cent of all municipalities with fewer than 30,000 inhabitants in the area). The other three licensed operators are allowed to use the other operator's network to provide services to their clients, provided that they roll out their networks in their assigned area. Accordingly, operators are allowed to share each other's infrastructure in order to provide services in communities with fewer than 30,000 inhabitants. Although the regulator has not made completely clear what is meant by "network sharing", it is believed that it includes sharing passive (masts, towers, site equipment as well as active network elements (antennas, transmission system, RNCs). Spectrum sharing is also allowed, provided that the operator requiring spectrum sharing is licensed to provide services according to the respective technology. The total population in the areas under this coverage obligation is 17.3 million. The intention of the regulator is that the whole Brazilian territory be covered by broadband wireless by 2016.

4.5 India

In India, regulator TRAI has recommended passive and active infrastructure sharing to be allowed in the country in order to promote roll-out and increase availability and affordability of services.[73] The Indian Department of Telecommunications has set as a government target to establish a subsidy support scheme for shared passive wireless infrastructure in rural areas with about 18,000 towers by 2010 and to increase sharing in urban areas to 70 per cent by 2010.[74]

Recently, the Indian Universal Service Obligation Fund has launched a scheme to provide subsidies for setting up and managing around 8,000 towers for the provision of mobile services in remote areas with no wireless coverage. The condition for receiving the subsidy is that the infrastructure built be shared by at least three operators. According to the India Department of Telecommunications, operators have already entered into sharing agreements and the mobile services provided through these shared towers should be operational by May 2008.[75]

4.6 Malaysia

The Malaysian Communications and Multimedia Commission (MCMC) has identified infrastructure sharing as one of the criteria for issuing licenses for 3G mobile spectrum. In its invitation to submit applications for IMT-2000 spectrum, the MCMC required applicants to demonstrate their capacity to provide commitments in infrastructure sharing, including (a) sharing of physical facilities (tower, floor space, antenna) and (b) sharing of network capacity and capabilities (traffic volume and access conditions) and to maximize the use of existing network facilities, including network capacity, base stations and backbone facilities. Applicants should also demonstrate its commitment and capability to provide domestic roaming.[76]

4.7 Jordan

In Jordan, all licensees are required to provide infrastructure sharing and collocation to other licensees, subject to availability. The Jordan Telecommunications Regulatory Commission (TRC) issued a statement on the implementation of infrastructure sharing and national roaming for mobile telecommunications operators in Jordan.[77] In this statement, TRC reserves the right to intervene whenever service providers fail to reach an agreement on infrastructure sharing. If TRC determines that infrastructure sharing is feasible, it will determine the terms and conditions under which it must take place. Operators are also required to provide each other national roaming agreements that need to be deposited with TRC for agreement.

5 CONCLUSIONS AND BEST PRACTICES

5.1 Conclusions

It is clear that network sharing agreements may entail benefits for operators and the general public. Such agreements may entail significant financial benefits for operators by avoiding the costs of building or upgrading overlapping sites and by consolidating existing sites. Operators may achieve considerable savings in rent, maintenance and transmission costs. They may also achieve economies of scale by combining operating and maintenance activities. Network sharing may further help operators in attaining better coverage, since they may choose to use only those sites that provide deeper and better coverage, decommissioning sites with poor coverage possibilities. Operators may reinvest those savings in upgrading their networks and providing better roll out and coverage to end-users. Network sharing agreements may also bring substantial environmental benefits, by reducing the number of sites and improving the landscape.

There are also a number of obstacles to be overcome when dealing with network sharing agreements. From an economical and practical point of view, network sharing is a large and complex process that requires a number of managerial resources. Therefore, the concrete benefits generated by network sharing should be analyzed by regulators and policy makers on a case-by-case basis, taking into account the specific characteristics of each market involved.

As shown above, promoting network sharing is a useful tool for regulators and policy makers that want to encourage network deployment and coverage improvement in un-served or under-served areas. There are several instruments that can be used to promote network sharing. National roaming arrangements are probably the most simple and effective arrangements. While national roaming leads to a certain level of uniformity between operators, it is important to analyze to what extent this uniformity leads to a significant restriction of competition. National authorities that have anti-competitive concerns may allow network sharing for a limited period (for example for a period of one or two years) of time in order to promote roll out in an initial phase of network deployment. After such an initial phase, operators would be required to provide coverage using their own networks. Other types of arrangements, such as active infrastructure sharing, an open access model (allowing and promoting the entry of MVNO's) and functional separation, may also work well to promote roll-out of wireless infrastructure and the advancement of competition. However, these types of arrangements may be difficult to enforce. Such measures require a strong regulator and efficient judicial system, with appropriate powers to impose the necessary measures.

When analyzing the examples of network sharing agreements around the world, regulators and policy makers can consider the way in which the respective markets have worked and have developed. For example, it is relevant to note that a number of network sharing agreements mentioned in developed countries have preceded later mergers between the companies involved.[78] In other cases, the companies involved in network sharing arrangements have not merged between themselves, but have seen consolidation take place in the market.[79] In the past few years, there has been a large consolidation wave in the telecommunications market across the globe.[80] It is possible that this consolidation wave could have been avoided if operators would have been allowed more freedom to share their infrastructure and to concentrate on competing as far as their services are concerned.

5.2 Best practices

This paper has identified a number of best practices to promote competitive passive and active mobile infrastructure sharing, including domestic roaming:

- ✓ Establish clear, objective and transparent policy goals involving network sharing.
- ✓ Provide guidance on types of sharing allowed.
- ✓ Establish clear guidelines for the conclusion of voluntary sharing agreements, including time limits to conclude agreements and to provide actual access.

- ✓ Create efficient dispute settlement mechanisms and judicial review, including specialized dispute settlement bodies.
- ✓ Allow and stimulate self regulation.
- ✓ Promote dialogue between authorities, community members and operators about the installation of infrastructure.
- ✓ Allow network sharing, in particular site sharing and national roaming, in rural and remote areas.
- ✓ Make thorough and objective assessment of the competitive situation, including research on consumer preference and consumer choice.
- ✓ Only impose restrictions that are strictly necessary to promote competition and proportionate to the policy goals established.
- ✓ Consider whether an open access model (such as the entry of MVNOs) or even functional separation would be viable, depending on the actual situation
- ✓ Consider providing subsidies related to network sharing in rural and remote areas calculated to cover real costs and distributed in a competitive fashion .
- ✓ Monitor compliance with the requirements established, by requiring operators to provide information on compliance on a regular basis and by creating an open dialogue with operators.
- ✓ Consider establishing websites publicizing the location of towers and antennas in a country.

In addition to the above mentioned general guidelines for best practices, this paper has identified a number of practical cases that may serve as examples to be followed with regard to network sharing:

- ✓ **United Kingdom: the Mobile Operators Association (MOA)** (www.mobilemastinfo.com), an association between the five UK mobile network operators (3, O2/Telefonica, Orange, T-Mobile and Vodafone plays an important role as representative of the operators on radio frequency health, scientific research and town planning issues associated with the use of mobile phones. MOA is a key element in sharing relevant information with local authorities, elected councilors, resident groups, amenity bodies and the public in general. MOA has developed 'Ten Commitments to best siting practice" aimed at ensuring transparency in building mobile phone networks, providing information to the public and local authorities and increasing the community's role in the siting of radio base stations.
- ✓ **The Netherlands: National Antenna Registry** (www.antenneregister.nl). The Dutch government has created a national registry of all towers and antenna installations in the country. Operators are required to provide the information to the so-called Antenna Bureau, a government institution that makes the information available to the public. Via a website, members of the community can enter their postal code and find information about the presence of antennas in their neighborhood. The Antenna Bureau provides information to the public about health, technical and legal issues relating to the presence of antennas, increasing the involvement of the community on the roll out of mobile networks.
- ✓ **The Netherlands: efficient judicial review:** all decisions by the Dutch regulator OPTA involving network sharing or other regulatory issues, are subject to judicial review in only one instance by the Trade and Industry Appeals Tribunal (CBB). The CBB is a highly specialized tribunal, with a number of judges specialized in telecommunications regulation. The CBB usually issue judgments on highly complicated issues in a fast and efficient way, providing legal certainty to the parties involved. Judgments of the CBB are not subject to appeal.
- ✓ **Spain**: **network sharing agreement between Orange and Vodafone**: Orange and Vodafone have agreed to share their mobile networks in order to provide 3G wireless services to 19 provinces in rural areas of the country.

- ✓ **India**: using universal services funds to subsidize network sharing arrangement in rural and remote areas.

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[1] Please note that it is also possible to share passive elements of the core network, such as ducts or dark fiber. This chapter will deal only with sharing of passive elements of the radio access network.

[2] Current scientific evidence indicates that exposure to radiofrequency fields, such as those emitted by mobile phones and antennas, is unlikely to have negative health effects. In response to health concerns raised by certain communities, the World Health Organization (WHO) established a project to assess the scientific evidence of possible health effects of electro magnetic fiels. See www.who.int/peh-emf/en/index.html. The International Commission for Non-ionizing Radiation Protection (www.icnirp.de) has established guidelines for the maximum level of radiofrequency levels in areas of public access from antennas and for users of mobile handsets.

[3] This principle is established in the European Union Directive [Framework directive], consideration 23: "Facility sharing can be of benefit for town planning, public health or environmental reasons, and should be encouraged by national regulatory authorities on the basis of voluntary agreements. In cases where undertakings are deprived of access to viable alternatives, compulsory facility or property sharing may be appropriate. It covers inter alia: physical collocation and duct, building, mast, antenna or antenna system sharing. Compulsory facility or property sharing should be imposed on undertakings only after full public consultation."

[4] Today's standard 3G equipment consume ca. 4,000 KWh of Grey energy per year per Node which corresponds to 2.5 tons of CO2 or equivalent need of 120 trees per Node to compensate for the environmental effect. In a developing country with no or little alternative Green energy network sharing can significantly reduce the environmental impact.

[5] This is mainly the case in Western European countries, where 2G networks have been deployed in a relatively early stage and where incumbent operators have gained a substantial advantage over new comers.

[6] This is the case in Brazil, where regulatory authorities are betting on the 3G mobile technology to provided universal mobile services in the whole Brazilian territory. The Brazilian case is dealt with in Section 4.

[7] This is more likely to be the case in roof-top constructions than in towers or mast.

[8] National roaming concerns a situation where the cooperating operators do not share any network elements as such but simply use each others' network to provide services to their own customers. National roaming arrangements allow the roaming operator to rely completely on the infrastructure of the operator providing national roaming, instead of building its own infrastructure in the roaming area. According to certain competition authorities, national roaming agreements may restrict competition between the roaming operators. This will is addressed in Section 3.2.

[9] This was the opinion of the European Commission when it judged the site sharing arrangement for 3G mobile communications between T-Mobile Deutschland and 02 Germany: Commission Decision of 16 July 2003, Case COMP/38.36.

[10] For example, in India restrictions apply for building wireless sites in certain areas, such as government areas like Lutyens zone in New Delhi and in military areas such as Cantonments. The Telecom Regulatory Authority of India (TRAI) recommended identifying such areas as Criticial Infrastructure Sites (CIS) and to mandate sharing. See TRAI Recommendations on Infrastructure Sharing, 11 April 11 2007. In the European Union, the Framework Directive of 11 March 2002 (Directive 2002/21/EC), requires Member States to impose facility sharing only where undertakings are deprived of access to viable alternatives because of the need to protect the environment, public health, security, or to meet town and country planning objectives (Recital 23 and Article 12).

[11] See TRAI Recommendations on Infrastructure Sharing, 11 April 11 2007, p. 12.

[12] TRAI recommended having service providers make a commitment that the site would be shared by at least three service providers.

[13] TRAI recommended introducing an obligation for licensees to announce on their web sites the details regarding the existing and future infrastructure installations available for sharing with other service providers. TRAI Recommendations on Infrastructure Sharing, 11 April 11 2007, p. 42.

[14] The Brazilian regulator ANATEL has established a term of sixty days for the completion of a site sharing agreement, after the owner of the infrastructure has replied positively to a site sharing request. See Regulation on Infrastructure sharing between telecommunication service providers, Anex to resolution 274 of 5 September 2001.

[15] Regulators should also bear in mind that roof tops may be less adequate for site sharing, usually due to lack of space or limitations imposed by landlords.

[16] The Dutch Regulator OPTA imposed an obligation on incumbent KPN to provide coordinates of all its sites to new entrant Dutchtone, within five days after request by Dutchtone. This applied to all sites, regardless of whether KPN considered certain sites to be inadequate for site sharing. According to OPTA, Dutchtone needed that information in order to determine the sites for which it would like to make a request for site sharing. OPTA took into account that one of the principle objectives of the Dutch Telecommunications Act was to promote competition and that site sharing should allow Dutchtone to roll out its network in order to compete with KPN (OPTA's decision of 3 November 1999, available in Dutch on www.opta.nl/asp/nieuwsenpublicaties/achtergrondinformatie/document.asp?id=236)

[17] Cf. Article 8 of the European Framework Directive, according to which one of the principle policy objectives of the European electronic communications policy is to promote efficient investment in infrastructure.

[18] In the UK, the Mobile Operators Association (MOA) plays an important role regarding infrastructure sharing. For example, MOA has developed guidelines for site sharing, called " Ten Commitments of best Siting Practice", which include guidelines for involving local communities in the process. See www.mobilemastinfo.com. Among other things, MOA has created a cross industry operated data base website for mast and site sharing. Using this data base, operators can handle sharing applications and monitor their progress online. The data base is also used to provide information on mast and site sharing to the government authorities.

[19] According to the common guidelines developed by the UK Mobile Operators Associations (MOA), when submitting a new permit application for a new mobile site, operators that cannot utilize an existing mast or structure must demonstrate the reason why to the local planning authority.

[20] One example of structural separation occurred in the Netherlands. The Dutch government ordered the national radio broadcasting company (Nozema) to be split in two separate entities: (i) Novec, a state owned company that owns the towers and masts and (ii) Nozema Services, a company which only provides transmission services to television and radio broadcasters. Nozema Services was later sold to KPN, the Dutch telecommunications incumbent. The Dutch competition authority (NMa), that reviewed the acquisition of Nozema by KPN, ordered KPN to divest its towers to an independent third party, because KPN would have incentives to prevent third parties from putting their infrastructure on the towers (NMa's decision of 7 March 2003, Case No. 5454) See: www.nmanet.nl/nederlands/home/Actueel/Nieuws_Persberichten/NMa_Persberichten/Persberichten_2006/NMa_KPN_mag_Nozema_overnemen_mits_zendmasten_verkocht_worden.asp. The NM'a decision related mainly to the market for FM-transmission, that

require higher masts and towers, making the infrastructure more difficult to replicate. However, the decision introduced a new type of company into the Dutch market, i.e. a private company which owns transmission towers and leases space and other facilities (such as power supply, air conditioning and alarm installation) to different wireless operators, such as mobile operators and broadcasters. Currently, the former KPN towers are owned and operated by Alticom B.V., a subsidiary of TDF (Teledifusion de France) S.A., a large French broadcasting and tower operator.

21 See Press Release of 13 November 2007, IP/07/1677, Commission proposes a single European Telecoms Market for 500 million consumers.

22 In the United States, the majority of mobile sites are owned by tower companies, and not by mobile operators. Among successful tower companies in North America are: American Tower, Crown Castle and Spectra Site. See on outsourcing of sites a short paper published by the consulting firm Arthur D. Little: www.arthurdlittle.de/downloads/artikel/sharing_outsourcing_mobile_network_infrastructure.pdf.

23 The company Alticom B.V., which is a subsidiary of the French company TDF S.A., has recently entered the Dutch market in order to operate a tower business for wireless transmission. TDF also operates a tower business in other European countries.

24 In fact, this model is comparable to the situation where the whole infrastructure (or a substantial part of the infrastructure) is owned or operated by a different operator. These models (functional and structural separation) are briefly dealt with in Section 3.3.

25 One illustrative example is the famous Eiffel Tower in Paris, France. The Eiffel Tower is owned by the City of Paris. It is largely used for broadcasting of radio and television, but also of mobile telecommunications and other forms of wireless transmission.

26 In the Netherlands, the manager of the national high tension electricity network, Tennet, owns certain towers that are used for radio, television, and other forms of wireless transmission. In the UK, [National grid and Arqiva] make their infrastructure available for wireless transmission and participate in discussions and agreements about site sharing.

27 A right of superficies is an encumbrance that guarantees ownership of the object on which it rests, avoiding acquisition by accession.

28 TRAI recommended civic authorities in India to charge such amounts from all service providers sharing infrastructure so that the total amount charged per tower should not be more than 1.2 times of the amount being charged from individual service providers when towers are not shared. See Telecommunication Regulatory Authority of India (TRAI), Recommendations on Infrastructure Sharing, 11 April 11, 2007, p. 29.

29 An average mobile operator would spend approximately 60% of all its technology expenses in site infrastructure. Possible 50% of these costs may be attributed to rural or remote areas, that generate much less traffic – and cosequently less revenue - than urban areas.

30 See www.dot.gov.in/osp/Brochure/Brochure.htm.

31 Section 3.2 deals with the competitive impact of national roaming agreements.

32 This option may not be available for the Members States of the European Union, providing subsidies to firms that may affect competition, can constitute a State Aid and may be illegal. Subsidies for deployment of broadband in certain remote areas may be permitted, but only after prior approval by the European Commission.

33 Many European mobile operators have contemplated active sharing of their 3G mobile networks. This was triggered, among others, by the high license costs paid for 3G licenses in Europe, the economic downturn that followed the 2000 3G-auctions and the increasing doubt about the development of the UMTS-technology and the availability of adequate handsets. The need for an much larger number of base stations for 3G as compared with 2G also made operators contemplate infrastructure sharing in order to reduce costs.

34 This is the case in India, where the licensing regime for mobile telecommunications does not permit active sharing. See Telecommunication Regulatory Authority of India (TRAI), Recommendations on Infrastructure Sharing, 11 April 11, 2007, p. 16.

35 TRAI recommended a re-look in the existing licensing regime in India as far as active infrastructure sharing is concerned. See" Recommendations on Infrastructure Sharing, 11 April 11, 2007, p. 17.

36 For example, the Brazilian regulatory Anatel has expressly allowed spectrum sharing in case operators decide to share their networks in order to provide coverage in rural or remote areas (communities with less than 30,000 inhabitants). See Tender Document for 3G mobile services of October 2007 (Tender No 002/2007SPV-Anatel, available at www.anatel.gov.br), clause no 4.13 (p. 11). Section 4 deals further with the Brazilian example.

37 Certain equipment manufacturers supply antennas that are adequate for antenna sharing. Nokia is one of the equipment suppliers that provides equipment intended for network sharing. See Nokia´s press release on the solution provided to Optus´3G network in Australia (http:press.nokia.com/PR/200511/1020905_5.html.

38 This situation may also be called "ancillary sharing".

39 This was required by the Dutch regulatory authority, when judging the proposed network sharing arrangement for 3G mobile services between operators Ben and Dutchtone. See Decision of NMa of 11 October 2002, Case No. 2816/35.

40 The French government launched a programme called "programme zone blache" or "dead zone programme" aimed at providing mobile coverage in rural zones where operators had no coverage. The intention was to provide mobile coverage to 99% of the French population by the end of 2007, covering more than 3,000 rural communities in France (see ARCEP, annual report 2006, p. 359-360, available at www.art-telecom.fr). Coverage may be achieved either through site sharing or through roaming.

41 Ofcom, the UK telecommunication regulator, has published an extensive survey on MVNO's in the UK. See Ofcom, Interim Communications Report, February 2006 (available at www.ofcom.org.uk/research/cm/interim/feb06_report/comms_mkt.pdf).

42 Ofcom, Interim Communications Report, February 2006.

43 This was recently confirmed by a market research done by the European Commission, when assessing the competitive impact of the merger between two Dutch mobile network operators, T-Mobile and Orange. See Decision of the European Commission of 20 August 2007, Case No. Comp/M.4748 – T-Mobile / Orange Netherlands.

44 This is the case in Spain, where the telecommunications regulator, CMT (Comision del Mercado de las Telecomunicaciones) imposed regulated MVNO access on the three mobile operators Telefonica Mobiles, Vodafone and Amena. See Notification of Adopted Measure pursuant to Article 7(5) of Directive 2002/21/EC, available at http://circa.europa.eu/Public/irc/infso/ecctf/library?l=/espaa/adopted_measures/es20050330/adopted_measure/_EN_1.0_&a=d .

45 Cf. the success of Virgin Mobile, in the United States and the United Kingdom.

46 For example, sharing of radio backhaul is not permitted under the licensing conditions of mobile operators in India. See TRAI, Recommendations on Infrastructure Sharing, 11 April 11, 2007, p. 21.

47 This is covered in the GSR Discussion Paper, Extending Open Access to National Fibre Backbone Networks in Developing Countries.

48 Application of spectrum liberalization and trading to the mobile sector (p. 86). Ofcom, public consultation published on 20 September 2007, available at: www.ofcom.org.uk/consult/condocs/liberalisation/liberalisation.pdf.

[49] Commission Decision of 16 July 2003 relating to a proceeding under Article 81 of the EC Treaty and Article 53 of the EEA Agreement (Case COMP/38.369: T-Mobile Deutschland/O2 Germany: Network Sharing Rahmenvertrag), OJ 2004, L 75/32.

[50] Commission Decision of 30 April 2003 relating to a proceeding under Article 81 of the EC Treaty and Article 53 of the EEA Agreement (Case COMP/38.370: 02 UK Limited / T-Mobile UK Limited: Network Sharing Agreement), OJ 2003, L 200/59.

[51] In the US 3G sharing was pre-empted by the merger of companies that initiated sharing arrangements.

[52] It is no longer possible to receive a formal exemption of the prohibition to conclude restrictive agreements under Article 81(3) of the EC Treaty. Under the current regime, firms have to make their own assessment of whether their agreement qualifies for an exemption.

[53] European Court of First Instance 2 May 2006, Case T-328/03, O2 (Germany) & Co OHG vs. European Commission, available at http://curia.europa.eu/jurisp/.

[54] European Court of First Instance 2 May 2006, Case T-328/03, O2 (Germany) & Co OHG vs. European Commission, recitals 108 and 109.

[55] European Court of First Instance 2 May 2006, Case T-328/03, O2 (Germany) & Co OHG vs. European Commission, recital 101.

[56] In fact, depending on market conditions, the competition parameters influenced by network sharing (such as coverage, network quality and transmission speed may be a minor factor influencing consumer choice. A study made in the United States (see JD Power and Associates, 2006 Wireless Prepaid Customer Satisfaction Study, press release available at: www.jdpower.com/corporate) showed that pre-paid consumers base their choice to a large extent on aspects that are not related to the quality of the network, but rather to the level of the service provided such as price, brand, customer service and account management.. Accordingly, in markets with those characteristics, network sharing arrangements may have a limited impact on the competitive situation, or no impact at all,

[57] This approach was chosen by Brazilian regulator Anatel when it issued licenses for the provision of 3G mobile services in 2008. Anatel allowed mobile network sharing in communities with less than 30,000 inhabitants. The Brazilian example is described further in section 4.

[58] Press Release of 13 November 2007, IP/07/1677, Commission proposes a single European Telecoms Market for 500 million consumers. The Commission has not proposed to introduce structural separation in the European electronic communications sector. Structural separation is a remedy that is being considered in the energy sector (see Press Releases IP/07/26 and IP/07/29).

[59] Proposal for a directive of the European Parliament and the Council, amending Directives 2002/21/EC on a common regulatory framework for electronic communications networks and services, 2002/19/EC on access to, and interconnection of, electronic communications networks and services, and 2002/20/EC on the authorization of electronic communications networks and services. Presented by the European Commission on 13 November 2007, COM(2007)697 final.

[60] Proposal for a directive of the European Parliament and the Council, amending Directives 2002/21/EC on a common regulatory framework for electronic communications networks and services, 2002/19/EC on access to, and interconnection of, electronic communications networks and services, and 2002/20/EC on the authorization of electronic communications networks and services, para. 43.

[61] This topic is discussed in the GSR paper on functional separation.

[62] The UK introduced functional separation of fixed incumbent BT in 2005. Following the announcement of functional separation, BT's share price increased. Functional separation has allowed for substantial deregulation and for a significant boost of competition: when it was introduced in 2005, only 105,000 unbundled lines existed. Since then, the number has grown to 3 million. See European Commission, 2007 Telecoms Report # 2, More competition for a stronger Europe, available at http://ec.europa.eu/information_society/doc/factsheets/tr2-morecompetition.pdf.

[63] T-Mobile and Orange have agreed to share their 3G infrastructure in the Netherlands (the actual implementation of the agreement was limited to sharing of passive infrastructure). The operations have started as a joint venture in 2001. However, the joint venture was closed down in December 2004. The reason given by the parties was that they both could acquire UMTS equipment on a more attractive basis by using deals organized by their respective parent companies (Deutsche Telekom and France Telecom). See www.planet.nl/planet/show/id=118880/contentid=532135/sc=ba371f. Orange Netherlands was eventually not able to introduce 3G services on the market on an independent basis and was acquired by T-Mobile in October 2007, reducing the number of independent network operators in the Netherlands to 3. Although the Dutch authorities had issued five 3G licenses, KPN acquired Telfort in 2005 and T-Mobile acquired Orange in 2007.

[64] See Press Release by Orange UK and Vodafone UK of 8 February 2007, available at: www.vodafone.com/start/media_relations/news/local_press_releases/uk_press_releases/2007/vodafone_uk_and_orange.html

[65] Vodafone's non-confidential response to Ofcom's consultation Application of spectrum liberalization and trading to the mobile sector (p. 86). Ofcom, public consultation published on 20 September 2007, available at: www.ofcom.org.uk/consult/condocs/liberalisation/responses/Vodafone.pdf

[66] Press release by Orange and Vodafone of 10 October 2007, available at:www.francetelecom.com/en/financials/investors/news/CP_infos/att00041022/071010_CP_Vodafone_Orange_sharing.pdf

[67] Press release of 18 December 2007, "T-Mobile and 3 create Britain's largest 3G network", available at: www.t-mobile.net/CDA/07-12-18_tmuk_3gnetwork,20,,newsid-6011,en.html

[68] The MO-Ran concept was developed by Nokia, which is reported to be the original equipment supplier by both T-Mobile and 3.

[69] See press release by both parties available at: www.t-mobile.net/CDA/07-12-18_tmuk_3gnetwork,20,,newsid-6011,en.html.

[70] FCC Public Notice – February 12, 2003, DA 03-418: " Wireless Communications Bureau grants consent for the full and partial assignment and transfer of control of licenses to implement GSM corridor" . This network sharing agreements no longer has any significance, after the merger between ATT Wireless and Cingular Wireless in the beginning of 2007.

[71] Policy Framework for the Auction of Spectrum Licences for Advanced Wireless Services and other Spectrum in the 2GHz Range, Industry Canada, November 2007, available at the website of Canada's Department of Industry: http://strategis.ic.gc.ca/epic/site/smt-gst.nsf/vwapj/awspolicy-e.pdf/$FILE/awspolicy-e.pdf

[72] These measures are included, inter alia, in Tender Document of October 2007 (Tender No 002/2007/SPV-Anatel, available at http://sistemas.anatel.gov.br/SAE/Edital/Download/Tela.asp?SISQSmodulo=6376.

[73] Telecommunication Regulatory Authority of India (TRAI), Recommendations on Infrastructure Sharing, 11 April 2007.

[74] See www.dot.gov.in/osp/Brochure/Brochure.htm.

[75] See Universal Service Obligation Fund, Implementation Status, available at www.dot.gov.in/uso/implementationstatus.htm.

[76] Malaysian Communications and Multimedia Commission, Applicant Information Package No. 1 of 2005. Available at : www.mcmc.gov.my/what_we_do/spectrum/pdf/3G%20round%202%20AIP_final.pdf

[77] TRC Statement on the implementation of infrastructure sharing and national roaming for mobile telecommunications operators in Jordan, 15 March 2005. Available at TRC's website: www.trc.gov.jo/index.php?option=com_content&task=view&id=309&Itemid=424&lang=english.

78 This was the case with T-Mobile and Orange in the Netherlands and ATT and Cingular in the USA.

79 After its network sharing arrangement with T-Mobile in the UK and in Germany, the company O2 was acquired by Telefonica.

80 Worth mentioning are: the acquisition of Bell South by AT&T; the merger between Verizon en MCI; the acquisition of O2 by Telefonica of Spain, the acquisition of Orange Netherlands by T-Mobile; the acquisition of a controlling interest in Telecom Italia by Telefonica.

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GSR 2008

Discussion Paper

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INTERNATIONAL TELECOMMUNICATION UNION

8th Global Symposium for Regulators

Pattaya, Thailand, 11-13 March 2008

Work in progress, for discussion purposes

SPECTRUM SHARING

PREPARED BY: ADRIAN M. FOSTER CMC

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International Telecommunication Union (ITU), Geneva

TABLE OF CONTENTS

page

1 ......Introduction 5
1.1 Traditional Spectrum Management Approach 5
1.2 Mobile Telephony and Broadband Ubiquity...6
1.3 The need for Spectrum Sharing 7
2 ......Demand for Spectrum 8
2.1 Introduction...8
2.2 Spectrum Management Goals and Objectives 8
2.3 Spectrum Scarcity...8
2.3.1Demand for New Services 9
2.3.2Administrative Scarcity 9
2.3.3Technical Issues 11
2.4 Service Innovation 11
2.5 Technology Innovation...12
2.5.1Analogue Broadcast Switch-off and the Digital Dividend 13
3 ......Improved Access through Spectrum Sharing 13
3.1 Introduction...13
3.2 Forms of Spectrum Sharing 14
3.3 Which bands can be shared?...14
3.4 Administratively Managed Spectrum Sharing...14
3.5 Using Markets to Improve Access...15
3.5.1Market Solutions to Rebalance Spectrum 15
3.6 Technically Enabled Spectrum Sharing 15
3.6.1Underlay Technologies 16
3.6.2Overlay Technology and Dynamic Spectrum Access 17
3.6.3Emerging Technology Enablers 17
4 ......Trends in Spectrum Policy and Regulatory Reform...18
4.1 Introduction...18
4.2 Spectrum Policy Reform 18
4.3 Spectrum Authorization Reform 19
4.3.1Spectrum Trading 19
4.3.2Interference Management 21
4.3.3Government Use of Spectrum – Is it Different? 22
4.3.4Spectrum Transfers 22
4.3.5Spectrum Commons 22
4.3.6Spectrum White-spaces 23
4.3.7Regulatory Structure 23
5 ......Best Practices - International Trends 24
5.1 Introduction...24
5.2 Best Practices – Administrative and Market-based Sharing 24
5.2.1Spectrum Planning and Allocation 24
5.2.2Spectrum User Rights 24
5.2.3License Database 24
5.2.4Dispute Resolution 25
5.3 Country Examples 26

5.3.1Mauritius – Broadband Wireless Access 26
5.3.2Brazil – Broadband Wireless Access 26
5.3.3New Zealand – Spectrum Trading and Spectrum Commons 26
5.3.4Guatemala – Spectrum Trading 27
5.3.5United States – Flexible Spectrum Use and Broadband Wireless Access 27
5.3.6United Kingdom – Flexible User Rights and Spectrum Trading 28
5.3.7Europe - Flexible User Rights and Spectrum Trading 28
5.3.8Canada – Technology Neutrality and Broadband Wireless Access 29
6 ...... Implementing Spectrum Sharing 29
6.1 Action, Market Structure Issues and Practical Steps Implementing Spectrum Sharing 29
6.1.1Planning 29
6.1.2Assessing Demand and Scarcity 29
6.1.3Valuing Spectrum and Compensation of Public Sector Users 30
6.1.4Monopolisation of the Market 30
6.1.5Market Liquidity 30
6.2 Practical Steps........ 31
6.2.1Role of the Regulator 31
6.2.2Band Allocation Strategies 31
6.2.3Channelling Plans 32
7 ...... Conclusions 32

TABLES

Table 1: Predicted spectrum requirements by the year 2020 for IMT 12
Table 2: WiMax BWA Bands 12

BOXES

Box 1: General Principles for Successful Commons Management 23

FIGURES

Figure 1: Representation of Frequency Assignments for a Single GSM/UMTS Operator 6
Figure 2: Mobile technologies worldwide, by June 2007 7
Figure 3: UK License Exempt Band Utilization 9
Figure 4: Composition of public sector spectrum holdings below 15 GHz, United Kingdom ... 10
Figure 5: Artificial scarcity 11
Figure 6: FCC Part 15, Subpart F, 15-502-15.525 UWB low-power devices 16

1 INTRODUCTION

This chapter reviews various trends in spectrum sharing methods used by spectrum managers who are responding to increasing demands for spectrum coming from the unstoppable surge in new services and technologies.

Spectrum sharing encompasses several techniques – some administrative, technical and market-based. Spectrum can be shared in several dimensions; time, space and geography. Limiting transmit power is also a factor which can be utilized to permit sharing. Low power devices in the spectrum commons operate on the basis of that principle characteristic – propagation – and as we shall see later with Dynamic Access Spectrum Sharing, take advantage of power and interference reduction techniques. Sharing can also be accomplished through licensing and/or commercial arrangements involving spectrum leases and spectrum trading.

In considering the need to share spectrum, we begin with a discussion of various sources of spectrum demand and causes of scarcity in relation to spectrum management goals and objectives. It should be helpful to briefly review administrative, market-based and technically enabled solutions for spectrum sharing and then review the important policy decisions being considered by more than a few regulators to change spectrum assignment licensing practises.

Spectrum sharing is not a universal trend for all regulators. There are varying approaches by regulators for managing the unlicensed but regulated spectrum commons ranging from imposing license and permits constraints to few if any constraints at all beyond technical specifications. The allocation of ISM (Industry, Scientific and Medical) bands for unlicensed use by low power devices such as Wi-Fi has been encouraged by the ITU across all regions. Making changes to spectrum allocations is a powerful means for encouraging spectrum sharing by different services such as fixed and mobile but as recent studies have shown many countries continue to reserve significant amounts of spectrum for exclusive (government use)[1]. The WRC-07[2] has made significant strides increasing the amount of spectrum available to broadband services. The next important step by regulators is to begin planning for the use of these bands. We make reference to country examples in both developed and developing country where progress is being made and we will point out the common success factors.

Spectrum sharing can be achieved through technical means and through licensing arrangements. Important techniques and the concepts behind them using advanced technologies such as cognitive radio are reviewed in light of the likelihood that these technologies will not be commercially available in the near future. Spectrum trading is also occurring in several countries and the experiences in several prominent examples are reviewed.

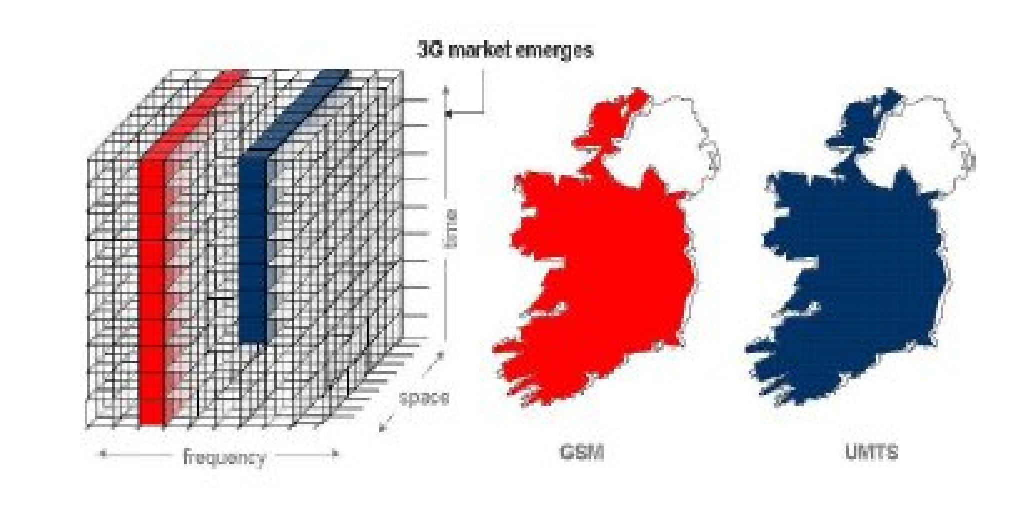
A common issue for both innovative technologies and market-based methods is arriving at the right balance. Resolving interference issues inherent in methods based on the principle of technological neutrality is an issue of great importance. Interference cannot be eliminated and so identifying interference management models which support spectrum sharing under either administrative, market-based and spectrum commons remain as an ongoing requirement and challenge for spectrum managers. These issues are discussed and examples of possible solutions are given.

The chapter finishes by reviewing some best practises for encouraging spectrum sharing by laying down suggestions for a roadmap.

1.1 Traditional Spectrum Management Approach

In the traditional administrative spectrum management model, a spectrum manager specifies detailed rules and constraints affecting how, where and when spectrum can be used and who has access to spectrum. Minimizing harmful interference lies at the heart of the traditional model which places an emphasis on the technical management of radio spectrum. As a consequence, different services are sometimes allocated to different frequency bands, although in most frequency bands, more than one radio service is allocated, and sharing between services takes place under specified technical criteria.

Figure 1: Representation of Frequency Assignments for a Single GSM/UMTS Operator



Note: No notion of Liberalization is assumed in the depiction of license features.

Source: Linda Doyle & Tim Forde: Towards a Fluid Spectrum Market for Exclusive Usage Rights. Trinity College, University of Dublin, 2007

In circumstances where the demand for radio spectrum is below the available supply and innovation is occurring steadily and predictably, as in the past, the traditional model works adequately. In recent years, however, demand for spectrum use has grown significantly, particularly in those frequency bands designated for mobile communications. Furthermore, applications such as mobile telecom services, fixed broadband wireless access services, high definition terrestrial TV services, mobile terrestrial TV services, etc.,[3] are able to work in the same frequency bands.

The economic value associated with contemporary uses of radio spectrum is often considerable and has grown significantly in recent years. The economic significance and intensified competition among the many different applications using spectrum, particularly for bands lying below 3GHz, is undermining the effectiveness of the traditional model. As the traditional approach targets technical factors and focuses primarily on harmful interference, it is relatively inflexible and less amenable for dealing with criteria such as economic efficiency.

The traditional model is viewed as inflexible by a number of commentators. The traditional model usually requires new equipment to be tested regarding interference and this can cause delays to the introduction of new services.[4] The traditional model can also lead to costly regulatory errors, such as those which have occurred in Europe, where regulators reserved certain valuable frequency bands for new services such as the terrestrial flight telephone system (TFTS) and the European radio messaging system (ERMES) that have failed to deliver the benefits proclaimed by proponents.

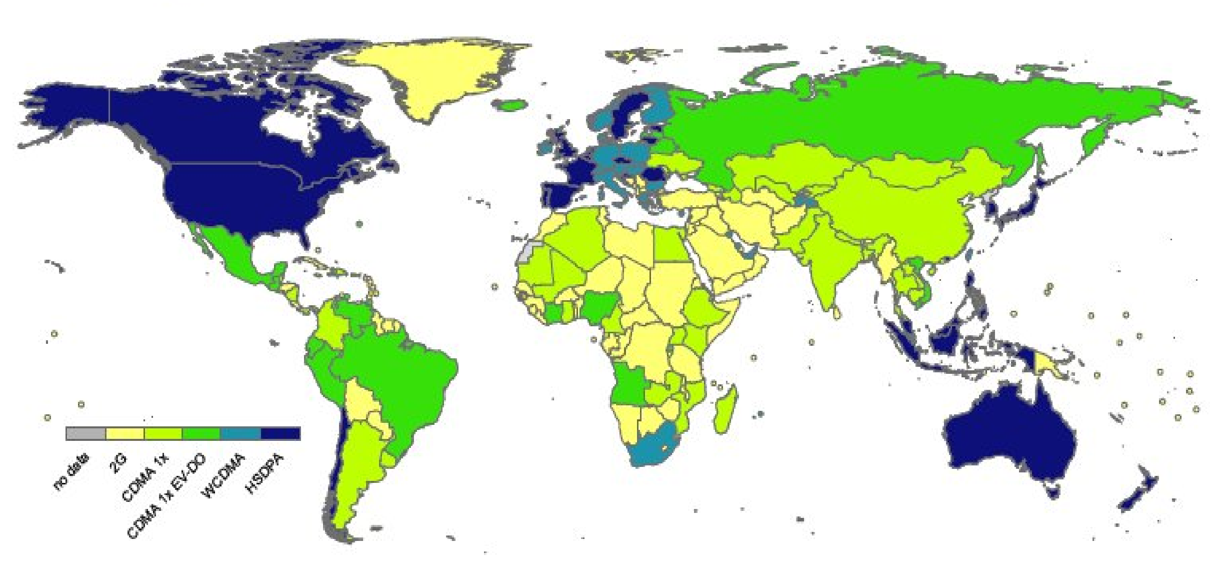
1.2 Mobile Telephony and Broadband Ubiquity

An observer cannot escape noticing the almost commonplace use of mobile cellular phones and wireless laptops whether one lives in Vienna, Vancouver or Vientiane. In 14 out of 31 OECD countries, mobile cellular subscriber penetration rates exceed 100 per cent with Luxembourg having the highest at 157 subscriptions per 100 inhabitants[5]. In developing countries, mobile cellular penetration rates approximate 32 subscribers per 100 inhabitants. And not surprisingly, the average mobile cellular use as a per cent of total telephone subscriptions in least developed countries is more than 92 per cent of total telephone subscriptions[6], a consequence of the lesser cost of wireless infrastructure.

Over the past year, the number of broadband subscribers in the OECD has increased 24 per cent from 177 million in June 2006 to 221 million in June 2007 with DSL representing 62 per cent of all broadband connections. Fixed and Mobile wireless broadband (less than 2 per cent) is expected to become increasingly important in rural and broadband cellular applications. Overall broadband penetration rates in the OECD increased from 15.1 to 18.8 subscriptions per 100 inhabitants a year later in June 2007[7].

Increased penetration and access have occurred along with significant levels of investment in telecommunications services capital equipment reaching 579 billion USD in 2005 growing at a Compound Annual Growth Rate (CAGR) of 12 per cent over the 10 year period from 1996 to 2005. This investment has unleashed widespread innovation and creativity in the development of new technologies and services including IMT and WiMax which are described alongside other innovations later on in Section 2.5 below.

Figure 2: Mobile technologies worldwide, by June 2007



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Source: ITU, based on data from 3Gtoday

1.3 The need for Spectrum Sharing

As the demand for spectrum increases and frequency bands become more congested especially in densely populated urban centres, spectrum managers are following diverse approaches to sharing frequencies: using administrative methods including inband sharing, licensing such as leasing and spectrum trading, and the unlicensed spectrum commons combined with the use of low power radios or advanced radio technologies including ultra-wideband and multi-modal radios,

In the next sections of this paper we examine in more detail aspects of the demand for spectrum and spectrum scarcity, innovations in services and technological advances, various spectrum sharing techniques and examples from several countries

2 DEMAND FOR SPECTRUM

2.1 Introduction

The broad theme of effective spectrum management is explored in this section and put into context in terms of spectrum scarcity and innovation. First, generally accepted spectrum management goals and objectives will be put forward. Second, spectrum scarcity is discussed and explained in terms of three aspects: scarcity due to increased demand, administrative processes, and technical issues, such as interference management and technical obsolescence.

Before moving on, it is important to note that the amount scarce spectrum within a country or local is relative and may also vary from one country to another. When examining various spectrum management approaches for spectrum sharing it is important for the spectrum manager to keep in mind that differences do exist between countries and between urban, rural and remote regions,

2.2 Spectrum Management Goals and Objectives

Broadband wireless access is an innovative solution for connecting the world, one of the main objectives of the ITU, extending connectivity to a greater number of people through availability of ICT services to all geographical areas. This can be accomplished through more efficient use of the spectrum resource through promotion of more effective management.

Related core spectrum management objectives include:

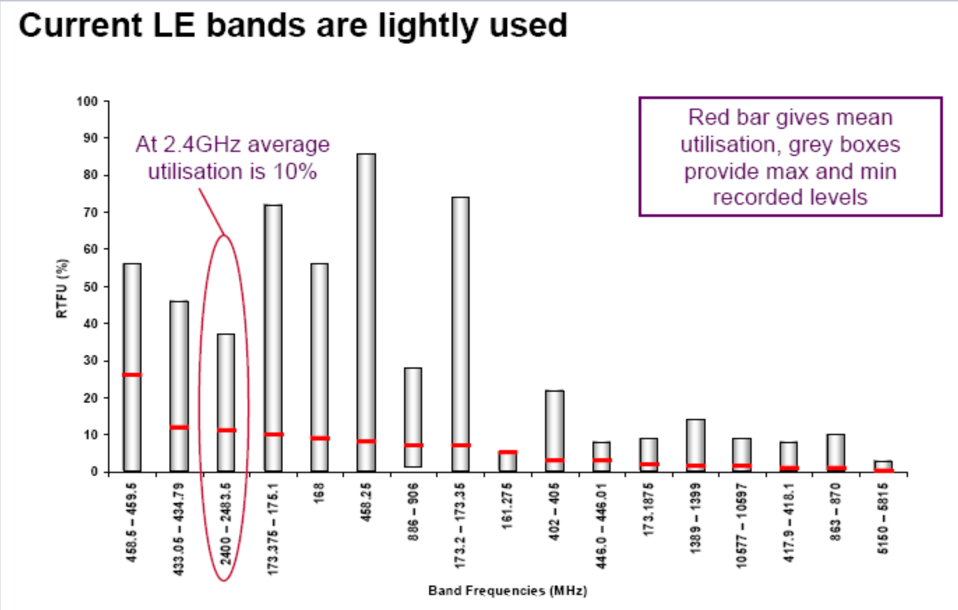
- Planning for future needs and management and monitoring the utilization of the spectrum resource in accordance with legislative and public policy objectives and international agreements;
- Improving the efficient and optimum use of the spectrum resource through adoption of advanced spectrum allocation, management techniques and licensing processes based on operational requirements and technical and economic viability;
- Ensuring flexibility and adaptability and ease of access to the spectrum resource in response to technological advances, and economic, social and market factors.
- Ensuring national interests are protected while striving for global harmonization of spectrum along with coordinated spectrum policies and utilization working with regional and international organizations and in compliance with treaty obligations, including those of the ITU.
- Supporting and promoting innovation, research and development in new radiocommunication techniques and spectrum-based services and applications
- Coordinating and establishing well balanced national spectrum and radiocommunication policies and plans by widely consulting with all interested parties and the general public.

2.3 Spectrum Scarcity

Spectrum scarcity is discussed in the next few paragraphs. It is important to recall that increased spectrum scarcity can be met in part by existing operators. As discussed later on, sufficient incentives are needed to ensure frequencies will be used efficiently by existing users or, as in the case of license-exempt spectrum reduction, in the number of restrictions and barriers on use. As well, as pointed out earlier on, there can be differences between urban and rural areas, where, in the case of the latter, spectrum is less congested. Congestion and scarcity can occur as a result of some types of services allocated for use in certain geographic areas such as maritime services in coastal areas.

The Ofcom Spectrum Framework Review in 2004 examined the potential for greater sharing and use of License Exempt (LE) bands and determined that utilization of certain LE bands was less than optimal.

Figure 3: UK License Exempt Band Utilization



Note: Ofcom Spectrum Framework Review in 2004

2.3.1 Demand for New Services

As pointed out earlier the growth in demand for wireless mobile telephony worldwide over the past decade is such that the worldwide number of mobile phone subscribers now surpasses the total of fixed-line customers. Increased competition leading to lower prices especially in the mobile and ISP sectors have resulted from a combination of positive effects from liberalization, deregulation and privatization in telecommunication services.

As the demand for services changes, it may be desirable (for example) to switch some services to higher frequencies and reform/refarm the spectrum for better-suited new services, resulting in one of the biggest challenges facing spectrum regulators: the reallocation of spectrum. It is very often difficult to reallocate these frequencies for a different use when frequencies have been used for one purpose, perhaps for decades.

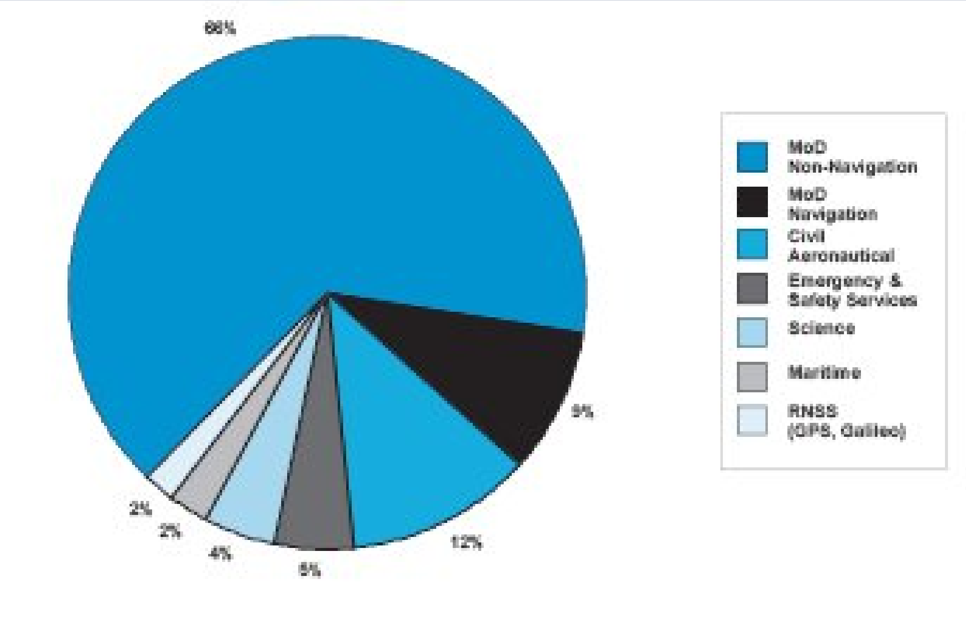
2.3.2 Administrative Scarcity

Administrative processes for determining spectrum use including changes to international and national allocations and the refarming of spectrum from current uses are lengthy and complicated exercises. Resolving disputes between users using fact finding forums, hearings and often leading to the use of dispute mechanisms are costly and very time intensive. These combine to create regulatory-induced scarcity due to excessive rigidity.

European Commission: "The deployment of innovative wireless services and technologies is increasingly hampered by the reservation of certain spectrum bands for narrowly defined services coupled with rigid usage conditions that are unduly constraining spectrum use".[8]

The reallocation (refarming) of spectrum from government exclusive use to civil and commercial uses continues to be a problem in both developed and developing countries. Significant blocks of spectrum are allocated for government use, often for military and other ministry communications systems. As reported in the Independent Audit of Spectrum Holdings (the Cave Audit) to the UK Government in 2005, government holdings of spectrum approximate 50 per cent of the spectrum below 15GHz. Figure 4 below, illustrates the relative share of spectrum between various government services.

Figure 4: Composition of public sector spectrum holdings below 15 GHz, United Kingdom

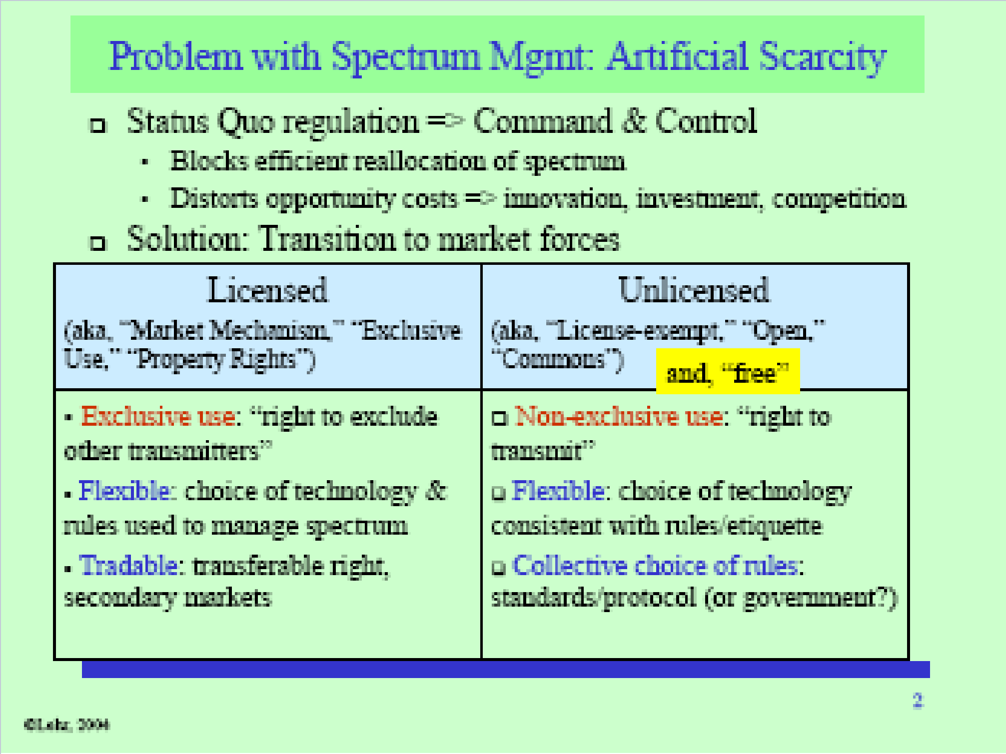


Source: Independent Audit of SPECTRUM HOLDINGS: HM Treasury, 2005, Figure 1, page 13.

Scarcity can also exist due either to delays or even reluctance on the part of stakeholders to engage in efforts to resolve issues related to access to spectrum. This has been a problem for new entrants into mobile markets. There are numerous examples of decisions made by regulators concerning spectrum "set asides" which ultimately favour one party over another creating spectrum scarcity.[9]

Two of the mechanisms gaining favour in efforts to alleviate administrative scarcity are the use of market methods such as spectrum trading or in-band migration and the spectrum commons. Trading of spectrum licenses is taking place in Australia, New Zealand, the UK and United States amongst others with Guatemala utilizing spectrum trades of commercial spectrum assignments since 1996. This topic is explored further in later paragraphs under Section 4.3. Spectrum Authorization Reform: the chart below illustrates how three models of spectrum management, administrative, market-based and spectrum commons, are related.

Figure 5: Artificial scarcity



Source: Managing Shared Access to the Spectrum Commons, William Lehr (MIT) and Jon Crowcroft (Cambridge).

2.3.3 Technical Issues

Technical issues can also contribute to spectrum scarcity. For example, licensees are typically required to comply with an applicable radio system plan and specification which, by implication, may limit the types of efficient technologies used by the licensee. While the intention is to create certain protective technical restrictions improving overall technical efficiency, lack of flexibility in spectrum management may result in scarcity. Another aspect of the same problem is technical obsolescence of equipment often utilized by governments in exclusive allocations of spectrum. The use of innovative technologies in response to these problems is discussed in the paragraphs below.

2.4 Service Innovation

Convergence of wireless telecommunications technology with Internet technology is not a new topic. For spectrum managers, the challenges are to address the evolution of technology and growth in demand, ensuring that sufficient spectrum is available for current and future generations of services while protecting public safety and security. The main issues at WRC-07 were new allocations and identification of spectrum for International Mobile Telecommunications (including IMT-2000, BWA, and IMT Advanced broadband wireless access systems, all known now collectively as IMT). The goal of the conference agenda was to earmark spectrum at a worldwide level to facilitate this development, tapping into the higher frequencies beyond 1GHz, increasing the capacity of new systems. Table I below nicely characterizes the issue:

Table 1: Predicted spectrum requirements by the year 2020 for IMT

Predicted Total ***1280 MHz Low*** *1720 MHz High*	*Identified*	*Low Demand Net Additional MHz needed*	*High Demand Net Additional MHz needed*
Region One (Europe, Africa and Middle East)	*693 MHz*	*587 MHz*	*1027 MHz*
Region Two (Americas)	*723 MHz*	*557 MHz*	*997 MHz*
Region Three (Asia)	*749 MHz*	*531 MHz*	*971 MHz*

Note: Prediction based on one network deployment

Source: ITU 2007

2.5 Technology Innovation

In some countries, a more liberalized approach towards spectrum management has evolved, most notably in the United States, and this has resulted in considerable innovative in the use of Wi-Fi, WiMax and Ultra-wideband (UWB). The use of these innovative technologies has emerged many years before similar large scale deployments, largely as a result of regulatory actions designed to promote flexibility and unlicensed use.

- Wi-Fi is a trademark moniker for a set of product compatibility standards based on the IEEE 802.11 technical standard. It is used primarily for wireless local area networks, typically using the 2.4 GHz ISM or Unlicensed Band;
- WiMax is the next evolution of Wi-Fi based on the IEEE 802.16a amended standard having a range of up to 31 miles. WiMax is primarily aimed at making broadband network access widely available without the expense of stringing wires (as in cable-access broadband) or the distance limitations of Digital Subscriber Line.

Table 2.0 lists bands identified for BWA services:

Table 2: WiMax BWA Bands

Region	*Existing Bands*	*WRC-2007 (Additional Bands)*
Region One (Europe, Africa and Middle East)	*3.5 GHz and 5.8 GHz*	*450-470 MHz, 790-862 MHz[10], 2300-2400 MHz, 3400-3600 MHz*
Region Two (Americas)	*2. 5GHz, 3.5GHz and 5.8GHz*	*450-470 MHz, 698-862MHz[11],2300-2400 MHz,*
Region Three (Asia)	*2.5 GHz and 5 GHz.*	*450-470 MHz, 790-862 MHz[12],2300-2400 MHz, 3400-3500 MHz or 3500-3600 MHz,*

Source: GSR Discussion Paper on WRC-07 Results and Impact on Terrestrial BWA Services

2.5.1 Analogue Broadcast Switch-off and the Digital Dividend

Different approaches have evolved in Europe and United States with respect to the migration from analogue to digital TV.

In Europe, a crowded place, the nature of terrestrial broadcasting signals requires careful planning of frequencies. The ITU Regional Radiocommunication Conference (GE06) establishes detailed allotments to each country based on prospective digital transmission to replace the analogue regime agreed in television in 1960. Within the European Union, the latest date for analogue switch-off is 2015. GE06 leaves significant scope for flexibility in implementing the plan.

- First, there is a high degree of flexibility regarding the location of transmitters within the service area and interference envelope in the plan.
- Secondly, a declaration was signed permitting services other than broadcasting, provided they did not cause interference to allotted broadcast frequencies and would not receive any protection from interference beyond what would be granted for broadcasting use.

In the United States, the regulator has been heavily involved with managing the transition from analogue to digital television. With adoption of the ATSC standard for terrestrial digital television transmission in 1996, the FCC set 2006 as a target date for completing the transition, with provision for reviewing this decision every two years. Recent legislation requires the end of analogue television broadcasting by 17 February 2009 and provides for a digital-to-analogue converter box subsidy. However, legislation permits television stations to retain their analogue authorization beyond that date in markets where household penetration of DTV reception equipment is less than 85 per cent.

3 Improved Access through Spectrum Sharing

3.1 Introduction

Spectrum sharing typically involves more than one user sharing the same band of spectrum for different applications or using different technologies. When a band already licensed to an operator is shared with others it is known as *overlay spectrum sharing*. For example a spectrum band used for TV distribution in one geographical area could be used for an application such as broadband wireless access in another area without any risk of interference, despite being allocated on a national basis[13].

Good questions to ask are: When is spectrum sharing or other methods for improving access to spectrum, such as spectrum trading, truly required; and, when does it make the most sense? For example, does spectrum sharing make better sense in developed or developing countries, in urban or rural areas, and are there different degrees or dimensions to spectrum sharing such as geographic sharing? Another factor to consider in determining whether it makes sense is cost which include the costs of regulation and transaction costs. Will spectrum sharing deliver on the promise of developing innovative broadband applications for developing country users', positively impacting accessibility and affordability of ICT services?

The answer to the question, when is sharing required should be conceptually fairly straightforward. Spectrum sharing is required when sufficient demand for spectrum exists, causing congestion, and the technical means exist to permit different users to coincide; and other means for adjusting spectrum use and assignment have become burdensome and costly undermining the goals of economic and technical efficiency. The implications for spectrum managers are that spectrum management policies are evolving towards more flexibility and market-oriented models to increase opportunities for efficient spectrum use.

The answers to the remaining questions involve some review and discussion and will be explored in the next few paragraphs.

3.2 Forms of Spectrum Sharing

There are generally several ways to share spectrum and to achieve the goal of improving access to spectrum by giving more users greater flexibility in its use by implementing:

- Liberalized methods for assigning spectrum rights such as leasing, trading and the spectrum commons;
- A new paradigm for interference protection taking into account new technologies such as dynamic spectrum access where underlay technologies are used based on power limits, such as UWB, mesh networks, software defined radio (SDR), smart antennae and cognitive radios.

3.3 Which bands can be shared?

There are frequency bands which are being shared by some users by maintaining geographic separation and ensuring strict adherence to operational constraints preventing interference between services. One good example is spectrum shared by satellite and fixed links where the microwave links transmit horizontally and interaction between systems is limited. As well, fixed and mobile services also share bands and do so by maintaining geographic separation and limits on power.

Potentially all bands can be shared and many bands remain underutilized, i.e. it is technically possible to share bands using combinations of administrative means (assignment – time, geographic, and interference management constraints) and technical solutions – filters, smart antenna, smart transmitters (such as SDR and cognitive radio) and transmit power limitations combined with a relaxation of interference constraints. An important exception may result from a spectrum policy decision to maintain exclusive band and assignments for public safety and security services.

The more interesting question is which bands are of interest for sharing? For BWA, bands need not necessarily be contiguous, but must have sufficient bandwidth (i.e., 2.5 MHz) to support broadband applications such as video, and should be located where good propagation characteristics exist (i.e., below 1 GHz), and wide geographic coverage. Bands with low occupancy and utilization could also be of interest (i.e. above 15 GHz).

3.4 Administratively Managed Spectrum Sharing

Administrative management of spectrum sharing generally involves regulator processes, which establish where sharing should take place, define the sharing rules to be applied for radio system performance and applicable technical standards, equipment specifications and equipment type approval. There are several steps which can be taken by the regulator to improve spectrum sharing:

- Establish policies to make spectrum allocation and licensing assignments that are based on marketplace demands and to develop fair, efficient and transparent processes for awarding licenses. This may mean beginning a process to evaluate existing allocations and determine how much spectrum can be allocated on a shared or non-exclusive basis;
- Conduct an independent audit of spectrum holdings to identify bands where immediate changes can take place.
- Conduct consultations with stakeholders to obtain necessary information to support decisions on sharing and technical standards;
- Encourage solutions based on negotiations between affected parties including the payment of compensation;

- Establish specifications which encourage the utilization of spectrum-efficient technologies and implement mechanisms such as the use of spectrum-fee incentives to begin the transition to commercial allocations, assignments and users;
- Consider the use of band managers who manage and resolve issues on the part of licensees within the band. There are several models where the spectrum management activity is delegated by the regulator to a band manager on an exclusive and non-exclusive basis:
  - The Regulator performs the tasks;
  - A Band manager is delegated the tasks;[14]
  - Sharing is non-exclusive: either the regulator or band manager define the rules;
  - Exclusive licenses, such as for a mobile operator, which largely determine the technologies to be used and how to utilize assigned frequencies for various applications and networks.

3.5 Using Markets to Improve Access

As a starting point, economically efficient use of spectrum means the maximization of the value of outputs produced from available spectrum, including the valuation of public outputs provided by the government or other public authorities. From an economic efficiency viewpoint, spectrum should be divided in such a way that the benefits to the overall economy are the same from different uses of spectrum for an equivalent incremental amount of spectrum assigned to either use. Market-based approaches such as auctions[15] and spectrum trading are viewed by economists as superior to administered methods with regards to achieving economic efficiency.

3.5.1 Market Solutions to Rebalance Spectrum

Market methods are being employed both at the primary issue of spectrum licences, when auctions are used, and, more significantly, by allowing spectrum rights to be bought and sold in the lifetime of a licence and allowing a change of use of the relevant spectrum.

In cases where spectrum is a scarce resource, and like all scarce resources in a competitive market, efficient allocation decisions are premised on prices. Well designed and properly managed auctions are appealing since they ensure that frequencies go to the firm which bids the most, and that may in certain conditions be the most efficient firm. Efficiency is further enhanced if the successful licensee chooses which services to provide and technologies to use[16].

Spectrum trading contributes to economic efficient use of frequencies since trades should only take place if the spectrum is worth more to the new user than it was to the old user, reflecting the greater economic benefit the new user expects to derive from its use. In the absence of misjudgements or irrational behaviour or external effects, some commentators view that spectrum trading contributes to greater economic efficiency.

3.6 Technically Enabled Spectrum Sharing

Technically efficient use of spectrum, at a basic level, implies the fullest possible use of all available spectrum. Two measures of technical efficiency are occupancy and data rate. Time, for example, can be used as a measure of technical efficiency in the sense of how constant or heavy the usage of spectrum is over time. Data rate means how much data and information can be transmitted for a given amount of spectrum capacity. Spectrum sharing technologies including spread spectrum, dynamic access and Ultra-wideband (UWB) are introduced and described in the next paragraphs.

3.6.1 Underlay Technologies

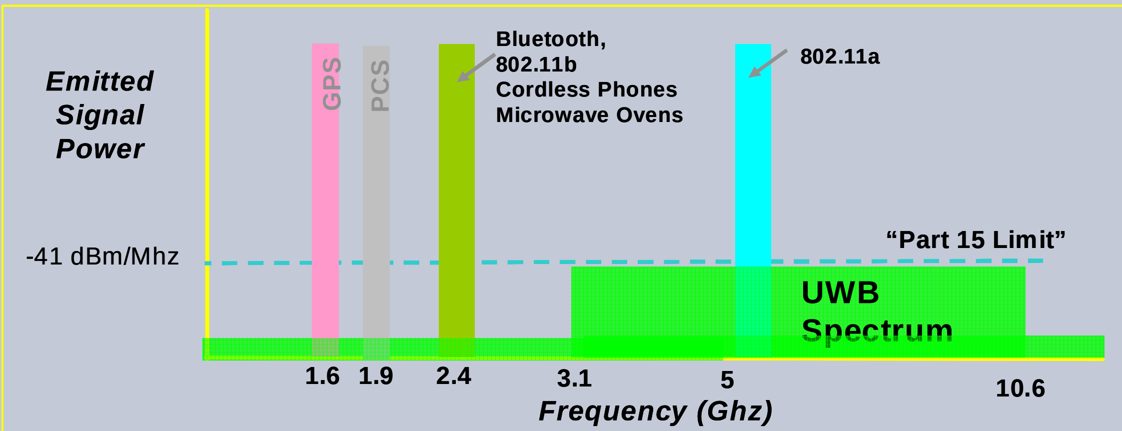
Spectrum underlay technique is a spectrum management principle by which signals with a very low spectral power density can coexist, as a secondary user, with the primary users of the frequency band(s). The primary users deploy systems with a much higher power density level. The underlay leads to a modest increase of the noise floor for these primary users.

Ultra-wideband

Ultra-wideband spectrum is an active overlay technology which transmits information spread over a large bandwidth (>500 MHz) while sharing spectrum with other users. The FCC[17] defines UWB in its Part 15 Rules – see Figure 5 below. The ITU defines UWB in terms of a transmission from an antenna for which the emitted signal bandwidth exceeds the lesser of 500 MHz or 20 per cent of the center frequency.

Due to the extremely low emission levels currently allowed by regulatory agencies, UWB systems tend to be short-range and indoor applications. However, due to the short duration of the UWB pulses, it is easier to engineer extremely high data rates, and data rate can be readily exchanged for range by simply aggregating pulse energy per data bit using either simple integration or by coding techniques.

Figure 6: FCC Part 15, Subpart F, 15-502-15.525 UWB low-power devices



Source: Microsoft

Spread Spectrum

Spread spectrum is a technique of spreading a signal out over a very wide bandwidth, often over 200 times the bandwidth of the original signal. A spread spectrum transmitter spreads the signals out over a wide frequency range using one of the following techniques:

- Direct sequence spread spectrum - Spread spectrum broadcasts in bands where noise is prominent, but does not rise above the noise. Its radio signals are too weak to interfere with conventional radios and have fewer FCC (Federal Communications Commission) restrictions. Data is altered by a bit stream that represents every bit in the original data with multiple bits in the generated stream, thus spreading the signal across a wider frequency band.
- Frequency hopping spread spectrum - using this technique, the original data signal is not spread out, but is instead transmitted over a wide range of frequencies that

change at split-second intervals. Both the transmitter and the receiver jump frequencies in synchronization during the transmission.

CDMA (Code Division Multiple Access) is a digital cellular standard that uses wideband spread spectrum techniques for signal transmission.

3.6.2 Overlay Technology and Dynamic Spectrum Access

There are two types of overlay, passive or active (dynamic).

- The Amateur radio service has shared spectrum with various government users using passive overlay technologies which require the user to look for a CB radio channel that is free. A passive overlay technology is different from an active overlay technology.
- Active overlay technologies are beginning to emerge and be trialed. A major trial is currently taking place in Ireland involving several major manufacturers of equipment and devices. There are several possible approaches being studied.

In 2007, as part of Pakistan's consultation on infrastructure sharing for mobile companies, the concept of spectrum pooling, which is a form of spectrum sharing achieved by overlay, was considered. It was pointed out in the consultation report that no country has yet to permit this type of sharing.[18] .

Dynamic Spectrum Access[19]

Dynamic spectrum access, which is in its early stages of development, is an advanced approach to spectrum management that is closely related to other management techniques such as flexible spectrum management and spectrum trading. It involves unitizing spectrum in terms of time slots and/or geographically. This allows users to access a particular piece of spectrum for a defined time period or in a defined area which they cannot exceed without re applying for the resource.

It permits communications to work by:

- Monitoring to detect unused frequencies;
- Agreeing with similar devices on which frequencies will be used;
- Monitoring frequency use by others;
- Changing frequency bands and adjusting power as needed.

The benefit of increased access to spectrum and better efficiency need to overcome several hurdles including:

- Potential for increased interference and effect on quality of service and compliance with regulations;
- Technical issues related to unseen devices competing for similar frequencies (the hidden node problem) and development of complex equipment.

Dynamic spectrum access is often associated with, although not exclusively dependent on, technologies and concepts such as Software Defined Radio (SDR) and Cognitive Radio, which are described in the next paragraphs.

3.6.3 Emerging Technology Enablers

In addition to the spectrum sharing techniques described in the previous paragraphs there are emerging technologies which are important to enabling these techniques as well as fostering potential new methods for spectrum sharing. The most prominent enabling technologies are described in the next few paragraphs.

Software-defined Radio (SDR) and Cognitive Radio (CR)[20]

Software defined radio are radio systems implemented on general purpose hardware where specific operational characteristics are implemented in software – different radio systems and standards are essentially loaded as software programmes (e.g. a GSM program or a Wi-Fi program). A radio increases its flexibility as more of its functionality is software-based.

SDR technologies are slowly making their way into commercial radio systems as technology developments make it economical for manufacturers to do so.

SDR enables more flexible spectrum allocation since these radio systems potentially use spectrum more intensively and are more tolerant of interference.

A cognitive radio is a radio that is to some degree aware of the environment by monitoring transmissions across a wide bandwidth, noting areas of unused spectrum and is able to modify its transmission using appropriate modulation and coding methods. From a user standpoint the certainty of finding unused spectrum in congested areas may fall low enough to impair its usefulness of as a mainstay communications device.

Smart Antennas and Other Technologies

Smart Antenna applications and technology have emerged in the past ten years and are interesting for their ability to significantly increase the performance of various wireless systems such as 2.5 generation (GSM-EDGE), third generation (IMT 2000) mobile cellular networks and BWA. Smart Antenna technologies exploit multiple antennas in transmit and receive mode with associated coding, modulation and signal processing to enhance the performance of wireless systems in terms of capacity, coverage and throughput. The Smart Antenna is not a new idea but has been more cost effective with the advent of digital-signal processors and general-purpose processors and application-specific integrated circuits (ASICs).

Multi-modal radios are capable of operating across multiple bands and technologies. The tri-band and world mobile phone are examples of multi-modal radios. Frequencies continue to be divided in discrete elements, reducing the need to harmonize frequency allotments, while harmonizing technical standards on a regional or global basis is not as critical.

4 TRENDS IN SPECTRUM POLICY AND REGULATORY REFORM

4.1 Introduction

In recent years, spectrum management policy and regulation have evolved considerably by reflecting the changes in the demand and supply of services reliant upon radio spectrum. Many significant developments have occurred in both the reform of the institutions and in spectrum authorizations including increased use of market-based mechanisms and greater flexibility by reducing the constraints on applications of new technologies.

4.2 Spectrum Policy Reform

There has been a recent shift away from relying predominantly on the traditional model, most notably in countries where demand for radio spectrum use is rising fast. These trends in spectrum management policy are discussed below.

Two features of more progressive spectrum management policies are liberalization and flexibility.

Liberalization is the extent to which spectrum usage rights can be managed through market-based mechanisms[21]. This covers issues ranging from competitive assignments (such as auctions) to secondary trading. Within this environment, management is delegated as much as possible to participants within the spectrum arena. Spectrum management agencies in this setting perform the role of 'light-handed' regulation.

Flexibility involves the relaxation of constraints on usage and technologies (either as a commons or in the form of managed shared use), as well as the possible expansion of licence-exempt frequencies. Very few countries have opened up large parts of the spectrum as a genuine commons.[22] Most notably the United States has embarked on a path of considerable innovative activity. The use of WiFi, WiMAX and UWB in the US has emerged many years before its deployment in most other countries, due both to the size of the market and as a result of regulatory actions designed to promote flexibility and unlicensed use.

The benefits of liberalization are strengthened in the presence of greater flexibility and the benefits of flexibility are greater within a liberalized environment. Thus liberalization and flexibility are closely intertwined.

4.3 Spectrum Authorization Reform

The European Commission regards technology and service restrictions as increasingly incompatible with convergence. A trading regime is anticipated that will embrace flexibility, i.e., the right of a spectrum holder to use its spectrum for any service subject to technical constraints. Policy in the EU embraces the principle of technological neutrality and service neutrality.

- Technological neutrality means that there should be a minimum of constraints applied while ensuring that interference is appropriately addressed. However, in some cases, the necessary interference management imposes constraints that in practice are more beneficial for one technology than for another.
- Service neutrality means that the choice of service offered via spectrum usage rights is made by the rights holder. It is widely recognized that constraining the services for which the spectrum can be used is generally not justifiable from the standpoint of technical spectrum management. According to the EC, “in the field of terrestrial electronic communications, these categorizations are rapidly becoming obsolete.”[23]

Lack of flexibility in spectrum management has, according to the EC, led to a spectrum bottleneck for new radio technologies.[24] Detailed ex ante administrative decisions and a requirement for prior regulatory approval often delays or even prevents the introduction of new products. To render spectrum distribution more flexible, the application of spectrum markets (secondary trading) and licence-exempt use (the “commons” model) have been embraced by the EC.[25]

4.3.1 Spectrum Trading

Spectrum Trading is a mechanism whereby rights and any associated obligations to use spectrum can be transferred from one party to another by way of a market-based exchange. In contrasting spectrum re-assignment with spectrum trading; in a trade, the right to use the spectrum is transferred voluntarily by the present user, and a sum is paid by the new user of the spectrum which is retained, either in full or in part, by the present (transferring) user.

Efficiency Gains

Spectrum trading denotes a mechanism whereby rights to use spectrum are transferred from one party to another for a certain price. This contributes to a more efficient use of frequencies because a trade will only take place if the spectrum is worth more to the new user than it was to the old user, reflecting the greater economic benefit the new user expects to derive from the acquired spectrum.[26] These efficiency gains will not be realized, however, if transaction costs are too high and one of the aims of any spectrum trading regime should be to keep down transaction costs. After all, the goal is to facilitate transfers by establishing a swift and inexpensive mechanism. If neither the buyer nor the seller behave irrationally or misjudge the transaction, and if the trade does not cause external effects (e.g., anti-competitive behaviour or intolerable interference), then it can be assumed that spectrum trading contributes to greater economic efficiency and boosts transparency by revealing the true opportunity cost of the spectrum.

Indirect Benefits

Furthermore, trading has other relevant indirect effects:

- it enables licensees to expand more quickly than would otherwise be the case;
- it makes it easier for prospective new market entrants to acquire spectrum;
- if spectrum trading were combined with an extensive liberalization of spectrum usage rights, there would be a considerable incentive for incumbents to invest in new technology in order to ward off the threat of new entrants in the absence of other barriers to entry (i.e., the unavailability of spectrum); this, in turn, would boost market competition.

Forms of Spectrum Trading

In a consultancy report commissioned by the European Commission, Analysys et al.[27] identify the following methods for transferring rights of use:

- Sale – Ownership of the usage right is transferred to another party.
- Buy-back – A usage right is sold to another party with an agreement that the seller will buy back the usage right at a fixed point in the future.
- Leasing – The right to exploit the usage right is transferred to another party for a defined period of time but ownership, including the obligations this imposes, remains with the original rights holder.
- Mortgage – The usage right is used as collateral for a loan, analogous to taking out a mortgage on an apartment or house.

In terms of the trade itself, there are a variety of mechanisms that can be used. These include:

- Bilateral negotiation: The seller and (prospective) buyer directly negotiate the terms of the sale and are not subject to any particular constraints set by the regulator.
- Auctions: Once a type of auction has been chosen and the rules have been decided primarily by the seller, prospective buyers have the opportunity to acquire the spectrum usage rights by bidding in the auction.
- Brokerage: Buyers and sellers employ a broker to negotiate, with their consent, the contractual terms under which the transfer of usage rights can take place.
- Exchange: This refers to the establishment of a trading platform, similar to a stock market, where transfers take place according to specific rules.

These mechanisms are most likely to be used in combination. In the first instance an auction will be used as the primary means of assignment, tradable spectrum is listed on an exchange and either direct negotiation or brokerage facilitates the transfer of spectrum user rights. As discussed earlier, band managers may be delegated responsibility for managing certain bands on behalf of the regulator.

Property Rights

Minimal enforceable and identifiable property rights are central to trading radio spectrum. Without them considerable additional costs would be incurred by prospective buyers ultimately depressing the amount of trading activity. As well, spectrum could become valueless if others were able to infringe on the spectrum property by way of interference with it. Finally, it is desirable for property rights to be set in ways which minimize the subsequent reshuffling of rights. This is in the interests of greater efficiency since such trading and the bargaining which underlies it may have a transaction cost.[28]

The regulator will have a role in establishing property rights and in maintaining data and registries to facilitate ongoing efficient spectrum market operations.

Tradable Licenses and Spectrum Prices

This is the core to the market-based approach where spectrum licences are fully transferable (primary users may replace each other), and sub-leasing/sub-division should be possible.

The core characteristic of enabling market mechanisms for exclusive licences is to allow such licences to be tradable and amenable to division and aggregation (although with respect to aggregation, there may need to be controls to protect against the creation of undue market power).[29] For tradability, it is best that the primary licensee be able to transfer its licence to a new primary licensee.

The goal of tradable licences has several beneficial implications:

1. First, if licence ownership may be transferred, it is possible for market forces continuously to provide incentives for spectrum to be allocated to its highest value use, and for whatever use for which it is currently employed to reflect its true opportunity cost. This induces powerful incentives to use spectrum efficiently.
2. Second, the more spectrum that is tradable in this way, the more liquid will be secondary markets and the lower the average opportunity cost or scarcity rents associated with spectrum access rights. Encouraging spectrum prices to be as low as possible, consistent with aggregate demand and supply factors, will enable low-cost access for new applications and services which is an important overall goal of spectrum reform.

In short, trading lowers the costs for selling and acquiring new spectrum. Despite these benefits, the transition to tradable licences may need to take place in a two-phase approach as is discussed below.

4.3.2 Interference Management

An exclusive use license defines the rights to occupy the spectrum volume for a user. The primary user has a presumptive right to exclude other users from occupying their electrospace. Secondary users may have the right to occupy the electrospace if they can do so without causing interference to primary users, although they have no interference protection rights of their own.

Spectrum managers are fundamentally concerned with managing interference and in establishing the methods, techniques, information and processes needed to protect users and uses from harmful interference. Harmful interference arises in radio systems when a transmitter's ability to communicate with its intended receiver(s) is limited because of the transmissions of other transmitters. The problem may be thought of as arising from the limitations of the receiver: better receivers are more able to extract the desired signal from a noisy environment of background radiation and other transmitters.[30]

There are three categories of interference that are of principal concern:

1. In-band interference from adjacent areas;
2. In-band interference from adjacent frequencies;
3. Out-of-band interference.

Taken together, by properly defining the electrospace[31] along with the size of the volumes, it is possible theoretically to specify transmitter (Tx) and receiver (Rx) occupancy rights so that a Tx/Rx must operate in different and distinct electrospace volumes to ensure non-interfering operation.

Interference cannot be eliminated and so identifying interference management models which support spectrum sharing under either administrative, market-based and spectrum commons remain as an ongoing requirement and challenge for spectrum managers. The goal is to develop an appropriate regime which protects user rights and finds the right balance for flexibility, innovation, and service neutrality. Finding the balance and structuring the appropriate response continues to be debated.

4.3.3 Government Use of Spectrum – Is it Different?

In a market economy, inputs such as land, labour and capital equipment are distributed throughout the economy via a market process: the provider of capital or employee moves to whichever activity offers the best rewards. Spectrum is one input among others (water, electricity) in a variety of production processes. Market systems, when workably competitive, promote economic efficiency as inputs are put to use where they yield the highest returns[32].

Does this argument apply in the case of public sector trading? At first sight it may seem incongruous to require a public sector body such as a fire service or a defence force to compete in a market place for spectrum with commercial providers of services such as mobile broadcasting.

However this is exactly how public sector organizations acquire other inputs – such as employees, vehicles, land, and office space.

The arguments for special arrangements for spectrum for the public sector seem to be that:

- it is indispensable to the provision of service such as defence radar;
- the service itself (such as an ambulance service) has a very high priority and
- under past spectrum management practice, the only way to acquire spectrum was by administrative methods.

The use of markets to allocate other equally indispensable inputs into vital public services appears to negate the first two and the third could be resolved by the development of a spectrum market place.

Government use of spectrum utilized to provide services similar to those provided by the private sector should be, at a minimum, subject to prices reflecting the market price or opportunity cost and such spectrum should trade in secondary markets.

4.3.4 Spectrum Transfers

Spectrum Transfers are generally understood to mean some form of lease or sublease arrangement including features such as frequency assignment transferability or divisibility.

- Transferability - licences may be transferred (disaggregated);
- Divisibility or divided (partitioned) – licenses may be subject to either approval or notification to the appropriate authority subject to service and technical restrictions. Since spectrum can be assigned nationally or on a regional/local basis, a given assignment can be partitioned and shared by users at different locations[33].

Other examples include:

- Irish model: encouraging smaller market players to provide broadband fixed wireless access in very small service areas (recently updated to cover a 21km radius around a base station)[34].

4.3.5 Spectrum Commons

A spectrum commons is a part of the spectrum that is free from centralized control where anyone can transmit without a license. For this reason it is sometimes referred to as license-exempt or unlicensed spectrum.

In practice what is referred to as a spectrum commons can have varying degrees of management. Licence-exempt bands (e.g. the ISM bands[35]) are an example of a spectrum commons with some management in terms of power restrictions on individual users as applied in the US under the FCC Part 15 rules. In Europe there is a further degree of control in that devices used for communication in these bands must conform to certain technology standards (e.g. ETSI approval). So far this approach has only been used in limited bands for short range applications. However, significant innovation has emerged in these bands (e.g. Wi-Fi) which have led some to call for more spectrum to be managed similarly.

Ofcom has published general guiding principles for successful management of the spectrum commons which appear in Box 1.

Box 1: General Principles for Successful Commons Management

1. Clearly defined boundaries – the rights to withdraw resources as well as boundaries need to be carefully and clearly defined.
2. Congruence between appropriation and provision rules and local conditions.
3. Collective-choice agreements – those affected can influence rule changes.
4. Monitoring – active ongoing monitoring of conditions and behavior.
5. Graduated sanctions – sanctions by users and officials for violating operational rules.
6. Conflict resolution mechanisms – rapid access to low-cost arenas for resolving disputes.
7. Minimal recognition of the rights to organize – governments accepts users' rights to devise their own governance institutions.
8. For larger systems including a commons use multiple layers for 1-7 above.

Source: Ofcom 1990

4.3.6 Spectrum White-spaces

Most radio and TV broadcast channels are separated by small amounts of unused channels called white space which are used to limit interference between active channels. Technology companies and consumer advocates believe the use of this underutilized and unassigned spectrum could be used for new services such as BWA. Not surprisingly, TV broadcasters oppose allowing any unlicensed device to use white-space spectrum because, they argue, these devices would interfere with television broadcasts, potentially harming the federally mandated transition from analog to digital TV service.

4.3.7 Regulatory Structure

Regulatory institutional reform leading to the combination of telecommunications, broadcasting and spectrum regulators can help facilitate spectrum sharing. There are several examples of where this has occurred or is being considered.

- In Australia the Spectrum Management Agency, Australian Communications Authority and the Australian Broadcasting Authority were merged in several steps beginning in 1997 to create the Australian Communications and Media Authority;
- The Canadian Telecommunications Policy Review Panel Report recommended to the government that Industry Canada transfer its spectrum regulatory functions to the CRTC.
- The UK has recently set up such a combined regulator (Ofcom) which regulates broadcasting, (wireline and wireless) telecommunications and spectrum.
- In Germany, regulation of spectrum is combined with regulation of telecommunications (and of other infrastructures), but separate from regulation of broadcasting.

It is debatable whether the duties of such an independent spectrum regulator should be combined with those of regulating competition and protecting consumers in downstream service markets.

5 BEST PRACTICES - INTERNATIONAL TRENDS

5.1 Introduction

In most countries, the use of radio spectrum has been, and in many cases remains, very closely managed and supervised, in accordance with an agreed international framework established by the Member States of the International Telecommunication Union (ITU). Such management is predicated on a need to minimize harmful interference and has resulted in the application of what is sometimes referred to as the "command and control" model. In recent years, there has been a shift away from relying predominantly on the traditional model, most notably in countries where demand for radio spectrum use is rising fast.

5.2 Best Practices – Administrative and Market-based Sharing

The aim of this section is to describe best practices in a system of reformed spectrum management that incorporates a greater reliance on spectrum sharing techniques which increase flexibility and are forward-looking. This section will describe (and evaluate) the different routes taken by some countries and regions which have modified and reformed their system of spectrum management to operate more flexible systems that permit a more efficient use of radio spectrum.

5.2.1 Spectrum Planning and Allocation

Spectrum planning processes provide direction and cohesion in support of policy formulation and support future steps to achieve optimal spectrum use. Major trends and developments in technology and the needs of current and future users of the frequency spectrum should be closely monitored and mapped. The types of user requirements for frequency management systems, such as monitoring systems, channel plan techniques, and tools must also be planned and developed.

5.2.2 Spectrum User Rights

When existing licences become tradable and are subject to a change of use, rights should be established consistent with current uses; this will avoid conflicts of rights and permit parties to renegotiate rights when circumstances change. Discussion of spectrum user rights is a very detailed topic dealing with questions such as:

- Easements for new technologies[36] – whether to allow them?
- Vacant spectrum – whether it should be placed in the market place (subject to international agreements)?
- Fall back or insurance policies such as compulsory purchase of spectrum when there are hold-out owners of spectrum - should it be confined to national security needs?
- Spectrum licensees - should users pay a perpetual annual charge, or will these charges discourage efficient trading.

Discussion of these topics and answers to these questions are beyond the scope of this discussion paper.

5.2.3 License Database

The ability of potential sellers and buyers (and regulators) to keep track of current licences is an important component of tradable markets facilitated by a publicly available database. Knowledge of the location of existing Tx's and Rx's (where feasible) will allow potential purchasers of rights to accurately model the existing interference environment they are seeking to enter and to enable them to properly assess the rights they seek to acquire.

The information should enable regulators if called upon to adjudicate spectrum disputes and to enable them to track and assess the usage of spectrum in differing bands.

Finally, the database should include additional tools to analyze data on spectrum historical occupancy/usage and to interpret alternative propagation models.

In the US a spectrum auction and trading system is operated by Cantor-Fitzgerald, the Wall Street brokerage, providing an example of the sorts of capabilities that are needed at a minimum[37]. Cantor Spectrum & Tower Exchange provides an open or closed transparent forum for both primary (auction) and secondary (post-auction) market spectrum transactions in both public and private marketplaces.

- Sellers/Lessees can review FCC licensee information obtained by the exchange and see a snapshot in real-time.
- Qualified licence sellers/lessors or public sector entities offer radio frequency spectrum and digital sub-channel capacity in a multi-dimensional format showing coverage area, population, frequency range, radio service rules, terms and conditions, channel, time slot, etc.
- Buyers/lessees search for specific assets (or receive electronic notification), and can easily evaluate and bid on them.

This type of system helps facilitate the critical matching function that liquid markets depend on.

5.2.4 Dispute Resolution

It is quite likely with the arrival of the spectrum commons and increased sharing of spectrum through transfers and trades, effective means other than regulatory adjudicative intervention will be required to resolve issues between parties.

There are two trends at work:

- rapid changes in telecommunications sector and
- changes in the realm of dispute resolution procedures.

The expansion of the global telecommunications market with its emphasis on innovative and fast-changing technology may need to be accompanied by dispute resolution procedures which are fast and flexible – and suited to the types of disputes which the global telecommunications industry will produce. In turn, the dispute resolution field is increasingly offering new models that may be useful to the telecommunications sector's new needs.

While most regulators decide between the positions of disputing parties, typically after a formal process that involves the presentation of arguments by those parties, there is a trend towards more flexible and consensual methods – alternate dispute resolution (ADR) including: negotiation and arbitration. Most telecommunications licenses include guarantees of access to arbitration. Even so, it is helpful to have developed guidelines for managing ADR processes such as those issued by Ofcom governing ADR between public telecommunications operators and the public:

- Independent and impartial;
- Transparent, providing regular communication to the public throughout the process;
- Effective (with an expectation from Ofcom the disputes will be resolved in less than six weeks);
- Able to properly investigate disputes and make awards of appropriate compensation.

New Zealand provides an interesting example where the devolution of interference management has been taken one step further. Under its framework of tradable "management rights", a "management right" owner would essentially assume the role of the regulatory administration in setting boundary conditions for its "licensees" within the band for which it holds "management rights".

This approach effectively reduces the interference management burden on the administrative regulator. Nevertheless, it has been noted that in one case, the regulator had to intervene significantly:

- Management rights for cellular bands around 900 MHz allowed the operation of AMPS and GSM systems in adjacent bands. Interference problems resulted and the regulator intervened by releasing spare spectrum to act as a guard band.

5.3 Country Examples

The following country examples reflect many best practices described in the preceding section, examining current practices for spectrum trading and spectrum commons. Given the recent focus at the international level on identifying bands for Broadband Wireless Access, this section also looks at the leading practices of several developing and developed countries where BWA is being implemented.

5.3.1 Mauritius – Broadband Wireless Access

In early 2005 with spectrum pollution occurring in the 2.4GHz band, the Information and Communication Technologies Authority (ICTA) conducted public consultations to receive input on proposed BWA frequency band allocations, technical characteristics and regulatory requirements. ICTA issued its decisions within three months. Those decisions opened the 2.5GHz band for Mobile and Nomadic BWA (IMT-2000) applications by 2010, the 3.5GHz band immediately for Fixed BWA and the 5.1 - 5.3GHz band for low power in-building applications. In 2006, ICTA additionally opened the 5.4GHz and 5.8 GHz bands for BWA. Band plans and technical rules were established limiting allowable power levels, separation and channelization.

As of 2007, there are two mobile licensees providing IMT-2000 and WiMax services on a national basis.

5.3.2 Brazil – Broadband Wireless Access

In January 2008, ANATEL in Brazil issued four licenses per licensed area for 3G wireless deployment throughout the whole country. Coverage obligations for all licensed operators will lead to the whole Brazilian territory being covered (probably eight years after the licenses have been issued). Operators are allowed to share network components such as towers as well as spectrum in order to provide services in municipalities with less than 30,000 inhabitants. ANATEL will likely issue new regulations on the conditions for spectrum sharing and sharing of active elements of the network. Spectrum sharing arrangements must be authorized by ANATEL. The rules governing the 3G auction in Brazil refer expressly to spectrum sharing as a means of providing coverage in rural and remote areas (i.e. municipalities with less than 30,000 inhabitants).

ANATEL issued a number of licenses for WiMax in the 2.6MHz band and five licensees in the 3.5MHz band. A new auction for additional 3.5MHz spectrum is planned for 2008. Some of the licenses have already started authorized trials.

5.3.3 New Zealand – Spectrum Trading and Spectrum Commons

The Radiocommunications Act 1989 was pioneering and radically changed the landscape of spectrum management. New Zealand was the first country to redefine spectrum in terms of property rights and to assign it in a tradable form. New Zealand also pioneered the application of competitive assignments based on auctions for radio spectrum, with the first auction held in 1989.

There are three licensing systems that apply to spectrum in New Zealand:

- The Management Rights Regime (MRR) (applicable to spectrum used primarily for commercial purposes);

- The Radio Licence Regime (RLR), earlier known as apparatus licensing, (an administrative assignment process which applies to spectrum used for applications in the public interest); and
- General User Licences for devices such as low-powered devices: garage door openers and Wi-Fi).

5.3.4 Guatemala – Spectrum Trading

Guatemala and El Salvador are two small Central American countries (with populations of 12,728,111 and 6,948,073 respectively) which decided in 1996/97 to adopt a simple but effective form of spectrum market which, in the case of non-public sector spectrum, gave private parties exclusive control over use of bandwidth and confined the regulator to defining, issuing and protecting spectrum rights. This account focuses on Guatemala; the regime in El Salvador is similar but less well documented.[38]

The so-called titulos de usufuncto de frecuencias (TUF) created could be leased, sold, subdivided or aggregated at will and last for 15 years (renewable on request); they are thus virtually private property. Regulation is restricted to setting aside bands for use by the state and adjudicating interference disputes which are not resolved by mediation.

A physical TUF is a paper certificate listing the frequency band, hours of operation, maximum transmitted power, maximum power emitted at the border, geographic territory and duration of right.

5.3.5 United States – Flexible Spectrum Use and Broadband Wireless Access

The United States has been a leader in regard to spectrum liberalization. Liberalized spectrum management primarily relates to non-government spectrum, whereas the framework for government spectrum continues to be traditional. Spectrum Policy Initiative – 2003 addressed several important components:

- Auctions: it was proposed that the FCC should granted permanent authority to assign licences via auction (competitive bidding);
- Spectrum Licence User Fees - to ensure that licence holders pay the opportunity costs of their spectrum use.

The United States has also moved progressively in the direction of flexible use of spectrum, in conjunction with generally liberalized practices. The Communications Act specifically authorizes the FCC to permit flexible use where:

- such use is consistent with international agreements to which the United States is a party;
- the Commission finds, after notice and an opportunity for public comment, that such an allocation would be in the public interest;
- such use would not deter investment in communications services and systems, or technology development; and
- such use would not result in harmful interference among users.[39]

The FCC Spectrum Policy Task Force – 2002 advocated:

- increased reliance on both the exclusive use and the commons models, and reduced use of traditional allocation mechanisms;
- maximum feasible flexibility for licensees, limited only by interference concerns;
- increased use of spectrum trading, including the ability to lease spectrum on a rapid or an overlay or underlay basis.

An example of spectrum sharing in the United States is the deployment of UMTS/HSPDA services. UMTS operators wanting to implement a European style 2100/1900 MHz system needed to share spectrum with existing 2G services in the 1900 MHz band. The 2100 MHz band was unavailable since it is used for satellite communications. Some of the 2100 MHz range was subsequently freed up for 3G services, together with some of the 1700 MHz (for the uplink).

UMTS/HSPDA service in the United States was launched by the end of 2004 strictly using the existing 1900 MHz spectrum allocated for 2G PCS services. As well in some cities a UMTS network using 850 MHz to enhance existing 1900 MHz UMTS network was rolled out using dual band phones.

Spectrum sharing was achieved through the use of dual band network elements, filters, etc. and a channel plan providing for minimal carrier spacing on a site by site basis.

5.3.6 United Kingdom – Flexible User Rights and Spectrum Trading

OFCOM is currently shifting U.K. spectrum policy towards a flexible system of spectrum management through the liberalization of spectrum usage rights and spectrum trading. A gradual approach is being adopted, embracing progressively more bands and greater flexibility in use but relying on competitive assignment methods. This progression is exemplified by OFCOM's intention to apply service and technological neutrality in a forthcoming spectrum assignment involving frequencies currently used to support terrestrial analogue TV broadcasting, the proposed use of spectrum user rights in a forthcoming auction of the L Band, and in other auctions.

The United Kingdom has also adopted the policy of extending market methods of spectrum management to public sector spectrum, giving public sector users the right to trade or lease their spectrum and the obligation to go into the market place to acquire additional spectrum. OFCOM is also extending the application of administrative incentive pricing (AIP). [40]

5.3.7 Europe - Flexible User Rights and Spectrum Trading

The European Union (EU) does not manage radio spectrum; instead the Member States supervise its management at the national level and in international coordination. However, the management of radio spectrum in EU Member States is influenced significantly and increasingly by European legislation which is aimed at facilitating harmonization of regulation and promoting competition through the liberalization of markets. The key legislation is contained in a number of directives and decisions passed in 2002.

The Radio Spectrum Decision[41] laid the foundation for a general EU radio spectrum policy and is binding on all Member States. The objective of the Radio Spectrum Decision is to ensure coordination of radio spectrum policy approaches by facilitating harmonized conditions for the availability and efficient use of radio spectrum.

The Radio Spectrum Decision encourages the European Commission to organize consultations to take account of the views of Member States and all other stakeholders. To facilitate more effective consultations, the Radio Spectrum Policy Group (RSPG) was established by separate decision[42].

The RSPG launched a consultation on secondary trading of spectrum in February 2004 following a request received from the EC in 2003 for an opinion on secondary trading. In November 2004, the RSPG published its Opinion on secondary trading[43].

RSPG has adopted a cautious stance with regard to spectrum trading considering it to "be beneficial in certain parts of the spectrum" and that "European administrations should introduce secondary trading with due care".

The EU now proposes that one-third of the spectrum below 3GHz could have flexible usage rights and be tradable by 2010[44].

RSPG is elaborating on the concept of Wireless Access Policy for Electronic Communications Services (WAPECS) to move away from too narrowly specified allocations and applications, for which specific spectrum is designated.

5.3.8 Canada – Technology Neutrality and Broadband Wireless Access

Access to the spectrum is gained through one of the four forms of authorization: apparatus licenses, spectrum licenses, broadcasting certificates and radio operator certificates. There are two main types of licenses: apparatus and spectrum licenses.

Spectrum licenses represent the more market-oriented form of licensing in the mixed market/administrative system. They authorize the operation of (non-specified) devices within a defined geography. The geography is be defined by bandwidth, geographic area, and time. Licensees are free to use any type of equipment for any purpose, although they are subject to licence conditions and technical frameworks designed to minimize the risk of interference with other spectrum users.

Spectrum licenses are transferable and can be divided and aggregated. They are issued for periods of up to ten years. They are generally renewable.

6 IMPLEMENTING SPECTRUM SHARING

Success in implementing spectrum sharing requires both vision and commitment for moving from current regulatory allocation and assignment practices based on a sound understanding of technology and systems operating under predictable circumstances.

Spectrum policies should address incentives for innovation, promote flexibility, establish spectrum users' rights and determine practical methods for compliance monitoring, interference management and dispute resolution. These factors apply whether spectrum is used in the spectrum commons or shared by some other means where implementation relies heavily on advanced radio technologies designed to facilitate spectrum sharing.

An additional step could be to follow the path being used by the FCC and the NTIA in the United States to create a Spectrum Sharing Innovative Test-Bed for studying spectrum sharing emerging radio systems such as software defined radio and methods and techniques such as dynamic spectrum access.

6.1 Action, Market Structure Issues and Practical Steps Implementing Spectrum Sharing

In the next few paragraphs action and practical steps for implementing spectrum sharing are identified.

6.1.1 Planning

Analysis of current and future spectrum uses will be needed to help determine which bands should be included and how and when they should be released, say by auction for example. Planning will involve consultation with various stakeholders and with industry fora. At a minimum careful review and understanding of recent decisions at WRC and certain leading countries will be both helpful and necessary. A chief concern will be ensuring sufficient spectrum is available to satisfy demand and for proper market functioning. As we have seen earlier the extent to which spectrum is allocated for commercial or exclusive government use has an important bearing on improved access. Processes to review and understand government requirements and to shift spectrum away from exclusive use require both time and negotiation.

6.1.2 Assessing Demand and Scarcity

Market-based methods work best when demand is sufficient and rules and rights are clear. We address values and rights below. For developing countries the real absence of scarcity and emerging demand for services might prove sufficient to cause delay in the introduction of spectrum sharing policies and assignment practices. The difficult question to answer is the impact of delay on the economy overall coming from investment and productivity. Favouring the creation of attractive markets for investors who can deploy or utilize advanced services and technologies can not to be ignored by spectrum policy makers.

6.1.3 Valuing Spectrum and Compensation of Public Sector Users

Spectrum should reflect its opportunity cost which is best determined by market methods. Administrative methods for establishing near market prices such as the use of AIP (administrative incentive prices) needed to be considered. Spectrum values should be reflected in investment decisions by all users including government users. By encouraging economic efficiency spectrum sharing is facilitated through trades, transfers and leasing. Decisions will be required to determine whether special markets exist for Public Sector Users and whether they should be compensated to facilitate better access and sharing.

Determining Spectrum User Rights and Interference Rules – the use of service and technology neutral licenses will facilitate spectrum sharing and improve license flexibility while ensuring that user's rights are protected and the utility of spectrum is protected through adequate interference management. Interference management and rules remain as important areas of further study especially as enabling radio technologies such as SDR evolve.

6.1.4 Monopolisation of the Market

If spectrum markets lead to the monopolization of the supply of downstream services (i.e., if a single firm could corner the entire spectrum capable of producing such a service), and there are no other competing or substitute technologies or services, a spectrum market could then easily produce worse results than an administrative system which led to competition among downstream suppliers of services. Is that likely?

This depends upon the degree of flexibility the regulator allows the market to exhibit. If there are no prior allocation restrictions (limiting certain services to certain bands) and if the arena in which the market operated is extensive, building a spectrum monopoly leading to dominance in downstream markets is not likely to succeed. For major services such as mobile voice or data, or mobile broadcasting, the required spectrum holdings would be very large. The danger does increase either if there are allocation restrictions or if the scope of the market is small (and other barriers to entry are high).

Next, if competition law is considered to be inadequate, special procedures can be put into place to limit the acquisition of spectrum licences requiring prior approval of transfers or the application of merger-control procedures which vet a proposed concentration of spectrum for its impact on the relevant anti-trust market.

Finally, spectrum regulators can construct auction rules for the release of new spectrum in ways which promote competition. There are several examples:

- The current debate in the United States over conditions to apply to the forthcoming 700 MHz auction (including a possible requirement that some spectrum should be auctioned subject to an open access obligation);
- Previously mentioned auction rules for 700 MHz in Canada stipulating that there will be spectrum set aside for new entrants.

6.1.5 Market Liquidity

Another key requirement for an effective market is that it have sufficient liquidity (i.e., volume of trades) to provide participants with a reliable method of transacting. Illiquid financial markets notoriously exhibit high spreads or differences between the buy and sell price, to compensate the intermediary for the cost of holding stock.

International experience in spectrum trading was highlighted in the sections above and the following similarities and differences were exhibited:

- there were few , if any, signs of intermediaries being active in the market;

- there were no signs of speculators entering the market;
- several countries exhibited significant levels of trade (Guatemala and El Salvador) or a number of significant (i.e. a value of USD 100,000,000) trades (the United States);
- in Australia and New Zealand, levels of trade were fairly low (roughly equal to the turnover of commercial property) reflecting an orderly turnover in spectrum through trades;
- in the United Kingdom, trades in the limited bands available have been infrequent, but the number of traded bands has been small and the spectrum regulator is in the middle of a large programme of spectrum awards which may provide an alternative source of spectrum to those who want it.

Liquidity of spectrum markets remains a real issue and the design of liberalization measures should be in the foreground.

6.2 Practical Steps

6.2.1 Role of the Regulator

The regulator in exercising its primary responsibilities related to spectrum management goals and objectives referred to earlier in Section 2.2 should decide on what is the appropriate balance and mix of administrative and market-based techniques. It is a matter of reliance on methods which will ensure access and protection from interference. The current balance favours administrative approaches and it is the view of this author that a shift towards market-based methods should be acknowledged and encouraged by regulators. The practical steps involved in this shift in stance include:

- Spectrum legislation and regulation creating expanded authority by the regulator to manage, assign, and license while permitting spectrum use flexibility, technology neutrality, and sharing.
- Creating the necessary mechanisms, tools and processes to capture and include the needs and expertise of current and future spectrum users.

These may seem like obvious steps to take. Making the decision to increase access and improve sharing requires a very strong commitment from the regulator for change and including stakeholders and users as integral partners in the process of determining which approaches, methods and spectrum should be made more accessible. It is the commitment to change and inclusion which is often lacking and so the process sputters to a stalemate.

Advocating the use of innovative technologies is also a key role of regulators. Providing the means to test and trial new technologies by making spectrum available and through test licenses are two very practical steps that can be taken. ComReg in Ireland has indicated that it is keen to encourage innovative developments and more efficient ways to use spectrum through their test and trial licence scheme[45]

6.2.2 Band Allocation Strategies

Regulators have a powerful tool in allocating spectrum for various uses and users. By limiting the restrictions on uses and users access is improved. Knowing how to go about this requires information, some consensus and where this is lacking, the means to smooth an adjustment. What can be done? The regulator can:

- acquire the information needed to assess use, users and utilization. Spectrum audits can be performed to fill in the gaps in information;
- consult with current and prospective users;
- clear zones of spectrum through incentives and adjustments like refarming;

- examine ways to license or unlicense underutilized spectrum to increase use and sharing;
- reinforce the application of technical standards and compliance to ensure interference is managed and manageable;
- utilize band managers to manage use and users in bands where demand has been pooled and where trading can now take place.

6.2.3 Channelling Plans

Creating channelling plans which compact spectrum assignments and increase the number of occupants through techniques such as re-use are critical to easing problems of congestion and potential interference.

7 CONCLUSIONS

Where the demand for radio spectrum is below the available supply and innovation is steady and predictable, as in the past, the traditional model works reasonably well. With penetration rates exceeding 100 per cent in many countries and with penetration growing rapidly in most developing countries, the demand for spectrum is increasing and frequency bands especially below 3 GHz are becoming more congested in densely populated urban centres everywhere.

Administrative spectrum sharing is based primarily on technical decisions – witness the nature of discussion and time taken to reach agreement at WRC – 03 and 07 on IMT-2000 and BWA. Where changes to expand allocations for these types of services are in the forefront of global consensus and agreements, regulators and users are sometimes propelled by market place demand or lag with decision-making processes. Compensation to existing licensees who may need to exit the band in question is often driven by politics or their legitimate demands as interpreted by the courts. Where markets are underdeveloped, demand does not provide sufficient impetus or the financial means to drive and smooth the process.

Spectrum trading occurs primarily in developed markets, although Guatemala and El Salvador are notable exceptions, and depends on clear rules for user rights and interference management. Spectrum trading, like spectrum leasing, is accomplished easiest when the spectrum to be traded will be used for the same service and in the same band which acts as a mechanism for correcting imbalances amongst providers. It is an open question whether trading and flexibility should be confined to a few selected bands. Technical neutrality exists to the extent technical rules governing interference are respected.

The spectrum commons works best for low power devices. In cases where technical rules are obviated such as high power, wide area Wi-Fi as seen in some developing countries early in the application of this technology, problems of interference result. Dynamic Spectrum Access using technologies such as cognitive radio do show promise but are too early for commercial application. Technical rules and interference management will continue to be a primary focus for regulators.

In general, all bands could be potentially be shared, i.e. it is technically possible to share bands using combinations of administrative means (assignment – time, geographic, channelisation) and through technical solutions such as filters, smart antennae, smart transmitters (such SDR and cognitive radio) along with transmit power limitations combined with some relaxation of interference constraints. One important exception will be the desire to maintain exclusive bands and assignments for public safety and security services.

Interference cannot be eliminated and must be managed so identifying interference management models which support spectrum sharing under either administrative, market-based and spectrum commons will remain as an ongoing requirement and challenge for spectrum managers. The goal is to develop an appropriate regime which protects user rights and finds the right balance for flexibility and innovation, and service neutrality. Finding the balance and structuring the appropriate response continue to be debated and technologies such as software defined radio and other techniques hold significant promise.

Spectrum sharing can be successfully implemented by combining vision, commitment and careful planning by spectrum managers and regulators with a view to evolving spectrum allocations and assignments to permit greater flexibility and access to the spectrum resource.

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[1] As reported in the Independent Audit of Spectrum Holdings reported in 2005 by Prof. Martin Cave to the UK Gov't (referred to here as the Cave Audit), government holdings of spectrum approximate 50 per cent of the spectrum below 15GHz.

[2] See also GSR Discussion Paper on WRC-07 Results and Impact on Terrestrial Broadband Wireless Access Systems, at: www.itu.int/ITU-D/treg/Events/Seminars/GSR/GSR08/wednesday.html

[3] These services are able to function within the UHF band of frequencies (300MHz up to 3GHz)

[4] See Hausman, J. and T. Tardiff, "A cost of regulation: delay in the introduction of new telecommunications services" in *The Economics of the Information Society,* edited by Alain Dumont and John Dryden, European Commission/OECD 1998.

[5] OECD Communications Outlook, 2007. The overall rate across the 31 OECD countries is 80 subscribers per 100 inhabitants.

[6] ITU World Telecommunications/ICT Indicators Database.

[7] OECD Broadband Portal – Press Release November, 2007

[8] European Commission: 8 February,2007

[9] 40 MHz out of 105 MHz was set aside for new entrants in the recent decision concerning upcoming auctions of 700 MHz spectrum in Canada: November 27, 2007

[10] Available after 17 June 2015.

[11] Brazil – 698-806 MHz mobile service on a secondary basis.

[12] Additional band 698-790 MHz adopted by China, India, Japan, New Zealand and Singapore.

[13] E.g. US initiatives to permit other users in TV 'white space' spectrum. White space spectrum are un-used frequencies between active channels. See also Ofcom's consultation on the Digital Dividend - www.ofcom.org.uk/consult/condocs/ddr/ddrmain.pdf

[14] For more on Band Managers see ICT Regulation Toolkit Module 5 Radio Spectrum Management, Section 1.6.2 Outsourcing.

[15] Objections to auction rules raised by interested parties are part of the process for ensuring public interests are protected. The 700 MHz band auction in the United States may raise over 15B USD however questions of fairness to bidders raised in arguments concerning preclusion of wholesale rates and minimum bid prices for smaller companies and start-ups such as Frontline do highlight the types of challenges faced by the regulator in getting the rules and design right.

[16] For more on Auctions see ICT Regulation Toolkit Module 5 Radio Spectrum Management, Section 4.5 Auctions and Cave, Doyle and Webb: Essentials of Modern Spectrum Management, Chapter 5, pp. 43-83, Cambridge University Press, 2007.

[17] FCC Title 47 CFR Part 15 Rules

[18] www.pta.gov.pk/media/paper_080807_1.pdf)

[19] This section is taken from 'Dynamic Spectrum Access' ComReg Briefing Paper 07/22 April 2007, pp 8-9

[20] See 'Dynamic Spectrum Access' pp 12-13 and Reports ITU-R M.2063 and ITU-R M.2064. Issues also on the agenda of WRC-11

[21] In some cases market-based methods of spectrum management need to be assisted in the early stages by administrative intervention. This is particularly the case with regard to the pricing of radio spectrum. While secondary trading offers the possibility of spectrum commanding market prices, in practice thin volumes of trade in the initial stages tend to diminish the benefits of relying on the price mechanism. In some countries, notably the U.K., spectrum prices are largely determined administratively, based on economic principles — known as administrative incentive pricing (AIP).

[22] Recently the FCC in the United States has designated 50MHz of frequency in the 3.65GHz to 3.7GHz band as a commons

[23] COM(2005) 400 Final

[24] COM (2005) 411 Final 6 September 2005.

[25] Spectrum Allocation and bottlenecks/competition problems, ERG (06) 45b.

[26] M. Cave and W. Webb (2003), Designing property rights for the operation of spectrum markets, *Papers in spectrum trading*, University of Warwick, Warwick Business School.

[27] Analysys, Dotecon, and Hogan and Hartson (2004), Study on the conditions and options in introducing secondary trading of radio spectrum in the European Community. Final report for the European Community, Cambridge (U.K.), Analysys.

[28] For a discussion of the degree to which transactions costs will deter the emergence of efficient outcomes through private bargaining and trading, see M. Cave, C. Doyle and W. Webb*, Essentials of Modern Spectrum Management*. Cambridge University Press, pp.124-8.

[29] Spectrum caps offer one mechanism for protecting against excess aggregation of market power. If these are adopted, they should be relatively loose and should be linked to other findings of market power.

[30] Focus here will be on intentional transmitters rather than unintentional radiators such as electric motors.

[31] Electrospace has several dimensions: frequency, location, directions of arrival and time.

[32] Several of these paragraphs are drawn from M. Cave, C. Doyle and W. Webb Op.cit. above Ch 15.

[33] In 1998, Industry Canada policy changes set in motion a process whereby a potential new service provider could apply to use un-utilized (otherwise assigned) frequencies in a geographical area. The result being that assigned but un-utilized frequencies would be re-assigned to interested parties who provided a 'comprehensive' plan to deploy mobile services. Where more than one party applied, Industry Canada awarded spectrum authorizations based on a comparative review of accepted applications.

[34] See Trends in Telecommunication reform 2004/2005

[35] ISM bands include ITU Radio Regulation 5.150 unlicensed bands and bands allocated for low power devices. Lower power device frequencies refer to a whole range of frequencies from 160 KHz. to 10.55 GHz.

[36] Overlay" for agile radios or Underlay for Ultra Wideband (UWB).

[37] See www.cantor.com/brokerage_services/spectrum_and_tower for further information about their system.

[38] See G. Ibarguen,"Liberalising the radio spectrum in Guatemala*"*, *Telecommunications Policy* 27, pp. 143-554, 2005. T. W. Hazlett, G. Ibarguen and W.A. Leighton, Property Rights to Radio Spectrum in Guatemala and El Salvador: An Experiment in Liberalization, available on SSRN

[39] 47 U.S.C. 303(y).

[40] Administrative Incentive Prices: intended to encourage licensees of non-auctioned spectrum to use their spectrum rights efficiently; legislation enables annual licence fees to be set above administrative cost to reflect a range of spectrum management objectives (efficient management and use, economic and other benefits, innovation and competition), having regard in particular to availability and present and expected future demand for spectrum. OFCOM has been using AIP since 1998 and revised the approach in 2004. There AIP is used to value spectrum at its marginal value as a proxy for the opportunity cost to the representative spectrum user in those bands where AIP fees were charged.

[41] Decision No 676/2002/EC of 7 March 2002 on a regulatory framework for radio spectrum policy in the European Community (Radio Spectrum Decision).

[42] Commission Decision 2002/622/EC of 26 July 2002 establishing a Radio Spectrum Policy Group.

[43] The RSPG Opinion on Secondary Trading of Rights to use Radio Spectrum, RSPG04-54 Rev. (final), 19 November 2004

[44] Communication from the Commission to the Council, European Parliament and the European Economic and Social Committee and the Committee of the Regions, "A market-based approach to spectrum management in the European Union", COM (2005)400 Final, 14 September 2005.

[45] See ComReg Document 05/35 for details of the ComReg test and trial licensing scheme - www.comreg.ie.

International Telecommunication Union

GSR 2008

Discussion Paper

Comments are welcome and should be sent by 13 April 2008 to GSR08@itu.int

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I N T E R N A T I O N A L   T E L E C O M M U N I C A T I O N   U N I O N

8th Global Symposium for Regulators

Pattaya, Thailand, 11-13 March 2008

Work in progress, for discussion purposes

WRC-07 RESULTS AND IMPACT ON TERRESTRIAL BROADBAND WIRELESS ACCESS SYSTEMS

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February 2008

COMMENTS ARE WELCOME AND SHOULD BE SENT BY 13 APRIL 2008 TO

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TABLE OF CONTENTS

page

1 ...... Additional Spectrum for Broadband Systems 1
2 ...... The Evolution of IMT 1
  2.1 IMT-2000/3G 1
  2.2 The Rise of WiMAX 2
  2.3 The Evolution of "IMT-Advanced" 3
3 ...... The Radiocommunication Assembly Acts on WiMAX 3
4 ...... Spectrum Decisions at WRC-07 5
  4.1 The IMT Candidate Bands 5
  4.2 Bands Eliminated Early 5
  4.3 Bands Negotiated at WRC-07 6
    4.3.1 The UHF Band 6
    4.3.2 The C Band 8
    4.3.3 The Remaining Bands 9
5 ...... Implications for Administrations 9
  5.1 Regional Variations 9
  5.2 Spectrum Sharing Challenges 10
    5.2.1 Broadcasting 10
    5.2.2 Satellite Systems 11
6 ...... Looking Ahead 11

TABLES

Table 1: Review of Actions in WRC-07 Agenda Item 1.4 8

FIGURES

Figure 1: ITU Regions 7

1 ADDITIONAL SPECTRUM FOR BROADBAND SYSTEMS

Since the implosion of the "dot-com" bubble during the first years of this decade, the global telecommunications industry has focused primarily on the growth of two sub-sectors: mobile services and Internet access services. It was perhaps inevitable, then, that attention would turn to the nexus between these two growth markets: broadband wireless access (BWA) systems.

The need to identify sufficient spectrum availability for current and future generations of BWA systems proved to be the dominant issue at the ITU World Radiocommunication Conference (WRC) held from October 22 to November 16, 2007 (WRC-07). Several WRC agenda items touched upon issues relating to BWA, but most of the work focused on Agenda Item 1.4 – a catch-all agenda item that proved to be the most contentious of the Conference. In the end, the WRC agreed upon a mix of new allocations and identifications in bands below 4 gigahertz:

- 450-470 MHz (global);
- 698-806/862 MHz (with some countries identifying only 790-862 MHz)
- 2300-2400 MHz (global); and
- 3400-3600 MHz (through opt-in provisions in new footnotes to the Radio Regulations);

To understand how WRC-07 arrived at these bands – and more importantly, to understand where the industry goes from here – it's necessary first to explain how the burgeoning development of commercial wireless technologies ran headlong into a logjam of constrained spectrum.

2 THE EVOLUTION OF IMT

2.1 IMT-2000/3G

To its credit, the ITU saw this coming – or at least, it saw the potential of BWA early on. And it acted to take a leadership role, through the development of a "family" of five air interface standards that was given the collective name "IMT-2000" ("International Mobile Telecommunications" pegged to the start of the new century).[1] The actual standards are:

- IMT-Direct-Sequence (IMT-DS)
  - Also known as Wideband-Code Division Mulitple Access (W-CDMA) or UMTS Terrestrial Radio Access – Frequency Division Duplexing (UTRA-FDD), used in the Universal Mobile Telecommunications System (UMTS) 3G standard.
- IMT-Multi-Carrier (IMT-MC)
  - Also known as Code Division Multiple Access 2000 (CDMA2000), the successor to second-generation (2G) CDMA
- IMT-Time-Division (IMT-TD)
  - This comprises: TD-CDMA (Time Division - Code Division Multiple Access) and TD-SCDMA (Time Division - Synchronous Code Division Multiple Access).
- IMT-Single Carrier (IMT-SC)
  - Also known as Enhanced Date rate for GSM Evolution or "EDGE"
- IMT-Frequency Time (IMT-FT)
  - Also known as Digital Enhanced Cordless Telecommunications or "DECT"

Collectively, the IMT-2000 standards became the basis for what the industry and regulators came to refer to as “third-generation” or “3G” mobile systems, distinguishing them from the existing generations of analogue (1G) and digital (2G) mobile systems.[2] IMT-2000 envisioned transmission speeds ranging from 2 megabits per second (Mbit/s) on a stationary or nomadic basis, up to 348 kilobits per second (kbit/s) at vehicular speeds.

At two different Conferences – the 1992 World Administrative Radiocommunication Conference (WARC-92) and the 2000 World Radiocommunication Conference (WRC-2000) – the ITU denoted spectrum bands for IMT-2000.[3] The initial bands, approved in 1992, were 1885 - 2025 MHz and 2110 – 2200 MHz (see RR No. 5.388). WRC-2000 added 806-960 MHz, 1710-1885 MHz and 2500-2690 MHz (see RR Nos. 5.317A and 5.384A). By 2001, then, the following bands were identified for 3G systems in the Radio Regulations[4]:

- 806-960 MHz,
- 1710-2025 MHz,
- 2110-2200 MHz, and
- 2500-2690 MHz.

Not all of these bands were available in all countries, however, and therefore different national administrations were able to assign only a fraction of the overall amount of spectrum the ITU had identified. Moreover, different countries took different approaches. Some (for example, in Europe) set aside entirely new bands of spectrum, commonly in paired bands, to allow existing operators to maintain 2G operations and add on 3G networks in separate bands. Other administrations (e.g., the United States) were slower to set aside new bands for 3G, but they encouraged existing operators to evolve their 2G operations toward 3G capabilities, using their already-licensed spectrum.

Even before the majority of the world’s economies could implement 3G systems, however, industry groups were forecasting further spectrum requirements. In 2003, the WRC approved Agenda Item 1.4 for the next Conference, setting the stage for a show-stopping debate, four years later, over identification of additional bands.

2.2 The Rise of WiMAX

The development of the IMT-2000 suite of technologies was not, meanwhile, the only progress being made on BWA systems. Standards work continued, in parallel, on another approach to providing wireless last-mile services at high data rates: something called a *wireless metropolitan area network* or “Wireless MAN.” Developed under the IEEE 802.16 standard, it became known as the “Worldwide Interoperability for Microwave Access” or “WiMAX.” In June 2001, an industry group, the WiMAX Forum, was formed to advocate for interoperability and acceptance of the standard[5].

On first impression, WiMAX sounds something like Wi-Fi – a technology in widespread use by the middle of this decade. Despite the similarity in nomenclature, however, WiMAX and Wi-Fi were designed for entirely different applications. Wi-Fi is a short-range technology, often used over unlicensed spectrum (i.e., in retail or public spaces such as coffee shops and airports), while WiMAX has a longer range (up to 50 kilometers) and primarily utilizes licensed spectrum. Different “extensions” of the technology allow for fixed (IEEE 802.16d) or fixed and/or mobile (IEEE 802.16e).

While they developed on different paths, WiMAX and IMT-2000 are really evolving toward functional equivalency. Both are being developed to provide broadband Internet access (roughly equivalent to a DSL line), as well as voice connectivity. So in terms of market definition, either set of technologies (WiMAX or IMT-2000) could be said to be "substitutable" for each other, particularly since they continue to evolve toward something called "4G."

2.3 The Evolution of "IMT-Advanced"

As early as 2000, the ITU had commenced work on standardizing systems beyond IMT-2000 – now known as IMT-Advanced. The framework for the development of IMT-Advanced is specified in Recommendation ITU-R M.1645. This prompted a range of global research and development activities:

- The Third Generation Partnership Project (3GPP) terms of reference were expanded to drive improvement of the W-CDMA-based UMTS standard, a project known as 3GPP *Long-Term Evolution* or "LTE."
- Similarly, a separate group, the Third Generation Partnership Project 2 (3GPP2) began to pioneer improvements to the CDMA2000 standard, under the banner of *Ultra Mobile Broadband* or "UMB."

Both projects aspire to increased capabilities, laying down stakes as "next generation" or "fourth generation" (4G) technologies. Meanwhile, the IEEE 802.16e group was considering enhancements to its standard to meet the IMT-Advanced requirements. So even while most countries were only beginning to license 3G networks, the technology trends appeared to point toward even greater capabilities, provided by both WiMAX and IMT-Advanced developments.

The biggest functional difference between WiMAX and IMT-Advanced was that while the latter was by definition a mobile service, WiMAX had multiple incarnations that could be either fixed, mobile or nomadic. In fact, many administrations did not wait for the completion of standards work on mobile WiMAX (i.e., the IEEE 802-16e extension), but rather began issuing licenses for WiMAX in the fixed service – as a wireless substitute for DSL or fiber-based systems. And ironically, there were no existing "identifications" of spectrum for WiMAX (as there were for IMT-2000). So national administrations had substantial flexibility, during the early years of this century, to authorize WiMAX in multiple bands. By the middle of the decade, the most popular bands for fixed WiMAX were the 3.5 GHz band, the 5 GHz band (in a small slice of unlicensed spectrum), and the 2.5 GHz band (the same band identified for IMT-2000).[6]

As this storm of commercial rivalries and possibilities gathered, the 2003 WRC seeded the clouds by placing on the agenda for WRC-07 its item to consider expanding the bands identified for IMT-2000 and "systems beyond IMT-2000." The stage was set for two significant events – both occurring within days of each other – that would reorder the spectrum use profile of multiple bands below 5 GHz.

3 The Radiocommunication Assembly Acts on WiMAX

In November 2006, IEEE proposed incorporating *orthogonal frequency division multiple access* or *OFDMA)* into the existing Recommendation ITU-R M.1457. Behind the technical jargon was a momentous proposal, to add an OFDMA-based air interface (known officially as *OFDMA TDD WMAN)* to the family of IMT-2000 systems. This is the very air interface that underpins WiMAX. From a market standpoint, the 3G and WiMAX worlds appeared headed toward convergence, and the proponents of WiMAX wanted the ITU to recognize that. The proposal was considered over the next year by ITU-R Working Party 8F (WP8F) [7].

The question of whether to add the WiMAX air interface into the IMT-2000 suite tapped directly into a debate within the telecommunication industry over technology neutrality. Particularly in Europe, the developing WiMAX technology had been seen as a potential market rival to 3G licensees and equipment makers, still struggling to gain a widespread commercial footprint for UMTS.[8] They also questioned whether WiMAX, traditionally a fixed service platform, was mature enough to be considered for mobile service. Other countries – notably the U.S. and the U.K. – staked out a position for technology neutrality in bands such as 2500-2690 MHz, allowing either WiMAX or 3G mobile systems.

The proposal to expand IMT-2000 crystallized the debate over WiMAX. WP8F proceeded with its analysis and gave the proposal a positive preliminary recommendation during a meeting in Japan in May 2007. Germany and China, however, continued to raise technical questions concerning the potential for unwanted radio emissions from WiMAX base stations. That necessitated a special meeting to resolve these concerns, held in September 2007 in the Republic of Korea. There, Working Party 8F prepared a draft revision of the recommendation and forwarded it to the Radiocommunication Assembly (RA).

In a meeting held 15-19 October 2007 – immediately prior to the start of WRC-07 – the RA reached a consensus on:

- Revising Recommendation ITU-R M.1457 by adding OFDMA-based technologies;
- Adding the specific WiMAX air interface, OFDMA TDD WMAN, as the sixth IMT-2000 technology; and
- Revising the naming conventions for various technologies:
  - 3G technologies will continue to be known as “IMT-2000”
  - 4G technologies will be known as “IMT-Advanced” and
  - Collectively, all of the 3G and 4G technologies will be known as simply “IMT”

The RA’s decisions were almost immediately overwhelmed by the start of the WRC the following Monday. Nevertheless, although the RA decisions can be viewed as essentially definitional, they may be just as far-reaching as the spectrum-use decisions made by the vastly larger Conference that followed.

First, the RA gave a tremendous boost to the fortunes of mobile WiMAX (and its corporate backers) by recognizing it as a legitimate mobile technology, on parity with W-CDMA and CDMA2000. Of course, the decision did nothing to alter the relative empirical virtues of the technologies themselves. But through the WP8F process,[9] WiMAX gained the ITU-R’s “seal of approval” – hugely important for the potential future deployment of the technology in the competitive global market.

Second, the decision bolstered arguments for technology neutrality. If mobile WiMAX could be accepted as a functional equivalent to the longstanding IMT-2000 standards, it lent credibility to the idea that a broad choice of network technologies was possible, so long as they were technically capable and compatible. Supporters of including WiMAX immediately praised the decision as a pro-consumer measure, saying that it would let market forces pick the most cost-effective and functional technologies.

Third, the decision on naming conventions appeared to signal, at least symbolically, a new chapter on broadband wireless access systems. By definition, the list of 3G technologies is now underlined and the book on IMT-2000 is now essentially closed (although deployment of networks is, in many places, just beginning). The era of IMT-Advanced technologies – 4G – has begun. The ITU-R announced at the end of the RA that 2008 will see an “open call for candidates” to be defined as IMT-Advanced technologies.[10] The ITU further predicted that 4G systems could be commercially available as early as 2011 – perhaps coincidentally, the year of the next WRC.

4 SPECTRUM DECISIONS AT WRC-07

As delegates gathered in Geneva for the WRC during the weekend of 20-21 October, 2007, it was apparent that BWA issues were among the most important – and perhaps the most contentious – matters to be resolved. The focus would be on Agenda Item 1.4, which called upon the Conference:

"To consider frequency-related matters for the future development of IMT-2000 and systems beyond IMT-2000 taking into account the results of ITU-R studies in accordance with Resolution 228 (Rev.WRC-03)".

This amounted to a rather broad mandate, but the net result was that over the four previous years, administrations had utilized the agenda item to consider several additional spectrum bands to identify for IMT-2000 and/or IMT-Advanced.

4.1 The IMT Candidate Bands

As a result of the final Conference Preparatory Meeting, held in Geneva during February 2007, the Conference had teed up the following new spectrum bands for consideration:

- 410-430 MHz
- 450-470 MHz
- 470-960 MHz
- 2300-2400 MHz
- 2700-2900 MHz
- 3400-4200 MHz
- 4400-4990 MHz

With the seemingly large range of bands from which to choose, there was no consensus going into the conference on which band(s) would be most appropriate for IMT. The problem was that each of the bands was already heavily constrained with other uses. Because of previous divergence in uses globally, each of the regional groups -- e.g., CEPT (Europe), CITEL (Americas), APT (Asia-Pacific), ATU (Africa), RCC (the former USSR republics) and the ASMG (Arab countries) -- had a slate of different candidate bands they favored and opposed. This was also sometimes true *within* the regional groups. As the Conference was about to find out, the slates did not match up.

4.2 Bands Eliminated Early

As the Conference got under way, it became apparent that certain of the bands would not be practical because of a combination of lack of positive support and/or overwhelming opposition. As a result, Working Group 4A (a subcommittee of WRC-07 Committee 4, which considered Agenda Item 1.4), agreed that three of the bands lacked sufficient support to go forward in the identification process. These were the following:

410-430 MHz – Most regional groups opposed the identification of this band because of its existing uses, which included everything from space mission communications to public mobile radio (PMR) and public access mobile radio (PAMR).

2700-2900 MHz – This band already was allocated, in all three Regions, for aeronautical radionavigation and ground-based meteorological radars. Aeronautical radionavigation is classified as a safety-of-life service, and ITU-R studies showed that sharing the band with IMT systems was not feasible.

4400-4990 MHz – In North America and Europe, this band was already extensively used for fixed and mobile services, and segments of the band were also used for fixed satellite service and public protection and disaster relief (PPDR) applications. Japan maintained its support for identification of this band in the face of both opposition and lack of interest in much of the rest of the world. In the end, although Japan reserved its right to reintroduce the band in Committee 4 or the plenary, it was never able to garner sufficient support from other administrations.

4.3 Bands Negotiated at WRC-07

As a result, Committee 4 eliminated these three bands from consideration as IMT bands. That left four remaining bands to be considered for identification for terrestrial IMT: 450-470 MHz, 470-960 MHz, 2300-2400 MHz, and 3400-4200 MHz. In practice, however, proposals regarding the 470-960 MHz band centered on the heart of the UHF band: 698-806/862 MHz.[11]

Ultimately, the negotiation at WRC-07 came down to a decision on reconciling two highly contested bands: the 698-806/862 MHz or "UHF band," and the 3400-4200 MHz or "C band." In a situation with no clear favorite prior to the Conference, these two bands drew diametrically opposite support; that is, administrations tended to favor one and oppose the other, for reasons that will be explored in the following subsections.

4.3.1 The UHF Band

The issue of whether to identify all or part of the 698-806/862 MHz band cannot be understood without understanding the costs and opportunities inherent in the so-called "digital dividend." For decades this band has been allocated globally (and accepted almost universally) as broadcasting spectrum and used for analogue television. The advent of digital television ("DTV"), however, created a new possibility to broadcast more channels over the same amount of spectrum. Thus, the conversion, over time, to digital broadcasting transmission could allow the consolidation of spectrum usage, freeing up "excess" spectrum for other uses. This was to be the dividend: efficiency from digital transmission would allow governments to benefit the public by redirecting the use of this newly recovered spectrum.

At a certain juncture, however, it appears that national and regional approaches to leveraging the digital dividend diverged onto different paths. There are at least two reasons for this divergence:

- Different countries varied in the speed at which they planned to complete the transition to DTV broadcasting, and
- Governments were divided over how to re-allocate the dividend, with some seeking to retain it for expanded broadcasting and others seeking to make it available for BWA systems.

Essentially, administrations with conservative transition timelines were skeptical of identifying the UHF Band for BWA systems. The opponents of identification argued that it was premature to identify the band, since many countries were still using it for broadcasting and would continue to do so for at least the next eight years. They cited the output of ITU Regional Radio Conference 2006 (RRC-06) held in Geneva the previous year – known as the "GE-06" Agreement. This agreement did not call for completing the DTV transition until 17 June 2015 in parts of Region 1 (see RR No.5.2) situated to the west of meridian 170° E and to the north of parallel 40° S, except the territory of Mongolia, and in the Islamic Republic of Iran (all together 120 countries). Moreover, the GE-06 Agreement allowed for the band (also known as "Bands IV-V") to continue as a digital broadcasting band – including for mobile broadcasting -- using standards such as DVB-T (Digital Video Broadcasting-Terrestrial) and DVB-H (Digital Video Broadcasting – Handheld). So it appears that the platforms driving continued use of the UHF band in Europe grew out of the broadcasting model, as embraced in the GE-06 Agreement.

Figure 1: ITU Regions

Source: ITU

By contrast, countries outside the RRC-06 planning area appeared more likely to promote or at least acquiesce in the use of part of the UHF band for IMT systems. The proponents of IMT identification for the digital dividend took a position that countries could complete the DTV transition at their own pace; the IMT designation would be waiting for them whenever they could make use of it.[12] Moreover, they argued that the frequencies in the 700 MHz band were intrinsically ideal for mobile services, because of their range, ability to penetrate into buildings and general propagation capabilities. The high quality of the spectrum could translate into lower costs for network infrastructure, they argued.

The output agreement reached at WRC-07 was essentially a compromise that, however, did provide a global identification in the UHF range – albeit with regional differences in the size of the band and the timing of implementation. More specifically:

- *In Region 1 (Europe, Africa and part of Asia),* the 790-862 MHz band was identified for IMT, but only after 17 June 2015 – and subject to conformity with the GE-06 Agreement;

- *In Region 2 (the Americas)*, the 698-862 MHz band was identified for IMT systems with a co-primary allocation, except that in Brazil, the 698-806 MHz band will be allocated to mobile service on a secondary basis;

- *In Region 3 (Asia-Pacific),* several nations, including China, India, Japan, New Zealand and Singapore, opted to identify the 698-790 MHz band, in addition to the 790-862 MHz band, which was accepted by all countries in the region[13].

The net result was that, after 17 June 2015 there would be a global identification of the 790-862 MHz band for IMT. In addition, major portions of the world – including the Americas and the most populous nations of Asia – identified a larger band (698 – 862 GHz). With the notable exception of China, those countries will implement the identification without the eight-year delay.

4.3.2 The C Band

The 3400-4200 MHz band had been traditionally a band shared among fixed and fixed satellite services, on a co-primary basis, with mobile, amateur and radiolocation allocations in some sub-bands and regions. In addition, many countries already had turned to the lower portions of the band (3400-3700 MHz) to begin licensing fixed WiMAX networks.

The C-Band became the primary focus of administrations that opposed identifying the UHF band – particularly in Western Europe (CEPT) and East Asia (e.g., Japan and Republic of Korea). The large block of contiguous spectrum was attractive, despite the presence of satellite downlinks in the band. The satellite industry, however, opposed what it viewed as an incursion into vital FSS spectrum, citing concern about the ability to prevent or mitigate interference with a wave of ubiquitous mobile devices. The satellite industry's mantra entering the Conference was "No Change" to the C-Band, a position that was echoed by the United States and several other administrations concerned about the potential effects on incumbents.

As the Conference went on, the debate in Agenda Item 1.4 pitted the proponents of the UHF band against proponents of the C Band – with very little yielding in the positions on either side.

Ultimately, in the final hours of the Conference, the same agreement that yielded a compromise on the 698-806/862 MHz (UHF) band also provided a result on 3400-4200 MHz (the C Band). There would be no change to the majority of the C band, from 3600-4200 MHz. With regard to the remaining, lower portion (3400-3600 MHz), the result was fractured along regional lines once again:

- *Region 1* – Nearly 90 countries opted in, through a footnote to the Table of Allocations in the Radio Regulations, to a mobile allocation and IMT identification for the 3400-3600 MHz band[14];
- *Region 2* – There was no identification for IMT, but a footnote was added to allow certain countries to "opt-in" to a primary mobile allocation (with no IMT identification) in the 3400-3500 MHz band;
- *Region 3* – Several of the most populous countries, including China, Japan and Pakistan, opted in to a mobile allocation and/or IMT identification in either the 3400-3500 MHz band or the 3500-3600 MHz band – and in several cases, both.

Table 1: Review of Actions in WRC-07 Agenda Item 1.4

Band	Region 1	Region 2	Region 3
450-470 MHz	IMT identified	IMT identified[15]	IMT identified
UHF Band	790-862 MHz Effective 2015	698-862 MHz Effective now	698-862 MHz or 790-862 MHz, Depending on country
2300-2400 MHz	IMT identified	IMT identified[16]	IMT identified
C Band	3400-3600 MHz Opt-in by footnote	3400-3500 MHz Opt-in to primary allocation by footnote	3400-3600 MHz Opt-in by footnote

Source: ITU

Where countries opted in to IMT identifications, the footnotes stipulated that those countries follow required agreement or coordination procedures.[17] In addition, the Conference added interference safeguards in the form of power flux density (PFD) limits on the IMT systems. While there was no global identification, the "opt-ins" allowed many countries to signal their intent to move forward with IMT systems in the lower portion of the C Band.

4.3.3 The Remaining Bands

The 450-470 MHz and 2300-2400 MHz bands were not as contentious as the UHF and C Bands, although support for identifying them was not universal. In the final agreement, both bands were identified globally, with provisions added to protect incumbents from interference.[18]

5 IMPLICATIONS FOR ADMINISTRATIONS

The results of four long weeks – culminating in a marathon all-night session – in Geneva during the autumn of 2007 will be felt into the next decade. The bottom line is that national regulators were given multiple options for adding spectrum to the total amount that could be deployed for terrestrial IMT systems – current and future. In addition, the ITU laid the groundwork for further development of IMT-advanced systems, along the lines of mobile WiMAX, Long-Term Evolution (LTE) and Ultra-Mobile Broadband (UMB) technologies.

Some general trends are apparent:

- WRC-07 did agree to open up the UHF band worldwide (with regional variations discussed above), endorsing at least a partial use of the digital dividend for BWA systems;
- The Conference acted mostly to protect countries' preferences for IMT spectrum – preserving administrations' multiple options -- rather than picking a single option and disallowing the rest[19];
- Wherever it could, the Conference sought to ameliorate the effects of IMT deployment upon incumbents – either through coordination requirements or regulatory mandates such as power limits.

The results of WRC-07 reflect the realities of regional divergence in allocations, as well as the constraints on spectrum usage posed by the need to share spectrum.

5.1 Regional Variations

Given the vast gulf in competing proposals coming into the Conference, a compromise with regional variations was perhaps the most that could be realistically achieved. Administrations were bound by the need to protect their incumbents in all of the bands proposed for identification. As a result, there are clear regional differences around the world in how the WRC-07 bands are likely to be utilized – at least initially.

- Europe and Africa – The countries that are partners in the GE-06 agreement will likely opt for bands other than UHF, at least until the middle of the next decade. The delayed transition to digital TV broadcasting will force them to pursue their other options, including the lower C-Band frequencies (3400-2600 MHz) that many of them proposed before and during WRC-07.
- North America – The United States and Canada have already stated that they will not be using the "globally" identified spectrum at 450-470 MHz and 2300-2400 MHz. In addition, the U.S. has so far stood firmly against allocating all but a small sliver of the C Band (3650-

3700 MHz) for BWA. Conversely, the U.S. has already proceeded to auction spectrum for BWA in the 700 MHz band.

- Asia-Pacific – The countries in this region were largely split in their support of the UHF or C Band positions. In the end, however, many of them chose to take advantage of identification or primary allocation in both bands – including the populous markets of India, China, Japan and the Republic of Korea.
- South America – Region 2 identified the larger portion of the UHF band (698-862 MHz), and some of the countries also signed onto the footnote designating mobile service as primary in the 3400-3500 MHz band. Brazil was among those countries, and it also departed from the regional position on UHF, where it will maintain a secondary allocation for mobile service.

It will now be up to industry to continue developing, marketing and deploying BWA equipment in the plethora of bands now available to it.[20] But the presence of regional variations poses the question of whether the industry has been given sufficient cues or direction regarding the band(s) for which it should build equipment. The implicit goal in establishing global identification of spectrum, after all, is to promote a global market that will provide economies of scale in equipment manufacturing. The question now is whether any single band – and which one – will become the predominant site for future IMT buildouts.

The long-term outlook seems to favor the build-out of systems in the UHF band – not only because of the inherent propagation characteristics (which may lower operators' costs) but also because of the omnipresent identification of the 790-862 MHz band after 2015. In the end, however, the existence of large equipment markets in North America, Europe and the Asia-Pacific may help ensure the viability of multiple bands, in addition to the UHF band. The Asia-Pacific markets may be key to this process, as they have the most flexibility to allocate any or all of the spectrum bands approved at WRC-07.

5.2 Spectrum Sharing Challenges

One of the most important factors in determining which bands are used for future IMT services is the situation regarding spectrum sharing in each band. Both the UHF and C Bands pose real challenges for the advent of ubiquitous IMT devices.

5.2.1 Broadcasting

The transition to DTV is well under way in some countries, but in many others, it has barely begun. The RRC-06 agreement reflected the reality that in many countries, it will take years to convert the UHF band from an analogue broadcasting band into a home for digital media. Even then, it is not clear that all countries would prefer to follow the lead of the United States in reclaiming spectrum from broadcasters and auctioning it to new licensees that would build IMT systems.[21]

One of the primary arguments against identifying the UHF band during WRC-07 was the issue of potential sharing between IMT and broadcasting systems in the band. This issue was not resolved to the satisfaction of those administrations that had opposed identification. So the UHF sharing issues will carry over into the next WRC, as the WRC-07 delegates approved an agenda item (1.17) for WRC-11 with the following language:

"To consider the results of sharing studies between the mobile service and other services in the band 790-862 MHz in Regions 1 and 3, in accordance with Resolution 749 (WRC-07), to ensure the adequate protection of services to which this frequency band is allocated, and take appropriate action";

This could be a wedge issue for some administrations to reopen the entire question of identification of the UHF band. That effort may come too late, however, because the United States is currently scheduled to complete the DTV transition in February 2009, shutting off over-the-air analog broadcasts and paving the way for deployment of new BWA systems by licensees from the January 2008 700 MHz band auction. For the U.S., the sharing issue has been avoided by essentially moving the broadcasters and giving the freed spectrum to their IMT successors.

5.2.2 Satellite Systems

In addition to broadcasting, there remain sharing issues with regard to the compatibility of terrestrial BWA systems with satellite systems. WRC-07 dealt with one such issue, relating to BWA systems (WiMAX, in particular) and future satellite systems in the 2 gigahertz range. As previously noted, the 2500-2690 MHz band had been identified for broadband wireless access systems (IMT-2000 and WiMAX) by previous WRCs. Some countries (e.g. the United States) had already licensed the band to companies planning to offer terrestrial services. However, the band also was allocated internationally for sharing with fixed satellite service (FSS), mobile satellite service (MSS) and broadcasting satellite service (BSS). By WRC-03, there was a growing recognition of the potential of incompatibility between the potential use of the band for BWA systems and the use for satellite systems – particularly MSS. Several countries – many of them in Asia – were preparing to launch satellites in this band, raising fears of interference that could compromise the ground-based systems.

In Agenda Item 1.9, WRC-07 considered proposals to establish regulatory limits on the future satellite systems in order to protect terrestrial systems from over-the-horizon interference -- but without unduly hampering the satellite systems. The conference adopted limits on future satellite systems designed to avoid interference[22].

Another potential sharing problem arose with proposals to identify the C Band for IMT. Initially, many proposals included the entire band, from 3400 to 4200 MHz. This would have posed sharing issues for the communications satellite systems that employ the C Band. The final agreement at WRC-07 left most of the larger band untouched, but allowed “opt-in” use of the 3.4-3.6 GHz band, which is commonly known in the industry as the “extended C Band.”

The industry now faces a somewhat confused situation, in which some of its operators, in some countries, may be subject to interference in the lower C Band frequencies. The footnotes that enable “opt in” access to the band do require mutual agreement between administrations in some circumstances. Meanwhile, the footnotes also spell out power flux density limits that the terrestrial IMT systems must comply with in order to protect the satellite incumbents.

As countries implement the IMT provisions of WRC-07 over the next four years, the broadcasting and satellite industries will seek to work with governments to ensure that they are not overwhelmed by future BWA system deployments. Meanwhile, administrations and sector members alike will begin preparing for WRC-11. The next section previews the relevant issues that could impact on BWA systems four years from now.

6 LOOKING AHEAD

As the previous section indicated, WRC-07 did not completely resolve the questions of spectrum sharing and protection of incumbents in the IMT bands. Moreover, the battle over the UHF band raised new questions regarding convergence between mobile, fixed and broadcasting services. Several of these compatibility and convergence questions have been teed up for WRC-11, in the following agenda items:

Agenda Item 1.2 – This item calls for studies pursuant to Resolution 951, in which the ITU noted the increasingly blurred lines between terrestrial broadcasting, fixed and mobile services – precisely the kind of blurring associated with the digital dividend services in the UHF band. At present, there appears to be little understanding of what the agenda item would lead to – it is essentially open-ended – but the language calls on WRC-11 to "take appropriate action with a view to enhancing the international regulatory framework."

Agenda Item 1.17 – This item is an explicit follow-up to WRC-07 Agenda Item 1.4; it calls for studies on sharing between mobile services and other services (i.e., broadcasting) in the upper UHF band (790-862 MHz) in Regions 1 and 3. Accepted at the insistence of countries opposed to IMT identification in the band, the agenda item calls on WRC-11 to "ensure the adequate protection of services to which this frequency band is allocated, and [to] take appropriate action." Needless to say, this also ensures a revisiting of the UHF identification decision, particularly in Region 1.

Agenda item 1.19 – The 2011 conference will also take up "regulatory measures and their relevance, in order to enable the introduction of software-defined radio and cognitive radio systems." Meanwhile, ITU-R will be conducting studies, and discussions will proceed over the next four years regarding how to begin "regulating" (or perhaps even *whether* to begin regulating) the Dynamic Spectrum Allocation (DSA) systems.

Until then, the focus shifts to the business world and to the national governments that will implement the WRC-07 decisions. It looks certain to be a world of even greater complexity in four years – not less.

---

[1] The specifications of these air interfaces are included in Recommendation ITU-R M.1457.

[2] See ITU information briefing at www.itu.int/osg/spu/imt-2000/technology.html#Cellular%20Standards%20for%20the%20Third%20Generation

[3] Interestingly, the ITU utilized what it called an "identification" of bands, which is not the same as an allocation. Following the Radio Regulations, allocations are made for particular radiocommunication services – in this case, the mobile service. The identification process serves as an official endorsement by the ITU for a particular technology or application – in this case, for IMT-2000. The underlying allocation would still be mobile, and technically, countries could license IMT-2000 in any band bearing a mobile allocation. The identification is meant to narrow down the choice and provide guidance to administrations through a global harmonization process.

[4] Resolution ITU-R 212 (Geneva 1992) and RR Footnotes S5.317A and S5.384A (Istanbul 2000).

[5] www.wimaxforum.org/home/

[6] In Europe, the 2.5-2.69 GHz band was reserved solely for IMT-2000, while in many other countries, including the United States, both fixed and mobile services were allowed, making this band an ideal crossover point for mobile WiMAX. See www.wimax.com/commentary/spotlight/wimaxspotlight2005_04_25

[7] WP8F addressed IMT-2000 and systems beyond IMT-2000.

[8] "WiMAX Spectrum Row Heats Up," ZDNet, July 18, 2006, http://news.zdnet.co.uk/communications/0,1000000085,39279140,00.htm

[9] Incidentally, the RA also restructured the working parties, realigning and renumbering them; consequently, the WiMAX debate will likely be remembered as the "last hurrah" of WP8F.

[10] See "ITU-R Newsflash: ITU-Radicommunications Assembly Expands IMT-2000 Radio Interface Family with OFDMA technology; establishes IMT-Advanced as the name for 4G, 19 October 2007."

[11] The different configuration, "806/862" refers to the fact that in some regions, the spectrum between 806-862 MHz had already been set aside, with the result that an identification of the entire block would only take in 108 MHz of new spectrum (i.e., 698-806 MHz).

[12] CITEL among others, was an active proponent of identifying the UHF band at the Conference, proposing a "package" deal covering the four remaining terrestrial bands. With part of CEPT actively opposing identification of the UHF band, the swing votes were largely in Asia and Africa.

[13] China, out of deference to interference concerns of its Geneva-06 neighbors, delayed implementation of the IMT identification until 17 June 2015 in its territory.

[14] In the Table of Allocations, footnotes are often used to allow countries to note differences in the allocations within their jurisdictions.

[15] Not effective in the U.S. or Canada.

[16] Not effective in the U.S. or Canada

[17] These measures are spelled in RR Nos. 9.21, 9.17 and 9.18.

[18] The United States and Canada presented declarations that the bands would not be used for IMT in those countries.

[19] Some countries (e.g., Japan) saw some of their favoured bands be eliminated due to lack of support by other administrations, but these were perhaps exceptions that proved the rule.

[20] In the immediate aftermath of WRC-07), industry groups did weigh in to endorse the decisions to identify spectrum. See, for example, the CDMA Development Group (CDG) press release dated 20 November 2007: "CDG Applauds Landmark at ITU WRC-07:International Telecommunication Union Approves 450 MHz and 700 MHz bands for 3G and Next-Generation (IMT) Mobile Services, http://biz.yahoo.com/pz/071120/131766.html (downloaded 23 January 2008)

[21] Ironically, while broadcasting and telecommunications remain separate industries or sector, the types of services and applications they want to offer are converging. Both industries are avidly preparing standards and technologies to deliver interactive multimedia content (including video programming) to both fixed and mobile terminals.

[22] Ironically, despite this action, strongly favored by the U.S., the American operator Sprint almost simultaneously suspended plans (at least temporarily) to roll out WiMAX service in the 2500-2690 MHz band.

International Telecommunication Union

GSR 2008

Discussion Paper

Comments are welcome and should be sent by 13 April 2008 to GSR08@itu.int

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END-USER SHARING

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February 2008

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TABLE OF CONTENTS

page

1 ...... Introduction 5
2 ...... End-User Phone Sharing 6
    2.1 Public Call Offices 7
    2.2 Village Phone Operators 8
    2.3 Value-added Services 8
        2.3.1 Text and Data Sharing over Mobile Phones 8
        2.3.2 In-coming and Voice Messaging Services 9
        2.3.3 M-Commerce 9
    2.4 Second-hand Phones – the Final Word in End-user Phone Sharing 11
    2.5 Conclusion 11
        2.5.1 The Role of Regulators 12
3 ...... End-User Computer Sharing 12
    3.1 Cybercafes and telecenters as end-user sharing 13
        3.1.1 Two Examples from Latin America 13
    3.2 Co-present Computer Sharing 16
        3.2.1 Co-present Sharing in Schools 16
        3.2.2 Co-present sharing in Other Settings 17
    3.3 Low-cost Appliances and End-User Sharing 17
        3.3.1 Jhai PC / Jhai Network 18
    3.4 End-user computer sharing as an *assistive design* 19
    3.5 Conclusions 20
        3.5.1 The Role of Regulators 20
4 ...... End-User Network Sharing 20
        4.1.1 The Role of Regulators 22
5 ...... Conclusions 22

BOXES

Box 1: Many "users" for one computer 5
Box 2: Students share a computer even in the presence of plenty of unused machines 6
Box 3 - Clockwise from top left: An Eircom unmanned phone booth, an MTN VNO phone office in Kampala, a Grameen Village Phone Operator, and a locally owned and operated PCO in Bihar, India 7
Box 4: Developing an in-coming shared voicemail message service in Liberia 9
Box 5: WIZZIT Programme customer findings 10
Box 6: First Person Account - Mark Davies, CEO, Busylab on m-commerce and TradeNet ... 11
Box 7: Regulatory and Political Hurdles in the Sustainable Access in Rural India Project 14
Box 8: Cybercafe case study - the eCenter project in Krygyzstan 15
Box 9: Multi-point system with multiple mice for a single PC 17
Box 10: Split-Screen PC Sharing for SME's 17
Box 11: OLPC - all his and no longer needs to share? 18
Box 12: The Jhai PC 2.0. A client/server model that is supportive of end-user sharing? 19
Box 13: Assistive end-user operator intermediation in the SARI project 19

Box 13: Wi-Fi access points detected in downtown Kigali, Rwanda. Each black dot represents a hotspot 21
Box 13: Wifi access points detected in downtown Monrovia, Liberia. Each black dot represents a network 21

TABLES

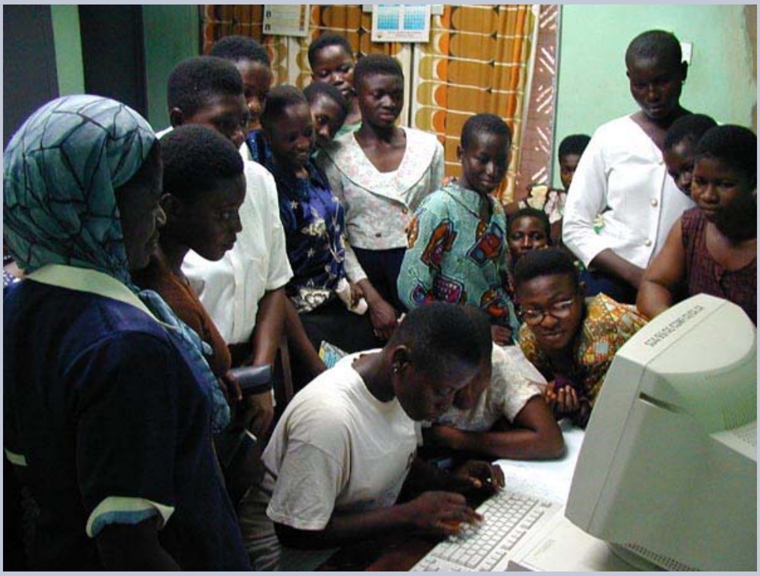
Box Table 1 - Summary of user characteristics 15

1 INTRODUCTION

Sharing of technologies is a ubiquitous behavior among most of the planet's people. These common acts of sharing by end-users, the actual consumers of the product as opposed to those positioned elsewhere along the product production or delivery value chain, are motivated by disparate reasons. To be sure, especially in low-development settings, sharing is commonly a product of income–poverty both in developed and developing countries, weak infrastructures, scarcity or want. But especially in these contexts technologies are culturally programmed for sharing. A visit to a small rural village in northern Ghana, for example, makes the point. Here all technologies, regardless of their conditions of ownership, are shared among their users: bicycles, a diesel moped, and the village water pump. In particular, information and communication technologies are universally shared among these village inhabitants: the radios and televisions crowded around by neighbors anxious to follow a broadcast football match and the few mobile phones in private ownership shared generally on a cost-recovery basis. The only computers in the village are shared on a for-profit basis at the modest local cybercafé.

If scarcity is the mother of sharing in this village, culture and community is the father. Box1 shows more than a dozen members of the community gathering to share an experience with the single computer. To be sure they are sharing the artifact itself, the personal computer. But they share other elements of the encounter – the expertise of the young man typing, the directions of the teacher looking on, and the encouragements all around. In classroom settings the value of this particular form of end-user sharing has been well understood. In certain environments, collaborative learning experiences, in which multiple students share single machines, have been shown to actually enhance learning outcomes when compared with one-person one-computer experiences.[1,2] Indeed end-user sharing of computers has been shown to enrich collaboration, reduce conflict, encourage peer-learning, and strengthen communication.[3]

Box 1: Many "users" for one computer



Source: M.L. Best

Thus, if scarcity of the personal computer is still not a complete account of the end-user sharing depicted in Box 1, it is even less of an explanation for the sharing depicted in Box 2. In this image three students are crowding around a single computer even in the presence of plenty of available machines visible in the background.

Box 2: Students share a computer even in the presence of plenty of unused machines

Source: M.L. Best

This chapter will explore various end-user sharing models for information and communication technologies and will consider the properties of sharing, the ways that ICTs can encourage and enhance sharing, business models and applications that are predicated on end-user sharing, and the roles of the regulator as it relates to sharing. The telephone will first be discussed, and then the computer, the network, and the broad area of information and knowledge sharing.

2 End-User Phone Sharing

Without question the stunning success of mobile telephony has catalyzed the spread of phone services the world over and, in turn, end-user sharing of phones particularly in low-income settings. Indeed, end-user phone sharing has been the most ubiquitous of two-way communication end-user sharing common across the globe, at least in the form of public paid telephones. Until recently public phone boxes were common sites in low- and high-income contexts alike. But today in high-income countries, as mobile phone penetration rates have soared, public phone facilities have been on the decline. In many low and middle-income settings, however, public phone facilities remain common. One report notes that most users in most African countries are likely for the foreseeable future to obtain telephony access primarily through public access facilities – whether booths managed by telecommunications operating companies or privately-managed teleshops.[4]

Several end-user telephone sharing models have been put in place. They can be organized into a simple taxonomy:

1. Unmanned coin- or card-operated public phone boxes often owned by a major incumbent fixed-line operator.
2. Large and branded public phone facilities, sometimes referred to as a Virtual Network Operator (VNO).[5]
3. Entrepreneurial locally-owned and operated Public Call Offices (PCO), often without branding.
4. Local Village Phone Operators (VPO), such as so-called “village phone ladies.”
5. Roaming fixed-wireless phone operators, often with purpose-built telephone terminals that provide point-of-sale billing data.
6. VoIP phone services generally co-located with cybercafés.

Box 3, below, shows an example of four of these options.

Although the widespread adoption of mobile telephony in high-income countries has spurred the decline of shared public phone booths, the opposite is true for low-income areas where formal and informal telephone sharing models remain common. The high prevalence of sharing means that the relatively low subscriber penetration rates often reported can be misleading. With routine informal sharing in addition to prevalent formal private service re-sellers and public access facilities, it is clear that phone use extends far beyond the subscriber base. According to the ITU-infoDev ICT Regulation Toolkit module on Universal Access, even in the presence of low barriers to phone entry including low priced handsets and the low levels of revenue required per subscriber for most operators, many rural people will still not be able to posses their own telephone and instead will make use of shared access facilities.[6] For the foreseeable future end-user phone sharing will remain a common experience.

Case numbers 3 and 4 from the list above, the PCO and VPO will be discussed at greater length in section 2.1 and 2.2. While option 6, VoIP providers, will be treated in the following section on end-user computer sharing. In addition, the considerable rise in sharing of phone applications that extends well beyond basic voice services will be explored below.

Box 3 - Clockwise from top left: An Eircom unmanned phone booth, an MTN VNO phone office in Kampala, a Grameen Village Phone Operator, and a locally owned and operated PCO in Bihar, India

Source: (from left to right) Eircom, M.L. Best, Grameen, M.L. Best

2.1 Public Call Offices

The public call office, consisting of a locally owned and operated entrepreneurial facility, is a ubiquitous site in many low-income areas. In no place is this more the case than India where the yellow PCO/STD/ISD (Public Call Office, Subscriber Trunk Dialing, International Subscriber Dialing) signs appear, seemingly, on every town's street corners. The Indian PCO phenomena offers a critical case for study of both the importance of end-user telephone sharing as well as the struggles of regulatory liberalization within the ICT sector.

What started slowly and with lengthy administrative procedures and regulatory resistance has blossomed into millions of facilities and, according to India's Department of Telecommunications, a presence in 92 per cent of all Indian Villages.[7] Key to this growth was the establishment of agreeable revenue sharing terms by the Department of Telecommunications; terms that have existed in their current form since their inception in the 1980s. Small scale local entrepreneurs keep 20 per cent of call charges while 80 per cent goes to the phone operator. Twenty years later, with the rise of mobile telephones, the state of these PCOs still seems stable although mobile phones do compete with the PCO[8].

2.2 Village Phone Operators

A PCO often offers service over a fixed-line phone, in a permanent facility, and with formal revenue sharing terms agreed to with the operator. In comparison, the Village Phone Operator is often an individual with a mobile phone and only an informal facility. Famously, in Bangladesh the Grameen Phone network has installed, since 1995, local phone operators who re-sell basic shared communication services. It is estimated to generate net incomes of $624 per operator[9], above the country's average per capita annual income. This program, an offshoot of the Grameen Bank microcredit organization, has leased cell phones to poor rural women who set up local village pay phone shops.[10] In a review of the early experience of the Grameen Phone project, the service was found to be of considerable benefit both to the provider and the users. Not least, the average operator was earning between 24 and 40 per cent of household income from providing phone services and the estimated consumer surplus (the money saved by making the call as opposed to the other options that would have been available including travel) from phone usage ranged as high as USD2.70–USD10.00 per call.[11] A related study, interviewed more than 400 users and operators across 50 villages.[12] They found that the village phone program was particularly pro-poor and led to specific social development outcomes. For instance, the intensity of use among villagers living below the local poverty line was 50 per cent higher than non-poor people and most calls placed by poor users were related to economic matters. In addition, the poor community members enjoyed a much higher consumer surplus for each call compared with non-poor users. These researchers also discovered that by placing the mobile phones in the hands of the women of the village there was a noticeable empowerment of these women with reports of enhanced mobility, decision making powers, knowledge, and confidence among these village females—a powerful social development outcome.

Thus, VPOs have been shown to be valuable examples of phone sharing particularly in rural low-income settings.

2.3 Value-added Services

To date end-user phone sharing has focused on basic outgoing voice services. But in some cases value added or data services are being offered in addition to the incoming and voice messaging services briefly mentioned below. Indeed, some argue that shared mobile phones can act « as an infrastructure service; a financial sector service (virtual currency, electronic accounts or banking); a market, weather, and health information exchange mechanism; and an investment sector service».[13]

2.3.1 Text and Data Sharing over Mobile Phones

Basic text messaging is perhaps the simplest and thus most common value-added shared phone service. A study carried out in South Africa found that inbound text messages for entrepreneurial small-business phone subscribers outweighed outgoing messages by eight to one.[14] The reason for the significant preponderance of incoming text messages is because, they argue, these particular phone owners informally relay text messages to others in their community who either do not own a phone or perhaps cannot read or write. Sometimes this service is offered for a fee, marking a clear example of small-scale and often informal text messaging shared business services.

Moving beyond simple person-to-person text messaging a number of SMS-based agricultural text services have been deployed, some of them focusing on end-user sharing of information.[15] For example in Senegal a collaboration between the French company, Manobi, and the Senegalese mobile operator Sonatel, have offered real-time agricultural price information via text or voice messaging and the internet. One study found that targeted information provided by Manobi allows producers to improve their negotiation capacity as they sell their goods into market.[16] The International Development Research Centre (IDRC), one funder of the project, has estimated that this enhanced negotiation capacity results in 15 per cent higher profits for the farmers.[17] However it was also found that the agricultural commodity chain was not generally altered because farmers are often tied by social links, credit, transport, etc.[18] Although profits increased the overall system of trade was rarely altered.

A similar project, with both SMS and Internet agricultural price services, has been offered by the Zambia National Farmers Union.[19] The Smallholder Enterprise and Marketing Programme (SHEMP) provides agricultural prices for 12 major commodities in response to SMS requests according to a major funder for the program, International Fund for Agricultural Development (IFAD).[20] This price information is disaggregated by district, province, and for the nation, again giving stronger negotiation and decision powers as the information is shared and spread among small scale farmers.

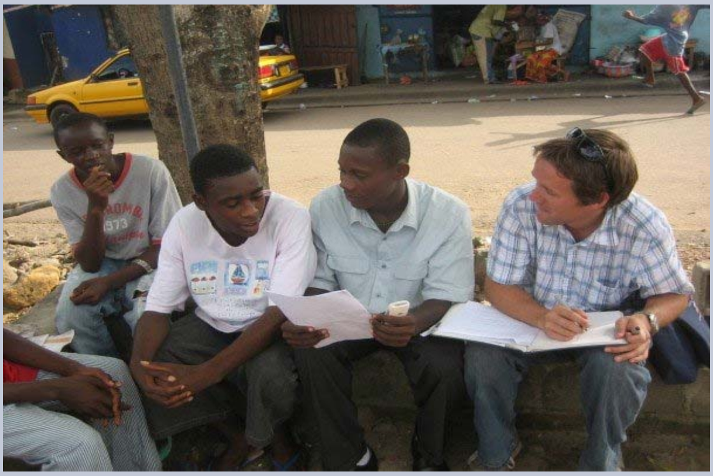
A new agricultural trading system for mobile phones has also been deployed in Africa. Created by a small software development company in Accra,[21] TradeNet aims to link a wide-range of African agricultural traders using mobile phone SMS capabilities. According to popular press reports and web contributions,[22] TradeNet has been piloted for the last 12 months in several African markets, and price and supply-chain information has been collected. According to these online reports, Uganda Foodnet has conducted user satisfaction assessments concluding that 68 per cent of those farmers contacted had used Tradenet to access market information and 91per cent reported that these interactions had a positive impact on their business.[23] (See Box below for the views of TradeNet's founder).

2.3.2 In-coming and Voice Messaging Services

Commercial shared phone services have focused almost exclusively on outgoing calls where an end-user comes to the shared phone facility to place a call to some second party. But incoming calls are also a potential service for shared phone operators. Recent survey work has found that many users would make use of incoming services at public shared phone facilities.[24] Regrettably, two challenges have reduced the frequency and efficiency of this offering. First, consistent business and revenue-sharing models have yet to be developed especially as most all mobile phone networks are caller-pays. Thus there is no clear way to price a received phone call. This provides some scope for regulatory and operator intervention with the creation of a special incoming shared call or message priced service.

Furthermore, technical challenges have inhibited in-coming service scaling. Researchers at the Georgia Institute of Technology recently studied enhanced handsets that support locally managed voicemail boxes. This modest technological affordance would allow local entrepreneurs the option of providing a private extension and message box for local customers. The entrepreneur might price this per message, on a monthly rental basis, or offer it free of charge to regular customers of their outgoing call services. Experiments with a prototype phone system in Liberia suggest that users and local phone entrepreneurs find this service of high value.

Box 4: Developing an in-coming shared voicemail message service in Liberia



Source: John Etherton

2.3.3 M-Commerce

In addition to agriculture information sharing systems over mobile phones, another new and promising area for mobile-phone data and enhanced services is financial and banking services, often referred to as "m-commerce." Basic mobile financial services could include secure savings accounts, non-usurious credit opportunities, currency management, and fund transfers and cash delivery. M-commerce has the potential of removing the biggest obstacle for commercial banks to serve low-income communities, the high transaction costs associated with very modest sized accounts. Mobile banking (and digital banking more broadly) has been shown to significantly lower transaction costs compared with brick-and-mortar banking. Researchers have proposed a taxonomy of m-commerce services:

- joint ventures in which a mobile operator works with a financial services provider to offer services (e.g. Wizzit below),
- m-payment platforms through which typically online service providers offer payment options over mobile networks using multiple banking partners,
- and non-bank driven ventures through which independent companies or public sector organizations offer m-commerce services (e.g. GCash below).[25]

One high-profile example of a mobile banking joint venture program is called Wizzit. Established in 2004, Wizzit has already signed up 50,000 South African customers and hopes to eventually reach 16 million.[26] Users can deposit cash into their cell-based accounts through any post office or the brick-and-mortar bank branches of two participating financial institutions. There is no minimum balance or annual fee to join the program, but users pay a per-transaction fee of between 15 to 78 US cents.

Box 5: WIZZIT Programme customer findings

The Consultative Group to Assist the Poor (CGAP),[27] have examined the WIZZIT program customers finding that they use WIZZIT « because it is "cheaper" (70 per cent), "safe" (69 per cent), "convenient" (68 per cent) and "fast" (68 per cent). By comparison, customers visiting a brick-and-mortar bank report spending an average of 32 minutes in queue and USD 2.27 to reach a bank branch by bus or other transport ».[28] Thus WIZZIT customers enjoy a consumer surplus and the commercial bank enjoys reduced transaction costs for these (previously unbanked) users.

Another widely reported m-commerce example, GCash, originated in 2004 from a mobile phone operator in the Philippines.[29] This system, described as a virtual wallet, allows a subscriber to deposit money, transfer funds, make remittances, and receive cash. This system was developed by non-bank organizations but was offered special regulatory relief with bilateral agreements between the operator and the Central Bank.[30]

In the Democratic Republic of the Congo Celpay, a company owned by South Africa's FirstRand Banking Group, offers mobile banking services to approximately 25,000 Congolese subscribers.[31] Across the country a set of « human teller machines » man small booths with a mobile phone and cash box. By transferring phone credits through the mobile network people are able to send cash to their family or business associates in even rural areas. In this way, prepaid phone credits become almost a parallel currency to Congo's official franc.

In Kenya a major mobile operator[32] offers money transfers via SMS text messages. This initiative, called M-PESA, has enjoyed fairly wide user adoption with a reported 20,000 subscriptions within the first month of operation. The system supports fairly straight forward financial services aimed at unbanked people. Customers "turn cash into e-money" at a Safaricom dealer. The customer can then transfer the money to other individuals, make cash withdrawals, make direct purchases at participating businesses, or purchase prepaid telephone minutes[33].

In a report authored by the project's principal originators considerable regulatory hurdles to establishing the M-PESA program were identified[34]. When the service was launched, the operator offering the service did not have a banking license nor staff expertise in all appropriate areas. Furthermore, the Central Bank of Kenya clearly needed to be engaged in the process. Over time the expertise and relationships where established and eventually the Central Bank cleared the launch of this m-banking service.

Box 6: First Person Account - Mark Davies, CEO, Busylab on m-commerce and TradeNet

"What is clear to me, is that the potential opportunity for mobile commerce is huge. I believe that mobile networks theoretically connect almost 500 million in Africa to the Internet in the sense that they can be used to send and receive personalized, transactional data. Moreover, each month we discover new potential ways in which these networks can be leveraged. Whereas I think we began TradeNet as a technology solution for Agric projects focusing merely on prices, we now realize that it's not so much about agriculture or about prices, as it is about communities and finding a delivery channel to serve their varied needs. The needs may start with agriculture, but extend to e-government, credit, transport, weather, inventory, health etc. Our focus is to build that delivery channel, which constitutes one part technology, and ninety-nine parts people, to find agents that can replicate some of the innovation behind Grameen phone micro-entrepreneurs, and to extend it to personalized data services, rather than just voice. TradeNet is launching, later in 2008, an 'openmarkets' approach not dissimilar to how Facebook allows third party applications to leverage their profiles and access. So we will create a standard interface to both data sources and mobile operators for any third party application, thus accelerating innovation of services on mobile phones targeted at these communities. And whoever ends up with the best service, and the best data-profiling will become the natural choice for advertisers and businesses seeking to sell new services to the broadest market. I believe that conventional market information services were limited by the scope of commercial services they were hoping to serve. And by providing a channel for commercial activity you can be highly profitable, not just sustainable, and that by collecting the chatter of all your activities and agents as they use their own private tools and spaces on your platform, you back into a public MIS with adequate guarantees over content privacy for paying customers. It's a fascinating challenge, and more about anthropology than technology, as always. All products are defined by their customers, and in the past international donors have been those customers, and thus the usability and relevance of these services to target recipients have mostly missed their mark. By being a commercial service, dependent and driven by the actual end users, we hope to shape a completely different product, and have fun working through all the challenges and mistakes along the way." (source: personal communication)

2.4 Second-hand Phones – the Final Word in End-user Phone Sharing

Perhaps the final way that end-users share phones is through the trading and handing-down of used mobile phone handsets as subscribers up-grade and replace their units. Sometimes this is a formal process, for instance many handset vendors will accept old phones when they sell you a new one. In high-income countries there are also many NGO's who take used handsets, refurbish them, and resell them in low-income settings.

This second-hand phone market is a virtuous cycle thanks to at least two reasons. First it limits the environmental impact of discarded mobile handsets which otherwise might collect in landfills. These discarded phones are made up of significant amounts of plastic; some dangerous heavy metals; and of even more concern, batteries. In addition the second-hand phone market lowers the barriers to entry for many low-income telephone subscribers. Indeed, in many markets used phones can be priced at USD 30 or even less.

In a survey in Bucharest, Romania, researchers discovered that among pre-paid phone users a full one-third had purchased and where using a second-hand phone[35]. In some low-income settings this proportion is likely to be much greater. And the supply of second-hand phones, especially coming from high-income countries, seems inexhaustible. In 2007 over 60% of all handsets worldwide are replacements thus the pool of functioning second-hand mobile phones is substantial.[36] In the United Kingdom alone there are an estimated 90 million old phones in subscriber's possession with15 million phones going out of use every year as people invest in newer units[37].

The second-hand phone market may voice the final word in end-user phone sharing as handsets move from subscriber to reseller to subscriber.

2.5 Conclusion

End-user sharing of telephone services continues to be a critically important mechanism by which many people are able to enjoy basic voice and increasingly value-added network services. As was previously noted, the startling rise of mobile phone penetration has sat Janus faced toward end-user sharing: in some high-income locations mobile phones have supplanted shared phone facilities while in other areas mobile phones are the core technology for voice and data shared services.

Despite these tensions, shared phone services have a rich and robust foreseeable future across much of the planet. But to ensure continued success, regulators must attend to the special requirements of shared service. In a broad study of innovative demand models for telecommunications, one study[38] has noted four barriers to the use of these shared facilities, all admitting to regulatory responses:

- Quality of user environment (notably privacy and queuing),
- Quality of attendant service,
- Quality of network service and call completion,
- Price and methods of payment.

2.5.1 The Role of Regulators

As noted, regulatory reform and support is critical to establish strong m-commerce programs. This is especially true as telecommunications regulation needs to interface with (the often more stringent) banking and finance regulatory regimes. That said, there are a few examples where innovative cutting edge m-commerce innovations have emerged in spite of civil conflict.

Regulators can play a critical role in encouraging end-user sharing, and thus universal access, to telephone services. Some best-practice regulatory policies include:

- Support fair, transparent, and uniform revenue-sharing terms for private small-scale PCO entrepreneurs. These terms can be the one fundamental policy that creates (or could, if poorly defined, destroy) PCO markets. See for example India's experience as described in section 2.1. Basic service operators, including powerful incumbents, need to be reminded of the India example. In this case the government operator initially resisted sharing revenue with PCO operators fearing it would unreasonably drain their income stream. In the end, however, PCOs have proven to be one of the largest sources of revenue for the operators tapping a previously unavailable and under serviced market.
- Create policies that allow individual village phone operators the rights to re-sell voice services without seeking special licenses or paying large fees. Whether formally or informally operated, VPO services have shown to be effective and market competition has generally been very capable at ensuring fair re-selling rates and adequate service. Indeed directly regulating VPO services may be onerous to the point of near impossibility since so many of these operators may "fly below the radar screen".
- Operator training for VNOs, PCO's and indeed VPOs is important and the regulator can help set policy to ensure attendant training, the development of appealing and consistent user experiences, and responsive environments.
- Specialized telephone terminals, or indeed even simple handsets, need to be able to price a call. For systems that allow a range of calls including international and inter-network domestic phoning, specialized pulse-counting technology may be needed. The regulator can help ensure that end-users are charged accordingly by encouraging the development and use of these specialized terminals. In simpler environments it may be enough to just count the seconds the call is connected. Related to this, regulators can encourage more simplified domestic tariff structures (for instance tariffs that do not vary from mobile to fixed line or mobile to mobile) which will make pricing easier to compute and more transparent.
- It is important to encourage data and text services. In the sections below broadband services over hybrid copper/fiber networks will be mentioned. But with respect to mobile operators regulatory policy can be developed that encourage progression towards 2.5 and 3 G (and whatever lies beyond). These underlying network technologies will go a long way in supporting value-added service innovation. This point notwithstanding, it is striking the capabilities and wide uses of simple text messaging services over modest second generation digital mobile networks; how much can be done with seemingly so little should not be under-estimated.
- The regulator's role in encouraging m-commerce technologies is paramount and may require close coordination with banking and financial state regulators including, often, the central bank. Considerations include how and when a service becomes a bank, security and protections against money laundering and irregular market uses, privacy concerns, etc. Best-practice in such coordinated regulatory regimes is only now beginning to emerge globally.
- Second-hand phone markets can be encouraged by supporting operator programs to receive used handsets as subscribers upgrade their units.

3 END-USER COMPUTER SHARING

This chapter will now turn to end-user sharing of computer systems. The most common form of such sharing is what occurs in schools or at a cybercafé or telecenter. Many aspects of computer systems design discourage end-user sharing. Indeed the very name, the personal computer, illustrates how hostile to sharing these technologies may in fact be. But some researchers are attempting to turn the personal computer into something more sharable by communities of users.[39] This and other innovations will be reviewed in greater detail in this section.

3.1 Cybercafes and telecenters as end-user sharing

The concept of the telecenter emerged from a community driven movement in Scandinavia in the 1980s. Today telecenters can be found in many countries and are referred to by a plethora of terms—tele-cottages, public information access points, public internet access points, multi-purpose communications centers, and others. While each of these terms may represent slight differences in the object being discussed, the common meaning used here are publicly accessible shared computing or Internet resources that are available with or without fees.

Many typologies have been proposed for telecenters which are helpful in organizing our consideration of this shared-use ICT model.[40,41] These include discrimination on the following primary axes:

- Location (e.g. urban vs rural, co-located vs stand alone, in an area of low or high social or economic development)
- Service bundle (e.g. simple computer operations, Internet and email, FAX, training, copying, typing, desktop publishing)
- Organization model (e.g. for profit, not-for-profit, community owned, local entrepreneur, large-scale business, government service centre)

A few studies have helped identify the importance of shared computer facilities especially in low-income settings. A survey of 280 small and medium enterprises (SMEs) conducted across 14 African nations, found that more than half of the respondents reported that the internet was either important or very important to their business.[42] Those findings notwithstanding, the survey found that only 18.7 per cent of responding enterprises had direct access to the internet while 40 per cent had direct access to a computer, and more than 80 per cent have access to a mobile phone. Indeed 40 per cent of the SMEs that stated they did not have direct access to the Internet nevertheless felt that the technology was important or very important to their businesses. (Significantly, 70 per cent of SMEs that did not have a mobile phone felt that technology is important or very important to their businesses.) This dramatic access gap among SMEs is closed in most cases through the use of cybercafés and other shared access facilities. Seventy-two percent of respondents that did not have direct access to the Internet where able to use cybercafés for some access.

3.1.1 Two Examples from Latin America

The National Program of Infocentros (Programa Nacional de Infocentros) is an initiative that started in Chile in 2001 in response to the presidential mandate to coordinate public sector efforts (and private sector partners) to provide Internet access to communities in public shared facilities. These centers provide staff to assist users, Internet-connected computers to access local, regional, national and international information and in some cases fax machines, copying services and televisions. The presidential mandate charged the Chilean regulator, the Subsecretaría de Telecomunicaciones (SUBTEL), to coordinate the Infocentros program within the broader objective that within the 2000-06 period every Chilean citizen will have shared community or individual means of accessing the Internet. The government defined the Infocentros as "a public community facility with ICT capabilities and communication to access and/or generate content and services relevant to the community in which it is located"[43]. The presidential mandate also provided a set of guidelines to guarantee the program's sustainability through community participation, appropriate physical settings, and trained staff to adequately assist users within comfortable and secure facilities. User training programs also were established that served to encourage the creation of local content. This mandate also determined that the funds required to operate the facilities could be obtained from local governments, private sector contributions, public sector institutions and end users.

In accordance with the presidential mandate, these facilities are of a varied nature, they are located in public schools, public libraries, publicly and privately-owned facilities (in the latter case with government subsidies for their installation), youth community centers and NGO coordinated facilities. In its latest report, from November 2006, the government organization created by Subtel to coordinate the national network of Infocentros, the "Coordinación de la Red Nacional de Infocentros" (CONI) identified a total of 729 installed facilities that in 2006 provided services to 955,599 users (approximately 6 per cent of the population). These facilities were deployed in all 12 regions in which Chile is divided to better reach all of the population. This was accomplished through 4001 computers from which 3898 are connected to the Internet. Taking advantage of these resources, 77,307 users received training in basic computing skills at these facilities[44].

These numbers indicate that each computer was shared on average by 238 end users. Therefore the regulator has managed a project that has resulted in considerable end-user computer sharing. As the facilities are located primarily in libraries (approximately 60%), existing infrastructure can be leveraged and taken advantage of by users drawn there by the computing facility. The same applies for facilities that are located in public education institutions.

A program of similar nature to the one in Chile was established in Colombia in 2000, the Compartel program for Telecentros integrates efforts to bring access to the Internet as well as telephony to rural areas that lack these services. These Telecentros are privately run facilities which provide at least two computers and one telephone booth and are connected primarily through a satellite link to the phone and Internet. Over three phases, a total of 1,490 Telecentros have been deployed varying from facilities with two computers, a telephone line and a fax line to facilities with six to twelve computers, three telephone lines, one fax line, a scanner and web cameras. In total 6,900 computers and 4,907 telephone lines have been installed[45]. The Compartel program is also responsible for the coordination with other government entities required to provide and support Internet connectivity (with private operators) at 7,813 public schools, 1,047 city halls and 200 hospitals and to provide online training at the facilities in a variety of technical fields (in partnership with SENA, the Colombian national training service)[46]. These training courses range in content from arts and sciences to crafts, machinery operation, manufacturing and a large offering in Information Technology.

Box 7: Regulatory and Political Hurdles in the Sustainable Access in Rural India Project

The SARI (Sustainable Access in Rural India) Project aimed to demonstrate that the creation, deployment, and delivery of information and communication services and technologies in poor rural areas leads to improvements in health, empowerment, learning, and economic development amongst the poorest and most disadvantaged communities - and that such services can be realized in an economically sustainable fashion. Begun in 2000 the project grew to include nearly 100 Internet facilities in 50 villages spread throughout the Maduri district of Tamil Nadu, India. The project served to incubate nLogue Communications Pvt. Ltd., a start-up firm that extended and scaled the SARI model to districts throughout India.

A subdistrict headquarters of Madurai, the city of Melur, served as the technical base for the project. The parastatal phone operator, BSNL, has done a very good job of laying fiber throughout the country; indeed most subdistrict headquarters are connect by fiber to the major metropolitan areas and onward to the Internet. In this case, BSNL had fiber capacity stretching from Melur to Madurai city and it was this connectivity that was well suited to backhaul the SARI network connectivity. A request was submitted to lease fiber capacity from BSNL on usual commercial terms. Such a lease was a fairly standard matter and would usually take a month to prosecute. The SARI project waited one year for the network capacity to be sanctioned. The officials of the local BSNL calling circle cited the project's technical capacity to engage in unlawful VOIP services (since that time many VOIP services have been allowed in India). In Delhi additional political considerations were cited.

In this example political hurdles were placed before the project which ensured a substantial delay in its inauguration, and ultimately a delay in the availability of shared Internet facilities in this part of India. The impasse was cleared ultimately in a meeting attended by the communications Minister, BSNL's managing director, and the chair of the regulatory commission. This offers a clear example where a strong independent regulator, able to resolve disputes on commercial telecom activities, plays a crucial role in the deployment of shared computer services.

Box 8: Cybercafe case study - the eCenter project in Krygyzstan

Kyrgyzstan is a small Central Asian low-income landlocked country. It has achieved economic growth of around 4 per cent between 2000–2005.[47] The national estimate of people living below the poverty line was 39 per cent in 2003 with larger percentages in rural areas.[48] In 2002 the government approved a "National Strategy for ICT Development in the Kyrgyz Republic" as part of its attempt to use ICTs to address development issues. However, the growth of the Internet has been hampered by the monopolistic situation that prevailed in the telecommunication market up until recently. One consequence of this is that Internet subscription costs are high relative to average incomes. Few people of Kyrgyzstan use the Internet, with recent estimates (2006) putting Internet user rates at around 5.5 per cent.[49] In addition, PC ownership and mobile phone subscriptions are also low and were estimated at 1.9 per cent (in 2005)[50] and 10.29 per cent (in 2006)[51]. The need to provide shared alternatives for ICT access becomes important in this context and provides the rationale behind the eCenter project.

The eCenter project was launched in Kyrgyzstan in July 2005.[52] The goal of the project was to augment and network a group of telecenters across the country with the aim of promoting local economic development. Specifically, the centers sought to improve local access to ICTs through shared access, stimulate local business creation, improve computer skills, and increase opportunities in non-traditional employment training and job creation among the local population. Local project management was provided by the Civil Initiative on Internet Policy (CIIP)[53], a Kyrgyz non-governmental organization that focuses on the promotion of civil society interests in the development of national ICT policy.

Each of the eCenters provides a variety of fee-based services including Internet access and email, printing, scanning, copying, faxing, multi-media services and IP-telephony. The exact suite of services offered varies from center to center. Each center also delivers a curriculum of computer literacy courses which consist of several modules: Windows, Microsoft Word, Microsoft Excel and using the Internet. Additionally, some centers offer accounting courses and one offers leadership training.

User Interviews from the eCenter Program

A series of interviews were conducted to gauge user satisfaction with the shared eCenter services. Table 1 below summarizes the user distribution across the various centers. Most users were women and typically were young, suggesting the propensity to use ICTs is linked to age particularly where the general diffusion of such ICTs is low (i.e. rural areas). The education rates are similar to those nationally. Also, the user distribution was approximately proportional to the religious and ethnic composition of each community.

Box Table 1 - Summary of user characteristics

eCenter	Male %	Female %	Average age	Bachelors or higher %
Karakol	44	56	21	48
Bosteri	25	75	18	10
Ivanovka	53	47	18	5
Talas	33	67	23	15
Nookat	67	33	24	24
Karasuu	41	59	21	30
Naryn	31	69	24	47
Total for all users	43	57	21	32

Each respondent to the user survey was also asked to indicate how often they used a set of 24 eCenter services ranging from web-design, games, typing/printing documents to Internet use. They were instructed to rate their frequency of use on a six point scale from "several times a day" to "less then every few weeks" to "never". Overall, the services most used were the Internet, Microsoft office applications, and photocopying and printing documents. While this represented the popular response, identifying patterns in the frequency of use of these services was also of interest[54].

Three distinct user archetypes were identified among these user group usage profiles: There are new-users which make up 21 per cent of those within a user group, minimal-users that make up just 7 per cent, and super-users that make up 72 per cent. The new-users are most interested in the Internet coupons, course papers, phone cards, and FAXs; using these all, on average, once a day. The super-users, however, report frequent use of nearly all of the twenty-four surveyed services except for instant messaging. The most frequent service the super-users report employing is Skype. And, finally, the minimal-users do not report engaging any service with real frequency; for them the most common service they use is Microsoft Office and second most common is game playing but in both cases the average respondent said they used these services only once or twice a week.

The different approaches to the center for each of the user archetypes reveal that new-users and super-users visit the center much more than the minimal-users. The findings also show that super-users are the principal beneficiary of the coupon program. For example 57 per cent of such users report having received coupons for the Internet at this center whereas only 6 per cent and 1 per cent of low-level and new-users have participated in the program.

In general, the majority of users viewed the eCenters positively. When asked to be more specific in terms of their own experiences, typical comments included a satisfaction with the range of ICT services provided at the eCenter, good location, competitive prices, and also appreciation of the assistance and service of the staff. In fact, several users suggested that service was one of the advantages that the center had over other Internet café's where the staff was less likely to spend the time or effort to assist users with their activities.

3.2 Co-present Computer Sharing

Co-present computer sharing describes the condition where multiple individuals are sharing the same computer system at the same time. While this form of sharing can occur in telecenter environments, like those described above, this is not always the case; often individuals use their own machine while sharing only the overall telecenter space, peripheral devices, and personnel. Co-present sharing of a single machine can take at least three forms:

- Standard co-present computer sharing where multiple people gather around a single machine (recall 1 above). This is the simplest and most common form of co-present sharing routinely experienced in many cybercafes and schools.
- Single display groupware sharing, where a computer system supports only a single output device (a single display) but includes multiple input devices (e.g. multiple mice). In this experience the system is configured specifically to support co-present sharing around a collaborative task.
- And co-present groupware sharing where both multiple input and output devices are employed by multiple users. In this case the machine is configured to support co-present sharing but often where each individual works on his or her own task.

This section focuses on systems that support these last two cases, first in schools and then among small and medium enterprises (SME's).

3.2.1 Co-present Sharing in Schools

End-user sharing of PC's amongst students is ubiquitous, especially in low-income settings. A survey on classroom computer use within four different states in India noted that "during 28 field observations, we found no cases where only one child was at a single computer terminal."[55] At times, as many as 10 children grouped around one computer".[56] As mentioned above, this computer sharing is an outcome of resource constraints as well as social and pedagogical motivations; indeed, sharing can enhance communication, collaboration, and learning.[57]

A particular arrangement to support shared display groupware for children has been developed by Microsoft Research. In this system multiple mice are connected to a single computer machine (Box 9). Each mouse will control an individual's uniquely colored cursor on a single shared screen. In one experiment, a software company's research arm in India (compared learning levels in an English language retention task between students individually operating a standard computer and groups of students using a single display, multiple mouse system.[58] In the case of the single display groupware system five students worked together with one machine. It was found that students using the "multimouse" configurations performed equally well as those using single mouse/single user systems for this retention task. Moreover, in some cases the multimouse systems resulted in enhanced learning outcomes, for instance amongst boys when they were required to collaborate on the learning activity.

Box 9: Multi-point system with multiple mice for a single PC

Source: Microsoft Research

3.2.2 Co-present sharing in Other Settings

In addition to end-user computer sharing in telecenters and single display sharing in schools experiments have also examined end-user computer sharing in business environments. The same motivating factors have been sited: sharing as a cost-saving and sharing as an approach to enhance collaboration and communication.

In business settings, such as SME's, both of these motivating factors may well be obtained. One group of researchers has developed sophisticated stereoscopic display systems which produce individualized private output for two co-present users.[59] In order to accomplish this, users are required to wear specially instrumented glasses that synchronize with alternating display refreshes.

While this complex stereoscopic system may not have broad application, simpler co-present computer sharing technologies have also been developed. Microsoft Research India have developed a split-screen system especially targeted to small and medium businesses in low-income settings.[60] As the name suggests, here the single display is split vertically and two users are provided with their own keyboard and mouse.). Usability and effectiveness studies for this configuration are in the planning phases.

Box 10: Split-Screen PC Sharing for SME's

Source: Microsoft Research

3.3 Low-cost Appliances and End-User Sharing

The previous section discussed technological innovations that support end-user sharing of personal computers amongst co-located individuals. Indeed, the term « personal computer » loses meaning in these situations where the computer is shared and thus necessarily not personal but instead communal. Indeed end-user sharing of computers calls out for community computer designs as opposed to the personal computer.

This point notwithstanding, much attention has been recently placed on providing individual and therefore personal laptops to the children of the world. The number of low-cost computer designs (in some cases, also referred to as ultra low cost devices) offered by research groups, civil society, the public and private sectors has flourished in recent times with as many as fifty separate projects currently listed by the World Bank.[61] By far the project that has garnered the most media attention, and therefore been most responsible for accelerating the low-cost laptop market and driving major equipment vendors into the space, is One Laptop Per Child's XO. This project was launched by faculty and researchers from MIT's Media Lab. Whether this particular effort will yield successes or failure is still an open question as field pilots and evaluations have only just begun, with mixed outcomes, at the time of this writing. And the keyboard is famously small – perfect for that of an individual child but perhaps too restrictive for an adult or multiple children sharing the system.

But beyond the OLPC the larger question remains: Is the one-to-one computer model advocated by the OLPC design and related organizations the best or only appropriate approach to computing globally? Are resource constraints the principle challenge and all that is required is a system that is more affordable? Or, instead, is the sharing of technology a sufficiently strong and pedagogically valued model for many contexts?

Box 11: OLPC - all his and no longer needs to share?

3.3.1 Jhai PC / Jhai Network

Among the many other low-cost computer systems in production or under development is the Jhai PC 2.0, which is just now undergoing an initial field deployment in Laos. While the OLPC is modeled as a stand-along laptop with network connectivity, the Jhai PC 2.0 is a thin client/server technology based on the netPC system.[62] In this client/server model a simplified desktop computer (Box 12) is provided for the end-user. This computer system is not a stand-alone fully functioning personal computer and does not have full system capabilities. Instead it connects via a fast local network (e.g. Ethernet) to a server which is running a full operating system (e.g. Windows or Linux) along with a suite of applications. The server then provides to each client access to the OS environment along with the set of applications. One immediate advantage to this model is that the client appliances can be very cheap and low-power consuming while still functioning with full capabilities provisioned by the server. Furthermore, these systems should be easier for an administrator to maintain and upgrade since all clients would ultimately be controlled by a single server offering a single point of control and failure. A down-side for such a system model, however, is that the clients must be always connected to the server via a fast network and if the server system is not suitably sized for its workload then client performance may be profoundly affected.

Box 12: The Jhai PC 2.0. A client/server model that is supportive of end-user sharing?

Source: Jhai Foundation

In principle this client/server model should enhance end-user sharing capabilities. The close technical relationship between clients sharing a single server could support highly collaborative environments, file sharing, and multi-user applications since there is a far closer technical tie between the thin clients all sharing a single server.[63] Here too, however, the jury is still out. Initial test deployments are now under way in Laos and should soon provide indications on the effectiveness or not of this model.

3.4 End-user computer sharing as an *assistive design*

Conditions when end-user sharing of computers may be preferred to stand-alone computer use have previously been discussed. One additional and important case for such sharing is the example of human-to-system intermediation as an assistive affordance—when a computer operator uses the system at the behest of another person.

In the United States, consideration of end-user intermediation has focused particularly on workplace or household personal assistance services for people with mental or physical disabilities.[64] In these cases intermediaries may assist computer users who, for instance, do not have full hand or arm mobility and thus cannot manage a mouse or keyboard.

Box 13: Assistive end-user operator intermediation in the SARI project

Source: Elcot

In other settings end-user intermediation is often offered when the assisted individual does not enjoy sufficient print or computer literacy. In these cases a computer expert or operator, a friend, or a colleague provides assistance with the use of the machine. In a long-term study of rural computer use in Tamil Nadu, India, these cases of end-user intermediation in commercial telekiosks were examined. One study reported the results of interviews that asked 25 rural kiosk operators to describe their typical user. Of those 25 operators, 11 indicated that « many » or « some » of their customers were illiterate and thus would require intermediation to account for print literacy requirements. In addition, 18 operators stated that « many » or « some » of their users where computer novices and thus would require assistance to account for lack of computer literacy. In summary, the study revealed that at least half of the operators found that all but a few of their users required some form of intermediation as a shared assistive intervention.

3.5 Conclusions

So much has been written on the telecentre movement. Many successes have been observed but, similarly, there have been a significant number of failures. What cannot be argued against is that telecentres are the most predominant form of end-user computer sharing in many parts of the world. They can solve market access failures as well as help with capacity building and assistive use. Similarly, computers in schools are ubiquitous in many nations and a weighty literature has weighed the pros and cons of such interventions.

Compared to telecentres and computers in schools, however, very few experiments in novel systems for end-user computer sharing have been attempted. Some of the few adaptations include new input and output affordances for otherwise traditional computer systems (such as the multiple mouse system above). Sharing also touches on the growing interest in low-cost computer appliances generally targeted for one-person one-computer environments. An open question remains as to how these innovations will support (or diminish) sharing among users.

3.5.1 The Role of Regulators

Regulators can play a critical role in the support of end-user computer and Internet sharing. In general computing and the Internet have sat under much lighter regulatory frameworks as compared to basic voice services and it is recommended that this trend continue.

- End-user sharing via telecentres and cyber cafes can best be supported by continued light weight regulatory requirements on such businesses. It is often useful for ISP licenses to allow certain forms of capacity re-selling as well such that a telecentre can also share its bandwidth. In addition, as seen in the example from Colombia above, regulators can drive the establishment of shared-use telecentres and are critical proponents for such projects.
- Regulatory relief, public-private partnerships, and the application of universal service funds when available can help support computers-in-school initiatives. Here too cross-government coordination can be of use; regulators cooperating with the Ministry of Education can develop organized approaches to encourage these programs.
- Much is known about the role of the regulator to encourage broadband access and it is beyond the scope of this paper to overview those findings. Nonetheless it is worth remembering the prominent role played by regulators in this regard.
- Regulators can impose assistive design affordances in some contexts or make use of universal service funds for this purpose.

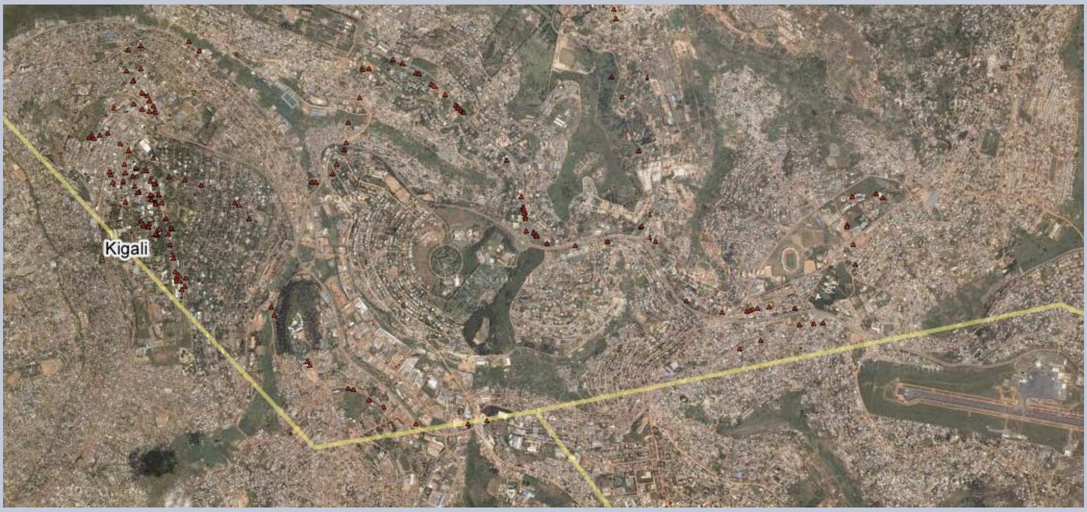
4 End-User Network Sharing

Sharing of computer networks is a constant insofar as all network providers co-locate user data over shared capacity pipes. But end-user sharing of computer networks means something a bit different. In particular, many Internet subscribers will share their capacity with friends (or strangers) by deploying open Wi-Fi hotspots. Nicholas Negroponte of MIT has likened this form of sharing to putting flower pots outside the windows of your home. The flowers are visible to the home owner inside but also are visible to all neighbors and people passing by; all these people are sharing the enjoyment of the flowers. An open Wi-Fi access point might provide a similar type of end-user sharing with the network used by the owner but open to use by neighbors or strangers passing by as well.

Researchers have studied the percentage of Wi-Fi access points that are open thus allowing free access[65]. For example JiWire[66] have estimated that the city of Paris in France has 424 freely open and shared access points compared with their 3,981 closed or pay networks (more than 10 per cent are free and shared). Boston, Massachusetts has 424 free and 3981 pay (over 10 per cednt free) and San Francisco, in the United States has 371 free and 1,025 pay (nearly one third open and shared).

Research done in 2007 by the Georgia Institute of Technology and a wireless location service provider[67] have detected 221 Wi-Fi access points in downtown Kigali, Rwanda (see Box 14) with 42 appearing to be open and shared. Similarly, downtown Monrovia, Liberia had 55 access points detected (see Box 15) with 10 open and shared.

Box 13: Wi-Fi access points detected in downtown Kigali, Rwanda. Each black dot represents a hotspot



Source: M.L. Best

It appears that end-user sharing of Wi-Fi networks follows similar patters worldwide with from 10-30 per cent of networks detected openly shared. Indeed we see this pattern in disparate communities ranging from San Francisco, California to Monrovia, Liberia.

Box 13: Wifi access points detected in downtown Monrovia, Liberia. Each black dot represents a network

Source: M.L. Best

4.1.1 The Role of Regulators

End-user non-commercial sharing of network capacity is at times prohibited either by the Internet service provider user's licenses or by regulation. But non-commercial sharing has not been shown to have significant market impacts and should generally be allowed. One concern is that open (shared) Wi-Fi networks, ostensibly, provide a network security risk. But given the current security and encryption protocols available under standard Wi-Fi technologies (802.11b, 802.11g) security is only properly realized through user managed end-to-end application level encryption. In this way, an open network is only marginally less secure under current popular protocols and the benefits of openness may outweigh the costs.

5 CONCLUSIONS

End-user sharing of information and communication technologies is ubiquitous. Research demonstrates that this sharing can satisfy desiderata of interests including:

- reduced costs,
- greatly increased access,
- enhanced collaboration and communication,
- added assistance for people with special needs,
- novel applications and innovative services,
- and improved learning outcomes.

Sharing of basic phone service, text and data services over the phone, computer and internet services all have broad applications. Furthermore, end-user sharing of network capacity is a common practice at least as open Wi-Fi networks are concerned.

Regulators have a critical role to play in the development of robust end-user sharing experiences. The overall primary considerations a regulator needs to address with respect to such sharing include:

- ensuring a competitive level playing field among operators where market elements are complimented and not constrained by end-user sharing,
- consumer protection including minimal service levels,
- data privacy, security, and protection,
- delivering on universal service aspirations,
- human capacity building in all relevant areas,
- high-capacity networks and innovative services,
- protect users, especially youth, and ensure data privacy as social networking sites and facilities increase in presence and use.

---

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8th Global Symposium for Regulators

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Work in progress, for discussion purposes

INTERNATIONAL MOBILE ROAMING REGULATION – AN INCENTIVE FOR COOPERATION

February 2008

COMMENTS ARE WELCOME AND SHOULD BE SENT BY 13 APRIL 2008 TO

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TABLE OF CONTENTS

page

1 ...... Introduction – Importance of international mobile roaming 3
2 ...... Calculating international mobile roaming costs 4
2.1 What is international mobile roaming? 4
2.2 Costs elements of international mobile roaming 6
2.3 Comparison of international mobile roaming and international mobile call costs .. 8
2.4 Other issues that can influence international mobile roaming costs 9
3 ...... International mobile roaming tariff regulatory strategies 10
3.1 No direct regulation 10
3.2 Wholesale regulation only 11
3.3 Retail regulation only 12
3.4 Combination of both 12
4 ...... Regulation of international mobile roaming charges: Case studies 13
4.1 The EU roaming regulation 13
4.1.1 History of roaming regulation in the EU 13
4.1.2 First results 16
4.2 Regulation of international roaming outside the EU 19
4.2.1 Initiatives in Arab States 19
4.2.2 Regulatory intervention in other regions 21
4.2.3 Self-regulatory practice: market developments 22
5 ...... Transparency issue 24
6 ...... Legal enforcement – Coordination and cooperation between regulators 25
7 ...... Conclusions 26

TABLES

Table 1: Cost structure of international mobile roaming services 7
Table 2: Estimation of international mobile roaming costs in the EU, euro cents per minute 8
Table 3: International mobile roaming vs. international call 9
Table 4: Wholesale regulation only 11
Table 5: Retail regulation only 12
Table 6: Wholesale and retail regulation 13
Table 7: Chronology of events related to international roaming in the EU 13
Table 8: Price caps evolution in the EU 15
Table 9: Retail prices of international mobile roaming in some EU countries (October 2007), eurocents 17
Table 10: Suggested regulation of international roaming rates in the Arab States 20
Table 11: Transparency measures 25

BOXES

Box 1: Technical explanation of international mobile roaming between two GSM networks 5
Box 2: Cheaper roaming: one phone but two numbers 24

FIGURES

Figure 1: Price changes of international mobile roaming in the EU when making a call and receiving a call abroad 16

Figure 2: Prices for an international mobile roaming voice call, when a call is made to or received from a non-EU country (billed minutes, April – September 2007) 18

Figure 3: SMS – price per message roaming (April – September 2007) 18

Figure 4: Liberalization of international gateways (percentage of countries in the region, 2007) 21

1 INTRODUCTION – IMPORTANCE OF INTERNATIONAL MOBILE ROAMING

The rapid growth in the number of mobile subscribers across the world over the past decade -- now numbering 50 per cent of the population -- has dramatically changed the telecommunications landscape. Mobile telephony has become the dominant form of telecommunications in both developed and developing countries, with the number of mobile phones overtaking fixed lines in the majority of countries around the globe. Without doubt, mobile telephony offers huge advantages for individuals, businesses and economies. Nevertheless, the rise of mobile communications has raised at least one troubling issue which is currently being widely discussed among regulators, operators and end user associations -- international mobile roaming rates.

International mobile roaming services allow customers of a home mobile network operator to use mobile services when traveling abroad. These services are enabled due to a direct or indirect (either through a broker or aggregator) relationship between the home and visited operator. As a result of the worldwide expansion of mobile markets and increased demand for international communications, international mobile roaming revenues now constitute a significant portion of mobile operators' revenues and profits. Telecommunications analysts[1] estimate that international mobile roaming rates generate approximately 5 - 10 per cent of operators' revenues globally (in some cases up to 15 per cent[2]), and constitute an even bigger slice of their profits. However, due to the lack of any viable alternative to international mobile roaming services, customers (especially those who must make mobile international calls, such as business users) continue to use these services even in the face of high tariffs. Therefore, the subject of international mobile roaming charges is now of great interest to many governmental organizations.

The view that international mobile roaming charges are disproportionately high relative to costs has been expressed in a number of other studies[3] and surveys[4] as well as in regulatory debates[5]. A study on international mobile roaming charges in the Arab States conducted by the Arab Regulators' Network (AREGNET) in 2006[6], found that prices charged for international mobile roaming are unsatisfactory to consumers. Specifically, the study highlights that:

- International mobile roaming charges in the region are not transparent. The details of charges are not widely known, and are difficult for users to find;
- International mobile roaming charges change frequently. This makes it even more difficult for subscribers to know what they can expect to pay for a roamed call;
- There are large differences in international mobile roaming charges between different networks. In many countries with more than one mobile operator, international roamers are charged differently depending on the network they are using.

According to an ITU BDT report on GSM Mobile Networks in West Africa[7], even for postpaid roaming, operators require a security deposit varying from USD 377.29 to USD 1508.40. Some operators also apply activation fees. In addition, most operators are reluctant to divulge the details of the charges they apply, explaining that costs depend on the operator in the visited country.

The European Commission (EC) started closely monitoring international mobile roaming prices in Member countries of the European Union (EU) in 2005, launching a website on roaming prices[8]. According to the EC[9], there had been little overall change in the levels of international mobile roaming tariffs in the first year after the website was first put online. On average, international mobile roaming prices were four times higher than national mobile calls. These differences, according to the EC, could not be explained by costs incurred by the operators. Operators were charging their customers 300 - 400 per cent more than the cost of these calls[10]. In addition, the EC found that receiving a call while roaming was also very expensive. The EC claimed that there are no agreed inter-operator tariffs for "received calls" at a wholesale level, so that operators could offer their customers lower prices without changing international agreements. As a result, the EC decided to regulate international mobile roaming prices in the EU by imposing wholesale and retail price-caps on both incoming and outgoing roaming voice calls. The decision has generated a lot of discussions, and opinions on its impact vary. Nevertheless, the EU case is an example that other regional economic groups are examining as they address the issue.

It is important to note that international mobile roaming services go beyond the boundaries of a single country. The availability of international roaming services largely depends on contracts signed between home and foreign operators while prices charged are related to the pricing principles and rates of both the home and visited operators (with the involvement of a third operator in some case as discussed below). This suggests that international mobile roaming is linked to cooperation and coordination between operators as well as regulators.

This paper will address a variety of issues raised by international mobile roaming charges: how do they differ from charges for non-roaming international mobile calls (i.e. when a mobile subscriber calls an international number from its home country); what is the structure of their costs; is there a need for regulatory intervention and, if so, how could they be regulated; and finally, is cooperation and coordination on international mobile roaming regulation beneficial? Issues related to national roaming are addressed in the GSR Discussion Paper on Mobile Sharing.

2 CALCULATING INTERNATIONAL MOBILE ROAMING COSTS

Before analyzing possible strategies to international mobile roaming regulation, it is important to understand the fundamentals of this service. This section will briefly describe international mobile roaming services and analyze its cost elements.

2.1 What is international mobile roaming?

Traditional international mobile roaming is defined as the ability for a mobile customer to make and receive voice calls, send and receive data, or access other services, when traveling outside the geographical coverage area of the home operator's network, while using a visited operator's network but being billed by the home operator. The user's mobile phone number also remains the same.

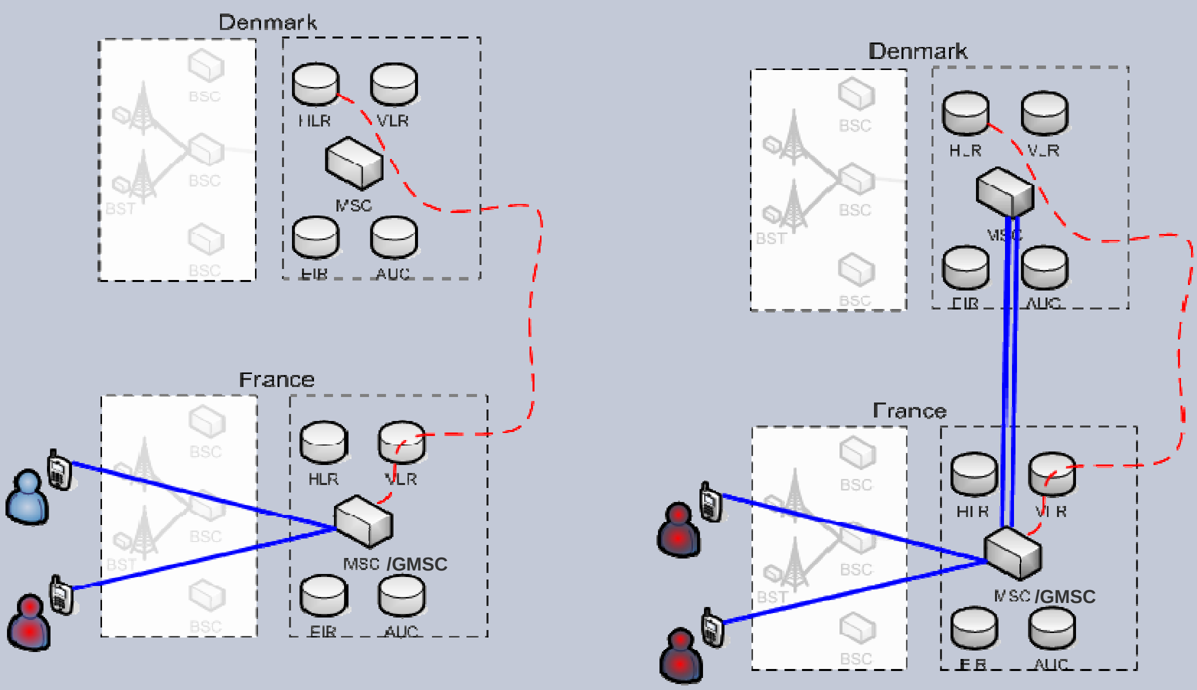
The details of international mobile roaming might differ among different types of mobile networks, but in general, the service could be described as follows:

- A visited network attempts to identify the subscriber's home network. If there is no roaming agreement between the two network operators, international mobile roaming service is impossible. The subscriber will not be able to make and receive voice calls, send and receive data, or access other mobile services;
- If an agreement exists, the visited network contacts subscriber's home network and requests service information about the roaming device and whether or not it should be allowed to roam;
- If successful, the visited network creates a temporary subscriber record for the device. The home network updates its information to indicate that the subscriber is using the host network to ensure that any information sent to that device will be correctly routed.
- Demanded calls are routed by visited and/or international transit and/or any fixed or mobile and/or home networks, depending on the type of call.
- The visited network captures the details of all calls, which are used to calculate wholesale international mobile roaming charges.
- The home operator pays wholesale charges to the visited operator. The subscriber pays retail charges for international roaming services to its home operator.

Box 1: Technical explanation of international mobile roaming between two GSM networks

In a GSM network, a call originated at a mobile device through the Base Station Subsystem (BSC) goes on to a Mobile Switching Center (MSC). The MSC contacts the Visiting Location Register (VLR). The precondition for registration by the VLR is that there is a roaming agreement between the visiting network and the user's home network. The VLR sends the location information of the mobile station to the subscriber's Home Location Register (HLR). In this way the HLR is always updated with regard to location information of subscribers registered in the network. The information sent to the HLR on GSM networks is normally the Signalling System 7 (SS7) address of the new VLR, although it may be a routing number. The MSC routes the call to a Gateway Mobile Switching Center (GMSC). The GMSC interrogates the called subscriber's Home Location Register (HLR) for a Mobile Station Roaming Number (MSRN), then uses the obtained MSRN to route the call to the correct MSC in which the called subscriber is present. The call then goes through the BSC to reach the destination device.

There are always signaling communications between the visited and home operator when roaming, even when the call is routed inside a visited country. Two examples are illustrated below. The diagram on the left shows a subscriber of a Danish operator traveling to France and calling a French operator's subscriber. The diagram on the right shows a subscriber of a Danish operator traveling to France and calling another subscriber of the same Danish operator, who is also currently visiting France. The dashed red lines indicate signaling channels, and blue lines indicate voice channels.



Note: EIR – *Equipment Identity Register* is a database that contains a list of all valid mobile stations within a network.

AUC – *Authentication Centre* is in charge of subscriber's authentication.

Source: Falch, M., Henten, A., Tadayoni, R. (2007), Regulation of international roaming charges the way to cost based prices?; Subramanya, S.R., Byung K. Yi. (2005) Mobile communications – an overview. At http://ieeexplore.ieee.org/iel5/45/33556/01594007.pdf?arnumber=1594007

It is important to note that international mobile roaming covers not only voice services, but the data services of 2.5G and 3G mobile services as well, and is applicable to different mobile technologies currently used (for example, GSM or CDMA). However, this does not necessary imply that a subscriber of any mobile operator could roam in every mobile network of every country. Before deciding to use mobile phone overseas, a subscriber has to check:

- if the technology used (for example, GSM or CDMA) is supported in a destination country; and

- if the home mobile operator has an agreement with any mobile operator in the destination country.

Mobile operators seeking to offer international mobile roaming services to subscribers must conclude international roaming agreements. The legal roaming business conditions negotiated between the roaming partners are usually stipulated in these agreements. The GSM Association and the CDMA Development Group broadly outline the content of such roaming agreements in standardized form for their members. Without such agreements mobile operators are not able to provide these services. The Australian Communications and Media Authority (ACMA), for example, has indicated that there are currently no agreements in place between Australian mobile operators providing CDMA services and overseas CDMA networks[11]. Consequently, an Australian mobile subscriber cannot use an Australian CDMA phone overseas. Likewise, there can be difficulties with some GSM phones as well, even if most of the world's mobile operators use the GSM standard. Countries have allocated different frequency bands for GSM communications, with some countries using the 900/1800 MHz bands and others having allocated the 850/1900 MHz bands. Devices can only work in a country with a different frequency allocation if they can support one or both of that country's frequencies (i.e. dual and triple band handsets).

2.2 Costs elements of international mobile roaming

As already mentioned, international mobile roaming agreements play an essential role in implementing international roaming. Among other technical specifications, international mobile roaming agreements set Inter-Operator Tariffs (IOT), which are agreed bilaterally between the home and visited network operators. Discounts related to the volume of traffic passed between operators can be negotiated as well.

Wholesale international mobile roaming charges (namely IOTs) involve the following elements:

- Mobile origination;
- Mobile/Fixed termination;
- International Transit;
- Roaming specific costs – costs incurred by operators for roaming-specific services, e.g. contracting, billing other operators, testing, specific signaling, etc.

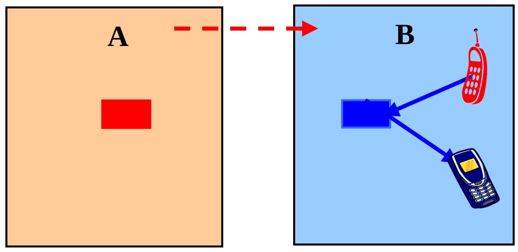
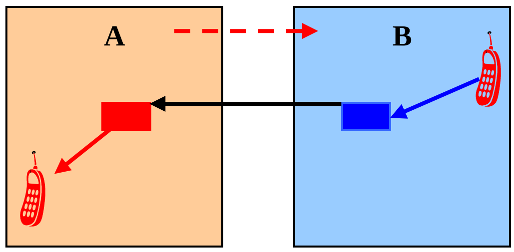
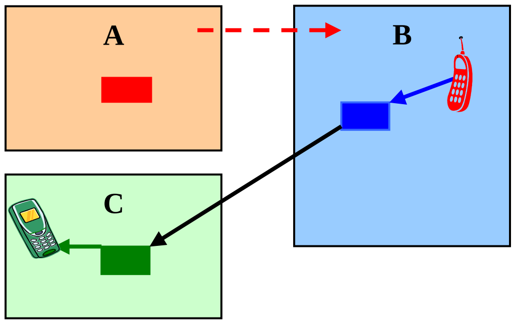
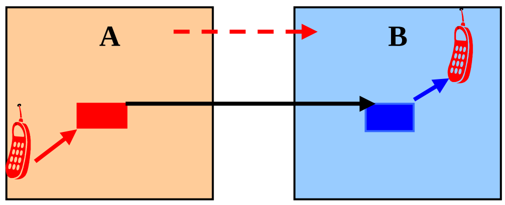
Retail international mobile roaming additionally includes specific retail costs (e.g. billing, marketing, etc.). Depending on the type of service supplied, it is possible to analyze each service according to the cost elements noted above.

There are four main types of international mobile roaming services:

- **Calls/ SMS/ other services inside a visited country** – when a traveler from country A goes to country B and makes a phone call inside the visited country (which means using mobile networks in country B). This might be a call to a subscriber of county B, to a subscriber of country A, which is also visiting country B, or to a subscriber of country C which is visiting country B.
- **Calls/SMS/other services from a visited country to the home country** - when a traveler from country A goes to country B and makes a call home. This might be a call to another subscriber of country A or to a subscriber of any other country which is visiting country A during the time of call.
- **Calls/SMS/other services from a visited country to a third country** - when a traveler from country A goes to country B and makes a call to country C. This might be a call to a subscriber of country C or to a subscriber of any other country which is visiting country C during the time of call.
- **Receiving calls/SMS/other services in a visited country** - when a traveler from country A goes to country B and receives a call from subscribers of either of the countries or even from third countries.

For the illustration of main international mobile roaming services and their cost structures see Table 1.

Table 1: Cost structure of international mobile roaming services

Call type	Cost elements	Illustration
Call inside a visited country A traveler from country A goes to country B and makes a call to a subscriber of country B.	Mobile origination in country B + *[National transit in country B]* + Mobile termination in country B + Roaming-specific costs + Retail-specific costs	
Call from a visited country to the home country A traveler from country A goes to country B and makes a call back home to a subscriber in country B.	Mobile origination in country B + International transit + Mobile or fixed termination in country A + Roaming-specific costs + Retail-specific costs	
Calls from a visited country to a third country A traveler from country A goes to country B and makes a call to a subscriber in country C. Note that country C may or may not be in a region where international roaming prices are regulated.	Mobile origination in country B + International transit + Mobile or fixed termination in country A + Roaming-specific costs + Retail-specific costs	
Receiving a call in a visited country A traveler from country A goes to country B and receives a call from either of the countries.	Mobile termination in county B + International transit + Roaming specific costs + Retail specific costs	

Note: In some cases, international transit services might be used several times. For example, if a subscriber of country A goes to country B and makes a call to a subscriber of country C, which is visiting country A at the moment of the call. This would lead to 1 mobile origination, 2 international transits (country A – country C, country C – country B), 1 mobile or fixed termination plus roaming-specific and retail-specific costs. For a detailed explanation please refer to Falch, M., Henten, A., Tadayoni, R. (2007), Regulation of international roaming charges: the way to cost based prices?

Mobile origination and mobile or fixed termination rates, which represent the major portion of costs in providing wholesale international mobile roaming, are usually regulated and well known in advance. In order to calculate how much a certain international mobile roaming service will cost, additional information about international transit, roaming-specific and retail-specific costs are needed. However, getting information about roaming-specific and retail-specific costs is a challenging task for regulators, since this information is often treated as commercial-confidential and is not freely available. Nevertheless, as a result of European investigation, some rough estimation of these costs is now available (see Table 2).

Intensive discussions about the level of retail costs took place during the EU debates. Initially the EC suggested adding a 30 per cent mark-up on the wholesale rate to cover retail costs (about 8 – 9 euro cents). Some consultancy companies[12] argued that retail costs alone constitute more than 30 per cent of roaming wholesale charges for at least some operators. Other researchers[13] pointed out that setting the margin at 30 per cent of the wholesale price is in line with the margin used for setting wholesale prices under the 'retail minus' principle, which is used for some wholesale telecom services. In Denmark, for instance, mobile service operators offer wholesale products at a price equivalent to the end user price minus 21 percent. This seems to be sufficient to cover both retail costs and some profit, as a number of service providers are able to operate on these terms. Nevertheless, certain consultants claimed[14] that retail costs are independent of wholesale costs and that a percentage mark-up is not appropriate. Instead, they argued, an absolute mark-up should be used, a view that was backed by the European Parliament. An absolute mark-up of 14 euro cents was calculated by the consultants commissioned by the European Parliament[15].

Table 2: Estimation of international mobile roaming costs in the EU, euro cents per minute

	Cost element	Cost per minute
Wholesale cost	Mobile origination	11.06 – 12.34*
	Mobile termination	11.06 – 12.34*
	Fixed termination	1.00 – 1.25*
	International transit	1.00 – 2.50
	Roaming-specific costs	1.00 – 2.00
Retail cost	Retail-specific costs (including reasonable rate of return)	14.00

Note: * average costs; values can vary based on calculation method chosen.

Source: Copenhagen Economics (2007). Roaming: An assessment of the Commission Proposal on Roaming.

The estimates provided in Table 2 are based on averages, but they at least provide an indication of the general level of wholesale and retail international mobile roaming prices compared to their costs. Of course, calculations and decisions based on averages will have a different impact on different operators. It will have more of an impact on small, independent operators that have no international gateways and which rely heavily on international mobile roaming revenues (e.g., in tourist areas).

2.3 Comparison of international mobile roaming and international mobile call costs

One of the suggested ways to avoid discussions on retail costs is to link international mobile roaming charges with charges for non-roaming international mobile calls, as proposed by the Arab States, see Section 4.2.1. This makes sense, given that cost structures of international mobile roaming and international mobile calls are very similar (see Table 3).

Table 3: International mobile roaming vs. international call

Call type	Cost elements
Retail charge for international call (call from mobile phone)	Mobile origination + International transit + Mobile or fixed termination + Retail costs
Retail charge for outgoing international mobile roaming call	Mobile origination + International transit + Mobile or fixed termination + **Roaming-specific costs** + Retail costs

In an ideal case -- when international mobile call rates are cost-oriented -- a regulator should only add roaming-specific costs in order to calculate costs of retail international mobile roaming services. This model takes into account regional specificities, such as non-liberalized international gateways, allowing international mobile call rates to be a proxy for evaluating retail international mobile roaming cost. The model, however, does not enable the regulator to calculate wholesale international mobile roaming costs or incoming international mobile roaming calls costs.

2.4 Other issues that can influence international mobile roaming costs

There are many additional issues that can be taken into consideration when trying to calculate costs and determinate reasonable charges for international mobile roaming. These include:

- **Liberalization of international gateways**. Liberalization of international gateways is one of the main prerequisites to introducing competitive prices for international mobile roaming. This is an argument often stressed by industry associations and understood by some regulators. For example, in its 2007 proposal on international roaming regulation AREGNET states that members of AREGNET encourage liberalization of international gateways[16]. According to the estimates of the GSM Association[17], international call prices decreased by 20 to 50 per cent in Arab countries that opened their international gateways to competitive provision. International roaming call prices between Arab countries with liberalized gateways are typically 25 per cent lower than between Arab countries with gateway monopolies. One of the cost elements of both international calls and international mobile roaming is international transit, and international gateways play a significant role in determining the costs of international transit. Liberalization of gateways could also lead to the increased quality of international communications and greater traffic volumes.
- **Market heterogeneity in a region** – in terms of population density, mobile and fixed penetration (maturity of the market), GDP and GNI per capita, and other economic indicators. Mobile incumbent operators in dense and mature mobile markets usually enjoy economy of scale and scope, meaning lower average cost of services.
- **Mobile operators' reliance on international mobile roaming revenues** – in terms of whether operators are providing services in tourist or non- tourist areas, and whether there are more incoming or outgoing mobile users. In some regions, like tourist destinations that are only popular at certain times of year, or areas near airports, mobile operators must make additional investments to satisfy the temporary increased demand, which has a negative impact on service costs.
- **Characteristics of the majority of operators in a country** – whether they are small or large, independent or part of an international alliance. Small and independent operators usually face higher costs, as they are not able to enjoy economy of scale and discounts offered by partners of alliances.

3 INTERNATIONAL MOBILE ROAMING TARIFF REGULATORY STRATEGIES

After analyzing international mobile roaming costs and actual prices charged, regulators might choose one of the following strategies:

- No direct regulation of any international mobile roaming tariffs;
- Regulating wholesale international mobile roaming rates only;
- Regulating retail international mobile roaming charges only;
- Regulating both wholesale and retail international mobile roaming rates.

This section provides a brief overview of each strategy.

3.1 No direct regulation

Regulators may decide not to take any policy and/or regulatory measures directly related to international mobile roaming rate regulation. Market and technological developments described below suggest that international mobile roaming markets could, to some extent, evidence increased competition and decreased roaming prices even without direct regulatory intervention:

- **Traffic redirection**. Historically, international roaming traffic was usually distributed randomly among operators of visited countries. This gave little incentive for operators to compete for roaming traffic by offering lower wholesale roaming rates (since such a strategy would not have warranted an increased share in roaming traffic). However the recent emergence of directing technologies allows operators to direct up to 80 – 90 per cent of their users' traffic to the networks of their preferred roaming partners[18]. They can then direct more roaming traffic onto partner networks in return for lower wholesale prices. This has led to wholesale discounts of up to 75 per cent in Europe and North America[19]. Some consultants[20] predict that retail roaming prices will fall by around half by 2011 because of greater transparency and technological evolution.
- **Rise of the groups and alliances** of mobile operators together with technical advances has fostered the internalization of roaming traffic within partner networks or groups and, potentially, competition for it.
- **Self-regulatory measures**, taken by industry associations, such as greater transparency through websites and codes of conduct, could have an impact on international mobile roaming prices.

Furthermore, proponents of the "no regulation" strategy claim that any reduction in international mobile roaming revenues may cause a "water bed" effect, whereby operators would seek to make up lost revenue elsewhere. This would mean that tariffs of domestic calls may rise as tariffs of international mobile roaming calls decline. In turn, this could threaten investment in the mobile sector. In the view of some consultants[21], it is more likely that the cost of domestic mobile calls will simply decline more slowly than before and/or mobile operators will reduce subsidies for handsets.

However, while deciding on a regulatory strategy, regulators can also take into account that:

- Available research suggests that traffic direction techniques do not guarantee downward pressure on wholesale tariffs. For example, they do not guarantee that direction of all roaming traffic[22] will be agreed in a cooperative manner (i.e., agreed reciprocally between partners). Moreover, customers can manually register with networks different from those preferred by the home operator. Every network can have coverage problems, even on a temporary basis, meaning that in cases of a gap in the preferred network, customers may register on a different network. Several studies[23] [24] confirm that the increased adoption of ever more efficient traffic control techniques has not necessarily been accompanied by a decrease in international roaming tariffs.
- The rise of alliances and groups could have an exclusionary effect on some smaller operators which would not be able to enjoy the wholesale rates applied within these alliances and groups;

- Substantial time may be needed until market developments will provide satisfactory results. Some analysts[25] believe that the latest technological developments such as IP mobile telephony may only resolve these market imperfections in the long term.
- During the debate in the EU, industry announced some initiatives to reduce wholesale and retail roaming prices. But according to the EC[26], those initiatives were a response to the threat of regulation as opposed to genuine competitive forces. This may indicate that in the absence of such threats there would eventually be a return to higher prices.
- Without regulatory intervention it might be almost impossible to wean operators off roaming revenues in developing markets (especially, where there are big disparities between the numbers of people coming to the country, e.g. as tourists, and those going abroad). In India, for example, foreign visitors pay up to 30 times more than locals to place the same call[27].
- There is no real alternative to international mobile roaming. The option to buy a local SIM card when traveling (known as "plastic roaming") may not be very attractive, because:
    - consumers lose or temporarily do not use their very important identifier – their telephone number;
    - consumers still require additional information – e.g. which of the operators operating in the country offers cheapest national calls or better QoS;
    - consumers may find it more difficult to resolve disputes with operators;
    - some operators which provide phones for their customers "lock" the phones making it impossible for consumers to change SIM cards while travelling abroad.

Therefore it seems that even though market/industry-led developments could favorably influence outcomes of the international mobile roaming market, some direct or indirect regulation may be beneficial in assisting in these developments, providing more rapid results and reducing the possibility of negative outcomes (such as the exclusion of smaller operators).

3.2 Wholesale regulation only

Since it is widely recognized that wholesale roaming rates play a significant role in retail international mobile roaming pricing one reasonable option could be to only regulate wholesale rates. Because wholesale tariffs (IOTs) are agreed bilaterally between the home and visited network operators, it should be fairly easy to collect and compare information about nominal wholesale tariffs, in particular since international roaming agreements usually follow a framework defined by industry associations. This makes implementation of such regulation relatively easy as well. The main issue of this regulatory approach, however, is to ensure that wholesale price reductions result in reductions in retail roaming prices. The European Regulators Group (ERG)[28], which initially suggested employing wholesale roaming regulation only, later agreed that a form of retail price control may be necessary at a later stage.

Table 4: Wholesale regulation only

Advantages	Disadvantages
1. Likely to avoid "water bed" effect on prices of other services. 2. Relatively straightforward to implement. 3. Leaves enough flexibility in retail pricing. 4. Relatively easy to collect information on wholesale tariffs.	1. Risk that wholesale rate reductions will not result in reduced retail rates and will lead to higher retail profit. Or the impact on retail rates will take a lot of time. 2. Limited means to influence retail prices – reliance on competition.

3.3 Retail regulation only

The most obvious and immediate way to reduce retail prices is to put retail regulation in place. However, in the absence of corresponding wholesale regulation, retail regulation alone could lead to significant market distortions, primarily in the form of possible margin squeezes, implemented by larger operators. The outcome of retail-only regulation depends on whether wholesale prices in effect are low and whether retail margins are such that retail-only regulation would bring about a decrease in retail prices without creating a price squeeze for certain operators.

As the EC noted in its assessment report, retail-only regulation is likely to benefit larger operators which already enjoy lower-than-average IOTs, and would not address the problems faced by smaller players.

Table 5: Retail regulation only

Advantages	Disadvantages
1. Effects retail prices directly and immediately. Consumers feel benefits immediately. 2. Implementation is easy and straight forward. 3. Simple, clear and well understood method by consumers, if price cap method has been chosen*. Protection of consumer rights benefit from this simplicity as well.	1. No control on wholesale level could lead to "margin squeeze", which means that the margin between the wholesale and retail rate is so small that efficient competitors are no longer able to profitably offer their services. 2. Retail pricing flexibility constrained and may reduce incentives for operators to offer different retail tariffs and packages. 3. Uniform retail price control would cause different pressure on different operators (more pressure on small, independent operators in tourist areas). 4. Difficult to estimate – how high retail prices should be, because of the asymmetry of information between operators and regulators and the great variety of retail tariffs.

Note: *A number of methods for implementing retail regulation exist, but the most effective is some form of price control, which can also be achieved in a number ways.

3.4 Combination of both

As both regulatory approaches have their advantages and disadvantages, the third option is the implementation of both wholesale and retail price control. If market forces proved insufficient to guarantee substantial pass-through of wholesale gains to the retail level, retail price control might be needed. In fact, this was the case in the EU. Despite some gains at a wholesale level, average retail charges remained high, with margins well above 100 per cent. Economic theory confirms that players do not necessarily have an incentive to use monopoly profits made at the wholesale level to compete for the acquisition and retention of domestic retail customers[29]. There is therefore a serious risk that if applied at the wholesale level only, the ultimate aim of regulation would not be achieved. Therefore, if regulators seek to have immediate results without causing significant market distortions, the combination of retail and wholesale regulation might be considered as the way out.

Table 6: Wholesale and retail regulation

Advantages	Disadvantages
1. Effects retail prices directly and immediately. Consumers feel benefits immediately. 2. "Margin squeeze" control.	1. Retail and wholesale pricing flexibility constrained and may reduce incentives for operators to offer different tariffs and packages. 2. Uniform price cap control would cause different pressure on different operators (more pressure on small, independent operators in tourist areas). 3. Some price rebalancing is likely to occur. 4. Difficulties in estimating price caps, implementation could be quite time consuming.

4 Regulation of International Mobile Roaming Charges: Case Studies

4.1 The EU roaming regulation

4.1.1 History of roaming regulation in the EU

The only notable example of roaming price regulation is found in the European Union. Roaming within the EU is covered by Regulation No. 717/2007 of 27 June 2007[30]. This Regulation imposes European-wide price-caps on wholesale tariffs and retail rates (called Eurotariff). The European Regulation is the result of a long procedure which must be put into perspective for the results to be fully understood.

The tension between mobile network operators and the European Commission grew gradually over time. Table 7 presents a brief overview of the chronology of events starting from the 1999 sector inquiry launched by the European Commission[31].

Table 7: Chronology of events related to international roaming in the EU

Data	Event
July 1999	The Commission launched a sector inquiry in-to mobile roaming prices
July 2001	Inspections at the premises of MNOs in the UK and Germany
February 2003	Wholesale roaming services are included in the Recommendation
July 2004	The Commission sent statements of objections to two UK MNOs: O2 and Vodafone
February 2005	The Commission sent statements of objections to two MNOs in Germany: T-Mobile and Vodafone
March 2005	The ITRE Committee of the European Parliament organized a hearing on international roaming with NRAs and market players
October 2005	The Commission opened a consumer-oriented website publishing the prices of international roaming across Europe
December 2005	The ERG alerted the Commission that measures taken by the NRA would not resolve the problem of high prices of roaming services
December 2005	The DG Competition opened an ex officio investigation in Members States under article 31 EC Treaty
December 2005	The European Parliament Resolution EP 2005/2052(INI) called the Commission to develop new initiatives concerning the high charges of roaming services

March 2006	The European Council pointed out the importance for competitiveness of reducing roaming charges
February - March 2006	First phase of the public consultation on international roaming
March 2006	Second version of the "international roaming" website
April – May 2006	Second phase of the public consultation on international roaming
May 2006	Hearing on "International roaming – Its economic implication" organized by the European Parliament ITRE and IMCO Committees
July 2006	The Commission published a proposal for regulation from the European Parliament and the Council on roaming on public mobile networks within the Community, together with an impact assessment of policy options related to this proposal
January 2007	Hearing organized by the Industry and Internal Market Committee on the proposal of regulation
April 2007	Report by ITRE and adoption by the Committee
23rd May 2007	Vote at the European Parliament
7th June 2007	The Council approves rules on roaming charges

Note: MNO – Mobile Network Operator

ITRE – Committee on Industry, research and Energy

NRA – National Regulatory Authority

ERG – European Regulatory Group

IMCO – Committee on Internal Market and Consumer Protection

Source: Lescop, D., (2007). Regulating International Roaming Charges: Why Less When More Is Possible? # Communications & Strategies, no. 66, 2nd quarter 2007.

Two major events were especially important, as they greatly contributed to the final result. One is the EC efforts to solve the international mobile roaming issue by introducing wholesale roaming services into the list of markets that may need *ex-ante* regulation. By the end of 2006 only Finland and Italy had concluded the formal procedure for the wholesale international roaming market, with the publication of a final decision[32]. The outcome of these first market analyses showed that, despite competition problems, the tools provided by the existing regulatory framework did not allow NRAs to take effective and decisive action to address international roaming problems and ensure that end users fully benefit from regulation. Since the action of National Regulatory Authorities (NRAs) was limited to the wholesale part of the market, any action taken by a particular NRA could have no effect on its own domestic consumers. The roaming case was caused the failure of both competition law instruments and the existing electronic communications framework[33].

The second event was the EC proposal on international mobile roaming rates regulation submitted in 2006, which marked the beginning of very intensive discussions between all stakeholders. The proposal of the European Commission set maximum price limits for the provision by all mobile operators of roaming services at wholesale and retail levels. The Commission considered the wholesale level first and stated that a good proxy for the underlying costs of a mobile call is twice the mobile termination rate (MTR). The upper wholesale limit for a roaming call within the visited country was 2 x MTR. To take into account additional costs involved in a transnational call, it was suggested that the upper boundary for a home or third country call should be set at 3 x MTR. Finally, for a call received, the upper boundary was 1 x MTR since it only requires termination. The Commission suggested MTR to be an EU wide average of the national peak rate MTRs (the last calculated rate was 11.6 eurocents). Retail ceilings were set at a 30 per cent margin above the underlying wholesale limits in line with the average Earnings before Interest and Taxes (EBIT) margin of 26.8 per cent in the European mobile sector in 2005[34].

The initial EC proposal was followed by:

- A draft opinion of the Committee on the Internal market and Consumer Protection for the Committee on Industry, Research and Energy (ITRE), published on 9 February 2007. There were several changes suggested, including:
    - To use the national average MTRs instead of national peak MTRs;
    - To use the 75th percentile of average (weighted average of peak and off-peak) mobile termination rates (last calculated rate was 12.34 eurocents);
    - To set the same upper wholesale boundary for all roaming calls - 2 x MTR.
- A report from ITRE, published in April 2007, suggested the following changes:
    - To calculate MTR as an average of peak and off-peak rates;
    - For the purpose of simplicity and transparency, to refer to actual roaming prices and not formulas for retail roaming prices.
- The final text was adopted by the European Parliament on 23 May 2007. Following discussions at the governmental level the result was higher rates than tabled in previous proposals. Price caps are defined in nominal terms and MTRs are used as benchmarks only. This likely reflects that the final outcome of the EU roaming debates was a compromise between all stakeholders. See Table 8 for illustration of changes in price cap values during the debates.

Table 8: Price caps evolution in the EU

		The EC proposal		EP 1st draft opinion	EP draft report	EP final decision
	Type of call	Formula	€-cents/min	€-cents/min	€-cents/min	€-cents/min
Whole-sale	Calling within a country	2 x MTR	23.20	24.68	23	30 (1st year) 28 (2nd year) 26 (3rd year)
	Calling home or to a third country	3 x MTR	34.80			
Retail	Calling locally	2 x MTR + 30%	30.16	38.68	40	49 (1st year) 46 (2nd year) 43 (3rd year)
	Calling home or to a third country	3 x MTR + 30%	45.24			
	Receiving a call	1 x MTR + 30%	15.08	26.34	15	24 (1st year) 22 (2nd year) 19 (3rd year)

Note: 1 MTR = 11.60 eurocents per minute

VAT excluded

Source: Copenhagen Economics (2007), Study Roaming: An assessment of the Commission Proposal on Roaming; Falch, M., Henten, A., Tadayoni, R. (2007), Regulation of international roaming charges the way to cost based prices?; EP (2007), Mobile roaming: EP committee votes for € 0.40 cap on calls made while abroad at www.europarl.europa.eu/news/expert/infopress_page/058-5108-101-04-15-909-20070410IPR05075-11-04-2007-2007-false/default_en.htm

According to the final text of the EU Regulation the average wholesale charge that a mobile operator of a visited network may levy on a mobile operator of a roaming customer's home network for a call originating on that visited network shall not exceed 30 eurocents per minute, inclusive *inter alia* of origination, transit and termination costs. The price cap shall decrease to 28 eurocents on 30 August 2008 and to 26 eurocents on 30 August 2009. The EU Regulation does not differentiate between international mobile roaming calls when calling within a country and international mobile roaming calls when calling to a third country.

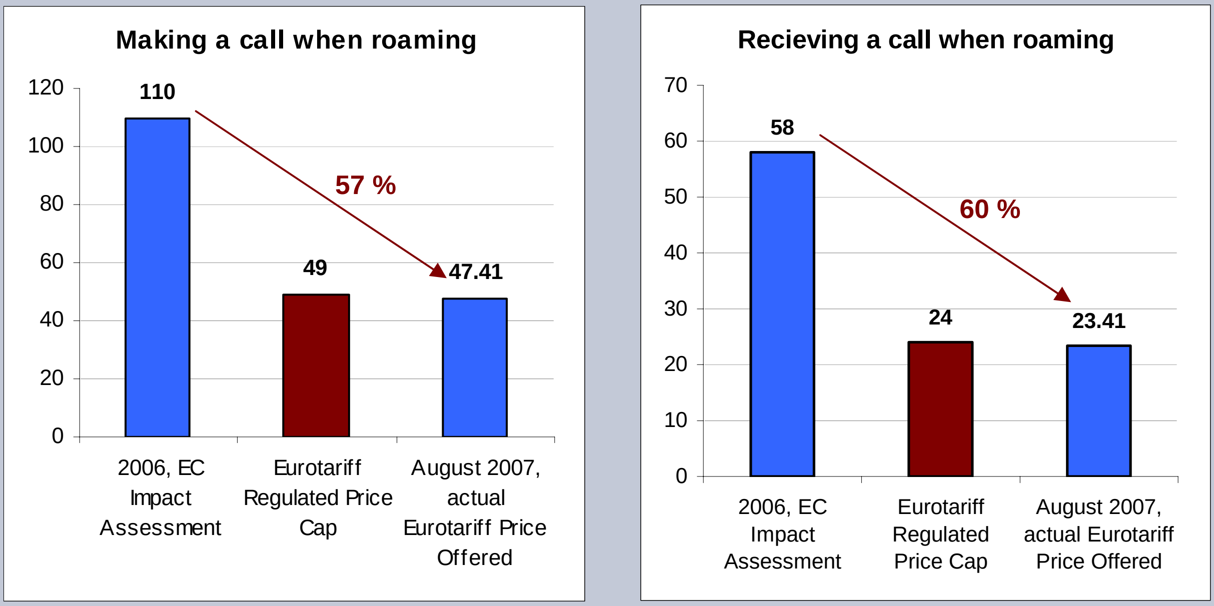
The retail charge (excluding VAT) of a Eurotariff which a home provider may levy on its roaming customer for the provision of a voice call shall not exceed 49 eurocents per minute for any call made, and 24 eurocents per minute for any call received. The price ceiling for calls made shall decrease to 46 and 43 eurocents, and for calls received to 22 and 19 eurocents, on 30 August 2008 and on 30 August 2009 respectively.

The EU Regulation also includes requirements for transparency of retail roaming charges. It requires operators to provide their subscribers with free-of-charge basic personalized pricing information on applicable roaming charges when they enter a foreign country. This information shall include the maximum charges a customer may be subject to under his/her tariff scheme for making calls within the visited country and back to his home country, as well as for calls received. European customers also have the right to request and receive, free of charge, more detailed personalized pricing information on the roaming charges that apply to voice calls, SMS, MMS and other data communication services, by means of a mobile voice call or by SMS.

4.1.2 First results

It is premature to judge the success or failure of the EU Regulation at this stage. First results, however, provided by the European Regulatory Group (ERG) and the EC[35], suggest that consumers in the European Union have been paying up to 60 per cent less for using their mobile phone abroad since summer 2007. Standard prices of international mobile roaming before the regulation were, on average, 110 eurocents per minute and 58 eurocents for receiving calls. Three months after the Regulation came into force these prices were 47.41 and 23.41 eurocents per minute respectively (see Figure 1).

Figure 1: Price changes of international mobile roaming in the EU when making a call and receiving a call abroad



Note: These are average prices

Source: European Commission, 2007

As a result, the EC, found that a number of operators throughout Europe have been offering Eurotariffs below the maximum levels allowed (See Table 9). The lowest Eurotariffs in Europe were found in the Netherlands (20 eurocents both for calls made and received), the United Kingdom (31.57 eurocents for calls made and 12.63 eurocents for calls received), Ireland (32.23 / 15.70 eurocents), Belgium (37.19 / 23.14 eurocents) and Austria (37.50 / 20.83 eurocents)[36]. This, according to the EU, could be the first sign that competition is evolving, even though more evidence is needed to show that other operators are following this model. At the same time some opponents have argued[37] that, from their point of view, there is a noticeable reduction in competition in voice roaming prices in the EU due to the recent Regulation. These opponents note that there are only a few operators offering tariffs below the cap, mainly the more innovative tariffs (like bundles or Passport) launched before regulation.

Table 9: Retail prices of international mobile roaming in some EU countries (October 2007), eurocents

	Eurotariffs	The Netherlands	UK	Ireland	Belgium	Austria
Calls made	49	20	31.57	32.23	37.19	37.50
Calls received	24	20	12.63	15.70	23.14	20.83

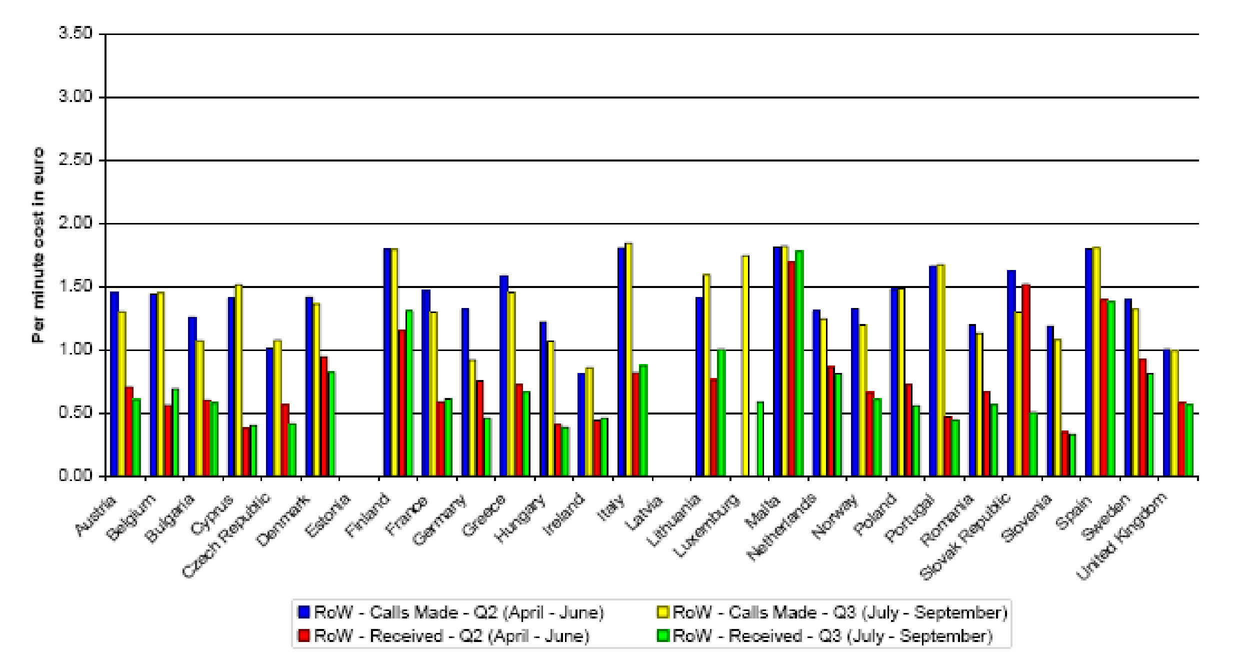
Source: Reding V. DG for Information Society and Media (2007). Eurotariff: Three months later at http://europa.eu/rapid/pressReleasesAction.do?reference=IP/07/1445&format=HTML&aged=0&language=EN&guiLanguage=en

ERG estimated[38] that around 200 million mobile subscribers across Europe were able to benefit from Eurotariff rates at the end of August 2007. The EC estimated[39] that over 400 million EU citizens will be benefiting from the Eurotariff by the end of September. According to the ERG report, many providers of international roaming services offer the Eurotariff as the default roaming tariff, but importantly consumers are still free to choose alternative roaming tariffs where these might better suit their needs since several providers also offer other roaming tariffs. According to the ERG benchmark data report on international roaming for April to September 2007[40], many roaming charges show a clear reduction between the April to June and the July to September periods. ERG compared roaming data of the 2nd and 3rd quarter of 2007. Between these periods the average retail charge across Europe for voice roaming calls was reduced from 0.69 to 0.62 eurocents per minute billed. The corresponding average retail charge for voice roaming calls received reduced from 0.34 to 0.30 eurocents per minute billed.

ERG monitored prices of roaming voice calls that are not subject to the provisions set out in the EU regulation (i.e. calls to a non-EU country or received form a non-EU country), since during the regulatory debates there were concerns that European operators might raise the wholesale rates they charge non-European operators when their customers roam in their networks. According to the ERG data, prices for these calls, both making and receiving, remained fairly constant (see Figure 2). Although SMS and data are currently excluded from EU regulation, they considered it important to collect information on these services as well. According to the data collected, the average charge for sending an SMS within the EU remains unchanged, but in some countries an increase in this charge is observed (see Figure 3). As with SMS, the average price of a megabyte of data roaming varies considerably across different EU countries. The average EU price of a megabyte of data roaming reduced slightly between the second and third quarter of 2007: from 5.51 to 5.24 euros.

ERG also gathered information related to traffic direction or traffic steering, i.e., operators' ability to steer traffic onto a preferred or partner network. In many studies on international roaming[41] there were concerns expressed that discounts that members of alliances enjoy at a wholesale level are rarely replicated at the retail level. The ERG study[42] found that none of the providers that responded to the information request stated that traffic steering was used to the disadvantage of consumers through higher charges. In general such techniques were used to offer consumers a better deal, through either lower retail price or enhanced services, or both.

Figure 2: Prices for an international mobile roaming voice call, when a call is made to or received from a non-EU country (billed minutes, April – September 2007)



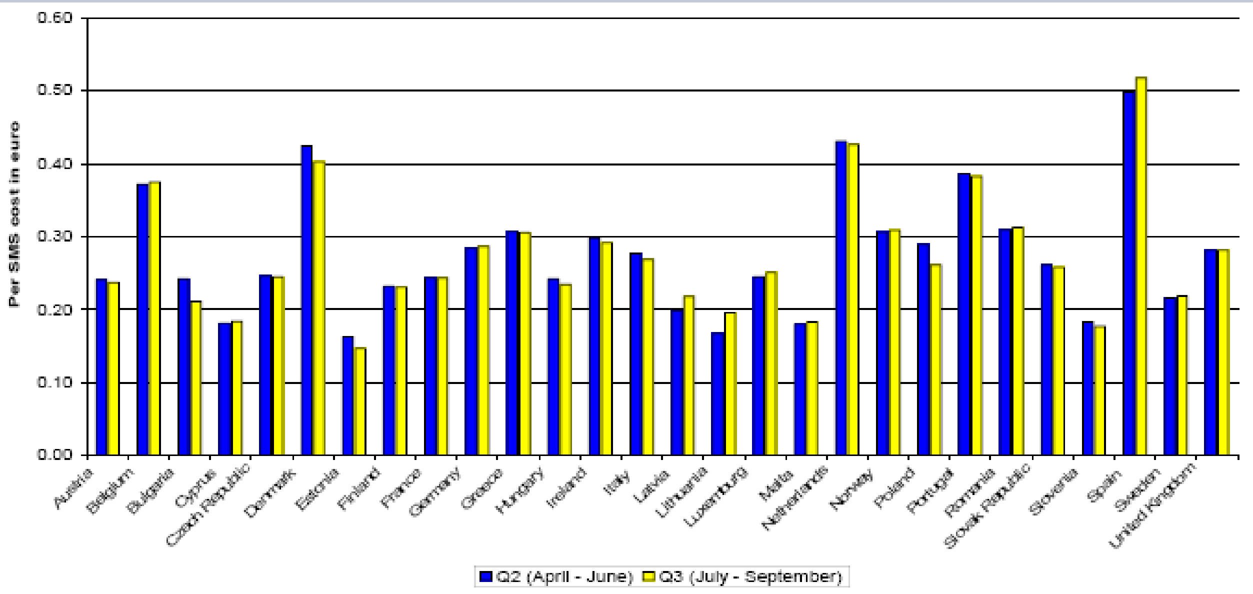
Note: Average: Calls made Q2 - € 1.37; Q3 - € 1.31

Calls received Q2 - € 0.69; Q3 - € 0.66

RoW – Rest of World

Source: ERG (2008), International Roaming, ERG benchmark data report for April and September 2007 at http://erg.ec.europa.eu/documents/docs/index_en.htm

Figure 3: SMS – price per message roaming (April – September 2007)



Note: Average: Q2 - € 0.29; Q3 - € 0.29

Source: ERG (2008), International Roaming, ERG benchmark data report for April and September 2007 at http://erg.ec.europa.eu/documents/docs/index_en.htm

After regulating prices of international mobile roaming voice calls, the EC has set its sights on prices of SMS and date transfer. The EC states that it cannot accept extraordinary mobile operators' profits on roaming customers and from time to time expresses its considerations about possible regulation of international mobile data roaming[1]. The latest public message was given by EU commissioner Viviane Reding during the Mobile World Congress in Barcelona, in February 2008[43]. The EU Commissioner said that the EC would like to see credible price reductions of international mobile SMS and data roaming by the whole industry on a voluntary basis before July 1 2008. Based on the offers on the market on that date, the EC will decide whether or not further regulation will be required.

The EC[44] indicated that it will carefully monitor the situation in the market, including additional possible problems like inadvertent roaming, impact on smaller operators, traffic steering and domestic mobile prices. ERG will benchmark data for every 6 months[45]. By the end of 2008 the EC[46] will report to the European Parliament and the Council about:

- Whether the objectives of the current regulation have been met?
- Should the regulation be extended?
- Is there any need to regulate roaming data services?

This should encourage mobile operators to make changes in prices of some roaming or even domestic services. Knowing the fact that once in place price cap regulation could be hard to stop, since there will always be the suspicion of a price rise by SMP operators[47], it is likely operators will resist any attempt to regulate. Therefore, it is safe to say that the tension between mobile network operators and the European Commission will continue.

4.2 Regulation of international roaming outside the EU

4.2.1 Initiatives in Arab States

One of the most notable initiatives to regulate international roaming prices outside the EU is found in the Arab States.

As already mentioned, in 2006 the Arab Regulators' Network (AREGNET) conducted a study on international mobile roaming prices in the Arab States, which found that retail prices charged for international mobile roaming are unsatisfactory. According to the results of the study[48], the variation in price per minute of calls to a home country while roaming ranges from 200 per cent to 1000 per cent, indicating great variability in roaming prices among Arab States. Prices per minute of roaming calls within a country are from 5 to 15 times higher than prices of regular local calls, which show a huge difference in prices within the same country.

In June 2006, following the results of the study, the Arab Telecommunications and Information Council of Ministers asked ARENGET to start regulating international mobile voice call roaming by January 2007. In May 2007, the ARENGET Plenary adopted a recommendation to be presented to the Arab Telecommunications and Information Council of Ministers. In July 2007, the 11th Ordinary Meeting of the Arab Telecommunications and Information Council of Ministers considered the recommendation. The initial AREGNET proposal to regulate retail roaming rates only was as follows[49]:

- A call from an Arab consumer to his/her home country should not exceed by more than 15 per cent a mobile international minute price from his/her original country to a visiting country;

[1] "I would like to say one word about the high roaming prices for mobile data. In cooperation with the national regulatory authorities, we will monitor data roaming prices during the next eighteen months. The operators should know this, heed these warning signals very carefully and bring the prices down to normal by themselves in order to avoid further regulation. " – Quote from the V. Reding speech 07.06.2007 at http://ec.europa.eu/information_society/newsroom/cf/itemdetail.cfm?item_id=3455

"This initial ERG report published today confirms the general trend towards lower roaming prices but it would be premature to draw firm conclusions at this stage. However, on the basis of the figures in the report, I remain concerned about prices for SMS and data roaming services. We will watch developments very closely and respond appropriately by the end of 2008." – said Viviane Reding, the EU Telecoms Commissioner, 17.01.2008 at www.europa.eu/rapid/pressReleasesAction.do?reference=IP/08/58&format=HTML&aged=0&language=EN&guiLanguage=en

- A call from a visiting Arab consumer from his/her mobile phone to a mobile phone in a visiting country should not exceed by more than 15 per cent a local minute price of a visiting operator;
- A call from a consumer to any Arab country other than his/her original country should not exceed a mobile international minute price from his/her original country to the other Arab country by more than 15 per cent ;
- A price for receiving a call should not exceed a local minute price in a visiting country.
- Wholesale prices applied between operators are not regulated, leaving these prices to be agreed through bilateral agreements.

The meeting did not approve this proposal mainly because it was considered incomplete, and a revised recommendation was subsequently prepared. The new proposal suggests regulating both wholesale and retail charges as follow (summarized in Table 10):

- **Wholesale rate for outgoing calls to home country or third Arab country.** Wholesale roaming rates for calls home or to a third country should not exceed the visited operator's retail charge for international calls to a respective country plus an additional margin of 50 per cent for the first year, 40 per cent for the second year and 30 per cent subsequently.
- **Wholesale rate for outgoing call within visited country.** Wholesale roaming rates for a call inside the visited country should not exceed a visited operator's retail charge for local calls in the country plus an additional margin of 50 per cent for the first year, 40 per cent for the second year and 30 per cent subsequently.
- **Retail rate for all outgoing calls.** Retail rates for outgoing calls should not be higher than a wholesale rate for an outgoing call plus and additional margin of 30 per cent.
- **Wholesale rate for an incoming call.** A visited mobile operator, as well as any intermediate visited country's international facilities operator, must not charge the operator of a subscriber's home network, or any intermediate home country's operator of international facilities, a wholesale rate that would be higher than a normal rate applied for terminating an international call.
- **Retail rate for an incoming call.** An operator of a subscriber's home network should not charge its subscriber a retail rate higher than its retail charge for international calls to a visited network.

Table 10: Suggested regulation of international roaming rates in the Arab States

Call type	Wholesale rate	Retail rate
Call to a home country or to a third country	Visited operator's retail charge for international calls* to a respective country x [1.5; 1.4; 1.3]**	Wholesale rate x 1.3
Call within a visited country	Visited operator's retail charge* for local calls x [1.5; 1.4; 1.3]**	
Call received	Not higher than a normal rate for international call termination	Home operator's retail charge for international calls to a visited operator

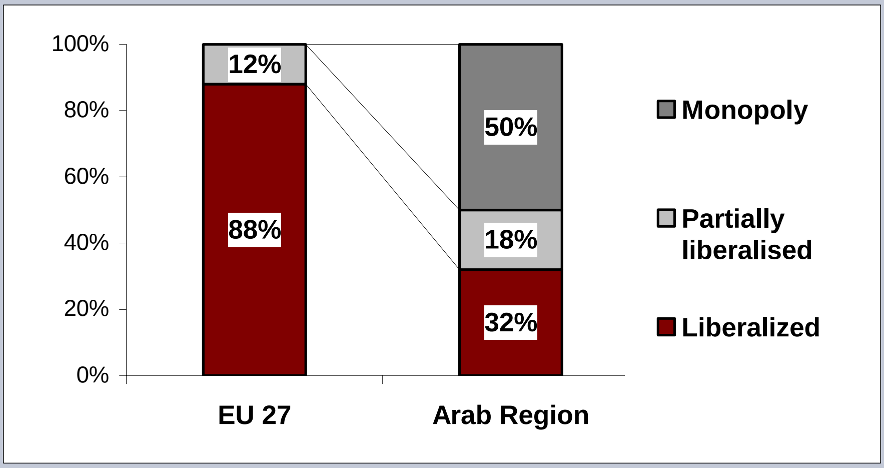
Note: * calculated as an annual average of various retail charges, applied by a visited operator, calculated as a total revenue divided by total minutes.

** additional margin for the first, second and subsequent years respectively.

Source: AREGNET (2007). Roaming regulation in the Arab countries.

The important issue is that the proposed regulation links international roaming prices with retail prices of regular international calls. This model, of course, takes into account regional specifics, such as non-liberalized international gateways (there are a significant number of Arab States that have not yet liberalized their international gateways – see Figure 4). The proposed regulation is simple, clear and flexible enough. In the European case, moving away from a "formula based" to a given price cap has introduced simplicity and more clarity for end users, but at the same time regulators have lost some flexibility to change international roaming prices together with MTR changes without reviewing the regulation at the EU level.

Figure 4: Liberalization of international gateways (percentage of countries in the region, 2007)



Source: *ATKearney (2007). Comments on proposed voice roaming regulation in the Arab countries.*

However, AREGNET[50] identifies some inherent constraints, which are important to take into account:

- "The model links wholesale charges applicable to foreign operators with local retail charges. Therefore application of this model would punish operators of countries where market liberalisation and tariff rebalancing have progressed further as proceeds of local competition and sector reform would be automatically enjoyed by foreign operators without the reciprocal benefit. This would to some extent be mitigated by retail price regulation as such regulation would force pass-through of savings in wholesale costs and thereby would benefit visited operators because of increased volumes of traffic.
- The model is based on costs to the extent only to which retail charges for international calls are close to costs. This may not be the case in some countries because of the stage of market liberalisation and sector reform.
- The model is not easy to apply. Agreement would be necessary, which prices should be taken as a reference when applying price-caps (lowest, highest, some form of average), and subsequent enforcement would be needed. It would not be easy for operators to verify if their roaming partners adhere to the regulation as they may not necessarily have the information necessary.
- The model is not applied in other regions that regulate roaming (namely – the EU). Therefore it could be not easy to agree on inter-regional regulation, if it considered desired at a later stage. "

4.2.2 Regulatory intervention in other regions

In September 2005 the Australian Competition & Consumer Commission (ACCC) published its report on the provision of international inter-carrier roaming services. Although ACCC found wholesale and retail charges for roaming services to be too high and consumers to lack information on the offerings, ACCC did not decide to take any significant regulatory action other than further monitoring of prices, liaising with other overseas regulatory authorities and, possibly, contributing to consumer awareness initiatives.

On the other hand, outside Europe, some believe that there is little prospect of international roaming charge regulation. Sometimes national regulators have no incentive to force their own operators to cut prices if they cannot force reciprocity from operators in other countries.

Furthermore, regulation of international roaming is more complicated than regulation of other telecom services basically because regulation of international roaming is difficult to implement at the national level as operators from more than one country are involved. When a consumer travels abroad, it is another "foreign" operator that provides facilities for making and receiving calls, and bills the home operator for this wholesale service. The price of these wholesale services has been traditionally high, with correspondingly high retail charges being passed on to the customer in the bills received from his or her own operator. But the regulator of country A has no legitimate power to control prices of an operator operating in country B. This is why coordination is essential.

4.2.3 Self-regulatory practice: market developments

While regulation was the answer to the international mobile roaming issue in the EU, self-regulatory practices may also provide an alternative.

One of the features of the international mobile roaming market is that mobile operators rarely limit themselves to one partner per country and usually aim to sign roaming agreements with virtually every mobile operator. This is not only because they want to offer their subscribers better choice and coverage within visited countries, but mainly to benefit from the reciprocity of roaming arrangements and the possibility to serve as many inbound users as possible. Furthermore, as some mobile operators are active in several countries, e.g., through ownership of mobile operators, the development of alliances and groups allow their members to enjoy lower wholesale charges.

The recent rise of alliances and groups is evidenced by developments in Europe, where groups (e.g., Vodafone, Orange, T-Mobile, TeliaSonera, Tele2) and alliances between network operators (Freemove[51] and Starmap[52]) have emerged. Similar consolidation is being evidenced in the Arab States by regional expansion of several operators (including Zain/MTC, Orascom, Qtel, Etisalat, Batelco, and MTN). The formation of alliances and groups bring some noticeable developments in the area of international roaming:

- Decrease in wholesale roaming tariffs[53]. Before the EU Regulation took place, Freemove alliance, which joins four mobile operators (Orange, TIM, T-Mobile and TeliaSonera) operating in 26 countries across Europe, the United States and Brazil and member operations extending to 47 countries worldwide[54], decreased international wholesale rates to 72 eurocents per minute in January 2006 and to 45 eurocents per minute from 1 October 2006. Freemove also planned to decrease these rates further to 36 eurocents per minute from 1 October 2007. Vodafone similarly decreased wholesale roaming tariffs to 70 eurocents per minute in May 2006 and 45 eurocents per minute in Q3 2006. One of the incentives for these developments could also have been the threat of regulation from the European Commission.
- Merger of national networks/markets to broader "one network" areas. In September 2006 Celtel, a subsidiary of Zain/MTC, abolished roaming charges in East Africa between Kenya, Tanzania and Uganda. Afterwards it has expanded its roaming service offer to 12 African countries, enabling around half of all African mobile phone subscribers to communicate across national borders without incurring extra costs. Celtel's roaming service is now available in Nigeria, Niger, Chad, Sudan, Burkina Faso and Malawi, as well as the Republic of Congo, Democratic Republic of Congo, Gabon, Kenya, Tanzania and Uganda. Launched a little over a year ago, Celtel's roaming service will extend services to a population of nearly 400 million people, living in an area twice as large as Western Europe[55]. In this "single network" area customers can make calls at local rates and receive incoming calls free of charge without any prior registration or fee.

  In a competitive move, Safaricom Kenya immediately entered into an agreement with Vodacom Tanzania and MTN Uganda to offer similar roaming services at domestic rates. Later on the MTN Rwanda, UCOM (Burundi) joined the alliance, called KAMA KAWAIDA[56].

  Zain/MTC has also recently announced similar plans for Saudi Arabia, Bahrain, Jordan and Iraq. Is it expected that Zain/MTC One Network will be extended to these countries in the first half of 2008[57]. Similar initiatives are also being implemented by other operators.

Hutchison Whampoa, trading as 3, has abolished roaming charges for calls received by its customers on its own networks in: Australia, Austria, Denmark, Hong Kong, Italy, the Republic of Ireland, Sweden and the United Kingdom[58]. TeliaSonera (Omnitel, LMT and EMT) and Tele2 operations in the Eastern European Baltic States also offer services for customers roaming in the respective countries, without charges for incoming calls and at reduced charges for outgoing ones[59].

- The Telecel networks, represented in five countries in West Africa (Benin, Burkina Faso, Cote d'Ivoire, Niger and Togo) in addition to Gabon, offer their customers a roaming service called "@Sim". The subscription involves two or more SIM cards, one for the home network and the others for the local networks in the countries to be visited[60].
- Given the heavy volume of travel between Hong Kong, SAR, China and the mainland in China, a number of solutions to roaming charges have been developed. One of the options – one SIM card with two numbers, or even three, for the mainland, Hong Kong, China and Macau, China[61].
- Conexus Mobile Alliance, created in April 2006, has nine members in Asia: Far EasTone Telecommunications Co., Ltd. (Taiwan); Bharat Sanchar Nigam Limited (India), Mahanagar Telephone Nigam Limited (India); Hutchison Telecommunications (Hong Kong) Limited (Hong Kong and Macau); PT Indosat Tbk (Indonesia); KT Freetel Co., Ltd. (South Korea); NTT DoCoMo, Inc. (Japan); StarHub Ltd. (Singapore) and Smart Communications, Inc. (Philippines). It was formed to enhance members' competitiveness in international roaming services, especially for Broadband wireless services in their own countries/regions and across Asia-Pacific[62]. In the beginning of 2008, the member operators jointly rolled out the first pay-per-day data roaming flat rate plan in Asia. Subscription is not required in most of the member networks. Members' customers will be automatically charged based on the data roaming flat rate tariff plan while roaming on to members' networks[63].

Several other market developments, indicating increased competition in international roaming market have been observed:

- Increased marketing activities targeting inbound customers: advertisement in airports, tourists' areas.
- Emergence of some regional/global offerings specifically targeting the market of roamers. Examples of innovative offerings are services of UK-based Cherry mobile[64] and Oneroam[65] as well as of US-based OneSIMcard[66]. These companies aim to offer local-type (without charges for incoming calls and lower charges for outgoing ones) services with the same SIM-card, which may be used in many countries. They base their offerings on specific agreements with local mobile network operators, including mobile virtual network operator type agreements.

Some recent technological developments will also enable operators of visited countries to target frequent roamers. An example of such a development is the possibility to assign a local number of a visited country to a foreign customer using a single SIM card of his home network operator[67]. Operators of the Arab region are starting to provide this kind of services. An example is a recent announcement by Saudi Telecom[68] that visitors to Saudi Arabia from all over the world will be able to get a local Saudi Arabian telephone number using the same SIM card of their home operator. After obtaining the number they will be able to use local Saudi Telecom's "Al Jawal" services on a pre-paid basis.

There are certain industry led developments fostering transparency of roaming tariffs as well. Following the ARAGNET study, the GSM Arab World launched a website that allows comparison of roaming tariffs[69]. This website replicates one designed for the European region. Some industry associations[70] also promote voluntary codes of conduct for information on international retail prices. The operators who sign up for the code of conduct commit themselves to provide information on roaming via:

- A customer service number of the home operator;

- An Internet site of the home operator;
- SMS (the minimum requirement is to provide a link to a website with roaming information or a phone number of a customer service).
- The code of conduct also encourages operators to provide information on roaming via: retail outlets; printed material; information at airports, borders and etc.

Box 2: Cheaper roaming: one phone but two numbers

There are two ways to avoid using a second phone while keeping two numbers. The first option is to buy a small device, called a dual SIM card adapter. Once inserted in the phone, it allows the handset to carry two SIM cards - and therefore two phone numbers - at the same time. The other option is to have a second number added to an existing SIM card through the subscriber's carrier.

One reason the dual SIM card device is not widespread is that mobile phone operators are reluctant to share their clients with competitors. Giving customers the possibility to easily use two SIM cards opens the opportunity for them to have cards from different companies.

Even with two SIM cards, though, a user cannot simultaneously receive phone calls coming in to the two different phone numbers. To switch between the phone numbers, in most cases, the phone has to be shut off and turned back on. That makes the dual-SIM-card phone potentially appealing for somebody who travels in two countries and has local phone numbers in each place to save on roaming charges.

There are some phones that leave the factory ready to take two SIM cards, although they are not big sellers.

Source: *International Herald Tribune, 2005*[71]

5 TRANSPARENCY ISSUE

It is necessary to recognize the important role that transparency can play in raising consumer awareness on the differences between operator's mobile roaming rates. One of the first initiatives of the EC to improve the situation in international roaming market was to encourage greater transparency in retail roaming prices. The website on roaming prices comparison across the EU was launched in 2005. Although afterwards the EC realized that transparency measures were not enough, all the parties – the EU, regulators, and mobile operators and consumers associations - have understood the significance of transparency. Surveys[72] conducted before the EU roaming regulation indicated that more than 40 per cent of European users did not have a clear idea of the cost of calls abroad. This means, that if price transparency is weak, roaming customers do not have full information about the range of roaming tariffs available in different countries on different networks, therefore they are not able to make sound decisions on consumption, and where to use the service or not.

A range of initiatives has been taken by different stakeholders:

1. The EC launched the website on roaming prices;
2. The ERG formed a project team to analyze roaming prices transparency in the EU and to suggest possible measures, if necessary.
3. First GSM Europe, then GSM Arab World, both branches of the GSM Association, developed a voluntary code of conduct for operators, the goal of which is to provide better information to consumers.
4. Two websites that allow comparison of roaming tariffs were launched by industry association – one for the European region and another for Arab region. AREGNET has recommended that information be published in the Arabic language to make it more user-friendly.
5. Finally, the EU regulation creates a system to enhance transparency of retail roaming charges. Article 6 of the EU regulation states: "*To alert a roaming customer to the fact that he will be subject to roaming charges when making or receiving a call, each home*

provider shall, except when the customer has notified his home provider that he does not require this service, provide the customer, automatically by means of a Message Service, without undue delay and free of charge, when he enters a Member State other than that of his home network, with basic personalised pricing information on the roaming charges (including VAT) that apply to the making and receiving of calls by that customer in the visited Member State." In addition consumers have the right to request and receive more detailed information free of charge.

However, each transparency measure has its advantages and disadvantages. For some examples see Table 11.

Table 11: Transparency measures

Measure	Advantages and disadvantages
National or international website	**Advantages:** • Would provide a one-stop shop for information and comparisons of retail roaming prices for operators. • Consumers could consult the site anywhere where Internet access available. **Disadvantages:** • Might be difficult to find appropriate methodology for the comparison of numerous combinations of different and complex offers. • Legal uncertainty- who is responsible for the accuracy of the information.
To inform customers by SMS	**Advantages:** • Would provide a one-stop shop for information and comparisons of retail roaming prices for operators. **Disadvantages:** • Might be difficult to find appropriate methodology for the comparison of numerous combinations of different and complex offers. • Legal uncertainty - who is responsible for the accuracy of the information.
Information in paper form	**Advantages:** • Easy to implement. • Easy to access customers in interest (airports, country borders) **Disadvantages**: • Information might be lost. • Operators may have to meet additional costs for producing, updating and distributing information.

Source: ERG (2005). ERG Project Team on International Roaming Retail tariff Transparency.

6 LEGAL ENFORCEMENT – COORDINATION AND COOPERATION BETWEEN REGULATORS

The EU case is unique because of the institutional framework that allows directly applicable and enforceable legislation for the whole EU. Regulation of roaming is essentially cross-border by nature. Wholesale regulation in one single country benefits operators and consumers in another country, but provides no benefits to either local consumers or market players. Therefore reciprocity is a must. This is evidenced by the EU practice, where a mere inclusion of wholesale markets of international roaming into the Recommendation of the European Commission[73] as the market that national regulatory authorities had to analyze did not produce results. The change was effectuated with a central compulsory legal instrument – namely the Regulation – only.

Therefore for other region organizations or economic groups it is important to coordinate and adopt a common regulation that would be made compulsory and enforceable with, preferably, the possibility of direct enforceability by market players concerned via both administrative and civil law measures. Bur first it is a question of political will.

Possible instruments for such implementation are:

- International (regional) treaties; or
- Agreements between regulators.

The appropriate option should be chosen after a careful analysis of legal systems and different powers of regulators concerned to enter into mutually binding agreements and to make provisions of such agreements the binding and enforceable part of the local legal systems.

The other issue to consider is whether an agreement should:

- Cover all the countries of the region from the start. It is a theoretically preferable option as it would rapidly provide all customers in the region with benefits of more affordable international mobile roaming services. However as different countries could have different regulatory priorities and/or could be at different stages of market development, it could be unrealistic to expect that all countries would commit to a common regulation proposed from the start; or
- Start between a smaller group of countries, and apply the agreement among interested countries only, while being open to other countries to join later. Any country would be free to join the agreement at any stage. Such an approach would give an opportunity for some countries to ensure lower international roaming prices for their consumers sooner and for other countries to wait for the results of regulation and then decide if they want to join.

The second approach seems to be more realistic. As a first step, the initial signatories would also have to identify who would be responsible for administering the agreement. Then it would also be important to publicize the agreement and its outcomes via, *inter alia*, special website with links from participating countries' websites.

From a consumers' perspective it seems to be in a country's or region's interest to enter into a bilateral agreement with the EU on international roaming[74]. While similar agreements on other services such as land and air transportation between the EU and non – EU countries already exist, a bilateral agreement on international roaming may be more difficult to implement because of the differences that exist between regulatory frameworks.

During the EU consultation, questions were raised by some EU operators regarding the compatibility of the regulation of wholesale international roaming tariffs with Article XVII of the GATS and paragraph 5 of the GATS Annex on Telecommunications. Some EU operators also expressed concern that as a result of the GATS obligations they would be required to offer wholesale roaming tariffs to non EC-based mobile operators at a level not exceeding the regulated level, while at the same time such operators could charge EC-based operators higher, unregulated, wholesale prices. In response, the EC[75] explained that pursuant to Article XVII of the GATS national treatment has to be accorded to like services and service suppliers. Paragraph 5 of the GATS Annex on Telecommunications contains a further non-discrimination obligation which requires the application of terms and conditions no less favorable than those accorded to any other user of like public telecommunications transport networks or services under like circumstances.

7 CONCLUSIONS

International mobile roaming is becoming an increasingly important issue on the international regulatory and policy agenda. There are several reasons for the growing importance of international roaming, as highlighted in this paper. This is not only because of higher demand for roaming services, as mobile penetration is growing across the world; nor is it only because international mobile roaming charges are an important cost factor for businesses across the world. International roaming should be viewed in a much wider context as a tool for forging regional cohesion. Therefore, for regional economic groups seeking closer cohesion and integration, international mobile roaming is one of the barriers that can be removed. This should be understood not only by regulators and policy makers, but also by operators. As long as industry, through self-regulatory measures, fails to deliver sufficient results, regulators are likely to intervene to try to improve the situation.

Although the history and practice of international mobile roaming regulation is very recent, it has already taught all stakeholders one lesson: whichever approach to international mobile roaming rate regulation is chosen, the success and final result depends largely on how closely different stakeholders cooperate and how openly they discuss and debate the issues. The outcome of the EU regulatory debates was a compromise between all stakeholders. The Arab region is currently in the middle of this process, and is working to allow the voices of all parties concerned to be heard. Whichever regions move to initiate a similar process should be ready to discuss – both to talk and to listen.

Currently, international mobile roaming services are usually vertically integrated, meaning that both network and service operations are carried out by the same operator, thus giving greater control to mobile operators over their customers. Upcoming next-generation networks and the move to mobile IP networks could change the status quo, making the roaming problem less relevant. Today, however, international roaming rates remain highly relevant, requiring cooperation and dialogue among all stakeholders.

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International Telecommunication Union

GSR 2008

Discussion Paper

Comments are welcome and should be sent by 13 April 2008 to GSR08@itu.int

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Work in progress, for discussion purposes

IPTV AND MOBILE TV: NEW REGULATORY CHALLENGES FOR REGULATORS

BY JANET HERNANDEZ AND MINDEL DE LA TORRE

COMMENTS ARE WELCOME AND SHOULD BE SENT BY 13 APRIL 2008 TO

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TABLE OF CONTENTS

page

1 ...... Introduction 5
2 ...... What is IPTV? 6
2.1 Definition 6
2.2 Technical aspects 8
2.3 Who provides IPTV services? 9
2.4 Market potential 10
3 ...... What is Mobile TV? 11
3.1 Definition 11
3.2 Technical Aspects 11
3.3 Mobile TV Standards for Dedicated Systems 13
3.4 Consumer Issues for Mobile TV 14
3.4.1 Are new handsets required for end users? 14
3.4.2 Payment options 15
4 ...... Legal frameworks for IPTV and Mobile TV 16
4.1 Legal Framework for IPTV and Mobile TV 16
4.1.1 How are countries classifying IPTV and mobile TV? 16
4.1.2 What laws apply to carriage and content? 19
4.1.3 What content issues are usually provided for in content laws? 19
4.1.4 Responsibility for complying with content laws 20
4.1.5 Legal issues related to acquiring content 22
5 ...... Licensing issues 24
5.1 Licensing of IPTV Providers 25
5.2 Licensing of Mobile TV 27
6 ...... Regulatory authorities responsible for IPTV and Mobile TV 28
7 ...... Other legal and regulatory issues 30
7.1 Standards 30
7.2 Quality of Service Issues 31
7.3 Ownership Issues 31
7.4 Spectrum 32
7.5 Unbundling 32
8 ...... Conclusions 33
Glossary of Terms 34

TABLES

Table 1: Comparison of IPTV, Internet TV, and Internet Video 8
Table 2: Video Services over Mobile Networks 12
Table 3: Payment Options for Mobile TV 15
Table 4: Pakistan: IPTV Channel Distribution Service Licence 25
Table 5: Singapore: Two-Tier Licensing Framework for Broadcasting IPTV Services 26

Table 6: Hong Kong: Regulation of Mobile TV, IPTV, and Internet TV 27
Table 7: Regulatory Entities Involved in Telecommunications and Broadcasting.................... 28

BOXES

Box 1: Services Being Offered by IPTV Providers... 7
Box 2: Mobile TV Standards 13
Box 3: Directive on Audiovisual Media Services 21
Box 4: Checklist for Regulators Introducing IPTV and Mobile TV 33

FIGURES

Figure 1: Operational Diagram of IPTV 9
Figure 2: Distribution of IPTV subscribers by region 10
Figure 3: Supply Chain for Content 23

1 INTRODUCTION

Today, telecommunications providers face a new competitive landscape. Significant competition from alternative fixed operators, VoIP providers, and mobile operators have decreased their voice revenues and lowered voice average revenue per user (ARPU). Telecommunications providers are looking to recapture some of their lost revenues through bundled services of voice, video and data (multiple play offers). While telecommunications providers have been able to offer voice and data, they have been constrained in their ability to offer video services. This puts them at a disadvantage with cable providers that offer video services and have upgraded their networks to offer broadband Internet access and voice telephony services. However, upgraded Internet Protocol (IP) platforms now offer telecommunication providers the ability to directly offer video services. These services, referred to as IPTV services, allow telecommunication providers the ability to offer a range of video services (including live television channels, video-on-demand (VOD), and various interactive services) through their IP platforms.

For countries struggling with the appropriate means and incentives to foster broadband development, the introduction of video services by fixed telecommunications providers may prove to be a key facilitator for such deployment. Fixed telecommunications providers are upgrading their facilities to obtain more bandwidth capacity in order to offer video services and acquire a new revenue stream. Therefore, these new video offerings are directly affecting the roll-out of new broadband services. As a result, the provision of IPTV services has the potential to not only increase competition in the video marketplace, but also to advance the broadband access goals of many countries.

Mobile television (mobile TV) is also being introduced in a number of countries. Unlike 3G mobile operators that offer video services, mobile TV allows a user to view live television channels. For mobile providers looking for ways to maintain and increase growth, mobile TV is a new avenue to increase their ARPU through content and services.

For both types of services, obtaining content that will attract users to their service is a key element. The market to obtain content, however, is highly competitive. Telecommunications and mobile providers must compete for content with terrestrial broadcasters, cable and satellite operators, and Internet service providers (ISPs). The ability to acquire content rights is likely to impact the success of IPTV and mobile TV business cases, but other factors are important as well, including competition from competing platforms, customer interest and take-up, and regulatory and legal barriers to entry.

The introduction of IPTV and mobile TV will provide substantial benefits to consumers. IP platforms and mobile devices, satellite and cable television, and the transition from analogue television to digital terrestrial television (DTT) will allow consumers access to a broad range of platforms to receive multi-media content. Moreover, they can watch a television programme or movie live or at a time of their own choosing; they can use devices to edit commercials; and they can watch such programming over their television, computer, or their mobile phone.

For regulators, there are a variety of factors to consider in relation to these new services. In the case of IPTV, such factors are potentially broader due to the fact that incumbent telecommunications providers are subject to legacy regulation. Because of this, the regulator must determine the impact of such regulation on providers' ability to offer services and on providers' incentives to incur the significant investments and high risks associated with deploying/upgrading infrastructure to allow for the provision of IPTV services. As such, in the case of IPTV, regulators initially should determine if there are any legal or regulatory restrictions to incumbent telephone providers' ability to provide video services within their markets. If incumbents are not restricted from entering the video market, regulators should consider if the application of existing regulation, specifically issues such as access obligations to dominant providers' network, might skew the incentives for investment in deployment/upgrading of networks to support IPTV services.

Having performed this initial review, regulators might look at how, if at all, IPTV and mobile TV fall within the existing regulatory framework for broadcasting services. As such, they must determine if these services fall within the definition of television broadcasting included in a country's laws or regulations and if so, what type of regulation would be imposed on such providers. Finally, regulators must determine if extending existing broadcasting regulation to these services is the best mechanism to foster their deployment.

This chapter seeks to provide a roadmap of the issues related to IPTV and mobile TV.[1] It discusses the elements of these services, including how such services are defined, their technical aspects, and the particular services that can be provided to consumers. In addition, it addresses the legal frameworks for IPTV and mobile TV. This includes discussion of the regulatory classification of such services, the regulation of content and its potential application on IPTV and mobile TV, the legal issues related to acquiring content, and the licensing issues related to these new services. In addition, the chapter discusses current institutional regulatory structures in the context of an environment that is converging and allows content and telecommunications services to share the same delivery platform. Finally, the chapter discusses some of the ancillary issues related to the deployment of such services, such as standards, quality of service, ownership issues, spectrum, and unbundling.

2 WHAT IS IPTV?

2.1 Definition

The term IPTV can cause some confusion. In narrow terms, IPTV is defined as the provision of video services (e.g., live television channels and near video-on-demand (VOD) or pay-per-view) through an IP platform. However, some define IPTV services to encompass all the possible functionalities associated with an IP platform. For example, some define IPTV services as multimedia services, such as television services, video, audio, text, graphics, and data, which are provided by an operator over a managed IP-based network for delivery to the consumer.[2] This encompasses not only linear video services but other ancillary interactive video and data services, such as Video On Demand (VOD), web browsing, advanced email and messaging services. The interactive services associated with IPTV allow the viewer to determine what and when to watch, and also allow the user to teleshop or order movie tickets using the IPTV service. IPTV providers now commonly include in their commercial packages a personal video recorder (PVR) through a hard disk in the set-top-box (STB) or on the network, allowing 'time-shifted' viewing of TV broadcasts or 'catch-up' viewing if the viewer pauses a live broadcast programme.[3] With the IP-based managed network, the service provider is able to offer a high level of Quality of Service (QoS) and Quality of Experience (QoE), security, interactivity and reliability.

IPTV providers are making content agreements and developing innovative applications in order to compete with cable and satellite television. This includes striking deals for special viewing packages such as sports. High definition (HD) has also been launched by a number of IPTV providers. In Hong Kong, PCCW recently introduced stock trading on its "now" IPTV service. In France, Iliad's "TV Perso Freebox" lets subscribers post their own videos for view by others.

IPTV can be confused with Internet video or Internet TV. However, the services are quite different. Internet video and Internet TV are both offered over the public Internet. Internet video is an unmanaged service that offers the streaming of video through the public Internet. Internet video companies include user-generated video websites like YouTube or Metacafe where users can upload and view others' videos. Today, these services tend to lack a QoS standard and are without any real control over production quality.[4]

Box 1: Services Being Offered by IPTV Providers

- ✓ Television channels
- ✓ Radio stations
- ✓ Pay-per-View live events (e.g., football)
- ✓ Video on Demand (access to movies and other stored content)
- ✓ Personal video recorder (allows recording, storage, and pause ("Live-pause"), fast-forward, rewind and "catch-up TV")
- ✓ Automatic serial recording (e.g. daily news)
- ✓ Recording can be programmed from anywhere via Internet or mobile phone
- ✓ TV Guide (EPG = Electronic Programming Guide)
- ✓ Image within image: keep watching main program, but browse through other channels shown on small window
- ✓ Parent Control: block individual channels or shows
- ✓ Set limit of monthly expenses (for video downloads)
- ✓ Instant box office on TV through partnership (i.e., customers can preview theatrical trailers then pick the seats and purchase tickets from movie theatre by clicking on the buttons on their remote control)
- ✓ Stock trading
- ✓ High Definition TV
- ✓ Personal videos (subscribers can post their videos on the network for view by others)

Source: IPTV – Reinhard Scholl, Speech, ITU Telecommunication Standardization Bureau, *Market, Services, Regulation, Standards*, Presentation at Competitive Platforms for the Delivery of Digital Content, (June 21-22, 2007) and Telecommunications Management Group, Inc. research.

Internet TV companies, like Joost, Babelgum, Zattoo, and Akimbo, tend to operate on peer-to-peer rather than managed networks and typically offer free, ad-based service. However, they offer similar or identical services to IPTV in several key areas. First, like IPTV, Internet TV provides professionally-produced and copyright-protected video. They also tend to use MPEG 4, the same encoding technology used by IPTV providers, for high video quality and offer near-TV quality picture resolution. While IPTV allows the subscribers to more easily switch from television to computer, users are increasingly able to view video on their television sets with Internet TV. For Internet TV providers like Joost that offer VOD, users can rewind and fast forward videos similarly to how IPTV users rewind and fast forward with PVR. However, Internet TV providers that stream live television, such as Zattoo, do not yet have this capability. Although limited in their service areas, both the U.S.-based Joost and European-based Zattoo have negotiated Digital Rights Management (DRM). DRM allows operators to prevent end users from copying or converting copyrighted materials and is considered a necessary component to offering IPTV.

Table 1: Comparison of IPTV, Internet TV, and Internet Video

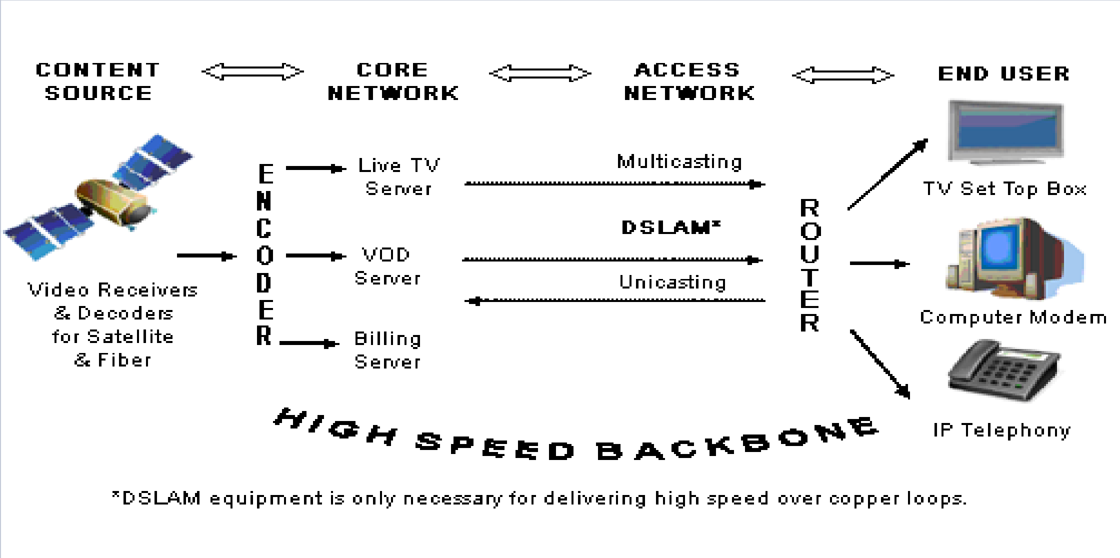
	IPTV	Internet TV	Internet Video
Examples of Operators	U-verse (AT&T) Opzioni TV (Fastweb) Orange TV (France Telecom) Imagenio (Telefonica) Now TV (PCCW)	Joost Zattoo Babelgum Akimbo	Youtube Metacafe
Users	Subscribers only; closed network	Free, ad-based service	Free, ad-based service
Services (Live TV, VOD, Interactive services	Live TV VOD Interactive services	VOD and/or live TV and Internet in multi-task environment	Video clips only
Network	IP-based platform; Managed network	Public Internet; Peer-to-Peer	Public Internet
Video Production	Professional video only	Professional video only	Amateur/user-generated video only
Video Quality	Managed QoS MPEG 2 to MPEG 4, MSVCI	Managed QoS High – MPEG 4	Unmanaged QoS Low, but improving
Receiver device	STB with TV or PC	PC	PC
Resolution	Full TV display	Near full TV display	QCIF/CIF
Copyright	Content is protected through DRM	Content is protected through DRM	No copyright protections
Status of roll-out	Deployed in limited geographic areas in various countries	Trial stages only	Fully accessible

Source: Based on IPTV – Market Regulatory Trends and Policy Option in Europe, Background Material, ITU-T IPTV Global Technical Workshop: Driving The Future Of IPTV, Document: IPTV/01, 1 November 2006, Seoul, 12-13 October 2006, at p. 7 and Telecommunications Management Group, Inc. research

2.2 Technical aspects

The basic elements of an IPTV operation consist of four components: the content source, the core network, the access network, and the end user, as shown in Figure 1 below.[5] The content source is the video provider that owns or is licenced to sell live television programming, VOD, or other downloaded services. Live television is typically received via satellite or through fibre while VOD is stored by the network operator. Content passes through an encoder, or headend, which prepares the content for transmission on the network. The core network encodes the video streams using MPEG-2, although the use of MPEG-4 (H.264 AVC[6], Windows Media VC-1) is on the rise. Once encoded, the content is encapsulated into IP packets, and is then ready for delivery to subscribers.

Figure 1: Operational Diagram of IPTV



Source: Telecommunications Management Group, Inc.

Live television is delivered via multicast, which allows many end users to receive content from one packet through efficient use of the IP network. Channels are essentially IP multicast group addresses that subscribers request to join. Unlike with a cable system or over-the-air television that "tunes" to a channel, the IPTV STB only acts as an IP receiver. The STB changes channels by using the protocol to join a new multicast group. When the local switch office obtains the channel change request, it confirms that the subscriber is authorized to view the content and adds the user to the channel distribution list. Therefore, only signals being watched are sent from the local office, through the Digital Subscriber Line Access Multiplexer (DSLAM) if necessary, and finally to the user.

Rather than a "one-to-many" transmission like multicast, VOD is unicast, or "one-to-one." When an end user requests a VOD, the servers pull pre-compressed video streams and transmit them as IP packets. Typically, the local switch office uses a VOD server to stream from the server to a particular subscriber's location. The stream is generally controlled by Real Time Streaming Protocol (RTSP), which allows the user to play, pause, and stop the programme.

If the video stream is to be delivered over copper loop to the subscriber, the IPTV provider must use DSLAM equipment to deliver IP packets to the subscriber after the content is encoded. DSLAMS are located either along the core network or access network.

At the customer premises, the STB allows subscribers to select the content they want to watch and provides user control over functionality such as rewind, fast forward, and pause over non-live programmes. The two-way functionality of IPTV services not only allows subscribers to choose their services with the press of a button, but also offers interactive capabilities, which allow a user to easily manage their multimedia sessions and personalize their preferences.

2.3 Who provides IPTV services?

The main providers of IPTV services tend to be telecommunications service providers; however, cable operator and satellite operators are also starting to deploy this service. There are two types of telecommunication providers offering IPTV: incumbent operators and newcomers. The former includes operators such as France Telecom, PCCW in Hong Kong, Telefónica in Spain and AT&T

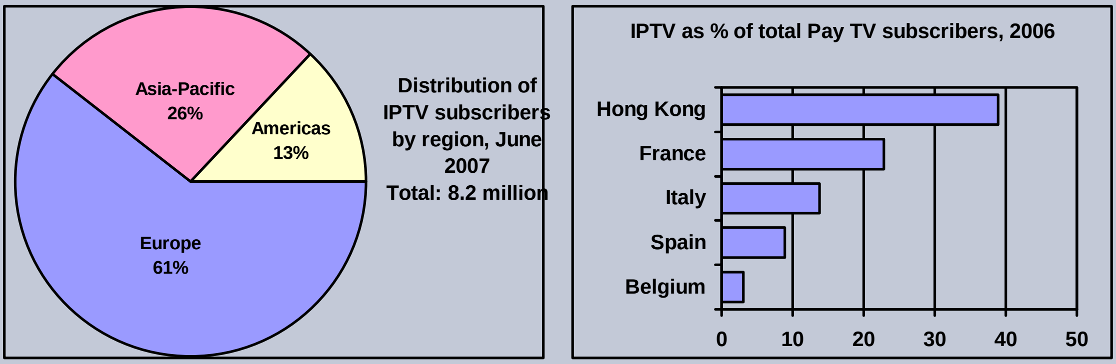
and Verizon in the United States. Incumbents are offering the service over their copper ADSL network or increasingly over fibre access networks. Newcomers include Iliad in France, Fastweb in Italy and Hanaro in Korea. These newcomers have often been successful by offering IPTV as part of a basic ADSL subscription. IPTV service typically offers from 40 up to 300 TV channels, as well as VOD, High Definition (HD), and PVRs. Coverage and deployment vary widely. For instance, AT&T currently only offers their "U-verse" service in select cities in a dozen U.S. states. However some deployments are having an impact. In Hong Kong, PCCW's "now" IPTV service had 560,000 subscribers in June 2007 and accounted for almost 40 percent of all subscription television subscribers. IPTV has also been successful in Italy and France where conventional subscription television penetration is not as developed as in other Western European nations.

Equipment manufacturers are increasingly introducing an element of IP into their STBs.[7] It is estimated that by 2010, of the 30 million IPTV STBs deployed in the world, around half will be hybrid (i.e., IPTV combined with some form of digital cable, terrestrial, or satellite front end). In addition, some established subscription TV operators are combining IPTV technology and services with their existing package of channels to offer enhanced functionality (such as on-demand content).[8] For example, Premiere in Germany is planning to offer a combined satellite and IPTV service in partnership with Deutsche Telekom (DT), allowing access to DT's IPTV offering and to its own satellite subscription service. In Japan, subscription television satellite operator Sky PerfecTV has rolled out an IPTV offering. BT of the UK has launched a combined IPTV/DTT service (BT Vision) that provides traditional broadcast-based channels over DTT alongside additional content over an IP connection.

2.4 Market potential

According to the DSL Forum, there were some 8.2 million IPTV subscribers worldwide in June 2007.[9] This is an increase of 127 percent from a year earlier. Europe leads in deployment, accounting for more than half of the world's IPTV subscribers (see Figure 2). Indeed four of the top five countries by IPTV penetration as a percent of total pay TV subscribers are European (see Figure 2). IPTV has been most successful in Hong Kong where it accounts for around two out of five pay television subscriptions. One study forecasts 14.3 million IPTV subscribers and USD 3.6 billion in revenues in 2007.[10]

Figure 2: Distribution of IPTV subscribers by region and leading IPTV countries by penetration, June 2007



Source: Adapted from DSL Forum and regulator and operator reports.

There are several forecasts for IPTV evolution with the number of subscribers ranging from 41 to 73 million by 2011.[11] However, given that IPTV is at a stage of initial market development these figures should be treated with caution. Some jurisdictions such as France and Hong Kong have been extremely successful with IPTV and if these experiences can be replicated elsewhere, then the figures could be much higher. Also, most major deployments have thus far been limited to developed economies. The potential for IPTV in developing nations could be significant in markets lacking traditional subscription television outlets such as cable or satellite television. However, this needs to be balanced against the high investment costs of installing broadband infrastructure.

IPTV presents an opportunity for traditional telecommunications providers to offer triple play services. In addition, unlike new entrants, most major operators launching IPTV operations have the financial resources available to upgrade their networks, as well as a database of consumers from which to leverage. However, there are bottlenecks that impact IPTV strategy. First, coverage is far from ubiquitous. In order to deliver IPTV, high-speed broadband is required. While many operators have launched broadband, in some markets it is not available nationwide or speeds are too slow to support IPTV (IPTV requires a downstream broadband connection of at least four megabits per second (Mbps)). A second issue is that some telecommunications operators already provide television service through cable and satellite ownership or partnership agreements.

3 WHAT IS MOBILE TV?

3.1 Definition

Mobile television is the wireless transmission and subsequent reception of television content – video and voice – to platforms that are either moving or capable of moving. Mobile TV allows viewers to enjoy personalized, interactive television with content specifically adapted to the mobile medium. These features of mobility and personalized consumption distinguish mobile TV from traditional television services. The services and viewing experience of mobile TV over mobile platforms differ in a variety of ways from traditional television viewing, most notably in the size of the viewing screen.

The technologies used to provide mobile TV services are digital-based and much of the terminology used in mobile TV descriptions is closely tied to corresponding Internet phraseology. For example, the terms unicast and multicast in the context of mobile TV are used to describe the transmission of television content to a single user (subscriber) from a single source at any one time (unicast) and the transmission of the same television content from a single source to multiple users simultaneously (multicast). These definitions correspond quite well with those given for similar Internet-based applications.[12] Unicasting and multicasting are distinct from broadcasting in that broadcast signals can be received by every user on the network simultaneously.

3.2 Technical Aspects

There are currently two main ways of delivering mobile TV. The first is via a two-way cellular network and the second is through a one-way dedicated broadcast network. Each approach has its own advantages and disadvantages. Delivery over an existing cellular network has the advantage of using an established infrastructure that would inherently reduce deployment costs while at the same time providing market access to the current cellular subscribers which could, theoretically at least, lead to enhanced subscribers for mobile TV services. The main disadvantage of using current second and third generation (3G) cellular networks for the delivery of mobile TV is that mobile TV competes with voice and data services for bandwidth, which can decrease the overall quality of the mobile operator's services. The high data rates that mobile TV may demand could severely tax an already capacity-limited cellular system. In addition, it cannot be taken for granted that the mobile handset used for cellular services would be useful for most mobile TV applications without major redesign. Issues such as screen size, received signal strength, battery power, and processing capability may well drive the mobile TV market to design hand-held receivers that provide a higher quality of voice and video than is available on most current cellular handsets.

Many advanced second-generation mobile service operators and most 3G mobile service providers are providing VOD or streaming video. These services are mainly unicast with limited transmission capacity and are built upon the underlying technologies used in the mobile cellular system itself – GSM, WCDMA, CDMA2000.[13] An example of a technology designed to work on a 3G network is Multimedia Broadcast Multicast Service (MBMS), a multicast distribution system that can operate in a unicast or multicast mode.[14] MBMS has been designed by the 3rd Generation Partnership Project (3GPP) to provide mobile TV services over existing GSM and WCDMA cellular networks. It operates in the 5 MHz WCDMA bandwidth and supports six parallel real-time broadcast streaming services of 128 kbit/s each per 5 MHz radio channel.

Table 2: Video Services over Mobile Networks

	Live Mobile TV Over 3G Network	Live Mobile TV Over Dedicated Network
Examples of Operators	Orange Mobile TV AT&T Wireless (using MobiTV)	V-Cast Mobile TV (Verizon) 3 Italia
Users	Subscribers only; closed network	
Services (Live TV, VOD, Interactive services	Live television VOD, instant messaging	
Network	3rd generation mobile networks	One way dedicated broadcast network
Technology Platform	MBMS	MediaFLO DVB-H/SH DMB
Video Production	Professional video	
Video Quality	Managed QoS MPEG-4	
Receiver device	Requires a standard 3G cellular phone	Requires a new dual-mode handset capable of receiving the broadcast signal and the cellular signal for phone calls and mobile Internet access
Status of roll-out	Relatively wide availability—service is available to any 3G subscriber on a network offering mobile TV	Limited availability in certain countries; trial stages elsewhere
Relative Limitations	3G network may not be able to support mobile TV traffic as the number of 3G voice and data users grow	Cost of building a dedicated network

Source: TMG, Inc. research

Dedicated mobile TV delivery systems, however, can be and are designed to optimize the provision of mobile TV. These delivery systems can be either totally terrestrially based, completely satellite based, or a combination of both. One of the major advantages of a dedicated mobile TV delivery system lies in the relative ease that mobile TV content can be provided to numerous users simultaneously. On the other hand, the disadvantages include the large capital investments in infrastructure that are required and the limited content options that are currently available, although that should abate significantly as the mobile TV market grows.

3.3 Mobile TV Standards for Dedicated Systems

There have been significant advances in the development of standards used to support mobile TV transmissions and mobile multimedia by dedicated delivery systems. These include standards for digital video broadcasting-handheld (DVB-H), digital multimedia broadcasting (DMB), Integrated Services Digital Broadcasting-Terrestrial (ISDB-T), and MediaFLO (see Box 2 below). These standards employ advanced modulation techniques such as orthogonal frequency division multiplexing (OFDM) and are interoperable with mobile telecommunications networks.[15]

DVB-H is the mobile TV standard that has been identified for operation in most of Europe due to its compatibility with GSM and WCDMA mobile standards. T-DMB is being used in Korea, Japan, and Indonesia, and a satellite version of the technology (S-DMB) is operating in Korea. ISDB-T was developed in Japan to provide mobile TV services. MediaFLO technology is being extensively deployed in the United States for mobile TV applications.

In addition to the standards referred to above that form the basis for Recommendation ITU-R BT.1833, there are other mobile TV transmission technologies in various stages of standardization or deployment in various countries around the world. These include DAB-IP mobile TV technology, Advanced-VSB technology, and the China Mobile Multimedia Broadcasting (CMMB) system.

Box 2: Mobile TV Standards

Standards that form the basis for Recommendation ITU-R BT.1833:

- ✓ DVB-H: is based on the DVB-T digital broadcast standard and is optimized for handheld terminals. DVB-H incorporates time-slicing to reduce power consumption and to allow time for a smooth handover from one cell to another. It is designed to operate in bandwidths of 5 MHz, 6 MHz, 7 MHz, and 8 MHz which correspond to the bandwidths used by broadcasting services around the world.
- ✓ Terrestrial Digital Multimedia Broadcasting (T-DMB): is an enhancement of the T-DAB system to provide multimedia services including video, audio, and interactive data services for handheld receivers in a mobile environment. It operates in a channel bandwidth of 1.712 MHz and is completely backward compatible with the T-DAB system for audio services.
- ✓ ISDB-T: There are two distinct systems identified in Recommendation ITU-R BT.1833 for mobile TV: one is based on the ISDB-T-one segment and operates in bandwidths of 1.75 MHz, 2 MHz, or 2.33 MHz, and the other system is a hybrid terrestrial/satellite system Multimedia System “E” based on Digital System E of Recommendations ITU-R BO.1130 for the satellite component and ITU R BS.1547 for the terrestrial component. It operates in a 25 MHz bandwidth. Receivers are typically handheld with a 3.5 inch wide display for video and data broadcasting in addition to high quality audio. The satellite part of the standard provides nation-wide coverage in Japan with terrestrial gap-fillers augmenting areas that are shadowed from the satellite path.
- ✓ Media Forward Link Only (MediaFLO): is an end-to end system that enables broadcasting of video streams, audio-only streams, digital multimedia files, and data-casting to mobile devices, including handheld receivers. The system is designed to optimize coverage, capacity, and power consumption for handheld receivers. It can operate in channel bandwidths of 5 MHz, 6 MHz, 7 MHz, or 8 MHz.

Other mobile TV technologies in various stages of standardization or deployment:

- ✓ DAB-IP mobile TV technology: is a variant of the ETSI DAB standard and was standardized by ETSI in mid-2006. It has a limited amount of channels compared to DVB-H or MediaFLO but as of 2006 was the only standard that could be deployed commercially in the United Kingdom, as the spectrum needed for DVB-H was not available.
- ✓ Advanced-VSB technology: builds on the current North American ATSC television transmission standard to enable mobile receivers to receive television broadcasts. It is backward compatible with current digital television receivers in the United States.

✓ The China Mobile Multimedia Broadcasting (CMMB) system: is a satellite/terrestrial wireless broadcast system designed to provide audio, video and data service for handheld receiver. The system employs high-power satellite signals and a complementary terrestrial network. The CMMB system can operate in 2 MHz or 8 MHz channels, uses OFDM modulation, and supports interactive services by cooperating with terrestrial telecom networks.

Sources: Recommendation ITU-R BT.1833, Appendix 1; Recommendation ITU-R BT.1833, Table 1; Appendix 2, Table 1; Recommendation ITU-R BT.1833, Tables 1, 2, 3; Section 4.4; Annex 4; Appendix 2, Table 1; Recommendation ITU-R BT.1833, Tables 1, 2, 3; Section 4.3; Annex 3; Appendix 2, Table 1; Recommendation ITU-R BT.1833, Tables 1, 2, 3; Section 4.1; Annex 2; Appendix 2, Table 1; and Recommendation ITU-R BT.1833, Tables 1, 2, 3; Section 4.5; Annex 5; Appendix 2, Table 1.

3.4 Consumer Issues for Mobile TV

3.4.1 Are new handsets required for end users?

As noted above, there are several types of mobile broadcasting technologies, each with its own set of required hardware and software. Current 3G networks – whether WCDMA or CDMA2000 based – can be modified to deliver mobile TV using technologies such as MBMS described earlier. These technologies have the backing of relevant standards organizations and it would be expected that many 3G handsets would include the capacity to receive and display mobile broadcast-like content.

Mobile TV technologies such as DVB-H, MediaFLO, or DMB, require additional components and software not found in most current 3G handsets. With the addition of each new component, handset design becomes more complicated as vendors attempt to integrate new functionality into form factors that are not only acceptable, but attractive to consumers and operators.

Unless the mobile TV signals are transmitted in the same frequency band that can be received on the mobile handset, reception of broadcast signals on mobile handsets will require an additional receiver/tuner, and perhaps antenna and decoder. Also additional software, battery power, and memory are likely to be necessary.

The most crucial component for receiving mobile TV signals is a platform tuned to the frequencies that are carrying the transmitted signals. Because mobile TV technologies tend to operate in bands not traditionally used for mobile communications (e.g., the 700 MHz band rather than the 800 MHz and 1900 MHz bands in the United States), handset manufacturers must include two receivers: one for the voice and/or data service, and one for the mobile broadcast service. In addition, it is necessary for the two receivers to be separate so as to allow, for example, the interruption of television reception to receive an incoming phone call.[16]

In addition, as handsets become more complex – even without taking mobile TV into account – they have begun to incorporate more and more software applications, which adds additional memory and sometimes power-consuming burdens onto the operation of the handset. Mobile TV will necessitate the inclusion of decoder software, media file players and service or programme guides.[17] While many current handsets include some sort of media player, often for music files or multi-media service (MMS) messages, they will require more robust or additional players to accommodate the demands placed by providing a true mobile TV capability.

Along with the additional receiver and software mentioned above, other handset considerations are antenna-related needs, the receiver's power consumption needs, and sufficient memory to buffer or simply display the received content.

3.4.2 Payment options

Operators can implement a variety of payment options with respect to mobile TV services, each with its own benefits and drawbacks. The plans need not be mutually exclusive; there can be a variety of options for different types of consumers or different types of content. As has been implemented with cable and satellite television systems around the world, pay-per-view pricing enables consumers to pick and choose specific content or programmed material that they would like to view, with à la carte pricing, meaning that they only pay for that content that interests them. This model does not generate a steady revenue stream for operators, but it lowers the barrier to entry for consumers, enabling them to sample content (or, indeed, the concept of mobile broadcasting in general and mobile TV in particular) without requiring a long-term commitment. In addition, pay-per-view is particularly well-suited to one-off broadcasts, such as high-profile sporting events or movies. Mobile TV operators can also offer customers a subscription plan. In a subscription model, operators charge a set price for access to particular content, or more likely, access to a bundle of content streams or channels. Operators can offer a variety of different subscription bundles and prices so as to target different demographic groups.

Table 3: Payment Options for Mobile TV

	Mobile TV Services	Payment Plans
Pay-per-view	2006 FIFA World Cup matches that took place over the course of a month; some operators, such as Germany's T-Mobile, implemented a hybrid pricing plan with a pay-per-view component.	T-Mobile offered live streaming of more than 20 matches to subscribers who paid EUR 7.50 (USD 9.66) per month plus EUR 2 (USD 2.58) per day that they wanted to use the service. T-Mobile's World Cup coverage was available to any subscriber with a 3G handset and 3G coverage. Subscribers to more-inclusive tariff plans had this offering available to them at no extra charge.[18]
	In Qatar, Qtel offers both live and on-demand mobile TV services on a pay-per-view basis.[19]	Access to live streams is priced at QR 3 to QR 15 (USD 0.82 to USD 4.12), depending on the length of time the user wants to view the stream, from one minute to 15 minutes. Qtel also offers delayed access to streams from earlier in the day for reduced prices. On-demand video clips are priced at QR 6 (USD1.65) each. Access to Qtel's mobile TV service requires the subscriber to have access to Qtel's mobile Internet service, which carries its own fee.

Subscription	In the United States, Verizon Wireless has V CAST Mobile TV with three subscription offerings:[20]	Subscription offerings range from USD13-25: Limited package: four content streams provided by three major U.S. broadcasters Basic package: eight content streams provided by seven major U.S. broadcast and cable networks, plus, for an added fee, downloadable video clips from a variety of content providers, as well as unlimited email access. Select package: eight content streams provided by seven major U.S. broadcast and cable networks, plus unlimited downloadable video clips from a variety of content providers, as well as unlimited email access.
Hybrid	Vodafone New Zealand offers consumers a subscriber plan to its Mobile Sky TV service with the option of viewing additional one-off events and programming.[21]	The Mobile Sky TV service subscription is NZD 2.50 (USD 1.93) per week, with international rugby matches available for an additional NZD 3 (USD 2.31). Vodafone New Zealand plans to roll out full-length movies over its Mobile Sky TV service as well.

Sources: The Unwired, "MULTIMEDIA: T-Mobile Germany streams the FIFA World Cup live over UMTS," May 12, 2006, http://www.theunwired.net/?item=multimedia-t-mobile-germany-streams-the-fifa-world-cup-live-over-umts; Qtel Mozaic MOB, http://mobile.mozaic.qa/wnf/t123/0/2203/m/1?og=ct&; Verizon Wireless, http://products.vzw.com/index.aspx?id=mobileTV&lid=//global//features+and+downloads//mobileTV#overview; Vodafone New Zealand, http://www.vodafone.co.nz/personal/vodafone-live/mobile-tv.jsp

4 LEGAL FRAMEWORKS FOR IPTV AND MOBILE TV

4.1 Legal Framework for IPTV and Mobile TV

4.1.1 How are countries classifying IPTV and mobile TV?

The introduction of IPTV and mobile TV services presents regulatory problems closely linked with convergence of the ICT and broadcasting sectors. IPTV and mobile TV provide new platforms and/or devices to distribute digital television content, as well as the ability to provide a variety of multimedia services. With this development, regulators are looking to see whether these services should be considered as broadcasting services, telecommunications services, information service or whether they should be exempt from regulation altogether.

Some regulators have sought to classify these services as a means of creating regulatory certainty. Others have opted to adopt policies to facilitate their deployment but are waiting until market and technologies develop before issuing a regulatory determination. However, for operators of IPTV and mobile TV services, this exercise of regulatory classification is critical. It is necessary for such operators to have a clear set of rules that will create the adequate environment for investment and deployment of these services. This is particularly important given that such regulatory classifications will have a direct impact on issues such as market entry, licensing, content regulation requirements, ownership requirements, geographic coverage (nationwide, regional or local licence), and other regulatory obligations such as fees.

4.1.1.1 Classification of IPTV services

Countries are taking various approaches in classifying IPTV. These positions range from simply abstaining from issuing an upfront official position, instead focusing on issues deemed relevant to promote competitive entry into the video market; to considering IPTV, and all its related functionalities as a broadcasting service and regulating them accordingly. Some countries are also developing a broad middle ground, where some services offered over IPTV platforms are considered to be broadcasting services as defined under a country's existing regulatory framework while others, such as VOD, are not considered to fall within such category.

In the United States, for example, IPTV has yet to be classified. The FCC initiated a proceeding on IP-enabled services in 2004 pursuant to which it made certain determinations related to IP services, such as VoIP, but it did not issue any determination regarding IPTV services.[22] This fact, however, has not precluded the FCC from addressing certain perceived barriers to the deployment of IPTV services through a series of regulatory decisions. These include issues such as declining to require incumbent local exchange carriers to provide unbundled access to their hybrid or FTTH loops for the provision of broadband services; relaxing the process for issuing cable franchises (licensing process) to facilitate entry into the video market mainly by existing facilities-based local exchange carriers intending to provide IPTV services; and finding that clauses granting cable providers exclusive access for the provision of video services to multiple dwelling units and other real estate developments harm competition and broadband deployment and were accordingly proscribed under the Communications Act of 1934, as amended.[23]

On the other end of the spectrum, some countries have adopted a technology neutral approach towards classifying IPTV. For example, in Canada, the regulatory authority, CRTC, considers IPTV as one of the broadcast distribution technologies available for television programming.[24] Services offered over this platform, including VOD, are deemed to be broadcasting services and providers offering IPTV fall within the category of broadcasting distribution undertakings, and are licenced accordingly.

Another approach is that taken by jurisdictions such as Korea, Singapore and Pakistan where IPTV has not only been specifically classified as a broadcasting service, but new categories of broadcasting licences have been established. In Singapore, for example, broadcasting includes the transmission of any television programming taking the form of either full scheduled channels and/or VOD content to households via a broadband connection using Internet protocol.[25] Korea has enacted a new law that classifies IPTV as an "Internet multimedia broadcasting" service -- defined as a "type of broadcasting whereby various types of content, including real-time broadcasting programmes, are provided to users through television sets by way of Internet protocol that allows interactivity using fixed-line telecommunications facilities."[26]

Some jurisdictions are basing their regulatory classification of IPTV services on the degree of interactivity they allow. On this basis, many countries are regulating the television broadcast component of IPTV and its VOD capabilities differently. For instance, in the EU countries and New Zealand, regulation is differentiated based on whether the content being offered to the user is linear (programming transmitted at a scheduled time) or non-linear (content that is selected by the user and viewed when the viewer wishes). Linear programming is generally subject to broadcasting and content regulation. Non-linear content is not subject to broadcast regulation, such as in New Zealand, but is subject to certain content regulation, as in the EU countries.

4.1.1.2 Classification of Mobile TV

Given that mobile TV has only recently started being deployed, regulators have only begun to consider the possible regulatory classification of these services. Nevertheless, specific trends can be distinguished. Some jurisdictions have opted for a light-handed approach, classifying mobile TV as an information service, while others regulate it, or are proposing to regulate it, as a broadcasting service.

In the United States, mobile TV services (both second generation and 3G, as well as dedicated mobile systems offering live television channels) are classified as information services and are not subject to broadcast rules and regulations.[27]

In Singapore, the broadcasting regulator, MDA, is proposing to classify mobile TV services and cellular mobile TV services (point-to-point video distribution services) as broadcasting services. MDA determined that a technology neutral approach suggests that both types of mobile TV services should be regulated in the same manner, independent of the transmission platform.[28] 3G mobile providers in Singapore strongly oppose this determination and its regulatory implications since it is their position that their current licences allow them to offer such services and they should not be regulated as broadcasters.[29]

Other jurisdictions have found that existing broadcasting regulations are not applicable to mobile TV services.[30] For example, in Hong Kong SAR, the Broadcasting Ordinance is drafted in the context of television reception at a specified premise rather than for an audience with mobility. Given this, Hong Kong SAR is proposing two alternative approaches. The first option provides for a self-regulatory approach, whereby mobile TV would not be classified as a television programming service. Instead, mobile content would be regulated in the same manner as content provided over the Internet (i.e., subject to the Control of Obscene and Indecent Articles Act and the Prevention of Child Pornography Ordinance, but not the Broadcasting Ordinance) and providers would be required to draw up industry codes of practice of voluntary compliance.[31] The second proposed approach calls for amending the Broadcasting Ordinance to include mobile TV services as a new category of service (including those offered over 2.5/3G mobile networks and those offered through broadcasting networks) within its scope.[32]

Other authorities have effectively amended existing broadcasting regulation to include mobile TV within their purview. For instance, in 2006 the Italian regulator, AGCOM, amended the 2001 digital terrestrial television regulations to extend its application to mobile TV services delivered over broadcasting networks (i.e., in the case of Italy's DVB-H networks).[33] As such, AGCOM has classified these mobile TV services as broadcasting services. Similarly, in South Korea amendments were introduced to the broadcasting regulations to include mobile TV services over broadcasting networks within their scope. As such, new "mobile multimedia broadcasting services" (both terrestrial and satellite) were created.[34]

By contrast, regulators in other jurisdictions have chosen to tread more lightly. The Canadian regulator, CRTC, exempted mobile TV service over the public Internet from licensing or other requirements of the Broadcasting Act of 1999 and 2006.[35] The exemption applies to operators that use point-to-point technology to deliver the service, meaning that the operator transmits a separate stream of broadcast video and audio to each end user. The CRTC determined that due to a variety of factors, it was unnecessary and potentially detrimental to the development of mobile broadcasting to impose the more stringent broadcasting conditions upon these operators. These factors include the finding that point-to-point mobile TV will not have a significant impact on traditional broadcasters due to the limitations of the wireless technology employed, the battery life, screen size of the handset, as well as the type and range of programming choices offered by the mobile broadcasters,[36] However, the CRTC has yet to make a determination regarding the regulation of dedicated point-to-multipoint mobile TV systems.

4.1.2 What laws apply to carriage and content?

Traditionally, the regulation of telecommunications networks falls under telecommunications laws and regulations and the regulation of cable networks are covered through broadcasting or cable television legislation. Content regulation, in turn, is typically addressed through specific legislation, codes of conduct developed by the government or in coordination with the sector, or self-regulation. Countries take different approaches regarding which companies are subject to content regulation. In certain instances, content restrictions may only apply to free over-the-air broadcasters. In other instances, the regulations may apply to both free over-the-air broadcasters and subscription television providers. Yet other times, specific content regulations may be developed for different types of operators (e.g., a specific programming code for subscription television operators).

4.1.3 What content issues are usually provided for in content laws?

4.1.3.1 Must carry obligations

A recent survey shows that most OECD countries impose some form of must-carry regulation.[37] Must carry generally involves the obligation of a cable operator (and in certain instances, satellite operators) to rebroadcast the signals of local or public over-the-air television stations. The rationale behind such policies typically centers on ensuring public access to local/regional content and public programming as well as public safety announcements, e.g. in the case of extreme weather conditions.

4.1.3.2 Nationally produced content

It also is common for audiovisual laws and licences to require licensees to include national (or regional) content in their programming, utilize national production resources, and meet cultural diversity goals. Many countries include quotas for national content, such as Malaysia (80 percent), France (prime-time programming must be 40 percent French and 60 percent European), and Brazil (80 percent for non-cable broadcasters). In Canada, national content is a “cornerstone” policy of Canada’s Broadcasting Act, and requires the use of Canadian production resources for television and radio programming, air-time quotas for Canadian content, as well as national ownership and control requirements. The requirements apply to cable operators, direct-to-home satellite providers, and multipoint distribution systems.

To encourage local television and film production, some countries also include tax incentives, such as tax credits as high as 25 percent, in their laws and regulations (e.g., Canada, city of New York in the United States, and Ireland).

4.1.3.3 Decency; programming standards

Content laws often include standards related to programming and restrictions regarding language, sex/nudity, violence, and gambling. These rules may apply only to free over-the-air broadcasting, as in the case of United States with regard to obscene speech. In other countries, such as Hong Kong and Singapore, the code of practice regulating content applies to free over-the-air and subscription television.

4.1.3.4 Protection of minors

It is also quite common for countries’ audiovisual policies to include rules protecting minors from harmful programming and to have restrictions regarding advertising associated with children’s programming. In the EU, as well as in Australia, Japan, Norway, Singapore, India, and Hong Kong, these policies generally apply to free over-the-air broadcasters, cable and satellite providers. With regard to advertising, Norway has a complete ban on advertisements specifically directed at children, and also bans the airing of advertisements immediately before, or immediately after, children’s programmes. Australia bans advertisements that state or imply that a person who buys a product or service for a child is more generous than a person who does not.

4.1.3.5 Fight against racial and religious hatred

Numerous countries, including Australia, Hong Kong, Mauritius, and Singapore, as well the EU countries, have content laws prohibiting racial and religious hatred in television. These laws apply to both free over-the-air and subscription television operators.

4.1.3.6 Role and means of supporting public broadcasting

Public television stations have traditionally been the dominant form of broadcast television in many countries. Their missions typically center on broadcasting throughout a country's territory, providing quality or educational programming, and providing programming with no or fewer commercial influences. These stations may also further specific public policies, such as promoting linguistic policies (e.g., Canada); promoting the country in the international community (e.g., United Kingdom); providing warnings of impending natural disasters (e.g., Japan); promoting religious objectives (e.g., Pakistan); and more recently, rivaling the dominance of U.S. 24-hour news channels, e.g., France (France 24), UK (BBC), Spain (Canal 24 Horas), CCTV News (China) or NHK World (Japan). Public funding may be in the form of subsidies or television taxes, sometimes in combination with advertising revenues.

4.1.3.7 Fair Advertising codes

In many countries, such as the EU countries, Australia, India, and Singapore, free over-the-air television and subscription television broadcasters are typically subject to certain restrictions related to advertising. These restrictions encompass a variety of issues, including the type of advertising that is permitted, the duration of the advertisement, when the advertisement can be shown, and advertising restrictions associated with children's programming. (See discussion below of the new EU Audiovisual Media Service Directive.)

4.1.3.8 Political fairness and programming standards associated with accuracy and impartiality in the reporting of new and current affairs

Free over-the-air and subscription television operators are also often subject to policies requiring accuracy in reporting and a balance in time allotted to political or public figures or groups, as well as a right to reply for individuals, organizations and governments (sometimes mandatory and other times discretionary). In some instances, these policies are developed through industry self-regulation, such as the Australian Commercial Television Industry Code of Practice (applicable to free-to-air television stations) and the Australian Subscription Television & Radio Association's Codes of Practice (applicable to subscription television operators), and the Code of Ethics of the Canadian Broadcast Standards Council (applicable to both types of operators).

4.1.4 Responsibility for complying with content laws

With regard to IPTV and mobile TV, many countries have only recently started to grapple with whether IPTV and mobile TV providers should comply with content regulations. In the EU, for example, the European Commission has recently decided to amend the Television Without Frontiers Directive ("TWF"), last revised in 1997, to address the new scope of audiovisual services. The European Commission approved on 18 December 2007, the Audiovisual Media Service Directive ("AVMS Directive") that will apply to all "audiovisual media services" (i.e., services providing moving images with or without sound). This includes traditional television broadcasts (termed "linear" audiovisual media services) as well as on-demand services (termed "non-linear"). Under the AVMS Directive, both of these services are subject to a basic tier of rules (e.g., rules protecting minors and promoting European works), and traditional television services will be subject to certain additional obligations. Therefore, IPTV or mobile TV providers will be subject to these basic rules to the extent that they offer television broadcasting and on-demand services. However, such operators will not have to adhere to the content regulations if they are merely retransmitting television or on-demand programming without altering the content.

Box 3: Directive on Audiovisual Media Services

Basic definitions of Directive:

Audiovisual media service (AMS): defined as either television broadcasting (linear) or on-demand audiovisual media (non-linear).

Television broadcasting: AMS provided by a media service provider (MSP) for simultaneous viewing of programmes on the basis of a programme schedule (includes quasi-simultaneous viewing where technical time lag between transmission and reception of broadcast). Examples of such services include analogue and digital television, live streaming, webcasting, and near VOD (pay-per-view).

On-demand audiovisual media: AMS provided by a MSP to be shown at a time chosen by the user at his individual request on the basis of a catalog of programmes selected by MSP. Examples include VOD.

Media service provider: excludes persons who merely transmit programmes for which editorial responsibility lies with third parties.

Summary of Directive:

- ✓ To create a level playing field and avoid distortions of competition, the EU Directive applies a basic tier of rules to all audiovisual services (both linear and non-linear services).
- ✓ These rules impose requirements relating to the protection of minors, encouraging cultural diversity, preventing incitement to hatred, prohibition of surreptitious advertising, product placement and advertising, promotion of European work, and basic consumer protection rules.
- ✓ Television broadcasters are subject to certain additional requirements beyond the basic tier, such as additional restrictions related to advertising.
- ✓ All audiovisual media services, however, will benefit from increased flexibility in the advertising rules (except for strict new rules on product placement).
- ✓ The EU Directive justifies the imposition of lighter regulation for on-demand audiovisual services versus television broadcasting because of the choice and control that the user can exercise with on-demand services and the impact that they have on society.
- ✓ Exclusive rights related to television broadcasting rights for events of high interest to the public are permissible, but they must grant the right to use short extracts, not exceeding 90 seconds, for purposes of general news programmes on fair, reasonable and non-discriminatory terms taking due account of exclusive rights. In addition, each Member State may impose restrictions on exclusivity if it lists the event as being of major importance for society (e.g., Olympics, national football finals)
- ✓ Member States may apply stricter or more detailed rules, as long as these regulations do not contradict the AVMS Directive's general principles.
- ✓ The Directive does not cover non-economic audiovisual services and those services that are not in competition with television broadcast (i.e., private websites, electronic versions of newspapers and magazines, and websites and services that provide and distribute audiovisual content generated by private users for purposes of sharing and exchanging).
- ✓ The new regime will not apply directly to providers until Member States pass enacting legislation, which they are required to do by end 2009.

Source: Directive 2007/65/EC of the European Parliament and of the Council of 11 December 2007 amending Council Directive 89/552/EEC on the coordination of certain provisions laid down by law, regulation or administrative action in Member States concerning the pursuit of television broadcasting activities, Official Journal of the European Union, 18 December 2007, L. 332/27

4.1.4.1 Application of Content Regulation to IPTV Providers

In certain jurisdictions, regulators are determining that IPTV providers should be subject to the same content regulation imposed on subscription television providers. For example, IPTV providers operating in Singapore are subject to the programming code imposed on subscription television providers. In addition, must carry obligations apply to fixed IPTV operators in numerous EU countries, such as Belgium (in the French-speaking community), France, Sweden, and the United Kingdom (although in practice, the parties have negotiated commercial arrangements). The U.S. Federal Communications Commission, however, has yet to rule on what the regulatory status of IPTV will be and whether the must-carry rules will apply to such services.

Like in the EU, the regulator in India, TRAI, has issued recommendations that would not subject telecommunications providers offering IPTV services to content regulation for unaltered content obtained from television broadcasters licenced in India.[38] However, TRAI is recommending that IPTV providers be required to comply with the programme and advertisement code under the Cable Television Network (Regulation) Act 1995 if they obtain "broadcasting content, Internet-related content or VOD including movie related content" (e.g., music-on-demand, games, or locally developed content). In addition, telecommunications service providers offering IPTV services may only show news channels that have been approved by the Ministry of Information and Broadcasting.

4.1.4.2 Application of Content Regulation to Mobile TV

Many countries are applying fixed television broadcast regulations regarding content to mobile TV providers. The EU, for example, is imposing the same restrictions that apply to advertising on television broadcasting services to mobile TV. In Singapore, the MDA (the entity responsible for mobile broadcasting) is conducting a public consultation in which it is proposing that mobile TV service providers, as well as cellular mobile TV providers, be subject to broadcasting regulation, including the MDA's programming codes for free over-the-air content, subscription content, VOD and other kinds of content.[39] Singapore is also proposing that the existing framework for advertising regulation, including those in the voluntary Singapore Code of Advertising Practice and the MDA television advertising and sponsorship codes, apply to mobile TV services.

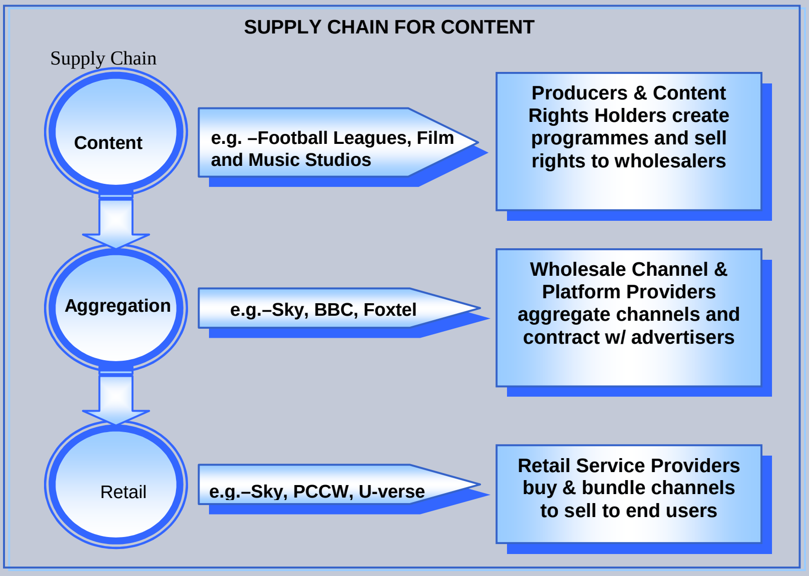
In Australia, a new regulation for content service providers restricting access to minors to certain content applies to mobile premium services, including mobile portal and premium rate SMS/MMS services.[40] This new regulation removes content-related provisions regarding mobile phones from the Telecommunications Service Provider (Mobile Premium Services) Determination of 2005 and applies the new Restricted Access System Declaration, enacted in accordance with the new Schedule 7 of the Broadcasting Service Act 1992, to mobile premium services such as mobile TV.

4.1.5 Legal issues related to acquiring content

IPTV service and mobile TV providers need to offer desirable content if they want to attract viewers. Locating and contracting with each individual content provider, ensuring that the provider has the necessary rights to distribute the material and then managing those relationships can be a time-consuming and difficult task. IPTV and mobile TV providers may also find themselves in a difficult negotiating position as movie studios and other content providers want the largest audiences for maximum exposure, guarantees of a secure distribution chain that safeguards their intellectual property rights, as well as guarantees of high-quality transmission. Start-ups may find it difficult to compete with the more established media entities that deliver programming over traditional media (broadcast, cable, and satellite) with more resources, experience, and viewers.

A new breed of business — the content aggregator — has sprung up to fill the gap between retail providers (e.g., IPTV and mobile TV providers) and the content providers. Content aggregators act as middlemen which obtain the rights to content and then facilitate the distribution of the content through their clients. Additionally, they typically offer security enhancements and due diligence services, i.e., ensuring that the content provider has legitimate rights to distribute the content. IPTV and mobile TV providers get one-stop-shopping for content as well as assistance in negotiating licence agreements and understanding the contours of their distribution rights. Content providers get wider exposure for their material via outlets that may have otherwise gone untapped.

Figure 3: Supply Chain for Content



Source: Telecommunications Management Group, Inc.

4.1.5.1 Vertical integration between content programmers and video distributors

Vertical integration gives the entity controlling both the content or programming rights and the distribution platform the ability to discriminate in favor of its affiliated video distributor (e.g., cable or satellite) to the detriment of competitors in the downstream market (see Figure 3). Although there may be economic efficiencies that benefit consumers, such discrimination may also lessen competition and diversity in the distribution of video programming, ultimately harming consumers. In India, for example, due to concerns about having control over content production and distribution, services, and platforms across different sectors, a proposed bill, the Broadcasting Services Regulation Act of 2007, would impose a 20 percent cross holding restriction between any "content broadcasting service provider" and any "broadcasting network service provider."

In the United States, exclusive contracts for satellite cable programming or satellite broadcast programming between vertically integrated programming vendors and cable operators are prohibited. These “Programme Access Rules” were introduced to address the concern that potential competitors to incumbent cable operators, particularly satellite television providers, would be unable to gain access to the programming offered by vertically integrated cable operators.

In countries such as Australia, Spain, and the United Kingdom, regulators have also imposed restrictions on exclusive content agreements between vertically integrated video programmers and distributors. These restrictions, however, have been adopted on a case-by-case basis in the context of mergers and other transactions. In Singapore, for example, the lack of vertical integration between video programmers and cable distributors was a determining factor for Ministry of Information, Communications and the Arts (MICA) to allow StarHub Cable Vision’s exclusive carriage agreements.

4.1.5.2 Exclusivity agreements over "premium content"

Generally, exclusivity agreements between content programmers and subscription television distributors are permitted in many countries. In fact, the grant of exclusive broadcasting rights is an established commercial practice in many jurisdictions. Rights to football matches, for example, has proved to be particularly contentious as football leagues have traditionally sold exclusive rights to one channel in a geographic area. Out of the nine countries surveyed in a recent ITU report, IPTV operators in only two countries (Belgium and the Netherlands) had secured exclusive distribution rights, and these were secured by established operators.[41]

In certain instances, exclusive agreements have raised competition concerns from regulatory authorities. Some jurisdictions have found that (i) vertical integration and/or (ii) exclusive control over "premium" or "must have" content could be used as a strategic tool to exclude or raise a competitor's costs in the subscription television distribution market. What type of content is considered "premium content" or "must have" content depends, of course, on a country-specific assessment. The FCC, for instance, considers "must have" content as "programming for which there are no readily available substitutes and, without access to which, competitive Yet some groups want the government to require cable television and direct-broadcast satellite multichannel video-programme distributors (MVPDs) would be limited in their ability to compete in the video distribution market."[42]

4.1.5.3 Restrictions of exclusivity over specific content

Although the benefits of entering into exclusive content distribution agreements are generally accepted, in certain jurisdictions the regulatory framework restricts exclusive broadcasting of certain events or content, particularly over subscription television networks. At the European Community level, for example, under the Audiovisual Media Services Directive certain events deemed by a Member State as "being of major importance for society" must be transmitted over free over-the-air stations. The list of events of major importance in most EU Member States mainly includes sporting events, ranging from the Olympic Games to relevant national and international tennis, football, rugby, and cycling competitions, among others.

5 LICENSING ISSUES

Traditionally, licences have been granted on the basis of the service to be offered or the network that was being used. However, governments are shifting away from this approach due to the impact of convergence and are adopting more flexible licensing regimes. In a number of jurisdictions, regulators have introduced technology neutral licences with broader service categories or have introduced a unified and technology neutral licence, whereby the licensee can offer a range of services through one licence. Some jurisdictions have eliminated the need for licensing and only require a notification or registration before, or shortly after, commencing to provide services (e.g., Japan and EU), unless scarce resource such as numbers or spectrum are involved. In more limited instances, the government has eliminated any filing requirements with the regulator entirely on the basis that the services fall outside of the regulator's authority.

However, the introduction of services like IPTV and mobile TV, particularly given its broadcasting component, has prompted many regulators to review their licensing framework and consider how to licence a provider that may offer a variety of traditional and non-traditional video services. Should these services be licenced as broadcasting services, telecommunications services or information services? Is a new type of licence or licence category required for IPTV and mobile TV providers? Should IPTV and mobile TV providers be subject to different licences depending on the services that they offer subscribers? Should separate licences be required for content and carriage?

5.1 Licensing of IPTV Providers

Regulators are taking different approaches regarding licensing requirements imposed on IPTV providers. In a number of instances, the licensing requirement is based on the service being offered rather than on the particular platform through which the service is being offered, i.e., a technology neutral approach. Therefore, to the extent that an IPTV provider is offering live television, it is subject to the same licensing requirements imposed on television broadcasters. In Europe, a technology neutral approach is followed whereby any television service channel provided over any platform (e.g., cable, satellite Internet, ASDL, mobile network) is considered a broadcasting service. For example, in France, an operator providing IPTV services must submit a declaration to the Conseil Superieur de l'Audiovisuel (CSA), although small operators with annual programming budgets of less than EUR 150,000 do not have to submit a declaration.[43] Similarly, Canada requires any television service, including VOD, provided over a managed IP network to have a Broadcast Distribution Undertakings licence. However, in Europe, VOD is not considered a television service due to its two-way interactivity.

Table 4: Pakistan: IPTV Channel Distribution Service Licence

Issuing Authority	Pakistan Electronic Media Regulatory Authority
Primary Requirements	Must hold Fixed Local Loop Licence from PTA for region to be served
	Company Incorporated in Pakistan
	Majority of shares cannot be owned or controlled by foreign nationals or whose management control is vested in foreign nationals
Coverage	Per Zone: Two Categories A and B (Category A – 4 zones including Karachi and Islamabad; Category B – 10 zones)
Fee Structure	Application Processing Fee: Rs 20,000 (approx. US$ 320) Category A licences: Rs 1,000,000 (approx. US$ 16,000) per zone Category B licences: Rs 500,000 (approx. US$ 8000) per zone
Security Deposit	10 percent of licence fee (refundable after 1 year after satisfactory operation)
Licensing Term	5 years
Annual Renewal Fee	30 percent of the licence fee plus 5 percent of the annual gross revenues

Source: Pakistan Electronic Media Regulatory Authority, Guidelines for Submission of Statement of Qualifications for IPTV Channel Distribution Service Licence

In countries such as Korea, Pakistan, and Singapore, the broadcasting authority has developed new licences for the provision of IPTV services. Under Korea's new Internet Multimedia Broadcasting Business Act, IPTV providers require an Internet multimedia broadcasting licence from the Minister of Information and Communications. In Pakistan, IPTV providers must not only obtain an IPTV Channel Distribution Service Licence from the Electronic Media Regulatory Authority to provide service, but must also hold a Fixed Local Loop Licence for the same areas in which they seek to provide IPTV (See Table 4).

In 2007, Singapore's MDA developed a technology neutral licence framework to facilitate the introduction of new media services like IPTV. All media service operators seeking to offer any IPTV services or any form of subscription television services, in or from Singapore, require a licence from MDA. The MDA defines IPTV as the transmission of television programming taking the form of either full scheduled channels and/or video-on-demand content to households via a broadband connection using Internet protocol. Using the IPTV network, service providers can also offer rich interactivity and services such as television commerce, VoIP, video conferencing, and gaming (seeTable 5). Under this new framework, however, ownership restrictions under the Broadcasting Act would apply to nationwide licensees with over 100,000 subscribers but not to niche licensees with fewer than 100,000 subscribers. The disadvantage of this two-tier distinction is that as licensees grow their subscriber base they may find themselves in a difficult situation if they have foreign ownership since the Broadcasting Act prohibits a foreign entity holding more than a 49 percent interest. The MDA is proposing a similar two-tier approach for mobile TV providers that would also face this ownership constraint.

Table 5: Singapore: Two-Tier Licensing Framework for Broadcasting IPTV Services

	Niche Subscription TV Licence	Nationwide Subscription TV Licence
Number of subscribers	100,000 subscribers	Unlimited number of subscribers
Licence term	5 years	10 years
Licence fee	2.5% of total revenue; minimum annual licence fee of $5,000 will be applicable during duration of licence. New service licensees may enjoy a concessionary rate of 0.5% of total revenue or $5,000, whichever is the higher amount during first three years of licence term	2.5% of total revenue; minimum annual licence fee of $50,000 per annum will be applicable throughout. New service licensees may enjoy a concessionary rate of 0.5% of total revenue or $50,000, whichever is the higher amount during first three years of licence term.
Performance bond	$50,000, in the form of either banker's guarantee or cash.	$200,000, in the form of either banker's guarantee or cash.
Ownership	No ownership conditions	Subject to ownership restrictions set forth in Part X of Broadcasting Act
Must carry	Not applicable	Must carry obligations for enabling access to local free-to-air channels are applicable
Advertising revenue	No cap on advertising revenue	Advertising revenue not to exceed 25 percent of total revenue
Advertising time limit	14 minutes per hour advertising time limit applies for channels with scheduled programming (not applicable for VOD content and interactive advertising services.	
Content guidelines	Subscription TV programme code applies if scheduled programmes are offered. VOD programme code applies if on-demand programmes are offered.	

Source: http://www.mda.gov.sg/wms.www/devnpolicies.aspx?sid=88#3

Hong Kong has not established a special category of licence for IPTV providers. Instead, it regulates IPTV providers in the same manner as a subscription television provider, requiring them to obtain a domestic subscription television programme licence. However, as in Pakistan, such licences can only be obtained if the operator already holds a fixed licence.

India's regulator, TRAI, is recommending that IPTV telecommunications providers be regulated under the terms of their telecommunications licence and that cable operators be regulated under the terms of the Cable Television Network (Regulation) Act, 1995. TRAI has indicated IPTV services provided by telecommunications operators are not the same as a cable service, based on the technical aspects of the services and the manner in which the channels are delivered to the user (e.g., cable channels are pushed to the user whereas IPTV channels are pulled by the user). From a licensing perspective, TRAI is recommending that telecommunications service providers holding a Unified Access Services Licence or Cellular Mobile Telephony Service (CMTS) Licence be allowed to provide IPTV services without any other registration under their licence.[44] ISPs with a net worth of more than a billion Rupees (approximately US$ 25 million) can also provide IPTV services after obtaining permission from the regulator. Similarly, cable television operators can provide IPTV services through their current authorization.

5.2 Licensing of Mobile TV

With regard to mobile TV, the licensing approaches are very similar to IPTV services. In a number of jurisdictions, the government makes a distinction between content and carriage. In Singapore, for example, the MDA is proposing that mobile TV be subject to the existing licensing structure for fixed digital broadcasting, which involves obtaining both a multiplex licence and a broadcasting service licence issued by the MDA under the Broadcasting Act, as well as a Facilities-Based Operator licence issued by the Information Development Authority (IDA) under the Telecommunications Act.[45] However, in the United States, a licensee operating one of the C block (710-716/740-746 MHz) or D block (716-722 MHz) licences in the UHF band can provide "flexible fixed, mobile, and broadcast uses, including mobile and other digital new broadcast operations, fixed and mobile wireless commercial services (including FDD- and TDD-based services)…[that] could also include two-way interactive, cellular, and mobile TV broadcasting services."[46]

In January 2008, Hong Kong issued a consultation on mobile TV whereby it proposes to licence such services as a new category of television programme service under the Broadcasting Ordinance or to regulate mobile TV by general laws (as currently is the case) but to require the industry to implement a code of practice for self-regulation.[47] Currently, mobile TV providers offering streaming-type mobile TV services already available on 2.5 GHz and 3 GHz mobile networks are not subject to broadcasting regulation and can offer services if they hold a mobile carrier licence.

Table 6: Hong Kong: Regulation of Mobile TV, IPTV, and Internet TV

	Mobile TV	IPTV Services	Internet TV
Carriage Licences	Mobile licence or unified carrier licence (proposed by OFTA to replace both fixed and mobile carrier licence in future)	Carrier licence required for conveyance of IPTV services	No licence required
Content Licences	Not currently applicable to mobile TV on 2.5 and 3 GHz	Broadcasting licence required: IPTV service over fixed network is categorised as domestic pay TV programme service	Exempted from the licensing requirement under the Broadcasting Ordinance

Source: Consultation on Digital Broadcasting: Mobile Television and Related Issues, UCAC Paper No. 3/2007, 26 April 2007, at p. 12, available at http://www.ofta.gov.hk/en/ad-comm/ucac/paper/uc2007p3.pdf

In January 2008, the regulator in India, TRAI, issued recommendations related to mobile TV. Since cellular licensees in India are already allowed to deliver video content over their networks, the recommendations primarily address mobile TV licensing for dedicated broadcast networks.[48] TRAI proposes to award mobile broadcast licences in the 582-806 MHz band for Digital Terrestrial Television (DTT) and in the 2520-2670 MHz band for satellite transmission through a tender process. TRAI further recommends that mobile TV operators should not be responsible for following content codes if they simply retransmit channels without altering content.

6 REGULATORY AUTHORITIES RESPONSIBLE FOR IPTV AND MOBILE TV

Today, 148 countries have separate regulatory authorities. Among these, a number of jurisdictions have converged regulators, such as in the Australia, Finland, Iraq, Italy, Japan, Kenya, Mali, Malaysia, South Africa, Singapore, Uganda, United States, and United Kingdom.[49] In the past seven years, close to 30 countries have established converged regulators. The rationale for this shift is that a converged regulator is better suited to respond to an environment where distinctions based on service and network are becoming blurred. A converged regulator can allow providers and users with one government entity to look to for all matters involving the communications sector.

Despite this trend, most OECD countries still have separate regulators for broadcasting and for telecommunications.[50] In addition, content regulation is typically addressed by a separate ministry or government authority (e.g., India and Saudi Arabia) or by the broadcasting authority (e.g., Botswana, Chile, and Colombia). In India, there are two entities responsible for content regulation. The Ministry of Information and Broadcasting monitors content related to broadcasting and film, and the Ministry of Information Technology regulates content related to the Internet.[51]

As noted in Table 7, many countries still have multiple government authorities responsible for the functions of broadcasting licensing, telecommunications licensing, spectrum allocation, and content regulation.

Table 7: Regulatory Entities Involved in Telecommunications and Broadcasting

Country	Telecoms Carriage	Telecoms Spectrum	Broadcasting Carriage	Broadcasting Spectrum	Content
Argentina	National Communications Commission (CNC); Communications Secretariat (SECOM)	CNC	Federal Broadcasting Committee (COMFER)	CNC	COMFER
Botswana	Ministry of Communications, Science and Technology (MoCST); Botswana Telecommunications Authority (BTA)	BTA	National Broadcasting Board (NBB)	NBB	NBB; BTA
Colombia	Ministry of Communications (MoC); Telecommunications Regulatory Commission (CRT)	MoC	National Television Commission (CNTV)	CNTV	CNTV
Chile	Telecommunications Secretariat (SUBTEL) within Ministry of Transport and Telecommunications	SUBTEL	National Television Council (CNTV)	SUBTEL	CNTV
Egypt	National Telecommunication Regulatory Authority (NTRA); Ministry of Communications and Information Technology (MCIT)	NTRA	Egyptian Radio and Television Union [ERTU]	ERTU	Ministry of Interior *(Internet security);* ERTU *(Broadcasting)*
France	Regulatory Authority for Electronic Communications and Postal Service (ARCEP)	National Spectrum Agency (ANFR)	Higher Council for Radio and Television (CSA)	ANFR; CSA	ARCEP; CSA

Hong Kong (SAR)	Office of the Telecommunications Authority (OFTA)	OFTA	Broadcasting Authority (BA) and OFTA	BA; OFTA	BA
India	Telecommunications Regulatory Authority of India (TRAI); Department of Telecommunications (DoT)*(for licensing)*	DoT	TRAI /Ministry of Information and Broadcasting (MI&B) *(for licensing)*	DoT	Ministry of Information Technology (MIT) *(Internet;* MI&B *(Broadcasting)*
Jordan	Ministry of Information and Communications Technology (MoICT); Telecommunications Regulatory Commission (TRC)	TRC	Audiovisual Commission (AVC)	AVC in coordination with TRC	AVC
Mexico	Communications and Transportation Secretariat (SCT) and Federal Telecommunications Commission (COFETEL)	SCT	SCT; Secretariat of Public Education (SEP)	SCT	SEP; General Directorate for Radio, Television and Cinematograp hy (RTC) within Executive Secretariat (Secretaría de Gobernación)
Pakistan	Ministry of Information Technology – IT and Telecom Division (MoIT) and Pakistan Telecommunications Authority (PTA)	PTA	Pakistan Electronic Media Regulatory Authority (PEMRA)	PTA	PEMRA
Singapore	Infocomm Development Authority (IDA)	IDA	iDA; Media Development Authority (MDA)	IDA	MDA
Uganda	Uganda Communications Commission (UCC)	UCC	Uganda Broadcasting Council (UBC)	UBC; UCC	UBC
United Kingdom	Office of Communications (Ofcom)	Ofcom	Ofcom; Department for Culture, Media, and Sport	Ofcom	Ofcom
United States	Federal Communications Commission [FCC]/ Public Utility Companies (PUCs)	FCC	FCC; local government for cable TV franchises	FCC	FCC, Federal Trade Commission (FTC), and Department of Justice (DoJ)

Source: Based upon Telecommunications Management Group, Inc. research and Telecommunication Regulatory Institutional Structures and Responsibilities, OECD Paper, DSTI/ICCP/TISP(2005)6/Final, at p. 31, 32.

Operators seeking to offer converged services are required to follow the processes of more than one regulator and multiple regulations, often resulting in duplication and delay in rolling out their services. In addition, given that IPTV services and mobile TV services encompass television services as well as other video services, jurisdictional disputes have arisen between the broadcasting and telecommunications authorities, with each authority asserting jurisdiction and reaching different conclusions about how the services should be regulated. In Korea, for example, the Korean Broadcasting Commission was of the opinion that converged service providers should be regarded as a broadcasting company whereas the Minister of Information and Communication argued that it should be regulated as a value-added service. Similar debates have arisen in Colombia between the National Television Commission (CNTV) and the Ministry of Communications regarding which entity has authority over IPTV services and how they should be regulated. The result of this is that telecommunications operators seeking to offer such services have been unable to obtain the necessary authorization, while other telecommunications operators that hold cable television licences have been able to begin the deployment of IPTV services.

In China, the Ministry of Information Industry (MII) and the State Administration of Radio, Film and Television (SARFT) share the responsibilities related to broadcast licensing. This has resulted in confusion regarding which agency regulates converging services like IPTV.[52] SARFT has interpreted a joint provision restriction contained in a 1999 law as barring telecommunications operators from offering video services and has twice used its licensing authority to block telecommunications operators from providing IPTV over their networks. Since telecommunications operators are prohibited from controlling the IPTV infrastructure, they must enter into joint arrangements with broadcasters. For example, China Telecom, the country's leading telecommunications operator, partnered with Shanghai Media Group, which is one of four broadcasters that was granted an IPTV licence. Currently, this partnership is the only network to have begun commercial IPTV deployment.[53]

As governments look at how to facilitate the development of new services such as IPTV and mobile TV, they should consider whether their institutional frameworks are best suited for expediting the roll-out of new services or whether such frameworks need to be modified. Korea, for example, had four government authorities responsible for regulating the communications sector: the Telecommunications Commission, the Ministry of Information and Communication, the Broadcasting Commission, and the Ministry of Culture and Tourism, each with their jurisdiction and regulation. This was delaying the roll-out of IPTV services. In December 2007, Korea enacted a new law eliminating the Ministry of Information and Communications (MIC) and transferring its functions to the Ministry of Commerce, Industry and Energy, the Ministry of Culture and Tourism, and the Ministry of Government Administration and Home Affairs.[54] In addition, a unified commission will be created that encompasses the merger of the Korean Broadcasting Commission with the Telecommunications and Broadcasting Policy Office of the now-defunct MIC, and will supervise broadcasting and communications.

7 OTHER LEGAL AND REGULATORY ISSUES

7.1 Standards

Governments need to consider which mobile TV and IPTV standards should be authorized in their country, or whether they will leave the choice of standards up to the providers. A number of different standards are available for IPTV, such as Microsoft or DVB based standards. These standards are not interoperable and can create difficulties for consumers that want to change service providers, as this may require changing hardware and getting used to new user interfaces. The challenge for the industry and regulators is to create open standards as well as facilitate interoperability between different standards. With the development of multi-platform STBs, the industry can contribute to the creation of more choices and better utilization of resources. Regulations should encourage this development.

In addition, regulators need to consider whether the laws on equipment to be used for provision of television services impose barriers to the roll-out of IPTV or mobile TV. For example, in India, concerns have been raised about whether the use of IPTV STBs by cable operators would violate the Cable Television Networks (Regulation) Act, 1995, which does not allow the use of equipment in the cable network that does not conform to the Indian Standard. Since an Indian Standard for IPTV STB does not exist, TRAI has indicated that there is no violation of the Act; however, it is recommending that the Bureau of Indian Standards (BIS) be tasked with expediting the development of a standard for IPTV STB specifications.

7.2 Quality of Service Issues

Quality of service is likely to be an issue considered by regulators. With services provided over the Internet, quality of service is a "`best effort' medium." However, with IPTV and mobile TV, a provider has the ability to offer customer quality of service since it offers its service through a privately managed network. In addition, given the importance of better picture quality with IPTV and mobile TV, it is in the interest of the operator to provide high quality service; otherwise the consumer will go elsewhere. In Singapore, the MDA is determining whether it should impose quality of service requirements on mobile TV and has proposed not to mandate picture quality or performance indicators for customer service. The reason being that it expects that imposing picture quality requirements will limit the mobile TV providers' flexibility to determine the optimal mix of formats, and that performance indicators for customer service are not necessary given the competitive environment. However, the MDA is proposing to impose minimum network coverage requirements to ensure that mobile TV services are offered nationwide in Singapore and to ensure that outdoor coverage meets a 95 percent threshold, although the MDA is not proposing any indoor coverage levels.[55]

7.3 Ownership Issues

A number of countries have ownership restrictions that may impede the development of IPTV and mobile TV services. Some countries, for example, have joint-provisioning restrictions that bar a telecommunications provider from operating a cable subscription services. For example, Argentina's law forbids a telecommunications provider from offering of any type of broadcasting services over any platform, whether or not it is subscription-based. In Brazil, incumbent telecommunications providers are prohibited from providing cable broadcasting services in areas where they offer telecommunications services. However, they are permitted to provide VOD after obtaining a direct-to-home licence and may also offer satellite television.

In addition, countries may have cross-ownership restrictions that prevent a telecommunications provider from owning a cable provider and vice versa. Unlike joint provision restrictions, cross-ownership restrictions do not necessarily restrict the affected firm from entering a specific market, provided its entry strategy does not involve the acquisition of an existing market participant. In the context of public switched telecommunications networks and cable television services, such limitations generally are directed at safeguarding the independence of competing service providers with the end goal of fostering facilities-based competition. In India, for example, broadcasters and cable operators may only own up to 20 percent in satellite television companies. In January 2007, TRAI issued recommendations to the Ministry of Information and Broadcasting proposing to also extend this 20% cap to mobile TV providers.

In response to convergence, however, a number of jurisdictions are pursuing legislation to eliminate or modify these restrictions. For example, in Mexico, a Convergence Agreement was introduced that eliminated the joint provision restrictions barring incumbent Telefonos de Mexico from directly or indirectly providing television services under its concession contract. Pursuant to the Convergence Agreement, the Mexican Government relaxed this limitation allowing entry by the incumbent telecommunications provider into the cable television services market, subject to a set of conditions including the adoption of clear interconnection rules and number portability processes. However, due to competition concerns related to joint ownership in Mexico, the Communications and Transport Secretariat and the Federal Competition Commission have established a presumption that joint ownership would stifle inter-modal competition in the newly opened convergent communications sector in Mexico. Only where this presumption is rebutted by an interested party, and evidence of efficiencies derived from cross-ownership are duly presented, may the Competition Commission grant a waiver of the cross-ownership restrictions.[56]

The Brazilian Congress is currently working on a comprehensive law that would eliminate the joint provisioning restriction.[57] However, in other jurisdictions, cable operators have mounted strong efforts to counteract any attempt to change such restrictions. For example, in an attempt to prevent telecommunications providers from offering IPTV, the Argentine Cable Television Association filed an appeal with the Federal Administrative Court (affirmed by the Supreme Court), which upheld the constitutionality of the law barring telecommunication companies from the broadcasting services market.[58]

Traditionally, there has been a greater sensitivity regarding broadcasting services and foreign ownership. As a result, while foreign ownership restrictions have been eliminated in many countries for telecommunications companies, they still remain in place for traditional broadcasting companies. For example, in India, the foreign ownership cap for telecommunications providers is 74 percent and 49 percent for cable operators.[59] Similarly, Korea has different foreign ownership restrictions for the broadcasting and telecommunications sector.[60]

7.4 Spectrum

The major issue facing the deployment of any mobile TV system is access to the spectrum needed to support the services. The availability and cost of spectrum will dictate in large measure the technology deployment options available to the operator. For example, if a potential operator wishes to deploy a satellite-based mobile TV system, then there must be an allocation for satellite broadcasting in the desired service area. If there is no spectrum available for a dedicated terrestrial mobile TV network, then the mobile operator must provide mobile TV service in the bands that are already being used for more traditional mobile services. This will limit the mobile provider's options and may have a possible impact on the quality of service available to the consumer. As countries move to identifying spectrum for dedicated mobile TV networks, considerations have to be given to compatibility between new and existing services. The choice of the technology to be used to provide mobile TV services should be left to the operator as long as it operates in a manner consistent with national and international frequency allocations.[61]

7.5 Unbundling

Unbundling of the local loop allows for new entrants to access the fixed infrastructure of incumbents and provide advanced services, including IPTV and ancillary interactive services, through these networks. Access to incumbent's local loops expands new entrants' potential market and may increase competition on IPTV services.[62]

Unbundling of the local loop has been required in a number of countries. All OECD countries, with the exception of Mexico, require some form of unbundling, and many developing countries, such as Colombia, Peru, or South Africa, have introduced or are introducing mandated local loop unbundling in their regulatory frameworks.[63]

In many countries where IPTV has a high penetration, such as France, Italy and Spain, unbundling of the local loop has been a key factor for new entrants to develop competing offers and increase IPTV penetration. In Japan, the main broadband competitor, Yahoo! BB, offers an IPTV service based offer on unbundled infrastructure that competes with the incumbent's IPTV fiber-based offer.

As incumbents are releasing plans to upgrade their networks and build NGN fiber-based networks, regulators are considering whether unbundling rules need to be modified in order to avoid disruption of alternative operators broadband and IPTV services over unbundled loops. For instance, European countries, such as the United Kingdom, have conducted consultations to adapt their existing unbundling rules to the new fiber-network architecture. Among the issues being considered in these consultations are the feasibility of unbundling the last mile of fibre network architecture, and the introduction of access obligations to new elements of the local loop, such as street cabinet access, ducts and the fibre itself.[64]

8 CONCLUSIONS

The deployment of IPTV and mobile TV changes traditional perceptions and challenges legal regulation. However, both services offer enormous opportunities to provide consumers with new platforms to receive multi-media content, enhance competition, and increase broadband deployment.

However, as noted in the checklist (see Box 4), governments need to look at their regulatory frameworks and institutional structures, and determine how best to facilitate the deployment of these services. Recognizing this, a number of countries have initiated consultations to address the regulatory issues related to these services. In addition, governments are considering the need of maintaining legislative or regulatory restrictions that prevent a telecommunications provider from operating video services in a multi-platform multi-service environment since this may result in limiting

Box 4: Checklist for Regulators Introducing IPTV and Mobile TV

For regulators, there are a variety of factors to consider in relation to these new services. In the case of IPTV, such factors are potentially broader due to the fact that incumbent telecommunications providers are subject to legacy regulation. Because of this, regulators need to consider the following questions:

- ✓ What is the impact of legacy regulation on providers' ability to offer services and on providers' incentives to incur the significant investments and high risks associated with deploying/upgrading infrastructure to allow for the provision of IPTV services?
- ✓ In the case of IPTV, are there any legal or regulatory restrictions to incumbent telephone providers' ability to provide video services within their markets (joint provision restrictions or cross-ownership restrictions)?
- ✓ If incumbents are not restricted from entering the video market, does the application of existing regulation, specifically issues such as access obligations to dominant providers' network, skew the incentives for investment in deployment/upgrading of networks to support IPTV services?

Having performed this initial review, regulators might look at how, if at all, IPTV and mobile TV fall within the existing regulatory framework for broadcasting services.

- ✓ Do the services offered by the IPTV or mobile provider fall within the definition of television broadcasting included in a country's laws or regulations? If so, what type of regulation would be imposed on such providers?
- ✓ Does a mobile TV provider require multiple licences under the existing legal framework (telecommunications, broadcasting, and content)?
- ✓ Does your regulatory framework provide for a technology neutral approach for granting licences?
- ✓ How many regulatory entities claim jurisdiction over IPTV and mobile TV services? If not, can one entity be given the authority to regulate IPTV? Or mobile TV?
- ✓ Should laws and regulations relating to content be applicable to IPTV and mobile TV services?
- ✓ Are there legal restrictions that impede investment in IPTV and mobile TV services (e.g., foreign ownership restrictions)?
- ✓ Is extending existing broadcasting regulation to these services the best mechanism to foster their deployment?

Source: Telecommunications Management Group, Inc.

choices and benefits for consumers. In addition, governments are looking at the manner in which these services should be regulated, including the appropriate licensing requirements and regulatory obligations. In some countries, regulators are opting to treat the offering of television programming as broadcasting and regulating IPTV and mobile TV providers in the same manner as traditional broadcasters. However, other countries may, for policy reasons, choose to subject these new services to lighter regulation for a certain period of time until the market develops.

For regulators, there is no right or wrong approach. However, what is important is to provide operators of such services with regulatory certainty regarding the manner in which they will be regulated and try to eliminate impediments due to jurisdictional debates between government agencies or onerous regulatory hurdles and cumbersome licensing requirements that may delay the deployment of such services.

GLOSSARY OF TERMS

Mobile TV: Wireless transmission and reception of video and voice television content to platforms that are either moving or capable of moving. The transmission can be over a dedicated broadcast network or a cellular network.

MVPDs: *Multichannel video-program distributors.* An MVPD may be a cable operator or satellite TV operator that sells multiple channels of video programming.

PVR: *Personal Video Recorder*. A device that records video in a digital format and stores the video on a disk drive or other medium. The term *DVR* (Digital Video Recorder) is also used.

Internet TV: A system that distributes professional television content over the Internet. While IPTV typically transmits on discrete service provider networks, Internet TV is usually over peer-to-peer networks.

Internet Video: An unmanaged video service that offers user-generated streaming video over the Internet.

Headend: Equipment or facility that receives, stores, and processes television signals for distribution to a local region. The headend may control interactive features, manage VOD, and insert advertisements.

MPEG: *Moving Pictures Experts Group*. An ISO/ITU universal standard that compresses digital video for digital TV, DVDs and PVRs. MPEG-2 is used for digital TV STBs and DVDs. MPEG-4 offers better compression technology to deliver multimedia for fixed and mobile video.

STB: *Set-top box*. A device connected to a television that receives and decodes digital television broadcasts and interfaces with the Internet through the user's television.

DTV: *Digital television*. A system for broadcasting and receiving video and sound through digital signals rather than through traditional analog signals.

Unicast: A transmission between a single sender and a single receiver over a network. See also *Multicast* and *Broadcast*.

Multicast: A transmission from a single sender to multiple, specific receivers on a network. See also *Unicast* and *Broadcast*.

Broadcast: A transmission from a single sender to all connected devices. See also *Unicast* and *Multicast*.

RTSP: *Real Time Streaming Protocol*. A protocol that enables users to remotely control streaming video from a server, which allows users to play, pause, and stop the video.

MBMS: *Multimedia Broadcast Multicast Service*. A broadcasting service developed by the 3rd Generation Partnership Project (3GPP) that provides mobile TV over 3G cellular networks.

Technology-Neutral: A general term referring to rules that allow operators to adopt any technology standard for a particular service.

Multiplex: The transmission of more than one digital channel within a single frequency.

DTH: *Digital-to-Home*. A satellite television system that allows end users to receive signals directly from geostationary satellites. The term *DBS* (Direct Broadcast Satellite) is also used.

CIF/QCIF: *Common Intermediate Format/Quarter Common Intermediate Format*. An international standard size for low-resolution image and video display formats. CIF dimensions are 352 x 288 pixels and QCIF are 176 x 144 pixels.

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[1] This paper will focus on IPTV and mobile TV, not digital terrestrial television, advertising, user-generated content and m-banking.

[2] *See* ITU-T IPTV Focus Group definition.

[3] ITU IPTV Global Technical Workshop, *Driving The Future Of IPTV* 13 (2006), available at www.itu.int/osg/spu/stn/ digitalcontent/4.9.pdf.

[4] Mark Rooney, *Pace Micro Technology: IPTV White Paper* 3 (2006), available at www.iptv-news.com/content/view/758/61/.

[5] Wei Li, Hong Liu, and Yiyan Wu, Communications Research Centre Canada, *IEEE: Introduction to IPTV*, available at www.ieee.org/ organizations/society/bt/iptv1.pdf.

[6] H.264 generally provides a 40 percent saving in bandwidth over MPEG-2 encoded content, allowing IPTV providers to offer high definition (HD) television to the home.

[7] Rooney, s*upra* note 4, at 4.

[8] Off. of Comms. (Ofcom), *The International Communications Market 2006* 99 (2006), available at www.ofcom.org.uk/ research/cm/icmr06/icmr.pdf.

[9] Press Release, DSL Forum, IPTV Deployments More Than Double in a Year as Broadband Continues to Achieve Strong (Oct. 8, 2007) www.dslforum.org/dslnews/pdfs/pr_bwfeurope100807.pdf.

[10] Tekrati, *IPTV Subscribers to Top 14 million in 2007, 63 million in 2011, Says MRG*, May 18, 2007, http://telecom.tekrati.com/ research/8793/.

[11] Martin Olausson, Strategy Analytics, *Strategy Analytics Forecast 41 Million IPTV Subscribers by 2011*, available at www.strategyanalytics.net/default.aspx?mod=ReportAbstractViewer&a0=3259), Press Release, Gartner, Gartner Projects 49 Million by 2010, available at www.gartner.com/it/page.jsp?id=496291, and Press Release, Multimedia Research Group, MRG 73 Million by 2011, available at www.mrgco.com/press_releases.html#GF1007.

[12] Networking Glossary, Searchnetworking.techtarget.com (last visited Feb. 12, 2008).

[13] Comms. and Tech. Branch, Com., Industry and Tech. Bureau*, Hong Kong Consultation on Digital Broadcasting: Mobile Television and Related Issues* 7 (2007), available at www.cedb.gov.hk/ctb/eng/paper/doc/mobile_TV.pdf.

[14] ITU, Recommendation ITU-R BT.1833: *Broadcasting of Multimedia and Data Applications For Mobile Reception by Handheld Receivers app. 1* (2007).

[15] ITU-R BT.1833, *supra* note 14; Int'l Telecomm. Union (ITU), ITU-R Report BT.2049-1: *Broadcasting of Multimedia and Data Applications for Mobile Reception* (2005) provide further detailed information on these standards.

[16] Informa UK, *Mobile TV: Broadcast Network Rollouts, Business Models and Handsets* 177 (3rd Ed. 2007).

[17] *Id*. at 181.

[18] Arne Hess, The Unwired, *MULTIMEDIA: T-Mobile Germany Streams the FIFA World Cup Live Over UMTS*, May 12, 2006, available at www.theunwired.net/?item=multimedia-t-mobile-germany-streams-the-fifa-world-cup-live-over-umts.

[19] Qtel Mozaic MOB, http://mobile.mozaic.qa/wnf/t123/0/2203/m/1?og=ct& (last visited Feb. 20, 2007).

[20] Verizon Wireless, V-Cast Mobile TV, http://products.vzw.com/index.aspx?id=mobileTV&lid=//global//features+and+downloads// mobileTV#overview (last visited Feb. 20, 2007).

[21] Vodafone New Zealand, www.vodafone.co.nz/personal/vodafone-live/mobile-tv.jsp (last visited Feb. 20, 2007).

22 *In the Matter of IP-Enabled Services,* 19 FCC Rcd 4863, 4878 (2004).

23 *In the Matter of 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*, 18 FCC Rcd 16978, 17103-04, 17149, ¶¶ 200, 288 (2003). These rules were upheld by the D.C. Circuit Court of Appeals on Mar. 2, 2004, in *United States Telecom Ass'n v. FCC*, 359 F.3d 554, 564-76 (2004) ("USTA II); *In the Matter of Implementation of Section 621(a)(1) of the Cable Communications Policy Act of 1984 as amended by the Cable Television Consumer Protection and Competition Act of 1992,* 20 FCC Rcd 18581 (2006); *In the Matter of Exclusive Service Contracts for Provision of Video Services in Multiple Dwelling Units and Other Real Estate Developments*, 22 FCC Rcd 20235 (2007).

24 Can. Radio-television and Telecomms. Comm'n (CRTC), *The Future Environment Facing the Canadian Broadcasting System: A Report Prepared Pursuant to Section 15 of the Broadcasting Act* (2006), available at www.crtc.gc.ca/eng/publications/ reports/broadcast/rep061214.htm?Print=True. ("There are four broadcast distribution technologies available for television programming: conventional over-the-air (OTA) transmission, cable distribution, DTH satellite distribution and Internet Protocol Television (IPTV)").

25 *See* Media Dev. Auth. (MDA), *Licence Framework for Broadcasting IPTV Services*, available at www.mda.gov.sg/wms.www/ devnpolicies.aspx?sid=88.

26 Internet Multimedia Broadcasting Business Act (Korea), approved by National Assembly in 2007, and to be implemented in April 2008.

27 *Nat'l Cable & Telecomms. Ass'n v. Brand X Internet Servs*., 545 U.S. 967 (2005).

Cable & Sat. Broad. Ass'n of Asis (CASBAA), *MDA Public Consultation on the Policy and Regulatory Framework for Mobile Broadcasting Services in Singapore* (2007), available at www.mda.gov.sg/wms.file/mobj/mobj.1180.Casbaa.pdf.

29 *See* Singapore Telecom Mobile PTE LTD, *Submission to the Media Development Authority of Singapore, Policy & Regulatory Framework for Mobile Broadcasting Services in Singapore* (2008), available at www.mda.gov.sg/wms.file/mobj/mobj.1196.SingTel.pdf. *See also*, StarHub Mobile PTE LTD, *Response to MDA Consultation Paper, Policy and Regulatory Framework for Mobile Broadcasting Services in Singapore* (2008) available at www.mda.gov.sg/wms.file/mobj/mobj.1200.StarHub.pdf.

30 After an initial public consultation in early 2007, regulatory authorities in Hong Kong, SAR have noted that mobile TV services provided over 2.5G/3G mobile networks and broadcasting networks currently do not fall within the purview of the Broadcasting Ordinance. Nevertheless, authorities have found that some form of regulation for the public good should be applicable to these services (*e.g.,* protection of public moral and children). *See* Comms. and Tech. Branch, Com., Industry and Tech. Bureau, *supra* note 13. *See also* Comms. and Tech Branch, Com. and Econ. Dev. Bureau and Of. of the Telecomms. Auth., *Second Consultation on Development of Mobile Television Services*, ¶¶ 6.2, 6.4 (2008) ("Hong Kong Second Mobile TV Consultation").

31 Hong Kong Second Mobile TV Consultation, at ¶¶ 6.6, 6.7.

32 *Id*. at ¶ 6.11.

33 Comms. Reg. Auth. (AGCOM), Delibera n. 266/06/CONS, Modifiche al regolamento relativo alla radiodiffusione terrestre in tecnica digitale di cui alla delibera n. 435/01/CONS. Disciplina della fase di avvio delle trasmissioni digitali terrestri verso terminali mobili, available at www.agcom.it/provv/d_266_06_CONS.htm.

34 Enforcement Decree of the Broadcasting Act, art. 1-2(3) (2007) (Korea), available at www.kbc.go.kr/english/file/sponsor.pdf.

35 Can. Radio-television and Telecomms. Comm'n (CRTC), Canada Broadcasting Public Notice CRTC 2007-13, Feb. 7, 2007, available at www.crtc.gc.ca/archive/ENG/Notices/2007/pb2007-13.htm.

36 *Id*. at ¶ 42. The CRTC further noted that it would initiate a further proceeding to examine whether mobile TV services not delivered and accessed over the Internet would be exempt from the broadcasting conditions. It found that, at the time, much remained unknown about the potential impact of the broadcast-based or point-to-multipoint mobile technologies, particularly if they could become a substitute for conventional television. *Id*. at ¶ 27.

37 OECD *Communications Outlook 2007* (2007), available at http://213.253.134.43/oecd/pdfs/ browseit/9307021E.PDF.

38 Telecomm. Reg. Auth. of India (TRAI), *Recommendations on Provision of IPTV Services*, at 25-26 (Nov. 28 2007).

39 Media Dev. Auth. (MDA), *Public Consultation on Policy and Regulatory Framework for Mobile Broadcasting Services in Singapore*, at 18 (Nov. 21, 2007), available at: www.mda.gov.sg/wms.file/mobj/mobj.1167.Mobile%20TV%20Consultation.pdf.

40 Ausli. Comms. & Media Auth. (ACMA), *Restricted Access System Declaration 2007*, (Dec. 20, 2007). This new rule for restricting access to age restricted content becomes effective on Jan. 20 2008.

41 ITU IPTV Global Technical Workshop, *Driving The Future Of IPTV*, p. 9 and Table 7.2 in Annex II (2006), available at www.itu.int/osg/spu/stn/ digitalcontent/4.9.pdf.

42 Hong Kong Second Mobile TV Consultation, *supra* note 32.

43 OECD, *IPTV: Market Developments and Regulatory Treatment*, DSTI/ICCP/CISP(2006)5/FINAL, at 24 (Dec. 17, 2007), available at www.oecd.org/dataoecd/11/23/39869088.pdf.

44 Telecomm. Reg. Auth. of India (TRAI), *IPTV Services*, *supra* note 40, at 18-20.

45 Med. Dev. Auth. (MDA), *Mobile Broadcasting Services*, *supra* note 41, at 8.

46 FCC, *FCC Auction 49: Lower 700 MHz Band Fact Sheet*, available at: http://wireless.fcc.gov/auctions/default.htm?job=auction_factsheet&id=49.

47 Hong Kong Second Mobile TV Consultation, *supra* note 32.

48 TRAI, India, *Recommendations on Issues Relating to Mobile Television Service*, (Jan. 23, 2008).

49 ITU Telecommunications Regulatory Database (2007).

50 OECD, *Policy Considerations for Audio-Visual Content Distribution in a Multiplatform Environment*, DSTI/ICCP/TISP(2006)3/FINAL, Jan. 12, 2007.

51 TRAI, *IPTV Services*, *supra* note 40, at 20.

52 MII coordinates the deployment of the public telecommunications network, the television and radio broadcasting networks. However, the State Administration of Radio, Film, and Television (SARFT) regulates broadcast content transmitted via radio, TV, satellite, cable, and the Internet and has authority to award or revoke licences to produce, distribute, and broadcast films, TV, and radio programs.

53 China Telecom provides the equipment and broadband network while the broadcaster holds the IPTV licence and contributes video content.

54 *Farewell to the Ministry of Information and Communication*, Telecom Korea News Service, Jan. 16, 2008.

55 *See* Media Dev. Auth. (MDA), *Mobile Broadcasting Services*, *supra* note 41, at 6.

56 *See* Fed. Competition Comm'n, OF. No. PRES-10-096-2005-117, Opinion Twelve (Oct. 31, 2005); Fed. Competition Comm'n, OF. No. PRES-10-096-2006-102, Opinion Eleven (Jul. 7, 2006); Commns. and Transport Secretariat, Convergence Agreement, Second Accord (Oct. 3, 2006).

57 The draft law nº 29 establishes that the concessionaires operating at the switched fixed line services would be allowed to offer cable TV; except in localities where a cable TV provider launched its operations less than one year before the issuance of the new law (draft 29). In those localities, the concessionaires would need to wait one year after the issuance of the law in order to acquire a cable TV licence.

58 *Cooperativa Telefonica de Libertador General San Martin before the Supreme Court of the Nation* (interpreting article 45 of Broadcasting Act 22.285, as amended by Law 26.053 of Sept. 14, 2005), available at www.atvc.org.ar/?pagina=legales_articulo_45.

59 TRAI, India, *IPTV Services*, *supra* note 40, at 28.

60 Foreign equity cap for broadcasters and backbone telecommunications service providers is capped at 49 percent. However, the method of calculating foreign equity different under the Telecommunications Business Act (calculation is based only on stocks with a voting right) and the Broadcasting Act (calculation is based on all stocks). Int'l Telecomms. Union (ITU), *IPTV Case Study of Korean Digital Convergence*, Study Group 1, ITU-D/E/57-E, at 10 (Nov. 4, 2007).

61 For example, in the ongoing Public Consultation on *Policy and Regulatory Framework for Mobile Broadcasting Services in Singapore*, the Media Development Authority (MDA) has proposed not to mandate a single standard for mobile television service in Singapore as the MDA found it premature for a small market like Singapore to set a "particular standard when there is no obvious global champion," as well as no need for the MDA to depart from its policy of technology neutrality. *Supra* note 40, at 6.

62 *See* Org. for Econ. Coop. and Dev. (OECD), *IPTV*, *supra* note 44, at 15.

63 For OECD countries, *see* Org. for Econ. Coop. and Dev. (OECD), *supra* note 39, at 53-59.

64 *See* Off. of Comms. (Ofcom), *Regulatory Challenges Posed by Next Generation Access Networks* (Nov. 23, 2006), available at www.ofcom.org.uk/research/telecoms/reports/nga/nga.pdf.