20th Global Symposium for Regulators (Virtual Event, 2020)

The Regulatory Wheel of Change: Regulation for Digital Transformation

Discussion Papers

How Broadband, Digitization and ICT Regulation Impact the Global Economy

Global Econometric Modelling – Expert Report

GSR-20 Discussion Paper

August 2020

Acknowledgements

This report has been prepared by the International Telecommunication Union (ITU) with the collaboration of the ITU Telecommunication Development Bureau (BDT) Regulatory and Market Environment Division (RME). It is based on regional findings from research prepared for the ITU global study on the economic contribution of broadband, digitization and ICT regulation published in 2018. Each of the regional studies is available here: https://www.itu.int/en/ITU-D/Regulatory-Market/Pages/Economic-Contribution.aspx.

This study is based on extensive compilation and analysis of statistical data from national and international sources and on data from the ITU ICT Regulatory Tracker and the Digital Ecosystem Development Index, developed with funding from CAF (Corporación Andina de Fomento) Development Bank for Latin America.

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Contents

Executive summary: how broadband and digitization impact the global economy

This study uses econometric modelling to examine *two major components* of great importance to all those concerned with investment decisions in ICT and the digital ecosystem over the coming decade. The modelling is built on data from 139 countries between 2007 and 2018 – an up-to-date data set that is robust, high-quality and global in scope.

The first component we examine is how broadband and digitization impact the economy. The second is how institutional and regulatory maturity impact the growth of the digital ecosystem.

Four major findings

Our evidence points to four major findings which we believe are of great import in informing governments, policy-makers, regulators and operators as they formulate general infrastructure and ICT investment decisions in the years ahead. The findings are:

1. Developing countries should implement policies to maximize mobile broadband adoption, as the main digital technology contributing to economic development.
2. Industrialized nations should adopt policies which favour fixed broadband penetration as a key contributor to their economic growth.
3. Beyond broadband, all countries should aim to increase the development of digitization, which encompasses not only infrastructure deployment but its usage to foster the digital transformation of industries and improve consumer wellbeing.
4. Regulatory and institutional maturity in the ICT arena do indeed make a significant difference – and are important in driving the growth of digitization.

The study confirms that the economic impact of fixed broadband is guided by a return to scale effect: *economic impact grows with penetration*. The economic benefit of mobile broadband depicts a saturation effect: *its economic contribution declines with penetration*.

Developing countries – accelerate your development of mobile broadband

Developing countries should accelerate the development of mobile broadband to maximize economic impact. Penetration of mobile broadband in OECD countries is at 74 per cent in terms of unique subscribers – but comparable figures for Africa are 31 per cent, for Latin America 57 per cent and for Asia Pacific 52 per cent.[1] Since we have found that economic impact of mobile broadband is higher in developing countries, such countries should maximize its adoption.

Six concrete steps for developing country governments to consider:

- Policy and regulation. Encourage policy and regulatory measures that facilitate infrastructure deployment in rural and isolated areas: these include the sharing of infrastructure, interconnectivity, and effective use of spectrum.
- Emerging technologies. Promote the use of emerging technologies to address the need for affordable digital infrastructure and services.
- Incentives and collaboration. Promote deployment of mobile broadband infrastructure in remote and rural areas through incentives that are attractive to private sector operators. Stimulate collaboration between private sector firms within your digital ecosystem.

[1] Source: Prorated GSMA Intelligence figures for 2020.

- Affordable pricing. Focus on mobile broadband affordability of non-adopters: implement government initiatives that drive affordable pricing for your most vulnerable populations.
- Content of importance and relevance to your citizens. Complement economic-focused efforts by promoting the development of local Internet content and languages.
- Skill up your non-adopters. Focus on building the digital skills of non-adopters to address digital illiteracy.

Industrialized countries – focus on technologies that boost digitization of your production

Industrialized nations should focus on technologies that accelerate the digitization of production: these include ultra-broadband wireline (FTTx and DOCSIS 3.1) and 5G – critical infrastructure technologies that enhance digitization of production, which will in turn boost economic impact. OECD countries have reached 5G coverage of 39 per cent[2] while FTTx household penetration is at 21 per cent.[3]

Seven concrete steps for developed countries to consider:

- Grow infrastructure and demand. Promote commercial and investment cases that combine the benefits of telecommunications infrastructure with other enabling technologies (e.g. AI, AR/VR) to grow infrastructure and ICT demand from enterprises.
- Use regulatory sandboxes enabling enterprises to test emerging technologies and use cases free of regulation.
- Spectrum allocation and new services. Launch 5G pilot projects to obtain feedback and to support design of future spectrum allocations – at the same time stimulating the adoption of new services.
- Balance new technologies with re-skilling. Recognize that advanced technologies can eliminate jobs. As you move to the digital transformation of production, ensure digital skills requirements are identified and retraining taken into account.
- Flexibility in regulation. Keep enough flexibility on regulatory rules and procedures (for example the use of spectrum) to foster innovation and new technologies.
- Long-term policies. Recognize that building infrastructure is a multi-year process that needs to be underpinned by long-term policies for predictability and regulatory certainty.
- Balance consumer protection with commercial returns. Recognize that competition models need to protect consumers, while ensuring adequate returns are available to commercial players making the investment.

[2] Source: Prorated GSMA intelligence 5G coverage for 2020.
[3] Source: Prorated IDATE FTTx penetration for 2019.

Addressing all countries – make regulation and ICT policy work for your economy

The paper clearly demonstrates that broadband technologies on one hand, and effective ICT regulation on the other, undoubtedly help grow national economies and the prosperity of the people.

All countries should leverage regulatory frameworks and institutions in accelerating digitization – forging sound ICT policy that maximizes economic impact within a simplified institutional architecture.

We recommend three specific policy approaches:

- Incorporate the economic impact of digitization in your assessment of policies. Policy-makers and regulatory agencies in all countries should integrate advanced socio-economic impact analysis into their policy development. Often, ICT policy-making takes only the engineering perspective into account. This task is best accomplished through close collaboration and partnership with academia and research institutions.
- Be collaborative and quick. Adopt a collaborative approach involving policy-makers, regulators and private operators. Build policy and regulation on principles of simplification and speed.
- Consult and be transparent. Allow for intense public participation and consultation with civil society as you build regulation. Give stakeholders the most transparent information.

The three focus areas for this paper

This paper uses global econometric analysis – based on robust, reliable data – to measure the impact of broadband (fixed and mobile) and digital transformation on the economy as a whole. It also examines how institutional and regulatory variables impact the development of the digital ecosystem at global level.

The study builds on previous ITU-published studies – using econometric modelling – that looked at how broadband, digitization and ICT regulation[4] contribute to the economy at the global and regional levels.

The study is built on three key analyses:

1. How fixed and mobile broadband are impacting the economy: Economic models, designed to explore how broadband contributed to the economy, have been developed primarily in the first decade of the 21st century. Are they still valid? This study brings fresh scrutiny to bear. On the basis of large data sets, the paper relies on long historical series and asks whether the economic boost of broadband increases with penetration – the so-called return to scale effect[5]… or is broadband's economic impact undergoing a "saturation effect"

[4] ITU's *The economic contribution of broadband, digitization and ICT regulation* and Regional Econometric Modelling Reports are available at: https://www.itu.int/en/ITU-D/Regulatory-Market/Pages/Economic-Contribution.aspx.

[5] Generally, the returns to scale effect refers to a reduction in unit cost as the scale of production increases over time, when inputs such as physical capital usage are variable. The ITU Broadband Series *Impact of Broadband on the Economy*, 2012 (https://www.itu.int/pub/D-

therefore yielding diminishing returns. Importantly, the analysis asks what the key differences are in how fixed and mobile broadband play in an economy, according to its level of development.

2. How digitization contributes to the economy: It's important to note that "digitization" is much broader in scope than broadband. It encompasses digital services infrastructure, connectivity, digital transformation both of households and production, the development of digital industries, and the availability of digital factors in production. So what is the impact of digitization on GDP and productivity when compared to broadband? The paper presents analysis of this question region by region.
3. How policy and regulatory frameworks affect market growth in digital services and applications**:** How exactly do regulation and institutions impact the development of the digital economy – *the transformation of the techno-economic environment and socio-institutional operations through digital communications and applications*. Given that growth of digitization is driven largely by the private sector, just how important are policy and regulatory variables in growing the digital economy?

PREF-BB.RPT2-2012) states that according to the returns to scale theory, the economic impact of broadband increases exponentially with the penetration of the technology.

At a glance: our seven key findings

Mobile broadband generates a **larger economic contribution** than fixed broadband, when examined globally.

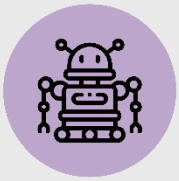
Developing countries **benefit more from mobile broadband** than industrialized countries.

Developed countries with high penetration of fixed broadband enjoy **larger benefit from the technology** than developing nations.

The **economic contribution of digitization** is higher in advanced economies than in emerging countries.

Digitization contributes significantly to **labour** and total **factor productivity**.

The development of digitization is driven by **institutional and regulatory factors** and not only by variables such as economic development.



Digitization accelerates when a country introduces **structural changes in policy and institutions** which are related to digital technologies – after a time lag.

Fixed broadband and its impact on the economy

Developed countries, with high penetration of fixed broadband, realize larger benefit from the technology than developing nations. The impact is driven by a "*return to scale":*

- When fixed broadband penetration is low, economic impact is minimal;
- But – when fixed broadband infrastructure reaches a critical level of development, typical of developed countries, it starts to have a significant impact on the economy.[6]

Impact of fixed broadband at global and regional levels

We examined data for 139 countries between 2010 and 2017 (in some cases between 2007 and 2018, and for others between 2011 and 2017).

In each case, we ran identical econometric structural models, each using four equations[7]:

Aggregate production function	$\text{GDP per capita}_{it} = a_1(\text{Capital}_{it})+a_2(\text{Education}_{it})+a_3(\text{Broadband\_Penetration}_{it})+ e_{it}$ (1)
Demand function	$\text{Broadband\_Penetration}_{it}=b_1(\text{Rural\_population})_{it)}+b_2(\text{Broadband\_Price})_{it}+b_3(\text{GDPC})_{it}+b_4(\text{HHI})_{it}+e_{it}$ (2)
Supply function	$\text{Broadband\_Revenue}_{it}=c_1(\text{Broadband\_Price})_{it}+c_{2(}\text{GDP per capita})_{it}+c_3(\text{HHI Fixed broadband})_{it}+ e_{it}$ (3)
Output function	$\Delta\text{Broadband\_Penetration}_{it} = d_1(\text{Fixed\_Broadband\_Revenue}_{it})+ \varepsilon_{4it}$ (4)

- We ran the econometric model first *for all countries* and then *for distinct groups of countries* according to their level of development:
    - Countries with GDP per capita higher than USD 22K (50 countries)
    - Countries with GDP per capita between USD 12K and USD 22K (26 countries)
    - Countries with GDP per capita lower than USD 12K (63 countries)

- We also measured the economic impact of fixed broadband by region:
    - Africa (34 countries)
    - Americas (18 countries)
    - Arab States (14 countries)
    - Asia Pacific (18 countries)
    - Commonwealth of Independent States (8 countries)
    - Europe (38 countries)

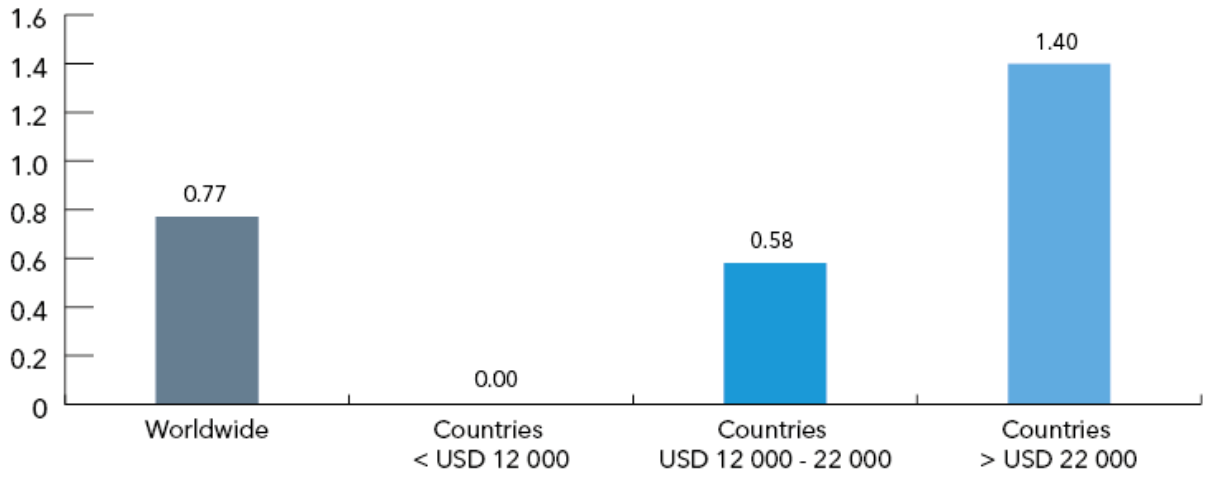
[6] This was already detected in early studies conducted with 2007 OECD data (see Czernich *et al*., 2009).

[7] As explained by Roller and Waverman (2001): "This approach uses all the exogenous variable in the system of equations (i.e., those that we can reasonably assume are not determined by the other variables in the system, such as the amount of labor and the amount of total capital) as 'instruments' for the endogenous variables (output, the level of penetration, and the prices). Instrumenting the endogenous variables essentially involves isolating that component of the given endogenous variable that is explained by the exogenous variables in the system ('the instruments') and then using this component as a regressor."

Confirmed – globally, fixed broadband impact is higher in more developed countries

The econometric models run for the global sample confirm the "return to scale" effect: fixed broadband economic impact tends to increase with economic development (see Figure 1).

Figure 1: Global sample: GDP growth impact of an increase in 10% of fixed broadband penetration (in per cent)[8]

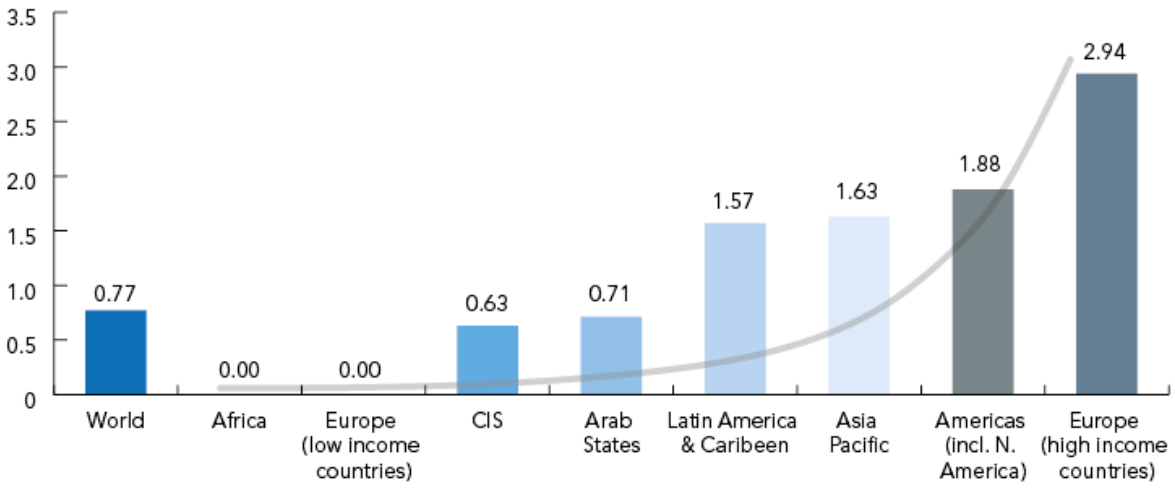


Note: The impact on countries with GDP per capita under USD 12 000 is not statistically significant.
Source: ITU publications on the Economic Contribution of Broadband, Digitization and ICT Regulation regional studies[9]

[8] Detailed results of econometric models are included in Appendix E.
[9] See: https://www.itu.int/en/ITU-D/Regulatory-Market/Pages/Economic-Contribution.aspx.

Models run by region tell the same story

Figure 2: Regional GDP growth impact of an increase in 10% of fixed broadband penetration (in per cent)



Source: ITU publications on the Economic Contribution of Broadband, Digitization and ICT Regulation regional studies

What the modelling showed by region

We applied econometric modelling to all of the world's regions. We assumed an increase of 10 per cent in fixed broadband penetration to calculate increase (or not) in GDP per capita. Our models suggested the following:

- Africa: most African countries would see no increase.
- Americas: countries across this region (North America and for Latin America and the Caribbean) would enjoy an increase of 1.88 per cent. Latin America and the Caribbean only would enjoy an increase of 1.57 per cent.
- Arab States: countries would enjoy an increase in 0.71 per cent.
- Asia Pacific: the entire region would enjoy an increase of 1.63 per cent while mid and low-income countries in the region would see no increase.
- Commonwealth of Independent States (CIS): the region increase in 0.63 per cent in GDP per capita.
- Europe: the results confirm that an increase of 10 per cent in fixed broadband penetration in high-income European countries would yield an increase in 2.94 per cent in GDP per capita. If only low-income European countries are included in the model, the impact is statistically not significant.

Mobile broadband and its impact on the economy

The economic contribution of mobile broadband is greater in countries and regions with lower levels of economic development and lower relative mobile penetration. The impact of mobile broadband is driven by a "saturation" or "diminishing returns" effect.[10]

Impact of mobile broadband at global and regional levels

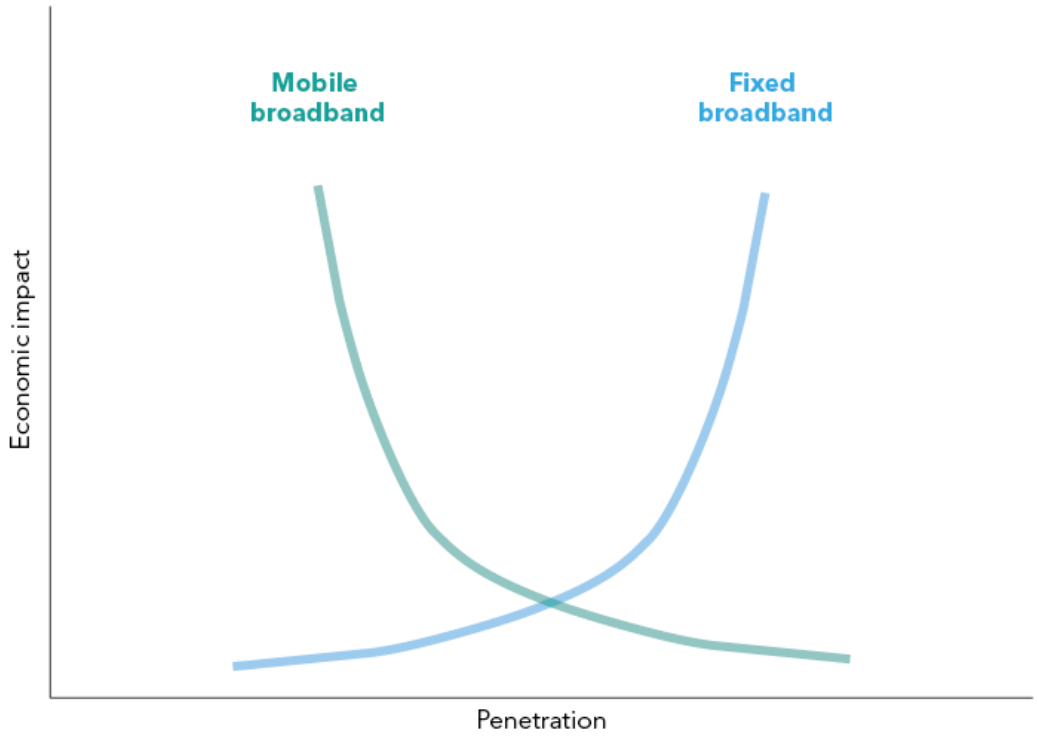
The corollary is that the economic impact of mobile broadband diminishes in countries and regions with higher levels of penetration and development.

How is this explained? A number of factors are at play:

- Early broadband adopters (such as large enterprises and government services) gain most from mobile broadband, while late adopters (such as small and medium enterprises) will gain less.
- Incremental infrastructure deployment will *not* yield proportional gains where critical levels of telecommunication/ICT infrastructure and usage have already been attained.
- The national economic impact is at its maximum when telecommunications/ICT infrastructure investment has reached critical mass. Beyond that point, economic impact slows down, reflecting "diminishing returns".
- In countries with low fixed broadband penetration (i.e. low GDP per capita), mobile broadband is the technology with high economic impact – the "substitution effect".

[10] In economics, diminishing returns is the decrease in the marginal (incremental) output of a production process as the amount of a single factor of production is incrementally increased, while the amounts of all other factors of production stay constant. In this case, we apply the concept to explain that the economic impact of mobile broadband decreases with penetration. We apply the concept of saturation to explain that, after a certain point in the diffusion process, no matter how much mobile broadband is adopted, no tangible economic effect will register.

Figure 3: Economic contribution – fixed versus mobile broadband



Source: ITU

Impact of mobile broadband declines as penetration levels increase

In economic terms, the impact of mobile broadband tends to decline with penetration. Governments should not however stand down policies aimed at stimulating its adoption: mobile broadband in many countries is the single most important technology that provides citizens and consumers with access to the Internet, thereby providing enormous social value.

The economic impact of mobile broadband – globally and by region

This study measured the economic impact of mobile broadband both at the global level and by region to test the "diminishing returns" effect. We looked at data for 139 countries between 2010 and 2017 (in some cases through 2018).

- We ran the econometric structural models (composed of four equations specified similar to the case of fixed broadband) to test the economic impact of mobile broadband:
    - For the global analysis, we relied on 3 858 observations between 2010 and 2017. For the regional analysis, we utilized a total of 4 061 observations between 2010 and 2018.
    - Models included country, year and fixed effects.

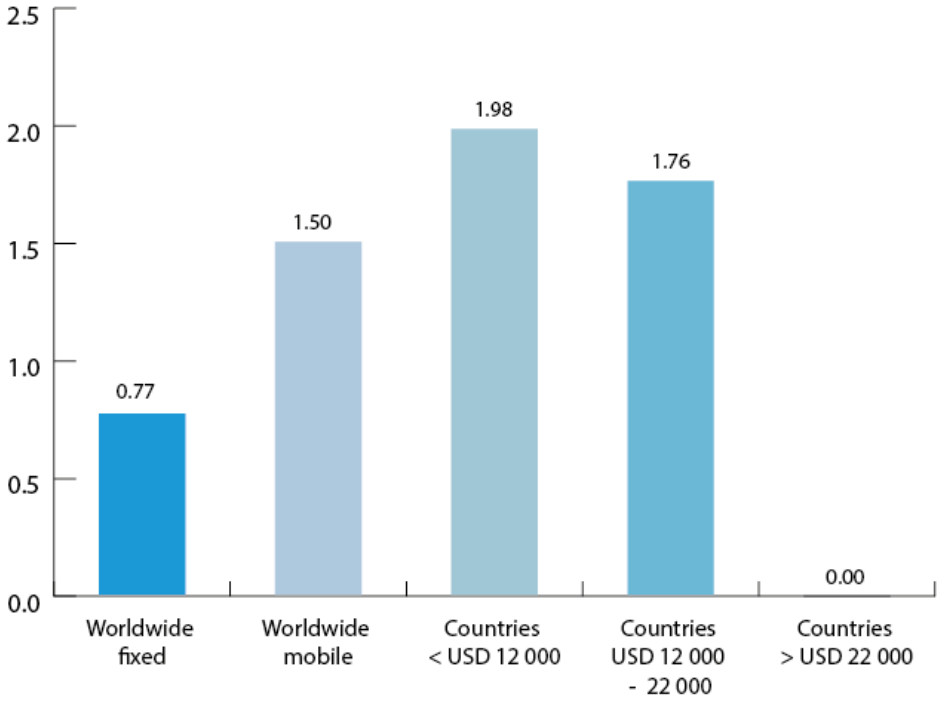
- We ran the econometric model first *for all countries* and then *for distinct groups of countries* according to their level of development:
    - Countries with GDP per capita higher than USD 22K (50 countries)

- Countries with GDP per capita between USD 12K and USD 22K (26 countries)
- Countries with GDP per capita lower than USD 12K (63 countries)

- We also measured the economic impact of mobile broadband by region:
  - Africa (34 countries)
  - Americas (18 countries)
  - Arab States (14 countries)
  - Asia Pacific (18 countries)
  - Commonwealth of Independent States (8 countries)
  - Europe (38 countries)

Globally, mobile broadband economic contribution is higher than fixed broadband, although impact decreases with economic development

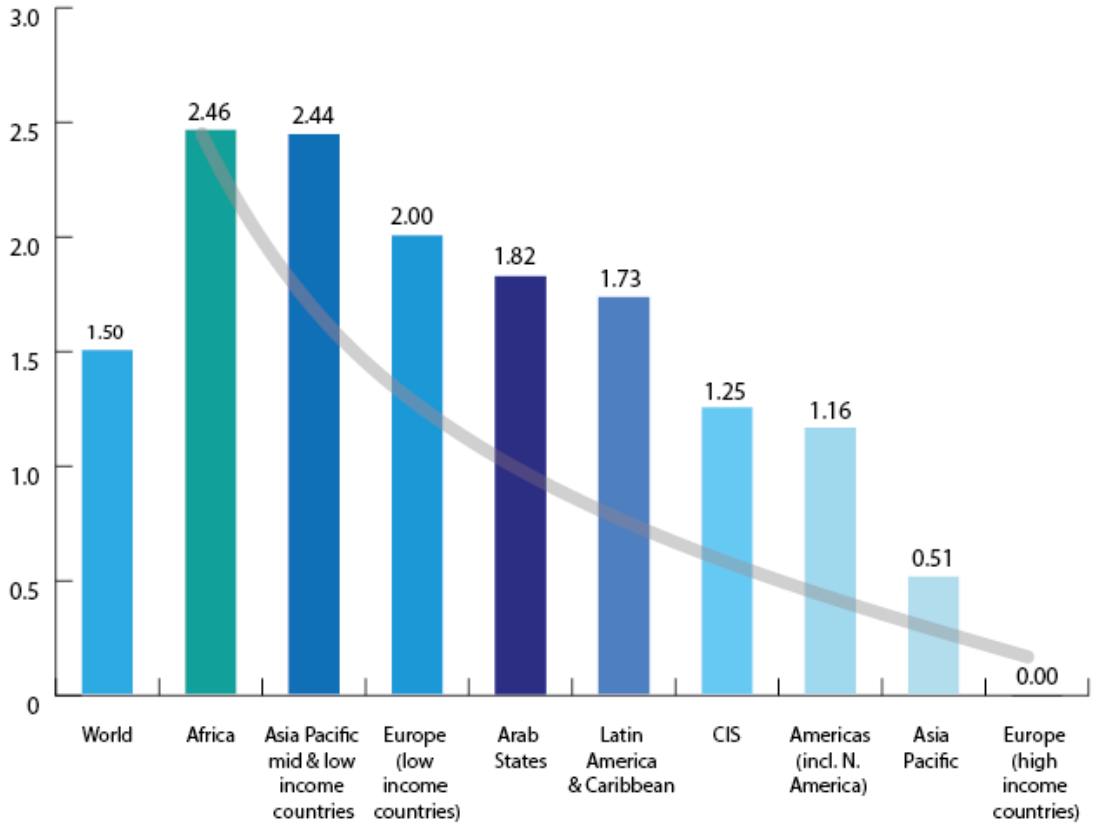
Figure 4: Global sample: growth impact of an increase in 10% of mobile broadband penetration (in per cent)



Source: ITU publications on the Economic Contribution of Broadband, Digitization and ICT Regulation regional studies

Regional analysis: developing economies benefit more from mobile broadband

Figure 5: Regional GDP growth impact of an increase in 10% of mobile broadband penetration (in per cent)



Source: ITU publications on the Economic Contribution of Broadband, Digitization and ICT Regulation regional studies

What the modelling showed by region

We applied econometric modelling to all of the world's regions. We assumed an increase of 10 per cent in mobile broadband penetration to calculate increase (or not) in GDP per capita. Our models suggested the following:

- Africa: the majority of countries would enjoy an increase of 2.46 per cent.
- The Americas: North America, Latin America and Caribbean would enjoy an increase of 1.16 per cent in GDP per capita. Latin America and the Caribbean countries only would enjoy an increase of 1.73 per cent.
- Arab States would enjoy an increase in 1.82 per cent in GDP per capita.
- Asia and Pacific countries overall would enjoy an increase of 0.51 per cent. Mid and low-income countries only would enjoy an increase of 2.44 per cent.
- Commonwealth of Independent States would enjoy an increase of 1.25 per cent.

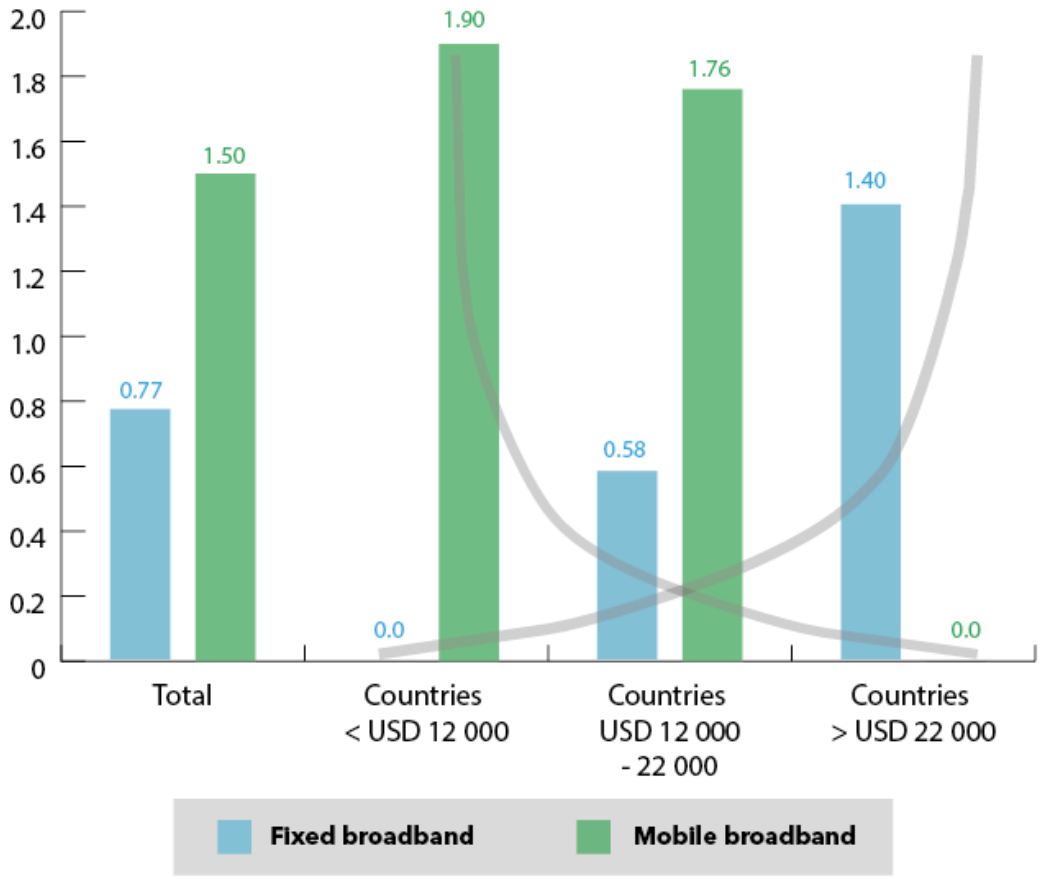
- Europe region countries overall would enjoy an increase of 2.1 per cent. When we include low-income European countries, the increase would be 2.0 – most regional economic impact is concentrated in countries with GDP per capita lower than USD 20 000.

Fixed vs. mobile broadband – economic impact by level of development

Using structural models for the global sample, our analysis of 139 countries confirms the following:

- Fixed broadband (data between 2010 – 2017): its contribution is greater in developed countries, with high penetration of fixed broadband, reflecting the "return to scale" effect.
- Mobile broadband (data from 2010 – 2018): its economic dividend is greater in countries and regions with lower levels of economic development and lower relative mobile penetration reflecting the "diminishing returns" effect. This contribution diminishes in countries and regions with higher levels of penetration and development.

Figure 6: GDP growth impact of an increase in 10% of broadband penetration (in per cent)



Source: ITU publications on the Economic Contribution of Broadband, Digitization and ICT Regulation regional studies

Regional analyses confirm both effects and are summarized in Figure 7 below.

Figure 7: Regional GDP growth impact of an increase in 10% of broadband penetration (in per cent)

	Fixed broadband impact	Mobile broadband impact
Africa	Impact in Africa is as low as that estimated for the global sample of low-income countries – not statistically significant	Impact in Africa is a 2.46% increase – higher than that estimated for low-income countries in the global sample at 1.98%
Asia-Pacific	Overall region: 1.63% and comparable to high-income country global figure of 1.4% because of weight of high-income economies in the region. Zero impact in both low-income groups of countries	Low and medium-income countries enjoy 2.44% increase, higher than overall region's total of 0.51%
Europe	Impact is higher in high-income countries at 2.94% than that of Europe's low-income countries (0.07%, although not significant). Higher too than high-income countries in the global sample (1.4%)	Impact is not significant for high-income countries while low-income countries would enjoy a 2.0% increase – this is statistically significant
Arab States	Impact is 0.71% – higher than the global sample of medium-income countries at 0.58% but lower than high-income countries at 1.40%	Impact is a 1.82% increase – lower than that of low-income countries at 1.90 % but positive and statistically significant relative to high-income countries
Americas	Impact is higher for Americas (United States and Canada) at 1.88% than in Latin America and Caribbean at 1.57%	Impact is a 1.73% increase in Latin America and the Caribbean – higher than in the Americas (United States and Canada) at 1.16%
Commonwealth of Independent States	Impact is 0.63% – somewhat higher than global sample of medium-income countries at 0.58 % but lower than high-income countries at 1.40 %	Impact is a 1.25% increase – which is lower than global sample of low-income countries at 2.0 % but is positive and statistically significant relative to high-income countries

Source: ITU

The economic impact of digitization

What is digitization?

- Digitization is the transformation of the techno-economic environment and socio-institutional operations through digital communications and applications.
- Digitization metrics quantify:
  - The cumulative effect of adoption and usage of multiple information and communication technologies across individual users and enterprises;
  - The development of digital industries;
  - The factors of production of the digital economy;
  - The level of competitive intensity.

An index to measure the development of digital ecosystems: eight pillars, 64 indicators

As the digital ecosystem landscape becomes increasingly complex, we needed to build an index that reflects a wider range of domains and indicators.[11] We have used the Digital Ecosystem Development Index to measure the level of regional digitization, as well as to understand the progress achieved so far and the nature of the challenges ahead.

This Index is a composite metric that quantitatively assesses the eight pillars that make up the digital economy. The Index breaks these down into 64 indicators as set out in the graphics that follow.

[11] The Index for Development of the Digital Ecosystem was developed under funding from CAF Development Bank of Latin America.

Figure 8: Eight elements – the structure of the Digital Ecosystem Development Index

Note: Links are drawn only for relatively strong causal relationships.
Source: CAF

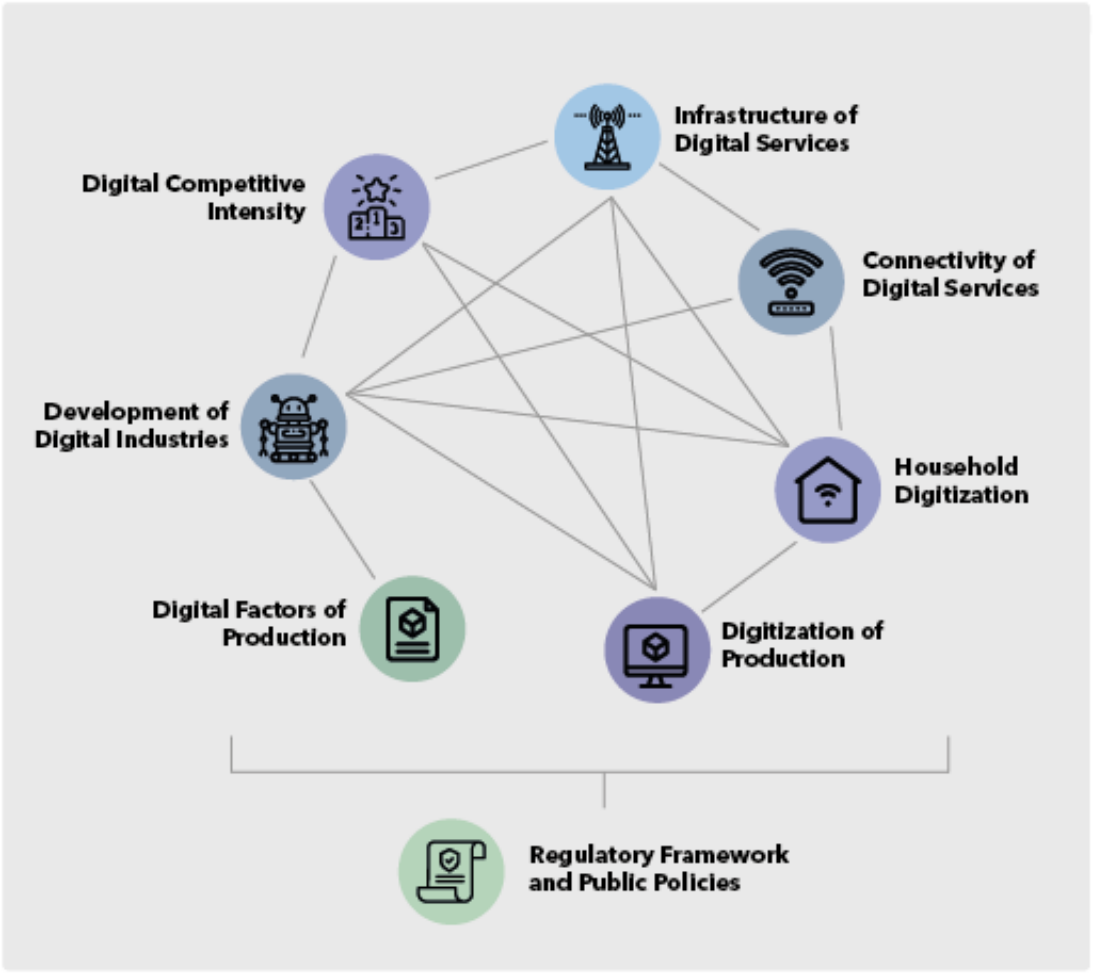
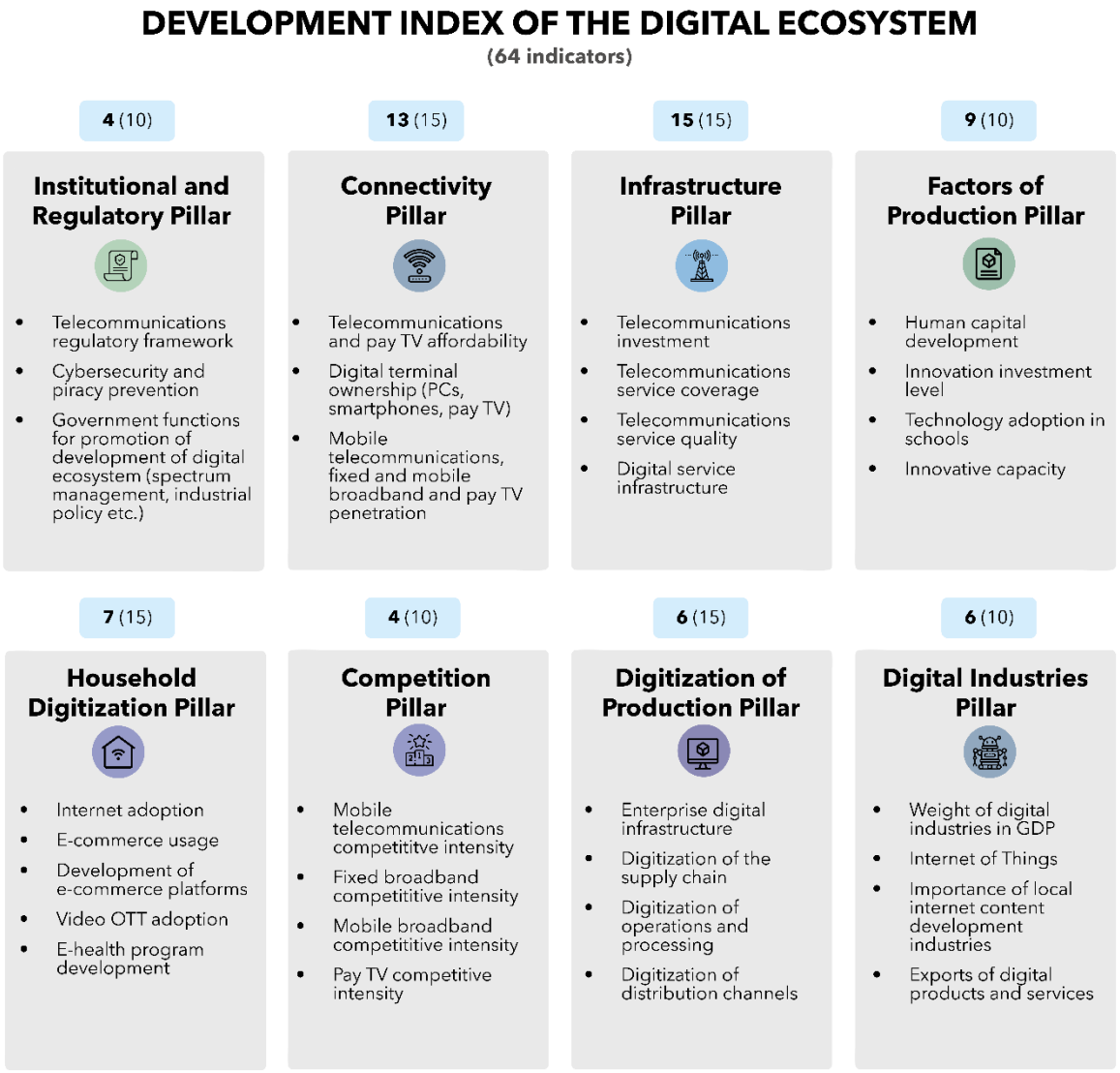


Figure 9: The Index – 64 indicators grouped in eight pillars



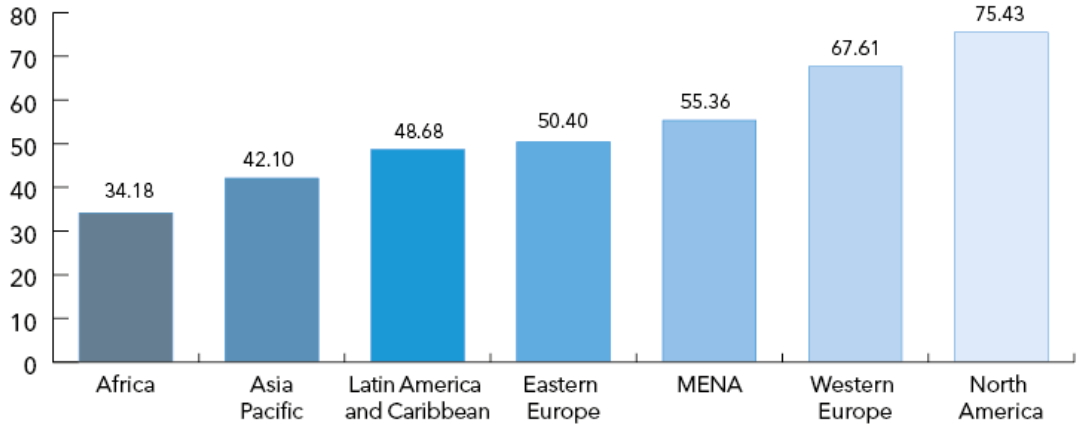
Note: Numbers in bold indicate total number of indicators within each pillar (some examples are included below each box), while the numbers in brackets represent the relative weight of the pillar for calculation of the index.

Source: CAF

Note: Numbers in bold indicate total number of indicators within each pillar (some examples are included below each box), while the numbers in brackets represent the relative weight of the pillar for calculation of the Index.
Source: CAF

As expected, advanced economies depict a higher digitization index (see figure 10)

Figure 10: Comparative development of the digital ecosystem (2018)

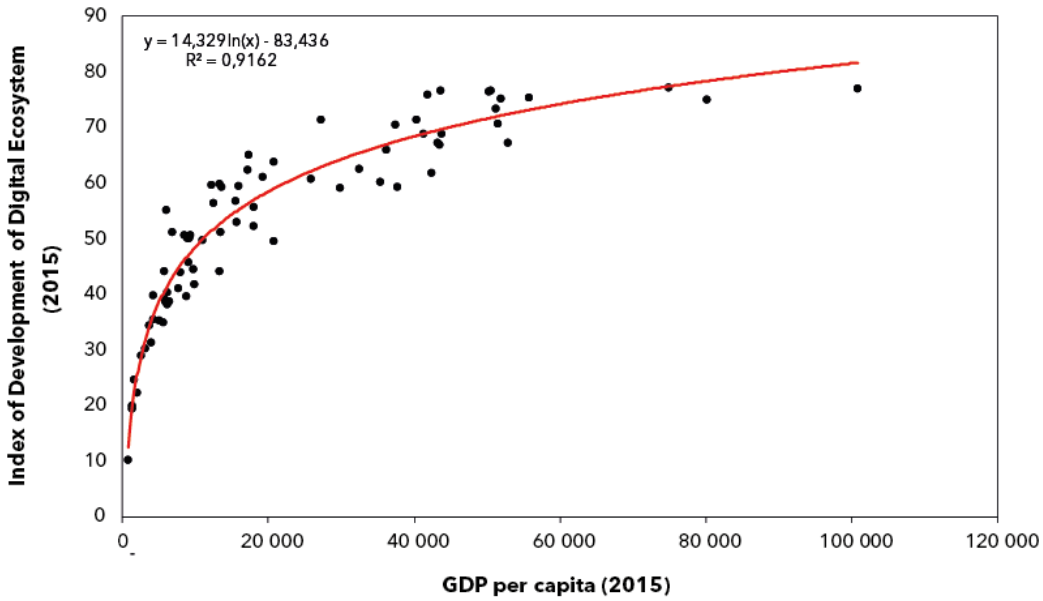


Source: ITU publications on the Economic Contribution of Broadband, Digitization and ICT Regulation regional studies

Digitization correlates with economic development

Digitization is correlated with economic development (see Figure 11 below).

Figure 11: Correlation between GDP per capita and Digital Ecosystem Development Index, 2015



Source: ITU

This study tested three hypotheses in regard to how digitization impacts the economy:

- Its impact is higher than standalone information technologies;
- Impact increases at higher development stages;
- There is a positive impact on productivity.

The econometric models are built on data for 73 countries between 2004 and 2015:

- Africa (4 countries)
- Americas (24 countries)
- Arab States (3 countries)
- Asia Pacific (9 countries)
- Europe (24 countries)
- Commonwealth of Independent States (9)

The endogenous growth model tests the impact on GDP growth and is based on the Cobb-Douglas production function:

$$\text{Log}(GDP_{it}) = a_1 \log(\text{Fixed capital formation}_{it}) + a_2 \log(\text{Labour force}_{it}) + a_3 \log(\text{digitization index}_{it}) + a_4 \log(\text{previous year GDP}) \varepsilon_{it}$$

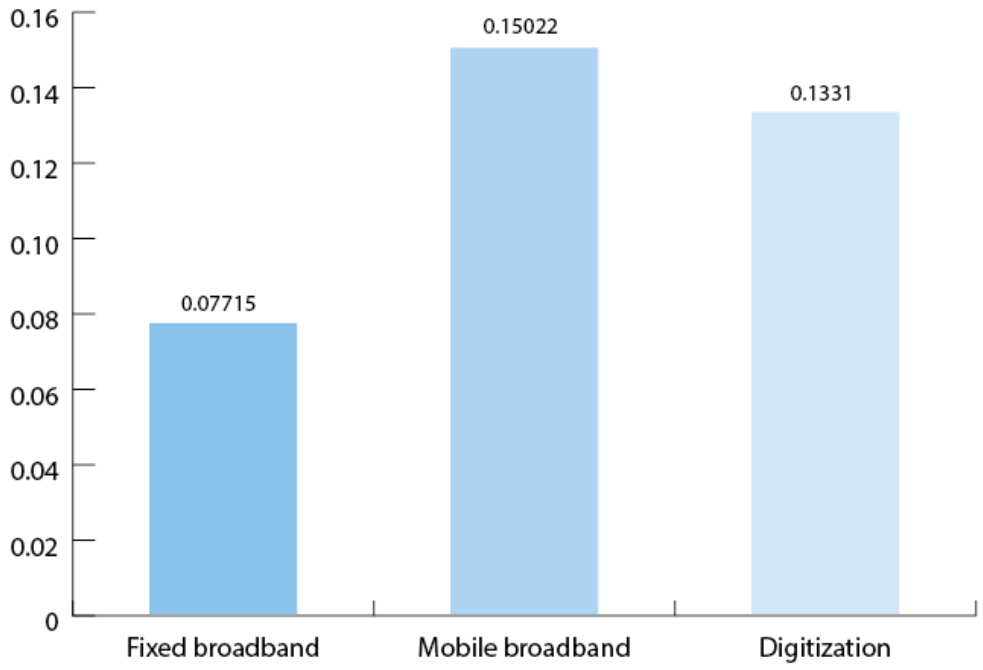
The model to test the impact of digitization on productivity:

$$\text{Log}(\text{Productivity}_{it}) = a_1 \log(\text{Growth of digitization}_{it}) + a_2 \log(\text{digitization index}_{it}) + \varepsilon_{it}$$

Digitization – on par with mobile broadband in boosting economies

On a global scale, digitization has a larger economic contribution than fixed broadband, on a par with that of mobile broadband.

Figure 12: Impact on GDP of 1% increase in independent variable, 2014-2015

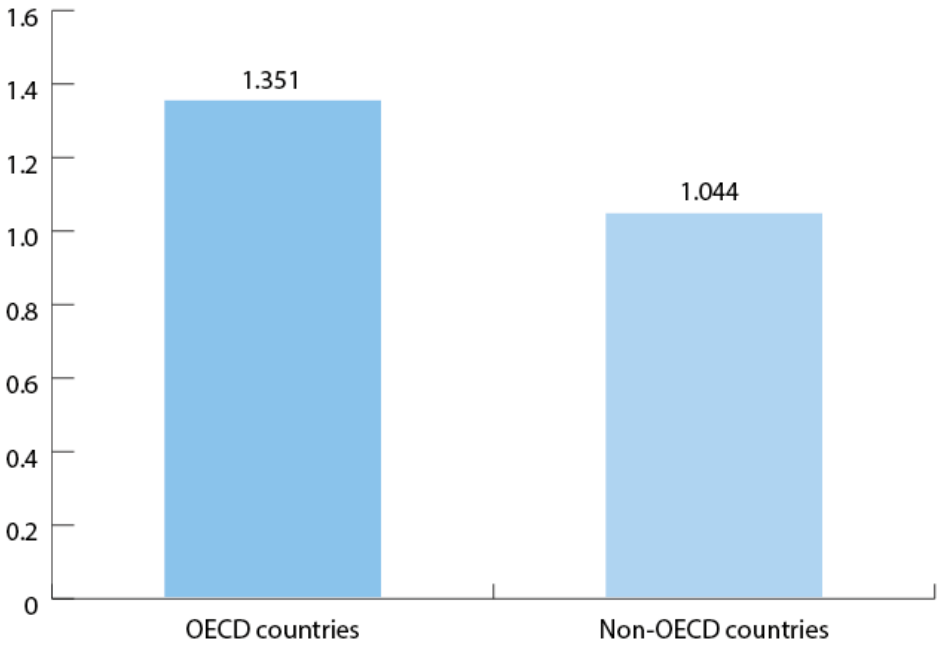


Source: ITU publications on the Economic Contribution of Broadband, Digitization and ICT Regulation regional studies

Digitization boosts advanced economies

The impact of digitization on advanced economies is higher than in emerging countries, confirming the “return to scale” effect (see Figure 13 below).

Figure 13: Impact on GDP of 10% increase in digitization, 2014-2015



Source: ITU

Digitization boosts productivity

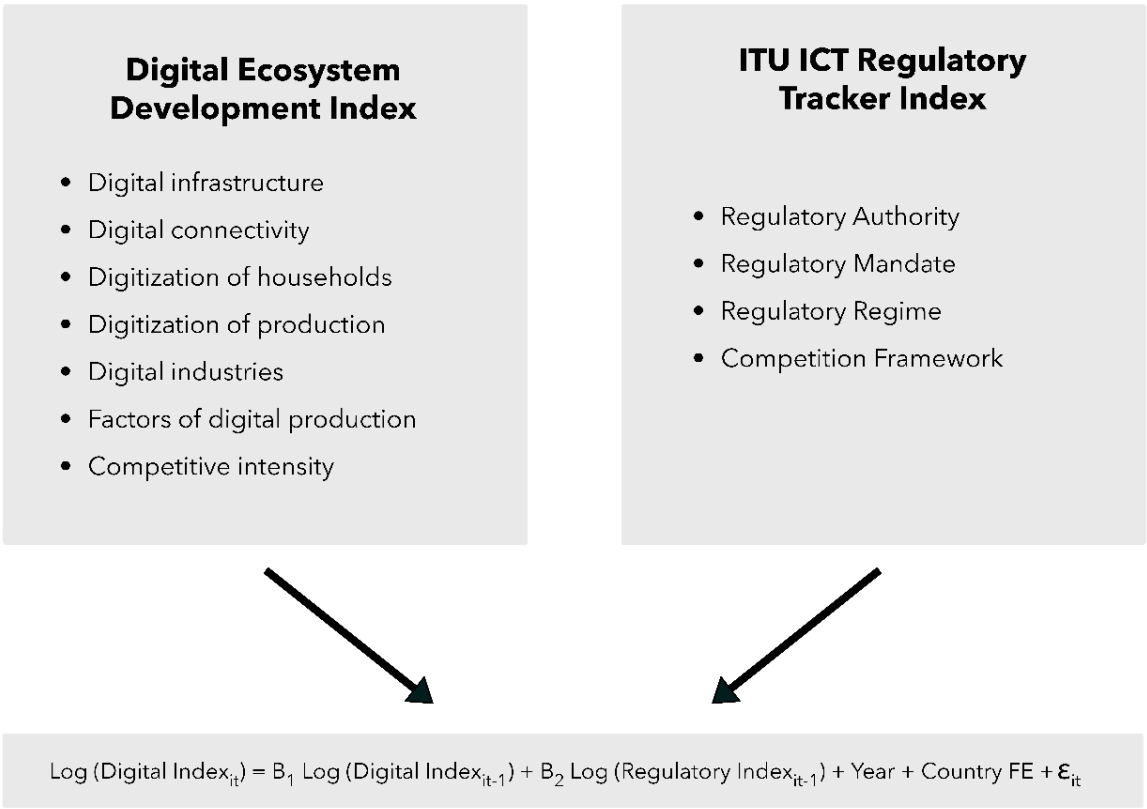
Digitization boosts labour productivity – 10 per cent digitization yields an increase of 2.62 per cent. Ten per cent increase yields an increase of 2.28 per cent in total factor productivity.

Policy and regulation drive development of digitization

Institutional and regulatory factors drive the development of digitization in addition to endogenous variables.

We see an acceleration in the digital ecosystem development following changes to policy and institutions that influence deployment and adoption of digital technologies. Note there is a time lag between change and effect.

How did we measure the impact of policy and regulation on digitization? This was based on a multivariate regression model that included two indices as set out below:



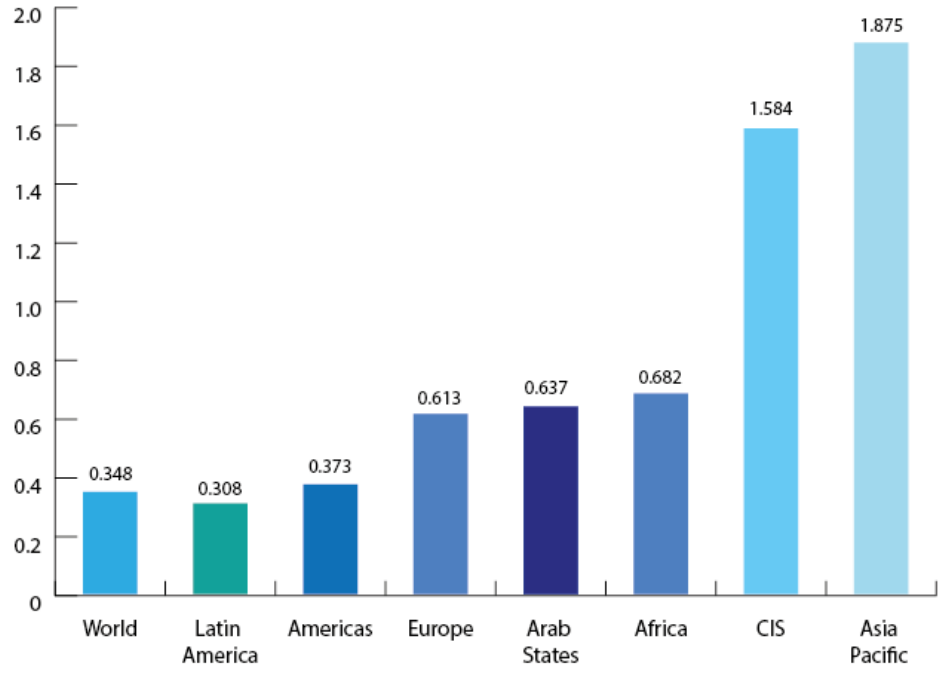
Regional results confirm the importance of regulation and policy

All our regional results confirm the importance of regulation and policy on the development of digitization.

Here we list three mechanisms (that can occur simultaneously) that drive this effect:

- Changes in policy and/or institutions drive increased public ICT investment, which in turn improves network reliability and affordability.
- Institutional change facilitates more effective public policy which in turn can help drive the development of a national digital agenda / a broadband plan / the creation of legislative consensus.
- Sending a signal to the private sector: institutional changes signal to the private sector that ICT and digital development are a cornerstone – in response the private sector (operators and other Internet players) increases investment and commercial aggressiveness. In this way, public initiative functions as a multiplier.

Figure 14: Impact of the 10% of the lagged ITU ICT Regulatory Tracker on the Digital Ecosystem Development Index



Source: ITU publications on the Economic Contribution of Broadband, Digitization and ICT Regulation regional studies

ANNEX A: Review of the related research literature

A review of the research literature on the economic contribution of telecommunications and digital technologies, as well as the impact of the policy variable on the development of telecommunications and digitization has been prepared and published in each of the regional econometric studies.[12] Whenever applicable, the literature was reviewed both in terms of global results and by region in order to ascertain the level of progress of research in each region of the world. The review set the stage for defining the theoretical frameworks that guided this study.

A.1. THE ECONOMIC CONTRIBUTION OF FIXED AND MOBILE BROADBAND

Studies on the economic impact of telecommunications have been produced for the past two decades confirming, to a large extent, that wireline and wireless telephony, as well as fixed and mobile broadband have an impact on economic growth and, in some cases, on employment and productivity (Hardy, 1980; Karner and Onyeji, 2007; Jensen, 2007; Katz *et al*., 2008; Katz, 2011; Katz *et al*., 2009; Katz *et al.*, 2012, Arvin and Pradhan, 2014). Along these lines, a critical issue of the evolving research on network externalities of telecommunications is the impact pattern telecommunications penetration levels may have on output and employment. For example, is there a linear relationship between broadband adoption and economic growth, whereby higher penetration yields larger impact? Or, are we in the presence of more complex non-linear causal effects, such as "increasing returns to scale" and/or "diminishing returns" due to saturation? Along those lines, is it possible to identify a particular effect of increasing returns linked to broadband speed?

The following section summarizes first, the historical evolution of econometric modelling studies of broadband economic contribution. Following this, it examines specific results from studies that have evaluated contribution patterns such as identifying potential returns to scale or diminishing returns effects. More specifically, it focuses on the particular research domain of return to speed. Finally, it examines econometric research conducted within particular geographic regions.

A.1.1. Historical evolution of econometric modelling of broadband economic contribution

Broadband technology is a contributor to economic growth at several levels. First, the deployment of broadband technology across business enterprises improves productivity by facilitating the adoption of more efficient business processes (e.g., marketing, inventory optimization, and streamlining of supply chains). Second, extensive deployment of broadband accelerates innovation by introducing new consumer applications and services (e.g., new forms of commerce and financial intermediation). Third, broadband leads to a more efficient functional deployment of enterprises by maximizing their reach to labor pools, access to raw materials, and consumers (e.g., outsourcing of services, virtual call centers).

Quantitative research aimed at generating statistical evidence regarding the economic impact of broadband is fairly recent. The review of the research indicates that there are multiple approaches to estimate the economic impact of broadband, ranging from highly sophisticated econometric techniques to qualitative micro-level case studies.

A.1.2. The "return to scale" or "critical mass" effect

[12] The Regional Econometric Studies are available at: https://www.itu.int/en/ITU-D/Regulatory-Market/Pages/Economic-Contribution.aspx.

Research on the causal link between broadband penetration and economic output indicates the existence of a non-linear relationship between the two (following an inverted U shape). At low levels of broadband penetration, the impact of broadband on the economy is minimal because the impact of telecommunications infrastructure on economic output is only maximized once the infrastructure reaches a critical mass point, generally associated with levels of penetration of developed countries.

According to the evidence generated by this body of theory, the impact of telecommunications networks on economic output is maximized once the infrastructure reaches critical mass generally associated with high levels of penetration.

The implication of this evidence for developing countries is quite significant. Unless emerging economies do not strive to dramatically increase their penetration of broadband, the economic impact of the technology will be quite limited.

A.1.3. The saturation and "diminishing returns" effect

At the other end of the diffusion process, some authors have pointed out a potential "saturation" effect. They have found that, beyond a certain adoption level, the contribution of a telecommunications technology to the economy tends to diminish. For example, Atkinson *et al.* (2009) point out, albeit without quantitative evidence, that network externalities decline with the build out of networks and the maturation of technology over time. There is evidence that supports this argument. It has been demonstrated in diffusion theory that early technology adopters are generally those who can elicit the higher returns of a given innovation. Conversely, network externalities would tend to diminish over time because those effects would not be as strong for late adopters. Along those lines, Gillett *et al.* (2006) argued that the relation between broadband penetration and economic impact should not be linear "because broadband will be adopted (…) first by those who get the greatest benefit (while) late adopters (…) will realize a lesser benefit" (p. 10).

To test the saturation hypothesis, Czernich *et al.* (2009)[13] added dummy variables to account for 10 per cent and 20 per cent broadband penetration to their models explaining broadband contribution to OECD economies. They found that 10 per cent broadband penetration has a significant impact on GDP per capita: between 0.9 and 1.5 percentage points. However, the transition from 10 per cent to 20 per cent yielded non-significant results. This led the authors to postulate that broadband saturation and diminishing returns occurs at the 20 per cent point. Gillett *et al.* (2006), presented above, also included saturation as an independent variable and found that it was negatively related to the increase in economic growth (notwithstanding the possible influence of network effects). In an implicit confirmation of this postulate, Qiang *et al.* (2009) found that economic impact of a 1 per cent increase in broadband is higher in low and middle-income economies and lower in high-income economies.[14] Similarly, in their study of the impact of broadband in Kentucky, Shideler *et al.* (2007) found that economic impact is highest around the mean level of broadband saturation at the county level. Again, this was due to diminishing returns to scale. According to this last study, a critical amount of broadband infrastructure may be needed to sizably increase employment, but once a community is completely built out, additional broadband infrastructure will not further contribute to employment growth. In the case of mobile telephony, Gruber and Koutroumpis (2011) show as well, that mobile telephony's effects on GDP growth correlate with wireless penetration growth up until penetration rates reach 60 per cent, at which point effects tend to subside.

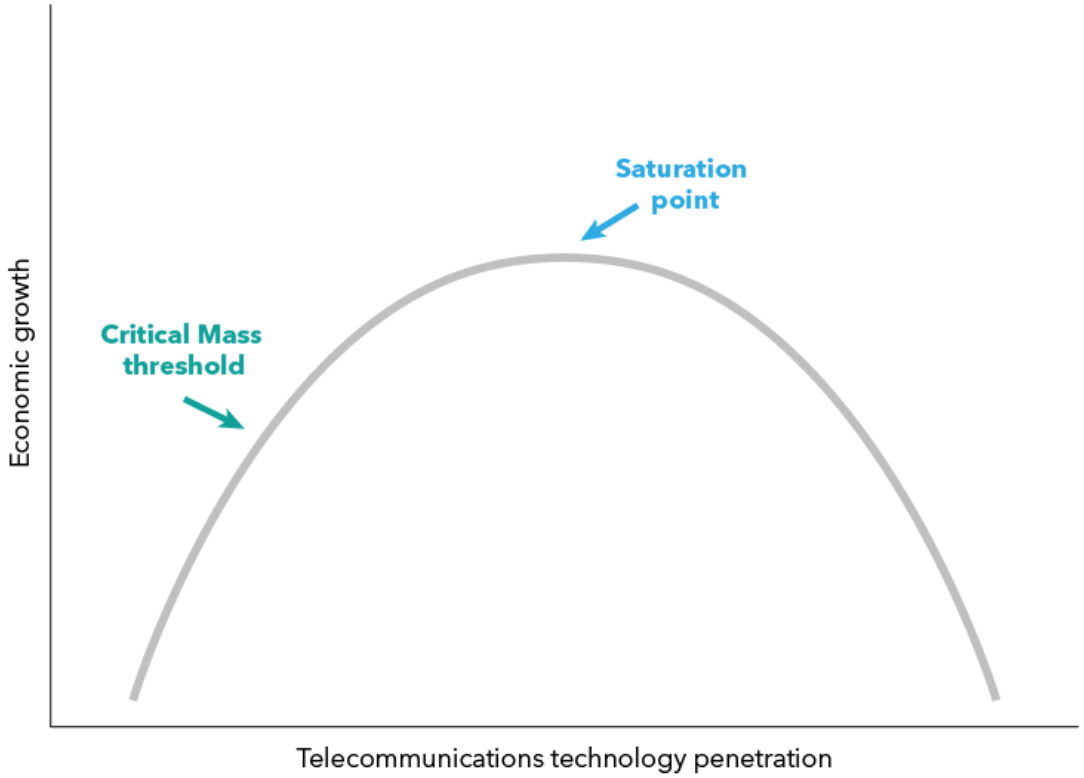
[13] Op. cit. above.

[14] Op. cit. above.

One should be very careful, however, in interpreting the evidence of “diminishing returns”. The saturation evidence still needs to be carefully tested particularly in terms of what is the point beyond which the economic impact tends to diminish. Furthermore, even if there were to be found confirming evidence of saturation with regard to contribution to GDP or employment creation, that would not put into question the need to achieve universal broadband in terms of the other social benefits it yields to end users.

With both points of view in mind – need to achieve critical mass and diminishing returns –, it would appear that the strength of the relationship between telecommunications and economic growth is highest once the technology has achieved a certain critical mass but before it reaches saturation (see Figure A-1).

Figure A-1. Conceptual framework for the impact of broadband on economic output over the diffusion process



Source: Authors

Figure A-1 shows an inverted U shape of the non-linear relationship between broadband penetration and output. It appears that broadband penetration has only marginal impact until a critical mass of users is achieved. The impact increases beyond the critical mass threshold and until reaching a saturation point – above which the gains in connectivity and access to broadband do not generate additional economic output.

Theoretically, it would appear that there is a non-linear (or inverted U shape) relationship between broadband penetration and output. At low levels of broadband penetration, we believe the impact of broadband on the economy is minimal due to the need to reach "critical mass". According to this theory, the impact of telecommunications infrastructure on the economic output is maximized once the infrastructure reaches a critical mass point generally associated with levels of penetration of industrialized countries. Beyond that point, economic impact tends to slow down, depicting "diminishing returns". As a cautionary point, the literature has evidenced an important dispersion in the level of penetration that would indicate a saturation point when economic impact tends to diminish: it ranges between 20 per cent and 60 per cent.

A.1.4. The "return to speed" effect

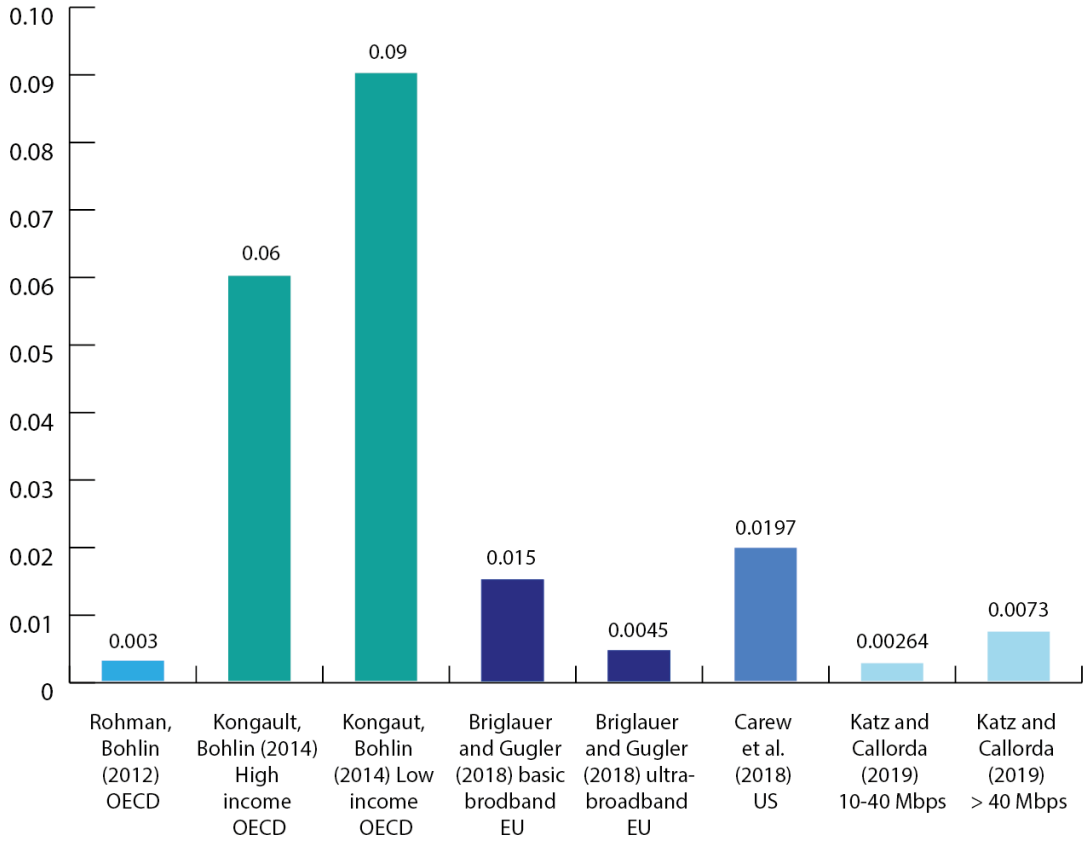
Beyond research the aggregate economic contribution of broadband, studies have recently started focusing on the so-called "return to speed". Research on the contribution of broadband speed to economic growth generally concludes that faster Internet access has a positive impact on GDP growth. Two types of effects explain this causal relationship. First, faster broadband contributes to

an improvement of productivity resulting from the adoption of more efficient business processes. For example, improved marketing of excess inventories and optimization of the supply chain are two of the effects that might be generated. Second, faster connectivity yields an acceleration of the rate of introduction of new products, services, and the launch of innovative business models.

An early study that assessed the impact of broadband speed on GDP (Rohman, Bohlin, 2012) looked at 33 OECD countries and concluded that a 100 per cent increase (or doubling) of speed yields a 0.3 per cent increase in GDP with a sample mean of 8.3 Mbps. Following on this study, Kongaut and Bohlin (2014) used a similar approach, but differentiated between high and low-income OECD countries and determined that an increase in broadband speed of 1 per cent yields an increase in GDP per capita of 0.09 per cent for low income countries and 0.06 per cent for high income countries.

Two studies completed in 2018 provided additional evidence of broadband speed impact on GDP. Briglauer and Gugler (2018) looked at data for 27 EU Member States between 2003 and 2015. In this case, 1 per cent increase in basic broadband adoption was found to increase GDP by about 0.015 per cent, while 1 per cent increase in ultra-fast broadband adoption led to an incremental increase of 0.004-0.005 per cent of GDP. In another iteration, Carew *et al*. (2018) concluded that a 1 per cent increase in speed equates to a 0.0197 per cent in real GDP. Therefore, a doubling of speed (100 per cent increase) yields 1.97 per cent increase in GDP. A recent study by Katz and Callorda (2019) based on an extensive dataset of 159 countries found that the impact on GDP of fixed broadband download speeds under 10 Mbps is non-existent, while once the average speed is in a range between 10 and 40 Mbps, the effect on GDP is positive and statistically significant. The effect on GDP is even greater for download speeds in excess of 40 Mbps. The results of this study (see Figure C-5) are in the range of what was estimated by Briglauer and Gugler (2018) for the EU ultrabroadband impact, while the difference with Carew *et al*. (2018) is likely because, since broadband adoption is not included as independent variable for control purposes, the effect of speed subsumes broadband penetration.

Graphic A-2. Studies measuring the GDP impact on Broadband Speeds (impact of 1% increase in speed on GDP) (%)



Source: Compiled by the authors

As indicated in Graphic A-2, while all studies conclude that broadband speed has an impact on GDP, the range of contribution varies. Some of the difference is explained by methodologies used. For example, Carew *et al*. (2018) did not include broadband adoption as an independent variable which means that the effect of speed subsumes broadband penetration. In other cases, the difference can be explained by the timing of the data used.

Can a saturation effect attached to broadband penetration and GDP be extended to broadband speed? Koutroumpis (2018) argues that a country that has reached the saturation point in speed may experience additional GDP growth although this would not be attributed to the network anymore but to new products and services enabled by the network.

A.1.4.1. Broadband speed and household income

While broadband speed has been consistently found to have a positive effect on economic growth, the evidence of a positive contribution of Internet speed to household income is less conclusive. Rhoman and Bohlin (2013) concluded that there are positive benefits from broadband speed on income, though they are not linear and continuous, but nonlinear and stepwise. Furthermore, the authors found that the impact for lower speed is greater in BRIC countries and for higher speeds it is greater in OECD countries. On the other hand, Ford (2018) analysed data of US and found no economic payoff from a 15 Mbps speed difference.

A.1.4.2. Broadband speed and enterprise productivity

The contribution of broadband speed to enterprise productivity has been studied in terms of its efficiency enhancement and productivity levels. In a study of Irish firms, Haller *et al.* (2019) found significant productivity gains from broadband availability in two services sectors: information and communication services and administrative and support service activities. The effects measured for these two sectors were large, equivalent to about a third of the typical variation in productivity. Smaller effects were found in other sectors. These results suggest the benefits of broadband for productivity depend heavily upon sectoral and firm characteristics rather than representing a homogeneous effect. Cariolle *et al.* (2018) study firms in 62 countries, using World Bank data, and detected a large impact of broadband speed on a firm's average annual sales and sales per worker.

A.1.4.3. Broadband speed and job creation

Research on the impact of broadband speed on employment, which takes place through the contribution to firm relocation and start-up incubation, is fairly conclusive. With the exception of one study, all research has been focused on the United States. Whitacre *et al.* (2014) looked at local level data of non-metropolitan United States counties between 2001 and 2010 and identified a positive impact of broadband speed on unemployment reduction. In particular, rural areas with fast broadband tend to attract more creative class workers. Bai (2016) studied United States counties between 2011 and 2014 and found that while broadband has a positive impact on employment, ultra-fast broadband has less incremental effects. Lobo *et al*. (2019) studied the counties within the US state of Tennessee and found that unemployment rates are about 0.26 percentage points lower in counties with high speed broadband compared to counties with low speed service. Coinciding with Whitacre *et al*. (2014), this study found that better quality broadband has a disproportionately greater effect in rural areas.

The only study conducted outside the United States was done by Hasbi (2017), analysing panel data on 36 000 municipalities in France between 2010 and 2015, the author found that deployment of high-speed broadband (> 30 Mbps) increases company relocation and start-up development in those areas in the non-agricultural sector. These two effects yield a positive contribution to reduction of unemployment.

A.1.4.4. Broadband speed and consumer surplus

Consumer surplus is defined as the amount that consumers benefit from purchasing a product for a price that is less than what they would be willing to pay. Broadband consumer surplus, typically assessed against dial up or pricing differences, indicates a high willingness to pay for speed. Most studies of consumer surplus derived from faster speed are based on surveys or focus groups where consumers stipulate the amount they would be willing to pay for a service such as broadband (Savage *et al.* (2004); Greenstein and McDewitt (2011); Liu *et al*. (2018)).

Finally, other studies on consumer surplus focus the assessment of how consumers react to variations in price according to their data usage.

A.2. REGIONAL STUDIES OF THE ECONOMIC IMPACT OF BROADBAND

While some of the research reviewed above focused on specific geographies, it was pertinent to reevaluate it in light of progress that has occurred in each region of the world to ascertain what has taken place in terms of econometric modelling at the regional level. As mentioned above, the full description of this research is available on each regional econometric study.

A.3. THE ECONOMIC IMPACT OF DIGITIZATION

The study of a country or region stage of development in the adoption of Information and Communication Technologies has been progressing over the last twenty years. While the original focus was to assess the deployment and adoption of telecommunications and information technology infrastructure (broadband, mobile telephony, computers), research has been gradually expanding its focus to include dimensions such as the use of digital technologies (electronic commerce, electronic government, social networks) as well as the development of industries within the full digital value chain (Internet platforms, Collaborative Internet Services, etc.).

This new perspective has led to the emergence of the concept of digitization. This chapter focuses first on providing a definition of digitization. Given that this phenomenon is comprised of multiple technology trends, its measurement requires the development of composite indices. The efforts in this domain are being reviewed in the second section. Once measurement of digitization was established, the estimation of its economic impact was conducted.

A.3.1. What is digitization?

Digitization *per se*, is the process of converting analogue information to a digital format. Digitization, as a social process, refers to the transformation of the techno-economic environment and socio-institutional operations through digital communications and applications.[15] Unlike other technological innovations, digitization builds on the evolution of network access technologies (mobile or fixed broadband networks), semiconductor technologies (computers/laptops, wireless devices/tablets), software engineering (increased functionality of operating systems) and the spillover effects resulting from their use (common platforms for application development, electronic delivery of government services, electronic commerce, social networks, and availability of online information in fora, blogs and portals). In order to measure the economic impact of digitization it is necessary to develop composite metrics that allow us to determine a country's level of digital eco-system development.

Digitization metrics aim to quantify the cumulative effect of adoption and usage of information and communication technologies. While most of the research literature measuring the social and economic impact of ICT focuses on discrete technology platforms, the holistic adoption and usage of information technology results in enhanced effects that go beyond the contribution of specific platforms. Furthermore, to achieve a significant impact, digitization has to be widely adopted in the economic and social fabric of a given country. As such, they have to be widely utilized by individuals, economic enterprises and societies, embedded in processes of delivery of goods and services (e.g. eCommerce), and relied upon to deliver public services (e.g. eHealth, eGovernment).

A.3.2. Measurement of digitization

The study of a country or region stage of development in the adoption of Information and Communication Technologies has been progressing over the last twenty years. While the original focus was to assess the deployment and adoption of telecommunications and information technology infrastructure (broadband, mobile telephony, computers), research has been gradually expanding its focus to include dimensions such as the use of digital technologies (electronic commerce, electronic government, social networks) as well as the development of industries within

[15] See Katz and Koutroumpis, 2013a.

the full digital value chain (Internet platforms, collaborative Internet services, etc.). In this process, a number of indices have been developed along the way, including the International Telecommunications Union's *ICT Development Index*, the World Bank's *Knowledge Economy Index*, the World Economic Forum *Network Readiness Index*, and the Inter-American Development Bank's *Broadband Development Index*. However, most of the indices developed so far tend to either address a particular aspect of the digital ecosystem, such as broadband penetration, or include a limited number of indicators.

The first index of digitization developed[16] was based on six components (see Table A-3).

Table A-3. Structure of Original Digitization Index

Components	Subcomponents	Sub-Subcomponents
Affordability	Residential fixed line cost adjusted for GDP per capita	Residential fixed line tariff adjusted for GDP per capita
		Residential fixed line connection fee adjusted for GDP per capita
	Mobile cellular cost adjusted for GDP per capita	Mobile cellular prepaid tariff adjusted for GDP/capita
		Mobile cellular prepaid connection fee adjusted for GDP per capita
	Fixed broadband Internet access cost adjusted for GDP per capita	
Infrastructure Reliability	Investment per telecom subscriber (mobile, broadband and fixed)	Mobile investment per telecom subscriber
		Broadband investment per telecom subscriber
		Fixed line investment per telecom subscriber
Network Access	Network Penetration	Fixed Broadband penetration
		Mobile Phone penetration
	Coverage, Infrastructure and Investment	Mobile cellular network coverage
		PC population penetration
		3G Penetration
Capacity	International Internet bandwidth (kbps/user)	
	% Broadband connections higher than 2 Mbps	
Usage	Internet retail volume	
	E-government usage	
	% Individuals using the internet	
	Data as % of wireless ARPU	
	Dominant Social Network Unique Visitors per month Per Capita	
	SMS Usage	
Human Capital	% Engineers in labour force	
	% Skilled labour	

Source: Katz and Koutroumpis, 2013a

The increasing complexity of the digital eco-system required constructing an index that reflected a larger number of domains and indicators. The index for measuring the development of a digital ecosystem, constructed with support of CAF Development Bank for Latin America,[17] is a composite metric for quantitatively assessing the eight pillars comprising the digital economy.

According to this conceptual structure, the digital ecosystem is defined as a set of interconnected components (or pillars) operating within a socio-economic context. For example, the development of the infrastructure of digital services provides individuals, businesses and public organizations access to digital content and services. It also supplies interconnectivity to players within the digital value chain (e.g. developers of digital content, Internet platforms, etc.) so they can deliver a value

[16] Katz and Koutroumpis, 2013a; Katz *et al*., 2013b, Katz *et al*., 2014.

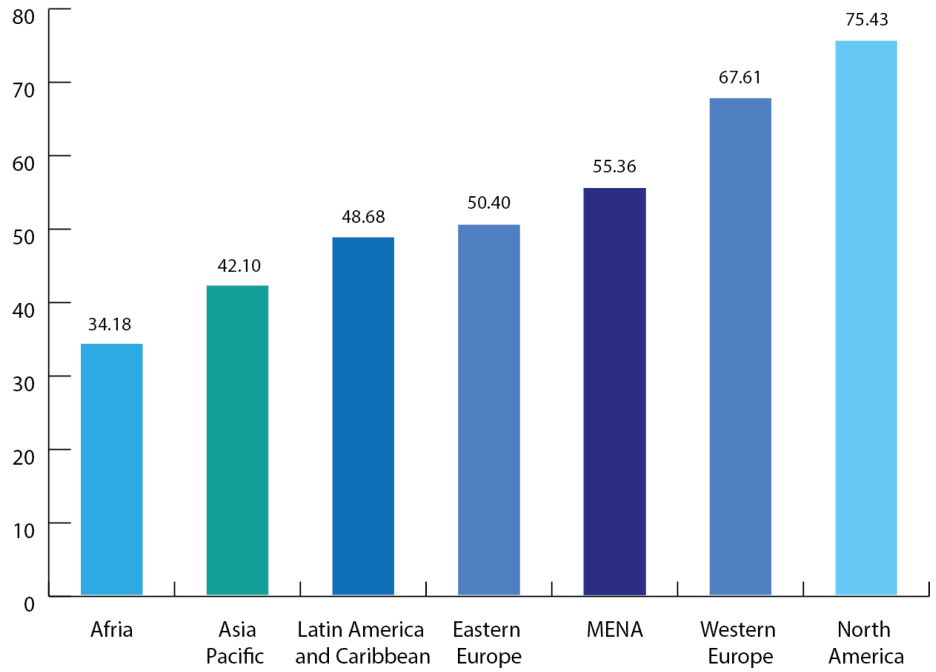
[17] Katz and Callorda, 2018.

proposition to users. Digital connectivity measures the adoption of terminals (computers, smartphones) and services (broadband, wireless telephony) in order to allow individuals and organizations to gain access to networks. Network access enables the use of digital products and services, which is defined as digitization. This term is used to measure not only the use of digital services by individual consumers (household digitization) but also its assimilation by enterprises (digitization of production). The demand of digital products and services by individual consumers, enterprises and governments is met by the offer supplied by digital industries (which comprise Internet platforms, media companies, telecommunications operators and equipment manufacturers, among others). These firms can be located within the country where demand is located or, enabled by virtual business models, can be based beyond its frontiers. In order for digital industries to operate within the country, they require conventional factors of production ranging from human to investment capital. Finally, for digital industries to generate static and dynamic consumer benefits, they need to operate within a sustainable competitive environment, and receive the appropriate incentives and controls embodied in a regulatory framework and public policies.

Given that the digital ecosystem embodies a complex interaction among its eight components, the measurement of its development requires the creation of an index composed of eight pillars, each of which is a composite sub-index based on multiple indicators. In total, the Digital Ecosystem Development Index is based on 64 indicators (see image relating to the measurement of digitization conducted by an index composed of 64 indicators grouped in eight pillars, and shown above in Figure 9).

This index has been used to measure the development of regions of the world (see Graphic A-5), as well to understand the progress achieved so far and the nature of the challenges facing ahead.

Graphic A-5. Comparative Development of the Digital Ecosystem (2018)



Note: Countries included in each region are those with GDP per capita higher than USD 5 000 and a population of 5,000,000 or more, which include Australia, China, South Korea, India, Japan, Malaysia, New Zealand, Singapore, and Thailand for Asia Pacific, Canada and United States for North America, Cote d'Ivoire, Egypt, Kenya and South Africa for Africa, Azerbaijan, Belarus, Bulgaria, Czech Republic, Estonia, Hungary, Kazakhstan, Latvia, Poland, Romania, Russian Federation, Slovakia, Slovenia, and Turkey for Eastern Europe, Austria, Belgium, Denmark, Finland, Germany,

Greece, Iceland, Ireland, Italy, Luxemburg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom for Western Europe, Israel, Lebanon Saudi Arabia and United Arab Emirates for Middle East and North Africa, and Argentina, Barbados, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Trinidad & Tobago, Uruguay, and Venezuela for Latin America and the Caribbean.

Source: Authors

The Index facilitates the estimation of digitization economic impact.

A.3.3. Economic impact of digitization

The original index, discussed above, was used to test the impact of digitization on economic growth. For this purpose, we used an endogenous growth model that links Gross Domestic Product to the Fixed Stock of Capital, Labor Force and the Digitization Index as a proxy of technology progress. This model for economic output stems from the simple Cobb-Douglas form:

$Y = A(t)K^{1-b}L^{b}$
where

$A(t)$ represents the level of technology progress (in our case the Digitization Index),
K corresponds to the fixed capital formation, and
L to the labour force.
By converting all terms to logarithms, the coefficients were estimated through an econometric model.

$$log(GDP_{it}) = a_1 log(k_{it}) + a_2 log(L_{it}) + a_3 log(D_{it}) + \varepsilon_{it}$$

The Digitization Index was found to have a positive and significant effect at the 5 per cent level indicating a strong effect on economic output. A ten-point increase in the Digitization Index had approximately a 3 per cent impact on GDP for the period 2004-2010 resulting on an annualized effect of 0.50 per cent.[18][19]

The Digital Ecosystem Development Index was run for 73 countries for the period 2004-2015, which resulted in 803 observations, and included fixed effects by country (Katz and Callorda, 2018). According to the model, an increase of 1 per cent in the Digital Ecosystem Development Index results in a 0.13 per cent growth in GDP per capita. This means, for example, that an increase in the Digital Ecosystem Development Index from 50 to 51 will yield an increase of per capita GDP of 0.26 per cent (accounting both for direct and indirect effects on output).

The model was also run for OECD and non-OECD countries to test for a "return to scale" effect. The results indicate that the impact of the digital ecosystem on more advanced economies is higher than emerging countries. Thus, an increase of 1 per cent in the Digital Ecosystem Development Index yields an increase of 0.14 per cent in per capita GDP for OECD countries, while the impact of a

[18] This was used as a base case of an "average" country whose Digitization Index increased by 10 points.
[19] Annual Growth Rate (CAGR) attributed to digitization derives from formula (1):

$$CAGR = \left[\left(\frac{\frac{Digitization_{2010}}{100-Digitization_{2010}} - \frac{Digitization_{2004}}{100-Digitization_{2004}}}{\frac{Digitization_{2010}}{100-Digitization_{2010}}} \right) * \hat{a}_3 + 1 \right]^{1/6}$$

similar change in non-OECD countries will be 0.10 per cent. In other words, the higher the economic development, the stronger the contribution of the digital ecosystem on economic growth.

A.4. THE IMPACT OF POLICY ON DIGITIZATION

While very limited research has been conducted so far in terms of measuring the impact of policy on the development of digitization, substantial work has been done regarding the impact of public policies on the development of specific technologies. The policy variables that affect digitization and ICT sector performance have multiple dimensions, ranging from the regulatory to the institutional ones, both being either specific or not to the sector. In general terms, variables can be grouped in three categories: 1) the institutional framework, 2) the regulatory framework, and 3) non-sector specific policies which can have a spillover effect on the ICT sector.

The institutional framework variables comprise the factors such as the type of governmental entities that are in charge of developing digital policy or regulating the ICT sector and the providers of service. For example, the variables included in this cluster comprise the overall policy environment (e.g. existence of Cabinet-level position centralizing all digital policy matters (telecommunications, content, computing), the scope and scale of a telecommunications national regulatory authority, its enforcement powers, and independence, the existence of an overarching ICT national planning process, and the scope of government participation in the digital sector.

The regulatory framework cluster comprises all the variables related to specific policies and regulatory approaches. They include market entry regulation (e.g. vertical separation, local loop unbundling, rights of way, numbering scheme, spectrum management), price regulation (interconnection, mobile termination rates, weighted average cost of capital, retail pricing), investment incentive regulation (e.g. asymmetry), the regulatory process (e.g. market analysis ex-ante), and the application of regulation (e.g. technological neutrality, operational conditions, compliance monitoring).

Finally, non-sector specific policies that can have an impact on the performance of the sector comprise variables such as direct foreign investment restrictions affecting market entry and capital structure, other trade restrictions affecting services supply, proactive long term government planning, and regulation of audiovisual content affecting convergence (e.g. restrictions of telecommunications carriers regarding content distribution). In particular, policies that promote and facilitate the adoption of ICT by late adopters (socio-economic disenfranchised and small and medium enterprises), such as digital literacy programmes and equipment subsidization, play an extremely important role in fostering the emergence of a high-performance sector.

ANNEX B: Countries analysed for economic impact of fixed and mobile broadband

- Argentina
- Australia
- Austria
- Azerbaijan
- Barbados
- Belarus
- Belgium
- Bolivia
- Brazil
- Bulgaria
- Canada
- Chile
- China
- Colombia
- Costa Rica
- Côte d'Ivoire
- Cuba
- Czech Republic
- Denmark
- Dominican Rep.
- Ecuador
- Egypt
- El Salvador
- Estonia
- Finland
- France
- Germany
- Greece
- Guatemala
- Haiti
- Honduras
- Hong Kong, China
- Hungary
- Iceland
- India
- Ireland
- Israel
- Italy
- Jamaica
- Japan
- Kazakhstan
- Kenya
- Korea (Rep.)
- Latvia
- Lebanon
- Luxembourg
- Malaysia
- Mexico
- Netherlands
- New Zealand
- Nicaragua
- Norway
- Panama
- Paraguay
- Peru
- Poland
- Portugal
- Romania
- Russian Federation
- Saudi Arabia
- Singapore
- Slovakia
- Slovenia
- South Africa
- Spain
- Sweden
- Switzerland
- Thailand
- Trinidad & Tobago
- Turkey
- United Arab Emirates
- United Kingdom
- United States
- Uruguay
- Venezuela

ANNEX C: Data sources for models testing the economic impact of fixed and mobile broadband

Indicator	Source
GDP per Capita (PPP)	IMF
Fixed Broadband Subscriber Penetration	ITU - OVUM
Capital - Gross Capital Formation (% of GDP)	World Bank
Education- School Enrolment, tertiary (% gross)	World Bank
Fixed Telephone Subscribers	ITU
Rural Population (% of total population)	World Bank
Fixed Broadband Price	ITU
HHI Fixed Broadband	OVUM
Fixed Broadband Revenue	ITU - OVUM
Mobile Broadband Unique Subscribers Penetration	GSMA
Mobile Unique Subscribers Penetration	GSMA
Mobile Broadband Price//ARPU	ITU - GSMA
HHI Mobile Broadband	GSMA
Mobile Broadband Revenue	GSMA

ANNEX D: Indicators included in Digital Ecosystem Development Index and data sources

Pillar	Sub-pillar	Indicator	Source
Infrastructure	Investment	Telecommunications investment per capita in current prices – five-year average (USD PPP)	World Bank; ITU
Infrastructure	Quality of service	Average fixed broadband download speed (Mbps)	Akamai
Infrastructure	Quality of service	Average mobile broadband download speed (Average Mbps)	Akamai
Infrastructure	Quality of service	Fixed broadband connections with download speed higher than 4 Mbps (percentage)	Akamai
Infrastructure	Quality of service	Fixed broadband connections with download speed higher than 10 Mbps (percentage)	Akamai
Infrastructure	Quality of service	Fixed broadband connections with download speed higher than 15 Mbps (percentage)	Akamai
Infrastructure	Quality of service	Fibre optic broadband connections as a percentage of total fixed broadband connections	ITU; FTTH; OECD
Infrastructure	Quality of service	International broadband bandwidth per Internet user (bit/s)	ITU
Infrastructure	Coverage	Fixed broadband coverage (% of households)	Eurostat, CAF Ideal; OECD
Infrastructure	Coverage	2G coverage	ITU
Infrastructure	Coverage	3G coverage	ITU
Infrastructure	Coverage	4G coverage	ITU
Infrastructure	Service infrastructure	IXPs per 1 000 000 population	Packet Clearing House; UNCTAD
Infrastructure	Service infrastructure	Number of secure servers (per 1 000 000 population)	World Bank
Infrastructure	Service infrastructure	Number of satellites (per 1 000 000 population)	N2yo.com
Connectivity	Affordability	Monthly fixed broadband subscription as percentage of GDP per capita	ITU
Connectivity	Affordability	Monthly mobile broadband smartphone subscription (500 MB cap, prepaid) as percentage of GDP per capita	ITU
Connectivity	Affordability	Monthly mobile broadband PC subscription (1 GB cap, postpaid) as percentage of GDP per capita	ITU
Connectivity	Affordability	Monthly pay TV subscription as percentage of GDP per capita	Business Bureau; CAF; PwC; TAS
Connectivity	Penetration	Fixed broadband penetration (connections per 100 households)	ITU
Connectivity	Penetration	Mobile broadband penetration (connections per 100 population)	ITU
Connectivity	Penetration	Unique mobile broadband users (per 100 population)	GSMA
Connectivity	Penetration	Pay TV penetration (connections per 100 households)	Business Bureau; CAF;

Pillar	Sub-pillar	Indicator	Source
			PwC; TAS; ITU; Convergencia
Connectivity	Ownership	Penetration of computers (% of households)	ITU
Connectivity	Ownership	Smartphone users (per 100 population)	GSMA
Connectivity	Ownership	Percentage of population with access to electric energy	World Bank
Household digitization	Internet use	Percentage of population using the Internet	ITU
Household digitization	Internet use	Penetration of dominant social network (users per 100 population)	OWLOO
Household digitization	Internet use	Mobile data ARPU as percentage of total ARPU	GSMA
Household digitization	E-government	E-government index	UN
Household digitization	E-commerce	Internet commerce as percentage of total retail commerce	Euromonitor
Household digitization	Telemedicine	National health policy (binary variables)	WHO
Household digitization	OTTs	Video on demand penetration (per cent households)	PwC
Digitization of production	Digital infrastructure	Per cent enterprises with Internet access	UNCTADstat; TAS; Eurostats
Digitization of production	Digital supply chain	Per cent enterprises using Internet for electronic banking	UNCTADstat; TAS; Eurostats
Digitization of production	Digital supply chain	Per cent enterprises using Internet for purchasing inputs	UNCTADstat; TAS; Eurostats
Digitization of production	Digital distribution	Per cent enterprises that sell products over the Internet	UNCTADstat; TAS; Eurostats
Digitization of production	Digital processing	Per cent workforce using the Internet	UNCTADstat; TAS; Eurostats
Digitization of production	Digital processing	Per cent workforce using computers	UNCTADstat; TAS; Eurostats
Competitive intensity	Competition level	HHI fixed broadband	Convergencia; Regulators; TAS
Competitive intensity	Competition level	HHI mobile broadband	GSMA; Regulators
Competitive intensity	Competition level	HHI pay TV	Convergencia; Dataxis; Ofcom; TAS; Regulatory agencies
Competitive intensity	Competition level	HHI mobile telephony	GSMA; Regulatory agencies
Digital industries	Exports	High technology exports (USD per capita in current prices)	World Bank
Digital industries	Exports	ICT services exports (USD per capita in current prices)	World Bank
Digital industries	Weight of digital industries	Digital ecosystem sales as a percentage of GDP	PwC; TAS; ITU

Pillar	Sub-pillar	Indicator	Source
Digital industries	Weight of digital industries	Telecommunications operators revenues per capita (USD in current prices)	ITU
Digital industries	Weight of digital industries	Computer software spending (per cent of GDP)	INSEAD
Digital industries	IoT	M2M connections (per 100 population)	ITU; OECD
Digital industries	Content production	Wikipedia pages edited per month (per million population between 15 and 69 years old)	INSEAD
Factors of digital production	Human capital	Education years expectancy (years)	World Bank; UNESCO
Factors of digital production	Human capital	Tertiary school enrollment (per cent population)	World Bank; UNESCO
Factors of digital production	Schools	Per cent educational establishments with Internet access	UNESCO; CEPAL
Factors of digital production	Schools	Computers per students ratio	UNESCO; CEPAL
Factors of digital production	Innovation	USPTO patents per country (per 1, 000 000 population)	USPTO
Factors of digital production	Innovation	Intellectual property revenues (USD per capita PPA in current prices)	World Bank
Factors of digital production	Investment in innovation	R&D spending (per cent of GDP)	World Bank; UNESCO
Factors of digital production	Economic development	GDP per capita (USD current prices)	IMF
Factors of digital production	Economic development	Electric energy consumption (kWh per capita)	World Bank
Institutional and regulatory	Cybersecurity and piracy	Per cent of non-licensed installed software	BSA, The Software Alliance
Institutional and regulatory	Cybersecurity and piracy	Commercial value of non-licensed software (as per cent of GDP)	BSA, The Software Alliance
Institutional and regulatory	Government role	Per cent of regulatory agency attributions based on ITU Regulatory Tracker	ITU; TAS
Institutional and regulatory	Government role	Per cent of regulatory agency functions based on ITU Regulatory Tracker	ITU; TAS
-	-	Population	World Bank
-	-	Exchange rate PPP	IMF
-	-	Number of households	ITU
-	-	GDP per capita for first quintile (USD in current prices)	IMF; World Bank

ANNEX E: Econometric methodology

Economic contribution of fixed and mobile broadband

The state-of-the-art econometric models currently in use consist of four equations: an aggregate production function modelling the economy and, subsequently, three functions: demand, supply and output.[20] In the case of mobile telecommunications, for example, the last three functions model the mobile market operation and, controlling for the reverse effects, the actual impact of the infrastructure, as follows:

- In the production function, GDP is linked to the fixed stock of capital, labour and the mobile infrastructure proxied by mobile penetration.
- The demand function links mobile penetration to the average consumption propensity of individuals proxied by GDP per capita, the price of a mobile service proxied by ARPU (average revenue per user), the per cent rural population, and the level of competitive intensity in the mobile market measured by the HHI (Herfindahl Hirschman) index.
- The supply function links aggregate mobile revenues to mobile price levels proxied by ARPU, the industry concentration index of the mobile market (HHI), and GDP per capita.
- The output equation links annual change in mobile penetration to mobile revenues, used as a proxy of the capital invested in a country in the same year. The econometric specification of the model is:

Aggregate Production function: (1)

$$GDP_{it} = a_1K_{it} + a_2L_{it} + a_3Mob\_Pen_{it} + e_{it}$$

Demand function: (2)

$$Mob\_Pen_{it} = b_1Rural_{it} + b_2Mob\_Price_{it} + b_3GDPC_{it} + b_4HHI_{it} + e_{it}$$

Supply function: (3)

$$Mob\_Rev_{it} = c_1MobPr_{it} + c_2GDPC_{it} + c_3HHI_{it} +$$

Output function: (4)

$$\Delta Mob\_Pen_{it} = d_1Mob\_Rev_{it} + \varepsilon 4_{it}$$

In order to test the current economic impact of telecommunication technology, two models were constructed (one for fixed broadband and another one for mobile broadband) and specified for two cross-sectional samples of countries. This methodology would allow the three hypotheses explained above to be tested while controlling for endogeneity effects.[21]

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[20] Originally developed by Roller and Waverman (2001) and implemented by Koutroumpis (2009), Katz and Koutroumpis (2012a; 2012b), and Katz and Callorda (2014; 2016; 2018).

[21] As explained by Roller and Waverman, "This approach uses all the exogenous variable in the system of equations (i.e. those that can reasonably be assumed are not determined by the other variables in the system, such as the amount of labour and the amount of total capital) as 'instruments' for the endogenous variables (output, the level of penetration, and the prices).

Economic impact of digitization

Digitization, as a social process, refers to the transformation of the techno-economic environment and socio-institutional operations through digital communications and applications. Unlike other technological innovations, digitization builds on the evolution of network access technologies (mobile or fixed broadband networks), semiconductor technologies (computers/laptops, wireless devices/tablets), software engineering (increased functionality of operating systems) and the spillover effects resulting from their use (common platforms for application development, electronic delivery of government services, electronic commerce, social networks, and availability of online information in fora, blogs and portals). In order to measure the economic impact of digitization it is necessary to develop metrics that determine a country's level of digital eco-system development.

The study of a country or region stage of development in the adoption of ICTs (information and communication technologies) has been progressing over the last 20 years. While the original focus was to assess the deployment and adoption of telecommunication and information technology infrastructure (broadband, mobile telephony, computers), research has been gradually expanding its focus to include dimensions such as the use of digital technologies (electronic commerce, electronic government, social networks) as well as the development of industries within the full digital value chain (Internet platforms, collaborative Internet services, etc.). In this process, a number of indices have been developed along the way, including the International Telecommunication Union ICT Development Index, the World Bank Knowledge Economy Index, the World Economic Forum Network Readiness Index, and the Inter-American Development Bank Broadband Development Index. However, most of the indices developed so far tend to either address a particular aspect of the digital ecosystem, such as broadband penetration, or include a limited number of indicators.

For the application of this methodology an endogenous growth model was used, which links GDP to the fixed stock of capital, labour force, and the digitization index as a proxy of technology progress. This model for economic output stems from the simple Cobb-Douglas form:

$$Y = A_{(t)} K^{1-b} L^{b}$$

where
$A_{(t)}$ represents the level of technology progress (in our case the digitization index),
K corresponds to the fixed capital formation, and
L to the labour force.

By converting all terms to logarithms, the coefficients can be estimated through an econometric model.

$$\log(GDP_{it}) = a_1 \log(k_{it}) + a_2 \log(L_{it}) + a_3 \log(D_{it}) + \varepsilon_{it}$$

Since the development of the original digitization index, a number of changes occurred within this phenomenon, adding complexity that was not accounted for in the original index. For example, the development of the **infrastructure of digital services** provides individuals, businesses and public organizations access to digital content and services. It also supplies interconnectivity to players within the digital value chain (e.g. developers of digital content, Internet platforms, etc.) so they can deliver a

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Instrumenting the endogenous variables essentially involves isolating that component of the given endogenous variable that is explained by the exogenous variables in the system ('the instruments') and then using this component as a regressor."

value proposition to users.[22] **Digital connectivity** measures the adoption of terminals (computers, smartphones) and services (broadband, wireless telephony) in order to allow individuals and organizations to gain access to networks. Network access enables the use of digital products and services, which is defined as digitization. This term is used to measure not only the use of digital services by individual consumers (**household digitization**) but also its assimilation by enterprises (**digitization of production)**.

The demand of digital products and services by individual consumers, enterprises and governments is met by the offer supplied by **digital industries** (which comprise Internet platforms, media companies, telecommunication operators, and equipment manufacturers, among others). These firms can be located within the country where demand is located or, enabled by virtual business models, can be based beyond its frontiers. In order to develop digital industries within a country, they require conventional **factors of production** ranging from human to investment capital.

Finally, for digital industries to generate static and dynamic consumer benefits, they need to operate within a sustainable **competitive environment**, and receive the appropriate incentives and controls embodied in a **regulatory framework and public policies**. As a result, the digital ecosystem could be defined as a set of interconnected components (or pillars) operating within a socio-economic context.

In order to assess the existence and strength of the causal link between digital ecosystem development and economic development, an endogenous growth model based on the Cobb-Douglas production function was specified linking the stock of fixed capital, labour force, and the CAF Digital Ecosystem Development Index. The model also controls for GDP per capita for previous year to account for inertia effects:

$$Y_{(t)} = A_{(t)} K_{(t)}^{1-b} L_{(t)}^{b}$$

By converting all equation terms to logarithms, the level of impact of each independent variable of the growth of the digital ecosystem was estimated:

$$\log (GDP_{it}) = a_1 \log (K_{it}) + a_2 \log (L_{it}) + a_3 \log (A_{it}) + \varepsilon_{it}$$

Where:

$K_{(t)}$ measures the level of fixed capital formation
$L_{(t)}$ measures labour force
$A_{(t)}$ measures the CAF Digital Ecosystem Development Index

In this model, since both the dependent and independent variables are indices, the analysis is essentially correlational. In that sense, from a policy standpoint, if regulation improves in a given country, the digital ecosystem is expected to grow as well. The reverse causality hurdle is partly addressed by measuring how the rate of change in the ICT Regulatory Tracker affects the rate of development of the digital ecosystem.

Economic impact of policy and regulatory framework on the growth of markets for digital service

[22] Telecommunications services provide value insofar that they allow consumer access to the Internet.

The analysis of the economic impact of policy and regulatory framework on the growth of markets for digital service relies on the ITU ICT Regulatory Tracker as the independent variable to test its impact on the CAF Digital Ecosystem Development Index. For this purpose, two models were developed initially: the first tests the correlation between the ICT Regulatory Tracker and the CAF Digital Ecosystem Development Index. The underlying premise is that higher regulatory performance is directly related to the development of the digital economy:

$$Dig.Index_{it} = \beta_1 Reg.Index_{it} + Year\ F.E. + Country\ F.E. + e_{it}$$

Beyond measuring the correlation between both variables, a model with lagged variables was developed. In this case, the specified model is as follows:

$$Dig.Index_{it} = \beta_1 Reg.Index_{it} + \beta_2 Reg.Index_{it-1} + Year\ F.E. + Country\ F.E. + e_{it}$$

Finally, the variables were converted to logarithms to test causality of change in values of both indices:

$$\ln (Dig.Index_{it}) = \beta_1 \ln (Dig.Index_{it}) + \beta_2 \ln (Dig.Index_{it-1}) + Year\ F.E. + Country\ F.E. + e_{it}$$

Furthermore, one cannot detect in this analysis a component of the ICT Regulatory Tracker that has higher importance than the rest when correlated with the CAF Digital Ecosystem Development Index and its pillars. It is clear that growth in the ICT Regulatory Tracker components go in tandem with an improvement in all pillars of the Digital Ecosystem. A second set of regressions showed that the regulatory regime component of the ICT Regulatory Tracker appears to be the main path of impact of the CAF Digital Ecosystem Development Index.
ICT Regulatory Tracker and CAF Digital Ecosystem Development Index pillars

TABLE: Colored with white lines

ICT Regulatory Tracker	ICT Regulatory Tracker (w/o Competition component)	Regulatory authority component	Regulatory mandate component	Regulatory regime component	Competition framework		
CAF Digital Ecosystem Development Index	Infrastructure of Digital Services	Connectivity of Digital Services	Household digitization	Digitization of production	Digital Competitive Intensity	Development of Digital Industries	Digital factors of production

Acronyms

AI	Artificial Intelligence
AR	Augmented Reality
APRU	Average Revenue Per User
BDT	Telecommunication Development Bureau
BRIC	Brazil, Russia, India and China (ITU)
CAF	Corporación Andina de Fomento
CEPAL	Commission économique pour l'Amérique latine et les Caraïbes
CIS	Commonwealth of Independent States
FTTH	Fibre to the Home
FTTx	Fibre to the x
GDP	Gross Domestic Product
HHI	Herfindahl Hirschman Index
ICT	Information and Communication Technology
IMF	International Monetary Fund
IoT	Internet of Things
ITU	International Telecommunication Union
M2M	Machine-to-Machine
OECD	Organisation for Economic Co-operation and Development
OTT	Over The Top
PPP	Public-Private Partnership
R&D	Research and Development
RME	Regulatory and Market Environment Division
SMS	Short Message Service
USPTO	United States Patent and Trademark Office
UNCTAD	United Nations Conference on Trade and Development
UNESCO	United Nations Educational, Scientific and Cultural Organization
VR	Virtual Reality
WHO	World Health Organization

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ECONOMIC IMPACT OF COVID-19

ON DIGITAL INFRASTRUCTURE

Report of an Economic Experts Roundtable

organized by ITU

GSR-20 Discussion Paper

July 2020

Acknowledgements

The following report was prepared by Dr Raul Katz, Director of Business Strategy Research (Columbia Institute for Tele-Information) based on the input from participants in the Economic Experts Roundtable, organized by the International Telecommunication Union (ITU) on 26 June 2020, and from research carried out since the start of the COVID-19 pandemic.

ITU would like to thank Mayssaa Issa, Head, Research and Intelligence Practice (Delta Partners Group); Matt Yardley, Managing Partner (Analysys Mason); German Cufre, Global Head, Telecommunications, Media and Technology (International Finance Corporation); Shaun Collins, CEO (CCS Insight); Steve Brazier, President and CEO (Canalys); Paul Lam, Strategy Officer, Digital & Technology (Asian Infrastructure Investment Bank); Tim Kelly, Lead Digital Development Specialist (World Bank); Alison Gillwald, Executive Director (Research ICT Africa); Alexandra Rehak, Chief Analyst (OMDIA); Audrey Plonk, Head, Digital Economy Division (OECD); Rohan Samarajiva, Chairman (LIRNEasia); Guy Zibi, Managing Director (Xalam Analytics); and Jonathan Woetzel, Director (McKinsey Global Institute) and Senior Partner (McKinsey) for participating in the roundtable.

The roundtable was moderated by Tomas Lamanauskas, Special Advisor, Crisis Strategy (ITU) and Catalin Marinescu, Head, Strategy and Planning Division (ITU).

ECONOMIC IMPACT OF COVID-19 ON DIGITAL INFRASTRUCTURE

Report of an Economic Experts Roundtable organized by ITU

Executive summary

The views of the participants of the economic experts roundtable on the impact of COVID-19 on digital infrastructure can be synthesized as follows:

- While overall telecommunication networks have exhibited consistent resilience in the face of the changes in traffic,[1] accessible ultra-broadband technologies such as fibre-to-the-home (FTTH) appear to be better prepared to respond to spikes in broadband traffic. Countries with the largest deployments of accessible ultra-broadband have exhibited less slowdown in latency and download speed.[2]
- Wi-Fi capacity has been stressed by an 80 per cent increase in PC uploads to cloud computing platforms with additional peaks from video conference calls,[3], requiring additional spectrum to be assigned for unlicensed use.
- As is the case with the whole economy, the pandemic has had an almost immediate impact on the financial performance of digital infrastructure companies. The annual negative revenue impact on telecommunication operators could be up to 10 per cent, with some services requiring 18 to 24 months to return to pre-COVID-19 levels.[4] While media companies have been more significantly affected by the decline in advertising revenues as a result of the ensuing economic recession, Internet platforms have fared better in the economic downturn, which was implicitly reflected in different market capitalizations.
- The increase in traffic has resulted in an acceleration of capital expenditure (CAPEX) related to the expansion of capacity (i.e. operations and maintenance CAPEX). On the other hand, spending not related to an increase in capacity (i.e. network modernization) is being postponed, especially among emerging countries. While the top five African operators spent USD 5.5 to 6 billion in 2019, it was expected that this would drop to USD 4.5 to 5 billion in 2020. Most experts agreed that, in the light of financial pressure, new infrastructure models (e.g. passive, rural and RAN sharing) would become more prevalent to reduce cash outlays.
- Future sources of funding to fill the gap could emerge from some governments (if capable of fostering counter-cyclical measures) or development finance institutions. As an example, the International Finance Corporation (IFC) is deploying a USD 2 billion line of credit and seeking investment opportunities.

[1] Sinibaldi, G. (2020). *COVID-19 is revolutionizing digital communications and testing providers' reliability and ability to innovate*. Analysys Mason, April.
[2] Katz, R., Jung, J. and Callorda, F. (2020). *Can digitization mitigate COVID-19 damages? Evidence from developing countries*. SSRN.
[3] Gil, T. et al. (2020). *The new normal: holiday level Wi-Fi upload.*
[4] Delta Partners. (2020) *Outlook for telecom operators post COVID-19. Global telecom executives survey*. May, p. 8.

- Current conditions of the digital economy sector could lead to industry consolidation, particularly among low-cost telecommunication operators in the developing world[5], and the public cloud, satellite TV, and in-flight Internet access sectors.

The roundtable participants fully agreed on the capacity of digital infrastructure to enhance social and economic resilience in the face of the pandemic:

- While research on the contribution of digitization to mitigate the impact of pandemics is limited, emerging evidence is compelling about its positive effects. In the medium term (e.g. 2021), countries with top connectivity infrastructure could mitigate up to half of the negative economic impact.
- That being said, some factors exist that limit the capacity of digitization to improve social and economic resilience.
- First and foremost, the digital divide has been highlighted as a critical barrier to the mitigation value of digitization. In particular, population unserved or partially served by broadband cannot benefit from distance learning for children, telecommuting, access to e-commerce and healthcare information. Population coverage of 4G networks in Sub-Saharan Africa is 53 per cent and 78 per cent in Eastern Europe.[6] Beyond coverage, demand-side barriers (such as limited affordability and digital illiteracy) have become a critical barrier. Internet adoption in Latin America and the Caribbean is 70 per cent, 38 per cent in Sub-Saharan Africa, and even advanced economies still have some gaps (91 per cent in North America, and 86 per cent in Western Europe).[7]
- While large enterprises benefit from access to well-established digital solutions in place (collaboration tools, employee devices, cloud, VPN, etc.) and connectivity, this is not the case for a large portion of small and medium-sized enterprises (SMEs), particularly in developing countries. The use of the Internet for business purposes in Sub-Saharan Africa is as low as 7 per cent on average.[8]
- Furthermore, the benefits of digital infrastructure for dealing with the pandemic is limited to those industries that are well on their way to digital transformation, such as logistics.
- While supply chains have been fairly resilient with the help of digital technologies, the situation in developing countries is less positive.
- While governments have been very active in deploying policies aimed at improving the resilience of digital infrastructure (over 250 different regulatory responses have been identified around the world),[9] the current shock is calling into question some of the basic policy tenets of digitization development, most importantly in terms of how the digital divide needs to be tackled.

[5] Low-cost telecommunications operators, also called "budget operators, have highly streamlined operating models that enable them develop offers targeted for low income population.
[6] GSMA Intelligence.
[7] 2020 extrapolation from International Telecommunication Union 2019 data.
[8] Research ICT Africa (2020). *A demand side view of informality and financial inclusion* (February 27).
[9] OMDIA (2020). *Telecoms regulation COVID-19 Tracker*.

In order to increase the power of digitization to mitigate the pandemic disruption, the digital infrastructure sector needs to re-examine some of the digital sector basic fundamental premises that were held before COVID-19:

- It is crucial for governments to learn from these hard lessons and take concrete, actionable measures in the telecommunication sector to enable the private operators to provide universal access to quality digital infrastructure networks for all and support the development of a digital economy.
- Governments should take a much broader, holistic view of investment in high-speed broadband networks, considering the economic, social and environment/climate benefits and costs of investment.
- Regulatory frameworks may need to be adjusted to stimulate investment whilst maintaining a "sensible" level of competition, shifting from a "purist" to a "pragmatic" viewpoint on State aid regulations.
- It is paramount for governments in emerging markets to keep making progress on digital infrastructure regulation, particularly pertaining to shared infrastructure.
- The roundtable experts argued that COVID-19 could be a window of opportunity to drive digital transformation in sectors which have not promoted it in previous decades. Similar to the effect of SARS in China in 2003 which triggered the tremendous growth in e-commerce, new production modes would emerge. As a result, COVID-19 could become a catalyst for the adoption of digitization in sectors where it had not occurred before, especially in more business-oriented applications.

1. Introduction

The COVID-19 outbreak has led to revised growth forecasts for the global economy. Every aspect of our lives has been affected by the outbreak. Its impact on economic activity is extremely broad: from dramatically diminished consumer discretionary spending to a freeze on business activities including capital budgets, hiring, and a reduction in everything but essential operational expenses. Even so, it is clear that under the current conditions some businesses may become more critical to our lives and could face an increase in demand, such as in the case of the information and communication technology (ICT) industry.

During the global pandemic, digital technologies have become a critical enabler of connectivity facilitating the continuity of our regular lives and connecting people more than ever before. As cities and countries have been asking the population to stay at home, more people have turned to their computers and smartphones as a lifeline and tools to substitute their in-person activities online. Some of the habits may continue in the "new normal"- or at least until a long-term solution to the current challenges, such as a vaccine, is found. Hence, the need to access a reliable digital infrastructure has become increasingly important, and certain aspects of ICTs are critical in a period of isolation, such as increased ICT opportunities from telework, telemedicine, food delivery and logistics, online and contactless payments, remote learning and entertainment.

In line with this, the International Telecommunication Union (ITU) gathered leading ICT economic experts to exchange views on the latest research and analysis on: (a) the economic impact of COVID-19 on digital infrastructure; and (b) the contribution of the said infrastructure to building social and economic resilience in the context of the pandemic. In preparation for the roundtable, a survey was sent to the panellists, requesting them to share any relevant research they had carried out on the two topics. The roundtable was held on 24 June 2020[10].

The following paper provides a summary of the responses to the survey, along with their comments over the course of the roundtable and references to the research conducted to date. The findings and conclusions provide a concise and actionable report of potential initiatives within the digital economy space to increase social and economic resilience.

[10] ECONOMIC EXPERTS ROUNDTABLE "COVID-19 and the Digital Economy" was held on 24 June 2020. More information including the recording of the session is available at https://www.itu.int/en/ITU-D/Regulatory-Market/Pages/Events2020/EconomicRoundTable/home.aspx

1. The impact of COVID-19 on digital infrastructure

A primary motivation for assessing this issue was to understand how telecommunication networks have performed in the face of the pandemic-triggered lockdown. Along those lines, even if networks performed appropriately, could we identify any potential points of failure to be considered in future planning? Another concern that triggered the need to address the issue of impact on digital infrastructure was to understand whether the financial disruption caused by the pandemic was going to have an impact on the rate of deployment of advanced telecommunication technologies, such as 5G and FTTx. Would that impact countries differently? OECD countries have reached a 5G coverage of 34 per cent[11] while FTTx household penetration is at 34.61 per cent.[12] Would the potential curtailment of capital affect this development vector in advanced economies? On the other hand, 5G population coverage in emerging economies is embryonic (3.2 per cent in Latin America, 15.0 per cent in Asia-Pacific, 16.4 per cent in Eastern Europe, 15.4 per cent in the Arab States, and still at 0 per cent in Sub-Saharan Africa).[13] Similarly, in the case of FTTx, household penetration in the developing world is relatively low (12.3 per cent in Latin America, and 0.6 per cent in Sub-Saharan Africa).[14] In this context, would a slowdown in spending in the developing world accentuate the gap between advanced and emerging countries? And finally, would the impact on capital spending, particularly in developing economies, weaken the objective of achieving universal broadband coverage?

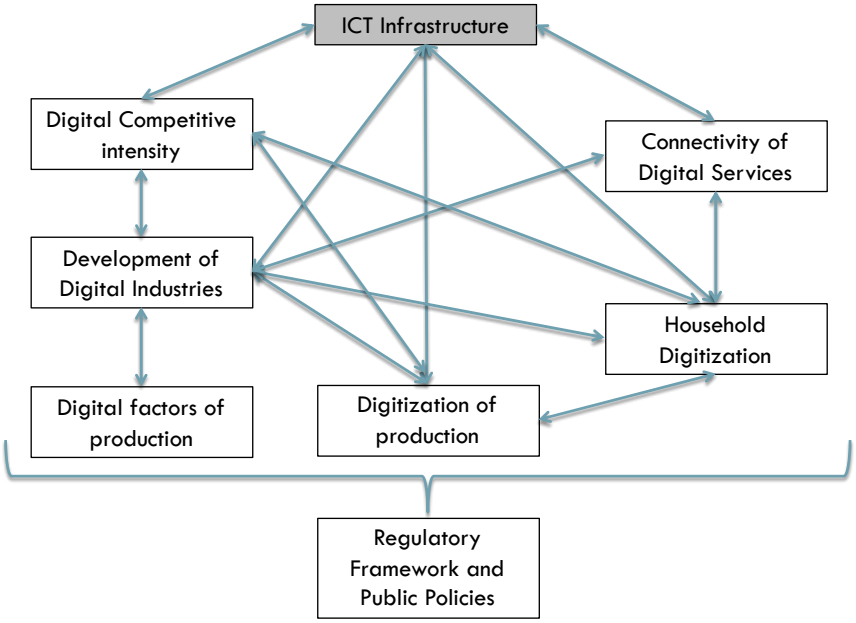
1.1. Impact on telecommunication networks

Digital infrastructure represents a critical component of a country's economy, facilitating the flow of goods, enabling exports, and ensuring the delivery of public services to the population. Telecommunication networks, the backbone of digital infrastructure, are structured around three components: a) international networks, which ensure a nation's connectivity with the rest of the world, b) domestic transmission backbones, which support the transport of signals between urban centres, and c) access networks, deployed to reach the "last mile" of telecommunication users. From a technology standpoint, international networks are supported by submarine cables, fibre-optic or microwave terrestrial networks, and satellite communications. Domestic transmission backbones are based on either fibre-optic, microwave, or satellite links. Access networks can rely on legacy technology (such as copper wires), or fibre-optic, cable modem links and wireless networks. Each technology has been evolving over time, based on successive waves of innovation, such as wireless "generations" (2G, 3G, 4G, and 5G).

Digital infrastructure is at the centre of an ecosystem called the digital economy. This ecosystem is composed of eight interconnected components (see Figure 1).

[11] Source: Prorated GSMA intelligence 5G coverage for 2020.
[12] Source: Prorated IDATE and other public sources of FTTx penetration for 2019.
[13] Source: Prorated GSMA intelligence 5G coverage for 2020.
[14] Source: Prorated IDATE and other public sources of FTTx penetration for 2019.

Figure 1. Structure of the digital economy



Source: Katz et al. (2018).

The infrastructure of digital services provides individuals, businesses and governments with access to digital content and services. It also supplies interconnectivity to players within the digital value chain (e.g. developers of digital content, Internet platforms, etc.) so that they can deliver a value proposition to users. If the infrastructure does not perform in response to social and economic demands, it has a negative impact on the whole digital ecosystem. This is the reason why it is critical to evaluate how telecommunication networks have performed in response to recent massive disruptions.

1.1.1. Impact of traffic changes on network performance

The gradual deployment of prophylactic measures taken to deal with COVID-19, such as the closure of workplaces and home quarantine, has led to a spike in telecommunication network usage. Overall, Internet traffic has increased by approximately 30 per cent. The transition to telecommuting has brought about a shift from enterprise to residential access. Traffic no longer comes primarily from central business districts, shifting instead to residential areas. Similarly, in response to the lockdown, a portion of data traffic has shifted from mobile to fixed/Wi-Fi networks. Daily traffic patterns have also changed. Contrary to the period prior to COVID-19, Internet traffic has started to surge in the morning at levels close to the evening peak, partly as a result of telecommuting, but also driven by sustained streaming usage.[15] Finally, mobile voice traffic has grown strongly, driven by an increase in both the number of calls and their duration.

Looking forward, some experts consider that the overall increase in traffic will become a fixture of the future. As one roundtable expert put it, "the likelihood is that once traffic reaches new levels, it won't go back, as binge TV watching, and home-based working become

[15] Reynolds, M. (2020). *State of the Internet amid coronavirus pandemic*, S&P Global Ratings June 16, p. 2.

part of the 'new normal'". Table 1 provides some examples of the increase in traffic compiled from telecommunication operators and OTT platforms.

Table 1. Internet usage increase triggered by COVID-19 (examples)

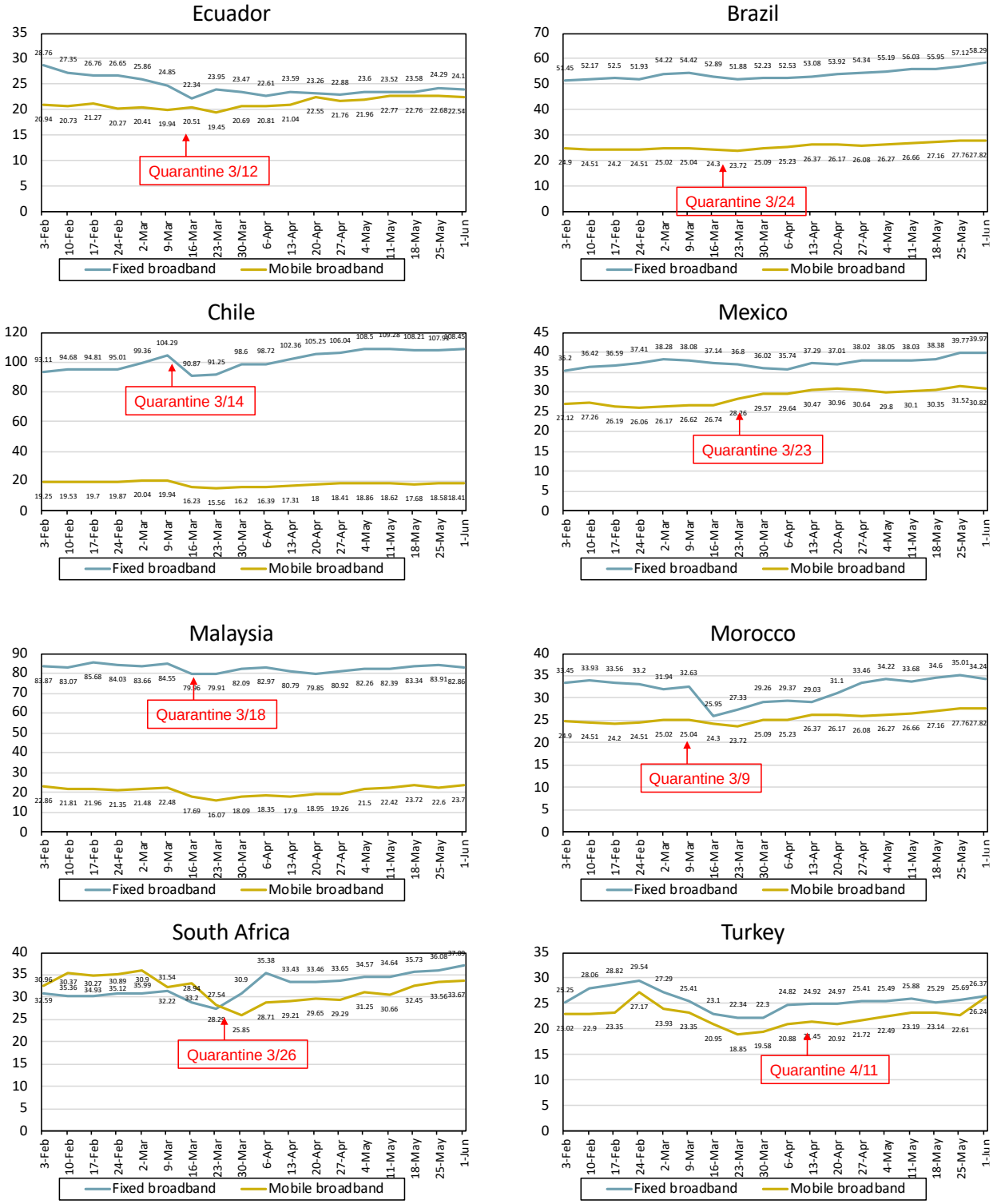
Area	Service provider	Area of usage percent increase	Source
Telecommunication traffic	AT&T (US)	Core network traffic (22%)	AT&T
	British Telecom (UK)	Fixed network traffic (60% on weekdays)	British Telecom
	Telecom Italia (Italy)	Internet traffic (70%)	Telecom Italia
	Vodafone	Mobile data traffic in Italy and Spain (30%)	Vodafone
Over The Top	Facebook	Facebook Messenger (50%)	Facebook
		WhatsApp (Overall: 50%; Spain: 76%)	WhatsApp
		Video calling (100%)	Facebook
	Netflix	Subscriber base (9.6% or 16 million)	Netflix
	E-commerce (Mexico)	Number of Users (8%)	Competitive Intelligence
Video conferen.	Zoom	Daily usage (300%)	JP Morgan
	Cisco Webex	Subscribers (33%)	Cisco
	Teams (Italy)	Monthly users (775%)	Microsoft

Source: Analysys Mason (2020).

The above reported increases in usage have led, consequently, to a temporary erosion of certain network quality indices. According to Ookla/Speedtest, the average Internet speed and latency indices of several countries have changed dramatically since the beginning of February 2020.

On the other hand, the lockdown measures triggered by the spread of COVID-19 did not affect all countries and regions in a uniform fashion or at the same time. To start with, the worldwide rate of contagion had an impact on the time at which national lockdowns were put in place. For example, the lockdown in China was implemented on 2 February 2020, while the quarantine in Europe and the United States started in mid-March 2020. In addition, countries did not follow a uniform lockdown pattern. Some countries adopted strict quarantine, affecting schools, workplaces, retailers and the like in a uniform fashion throughout their territories. Other countries imposed lockdowns in selected regions and/or states. In some countries where quarantine was imposed nationwide, the implementation of measures was gradual. Finally, there were some cases where lockdowns were not enforced (e.g. Sweden, Kenya). Different lockdown models have had varying impacts on the performance of networks: uniform national lockdowns caused a decline in broadband speeds and an increase in latency, while gradual measures have had less noticeable effect. Graphic 1 presents some selected examples across developing countries.

Graphic 1. Internet speed in selected countries (February-June 2020)



Source: Katz, R., Jung, J. and Callorda, F. (2020). Can digitization mitigate COVID-19 damages? Evidence from developing countries. SSRN. from Ookla/Speedtest.

The data presented in Graphic 1 show decreases in broadband speed during March and April 2020, likely reflecting peaks in Internet access combined with changes in behaviour and traffic flow as, for instance, more people began to work from home. This is particularly evident in the case of fixed broadband in all reported cases, although with more intensity in Ecuador,

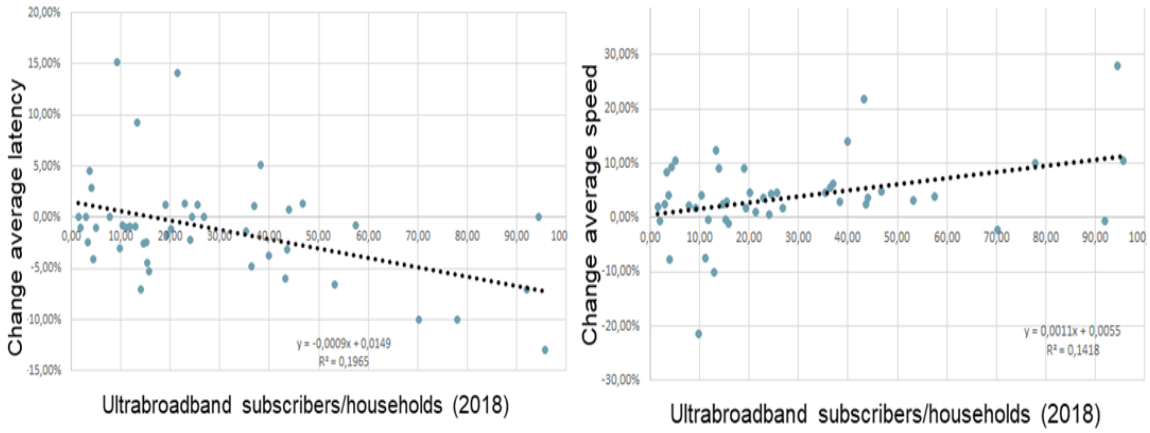
Chile, Morocco, South Africa and Turkey. In the case of mobile broadband, significant variations were identified in Morocco, South Africa and Turkey.

1.1.2. Network resilience and potential "pain" points

As has been reported by many analysts, most telecommunication operators have been able to cope with the surge in demand with limited disruption. The surge has not affected the overall Internet, particularly in advanced economies, where there are different possible routing paths and networks to rely upon. Since the telecommunication, cable and fibre-only companies that run the Internet backbone keep 50 per cent of available capacity all the time, this means that, in the aggregate, capacity was able to handle increased traffic. Furthermore, while caught off guard in the initial stage of the lockdown, service providers put in place a number of fixes and practices to accommodate the surge. For example, consumers were encouraged to enable Wi-Fi calling on their devices to reduce cellular traffic. Some operators opened up their public Wi-Fi hot spots to all of their customers. Others offered free calls for elderly users, fixed voice bill caps, as well as prioritized calling to emergency numbers.[16]

In addition, some digital infrastructure was better able to handle the increase in traffic. Countries that had a higher level of ultra-fast broadband infrastructure deployed (for example, those with higher penetration of optical fibre) have appeared to handle the increase in traffic better. Correlations shown in Graphic 2 provide evidence that the higher the ultra-broadband penetration in a given country, the less the increase in latency and the decline in download speed from the levels before the pandemic.

Graphic 2. Impact of COVID-19 induced traffic increase on latency and speed (changes from November 2019 – January 2020 and March 2020)



Source: Katz, R., Jung, J. and Callorda, F. (2020). Can digitization mitigate COVID-19 damages? Evidence from developing countries. SSRN.

On the other hand, traffic surges and the changes in patterns have highlighted potential network pain points. One of the most immediate effects of the pandemic has been the shutting of offices, schools, and factories to prevent contagion, which in turn has led to a dramatic increase in telecommuting, and consequently, in data traffic from households. One of the network pain points is the broadband uplink. Enterprise traffic is less asymmetric than consumer traffic. Useable frequencies in coaxial cables are a scarce resource (particularly

[16] Sinibaldi, G. (2020). *COVID-19 is revolutionizing digital communications and testing providers' reliability and ability to innovate*. Analysys Mason, April.

under legacy standards) and are allocated according to typical current traffic rather than to increased need.[17]

This natural increase in the number of devices using video conferencing and cloud computing platforms now connected at home has created a bottleneck in Wi-Fi routers that operate on non-licensed spectrum. Based on traffic measurement statistics, this technology has experienced peaks as a result of increased telecommuting (see Graphic 3).

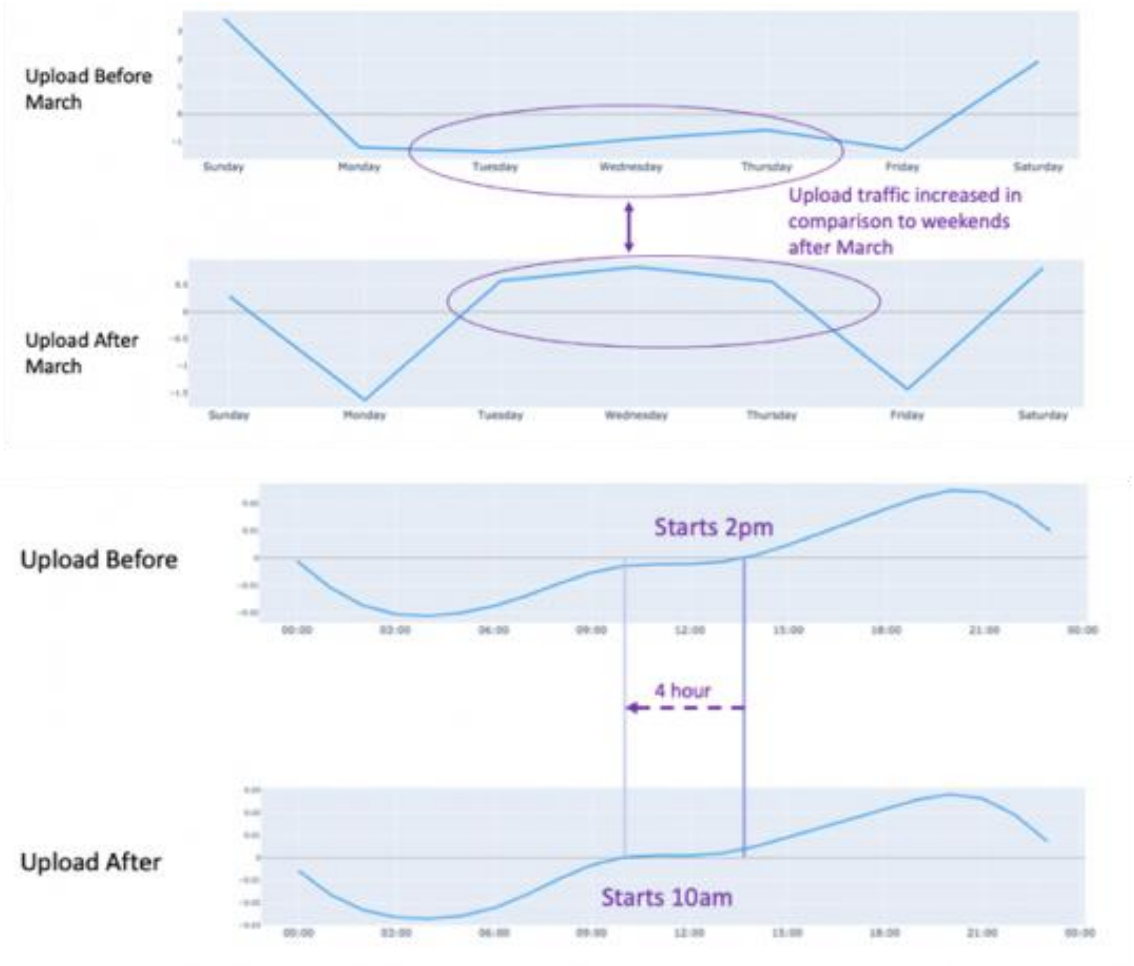
Graphic 3. Global Wi-Fi traffic growth (December 2019 – April 2020)

Source: Gil, T. et al. (2020). The new normal: holiday level Wi-Fi upload.

As depicted in Graphic 3, data collected from 125 million Wi-Fi routers around the world have shown an 80 per cent increase in PC uploads to cloud computing platforms with additional peaks from videoconference calls since the end of March. In addition, a change in usage patterns has caused an increase in router traffic. The traditional weekday-weekend and time-of-day usage patterns have shifted. With videoconferencing happening from home during the week, what used to be weekend traffic profiles are now occurring throughout the week. We have also seen a 4-hour earlier start to peak upload traffic patterns during the day (see Graphic 4).

[17] Wood, R. (2020*). COVID-19: operators should be concerned about the robustness of networks rather than capacity*. Analysys Mason (March), p. 2.

Graphic 4. Wi-Fi upstreaming behaviour



Source: Gil, T. (2020). The new normal: holiday level Wi-Fi upload.

This increase has contributed to the saturation of unlicensed spectrum bands (generally 2.4 GHz and 5 GHz). According to Assia, a Wi-Fi system company,[18] interference on the 2.4 GHz band was already high before the March lockdown but has since jumped by another 10 per cent. Even more remarkable is that interference on the 5 GHz band is up by 30 per cent since the start of the lockdown.

1.1.3. The future of networks

There is universal consensus that, despite the initial impact, fixed and mobile broadband networks and the Internet backbone have shown a high level of resilience in the face of the COVID-19 disruption. Looking forward, however, it is critical to examine some potential points of failure to be addressed in the future. As shown below, when examining consumer demand, some of the current traffic patterns will become permanent as telecommuting persists. Under these conditions, this most probably means that the home broadband connectivity and remote computing systems will remain ever more critical in terms of speed, latency, security,

[18] Gil, T. (2020). *The new normal: holiday level Wi-Fi upload.*

reliability and cost.[19] Researchers expect demand for quality home broadband to be more important than ever. One possible effect could be a deceleration in the churn on traditional wireline voice services for those looking for a more reliable work-from-home solution if they have wireless coverage or broadband issues.[20]

From an industrial standpoint, wireline carriers with substantial fibre-optic deployment will benefit, while service providers with a significant copper/DSL base will lose subscribers. With a change in traffic patterns, a reduction in traffic asymmetry will push for greater reliance on upstream capacity. This will also prompt some carriers to review their service levels and offers.

From a technology perspective, current spectrum assignment decisions to increase bands assigned to Wi-Fi (April voting by the FCC, ongoing consideration in Brazil, decision in the Republic of Korea) should have a significant effect in alleviating the household router bottleneck.

1.2. The impact on the digital economy

As expected, the economic recession has and will continue to exert an impact on the performance of industries comprising the digital economy. For the purposes of this analysis, we define the digital economy as composed of the firms providing digital goods and services, either for final or intermediate consumption.[21] The questions raised in the roundtable focused on issues of future financial performance and the consequent effect on capital spending, shedding some light on the differences between advanced and developing economies.

1.2.1. Financial performance

As is the case with the whole economy, the pandemic had an almost immediate impact on the financial performance of digital infrastructure companies. The intensity of the impact was more acute for telecommunication service providers than Internet platforms. Revenues of telecommunication operators in the first quarter of 2020 declined an average of 0.9 per cent for an average lockdown period of approximately 15 days. Consistent with the different lockdown patterns reviewed above, revenue declines varied by region, with the most important impact taking place in Europe. Revenue decline has been driven by a logical reduction in roaming due to travel restrictions plus a decline in equipment sales as a result of store closures and the postponement of in-premise customer installations. Revenue decline has been partially compensated by fixed line and B2B revenue driven by products and services required to support telecommuting workers.[22] It should be pointed out, however, that the above revenue forecasts were not uniform across all markets and all operators within a single

[19] Flannery, S. et al. (2020). *Global Technology: Can WFH Plays WFH (Work from Here*), Morgan Stanley. June 9.
[20] Flannery, S. (2020). *Mapping the new normal for telecom services and communications infrastructure,* Morgan Stanley. June 11, p. 3.
[21] See Ahmad, Nadim, and Jennifer Ribarsky, 2017, *Issue Paper on a Proposed Framework for a Satellite Account for Measuring the Digital Economy*, Presented at the 5th IMF Statistical Forum.
[22] Delta Partners (2020). *COVID-19's impact on telecom operators.* June.

market. For example, as reported by a roundtable expert, dominant operators in several African markets appeared to be performing fairly well under the current conditions.

Beyond telecommunications, the digital media sector was immediately affected by COVID-19, especially in out-of-the-home content consumption due to social distancing and mandated closures of live events and cinemas. As expected, television viewing has skyrocketed. Even as content preference changed, the average consumer in North America watched seven hours of television daily, up one hour from the pre-pandemic period.[23] Furthermore, despite economic concerns, consumers have been adding more streaming subscription services, beyond the usual Netflix.[24] PayTV operators have been offering free and low-cost Internet packages to qualifying households. A recent study by CTAM found that 7 per cent of households in the United States had signed up for broadband in the two months since the crisis began, and 17 per cent of those did not have Internet at home at all before.[25]

The forward-looking view of the financial impact on digital economy companies is more uncertain. Of the 29 major telecommunication carriers monitored by Delta Partners, 14 have suspended guidance. Underlining the uncertainty, there has been no consensus among economic experts on the future financial impact. One roundtable expert estimated that the ongoing extension of lockdown in the second quarter of 2020 will yield a revenue decline between 2 and 4 per cent.[26] Another researcher forecasted a decline in the range of 4 per cent (or USD 51 billion) for the whole year compared to 2019. Telecommunication executives believe the annual revenue impact could be as much as 10 per cent, with some services (e.g. international roaming revenue) requiring 18 to 24 months to return to pre-COVID-19 levels.[27] Some of the revenue decline would be compensated by increased broadband usage by enterprises. With social distance persisting, companies would continue to migrate to low-touch models of interaction.

As reported by one expert, the decline in revenues, combined with an increase in bad debt and increased marketing costs has resulted in a negative EBITDA impact of -2.1 per cent in the first quarter of 2020. Again, the larger decline took place in Europe (BT: -4.7 per cent, Telia: -1.3 per cent, Telefonica: -0.8 per cent) and the United States (AT&T: -2.9 per cent). As stated by one roundtable expert, increasingly there was an impact on the working capital requirements as all operators deferred payments, shifted to a cash conservation mode including a CAPEX freeze and sought to refinance maturities of debt becoming due in the next 12 months. Finally, another roundtable expert estimated that a dramatic slowdown in sector performance would materialize in 2021, especially in the developing world, since by then the larger economic crisis would have percolated through telecommunications.

[23] Williams, J. (2020). *TV, streaming models may be permanently changed by COVID-19*, S&P Global Ratings June 9, p. 2.
[24] Reynolds, M. (2020). *State of the Internet amid coronavirus pandemic*, S&P Global Ratings June 16, p. 2.
[25] Williams, J. (2020). *TV, streaming models may be permanently changed by COVID-19*, S&P Global Ratings June 9, p. 2.
[26] Delta Partners. (2020) *COVID-19's impact on telecom operators. Assessment of Q1 results announcements from global listed telecom operators*. June, p. 13.
[27] Delta Partners. (2020) *Outlook for telecom operators post COVID-19. Global telecom executives survey*. May, p. 8.

Media companies were also highly affected by the decline in advertising revenues as a result of the ensuing economic recession. As in the case of telecommunications, these players have taken action to preserve and increase cash balances, through either issuance of debt or drawing down of revolving credit facilities, as well as implementing cost-cutting measures.[28]

Finally, roundtable experts pointed out that, because of lower dependence on infrastructure spending, Internet platforms (or "Over The Top" providers) would generally be faring better than network operators during the economic downturn, a trend which was implicitly reflected in different market capitalizations.

1.2.2. Capital spending

The capital investment of a telecommunication service provider is composed of (i) an amount targeted for network modernization (such as 5G or FTTH deployment) and (ii) other non-discretionary expenditures (i.e. investments that cannot be eliminated since they have an impact on the ongoing quality of service). Non-discretionary capital expenditures include the replacement of legacy network equipment (such as a 3G base station) or the so-called "surgical" deployment of infrastructure aimed at addressing sudden non-forecast peaks in traffic. These non-discretionary components are generally labelled "maintenance CAPEX". When facing a big technological modernization wave such as the deployment of 5G, telecommunication carriers begin gradually reducing their maintenance CAPEX and transferring investment capital to the deployment of new networks. In the case where modernization takes place within high-capital efficient technology areas, the transition can be achieved within the ongoing CAPEX load, avoiding any increase. On the other hand, if the transition requires a higher rate of innovation, CAPEX will increase in relation to the sum assigned in previous years. As expected, innovation investment will yield efficiencies on the operating side.

The increase in traffic reported in Graphic 1 has resulted in an acceleration of CAPEX related to the expansion of capacity (i.e. maintenance CAPEX). Consequently, spending not related to an increase in capacity (i.e. network modernization) was partially postponed, especially in Europe.

[28] Sarma, N. and Lynch, N. (2020). *Pandemic and recession deal blows to credit metrics of US Media and Entertainment Industry*, S&P Global Ratings. June 19, p. 5.

Table 2. CAPEX priorities as announced by selected carriers

During COVID	Future plans
• Telefonica: FTTx, capacity upgrades, network virtualization, improvement of customer experience	• BT: FTTP and 5G within five-year programme
• TIM: IT, 4G, transport network (95%) and FTTH (15%)	• ETISALAT: 5G, data centres and capacity upgrade
• Vodafone: capacity upgrade and Gbit/s network infrastructure	• MTN: resilience and capacity of networks
• Ooredoo: network upgrades and maintenance, IT transformation programme	• KPN: FTTH and mobile network modernization

Source: Delta Partners. COVID-19's impact on telecom operators. Assessment of Q1 results announcements from global listed telecom operators.

Underlining the financial uncertainty, the forward-looking view on capital spending as discussed in the economic experts roundtable was somewhat mixed. First and foremost, the long-term outlook in CAPEX was contingent upon the speed of recovery. Secondly, most experts agreed that, in the light of financial pressure, new infrastructure models (e.g. passive, rural and RAN sharing) would become more prevalent to reduce cash outlays.

In addition, roundtable experts held similar views regarding the future evolution of overall CAPEX. The most dramatic view forecasted that the revenue decrease would trigger cash conservation modes, including CAPEX freezes or some 5G reduction (driven in part by supply change delays, or launch postponement).[29] A second position estimated that a shift to investment in network capacity and resilience would occur, with a consequent delay in 5G deployment. A third position considered that investment in network modernization would be primarily focused on urban environments, postponing deployment of new technology in suburban and/or rural areas.

Another dimension affecting the overall capacity of infrastructure players to invest concerns Internet platforms that have been relatively unaffected by the stock market and enjoy a continuing capacity to invest in deploying infrastructure, either in submarine cables (see Facebook and Google deployment) or last-mile networks in developing countries.

All experts agreed that future capital spending would vary by geographical area. On the question of investment in 5G, service providers in countries with relatively advanced 5G deployment (e.g. operators in advanced economies) would continue with their plans, while operators in nations with embryonic deployment (e.g. developing countries) would slow down 5G investment. For those carriers pursuing 5G roll-out, investment in network modernization would be primarily focused on urban environments, postponing deployment of new technology in suburban and/or rural areas. The low ARPUs in developing countries would force telecommunication operators to postpone capital spending in 5G. As an example,

[29] The delays in 5G roll-out could also be the result of: disruption to network equipment vendors' global supply chains; reduced capacity for equipment manufacturing, delivery and commissioning; delays to 3GPP Release 16 Stage 2 and Release 17 standards that could impact 5G uptake for the next several years; and spectrum licensing put on hold or at least postponed in many countries until the crisis begins to recede.

a roundtable expert mentioned that the top five African operators spent USD 5.5 to 6 billion in 2019 while it was expected that this would drop to USD 4.5 to 5 billion for 2020. As mentioned by one expert: "The reduction of telecommunications capital spending as a result of the COVID-19 induced economic downturn will have a negative impact on the rate of network expansion, particularly in rural areas." In addition, some experts considered that "delayed deployment of 5G and extended high-speed and fibre networks in many countries means a longer period before businesses and consumers in these markets get access to higher speeds and advanced services. This could actually worsen the impact of the economic downturn".

On the positive side, an expert considered that some slowing of 5G deployments may not all be bad news for the broader ecosystem: "Any slowdown could allow operators more time to rectify issues that were not fully resolved in the rush to deploy commercial 5G services. This includes work on optimizing 5G NR performance, improving the fallback experience in dual-connectivity mode, and addressing device-related issues, such as the effects of overheating in smartphones".[30] Interestingly enough, COVID-19 might trigger a shift in where operators re-focus their use cases. For example, reduced interest in areas such as targeted coverage for large venues like sports and concerts could be replaced by a greater focus on the wider support for low-latency applications, such as the use of robotics in health care and edge computing.

1.2.3. Future sources of funding

A related question on the future trend in capital spending is whether other sources of funding would be available to fill potential gaps. Some experts pointed out the need for public counter-cyclical spending (Singapore or Korea Digital Deal), arguing for the need to call for governments to take a more proactive role in providing funds to address the digital divide. Yet, while most roundtable participants agreed with the need to tackle unserved populations, some mentioned that since the telecommunication industry had been substantially less affected compared to other sectors (e.g. airlines, travel and lodging, etc.), public funds would not be expected to flow to the digital sector. Furthermore, while other experts agreed with the need for counter-cyclical interventions, they raised the question as to whether developing country governments would have the cash to fund the digital divide initiative. In particular, many highly indebted African States would not be able to fund infrastructure investments.

Beyond the public sector, many experts pointed to the role that could be played by development finance institutions (World Bank/International Finance Corporation (WB/IFC)), Inter-American Development Bank (IDB), Asian Infrastructure Investment Bank (AIIB)) as spending gap fillers. This is supported by recent moves from the IFC that has been deploying a USD 2 billion line of credit and seeking investment opportunities. From a somewhat complementary perspective, some experts argued that rather than providing public funds, governments could alleviate the shortfall by providing incentives that would allow the private sector (i.e. telecommunication carriers) to continue to invest, either in addressing the digital divide or deploying advanced technologies (5G and FTTx). This could include alleviating the taxation burden or re-examining spectrum auction rules.

[30] OMDIA (2020). *COVID-19 Market impact: Service Provider Markets*, May.

Finally, there was uncertainty as to whether public capital markets and/or private equity could play a role in this circumstance.

1.2.4. Impact on industry structure

Given the potential impact of the recession on the telecommunication sector, some experts raised the issue of whether this could have an effect on industry structure. Some consensus emerged in terms of the potential for consolidation, although views diverged as to which players would be acquired as a result of financial difficulties. Recent bankruptcy filings (OneWeb, Intelsat, Frontier and Windstream) could pre-announce a wave of industry consolidation.

This view was not universally shared by roundtable experts. For example, while some new entrants may struggle in the short term for cash, their financial backers, which are increasingly infrastructure funds, would help them through it. Along those lines, some of those investors' traditional sectors (toll roads, airports, etc.) are less resilient to COVID-19-like shocks, so funders might redirect a greater share of their funds towards digital over the longer term, to mitigate similar future events. An additional counterpoint to the impending sector consolidation is the argument that network sharing agreements could alleviate the cash crunch and become a mitigant to acquisition threat.

One expert pointed to the industry exit by low-cost carriers in developing countries. These budget telecommunication operators originally entered the market with offers particularly targeted to low-income populations. Their business model could become stressed by the reduction in consumer spending. Another expert considered that new telecommunication entrants that were not adequately backed by strong investors would be acquired.

Beyond telecommunications, consolidation was also mentioned as a possibility in cloud services, satellite TV, and in-flight Internet access.[31]

The changes in industry structure were considered to be a risk to the ability of the sector to increase social and economic resilience. For example, industry concentration could result in a limit for the sector on deploying technology in lower income areas. Another risk could derive from the extreme concentration of public cloud service providers. As explained by one roundtable expert, the pandemic has accelerated the adoption of the public cloud, with services (outside China) dominated by Amazon Web Services, Microsoft Azure and Google Cloud. This could potentially lead to a situation where cloud providers become "too big to fail", and the need for government protection in case of a financial or technical failure. Furthermore, the replacement of on-premise computing with the public cloud means a shift from local/national companies to global multinational corporations (MNCs). This has consequences for how much local tax is collected, and where well-paid jobs are created. In this context, as stated by a roundtable expert, "contrary to what occurs in the case of

[31] Flannery, S., Park, L., Lam, L. Roper, A., and Barajas, D. (2020). *Mapping the new normal for telecom services & communications infrastructure*. Morgan Stanley (June 11), p. 6.

telecommunication networks, the global public cloud providers are regulated in a relatively low ‘light-touch’ way”.

2. Does digital infrastructure increase social and economic resilience?

The second topic addressed in the roundtable of economic experts focused on the contribution of digital infrastructure to social and economic resilience in the face of the pandemic. For analytical purposes, we define socio-economic resilience as the ability of a society to overcome crucial challenges such as wars or pandemics and return to normalcy, thereby providing a path for future development. In the words of a roundtable expert, after medical treatment, the next most important and critical infrastructure during the COVID-19 pandemic was telecommunications. Two key issues prompted the need to address this topic: if digital infrastructure was a key contributor to social and economic resilience, were developing economies less prepared than advanced nations to face the consequences of the pandemic? Furthermore, with a high rate of digital divide in developing countries, was the obligated reliance on ICT reinforcing social exclusion and inequality? In this context, the roundtable focused first on social resilience, highlighting the challenges of the digital divide. It also focused on economic resilience, summarizing the research evidence on the capability of digital infrastructure to support the production and distribution of goods and services. As background information, we begin by highlighting any existing research on the contribution of digital infrastructure to building socio-economic resilience in the face of pandemics.

2.1. State of research regarding the contribution of digital infrastructure to resilience in the face of pandemics

Following the initial wave of the fear of contagion and the implementation of prophylactic measures, anecdotal evidence immediately emerged, suggesting that digital technologies could contribute to counteracting the isolation implied by social distancing measures, increasing the awareness of virus prevention measures, and allowing economic systems to continue to operate, at least partially. The exponential increase in Internet traffic (analysed in Chapter 2), the reliance on telecommuting, and the need to maintain high-performing supply and distribution chains support this claim. In this context, we inquired about the existence of research testing the link between highly developed digital ecosystems and country preparedness in the face of pandemics: the short answer is that research on this topic is still limited. When asked in the survey, experts generally referred to prior studies on broadband economic impact, digital use case impact research, and descriptive analyses of issues such as the impact on telecommuting or online learning.

However, the following was identified in terms of relevant research on this topic:

- A study of digitization as a mitigation factor of SARS-CoV.[32] This study was based on a multivariate regression model of a panel of 170 countries' data of a production function combined with broadband penetration and a dummy variable for SARS CoV impact. Results indicated that countries with the largest broadband infrastructure had the ability to offset, at least partially, the negative effects of the pandemic.

[32] Katz, R., Jung, J. and Callorda, F. (2020). *Facing the COVID-19 pandemic: digitization and economic resilience in Latin America.* CAF Development Bank for Latin America, April.

- An analysis of the relationship between the digitization of production index and GDP downward adjustment from COVID-19.[33] This analysis presented a correlation between the IMF GDP downward adjustments and an index of digitization of production. The correlations indicated that while digitization had no apparent impact on a country's ability to mitigate the recession in 2020, countries with higher digitization of their economy tended to be associated with a smaller downward GDP adjustment in 2021, as forecast by the IMF.
- Preliminary analysis (Katz et al., in process), based on ordinary least squares of a panel regressing GDP impact (including a 2021 IMF forecast), of the relationship between fixed broadband penetration, fixed capital, labour and per capita spending on health care, and the number of COVID deaths per 1 000 000. The results indicated that within the top connectivity countries, more than half of the long-term negative economic impact could be reduced by digital infrastructure.

2.2. Limits to the capacity of digital infrastructure to increase resilience in the face of pandemics

Having established, at least partially, the contribution of digital infrastructure to the mitigation of some of the pandemic effects, it was pertinent to understand if there were any potential limits to digitization's positive contribution. All roundtable experts agreed that the primary limitation was the digital divide, with the consequent impact on the reduction in the capacity to telework, and for students to rely on distance learning. Research in both areas is quite conclusive in confirming this perspective. In addition, barriers could exist in other areas as well, such as the slow digitization of production and institutional failures in the implementation of upgrades to ICT capacity vis-à-vis the pandemic.

2.2.1. The impact of the digital divide

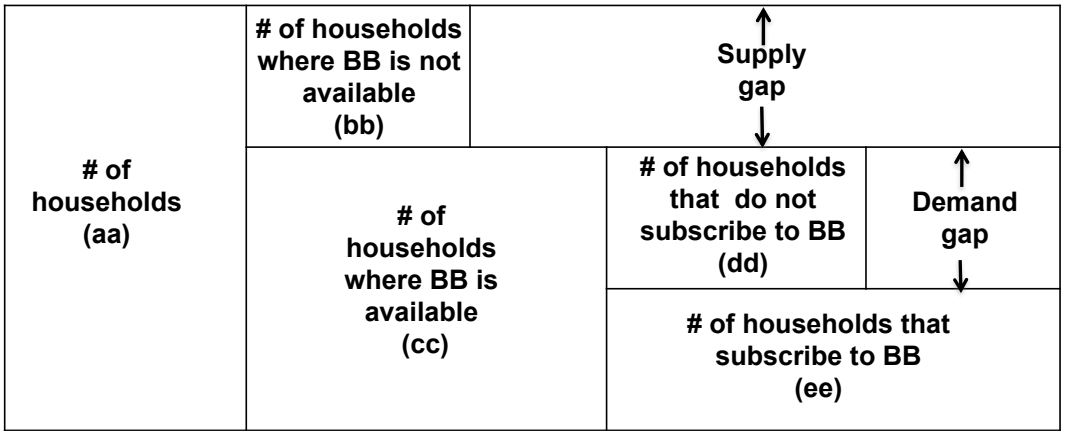
The digital divide within all nations and between advanced and developing economies has been further exposed by the pandemic. As stated by all roundtable experts, the gaps in reach and quality of digital connectivity as well as in Internet literacy would be a determining factor in the development of countries going forward. In the words of a roundtable expert "digitization is currently a mitigant of the pandemic-induced disruption for only a very small elite in Africa". Internet usage in the continent, though increasing is generally low: 50 per cent for South Africa was the highest, with Nigeria and Kenya - around 30 per cent, and some countries - 10 per cent.[34] This view was similar to a perspective from an expert located in Asia: "If you are not online, then you are missing out on everything - both normal livelihood and work. The government's responsive policies are also assuming the online economy works for everyone."

The debate about the digital divide in Internet use and broadband has largely revolved around the statistics on households that own a computer and have adopted broadband. Thus, political discussion and public opinion have been around the need to increase take-up by expanding telecommunication network coverage. The underlying premise is that the digital

[33] Katz, R., Jung, J. and Callorda, F. (2020). *Can digitization mitigate COVID-19 damages? Evidence from developing countries.* SSRN.
[34] Research ICT Africa (2018). *After Access survey*.

divide would be narrowed if the issues holding up infrastructure investment were resolved. Without denying that there is some causal relationship between investment and the divide, it is important to stress that one of the fundamental variables accounting for digital exclusion lies on the demand side rather than the supply side. While the supply gap measures the portion of the population of a given country that cannot access broadband because of lack of service, the demand gap focuses on the potential users that could buy broadband service (since operators offer it in their territory, either through fixed or wireless networks) but do not do so (see Figure 2).

Figure 2. Relationship between broadband supply and demand gap



Source: Katz and Berry (2014). Driving demand of broadband networks and services. London: Springer.

According to Figure 2, the supply gap is defined by the number of households where either fixed or mobile broadband are not available (bb), while the demand gap is measured by the non-subscribing households of those where broadband is available (dd). Accordingly, the concept of digital divide is the sum of both groups (bb + dd). While policy discussion has been intense regarding the need for providing universal coverage (and therefore, eliminating the supply gap), the demand gap has not benefited from an equal level of attention. COVID-19 has brought this issue to the forefront.

The constraints on the ability of digital infrastructure to enhance social and economic resilience have to do with both the supply (coverage) and demand (affordability and digital literacy) gaps. Research can already provide an indication of the supply and demand gaps as limits to the impact of digital infrastructure on fostering socio-economic resilience in the face of the pandemic. This highlights the importance of integrated supply and demand side measures in addressing this inequality. Although many countries have over 90 per cent broadband coverage (3G), they have less than 25 per cent Internet penetration. The barrier to Internet access also includes the cost of devices and service, digital illiteracy and lack of appropriate content.[35]

The digital divide as a limit to distance learning

[35] Katz, R. and Berry, T. (2014). *Driving demand of broadband networks and services*. London: Springer.

Countries' lockdown and school closures have resulted in students being compelled to attend classes via broadband access from home. In this context, a critical question is the potential social impact of this move to home schooling supported by access to technology. As stated by one roundtable expert: "As a high percentage of the world's students are out of formal classes at the moment, the availability of remote learning for some students, but not others will create new digital divides which will impact the future career paths of students, particularly those in school-leaving years. The main cause of this new digital divide is a lack of affordable bandwidth, particularly outside major cities. But a secondary cause is a lack of suitable devices for remote learning, and a need to share them between several members of a family." The impact is likely to be long term with the loss of six month's education having a knock-on effect on future schooling, although the effects would be regional, with some rural areas, in particular, or poor parts of cities, suffering more than others. In Kenya, for instance, all students will be obliged to repeat the 2020 school year, irrespective of whether they have participated in online learning.

The impact of home broadband access on student performance was an area of research that had garnered considerable attention already before the pandemic.[36] Among the more robust analyses, the following conclusions were drawn:

- Having a computer at home increased school enrolment by 1.4 percentage points, after socio-demographic controls.[37]
- Teenagers who have access to home computers are 6 to 8 percentage points more likely to graduate from high school than teenagers who do not have access, when controlling for socio-demographics.[38]
- High school students with home computer access have a strong positive relationship with academic performance.[39]
- However, in a quasi-experimental approach, no evidence on educational outcomes such as grades and test scores were identified in a grade 6-10 group in California.[40]
- One important study in North Carolina found mild negative effects between home computer and broadband access and maths and reading test scores using panel data and fixed effects, although the broadband access variable was not clearly defined in this study.[41]

[36] For survey of the research literature, see Bulman, G. and Fairlie, R. *Technology and Education: Computers, Software, and the Internet.* National Bureau of Economic Research Working Paper 22237, Cambridge, Massachusetts, 2016, retrieved from: http://www.nber.org/papers/w22237.
[37] Fairlie, Robert W. 2005. "The Effects of Home Computers on School Enrollment," *Economics of Education Review* 24(5): 533-547.
[38] Beltran, Daniel O., Kuntal K. Das, and Robert W. Fairlie. 2010. "Home Computers and Educational Outcomes: Evidence from the NLSY97 and CPS," *Economic Inquiry* 48(3): 771- 792.
[39] Ibid.
[40] Fairlie, Robert W., and Jonathan Robinson. 2013. "Experimental Evidence on the Effects of Home Computers on Academic Achievement among Schoolchildren," *American Economic Journal: Applied Economics* 5(3): 211-240.
[41] Vigdor, Jacob L., Helen F. Ladd, and Erika Martinez. 2014. "Scaling the Digital Divide: Home Computer Technology and Student Achievement," *Economic Inquiry*. 52(3): 1103–1119.

- Access to broadband among junior high school students increased their test scores, range of college applications and admissibility.[42]
- College graduation: Minority students are more likely to graduate from community college if they have access to a computer at home[43]

The critical fact in the research evidence presented above is that it was conducted under situations where classes were still delivered in schools. Under these conditions, home computer and broadband access represented a complement to the education received in class (the term used in the United States to quantify the students with no technology access was "homework gap"). Under lockdown conditions, the technology becomes the only link existing between the student and the teacher. In other words, the "homework gap" becomes the "school gap". One roundtable expert estimated that at least 1.5 billion students depend now on home schooling and distance learning. Along those lines, students with no computer and/or broadband access become forcibly excluded from attending school. In that regard, the statistics in an advanced economy such as the United States are quite alarming. The 2017 American Community Survey prepared by the U.S. Census Bureau estimates that 5 013 242 children under 18 years old reside in a household with a computer but no broadband subscription, while 2 036 753 children under 18 years old reside in a household without a computer. All in all, over 7 million students in the United States are affected by the "school gap" under pandemic-induced lockdown conditions. If this situation is that of an advanced economy with broadband adoption in excess of 85 per cent of households, it is fair to assume that the developing world is facing a much more serious situation.

The digital divide as a limit to telecommuting

When looking at the increase in Wi-Fi traffic and its impact on telecommunication networks, we alluded in Chapter 2 to the massive upsurge in telecommuting. Along these lines, it is also pertinent to examine teleworking's impact on the labour market and its social implications. What is the magnitude of the changes caused by the pandemic as measured by the number of workers who now work from home? Can we establish some perspective as to which sectors are most affected and which are least affected? In theory, knowledge workers (e.g., researchers and software developers) would adapt most easily to this new way of working. It is important to determine, then, the number of workers who – due to their occupations – cannot work from home. Four pieces of research have been issued since the outbreak of the pandemic and focus on estimating the portion of the labour force that could continue to work from home.

Relying on Chile's National Socio-economic Characterization Survey (CASEN) carried out by the Ministry of Social Development in 2017, Katz et al. (2020a)[44] assessed the likelihood of: a) occupations whose workers were likely to continue going to the workplace location (e.g.

[42] Dettling, L., Goodman, S. and Smith, J. (2012). *Every little bit counts: the impact of high-speed internet on the transition to college.* Finance and Economics Discussion Series 2015-108. Washington: Board of Governors of the Federal Reserve System, retrieved from: http://dx.doi.org/10.17016/FEDS.2015.1.
[43] This estimate is conservative since dropout rate is expected to be higher in rural counties than the national average.
[44] Katz, R., Jung, J. and Callorda, F. (2020). *Facing the COVID-19 pandemic: digitization and economic resilience in Latin America.* CAF Development Bank for Latin America, April.

essential workers), and b) occupations that could not rely on telecommuting (for example, a factory operator cannot continue working if staying at home).[45] Once completed, the probability analysis yielded the percentage of the workforce that could work from home, the percentage that were obliged to continue to go to their workplace, and the percentage that could not telework. Of the 7 830 958 total employed workers in Chile, 1 610 241 (20.6 per cent) were obliged to continue to go to their workplace (e.g., health personnel, security forces, food processing workers, etc.) because their occupations were considered to be essential. Based on lockdown rules, the remaining 6 220 717 workers (79.4 per cent) could not go to their workplace. Of these, 1 801 187 (28.9 per cent) could continue to work by telecommuting from home, while 4 419 530 (71.1 per cent) could not work remotely from home. In sum, under lockdown conditions of the 7 830 958 total workers in Chile, 56.4 per cent were either not allowed to go to work or could not continue to work by telecommuting.[46]

It is especially important to consider the social implications of these numbers. While some members of the workforce can continue to work under lockdown conditions, a large proportion of the total workforce face unemployment when the companies they work for cease operations, with each company choosing whether or not to continue paying its employees (as permitted by labour law). These social implications are even more serious when examining the number of affected workers with low education and/or low income. First, of the 1 801 187 workers who could telework, 1 234 063 (or 68.5 per cent) had higher education degrees and 1 322 528 (73.4 per cent) were in the 4th or 5th income quintiles. Second, of the 4 419 530 workers who could not go to the workplace and could not work remotely, 1 615 099 (36.5 per cent) had – at most – a basic level of education and 1 509 041 (or 34.1 per cent) fell within the 1st or 2nd income quintiles.

A similar analysis was conducted by Katz et al. (2020b)[47] for South Africa, relying on statistics from South Africa's Quarterly Labour Force Survey carried out by the Department of Statistics in the fourth quarter of 2019. In this case, of the 16 640 794 employed workers, under lockdown conditions, the remaining 13 503 278 workers (81.2 per cent) could not go to their workplace. Of these 13 503 278 workers, 3 500 786 (25.9 per cent) could continue to work by telecommuting from home. The remaining 10 002 492 workers (74.1 per cent) could not work remotely from home. In sum, of the 16 640 794 total workers in South Africa, 60.1 per cent were either not allowed to go to work or could not continue to work by telecommuting. The analysis by educational and inclusion levels within the formal sector indicates the disproportionate impact of disruption on the most vulnerable social groups. The percentage of people that remains employed was, as expected, much larger for highly educated people and for those workers associated with the formal sector. Of the 10 million workers (60 per cent of the workforce) that could not go to work or telecommute, 39 per cent were in the

[45] The probabilities for (a) were based on the official rules issued by governments for the so-called "essential" occupations, while the likelihood of (b) was based on the authors' understanding of work an occupation entails.

[46] This percentage is consistent with the estimate of Hevia & Neumeyer (2020) who calculated the number of affected employees per company based on PIAAC data. The authors estimated that 53 per cent of the workforce in Latin America could risk unemployment because they work for companies with five or fewer employees and with limited access to emergency funding.

[47] Katz, R., Jung, J. and Callorda, F. (2020). *Digitization: a resiliency plan for developing countries facing pandemics.* Presentation to the International Finance Corporation.

informal sector. In contrast, there were no big differences by gender in the percentage that stayed employed.

By applying the work-from-home classification from Occupational Information Network (O*NET) surveys to U.S. Bureau of Labor Statistics, Dingel et al., (2020) estimate that 37 per cent of jobs in the United States could rely on telecommuting. While the authors did not conduct an analysis by income or education, they estimated that over 45 per cent of jobs in San Francisco, San Jose, and Washington DC, three cities with a concentration of high-income population, could be done from home.[48]

Albrieu (2020) relies on Dingel et al. (2020) methodology and estimates that in the case of Argentina, according to an occupational analysis of the National Household Survey, between 27 per cent and 29 per cent of the labour force of 11.8 million could rely on telecommuting. However, an analysis of the effective use of ICT (availability of PCs and in-home broadband connectivity) among that base resulted in a reduction to 18 per cent. The social implications in this case were similar to the ones drawn for Chile and South Africa. Fifty per cent of jobs in the top income decile could be handled through teleworking, while that ratio drops to one in 10 in the lowest decile.[49]

Even after the COVID crisis passes, researchers do not expect a full return to the prior working and studying patterns. Flannery et al. (2020) estimate that, once the pandemic subsides, we will end up with some hybrid version of today (54 per cent working full/part time from home) and where we were prior to the crisis (27 per cent). Many more may continue to work from home several days a week, thus still needing the telecommuting infrastructure even if they do return to the office on a semi-regular basis.[50]

The digital divide as a limit to social resilience

Beyond the impact on distance education and telecommuting, the digital divide will exacerbate the disadvantage of unserved or non-digitally literate populations, limiting their access to payments and commerce (for the unbanked) or healthcare services and information (for the elderly, among others).

2.2.2. Digitization of production

Are there any limitations to the power of digital infrastructure to support the production side of the economy? Are large corporations better prepared to continue operating while SMEs face greater disruptions? What are the sectors that are better prepared in terms of their digital transformation? What about the ability of digital infrastructure to increase supply chain resilience in the face of the pandemic?

Digital resilience by size of establishment

[48] Dingel, J., Neiman, B. (2020). *How many jobs can be done at home?* Becker Friedman Institute for Economics at University of Chicago (April).
[49] Albrieu, R. (2020). *Evaluando las oportunidades y los limites del teletrabajo en Argentina en tiempos del COVID-19*. Buenos Aires: CIPPEC (April).
[50] Flannery, S., Park, L., Lam, L. Roper, A., and Barajas, D. (2020). *Mapping the new normal for telecom services & communications infrastructure*. Morgan Stanley (June 11).

Different views were presented with regard to the type of enterprises which would most likely be disrupted by the pandemic, when considering their level of digitization. One group of experts argued that large corporations have well-established digital solutions in place (collaboration tools, employee devices, cloud services, VPN, etc.), while being more resilient and financially stronger. Furthermore, SMEs would be more affected because of their concentration in the retail and hospitality sector, which is being severely impacted by closures and restrictions due to social distancing, and so on.

Another group considered that SMEs have the ability to move online quickly and adapt to the new environment. For example, most SMEs are more agile in changing their business models and adapting their online sales/channels. A roundtable expert stated that there are some indications that the informal sector and SMEs have been able to pivot more quickly to respond to changing demands, while large online companies have continued to do things in the same way without dealing with context-specific disruptions.

In the end, most experts agreed that the answer to this question would depend upon the sector. For example, a large manufacturing firm would still struggle due to lockdown restrictions impacting the production line, while any SMEs in their supply chain would also be negatively impacted. On the other hand, firms already in the digital economy space would find it easier to cope. In this sector, large global digital economy players remained fairly agile and able to adapt to the COVID-19-induced conditions.

Digital resilience by sector

Roundtable experts concurred with the view that as businesses, public sector bodies and ICT providers looked to address the changed environment, many industries accelerated digitalization and automation. This is true even in areas that had previously lagged behind, e.g., the healthcare sector which had been slow to adopt Internet-of-Things (IoT) solutions. For example, connected medical devices (both clinical and consumer grade) and e-health are seeing increased demand, due to the need for remote consultation and diagnoses; while in logistics and supply chain, connected solutions and asset tracking have enabled fast rerouting of supply chains to help fill gaps (for key goods, medicines and equipment), and support business resilience. Additionally, telecommunication service providers have been actively repurposing IoT solutions including infrared cameras, home alarm systems, and autonomous delivery vehicles and drones, for monitoring, public health announcements, disinfectant spraying and deliveries to affected areas. In some cases, the shift to digital is driven "bottom-up" by consumers, e.g. the adoption of connected thermometers by a broad base of consumers in the United States meant that temperature data points were being uploaded and shared at scale across the country and could be used to predict virus hotspots in advance.

In other sectors where digitization had been ongoing for a while, the pandemic has highlighted its value (e.g. for logistics and supply chain, where much greater agility is enabled through the use of track-and-trace applications, connected and integrated fleet management; or for retailers, where there has been an increased uptake of contactless payment terminals and solutions). This may lead to increased investment in digital solutions. This does not

encompass only telecommunications but also data management, automation, and in some cases, artificial intelligence.

On the other hand, low digitization sectors, such as construction, will be hard hit. As an example, a roundtable expert located in Asia mentioned that the construction sector in Singapore would shrink by 10.3 per cent this year due to the COVID-19 impact.

Digital resilience and supply chains

As explained in Calatayud et al. (2019)[51], production in modern economies is organized around supply chains, which involve business processes ranging from product design to customer delivery.[52] The performance of supply chains is driven by the efforts and behaviours of multiple stakeholders, such as manufacturers, logistics service providers and technology suppliers, and enabled by public policies on developing a country's infrastructure and business environment.[53] The increasing interdependency of supply chain stakeholders is the result of a number of business trends that have emerged in the last three decades, including process and product specialization, outsourcing, offshoring, just-in-time production and consumer-driven production. With design, production and distribution processes scattered among a variety of firms and parties, companies no longer compete in isolation, but rather as participants in interconnected supply chains.

According to one roundtable expert, supply chains in advanced economies have actually adjusted remarkably quickly to the challenges of COVID-19. Digitization has certainly helped on this front – specifically, simple connected solutions like asset tracking (e.g. for shipments and logistics) combined with monitoring dashboards and fleet management solutions were able to deliver a lot of agility to the supply chain and that has been fully demonstrated by how quickly supply chains had been reconfigured to adjust. Cellular coverage and availability represent key underlying features.

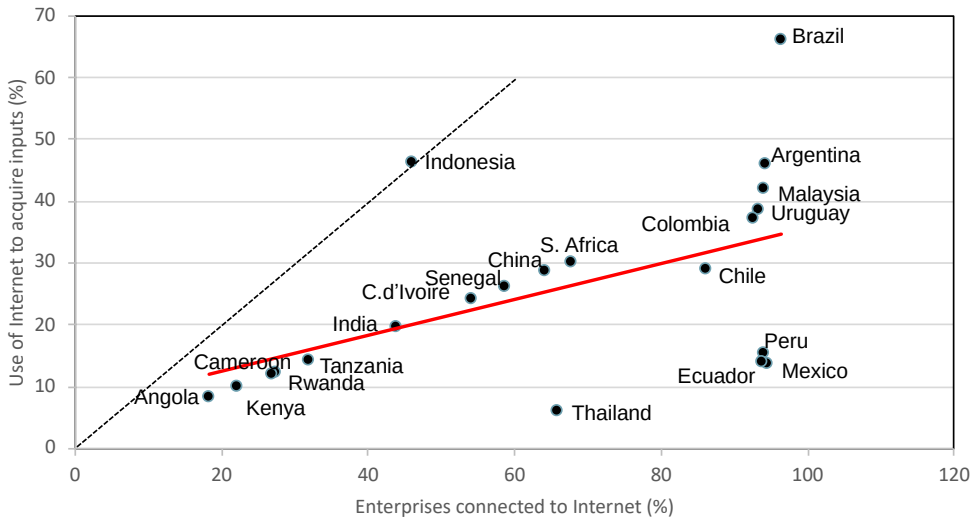
A second perspective was less optimistic about the ability of supply chains to face the disruption. Firstly, as explained by one roundtable expert, the digitization of supply chains without the digital transformation of analogue complements (customs, ports, etc.) would fail. Another expert added that supply chains were not shielded from disruption risk embodied by the stress of a COVID-like disruption. Digital infrastructures have to be stress-tested to respond of various shock scenarios to determine the actions that should be taken to rebuild their supply chains and mitigate future risks. A comprehensive understanding of supply-chain risk should consider two distinct elements: 1) the underlying vulnerabilities in the supply chain that make it fragile; 2) the level of exposure or susceptibility to unforeseen events (or shocks)

[51] Calatayud, A., Lechmacher, W., Betti, F. and Katz, R. (2019). *Supply Chain 4.0 Global Practices and Lessons Learned for Latin America and the Caribbean*. World Economic Forum.
[52] The concept of supply chain is different from value chain. A value chain is used either as a set of interrelated activities a company relies upon to create value and build competitive advantage (see Porter, M., *Competitive Strategy*, New York: Simon and Shuster, 1995) or a combination of different industry players to meet a market requirement (see Stigler, G., "The Division of Labor is Limited by the Extent of the Market", *The Journal of Political Economy*, vol. 59, no. 3, 1951, pp. 185-193).
[53] Calatayud, A., *The connected supply chain: Enhancing risk management in a changing world*, Inter-American Development Bank Discussion Paper No. IDB-DP-508, 2017.

that exploit these vulnerabilities. Investing in resiliency and continuity could help companies manage the risk or loss from future crises and disruptions.[54]

The above perspectives differ dramatically from the situation in developing countries. As explained by another roundtable expert, in Africa for example, lockdowns have resulted in the rupture of informal value chains, which has led to a major urban food security crisis in some areas. The potential destruction of these survivalist economies has meant that the informal economy has often been unable to serve as the usual buffer to economic shocks. The low enterprise adoption of the Internet indicates a very limited digital substitution of informal physical business activities such as the procurement of supplies or distribution of products and services.[55] The use of the Internet for business purposes in Sub-Saharan Africa is as low as 7 per cent on average. South Africa has the highest Internet use by informal enterprises (24 per cent), followed by Senegal (20 per cent). Internet use by informal enterprises in Ghana and Mozambique is slightly higher than the overall average, at 8 per cent and 7 per cent respectively, but in Kenya (4 per cent) and Uganda (4 per cent) it is far lower. Rwanda, one of the poorest countries among the surveyed countries, has the lowest Internet use among informal entrepreneurs, with only 1 per cent of them using the Internet. Graphic 5 provides evidence which suggests that while Internet adoption at the enterprise level in developing countries is high, the use of the Internet in supply chain operations is low.

Graphic 5. Percent of enterprises connected to the Internet vs percent of enterprises using the Internet to acquire inputs (2018)



Note: The difference between countries is mainly due to differences in survey sampling approaches (e.g. inclusion or not of microenterprises).
Sources: Statistics offices and Ministries of the respective countries; Katz, R., Jung, J. and Callorda, F. (2020). *Can digitization mitigate COVID-19 damages? Evidence from developing countries*. SSRN.

From the sample of countries presented in Graphic 5, only Indonesia seems to have a level of use of the Internet in the supply chain comparable with its level of Internet adoption among enterprises.

[54] McKinsey & Co. *Is your supply chain risk blind or risk resilient?*
[55] Research ICT Africa (2020). A *demand side view of informality and financial inclusion* (February 27).

Another example of bottlenecks in the supply chain is related to governments' limited capacity to support foreign trade. Despite the progress in many nations that has occurred in recent years, developing countries continue to lag behind international best practices. Evidence of this lag, for example, can be seen in the time required to process foreign trade documentation by customs agencies (see Table 3).

Table 3. Time required to process foreign trade documentation (2018, in hours)

Region	Exports	Imports
Asia-Pacific	55.6	53.7
Latin America & Caribbean	35.7	43.2
MENA	66.4	72.5
South Asia	73.7	93.7
Africa	71.9	96.1
OECD	2.3	3.4

Source: World Bank. Doing Business 2019.

Therefore, the limited digitization of companies – mainly of SMEs – along with logistics chain bottlenecks represent obstacles to the development of supply chain resilience to deal with COVID-19.

2.2.3. The impact of institutional failures

To begin with, experts were very clear about the multiple initiatives of policy-makers and regulators to help improve the performance of digital infrastructure in mitigating the impact of the pandemic. For example, OMDIA has counted over 250 regulatory responses to the virus worldwide, impacting the telecommunication and ICT sector.[56] These fall into several categories including mandating the lifting of broadband speed caps, making additional spectrum available immediately (e.g. in the United States, the FCC has granted temporary spectrum access to 33 mobile Internet service providers to help them ensure connectivity in rural communities during the COVID-19 pandemic. For instance, the Special Temporary Authority (STA) allowed companies to use the lower 45MHz of spectrum in the 5.9GHz band for 60 days); postponement of operators' fees and taxes; and suspension of net neutrality regulations.

However, the response to the pandemic challenge has highlighted some critical policy shortfalls, which have characterized the way the digital sector has functioned until now. In particular, the failure to enable critical infrastructure deployment (wholesale access, i.e. connectivity to backbones such as submarine cables and terrestrial long-haul networks) and the expected persistence of governments to extract rents based on spectrum auctions, will keep input prices high, with a negative impact on digital affordability. To perpetuate this situation, governments could perceive spectrum auctions as an opportunity to offset massively the debt incurred from COVID-19, rather than as an opportunity for reinvestment to redress digital inequality.

[56] OMDIA (2020). *Telecoms regulation COVID-19 Tracker*.

3. Industry implications

In the light of the assessment provided above, roundtable experts were asked about potential recommendations to policy-makers and regulators in order to increase the power of digital infrastructure to mitigate the pandemic disruption. In response, a roundtable expert was fairly adamant about the need to re-examine some of the digital sector basic fundamental premises that were held before COVID-19. "If there is one important realization from COVID-19 it must be we cannot go back to the ways things were: we cannot go back to the extremely different experiences we had before the pandemic. Digital inequality has been a critical determinant of survival and life opportunities under lockdown. From a policy and regulatory perspective, we cannot do the same things again and hope for different outcomes – we need to embark on policy experimentation in developing countries that are going to be more financially constrained than ever; these policies should be aimed at more equitable and affordable broadband access. This will require reviewing everything we have taken as givens, from the way and what we license spectrum, to the way we govern and fund global public goods such as the Internet." As another roundtable expert stated: "At the theoretical level, digital technologies could make an enormous difference but in the practical world, we need to know whether the policy-makers see it that way or how they respond to challenges.**"**

3.1. The role of governments

For the first time, in many emerging markets, digital infrastructure is seen as "essential", along with traditional infrastructure sectors, or even more so. As one roundtable expert stated: "Connectivity is the national critical infrastructure that is now as important as water, electricity and food to a nation. After clinical treatments, connectivity will be the single most important industry that will drive business and society out of lockdown".

Unfortunately, the pandemic has also exposed the access and connectivity limitations that digital infrastructure faces in less developed markets. These limitations are both technology based and not (the latter to include literacy, affordability and lack of relevant local content). This is the time that the cost of the digital divide has become more obvious than ever and this is the time that governments should see it as an opportunity to digitalize their economies.

The pandemic has demonstrated the importance of digital connectivity for people and economies in emerging markets. It is therefore crucial for governments to learn from these hard lessons and take concrete, actionable measures in the telecommunication sector to enable the private sector to provide universal access to quality digital infrastructure networks for all and support the development of a digital economy. For example, in the short term, governments and operators could focus on immediate sector needs including the release of emergency spectrum, deferring licence fee payments, or issuing technology-neutral licences.

3.1.1. The need for a digital resilience plan

Governments should take a much broader, holistic view of investment in high-speed broadband networks, considering the economic, social and environmental/climate benefits and costs of investment. The COVID-19 experience will, over time, provide valuable data on the cost of not having a fully-formed mitigation plan in place.

The different components of broadband networks (backbones, access, IXP, etc.) tend to operate independently. This raises the need, as proposed by a roundtable expert, to provide for better coordination between different networks and their owners/operators in the event of network failures (e.g. better fail-over mechanisms, operator-led rather than end-user-led networks). Similarly, there may be a need for a more coordinated approach to monitoring quality of service for all user groups, at a high level of "resolution", framed around improving reliability and resilience under a "high-load" case (e.g. where more people need to work from home, for a longer period of time). As one roundtable expert stated: "We may need to think about network quality and resilience differently in the future than how we do today."

Looking to the future, it is critical that countries begin work immediately on a digital resilience plan to address future pandemic disruptions. This will require, in the first place, a comprehensive diagnosis to be conducted of country resilience covering areas such as infrastructure deployment, service quality, stress testing of current infrastructure deployed, the components of digital divide (urban vs rural, income groups, large enterprises vs SMEs), an assessment of applications and usage levels across social groups, the evaluation of the level of digitization of production (by sector and enterprise size, entailing both technology adoption and assimilation in business processes) and the resilience of State operations (administrative processes and delivery of public services). After that, countries will be able to develop plans to address their respective shortfalls and to be better prepared for the next pandemic. The plans should address infrastructure deployment (backbone and distribution networks, spectrum availability, both licensed and unlicensed), initiatives to address all components of the digital divide, training and stimulation of consumer apps, concurrent efforts with the private sector to stimulate the digital transformation of production, as well as initiatives to address shortfalls in State operations.

Building digital resilience demands capable and adaptive institutions to manage the increasing complexity of globally integrated infrastructures and markets and coordinate across the public sector and between public and private sectors, enabling experimentation to deliver on public policy objectives.

3.1.2. A new regulatory framework?

Regulatory frameworks may need to be adjusted to stimulate investment whilst maintaining a "sensible" level of competition shifting from a "purist" to a "pragmatic" viewpoint on State aid regulations. This should prompt governments and regulators, in the words of a roundtable expert, "to double down on the release of spectrum, planning authorization and competition regulation".

Several policy initiatives around spectrum policy for consideration were pointed out by roundtable experts. In developing countries, the opportunity of implementing spectrum licensing conditioned upon infrastructure sharing, enabling secondary and dynamic spectrum use, implementing default licensing exemption for communities, and making 5G licences conditional on meeting substantive coverage of earlier technologies (4G) should be considered. In all countries, advanced and developing, expanding the amount of spectrum allowed for unlicensed use should also be considered.

3.1.3. The importance of infrastructure sharing

It is paramount for governments in emerging markets to keep making progress on digital infrastructure regulation, particularly pertaining to shared infrastructure. In the aftermath of the COVID-19 situation, increased interest from governments, development finance institutions and non-traditional ICT infrastructure investors, will most likely drive the emergence of shared ICT infrastructure models to encourage capital intensive deep fibre investments that are critical for 4G and 5G deployment. This will increase economic resilience across multiple sectors and ultimately enable last-mile fibre access that facilitates better densification, broadband competition and the narrowing of the digital divide.

3.1.4. Digital divide priority

As stated by a roundtable participant: “Governments must take action and develop investment cases to support ubiquitous access to high-speed broadband, taking into account all the economic, social and environmental impacts”. Priorities for investments are in bankable rural business models as well as broadband connectivity predominantly in the area of shared, carrier-neutral infrastructure that could reduce the break-even cost of deploying costly infrastructure in sparsely populated, poor regions. Shared infrastructure has been proven to be a model in tower and submarine cable infrastructure, and it is time to apply it to terrestrial broadband infrastructure as well.

3.2. A need to re-examine capital investment of telecommunication operators

In all fairness, roundtable experts did not all agree on the need to rethink future capital spending trends. One perspective was captured in the words of one expert: “Connectivity is one of the solutions to COVID-19. Both mobile and fibre are as important to a nation’s development in the next five years as any other utility.” This should prompt a faster roll-out of high-speed broadband underpinned by a very strong investment case.

A divergent view argued for a “diversion of productive private capital investments from 5G to other broadband networks” or incentivizing new non-traditional investors in “new” technologies (dynamic spectrum). Along those lines, prompted by government policy, carriers should revive rural connectivity agendas, which had become low priority in order to favour 5G deployment.

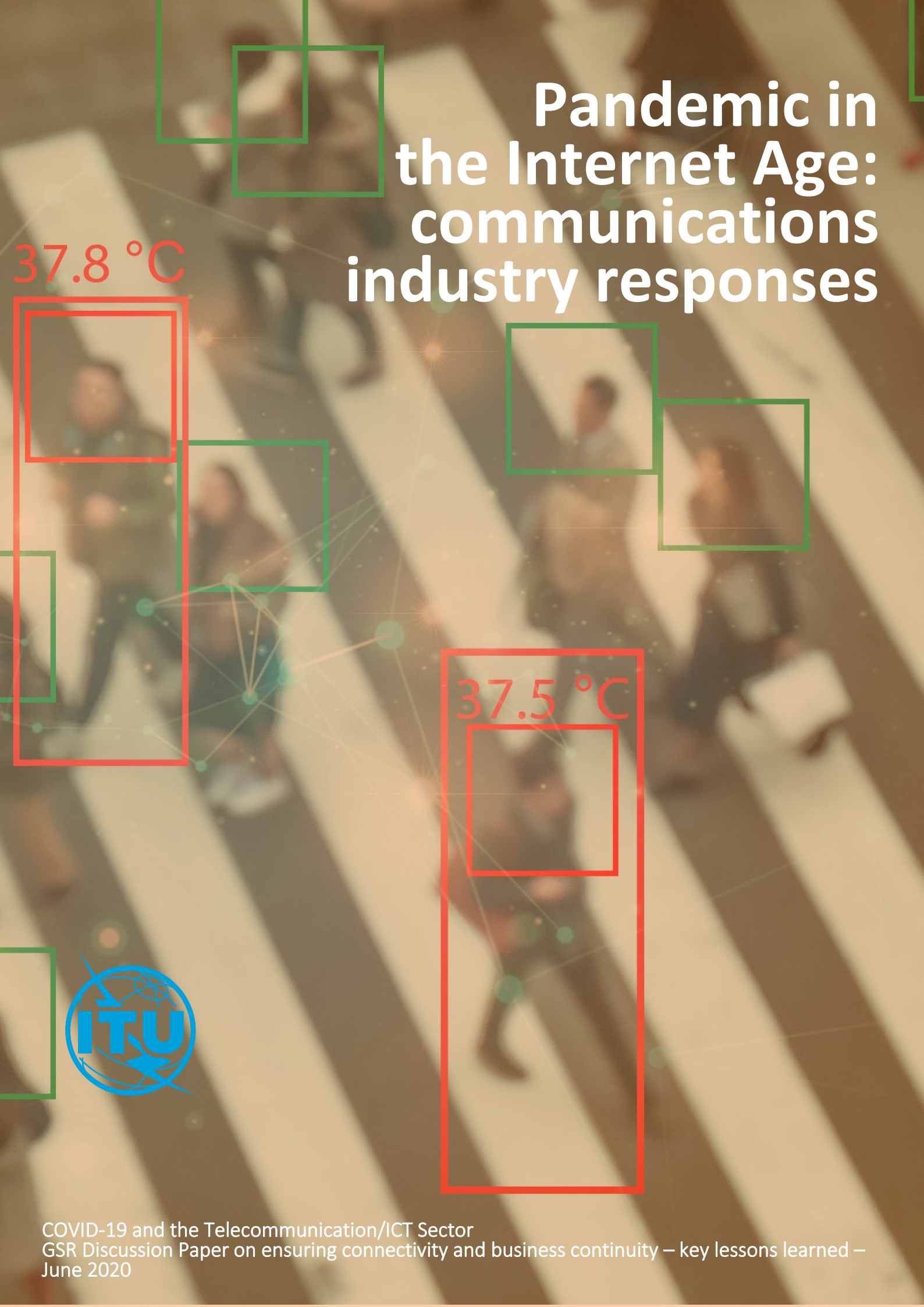
3.3. An acceleration of the digitization of production

The roundtable experts estimated that COVID-19 could be a window of opportunity to drive digital transformation in sectors in which it had not been a focus in recent decades. Similar to

the effect of SARS in China in 2003 which triggered tremendous growth in e-commerce, new production modes would emerge. As a result, COVID could become a catalyst for the adoption of digitalization in sectors where it had not occurred before, especially in more business-oriented applications.

In order to increase the digital resilience of production, enterprises engaged in the manufacturing of physical goods should accelerate their migration to automated processes to enable the production of physical goods with less manpower (environments characterized by the "remote control" of production). In the words of one expert, this approach should focus on "re-examining production chains, emphasizing the role of critical national infrastructure as an enabler, the multiplicity/diversity of supply, assurance and quality of service, the role of trusted suppliers, and better fail-over mechanisms".

As stated by another roundtable expert: "There's a popular meme that neatly captures the tipping point of digital: it is a short questionnaire asking who is driving your digital transformation. The first two options are "CEO" and "chief digital officer." Below that, highlighted with a bright red circle, is "COVID-19."



Pandemic in the Internet Age: communications industry responses

COVID-19 and the Telecommunication/ICT Sector
GSR Discussion Paper on ensuring connectivity and business continuity – key lessons learned –
June 2020

This report was prepared by the International Telecommunication Union (ITU), by ITU expert Mr Scott W. Minehane of Windsor Place Consulting (WPC) under the supervision of the ITU Regulatory and Market Environment Division of Telecommunication Development Bureau (BDT) and the ITU Radiocommunication Bureau, with extensive input especially from Ms Sofie Maddens and Ms Carmen Prado-Wagner. The author also acknowledges the assistance of Mr Tomas Lamanauskas of Envision Associates and the input and research undertaken by his associates and staff at WPC, including Mr Simon Molloy, Ms Pia Castillo and Ms Shankari Thananjeyan.

Importantly, the opinions, findings and conclusions expressed in this publication do not necessarily reflect the views of ITU or its membership.

Contents

1 Introduction

1.1 Pandemic in the Internet age

The world has entered the first global pandemic of the Internet age. At the time of the last global pandemic,[1] the Spanish flu of 1918, Alexander Bell's telephone patent was already 43 years old but the first transcontinental telephone call between New York and San Francisco had occurred only three years earlier. The global telecommunications network was still in its infancy and the digital toolbox of the 21st century was unimagined.

In countless ways 2020 represents a discontinuity for humanity. Pandemics are nothing new in the human experience. From a long-term perspective they are the norm. What makes the social and economic cost of COVID-19[2] so immense is the scale and extreme interconnectedness of the modern global economy where exports are estimated to be 40 times larger than in 1913. As the world's population approaches 8 billion – there is much more to lose, in human and economic terms, in 2020 than at any time in history. Our interconnectedness means that the virus can spread fast, far and wide to an extent that is genuinely unprecedented. The global nature of today's news means that information and developments in relation to COVID-19 are reported and amplified worldwide. The economic consequences of the current pandemic are now regularly compared to the Great Depression of the 1930s.

But in 2020 humanity has a new set of tools that can be brought to bear on the pandemic threat: the global telecommunications and ICT networks, encompassing trillions of dollars' worth of infrastructure, billions of personal and corporate digital devices, and a vast stock of human capital consisting of digital skills, knowledge and work practices.

Moreover, the world's ICT infrastructure is a core and indispensable input for global and national economies and the well-being of all societies. It is critical that the functionality of information and communications systems is maintained, and even extended, through the emergency and recovery phases of the COVID-19 pandemic. Importantly, the crisis conditions saw excellent collaboration among different sectors (e.g. health, educations, security etc.) with the ICT sector.

The purpose of this paper is to provide ICT stakeholders with an analysis of policy and regulatory measures taken during the COVID-19 pandemic and in preparation for recovery to ensure resilient connectivity, business continuity and service delivery while responding to communications and in particular data traffic increase, maintaining continuity of vital services, and ensuring affordable, safe, secured and trusted access to online services. The use of the digital tools has facilitated the continuation of a base level of economic activity in many countries notwithstanding the lockdowns which may have been put in place.

The report identifies regulatory and policy trends for the different groups of stakeholders as they developed in countries around the globe, examining both immediate and longer term responses, what measures need to be improved, identifying practices to be considered for inclusion as part of national emergency telecommunication as well as broader telecommunication / ICT contingency and development plans highlighting differences that may occur due to market maturity and economic development, and identifying also innovative regulatory measures needed to address challenges for operators, businesses, governments and end users including most vulnerable populations. The report also provides a checklist of actions and regulatory measures for better preparedness to complement the recently released ITU emergency communications guidelines.[3]

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1 There were flu pandemics in 1957 and 1968 but they pale in comparison to the 1918 pandemic. See www.cdc.gov/flu/pandemic-resources/basics/past-pandemics.html

2 COVID-19 or coronavirus disease 2019 is an infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). See https://en.wikipedia.org/wiki/Coronavirus_disease_2019

3 Refer to www.itu.int/en/ITU-D/Emergency-Telecommunications/Pages/Publications/Guidelines-for-NETPs.aspx

1.2 COVID-19 lockdowns, telecommunications and economic dislocation

There is an extensive academic literature on the relationship between telecommunications and national economic development which concludes, in general, that telecommunications in all its various forms makes significant contributions to productivity, competitiveness and economic growth. Not only is it essential to take, sometimes extraordinary, measures to ensure that telecommunications continues to contribute to the functioning of national economies, business and society, it is also necessary to recognise that our ICT infrastructure, tools and knowledge can enable our response to COVID-19 to be more effective and decisive than would otherwise be possible.

These tools and this knowledge can be deployed in multiple ways to limit the damage and suffering caused by the virus and improve society's capacity to deal with future threats. The ICT-centric responses include:

- Online working, education, socialising, entertainment, and commerce and retail which enable the continuance of many social and economic activities to an extent that would be impossible otherwise under lockdown conditions. This lessens the economic and social costs of the social and spatial isolation which is necessary to limit the spread of the virus;
- The use of mobile apps and big data to track, trace and execute responses to virus outbreaks is potentially a revolutionary weapon against the virus. The more quickly and accurately virus outbreaks can be identified, assessed and responded to, the less societies need to be locked down in response to the generalised increased viral threat we now face;
- Rapid dissemination of information by governments regarding virus responses, policy and regulations;
- Coordination of the emergency response; and
- Facilitating global collaboration in the search for virus treatments and vaccines.

Around the globe, Governmental responses to COVID-19 based on medical advice have emphasised 'flattening the curve'. Flattening the curve involves practising social distancing and economic lockdown in order to minimise the spread of the contagious virus. This approach recognises that eliminating the virus is all but impossible – but the objective is to keep infections within the capacity of healthcare systems especially intensive care units (ICUs) beds and ventilators.

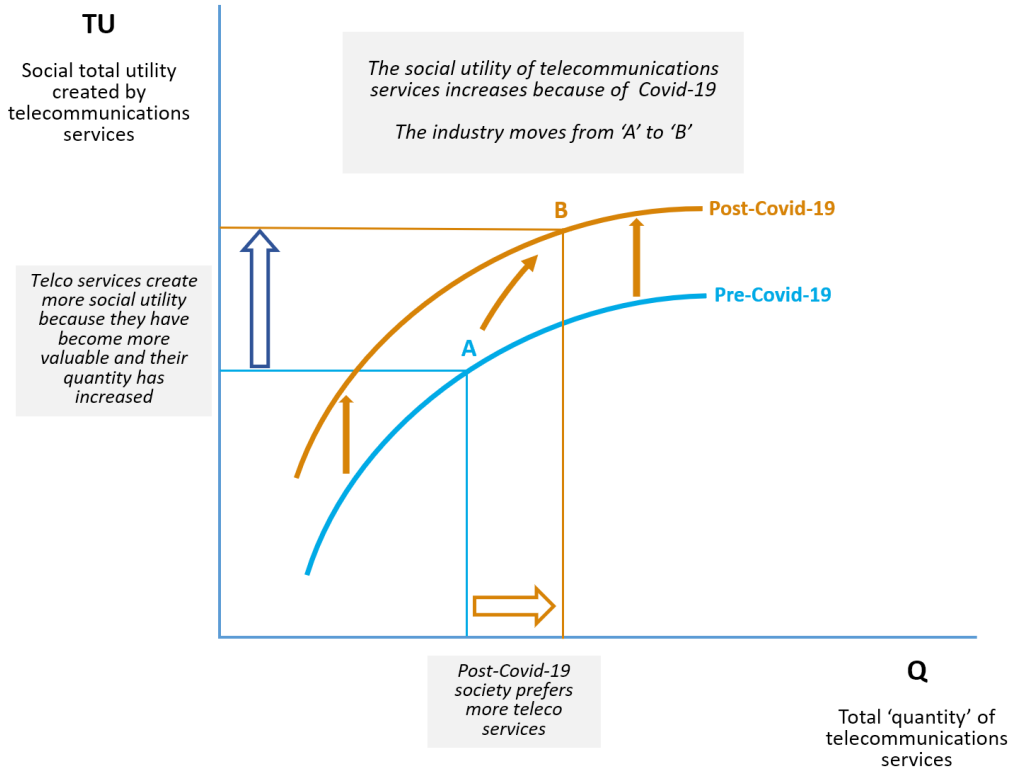
Lockdowns, however, come at enormous economic cost. Various governments are estimating the costs of their national lockdowns in tens of billions of dollars per month. Whether they acknowledge it or not, governments are in a process of experimenting with trade-offs between economic loss and restriction of the pandemic's spread. The navigation of this trade-off is currently occurring in the context of a great deal of uncertainty about the nature of the virus – its lethality, contagiousness etc. – and about the nature of the relative effectiveness of various types of social distancing and lockdown policies.

What the agile and effective use of ICT can achieve is a shift en masse of this trade-off. Our information and communication systems can decrease the economic costs of any level of lockdown and can be used to diminish the spread of COVID-19 for any given set of lockdown policies. We need to explore urgently and thoroughly the innovative ways in which our continued investment in telecommunications can lower this economic cost and increase the effectiveness of responses to the virus.

1.3 Telecommunications/ICT and the economics of the COVID-19 crisis

If it is the case that the smart and agile use of telecommunications and ICT services can shift the trade-off between saving lives and saving the economy, then what this means is that telecommunication/ICT services have suddenly become more valuable to society as a whole as a result of the COVID-19 crisis. In effect, the changed circumstances in the COVID-19 world mean that any level of telecommunication services now creates what economists call more 'utility' for society – telecommunications now delivers greater social welfare benefits than previously (**Exhibit 1**). Because connectivity services have suddenly become more valuable, it is rational and efficient for consumers and society as a whole to demand more.

Exhibit 1: Social utility function for telecommunications services moves out due to COVID-19



Source: ITU, June 2020

While it may be preferable and efficient to increase the level of telecommunication services, in the short run, the telecommunications and ICT sector will face challenges in achieving this. Spectrum may be crowded, infrastructure may be at capacity, new infrastructure will take some time to deploy, access to new spectrum will require some degree of regulatory approval, and so on. Nonetheless, as discussed in Section 2, the telecommunications sector has demonstrated remarkable agility in providing additional services and other responses within a very short time frame. Many of these responses, however, are expressly short-term and not sustainable in the longer run.

In the medium and longer term, there will be flexibility for more substantial and sustainable responses. In fact, it is likely that COVID-19 phenomenon will bring forward many sector reforms and innovations which were already underway, for example, assigning and sharing spectrum to specific applications, upgrading and deployment digital infrastructure, sharing infrastructure, moving to Internet Protocol (IP), institutional, policy and regulatory change, and deploying new generations of communications technology.

It is important to note that, from an economic perspective, the cost of delays in deploying new technologies and services has also increased. Because telecommunications and ICT services are now more valuable to society, each year of delay in providing better and increased levels of service now means the opportunity cost of this delay is greater. This means it is now socially optimal to bring forward the deployment of improved digital infrastructure, assignment of globally harmonized IMT spectrum and new generations of technological standards, for example, moving to 4G and 5G.

Finally, from the economic perspective, there are equity issues at stake in the provision of telecommunication services in the post- COVID world. Many commentators including the ITU itself have noted that the advent of COVID-19 exacerbates existing economic and social inequalities. Unemployment, for example, more heavily impacts the less well-off members of society. To the extent that improved access to telecommunications and ICT services can provide economic and social inclusion, access to services, gender equality, access to education and, potentially, access to employment, these services have a valuable role to play in offsetting these negative equity impacts of COVID-19.

1.4 Emergency, Recovery and the New Normal: Phases of Response by the telecommunications sector

As discussed above, the ICT/telecommunications sector has demonstrated significant flexibility in its response to the COVID-19 crisis. **Exhibit 2** provides an illustration of the actual and potential responses of the various components of the technology sector to COVID-19.

The three Phases in the timeline are denoted 'Emergency', 'Recovery', and 'new normal'. These could be thought of as representing the short, medium and long-term responses of the sector. This would be misleading, however, because the Phases are not defined by elapsed time but rather by government policy settings in response to actual and perceived threats from COVID-19 at different times.

The Emergency Phase is characterised by strong mandatory lockdown of various sectors of the economy while the recovery phase is characterised by the gradual cautious relaxation of lockdown conditions dependent upon success in suppressing the virus, new outbreaks and capacity of the medical system. The 'new normal' Phase is something that can be considered only speculatively at this stage because of the considerable uncertainty involved in looking further out. For example, were a highly effective vaccine to be developed within a reasonable timeframe, the 'new normal' would be very different from the situation in which no effective vaccine is forthcoming, immunity to the virus proves to be temporary or new strains of the virus evolve over time.

Exhibit 2: Phases of response by the telecommunications sector within the broader context of COVID-19

COVID-19: RESPONSE TIMELINE

	EMERGENCY 0 to 6 months	RECOVERY 6 to 18 months	NEW NORMAL from 18 months
INDIVIDUALS	• social distancing mandated • move to online work, education, socialising, commerce and retailing	• embed social distancing practices • adapt to new work, education, social practices	• social distancing as new normal • wearing masks becomes fashion • online proficiency improvement
BUSINESS/ CORPORATE SECTOR	• implement work from home • adapt on-site work practices to minimise contact	• design and embed new work practices • redesign workplaces for reduced contact and crowding	• what is better online stays online • ongoing economic weakness • new logistics & supply chains • reduced business travel
TELECOMMUNICATIONS OPERATORS	• manage immediate demand • provide immediate relief to customers • expand data caps • expand available spectrum and capacity	• expand infrastructure and total capacity • adapt network capacity for video content • develop superior video technologies	• continue to build capacity • adapt networks to increased video traffic, improve quality and reliability • accelerate 4G/5G deployments
GOVERNMENT	• require social distancing • impose lockdowns • limit international travel • testing and tracing • expand medical capacity • source scarce PPE • enhance social safety net • short-term fiscal stimulus	• cautiously adjust lockdown parameters • embed ongoing testing and tracing • assess post emergency phase COVID-19 and need for sovereign strategic production capabilities • focus on economic efficiency • longer term fiscal stimulus emphasising productive infrastructure • more collaboration among sectors	• promote economy wide efficiency measures • embed 'surge capacity' healthcare systems • find efficient policy to support strategic production and storage (e.g., PPE, fuel, critical medical equipment and reagents) • focus on debt reduction
TECHNOLOGY SECTOR	• offer productivity & remote education/ working tools • tracking, tracing outbreaks • quickly help businesses go online	• address COVID-19 fake news • big data responses/data processing • Improve remote cybersecurity • new tools for safe public transport, workplaces, education, health	• build services on new deployed digital infrastructure • mobile payments replacing money • Innovation driving digital markets

Source: ITU - WPC, May 2020

While it might be tempting to consider that an effective vaccine would allow the world to return to the pre- COVID -19 normal, a number of factors suggest that, even given an effective vaccine, the "new normal" may look quite different.

The first factor is that behaviours, both social and work practices, have already changed radically. The shift to remote working and education alone constitutes a substantial new experience and when the immediate threat of the virus recedes, it is unrealistic to expect that this change will have no ongoing impact. Some aspects of work and social life will be permanently affected.

Another factor that will make the 'new normal' different is that, even if an effective vaccine emerges, it will take time to inoculate populations of whole countries and its long-term

efficacy will be uncertain as will its effectiveness against new mutations. In addition, the world has been alerted to the pandemic threat. Such factors are likely to change behaviours long-term. Travel, for example, may be significantly less attractive for a long time and this will likely lead to a permanent increase in demand for rich communication systems. These are likely to be substantially video based which will drive demand for high-quality, reliable and low latency bandwidth.

There are also likely to be significant impacts on global supply chains. Countries have been alerted to the need to be more independent in the production of a range of critical medical supplies and equipment and COVID-19 appears to have heightened geostrategic tensions which will further encourage some rearrangement of supply chains. The effects of such changes on the demand for telecommunications services are difficult to predict.

National, regional and global macroeconomic considerations also feed into consideration of impacts on the telecommunications sector. There is little doubt the world is entering a period of lower economic growth than expected with the potential for severe and protracted recession being high. This would impact on the revenues, earnings and financial capacity of communications operators and their capacity to attract funding from external sources, for example, for infrastructure deployment and upgrades will likely be substantially diminished.

1.5 Structure of Report

The structure of this paper is straightforward following the three phases of the COVID-19 response timeline, namely emergency responses to COVID-19, the COVID-19 recovery phase and the new normal state. As such the report has five sections, namely:

1. Introduction;
2. COVID-19 Emergency Reponses (Section 2);
3. COVID-19 Recovery Phase (Section 3);
4. The new normal (Section 4); and
5. Conclusions and Recommendations (Section 5).

There is also an extensive Appendix providing a detailed summary of the policy, regulatory, and commercial initiatives taken by the sector between March and May 2020 – as a first emergency response in relation to addressing the spread of the coronavirus, the twin health and economic crisis wrought globally by COVID-19, based on the data collected in the ITU REG4COVID platform4.

4 The new Global Network Resiliency Platform (#REG4COVID) is a place where regulators, policy makers and other interested stakeholders can share information, view what initiatives and measures have been introduced around the world, and discuss and exchange among peers on experiences, ongoing initiatives, and innovative policy and regulatory measures designed to help ensure communities remain connected, see https://reg4covid.itu.int/.

2 COVID-19 Emergency responses

2.1 Overview

Telecommunications systems operate within the context of a complex and evolving equilibrium of user demand, changing technology, opportunities and incentives facing operators, regulatory settings, and broader government policy objectives.

COVID-19 pandemic has created complications and challenges for maintaining normal telecommunication and ICT services, including:

- the extreme demand for services from households;
- the requirements of health services and hospitals under stress;
- new and unusual patterns of demand; and
- the operation of lockdowns and associated barriers to ensure social distancing and stop/slow the spread of the coronavirus to normal operations including of operator employees and contractors.

These and other related forms of disruption all increase demands on telecommunications and online service providers. Operators must work under exceptional circumstances to ensure resilient connectivity, business continuity and service delivery while responding to communications demand and, in particular, data traffic increase, maintaining continuity of vital services, and ensuring affordable, safe, secured and trusted access to online services.

COVID-19 country restrictions and working and studying from home has resulted in unprecedented growth in global Internet and in some countries voice traffic – including peak demand - over a short period of time. While most data networks have seen an annual growth of 30 to 45 percent, in some countries there have been increases of up to 40 percent[5] from previous data usage levels in a few weeks.

We are also seeing unprecedented growth in latency-sensitive applications during business hours with reportedly some 300 percent growth in teleconferencing apps in the USA (e.g., Zoom, Skype) and 400 percent growth in gaming (with children being at home!). In Thailand, *dtac* reported an 828 per cent rise in data traffic from Zoom and a 215 per cent spike on Skype video conferencing apps between 1 January and 19 March 2020. This has meant that *dtac* has been optimising network capacity to keep up with traffic spikes due to an increasingly homebound workforce.[6] Satellite operators providing broadband connectivity directly to consumers, especially in rural and remote areas, have seen a 15-70 per cent (depending on the country) increase in data traffic across Europe and the Americas and an increase in subscriptions in United States, Mexico and Brazil.[7] Global submarine cable system traffic has also substantially risen. Increasingly too, commerce and shopping are going online with large increases across most product categories.[8]

Exceptional temporary policy and regulatory measures are therefore being taken by ICT stakeholders around the world to ensure immediate responses and alleviate network congestion, ensure continuity of vital services and access to online solutions for health, education, financial, governmental and social business continuity while protecting users' rights.

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5 See https://blog.cloudflare.com/on-the-shoulders-of-giants-recent-changes-in-Internet-traffic/ , www.telefonica.com/en/web/press-office/-/operators-advise-a-rational-and-responsible-use-of-telecommunication-networks-to-cope-with-traffic-increases and www.canberratimes.com.au/story/6695806/students-workers-benefit-from-nbn-data-boost/?cs=14231

6 See www.mobileworldlive.com/featured-content/home-banner/covid-19/

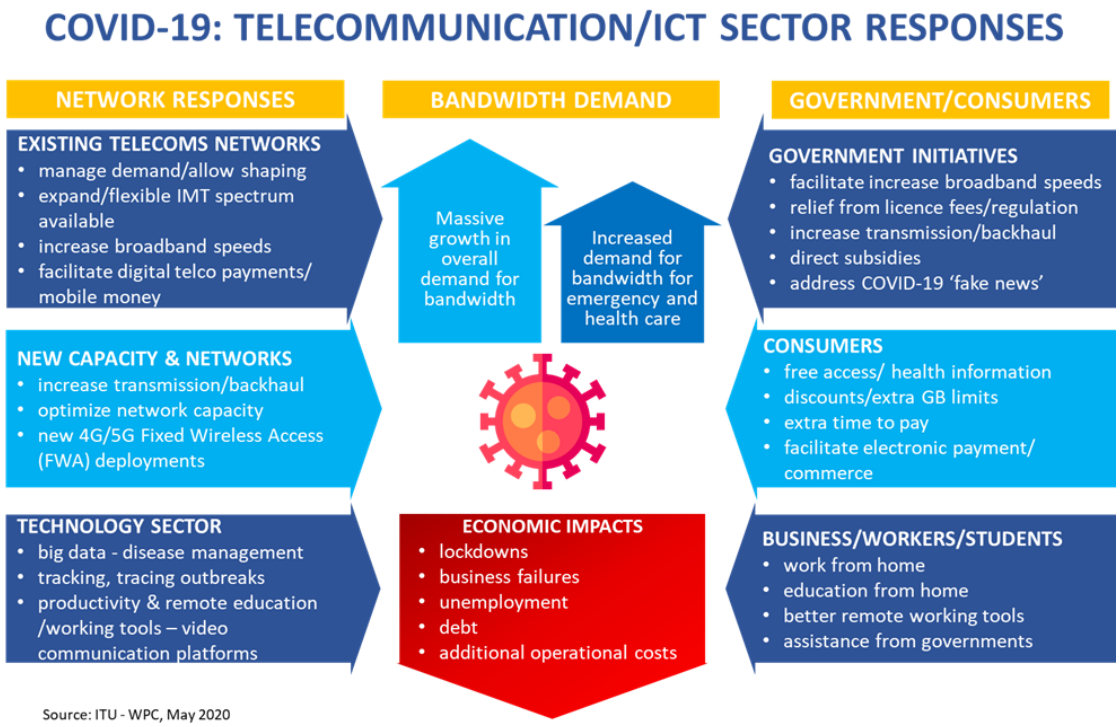
7 Furthermore, satellite operators support MNOs as they bring connectivity to suburban and rural areas and this connectivity has surged during lockdown. Refer to www.esoa.net/press-room/keeping-people-connected-informed-and-protected

8 See https://theblog.adobe.com/how-covid-19-is-impacting-online-shopping-behavior/

Partnerships have also been forged with digital platforms, such as, Netflix, YouTube and Amazon to restrict video streaming quality globally[9] in order to help reduce network congestion. Regulators have also provided additional temporary spectrum like in the USA[10] and South Africa in an attempt to ease network congestion.

The key telecommunications sector responses to COVID-19 are summarised graphically in **Exhibit 3** below.

Exhibit 3: COVID-19: Telecommunications sector emergency responses



2.2 General responses by stakeholders

In summary form, the common short term regulatory initiatives countries and stakeholders have implemented to address the immediate or emergency COVID-19 period (which we have defined as 0 to 3 or 6 months depending on the country or region) are contained in

9 See www.theverge.com/2020/3/24/21192384/youtube-video-quality-reduced-hd-broadband-europe-streaming

10 See www.fiercewireless.com/regulatory/u-s-cellular-gets-access-to-more-spectrum-for-covid-19-response

Exhibit 4 below. They are broadly in order of their observed global adoption. These common short-term regulatory measures and initiatives are based on online submissions to the ITU's REG4COVID platform as well as other industry sources including reports from industry stakeholders and press reports. A more detailed country by country summary is contained in **Appendix A**.

Exhibit 4: Key common short term regulatory initiatives

Initiative	Description
Increasing Broadband capacity and speeds	Regulatory bodies have been encouraging MNOs and wholesale providers to increase broadband speeds for customers to ensure quality of service (QoS) is maintained.
Providing free services to customers	Regulators have also supported other initiatives such as free access to educational websites as well as free data allowances to citizens during COVID-19 lockdown periods.
Providing information services on COVID-19	Policymakers in a number of countries have introduced new e-services such as a website dedicated to COVID-19 information, as well as a health platform to assist healthcare providers in remote areas to better utilise information technology and mobile health solutions
Network Management	Three forms of network management are common: • *Voluntary*: Telecom regulators are asking operators to take part in pledges or initiatives to maintain network connectivity and help customers cope with the coronavirus outbreak. Typically, these initiatives are not government mandate, but a voluntary measure on the part of providers. • *Mandatory*: A smaller number of regulators have also implemented mandatory measures requiring telco cooperation in enhancing network infrastructure, ensuring quality of telecommunication services, etc. in order to address the effects of the pandemic. *General*: There has also been a regulatory trend towards publishing new guidelines or revising existing ones to better handle congested and overloaded networks.
Allowing more flexible IMT spectrum use	Policymakers and regulators have engaged in responses designed to grant temporary IMT spectrum licenses in the midst of the pandemic. Such responses typically involve allowing the use of either vacant spectrum or unused spectrum of existing licensees. These additional temporary IMT spectrum licenses were designed to facilitate operators providing their customers with greater network access and improved quality of service.
Free access to online learning resources	Country governments have been working with operators to ensure access to online learning programs while the pandemic is ongoing.
Generally easing regulatory requirements on licensees	Government and regulators have taken steps to minimize the regulatory and reporting obligations on licensed operators.
New Fixed Wireless Access (FWA) networks	4G/5G FWA has been used in some areas to quickly deploy necessary wireless broadband infrastructure. The need for improved connectivity is due to the need to quickly augment coverage and capacity near health care facilities and/or over cities and urban/suburban areas which may be subject to social distancing requirements.
Addressing misinformation in relation to COVID-19	A number of countries have promulgated rules addressing misinformation in relation to COVID-19 including the link of 5G to the coronavirus.

Initiative	Description
Contact Tracing application development	A number of countries have created or are in the process of creating tracing applications in order to track the spread of COVID-19. Apple and Google have also announced its partnership to develop a contact tracing technology to reduce the spread of COVID-19.
Government subsidised broadband services	In a small number of countries, Governments have subsidized wireless broadband services to support the costs of consumers working and studying from home.

Source: ITU REG4COVID database and selected industry sources, 2020

To address the immediate country and economic needs arising from the COVID-19 pandemic, both fixed and mobile network operators, satellite and other providers have also offered or undertaken a number of short term initiatives, mostly on voluntary basis given their partnership with the community and corporate social responsibility. The most common short-term initiatives in their order of observed global adoption based on the ITU's REG4COVID database and other industry sources are summarised in **Exhibit 5** below. More detailed country examples are contained in **Appendix A**.

Exhibit 5: Common short-term Initiatives by operators

Initiative	Description
Additional Data Allowances	Many fixed operators, MNOs and wholesale providers have offered to provide their customers with additional data allowances as businesses and schools across the world transition to working remotely, due to the spread of the COVID-19 virus.
Increasing Broadband Speeds	Operators have upgraded Internet speeds – including transmission and backhaul capacity - to better accommodate the unprecedented number of people working and learning from home.
Relaxing of payment terms	Operators have relaxed the payment terms including downgrade plans/vouchers, payment of monthly invoices, and prepaid voucher validities dates etc.
Providing free services	MNOs have also commenced a variety of other initiatives for their customers, many at no extra cost. These include free access to networks and waiving overcharge fees.
Free access to online learning/education resources	In order to support distance learning and home-schooling during school closures, access to remote leaning opportunities and educational platforms has been made available at no cost by a number of operators.
Free access to health/government information	Operators are providing free access to information contained in government and social welfare sites, as well as to websites containing health information relevant to coronavirus crisis.
Facilitating mobile money transactions	Telecommunications companies (and banks) are encouraging consumers to avoid cash payment in favour of digital transactions to avoid the spread of the coronavirus.
Going digital in terms of recharges etc.	MNOs have facilitated prepaid mobile recharges being made online rather through physical scratch cards etc. to improve connectivity during any lockdowns

Source: ITU REG4COVID database and selected industry sources, 2020

In addition to telecommunications operators, the entire broader digital economy and ICT sector has also stepped up with a range of initiatives and free offerings in order to address the emergency needs arising from the spread of the coronavirus. A summary table of

selected measures (there are too numerous to fully enumerate) by content and online service providers can be found in **Exhibit 6** below.

Exhibit 6: Selected COVID-19 related Initiatives by Content and Online Service Providers

Initiative	Description
Lifting time limits in video calls	**Zoom** has lifted time limits on its video calls for the free versions in China, as well as for schools in Japan, Italy, and the US, by request.[11]
Reducing network demands	**Netflix** and **Youtube (Google)** reduced the resolution of their video content to assist in reducing the peak network demands on fixed and mobile networks experiencing additional COVID-19 demand.
Developing new technology	**Apple** and **Google** announced its partnership to develop a contact tracing technology to reduce the spread of COVID-19. The two companies have launched a comprehensive solution that includes application programming interfaces (APIs) and operating system-level technology to assist in enabling contact tracing. Given the urgent need, this solution is being implemented in two steps while maintaining strong protections around user privacy.
Range of free services including but not limited to:	**Microsoft** is offering anyone its premium version of Teams for free for six months and has lifted existing user limits on its free version. The premium Teams product was already available for no extra cost to those who pay for the Office Suite, and Teams had already been free for many schools.[12]
	Google announced that it would offer its enterprise videoconferencing features — for example, larger meetings of up to 250 people and the ability to record — for free to G Suite and G Suite for Education customers through July 1, 2020
	LogMeIn is making "Emergency Remote Work Kits" available for free for three months. Those kits are designed for nonprofits, schools, and health care organizations that aren't already customers. The kits include GoToMeeting, GoToWebinar--where users can host presentations for up to 3,000 users--and LogMeIn, which provides remote desktop access from numerous devices.[13]
	Cisco is offering the free version of its Webex service with no time restrictions. In addition, it will allow up to 100 meeting participants and has added toll-free dial-in features with a 90-day license for businesses that are not already customers.[14]
	Slack already offers a free tier, but the company is offering live Q&A and webinars to get the influx of new users up to speed.[15]

Source: ITU REG4COVID database and selected industry sources, 2020

2.3 International Stakeholders Action Items and Guidelines

A number of international stakeholders are releasing action items and guidelines as a result of COVID-19. These initiatives will provide support for governments, policy makers, and

11 www.vox.com/recode/2020/3/11/21173449/microsoft-google-zoom-slack-increased-demand-free-work-from-home-software

12 *Ibid.*

13 www.inc.com/jason-aten/these-5-tech-companies-are-providing-free-remote-working-tools-during-coronavirus-outbreak.html

14 *Ibid.*

15 www.nasdaq.com/articles/demand-for-microsoft-google-and-zooms-video-conferencing-software-surges-amid-the

international institutions in managing the response of the information and communications industry to the global pandemic.

The ITU's Emergency Communications Guidelines as well as ATU's Call for Harmonised Actions outline important guidelines for policy makers to formulate effective telecom responses in the wake of emergencies and disasters. The Broadband Commission's Agenda for Action and the ITU/World Bank/WEF/GSMA's Joint Action Plan and Call for Action include agendas, actions and objectives to guide global private-public sector collaboration and mitigate the impact of the COVID-19 pandemic on economies and societies. The ITU's REG4COVID platform provides general support for countries and their regulators through collating information on international best practice in terms of COVID-19 responses.

Ultimately, the initiatives similarly aim to highlight the importance of international cooperation and rapid action not only to support ICT networks and communities, but also to promote faster and better recovery in the longer-term. In addition, WHO is partnering with the ITU, the United Nations Children's Fund (UNICEF) and telecom operators to disseminate critical health information on COVID-19 via SMS to reach an estimated two billion people that are still using 2G phones.[16]

ITU'S REG4COVID PLATFORM

ITU's Global Network Resiliency (REG4COVID) Platform is a result of the ITU's call on the ICT community and others to rise to the challenge and show solidarity in the face of the pandemic's threat to humanity. The platform was designed to help national ICT policy-makers, regulators and industry stakeholders cope with increasing stress put on global networks during the COVID-19 crisis. It is expected to do so by encouraging the global ICT community to share information about initiatives that regulators and operators are introducing in areas such as:

- Consumer Protection;
- Traffic Management and Prioritisation of Traffic;
- Broadband availability, affordability and accessibility;
- Emergency Telecommunications;
- Universal Service Strategies; and
- Quality of Service and Quality of Experience

By facilitating the sharing of relevant information and expertise, it is hoped that countries will be able to find effective solutions to network problems by learning from international experiences and best practice.

While the REGCOVID platform is initially envisioned as an informative tool, it has also been expanded to provide an interactive and engaging platform for continuous sharing throughout this crisis and beyond.[17]

ITU EMERGENCY COMMUNICATIONS GUIDELINES[18]

The implementation of a national emergency telecommunication plan (NETP) is an essential prerequisite for policy, procedures, and governance that enable reliable and resilient information and communications in all four phases of disaster risk management: mitigation, preparedness, response and recovery. The effective management of the risk of disasters depends on communication and information sharing across all levels of government, within

16 https://news.itu.int/covid-19-how-do-we-contain-the-spread-of-disinformation-on-digital-platforms/

17 https://reg4covid.itu.int/ ; www.itu.int/en/mediacentre/Pages/STMNT01-2020-global-platform-telecommunication-COVID-19.aspx

18 Refer to www.itu.int/en/ITU-D/Emergency-Telecommunications/Pages/Publications/Guidelines-for-NETPs.aspx

communities, and between public and private organizations. It is intended primarily for national authorities responsible for the development and implementation of the NETP.

The Guidelines emphasise the importance of including an overall risk assessment for the particular country in the NETP and describes the topics that should be included in the NETP. The guidelines reviews how different networks and telecommunication/ICT services can be used in an emergency. They also outline existing international cooperation and coordination mechanisms, as well as how they can be implemented by a given country.

BROADBAND COMMISSION'S AGENDA FOR ACTION

There are three pillars of the Agenda for Action:

1. Resilient connectivity;
2. Affordable Access; and
3. Safe use of inline services for informed and educated societies.

(i) Resilient Connectivity

Sustain and extend resilient, stable and secure infrastructure to support all populations, including emergency responders.

Increase bandwidth, restore service access where this has been restricted, strengthen network resilience, manage network congestion, prioritize connections to critical government functions, vital services and strategic connectivity points.

(ii) Affordable Access

Increase affordability, availability and accessibility of services and devices to ensure business and service continuity, support digital connectivity to ensure access to information and to promote social cohesion during confinement.

(iii) Safe use of online services for informed and educated societies

Support safe use of online services by all, especially children and vulnerable population; respect the right to privacy and promote trust and security in the use of data.

Enable safe digital content sharing to support e- education, e-health, digital agriculture, e-financial services and mobile payments, and e-government platforms. Promote the use of broadband to provide distance-learning programmes for all ages.

ITU/WORLD BANK/WEF/GSMA'S JOINT ACTION PLAN AND CALL FOR ACTION[19]

The Digital Development Joint Action Plan and Call for Action by the World Bank, World Economic Forum (WEF), GSMA and the ITU highlighted that due to our high dependency on digital technologies to cope with social distancing, ensure business continuity, and prevent service interruptions, immediate action is needed to respond to the digital challenges posed by COVID-19. This is particularly important in relation to those affected by the digital divide and thus remain unconnected to online services. The Call for Action outline five key objectives:

1. Increasing bandwidth, strengthening resilience and security of networks, and managing congestion;

2. Connecting vital services and ensuring the continuity of public services to safeguard the welfare of populations;

3. Powering FinTech and digital business models to support the most impacted businesses and communities;

4. Promoting trust, security and safety online; and

[19] www.worldbank.org/en/news/statement/2020/04/21/the-world-bank-wef-gsma-and-itu-mobilized-in-the-fight-against-covid-19

5. Leveraging the power of mobile big data.

In order to achieve the above objectives, the following sequencing of activities over the immediate and short terms were discussed:

6. Promote network resilience;
7. Ensure access and affordability of digital services;
8. Support compliance with social distancing principles while providing vital connectivity;
9. Leverage e-health, telemedicine and Big Data to address the health crisis; and
10. Ensure institutional frameworks are fit for purpose.

Beyond these outlined steps in response to the crisis, however, the Call for Action also emphasises that recognising the importance of universal broadband access to enable essential services and social cohesion must bring a new urgency to eradicating the digital divide and promoting digital inclusion worldwide.[20]

ATU'S CALL FOR HARMONISED ACTIONS

The African Telecommunications Union (ATU) has provided a set of guidelines that it recommends every Member State to consider in order to combat the COVID-19 pandemic. Although Africa has so far recorded relatively few COVID-19 cases compared to the rest of the world, Heads of States and Governments across the continent are taking no chances as they take action in various ways to combat the disease. As such, the ATU is urging the Ministries of ICT, through the telecommunications regulators and operators in the Member States, to consider implementing the following recommendations:

(i) Activation of the Common Alerting Protocol (CAP)

Regulators should implement the Common Alerting Protocol (CAP) to enable authorities to effectively prevent and mitigate the spread of COVID-19.

(ii) Collaborative Practical Measures

Regulators should focus on

a) Network Capacity
b) Emergency Numbers
c) Guidelines for action during emergencies
d) Amateur radio operators and simplification of type-approval processes

(iii) Streamlined Regulation Processes

Rapid response in the wake of a disaster is critical. Consequently, regulators should streamline the process to allow telecom/ICT services to be available as soon as possible.

a) Licensing
b) Frequency assignment
c) Priority call routing
d) Network redundancy
e) Importing telecom/ICT equipment.

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20 http://pubdocs.worldbank.org/en/788991588006445890/Speedboat-Partners-COVID-19-Digital-Development-Joint-Action-Plan.pdf

(iv) Multi-stakeholder collaborations

There should be coordinated efforts during this period and clearly defined functions for different government institutions, e.g. ministries of foreign affairs, ICT and communications, customs, regulatory agencies and first responders such as hospitals among others.[21]

GIGA PARTNERSHIP

The COVID-19 pandemic has shown the importance of universal connectivity. Unfortunately, it has also identified shortcomings in the connectivity provided to school and education institutions in a number of countries, as worldwide 1 billion children were out of school during the lockdown phase. While a number of countries are individually addressing this issue at the global level, the GIGA partnership supported by the ITU, UNICEF and many other organisations are attempting to connect every school.[22] The focus is on providing meaningful connectivity and key digital services like education, financial services and health information, not just to children, but to whole communities. The 13 high-impact countries which are the focus between April and September 2020 are Rwanda, Kenya, Niger, Sierra Leone, Kazakhstan, Kyrgyzstan, Uzbekistan, El Salvador, Honduras, Dominica, Grenada, St. Lucia, and St. Vincent.

2.4 Observed Key Differences

An assessment of the types of COVID-19 emergency initiatives undertaken by Government/regulators, operators and content providers found a very high degree of commonality and consistency across global COVID-19 emergency responses (see the summary exhibits above and **Appendix A**). The key differences identified are, namely:

- ***Regulator mandated versus market offered emergency COVID-19 initiatives.*** While most markets saw, for example, MNOs freely offering additional data allowances and similar, there were a few markets where such increases were mandated by the regulator. In overall terms, most operators in most markets have been generous during the COVID-19 period recognising COVID-19 as a 1-in-100 year event with (i) significant impact on their customers both in terms of their heightened level of demand but also in terms of the adverse economic impacts on other customers and (ii) material – hard to quantify - impacts on the health sector, education and the broader economy.

  For example, in the United States, the Chairman of the Federal Communication Commission (FCC), Ajit Pai when commenting on market versus mandates approach, indicated that "he preferred a market-based approach as he believed private sector would rise up with their own corporate responsibility initiatives rather than being forced by regulators".[23] This has been the basis for *Keep Americans Connected* initiative where more than 700 companies have made such a pledge.[24] In contrast, a smaller number of regulators have also implemented mandatory measures requiring operator cooperation in enhancing network infrastructure, ensuring quality of telecommunication services, etc. in order to address the effects of the COVID-19 pandemic.

- ***Government funding to the telecommunications sector for COVID-19 related costs or discounts.*** Related to the difference above, the common feature of the assistance provided by the sector is that such additional costs of *inter alia* additional capacity, free hosting or customer discounts etc. is borne by the operator.

  There would seem to be only a few examples such as Thailand[25] where Governments have expressly made financial contributions for the additional costs borne by MNOs etc. Having said that there are many examples, where Governments or regulators

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21 http://atu-uat.org/

22 https://gigaconnect.org/covid/

23 www.radioworld.com/news-and-business/pai-coronavirus-philosophy and www.fcc.gov/keep-americans-connected

24 Refer to www.fcc.gov/keep-americans-connected

25 Refer to www.bangkokpost.com/business/1890240/mobile-users-get-10gb-perk-from-april-10

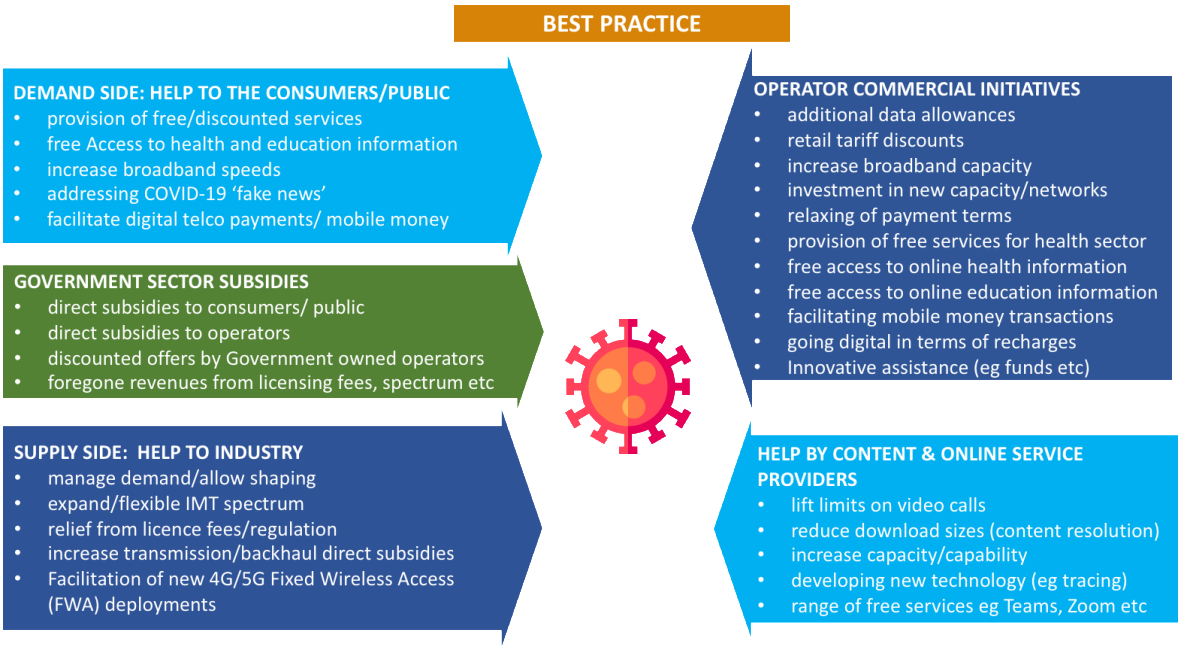
have foregone revenue and/or Government owned incumbents have provided a range of free or discounted benefits to customers and the broader population.

- ***Approach to Privacy issues.*** Another critical difference is in relation to country approaches to privacy issues especially in relation to contact tracing, information required to be provided by individuals found to infected with COVID-19 and information which companies which hold which could help combat coronavirus spread. Examples of this include India's National Railways makes installing India's tracing app mandatory for travel[26] after previously "advising" them of the need to install the app and China's QR code system which *inter alia* show a person's quarantine status and permits travel on subways etc.[27]

2.5 Overview and Best Practice

In overall terms, regulator and industry responses to the twin health and economic crises caused as a result of the spread of the coronavirus and ways to protect public health have been exemplary. Such responses shown in **Exhibit 7** below, have to the extent possible reduced the amplitude of the societal and economic dislocation caused by COVID-19 by providing connectivity in a period of self-isolation for most people and allowing the wheels of commerce to continue online to the extent possible.

Exhibit 7: Best practice in relation to emergency measures during COVID-19



Source: ITU, June 2020

While perhaps Governments could have provided more in the explicit subsidies to the sector, there is no doubt that other sectors of the economy like the health sector (requiring immediate government expenditures to expand capacity and capability) and aviation, tourism, hospitality, education etc. (requiring assistance to the ill effects of the lockdowns and social distancing) place a stronger demand for funds and assistance.

The larger risk going forward is what was authorised in haste has adverse impacts on sector competition, best practice for spectrum management etc. For example, temporary IMT spectrum licensing to address COVID-19 issues (such as South Africa's – see Exhibit 8 below) becomes permanent without having the opportunity to review/amend etc. given the investment made and the customers contracted. Likewise temporary retail tariff adjustments

26 This is notwithstanding the Indian Supreme Court has issued a directive stating that making the app mandatory is illegal. See www.outlookindia.com/website/story/india-news-indian-railways-makes-installing-aarogya-setu-app-mandatory-for-travel/352577

27 www.scmp.com/tech/apps-social/article/3064574/beijing-rolls-out-colour-coded-qr-system-coronavirus-tracking

result in sub-standard economic returns on capital for operators or distortions in tariff structures.

Exhibit 8: South Africa's temporary IMT Spectrum licensing

On 6 April 2020, the Independent Communications Authority of South Africa (ICASA) published a Government Gazette prescribing the minimum standards that licensees must adhere to for the entire period of the National State Disaster.[28] A critical measure introduced by the regulations is the temporary release of high demand spectrum (HDS) for the duration of the national state of disaster in order to ease network congestion, maintain good quality of broadband services, and enable licensees to lower cost of access to consumers.

ICASA considered written applications for temporary radio frequency spectrum assignments in the 700, 800MHz, 2300, 2600 and 3500MHz bands, including the use of Television Whitespaces (TVWS) in an effort to ensure connectivity for all during the National State of Disaster period. Applications were due on 9 April 2020.As the allocation of HDS spectrum has been delayed a number of times over an extended period in South Africa, there is considerable demand for additional IMT spectrum.

On 21 April 2020, following an assessment of 35 applications received, ICASA announced a range of temporary spectrum licences which would apply to November 2020. It has been made clear by ICASA that the emergency release of this spectrum does not negate the processes currently under way for the permanent assignment of this IMT spectrum through a spectrum auction.

ICASA determined *inter alia*:[29]

1. ***700/800 MHz.*** Due to the fact that analogue and digital Television Broadcasting services are still operating in the 700MHz and 800MHz frequency bands, sharing and co-existence in these frequency bands would have to be implemented systematically through a geographic separation of IMT Systems and Broadcasting Services in affected areas. Thus, Telkom was temporarily assigned 2x 20 MHz, MTN was temporarily assigned 2 x20 MHz and Vodacom was temporarily assigned 2 x20MHz.
2. ***2300 MHz.*** Telkom was temporarily assigned 20MHz in addition to the 60MHz it already has been licensed for in this band while Vodacom was temporarily assigned 20MHz.
3. ***2600 MHz (TDD).*** Of the 170 MHz which was available: Telkom was temporarily assigned 40MHz, Vodacom was temporarily assigned 50MHz, MTN was temporarily assigned 50MHz and RAIN Networks was temporarily assigned 30MHz in addition to the 20MHz it already has been licensed for in this band.
4. ***3500MHz band.*** Of the 116 MHz which was available: Telkom was temporarily assigned 12MHz in addition to 28 MHz it is currently assigned 28MHz in the 3500MHz band (so 40 MHz in total), Vodacom was temporarily assigned 50MHz, MTN was temporarily assigned 50MHz and Liquid Telecoms was temporarily assigned 4MHz; which adds to the 56MHz it already has been licensed for in this band (so 60 MHz in total).

Additional conditions.

All successful licensees for temporary IMT spectrum assignments are required to support and create virtual teaching and classrooms as determined by the Department of Basic Education and the Department of Communications and Digital Technologies in various districts during the National State of Disaster. Furthermore, all licensees must zero-rate all COVID-19 sites as identified from time to time by the Department of Health and published in the Government Gazette. ICASA has stated that temporary spectrum will cease in November 2020 when the spectrum will be auctioned.[30]

Source: ICASA, April 2020

28 www.icasa.org.za/legislation-and-regulations/ict-covid-19-national-disaster-regulations

29 www.icasa.org.za/news/2020/temporary-radio-frequency-spectrum-issued-to-qualifying-applicants-in-an-effort-to-deal-with-covid-19-communication-challenges

30 https://businesstech.co.za/news/telecommunications/399003/mobile-operators-will-stop-getting-access-to-free-spectrum-in-november/

3 COVID-19 recovery phase

3.1 Overview and Best Practice

In terms of the second phase, eight initiatives and reforms have been identified, which would significantly facilitate the COVID-19 recovery phase – in countries globally. The initiatives and reforms address both the pandemic issues directly and ameliorate the adverse economic impacts of COVID-19 by continuing to support work from home/school from home (WFH/SFH) activity where possible by consumers. These are detailed below and explored in further depth in this section:

(i) COVID-19 Contact Tracing Apps;
(ii) Accelerate the assignment of globally harmonized IMT spectrum;
(iii) Accelerate 4G/and in the future 5G deployment and the transition from legacy 2G/3G networks;
(iv) Deployment of Fixed Wireless Access (FWA) as complimentary and substitute broadband networks;
(v) Facilitate innovative and future technologies to bridge the 'digital divide';
(vi) Misinformation and COVID-19;
(vii) Cybersecurity and COVID-19; and
(viii) Big data responses/data processing.

3.2 COVID-19 Contact Tracing Apps

As part of (i) the process of the opening economies and societies after any lockdown, (ii) to ensure self-isolation if a person has been exposed to the coronavirus and (iii) as part of moving to the new normal, in the event of a positive test to the coronavirus, public health teams are using tracing to determine the other persons which may have been exposed. To make this process easier, faster and more automated, technology in the form of tracing applications on smartphones are being utilised to assist in this process.

While there is no consensus on the number of country tracing apps which have or are in the process of being developed, there could be as many 60+ country[31] apps being designed or deployed. There are at least 25 according to the MIT Technology Review[32], and 47 tracing apps in 28 countries according to the COVID Digital Rights Tracker[33] Irrespective of the exact number it is likely that a large number of countries will develop or utilise a tracing app given the global proliferation of the virus. They are taking advantage of the fact that approximately 50 percent of the world's population has a smartphone (and in certain markets the proportion is as high at 95 percent) and that individuals typically have their smartphones on them always.

Importantly, such apps supplement contact tracing but do not replace it as there are other critical factors like ventilation etc. that are not recorded in any tracing app.[34] South Korea which is seen as one of the global exemplars on handling COVID-19 does not use a contact tracing app although it uses multiple technology solutions where more personal information is collected and disclosed. [35]

The move to tracing apps has raised a number of important issues concerning privacy especially as to whether the information is location based and with whom the information is shared. Key to that debate is whether the data is stored centrally in a remote server typically managed by Government where matches are made with other contacts, should a person be diagnosed with COVID-19, or the information is decentralised and retained on the phone (see

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31 See comments from Associate Professor Frank den Hartog from the School of Information Systems and Technology Management at UNSW Canberra. Available at www.spatialsource.com.au/latest-news/covid-tracing-app-plagued-by-privacy-efficacy-concerns

32 Refer to www.technologyreview.com/2020/05/07/1000961/launching-mittr-covid-tracing-tracker/

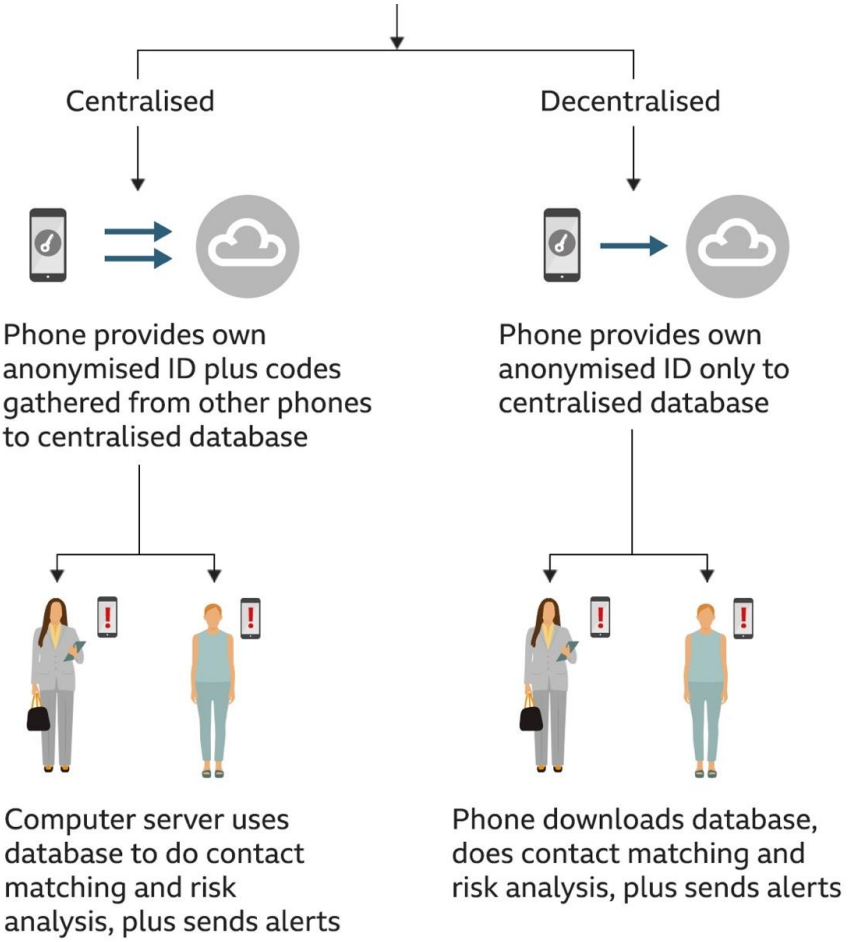
33 Refer to www.top10vpn.com/research/investigations/covid-19-digital-rights-tracker/

34 Jason Bay, *Automated contact tracing is not a coronavirus panacea*, 11 April 2020, Available at https://blog.gds-gov.tech/automated-contact-tracing-is-not-a-coronavirus-panacea-57fb3ce61d98

35 Norton Rose Fulbright, *The facts about COVIDSafe* Webinar, 1 May 2020.

Exhibit 9 below). The decentralised model using Bluetooth is supported by digital platforms such as, Apple, Google and other industry players.

Exhibit 9: Centralised versus decentralised apps



Source: BBC[36]

CONTACT TRACING APP AND INTEGRATION INTO MOBILE OPERATING SYSTEMS

On 11 April 2020, Apple and Google announced a joint collaboration which will open up their respective mobile operating systems to allow for the creation of advanced contact-tracing apps, which will run on iPhones and Android smart devices. The apps work by using Bluetooth technology in mobile phones to keep track of every other phone a person comes into close contact with over the course of a day; if that person later is diagnosed they have COVID-19, they can use the same system to alert all those people, dating back to before they would have become infectious (see **Exhibit 10** below)

Due to urgent public health need, Apple and Google are addressing this problem in two stages. First, in mid-May 2020, both companies released an application programming interface (API) that enables "interoperability between Android and iOS devices using apps from public health authorities." These apps are available for users to download on the Google Play Store and Apple App Store.[37]

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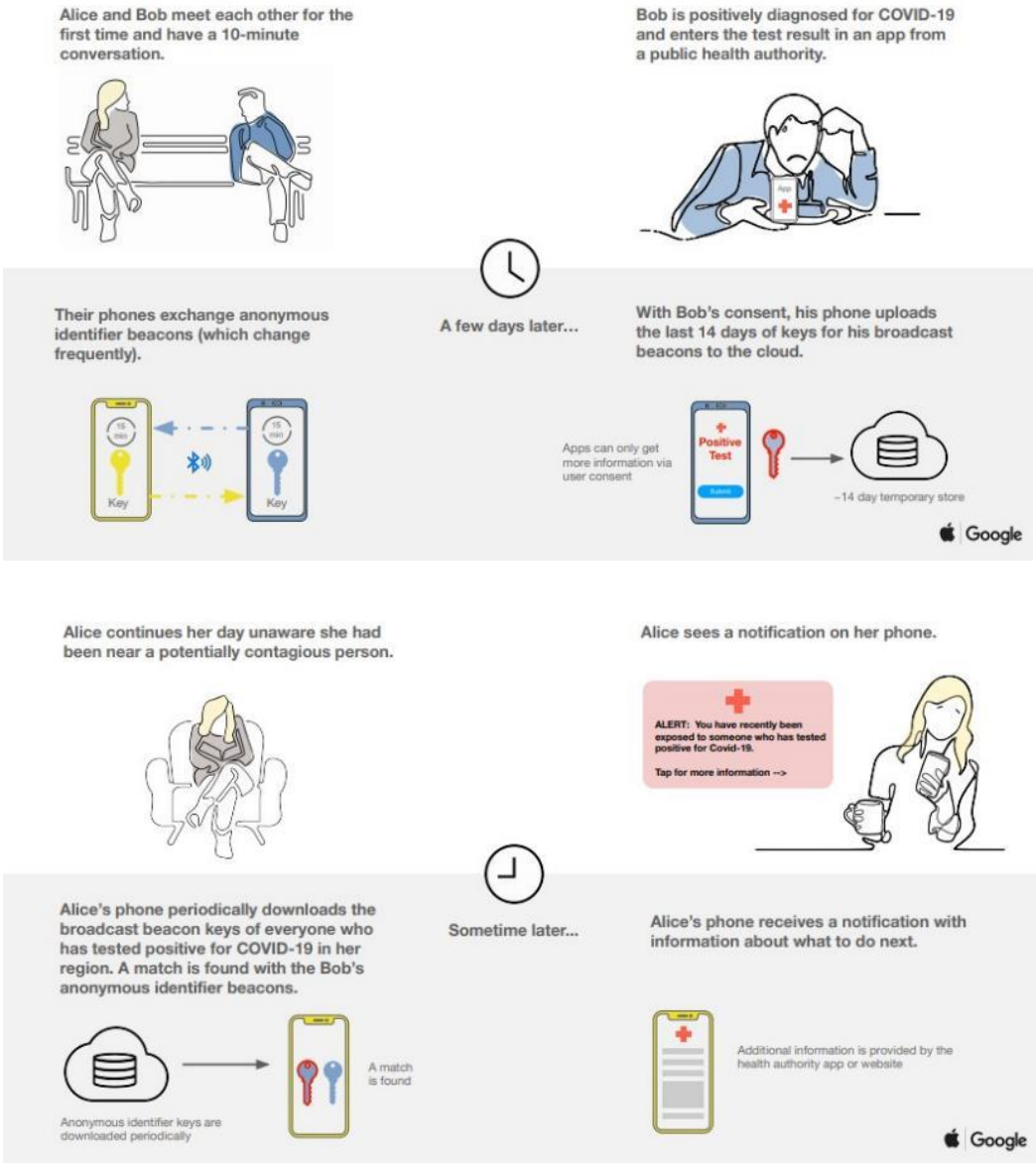
36 Refer to www.bbc.com/news/technology-52355028

37 As at 22 May 2020, 22 countries in 5 continents had been granted access to the exposure notification API. Refer to www.technologyreview.com/2020/05/20/1002001/apple-and-googles-covid-tracing-tech-has-been-released-to-22-countries/

On Android, the API become available for apps through an update to Google Play Services.[38] Anonymous COVID-19 contact tracing via Bluetooth (not GPS location) called "Exposure Notification" first became available with iOS 13.5 on iPhone. This software addresses known issues with iPhones where it was less effective in exchanging Bluetooth handshakes if the app is running in the background or the screen was locked. Previously, iOS13 in 2019 implemented tighter restrictions on Bluetooth to minimise location tracking.[39]

Exhibit 10: Apple-Google contact tracing apps



Source: Apple-Google, 2020

[38] For Android devices without Google Mobile Services (including those in China and newer smartphone releases by Huawei and Xiaomi etc) Google "intends to publish a framework that those companies could use to replicate the secure, anonymous tracking system developed by Google and Apple." It will be up to 3rd-parties to decide whether they want to use that system. Refer to www.theverge.com/2020/4/13/21220033/android-covid-19-tracking-updates-google-play-contact-tracing

[39] www.theverge.com/2019/9/19/20867286/ios-13-bluetooth-permission-privacy-feature-apps

Second, in the next few months, both Google and Apple will add support for a new Bluetooth Low Energy service into Android and iOS. For iOS, this new Bluetooth service will likely come via an iOS update, while for Android, this service will likely be added as part of another update to Google Play Services. Google says that adding a Bluetooth LE Contact Tracing service "is a more robust solution than an API and would allow more individuals to participate, if they choose to opt in, as well as enable interaction with a broader ecosystem of apps and government health authorities."[40]

PUBLIC ADOPTION OF CONTACT TRACING APPS

At the present time India's Aarogya Setu is the most popular contact tracing app, with more than 116 million reported downloads. To tackle adoption issues in India, the government has ruled all government and non-government sector workers must use it. Singapore's TraceTogether app[41] was launched in March 2020– now has more than 1.5 million users and is open source. If a person tests positive to COVID-19 in Singapore the data is then uploaded (with permission) to the country's Ministry of Health, who can access the phone numbers recorded as in 'close contact' and let people know they've been exposed.[42]

The Australian Government's voluntary COVIDsafe tracing app which was based on Singapore's tracing app but has been augmented has had more than 6.1 million downloads since 25 April 2020.[43] Colombia's contact tracing app which had more than 4.3 million downloads by 3 May 2020 removed the contact-tracing feature from its official coronavirus information app after the feature experienced glitches. They are now moving to the Apple-Google Bluetooth system when released as it is expected to be more reliable.[44] A number of other countries are also now waiting or redesigning their systems around the Apple-Google API and latter inclusion in their core operating systems.

The United Kingdom which has been testing its own contact tracing app on the Isle of Wight since 5 May 2020, may move to a second different tracing app using Apple-Google technology if this proves superior.[45] On 14 May 2020, it was announced that Denmark will also use a decentralised tracing app.[46] Switzerland, Latvia and Italy have also opted for Bluetooth technology based on technology from Apple and Google.[47] On 1 June 2020, the United States legislators released the first draft of the *Exposure Notification Privacy Act* to regulate privacy issues associated with contact tracing apps.[48] France launched StopCOVID on 3 June 2020 and within a day had over 600,000 downloads.[49]

There remains a number of key challenges to contact tracing apps namely:

(i) ***how does contact tracing for feature phones that still use 2G, do not have Bluetooth and cannot run tracing apps?*** Given the constraints of feature phone operating systems, getting the contact tracing app installed on basic phones is a significant challenge. Currently the only option is to do location tracking at the network level on legacy networks like 2G but the granularity of the location is not usually particularly accurate and there are a range of privacy issues. As it is understood that some Indian states have attempted to implement network-level tracing, the Indian Government (via tweet from the IT Minister) has stated that it will develop a COVID-19 contact tracing that will work on legacy 2G phones which

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40 www.xda-developers.com/google-apple-contact-tracing-coronavirus/

41 www.tracetogether.gov.sg

42 www.channelnewsasia.com/news/singapore/covid-19-contact-tracing-device-trace-together-app-12806842 . Note also that the Singaporean Government is developing and will "soon" roll out a portable and wearable contact tracing device for everyone in Singapore if it works.

43 www.covid19data.com.au

44 www.businessinsider.com/colombia-contact-tracing-apple-google-coronavirus-app-2020-5?r=AU&IR=T

45 www.ft.com/content/56b5919e-1590-415f-9296-3084c9e9e90a

46 www.dr.dk/nyheder/penge/efter-kritik-sadler-regeringen-om-ny-corona-app-skifter-til-apple-og-googles-teknologi

47 www.itnews.com.au/news/europe-pins-hopes-on-smarter-coronavirus-contact-tracing-apps-548982

48 www.technologyreview.com/2020/06/02/1002491/us-covid-19-contact-tracing-privacy-law-apple-google/

49 www.bbc.com/news/technology-52905448

comprise 550 million devices or more than 50 percent of India's mobile penetration.[50]

(ii) ***How will tracing apps work when international travel is re-opened after the current lockdowns?*** Currently, all of the tracing apps and contact databases are national and as such international roaming subscribers would need to download a country's tracing app for it to be of benefit if they are able to do so, as many apps are restricted to the country specific page in the Apple Store and in Google Play. It is unclear whether some international roaming arrangements will be established. These issues are likely to be first addressed in Europe given its extensive land borders and economic integration.

3.3 Accelerate the assignment of available globally harmonized IMT spectrum

The advent of working from home (WHF)/study from home (SFH) arrangements arising from the coronavirus pandemic has also highlighted the need for the assignment of available globally harmonized IMT spectrum in order to support higher bandwidth speeds, capacity and improved Quality of Service (QoS) and Quality of Experience (QoE). While available IMT spectrum has been made available on a temporary basis, in the COVID-19 recovery phase there is strong argument for Governments and industry regulators to accelerate the assignment of IMT spectrum. The ITU's Guidelines for the preparation of national wireless broadband masterplans for the Asia Pacific region recommended that each market except smaller country markets should assign at least 840 MHz of IMT spectrum in total, preferably over 1,000 MHz.[51] This is not including larger mmWave allocations for 5G. Other ITU studies recommend the release of a larger quantum of spectrum for IMT uses.[52]

While a number of countries have assigned IMT spectrum in the past 12 months, especially in the mid-band and mmWave for 5G, as the comparison below shows (see **Exhibit 11** below), the percentage of harmonised IMT spectrum licensed in each ITU region ranges between only 40 to 60 percent of the total harmonised IMT spectrum. Thus, depending on the country, a typical amount of spectrum yet to be licensed in 2019 was between 300 to 700 MHz.

Exhibit 11: Comparison of IMT spectrum licensed in each ITU region versus harmonised IMT spectrum

	Region 1 (EU/EFTA)	Region 1 (ASMG)	Region 1 (Africa)	Region 1 (CIS/Balkans)	Region 2	Region 3
Average spectrum licensed in 2019	757 MHz	556 MHz	477 MHz	430 MHz	426 MHz	549 MHz
Percentage of harmonised spectrum licensed	60%	52%	44%	40%	41%	60%
Typical amount of spectrum yet to be licensed (2019)	300 to 400 MHz	500 to 600 MHz	500 to 700 MHz	600 to 700 MHz	500 to 600 MHz	300 to 500 MHz

Source: LSTelcom, 201953 NB. Analysis undertaken pre -WRC-19.

It is especially important to facilitate the assignment of the digital dividend in the spectrum bands (600/700/800 MHz) in order to address the digital divide as sub-1 GHz spectrum is the fastest and most affordable method to provide broadband services. It is critical that regional

50 www.theregister.co.uk/2020/04/30/india_to_develop_contact_tracing_for_feature_phones/

51 ITU, *Guidelines for the preparation of national wireless broadband masterplans for the Asia Pacific region*, February 2013. Available at www.itu.int/pub/D-PREF-THEM.05-2013

52 Refer to ITU-R, *Future spectrum requirements estimate for terrestrial IMT, Report M.2290-0 (12/2013).* Available at www.itu.int/dms_pub/itu-r/opb/rep/R-REP-M.2290-2014-PDF-E.pdf

53 LSTelcom, Analysis of the World-Wide Licensing and Usage of IMT Spectrum, 5 April 2019, Available at www.esoa.net/cms-data/positions/2019_Study_LicensingUseofMobileSpectrum_1.pdf EU is European Union, EFTA is European Free Trade Area; ASMG is Arab Spectrum Management Group; and CIS is Commonwealth of Independent States.

and rural students and citizens during any lockdown periods due to COVID-19 also have access to affordable high-quality wireless broadband. High speed wireless broadband services should not be restricted solely to urban areas.

Ensuring that there is sufficient IMT spectrum available to operators is essential for effective broadband service deployment. Knowing that there will be sufficient spectrum in the future to support both 4G and 5G service offerings, MNOs and all market players in every market can confidently make the necessary long- term investments in digital infrastructure.

3.4 Accelerate 4G/5G deployment and the transition from legacy 2G/3G networks

Similar to the need for additional assignment of available IMT spectrum the increased demand for broadband services especially wireless broadband services during global lockdowns and WHF/SFH arrangements has given rise to both regulatory and operator queries about how 4G and in the future 5G deployment can be accelerated in order to support higher speed and greater capacity wireless broadband services. It is especially important where there is continued growth in demand for online services, establishing a new higher level normal after the peak of the COVID-19 cases. Such network and the devices which run on them support the downloading of apps, Bluetooth and other location services needed for contact tracing apps. South Korea for example will focus on 5G network deployment and artificial intelligence (AI) as part of its post COVID-19 recovery, as it considers 5G to be a growth engine.[54]

In many global markets, WHF/SFH due to the coronavirus has been a catalyst to seismic shifts in *inter alia* social media group interaction, online streaming of content and distribution, learning and online commerce. It has also resulted in profound regulatory changes in many countries. Such changes, which are beyond the scope of this report, allow online banking and financial transactions,[55] legal hearings, telehealth, pharmaceutical dispensation, and similar.

While many of these trends were occurring, the pace of changes, was in certain cases slow. In March and April 2020, in many countries, through a range of quick regulatory changes and just things moving instantly online these changes were made, affecting forever, the scope, level and nature of online activity. As the famous quote states "*There are decades where nothing happens; and there are weeks where decades happen.*"[56] Early 2020 is one of those times where decades happen in weeks as activities that could go online, did.

To support that additional and growing online demand (along with declining demand for circuit switched voice services in certain markets) there is likely a need to refarm existing 2G/3G spectrum to 4G and 5G services. As highlighted in a recent GSMA report on case studies in Asia-Pacific examining 2G/3G switch off and the transition from such legacy networks, [57] while the process takes three years from initial decision-making to switch-off on average, it can be shorter if adoption rates of new generation mobile technologies are relatively high. In order to assist the COVID-19 recovery phase and the transition to COVID normal, such transition should receive Governmental and regulatory support as it will provide significant additional wireless broadband speed and capacity.

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54 https://techwireasia.com/2020/05/south-korea-to-focus-on-5g-ai-in-post-covid-economic-recovery/

55 For example, temporary amendments to the law on digital signatures. See www.nortonrosefulbright.com/en-au/knowledge/publications/0c4f149c/out-of-the-dark-ages-for-now

56 Attributed to Lenin, 11 March 1918, first published *Izvestia VTsIK* No. 46, March 12, 1918 refer to English translation in www.marxists.org/archive/lenin/works/1918/mar/11.htm but is similar to a quote in a letter from Karl Marx to Friedrich Engels in Manchester 9 April 1863. English Translation available at https://marxists.catbull.com/archive/marx/works/1863/letters/63_04_09.htm

57 GSMA, *Legacy network rationalisation: Experiences of 2G and 3G migrations in Asia-Pacific, May 2020.* Available at www.gsma.com/spectrum/resources/legacy-mobile-network-rationalisation/

3.5 Deployment of FWA as complimentary and substitute broadband networks

Given the increased traffic from WFH and SFH, mobile operators are looking to quickly augment coverage and capacity over cities and urban areas which may be subject to social distancing requirement. The rapid deployment of 4G/5G fixed wireless access (FWA) services to (i) provide coverage where the fixed network is non-existent or somewhat limited and/or (ii) to quickly meet demand increases arising after the pandemic crisis, should be examined by operators, and regulators.

Instead of short-term approaches, the deployment of 4G/ and in the future 5G FWA services may provide more comprehensive fibre-like solutions.[58] They offer high speed broadband, low-latency, zero-touch, plug-and-play, quick delivery, flexible tariffs, and affordability. The latter is critical in both developed and emerging markets and in economies suffering dislocation as a result of COVID-19. FWA can effectively support the needs of WFH, SFH, telemedicine, and where necessary support health services which has been established for coronavirus spread prevention and treatment of patients. They can immediately address societal issues including providing connectivity, helping generate incomes and reducing societal isolation, etc.

FWA infrastructure -may be considered as an integral part of each country's digital evolution and digital infrastructure as defined by the ITU[59] and form part of technology neutral national broadband deployments in global markets.

This has been the case in Italy where FWA networks have proved to be very resilient even with traffic increases of more than 50 percent.[60] Furthermore, in Thailand, AIS Thailand and Truemove have launched the FWA package, which supports WFH/SFH activities. While in Egypt mobile operators have offered FWA packages during the coronavirus epidemic, with significant discounts for consumers of up to 50 percent.

Going forward, investment in and the early rollout of FWA services (i) supports the Government's health response to fighting the coronavirus, (ii) meets societal needs in the short to medium term during the COVID-19 crisis by helping to reduce the current pressures on existing telecommunications networks which arise from working and studying from home which were often not dimensioned for such traffic, and (iii) provides mobile operators with considerable commercial returns in the long term from investing in FWA networks.

The key thing to note commercially is that FWA services provide high speed 'FTTx-like' affordable connectivity sought by businesses – large and small, homeowners and consumers at their preferred locations during the current pandemic period but also into the future.

They are both an affordable substitute and a complement to the deployment of fixed FTTx services. Certainly, FWA can play an important role in the rapid achievement of the Government policy objectives of universal coverage (ie action to bridge the 'digital divide' may need to be accelerated as a result of country coronavirus responses) and create more competitive broadband markets going forward. Such commercial returns might be sustainable by sharing the cost of provisioning broadband access through the use of wireless 4G and 5G technologies.

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58 The GSA identified 395 operators in 164 countries selling FWA services based on LTE. In addition, of the 73 operators that have announced 5G launches worldwide, GSA counted 37 operators that have announced the launch of either home or business 5G broadband using routers. Of these 37, GSA identified 30 operators selling 5G-based FWA services. See GSA, *Global Status Update: Industry Report to determine the extent of FWA services,* April 2020

59 See ITU, *Digital Infrastructure Policy and Regulation in the Asia-Pacific Region*, September 2019. Available at www.itu.int/en/ITU-D/Regional-Presence/AsiaPacific/SiteAssets/Pages/Events/2019/RRITP2019/ASP/ITU_2019_Digital_Infrastructure_5Sep2019FNL.pdf

60 See www.bitmat.it/blog/news/94180/coronavirus-aumenta-la-domanda-di-connettivita-fwa: (in Italian).

3.6 Facilitate innovative and future technologies to bridge the 'digital divide'

The global COVID-19 pandemic has highlighted the critical importance of bridging the 'digital divide' which exists particularly in least developed markets, small island developing states (SIDS) and remote regions. While there has been great advances in providing terrestrial connectivity the numbers clearly show that there is significant room for improvement of those global indicators.

Consistent with the ITU's *Connecting the Unconnected* goals[61] innovative and future technologies may be utilised to address gaps in terrestrial fixed and mobile broadband service coverage. This is a very important step for the development of an information society with more inclusion and reliability.

Driven by customer demand, satellite operators have invested in cutting-edge high-throughput satellites which increase Internet capacities by hundreds of orders of magnitude while greatly lowering the cost per megabyte. Internet speeds and prices might be comparable to terrestrial services, but with ubiquitous satellite coverage.[62] Non-geostationary (GEO) satellite constellations also aim at providing affordable coverage and services. Previously unserved and underserved communities, which may not have been viable to serve by land-based networks, would then be connected.

Furthermore, solar-powered lightweight high altitude platform systems (HAPS) are examples of the current state-of-the-art of a technology that can be used to support affordable broadband connectivity in unserved areas.[63] It presents itself as an innovative approach – a complementary way to connect unserved and underserved areas. It will require harmonised spectrum to secure its many benefits and to achieve economies of scale. Such economies of scale will be crucial for successful low-cost deployments of HAPS technology.

3.7 Misinformation and COVID-19

Misinformation and false stories about the COVID-19 pandemic have spread quickly around the world. The rise of 'misinformation or fake news' has been attributed to political groups and state agents wishing to propagate distrust and divide for the purpose of political gains, as well as to innocent people spreading misconstrued information that is nevertheless harmful to public interests.[64] The growing concern is that the so-called 'disinfodemic' is dangerous to the public, prompting people at home to try unproven medicines that may be putting their lives at risk.[65]

One aspect of the false reporting has also been linking the spread of COVID-19 to 5G. Such theories have given rise to an anti-5G movement internationally, despite global and local authorities refuting the existence of any link between 5G technology and COVID-19.[66] In Europe, 5G phone masts have been damaged or destroyed in countries including the United Kingdom, France, Netherlands, Sweden, Ireland, Cyprus and Belgium.[67] Outside Europe, Australia and New Zealand have similarly seen tower vandalism. In addition, in Australia, an anti-lockdown COVID-19 protest was in part a demonstration against the installation of 5G.[68]

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61 www.itu.int/en/mediacentre/backgrounders/Pages/connect-2030-agenda.aspx

62 Kathryn Martin, Access Partnership, *WRC-19: Driving the growth of satellite broadband*, ITU News, No.5, 2019, page90

63 Agostinho Linhares, Anatel, *Broadband connectivity with high-altitude platforms*, *Ibid*, page 60

64 https://pursuit.unimelb.edu.au/articles/fake-news-in-the-age-of-covid-19

65 https://news.un.org/en/story/2020/04/1061592

66 See, eg www.itu.int/en/Pages/COVID-19/5g-covid-19-statement.aspx; www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public/myth-busters; www.bbc.com/news/technology-52370616

67 https://news.un.org/en/story/2020/04/1062362

68 www.theguardian.com/australia-news/2020/may/10/ten-arrested-and-police-officer-injured-at-protest-against-victorias-covid-19-lockdown-laws

There have been number of global efforts from international organisations, governments and social media companies towards addressing the avalanche of misinformation surrounding COVID -19. For example, the ITU issued a statement that there is no scientific link between 5G and COVID-19.[69] The World Health Organization (WHO) added a "Myth Busters" section to its online coronavirus advice pages, discrediting claims that 5G mobile networks spread COVID-19. It further clarifies that viruses cannot travel on radio waves/mobile networks and COVID-19 is spreading in many countries that do not have 5G mobile networks.[70]

In addition, WHO is partnering with the ITU, the United Nations Children's Fund (UNICEF) and telecom operators to disseminate critical health information on COVID-19 via SMS to reach an estimated two billion people that are still using 2G phones.[71]

Governments and regulators have also been taking steps to combat the potentially dangerous myths about coronavirus. For instance, the Uganda Communications Commission (UCC) launched a new fact-checking unit within the Commission that will verify online content to identify false or misleading information.[72] The UCC also warned that it is a criminal offence under Ugandan laws to deliberately create and distribute fake news.[73] In Thailand and Indonesia, authorities have arrested people for allegedly spreading untrue facts related to the pandemic.[74] In South Africa, the Minister of Communications and Digital Technologies has issued Directions that impose an obligation on broadcasting licensees to carry public service announcements related to the national effort to combat COVID-19 and its impact.[75]

At the same time, technology and social media firms are involved in initiatives to prevent and eradicate non-authoritative content from their platforms. Facebook, LinkedIn, Reddit, Google, Twitter, Microsoft, and YouTube released a joint statement pledging to work together to elevate correct information and combat fake news.[76] Facebook is also partnering with the WHO to share reliable health updates,[77] while Twitter clarified its anti-fake news action plan, stating that it will start alerting users when a tweet makes suspicious claims about COVID-19.[78]

However, the right balance must also be struck between protecting freedom of expression and diversity of opinion, while still ensuring that disseminated content is not harmful to the public interest.

3.8 Cybersecurity and COVID-19

The COVID-19 pandemic has resulted in many people now working from home for the first time. However, remote working has cybersecurity risks such as malware infection, unauthorised access, data security, and insecure devices used by staff.[79] Hackers and cyber scammers are taking advantage of these risks, with cybercrime accelerating as COVID-19 continues to spread.[80] A report by the security firm Mimecast examined the first 100 days of the crisis (January to March 2020), revealing that spam and opportunistic detections globally have increased by 26.3 per cent, impersonation was up 30.3 per cent, malware by 35.16 per cent and the blocking of URL clicks by 55.8 per cent.[81]

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69 www.itu.int/en/Pages/COVID-19/5g-covid-19-statement.aspx

70 www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public/myth-busters

71 https://news.itu.int/covid-19-how-do-we-contain-the-spread-of-disinformation-on-digital-platforms/

72 https://uccinfo.blog/2020/04/13/ucc-launches-fact-checker/; www.pmldaily.com/news/2020/04/covid-19-crisis-ucc-launches-fact-checking-initiative-to-identify-misinformation.html

73 *Ibid*.

74 www.washingtonpost.com/world/asia_pacific/exploiting-fake-news-laws-singapore-targets-tech-firms-over-coronavirus-falsehoods/2020/03/16/a49d6aa0-5f8f-11ea-ac50-18701e14e06d_story.html

75 www.ensafrica.com/news/detail/2412/south-africa-coronavirus-covid-19-obligations/

76 https://twitter.com/fbnewsroom/status/1239703497479614466

77 https://news.itu.int/covid-19-how-do-we-contain-the-spread-of-disinformation-on-digital-platforms/

78 https://apnews.com/c8a542e2f22004c0c06cbbe1e1b58a52

79 www.staysmartonline.gov.au/alert-service/cyber-security-essential-when-preparing-covid-19

80 www.forbes.com/sites/emmawoollacott/2020/05/05/exclusive-cybersecurity-and-covid-19the-first-100-days/#1bb423f039d5

81 *Ibid.*

The case of Zoom, the video-conferencing company, exemplifies the need for increased cybersecurity during the coronavirus crisis. Zoom became the video meeting service of choice for many companies commencing remote working. Daily meeting participants on the platform surged from 10 million in December 2019 to 300 million daily meeting participants in April 2020.[82] However, after reports of multiple security and privacy issues with the platform surfaced, Zoom was faced with a lawsuit by investors and shareholders claiming that Zoom's security flaws were not disclosed to them.[83] In response, Zoom has increased security measures including the acquisition of a security company, Keybase.[84]

In response to the increased cybersecurity threats, governments have taken to steps to address gaps in security. For example, the Welsh Government announced a GBP248,000 cyber grant scheme for local authorities to help strengthen their IT systems.[85] The Dutch data protection authority published a tool to help people choose a videoconferencing platform based on its privacy protections.[86] The Australian Cyber Security Centre released guidelines that outline key cyber security practices for people who are working from home.[87] Similarly, the UK's National Cyber Security Centre published a guide for organisations on how to prepare for an increase in home working.[88]

Digital providers have also introduced new initiatives and products to assist in making remote work arrangements more secure. For instance, Google Cloud launched BeyondCorp Remote Access, a cloud-based product that allows employees to have secure access to their company's internal web apps from any device or location.[89] Aruba also integrated Aruba ClearPass Policy Manager with Microsoft endpoint protection platforms to improve enterprise cyberattack protection.[90]

Telecommunications providers have joined these efforts to increase cyber resilience. Deutsche Telekom has partnered with WatchGuard, a network security vendor, to deliver cyber defence to small and medium-sized businesses.[91] Telenor Bulgaria is also offering a series of free videos discussing common online risks and how to overcome them.[92]

It should be highlighted that such activity compliments extensive work done by the ITU in the area of child protection online. The Child Online Protection (COP) Initiative which commenced in 2008 was within the framework of the Global Cybersecurity Agenda (GCA), and was aimed at bringing together partners from all sectors of the global community to ensure a safe and secure online experience for children everywhere. It resulted in the ITU in partnership with UNICEF issued *Guidelines for Industry on Child Online Protection* in 2014[93] following a consultative process.

3.9 Big data responses/data processing

Given the high level of uncertainty regarding the future course of the pandemic at this stage, the roles that information and communications technologies may play are similarly uncertain. It is possible, for example, that the COVID-19 pandemic remains a significant threat into the

82 www.cnet.com/news/zoom-security-issues-zoom-buys-security-company-aims-for-end-to-end-encryption/

83 *Ibid.*

84 www.cnet.com/news/zoom-security-issues-zoom-buys-security-company-aims-for-end-to-end-encryption/

85 www.telecompaper.com/news/welsh-govt-provides-funding-for-local-authorities-to-boost-cyber-resilience--1337279

86 https://iapp.org/resources/article/dutch-dpa-tool-comparing-privacy-features-on-video-call-apps/

87 www.cyber.gov.au/advice/covid-19-cyber-security-tips-when-working-home

88 www.ncsc.gov.uk/guidance/home-working

89 www.zdnet.com/article/google-rolls-out-beyondcorp-remote-access-for-browser-based-apps/

90 www.telecompaper.com/news/aruba-partners-microsoft-to-advance-enterprise-cyberattack-protection--1338055

91 www.globenewswire.com/news-release/2020/04/29/2023984/0/en/WatchGuard-and-Deutsche-Telekom-Partner-to-Deliver-Enterprise-Grade-Security-Solution-for-Small-and-Midsized-Businesses.html

92 www.telenor.bg/en/news/telenor-offers-series-free-videos-Internet-safety

93 Available at www.itu.int/cop

indefinite future because of mutation, immunity turning out to be only temporary or because an effective vaccine is not found. In such a scenario, governments may choose to deploy more aggressive technological countermeasures to manage outbreaks in the general course of the virus. Relatively non-intrusive tracing apps may be augmented by tracking apps which monitor location as well as contacts. Citizens may face restrictions on their ability to move across geographic distances either during local outbreaks or more generally.

The roles of big data, artificial intelligence (AI) and machine learning are difficult to anticipate. As data accumulate on the patterns of virus outbreaks and the relationships between individual behaviours and probabilities of infection and so on, it is possible that combination of big data and AI will assist governments in anticipating the risks of virus outbreaks within certain geographic regions and/or among various demographic groups.

If the virus does turn out to be more persistent than expected it is likely that there will be a high level of innovation in response. The global and national telecommunications systems and associated devices and technologies form a powerful platform to enable humans to mount a range of effective responses. Widescale human body temperature sensing systems, for example, could provide very early alerts regarding individual and local infection which along with tracking and/or tracing apps and telehealth services could provide authorities with very effective containment mechanisms. Of course, such systems raise significant privacy concerns but it is far from clear that societies will be unwilling to trade-off some loss of privacy for more effective virus control should the proliferation of coronavirus proved to be persistent.

Such strategies to contain the virus will be aimed not only at the medical objectives of containing infection rates within the capacities of medical systems but also be attempting to minimise disruptions to economic activity as a result of virus containment measures. To the extent that the COVID-19 pandemic threat persists in the longer term it will be critical to enable as much economic activity as possible to proceed as normally as possible within the constraints of containment objectives. This will only be done by making the best possible use of all data and knowledge that can be generated about the behaviour of the pandemic as global experience of this phenomenon evolves. Importantly such systems may be put in place for any future pandemics which arise.

4 The new normal

"As long as the virus is circulating in this interconnected world and until we have safe and effective vaccines available, everyone remains at risk. What countries and people have to do is "to find a way to live with this virus for now. And this is what we call the new normal".
Dr Takeshi Kasai, World Health Organisation (WHO), 14 May 2020[94]

The world including Governments, international organisations and regional institutions are grappling with what is the new normal; the post COVID-19 normal. So is the telecommunications and ICT sector.

4.1 Speculating on the 'new normal'

While necessarily speculative, key factors identified what is likely to comprise that 'new normal' for the sector are:

- Some short term measures will need to become long term measures: e.g. increased bandwidth demand due to video and streaming content – especially if COVID-19 turns to be more persistent than some are hoping due to virus mutation, impermanence of immunity responses and non-appearance (or very delayed appearance) of an effective vaccine. Business and social use of communications will need to make semi-permanent adaptations to social distancing regimes imposed by Governments or embraced by society;

- Unless supported by Government monies, short-term emergency measures cannot be sustained moving forward by the industry even though it is arguably better positioned that other sectors of the economy. Specifically, free additional data allowances provided by MNOs, free content by pay TV operators, etc. during the emergency phases will need to revert to pricing and supply where a commercial provider is able to make a reasonable rate of return. Such returns are necessary for investment in new networks and additional capacity. This is critical as it can be expected that national regulators while willing to accept lower QoS during the emergency phases of the COVID-19 pandemic are unlikely to accept this in the longer term; neither will customers;

- Even if the virus threat completely recedes, new habits and expectations formed during the COVID-19 pandemic (e.g. webinars, conferences, business meetings, WFH, SFH, online shopping, co-viewing etc.) will likely result in permanent changes in demand for services and, to the extent that the virus continues to be a threat, behavioural changes will be layered over the ongoing virus adaptations;

- Changing temporal patterns of demand will be difficult to predict and may be quite fluid as perceptions about the immediacy of the virus threat wax and wane. These changes may lead to more volatility and unpredictability in demand patterns at the country or regional level but could also lead to improved average utilisation of the sector's network investments;

- Contact tracing apps and associated coronavirus digital mitigation measures (discussed in section 3) will become ubiquitous, with appropriate national and international roaming protocols. The need for such apps is likely to drive the uptake of smartphones and attendant advanced mobile networks which are better able to support digital mitigation measures, even though global exemplar practice sees such apps as part of well-funded public health contact tracking efforts. Linked to this are new practices and requirements in the networks and cloud infrastructure related to security: for example, digital health certificates, and related issues of private data ownership.

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94 Dr Takeshi Kasai, the World Health Organisation's (WHO) regional director for the Western Pacific. Comments to the virtual *World Economic Forum-WHO joint briefing on COVID-19 response in the Asia-Pacific,* 14 May 2020

- The critical importance of social inclusion issues for the sector is also well recognised. The issue of universal service will be heightened, new forms of digital divide e.g. older users not being sufficient digital literate, gender divide, and the need for improved affordability for ubiquitous broadband for all citizens and residents. Inclusion and digital divide issues will be heightened due to the fact that the negative impacts of the pandemic will fall more heavily on the less well off. Thus on social equity grounds in the new COVID normal world, there are pressing reasons to accelerate connectivity and digital skills for an estimated 3.6 billion people who remain totally offline. As well as terrestrial network deployments innovative and future technologies such as non-GEO satellites and HAPS should be facilitated in order to connect the unconnected.

  As recently stated by ITU Secretary-General and Broadband Commission for Sustainable Development Co-Vice Chair Houlin Zhao "*As the COVID-19 pandemic accelerates, making in-roads in the developing world and threatening all of humanity, we need to take immediate action to ensure no one is left behind. This unprecedented crisis shows that nobody is safe until we are all safe. And it shows, with no ambiguity, that we will not unleash the full potential of broadband until we are all connected*."[95]

- The new normal means greater coverage and faster broadband speeds. As such the approximately 164 countries which have already have broadband plans as listed by the Broadband Commission[96] should review those plans, say by 2021, in order to assess the whether such plans are compatible with the new normal. As well as country coverage, the minimum broadband speed targets in such broadband plans ought to be adjusted in order to support increased demand for WFH and SFH.

4.2 Facilitating 'smart cities'

One of the core ideas associated with the concept of the digital economy is the 'smart city'. As defined by the UNECE and ITU through a multi-stakeholder approach involving over 300 international experts:

> *A smart sustainable city is an innovative city that uses ICTs and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects.*[97]

Smart cities use deeply embedded digital technology to achieve highly efficient operation both from an economic and an environmental perspective. Smart cities also use a range of distributed information systems and applications to optimise the provision of services to residents achieving a high level of fiscal efficiency as well. The COVID-19 pandemic is likely to provide greater impetus to the adopt of such systems and applications in urban areas.

Concept of smart cities is dependent on deeply embedded digital infrastructure at every level. The Internet of things is a central concept. In smart cities digital sensors will be everywhere; analysing traffic flows, measuring air quality optimising heating and cooling of buildings, ensuring efficient energy use and generation and so on. Sensors will report their data to a network of cloud-based interacting distributed applications all designed for efficiency and service delivery optimisation. They will be utilised to facilitate social distancing and for future contact tracing.

The concept of smart cities emphasises the importance of the trade-offs between equity and efficiency and city and rural investments in infrastructure.

In an effort to work towards the goal of making "cities and human settlements inclusive, safe, resilient and sustainable" (SDG 11), the ITU and UNECE launched the "United for Smart Sustainable Cities" (U4SSC) in May 2016.[98] The UN4SSC is a global smart sustainable city initiative, supported by 14 other United Nations agencies, programmes, funds and

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95 www.itu.int/en/mediacentre/Pages/PR05-2020-Broadband-Commission-emergency-session-Internet-COVID-19.aspx

96 https://broadbandcommission.org/publications/Pages/SOB-2019.aspx

97 www.itu.int/en/ITU-T/ssc/united/Pages/default.aspx

98 www.unece.org/fileadmin/DAM/hlm/projects/SMART_CITIES/U4SSC-brochure.pdf, page 2.

secretariats, and provides an international platform for information exchange, knowledge sharing and partnership building.

The key objectives of the U4SSC include generating guidelines, policies and frameworks for the integration of ICTs into urban operations, based on the SDGs, international standards and urban key performance indicators (KPIs), and helping to streamline smart sustainable city action plans, and establish best practices with feasible targets that urban development stakeholders are encouraged to meet.[99]

Part of the U4SSC's work focuses on accelerating job creation by enabling new business opportunities and encouraging the creation of small and medium-sized enterprises (SMEs) in smart sustainable cities through the adoption of appropriate policies and inclusion of innovative technologies including Internet of Things (IoT), blockchain, and artificial intelligence (AI). Such technologies are likely to ameliorate the adverse health and economic impacts of the pandemic.

Currently, the U4SSC is working on guidelines on tools and mechanisms to finance SSC projects; guidelines on strategies for circular cities; a city science application framework; guiding principles for artificial intelligence in cities; and blockchain in cities, *inter alia*.[100]

4.3 Accelerating the move to the digital economy in the 'new normal'

More broadly, the drive to create digital economies which was the focus globally of many Governments and regions prior to early 2020 will accelerate. Investment in digital infrastructure which was important before becomes even more critical.[101] This is because, anecdotally it seems that digital connected economies and societies are better able to mitigate associated economic losses that resulted from the lockdown. Recent studies undertaken in Latin America have postulated that "digitization plays a critical role in mitigating disruptions associated with pandemics."[102] The paper argues that analysis of forecast data on downward impact on GDP of COVID-19 indicates that higher digitization economies will suffer less economic damage over the long run. Optimally digital economies which are 'COVID ready' have *inter alia*:

- robust high speed broadband services;
- trusted digital payment systems and infrastructure;
- the ability to digitise SMEs and SME retail operations not just larger corporations;
- online classrooms including for tertiary studies;
- legal structures for digital contracting and digital signatures; and
- provision of services to unconnected and vulnerable populations including telehealth and related services.

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99 www.unece.org/fileadmin/DAM/hlm/projects/SMART_CITIES/U4SSC-brochure.pdf, page 4.

100 www.itu.int/en/ITU-T/ssc/united/Pages/default.aspx

101 ITU, White Paper *Digital Infrastructure Policy and Regulation in Asia-Pacific Region,* released 2 September 2019. Available at www.itu.int/en/ITU-D/Regional-Presence/AsiaPacific/SiteAssets/Pages/Events/2019/RRITP2019/ASP/ITU_2019_Digital_Infrastructure_5Sep2019FNL.pdf

102 CAF Digital Ecosystem Observatory, *Facing the COVID-19 Pandemic: Digitization and Economic resilience in Latin America,* Telecom Advisory Services LLC, April 2020. The paper highlights that (i) previous econometric analysis of the 2003 SARS-CoV virus' economic impact indicates that the countries with more developed connectivity infrastructure mitigated approximately 75 per cent of the associated economic losses that resulted from the measures taken to control its spread (e.g. quarantining, social distancing, interruption of air traffic, use of face masks, etc.) and (ii) there is substantial qualitative evidence confirming the contribution of digital technology to lessening the impact of the SARS-CoV virus (e.g. increase in 50 per cent of videoconferencing traffic in Southeast Asia, development of e-commerce sector in China).

4.4 COVID-19 and competition issues going forward

It is also important to highlight that the COVID-19 pandemic has sector competition impacts. There are changes in market power between segments of the communications and technology industries.[103] For example, it is possible that communications operators may face long-term reduced demand and/or higher costs while at the same time initial indications suggest that the 'big tech' companies such as Google, Apple, Facebook, Amazon, etc. may become significantly stronger under a range of potential future scenarios. This can arise not only because of their market power but also because of their critical role as the gatekeepers for smartphone operating systems which necessarily must be opened for contact tracing apps, policing COVID-19 fake news and alike. This issue has been highlighted in markets like France, Germany and the United Kingdom.[104]

This will shift the balance of market power between these two segments of the communications and technology industries which may, in turn, require new regulatory settings.

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103 There are range of broader competition impacts. In Australia, the COVID-19 pandemic has resulted in a rush of applications to the ACCC seeking to authorise coordination as between competitors which might otherwise contravene provisions of the Australian *Competition and Consumer Act* (CCA). *As detailed by Herbert Smith Freehills, a*s of 8 April 2020, the ACCC has made 16 COVID-19 interim authorisation determinations and more will follow. They detail that a broad range of public benefits have been accepted including facilitating the supply of essential products, facilitating the distribution of consumer and business relief and ensuring that competition will be maintained in post-pandemic markets. See Herbert Smith Freehills, *COVID-19: Pressure points: managing competition issues whilst allowing businesses to collaborate (Australia),* 9 April 2020.

104 www.euronews.com/2020/04/29/coronavirus-french-mps-approve-covid-19-tracing-app-despite-privacy-concerns and The Economist, Escaping the lockdown: Don't reply on contact-tracing apps, 16 May 2020 edition

5 Conclusions and Recommendations

5.1 Conclusions

In conclusion, there is no question that the COVID-19 pandemic constitutes a global health and economic crisis. This respiratory disease has been and remains the most significant public health challenge of the past 100 years, in respect of which its virology, its transmission and its effect on the human body are not fully settled in science.

The COVID-19 crisis is acting as a major catalyst for change, especially in cities and urban centres. Thus in Milan, an early epicentre of the outbreak, a plan was announced in late April 2020 to reallocate street space to walking and to embrace micromobility in response to COVID-19 and the need for social distancing. [105] Something similar is being embraced in Paris.[106] A similar debate is also occurring in relation to the post-COVID economy with commentators asking – should there be a return to the pre-pandemic status quo?[107]

Given the profound societal and economic effects of COVID-19, there will be resultant changes to the telecommunications and ICT sectors as well. In a post COVID-19 world it is difficult to envisage any scenario where the sector is not more important than before, especially since many industries and human interaction are moving online as a matter of necessity. We can expect higher levels of demand, increased customer demand for higher broadband speeds, more urgent need of connectivity to keep people safe and new innovative services and applications. The challenge for the industry is to meet these expectations and aspirations with increased ubiquity (ensuring that everyone no matter where they reside has a digital future and that students can continue to access knowledge, training and educational resources), better digital skills, and improved affordability (ensuring that everyone can afford to connect digitally).

As detailed in section 1.4 of this paper, there are three phases of telecommunications sector responses to COVID-19, namely emergency (0 to 6 months), recovery (6 to 18 months – covering the potential of second wave in the following autumn and winter) and the 'new normal'. While indicative timeframes are included it is important to emphasise that the phases are not defined by elapsed time but rather by government policy settings in response to actual and perceived threats from COVID-19 as they emerge.

Thus far, the policy and regulatory measures (summarised in Section 2 of this paper) taken during the COVID-19 pandemic to ensure resilient connectivity, business continuity and service delivery while responding to communications and in particular data traffic increase, maintaining continuity of vital services, and ensuring affordable, safe, secured and trusted access to online services have been generally successful. While there has been massive economic upheaval and significant job/income losses, the use of the digital tools has facilitated the continuation of a base level of economic activity in many countries notwithstanding the lockdowns which may have been put in place. Sector stakeholders have stepped up almost in uniformly to contribute greatly to that success recognising the health and economic challenges faced variously by their customers, the economy and society generally.

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105 'Milano Strade Aperte' (Milan Open Streets). See www.theguardian.com/world/2020/apr/21/milan-seeks-to-prevent-post-crisis-return-of-traffic-pollution and https://milano.repubblica.it/cronaca/2020/05/02/news/coronavirus_in_lombardia_a_milano_piazze_pedonali_e_strade_aperte_per_la_citta_lenta_-255437243/

106 www.archdaily.com/938870/paris-plans-to-maintain-anti-pollution-and-anti-congestion-measures-post-covid-19-lockdown

107 www.forbes.com/sites/nishandegnarain/2020/04/22/not-back-but-forward-what-the-post-covid-19-economic-recovery-models-are-getting-wrong/#b1f9837abb14

In the medium and longer term, there will be flexibility for more substantial and sustainable responses. It is important to note that, from an economic perspective, the cost of delays in deploying new technologies and services is increased. Because telecommunications and ICT services are now more valuable to society, each year of delay in providing better and increased levels of service now means the opportunity cost of this delay is materially greater. This means it is now socially optimal and arguably imperative to urgently bring forward deployment of new digital infrastructure, assignment of in-demand IMT spectrum and new generations of technological standards, for example, moving more rapidly to 4G and 5G as well as addressing the COVID-19 specific challenges around contact tracing and COVID-19 fake news (these are explored in Section 3 of this paper).

In doing so, it is critical that the equity issues at stake in accessing telecommunication and ICT services in the post- COVID world are addressed. To the extent that improved access to telecommunications and ICT services can provide social inclusion, access to services, gender equality, access to education and, potentially, access to employment, these services have a valuable role to play in offsetting these negative equity impacts of COVID-19.

Lastly, while the world is trying to comprehend what the 'new normal' will be having to live with COVID-19, it is clear that the changes as the Canadian Prime Minister, Justin Trudeau stated recently will be long lasting and "COVID-19 will be one of the things that creates changes in our society. Our responsibility as a society, as governments is trying to figure out how to minimize the negative impacts of those changes while maximizing the safety of [our citizens]"[108] The move to the 'new normal' as shown in Section 4 of this paper is speculative. However, it involves familiar challenges to policy makers of encouraging investment, fostering innovation, facilitating sector competition and pursuing social equity and inclusion in a challenging economic and societal environment.

As '[We] don't make the timeline. The virus makes its timeline'[109] the key elements of what is likely to comprise or influence the 'new normal' for the sector should be further reviewed in 12 months.

5.2 Checklist of Practice

In terms of a checklist of practice, **Exhibit 12** provides a summary of measures which could be adopted by Governments and regulators in relation to the emergency phase of the COVID-19. Countries which have not yet embraced such measures could consider doing so. In the recovery phase it recommended that Governments and policy makers ought to *inter alia* consider COVID-19 Contact Tracing Apps (having due regard to the need to implement adequate privacy protections), accelerate the assignment of globally harmonized IMT spectrum to improve wireless broadband speeds, accelerate 4G/5G and in the future deployment and the transition from legacy 2G/3G networks; enable deployment of FWA as complimentary and substitute broadband networks as necessary, address fake news in relation to COVID-19 (and 5G), institute enhanced cybersecurity measures and embrace big data responses/data processing responses to COVID-19.

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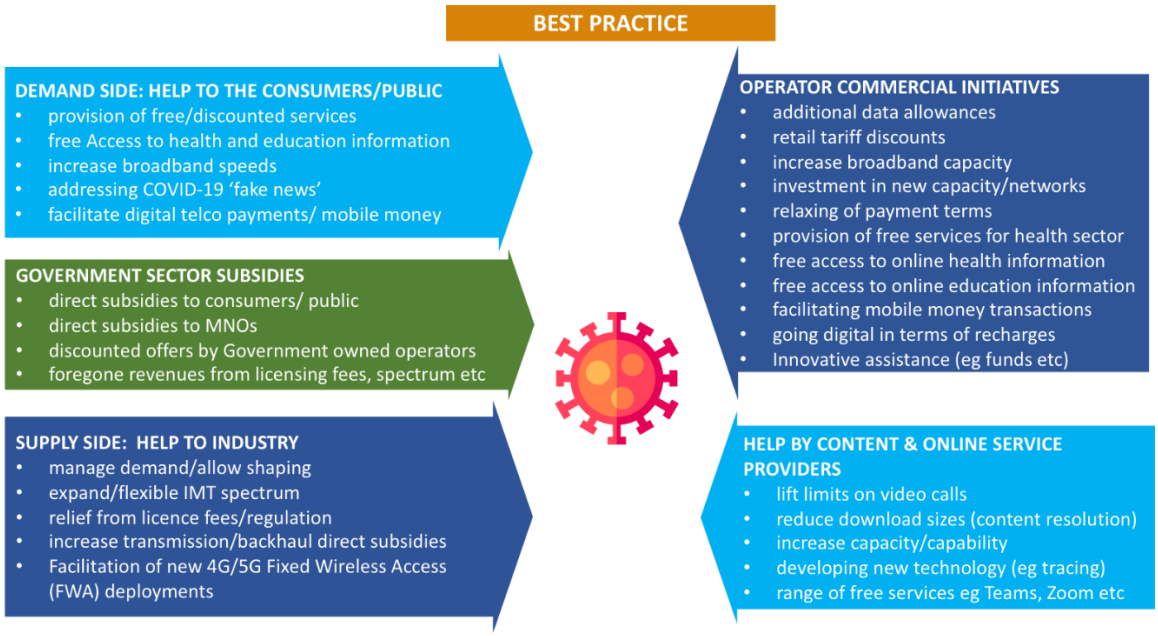
108 www.rcinet.ca/en/2020/05/14/covid-19-could-bring-permanent-changes-to-canadians-lives-trudeau-says/

109 Dr Anthony Fauci, Director of the US National Institute of Allergy and Infectious Diseases, Interview, 26 March 2020

Exhibit 12: Best practice in relation to emergency measures during COVID-19



Source: ITU, June 2020

6 Appendices – Detailed COVID-19 Initiatives

6.1 Short-Term Regulatory Initiatives

INITIATIVE: PROVIDING FREE SERVICES TO CUSTOMERS	
Country	**Examples**
Azerbaijan	The website www.evdeqal.az was launched jointly by the Ministry of Transport, Communications and High Technologies of Azerbaijan and the United Nations Development Programme providing users with online services in the categories of “education”, “delivery”, “medicine”, “food” and “entertainment”, as well as makes available detailed information about the challenges and opportunities during the period of Coronavirus epidemic. In order to support the campaign "Stay at home", 80 free foreign TV channels were also added to the package of terrestrial open broadcasting by the Teleradio Production Association of the Ministry of Transport, Communications and High Technologies. As from April 1, multiprogram foreign television channels of various content in the standard DVB-T2 will be available for free in the northern, western, southern regions and central Aran regions of the country.
Colombia	The following measures were taken for fixed and mobile users: 1. Postpaid mobile users with plans of less than 18 USD that cannot longer afford it, will have a minimum connectivity for 30 days. After this time, they will have access to 200 SMS in the operator's network and to 20 websites established by the Government. 2. Mobile users in prepaid without money left in the account will have access to 200 SMS on the operator´s network. Fixed service users cannot be charged with default interests, but the service may be suspended if the user cannot for lack of payment.
Dominican Republic	The resolution published by INDOTEL provides that the user's or consumer's telecommunications services may not be suspended or cancelled, as long as the state of emergency lasts. In that same period and for 5 days after its termination, the document prohibits the generation of late payment charges or delay in the payment of telecommunications services.
Egypt	NTRA agreed with the 4 telecom operators, in coordination with the Ministry of Health and Population (MoHP), on granting 3,000 minutes and 10 gigabytes per month, for free, for all mobile networks, to all doctors, nurses, administrative personnel and staff working in the isolation hospitals for COVID-19 patients, nationwide.
Honduras	CONATEL and Honduran operators agreed not to suspend service to customers during the crisis to guarantee that the telecommunications and connectivity services prevail. Likewise, they agreed to provide basic packages free of charge to customers facing difficulties can stay connected as well as access to web portals established by the government. It was also agreed that these measures should

INITIATIVE: PROVIDING FREE SERVICES TO CUSTOMERS	
Country	**Examples**
	not generate any cost for default or affect the user's credit risk.
Kuwait	Communication & Information Technology Regulatory Authority (CITRA) has provided additional free services and frequencies to mobile companies & main ISP's and in return the companies have provided 5GBc of Internet and local free calls daily to their customers within the 3 networks for a period of one month starting until 20 April 2020 due to the coronavirus
Iraq	The Iraqi Ministry of Telecommunications has announced that in order to facilitate the use of voice connectivity, they will ban all roaming charges on cellular calls, and require a 50 per cent reduction in tariffs for local voice telephony and 25 per cent reduction for international voice telephony
Japan	The Ministry of Internal Affairs and Communications of Japan requested four associations related to telecommunications carriers to extend the payment deadline for fixed-line and mobile phones due to COVID-19.
Kenya	The Government has waived fees for toll free numbers for both public and private entities offering COVID-19 related advisories and designated a short code to be used as emergency number by the Kenya Private Sector Alliance to facilitate business continuity for Micro, Small and Medium Enterprises (MSMEs). Kenya has also ensured that first responders in Government and health agencies have access to communication services at times of possible network congestion to ensure continued provision of emergency services.
Malaysia	The Government has mandated that MNOs provide 1 GB of wireless data per day free to their customers.
Mexico	Mexico's IFT is collaborating with the country's biggest telecommunications companies to offer emergency low cost Internet and mobile deals. The IFT is also facilitating access to multiprogramming channels on open TV to transmit educational content.
Namibia	The Communications Regulatory Authority of Namibia in consultation with Telecommunications Service Licensees, approved two Toll-Free emergency numbers for the reporting of Coronavirus-related incidents. The emergency toll free numbers are (0800 100 100) and (911). The number 0800 100 100 is linked to the Telecom Namibia Limited network and managed at the premises of the Ministry of Health and Social Services. The number 911 is linked to the Mobile Telecommunications Limited (MTC) network and will be routed to any emergency facility in the country. These emergency toll free numbers are active on all cellphone networks in Namibia and are free of charge.
Paraguay	ONATEL, as Telecommunications Regulator of the Republic of Paraguay, has inter alia has granted the special service number 154 for the National Contingency Program COVID-19, the operators have facilitated the navigation without data consumption of the official pages of the Ministry of Health and the WHO, and it has collaborated for Service Providers to send free text messages to their users with the warnings and recommendations of the Ministry of Health.
Qatar	The CRA Qatar coordinated with telecom service providers to double the speed of Internet for existing residential customers and double the mobile data for residential and business customers, free of additional charges
Saudi Arabia	The Communications and Information Technology Commission in Saudi Arabia has announced zero-ratings on

INITIATIVE: PROVIDING FREE SERVICES TO CUSTOMERS		
	Country	**Examples**
		educational platforms as well as approved educational and digital health platforms
	Vietnam	All telecommunications companies are to support the Ministry of Health to deploy a remote health care system to nearly 14,000 health facilities to reduce the burden of direct medical examination and treatment at hospitals.
	China	China Telecom was tasked with the deployment of 5G network at the Wuhan Leishenshan Temporary Hospital. This was done within 24 hours and provided high-speed 200 Mbps plus services with stable Wi-Fi coverage for 25,000 users involved in telemedicine, health records, monitoring and related fields.

INITIATIVE: INCREASING BROADBAND SPEEDS		
	Country	Examples
	Israel	The MOC has *inter alia*: (i) expanded connectivity between infrastructure providers and providers of retail services to end-users. (ii) Expanded connectivity between local providers and submarine cable operators, and (iii) Working with the Israeli Internet Association to expand connectivity to the Israel Internet Exchange (IIX).
	Lebanon	The Communications Minister announced the government's intention to double the speed of the Internet and consumption limits for Internet subscribers through the end of April
	Qatar	CRA State of Qatar coordinated with telecom service providers to double the speed of Internet for residential and business customers and ensured telecom networks continuity without affecting QoS.[110]

INITIATIVE: VOLUNTARY NETWORK MANAGEMENT		
	Country	**Examples**
	Austria	Austria's regulatory authority is allowing for certain bandwidth-heavy online services like video streaming to be throttled if need to ensure more essential services like government information portals can be transmitted at a constant speed. This is not being mandated due to EU regulation around net neutrality, and so it is up to operators and ISPs to decide if and when they will apply this measure (EU regulation does allow temporary exceptions to the net neutrality rule).
	Bosnia and Herzegovina	Communications Regulatory Agency (CRA) inter alia appealed to the operators of public telecommunications networks and services to -Act jointly and cooperatively concerning technical support, elimination of interference and malfunctions, and capacity sharing if necessary and to maintain the current level and quality of services and to provide priority in traffic to the competent institutions, bodies, and organizations if requested, or at the request of

110 https://cra.gov.qa/press-releases/impacts-of-covid-19-telecom-sector-helps-in-reducing-direct-communication-between-individuals

INITIATIVE: VOLUNTARY NETWORK MANAGEMENT	
Country	**Examples**
	relevant authorities, i.e., to provide priority access to emergency numbers.
Brazil	The major telecommunications operator Telefonica has voluntarily offered to grant zero-rating for collaboration platform usage amongst corporate customers. One of their competitors, Claro, has voluntarily opened up their public Wi-Fi networks to everyone, including non-customers. This move came after the Brazilian regulator Anatel asked operators to voluntarily take such measures, which further included free SMS and zero-rating of certain applications that could help citizens cope with the Covid-19 outbreak. Anatel also requested companies to not terminate service for any customers due to inability to pay for bills.
Cambodia	The telecommunication regulator of Cambodia has urged Internet operators to "broaden and effectively facilitate convenient connection and ensure proper backup to avoid interruption."
Chile	Ministerio de Transportes y Telecomunicaciones (MTT) of Chile activated a solidarity plan to guarantee connectivity during the COVID-19 outbreak. Telecommunications companies in Chile join the request of SUBTEL to establish measures in favor of users to address the COVID-19 contingencies.[111]
Colombia	In order to take the necessary measures to avoid the congestion of Internet traffic in Colombia during the State of Emergency, the Commission for Communications Regulation requested the main Internet access service operators to report the information on the evolution of its traffic, as well as information on the daily traffic starting March 30 to, from a baseline previously defined by the Commission, analyse the information on daily Internet demand until that the State of Emergency concludes. Said monitoring report is published on a weekly basis by the Commission.
Peru	The Peruvian regulator has requested citizens prioritize their use of Internet services for work, education and health purposes during working hours, and also encourages the use of instant messaging platforms to communicate to lighten the load of the network. They also included a plan to provide operators with more bandwidth to help operators ensure a continuity of services. The regulator has also requested – though not required – that heavy capacity streaming services only be used outside of the 8:00-18:00 time window
South Africa	ICASA is requesting all network service providers to heed the call to enable the country to mitigate the spread of COVID-19, by facilitating easy and affordable (and/or free) access to data. In this regard, the Authority is engaging the sector on possible ways of radio frequency spectrum relief for the duration of the declared state of disaster to ease congestion, ensure good quality of broadband services, and enable licensees to lower cost of access to consumers (particularly in relation to education, emergency and other social services). Furthermore, to the extent that the licensees will wish to tailor packages (specifically data packages) to respond to the pandemic, the Authority will

111 www.subtel.gob.cl/mtt-activa-plan-solidario-para-que-los-usuarios-no-pierdan-la-conectividad-durante-la-emergencia-por-coronavirus/

INITIATIVE: VOLUNTARY NETWORK MANAGEMENT	
Country	**Examples**
	consider relaxation of the tariff notification filing requirements to enable speedy roll-out of such packages.[112]
Spain	The Government and the telecommunications operators sign an agreement by which they extend the measures to guarantee the connectivity of people and companies. Companies commit to make every effort to ensure connectivity, network monitoring and operation capabilities, and speedy response to incidents, especially with regard to networks supporting emergency services.[113]
US	FCC Chairman Ajit Pai recently announced the Keep Americans Connected Initiative. In order to ensure that Americans do not lose their broadband or telephone connectivity as a result of these exceptional circumstances, he specifically asked broadband and telephone service providers, and trade associations, to take the Keep Americans Connected Pledge. So far, more than 700 companies and associations have signed the Chairman's pledge to Keep Americans Connected.[114]
Colombia	Through Decree 464 of 2020, where specific measures are adopted to guarantee that Colombians have access to communication services during the state of economic, social and ecological emergency, the national government determined the declaration of telecommunications, broadcasting services sound, television and postcards as essential, therefore, its installation, maintenance and operation must be guaranteed.[115]

INITIATIVE: MANDATORY NETWORK MANAGEMENT	
Country	**Examples**
Peru	OSIPTEL today ordered that companies operating public telecommunications services may not suspend or terminate such services for lack of payment while the State of Emergency decreed by the Government lasts.[116]
Poland	The President of UKE asks telecommunications operators to take the necessary actions to guarantee service continuity by preventing and removing the effects of network congestion resulting from increased demand during the SARS-CoV-2 virus outbreak. The regular ban on the use of non-standard traffic management measures is relaxed.
Italy	The Authority has implemented rt. 82 of the "Cura Italia" decree and adopted the first timely measures and initiatives for the market, aimed at enhancing the network infrastructures and guaranteeing their functioning and operability, improving their availability, capacity and quality.

112 www.icasa.org.za/news/2020/icasa-engages-with-licensees-to-open-their-services-to-all-south-africans-as-the-country-fights-the-scourge-of-the-covid-19-pandemic

113 www.mineco.gob.es/portal/site/mineco/menuitem.ac30f9268750bd56a0b0240e026041a0/?vgnextoid=7537dfde518f0710VgnVCM1000001d04140aRCRD&vgnextchannel=864e154527515310VgnVCM1000001d04140aRCRD

114 www.fcc.gov/keep-americans-connected

115 www.mintic.gov.co/portal/inicio/Sala-de-Prensa/Noticias/126323:Medidas-del-Gobierno-Nacional-para-garantizar-la-prestacion-de-los-servicios-de-comunicaciones-durante-el-estado-de-emergencia-economica-social-y-ecologica

116 www.osiptel.gob.pe/noticia/np-resolucion-estado-emergencia

INITIATIVE: MANDATORY NETWORK MANAGEMENT	
Country	**Examples**
Slovak Republic	New legislation attaches obligations to electric communications providers in the time of the pandemic that they have to freely exchange data of communicating parties. This new data processing is an attempt to help the health sector.
Vietnam	The Ministry of Information and Communications released Document No.1103 to demand that relevant organs ensure the quality and effectiveness of telecommunications, especially Internet connections, during the time of Covid-19 outbreak in Vietnam for operation and management tasks of state offices as well as teleworking of citizens
Africa	The African Telecommunications Union has put together a set of guidelines to assist in combating the COVID-19 pandemic. Recommendations include: a common altering protocol to mobilize communication medium to educate the public; network capacity reserved and free for authorities handling the crisis; streamlining regulation processes concerning services licensing, assignment of frequency bands, priority call routing, network redundancy, and importing equipment. German BNetzA published guidelines with solutions and measures for permissible traffic management to handle unexpected overload situations in the telecommunications network during the COVID-19 outbreak.

INITIATIVE: ALLOWING MORE FLEXIBLE IMT SPECTRUM USE	
Country	**Examples**
Cape Verde	ARME assigned additional spectrum to mobile communications operators, at no additional cost, as long as this COVID-19 situation continues. ARME also authorised the implementation of technological neutrality in the 900 MHz band so that, and depending on the operators' needs, 3G could also be used.
Ireland	The Commission for Communications Regulation (ComReg) in Ireland is temporarily releasing extra radio spectrum in the 700 MHz and 2.6 GHz bands to provide additional capacity for mobile phone and broadband provision and allowing the use of 2.1 GHz for 4G and other technologies, rather than just for 3G.
Israel	700MHz frequencies have been temporarily allocated to improve reception.
Oman	As part of a range of measures the TRA-Oman offered licensees an opportunity to use additional frequency bands without obtaining radio license during this period, if necessary, to allow them to use the planned frequencies required for delivering services or connect the base stations. Further, licensed companies were offered additional spectrum, especially in the C-band, to improve the quality of service and mitigate the pressure on the telecommunication networks.
Panama	Panama assigned more radio spectrum temporarily to operators, helping to considerably increase the traffic of messages. ASEP authorized to provide free of charge (for 90 days) an additional 120 MHz of the AWS band to each mobile phone operator to support the increase in traffic on their networks.
Portugal	Portugal's national regulatory authority announced the suspension of a digital terrestrial television migration

INITIATIVE: ALLOWING MORE FLEXIBLE IMT SPECTRUM USE		
	Country	**Examples**
		process that had been ongoing across their 700 MHz band. The justification provided was to ensure that no citizen would be left without access to a functioning television signal during the Covid-19 pandemic, and the process is expected to resume upon improved conditions related to the coronavirus crisis.
	Saudi Arabia	Additional frequencies are provided to Mobile telecommunications service providers to enhance the performance of the current networks of the fourth generation during the COVID-19 crisis.
	South Africa	In April 2020, ICASA released plans to assign high-demand spectrum in the 700MHz, 800MHz, 2.3GHz, 2.6GHz and 3.5GHz bands to ease network congestion, maintain good quality broadband services and allow licensees to lower the cost of access to consumers during the country's COVID-19 lockdown. As at 14 April 2020, it had received 35 applications.
	Trinidad and Tobago	TATT has assigned more spectrum to mobile operators, at no additional cost, for the next two months. It will consider an extension if necessary.[117]
	US	FCC USA proposed new rules for the 6 GHz band, unleashing 1,200 Megahertz for unlicensed use - draft rules would provide a boost to Wi-Fi and other unlicensed uses while protecting incumbent services in the band. The FCC's Wireless Telecommunications Bureau granted Special Temporary Authority to AT&T to use additional spectrum to serve Puerto Rico and U.S. Virgin Islands during the Coronavirus pandemic.
	Yemen	The Ministry has indicated its readiness to grant additional temporary frequency packages to licensed mobile phone companies during the Corona pandemic.
	Egypt	MCIT is supporting e-learning during the education suspension period, including increasing the download quota of home Internet packages by 20 per cent, at a cost of EGP200 million (USD12.6 million), borne by the state, and enabling free browsing of educational platforms and websites, to ensure education is not affected. MCIT also enabled free access to the hotlines dedicated for the MoHP, and added 200 staff to increase the call receiving capacity.

INITIATIVE: INTRODUCING NEW E-SERVICES		
	Country	**Examples**
	Albania	The National Agency of Information Society (NAIS) launched a dedicated website with the latest news (preventive restrictions undertaken by government, financial measures and up to date statistics) regarding the situation of Covid-19 pandemic in Albania and also all over the world. NAIS is also working to implement a dedicated software solution to manage COVID-19 cases.[118]
	El Salvador	The regulatory body SIGET is opening up several electronic communication channels to the public for free access during

117 https://tatt.org.tt/DesktopModules/Bring2mind/DMX/API/Entries/Download?Command=Core_Download&EntryId=1336&PortalId=0&TabId=222%E2%80%8B

118 https://coronavirus.al/

INITIATIVE: INTRODUCING NEW E-SERVICES		
	Country	**Examples**
		the COVID-19 crisis, so complaints and other forms of communication can be better received about the electricity and telecommunications sectors.
	Luxembourg	SATMED is a cloud-based e-health platform owned by the Government of Luxembourg and is aimed to help healthcare providers in remote areas make better use of information technology and mobile health solutions. SATMED leverages SES's satellite-enabled connectivity services to connect hospitals in remote areas.
	South Africa	A free communication service has been established by the South African regulator to provide public information on the novel corona virus, including a call centre and an interactive Whatsapp information service. This involves information provided by the Department of Health and by the National Institute for Communicable Diseases.
	Uzbekistan	The Ministry for Development of ICT implemented Telegram bot for online consultation of citizens with medical specialists on Coronavirus infection.[119] The Ministry also launched an information system for electronic reception and registration of all applications for humanitarian aid to the population during the quarantine period. The information system allows to keep a complete record and manage calls and applications for assistance through a call center. The equipment for operator workstations of the 1197 call center was arranged with computer and office equipment, telephony and the Internet. An updated version of the IVR recording on "1197" was introduced with a choice of language, receiving an information message, checking the status of an application, connecting with psychologists.

INITIATIVE: GENERALLY EASING REGULATORY REQUIREMENTS ON LICENSEES		
	Country	**Examples**
	Belgium	BIPT extends the deadline for submitting applications for obtaining additional spectrum for 4G.
	Brazil	In support of mobile phone, pay TV and fixed Internet users, the IFT and operators agree to contingency measures by COVID-19 (Communiqué 36/2020). Circular issued by the Federal Telecommunication Institute to request the municipal and state authorities of the country to provide telecommunications and broadcasting concessionaires with the development and execution of actions aimed at the installation, operation and maintenance, both preventive and corrective, of their infrastructure; as well as authorizing, procuring and safeguarding their entry, exit and transit.
	Mauritius	The requirement for a statutory delay of 30 days from the date of receipt of an application for license for the Authority to convey its decision shall no longer apply. The surcharge of 10 percent shall not be applicable where annual fees or any installment remain unpaid within the time specified in the Information and Communication Technologies (Licensing and Fees) Regulations 2003. The surcharge will become applicable should no payment be received within two weeks from the end of the lockdown period.

119 https://t.me/coronavirusYordamBot

INITIATIVE: GENERALLY EASING REGULATORY REQUIREMENTS ON LICENSEES	
Country	**Examples**
	In addition, the date of validity for licenses which have expired, or which are reaching their expiry date shall now be extended to 30 June 2020. Applications for renewal shall, however, be received by the Authority within two weeks from the end of the lockdown.
Peru	The Ministry of Transport and Communications (MTC) of Peru suspended administrative procedures related to broadcasting and private telecommunications services, therefore, they will not be affected by the lack of compliance with obligations, during the State of National Emergency
Yemen	Exempting entities and companies from licensing fees for electronic financial services for the year 2020

INITIATIVE: NEW FIXED WIRELESS ACCESS (FWA) NETWORKS	
Country	Examples
China	22 Chinese provinces and cities implemented 5G applications to combat COVID-19. Among them, were the provinces of Zhejiang, Guangdong, and Jiangsu as well as Beijing, Shanghai, and Wuhan. 5G-powered telemedicine, remote CT scanning, and remote ultrasound testing were utilized to tackle the shortage of medical personnel in the worst-hit areas and avoid person to person transmission of infection.
Oman	As part of a range of measures the TRA-Oman allowed licensees to provide telecommunications services by activating the wireless broadband service through WFBB-LTE-FDD using the 4G frequencies that were temporarily licensed for the mobile telecommunications services.
South Africa	In May 2020, Vodacom launched its 5G network in three major cities in South Africa. The launch encompasses twenty live sites, with a further rollout planned to cover all of South Africa. Vodacom was temporarily given access to 50 MHz of spectrum in the 3.5 GHz spectrum as a measure taken by ICASA as part of the COVID-19 pandemic.
Thailand	AIS, launched 5G networks in 158 hospitals in Bangkok and major cities across Thailand. The 5G network is helping hospitals launch telemedicine services and robots that help prevent direct contact between doctors and patients. Both AIS and True are also racing to offer high-speed home Internet services for the many Thais who need to work from home during the lockdown.

INITIATIVE: ADDRESSING MISINFORMATION ABOUT COVID-19 NEWS INITIATIVES	
Country	**Examples**
Myanmar, Romania, UK etc.	Requirement to block news sites provide misinformation regarding COVID-19 including in relation to 5G
Lesotho	The Lesotho Communications Authority warns that the publication and distribution of false information constitutes an offense under section 3(f) of the 2020 Declaration ofCovid-19 State of Emergency Notice. Additionally, the Public Health (COVID-19) Regulations under section 10(5)

INITIATIVE: ADDRESSING MISINFORMATION ABOUT COVID-19 NEWS INITIATIVES		
	Country	**Examples**
		provides that "no person shall publish or spread fake or false information. Any person who contravenes the provisions of sub-regulation (5) commits an offense and is liable to a fine not exceeding 5,000 Maloti or to imprisonment for a period not exceeding one month or both". The Authority will support law enforcement in ensuring that perpetrators who disseminate false information using online platforms are prosecuted and fined.
	Korea	Korea Communications Standards Commission is taking several steps to monitor Internet communication to prevent the spread of misinformation about COVID-19.
	South Africa	The Minister of Communications and Digital Technologies issued Electronic Communications, Postal and Broadcasting Directions imposing an obligation on broadcasting licensees are obliged to carry public service announcements related to the national effort to combat COVID-19 and its impact. Further, all Electronic Communication licensees, OTTs and ISPs have the responsibility to remove fake news related to COVID-19 from their platforms immediately after it is identified as such.
	Taiwan	Taiwan's National Communications Commission (NCC) regulates broadcasting and telecommunications services. Since the onset of the COVID-19 pandemic the NCC has: 1) Made clear to service providers and the public its stance on the dissemination of inaccurate news or broadcast features relating to the coronavirus, as well as where reliable information can be obtained. It has encouraged broadcasters to fact check their information before airing it.
	Uganda	The Commission found it important to create a "Fact Checker" platform to help combat the false news and is encouraging the public to run the content through the platform before blindly sharing it to their contacts.
	Argentina	The National Communications Agency and the state telecommunications company Arsat agreed with the telephone and Internet providers to intensify joint work to ensure federal connectivity so that all parts of the country have guaranteed network service during preventive isolation and required.[120]

INITIATIVE: TRACKING APPLICATIONS		
	Country	**Examples**
	Brazil	Santa Carina's State Government started to adopt an alert service via SMS text messages to inform the population about confirmed cases of COVID-19 at a distance of approximately 200 meters from the infected person's residence. The system is said to protect patients and SMS owners' anonymity.
	European Union	EU Member States are converging towards effective app solutions that minimise the processing of personal data, and recognise that interoperability between these apps can support public health authorities and support the reopening of the EU's internal borders.

120 www.enacom.gob.ar/institucional/acuerdo-para-asegurar-conectividad-entre-enacom-y-arsat-con-empresas-prestadoras_n2249

INITIATIVE: TRACKING APPLICATIONS	
Country	**Examples**
Namibia	The Faculty of Computing and Informatics at Namibia University of Science and Technology, in partnership with the Ministry of Health and Social Services and the World Health Organization Africa Office, are developing a self-report application that will allow Namibians in urban and rural areas to report their symptoms and indicate their locations for health workers to reach them faster. The application will be applicable to smartphones and basic phones through the use of SMS, and it will be offered in different languages.
Uzbekistan	Ministry for Development of Information Technologies and Communications launched the website "coronavirus.uz", which allows providing relevant information on COVID-19. The website provides information on epidemiological route for patients with confirmed infection and real-time data of infected citizens.

INITIATIVE: FREE ACCESS TO ONLINE LEARNING RESOURCES	
Country	Examples
Colombia	For mobile prepaid and postpaid services whose values do not exceed 18 USD, the operators must guarantee navigation to the user (zero rating) to a website related to education defined by the Ministry of Education at no cost.
Japan	The Ministry of Internal Affairs and Communications, Japan has requested four associations related to the telecommunications industry to secure a communications environment for student learning in connection with the spread of COVID-19 infections.
Mongolia	The Ministry of Education, Culture and Science, in coordination with the Department of Communications and Information Technology, is organizing a "TV LESSON" for primary and secondary school students throughout the country.
Kenya	With learning in public institutions suspended, the Government has designated Edu TV as a must-carry channel by all Broadcast Signal Distributors (BSDs) to facilitate home based learning. The public broadcaster, Kenya Broadcasting Corporation has allocated additional airtime to education related content.
Vietnam	The Ministry of Information and Communications (MIC) Viet Nam in accordance with the Prime Minister's Directive No. 16/CT-TTg dated on March 31, 2020 on the implementation of some urgent measures to mitigate, prevent and combat COVID-19 pandemic, all mobile services suppliers to provide free data access fees for students and teachers when implementing distance learning programs in education and training.
Saudi Arabia	The Communications and Information Technology Commission in Saudi Arabia has announced zero-ratings on educational platforms as well as approved educational and digital health platforms

INITIATIVE: GOVERNMENT SUBSIDISED BROADBAND SERVICES	
Thailand	The Thai MNOs are providing every Thai phone user with a national ID number (99+per cent of citizens) 10GB for free for a month. The Thai regulator, the NBTC through its

	Broadcasting and Telecommunications Research Fund (BTRF) approved allocating THB 3 billion (USD90 million) to support such assistance.[121]
Bahrain	The Authority has granted an additional two months to telecommunications companies to submit their financial documents without any fine or legal action.

INITIATIVE: GENERAL TRAFFIC MANAGEMENT	
Europe	Data collection on Internet network capacity in all EU member states was launched on 19 March 2020 by the joint statement from the European Commission and the Body of European Regulators for Electronic Communications on the increased demand for network connectivity due to the Covid-19 pandemic.[122]
Germany	German BNetzA published guidelines with solutions and measures for permissible traffic management to handle unexpected overload situations in the telecommunications network during the COVID-19 outbreak.
Poland	Pursuant to Regulation 2015/2120 of the European Parliament and of the Council, during such threats as the coronavirus epidemic, the regular ban on the use of non-standard traffic management measures may be reduced. The Regulation allows measures to be taken in order to preserve the integrity and security of the network, of services provided via that network and of the terminal equipment of end users; and prevent impending network congestion and mitigate the effects of exceptional or temporary network congestion.[123]
Portugal	Under the terms of the Open Internet Regulation (Article 3.3 of Regulation (EU) 2015/2120), operators are authorized to apply traffic management measures, to mitigate the congestion effects of the networks, exceptional or temporary, provided that equivalent categories of traffic treated in an equivalent manner.
Australia	At 6pm on 26 April 2020 the Australian Government released the COVIDSafe application. The application uses Bluetooth technology to trace a person's 'digital handshake'.

Source: ITU REG4COVID database as augmented by industry sources

6.2 Short-Term Commercial Initiatives

INITIATIVE: ADDITIONAL DATA ALLOWANCES	
Country	**Examples**
Australia	Australia's second largest telecommunications company Optus is offering one-off data quote boosts for the month of April. Telstra, another Australian operator, has also announced, they will be providing unlimited data at no additional charge for their home broadband customers for six weeks, and more data to use within a 30 day period for their mobile pre-paid and post-paid customers.
Bahrain	Zain Bahrain has removed usage caps on all fiber broadband packages until the end of May

121 www.bangkokpost.com/business/1890240/mobile-users-get-10gb-perk-from-april-10

122 www.rrt.lt/en/covid-19-important-information/covid-19/

123 https://uke.gov.pl/en/newsroom/ensuring-the-continuity-of-telecommunications-services-in-the-age-of-coronavirus%2c273.html

INITIATIVE: ADDITIONAL DATA ALLOWANCES	
Country	**Examples**
Bolivia	Bolivia ENTEL national state-owned service provider is now offering low tariffs combinations s in the wake of the COVID-19 emergency.
Brazil	Claro has voluntarily increased data consumption limits for their users
India	ACT Fibernet has announced unlimited data consumption for all subscribers for the month of March
Ireland	The main electronic communications providers made a commitment that any customer who does not have fixed broadband and who relies solely on mobile access to the Internet will have the opportunity to avail of affordable unlimited mobile data access/package.
Lebanon	OGERO doubles free of charge, the ceiling of Internet consumption and speed for the unlimited packages.
Nigeria	Telecom giant Airtel Nigeria are making SMS messages free for all customers across their network, on top of free data for customers to access educational and health sites.
Portugal	MEO offered to its clients 10GB of mobile data and sports premium iptv content, has created a dedicated COVID-19 channel in its SAPO portal and has partnered for the creation of the "SOS Vizinho" solidarity support line.
Spain	Telefónica Spain announced measures related to COVID-19 by increasing, at no extra cost the GB enjoyed by the Fusion and Movistar mobile customers with an additional 30 GB every month, for two months.[124]
Sri Lanka	Based on TRCSL guidance all operators have agreed and now have a mechanism to provide emergency credit and extra talk time for prepaid customers who may face difficulty purchasing top-ups due to curfew. Hutch is offering a 25 per cent discount on all Cliq data packages. Dialog Axiata and Mobitel are running offers to double your data with each data pack you purchase if you're a postpaid customer. Sri Lanka Telecom is offering unlimited data for its PEO TV app.
UK	Virgin Media's postpaid customers will be offered unlimited minutes to landlines and other mobile numbers, as well as a 10 GB data boost for the month at no extra cost. For broadband, any data caps on legacy products will be lifted. All telcos have also committed to remove all data caps on fixed broadband services. They have agreed to offer some new mobile and home phone packages to help people stay connected. Some of these packages include data boosts at low prices and free calls from home phones or mobiles.[125] Some providers have agreed to work with customers who are finding it difficult to pay their bill, have committed to remove all data caps on fixed broadband services. These providers will also make sure vulnerable customers or those who are self-isolating receive alternative methods of communication where possible, if the providers cannot fix priority repairs with their broadband or home phone services.
Uruguay	Antel has announced extra data for pre-paid and post-paid mobile, as well as extra data for fixed data services

INITIATIVE: INCREASING BROADBAND CAPACITY AND SPEEDS

124 https://www.telefonica.com/en/web/press-office/-/telefonica-announces-measures-related-to-covid-19

125 www.ofcom.org.uk/about-ofcom/latest/features-and-news/broadband-and-mobile-firms-commit-helping-customers-during-coronavirus

Country	Examples
Costa Rica	Internet service providers including Kolbi Hogar and Kolbi Pymes are automatically upgrading download speeds to 50Mbps for customers currently on plans of 30Mbps or less
India	Nationwide, ACT Fibernet has announced an upgrade to 300Mbps speed for users. Within Kerala, the state government asked ISPs to increase Internet speed by 30-40 per cent of present capacity, which they've agreed to do
Ireland	The main electronic communications providers made a commitment that any fixed broadband customers who do not have unlimited usage already as standard will be given the opportunity, if they require, to upgrade their package.
US	Comcast has announced they will increase Internet speed for their package that targets low-income families

INITIATIVE: RELAXING OF PAYMENT SERVICES	
Sri Lanka	TRSCL advised operators to continue services for all consumers ensuring no service disconnections based on non payment and to extend a grace period until end of April.

INITIATIVE: PROVIDING OTHER SERVICES TO CUSTOMERS	
Country	**Examples**
Australia	NBN Co announced it will waive charges for additional capacity of up to 40 per cent to Retail Service Providers for at least three months to help them support Australian residential and business nbn customers. The additional capacity pricing relief will apply to all fixed line, fixed wireless and satellite nbn technologies.[126]
Canada	Shaw will provide free access to its Shaw Go WiFi network, which runs across Western Canada. It will give everyone, even non-Shaw customers, free and unrestricted access until further notice to its Shaw Go WiFi network hotspots.
Egypt	In Egypt mobile operators have offered FWA packages during the coronavirus epidemic, with significant discounts of up to 50 percent for consumers.
Guatemala	Tigo has pledged it will not make service cuts due to non-payment in both mobile and residential invoiced services. On the contrary, if mobile prepaid users are active and have a delay in the payment of 2 consecutive invoices, instead of making the service cut, they will be credited call minutes, text messages and pages to browse.[127]
Japan	Allm introduced Join, a mobile application for medical professionals that aims to improve the efficiency of information sharing. As a chat-based communication app, it is used not only for communication within single medical institution but also as a platform for cooperation among medical institutions, emergency services and central/ local governments. In the COVID-19 pandemic situation, the combination of Join and InfoCOVID (a web service for COVID-19 also produced by Allm) can be a telemedicine platform for managing COVID-19 suspected or infected patients.
Moldova	Moldtelecom is offering unlimited calls in the Unite and Moldtelecom network, to all Unite subscribers to mobile

126 www.nbnco.com.au/blog/the-nbn-project/coronavirus-covid-19-and-nbn-working-from-home-tips-and-faqs

127 https://ayuda.tigo.com.gt/hc/es/articles/360045620733-Medidas-sustitutivas-por-COVID-19-a-usuarios-Postpago-M%C3%B3vil%E2%80%8B

INITIATIVE: PROVIDING OTHER SERVICES TO CUSTOMERS	
Country	**Examples**
	services, individuals and legal entities, both Prepay and subscription, for 2 months, until May 31. Moldtelecom offered the Chisinau City Hall 250 SIM cards containing unlimited calls in the Unite and Moldtelecom network to be used by the volunteers of the initiative group "Together against COVID - 19" to call and inform the 40,000 residents of Chisinau.
Nepal	Ncell Nepal is offering lowered charges for data, voice and text, including international calls, so its customers can stay connected. It also provides free cultural, education e-banking and e-health digital services to help them stay home during the lockdown.
South Sudan	Zain have donated mobile handsets to authorities and health workers, and launched a social media campaign to raise awareness.
Thailand	AIS Thailand and Truemove have launched the FWA package, which supports such activity from home.
Uganda	MTN Uganda is offering day-time data bundle that is enabling Ugandans to stay on-line and work from home. Customers get 1GB of data at just Ushs 2,000 valid between 9 am and 5 pm.
US	AT&T offers relief for U.S. customers by waiving domestic wireless plan overage charges for data, voice or text that are incurred because of the COVID-19 pandemic; and across the US, AT&T offers advanced capabilities and free smart phone devices to first responders and public safety agencies on FirstNet.

INITIATIVE: FREE ACCESS TO HEALTH/ GOVERNMENT INFORMATION	
Country	**Examples**
Bangladesh	Bangladesh NGOs Network for Radio and Communication (BNNRC) has been mobilizing all community radios for developing and broadcasting awareness building programs on COVID-19.
Bolivia	The state carrier, Entel Bolivia, is providing zero-ratings for access to health services
Cambodia	Cellcard's first 5G networks in Cambodia are to be used to provide telemedicine at 4 different locations across Phnom Penh to help critically ill patients from the coronavirus. Doctors from the Phnom Penh area will be able to conduct remote video consultations linking with mobile phones and devices anywhere in Cambodia.
Ghana	The mobile industry of Ghana has committed to zero-rating websites that provide COVID-19 awareness and safety protocols, and pledged to offer further packages for educational websites.
Lao PDR	The Ministry of Post and Telecommunications in co-operation with a Lao ICT company recently launched an official website so the public can access factual information during the country's Covid-19 crisis. The site is an information source to distribute the government's orders, announcements, and measures to control the coronavirus pandemic.
Nepal	As the first step of public awareness, NTC started to spread information about causes, precautions, and preventive measures of coronavirus through the ringback tone. Call centerHotline numbers 1115 and 1133 were made available for the COVID-19 call center, through which people can

INITIATIVE: FREE ACCESS TO HEALTH/ GOVERNMENT INFORMATION	
Country	**Examples**
	consult for the COVID-19 related information. Support to CCMC (COVID-19 Crisis Management Center) Nepal Telecom initiated IVR and toll-free service to assist COVID-19 control in collaboration with CCMC. Moreover, NTC supported CCMC to set up the call center at its office premise at Chhauni complex. Contact tracing services. A public survey was conducted with the help of the USSD service. The dial pin *1419# was used for contact tracing of COVID-19 suspects.
Paraguay	The Millicom telecommunications group is providing zero-rating for government communication channels and official information pages
Russia	Beeline is resetting to zero the cost of calls to the Moscow Department of Health, to the hotline in Moscow dealing with citizens returning from foreign countries, and to programs of the ministry of health of the Russian federation for its consumers. MTS is making many services free for its subscribers to do with directly combating the epidemic, such as free online urgent care consultations with a doctor or paediatrician. Free data traffic to official government information resources,
UK	O2 has said all NHS UK and some social welfare websites will be 'zero rated', meaning any data used on these sites won't count towards a customer's monthly allowance, while it will make efforts to help those who are not able to pay their monthly bill.

INITIATIVE: FREE ACCESS BY CUSTOMERS TO ONLINE LEARNING / EDUCATIONAL RESOURCES	
Country	**Examples**
Bahrain	Batelco offered free web browsing for customers on a number of sites for education purposes. The selected sites are Google Classroom, Schoology, Class Dojo, Microsoft Teams for Education, UOB website, Ministry of Education website and Polytechnic website. Free web browsing will enable open and free access to these sites without consuming customers' fixed home broadband allowances.
Croatia	In Croatia, children will be able to watch Da Vici Learning. With its interesting shows, educational TV channel inspires viewers to both learn and have fun
Ireland	The main electronic communications providers made a commitment that access to healthcare and educational resource websites identified by the Government will be zero-rated for all customers where technically feasible
Moldova	Through the TV channels from Moldtelecom, video lessons will be broadcast for students from primary, secondary and high school institutions, according to the national curriculum. The educational platform will be a useful alternative for students, parents and teachers. More than 300 teachers from 69 educational institutions are involved in the preparation of the video content, with the guidance of several teams of experts, coordinators, operators and volunteers. The process was started with primary school, middle school and high school, later the project will be extended to preschoolers.[128]
Poland	UKE prepared interesting educational materials for children and parents, during this challenging COVID-19 time.

128 http://educatieonline.md/

INITIATIVE: FREE ACCESS BY CUSTOMERS TO ONLINE LEARNING / EDUCATIONAL RESOURCES	
Country	**Examples**
Romania	Telekom Romania plans to offer free 4G Internet and licenses in the Adservio educational platform, to teachers, students and parents, by the end of the year.
Senegal	Sonatel is providing a free subscription to all students to online educational material, in partnership with different universities in Senegal. They are providing 1 Go of access to French, English and mathematics lessons for one month, with free renewal.
Slovenia	Telemach has partnered with the U.S. Chamber of Commerce, AmCham Slovenia and the National Education Institute of Slovenia to provide free Internet access to students from disadvantaged backgrounds and free tablets to 90 families across Slovenia.
South Africa	Telkom in South Africa has announced it will zero-rate dozens of educational websites so that students can continue to learn while away from physical classrooms
Spain	Telefonica's non-profit arm is planning to increase educational content through the online learning platform
Turkey	Turkish Ministry of Education teamed up with TRT (Turkish National Broadcaster) and TURKSAT (Turkish National Satellite Operator) to create three TV Channels for broadcasting educational videos. This service is aimed to provide necessary education for elementary, middle and high school students in line with their school curriculum while they are staying home.
Uzbekistan	IT Center Uzbekistan developed online lessons for distance learning in the field of information technology and posted on free of charge.

INITIATIVE: FACILITATING MOBILE MONEY TRANSACTIONS	
Country	**Examples**
Ghana	The mobile industry of Ghana has committed to collaborating with the Bank of Ghana to implement free mobile service transactions within certain bands to promote digital forms of payments
Kenya	Airtel Kenya offers free transactions on Airtel money across all bands due to the COVID-19 outbreak, making possible for Kenyans to send and receive money for free.[129]
Morocco	Onatel is making all cash transfers for water and electricity bills available at no additional in-app cost through their cash transfer app, Mobicash.
Rwanda	In Rwanda, banks and telecommunications companies have engaged with the country's National Bank to enable free transactions for users for three months. In the same announcement from the National Bank, zero charges on push-and-pulls services between mobile money wallets and traditional bank accounts has also been established. Commission fees have also been removed for digitally-enabled and contactless payment assessment at the point-of-sale, while at the same the mobile money transfer limit cap has also been increased (at varying rates for different categories of customers). This series of decrees has significantly mitigated much of the extant obstacles to mobile money transactions

129 www.airtelkenya.com/Airtel_offer_free

INITIATIVE: FACILITATING MOBILE MONEY TRANSACTIONS	
Country	**Examples**
Uganda	Airtel created Airtel Money in order to ensure the free flow of funds among loved ones and also ensure payment of bills and essentials is done remotely to avoid the need for physical cash. MTN customers can now send any amount of Mobile Money every day to other MTN MoMo customers free of charge.

INITIATIVE: GOING DIGITAL IN TERMS OF RECHARGES ETC.	
Country	Examples
India	Facilitate prepaid mobile recharges being made online rather through physical scratch cards etc. to improve connectivity during any lockdowns. Before lock-down, only about 35 per cent of Airtel consumers were recharging digitally on a regular basis. Remaining 65 per cent consumers were still dependent on retailers, most of which were now shut. To solve for this, Airtel accelerated its digital trajectory and moved from 35 per cent to 70 per cent online in a span of 10 days. This also involved Airtel extending airtime validity for over 80 million under-privileged customers during crisis period.
Rwanda	Airtel Rwanda is making all cash transfers free on its phone plans, to discourage in-person cash exchanges that might expose people to the coronavirus.

Source: ITU REG4COVID database as augmented by industry sources