ITU Publications
Study period 2018-2021

International Telecommunication Union
Development Sector

Study Group 1 Question 3

Emerging technologies, including cloud computing, m-services and OTTs: Challenges and opportunities, economic and policy impact for developing countries

Output Report on ITU-D Question 3/1

Emerging technologies, including cloud computing, m-services and OTTs: Challenges and opportunities, economic and policy impact for developing countries

Study period 2018-2021

Emerging technologies, including cloud computing, m-services and OTTs: Challenges and opportunities, economic and policy impact for developing countries: Output Report on ITU D Question 3/1 for the study period 2018-2021

ISBN 978-92-61-34531-0 (Electronic version)
ISBN 978-92-61-34541-9 (EPUB version)
ISBN 978-92-61-34551-8 (Mobi version)

Acknowledgments

The study groups of the ITU Telecommunication Development Sector (ITU-D) provide a neutral platform where experts from governments, industry, telecommunication organizations and academia from around the world gather to produce practical tools and resources to address development issues. To that end, the two ITU-D study groups are responsible for developing reports, guidelines and recommendations based on input received from the membership. Questions for study are decided every four years at the World Telecommunication Development Conference (WTDC). The ITU membership, assembled at WTDC-17 in Buenos Aires in October 2017, agreed that for the period 2018-2021, Study Group 1 would deal with seven Questions within the overall scope of "enabling environment for the development of telecommunications/ information and communication technologies."

This report was prepared in response to **Question 3/1: Emerging technologies, including cloud computing, m-services and OTTs: Challenges and opportunities, economic and policy impact for developing countries** under the overall guidance and coordination of the management team of ITU-D Study Group 1 led by Ms Regina Fleur Assoumou-Bessou (Côte d'Ivoire), as Chairman, supported by the following Vice-Chairmen: Ms Sameera Belal Momen Mohammad (Kuwait); Mr Amah Vinyo Capo (Togo); Mr Ahmed Abdel Aziz Gad (Egypt); Mr Roberto Hirayama (Brazil); Mr Vadim Kaptur (Ukraine); Mr Yasuhiko Kawasumi (Japan); Mr Sangwon Ko (Republic of Korea); Ms Anastasia Sergeyevna Konukhova (Russian Federation); Mr Víctor Martínez (Paraguay); Mr Peter Ngwan Mbengie (Cameroon); Ms Amela Odobašic (Bosnia and Herzegovina); Mr Kristián Stefanics (Hungary) (resigned in 2018) and Mr Almaz Tilenbaev (Kyrgyzstan).

The report was authored by the Rapporteur for Question 3/1 Mr Nasser Kettani (Microsoft, United States) in collaboration with Vice-Rapporteurs: Mr Geraldo Neto (Telecommunications Management Group, Inc, United States); Mr Christopher Hemmerlein (Facebook, United States); Mr Franklin Makokha (Kenya); Mr Zhen Zhang (China); Mr Henri Numbi Ilunga (Democratic Republic of Congo); Mr Charles Zoë Banga (Central African Republic); Mr Luc Servais Missidimbazi (Congo); Mr Ahmadou Dit Adi Cisse (Mali); Mr Abdoulaye Ouedraogo (Burkina Faso); Mr Darshan Thapa (Bhutan); Mr Serigne Abdou Lahatt Sylla (Senegal); Mr Arseny Plossky (Russian Federation); Ms Beyhan Aygün Akyüz (Türk Telekom, Turkey) and Mr Ram Babu Jatav (India).

Special thanks go to chapter coordinators for their dedication, support and expertise.

This report has been prepared with the support of the ITU-D study group focal points, the editors as well as the publication production team and ITU-D study group secretariat.

Table of contents

Acknowledgments iii

List of figures viii

Executive summary ix

Abbreviations and acronyms xi

Chapter 1 – Introduction 1

1.1 Background 1

1.2 Emerging technologies 1

1.3 The mobile world 4

1.4 COVID-19 pandemic 5

Chapter 2 – Cloud computing 7

2.1 Background 7

2.1.1 Previous study cycle of Question 3/1 8

2.1.2 Current status of research in ITU-T 8

2.2 Cloud state of the art and state of the business 8

2.3 New trends in cloud computing 9

2.3.1 Cloud moving to the edge 10

2.3.2 Move to software as a service 11

2.3.3 Algorithm as a service 13

2.3.4 IT as a service 13

2.4 Economics for the adoption of cloud computing 14

2.4.1 Enterprise cloud adoption models 15

2.4.2 Different business models 16

2.4.3 Data as business model 16

2.5 Considerations for cloud adoption 17

2.6 Trust 18

2.6.1 Security 19

2.6.2 Transparency 19

2.6.3 Control 20

2.6.4 Business continuity 20

2.7 Case studies of successful cloud-computing platforms used in developed and developing countries 20

2.8 Guidelines to spur development and uptake of cloud computing 21

Chapter 3 – M-services 22

3.1 Background 22

3.2 M-services state of the art and state of the business 22

3.3 New trends in m-services 23

3.3.1 Application integration platforms (e.g. Apple Arcade and Google Play Pass) 23

3.3.2 5G 24

3.3.3 Gaming genres 24

3.3.4 Progressive web applications 24

3.3.5 Rise of mobile health 25

3.3.6 Emergence of enterprise mobile apps 26

3.3.7 Increase in on-demand apps 26

3.3.8 Integration of payment gateways into mobile apps 26

3.3.9 Proliferation of instant apps 26

3.3.10 Increase in virtual reality and augmented reality usage 26

3.3.11 Use of accelerated mobile pages development 26

3.3.12 Synchronizing wearable technology with m-services 26

3.3.13 Widespread use of chatbots 27

3.4 Policies, strategies and relevant approaches in the field of m-services 27

3.5 Methods of development and deployment of m-services app economy 29

3.6 Ways to promote an enabling environment for the development and deployment of m-services 29

3.6.1 Government/national regulator 30

3.6.2 Ministries/government agencies 30

3.6.3 Telecommunication operators 30

3.6.4 App developers 31

3.6.5 ICT training institutions 31

3.7 Case studies and best practices 31

3.8 Guidelines to spur development and uptake of m-services 31

Chapter 4 – Over-the-top applications 33

4.1 Background 33

4.2 OTT state of the art and state of the business 35

4.2.1 New trends in OTT 37

4.2.2 Benefits of OTT 38

4.3 Impacts of the provisioning of OTT 39

4.3.1 Regulatory frameworks 39
4.3.2 Network infrastructure 42
4.3.3 Macroeconomic and microeconomic developments, including competition effect on the market 44
4.3.4 Competition 46
4.3.5 Evolving business models 47
4.3.6 Legal frameworks and commercial partnerships for the development and deployment of OTT 49
4.3.7 Economic and business model partnerships among telecommunication operators and OTT providers 52
4.4 Guidelines regarding OTTs 54

Annexes 55

Annex 1: Economic impact of OTTs on national telecommunication/ICT markets 55

Executive summary 55
Introduction 56
Context 57
ITU studies on OTT 58
ITU-D 58
ITU-T 58
Definitions 58
Move to digital world 59
The impact of OTTs on traditional telecommunications 60
Demand 61
Data traffic 61
Revenues 63
Costs 64
OTT infrastructure investment 65
MNO and OTT relationships 67
Measuring social impact of OTT platforms 69
Role of regulation 71
Regulatory considerations 71
Possible objectives for regulatory action 72
Looking ahead 73
Conclusions 74
Regulators and decision-makers 74
Telecommunication operators and OTT providers 75

Annex 2: Country case studies relating to cloud computing 76

Background of cloud-service development on the part of telecommunication operators in China 76

Major initiatives launched by telecommunication operators for cloud services 76

Proactively promote the "cloud transformation" plan to improve cloud computing service capabilities 76

Strengthen the construction of IDC (Internet data centre) resources and enhance the supply capacity of the infrastructure 76

Promote the integrated development of various technologies and enhance capacity for business innovation 76

Actively expand services at the PaaS and SaaS layers and enhance cloud-computing application capabilities 77

Combat the impact of the COVID-19 pandemic 77

Summary and suggestions 77

Cloud-computing regulation in Saudi Arabia, by Axon Partners Group 78

China case study 78

Bhutan case study 79

Islamic Republic of Iran case study 80

Nigeria case study 80

Annex 3: Case studies relating to m-services 82

Barbados case study on the m-Money service 82

M-financial services case study 82

Kenya case study on m-services (M-Akiba) 83

Kenya case study on m-farming 83

Annex 4: Case studies on OTT 85

Bahamas case study 85

Australia case study 85

Bahrain case study 86

Guinea case study 86

Côte d'Ivoire case study 87

List of figures

Figure 1: Demand versus innovation virtuous circle 2
Figure 2: Founding emerging technologies 3
Figure 3: Mobile – Internet – Cloud 4
Figure 4: Cloud regulation landscape by region 7
Figure 5: Cloud regulation projection by region 7
Figure 6: Worldwide public cloud service projection (2018 – 2022) 9
Figure 7: CAGR by cloud service category 10
Figure 8: Software as a service (SaaS) market from 2008 to 2020 (in USD billions) 12
Figure 9: Cloud provider categories 14
Figure 10: Enterprise cloud strategy and types of cloud used 16
Figure 11: M-services regulation landscape 22
Figure 12: M-services regulation by sector 22
Figure 13: Wearable-technology users in the United States (2014 – 2018) 25
Figure 14: Gross app revenues in USD billions (2018 – 2019) 27
Figure 15: Application downloads on Apple App Store 28
Figure 16: OTT regulation landscape by region (2019) 34
Figure 17: OTT regulation landscape by region (2018) 34
Figure 18: OTT regulation projections by region (2019) 34
Figure 19: OTT regulation projections by region (2018) 35
Figure 20: OTT regulation by category and region (2019) 35
Figure 1A: The Internet value chain and market size shares in 2015 60
Figure 2A: Global mobile data traffic and usage per application 62
Figure 3A: Evolution of voice traffic in comparison with revenues, investments and mobile broadband penetration 63
Figure 4A: MTN's revenues evolution by country 64
Figure 5A: Estimation of costs associated to mobile broadband traffic 65
Figure 6A: Average annual total investment by region (USD billion, 2014-2017) 66

Executive summary

The world has entered an era of accelerated technology innovation, driven by massive research and development investments and exponential progress in many technologies, especially digital. The growing set of technologies emerging every day is staggering. Digital technologies such as cloud computing, blockchain, artificial intelligence (AI), mobile, virtual/mixed/augmented reality, drones, Internet of Things (IoT) and 3D printing, are transforming every industry. And while each of these technologies is a breakthrough in itself, when combined with other technologies, its core potential is increased exponentially.

These technologies are innovative and disruptive by nature. They challenge incumbents in many industries to adapt their existing businesses and business models. They also create new opportunities for every industry to innovate, provide better products and services, bring better customer experiences, reduce costs and improve productivity.

These technologies are global by design. This is the first time in history that technologies are potentially made available to everyone on the planet simultaneously, not limited to the countries or companies that invented them, but available for everyone to use and innovate. Thanks to this global availability and scale, these technologies are affordable to many, including large and small businesses, government institutions, non-governmental organizations (NGOs) and start-ups everywhere in the world, including in developing countries.

With this comes a set of challenges for regulators and policy-makers, who want to understand the profound value and impact of these technologies and create an enabling environment that promotes adoption and spurs innovation while protecting the public interest.

Mobile technology is one such disruptive technology. It has changed the world over the last two decades by every measure. Billions of people in every corner of the planet have now access to mobile technology and billions have access to smartphones and the Internet. Mobile technology is used by consumers, businesses (large and small), governments, NGOs and researchers to effect all sorts of transactions, besides placing and receiving calls. Mobile technology is used to make payments, access social networks, attend online courses, get health services, book travel or rent a car, and buy almost anything.

Mobile services ('m-services') are profoundly changing the way we do everything, especially in developing countries. The potential for development of this industry is yet to unfold.

This report looks at that potential, the barriers and challenges for adoption and deployment of m-services, and the policies and regulatory guidelines that can support that development in developing countries.

The Internet, especially in combination with mobile technology, has provided an opportunity for a new set of services: IP-based services. These are often referred to as over-the-top (OTT) applications to users over an Internet connection, independent of the telecommunication network operator providing the Internet connection. Consumer demand for such offerings is growing rapidly as they want more of, and perceive large benefits from, these applications. Consumer demand for content, applications and services is creating demand for investment in broadband access and services. At the same time, increased broadband capacity leads to the

development and deployment of new generations of services and applications, such as mobile money transfer, m-banking, m-commerce and e-commerce. Such a virtuous circle requires network operators to seek new business models and arrangements to maintain a high level of infrastructure investment, particularly in developing countries.

This report also looks at the impact of OTT provisioning, the policy tools that enable the deployment of OTT applications and the best practices that create incentives for investment, especially in developing countries.

Cloud computing is considered by many key industry leaders to be the next technological revolution of the twenty-first century. The potential of mobile technologies and OTT applications as well as other technologies, such AI, blockchain and IoT, is being unleashed as a consequence of cloud computing. Work carried out in the 2014-2017 study period explored the question of access to cloud computing in developing countries. However, the trends in cloud computing, be it in terms of technology, business models, investments or adoption, are evolving so rapidly that it is important to look at those elements again and at the various tools and frameworks for developing cloud computing in developing countries.

In preparing this report, it was decided to draft a chapter for each topic. After an introduction and some background in **Chapter 1**, **Chapter 2** deals with cloud computing; **Chapter 3** looks at m-services; and **Chapter 4** addresses over-the-top services (OTTs).

Abbreviations and acronyms

Abbreviation	Term
AaaS	algorithm as a service
AI	artificial intelligence
AMP	accelerated mobile pages
API	application programming interface
AR	augmented reality
ASP	application service provider
B2C	business-to-consumer
BEPS	base erosion and profit shifting
CAGR	compound annual growth rate
CAPEX	capital expenditure
CDN	content delivery network
CSP	cloud service provider
ECS	electronic communications services
EECC	European Electronic Communications Code
GaaS	games as a service
GCC	Gulf Cooperation Council
GDP	gross domestic product
GSM	Global System for Mobile
GSMA	GSM Association
IaaS	infrastructure as a service
IAP	Internet access provider
ICS	interpersonal communications services
ICT	information and communication technology
IDC	Internet data centre
IGO	intergovernmental organization
IoT	Internet of Things
IP	Internet Protocol
ISO	International Organization for Standardization

(continued)

Abbreviation	Term
ISP	Internet service provider
ISV	independent software vendor
IT	information technology
ITaaS	IT as a service
ITU	International Telecommunication Union
ITU-D	ITU Telecommunication Development Sector
ITU-T	ITU Telecommunication Standardization Sector
IXP	Internet exchange point
LAN	local area network
MNO	mobile network operator
NB-ICS	number-based ICS
NGN	next-generation network
NGO	non-governmental organization
NI-ICS	number-independent ICS
OECD	Organisation for Economic Co-operation and Development
OPEX	operational expenditure
OSP	online service provider (an alternative term for OTT provider)
OTT	over-the-top
PaaS	platform as a service
PC	personal computer
PPP	purchasing-power parity
PWA	progressive web application
RCS	rich communications services
RIA	rich interactive application
RMIO	Rural Mobile Infrastructure Operator
SaaS	software as a service
SCC	smart cities and communities
SD-WAN	software-defined networking (SDN) in a wide area network (WAN)
SLA	service-level agreement
SMB	small and medium-sized business

(continued)

Abbreviation	Term
SME	small and medium-sized enterprise
SMS	short message service
UGC	user-generated content
UNCTAD	United Nations Conference on Trade and Development
USSD	unstructured supplementary service data
VAT	value-added tax
VoD	Video on demand
VoLTE	voice over Long-Term Evolution
VR	virtual reality
WTDC	World Telecommunication Development Conference
XaaS	x as a service

Chapter 1 – Introduction

1.1 Background

Cloud computing, IP-based services and m-services have emerged as major technologies. ITU, and the ITU Telecommunication Development Sector (ITU-D) specifically, have looked at various issues and opportunities to develop reports, policy recommendations and studies that help Member States to understand and leverage these technologies. Yet there is still a lot of work to be done.

During the World Telecommunication Development Conference (Buenos Aires, 2017) (WTDC-17), ITU revised WTDC Resolution 2 on the establishment of study groups. ITU-D Study Group 1 (SG1) was tasked to address and develop a report on Question 3/1 – *Emerging technologies, including cloud computing, m-services and OTTs: Challenges and opportunities, economic and policy impact for developing countries*.[1]

1.2 Emerging technologies

There has never been a better time in technology, especially digital technology. The progress experienced daily is staggering. Moore's Law[2] – the prediction that the number of transistors incorporated in a chip will approximately double every two years – has proven to be accurate and continues to hold true, thanks to the exponential nature of the law. As Kurtzweil suggests in his essay 'The Law of Accelerating Returns': "*So we won't experience 100 years of progress in the 21st century – it will be more like 20 000 years of progress (at today's rate)*".[3]

Moore's Law and Kurzweil's Law apply to other aspects of technology and to any information-driven domain. In this regard, similar progress can be seen across many emerging technologies. This is the case, for example, of mobile computing, which has evolved from feature phones to the very powerful smartphones of today; and networks, which have expanded rapidly from 2G to 5G. This exponential growth is also notable, for example, in cameras, storage media and 3D printers. The price-to-performance ratio of these technologies is falling exponentially, making yesterday's very sophisticated and expensive technologies available today to many at the price point of older technologies.

Now, smartphones are as powerful as former supercomputers, and are used to access such Internet services as videoconferencing with high fidelity, or mobile banking and stock trading, or virtual games with players who are thousands of miles apart.

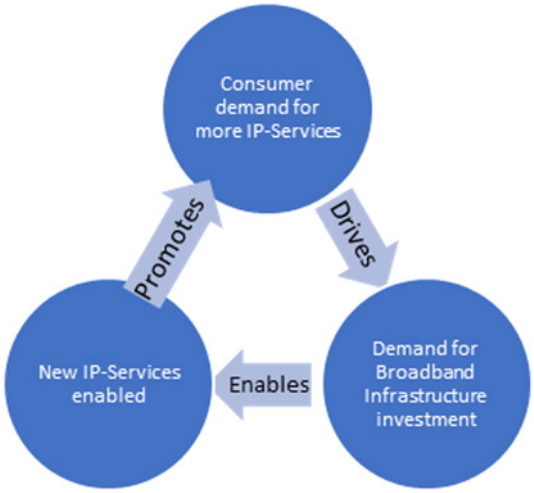
When combined, information-driven technologies such as mobile, Internet (IP-based), cloud computing and digital cameras drive even more acceleration and disruption. Today, many such emerging technologies are growing fast because they have established a virtuous circle that provides a framework for development and acceleration.

---

1 ITU. Final Report of the World Telecommunication Development Conference (Buenos Aires, 2017) (WTDC-17). Geneva, 2018.
2 Wikipedia. Moore's law.
3 Ray Kurzweil. Tracking the acceleration of intelligence. Essays. The Law of Accelerating Returns. 7 March 2001.

Consider IP-based applications or over-the-top (OTT) applications. Consumer demand for such offerings is rapidly growing as consumers want more of, and perceive large benefits from, these offerings. Consumer demand for content, applications and services creates demand for investment in broadband access and services as well as innovation in endpoint devices (smartphones, tablets, game consoles, smartwatches, etc.). At the same time, increased broadband networks and better endpoint devices also lead to the development and deployment of new generations of services and applications, such as mobile money transfer, m-banking, m-commerce, m-health, m-education and e-commerce. This is the virtuous circle that led to the development of technologies such as 3G, 4G and now 5G and more sophisticated endpoints. These technology advancements have created opportunities for applications and services that were neither known nor imagined.

Figure 1: Demand versus innovation virtuous circle

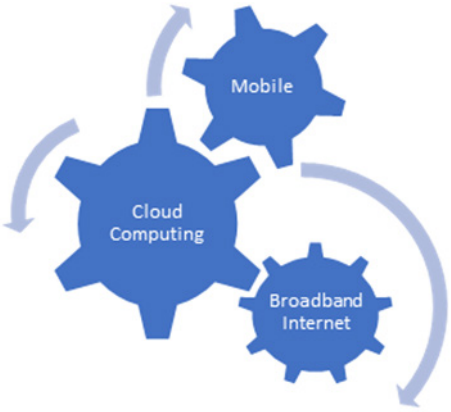


Source: ITU

This virtuous circle applies in the same way to all these trends. Consider the cloud. Consumer and enterprise demand for the cloud is driving more investment in cloud infrastructure and new cloud technologies, which in turn enables new advanced services such as AI, blockchain and big data, which are then adopted by users.

At the core of many innovations are technologies that enable others and drive accelerated innovation and disruption: the Internet, mobile technology and the cloud. The Internet, and especially broadband Internet, provides the backbone connectivity to everything, and nowadays everything is potentially connectable. Mobile phones, and in particular smartphones, provide people with the tools to access any service, anywhere, anytime, *de facto* enabling humans to be more mobile. The cloud provides the computing horsepower and the home to any service. While the cloud is one of the most important innovations of the digital era, it relies on the Internet and broadband, and when combined with mobile technology, especially smartphones (and many other forms of endpoints and Internet of Things (IoT)), it creates an environment of limitless innovation and disruption for every domain, discipline and industry.

Figure 2: Founding emerging technologies



Source: ITU

Our cars, medical devices, homes, speakers, watches, cameras and all sorts of sensors in cities, airports, malls, train stations, farms and even cows, are already connected and developers, start-ups, businesses and governments are adding more devices every day. Billions of connected devices are added every year to this grid.

While the number of people connected to the Internet has grown almost exponentially over the last decade, and passed the threshold of 50 per cent of the world population, including in every region except Africa, in 2018 for the first time the number of connected devices surpassed the world total population, and is growing faster. Gartner[4] estimated in 2017 that: *8.4 billion connected things will be in use in 2017, up 31 per cent from 2016 and will reach 20.4 billion by 2020. Total spending on endpoints and services will reach almost USD 2 trillion in 2017*.

By 2050, the world population is estimated to be almost 10 billion people. New production techniques will be needed to grow and extract adequate resources from around the globe to support this population's growing needs. Emerging digital technologies are changing the way industries respond to these challenges, helping improve the production and the distribution of resources and people. However, many of the locations requiring these smart solutions are remote and without communication infrastructure. Broadband connectivity and cloud computing are directly relevant to the sustainable growth of these industries, which include agriculture, energy, mining, transport and utilities. Thanks to broadband and cloud, they can be more efficient and operate more safely, regardless of location.

The Internet is the critical infrastructure that makes sense of these 'things', such as smartphones, tablets, game consoles, PCs and servers, that collect and send massive amounts of data to data centres around the world for storage, processing, decision-making, monitoring and management. The backbone that connects these things to data centres is broadband Internet and various other connectivity tools. Consumer demand for these devices and services drive investment in broadband, which then drives innovation in infrastructure, such as 4G, 5G, fibre and satellite. These new technologies will in turn enable new innovations and scenarios.

[4] Gartner. Newsroom. Press releases. Gartner Says 8.4 billion connected "things" will be in use in 2017, up 31 per cent from 2016. Egham, United Kingdom, 7 February 2017.

The cloud provides limitless computing power, data storage and processing, new off-the-shelf algorithms for every service and application to potentially disrupt every industry, with important intrinsic ingredients that are also by nature disruptive.

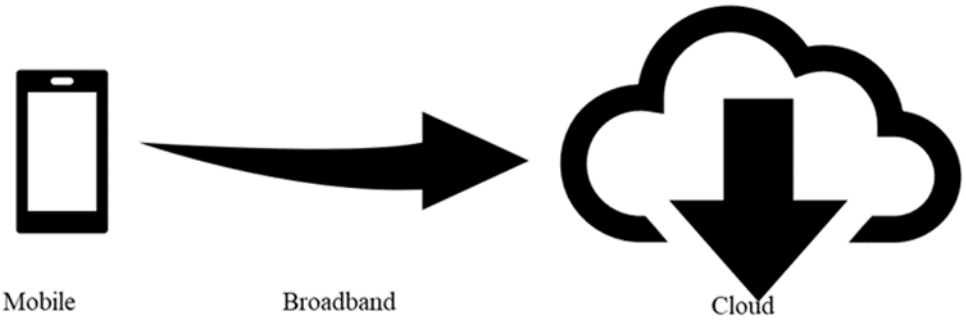
- This horsepower is available to everybody in the world (including developing countries), provided they have Internet connectivity. This is a breakthrough since supercomputers, such as those built by Cray, were only available to a few companies in the world that could afford them. Today, anybody in the world potentially has access to the cloud anytime, anywhere.
- It is accessible on demand, as pay-as-you-use, and at an infinitely small fraction of the cost of the enabling capital investments.
- It is always up to date with the latest innovations.
- It is always available, which means that the time-to-market for new products and services is reduced significantly from years to months and weeks.
- It is global, providing a scale and hence a market presence to anyone, especially young entrepreneurs, an impossibility less than a decade ago.

1.3 The mobile world

About a third of the world population uses smartphones. Smartphones have become the most used access to the Internet (displacing the PC) and a tool used to do almost everything, from meetings to socializing, working, playing, entertaining, shopping, learning and getting access to health, banks, agriculture advice and more. Smartphones have enabled mobility and made humanity more mobile than ever before.

What makes smartphones 'smart' are the applications that power the mobile phone. Most of these applications use the Internet to connect to back-end data centres or cloud services.

Figure 3: Mobile – Internet – Cloud



Source: ITU

Mobile, broadband and cloud technologies are interrelated and enable one another. Their ecosystems work together. Therefore, it makes sense for ITU to consider these three technologies in the same report. While each technology is at a different level of maturity and requires a different scope of study, addressing them under the same Question helps regulators and policy-makers to understand the intrinsic relationship of these technologies to help them make better policy decisions.

1.4 COVID-19 pandemic

The outbreak of the COVID-19 pandemic in 2020 created an unprecedented moment in modern history, forcing the lockdown of companies, cities and even countries. This global pandemic has demonstrated the major importance of ICT tools and connectivity, especially the value of m-services, OTTs and cloud applications.

As a consequence of the unprecedented lockdowns around the world hundreds of millions of office workers have been obliged to work from home; commercial travel has been stopped for millions of businesses, customers and partners alike; children have seen their schools close, forcing classrooms into the home; hospitals have been forced to focus on COVID-19 victims and find alternative solutions for people suffering from other illnesses; and courts around the world were closed, leaving justice for thousands of people on hold.

Governments worldwide have been forced to find solutions to address the challenges raised by the COVID-19 pandemic. In almost all cases, a combination of m-services, cloud and OTT applications has helped to mitigate the most pressing issues and provide a solid alternative to the physical world activities.

Over-the-top applications have connected communities, families, businesses, clients and partners all around the world to enable them to stay informed, socialize, practise sport or Yoga and be entertained. M-services were at the core of the pandemic response. Health authorities developed mobile applications for COVID tracing and provided remote consultation on telemedicine platforms using mobile networks, which also enabled the transfer of money to the most vulnerable, and education to those who did not have computers.

Experts invited to an online panel in May 2020,[5] and another in July 2020 as part of the WSIS 2020 Forum, discussed the impact of the cloud during the pandemic, and shared lessons learned:

- **Innovation**: Start-ups and innovators used the opportunity to create solutions within weeks to address the pandemic challenges surrounding security, health, solidarity, education and more. They leveraged the cloud to develop, scale and deploy their solutions. Large cloud service providers (CSPs) in many cases helped these start-ups by providing free and sponsored access to the cloud.
- **Enterprise**: Large and small enterprises have been using the cloud and OTTs in many ways to address business continuity, allowing employees to work remotely, and some companies are looking to extend this policy.
- **Government**: Governments have turned to the cloud and OTTs for business continuity in areas such as education (providing remote education), health (providing telemedicine), finance, justice and many other services. Government employees are also teleworking. Countries with stringent cloud policies or telecommunication regulations have needed to review these policies to allow for business continuity. Governments rapidly used the cloud to develop COVID-19 tracing applications.
- **COVID-19 research**: Many researchers around the world have leveraged the power of the cloud to conduct research on COVID-19, whether for DNA sequencing of the virus, or molecular modelling, vaccine research, treatment research or pandemic propagation prediction modelling. The cloud is also being used to support open data and data sharing amongst the various COVID-19 researchers around the world.
- **Consumers – citizens**: Citizens are using cloud, m-services and OTTs to access governments, banks, service providers and social networks. Consumers, as they live

[5] ITU. Public Web Dialogue: Cloud for COVID-19 Response. 27 May 2020.

through the lockdown, have organized themselves to 'telesocialize' with their friends and families, take Yoga or gym courses, or access COVID-19 information streams, all made possible through the cloud.

- **Non-governmental organizations (NGOs)**: NGOs around the world are organizing themselves to help the undeserved and most vulnerable communities. The cloud provides a ready-to-use platform to support their needs in terms of grant collection and management, communication and remote implementation.
- **Cloud service providers (CSPs)**: Most CSPs have faced high demand and pressure on their infrastructure to serve existing customers and meet workloads as well as the very high and unpredictable demand from new customers moving to the cloud. Some service providers have reported close to an eight-fold increase in demand for some services.
- **Infrastructure**: Certainly, one of the most satisfying lessons learned during the pandemic concerned the robustness of the Internet infrastructure. As demand grew by an order of magnitude in a matter of days, if not hours, from government, private sector, innovators, NGOs and citizens from around the world, the Internet infrastructure kept working and delivered on its promise to act as a critical infrastructure. Dr Marnix Dekker from the European Union Agency for Cybersecurity (ENISA) noted at a webinar organized by ITU during the WSIS 2020 Forum "… *whether it is the Internet infrastructure or the major cloud infrastructure, it responded to the growth, it was ready for scale out when needed because it was designed and developed for that matter*…".[6]
- **Preparedness**: This is probably the most important lesson of all. Those countries, governments, companies and institutions who were prepared were able to migrate online easily and faster than others. It is not only about technical readiness, but also human, governance, policy and regulatory readiness.

To that end, it is time for Member States, especially developing countries, to:

- promote the adoption of emerging technologies of the fourth industrial revolution in order to hasten the pace of development and socio-economic change;
- adapt legal and institutional frameworks to support the digital economy and the use of emerging technologies;
- support study programmes, research laboratories and improved technical capacity, including those at a regional and/or continental level, for the purpose of better understanding and implementing applications employing emerging technologies;
- develop and implement national and international strategies to develop and share resources as appropriate in regard to emerging technologies;
- develop effective policies for data protection and privacy in order to improve confidence and trust in the use of innovative technology;
- develop and implement strategies to achieve universal access to telecommunication/ICT services, including for persons with disabilities and persons with specific needs.

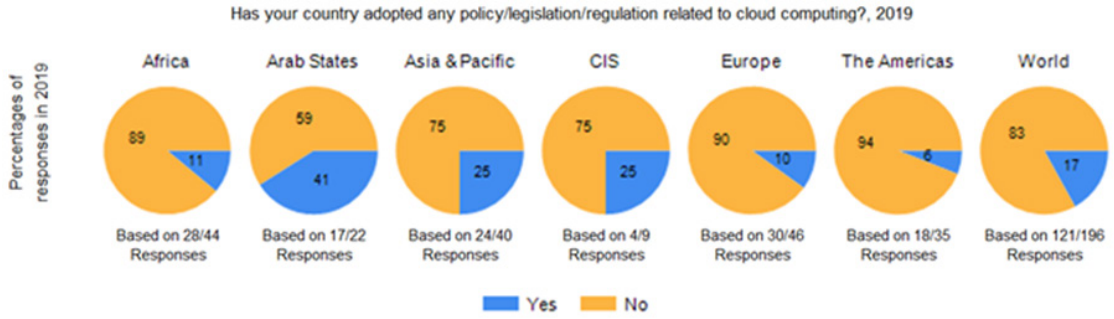
[6] ITU. WSIS Forum 2020. Session 279 – A roadmap to a trusted Cloud for Good. 9 July 2020.

Chapter 2 – Cloud computing

Cloud computing has emerged as a major technology trend of the 21st century. Cloud computing market data reflect massive market adoption, with a projection of USD 411 billion by 2020 and a compound annual growth rate (CAGR) of 13 per cent according to Gartner.[7]

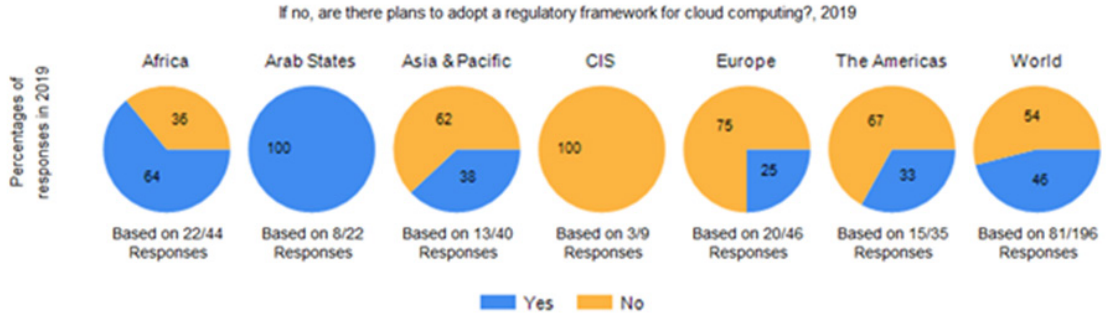
The 2019 data related to cloud computing from the annual ITU World Telecommunication/ICT Regulatory Survey on regulatory practices is summarized in **Figures 4** and **5**, which provide an overview of the trends in this area across ITU membership.

Figure 4: Cloud regulation landscape by region



Source: ITU World Telecommunication Regulatory Database, www.itu.int/icteye.

Figure 5: Cloud regulation projection by region



Source: ITU World Telecommunication Regulatory Database www.itu.int/icteye

2.1 Background

Cloud computing is a concept towards which the world is now gradually moving, in view of the many powerful advantages it offers. This concept can be summarized as a model that enables ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service-provider interaction.

The key characteristics of cloud computing are broad network access, measured service, multi-tenancy, on-demand self-service, rapid elasticity and scalability, and resource pooling. For many

[7] Louis Columbus. Forbes. Cloud Computing Market Projected To Reach $411B By 2020. 18 October 2017.

countries, cloud computing presents a possible solution to the lack of adequate computing resources, and it has achieved remarkable growth in many of the most developed countries. Cloud computing is considered by key industry leaders to be the next technological revolution of the twenty-first century.

2.1.1 Previous study cycle of Question 3/1

During the previous study period (2014-2017), Question 3/1 focused on analysis of the definition of cloud computing, the cloud-computing business model and challenges and opportunities related to cloud computing, and provided guidance that governments can implement to lead with cloud computing.

2.1.2 Current status of research in ITU-T

The key characteristics of cloud computing are economies of scale (infrastructure sharing) and flexibility of use. In view of the importance of the topic, cloud computing is dealt with by two study groups in the ITU Telecommunication Standardization Sector (ITU-T).

ITU-T Study Group 13 develops standards that detail requirements and functional architectures of the cloud-computing ecosystem, covering inter- and intra-cloud computing and technologies supporting XaaS (x as a service). This work includes infrastructure and networking aspects of cloud-computing models, as well as deployment considerations and requirements for interoperability and data portability. Study Group 13 also develops standards enabling consistent end-to-end, multi-cloud management and monitoring of services exposed by, and across, different service provider domains and technologies. Study Group 13 standardization work further covers network aspects of IoT, additionally ensuring support for IoT across future networks as well as evolving next-generation networks (NGN) and mobile networks. Cloud computing in support of IoT is an integral part of this work.

ITU-T Study Group 20 is responsible for studies relating to IoT and its applications, and smart cities and communities (SCC). This includes studies relating to big data aspects of IoT, SCC, e-services, and smart services for SCC.

2.2 Cloud state of the art and state of the business

Over the course of the last decade, cloud computing has become a disrupting force, impacting all business functions and initiatives. Gartner defines a strategic technological trend as "*one with substantial disruptive potential that is beginning to break out of an emerging state into broader impact and use*".[8] Cloud computing has emerged as one of the key IT industry evolutions of the twenty-first century. According to Gartner, the worldwide public cloud service is forecast to reach a value of USD 354 billion.

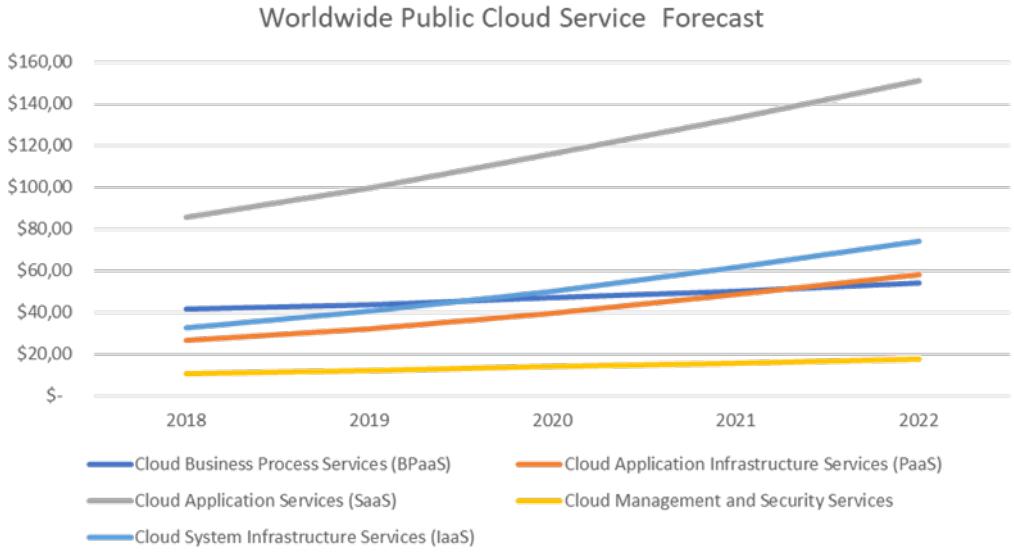
In 20 years of existence, it has been found that cloud computing has stimulated innovation within companies. New and existing functions, from customer care to cybersecurity, have progressively shifted to public, private and hybrid cloud services. The fastest growth has been seen in software as a service (SaaS). As early as 2016, the consultancy firm IDC predicted that close to one-third of the world market for business applications would be based on the SaaS model by 2018,

[8] Gartner. Newsroom. Press releases. Gartner identifies the top 10 strategic technology trends for 2020. Orlando, Fla., United States, 21 October 2019.

increasing SaaS annual turnover from USD 22.6 billion in 2013 to USD 50.8 billion in 2018. These estimates have been mostly confirmed by Skyhigh Networks data, which revealed that the average number of cloud applications being used had nearly tripled in the three years between 2013 and 2016.[9]

This very strong growth in cloud computing has forced analyst firms to revise their projections upwards. Use of cloud computing has become so omnipresent that many companies are adopting priority use of cloud-computing services (cloud-first policy). According to the latest annual report on cloud computing carried out by North Bridge, a growth equity and venture capital firm, 50 per cent of companies had a "cloud-first" or "cloud-only" strategy in place (90 per cent were using cloud computing in some form).[10]

Figure 6: Worldwide public cloud service projection (2018 – 2022)



Source: Gartner[11]

2.3 New trends in cloud computing

Advances in cloud computing are changing the dynamic nature of the technology. On the one hand, consumers, developers, IT managers and professionals are adopting the cloud as a primary consumption vehicle. On the other, this adoption is pushing cloud technology to evolve rapidly to provide more innovations and experiences to users.

As cloud computing matures in the market, major technological evolutions and frameworks are being developed by the community such as containers, distributed computing and serverless computing. At the same time, new significant trends are emerging, including but not limited to the following:

- Cloud continuum to the edge.

---

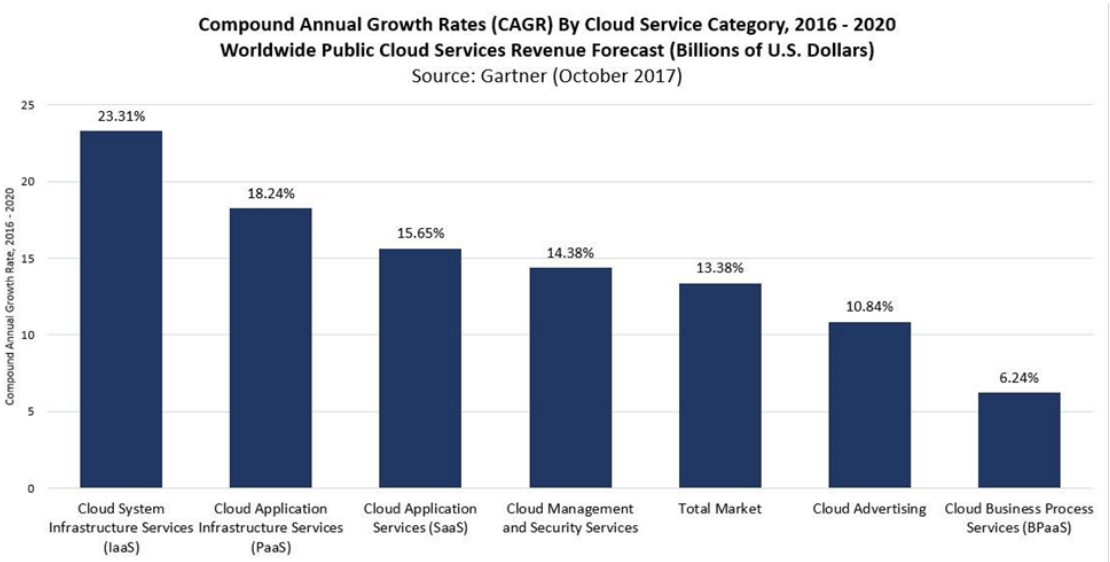
9 McAfee. 12 Must-Know Statistics on Cloud Usage in the Enterprise. The state of cloud adoption. Blog post, 9 March 2017.

10 Contel Bradford. StorageCraft. The What and the Why Behind Cloud First Policies. Cloud technology adoption is sky high.

11 Gartner. Newsroom. Press releases. Gartner Forecasts Worldwide Public Cloud Revenue to Grow 17% in 2020. Stamford, Conn., United States, 13 November 2019.

- Move to software as a service (SaaS) as a definitive market for many application service providers.
- 'Algorithms as a service' (although this is not a standard adopted terminology); 'IT as a service' (idem).

Figure 7: CAGR by cloud service category



Source: Gartner (October 2017)

2.3.1 Cloud moving to the edge

The rapid development of cloud computing in such sectors as the Internet, e-government, finance, industry and public services, in addition to the continuous increase in data volume, diversification of data processing and needs for data security and privacy, have posed many challenges to cloud-based data processing. With a strong push from industrial Internet and large-scale 5G commercialization in the making, edge computing has been growing fast, and by addressing the last-mile supply problem facing cloud native applications, it has become a vital pillar for implementing cloud computing in future development. The inevitable integration of edge and cloud computing will usher in a new stage of edge-cloud collaboration.

Both cloud computing and edge computing have their own merits. Cloud computing is efficient in global, non-real-time and long-cycle big-data processing and application; and superior in unified resource management, business decision-making support, big data-based machine learning and model training. Edge computing is more applicable to local, real-time and short-cycle data processing and analysis, and can better support quick responses to local tasks, and security.

Close collaboration between cloud and edge computing will meet the needs of a variety of use scenarios and increase the application value of both models. Capable of satisfying the needs for data processing and storage, edge computing can also be a collecting and preliminary processing unit of high-value data required by the cloud. In addition, cloud computing exercises uniform management over computing and storage resources on both the cloud and edge via a management network; it also delivers the resources to the edge by following the business rules and intelligent algorithms arising from big-data analysis and machine-learning training, which facilitates application by edge computing. It is therefore important to create a continuum

between the cloud and edge in order to facilitate the development and integration of such scenarios.

Some application scenarios of cloud-edge collaboration are outlined below:

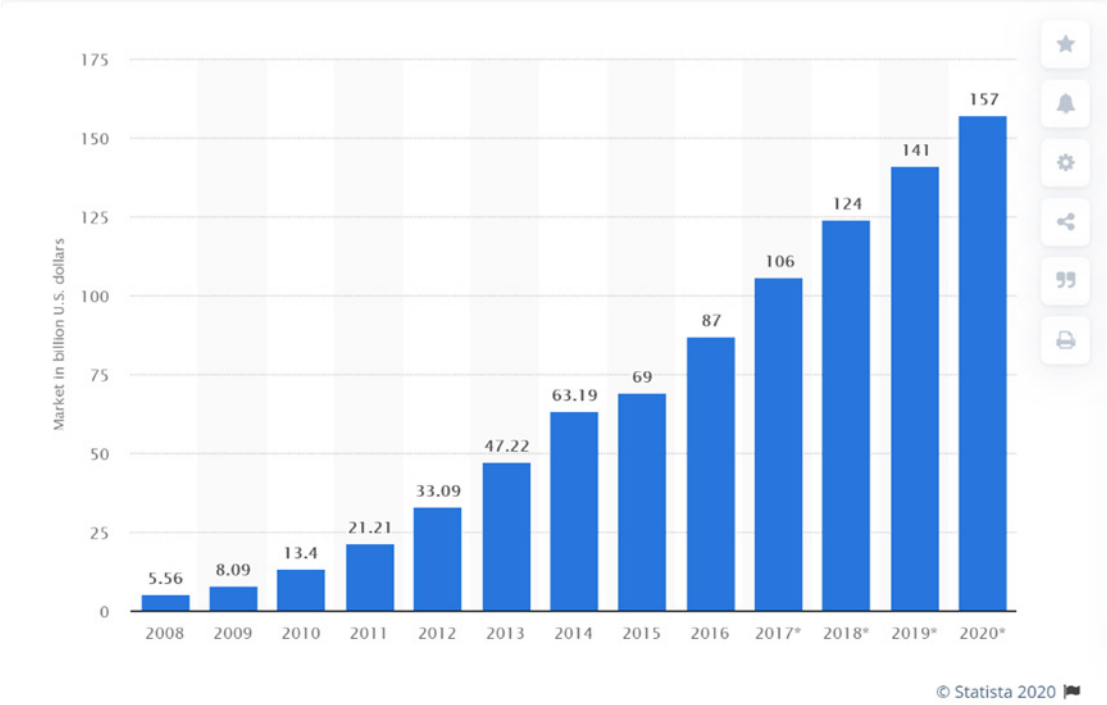
- **Industrial Internet scenarios**. The intelligent devices installed and connected on the edge enable mission-critical data processing and real-time response with near zero delays, thus greatly reducing network traffic through decentralized data processing. The cloud can gather edge data for unified storage and backup as well as achieve situation awareness and policy improvement based on big data and AI; it is also responsible for unified management of data transmission monitoring and edge devices.
- **Smart transportation scenarios**. By developing a smart transportation solution based on cloud-edge collaboration featuring the integration of the urban traffic "brain", road edge nodes and smart vehicles, sensing devices, such as laser-radars and cameras, will be integrated to allow collected data to interact with road edge nodes and nearby vehicles to extend "perception" and achieve vehicle-vehicle and vehicle-road collaboration. The urban traffic brain is responsible for collecting data from widely distributed edge nodes, computing the operating conditions of the transportation system and giving rational scheduling instructions to edge nodes, traffic signal systems and vehicles, based on big data and AI algorithms, thereby increasing the operating efficiency of the transportation system and minimizing road congestion.
- **Security monitoring scenarios**. The AI video analysis models carried by the edge computing nodes are designed for business scenarios such as intelligent security, video monitoring and face recognition, and performing local analysis, quick processing and real-time response by taking advantage of such edge computing characteristics as low latency, large bandwidth and quick response. The cloud performs AI training tasks, manages and delivers various AI algorithms in a unified manner and gathers edge-side video analysis results for convergence analysis and judgment.
- **Smart home scenarios**. A home local area network (LAN) of edge computing nodes (home gateways and intelligent terminals) processes huge amounts of heterogeneous data and uploads the processed data to a cloud platform in a unified way via the Internet or a 5G network. Users are able to control home terminals by connecting with the edge computing nodes via the network, and access historical data via the cloud.

2.3.2 Move to software as a service

As cloud computing gains momentum, application service providers (ASPs) for many disciplines are adopting the cloud as their main delivery mechanism. According to Statista, the size of the worldwide software as a service (SaaS) market is set to reach USD 157 billion in 2020.[12]

[12] Statista. Technology & Telecommunications. IT Services Total size of the public cloud software as a service (SaaS) market from 2008 to 2020.

Figure 8: Software as a service (SaaS) market from 2008 to 2020 (in USD billions)



Source: Statista 2020

Existing application service providers across disciplines – human resources, customer relationship management, enterprise resource planning, finance, communications and collaboration, accounting and even IT (such as security, management) – are moving their technologies to the cloud and preferring to use the cloud as their primary delivery mechanism. This move finds its rationale in various reasons:

- **Customer demand**: More and more customers now prefer a public cloud-based delivery model because they no longer have to manage any platform, they have transparent costs (only subscription), have moved from CAPEX to OPEX, have access to the latest versions and technologies provided by the vendor, have no need for additional hardware to deploy these applications, and can scale up and down easily (to add or delete users). However, additional network capacity to cater for cloud workloads and, in many cases, additional security and governance products might be needed.
- **Delivery, maintenance**: When moving to a public cloud-based delivery model, ASPs leverage the cloud to deliver applications online. They manage one version of the application for all customers worldwide, which makes it easier for them to innovate, fix errors or provide security updates. With this model, they can innovate very quickly and ensure all customers are using the same version worldwide regardless of where they are located and what version they had subscribed to at first. This has important implications for their cost model and their capacity to innovate and grow.
- **Innovation**: With the cloud, ASPs can deliver new experiences that are only possible on the public cloud. The public cloud provides scale, agility, technologies such as AI, blockchain, and IoT management at scale, and mobility, which enable ASPs to create new products, services and experiences that are otherwise hard or impossible to obtain using traditional delivery models.
- **Competition**: Traditional ASPs are facing fierce competition from small and agile start-ups that are leveraging the cloud to provide innovative new experiences and products, faster and cheaper. Innovative start-ups have changed the ASP landscape, forcing the large ASP players to reinvent themselves.

- **Scale**: The public cloud delivery model allows large and small ASPs to scale much faster than using the traditional on-premises delivery model. Thanks to the public cloud, there is no need to have offices everywhere to access customers, who can be served in a matter of minutes, and with only one version of their application to manage, the cost structure has changed, which allows the focus to be on innovation with fewer customer challenges to address.

2.3.3 Algorithm as a service

'Algorithm as a service' (AaaS) is not a term officially adopted by ITU or the International Organization for Standardization (ISO). However, AaaS is a major trend in the market that will have a profound impact on the innovation landscape, changing the way applications are developed and delivered.

AI is maturing and gaining momentum, and companies are using AI technology in applications, and providing access to AI products through application programming interface (API). This enables large and small companies to leverage advanced research from third parties delivered through the cloud using simple APIs. To illustrate this, consider companies that can use advanced natural language processing, speech-recognition or image-recognition algorithms developed by specialized companies in their applications, simply by calling on APIs. The algorithms are delivered through the cloud because the cloud provides scale, the cloud allows AI vendors to provide one version of their products, and customers always have access to the latest and best algorithm as they get more mature.

2.3.4 IT as a service

Again, 'IT as a service' (ITaaS) is not yet a term officially adopted by ITU or ISO. However, ITaaS is a major trend in the market that will have a profound impact on the way IT services are delivered to IT professionals who are managing IT infrastructure for private- and public-sector organizations.

This category of products and services includes security, backup, data governance, asset management and cloud management.

While many IT professionals enjoy great technical expertise and experience in managing IT infrastructure, they also experience challenges in terms of technology deployment, keeping up to date with the latest innovations and security updates.

The cloud is providing a new set of experiences for IT managers that were not possible before. For example, security professionals are turning to cloud computing to obtain greater visibility and insight into the security landscape, as well as near real-time updates, and in some cases solutions to zero-day security attacks. Cloud-based technologies are helping security experts to track data across networks and implement new and more secure data governance models. Advances in network architecture in the cloud are providing new solutions for security experts to move secure workloads to the public cloud and run them there as if they were running in on-premises data centres disconnected from the public Internet.

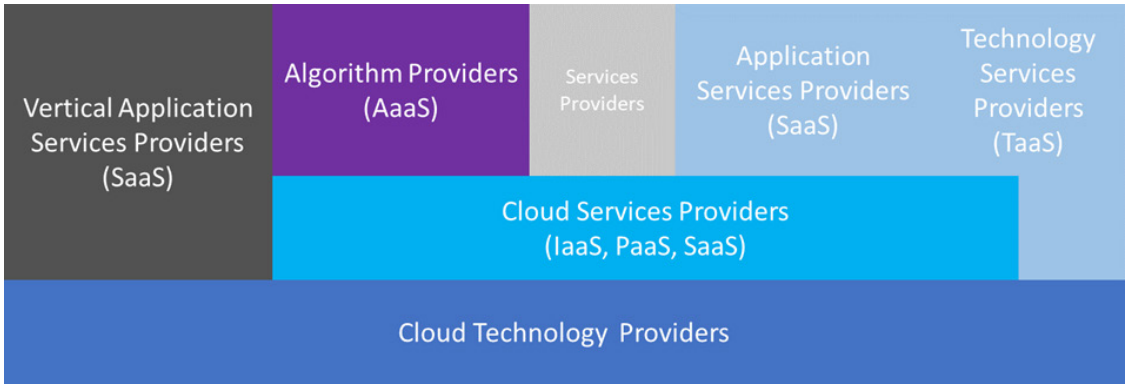
2.4 Economics for the adoption of cloud computing

Cloud computing, notably the hyper-scale cloud, changes the economic equation across the value chain and creates opportunities for new innovations, especially in business model innovation.

Cloud computing is a multi-faceted technology. ITU-T defines cloud computing as a paradigm for enabling network access to a scalable and elastic pool of shareable physical or virtual resources with self-service provisioning and administration on demand. The cloud-computing paradigm is composed of key characteristics, cloud-computing roles and activities, cloud-capability types and cloud-service categories, cloud-deployment models and cloud-computing cross-cutting aspects. ITU sets out three cloud capabilities: application (SaaS), platform (PaaS) and infrastructure (IaaS) as well as deployment models: public, private, community and hybrid. The combination of these create opportunities for a number of cloud options.

Cloud computing has a specific value chain, a set of potential players and services and many different business models, and enables new scenarios such as data-based business models. Regulators and policy-makers are invited to deep dive into these various models and understand the variations as they plan to develop specific policies and regulations.

Figure 9: Cloud provider categories



Source: ITU

There are various scenarios of cloud adoption:

- **Cloud technology providers**: Some public and private entities are implementing the cloud in their own IT infrastructure either for their own use (organizations can run their IT infrastructure and IT delivery processes using cloud-computing concepts) or to become cloud service providers (CSPs), providing cloud services for others or on behalf of others; for example, some government agencies have established shared infrastructure delivered as a cloud to various government agencies. To support this scenario, the ecosystem is composed of several industry players that provide technology and service components to help organizations become CSPs. This ranges from companies building data centres to hardware and network players, software vendors, security vendors (physical and software), energy and governance.
- **Cloud service providers (CSPs)**: Who delivers multipurpose cloud services? Some organizations, local and multinational, provide cloud services, in most cases in the form of public cloud services. These are CSPs. Services can be IaaS, PaaS or one of the various categories and capabilities described above. Their customers will be able to consume these services on-demand using self-service provisioning.

- **Application service providers (ASPs)** run on multipurpose cloud infrastructure. In this category, independent software vendors of all sizes develop cloud services for others to use; however, they need to use the cloud infrastructure to build and operate their cloud services rather than building their own. This category is probably the most dynamic in the marketplace, since small, medium and large organizations can use ready-to-use cloud infrastructure to deliver their own services to their customers, be it for consumers or enterprises.
- **Technology service providers** represent a specific category of ASP that leverage the cloud to provide applications to IT and technology users to run their own operations. This is an important evolution of how, for instance, security, governance and business continuity are being operated.
- **Vertically integrated clouds** are large-scale services (for example social networks or search engines) that are provided to users running on the vendor's own developed and integrated cloud infrastructure. In many cases, the underlying technology infrastructure is tailored to cater for the specific needs of the services they provide.
- **Algorithm providers** are a new dynamic category of service providers. Instead of providing fully fledged applications running on the cloud, they provide niche ready-to-use algorithms, developed and running on the cloud, to other application developers who will consume them on-demand through APIs. Most AI models are delivered through this mechanism as well as the development of other technologies such as blockchain.

While these scenarios are quite different, CSPs can provide more than one of the scenarios. Within this very specific chain, other organizations can play important roles:

- *Network infrastructure providers* provide the network access required for delivering the service. A big global challenge is the growing need for bandwidth and cloud services in remote locations.[13]
- *Service brokers* act as the primary contacts to customers, reselling or contracting on behalf of CSPs.
- *Traditional service providers* are part of a dynamic category of service providers who provide services to organizations willing to become CSPs or to those willing to consume cloud services such as security, audit, governance, compliance, training, change management, architecture guiding, managed services and migration services.

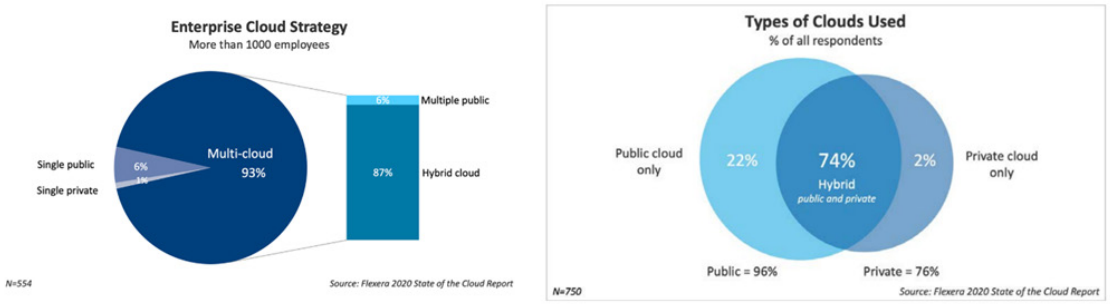
2.4.1 Enterprise cloud adoption models

Enterprise organizations, large and small, in both the public and private sectors, are consuming cloud services and recent research shows that most enterprises are using a hybrid model.

The hybrid model was identified early by ITU, but also by CSPs and enterprise organizations. This model provides flexibility for organizations that can leverage the cloud, deploy a progressive roadmap to adopt the cloud and comply with the regulatory obligations, or just meet their technical constraints.

[13] Use case: SES & Microsoft. See: Jennifer Sokolovsky. Microsoft. News. Azure Space partners bring deep expertise to new venture. SES. 20 October 2020.

Figure 10: Enterprise cloud strategy and types of cloud used



Source: Flexera 2020 State of the Cloud Report[14]

For example, the French NGO Syntec provided a framework to consider when adopting the cloud, including budget, cost control, scalability that remains out of sight to achieve transparency, improvement of effectiveness, deployment models (private, public or hybrid), and IT departments that need to examine carefully the different approaches. They concluded that, ultimately, a hybrid approach is often chosen for large enterprises.[15]

2.4.2 Different business models

Considering the value chain, various business models are being developed.

Some cloud services are designed for consumer needs and some are designed for enterprise level (and government) needs. In most cases, enterprise-grade services and consumer-grade services are governed by different principles, contractual clauses, service-level agreements (SLA), business models and security and privacy rules.

Enterprise-grade cloud services are those services designed for government and enterprise organizations. They are governed by enterprise grade contractual clauses, SLAs and security and privacy rules as they are then integrated into the overall supply chain of the organization. In most cases, CSPs provide an OPEX-based subscription model. The way the fees are calculated vary among CSPs, for example by user, by size (storage, compute, network) and through SLA.

Consumer-grade cloud services are designed for individual consumers to use and are governed by specific contractual clauses, SLAs and security and privacy rules. While a pay-as-you consume business model is applicable, other business models may be appropriate, such as *freemium* (free to a certain level and pay for more) and advertising business models (users are not the end customers/payers).

2.4.3 Data as business model

The very nature of cloud computing is about collecting, storing and processing data at scale with highly reduced costs compared to traditional computing models. As these new models develop, new business models based on data are being created. These will rely on capturing the maximum amount of data and leveraging big-data analytics, AI and new data-processing

[14] Flexera. Report. Flexera 2020 State of the Cloud Report.
[15] Syntec numérique. *Le cloud computing*. [in French]

technologies, to derive value from the data that can then be monetized. The following are examples of how this is unfolding:

- **Advertising**: Companies are providing cloud-based services to consumers for free. The purpose of the service is to collect and process data using various innovative data technologies, especially AI, and then create value for advertisers who are the end customers.
- **Industry-specific**: As many industries are transitioning to digital and are being information-enabled, capturing and processing data is creating massive business transformation and disruption. Many industries such as health, education, agriculture, justice, environment, pharmaceuticals and transportation are increasingly dependent on data, and companies are leveraging the cloud to capture and process data to create new products and services that disrupt these industries.
- **Technology-focused**: The adoption of cloud computing enables some service providers to capture technology-specific data that will create new value for users. For example, some service providers will capture data from networks, endpoints or operating systems, etc. that, once processed, can be turned into security services for users.

Developers are finding new ways to capture and process data, leveraging the cloud and creating added value for users and organizations. This is only possible thanks to the power of the cloud to capture, store and process data at scale, to provide technologies that are otherwise hard or impossible to support outside the cloud and most importantly at a cost that makes these innovations sustainable.

2.5 Considerations for cloud adoption

As organizations are adopting cloud computing, there are several elements that need special consideration and attention. These include:

- reliable connectivity;
- network connection security;
- access to data;
- authentication of persons accessing data and services;
- data encryption;
- data backup;
- access traceability and traceability of data operations;
- entity certification and cloud-computing provider security procedures;
- requirement for the CSP to provide information on security incidents when possible;
- provision for regular testing of data-recovery procedures and for fall-back procedures in the event of service interruption;
- conditions relating to contract termination.

To this end, developing countries are encouraged not only to rely on a mix of network access technologies to ensure data storage and secure access to data, but also to follow and participate actively in the work being done by ITU-T in the field of cloud computing.[16]

[16] ITU-T. Focus Group on cloud computing.

2.6 Trust

Cloud computing has emerged as an important and disruptive technology of the current decade (2020-2030). As seen from market-penetration figures, cloud computing is gaining momentum. For the cloud to "cross the chasm", as in Geoffrey Moore's technology paradigm,[17] and in relation to many other aspects that need to be addressed, trust has generated many questions from industry, users, governments and regulators.

Cloud computing is a disruptive technology that is reshaping the boundaries of companies and institutions using the cloud, as well as consumer habits. In the business space, there are three notable phases of IT adoption:

- **Phase 1**: During the first decades of information systems development, small and large entities in the public and private sectors were mostly using in-house computers and servers to capture, store, manage and process data and business processes. The users of these systems were mostly company employees. The boundaries of the institutions were well delimited inside a firewall. This protection is analogous to a 17th century castle with large and high walls, and hard to attack. The system of trust was built essentially around employees, vendors and some other technical controls and measures within the boundaries of the 'walls'.
- **Phase 2**: With the advance of broadband Internet, and many other technologies, the boundaries started to shift. Employees access these systems from outside the 'walls' of a company or institution. Partners access some of the systems that sit inside the 'walls. Customers interact with systems inside the 'walls' using various means including the web or mobile apps. Objects are now connected to some of these systems and provide data to or get orders from them. This is all using the Internet. But in most cases, these interactions are happening with the same paradigm: the IT system is inside a 'wall' and all these interactions need to cross it. The system of trust in this world is more complex. Trust is needed for employees and vendors, but new sophisticated technical, process and organizational measures are required to stop unauthorized access from someone sitting anywhere in the world who could perform a cyberattack, much like a 'catapult'. In this environment, security and protection are still all performed by the entities themselves.
- **Phase 3**: Some technological advances have pushed the boundaries further and have opened the 'wall' to a new form. Cloud computing is reshaping the 'wall', and in its outsourced form, it invites institutions for many good technical, economic and business reasons to move data and/or processing outside the traditional 'wall'. Within this paradigm, the IT system of any entity, with its new boundaries, has new stakeholders in addition to employees and vendors: the CSPs and their ecosystem.

Institutions and other stakeholders looking to leverage the outsourced cloud have legitimate concerns over control and processing of data, such as: *'I don't know where my data are'; 'I lose control'; 'What happens to my data once in the cloud?'; 'Is the cloud secure?'; 'The public cloud is exposed on the Internet, so* everyone *has access?'; 'What are cloud service providers doing with my data?'; 'Which third party has access to my data and under which processes*?'. Such concerns indicate that regulators, governments and CSPs need to prepare the ground for a new system of trust, if the full potential of this technology is to be unleashed.

Consumers are also using various cloud services, for example, to store pictures and documents, e-mail, chat with their families and friends, read books, listen to music and watch films or socialize.

[17] Geoffrey Moore. Crossing the Chasm, 3rd Edition. Marketing and Selling Disruptive Products to Mainstream Customers. Collins Business Essentials. Harper Collins. New York, 28 January 2014.

During the 2018-2021 study period, a report on cloud computing prepared in response to Question 3/1 suggested that cloud adoption requires a system of trust, and the report set out a framework of four pillars: security, privacy, compliance and transparency. That framework applies, in fact, to CSPs.

Building on that framework, it is suggested not only to develop it further, but also to address the trust discussion in the present report by adding the roles and responsibilities of governments and regulators. Many of the unanswered questions regarding a trusted cloud environment lie with governments and regulators.

The framework proposed below is for a trusted cloud environment.

2.6.1 Security

Protecting the cloud infrastructure and data are paramount for all stakeholders, including CSPs, customers and governments. Yet, in the cloud context, security is the business of all these stakeholders and does not lie solely with the CSP, who still has a major responsibility: a CSP should have accountability to protect customer data and systems. A CSP should also demonstrate as much as possible, within certain reasonable limits, that all necessary processes and governance are in place to protect customer data and systems, and there are international standards such as the ISO 27000 series, HIPPA (for health), PCI-SSC (for payment) and General Data Protection Regulation (GDPR) that identify minimum security guidelines. Some countries, such as Australia, France, Morocco, the United Kingdom and the United States, have developed specific security standards for industries such as justice, health, finance and security.

At the same time, with the advance of the cloud and its widespread adoption by many critical infrastructure institutions across the globe, it is important that all players should refrain from cyberwarfare and attacking tech companies that operate the cloud. Governments and regulators should provide confidence for both CSPs and their clients that they are not going to be the targets of cyberwarfare attacks. Stakeholders should also consider exchanging security information between CSPs (technology companies), and between governments and CSPs, to avoid any proliferation of cyberwarfare. This is an area that requires intense cooperation.

2.6.2 Transparency

Transparency is one of the key components of a trusted ecosystem that will create confidence among entities and consumers who are willing to use cloud services. In fact, they need to obtain some level of transparency, within reasonable limits of security, on what happens to their data once such data are in the cloud. CSPs should be able to provide a high degree of transparency in this regard in contractual agreements with their clients, for example.

Governments and regulators have an important role to play to enable more transparency in the ecosystem. In fact, for many legitimate reasons, governments around the globe might need to get access to data that reside with a CSP. CSPs who are willing to invest in cloud infrastructure are always struggling to understand local legislation and regulation with regard to government access to data, especially data stored locally; and this in many cases prevents more investments in cloud infrastructure by CSPs. For that matter, governments and regulators could gain by creating legislation and regulations that provide transparency to both CSPs and their customers in respect of the rules that govern access to data. CSPs will have more clarity on the rules and

processes, and clients will have more clarity as to what data they can move to the cloud and what data they want to keep on premises.

2.6.3 Control

Entities and citizens moving data and workloads to the cloud should be confident that they are in control of their data at all times. They should be able to leave the CSP when they want, and to fully retrieve their data; they need to have confidence that the CSP is not using their data for purposes other than providing the service to which they agreed. This should ideally be in their contractual agreements. At the same time, CSPs will need to develop technologies that provide their clients with control over data, such as encryption with personal keys and control of access.

Governments and regulators have an important role to play in this process. Legislation should hold entities and citizens moving data to the cloud accountable for that data, not the CSP, which is not responsible for what clients move to the cloud. Such legislation and regulation should clarify the roles and responsibilities of the CSP and its clients. Cloud enterprise clients should be held accountable for their data in the cloud as they are in full control of that data. For example, governments may, for legitimate reasons, need to access data, and that access should be gained directly through a request to the client, not the CSP.

2.6.4 Business continuity

As public and private institutions, including critical infrastructure, adopt cloud computing as a platform, business continuity becomes a critical element of their decision framework. CSPs should provide clear and transparent SLAs so that clients are confident that the SLA covers client workloads running in the cloud and that client data are accessible. CSPs should provide all clarity and transparency in their SLAs and develop clear contractual agreements that support them.

Government and regulators have also an important role to play in this process. In fact, for many legitimate reasons, governments might need to prevent a client from running a certain workload or accessing some important data. As entities are migrating to the cloud, they should be accountable for their data and workloads, not the CSP. As such, legislation and regulations should be developed that protect CSPs from being the target of government requests to stop delivering a service to a client or a whole country. A lack of such legislation is an obstacle to using the cloud and to all the good that the cloud provides, including lower costs, greater agility and access to more innovation.

Other industries, such as in the electricity sector, have a trusted value chain and ecosystem. Users plug in a device at home and trust that it will work. Governments have developed supporting policy and regulation frameworks. Industry players and providers comply with regulation. Third-party controls are in place to monitor compliance and consumers can use the system easily. This is an ultimate system of trust that needs to be reached as the cloud is deployed.

2.7 Case studies of successful cloud-computing platforms used in developed and developing countries

Several case studies were contributed during this study period. These include:

- Background of cloud-service development on the part of telecommunication operators in China

- Cloud-computing regulation in Saudi Arabia, by Axon Partners Group
- China case study
- Islamic Republic of Iran case study
- Bhutan case study
- Nigeria case study

The details of these case studies are provided in **Annex 2** to this report.

2.8 Guidelines to spur development and uptake of cloud computing

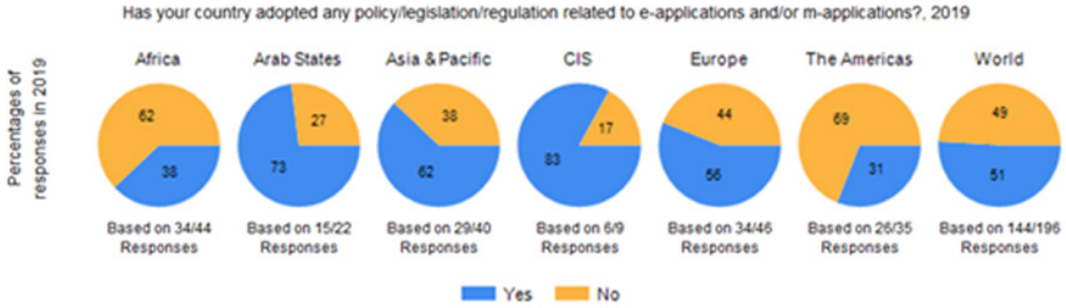
- Regulators are invited to develop their digital skills, in order to better understand and assess the development of the telecommunication/ICT market in the context of cloud computing. Regulators and policy-makers should adopt cloud-first policies to unleash the potential of the cloud for their constituencies, and digital transformation roadmaps.
- Regulators are encouraged to consider the latest infrastructure technology developments to access data in remote and unserved locations, and explore solutions provided by a mix of technologies to ensure countrywide and secure accessibility to cloud services.
- Governments are encouraged to engage in real dialogue and consult with different stakeholder groups before adopting new cloud policies and regulations.
- Regulators should strive to ensure that data can flow freely as a means of promoting continued growth, especially for small and medium-sized businesses (SMB). This, in turn, will benefit economic growth at the local, national and regional levels.
- Regulators are invited to liaise and coordinate with authorities in charge of data protection and avoid developing new regulations in this space.
- Regulators and policy-makers are encouraged to consider regulatory environments that support cooperation between cloud companies and telecommunication service providers, both terrestrial and satellite; such cooperation can extend access to the cloud to unconnected and under-connected populations.

Chapter 3 – M-services

3.1 Background

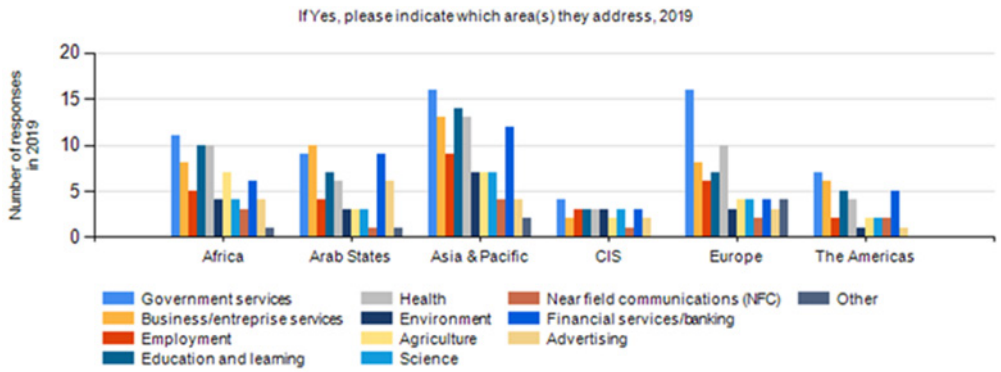
The 2019 data related to ICT applications (including mobile applications) from the annual ITU World Telecommunication/ICT Regulatory Survey on regulatory practices is summarized in **Figures 11** and **12**. The survey provides an overview of the trends in this area across the ITU membership.

Figure 11: M-services regulation landscape



Source: ITU World Telecommunication Regulatory Database, www.itu.int/icteye

Figure 12: M-services regulation by sector



Source: ITU World Telecommunication Regulatory Database, www.itu.int/icteye

Definition of m-services:

M-services are services that can be accessed through mobile handsets independent of temporal and spatial restraints.

3.2 M-services state of the art and state of the business

Different types of m-services exist, and can be classified as follows:

- **Communication services**: These are services that allow interpersonal communication. Examples include:

  - messaging services;
  - social media;
  - calling.
- **Content services**: These are services that provide certain information to users. Examples include:
  - browsing services: interaction with online environment;
  - gaming services;
  - content retrieval and sharing services;
  - multimedia services.
- **Business services**: These are commercial services provided via mobile handsets. They are categorized into banking services and market services:
  - Banking services include various business services such as online mobile payment and banking transactions.
  - Market services give customers the opportunity online to sell or buy products or services, advertising and electronic commerce applications.
- **Government services**: These include services related to public-sector modernization, assistance to government and national policies. such as:
  - e-government;
  - e-health;
  - e-education;
  - e-justice;
  - e-agriculture.

3.3 New trends in m-services

3.3.1 Application integration platforms (e.g. Apple Arcade and Google Play Pass)

Apple Arcade and Google Play Pass will result in innovative new games for consumers and new revenue streams for publishers.

Game publishers are usually the early adopters in all aspects of mobile technology, with new features and monetization models that then spread to other sectors. With subscriptions, this is reversed. As spending using mobile technology now accounts for over 50 per cent of all gaming revenue in the global games market, subscriptions will drive deeper engagement and greater customer lifetime value.

This trend is picking up in the mobile sector in general. In fact, during the 12 months ending September 2019, over 95 per cent of the top 100 non-gaming apps bought on iOS App Store and Google Play in the United States offered subscription services directly through in-app purchases. In addition, worldwide consumer spending on games was expected to surpass USD 75 billion in 2020.

For Apple Arcade, this means developers are free to design new game mechanics without the constraint of integrating in-app purchase opportunities. For Google Play Pass, existing games could get a second wind by finding new revenue streams beyond their existing in-app purchases or in-app advertising.

Both Apple Arcade and Google Play Pass will be important complements to their existing app store models. Regardless of initial performance, these subscription services will play key roles in long-term mobile gaming strategy – providing the opportunity to further strengthen the broader mobile gaming ecosystem. However, it will be challenging to get consumers out of the mindset of expecting all games on mobile devices to be free to download.

3.3.2 5G

5G is the next big move, and gamers will surely be first to reap the rewards. While bandwidth has been the main talking point around 5G, it is the low latency that excites gamers and publishers alike. There is demand for mobile online multiplayer core games that rely on better wireless connections.

Among the top 10 games by download in October 2019, core multiplayer online games were also the most frequently played by users. 5G is still in its infancy, but in 2020 telecommunication operators were moving to expand coverage, and gaming is likely to be the first test of market validation.

The 2019 Ericsson Mobility report predicts that by 2024, 34 per cent of all global mobile traffic will be on 5G, and 64 per cent of the world's population will have 5G coverage. Publishers should act now to ensure future versions of their applications can take advantage of faster 5G connections, while looking into version updates to see which of their competitors are doing the same.

3.3.3 Gaming genres

Auto battler games are currently the most popular genre. Their combination of strategy and chance positions them at the mid-point between card games like Hearthstone and strategy games like Starcraft.

The genre has already become of interest to e-sports fans, with the first Auto Chess Invitational offering a USD 1 million prize pool, which will support adoption and growing time spent per user on mobile devices. The rise of auto battlers calls attention to the fact that popular games are increasingly drawing on mechanics from multiple genres. Moving forward, publishers need to look beyond existing app store game classifications, and leverage data to create new games that grab consumer attention.

3.3.4 Progressive web applications

Progressive web applications (PWAs) will become an important link in the consumer journey. PWAs are mobile websites that look and feel like applications – ensuring a smooth user experience – without requiring users to immediately take the extra step of downloading an application. PWAs can help increase conversions by simplifying the user experience. This is particularly important as it allows users to test or use a more limited version of an app with less friction than a mobile website.

PWAs are a veritable bridge between mobile Internet and mobile applications. More specifically, PWAs have faster loading times than websites. This is particularly valuable where connectivity is poor and in developing markets where the lite version of an app has similar levels of popularity as the full one. In India, for example, Facebook Lite had nearly 90 per cent of the downloads of Facebook in the first half of 2019.

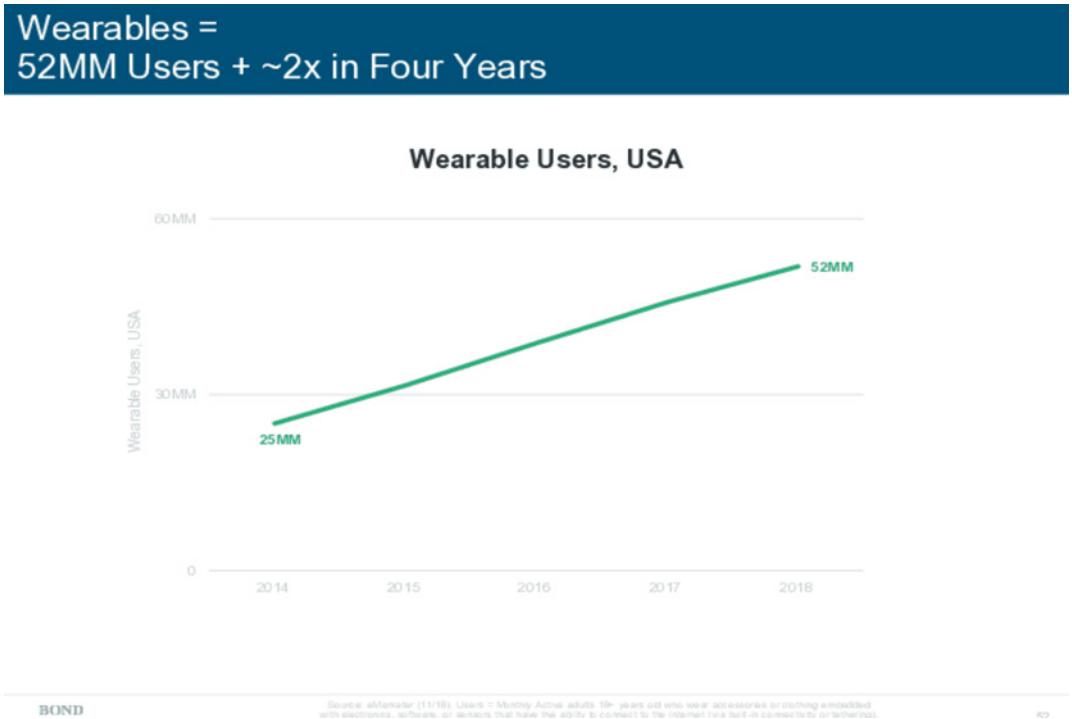
While PWAs are generally less valuable for applications that require sign-in to leverage full functionality (e.g. banking and communication), they will be an important option for sectors such as travel, retail and news – where users can test an experience before committing further. For example, Trivago has seen a 150 per cent increase in engagement among those who used the PWA compared to the mobile site.

3.3.5 Rise of mobile health

Digital health – specifically that driven by mobile (m-health) – is one major trend that is steadily impacting the lives of millions of people.

There are currently over 318 000 health applications on the market, with hundreds more being added each day. Consumers are driving this growth: they are quick to adapt! From telemedicine to wearables and everything in between, people love the convenience of managing their health on the go.

Figure 13: Wearable-technology users in the United States (2014 – 2018)



Source: Mary Meeker. Internet Trends 2019 report[18]

[18] Mary Meeker. Internet Trends 2019. Bond, San Francisco, CA., United States, 11 June 2019.

3.3.6 Emergence of enterprise mobile apps

Most mobile apps have been individual user apps. However, the current trend is development of enterprise mobile apps, especially B2B apps. Examples include Asana for project management, Google analytics, HootSuite app for managing company social media accounts such as Facebook, Twitter and LinkedIn; and WebEx for hosting and attending meetings on a tablet.

3.3.7 Increase in on-demand apps

On-demand apps act as mediators between providers of different services and customers. The app ecosystem will include more providers offering on-demand apps in the market. Examples include Uber and Taxify.

3.3.8 Integration of payment gateways into mobile apps

The convenience provided by mobile-payment options is seeing an increase in integration of mobile wallet into various mobile apps, especially shopping apps and e-commerce apps. There is an increase in other mobile-payment options such as Google Pay, Apple Pay, PayPal One Touch, Venmo and Square Cash.

3.3.9 Proliferation of instant apps

An instant app is a small mobile software used directly without the need for downloading and installation. The convenience brought by instant apps will also certainly help increase their production and use. Examples include Skyscanner for flights and hotels, NYTimes Crossword, Buzzfeed for news, Onefootball for information and statistics on world football leagues, Red Bull TV for sports information.

3.3.10 Increase in virtual reality and augmented reality usage

Increased use cases for virtual reality (VR) and augmented reality (AR) have led to usage in mobile apps to produce better-quality gaming apps. Examples of mobile games using AR and VR are: DinoTrek and VR Tank Training.

3.3.11 Use of accelerated mobile pages development

Accelerated mobile pages (AMP) is a technology that allows lightweight pages to load more quickly on smartphones and tablets. It is spearheaded by Google and Twitter to improve the performance of webpages on mobile devices. Mobile app developers are making more use of this technology to speed up load times in mobile devices.

3.3.12 Synchronizing wearable technology with m-services

Due to the increase in wearable devices for health purposes, e.g. fitness bracelets, smartwatches and healthcare monitors, there is an upsurge in the need to synchronize the data on the wearable devices with mobile apps. This pairing increases engagement in the sense that it is easier and convenient to access the data from the wearable devices on the mobile phone.

3.3.13 Widespread use of chatbots

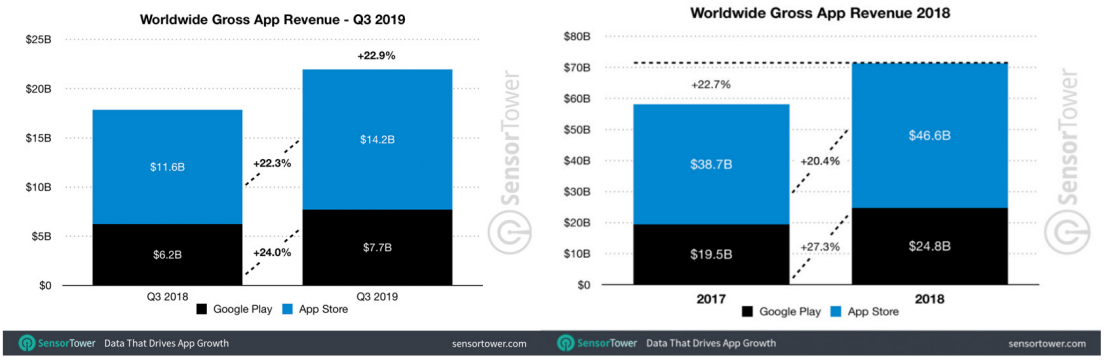
It is predicted that chatbot adoption will increase over different communication lines in the mobile app ecosystem. The increase is attributed to the need for real-time interaction between service providers and customers. The chatbot technology eliminates the need for human-to-human interaction.

3.4 Policies, strategies and relevant approaches in the field of m-services

One of the key pillars of the m-services ecosystem is the application store concept, which acts as a combination of marketplace, platform and trusted party, as well as a market gateway.

- **Marketplace**. For developers to make applications available to consumers and users, the mobile application stores are actual marketplaces. In fact, these marketplaces derive value for both the application developers (who in some cases are paid for the applications) and the application store owners (who get a base royalty out of each application payment). The revenue generated from these stores is growing significantly. For example, according to SensorTower, the world's mobile technology users spent USD 71.3 billion on apps and games in 2018.

Figure 14: Gross app revenues in USD billions (2018 – 2019)

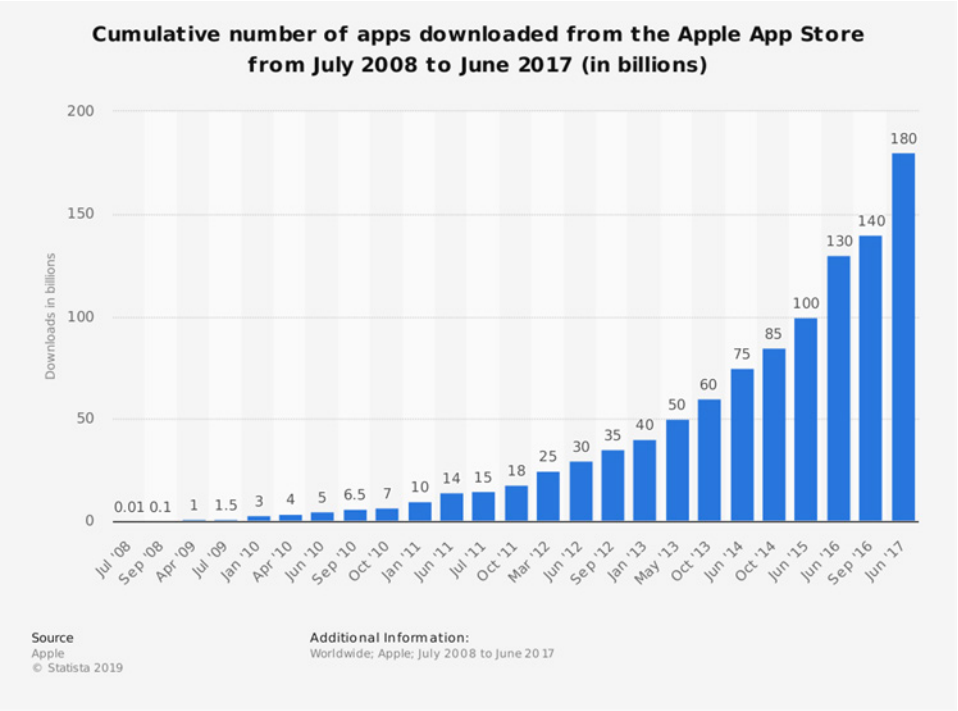


Source: SensorTower[19]

- **Platform and trusted party**. For mobile application developers and consumers, the mobile application stores provide a trusted platform that is a critical demand driver. Consumers trust application store providers to make the necessary security controls to provide them a secure platform from which to download applications.
- **Market gateway**. For mobile application developers, application stores represent an actual gateway to consumers. In fact, developers do not have an alternative to provide applications to consumers unless they go through these gateways.

[19] Sensor Tower. Global App Revenue Grew 23% in 2018 to More Than $71 Billion on iOS and Google Play. Blog post, 16 January 2019.

Figure 15: Application downloads on Apple App Store



Source: Statista 2019

The development of mobile services and the acceptance of these mobile applications by consumers has reached a level where everything from health to education, finance, work, socializing, farming, gaming and even fighting pandemics (like the COVID-19, via tracing) is going through mobile applications. While it is fine to celebrate how fast anyone who owns an app could potentially reach millions of consumers, it is equally important to bear in mind the issue of equitable access to these critical platforms and avoid market distortion.

The time has come for regulators and policy-makers to ensure that both developers and consumers enjoy equitable market access to these platforms. Special focus should be given to:

- *Cost of entry for developers*: It is important for application developers to be able to join these critical platforms and ensure that the platform owners do not apply high costs to entry for players to join.
- *Freedom of choice*: Developers should be able to publish their applications at the store of their choice and not be bound to using one store or a small number of platform owners. Hence, it is important that application store platform providers should allow for alternative application stores to provide the service and not create a tie between their operating system and the app store they provide.
- *Providing fast pass access*: During the COVID-19 pandemic, we have seen governments around the world wanting to provide applications to their citizens and various constituencies in the fight against this global health crisis. However, application store owners have applied unacceptable constraints on sovereign governments and hence delayed the fight against the pandemic. For example, for a ministry of health to create an account on a store, the process could take up to two months, or the publication of a government sponsored COVID-19 tracing application could take up to two to three weeks of review before publication. Governments should not be bound by application store owners to publish critical applications.

3.5 Methods of development and deployment of m-services app economy

Mobile services and applications play an important role in the vast digital ecosystem. The development of mobile services has been largely driven by increasing demand among consumers and emerging technologies. Grasping the potential of services can help to develop and use them. In addition to providing economic opportunities, these services can offer valuable assistance in the event of disasters. In this regard, governments, regulators and consumers must understand the real development potential of mobile applications and services.

To ensure the proper development and deployment of mobile services and applications, several fundamental criteria must be addressed such as simplicity, end-to-end automatization, confirmation in real time and collaboration.

- **Simplicity**: Making m-services easy to use for consumers is the key to project success. For example, it is important to design m-agriculture solutions to be able to interact with farmers in simple terms and, if possible, incorporate terminology in local languages.
- **End-to-end automatization**: Full end-to-end automatization – from the opening of an account to the buying and selling of securities – encourages people with busy schedules to take part.
- **Confirmation in real time**: Receiving real-time feedback for each transaction executed by users reinforces public confidence in the process.
- **Collaboration**: The collaborative participation and support of all industry actors are essential for building trust in products. For example, the involvement of farmers in the design and development of agricultural solutions is essential and can be achieved by providing them with different ways of giving feedback on the user-friendliness of the system. Success in fostering collaborative regulation requires focused attention on real and potential economic advantages and the policy and regulatory parameters of the application economy.
- **Digital literacy**: To promote growth in mobile services, it is essential that farmers, for example, are provided with training in basic digital literacy skills.
- **Accessibility**: It is essential that m-services are designed as accessible from the outset, in order to make sure that everybody can participate in the ecosystem, including persons with disabilities.
- **Solutions for local development:** *Example 1*: It is important that mobile farming solutions address a specific area of agriculture, such as only dairy farming or specific crops, e.g. tea or coffee. This will make solutions easier to use for farmers and provide them with specific information. *Example 2*: The M-Post platform provides customers with access to postal services through their mobile phones in Kenya. The platform turns mobile phones into formal postal addresses by allowing customers to acquire a virtual postal address, renew subscriptions and request delivery of items from the post office at a convenient location for them for a fee. In addition, M-Post allows customers to track their letters and packages in real time.
- **Ubiquity of banking agents and mobile operators**: To accelerate the uptake of mobile financial services, there must be a vast network of banking agents and mobile operators.

3.6 Ways to promote an enabling environment for the development and deployment of m-services

M-services are a subset of e-services, and span many facets of human life. This ranges from government-to-citizen services to business-to-customer services and person-to-person services.

Industries such as banking, agriculture, entertainment, education and health have benefited from the growth of m-services.

To facilitate and promote the uptake of m-services, an enabling environment needs to be nurtured. This requires identification and promotion of all the stakeholders involved in the m-services ecosystem.

3.6.1 Government/national regulator

The government and regulator have key roles to play in setting up an enabling environment for the development and deployment of m-services. This can take the form of taxes, universal access for basic mobile services, policies on automation of government services, policies on education curricula with regard to ICTs, incentives for innovative m-services, and policies that facilitate the life of start-ups and developers such as access to the latest technologies, international payment and hiring developers.

Example of incentives and policies:

- With regard to taxes, to spur uptake of m-services, mobile terminals and ICT devices could be exempted from taxation, which would lower the prices for ICT devices, making them affordable to more people.
- To facilitate use of m-services, the government, through the use of universal service funds and tax incentives for investment in underserved areas, should ensure universal access to basic telephony services, which will enable access to m-services offered via unstructured supplementary service data (USSD).
- For those countries with specific regulations/policies in respect of forex, it is recommended that start-ups and developers who need access to application stores and/or cloud services should have facilities to access these critical resources.

3.6.2 Ministries/government agencies

Ministries and government agencies should automate services and make them available via m-services, both using mobile apps and USSD platforms. The role to be played by these entities is mainly to ensure that as many services as possible are automated and customized for mobile access.

Also, there are specific regulated sectors under the supervision of the government and/or specific agencies such as finance, health and education for which it would be important for the government to allow the use of m-services. For example, m-payment and mobile banking are key use cases that should be developed with specific regulation under the supervision of central banks. This will spur financial inclusion and ecosystem innovation. Yet, to support financial inclusion, banking regulators could also allow flexible regulation to simplify the life of target audiences. M-education is another example.

3.6.3 Telecommunication operators

To spur the uptake of m-services, the role of telecommunication operators is to ensure basic network coverage in all places where they have been licensed to operate. Further, if they make their services affordable (SMS, data bundle costs and USSD costs), then the price of services provided via mobile phones will be low and encourage uptake of m-services.

3.6.4 App developers

Application developers play a key role with regard to m-services accessed via mobile apps and USSDs. The role of app developers in providing an environment for uptake of m-services includes developing several apps that automate and make government services /other general services accessible via the mobile platform. In addition, platforms should be as simple as possible to use and available in various languages that are easily understood.

3.6.5 ICT training institutions

Institutions play a key role in capacity building. To harness the role played by ICT training institutions in m-services uptake, institutions should formulate a practical approach to training on apps for the development of m-services. This could include getting in touch with government entities that offer services and exploring ways of automating their services for access via mobile platforms. The identified areas could then form projects for students to work on.

3.7 Case studies and best practices

A number of case studies were contributed during this study period. These include:

- Barbados case study on m-money service
- M-financial services case study
- Kenya case study on m-services (M-Akiba)
- Kenya cases study on m-farming

The details of these case studies are provided in **Annex 3** to this report.

3.8 Guidelines to spur development and uptake of m-services

- **Development of collaboration frameworks**: Countries are encouraged to develop collaborative frameworks encompassing academia, consumer organizations, app developers, mobile service providers, utility service providers and the government ministry for m-services research, development and roll-out.
- **Accessibility of m-services**: To enable high uptake, m-services should be accessible via both feature phones and smartphones.
- **Differentiation of m-services**: To spur uptake of m-services, the services should be tailored to the unique needs of the country in which they are to be used, to a niche market and with the use of local languages in some sectors, e.g. agriculture.
- **End-to-end automation**: There is a need for full vertical integration with all aspects of the process being executed via m-services, e.g. payments, for better consumer experience.
- **Real-time service response**: To enhance confidence in m-services, immediate or near immediate service response is essential.
- **Investments in mobile networks**: Due to accessibility of m-services via mobile phones, there is need for government and mobile networks to ensure wide and universal coverage of GSM networks to ensure countrywide accessibility to mobile networks that will facilitate use of m-services.
- **Digital literacy**: To ensure uptake in m-services that require a certain level of literacy, governments should invest in digital literacy of citizens.
- **Collaboration between the private sector and public authorities**: This collaboration is necessary to promote the adoption of mobile services.

- **Cross-sector collaboration on regulations is essential**: Examples include financial services, healthcare, government services and transportation. These essential services should be available as m-services, and regulators are invited to work together to enable them.
- **Need for solutions related to certain regulatory issues**: Solutions are required for issues such as interoperability of services, fraud via the development of mobile financial services and the absence of restrictions on the registration of multiple SIM cards.
- **Need to forge partnerships between national ICT regulatory authorities and central banks**: This is necessary in order to facilitate the financing of mobile services
- **Equitable market access to mobile application stores**: Regulators and policy-makers should ensure that both developers and consumers have equitable market access to mobile application stores with a special focus on choice, cost of entry and fast access to governments (especially in critical situations).

Chapter 4 – Over-the-top applications

4.1 Background

Over-the-top (OTT) applications have been a subject of interest to the ITU membership for several years. OTT applications have been considered as a policy matter in study groups within ITU-D and ITU-T, at the ITU Plenipotentiary Conference, and in the ITU Council Working Group on international Internet-related public policy issues.

Within ITU-T, the primary hub of study related to OTTs has been ITU-T Study Group 3, which addresses tariff and accounting principles including related telecommunication economic and policy issues. Study Group 3 studied OTTs within the scope of its Question 9/3 on "*Economic and regulatory impact of the Internet, convergence (services or infrastructure) and new services, such as over-the-top (OTT), on international telecommunication services and networks*".

At its meeting in April 2019, ITU-T Study Group 3 adopted Recommendation ITU-T D.262, entitled "*Collaborative Framework for OTTs*". This was the first ITU Recommendation to explicitly address the topic of OTTs. Study Group 3 further adopted Recommendation ITU-T D.266, entitled "*Enabling environment for voluntary commercial arrangements between telecommunication network operators and OTT providers*" at its meeting in August 2020. In addition to Study Group 3, ITU-T Study Group 2 (*Operational aspects)* has also considered OTTs in the context of operational aspects of numbering resources.

Within ITU-D, ITU-D Study Group 1 leads the study of OTTs. The 2017 World Telecommunication Development Conference (WTDC-17) approved the Buenos Aires Action Plan, which included Question 3/1 on "*Emerging technologies, including cloud computing, m-services and OTTs: Challenges and opportunities, economic and policy impact for developing countries*". This Question was the natural successor to ITU-D Question 1/1 from the 2014-2017 study period, which addressed "*Policy, regulatory and technical aspects of the migration from existing networks to broadband networks in developing countries, including next-generation networks, m-services, OTT services and the implementation of IPv6*".

On 1 October 2019, ITU-D Questions 3/1 and 4/1 co-hosted a workshop on *Economic impact of OTTs on national telecommunication/ICT markets*. The workshop brought together renowned experts from across the world and across stakeholder groups ranging from academia, governments, NGOs and independent experts to industry, including providers of OTTs and mobile network operators (MNOs). The workshop presentations, discussions and overarching conclusions are captured in an "annual deliverable"[20] that is also contained in **Annex 1** to this report.

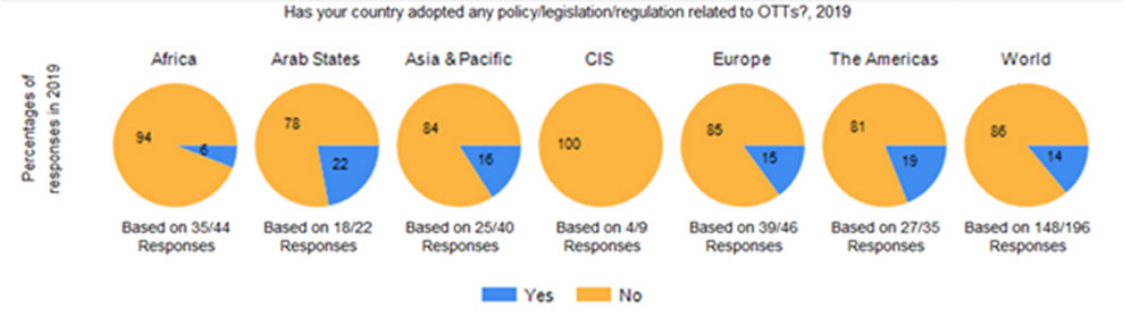
The interest in OTTs was also apparent at the ITU Plenipotentiary Conference (Dubai, 2018), which adopted Resolution 206 (Dubai, 2018), simply entitled "OTTs".[21] The language in Resolution 206 (Dubai, 2018) closely mirrors that in Recommendation ITU-T D.262. Prior to the Plenipotentiary Conference, the Council Working Group on international Internet-related public policy issues

[20] ITU. ITU-D study groups. Question 3/1 and Question 4/1 Annual deliverable 2019-2020. Economic impact of OTTs on national telecommunication/ICT markets.
[21] ITU. Plenipotentiary Conference (Dubai, 2018). Resolution 206 (Dubai, 2018), on OTTs.

conducted an open consultation in 2017on the topic of public policy considerations for OTTs. The consultation generated 71 responses from a variety of stakeholders and regions (10 from government and public-sector entities, 44 from the private sector and industry associations, 13 from civil society, 2 from academia and 2 from IGOs).

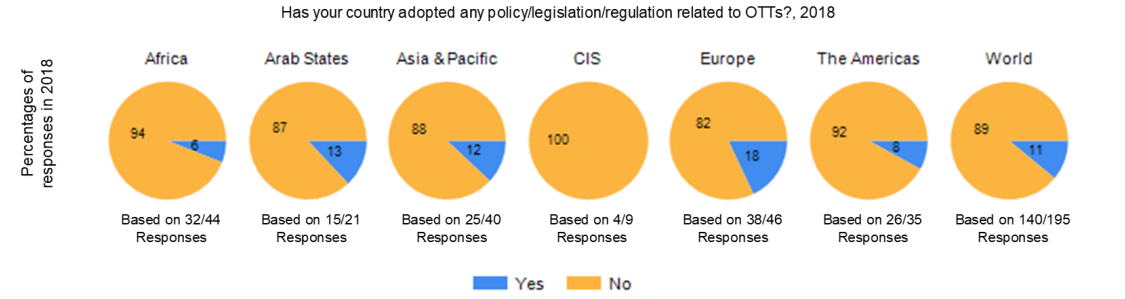
The 2019 data related to OTTs from the annual ITU World Telecommunication/ICT Regulatory Survey on regulatory practices is summarized in **Figures 16** to **20**, which provide an overview of the trends in this area across the ITU membership.

Figure 16: OTT regulation landscape by region (2019)



Source: ITU World Telecommunication Regulatory Database, www.itu.int/icteye

Figure 17: OTT regulation landscape by region (2018)

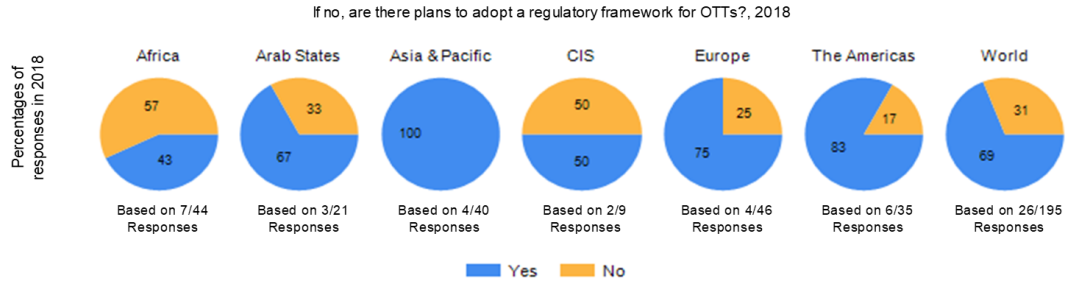


Source: ITU World Telecommunication Regulatory Database, www.itu.int/icteye

Figure 18: OTT regulation projections by region (2019)

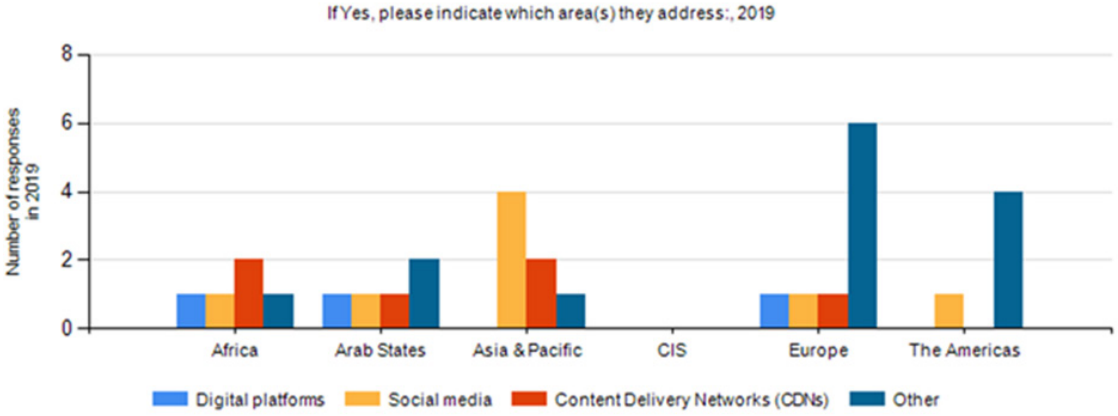
Source: ITU World Telecommunication Regulatory Database, www.itu.int/icteye

Figure 19: OTT regulation projections by region (2018)



Source: ITU World Telecommunication Regulatory Database, www.itu.int/icteye

Figure 20: OTT regulation by category and region (2019)



Source: ITU World Telecommunication Regulatory Database, www.itu.int/icteye

4.2 OTT state of the art and state of the business

It should be stated that there is no universally accepted definition or common understanding of OTTs, which makes the market difficult to define. The acronym OTT has attained broad acceptance as a standalone term referring to a wide array of online applications. Recommendation ITU-T D.262 establishes a working definition of OTT as: "*An application accessed and delivered over the public Internet that may be a direct technical/functional substitute for traditional international telecommunication services*", while also noting that "*the definition of OTT is a matter of national sovereignty and may vary among Member States*".[22]

Regardless of the definition, it can be said with certainty that the OTT landscape is large and growing, dynamic, innovative and competitive.

According to ITU data, 2019 marked the first full year when more than half of the world was connected to the Internet.[23] An estimated 4.1 billion people used the Internet in 2019. The global penetration rate increased from just under 17 per cent in 2005 to over 53 per cent in 2019.

22 ITU-T. Recommendation ITU-T D.262 (05/2019): Collaborative framework for OTTs.
23 ITU-D. Facts and Figures 2019. Measuring Digital Development.

There were 3.8 billion mobile Internet users in 2019, a figure projected to reach a milestone of 5 billion by 2025.[24] Critically for the OTT market, more and more people are reaching the Internet through 4G and 5G wireless technology, which is vastly superior to previous generations in terms of latency and capacity for the rich media common to many OTTs. The difference is especially important for people in low-income countries, who are more reliant on mobile for Internet access. According to GSMA, in 2019 4G became the dominant mobile technology across the world with over 4 billion connections, accounting for 52 per cent of total connections.[25]

Catering to this large and growing market of broadband users are OTT application developers virtually unfettered by barriers to market entry. Launching a new mobile app or online service typically requires minimal staff, capital investment and infrastructure. With the rise of cloud computing, young companies no longer need to build expensive and complex data centres; they can rent (and seamlessly scale) computing power, dramatically decreasing the time and capital necessary to start and grow their businesses. And new entrants can easily distribute their applications to millions of people through app stores that provide instant access to a global audience.

Given these market conditions, OTT applications have flourished. By 2018, the Google Play store had roughly 3.6 million apps on offer. Its main counterpart, the Apple App store, had roughly 2.1 million iOS apps available at the end of 2017. Remarkably, less than 500 000 applications were available on both the iOS and Android operating systems, which demonstrates the great size and diversity of the OTT application market. In 2018, Tim Cook announced that there were 20 million registered iOS developers catering for the 500 million weekly visitors to the App Store alone. In 2019, consumers worldwide downloaded a remarkable 204 billion apps.[26],[27]

The OTT marketplace is also extremely innovative. Rather than offering simple substitutions for voice and SMS, OTT applications offer consumers a wealth of functions above and beyond these legacy services, including media and news consumption, gaming, e-commerce, payments, access to health and education resources, and pathways to civic participation and government engagement.

The OTT landscape is also remarkably dynamic and competitive, as users increasingly spread their time between more and more applications. The decreasing cost of high-speed Internet connectivity and the increasing processing power and storage space on personal devices allow people to move easily between different apps, add new ones or use several at the same time. There is considerable overlap between the user bases of competing applications, and OTT technologies impose virtually no constraints on end users from using many similar applications concurrently, a process known as 'multihoming'. In fact, the average smartphone user has more than 80 apps on their phone and uses close to 40 of those apps every month.[28] And because so many OTT applications are low-priced or free, users can try new technologies as often as they like. If a user does not enjoy a product or experience, they can – and do – abandon it and explore the myriad other options available. This creates strong competition for every OTT developer to offer new features to attract and retain users.

---

24 GSMA. The Mobile Economy 2020. London, United Kingdom, 2020.
25 Ibid.
26 Business of Apps. App Download and Usage Statistics (2020). Updated 6 May 2021.
27 App Annie. Report. The State of Mobile 2020.
28 Lexi Sydow and Sam Cheney. App Annie. 2017 Retrospective: A Monumental Year for the App Economy. 17 January 2018.

In Germany, for instance, a May 2020 report by the *Bundesnetzagentur* (Federal Network Agency) found that 65 per cent of survey respondents practise multihoming for communication OTT applications.[29] Of those, 35 per cent do so with four or more services, further illustrating the use of a diverse set of applications.

Some raise concerns that even with the presence of multihoming, network effects – which are often highlighted as a key factor in assessing market power – thwart competition and user desire to switch between services. In the Communications Market Sector Study carried out by the Australian Competition and Consumer Commission (ACC), it was suggested that although the potential to establish significant market power is reduced because of multihoming, there are some types of OTTs whose characteristics present competition concerns, generally benefiting from network effects and interoperability issues.[30] This, however, would appear to overstate the propensity of network effects to lead to market power. As noted in a paper by Dr Catherine Tucker, Sloan Distinguished Professor of Management Science at MIT Sloan School of Management, network effects in digital platforms may lead to instability rather than market dominance, and can even negatively impact the latter.[31] Moreover, network effects that do have positive outcomes for platforms are often localized, stemming from user focus on connections and use by, for instance, peers that matter to them and a desire for personalization.

4.2.1 New trends in OTT

As noted, OTT is an overly broad term that, in its most general sense, could potentially be used to refer to any type of online content, application or service, from basic websites to complex and large-scale services. While it is important to distinguish among the different types of OTTs, it should also be recognized that innovation may quickly stimulate development of new categories or shift the dynamics of existing OTTs.

Furthermore, it is important to distinguish OTTs from traditional services, recognizing that OTTs are generally complementary to traditional services, rather than substitutes for them. For instance, communications-based OTTs typically differ in a number of ways from traditional telecommunication services. For example, OTTs generally do not provide connection to a public network and instead create a type of closed-user group within the application. Thus, OTTs do not require scarce numbering resources, nor do they require interconnection agreements with traditional operators.

Likewise, audiovisual-based OTTs are generally viewed as complementary to traditional broadcasting and subscription-based services. They typically do not provide real-time programming, but focus on video-on-demand (VoD) services, which give users significantly more choice regarding the type of content they consume, as well as how and when they consume it. Furthermore, many audiovisual-based OTTs provide access to user-generated content (UGC), empowering users themselves to play a more central role in the production and publication of audiovisual content. The simplicity with which users can produce and publish their own content creates new opportunities to reach expanded audiences more easily and at lower cost, thereby contributing to more diverse, local and niche content offerings.

---

29 Bundesnetzagentur. Telekommunications. Digitization. OTT communication service. Nutzung von Online-Kommunikationsdiensten. May 2020. [in German].

30 Australian Competition and Consumer Commission (ACAC). Communications Sector Market Study Final Report. 5 April 2018.

31 Catherine Tucker. Network Effects and Market Power: What Have We Learned in the Last Decade?. Antitrust, Spring 2018.

The nature of OTTs is that they are accessed by consumers through their agreements with network operators. This means that OTTs do not control or operate network elements, which results in reduced barriers to entry and a greater competitive environment that does not typically require regulatory intervention.

4.2.2 Benefits of OTT

The COVID-19 global health pandemic has thrown the benefits of OTTs into stark relief. The pandemic has highlighted that for most people the Internet is no longer just a convenience, but a necessity. People with reliable Internet access have been able to use OTTs to more easily access and share critical health information, maintain contact with friends and family, work remotely, and otherwise mitigate the adverse impact of social distancing, quarantines and similar measures. The *Digital Development Joint Action Plan and Call for Action* from ITU, the World Bank, the World Economic Forum and GSMA put it plainly: "… *digital technologies offer the only opportunity for governments, individuals and businesses to cope with social distancing, ensure business continuity, and prevent service interruptions*".[32]

By creating value for consumers, OTTs stimulate demand for broadband networks and services that, in turn, incentivize network operators to deploy and expand infrastructure as consumers require increasing bandwidth. In other words, the availability of OTTs creates a virtuous cycle that increases the value of broadband network services and thereby drives further take-up and adoption of higher-value data plans.

The Commonwealth Telecommunications Organisation (CTO) published a report that analysed the revenue trends of MTN operations across Africa. The report concludes that "*MTN's revenue trends demonstrate two important points: (i) the overall revenue trends are positive despite growing number of OTT users and OTT traffic; and (ii) revenues and profitability are mainly the results of an operator's ability to seize revenue opportunities and mitigate risks*".[33] The report elaborates on the latter point, noting that "*operators may benefit from increased use of OTTs and roll out faster broadband networks to grow data revenues or they may try and stick to the analogue business model for as long as they can*", concluding that "*both strategies are business decisions and not the responsibility of the regulator*".

OTTs deliver significant benefits to consumers in terms of availability of innovative services, access to diverse and low-cost or free content, enhanced connectivity, and new opportunities to improve their lives. For instance, OTTs provide online learning tools and information exchange to improve outcomes across a variety of sectors, including education and healthcare.

---

[32] World Bank, ITU, GSMA and WEF. Digital Development Joint Action Plan and Call for Action – COVID-19 Crisis Response. Cologny/Geneva, Switzerland, April 2020.

[33] Christoph Stork et al. Commonwealth Telecommunications Organization (CTO). Over the Top (OTT) Applications & the Internet Value Chain: Recommendations to Regulators, Policy Makers and Tax Authorities. London, United Kingdom, 2020.

4.3 Impacts of the provisioning of OTT

4.3.1 Regulatory frameworks

The global growth and popularity of OTT applications have compelled some regulatory authorities to consider the applicability and suitability of traditional telecommunication regulations to the modern technological landscape.

In ITU, Recommendation ITU-T D.262 represents the clearest articulation by the membership of how regulatory frameworks can successfully adapt to the growth and popularity of OTT applications around the globe. The Recommendation states as follows:[34]

> *Member States should foster enabling legal and regulatory environments, and develop policies that are fair, transparent, stable, predictable and non-discriminatory; and that promote competition, foster technological and service innovation and encourage private sector investment incentives, in order to ensure the continuing growth and adoption of OTTs.*

ITU consideration of OTTs has been mirrored by other multilateral institutions and the regulatory authorities of many ITU Member States. Such regulatory consideration has commonly begun with the identification and definition of relevant markets and examination of the technological, economic and functional distinctions between OTTs and traditional telecommunication services. Such distinctions include, for example, control of underlying broadband access infrastructure, use of public numbering resources for routing calls, barriers to market entry, competitive environment, and functional features.

Legacy regulations on traditional telecommunication service providers were designed to address the market power resulting from incumbent control over network access facilities and resultant risks to end users and competitors – gating and consumer-protection factors that simply do not apply to OTTs. In contrast to traditional telecommunication operators, companies that provide OTT applications do not control the underlying broadband access points and are engaged in a highly competitive market and a cross-border approach to service provision. Consumers of telecommunication services are commonly bound by long-term contracts, whereas OTT users hold the power and can add OTT applications or stop using them at will.

Consideration of distinctions between different services and applications is exemplified by regulatory activity in the EU. The European Electronic Communications Code (EECC) was adopted in December 2018 and updates the regulatory framework applicable to electronic communications services (ECS) and networks across the EU. Internet-based messaging applications will be captured under the new framework for the first time by an expanded definition of ECS.

The new definition of ECS now has three categories: (i) Internet access services (e.g. an ISP); (ii) services consisting wholly or mainly in the conveyance of signals such as transmission of machine-to-machine communications or broadcasting; and, critically, (iii) interpersonal communications services (ICS), a category that includes text messaging, e-mail, and OTT messaging applications.

[34] ITU-T. Recommendation ITU-T D.262 (05/2019) (op. cit.).

The EECC applies different obligations to different categories of ICS:

- Number-based ICS (NB-ICS) – Traditional communication services that interconnect with the public telephone network. NB-ICS are subject to greater regulation relative to NI-ICS, but also benefit from certain rights relative to NI-ICS.
- Number-independent ICS (NI-ICS) – Online messaging services that do not interconnect with the public telephone network. A light-touch regulatory regime applies to NI-ICS.

The EECC justifies this narrowly tailored approach on the basis of the important differences between NI-ICS and NB-ICS. Among other things, NI-ICS, unlike NB-ICS, do not benefit from the regulations providing for an interconnected ecosystem, such as the right to be assigned public numbering resources. As a result, NI-ICS do not fall under the EU general authorization regime (which triggers a broader set of obligations, including registration requirements, administrative fees and switching/number porting) and are subject only to a limited subset of the obligations applicable to NB-ICS, such as security of services, transparency and accessibility.

Based upon these distinctions identified by the EU and others, there has been widespread recognition that traditional telecommunication regulations are ill-fitted and ill-equipped to address OTT applications. Extending such regulations to OTTs would be harmful to the communication market and, more importantly, to consumers. Arbitrarily imposing barriers on some types of services but not others would result in cost increases and fewer choices of innovative solutions for consumers, and at the macroeconomic level in decreases in investment, a reduction in healthy competitiveness, and less local content production.[35] The Australian Productivity Commission has noted that: "*Simply extending regulation without an assessment of its consequences and differences in risk between traditional and new business models could quash innovative new approaches, reducing choice and resulting in consumers paying higher prices than they otherwise would*".[36]

Regarding its decision to refrain from extending new regulations to cover OTTs, Bahrain's Telecommunications Regulatory Authority (TRA) concluded that "… *defining specific rules for an innovative and still evolving environment may lead to undesirable outcomes: stifling further innovation, limiting end-customer choice, and unduly influencing potential business relationships between Licensed Operators and OTT players*". Further details on the TRA decision to forbear on OTT regulations can be found in **Annex 4** to this report (OTT case studies).

Along similar lines, Hong Kong (China) Commerce and Economic Development Bureau (CEDB) conducted a review of its broadcasting regulatory framework in 2018. The review had a particular focus on online videos, which were not subject to the traditional broadcast licensing regime. Upon review, CEDB decided to maintain the status quo and did not propose to extend legacy obligations to OTTs, in part because "… *though OTT and other Internet TV and radio programme services are gaining their prominence, traditional media…are still highly pervasive and accessible*."[37]

Given the persistent innovation in the communications market exemplified by OTTs and the dynamic preferences of consumers, one could fairly question whether maintaining legacy

---

35 ITU. ITU Council Working Group on Internet (CWG-Internet): Online Open Consultation (June-September 2017). DigitalEurope reponse to ITU Consultation on OTTs. Brussels, Belgium, 18 August 2017.

36 Australian Government. Productivity Commission. Public Inquiry. Telecommunications Universal Service Obligation. (Final Report released 19 June 2017)

37 Hong Kong (China) Commerce and Economic Development Bureau (CEDB). Review of Television and Sound Broadcasting Regulatory Regimes – Consultation Paper, p. 46. 6 February 2018.

regulations upon telecommunication companies produces the best outcomes. The United States Council for International Business (whose member companies include traditional telecommunication service providers and OTT companies) has noted that: "*The underlying rationale for legacy voice telecommunication regulations does not neatly apply to providers of OTT applications that are either independent of or affiliated with networks, nor to today's network operators that also operate in the highly competitive markets*".[38]

A more productive alternative to extending traditional telecommunication regulations to new market entrants, therefore, is considering *relaxing* them on incumbent carriers. For example, Recommendation ITU-T D.266 encourages Member States to "*examine the appropriate level of regulations both to OTT providers and traditional telecommunication providers, which may include refraining from extending legacy telecommunication regulations to providers of OTTs and examining the reduction of the regulatory burden upon traditional networks and telecommunication services*".[39]

In the same vein, a 2016 letter from several European States advised the European Commission to "*… consider deregulation of traditional telecommunication services where this does not harm consumer interests, undermine regulatory enforcement powers or competition in the market, or compromise national security, public security or prevention, detection and prosecution of criminal offences*."[40]

Taking it one step further, regulators might consider adopting a light-touch approach to regulating their communications markets. In some cases, existing rules may need to be reconsidered entirely, as they may no longer be necessary given changed market conditions, or there may be more efficient ways of delivering the intended public-policy objectives reflecting legitimate needs of consumers and citizens.[41]

As regulators conduct such reviews, they must first consider the rationale behind the regulation (for example, protecting end users and competitors from the potentially anti-competitive effects of market power related to control of broadband access facilities), and not impose heightened regulation that risks destroying innovation. Policy-makers and regulators should strive to create an environment in which online content, applications and services are as widely available as possible. Only by adopting a policy mindset that appreciates the value of the entire Internet ecosystem, and fostering a positive environment for the development and proliferation of compelling online content, applications and services, will the Internet remain a platform for innovation, competition and sustainable economic growth, not only today, but also in the years to come.[42]

---

38 ITU. ITU Council Working Group on Internet (CWG-Internet): Online Open Consultation (June-September 2017). Public Policy Considerations for OTTs. Contribution of the U.S. Council for International Business (USCIB). 14 August 2017.

39 ITU-T. Recommendation ITU-T D.262 (05/2019) (op. cit.).

40 Joint Letter to Vice President Andrus Ansip and Commissioner Günther Oettinger of the European Commission from Belgium, Czech Republic, Denmark, Estonia, Ireland, Finland, Lithuania, Poland, Sweden and the United Kingdom. 27 January 2016.

41 Organisation for Economic Co-operation and Development (OECD). Digital Convergence and Beyond: Innovation, investment and competition and communication policy and regulation for the 21st century. *Working Party on Communication Infrastructures and Services Policy*. 24 May 2016.

42 ITU. ITU Council Working Group on Internet (CWG-Internet): Online Open Consultation (June-September 2017). Public Policy Considerations for OTTs. Microsoft's comments. 19 August.

4.3.2 Network infrastructure

OTT companies and telecommunication service providers engender benefits for each other in a symbiotic, complementary and mutually reinforcing manner. Richer OTT applications drive demand and willingness to pay for enhanced network access, whilst improved access coverage and quality enable greater use of messaging and other applications.[43]

OTT applications drive the demand for Internet connectivity services, thus increasing traffic and, consequently, the revenue of telecommunication service providers.[44] Broadband services are usually offered with commercial models linked to the data usage, involving transfer speed and traffic amount, typically tied to minimum consumption. Users who make heavy use of OTT applications are compelled to hire plans with higher performance and capacity.[45] In fact, a recent study has found that consumers who use OTT applications were more likely to buy new plans with higher bandwidth over the last two years, and the plans purchased are usually monthly plans, rather than pre-payment plans.[46]

Because OTT companies and network operators have both enjoyed the benefits of consumer hunger for broadband access, both sectors have invested heavily in the infrastructure to support it. For example, according to GSMA, mobile operators will invest USD 479 billion in mobile CAPEX worldwide between 2018 and 2020, excluding spectrum acquisitions.[47]

For their part, OTT providers invest billions of dollars annually in a combination of physical facilities (such as data centres), fibre-optic networks, servers and routers. This forms an essential part of the physical fabric of the Internet. OTTs may be accessible anywhere and anytime, but they need to be hosted and transported by physical networks, facilities and equipment. Rather than merely relying upon telecommunication network operators to deliver their content to end users, OTT companies are increasingly making direct investments in network infrastructure to improve service quality and reliability.

For example, Google invested in INDIGO undersea cable to improve cloud infrastructure in Southeast Asia. On 30 May 2019, Google announced that the INDIGO cable system, which connects Sydney, Perth and Singapore, was ready for service. The project was developed in partnership with AARnet, Indosat, Singtel, SubPartners and Telstra.[48]

The New Cross Pacific undersea cable connects the United States, China, the Republic of Korea and Japan, built by a consortium involving Microsoft, China Mobile, China Telecom, China Unicom, Chunghwa Telecom and KT Corporation, among other operators.

---

43 Brian Williamson. Communications Chambers. Next generation communications & the level playing field – What should be done?. June 2016.

44 Especially regarding mobile devices, the main means of accessing the Internet in developing countries, according to the study Cisco Visual Networking Index: Mobile Data and Internet Traffic, 2013-2018 (2017), which states that between 2013 and 2018 mobile data traffic will have an annual compound growth rate of about 61%.

45 ITU. ITU Council Working Group on Internet (CWG-Internet): Online Open Consultation (June-September 2017). Contribution of Associação Brasileira Das Empresas De Tecnologia Da Informação E Comunicações (Brasscom) to CWG-Internet: Online Open Consultation. 18 August 2017.

46 René Arnold et al. *Wissenschaftliches Institut für Infrastruktur und Kommunikationsdienste GmbH* (WIK). Report. The Economic and Societal Value of Rich Interaction Applications (RIAs). Bad Honnef, Germany, May 2017.

47 GSMA. The Mobile Economy 2020. London, United Kingdom. (op. cit.)

48 Brian Quigley and Michael Francois. Google Cloud. Google invests in INDIGO undersea cable to improve cloud infrastructure in Southeast Asia. 5 April 2017.

From 2014 to 2018, online service providers (OSPs, another term for OTTs) invested over USD 300 billion (USD 75 billion per year) in Internet infrastructure. Over 90 per cent of this has been in hosting infrastructure as OSPs build hyperscale data centres to support the explosion in online content and cloud services and install equipment in third-party colocation facilities. They are also investing large sums in infrastructure to transport data between these locations, including terrestrial fibre-optic networks and international submarine cables. Finally, OSPs are driving investment in delivery networks to support quality of service by bringing content as close as possible to end users.[49] These investments improve the quality of access networks and the performance of service delivery, helping network operators to extend coverage and reduce costs, and enabling them to provide more affordable services.

These investments are typically made in parallel with investments from a variety of other stakeholders in the global Internet landscape. Revenues from OSP activities support investments by players including telecommunication carriers, data centre operators and Internet service providers (ISPs), providing benefits to the whole ecosystem. Further growth in investment, both directly by OSPs and indirectly through other service providers, can be expected in the coming years, as OSPs strive to keep pace with the growing demand for content and cloud services across all regions of the globe.[50]

Government authorities have a vital role to play in facilitating infrastructure investment partnerships between providers of OTTs and network operators. Recommendation ITU-T D.266 states, for example, that: "*Member States are encouraged to develop policy frameworks to enable voluntary commercial arrangements among telecommunications network operators and providers of OTT applications so as to allow each to invest in Internet infrastructure, without subjecting the parties to traditional telecommunications regulatory requirements*".[51]

The COVID-19 pandemic has highlighted both the unilateral and in-parallel investments made by OSPs. Netflix, for instance, as a part of the Open Connect programme, has been deploying its own content delivery networks (CDNs) and partnering with ISPs since 2012. Notably, from 21 March, 2020 to 21 April, 2020, Netflix reportedly added four times the normal capacity at the peak of the pandemic.[52] Microsoft, to account for the rapid increase in demand for its services by businesses, governments and educators, among others, "… *doubled capacity on one of its own undersea cables carrying data across the Atlantic and negotiated with owners of another to open up additional capacity*".[53] As a result, it tripled deployed capacity on the America Europe Connect cable in two weeks. These represent just two cases out of many instances where OSPs rapidly scaled up infrastructure to account for increased demand.

OTT investment in network infrastructure generates economic value by improving the quality of access networks and the performance of service delivery, helping network operators to extend coverage and reduce their costs, enabling them to provide more affordable services. For example, Facebook investments in connectivity in sub-Saharan Africa (including submarine cables, edge network investments including caching servers and points of presence, and open transport networks) will deliver economic benefits of over USD 50 billion over the next five

---

49 David Abecassis et al. Analysis Mason. Infrastructure investment by online service providers. December 2018.
50 Ibid.
51 ITU-T. Recommendation ITU-T D.266 (08/2020). Enabling environment for voluntary commercial arrangements between telecommunications network operators and OTT providers.
52 Netflix. Reducing Netflix traffic where it's needed while maintaining the member experience. 21 March 2020,
53 Jennifer Langston. Microsoft. Growing Azure's capacity to help customers, Microsoft during the COVID-19 pandemic. 16 June 2020.

years (2020-2024) in nominal current GDP.[54] Its investments in the Association of Southeast Asian Nations (ASEAN) region will generate USD 70 billion over the same time period.[55] In addition, it is estimated that Facebook investments in Latin America will generate an estimated USD 27 billion per year in economic growth, create an additional 178 000 new jobs in the regional economy, and bring 30million new people online.[56]

For their part, governments should facilitate investment in broadband infrastructure from OTT companies, network operators, public funds and other interested parties. This begins by establishing a healthy investment climate for infrastructure. Taxes should be broad-based, easily understandable and enforceable. They should not discourage investment or impact low-income consumers by targeting ICT equipment, devices and services. Governments should encourage investment through import-duty exemptions, tax credits and asset depreciation tax allowances. Regulatory fees should generally cover only the administrative costs of regulation. Market-based spectrum pricing should be reasonable and primarily serve to allocate spectrum to the best use rather than raise revenue for the State.[57]

4.3.3 Macroeconomic and microeconomic developments, including competition effect on the market

The economic benefits generated by the Internet and OTTs are well established. The Geneva Declaration of Principles of the World Summit on the Information Society (WSIS) notes "… *these technologies can be a powerful instrument, increasing productivity, generating economic growth, job creation and employability and improving the quality of life of all*".[58] ITU Member States also issued the Busan Declaration in 2014, by which they agreed "*to facilitate economic growth and sociocultural development by intensively fostering the use of telecommunications/ICTs as a growth engine. In such efforts, telecommunications/ICTs should be viewed comprehensively, beyond the aspects of infrastructure and technology, to encompass economic development, enhancement of the quality of people's lives and social integration*".[59]

ITU Member States were wise to have made such a commitment to economic development through connectivity and the use of ICTs. For consumers and companies of all sizes, across all industries, data flows and reliance on digital technologies have changed how domestic commerce and international trade are conducted. Firms rely on data to engage with clients and customers, discern market demand and adapt products and services accordingly, operate production systems, manage workforces and expenditures, monitor supply chains, and conduct a range of other day-to-day business activities.[60] Studies estimate that about 75 per cent of the value added by data flows on the Internet accrues to "traditional" industries, especially via

---

54 David Abecassis et al. Analysis Mason. The impact of Facebook's connectivity initiatives: Sub-Saharan Africa and ASEAN. 2 July 2020.

55 Ibid.

56 NERA Economic Consulting. Assessing the Contribution of Connectivity Investments to the Development of Latin American Societies. A report for Facebook. Madrid, Spain, 22 May 2020.

57 Broadband Commission for Sustainable Development. Report of the Expert Group to the UN Broadband Commission. A New Deal: Investing in our common future: Policy recommendations to close the broadband gap. Geneva, Switzerland, February 2018.

58 World Summit on the Information Society (WSIS). WSIS Declaration of Principles – Building the Information Society: A global challenge in the new Millennium, paragraph 9.

59 ITU. Busan ICT Ministerial Meeting, 2014. Busan Declaration on the Future Role of Telecommunications/ICTs in achieving sustainable development, paragraph 8. Adopted on 19 October 2014.

60 Nigel Cory. Information Technology and Innovation Foundation (ITIF). The False Appeal of Data Nationalism: Why the Value of Data Comes from How It's Used, Not Where It's Stored. *Information Technology & Innovation Foundation*, 1 April 2019,

increases in global growth, productivity and employment.[61] The United Nations Conference on Trade and Development (UNCTAD) has further estimated that 50 per cent of all traded services are enabled by the technology sector, including by cross-border flows of information.[62] The macroeconomic impact of these trends has been well-documented, with estimates that cross-border data flows have increased current global GDP by at least 10 per cent, adding USD 7.8 trillion to the global economy in 2014 alone.[63] By plugging into the global digital network, technology such as OTTs enables firms across the world to access international markets with limited asset footprints, leading to the emergence of "born-global firms" which quickly attain global reach through reliance on existing available digital technologies and with minimal cross-border investment.

OTT providers themselves generate significant economic activity and value. For example, a recent study found that each 10 per cent increase in usage of rich interaction applications on the Internet (such as OTTs) has added on average USD 5.6 trillion in global GDP (0.33 per cent of GDP). These applications generate a significant component of the socio-economic impact of digitalization and utilization of the Internet itself.[64]

While it is instructive for policy-makers to understand such global trends, it is at the national level where the impact of OTTs is truly felt. For example:

- In India, a 17 per cent increase in Internet traffic during the period 2015-2016 resulted in an absolute increase of USD 103.9 billion (almost INR 7 trillion) in the country's GDP over that period. In addition to creating direct and indirect employment opportunities, Internet-based applications contributed a minimum of USD 20.4 billion to India's GDP during 2015-2016 – a number that was expected to grow to USD 270.9 billion by 2020, or nearly 8 per cent of India's GDP.[65]
- Europe had an estimated 1.64 million "App Economy" jobs as of January 2016.[66,67]
- In Burundi, subscribers have enjoyed the benefits not only of the new services offered by their own Internet networks, but also of less expensive or free voice and messaging services.[68]
- Brazil was home to 312 000 "App Economy" jobs in 2016.[69] The IT sector was predicted to grow by 5.6 per cent in 2017, against overall predicted economic growth of 0.2 per cent.

---

61 Matthieu Pélissié du Rausas et al. McKinsey Global Institute. Report. Internet matters: The Net's sweeping impact on growth, jobs, and prosperity. 1 May 2011.

62 United Nations Conference on Trade and Development (UNCTAD). Information Economy Report, 2009: Trends and Outlook in Turbulent Times. New York and Geneva, 2009: and Hosuk Lee Makiyama. European Centre for International Political Economy (ECIPE). Speech. Digital Trade in the U.S. and Global Economies. 2014.

63 James Manyika et al. McKinsey Global Institute. Report. Digital Globalization: The New Era of Global Flows. 24 February 2016.

64 Rich interaction applications are "applications that are used for a wide range of functions, allowing two parties to interact with each other in a long and growing number of ways". René Arnold et al. *Wissenschaftliches Institut für Infrastruktur und Kommunikationsdienste GmbH* (WIK). Report. The Economic and Societal Value of Rich Interaction Applications (RIAs). Bad Honnef, Germany, May 2017.

65 Rajat Kathuria et al. Indian Council for Research on International Economic Relations (ICRIER). Estimating the Value of New Generation Internet Based Applications in India. July 2017.

66 Michael Mandel. Progressive Policy Institute (PPI). The App Economy in Europe: Leading Countries and Cities. June 2016.

67 An App Economy Job is defined as: a) An ICT-related job that uses App Economy skills – the ability to develop, maintain or support mobile applications; b) a non-ICT job (such as human resources, marketing, or sales) that supports core App Economy jobs in the same enterprise; or c) a job in the local economy that is supported by the income flowing to core and indirect App Economy workers.

68 ITU-D SG1 Document 1/28 from Burundi

69 Michael Mandel and Elliott Long. PPI. Brazil's App Economy. February 2017.

- In Kenya, OTTs have acted as a catalyst by encouraging more citizens to utilize the Internet for social and economic purposes. "*Such benefits include lowered transaction costs, flexibility, convenience and increased transactions speeds*".[70]

Small and medium-sized enterprises (SMEs) in particular are increasingly utilizing the Internet and digital tools such as OTTs to grow and drive economic growth in their communities by overcoming traditional barriers of limited knowledge and expertise and leveraging a plethora of low-cost or free options online to grow their businesses.[71] For example, SMEs use the Internet to gain direct access to billions of customers instantly and establish trust and international brand awareness, which allow them to access regional and global markets. In fact, SMEs that are online are almost four times more likely to be exporting.[72]

More than 90 million small businesses worldwide are on Facebook, which helps them grow and create jobs.[73] In the Africa region, 94 per cent of small businesses use Facebook to show products and services, and 95 per cent use WhatsApp to communicate with customers and suppliers, according to a recent survey.[74] Furthermore, 93 per cent of small businesses say Facebook helps with attracting customers, 77 per cent say Facebook allows them to sell their products or services in other cities, states or countries, and 76 per cent say Facebook helps with increasing revenue.

The Analysis Group has estimated that a five percentage point increase in WhatsApp penetration alone in 2015 implies a global increase in GDP of purchasing-power parity (PPP) USD 22. billion (2015). Regionally, this translated to an increase of USD 10.6 billion in Asia; USD 5.4 billion in North America; USD 3.9 billion in Europe; USD 1.1 billion in the Middle East; USD 1 billion in South America; and USD 0.8 billion in Africa.[75]

4.3.4 Competition

There is some debate on whether or not OTTs represent competition to traditional telecommunication services. On the one hand, it has been noted that "*consumers do not use rich interactive applications (RIAs) and communications services as like-for-like substitutes; more often than not, consumers use them complementarily*".[76]

On the other, some observers have noted that there are some similarities in functionality between communications-oriented OTTs and traditional telecommunications. This is seen as a boon to consumers. In general, the technological developments that have led to the rapid increase in available OTT applications have also rendered traditional telecommunication markets significantly more competitive.

---

70 ITU. ITU Council Working Group on Internet (CWG-Internet): Online Open Consultation (June-September 2017). Kenya ICT Action Network (KICTANet) response to ITU CWG-Internet Online Open Consultation: Public Policy considerations for OTTs. 29 August 2017.

71 UNCTAD. Information Economy Report 2015: Unlocking the Potential of E-commerce for Developing Countries. New York and Geneva, 2015.

72 Oxford Economics. Local Business, Global Ambition: How the Internet is Fuelling SME Exports in Asia-Pacific. March 2017.

73 Facebook. Facebook for Business. Giving Small Businesses the Tools to Succeed on Facebook. 7 May 2019.

74 Facebook. Small businesses are growing with Facebook in Africa. Economic Impact Survey (2019), attached at Appendix 2.

75 Greg Rafert and Rosie Mate. Analysis Group. The Global and Country Level Economic Impacts of WhatsApp. February 2017.

76 René Arnold et al. *Wissenschaftliches Institut für Infrastruktur und Kommunikationsdienste GmbH* (WIK). Report. The Economic and Societal Value of Rich Interaction Applications (RIAs). Bad Honnef, Germany, May 2017.

The Botswana Communications Regulatory Authority, for example, has noted that OTTs have *"opened up a lot of space for competition, allowing the communication space to be occupied by numerous and diverse players as opposed to monopolistic or oligopolistic markets. The increased competition in the communication space has benefited the consumer in many ways. … Because there are varied suppliers of both broadcasting content and communication modes, the consumer enjoys the freedom to choose the quality of service they want at the price of their choosing"*.[77]

Further information on how one government determined that OTTs did not create any competition issues with network operators can be found in the case study on Australia in **Annex 4** to this report.

Empirical research bears this out. Research has shown that competition among businesses (even those in different industry verticals) can deliver improvements in production efficiency and bring newer and better products to consumers through innovation, leading to gains in economic growth and consumer welfare.[78] Therefore, regulations that prevent market entry and expansion from OTTs may be particularly damaging for economic growth. Because more competitive markets result in higher productivity growth, policies that lead to markets operating more competitively, such as enforcement of competition law and removal of regulations that hinder competition, will result in faster economic growth.

Policy-makers should therefore establish an environment conducive to competition and investment. The goal should be for users to affordably and efficiently access the plethora of bundled or standalone voice, data and video services in the IP-convergent world provided by such actors as access and content providers.[79]

4.3.5 Evolving business models

The telecommunication market has been one of perpetual innovation. The emergence of OTTs is not a unique phenomenon, but rather the most recent stage of the natural evolution of the market. Just as ITU has evolved since its early days as the International Telegraph Union, so too have its Member States and, more significantly, its Sector Members.

For decades, telecommunication carriers operated with a business model in which the product was voice, the metric of measurement was the minute, and incremental costs (related primarily to time and distance) resulted in incremental charges to the consumer. With today's flat IP networks, the product is connectivity, and the metric is bandwidth. The networks are insensitive to time, location and distance, and consumers are either connected or they are not.

The Regulatory Authority for Communication Technologies (ARTEC) of Madagascar noted that "*network operators obviously need to update their strategies and seek a new model better adapted to the current market*".[80] This is exactly what has begun to happen. Today, telecommunication operators are transforming their businesses into "data first" companies, with many developed country operators now making more than 50 per cent of their revenues from

---

77 ITU. ITU Council Working Group on Internet (CWG-Internet): Online Open Consultation (June-September 2017). Botswana Communications Regulatory Authority response to ITU CWG-Internet Online Open Consultation: Public Policy considerations for OTTs. 18 August 2017.
78 OECD. Competition Assessment Toolkit: Volume 1. Principles. Paris, France, 2016.
79 OECD. OECD iLibrary. Broadband Policies for Latin America and the Caribbean. Paris, France, 21 June 2016.
80 ITU-D SG1 Document 1/36 from Madagascar

data services.[81] This is a trend that will only continue as revenues from data services continue to increase. In fact, it is already estimated that data services revenue for some operators will largely offset the decline in voice service revenues, becoming the core business of the carriers.[82]

As the prominence of voice declines, speed and quality of broadband access has proven to be a determining factor in consumer network preferences. Consumers who demand the most data from their operator have been shown to spend more money on mobile contracts featuring high-speed data.[83] In Finland and Switzerland, for example, some mobile providers charge by the tier of speed that users elect rather than the amount of data they download. The mobile providers in these countries therefore welcome digital platforms and OTTs because they stimulate demand for faster services with higher charges.[84] Operators who have adopted data-centric tariff structures enjoy "*benefits such as reduced churn, increased net promoter scores, more stable in-bundle revenue streams, and the ability to link returns more directly to network investment*".[85] This business model should be facilitated by regulatory authorities. Telecommunication operators should be able to rebalance their tariffs to reduce their dependence on revenue from voice and SMS.

In addition, many network operators have moved beyond their traditional telecommunication businesses. For example, operators including Deutsche Telekom, Orange, Telefónica and Vodafone have deployed advanced IP-based communication services based on the RCS (Rich Communications Services) and VoLTE (voice over LTE) specifications that offer functionalities that compete directly with other popular OTT messaging services.[86] Such competition is healthy for the industry and beneficial for the consumer. Regulators should afford operators the flexibility to offer innovative communication services (such as messaging applications) that are not subjected to traditional telecommunication regulations, so long as the services are offered in a neutral way that do not favour proprietary applications over competitive alternatives.

A second route has been to capitalize upon the convergence of telecommunications and media, as exemplified by the AT&T acquisitions of DirecTV and Warner Media; and the suite of media, technology and communications that Verizon now offers under its subsidiary Verizon Media.

Further details on how a government has helped encourage new business models can be found in the case study on the Utilities Regulation and Competition Authority of Bahamas in **Annex 4** to this report.

A third route taken by more and more operators is to form commercial partnerships with third-party OTT companies.

---

81 David Abecassis et al. Analysys Mason. Broadband in Asia-Pacific: How investment, partnerships and policy are driving a global success story. October 2015.

82 According to the Vodafone Group, in its Annual Report 2014, it is estimated that between 2013 and 2017 data revenue from the telecommunication sector was set to grow by USD 128 billion, compared to a USD 38 billion decline voice revenue during the same period.

83 René Arnold et al. All Communications Services Are Not Created Equal–Substitution of OTT Communications Services for ECS from a Consumer Perspective. *TPRC44 Conference*, Arlington, VA, 30 Sept. - 1 Oct. 2016.

84 OECD. Key Issues for Digital Transformation in the G20. *Report prepared for a joint G20 German Presidency/ OECD conference*. Berlin, Germany, 12 January 2017.

85 Calum Dewar. Mobile World. Rebalancing the value from voice and SMS to data. New analysis: GSMA Intelligence reviews new approaches to data tariffs for operators in developed markets. 2 September 2014.

86 GSMA. Network 2020. A GSMA Insight Report. The Future of Mobile Communications. London, 2020.

4.3.6 Legal frameworks and commercial partnerships for the development and deployment of OTT

The successful development and deployment of OTTs depends in large part on stable and predictable legal and policy environments established by government authorities. As noted in this report, there is not yet a prevailing consensus around the world on the regulatory treatment of OTTs, and this has led to a variety of approaches, with varying degrees of success. Beyond the debate over the applicability of legacy telecommunication regulations to OTTs, government approaches to tax policy and the treatment of data flows also have immense impacts on the development and deployment of OTTs.

Tax

The prevalence of OTTs has had a major economic impact on economies around the globe. Many businesses – even small businesses – can now use OTT applications to operate across borders. This brings new opportunities for trade and growth, but in some jurisdictions tax authorities have had challenges adapting to this new economic paradigm.

Some governments have responded to the growth and popularity of OTTs by establishing consumer taxes on their use. Governments have cited several grounds for the taxes, including curbing a perceived loss of revenue from legacy and traditional telecommunication companies; rebalancing the "playing field" in the ICT sector; and moderating online speech for national security reasons.

Research has demonstrated, however, that these taxes are short-sighted at best and, at worst, produce the opposite results to those intended. Where implemented, the result is that the additional taxes have increased the cost of data consumption and led to slower broadband adoption. This results in lower tax revenue over the longer term as users adjust their behaviour and use less data. OTT taxes also increase the cost to connect for all – particularly those already struggling to afford a basic connection – and so defer until later economic advantages that broadband access engenders, which delays further economic development.

The Alliance for Affordable Internet (A4AI) and the Commonwealth Telecommunications Organisation (CTO) have both published principles for OTT taxation, which governments are encouraged to recognize.

A4AI:

- First, tax policy related to Internet access (and fiscal policy in general) is not gender neutral. Governments should therefore pay particular attention to how taxes impact women and other groups who exhibit lower rates of Internet use than others. It is therefore imperative that taxation policies are gender-responsive – meaning they actively consider gender issues and the gender gap in Internet access – from conception to implementation and monitoring.
- Second, fiscal policies that tax use of social media and other related Internet-based services distort people's use of the Internet. Governments should reassess the introduction of taxes, including conducting sensitivity and gender-responsive analysis of tax measures, considering potential harm to citizens and businesses, and re-evaluating their revenue and behavioural targets. Failing to consider the potential harm of taxes on citizens and businesses may ultimately lead to large social costs.
- Third, social media taxes appear to contribute to a shrinking civil-society space. Governments must recognize that effective policy development, and the functioning

of society in general, depends on a strong and active civil society, including women's rights groups. For many of these organizations, social media and the Internet are crucial organizing and operating tools, and such taxes undermine their work.

- Finally, tax policies, when poorly designed, can have an adverse effect on the objective of revenue generation, harming taxpayers and failing to achieve revenue targets.

CTO:

- *Broad-based*: A broad base of taxation means that a lower tax rate is required to raise the same revenue, while sector-specific taxes distort incentives and require higher levels of taxation to obtain the same revenue.
- *Consider externalities*: Excise duties should be imposed on activities with negative externalities where the objective is to lower consumption, such as alcohol or tobacco, and should not be imposed on sectors with positive externalities, such as telecommunications.
- *Simple and enforceable*: Taxes should be clear, easy to understand and predictable, thereby reducing investor uncertainty and ensuring better compliance.
- *Incentives for competition and investment should be unaffected*: Higher taxes for one sector in comparison to the rest of the economy could reduce investment in that sector.
- *Progressive not regressive*: The tax rate should increase as the taxable amount increases. Specific value taxes on small amounts should be avoided because they make the poor pay more.

In addition, several multilateral bodies have begun developing new tax policies for the digital era. OECD has initiated discussions that centre on where tax should be paid. Traditional finance and tax rules result in most revenue being taxed by the country of domicile of a business, not necessarily where the revenue is earned. And with the global economy becoming increasingly digital, businesses of all types are seeing revenue in places where they have no physical presence.

The current proposal, still being negotiated by over 135 countries and jurisdictions within the OECD/G20 Inclusive Framework on base erosion and profit shifting (BEPS), will have two pillars. The first addresses allocation of tax revenue to a broader set of countries than would traditionally have nexus to tax that revenue. The second pillar will tighten global minimum tax rules to make sure all income is taxed somewhere.

In addition, the European Union created a set of workable rules for VAT collection by non-resident digital businesses. The non-resident businesses remit the VAT to the governments where the purchasers reside, much like a resident seller would. The EU also created a "mini one-stop-shop" for administering the new regime. Within its first year, B2C VAT on electronically supplied services generated an additional EUR 3 billion in tax revenues for the EU, rising to over EUR 4.5 billion by 2018.

This B2C VAT regime has been replicated in nearly 25 non-EU countries since 2015, bringing the total to almost 50 countries, many of which are developing countries. Some regions have seen broader adoption of the regime, for example, the Gulf Cooperation Council (GCC), where businesses worked with governments to implement consistent rules across the region to comply with a newly enacted regional VAT agreement.

By and large, the countries that have worked collaboratively with taxpayers and implemented regimes that follow best practices have seen much smoother and successful implementation. As more of the economy goes digital, revenue collection will increase, which can be especially valuable in countries with large informal economies. Not only does adoption of an existing

set of principles reduce friction for international businesses, it also removes the need for tax administrations to reinvent the wheel. Countries looking to boost compliance and harness the power of the digital economy can adopt these rules and expect increased tax revenue.

Data flows

As noted earlier in this report, the flow of data across international borders has been at the root of substantial economic growth. Despite the economic benefits that arise from the ability to share data easily across borders, a wide variety of countries have instituted measures that restrict cross-border data flows, including data-residency requirements. The public policy rationales behind such policies vary, and include fears of economic development, privacy, security and access for data. No matter the justification, the end result is often one that inhibits value generation, reduces exports and foreign direct investment, and results in productivity losses for local companies that rely on a wide range of digital services, all without added benefits in terms of privacy or data security. At the macroeconomic level, one prominent study assessing the impact of proposed or enacted data localization legislation in seven economies estimated negative GDP impacts in each instance: Brazil (–0.2 per cent), China (–1.1 per cent), European Union (–0.4 per cent), India (–0.1 per cent), Indonesia (–0.5 per cent), Republic of Korea (–0.4 per cent) and Viet Nam (–1.7 per cent). At the firm level, such restrictions can have a meaningful impact on the cost and availability of key digital services. Specific analysis undertaken with respect to cloud services found that data-localization policies restrict access to the most cost-competitive global cloud providers, and significantly raise costs for local companies purchasing cloud-computing services.

In the modern global economy, data are already an essential means of widening consumer choice and the affordability of goods and services, helping SMEs reach global markets, and fostering international production through global value chains – and the uses of data are widening. Any regulatory measures restricting data flows will therefore also have detrimental consequences for trade and economic development. These consequences are likely to be particularly acute for SMEs, as data-restrictive policies affect access to a range of cost-efficient digital technologies, including OTT communication applications that many small businesses rely on. As regulators consider approaches for addressing legitimate concerns around economic development, privacy, security and access for data, regulators should avoid policies that call for data localization or otherwise restrict the flow of data. Instead, regulators should recognize the enormous societal and economic benefits from innovative new technology and data-based services and should pursue policies that promote the ability of firms and consumers to leverage these technologies.

There is tremendous potential value in cooperation between OTT companies and telecommunication service providers. When supported by an enabling policy and regulatory environment, such cooperation can extend broadband access and new services to unconnected and under-connected populations.

Recommendation ITU-T D.262 states that "*Member States should encourage mutual cooperation as far as practical between OTTs and network operators, with a view to fostering innovative, sustainable, viable business models and their positive roles in fostering socio-economic benefits*".[87]

[87] ITU-T. Recommendation ITU-T D.262 (05/2019) (op. cit.).

The Botswana Communications Regulatory Authority notes that "*Partnerships could be forged in spaces of infrastructure development cost sharing in order to ensure seamless and fast delivery of broadband Internet enough to carry traffic of both OTTs and traditional modes of communications*".[88]

Examples of this type of collaboration abound. For example, Facebook (an OTT), Airtel and BCS (two network operators) have completed a 770 km fibre-optic build in Uganda that will provide backhaul to over 3 million people and enable cross-border connectivity with neighbouring countries. Facebook and Telefónica have announced that they will be jointly investing in bringing mobile-broadband connectivity to rural Peru based upon an innovative legal/regulatory structure called Rural Mobile Infrastructure Operator (RMIO).

In May 2020, a broad consortium including MTN GlobalConnect, Orange, STC, Telecom Egypt, Vodafone, Facebook and WIOCC announced that they will partner to build 2Africa, which will be the most comprehensive undersea cable to serve the African continent and Middle East region.[89] 2Africa will interconnect 23 countries in Africa, the Middle East and Europe, and will provide nearly three times the total network capacity of all the subsea cables serving Africa presently.

With evolved networks and 5G (SDN, virtualization and network slicing) it will become even more important that countries have regulatory frameworks in place that foster and encourage the development of new business models based upon collaborations and partnerships between network operators and other industries, including OTTs. Recognizing the early stage of new business models enabled and driven by 5G, the market and players should retain the freedom to develop such partnerships with any potential regulatory effort being focused on identifying possible barriers for the development hereof in existing telecommunication regulation.[90]

4.3.7 Economic and business model partnerships among telecommunication operators and OTT providers

As noted, OTTs and traditional telecommunication service providers have a symbiotic, mutually reinforcing relationship. Richer OTT applications drive demand and willingness to pay for enhanced network access, whilst improved access coverage and quality enables greater use of messaging and other applications. Many companies have taken one step further, by forming commercial partnerships that bundle their services together.

GSMA has noted that "*value in the digital economy comes from attracting complementary participants, so it is more important for mobile operators to catalyse the formation of new ecosystems and partnerships as opposed to going it alone*."[91]

A growing number of OTTs and traditional telecommunication operators have leveraged this relationship by developing commercial partnerships with one another.

A 2017 analysis on The State of Digital Transformation surveyed 83 fixed-line and mobile operators from around the world. When asked how the operators are responding to the rise of

---

88 ITU CWG-Internet. Botswana Communications Regulatory Authority response to the CWG Online Open Consultation (op. cit.).

89 Cision. PR Newswire. News. 2Africa: a transformative subsea cable for future internet connectivity in Africa announced by global and African partners. Menlo Park, Ca., United States, 14 May 2020.

90 ITU CWG-Internet. DigitalEurope reponse to the CWG Open Consultation. (op. cit.).

91 GSMA Intelligence: Mobile operators: the digital transformation opportunity. June 2016.

OTTs, 42 per cent of operators stated that they are partnering with an OTT provider, such as WhatsApp, by bundling partner services with their own.

Some key examples include the following:

- In South Africa, Vodacom partnered with Deezer, a music streaming service to offer subscribers unlimited music access for ZAR 59 per month (around USD 3.82).
- In India, Airtel and Vodafone have partnered with Netflix. With this partnership, the mobile operators gain more diverse content, while Netflix further broadens its distribution platform.
- NTT Docomo introduced a function for smartphone users to directly access LINE (the most popular messaging and voice application in Japan with 180 million worldwide monthly active users) from the dial screen so that the user can easily choose between legacy voice and LINE to initiate a call.
- KDDI, the second largest mobile operator in Japan, released a mobile application that enables Skype communications.
- EE, a mobile operator in the United Kingdom owned by BT, bundles Apple Music with its postpaid mobile plans.
- Virgin Media, the largest cable operator in the United Kingdom, was among the first to actively advertise Netflix by providing the service on a discount for six months to new subscribers.

The Economic Times reports for example that, in India, "*Telecom operators are expanding further into content partnerships seeking new revenue opportunities by better utilizing the massive infrastructure they have built. From movies and music to e-magazines, the country's three big telecom operators are partnering with content providers in what analysts see as a win-win for both*." Vodafone (India's second largest telecommunication operator) offers video content from content providers like Discovery Communications India and AltBalaji for its platform Vodafone Play, and a free year of access to Netflix for its RED plan subscribers. Meanwhile, Idea Cellular has partnered with Ditto TV and Yupp TV, Eros and Balaji to provide video content to its customers.

In Germany, Vodafone Deutschland has integrated Netflix in its home gateway GigaTV. The streaming service is available both on the GigaTV 4K box and in the GigaTV app on smartphones and tablets. Through the integration, viewers wanting to use Netflix no longer have to leave GigaTV and launch the Netflix app, but can access the service directly on the GigaTV user interface.

Amazon has partnered with mobile operators around the world through its Amazon Fuse product, which offers subscribers access to Amazon Prime, Prime Video and Amazon Music Unlimited. Amazon touts this feature as an opportunity for partner operators to "*add revenue, drive acquisition and increase loyalty*" while in turn they are able to expand the reach of their services to new customer bases.

Facebook has partnered with mobile operators in over 55 countries around the world to launch its Free Basics programme, which provides people access to a range of basic services like news, maternal health, travel, local jobs, sports, communication and local government information without data charges. By enabling people to experience the benefits of connectivity, Free Basics provides an on-ramp to the broader Internet. After giving people an opportunity to experience connectivity, the Free Basics programme incentivizes them to begin purchasing data packages from partner operators in order to access the broader Internet.

For those already online but who may be under-connected and only able to afford data intermittently, programmes like Free Basics also can provide a baseline of connectivity to help them stay online more consistently. Rather than dropping off the Internet completely when an individual periodically runs out of data, the baseline of connectivity can help smooth the gaps in connectivity, keeping people connected and incentivized to continue topping up with more data when they are able to do so. This benefits both consumers and mobile operators.

Regulatory officials are urged to support these types of innovative partnerships between OTTs and mobile operators, as they provide a win-win-win situation for the commercial entities involved and, most importantly, for consumers. The World Bank Digital Development Partnership has encouraged regulators to favour "*… operators initiatives to bundle or develop partnerships with OTT service operators. This could be done with a changed regulatory framework temporarily applied to new initiatives and development*". Partnerships are best enabled through flexible regulation that permits innovative models for expanding connectivity and bringing more people online and avoiding overly restrictive rules on the ability of mobile operators to offer differential pricing or zero-rating programmes.

4.4 Guidelines regarding OTTs

Regulators are invited to develop their digital skills, in order to better understand and assess the development of the telecommunication/ICT market in the context of OTTs.

Regulators are invited to consider the evolution of the Internet value chain and assess the telecommunication/ICT market as a whole in order to consider relevant measures in line with market realities.

OTT regulations, if proven necessary, should be based upon actual evidence of harm to consumers and be designed to address that harm. They should also be based on a quantitative analysis of the socio-economic effects of such regulation.

Tax policies associated with OTTs should properly account for potential harm for citizens and businesses, paying particular attention to how taxes impact vulnerable communities and the adoption and use of broadband Internet, as failing to consider such harm may ultimately lead to large societal costs.

Governments are encouraged to engage in real dialogue with and consult different stakeholder groups before adopting new policies and regulations.

Telecommunication operators are encouraged to consider adopting data-driven business models and to rebalance their rate grids in order to reduce their dependence on telephone and SMS services. Regulators should permit operators to pursue this strategy.

OTT providers and telecommunication operators are encouraged to explore different models of partnerships and agreements including investments in network infrastructure. Regulators should facilitate such partnership agreements and request further insight into them as necessary.

Regulators are encouraged to ensure that data can flow freely as a means of promoting continued growth, especially for SMBs. This in turn will benefit economic growth at the local, national, and regional levels.

Annexes

Annex 1: Economic impact of OTTs on national telecommunication/ ICT markets

Note:

The material in this Annex was first published in May 2020 as a free public paper:

ITU-D study groups – Question 3/1 and Question 4/1 Annual Deliverable 2019-2020: Economic impact of OTTs on national telecommunication/ICT markets.

Accordingly, it is reproduced here without further editing. Moreover, since the text was published in all six official languages of the Union, this Annex 1 is provided in the corresponding language in the respective editions of the Output Report on Question 3/1.

Executive summary

The big move to data

Changes in network technology and the transition from voice and SMS to a more data-centric business model have paved the way for OTT success, transforming the way people access resources for health, transportation, education, agriculture, government and financial services. Increasingly, mobile network operators (MNOs) are embracing data-centric business models as data drives the ongoing digital revolution in virtually every industry vertical.

How are OTTs impacting MNO demand, revenue and cost?

Demand: The exponential increase in data traffic and use of OTTs results both in new subscribers for broadband services and existing subscribers upgrading their subscriptions for greater speed and bandwidth. In terms of voice and SMS services, the picture is less clear with some countries in Africa showing stable use or even an increase in voice traffic. These trends reflect the reality that network traffic, and demand for legacy services, depend on a multitude of variables, not simply on the prevalence of OTTs.

Revenue: Data services are increasingly important in MNO revenue streams but can business opportunity and risk mitigation boost profitability? How far do OTTs contribute to MNO revenue indirectly by boosting demand? Are changes in business model the way forward – for example OTTs and network operators co-investing?

Cost: Data traffic accounts for a significant share of network costs. In Europe, for example, MNOs are expected to spend hundreds of millions of Euros per year to handle Internet traffic – in addition to incurring costs required to provide traditional services.

How can OTT investment be boosted?

Complementary relationships exist between OTT services and network services. Hyperscale OTT service providers are increasingly investing in infrastructure and connectivity projects to support the availability of high-speed broadband, and numerous collaborative initiatives exist between operators, development agencies and Internet companies aimed at co-investment in network infrastructure. Despite these gains in connectivity, there is a continuing need for increased and improved broadband network infrastructure. How can OTT investment into extending network connectivity be boosted?

The huge promise of partnership

OTTs and network operators need each other to thrive in today's communications marketplace. OTTs provide the content that drives demand for telecoms operator services. It is not a 'zero sum game' but rather a symbiotic relationship. OTT applications increase revenues for operators' core access services by driving demand for data services. So direct commercial partnerships between operators and OTTs have vast potential: research suggests such partnering could increase telco free cash-flow by a massive 50 per cent.

OTT platforms: what impact?

OTTs have helped usher in economic and social transformation beyond traditional communications services in the ever-growing digital economy. At the same time, this success has brought with it new challenges – such as increased competition between informal vendors on OTT and physical retailers, or the need to modernize tax codes appropriate to the new digital economy. A number of barriers to connectivity exist in some countries, such as the high cost of Internet data; introduction of additional taxes to raise revenue, including content license fees and excise taxes; fiscal instruments in some countries, including new forms of taxation on the use of OTTs – measures which may have a detrimental impact on women and their ability to access the digital economy.

Digital transformation of network communications: challenges for regulators

OTTs are a vast and diverse collection of businesses. Regulators need to see the benefits that OTTs deliver while adapting regimes to address new challenges. And while OTT innovation can be rapid, regulation sometimes struggles not only to keep pace but to address large-scale OTT operations outside of the regulator's national mandate, thus a need for improved international cooperation. In addition, a one-size-fits-all approach to regulating OTTs will not work. When new service delivery models disrupt the old, regulation should be informed by evidence rather than fear of the unknown. Is light-touch, flexible regulation the answer?

Introduction

This paper reflects on the growing importance of 'Over-the-Top' applications (OTTs) and their increasing ubiquity and influence in a digital world. It is the product of a workshop that brought together experts and stakeholder groups from regions around the world to consider the "Economic Impact of OTTs on National Telecommunication/ICT Markets".

It is exploratory in nature. With the transition from a voice and SMS-centric business model to a mobile Internet access business model, the paper takes a closer look at mobile network

operator (MNO) and application service provider (ASP) relationships, finding that OTTs and network operators need each other to thrive in the contemporary communications marketplace.

The paper also raises a number of important questions: How are OTTs impacting demand, revenue and cost of mobile network operators? How can OTT investment in infrastructure be boosted? What is the social impact of OTT platforms and how can it be measured? How to build partnerships between MNOs and OTTs for maximum potential? How can ICT regulation transition from past models to keep pace with the new and rapidly changing landscape of OTTs?

Such questions raise complex issues that stakeholders need to navigate together in the decade to come. This paper then is a valuable first step on the pathway to balanced digital markets that remain innovative and underwrite meaningful connectivity.

Finally, the paper proffers a number of conclusions, extracted from workshop discussions, for governments and regulators to consider. It is hoped that this paper will help stimulate discussion and dialogue as this important debate moves forward.[92]

Context

The impact of 'Over-the-Top' applications (OTTs) is currently one of the most discussed and debated topics in the telecommunications/ICT industry. The demand for OTTs has reshaped several aspects of the telecommunication/ICT market and changed the way citizens and businesses consume digital technologies and services across the globe. This impact spans issues of business models, infrastructure development, competitiveness and telecommunications regulations, as well as the changing dynamics of consumer behaviour, social engagement and the resulting social and economic changes.

This paper stems from a workshop held on 1 October 2019 on the topic of **"Economic Impact of OTTs on National Telecommunication/ICT Markets"**[93], which brought together renowned experts from across the world and across stakeholder groups. The workshop was a joint effort of the management teams of ITU-D Study Group 1,[94] working on two topics: Question 3/1, which studies "Emerging technologies, including cloud computing, m-services, and OTTs"; and Question 4/1, which studies "Economic policies and methods of determining the costs of services related to national telecommunication/ICT networks".

This paper is the product of collaboration between a wide range of stakeholders – academia, governments, private sector, NGOs, independent experts, OTTs, Mobile network operators (MNOs), regulators and regional and international organizations – and it reflects a balanced view of the differing perspectives on a range of subjects. As such, the paper seeks to provide insights on the impact of OTTs on ICT markets. Finally, it offers a number of conclusions, extracted from workshop discussions, for governments and regulators to consider. It is also hoped that the paper will foster further dialogue and engagement between OTTs and MNOs.

---

92 Disclaimer based on the discussion and decision of TDAG 2019: This report as like as another annual deliverable will be published on the ITU-D study group website under the auspices of the Chairmen of Study Groups 1 and 2 respectively, under a new section to be added titled "Ongoing Work." This annual deliverable is released to provide ITU membership with timely information on important issues to study group participants.

93 Material from the workshop on the Economic Impact of OTTs on National Telecommunication/ICT Markets, 1 October 2019, is available at: https://www.itu.int/en/ITU-D/Study-Groups/2018-2021/Pages/meetings/joint-session-Q3-1-Q4-1_oct19.aspx.

94 https://www.itu.int/itu-d/study-groups.

ITU studies on OTT

ITU-D

A discussion in ITU-D on OTT was started at 2014 World Telecommunication Development Conference (WTDC-14) which added the topic for the study period 2014-2017 to the scope of ITU-D Study Group 1 Question 1/1 (Final Report on Question 1/1)[95]. This Report includes views on the national experiences of Brazil, Central African Republic and People's Republic of China with respect to OTTs. WTDC-17 decided to move this topic to Question 3/1.

As part of the work of the Secretariat of ITU's Development Bureau (BDT), a Digital Economy portal[96] was developed to integrate ITU's work on policy and regulatory research, data collection on the evolution of the digital ecosystem. Recent research and analysis have also been integrated into the ITU Global ICT Regulatory Outlook series since 2017.

ITU-T

Initial ITU studies on OTT were started at ITU-T Study Group 3, "Tariff and accounting principles and international telecommunication/ICT economic and policy issues" (ITU-T SG 3) in the period 2013-2016. For this purpose, the group established Question 9/3: "Economic and regulatory impact of the Internet, convergence (services or infrastructure) and new services, such as OTT, on international telecommunication services and networks". The first deliverable from the rapporteur group of this Question was a Technical Report[97] approved in 2017. The goal of this report was to provide details about national experiences relating to OTTs. Subsequently, the group developed ITU-T Recommendation D.262[98], *Collaborative Framework for OTTs*, which was approved in 2019. Currently, ITU-T SG 3 is studying additional working items related to OTTs, although it has not adopted any other final outputs on the OTT topic.

Definitions

There is no universally accepted definition of the term 'OTT'. ITU-T Recommendation D.262 includes a working definition for OTTs: *"An application accessed and delivered over the public Internet that may be a direct technical/ functional substitute for traditional international telecommunications services."* It includes a footnote stating that the definition of OTT is a matter of national sovereignty and may vary among Member States – each country is then free to define the boundaries and scope of OTTs and formulate its own public policies and regulations.

The United Kingdom Office of Communications (Ofcom) defines OTTs *as "a range of services, including messaging services, voice services (VoIP), and TV content services."*

---

95 Final Report on Question 1/1: "Policy, regulatory and technical aspects of the migration from existing networks to broadband networks in developing countries including next-generation networks, m-services, OTT services and the implementation of IPv6", available at: https://www.itu.int/pub/D-STG-SG01.01.1-2017.

96 https://www.itu.int/en/ITU-D/Regulatory-Market/Pages/Collaborative_Regulation/App_Economy.aspx.

97 Technical Report on Study on Economic Impact of OTTs: http://handle.itu.int/11.1002/pub/8106272c-en.

98 ITU-T Recommendation D.262 "Collaborative framework for OTTs": https://www.itu.int/rec/T-REC-D.262-201905-I.

The Body of European Regulators for Electronic Communications (BEREC) defines OTTs as *"content, a service, or an application that is provided to the end-user over the public Internet"* with three different distinctions:

- "OTT-0 as electronic communication services (ECS) that are able to terminate on fixed-line or mobile network such as Skype-out calls".
- "OTT-1s are not electronic communication services (ECS) but potentially competing with them".
- "OTT-2 encapsulates all other OTT services that are not captured by OTT-0 and OTT-1 (e-commerce, video, music streaming, etc.)".

Many experts are of the opinion that the term itself, 'Over the Top', is not an accurate depiction of the way the Internet is delivered and accessed. Most experts agree that the definition needs to evolve to better reflect the development of the digital world (as discussed below) and an era that sees digital transformation of every sector, domain or discipline. This massive digital transformation will only be possible thanks to the Internet and to various online services delivered and are yet to be developed and delivered over time to consumers and businesses.

Experts use terms such as 'digital platform', 'application service provider' (ASP), 'online service provider' (OSP) or 'content and application providers' (CAPs) to reflect this evolution. While we acknowledge the shortcomings of certain definitions and the popular use of different terms, for simplicity and brevity the following paper uses the term 'OTT' to reflect all of these underlying concepts and terms.

Move to digital world

For decades, telecommunications carriers operated with a business model in which the main product was voice, the metric of measurement was the minute, and incremental costs (related primarily to time and distance) resulted in incremental charges to the consumer. This has changed. With today's IP networks, the product is now connectivity, and the metric is bandwidth. The networks are insensitive to time, location and distance, and consumers are either connected or they are not. Under such IP networks, the value chain has evolved.

Such changes in network technology have supported the creation of an ecosystem of 'online applications' (OTTs) that introduce completely new use cases including the Internet of Things (IoT), connected cars, smart education, smart health, smart agriculture.

Consumer preferences have switched from traditional legacy services to OTTs, especially in some use cases such as messaging. Telecommunications business models have begun to evolve accordingly. With OTTs used increasingly for voice and message communication, the general trend is a transition from voice and SMS towards data as a primary source of mobile network operators (MNO) revenues. Many operators have decreased their reliance upon voice and SMS charges and have turned towards data-centric business models. Operators who have adopted data-centric tariff structures enjoy benefits such as reduced churn[99], increased net promoter scores, more stable in-bundle revenue streams, and the ability to link returns more directly to network investment.

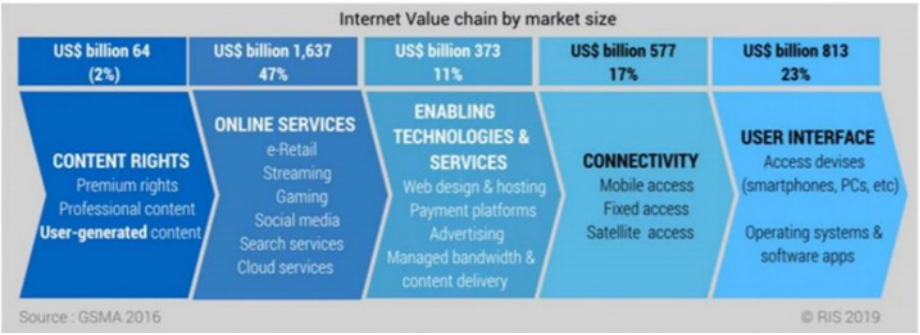
[99] https://www.mobileworldlive.com/featured-content/home-banner/rebalancing-value-voice-sms-data/.

The move from voice to data has smoothed the path for OTTs, enabling easy access to new services – health, transportation, education, agriculture, government and online finance. Result: MNOs are moving to data-centric business models.

The transition from a voice and SMS-centric business model to a mobile Internet access business model is seen by many observers as inevitable and could lead to MNOs eventually becoming essentially 'connectivity' providers, distinguishing their products by speed and quality of service (QoS), and competing with other forms of access, such as public Wi-Fi and connectivity in places of work, study and home. Some industry observers predict that eventually MNOs will no longer charge for voice and SMS, and will change their billing model towards one based on bandwidth and/or data consumption. This transition will coincide with the ongoing digital revolution in virtually every industry vertical. Consumers and citizens will access resources for health, transportation, education, agriculture, government and finance online, aided by improved digital networks and data-centric business models. Fittingly, the last decade of mobile network investment has gone into 2.5G, 3G, 4G, 5G technologies, which are all about data.

Other industry observers have suggested that in addition to providing access to the Internet, network operators will seek to diversify their businesses. As illustrated in Figure 1A, the Internet value chain offers significant commercial opportunities for market participants.

Figure 1A: The Internet value chain and market size shares in 2015



Source: GSMA[100]

The impact of OTTs on traditional telecommunications

There is ongoing debate on the impact of OTT services in traditional telecommunication/ICT operators. This impact is expected to be more acute for MNOs which are more sensitive to traffic variations. Mobile network operators face their operations being impacted under three main dimensions:

- Demand
- Revenues
- Costs

[100] GSMA "The Internet Value Chain: A study on the economics of the Internet", May 2016, https://www.gsma.com/publicpolicy/wp-content/uploads/2016/09/GSMA2016_Report_TheInternetValueChain.pdf.

Demand

ICTs mobile network operators have highlighted that consumer demand for OTTs has led to a booming increase in data traffic while traditional telecommunications services (non-IP voice calls and SMS) are becoming less relevant. This demand for OTTs results in both new subscribers for broadband services and existing subscribers upgrading their subscriptions for greater speed and bandwidth.

BEREC states that *"ultimately, it is the success of the [content and application providers] […] which lies at the heart of the recent increases in demand for broadband access (i.e. for the ISPs' very own access service)"*[101]. This supports the view that without new and innovative online content and applications, the value of Internet access to users would be severely reduced. In fact, according to a study by Google, 69% of YouTube users say they would upgrade their broadband connection if they thought that it would work faster[102].

Data traffic

Global data traffic is growing exponentially, and some market analysts estimate that this is due to the use of OTTs. Ericsson expects that global mobile data traffic will be multiplied by five between 2018 and 2024 (from 28 to 131 Exabytes per month)[103]. Growth trends are confirmed by the historical information of data consumption in the case of Airtel Africa[104], Sonatel Senegal[105] and the overall Zimbabwean market[106]. Additionally, there are studies indicating that in many prominent markets, most of the data traffic handled by MNOs is associated with only a few application categories (82% of mobile data traffic is expected to be associated with video and social network applications[107]) and a few applications (the three main video applications in terms of traffic account to 42% of mobile traffic while the three main social networking applications account for 22% – see Figure 2A).

---

101 Keynote address by Dr R. Pepper, Facebook at ITU workshop on the Economic impact of OTTs on national telecommunication/ICT markets, Geneva, 1 October 2019, available at: https://www.itu.int/dms_pub/itu-d/oth/07/1a/D071A0000040002PDFE.pdf.

102 ICM Research "Broadband Consumption Study, France and Germany", 2013.

103 "Ericsson Mobility Report June 2019": https://www.ericsson.com/49d1d9/assets/local/mobility-report/documents/2019/ericsson-mobility-report-june-2019.pdf.

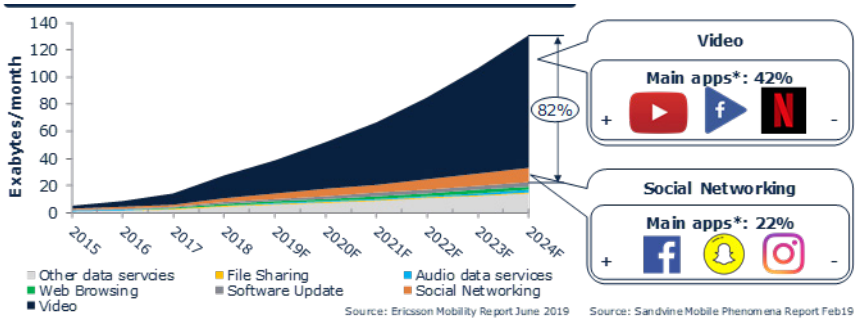
104 Submission and presentation by Research ICT Solutions at ITU workshop on the Economic impact of OTTs on national telecommunication/ICT markets, Geneva, 1 October 2019, available at: https://www.itu.int/dms_pub/itu-d/oth/07/1a/D071A0000090001PDFE.pdf and https://www.itu.int/dms_pub/itu-d/oth/07/1a/D071A0000090002PDFE.pdf.

105 Presentation by Sonatel, Senegal at ITU workshop on the Economic impact of OTTs on national telecommunication/ICT markets, Geneva, 1 October 2019, available at: https://www.itu.int/oth/D071A00000A/.

106 Presentation by POTRAZ, Zimbabwe at ITU workshop on the Economic impact of OTTs on national telecommunication/ICT markets, Geneva, 1 October 2019, available at: https://www.itu.int/oth/D071A00000F/.

107 According to Sandvine's "The Mobile Internet Phenomena Report February 2019", the three main video applications in terms of traffic are YouTube, Facebook Video and Netflix. The three main social networking applications are Facebook, Snapchat and Instagram: https://www.sandvine.com/hubfs/downloads/phenomena/2019-mobile-phenomena-report.pdf.

Figure 2A: Global mobile data traffic and usage per application



Source: Axon Partners Group from Ericsson and Sandvine's reports

Note (*): Main apps in terms of traffic. Percentage of global download traffic of the three main apps (in terms of traffic) per category as per Sandvine's reports[108]

Voice calls and SMSs

In terms of traditional services, there is not such a clear trend. Several MNOs believe that OTTs are associated with a decrease of international calls traffic (such as in the case of Zimbabwe and Sonatel Senegal[109]). On the other hand, this effect is not necessarily transposed to the overall voice traffic. In particular, the following behaviours have been reported:

- In the case of Zimbabwe[110], overall voice traffic nearly halved between 2014 and 2016, showing some recovery in 2018.
- Airtel Africa shows a steady increase in voice traffic from 2012 to 2018[111].
- ECTEL countries show a relevant decrease of voice traffic from 2014 to 2017, and a slight increase in 2018[112].
- These trends indicate that network traffic, and demand for legacy services, depend on a multitude of variables, not exclusively on the prevalence of OTTs.

[108] Please note that Sandvine information includes only data for the countries in which they work which cover 2.5 billion subscribers (for instance it does not include China and India customers and thus their consumption).

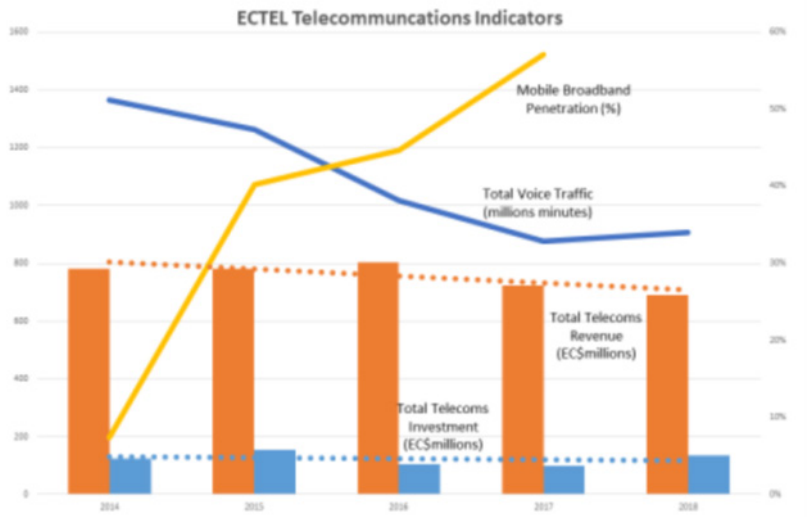
[109] Presentation by Sonatel, Senegal at ITU workshop on the Economic impact of OTTs on national telecommunication/ICT markets, Geneva, 1 October 2019, available at: https://www.itu.int/oth/D071A00000A/.

[110] Presentation by POTRAZ, Zimbabwe at ITU workshop on the Economic impact of OTTs on national telecommunication/ICT markets, Geneva, 1 October 2019, available at: https://www.itu.int/oth/D071A00000F/.

[111] Submission and presentation by Research ICT Solutions at ITU workshop on the Economic impact of OTTs, Geneva, 1 October 2019, https://www.itu.int/dms_pub/itu-d/oth/07/1a/D071A0000090001PDFE.pdf and https://www.itu.int/dms_pub/itu-d/oth/07/1a/D071A0000090002PDFE.pdf.

[112] Presentation by Digicel at ITU workshop on the Economic impact of OTTs on national telecommunication/ICT markets, Geneva, 1 October 2019, available at: https://www.itu.int/oth/D071A000003/.

Figure 3A: Evolution of voice traffic in comparison with revenues, investments and mobile broadband penetration



Source: Digicel from ECTEL indicators

Revenues

In terms of revenues, there is agreement that data services are typically increasing their share in MNO revenue streams. This trend was confirmed in the case of the Zimbabwean market as well as MTN Nigeria, Airtel Nigeria and MTN Ghana[113].

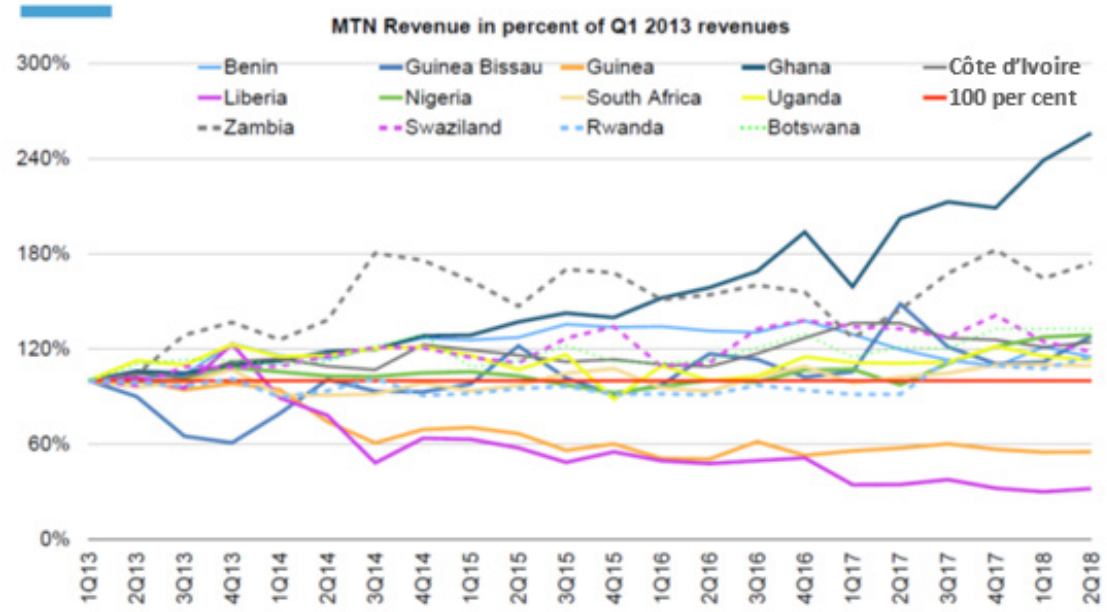
In absolute terms, some markets are reporting revenue decay (such as in the case of ECTEL countries, with telecom services revenues falling from 2014 to 2018[114], or in the figure reported by McKinsey pointing to European operators losing 25% of revenues in the period).

On the other hand, some operators are reporting revenue increases (such as MTN in 13 out of 15 African operations).

[113] Submission and presentation by Research ICT Solutions at ITU workshop on the Economic impact of OTTs, Geneva, 1 October 2019, https://www.itu.int/dms_pub/itu-d/oth/07/1a/D071A00000090001PDFE.pdf and https://www.itu.int/dms_pub/itu-d/oth/07/1a/D071A00000090002PDFE.pdf.

[114] Presentation by Digicel at ITU workshop on the Economic impact of OTTs on national telecommunication/ICT markets, Geneva, 1 October 2019, available at: https://www.itu.int/oth/D071A000003/.

Figure 4A: MTN's revenues evolution by country



Source: Research ICT Solutions

Therefore, it is expected that operators' revenues and profitability associated with Internet traffic are to some extent subject to the operator's ability to seize revenue opportunities and mitigate risks. Some workshop participants indicated that OTTs do contribute to MNOs' revenues and investment indirectly by boosting demand. However, it may be the case that increasing costs associated with Internet traffic can be recovered by subscribers' contributions, requiring other revenue streams and further evolution of operator business models (such as co-investment programs between OTTs and network operators).

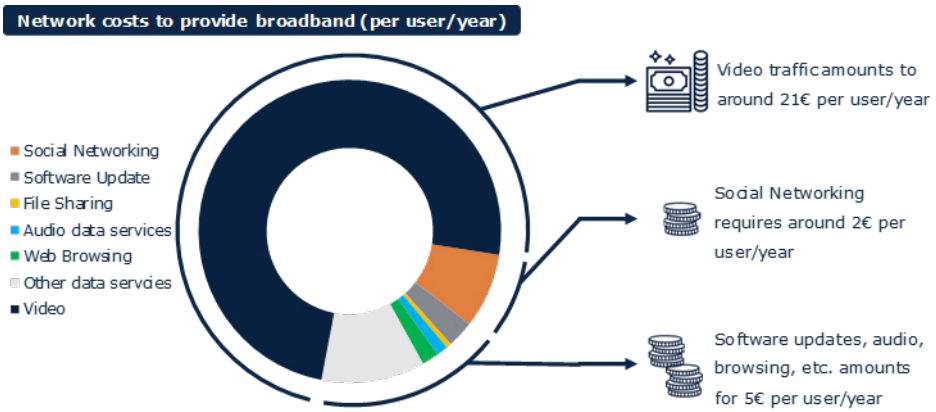
Costs

There is little public information available on the impact of OTT Internet traffic on mobile network operators' costs. It is safe to affirm that OTT data traffic accounts for a share of the network costs, although the actual level and relevance for operators' financials will significantly depend on the specificities of each operator (such as coverage levels, country's geographic and topographic characteristics, demand density, etc.).

A recent assessment from Axon Partners Group indicates that the cost for a hypothetical generic operator in Europe can amount to tens of Euros per year and per subscriber[115], on top of costs associated with the provision of traditional services. In absolute terms, this means that MNOs are expected to spend hundreds of millions of Euros per year to handle Internet traffic in addition to the costs required to provide traditional services, which is generally in line with historical trends for capital expenditures.

[115] Estimation by Axon Partners Group (see https://www.itu.int/oth/D071A000001/) based on the model developed for the European Commission and published on its webpage: https://ec.europa.eu/digital-single-market/en/news/finalisation-mobile-cost-model-roaming-and-delegated-act-single-eu-wide-mobile-voice-call.

Figure 5A: Estimation of costs associated to mobile broadband traffic



Source: Axon Partners Group based on European Commission's public model and Ericsson's report

Moreover, as indicated above, data services are growing their share in operators' revenue streams and, therefore, they should expect to recover a bigger share of fixed and common costs than were recovered by traditional services in the past.

How are OTTs impacting MNO demand, revenue and cost?

Demand: *While OTT use is driving increased broadband subscription, some African countries report voice traffic as stable or increasing.*

Conclusion: *increased network traffic arises from several drivers, not exclusively from OTTs.*

Revenues: *Yes, data services are increasingly important in MNO revenue streams but can business opportunity and risk mitigation boost profitability? How far do OTTs contribute to MNO revenue indirectly by boosting demand? Are changes in business model the way forward – for example OTTs and network operators co-investing?*

Costs: *Data traffic accounts for significant network cost. For example in Europe, MNOs spend hundreds of millions of Euros annually on top of costs of traditional services.*

OTT infrastructure investment

It has been recognized that a complementary relationship exists between OTT services and network services. While telecommunications service providers highlight the need to increase investments in infrastructure, some or a large portion of this need is generated by the data demand spurred by consumer's use of OTT applications and services.

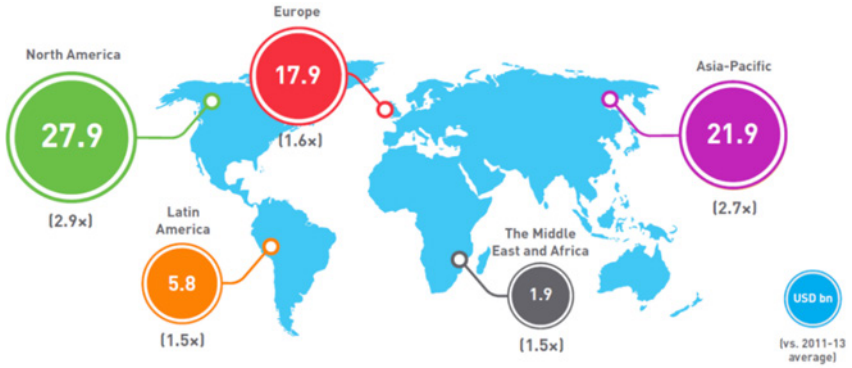
Traditional telecommunications network providers have expressed concerns about revenue streams shifting away from voice traffic subscriptions and towards mobile broadband subscriptions and the investments that they have made in the ICT sector. As noted, the roll out of telecommunications infrastructure has generally resided with telecommunications

providers, resulting in significant network investments by such providers. However, the nature of infrastructure demand and deployment is shifting.

While most sub-scale OTTs rely on MNO infrastructure for last-mile delivery to customers, hyperscale OTT service providers such as Facebook and Google are increasingly investing in infrastructure and connectivity projects around the world. During the workshop, many operators, such as Digicel and the SAMENA Telecommunications Council, acknowledged the ASP infrastructure investments while calling for consideration of additional partnership and financing methods to spur OTT investment into extending network connectivity.

Given the high data use of their customers, OTT providers have a growing vested interest in supporting the availability of high-speed broadband for users around the world. As such, they are increasingly investing in network infrastructure. According to Analysys Mason, from 2014-2017, OTTs invested over USD 23 billion in Internet infrastructure for transit and delivery, including terrestrial fibre networks, international submarine cables, and delivery networks. Analysys Mason indicates that the average annual OTT investment has increased from USD 33.2 billion per year (2011-2013) to USD 75.5 billion throughout 2014-2017. Investment is increasing all over the world, although at different rates. As illustrated below, from 2014-2017 average annual total investment in North America increased by 190% whereas in the Middle East and Africa, it increased by 150%.

Figure 6A: Average annual total investment by region (USD billion, 2014-2017)



Source: Analysys Mason

Additionally, numerous collaborative initiatives exist between operators and Internet companies aimed at co-investment in network infrastructure. For example, Telxius deployed a submarine cable between the US and the EU ('Marea') in collaboration with Microsoft, Facebook and, later, Amazon. Telefónica Perú launched the initiative *Internet para Todos* (Internet for Everyone) in collaboration with Facebook, Corporación Andina de Fomento (CAF) and International Development Bank (IDB) to bring Internet connectivity to several rural areas. Despite significant gains in connectivity, there is a continuing need for increased and improved broadband network infrastructure. Telecommunications service providers are challenged in increasing their investments given their shifting revenue streams impacted by lower voice traffic revenue and coming instead primarily from data services demand. OTTs feel direct pressure to increase network infrastructure too, since the more affordable and better broadband access is, the easier it is for people to use their services.

*As mobile broadband subscriptions increase, telecommunications providers face the need for increased infrastructure investment. So – **how to boost OTT investment?***

MNO and OTT relationships

The effect of OTTs on network operator profits is a matter of some debate. Operator revenues depend on a wide variety of factors including economic factors and regulatory environment, but critically also on an operator's ability to seize revenue opportunities and mitigate risk. Operators may benefit from increased use of OTTs and roll out faster broadband networks to grow data revenues or, conversely, maintain the analogue voice minute and SMS business model for as long as they can. While this is ultimately a business decision, trends suggest that the former course of action is best suited for long-term viability.

Simply put, OTTs and network operators need each other to thrive in the contemporary communications marketplace. OTTs provide the content that drives demand for telecoms operator services. Telecoms operators provide the connectivity and coverage that enable access to OTTs. It is not a 'zero sum game' but rather a symbiotic relationship: without each other, users would be left looking at blank screens.

There is a virtuous circle of content and access – more content brings more people online, which drives revenue for access providers, which further increases available and relevant content. OTT applications increase revenues for operators' core access services by driving demand for data services. Users also see value in faster connectivity. For example, 69% of users would upgrade their service if they thought it would make YouTube work better[116]. Research in African markets[117] suggests that a strategy of lower unit costs – providing prepaid products that resemble flat rate services – is the best way to maintain operator revenues.

As mentioned above, some operators have said that consumer demand for OTTs is responsible for decreasing volumes of international voice calling and a subsequent thinning of their high operating margins.

Much contemporary research does not support claims that operators are either losing voice traffic money because of OTTs. For example, voice traffic has grown every year on Airtel's African network since 2012. In many markets the lack of mobile broadband coverage and low smartphone penetration are the primary reasons why many MNOs in Africa still see increasing voice and SMS traffic[118].

As a further example, since 2013, revenues have increased in 11 of the 13 African markets in which MTN operates. The two exceptions to this general picture, MTN Liberia and MTN Guinea, can be explained by the impact of external macroeconomic shocks, not to OTT popularity. MTN's revenue developments demonstrate two important points: one, the general revenue

---

116 ICM Research, "Broadband Consumption Study, France and Germany", 2013.

117 Christoph Stork, Steve Esselaar, Chenai Chair and Safia Kahn - "OTTs - Threat or opportunity for African Telcos?", March 2016.

118 Presentation by Research ICT Solutions at ITU workshop on the Economic impact of OTTs on national telecommunication/ICT markets, Geneva, 1 October 2019, available at: https://www.itu.int/dms_pub/itu-d/oth/07/1a/D071A0000090001PDFE.pdf and https://www.itu.int/dms_pub/itu-d/oth/07/1a/D071A0000090002PDFE.pdf.

trends are positive despite growing numbers of OTT users and OTT traffic; and two, revenues and profitability are mainly the results of an operator's ability to seize revenue opportunities and mitigate risk.

The French telecoms consultancy IDATE conducted research on the revenue relationships between OTTs and telecoms operators for Europe[119] and Africa[120].

They found:

- Decreases in SMS revenues have been balanced by overall increases in revenue from data tariffs – driven by consumer demand for services such as VOIP and instant messaging.
- The biggest challenges for operators have come from regulation and internal competition in the telecom industry.
- The fastest shifts from SMS to alternate messaging platforms occurred in countries with the highest rates for SMS. Where SMS unit costs were lower, SMS volumes remain high.

While the indirect effect of OTTs on operators' revenues is a matter of debate, it is widely accepted that direct commercial partnerships between operators and providers of OTTs have vast potential for both sectors.

Such partnerships may include:

- Value-added services bundling – including OTT music or video streaming services in operator packages – can generate new revenues, as well as increase data usage.
- Rich communications services (RCS) – the next generation of SMS, enabling B2B2C revenues from businesses interacting with consumers through carrier channels.
- Carrier billing – enabling operators to use their strengths in customer and billing relationships to provide billing capabilities for CAPs app stores and content.

Analysys Mason estimates that if OTTs and telecoms operators partnered more closely together, it could increase telco operational free cash flow by almost 50% – or more than EUR 15 billion – in Europe, the Middle East and Africa[121]. The World Bank's Digital Development Partnership has encouraged regulators to "favour operators' initiatives to bundle or develop partnerships with OTT service operators. This could be done with a changed regulatory framework temporarily applied to new initiatives and development"[122]. Digital Service Taxes (DST) have been proposed in a number of jurisdictions and some MNOs, like Digicel, support the idea that earmarking a percentage of any new DST for an infrastructure fund could be considered. Individual countries might also come up with their own models to balance ICT infrastructure investment from various sources; such example is Vanuatu's Universal Service Fund "Pay or Play" model under which the Regulator can agree rollout commitments and forego levy payments.[123]

---

119 IDATE, "The impact of VoIP and instant messaging on traditional communication services in Europe", September 2015.
120 IDATE, "Impact of online communication services on the telecommunications market in Africa", July 2017.
121 Analysys Mason, "Digital Transformation through Partnerships", April 2017.
122 Digital Development Partnership, *ECOWAS ICT African Regulatory Watch Initiative on Licensing Regimes, OTTs, and International Gateway Liberalization*. March 2019.
123 Presentation by Digicel at ITU workshop on the Economic impact of OTTs on national telecommunication/ICT markets, Geneva, 1 October 2019, available at: https://www.itu.int/oth/D071A000003/.

The huge promise of partnership

OTTs and network operators need each other: content drives up demand and revenue. So direct commercial partnerships between operators and OTTs have vast potential: research suggests such partnering could increase telco free cash-flow by a massive 50%.

Measuring social impact of OTT platforms

OTTs offer essential economic and social features beyond traditional communications services, helping an entire ecosystem to take root and expand in the new digital economy. OTT opens up an alternative for reducing unemployment. For example, Côte d'Ivoire observes an increase in sales of products from Togo, Morocco, Turkey, –United Arab Emirates and China using OTT, thus creating a new trade axis. Barriers to social and business development raised by expensive legacy communications prices have been broken by using data.

Looking at how OTTs are used by populations, communities and businesses, there is clear evidence that they have social and economic impact on those who use them. OTTs have become marketplaces for the 'gig economy', helping young entrepreneurs leverage the power of the platform to create new P2P (peer-to-peer) retail businesses, reducing time-to-market or the need for a physical store. OTTs are used widely for socially relevant activities such as petitions, status and ratings. Craftsmen or merchants (sometimes with low literacy rates) can use OTTs to showcase their skills, and to advertise goods and services.

At the same time, this success creates new challenges – such as increased competition between informal vendors on OTT and physical retailers, or modernizing tax codes to account for the new digital economy.

It is difficult to measure this impact and the findings of the impact assessment would depend on the set of criteria chosen. Some analysts are calling for a set of universal key performance indicators (KPIs) that could measure the socio-economic impact of OTTs.

While the high cost of Internet data remains a major part of the connectivity challenge, there is a trend in countries in East and Southern Africa to introduce additional taxes to raise revenue, including content license fees and excise taxes. Such policies make data yet more expensive, putting Internet access further out of reach for many[124].

On another front, experience shows that policy and regulatory decisions are not neutral in their impact on populations. Recent research by the Web Foundation[125] highlighted how fiscal instruments have impacted Internet users in a number of countries (also confirmed in the research of Cenerva[126] on countries including Tanzania, Uganda, Benin, Colombia, and Zambia where new forms of taxation on the use of OTTs have been implemented or proposed). The

[124] Sarpong, 2018: http://webfoundation.org/docs/2018/08/Advancing-Womens-Rights-Online_Gaps-and-Opportunities-in-Policy-and-Research.pdf. See also: https://a4ai.org/why-is-africa-taxing-online-services.

[125] Presentation by Web Foundation at ITU workshop on the Economic impact of OTTs on national telecommunication/ICT markets, Geneva, 1 October 2019, available at: https://www.itu.int/dms_pub/itu-d/oth/07/1a/D071A0000100001PDFE.pdf.

[126] Presentation by Cenerva at ITU workshop on the Economic impact of OTTs on national telecommunication/ICT markets, Geneva, 1 October 2019, available at: https://www.itu.int/oth/D071A000007/.

Web Foundation was particularly interested in the impact of these taxes on women. Women are less likely to access and use the Internet[127], and yet there is little research looking at how they are affected by ICT-related tax policy. Such research is important to help inform fiscal and universal access policies.

The Web Foundation carried out research on the impacts of social media taxation in Africa (featuring expert interviews and focus groups conducted in Tanzania, Uganda and Zambia). Based on the experience of the participants surveyed for the study[128] and existing research on the impact of consumer-focused Internet taxes, governments in East and Southern Africa, and elsewhere, are encouraged to consider four significant things in evaluating their ICT fiscal policies:

- First, tax policy related to Internet access (and fiscal policy in general) is not gender neutral. Governments should therefore pay particular attention to how taxes impact women and other groups who use the Internet less frequently than others. It is therefore imperative that taxation policies are gender-responsive – meaning they actively consider gender issues and the gender gap in Internet access – from conception to implementation and monitoring.
- Second, fiscal policies that tax use of social media and other related Internet-based services distort people's use of the Internet. Governments should reassess the introduction of taxes, including conducting sensitivity and gender-responsive analysis of tax measures, considering potential harms to citizens and businesses, and re-evaluating their revenue and behavioural targets. Failing to consider potential harms of taxes on citizens and businesses may ultimately lead to large social costs.
- Third, social media taxes appear to contribute to the shrinking of civil society space. Governments must recognize that effective policy development, and the functioning of society in general, depends on a strong and active civil society, including women's rights groups. For many of these organizations, social media and the Internet are crucial tools for organizing and operating and such taxes undermine their work.

Finally, tax policies, when poorly designed, can have an adverse effect on the objective of revenue generation; harming taxpayers and failing to achieve revenue targets. Governments should undertake proper and representative stakeholder consultations, seeking input from varied stakeholder groups before rolling out such fiscal measures. The lack of awareness and confusing communication on such taxes and their rationale have eroded trust. Governments should also pursue evidenced-based principles in the imposition of taxes and must evaluate all revenue measures against a number of criteria – neutrality, efficiency, certainty, simplicity, effectiveness, fairness, flexibility, and equity.

OTT platforms: what impact?

OTT success brings new challenges – like 'click versus brick' in retail or the need to modernize tax codes. Perhaps we should exercise caution: some countries introduced taxes with unintended consequences – hampering connectivity in general and penalizing women in particular.

[127] Sambuli et al., 2018: http://webfoundation.org/docs/2018/08/Advancing-Womens-Rights-Online_Gaps-and-Opportunities-in-Policy-and-Research.pdf.

[128] Report available at https://webfoundation.org/research/who-wins-who-loses-understanding-womens-experiences-of-social-media-taxation-in-east-and-southern-africa/.

Role of regulation

Regulatory considerations

How, and if, regulatory frameworks and processes should respond to the emergence of OTTs and the digital transformation of network communications is the subject of debate among regulators and policy makers.

For many years, telecommunication regulatory frameworks were built around telecommunications operators that owned and controlled underlying network infrastructure, were guarded by high barriers to market entry, and were granted use of scarce public resources such as radio spectrum. Accordingly, telecommunications regulation was intended to prevent consumer harm stemming from these unique market conditions.

However, with the transformation of networking technology, the emergence of OTTs, and the interaction between the telecommunication network operators and many other different markets where OTTs operate, regulators have started to consider how appropriate and applicable such regulations are in the modern communications landscape. Regulators have observed the need to recognize that OTTs and telecoms networks operators are very different types of business. Accordingly, new regulatory paradigms may require a clear acknowledgement and understanding of the fully transformed value chain in the telecoms sector, and hence the need to rethink telecoms regulation in the new world of the IP-based Internet value chain. OTTs are just one aspect of this much-needed rethinking, not the cause itself. Some have suggested that a 'fresh look' at regulation of services, regardless of the medium, may be the answer.

It is vital that regulators consider both the benefits that OTTs have brought to consumers, societies, and economies at large, in addition to the challenges they bring. OTTs have facilitated positive transformation by bringing connectivity and new content that has transformed lives around the planet for the people who have access. In many markets, people cannot imagine life without their favourite OTTs. They depend upon OTTs to search for information, shop, plan holidays, commute, keep in touch with friends, stream music and video, and improve career prospects. Although some incumbent network operators may at times bristle against the reshaping communications market, the reality is that consumers and citizens enjoy the positive externalities of this new value chain. Simply put, at the time of writing, the good that OTTs have delivered seems to outweigh the valid concerns they actually raise. Even in scenarios where certain OTT platforms have established a dominant market position, there is still an open debate about whether there is tangible evidence of consumer harm as a result.

However, regulators must also consider the many new responsibilities that arise with the emergence of OTTs in the context of the entire communication ecosystem. Depending on the market or the OTT in question, these challenges may include negative externalities such as increased competition in some markets or increased barriers to entry in others, cybercrime and fraud, harmful content, fake news, potential for data breaches, or the loss/lack of control by regulators of players in their markets. Regulators must adapt their regimes to address new challenges to security, consumer protection, and taxation.

Regulators have been tuning their perspective to the new market realities and have identified some of the key challenges in adapting regulations to accommodate the growth of OTTs. However, many regulators are lacking an adequate understanding of how OTT applications operate. This results in an information asymmetry that is not easily overcome, given the

magnitude, scale, and diversity of OTTs. This is a particularly challenging issue in developing countries.

In addition, there is a challenge of speed. Innovation spurred by competition in the OTT sector moves at an order of magnitude faster than regulation. Regulation is a lengthy process, as regulators need to evaluate information and assess complex trade-offs and their net impact on consumers' welfare. These long-term decision processes did not pose great challenges in the era of traditional telecom regulation; however, they do today in the digital ecosystem. A further challenge is the fact that some of the most popular OTTs operate internationally, and regulatory bodies have national jurisdiction. Complying with cultural and regulatory standards of speech and content is a particularly acute challenge for many OTTs, as they vary wildly between jurisdictions.

On top of those challenges, regulators must also keep in mind that OTTs are a vast and diverse collection of businesses. A search engine is not the same as an app-store, a subscription movie service is not the same as a social network. In a world where a substantial proportion of all business is transacted over the Internet, it would be absurd for the nature of regulation to be determined by a one-size-fits-all approach. An additional source of complexity lies in the functional differentiation of many different roles playing simultaneously within the network infrastructure, and enormous geographical variation, between and within countries and regions – that could affect incentives towards all dimensions of competition, innovation and choice. For example, this is reflected in the distribution of different ARPUs across countries, because of geography, urban features, legacy infrastructures and disposable incomes.

Hence, when discussing the relevant regulatory framework, it is essential to understand that an OTT is not merely a player in a network of simple value chain relations that regulation of access terms and conditions can address. On the contrary, the entire set of interrelations shaping the ecosystem has to be taken into consideration to assess the possible intended and unintended consequences of regulation.

Let's see past the challenges and keep the benefits

Regulators need to see the benefits that OTTs deliver while adapting regimes to address new challenges. And while OTT innovation can be rapid, regulation sometimes struggles not only to keep pace but to address large-scale OTT operations outside of the regulator's national mandate. In addition, a one-size-fits-all approach to regulating OTTs will not work. When new service delivery models disrupt the old, regulation should be informed by evidence rather than fear of the unknown. Is light-touch, flexible regulation the answer?

Possible objectives for regulatory action

Workshop presentations addressed the issue of what should be included in the key regulatory objectives for ICT markets and for OTTs. As in other industries, these should aim to achieve sufficient levels of competition, consumer choice, innovation and investment. The different roles played by OTTs within the communications ecosystem imply that their actions and decisions can affect each of these key objectives. Hence, there was a view that the role and impact of

OTTs should be considered holistically from a regulatory perspective, and not from a narrow market segmented perspective.

When considering regulation at all, regulators are encouraged to consider the aim of regulation in general. These are twofold: 1) to seek to achieve those desirable and justified objectives for consumers and citizens that do not arise naturally from the market; and 2) regulate where there is 'market failure' and where the result brings net benefits.

Implicit in these objectives is that regulation could be enacted when a problematic behaviour or a proof of harm is found, not as a general blanket rule. In fact, regulators shouldn't over-regulate new markets "just in case". Regulation should be based on evidence. For example, there are clear calls from many stakeholder groups to 'control' or regulate OTTs, yet typically some proponents neither point to any market failure nor to any evidence of consumers and citizens being unhappy with their OTT services. A claim like MNOs lose revenues – whether accurate or not – would not count as a good reason to regulate against significant consumer and citizen benefits of OTT services when tested against the above key purposes of regulation. The lesson from history is that abstract or ideologically motivated approaches are rarely a good basis for policy.

New disruptive models of service delivery should not be regulated merely because they threaten an existing model, since such innovation and competition serve consumer interest. Regulators must also be cautious about the impact of their actions on innovation and competition. While important public policy considerations need to be addressed, regulation of OTTs driven solely by the motivation of 'levelling the playing field' between traditional and digital modes of service delivery would be detrimental to consumer interests. As noted previously, recently implemented taxes on OTTs, social media applications, VoIP phone calls, and data services without conducting sufficient impact assessments have led to decreases in Internet access, social unrest, and economic disruption rather than achieving policy objectives or recouping telecom revenues.

There is an increasingly relevant debate on platform regulation. This includes contributions such as the Furman Review[129], which proposed the creation of a new 'Digital Markets Unit' in the UK to consider competition issues raised by powerful online platforms, and a proposal from the UK Government that online platforms should have a new duty of care, in order to protect users from harmful content. This proposal, however, has not yet been implemented in UK legislation. Some experts also urged regulators to consider OTTs in the context of a long history of regulation punctuated by cases of regulatory failures. This risk is particularly relevant now, since all OTTs are different, and it is important that regulation should be informed by actual evidence rather than fear of the unknown.

Looking ahead

The Chair of BEREC shared his view that the most appropriate form of regulation to address these complex issues remains unclear. In Europe, EU Access regulation keeps access networks open, mandating companies owning the physical infrastructures with significant market power (SMP) to allow other retail service providers (RSP) to access the network elements required

[129] "Unlocking digital competition, Report of the Digital Competition Expert Panel", ISBN 978-1-912809-44-8, PU2242: https://www.gov.uk/government/publications/unlocking-digital-competition-report-of-the-digital-competition-expert-panel.

to reach end users. This is essential to allow RSPs to provide bundling like television and telecommunications services. Similarly, relevant, is the EU net neutrality regulation[130]. The new European Electronic Communications Code marginally addresses the role of OTTs, mainly focusing on user protection provisions regulations that will apply to all the elements of bundling, including OTTs and not simply to telecommunication services. As mentioned above, further critical contributions towards regulatory approaches can be found in the Furman Review, commissioned by the UK Government, which proposes the creation of a new 'Digital Markets Unit' to assess competition issues raised by powerful online platforms.

There are several different facets and features of new regulatory frameworks. Many regulators believe that the best route forward is for a light-touch, flexible approach to regulation. Such an approach is based more on principles – including consumer protection, investment promotion, and competition – than on codified rules that require strict adherence. Interestingly, some have argued that if governments were to design new models of regulation that are light-touch, flexible, and recognize the scale and quantity of market impact of an OTT player, they may encourage more OTT players to conform to regulation. For regulation to be effective, however, it is crucial to include an ethical dimension and to assess the main barriers and limits to its implementation. Others have highlighted the value of OTT companies voluntarily self-regulation and collaborating with governments to prevent online harm. Such an example is WhatsApp's collaboration with the Indian Government to combat fake news and misinformation[131]. Observers have noted such programs can actually reduce the tendency to over-regulate online services in response to real or perceived harm.

Many have pointed to the need for improved international cooperation. Some suggest that multi-country agreements on handling of data may be helpful, while others point out that an improved degree of standardization and harmonization of data protection regimes could help governments and reduce the compliance burden on OTTs as well. Others have identified the need for regulatory capacity building for developing countries.

Conclusions

Discussions resulting from the 1 October 2019 workshop organized jointly by the Rapporteur Groups for Questions 3/1 and 4/1 of ITU-D Study Group 1, as well as the analysis of the information provided on the issue of the economic impact of OTTs on national telecommunications/ICT markets, highlighted the need to be able to draw up guidelines for the various stakeholders.

Also, the reflection deserves to be continued within the framework of the final reports on the studies of Question 3/1 and Question 4/1 to provide a deliverable as for the requested guidelines.

But already, some relevant lessons can be learned:

Regulators and decision-makers

- Regulators are invited to develop their digital skills, in order to better understand and assess the development of the telecommunications/ICT market in the context of OTTs.

[130] https://berec.europa.eu/eng/netneutrality/.
[131] https://www.gadgetsnow.com/tech-news/whatsapp-vs-govt-of-india-all-you-need-to-know/articleshow/65541717.cms.

- Regulators are invited to consider the evolution of the Internet value chain and assess the telecommunications/ICT market as a whole in order to consider relevant measures in line with market realities.
- OTT regulations should be based upon actual evidence of harm from OTTs. It should also be based on a quantitative analysis of the socio-economic effects such regulation.
- Governments should assess in advance the potentially negative effects of taxes on OTTs for vulnerable communities, businesses and citizens in order to avoid a high social costs.
- Governments are encouraged to engage in real dialogue with and consult with different stakeholder groups before adopting new policies and regulations.

Telecommunication operators and OTT providers

- Telecommunication operators are encouraged to adopt data-driven business models and to rebalance their rate grids in order to reduce their dependence on telephone and SMS services.
- OTT providers and telecom operators need each other, so these two stakeholders should explore different models of partnerships and agreements including investments in network infrastructure and provide insight into these partnership agreements to regulators.

Annex 2: Country case studies relating to cloud computing

Background of cloud-service development on the part of telecommunication operators in China

As the three major telecommunication operators in China, China Mobile, China Unicom and China Telecom have advantages in terms of network and data that other cloud-computing service providers have difficulties to surpass. In recent years, telecommunication operators have taken cloud services as the basis for their own business development and digital transformation and have strengthened their overall strategy in the cloud-computing market. With the continuous improvement of cloud service capabilities, their market shares have also increased significantly.

Major initiatives launched by telecommunication operators for cloud services

Proactively promote the "cloud transformation" plan to improve cloud computing service capabilities

With a rich network resource base, telecommunication operators can give full play to their advantages of cloud network convergence and cloud network integration to build an information infrastructure of cloud network convergence. In recent years, all major operators have put forward their own cloud-computing development plans. For example, aiming at building a new generation of cloud network operation system and promoting enterprise digital transformation, they have set up leading cloud computing operation systems and management systems in line with the deep integration of clouds, networks, terminals and systems, thus further deepening the transformation from communication network operators to integrated information and communication service providers.

Strengthen the construction of IDC (Internet data centre) resources and enhance the supply capacity of the infrastructure

Major telecommunication operators are actively promoting the construction of a large number of key data centres, such as big databases, innovation incubation bases and R&D centres, and providing infrastructure support for the application and innovation of key sectors, such as industrial Internet, smart cities and supercomputing centres by relying on the strong network and localized operation service advantages of operators.

Promote the integrated development of various technologies and enhance capacity for business innovation

The new generation of information technology is developing in the direction of deep convergence, as are the cloud-computing strategies of the three major operators, namely deep integration or convergence of technologies such as 5G, AI, big data, edge computing and blockchain. Among them, the combination of '5G + Cloud + AI' is the most representative: the three are closely integrated with each other, becoming hugely powerful.

Actively expand services at the PaaS and SaaS layers and enhance cloud-computing application capabilities

While continuously developing basic services such as IaaS (infrastructure as a service) layer cloud computing, cloud storage and cloud network, the three major operators are also gradually enhancing their business strategic arrangements at the PaaS (platform as a service) layer and the SaaS (software as a service) layer in accordance with their own digital transformation requirements and related needs of the government as well as sectors such as finance, energy and industry. Regarding the PaaS layer, the support for middleware such as database and AI has been enhanced, and the capabilities in cloud computing, IoT, big data, blockchain and security have been comprehensively solidified. A number of common basic application support platforms have been developed and applied, including multi-source data processing platform, integrated deployment and operation and maintenance platform, multi-tenant management platform and public geographic information platform. With this, the difficulty of application development and delivery cycle can be reduced effectively, and the government and business customers can adapt to the requirements of the industry by acquiring one-stop smart support for customers, which fully empowers the government and enterprise customers. At the SaaS layer, the advantages of network and business resources are leveraged to provide differentiated and competitive SaaS application services on the basis of a unified PaaS platform, and gradually extend to sectors including government service, medical care and education with standardized SaaS products to expand their market shares rapidly.

Combat the impact of the COVID-19 pandemic

Since the beginning of 2020, the COVID-19 pandemic has been spreading across the world, severely affecting many traditional sectors. However, it has also provided a rare opportunity for the cloud-computing industry. Many enterprises and individuals have started to learn about and use cloud services because of the pandemic. Telecommunication operators in China have seized the opportunity and accelerated the expansion of related businesses, and developed a series of cloud services and applications such as cloud supervision at the Raytheon Mountain and Huoshenshan Hospitals, global live broadcast of cloud climbing (reaching summit of Mount Everest), cloud medical care, cloud classroom and cloud office, turning the impact of the pandemic into opportunities.

Summary and suggestions

This case study outlie mainly introduces the general situation of cloud-computing development on the part of telecommunication operators in China. Concerning the evolution of cloud-computing technology, operators rely on their own network resources to promote 'cloud network convergence' and 'cloud network integration'. At the same time, cloud computing is deeply integrated with 5G, AI, big data, edge computing, blockchain and other technologies, and new cloud service models such as '5G + cloud + AI' have been launched. In terms of cloud-computing business, operators have gradually shifted from only providing IaaS services, such as computing, storage and network, to the comprehensive development of IaaS, PaaS and SaaS services.

Cloud-computing regulation in Saudi Arabia, by Axon Partners Group

Cloud computing is often regulated through a mix of non-cloud-specific provisions (e.g. on data protection, consumer protection, law of contract, information security, intellectual property). Even if some of these provisions exist in the country, stakeholders have voiced concerns in recent years over legal uncertainty on the regulatory status of cloud computing, a potential need for some form of regulatory oversight through registration or licences, applicable information-security and data-protection rules, and the rights and obligations of each party.

The Communications and Information Technology Commission (CITC) – the ICT regulator of Saudi Arabia – has addressed these gaps through the adoption of a *Cloud Computing Regulatory Framework* (CCRF), which aims at the following objectives:

- Providing regulatory clarity and certainty on the rights and obligations of the providers and users of cloud computing services.
- Establishing a clear regulatory basis to manage potential security risks connected with the use of cloud services.
- Encouraging the improved quality of cloud services.
- Encouraging investment in a local cloud industry.

The CCRF provides a definition of, among other terms, cloud-computing services, and covers aspects such as the scope of the regulation, registration requirements, information security, protection of customer data, unlawful and infringing content, information on cloud-computing contracts and minimum content, customer protection and unfair contract terms, quality, and industry standards.

China case study

In recent years, China's cloud-computing industry development, industry promotion, market supervision and other important links of the macro-policy environment have become increasingly successful. The State has put forward relevant policies to promote the development of industry. At the same time, with the active promotion of 'Internet plus' action, application of cloud computing in China is accelerating and expanding its penetration from the Internet industry to traditional industries such as government affairs, finance, industry and livelihood services.

In the process of the development of cloud computing, China attaches great importance to the establishment of a cloud-computing standard system. Relevant national authorities shall take the lead in formulating the cloud-computing standard system. On 9 November 2015, the Ministry of Industry and Information Technology (MIIT) officially issued the guidelines for the construction of a comprehensive standardization system for cloud computing. The guidelines are based on the technology and products in the cloud-computing ecosystem, services and applications, such as the key link, and cloud security throughout the entire ecosystem, combined with cloud-computing development trends both at home and abroad, and a comprehensive standardized system for the cloud-computing framework, including the 'cloud', 'cloud resources, 'cloud services' and 'cloud security'. At the same time, 29 key development directions for cloud-computing standards were published to promote standardized development of the domestic cloud computing industry.

The cloud security standard is an important component of this system, which is used to guide the implementation of network security, system security, service security and information security in the cloud-computing environment. It mainly includes the standards for security management,

service security, security technology and product, security foundation and other aspects in the cloud-computing environment. The country has issued relevant national standards and industry standards to promote the development of this work.

On the basis of the development of cloud-computing infrastructure, the country also attaches great importance to the promotion and application of cloud-based big-data policy. The strategic development of big data is one of the top priorities in China's 13th five-year plan. It is indicated in the Outline of the 13th five-year plan that China will implement a comprehensive national strategy for the development of big data as an essential strategic resource to expedite the opening up and sharing of big-data resources and applications development with the aim of pushing ahead industrial transformation and upgrade, and innovation in social governance.

Based on the requirements of the 13th five-year plan, in order to further encourage the development of big-data technology and application, the Chinese Government has issued a '*Programme of action for big-data development*', a '*Plan for the development of big-data industry*', '*Pilot projects*' and other relevant policy documents to encourage and promote the development of big data. The release of these big-data industrial policies has played an important role in promoting the development of cloud-computing applications in China.

Bhutan case study

Ever since the formulation of the country's first IT policy in 2004, Bhutan has made major strides in terms of ICT advancement and development. Despite late introduction of IT in comparison to its neighbouring countries, Bhutan has achieved great feats, from digitalizing every form of government service/information to providing Internet/cellular connectivity across different parts of the country.

The Government Data Centre (GDC) is an unprecedented effort of the Royal Government of Bhutan to centralize to a private cloud all government systems, e-services and m-services that were previously hosted within agency premises. GDC is housed in the Thimphu Tech Park, and was brought into operation in March 2017. Primarily, GDC provides hosting services to business-critical applications of the government agencies in a secured environment with state-of-the-art facilities to provide a more reliable source of information for the whole of government. The infrastructure design and implementation works, including network, server and storage facilities, were developed in compliance with TIER 2 international standards, providing a service availability of 99.741 per cent.

The following are some of the key areas where the private cloud has had an impact:

- **Improved security:** A strict policy of testing services before putting them into a production environment has allowed GDC to scrutinize systems for any bugs and security loopholes. Moreover, during the tests and assessment the VPS/nodes are placed in the DMZ to rule out any compromises.
- **Increased accessibility**: As GDC is connected to the high-speed fibre-optic government-owned private network (known as GovNet), which connects almost all the government agencies across the country, it has boosted the proliferation of services.
- **Increase in availability of services** (99.741 per cent uptime): The data centre (GDC) has also implemented offsite backup services and ancillary facility redundancy to scale up the reliability of its services. With these features in place, availability of services is ensured at 99.741 per cent uptime.

- **Optimized government resources:** With GDC being the central platform for hosting government systems, the Department of IT and Telecom is now able to optimize resources by identifying and merging or reusing redundant systems with similar requirements.

Islamic Republic of Iran case study

New concepts and technology in the field of IT have created many opportunities for economic growth. Computer games is one area in which investment can have an effective economic impact. In this regard, computer games have been developed on the basis of new technology – such as the cloud – in recent years. Implementing computer games in the cloud environment or games as a service (GaaS) allows players to get service from remote servers directly to their local devices.

In the Islamic Republic of Iran, the Iran Computer and Video Games Foundation was established to lead the development process of computer game production by considering new technological capabilities (e.g. the cloud). In this regard, planning and supporting activities in different fields in the video and computer industry is a top priority for the country – as is identifying and trying elites in these fields.

The main objective of the Foundation is to plan for and support the cultural, artistic, technical and business activities in the Iranian game industry. The Foundation's activities include policy-making to support the development and distribution of computer games with the help of the private sector; supporting and monitoring expansion in the production and distribution of various types of computer and video games; and macro-planning of the gaming industry with regard to the social and educational aspects of games.

Nigeria case study

Oil and gas sites require robust communication platforms with round-the-clock support – from supporting remote staff and crew welfare, to enabling complex interoperability between technologies capable of real-time, data-rich streaming that are critical to running and monitoring operations. The operating companies are looking for digital solutions that enable them to do everything through a seamless workflow. They are also looking to be able to utilize real-time data on factors like rock formations, pressure and temperature monitoring, and leak detection, in order to create a safer and more efficient work environment.

Cloud computing can best support this portfolio of smart services, provided access to secure, reliable and resilient communication services is guaranteed. The oil and gas industry needs robust and dedicated/secure connectivity to the cloud across the entire chain of processes of exploration, production and distribution of natural resources. As the main connectivity providers for offshore rigs, satellite communication companies such as SES are now building a cloud-optimized ecosystem for them to optimize the operation of these high-value workloads. This evolution notably provides machine learning (ML) for production equipment, which supports diagnostic analysis in the cloud for preventive maintenance and improved yields in operation. ML advances will lead to AI, which then helps to dramatically improve management of the production process based on orchestration of a large volume of deep operating data.

In Nigeria, offshore rigs are prominent in the well-endowed coastal region. Together with the exploitation of resources in the delta of the Niger River, these make Nigeria one of the few major oil-producing nations still capable of increasing its oil output as a main source of revenue and

welfare for the country. The satellite operator SES signed a partnership with Microsoft Azure in October 2020 that provides its customers with access to Microsoft's new managed service, enabling them to communicate and control their satellite capacity, process data, and scale their operations directly within Azure. The option to route over Microsoft's global network and inject value-added, cloud-based managed functionalities such as enhanced security, SD-WAN or other virtual network functions into the service chain will ultimately endow the oil and gas sector in Nigeria with a much-improved performance, speed-to-market, flexibility and scalability on which to capitalize.

Other satellite operators are offering similar services to support cloud computing globally.

Annex 3: Case studies relating to m-services

Barbados case study on the m-Money service

In November 2018, Bitt Digital Inc. became the first fintech company to participate in the Barbados regulatory sandbox. Bitt's *m-Money* service provides users with a digital wallet that enables them to send, receive and store mobile money. The funds can be transferred between users and used at various merchants across Barbados.

Since July 2019, funds can only be added to the digital wallet via cash deposits at tellers distributed across Barbados. However, once in the wallet, the funds may be transferred freely to anyone with the app and without any transaction fees. Verified users may transfer up to BDS 20 000 per month and unverified users may transfer up to BDS 500 per month. While m-Money may be used outside of Barbados, users cannot deposit or withdraw funds outside the country.

Digital financial services, notably m-Money, are particularly beneficial for Barbados. Electronic payment methods are not commonly used, because the high fees associated with credit cards and lack of infrastructure for such systems deter many local business owners from using them. These factors also inhibit the export of goods and services, because foreign users cannot easily purchase them.

By participating in the digital sandbox, Bitt was able to launch its m-Money service without having to navigate the traditional licensing path that many financial institutions normally follow. This greatly facilitated Bitt's ability to launch its service.

M-financial services case study

Mobile financial services are monetary transactions executed by use of a mobile phone. They fall into two categories, namely mobile banking (m-banking) and mobile money.

M-banking involves the use of USSD short codes to interact in real time with one's bank account to either transfer funds from one account to another or pay for services and goods.

Mobile money involves the use of a mobile network operator app to interact in real time with one's mobile (electronic) wallet.

- *M-banking*: This platform uses either an app installed on the user's phone which requires Internet to operate or USSD, where the user dials a certain short code in the format *ABC # where A, B and C are numeric values. The regulator facilitates the USSD code through the national numbering plans. Examples of services that can be executed under m-banking include account-balance inquiry, inter-bank transfer services, loan application, purchase of airtime, payment for utilities and withdrawal services.
- *Mobile money*: The mobile money platform uses a mobile network app that is normally integrated in the SIM card toolkit and does not require Internet connection. Examples in Kenya include Airtel Money, T-kash and M-PESA.[132] Various services are provided under this platform depending on the MNO, e.g. send money (to mobile wallet), buy airtime, loans and savings, pay bills and utilities.
- *Collaboration partners involved*: Various stakeholders are involved, namely: the ICT and banking sector regulator through licensing the service, which builds confidence for the

[132] Airtel Payments Bank: Airtel Money Wallet; Safaricom: M-Pesa; Telkom Kenya: T-Kash.

users, and other key players such as banks, utility companies and goods and services merchants.

Kenya case study on m-services (M-Akiba)

The M-Akiba Bond is a retail bond issued by the Government of Kenya to raise money to fund infrastructural projects from time to time.[133]

The process for opening an account under the Central Depository System is handled through a mobile phone and is immediate, unlike for a conventional account where a person has to visit the Central Bank or an appointed commercial bank, a process which takes two days.

For a person to open an account, their mobile phone must be registered for mobile money services offered by mobile network operators.

The platform offers two options to buy the bond, namely via mobile wallet (mobile money) or via mobile banking using the PesaLink app.

Lessons learned and suggested best practices:

1) ***Simplicity***: Making the m-service easy to use for consumers was key in enabling the success of the project.
2) ***End-to-end automation***: The fact that all steps in the entire process, from account opening, through bond buying, to selling are all automated encourages people with busy schedules to participate.
3) ***Real-time confirmation***: Receiving feedback in real time for each transaction enhances public confidence in the process.

Collaboration: The support and collaboration of all industry players are key in building confidence in the product: the National Treasury, the Central Bank of Kenya, the Capital Markets Authority, the Nairobi Securities Exchange, the Central Depository and Settlement Corporation, the Kenya Association of Stockbrokers and Investment Banks, Safaricom and Airtel.

Kenya case study on m-farming

The mobile penetration level in Kenya stood at 106.2 per cent in December 2018.[134] This means most Kenyans rely on mobile phones not only for social communication purposes, but also as a tool for receiving and sharing commercial information, e.g. on agriculture.

This aspect has attracted the attention of tech-savvy young people aiming to take advantage of the sector's popularity and profitability to address food shortages in the country, and has thus prompted the development of applications that ease farming and allow access to vital farming information.

Some of these applications are:

- **iCow**: Farmers register their cows free of charge through the iCow portal and get regular SMSs on breeding and production patterns.[135]

---

133 Central Depository and Settlement Corporation (CDSC) (Kenya). M-Akiba Bond.
134 Communications Authority of Kenya. Second Quarter Sector Statistics Report for the financial year 2018/2019 (October-December 2018).
135 iCow. About us.

- **M-Shamba**: An interactive platform accessible from smart and feature phones. SMS is used to provide the farmer with information on production, harvesting, marketing, credit, weather and climate. The information is customized based on location, allowing farmers to know what to grow within the season in their region. Farmers can also share information on various platforms.[136]
- **M-Farm**: Connects buyers and farmers around their locality to sell produce; also provides the latest agri-trends. Uses SMS and website.[137]
- **ArifuMkulima**: Broadcast SMSs sent to registered users on weather, diseases, farm inputs and financial advice. Uses SMS and website.[138]
- **Kilimo Salama**: Provides farmers with up-to-date and full climate data via text message. Those with an app in addition receive information on ways to increase productivity, ensure food security and protect their crops during bad weather.[139]

Lessons learned and suggested best practices:

1) ***Simplicity***: It is important to design m-farming solutions that can interact with farmers in basic language and if possible incorporate local language terminology.
2) ***Farmer-centric solutions***: It is important for m-farming solutions to address a specific field in farming, e.g. dairy farming only or a specific crop, such as tea or coffee. This will make them easier for farmers to use and to provide farmer-specific information.
3) ***Digital literacy***: To spur growth of m-services, it is imperative that farmers are trained in basic digital literacy skills.

Collaboration: Involvement of farmers in the design and development of farming solutions is key. This is done through feedback from farmers on system usability, and also through the collaboration of an ecosystem of partners, including telecommunication companies, independent software vendors, start-up accelerators and incubators, farmer associations, government and academia.

136 M-Shamba. *Making it happen*. About us.
137 M-Farm. Connecting Farmers. Connect with buyers and farmers around you to sell your produce.
138 Heike Baumüller. Agricultural Innovation and Service Delivery through Mobile Phones: Analyses in Kenya. PhD thesis, University of Bonn, Germany, July 2015.
139 Kilimo Salama. About Kilimo Salama.

Annex 4: Case studies on OTT

Bahamas case study

The Bahamas Utilities Regulation and Competition Authority (URCA) has recognized that OTTs can spur operators to embrace new technologies and expand into new lines of business. While URCA noted that OTTs, particularly online voice, messaging and video services, can disrupt traditional operators' financial and business models, more progressive network operators are adopting data-centric models to reduce the impact of OTTs.

As an example, URCA stated that the new entrant to the mobile market, Be Aliv, has introduced WhatsApp customer care as one of its innovations. In URCA's experience, the growing demands for OTT applications in the Bahamas have not affected investments in networks and technologies or discouraged service innovation.

URCA further noted that OTT applications are complementary to electronic communication services and thus should not be subject to licensing requirements.

Rather than impose regulatory obligations that apply to traditional services on OTTs, URCA is encouraging traditional players to embrace new models and compete with one another at the network level, as well as at the OTT level.

Ultimately, URCA's approach is to encourage traditional players to improve on the quality, variety and prices of their services so as to remain competitive while also benefiting consumers.

Australia case study

In April 2018, the Australian Competition and Consumer Commission (ACCC) released its Communications Market Sector Study report,[140] which addressed all aspects of the communication sector, including a focus on OTTs. With respect to competition among OSPs, ACCC generally did not find any competition issues.

In terms of the relationship between OTTs and other areas of the communication market, the report highlights the complementary relationship between telecommunication service providers and OTTs in which OTTs are stimulating demand for broadband access. While telecommunication service providers may experience some decrease in revenue due to a number of factors, such as increased competition among telecommunication service providers and declining consumer demand for traditional telephony services, they are making up for this through increased data revenues. In addition, network operators are capturing new revenue streams in the OTT content market by partnering with OTTs or expanding their own online content service offerings.

These developments prompted ACCC to conclude that "*the availability of OTT services increases the value proposition of broadband services, which in turn is likely to drive further take-up and adoption of higher value plans*". In addition, both telecommunication service providers and OSPs appear to be making "*complementary investments in infrastructure and technologies to expand capacity and promote a higher quality of service*".

[140] Australian Competition and Consumer Commission (ACCC). Communications Market Sector Study. Final report. April 2018, available here.

Bahrain case study

In October 2016, Bahrain's Telecommunications Regulatory Authority (TRA) released its Position Paper on Internet and Online Applications. TRA stated that the rise of OTTs has delivered significant benefit to end customers that not only creates new business opportunities for innovative players, such as OTT providers, but also opens up new avenues for growth for licensed operators.

TRA concluded that "*defining specific rules for an innovative and still evolving environment may lead to undesirable outcomes: stifling further innovation, limiting end-customer choice, and unduly influencing potential business relationships between Licensed Operators and OTT players*".

Instead of regulation, TRA encourages reliance on market forces, finding that "*market dynamics should, to the fullest possible extent, drive this structural shift, as such dynamics will further promote Internet penetration along with innovation, help control prices, and deliver benefits to end-customers*".

In March 2018, TRA released a public consultation on Traffic Management and Pricing Practices Guidelines, which proposes basic principles for net neutrality in Bahrain. TRA stated that a "*Licensed Operator would not be allowed to degrade content, applications or services that might compete, at the OTT level, with its own non-IP services*", even in instances where the operator views the OTT as competing with the operator's services.

In a highly dynamic, innovative and competitive environment, reliance on market forces encourages investment as new and existing players explore new business formulas. Thus, allowing the market to develop without specific rules in an evolving environment is the preferred approach.

TRA's approach under proposed net neutrality rules will ensure that operators do not target certain types of OTTs. This, in turn, promotes investment in OTTs as it ensures that they will not be blocked, throttled or otherwise degraded at the network level and instead will be available to all consumers.

Guinea case study

With the creation of the Posts and Telecommunications Regulatory Authority (ARPT), the Guinean State took action in 2005 to liberalize the telecommunication sector, and in 2005, 2006 and 2007 granted licences to four private operators to use a GSM public telecommunication network. This reform has led to an overall improvement in access to mobile-telephony services in Guinea. SOTELGUI (Guinea Telecommunication Company), the historic operator, ceased to exist in 2012 and was replaced by Guitel (Guinea Telecom).

It was only in 2013 that three licences to use the 3G network with the same expiry dates as the 2G licences were granted to three of the existing operators.

In addition to these mobile operators, there are four Internet access providers (IAPs) that are mainly based in the capital (Conakry) and some of the country's large towns.

Guinea was connected to the ACE submarine cable in 2013, giving operators and IAPs higher bit rates. Through its broadband strategy, the State is in the process of laying 4 500 km of optical fibre, of which 4 350 km has been deployed so far.

Various meetings with, and surveys of, operators have shown that use of OTTs by consumers is increasing constantly. This new consumer behaviour, facilitated by being able to obtain terminals at lower costs, has led to a fall in revenue from traditional services and an increase in data traffic linked to voice, images and video. Another observation is the growing number of agreements between operators and OTT providers.

Côte d'Ivoire case study

Social media platforms are evolving. They are implementing social features like petition functionality, or advertisements (ads) in "Stories" or "Status". In search of strategies to build loyalty and profitability, OTTs are moving beyond traditional communications (voice, message) on their platform to offer functionalities in other sectors. This shift is also observed at the level of users: producers and consumers of goods and services, who carry out e-commerce operations on OTTs.

In Côte d'Ivoire, OTTs are being used increasingly for e-commerce. Consumers now prefer to buy on social media platforms. Craftsmen or merchants, sometimes with low literacy rates, publish their articles and catalogues on OTTs. Stories are now used as a showcase.

Compared to traditional e-commerce sites, consumers now prefer to buy from OTTs because of interactions, the ability to chat with the craftsman or merchant via messaging, to negotiate the price in real time or to place an order for custom-made products.

An entire ecosystem, revealing the true digital economy, is taking shape around OTTs.

New marketplaces are being created. The time-to-market is considerably shorter, and there is no longer a need for stores to display goods because OTTs become showcases. No need to use an experienced advertiser – it is possible to become known in 10 minutes, thanks to automatic sponsored ads of products to the target population.

Interest in smartphones from all levels is growing beyond entertainment to become a real business tool. In Côte d'Ivoire, the smartphone is the most widely used means of accessing social media platforms. More than 80 per cent of users access these platforms using mobile only.

The use of OTTs opens up an alternative that can serve to reduce unemployment. Many young people waiting to get decent jobs offer goods and services, and the income can be significant.

New business connections between countries are being created beyond the established axes. In addition to the traditional partners France and Nigeria, thanks to services via OTTs we can now observe an increase in supplies from Togo, Morocco, Turkey, the United Arab Emirates (Dubai) and China.

Issues identified

In Côte d'Ivoire, the e-commerce activity that is developing on social networks is mainly informal. These new windows, which benefit from the virtual world with a relatively small installation

budget, compete directly with physical retailers who also have to maintain physical stores, pay municipal taxes and manage other worries.

Countries, while taking an interest in this new economy, are considering ways of generating income from it, maintaining competition in a fair balance without imposing a tax burden that would risk curbing the positive impact, especially in terms of employment and professional integration.

Beyond assumptions about infrastructure, investment and telecommunications, OTTs raise many other questions. They occupy a certain place in developing countries that must be analysed and measured in order to provide relevant information to stakeholders to take informed decisions.

In accordance with Resolution 206 (Dubai, 2018) of the ITU Plenipotentiary Conference,[141] on the need to consider the policy issues and economic implications of OTTs, the following recommendations are made:

- Complete the Measuring the Information Society (MIS) questionnaire in order to take into account socio-economic indicators related to the use of OTTs; or
- Think about a new report for measuring the impact of OTTs.

[141] ITU. Plenipotentiary Conference (Dubai, 2018). Resolution 206 (Dubai, 2018), on OTTs.

Office of the Director
International Telecommunication Union (ITU)
Telecommunication Development Bureau (BDT)
Place des Nations
CH-1211 Geneva 20
Switzerland

Email: bdtdirector@itu.int
Tel.: +41 22 730 5035/5435
Fax: +41 22 730 5484

Office of Deputy Director and Regional Presence
Field Operations Coordination Department (DDR)
Place des Nations
CH-1211 Geneva 20
Switzerland

Email: bdtdeputydir@itu.int
Tel.: +41 22 730 5131
Fax: +41 22 730 5484

Digital Networks and Society (DNS)
Email: bdt-dns@itu.int
Tel.: +41 22 730 5421
Fax: +41 22 730 5484

Digital Knowledge Hub Department (DKH)
Email: bdt-dkh@itu.int
Tel.: +41 22 730 5900
Fax: +41 22 730 5484

Partnerships for Digital Development Department (PDD)
Email: bdt-pdd@itu.int
Tel.: +41 22 730 5447
Fax: +41 22 730 5484

Africa

Ethiopia
International Telecommunication Union (ITU) Regional Office
Gambia Road
Leghar Ethio Telecom Bldg. 3rd floor
P.O. Box 60 005
Addis Ababa
Ethiopia

Email: itu-ro-africa@itu.int
Tel.: +251 11 551 4977
Tel.: +251 11 551 4855
Tel.: +251 11 551 8328
Fax: +251 11 551 7299

Cameroon
Union internationale des télécommunications (UIT)
Bureau de zone
Immeuble CAMPOST, 3e étage
Boulevard du 20 mai
Boîte postale 11017
Yaoundé
Cameroon

Email: itu-yaounde@itu.int
Tel.: + 237 22 22 9292
Tel.: + 237 22 22 9291
Fax: + 237 22 22 9297

Senegal
Union internationale des télécommunications (UIT)
Bureau de zone
8, Route des Almadies
Immeuble Rokhaya, 3e étage
Boîte postale 29471
Dakar - Yoff
Senegal

Email: itu-dakar@itu.int
Tel.: +221 33 859 7010
Tel.: +221 33 859 7021
Fax: +221 33 868 6386

Zimbabwe
International Telecommunication Union (ITU) Area Office
TelOne Centre for Learning
Corner Samora Machel and
Hampton Road
P.O. Box BE 792
Belvedere Harare
Zimbabwe

Email: itu-harare@itu.int
Tel.: +263 4 77 5939
Tel.: +263 4 77 5941
Fax: +263 4 77 1257

Americas

Brazil
União Internacional de Telecomunicações (UIT)
Escritório Regional
SAUS Quadra 6 Ed. Luis Eduardo Magalhães,
Bloco "E", 10º andar, Ala Sul (Anatel)
CEP 70070-940 Brasilia - DF
Brazil

Email: itubrasilia@itu.int
Tel.: +55 61 2312 2730-1
Tel.: +55 61 2312 2733-5
Fax: +55 61 2312 2738

Barbados
International Telecommunication Union (ITU) Area Office
United Nations House
Marine Gardens
Hastings, Christ Church
P.O. Box 1047
Bridgetown
Barbados

Email: itubridgetown@itu.int
Tel.: +1 246 431 0343
Fax: +1 246 437 7403

Chile
Unión Internacional de Telecomunicaciones (UIT)
Oficina de Representación de Área
Merced 753, Piso 4
Santiago de Chile
Chile

Email: itusantiago@itu.int
Tel.: +56 2 632 6134/6147
Fax: +56 2 632 6154

Honduras
Unión Internacional de Telecomunicaciones (UIT)
Oficina de Representación de Área
Colonia Altos de Miramontes
Calle principal, Edificio No. 1583
Frente a Santos y Cía
Apartado Postal 976
Tegucigalpa
Honduras

Email: ituteguciglapa@itu.int
Tel.: +504 2235 5470
Fax: +504 2235 5471

Arab States

Egypt
International Telecommunication Union (ITU) Regional Office
Smart Village, Building B 147,
3rd floor
Km 28 Cairo
Alexandria Desert Road
Giza Governorate
Cairo
Egypt

Email: itu-ro-arabstates@itu.int
Tel.: +202 3537 1777
Fax: +202 3537 1888

Asia-Pacific

Thailand
International Telecommunication Union (ITU) Regional Office
Thailand Post Training Center
5th floor
111 Chaengwattana Road
Laksi
Bangkok 10210
Thailand

Mailing address:
P.O. Box 178, Laksi Post Office
Laksi, Bangkok 10210, Thailand

Email: ituasiapacificregion@itu.int
Tel.: +66 2 575 0055
Fax: +66 2 575 3507

Indonesia
International Telecommunication Union (ITU) Area Office
Sapta Pesona Building
13th floor
Jl. Merdan Merdeka Barat No. 17
Jakarta 10110
Indonesia

Mailing address:
c/o UNDP – P.O. Box 2338
Jakarta 10110, Indonesia

Email: ituasiapacificregion@itu.int
Tel.: +62 21 381 3572
Tel.: +62 21 380 2322/2324
Fax: +62 21 389 5521

CIS

Russian Federation
International Telecommunication Union (ITU) Regional Office
4, Building 1
Sergiy Radonezhsky Str.
Moscow 105120
Russian Federation

Email: itumoscow@itu.int
Tel.: +7 495 926 6070

Europe

Switzerland
International Telecommunication Union (ITU) Office for Europe
Place des Nations
CH-1211 Geneva 20
Switzerland
Email: eurregion@itu.int
Tel.: +41 22 730 5467
Fax: +41 22 730 5484

International Telecommunication Union
Telecommunication Development Bureau
Place des Nations
CH-1211 Geneva 20
Switzerland

ISBN 978-92-61-34531-0

Published in Switzerland
Geneva, 2021