

# Regulatory Framework of Mobile Broadband to Boost Economic Growth in a Digital Economy

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**Abstract**—The new digital ecosystem now revolves around Mobile Broadband—digital content, social networking and online commerce are a few examples of a plethora of services integrated in the mobile ecosystem. The mobile ecosystem relies heavily on availability and affordability of mobile broadband networks, smart phones, tablets and a wide range of supporting equipment to ensure widespread penetration. The ecosystem offers significant advantages not only to developed countries with high ICT skills, but even more so to developing countries and unconnected populations. The practicality of providing these solutions from mobile broadband arises from the fact that these underserved and poverty-stricken citizens may not have access to financial services and other basic services but have high mobile phone penetration. Analysis and regulatory framework was originated based on secondary research and primary research from in-depth interview with subject matter experts. Hence, this study has concluded a supportive regulatory framework that encourages the government and regulators to cooperate and encourage innovation pushing the creation of mobile industries and transition to digital economy. This study makes use of previous international experiences to provide the detailed recommendations of the supportive regulatory policy, which are tried and verified. Based on the aforementioned previous international endeavors, this study concludes that in order to stimulate economies of scale, facilitate compatible equipment affordability and ensure quality mobile broadband, spectrum assignment for 4G and the preparation of 700MHz Digital Dividend band allocation for regulators is highly recommended.

**Index Terms**—mobile broadband, supportive regulatory, framework, regulation, and digital economy

## I. INTRODUCTION

Mobile ecosystem is a key driver for socioeconomic development and national welfare. Today with all industries dependent on mobility it plays a vital role in bridging the digital divide which is the key to elevating emerging and third world countries into developed nations [1], [2]. With high proliferation of mobile devices, mobile broadband provides a gateway for internet access to remote and unconnected users to join the global online community, giving equal online experience to all to both urban (formerly connected) and as well as previously unconnected populations. In the past the absence of fixed

line broadband means that populations in rural and remote areas remain unconnected, nevertheless with rural and remote areas having higher mobile penetration than fixed line infrastructure and internet connectivity, it has become the only means for internet connectivity for rural and remote populations.

ITU estimated that globally internet connected users grew from 1.6 billion in 2008 to 2.9 billion by the end of 2014, accounting for approximately 40% of the global population. This leaves 60%, or approximately 4.4 billion people, still unconnected [3], [4]. Moreover, the greatest proportion of these unconnected populations is mainly from under-developed and developing countries. ITU found that consumers in developed nations use mobile internet as a complement to fixed broadband but developing countries, use mobile internet as a substitute to fixed broadband as it is the only means available for internet connectivity, especially in remote and rural areas [5].

Further, the success of mobile broadband is largely due to the high penetration of mobile devices. The high proliferation of mobile devices in under-served areas is a result of mobile operators and players in the mobile ecosystem such as network infrastructure providers, mobile service providers, handset manufacturers and chipset suppliers, making mobile handsets and mobile voice and data service packages more affordable. As handset prices fell, adoption of mobile and then smart phone penetration began to take up, hence, becoming a key strategy necessity in bringing mobile services to lower income segments [1], [4].

As affordability of mobile phones has resulted in effortless fast pick up mobile penetration in rural, remote or in unconnected populations; all businesses and industry sectors sought out mobility as a way to conduct business with this new previously untouched and unconnected massive target market. For instance, mobile money and wallets is now on the radar to provide services to large population of previously unbanked populations that carry mobile phones. Hence, it is unsurprising that for this to work smoothly, telecom regulators and finance regulators must collaborate to create and implement policies that protect as well as promote mobile banking. Most importantly, both regulators must coordinate to develop a framework that enables mobile operators and banks to develop and support the ecosystems needed to roll out sophisticated digital commerce propositions. [4]

Most importantly, seeing as mobile broadband is on the road to become a basic necessity for rural and remote populations to connect to businesses, global online community, financial services, improving quality of life and much more. It is critical more now than ever for governments and regulators to take into the account the role of infrastructure sharing among operators to ensure widespread and most excellent network infrastructure and highest quality of mobile service and internet connectivity. In fact according to GSMA, “a country’s regulatory framework should facilitate all types of infrastructure sharing arrangements, involving the sharing of both passive and active components of mobile networks”[4]. Therefore, if the government and regulator cooperate to drive innovation, investment and competition in mobile ecosystem will continue to expand, boosting socio-economic growth, productivity (higher GDP), creating prosperity from increase in quality of life in underserved areas and creating jobs in both ICT sector and other industries Fig. 1.

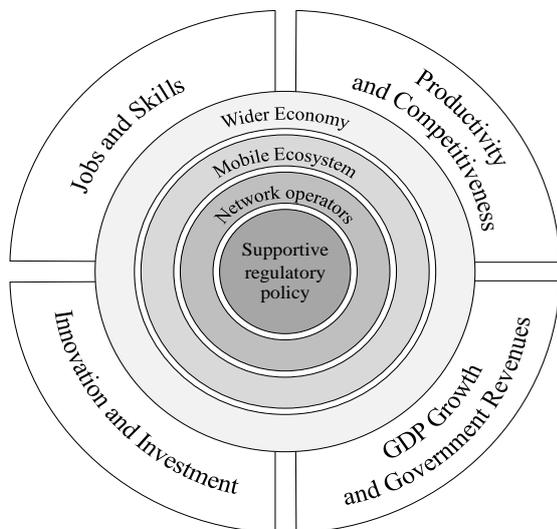


Figure 1. Socio-economic impact of supportive regulatory policy.

As evidenced in Fig. 1, Providing mobile broadband access to under-served or previously unconnected populations in remote and rural areas will continue to delivered high social and economic benefits, improved productivity that is increase in GDP, higher economic growth and improved quality of life for under-developed and developing populations, and ultimately transcending a nation from being underdeveloped economy to a developed economy [4], [6], [7]. Since the lack of broadband access has the potential to hinder opportunities for economic and social development in many developing countries, preventing the unconnected populations from truly engaging in the information age [3], [7]. Hence, governments and regulators that do not embrace and promote mobile broadband, is certain to ensure a country’s economy and socio-development falling behind the rest of the world.

Besides, mobile broadband not only has already had a profound impact quality of life of all individuals, but also has the potential to play an even more active role in

delivering the digital economy. Realizing the full potential of this digital economy will require effort from all players in the mobile ecosystem including mobile operators, governments, regulators and even technical engineers specialized in spectrum (a resource essential to provision of mobile service and mobile broadband). Therefore, it is the highest priority for all governments and regulators to ensure they allocate spectrum to the highest positive socio-economic activity which is presently mobile services and mobile internet.

This paper puts forward significant mobile broadband technologies, provides analysis on telecom regulation and spectrum assignment and further concludes and makes recommendation on regulatory policies and spectrum assignment essential to match with the future spectrum demand in developing countries.

II. RESEARCH METHODOLOGY

The goal of this paper is to propose a supportive regulatory framework that enables and promotes mobile broadband effectively. This paper adopts the in-depth interview approach to explore the research objective. In this research, source information is from academic papers, business reports and interview with subject matter experts on telecommunication policy.

The research framework of this paper is illustrated in Fig. 2.

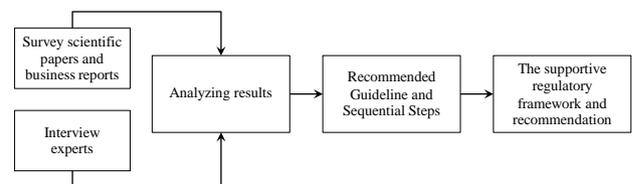


Figure 2. Research framework

The respondent profiles of our subject matter experts are shown in Table I. We classified subject matter experts into four categories depending on their area of expertise in Telecom Engineering, Economics, Social and Telecom Law. The total number of subject matter experts or respondents is 12 with 3 from each key focus area.

TABLE I. INTERVIEWING EXPERTS AND KEY FOCUS

Area of expertise	Numbers	Key focus
Telecom Engineering	3	Trend of technology and spectrum/Telecom regulations
Economic	3	Impact on economic and GDP
Social Science	3	Impact on society and human capital
Law	3	Law and regulations and changes

Further once qualitative data is compiled from secondary research and primary research (interviews with subject matter experts), we will analyze the results and use the qualitative data analysis to derive supportive

regulatory framework and provide recommendations for its practical use.

### III. SOCIO-ECONOMIC IMPACT OF MOBILE BROADBAND

There is a rapid migration from 2G mobile networks to mobile broadband networks around the world. Although mobile broadband connections (3G and 4G) accounts for less than 40% of total connections by 2014, it is expected to reach almost 70% by 2020 [1]. The rapid migration from 2G to mobile broadband was motivated by higher availability and affordability of smartphones coupled with more widespread network coverage. As mobile devices are now becoming increasingly affordable, this will lead to a large population of previously unconnected now adopting smartphones hence expecting to reach 63% adoption by the end of 2020 accounting for 2.9 billion phones running on mobile broadband networks [1].

In the modern day, mobile is the most important infrastructure in developing countries and is now a basic infrastructure that is readily available to even remote and rural populations that may not have access to other basic necessities which are electricity, sanitation and banking. Mobile devices have become a major contributor to addressing social, economic and environmental issues. These issues are particularly extreme in underdeveloped and developing countries, given they have high poverty, rapid population growth, political instability and even human rights issues [8].

To realize the full potential of mobility, populations must have access to mobile broadband networks and affordable devices. Despite the rapid progress in extending mobile network infrastructure and operators even subsidizing mobile phones to make it more affordable, this progress is still impeded as a large population still does not have access to mobile or fixed network internet [1].

The broadband gap and access to equal opportunities between both urban and rural poor communities that cannot be addressed by fixed broadband will be successful through mobile broadband. In addition to increase in GDP, the roll out of more broadband network infrastructure will create more jobs, particularly skilled jobs. This will have a positive impact on developing countries population and will increase skill of workforce in the country. [7]

Nevertheless, the major hindrance in creating a nationwide broadband infrastructure is spectrum allocation. There should be sufficient spectrum allocation to ensure quality of service (QoS) and nationwide penetration of mobile broadband. Careful consideration should also be given to ensuring that spectrum allocated is harmonized. According to GSMA, “harmonization is the uniform allocation of radio frequency bands across entire regions—not just individual countries” [9]. Spectrum harmonization is a key objective of ITU, regulators globally and all of mobile ecosystem [9]. It is pertinent that regulators and governments must work together to align their country’s spectrum band plan and harmonize it to the band plan of what is being done

internationally, so that mobile services are less expensive driving prices down and ultimately capturing economies of scale in terms of network infrastructure, mobile device manufacturing, and all of its parts. [7].

For spectrum allocation, it is not “one size fits all”, as market circumstances and specific objectives of governments vary from country to country. However, auction is one of the most popular methods for spectrum allocation, as it is efficient since spectrum demand exceeds supply. To minimize uncertainty [10], transparency, fair and predictable approach to spectrum allocation via auction or even in license renewal stage is the most crucial to minimize uncertainty for operators so they can make rational long-term investment decisions and ensure continuity of service [4]. To ensure all stakeholders benefits and views are taken into consideration, all industry stakeholders must be involved or educated during the decision process on spectrum allocation [8], [11].

### IV. ANALYSIS AND RESULTS

#### A. Supportive Regulatory Framework

In this research, we conducted twelve in-depth interviews with experts in various fields as shown in Table I. We also made a comprehensive review of scientific papers and business reports and interviewed telecommunication policy experts analyzing the supportive regulatory framework as contributed to the impact of broadband on the economy. Based on the collected evidence and a rigorous process of analyzing data, we can create the proposed framework as shown in Fig. 3. The proposed framework for the supportive regulatory policy demonstrates how the spectrum and broadband infrastructure enable economic growth.

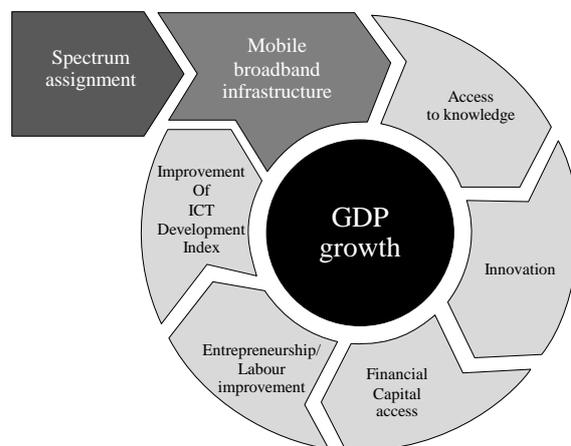


Figure 3. The proposed framework.

As illustrated in Fig. 3, there are five key aspects in the proposed framework as following:

- **Spectrum Assignment:** It is crucial that governments and regulators take into account industry and investor perspective when licensing spectrum to ensure that spectrum pricing is optimal but at the same time it is at a price that

motivates efficient usage. So that mobile service prices are affordable yet investors still have confidence to invest in innovative services resulting in affordable and innovative mobile services for users.

- **Spectrum licensing:** must be timely to meet the market demands and it should be carried out in consultation and consensus from all industry stakeholders to ensure spectrum licensing is transparent, fair and reduces uncertainty for long-term investment decisions. The cost of spectrum usage rights should be based on achieving the best outcome for society rather than on maximizing short-term revenue for government.
- **Mobile Broadband Infrastructure:** Improving mobile broadband coverage, investing in more advanced yet efficient technologies and providing sufficient capacity to cope with the increasing demand for data traffic cannot be achieved in a short time frame or with a focus on just one key regulatory measure. A coordinated regulatory framework in which collaboration is at the center of broadband policy is a major requirement for mobile broadband sector to maximize its social and economic impact.[4]
- **Access to Knowledge:** Education is a major driver of economic prosperity. A UNESCO report finds that “a \$1 investment in education could bring a \$10-15 return in economic growth” [12]. There is a significant connection between education through mobile broadband and economic growth. According to the World Economic Forum, “no socio-economic factor is a better indicator of a nation’s economic success than its investment in education and mLearning offers fascinating opportunities to systemically redefine the way that individuals and communities can contribute to society” [13]. Mobile Broadband technology plays a role in giving better quality of education and gives both teachers and students access to academic content remotely, ubiquitously. Mobile technology makes education more entertaining and gives opportunity for equal access to education and learning to previously unconnected populations especially in emerging and developing countries. This increases job skills and increase number of population for skilled jobs, resulting in higher quality of life and national competitiveness. [13]
- **Innovation:** Mobile broadband together with soft touch regulation enables an innovative environment and encourages investment on new technologies. This urges government to focus R&D and innovation, on creating infrastructure platforms for modern technologies such Big Data, Mobility, using social media for businesses and cloud computing to support innovative enterprise application development.[4]
- **Financial Capital Access:** With high mobile penetration and a technology more feasible than

even fixed broadband, it is the key to providing financial services to previously unbanked populations living in rural and remote areas. Some of the services that can be provided through mobility are financial services such as insurance, credit and savings. According to the GSMA the key to ensure success in financial inclusion via mobile devices is collaboration of government, banking sector and telecom regulators and most importantly, “the separation of financial and telecommunications regulatory responsibilities must be prioritized at a national level to ensure a stable and predictable environment for operators.”[4]

- **Entrepreneurship/Labor Improvement:** Launching businesses today requires access to information, ease of communication and most significantly mobility or mobile devices has become the key platform to market and sell products and services [14]. “There now are more mobile devices in used than desktop computers and this development has dramatically altered the way people operate business in all industry sectors” [14]. Indeed, mobile broadband is a powerful engine to increase economic growth and benefits for entrepreneurs. The business sector can benefit greatly from mobility, “but only if mobile operators continue to upgrade their existing networks and deploys new networks and services”[4]. A supportive regulatory framework creates a general systematic process that should be followed in order to drive socio-economic development and real benefits for individuals and businesses. If policy makers and regulators implement policies that encourage investment, competition and innovation, both the mobile sector and the wider digital economy will expand, creating prosperity, labor improvement and new entrepreneurship.
- **Improvement of ICT Development Index:** Results from many research papers showed that depending on a country’s ICT maturity, increasing in broadband connections penetration leads to an increase in GDP and job creation. The differentiation between ICT developing and developed nations has been done based on ITU’s ICT development index.

#### B. Recommendations for the Regulatory Policy: Principle Issues

In this sub-section, we provide a summary of recommendations from the study as following:

- 1) Based on international experience suggests that an independent regulator – separate from the government – is essential to ensure investor confidence and hence leads to further investment in new technologies and enhancing networks.
- 2) Basically, the spectrum licensing should be designed to achieve the most efficient of available mobile spectrum. An assignment process for the available

spectrum that is implemented by an independent regulator should ensure that the needs of individual operators can be accounted for. The conditions of the spectrum awarded, which should be technology- neutral so as to promote investment in the latest technology.

3) Considering the experience from many countries, the spectrum that is planned to be awarded for mobile broadband applications is unlikely to be sufficient to meet the operators' future spectrum needs. Hence, Re-farming of spectrum in the 700MHz band for mobile use would be a key step towards making further spectrum available in the future.

4) To save costs of mobile broadband roll out, the voluntary infrastructure sharing, in particular for roll-out in remote, rural and under-served areas. Regulators should allow operators to enter into voluntary commercial agreements if they wish to, in order to enable faster roll-out of mobile broadband services.

5) Regulators must be involved in WRC-15 to ensure any harmonizing spectrum will result in technical issues such as interference with neighboring countries, not able to capture economies of scale and resulting in not capturing affordability of mobile services, which can hinder socio-economic developing of rural and remote population.[4]

6) Regulators should ensure that existing universal service funds are targeted, time-bound and managed transparently. The funds should be allocated in a competitive and technically neutral way, in consultation with the industry.[4]

#### C. Recommendations for the Regulatory Policy: Future Demand for Spectrum

According to GSMA, "ideally, this new spectrum should comprise a mixture of coverage (i.e. lower frequency) and capacity (i.e., higher frequency) bands harmonized globally, or at least regionally" [1].

The WRC- 15 is the best consensus to determine on what to do in regards to harmonization of spectrum band plan and to ensure whether "telecoms industry can continue to meet the growing demand for affordable, ubiquitous, high-speed mobile broadband services". [1]

In the absence of new spectrum allocations at WRC-15, regulators will find it difficult to release enough spectrums to accommodate the ongoing rise in mobile traffic, resulting in a poorer experience for end-users and potentially more expensive mobile services.

It was also highlighted that operators need lower spectrum such as 700 MHz to enhance geographical coverage. This band is particularly important for rural and remote population internet access, as it allows better indoor penetration and greater rural access. The key to ensuring developing countries can eliminate digital divide is to allocate 700 MHz. Moreover, regional coordination to ensure harmonized allocation 700 MHz will ensure greater availability of mobile devices and affordability of mobile services and allow roaming across national borders and avoid technical issues between neighboring countries such as interference problems.

This paper also suggests that in order to stimulate economic of scale and facilitate compatible equipment affordability, the preparation of 700MHz band allocation for regulators is highly recommended.

#### D. Recommendations for the Changing Environment

The focus of activities for a regulator changes as the environment in which they are working evolves. This sub-section addresses the changing environment in terms of technology, networks, suppliers and consumer services. Fig. 4 depicts the key areas of change and stakeholders involved in the digital ecosystem.

There has been a significant advance in technology used in telecommunications networks. It might be argued that the advances have been stimulated from operators seeking cost savings and an increase in the capability of the technology solutions and systems. The need to seek cost reductions and increased capability has come about by the need for operators to improve their competitive advantage.

The top international vendors have risen to the challenge and are all driving advances in technology offering ever faster and cheaper fixed and wireless network systems based upon internet protocol (IP). Such advances have been underpinned by cooperation in developing new standards.

Standards making and in particular the 3rd Generation Partnership Project (3GPP), has played a key role in ensuring an international standard for the Long Term Evolution (LTE) mobile system. Firstly, 3GPP unites six telecommunications standard development organizations (ARIB, ATIS, CCSA, ETSI, TTA, TTC). Secondly, ITU standards (called Recommendations) are also fundamental to the operation of today's ICT networks. As a result, these institutions provide recommendations and standards after the consensus, discussion and working closely with all industry stakeholders. Hence, it is pertinent for regulators take their recommendations and standards into practice [15].

The high speed broadband fixed, 3G and now LTE or 4th generation wireless connectivity, has enabled the progressive development of ever increasingly smarter phones and terminals and an increasing range of applications and services. The IP broadband network not only enables mobile and fixed voice calls but also high speed internet connection. Consumer can now have any time anywhere access to online applications and services.

The ITU have allocated a wide range of spectrum bands to International Mobile Telecommunications (IMT)". It is in fact the advances in technology that has allowed economical multi-band radios to be produced and used in mobile telephones and other devices. The release of additional spectrum, the "digital dividend" from analogue TV to digital TV has also been a major boost for the telecommunications industry. ITU concluded that the number of fixed-broadband have reached 10.8 per 100 users in 2015, corresponding to a global penetration rate of 15 percent. At the same time, the number of active mobile-broadband subscriptions grew by 29 percent (CAGR) between 2011 and 2014 representing nearly four times the number of fixed-broadband subscriptions, but

still much fewer than total mobile subscriptions, which will reach an estimated 98.4 % of users globally by end of 2015. Total global Internet users will reach an estimated 3 billion worldwide by end of 2014 accounting for at least two-third of developing countries population.[16]

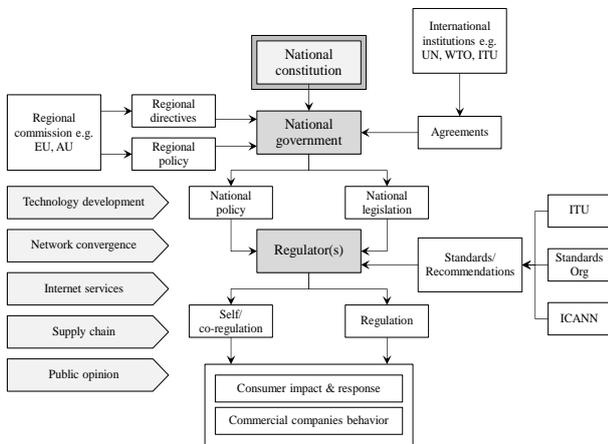


Figure 4. Changing environment [15].

## V. CONCLUSION

Mobile broadband technology represents a significant part of any modern economy. Through invention and innovation, new products and services are transforming entrepreneurship, education, health care, and governance, and will create a positive spillover effect on many industry sectors.

This supportive regulatory framework proposed in this research provides a general and systematic process that the government and regulator must follow to drive the social and economic benefits from mobile broadband services. This proposed framework illustrates that spectrum assignment is the backbone to creating a mobile broadband infrastructure, which is the key to narrowing digital divide (increasing access to knowledge), driving innovation, increasing financial inclusion, increasing job skill set of citizens (labor improvement) and ICT literacy of citizens. All of which results in increase in productivity and therefore, GDP. Further this research highlights the importance of soft touch regulation in mobile sector as excessive regulation can result in adverse effects such as delay in innovation, rising costs, limiting investment and harming consumer welfare.

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