The economic and social benefits of 3G in Pakistan

A report for
Qualcomm

August 2013

Phillipa Marks
Sarongrat Wongsaroj
Yi Shen Chan

About Plum

Plum Consulting is a specialised consulting firm offering strategy, policy and regulatory advice on telecoms, online and spectrum issues. We draw on economics, our knowledge of the sector and our clients' perspective to deliver soundly based solutions to problems. We are an international leader in advising on spectrum policy and regulation. We work in many countries in Asia, Africa, the Americas and Europe on issues affecting all uses of spectrum. Our clients include telecoms operators, regulators, equipment vendors, broadcasters and online service providers. Many of our project reports are published and can be seen at http://plumconsulting.co.uk/publications

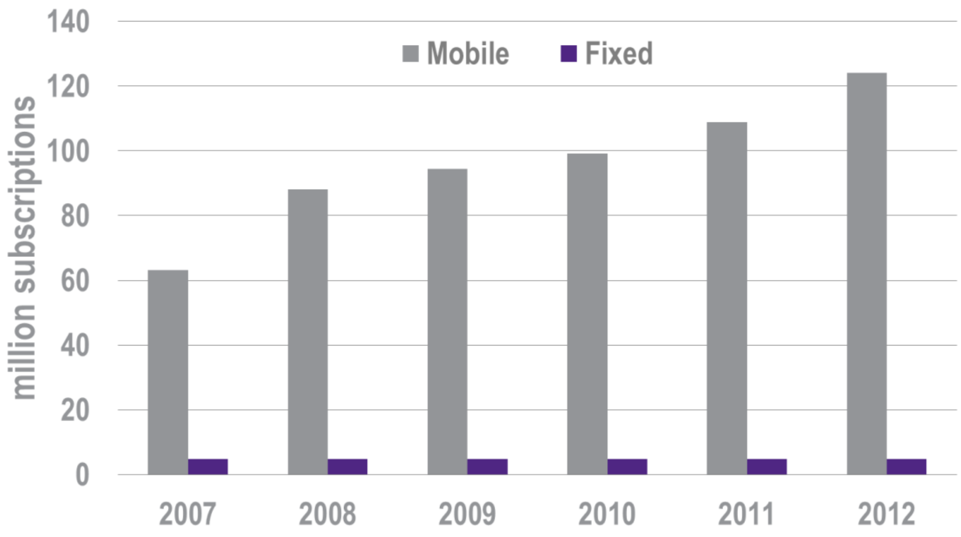
Plum Consulting, London
T: +44(20) 7047 1919, **www.plumconsulting.co.uk**

Table of Contents

Summary

It is widely accepted that broadband infrastructure and services contribute to economic growth and job creation. As a result many governments have made the development and use of broadband services a policy priority. In countries with limited fixed communications networks, such as Pakistan, voice calls and broadband data services are almost all provided over mobile networks (Figure 1).

Figure 1: Number of fixed and mobile subscriptions in Pakistan

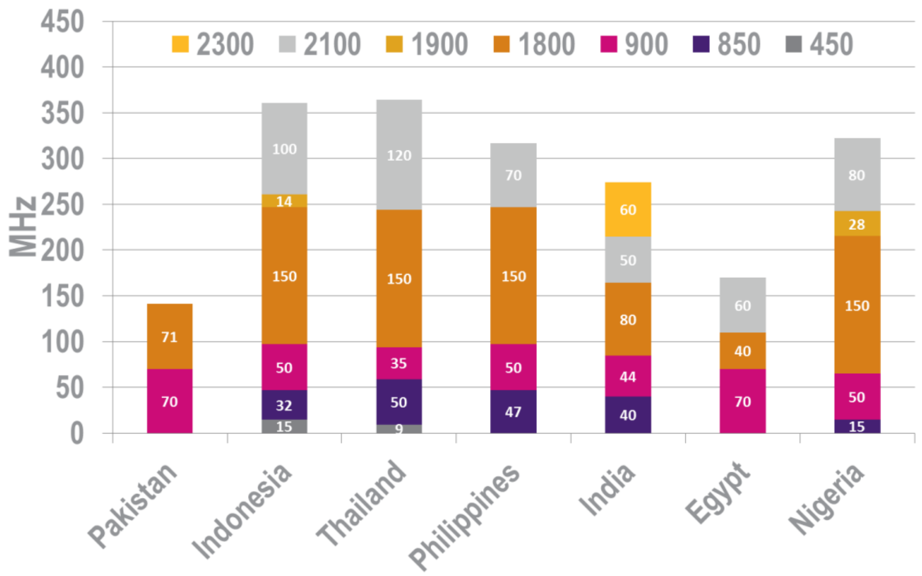


Source: PTA

Low cost provision of mobile broadband data services (often called 3G services) is only possible if mobile operators have plentiful access to radio frequencies. The main frequency band used globally for 3G services is the 2.1 GHz band. The 2.1 GHz band has been released in over 150 countries including many countries in South and South-East Asia (e.g. India, Indonesia, Thailand, the Philippines) and the Middle East and Africa region (e.g. Nigeria and Egypt) where it has been released for 3G services in the last 5 years.

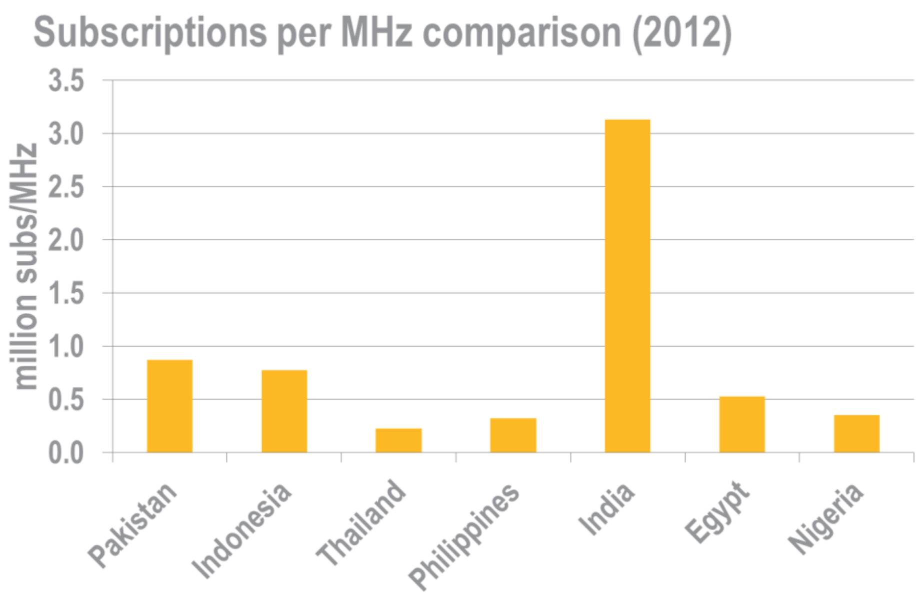
Mobile operators in Pakistan do not have access to the 2.1 GHz band and generally have access to very little spectrum compared with operators elsewhere (Figure 2). Also as shown in Figure 3 the number of subscribers supported per MHz is high relative to the comparator countries, with the exception of India.

Figure 2: Spectrum assigned to mobile operators by frequency band in Pakistan and comparator countries



Source: Plum Consulting, APT, national regulators

Figure 3: Mobile subscribers per MHz of spectrum assigned by country



Source: APT, national regulators, Informa

Release of the 2.1 GHz band in Pakistan has been repeatedly delayed for several years. Mobile operators in Pakistan are interested in acquiring the spectrum and its deployment for 3G broadband services has the potential to offer large economic and social benefits. We estimate that:

- It could result in additional GDP valued (in net present value terms) at between PKR380bn and PKR1,180bn in the period up to 2020

- This additional GDP could yield additional tax revenue for government of between PKR23bn and PKR70bn (in net present value terms)
- In a high-penetration scenario, it could generate up to around 900,000 jobs in 2018 if spectrum is released in 2013
- Auction revenues from the 2.1GHz award could range from PKR 102bn to PKR 180bn.

Use of 3G broadband services will also provide a wide range of social benefits (e.g. in education, healthcare etc). Many countries in the region are already reaping the benefits of mobile broadband connectivity in these areas. In the Philippines, schoolteachers in rural areas are now able to access multimedia teaching aids over smartphones. Meanwhile, in India the availability of mobile broadband means that healthcare can be more quickly and effectively delivered to residents in rural areas through mobile telemedicine units. Similarly in Pakistan, 3G services could support improved education and healthcare delivery and could enhance public health initiatives such as the dengue tracking system[1].

It is imperative that the government in Pakistan acts quickly to realise these benefits by assigning the 2.1 GHz spectrum. Further delays will be costly. We estimate that a two year delay would result in a loss of GDP of up to PKR440[2]bn – equivalent to a loss of at least PKR5bn per month for the next 7 years. Correspondingly, there will also be a loss of tax revenue of up to PKR26[3]bn – equivalent to a loss of t least PKR300m per month for the next 7 years.

[1] http://www.pitb.gov.pk/dengueTracking

[2] This is the loss expressed as the net present value of GDP for the period 2013-2022.

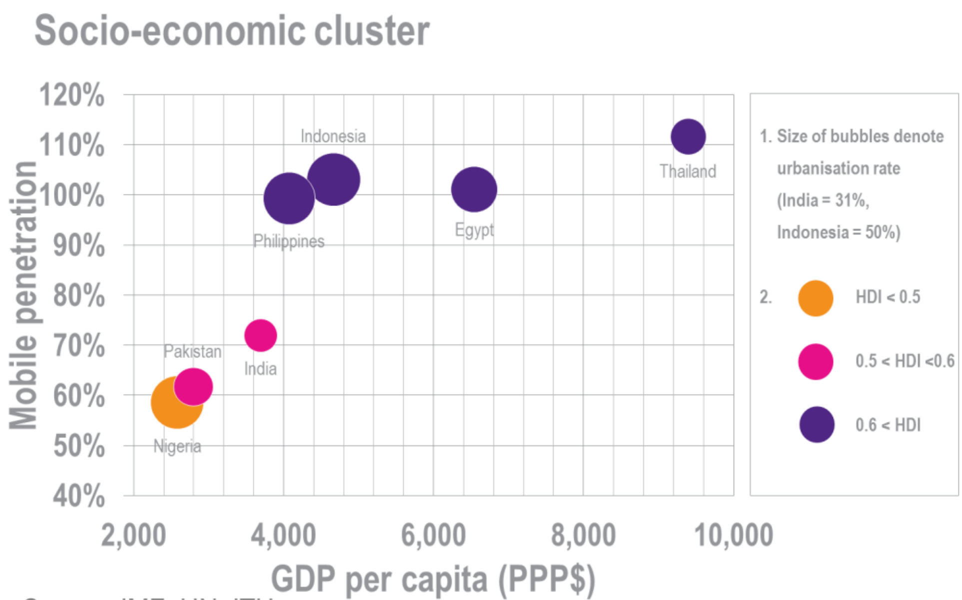
[3] This is the loss expressed as the net present value of governmental tax revenue.

1 Introduction

The release of the 2.1 GHz band in Pakistan has been repeatedly delayed for several years. Many other comparable countries in South and South-East Asia and the Middle East and Africa (MEA) region have released the band in the last five years, and in these countries 3G is the main platform for broadband services. This report was commissioned by Qualcomm to provide evidence of the economic and social benefits to Pakistan from timely release of the 2.1GHz band for 3G services.

Pakistan has a vibrant mobile market with five operators providing 2G services to a total of 124m subscribers[4]. Penetration of mobile services stands at around 70% which is low by international standards and is in part explained by relatively low levels of urbanisation and per capita income as is suggested by the data given in Figure 1-1. For the purposes of benchmarking future 3G demand in Pakistan and assessing spectrum value we have used data for the comparator countries shown in Figure 1-1. While Pakistan is towards the low-middle end of the range of countries shown in terms of GDP/capita, mobile penetration, urbanisation and human development index (HDI), the countries shown are not uniformly higher or lower in terms of these parameters and so provide a reasonable basis for comparison.

Figure 1-1: Socio-economic cluster diagram for comparator countries



Source: IMF, UN, ITU

In the remainder of this report we show why the 2.1 GHz band is needed for mobile broadband services in Pakistan (Section 2), quantify the economic benefits of releasing the 2.1 GHz band for 3G services and estimate the cost of further delay (Section 3) and describe the social benefits that mobile broadband can provide via improved provision of education, healthcare and government services (Section 4).

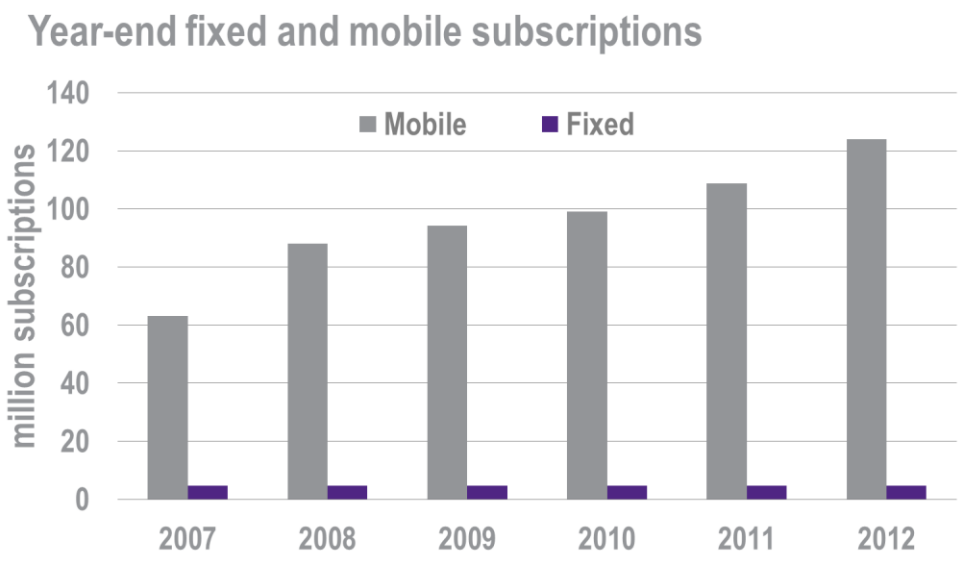
[4] November 2012 data see http://www.pta.gov.pk/index.php?option=com_content&task=view&id=269&Itemid=658

2 Spectrum at 2.1 GHz is needed for mobile broadband

2.1 Fixed networks will not meet Pakistan's broadband requirements

The number of subscriptions to fixed communications services[5] in Pakistan is low at around 6m and has been static over the last five years (see Figure 2-1). By contrast there are now more than 124m mobile subscribers and take-up of mobile services can be expected to grow further as network coverage is extended.

Figure 2-1: Number of fixed and mobile subscriptions in Pakistan 2007- 2012

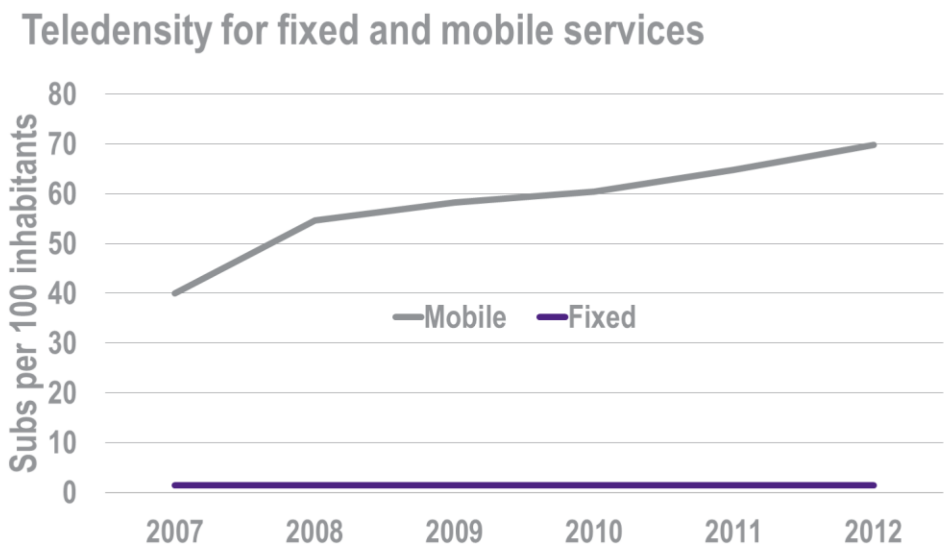


Source: PTA

The result is that while mobile teledensity has been on an upward trend the teledensity of the fixed phone service has been roughly static as Figure 2-2 shows. Fixed subscriptions include wireless broadband subscriptions over WiMAX and wired connections but exclude wireless local loop and CDMA EV-DO broadband subscriptions.

[5] Excluding Wireless Local Loop and CDMA EV-DO services, which are in effect a mobile service with a more limited roaming range

Figure 2-2: Teledensity for fixed and mobile services in Pakistan 2007-2012



Source: PTA

There is clearly a very strong consumer preference for mobile versus fixed communications services. This can be explained both by the lower cost, greater functionality and wider availability of mobile versus fixed services. The future of mass market broadband services in Pakistan in the next 10 years resides with mobile technology.

2.2 Broadband adoption in Pakistan is low

Broadband take-up in Pakistan is low by international standards. Like other comparable countries Pakistan has low fixed broadband penetration but unlike others the mobile broadband service is non-existent. Table 2-1 compares the levels of 3G mobile penetration from Informa Telecoms & Media and fixed broadband penetration from the ITU[6] across the countries and gives the year of release of the 2.1GHz spectrum for each country. Mobile and fixed broadband penetration in Pakistan is (almost) consistently lowest amongst the comparable countries shown in Table 2-1.

[6] http://www.broadbandcommission.org/Documents/bb_annualreport2012.pdf

Table 2-1: Mobile and fixed broadband penetration levels in 2011 and 2.1GHz release year

	Pakistan	Indonesia	Thailand	Philippines	India	Egypt	Nigeria
3G penetration - 2011	0.0%	11.5%	3.5%	16%	1%	0.7%	1.1%
ITU FBB penetration-2011	0.4%	1.1%	5.4%	1.9%	1.0%	2.2%	0.1%
2.1GHz release year	Future date	2006	2012	2005	2010	2006	2007

Source: ITU, Informa Telecoms & Media[7]

2.3 Existing spectrum assignments for mobile are insufficient

Mobile broadband is a low cost and quick way of achieving mass market provision of broadband, as it is possible for operators to offer the service by enhancing their existing 2G networks and offering 3G services to their existing customer base of 124m users. However to do this mobile operators in Pakistan need more spectrum in globally harmonised frequency ranges. Mobile broadband services require considerable amounts of spectrum if a reliable high speed service is to be offered to consumers.

Spectrum for mobile services in Pakistan is currently limited to the 900 MHz and the 1800 MHz bands, with a total of 2x70 MHz available shared between five operators[8]. Figure 2-3 illustrates the amounts of spectrum assigned to mobile operators in Pakistan and comparator countries. This shows that Pakistan is the only country of those shown that has yet to issue licences for the 2.1GHz spectrum and the total amount of spectrum assigned in Pakistan is low. As a result the number of subscribers/MHz in Pakistan is high relative to most comparator countries except India (Figure 2-4).

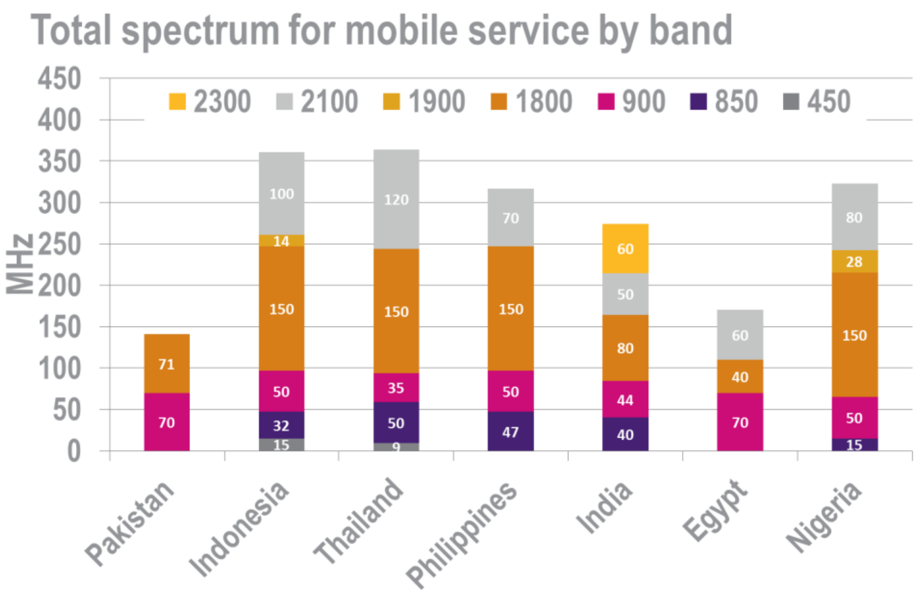
While the 900MHz and 1800MHz bands could be used to provide mobile broadband services in Pakistan, the five operators do not have sufficient capacity in these bands for mobile broadband as well as voice and text services. The 2.1 GHz band offers the additional capacity required for 3G mobile broadband services and the cost of 3G devices is falling rapidly because it is used on a global basis in more than 150 countries[9]. Several 3G devices now sell for US$100 or less, down from the US$500 mark half a decade ago. Examples of 3G smartphones and feature phones that retail for less than US$100 include Huawei XB U8510, Huawei Fusion 2 U8665, Nokia 301, Sony Ericsson Cedar and Sony Ericsson W8.

[7] © Informa UK Ltd 2013. All rights reserved.

[8] http://www.pta.gov.pk/media/Annex_C_GSM_optrs.pdf

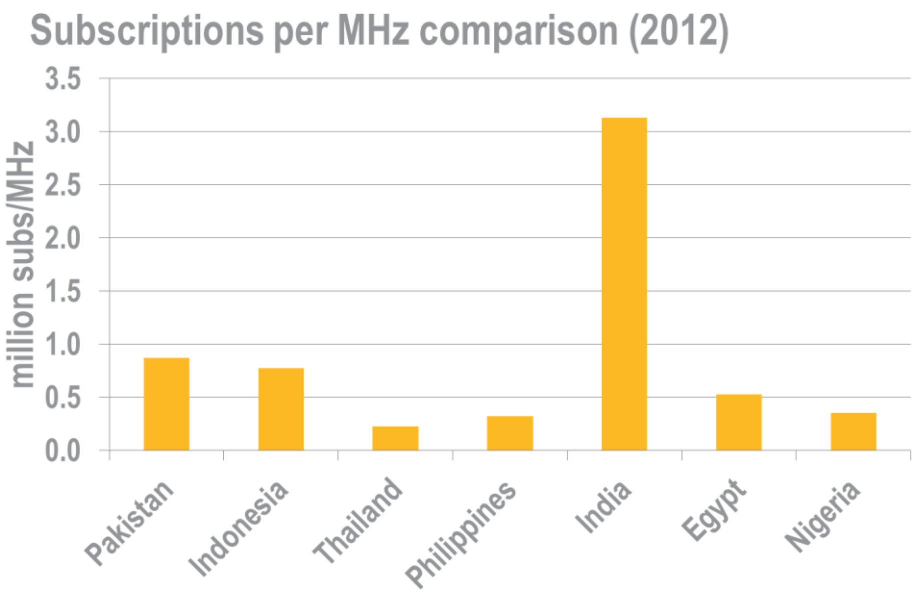
[9] According to the GSA, a total of 186 countries have adopted UMTS. Of these, 39 countries offer UMTS900.

Figure 2-3: Spectrum assigned to mobile operators in Pakistan and comparator countries



Source: Plum Consulting, APT, national regulators

Figure 2-4: Mobile subscribers per MHz of spectrum assigned by country



Source: APT, national regulators, Informa

2.4 Conclusion

Mass market broadband services will only occur in Pakistan if the government releases more spectrum. The obvious frequency band to release is the 2.1 GHz band because it is available in Pakistan, it is deployed on a global basis and there is low cost consumer equipment that can use the band.

3 The economic benefits from releasing the 2.1GHz band will be large

3.1 Introduction

The availability of broadband can enhance and expand the opportunities and capabilities for businesses. It offers access the Internet and the ability to exchange large amounts of data which gives rise to a wide range of economic benefits including[10]:

- **Improved firm productivity** – more efficient business processes; better supply chain management; lower costs of accessing suppliers/wholesale markets as a result of improved interaction and coordination among market agents
- **Extended geographic reach of markets** – facilitates e-commerce; enables access to wider customer base and new ways of delivering products and services. For example, in Indonesia between 2006 and 2011, e-commerce grew by 56% annually on average[11]. In addition, with the availability of mobile broadband beyond Jakarta, opportunities are opening up for online retail transactions. One relatively new entrant into the Indonesian e-commerce market, Rakuten reported that its sales outside of Jakarta rose from 10% to 45% of total sales between June 2011 and November 2012.
- **Lower barriers to entry –** reduced financial and reputational barriers to trade online (especially for Small and Medium Enterprises - SMEs), access to web tools and applications makes it easier for businesses to develop a web presence
- **Innovation** – new business models can be developed, perhaps based on e-commerce and eliminating need for intermediaries in some cases. Also new approaches to delivery of health, education and other government activities are made possible.
- **Greater employment opportunities** – better search and matching in the labour market; job creation in IT-related sectors; greater flexibility as result of tele-working.

An example from the agricultural sector which illustrates many of these benefits is the e-Choupal initiative in India involves the use of Internet kiosks in rural areas to provide timely access to information on rates of agricultural products, local weather, news, as well as best practices in farm management and risk management. In addition to providing an information service, the e-Choupal system gives farmers to the opportunity to sell their produce directly to the Indian Tobacco Company at previous day's closing price, thus, getting rid of the need for a middleman. It also offers seed, fertilizer and other resources for farming at lower prices than the traders. The system has resulted in savings of more than US$1million and productivity gains of up to 40%[12].

In this section we estimate the size of the economic benefits for Pakistan from releasing the 2.1 GHz band in terms of a stimulus to economic growth. This in turn could create new jobs and generate additional tax revenues for government. Payments for spectrum provide a further source of government revenues.

[10] For example, see OECD Work Party on the Information Economy (2011). The economic impact of internet technologies; ITU-UNESCO (2011). Broadband: a platform for progress. A report by the Broadband Commission for Digital Development.

[11] http://blogs.ft.com/beyond-brics/2012/11/12/indonesian-ecommerce-hots-up/#axzz2GwDdN4tI

[12] http://www.mobileactive.org/files/file_uploads/Impact%20of%20Phones%20on%20Indian%20Agriculture.pdf

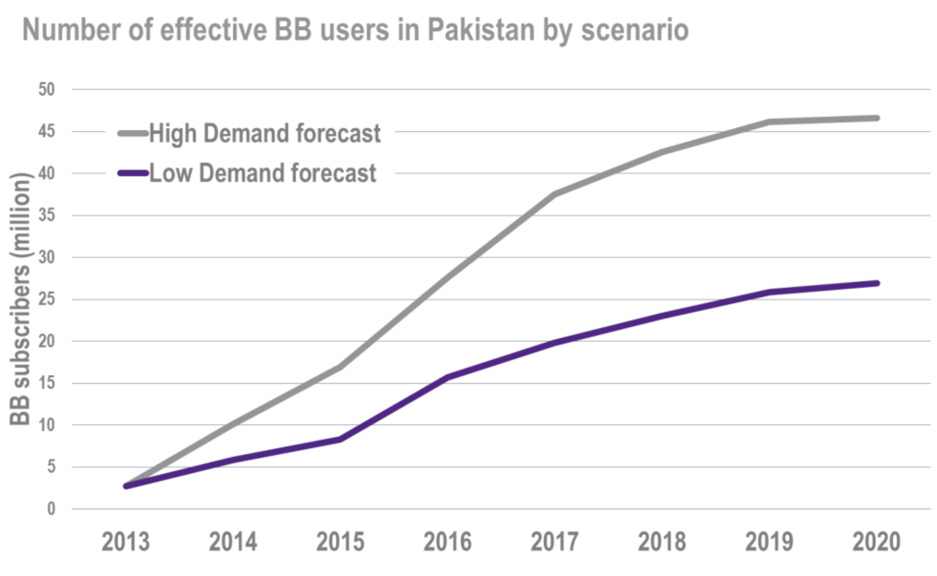
3.2 Once spectrum is released rapid growth in mobile broadband take-up and traffic can be expected

To estimate the benefits from 3G services we first forecast the possible take-up and use of the service for high and low demand scenarios. The key features of the scenarios are as follows:

- High demand scenario: The number of subscribers is projected based on Cisco's mobile data traffic forecasts[13] for Indonesia divided by an assumed traffic per subscriber. It is assumed that operators in Pakistan support the rapid take-up of 3G services by increasing network capacity through investment in many new base stations.
- Low demand scenario: The number of subscribers is projected based on Cisco's data traffic forecasts for India divided by an assumed traffic per subscriber. It is assumed that there is moderate investment in new base stations to support the growing data traffic and subscriber numbers.

The forecast number of effective mobile broadband subscribers is then added to our fixed broadband subscriber forecast until 2020. We assume the 2.1 GHz is available for use in 2014 and in 2016 operators start to use the 900MHz band for 3G services. The forecast numbers of effective broadband subscribers supported by fixed platform and the 900MHz and 2.1 GHz bands under each scenario are shown in Figure 3-1. We do not extend the forecasts beyond 2020 on the grounds that the networks are at full capacity by that time – this is why the growth in the number of subscribers is forecast to taper off at the end of the forecast period. It can reasonably be expected that if additional spectrum were be released by 2020 then subscriber numbers would continue to grow.

Figure 3-1: Forecast of effective broadband subscribers supported by 900MHz and 2.1 GHz and fixed platform in Pakistan by scenario



Source: Plum Consulting

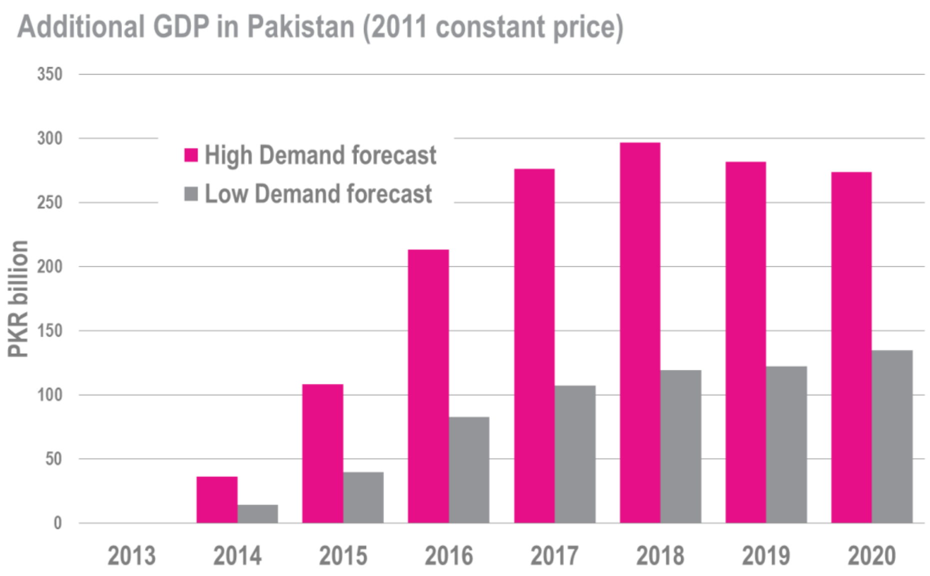
[13] http://ciscovni.com/vni_forecast/index.htm (Cisco VNI 2012)

3.3 Economic growth and job creation will be stimulated

Economic studies have shown that there is a positive relationship between broadband penetration and GDP growth in both high and low income countries. Estimates of the impact of a ten percentage point increase in broadband penetration on GDP growth rates range from 0.1-1.5 percentage points[14], with higher impacts found in lower income countries. We have used a conservative estimate of 0.5 percentage points and assumed this impact lasts 3 years.

The economic stimulus arising from the projected increase in take-up of mobile broadband in the two scenarios is shown in Figure 3-2 in terms of the impact on GDP over the period 2014-2020. With spectrum release in 2013, the net present value of additional GDP over the period to 2020 is PKR1180bn in the High Demand scenario and PKR490bn in the Low Demand scenario. This is equivalent to an average 0.13 percentage points increase in the annual GDP growth rate over this period.

Figure 3-2: Additional GDP for High and Low Demand scenarios



Source: Plum Consulting

As broadband is a general purpose technology it has the potential to bring significant benefits across the whole economy, and so we expect the release of spectrum for mobile broadband to have a positive impact on employment across agriculture, industry and services sectors. To estimate this impact we take the average ratio of jobs to GDP[15] and multiply this by the additional GDP generated by the release of spectrum[16]. For example, in 2018 spectrum release generates PKR297bn in

[14] There are reviews of the literature in "The State of Broadband in 2012: Achieving Digital Inclusion for All", A Report by the Broadband Commission, September 2012; "Broadband Strategies Handbook", Editors T Kelly and C Rossotto, The World Bank, 2012.

[15] The International Labour Office reports there were a total of 51.8m economically active people in Pakistan in 2008 (ILO LABORSTA Internet). GDP in 2008 at 2011 constant prices is estimated at PKR16.714bn (IMF World Economic Outlook Database, April 2012).

[16] In effect we assume that all GDP growth results in more jobs and not in higher wages.

additional GDP (under the high demand scenario) and this leads to an estimated for increase in employment of up to around 900,000 jobs.

Delays in the release of spectrum mean these benefits would be postponed and this results in a loss in both GDP and employment creation. A two-year delay would reduce employment by 2018 by up to 185,000 and the net present value of the GDP impact would be reduced by up to PKR440bn i.e. GDP would be lower by at least PKR5bn/month over the next 7 years[17].

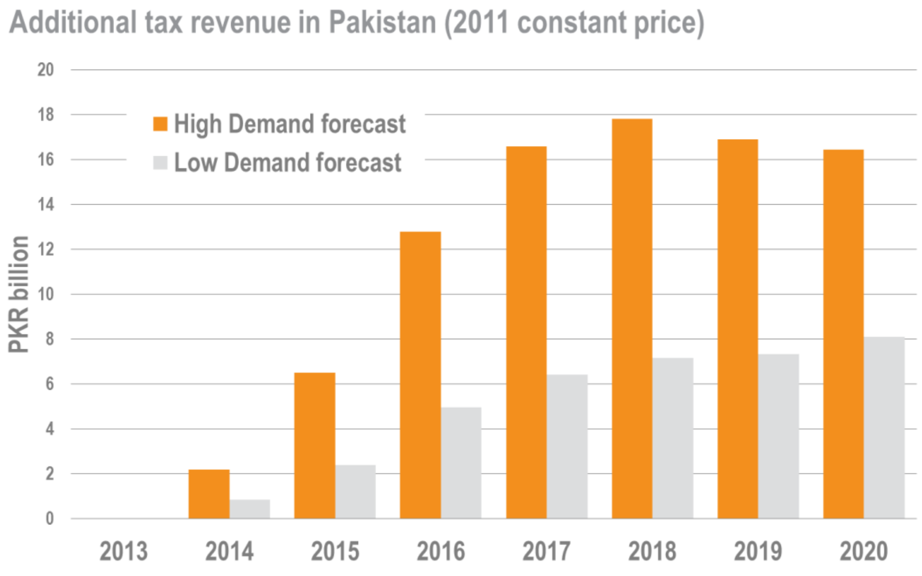
3.4 Government revenues will also increase

There are two potential sources of increase in government revenues, namely an increase in tax revenues and payments for spectrum.

3.4.1 Increased taxes

The increased taxes arise as a result of the general stimulus to economic activity i.e. they derive from taxes paid by all sectors of the economy. Our estimates of these impacts for the high and low demand scenarios are shown in Figure 3-3. The net present value of the additional tax revenues ranges from PKR29bn to PKR71bn.

Figure 3-3: Additional tax revenue for different demand scenarios



Source: Plum Consulting

Because delays in the release of spectrum lead to a loss in GDP, they will also reduce the government's tax revenue. We estimate that a two-year delay would result in a fall in tax revenues for

[17] 440bn/84 = 5.2bn. In fact because future values are discounted the value per month in later years will be higher than 5bn.

the period 2013-2022 of PKR26bn, expressed in net present value terms. This means that tax revenues would be lower by at least PKR300m/month over the next 7 years[18].

3.4.2 Revenues from spectrum payments

Operators' payments for 2.1 GHz licences will depend in part on how they are assigned. This could be by direct award, a beauty contest, an auction or a hybrid mechanism. Whichever approach is taken it is desirable that the award is conducted in a transparent, non-discriminatory manner and that the payment for the spectrum is judged as fair in terms of both process and outcome so that the assignment is not subject to challenge and possibly overturned.

Spectrum award outcomes cannot be predicted with certainty and depend importantly on national regulatory and market circumstances and market sentiment *at the time of the licence award*. But a range of values from comparator countries and previous Pakistan auctions can be informative. This data needs to be put on a common basis for the purposes of comparison – the standard approach is to report the value/MHz/pop in a common currency (in this case Pakistani Rupees using exchange rates at the time of the auction) and make an adjustment for inflation between the time of the auction and today (using the inflation rate for Pakistan). We have applied this approach to auction results for:

- The 2.1 GHz band in a number of low and middle income countries[19], namely Albania (AL), Bulgaria (BU), Brazil (BR), Chile (CL), Egypt (EG), Georgia (GE), India (IN), Indonesia (ID), Kenya (KE), Macedonia (MK), Thailand (TH) and Turkey (TR).
- The amount paid by Telenor Pakistan and Warid for 900MHz and 1800MHz spectrum in Pakistan in 2004.

The resulting values/MHz/pop and the time of the auction are shown in Figure 3-4. As can be seen there is a wide range of values across the countries and no obvious trend over time. Key drivers of auction values include national income now and in future (which affects demand), competitiveness of the mobile market (which affects operator profitability), population density (which affects the relative value of different frequency bands) and competitiveness of the auction itself.

The Pakistan value for the 900 and 1800MHz licences is towards the low end of the values and arguably sets a lower bound on the value of the 2.1 GHz spectrum. However, the value Nigeria in 2007 is even lower. This is because there were only four qualified bidders for four (2x10MHz) licences and so licences were acquired by the qualified licensees at the US$150m reserve price. We expect there to be competition between the five incumbent operators for the three 2.1 GHz licences in Pakistan and so do not think the Nigerian result provides a useful lower bound on value.

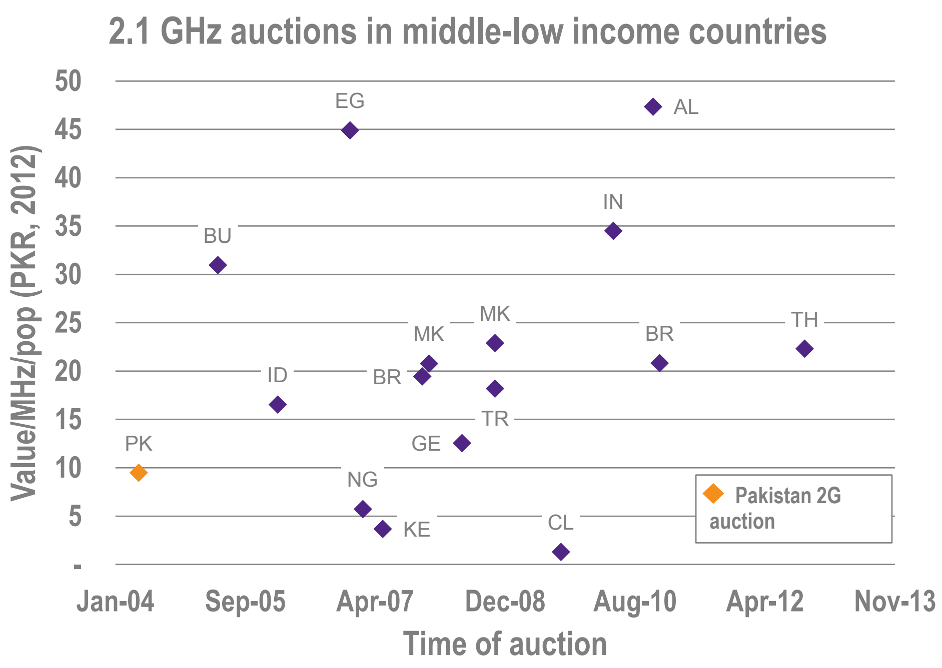
At the high end, it might be expected that the results in India would be relevant. However, the Indian auction value was the result of the very intense competition for spectrum in that market – with up to nine bidders in each area for three (and in some cases four) 2x5 MHz licences. Hence competition is more intense and spectrum per licence less than in Pakistan and so we think this does not provide a reliable guide for Pakistan. We also consider the values for Thailand, Brazil and Macedonia too high given that these countries are economically much stronger than Pakistan. We have used the Indonesian value to provide an upper bound on auction revenues for Pakistan. In the Indonesian case

[18] 26bn/84 = 309m. Because future values are discounted the value per month in later years will be higher than 300m.

[19] As defined by the World Bank.

three 2x5 MHz licences were awarded (with competition between five qualified bidders) and two more licences were directly awarded at the auction clearing price[20].

Figure 3-4: 2.1GHz auction results in middle-low income countries



To estimate of total payments for the spectrum (in 2012 prices) the value/MHz/pop needs to be multiplied by the amount of spectrum to be released - 2x30MHz i.e. 60MHz in this case – and the Pakistan population i.e. 180m. Using the Indonesian value of PKR 16.56/MHz/pop as an upper bound and the Pakistan value for 900 and 1800MHz licences of PKR 9.48/MHz/pop as a lower bound, indicates the revenues raised by the 2.1GHz award could range from PKR102bn -180bn (in 2012 prices).

[20] See "Auction for Allocating Frequency for IMT-2000: The Case of Indonesia", Loso Judijan, ITU Workshop: Market Mechanism for Spectrum Management, Geneva 22-23 January 2007.

plum

4 Socio-economic benefits

Broadband services could enhance the provision of education, health and government services in Pakistan by reducing delivery costs and improving service availability. For example, the dengue activity tracking system in the Punjab which relies on the use of Android smartphones to report breeding sites and more efficient reporting of sites would have been enabled if 3G services were available.

Many health and education resources already reside on the Internet and broadband connectivity enables these to be accessed and communication between service providers improved. In addition, low cost and flexible access to IT resources, such as file storage, software and databases, can be accessed using Cloud based services. These applications can be accessed through a web browser or mobile app and are particularly advantageous to small and medium sized enterprises because they substantially reduce the need for IT staff and hardware and can grow as the organisation itself grows[21].

Access to broadband technology and the internet can provide specific benefits to women enabling access to education and health resources and ways of generating income within their homes. However, women have less access to the internet than men in both developed and developing countries[22]. This has been recognised by the UN Broadband Commission which has set a target of gender equality in broadband access by 2020[23]. The Commission sees this as a key pillar of the global development agenda.

Many of the benefits from using broadband to deliver health and education services will not be reflected in the GDP estimates given in Section 3 as they occur over a long timescale (e.g. the benefits of better primary and secondary education can take 10 or more years to be realised in labour force productivity) and because they are about improving aspects of quality of life which are not captured by GDP measures. Similarly economic measures such as GDP do not reflect the benefits the broadband Internet clearly offers individuals in terms of easy and speedy communication with family members and friends living in other towns and cities or abroad. Below we discuss these less tangible benefits in qualitative terms, giving examples of the benefits delivered by broadband services in a range of countries.

4.1 Education and research

There are two main educational benefits which broadband access can help deliver. First, the Internet can improve education by enhancing remote communication and the delivery of teaching or training materials[24]. This could help ease perennial problems of the lack of teachers, facilities and resources and enable students in rural areas to access online learning materials via mobile phones or laptops outside the classroom.

Second, the broadband Internet can improve the quality of education by expanding the range of learning opportunities through online services and applications. These include email, discussion

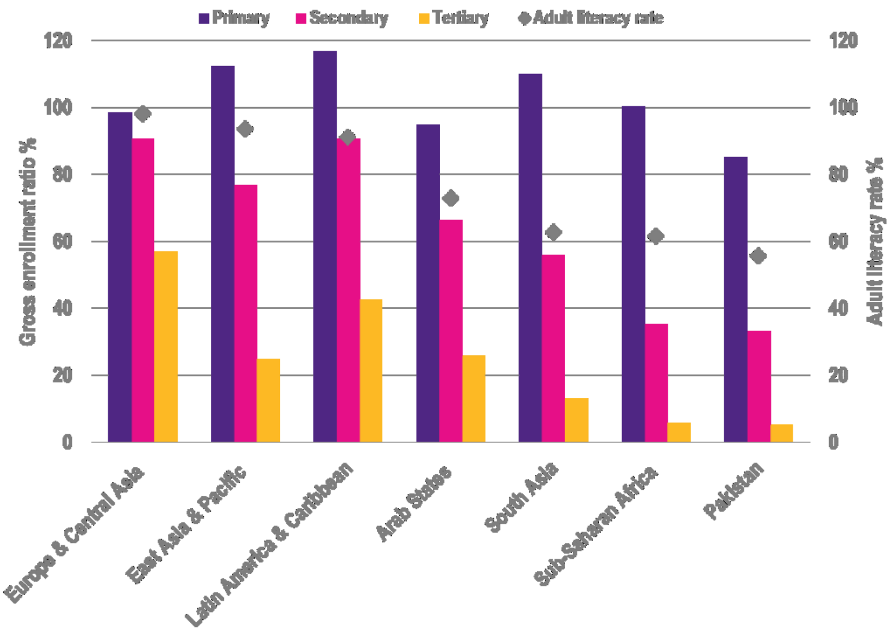
[21] Winning the SMB Cloud, McKinsey 2011. Cloud computing: opportunities and issues for developing countries, S Goundar, 2011 http://archive1.diplomacy.edu/poolbin.asp?IDPool=1335
[22] http://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2013.pdf
[23] http://www.itu.int/net/pressoffice/press_releases/2013/08.aspx#.UgIP4oZwZ1s
[24] OECD (2011).The economic impact of Internet technologies.

boards, live webcasts, podcasts, wikis, blogs, customised course management platforms such as Blackboard, WebCT, Moodle and Sakai.

The Text2Teach programme in the Philippines is an initiative that demonstrates how mobile broadband can help to enhance the quality of teaching resources. As part of the scheme, teachers are given a Nokia N86 8MP phone equipped with the Nokia Education Delivery application and connected to a 3G network[25]. The application enables teachers to download and readily access educational audios and videos for key subjects, including Math, Sciences and English, which have been created specifically as a highly effective visual teaching aid. The multimedia resource makes the learning experience more interactive, and students can learn faster and more effectively[26]. Schools also benefit from lower spending on visual teaching aids.

Around the world many universities have made their classes available online to the public for free. Having Internet access means tertiary education should become more accessible and affordable and help Pakistan close the gap with the rest of the world in the provision of tertiary education. This gap is shown graphically in Figure 4-1.

Figure 4-1: Enrolment and literacy rate



Source: Plum analysis of data in UN Human Development Report 2011

Apart from general education the Internet can also enhance academic and scientific research. For example the Internet can improve communication, and exchange of expertise, between researchers and research centres, as well as facilitate “virtual laboratories” and large-scale collaborative projects involving specialist researchers and ordinary citizens (e.g. NASA’s SETI@home project).

25 http://www.ayalafoundation.org/news.php?i=102

26 http://iskwiki.upd.edu.ph/flipbooks/Text2Teach/

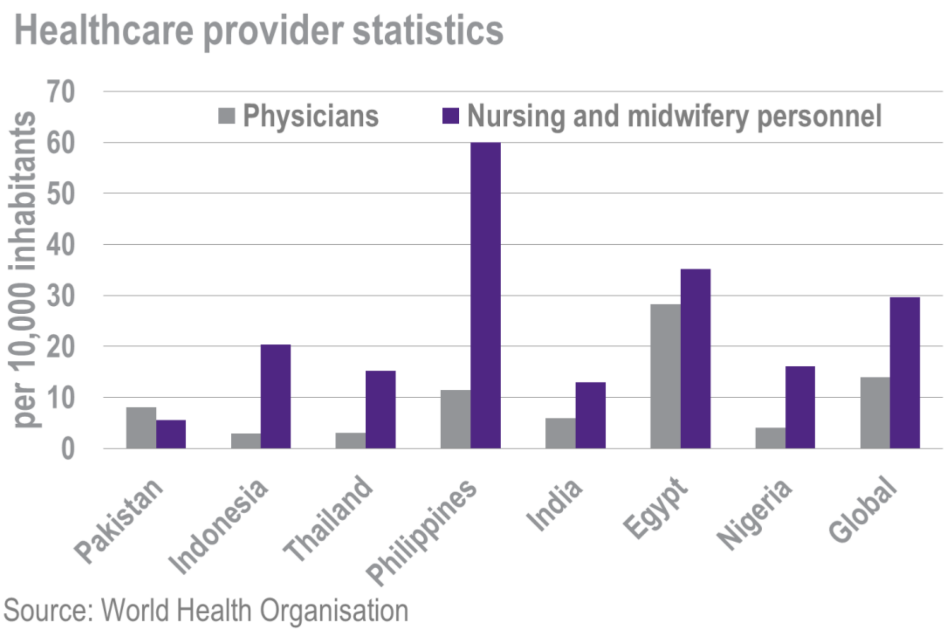
Table 4-1: Potential benefits of the broadband Internet for education and research

Key applications	Potential benefits of broadband Internet
Telepresence and e-education	Creates a virtual experience over a converged network, delivering real time face-to-face interactions, using advanced visual, audio, and collaboration technologies
Interactivity and personalisation	Brings lessons beyond school-based structures enabling teachers to provide individual coaching based on specific needs of individual students
E-learning and open source platforms	Use of open source e-learning platforms reduces costs of providing education and training
Cloud sourcing and information resources	Online reference databases which pool user-generated information to create collective knowledge resources e.g. Wikipedia, online dictionary, encyclopaedia, translation services
Academic research and e-science	Digitisation and storage of research materials (e.g. JStore, ScienceDirect, Google scholar); citizen participation and collaboration in science projects

4.2 Healthcare

Healthcare like education is a long-standing problem in Pakistan. Pakistanis have a life expectancy at birth of just 65.4 years and there is a child mortality rate of 87 per 1,000 live births according to the 2011 UN Human Development Report. The global average for life expectancy is 69.8 years and for child mortality is 58 per 1,000 live births. There are also fewer healthcare providers per capita, especially physicians, in Pakistan compared to the global average as illustrated in Figure 4-2:.

Figure 4-2: Healthcare providers in Pakistan and comparator countries



While broadband alone cannot substitute for doctors, nurses and health care workers, it can improve their productivity and the reach of their services. Table 4-2 gives a summary of e-health applications and their benefits.

Table 4-2: Potential benefits of the broadband Internet for healthcare

Key applications	Potential benefits of broadband
Education and awareness	Websites and social networking to support public health and behavioural change campaigns. Also helps in information sharing among health workers.
Data collection and health record access	Mobile applications to collect and/or access real-time patient data and records
Monitoring/medication compliance	Maintain care giver appointments or ensure medication regime adherence via one-way or two-way communications
Disease/epidemic outbreak tracking	Send and receive data on disease incidence, provide warnings during outbreaks and public health emergencies
Health/administrative systems	Accessible cloud-based drug inventory management, up-to-minute stock checking, verification of drugs to help combat counterfeit drugs
Analysis, diagnosis and consultation	Phone as point-of-care device. Mobile phone-based diagnosis, or microscope pictures sent to distant reference centres for tele-diagnosis

Public bodies South Asia are starting to use mobile services to provide health care in rural areas. Initiatives in Bangladesh, such as Telenor's Health Line[27], allow patients to connect with a health worker to receive free advice 24 hours. In another programme launched in 2010, public health workers contact pregnant women by SMS to remind them about periodic antenatal and postnatal care and provide advice on safe delivery.

It has been estimated that the use of telemedicine delivered by broadband could achieve cost savings of between 10% and 20%[28]. This would be particularly important for Pakistan where the majority of healthcare expenses are borne by private households[29]. The arrival of broadband could also further bolster the development of e-health services and expand their scope into areas such as visual tele-monitoring and emergency room consultations.

Enhanced medical applications are also made possible in countries where 3G mobile service is available. In India, the Apollo Telemedicine Networking Foundation has been using WCDMA/HSPA technology since 2008 to deliver healthcare to remote areas[30]. Services rendered include intensive care unit monitoring, provision of electronic health records and a mobile telemedicine unit. Through high-speed mobile data communications, the foundation is able to offer patients tele-consultation with medical experts, who have ready access to their electronic medical history. Additionally, the use of peripheral medical devices that transmit information over the mobile data network enables tele-consultants to provide virtual home-care.

In the Philippines, the Department of Health, Tarlac Provincial Health Office and Qualcomm, through the Wireless Reach initiative, set up the Wireless Access for Health project in 2010. It was rolled out across the entire Tarlac province in 2012. Using 3G technology, the project enhances the reporting process and facilitates access to accurate and timely patient information for clinicians and decision makers[31]. The project builds on the existing Community Health Information Tracking System, an electronic medical records system developed by the University of the Philippines, Manila. Amongst

[27] http://grameenphone.com/mobile-lifestyle/information/health-line

[28] Boston Consulting Group (2011) cited in ITU-UNESCO (2011) Broadband: a platform for progress

[29] World Bank (2006). Health Financing revisited: a practitioner's guide

[30] http://www.telemedicineindia.com/watwedo.html

[31] http://healthmarketinnovations.org/sites/healthmarketinnovations.org/files/Wireless_Access_for_Health_Tarlac.pdf

other things, the system has helped to cut the time needed to find and bring up patients' records from 4-5 minutes to a few seconds.

4.3 Government activities

Just as for businesses, government in Pakistan could use the broadband Internet in a number of beneficial ways to:

- Raise the productivity and efficiency of government departments. For example government departments might reduce basic paper filing, which incurs significant costs in terms of staff, transportation and resources, especially in rural areas.
- Widen the availability and improve the quality of government services. The development of e-government services, such as online systems for tax filing and public procurement, can give both citizens and businesses convenient, round-the-clock access to required government services using a broadband connection. Such e-government processes can help reduce processing times and improve national competitiveness.
- Strengthen governance processes. The Internet provides new channels and possibilities to promote governance by facilitating citizen to citizen, citizen to government and government to citizen interactions.

Potential e-government applications include government news/information updates; law enforcement/safety; elections; disaster and crisis management; data collection and monitoring and employment services[32]. Many pilot schemes have already been deployed since the start of the last decade in South Asia. Two examples of such programmes in India are the electronic service delivery system, e-Seva, and the online delivery system of lands record, Bhoomi.

e-Seva is a collection of services that are designed as one-stop shops for over 130 government-to-consumer and business-to-consumer services in Andhra Pradesh in India. They include payment of utility bills, registration of birth, sale and receipt of passport applications in Hyderabad[33]. Citizens benefit from the greater dispersion of service delivery points, which at the same time have instant access to the central database. This means they are able to make use of all these services at a location that is closer to their home or office. This cuts down the waiting and transaction time.

The Bhoomi project in Karnataka is an example of the use of process reengineering in E-Government to increase transparency and reduce corruption in the transaction process that takes place in land records offices. Before the project began, the public had no access to the records, and farmers had to bribe the accountant to obtain a copy of the Record of Rights, Tenancy and Crops, which are used for bank loan application. Furthermore, requests to alter records (upon sale or inheritance of a land), which officially should require a maximum of 30 days, sometimes took 1-2 years to process, due to internal inefficiency. Independent evaluation of the project has suggested that incidence of bribery has gone down significantly since Bhoomi's introduction[34].

Another country that is actively making a foray into the field of e-Government is Thailand. The government's aim is to provide transformed services, which comprise an integrated back office for government agencies, migration of information and services between government agencies and the

[32] Hellstrom, J (2010). The innovative use of mobile applications in East Africa, *Sida Review*, 2010:12.

[33] http://www.cse.iitb.ac.in/~cs671/paper_presentation/presentation_eseva.pdf

[34] http://info.worldbank.org/etools/docs/reducingpoverty/case/96/fullcase/India%20Bhoomi%20Full%20Case.pdf

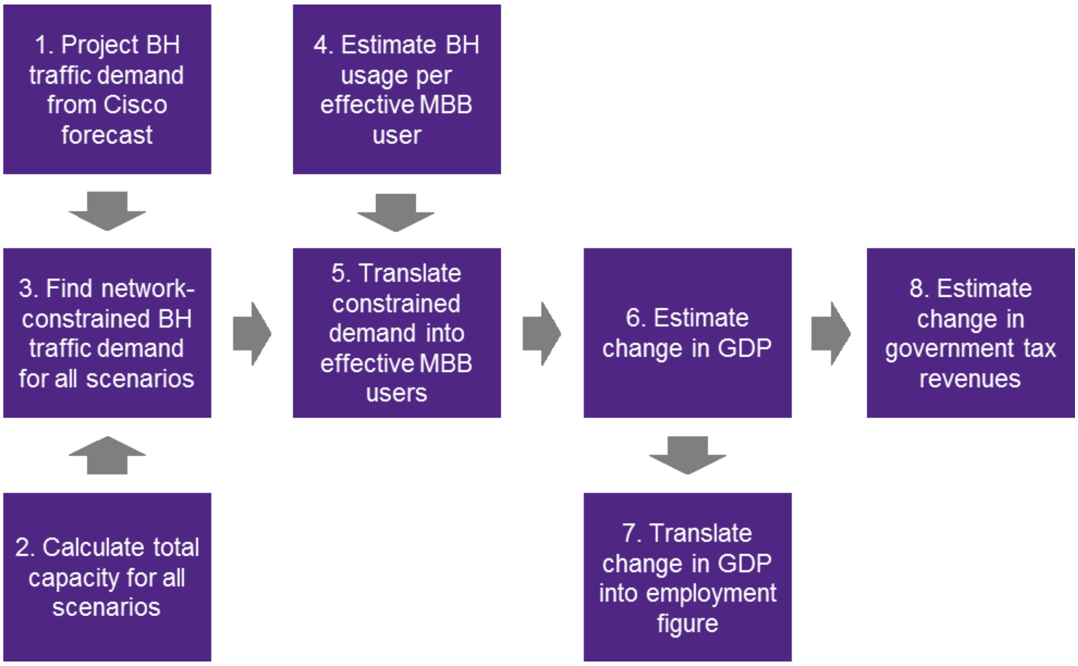
provision of government services through a universal, one-stop electronic platform for around 200 organisations[35]. The key motivation of this push is the government's belief there are benefits in terms of cost reduction as well as improved transparency of government's activities.

[35] http://www.futuregov.asia/articles/2011/jul/01/thailand-provide-transformed-government-services-2/

Appendix A: Modelling methodology

The structure of the model used to estimate the economic benefits of spectrum release is shown in Figure A-1. The modelling process is repeated for all scenarios to derive the incremental GDP, tax and employment associated with the introduction of 3G services. We discuss each step below and describe the data used in the model.

Figure A-1: Structure of the economic model



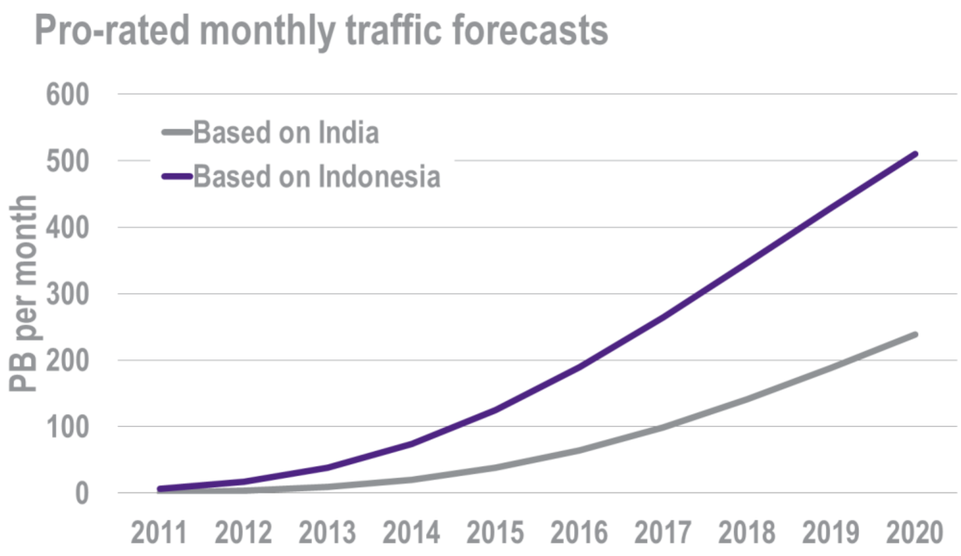
Step 1: Project busy hour traffic from Cisco forecast

We use Cisco's forecasts to underpin the traffic forecasts[36]. Most of the forecasts given are aggregated to the regional level (e.g. Asia as a whole), but Cisco does give separate forecasts for two of the comparator countries, India and Indonesia. Given the closeness of India and Indonesia to Pakistan on a number of socio-economic development measures illustrated in Section 1, India and Indonesia have been selected as the basis for deriving Pakistan's traffic forecasts.

We project the traffic forecasts by Cisco beyond 2016 by fitting a Gompertz curve. Then the traffic volumes are pro-rated to adjust for population differences. Figure A-2 shows the resulting traffic forecast projections.

[36] http://ciscovni.com/vni_forecast/index.htm (Cisco VNI 2012)

Figure A-2: Traffic forecasts for Pakistan



Source: Plum Consulting, Cisco

Pro-rated traffic from Indonesia is significantly higher than the forecasts derived from projections for India. These values are taken to be Pakistan's unconstrained mobile traffic forecasts for Pakistan in the High demand and Low demand scenarios respectively.

Pakistan's unconstrained total monthly mobile traffic forecast is, then, converted into the busy-hour (BH) traffic demand in gigabits per second under the assumption that usage during the busy hour makes up 10% of total daily traffic. We assume that 90% of the traffic is transmitted in the downlink.[37]

Step 2: Calculate total downlink capacity for all scenarios

The total downlink capacity available on networks depends on the number of base stations in urban areas and the quantum of available spectrum over the forecast period. The PTA reports the number of base stations installed between 2006 and 2011 and the amount of spectrum assigned at present. Both variables will need to be forecast[38] and an assumption about the urban: rural base station ratio required. The modelling assumptions for these and other network parameters are listed in Appendix B.

Step 3: Find network-constrained busy hour traffic for all scenarios

Available capacity for effective mobile broadband users from Step 2 is then compared with total unconstrained demand from Step 1. The lower of the two numbers is taken as "realised" traffic for each scenario.

[37] Plum, 2011, "Economic study of the benefits from use of 1452- 1492 MHz for a supplemental mobile downlink for enhanced multimedia and broadband services" http://www.plumconsulting.co.uk/pdfs/Plum_June2011_Benefits_of_1.4GHz_spectrum_for_multimedia_services.pdf

[38] Site sharing between 2G and 3G networks will be taken into account.

Step 4: Estimate busy hour usage per effective mobile broadband user

We estimate busy hour usage based on information available for India and Indonesia. Although India has a much larger population than Pakistan, India has a similarly low rate of urbanisation and similar levels of GDP per capita. Meanwhile, Indonesia is comparable in population size to Pakistan but is more urbanised and has a larger GDP per capita. In lieu of an ideal comparator, we use an average usage in the two countries as the proxy for Pakistan.

The traffic forecasts for India and Indonesia are reduced by 5% to remove traffic assumed to be generated by casual data users. The remaining data traffic is attributed to effective MBB subscribers i.e. subscribers whose use results n economic benefits. To obtain the usage per effective MBB subscriber the traffic forecasts are divided by projections of the number of 3G subscribers (as shown in Figure A-3). Figure A-4 shows the results for India and Indonesia are very similar and we take the average of the two to be a good estimate for Pakistan.

Figure A-3: Effective MBB subscriber forecast

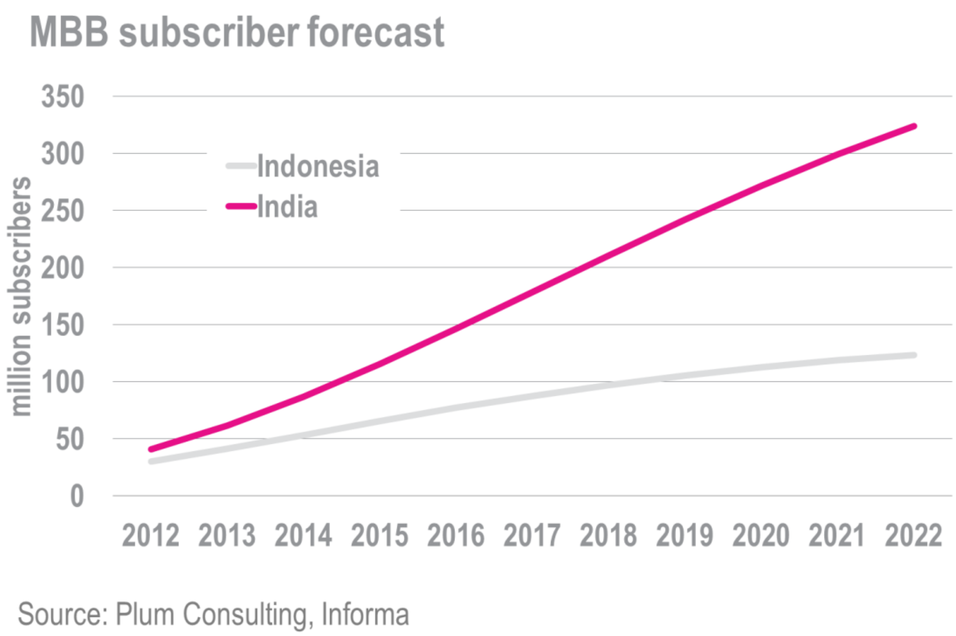
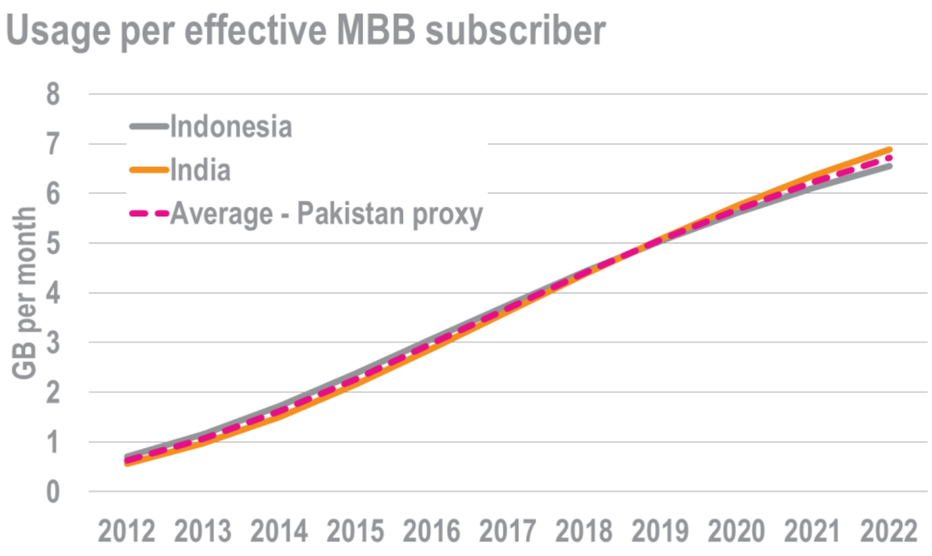


Figure A-4: Usage per effective MBB subscriber



Source: Plum Consulting

Step 5: Translate constrained demand into number of effective mobile broadband users in Pakistan

We divide the constrained busy hour traffic forecast (10%) from Step 3 by the busy hour usage per effective broadband user from Step 4 to give the number of effective mobile broadband users in each case.

As a check on whether the forecasts are plausible we expect affordability and literacy could limit the potential total number of users on a ten year view. We assume that assume that due to relatively low GDP per capita, only up to 50% of the population in urban areas could afford (financially and educationally) to become effective MBB subscribers. For the forecasts to be reasonable, the number of subscribers projected should fall below this affordability constraint, and it does in our model.

Step 6: Estimate change in GDP

Step 5 provides a take-up curve showing the number of effective mobile broadband users over time in each scenario (see Figure 3-1). From this curve and publicly available population forecasts, the mobile broadband penetration is calculated, and its year-on-year change derived. This is then multiplied by an estimate value for the percentage change in GDP growth arising from a 10 percentage point increase in broadband penetration to give a GDP growth stimulus from the growth in broadband penetration.

Step 7: Translate change in GDP into employment figure

To estimate this impact on employment, we will take the ratio of jobs to GDP in Pakistan and multiply this by the change in GDP.

Step 8: Estimate change in government tax revenues

The impact on governmental tax revenues is used by applying the national tax to GDP ratio to the GDP growth stimulus from mobile broadband. We use data from the Asian Development Bank's website to estimate the tax-to-GDP ratio.

Appendix B: Modelling assumptions

The following tables contain values for inputs to the model. The information sources are listed alongside the values.

B.1 Demographic assumptions

Parameter	Value used	Source
Population (million)		
2012	180	The UN (World Urbanization Prospects: 2011 Revision)
2014	187	
2018	199	
2022	211	
Urban population percentage		
2012	36%	Plum's projection based the UN's World Urbanization Prospects numbers for 2015, 2020 and 2025
2014	37%	
2018	39%	
2022	41%	
Average number of people per household	6.4	Calculated from numbers reported in Household Survey 2011 published by Pakistan's Bureau of Statistics
Maximum % of urban population that can afford mobile broadband service	50%	Plum's estimate used previously in another study

B.2 Market assumptions

Parameter	Value used	Source
Number of operators	5	PTA
Mobile population coverage (2012-2022)		
Urban	100%	Plum's estimate based on information from ITU's yearbook and PTA annual report 2011 (http://www.pta.gov.pk/annual-reports/pta_ann_rep_11.pdf)
Rural	92% - 94%	
Blended	92% - 94%	
Monthly data usage volume per effective mobile broadband subscriber		
2014	1.6 GB	Plum's estimates based on the methodology described
2018	4.4 GB	
2022	6.7 GB	

Parameter	Value used	Source
Number of fixed broadband subscriptions (million) 2012 2014 2018 2022	 2.2 3.1 4.4 5.3	Plum's projection based on PTA's statistics for fixed wired and wireless broadband lines

B.3 Network assumptions

Parameter	Value used	Source
% of traffic from occasional users	Up to 5%	Plum's estimate
% traffic in busy hour	10%	Plum study for Ericsson and Qualcomm[39]
% traffic in downlink	90%	Plum study for Ericsson and Qualcomm
% utilisation of capacity for reasonable quality of service for end user	60%	Plum study for Ericsson and Qualcomm
Sectors per BTS	3	
Spectrum efficiency (bps/Hz) 2012 - 2013 2013 - 2022 2022 and after	 0.35 0.35 – 1.25 1.25	Plum study for Ericsson and Qualcomm
Year on year change in spectrum efficiency between 2012 and 2021 (bps/Hz)	0.05	Plum's estimate
Number of BTS by operator at end-2011	Various	PTA: http://www.pta.gov.pk/annual-reports/pta_ann_rep_11.pdf
Growth rate of BTS count Urban areas Rural areas	 Various[40] 2%	 Plum's estimate Plum's estimate
Ratio of urban BTS count to rural BTS count	2:3	Plum's estimate based on previous studies for sub-Saharan African countries

[39] http://www.plumconsulting.co.uk/pdfs/Plum_June2011_Benefits_of_1.4GHz_spectrum_for_multimedia_services.pdf

[40] This depends on the traffic scenario. Under the High traffic scenario, operators are assumed to roll out more base stations to satisfy demand compared to the Low traffic scenario.

B.4 Economic assumptions for GDP growth model

Parameter	Value used	Source
Boost to GDP growth rate per additional 10pp broadband penetration	0.5 percentage points	Plum study for GSMA[41]
Duration of for which the growth rate boost persists	3 years	Plum study for GSMA
Discount rate	5%	Plum study for GSMA
GDP at 2011 constant prices (PKR billion)		
2012	18,677	IMF World Economic Outlook database April 2012 edition
2017	22,182	
15-year base-line GDP yearly growth rate[42]	2.5%	Plum's estimate based on IMF's near-term projection
Tax as a percentage of GDP for the modelling period	6%	Estimated based on averages calculated using information on GDP and tax available from Asian Development Bank's database[43]
Number of economically active persons per unit GDP	.0031	Estimated from International Labour Office data - ILO LABORSTA Internet. GDP estimate is from IMF World Economic Outlook Database, April 2012.

B.5 Spectrum assumptions

We assume that, in future, all new GSM 900/1800 devices will be UMTS-compatible (given the current trend) and 1800 MHz LTE handsets will be cheap enough, so that operators can gradually re-farm their 900 MHz and 1800 MHz spectrum for use with mobile broadband from 2016. The assumptions below are made based on the total quantum of spectrum available to operators as stated on the PTA's website. In addition, 2x30 MHz of the 2.1 GHz spectrum is expected to be released[44]. We assume that each of the 3 largest operators will receive 2x10 MHz each.

B.5.1 Total MBB spectrum available if the 2.1 GHz spectrum is not released

It should be noted that the bandwidth in each row of the tables below refers to the **total** bandwidth available for the mobile broadband service. Therefore, this also includes spectrum from bands other than the 2.1GHz band for which high-speed mobile data service is already possible i.e. the 900MHz (UMTS) and 1800MHz (LTE) bands. We assume that these bands will be re-farmed from 2G services over time.

[41] http://www.plumconsulting.co.uk/pdfs/Plum_Dec11_Benefits_of_spectrum_for_MBB_in_SSA.pdf

[42] The rate at which GDP is expected to grow in the absence of contribution from broadband

[43] http://www.adb.org/sites/default/files/ki/2012/xls/PAK.xlsx

[44] http://www.pta.gov.pk/media/prebid_conf_200912.pdf

B.5.1.1 Urban areas

Operator	2014	2016	2018	2020	2022
Mobilink	0 MHz	2x5 MHz	2x11 MHz	2x13.6 MHz	2x13.6 MHz
Telenor	0 MHz	2x2.5 MHz	2x9.8 MHz	2x13.6 MHz	2x13.6 MHz
Ufone	0 MHz	2x5 MHz	2x11 MHz	2x13.6 MHz	2x13.6 MHz
Zong	0 MHz	2x5 MHz	2x11 MHz	2x13.6 MHz	2x13.6 MHz
Warid	0 MHz	2x2.5 MHz	2x9.8 MHz	2x13.6 MHz	2x13.6 MHz

B.5.1.2 Rural areas (Not using 1800 MHz due to unfavourable propagation characteristics)

Operator	2014	2016	2018	2020	2022
Mobilink	0 MHz	2x2.5 MHz	2x5 MHz	2x7.6 MHz	2x7.6 MHz
Telenor	0 MHz	0 MHz	2x4.8 MHz	2x4.8 MHz	2x4.8 MHz
Ufone	0 MHz	2x2.5 MHz	2x5 MHz	2x7.6 MHz	2x7.6 MHz
Zong	0 MHz	2x2.5 MHz	2x5 MHz	2x7.6 MHz	2x7.6 MHz
Warid	0 MHz	0 MHz	2x4.8 MHz	2x4.8 MHz	2x4.8 MHz

B.5.2 Total MBB spectrum available assuming the 2.1 GHz band is released in 2013

The 2.1GHz allocation is the difference between the values shown below and the values in the tables given above for the corresponding operator and year. We assumed for modelling purposes that the three largest operators, Mobilink, Telenor and Ufone, will be the recipients of the 2.1GHz spectrum following its release.

B.5.2.1 Urban areas

Operator	2014	2016	2018	2020	2022
Mobilink	2x10 MHz	2x15 MHz	2x21 MHz	2x23.6 MHz	2x23.6 MHz
Telenor	2x10 MHz	2x12.5 MHz	2x19.8 MHz	2x23.6 MHz	2x23.6 MHz
Ufone	2x10 MHz	2x15 MHz	2x21 MHz	2x23.6 MHz	2x23.6 MHz
Zong	0 MHz	2x5 MHz	2x11 MHz	2x13.6 MHz	2x13.6 MHz
Warid	0 MHz	2x2.5 MHz	2x9.8 MHz	2x13.6 MHz	2x13.6 MHz

B.5.2.2 Rural areas (Not using 1800 MHz due to unfavourable propagation characteristics)

Operator	2014	2016	2018	2020	2022
Mobilink	0 MHz	2x7.5 MHz	2x15 MHz	2x17.6 MHz	2x17.6 MHz
Telenor	0 MHz	2x5 MHz	2x14.8 MHz	2x14.8 MHz	2x14.8 MHz
Ufone	0 MHz	2x7.5 MHz	2x15 MHz	2x17.6 MHz	2x17.6 MHz
Zong	0 MHz	2x2.5 MHz	2x7.6 MHz	2x7.6 MHz	2x7.6 MHz
Warid	0 MHz	0 MHz	2x4.8 MHz	2x4.8 MHz	2x4.8 MHz

B.5.3 Total MBB spectrum available under delayed release (2015) of the 2.1 GHz spectrum

B.5.3.1 Urban areas

Operator	2014	2016	2018	2020	2022
Mobilink	0 MHz	2x15 MHz	2x21 MHz	2x23.6 MHz	2x23.6 MHz
Telenor	0 MHz	2x12.5 MHz	2x19.8 MHz	2x23.6 MHz	2x23.6 MHz
Ufone	0 MHz	2x15 MHz	2x21 MHz	2x23.6 MHz	2x23.6 MHz
Zong	0 MHz	2x5 MHz	2x11 MHz	2x13.6 MHz	2x13.6 MHz
Warid	0 MHz	2x2.5 MHz	2x9.8 MHz	2x13.6 MHz	2x13.6 MHz

B.5.3.2 Rural areas (Not using 1800 MHz due to unfavourable propagation characteristics)

Operator	2014	2016	2018	2020	2022
Mobilink	0 MHz	2x2.5 MHz	2x12.5 MHz	2x17.6 MHz	2x17.6 MHz
Telenor	0 MHz	0 MHz	2x9.8 MHz	2x14.8 MHz	2x14.8 MHz
Ufone	0 MHz	2x2.5 MHz	2x12.5 MHz	2x17.6 MHz	2x17.6 MHz
Zong	0 MHz	2x2.5 MHz	2x7.6 MHz	2x7.6 MHz	2x7.6 MHz
Warid	0 MHz	0 MHz	2x4.8 MHz	2x4.8 MHz	2x4.8 MHz