

SPECTRUM FOR DEVELOPMENT

Steve Song

THE IMPACT OF ACCESS AND THE ROLE OF WIRELESS TECHNOLOGIES

No one who has spent time in an economically poor country could fail to recognise how profoundly communication technologies have affected the fabric of daily life, their invisible impact in changing social norms and in the way business is conducted. While the effect of information and communication technologies (ICTs) is a global phenomenon, the impact is most profound in the previously least connected countries.

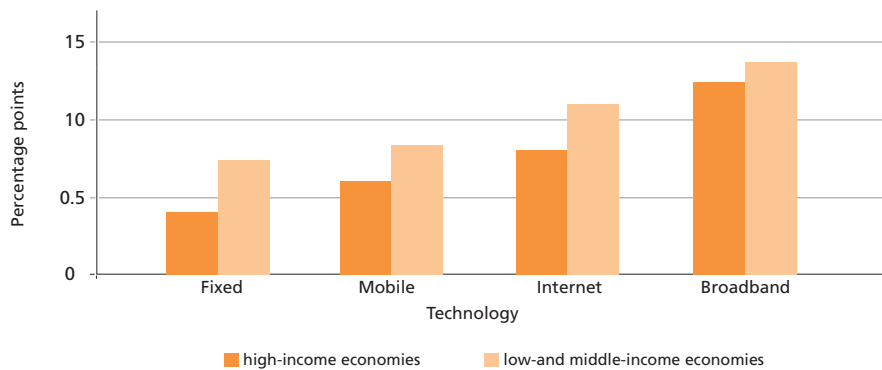
Evidence from the World Bank¹ suggests a link between density of communication infrastructure and GDP. There are two striking facts from the World Bank study:

- GDP increases with the robustness of the communication form, i.e. increase in broadband has more impact than a similar increase in telephone density;
- The impact is more profound in low and middle income countries.

It is not clear from the World Bank's work how evenly those economic benefits are spread across society or whether communication infrastructure may have served to exacerbate social and economic disparities between rich and poor.

¹ The World Bank *Information and Communications for Development 2009. Extending reach and increasing impact* (Washington DC: The World Bank, 2009), 3-17 siteresources.worldbank.org/INTEDEVELOPMENT/Resources/IC4D_2009_Overview.pdf

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The y axis represents the percentage point increase in economic growth per 10 percentage point increase in telecommunications penetration.

SOURCE: World Bank

There is evidence across a number of African countries that the poor are spending a disproportionate amount of their disposable income on mobile services.² At the same time, access is not yet ubiquitous, high-speed ADSL services are largely restricted to urban centres and even 3G networks have limited coverage in rural areas.

So how can the challenge of access and affordability be met in developing countries? The answer lies in the effective use of wireless technologies.

For rural access wired technologies are simply not practical. In the industrialised world, copper features heavily in last mile technologies for high-speed data whether via an ADSL-enabled copper telephone line or via the coaxial copper cable provided by cable television operators.

However copper-based last mile solutions present particular challenges in poor countries. The roll-out cost of copper infrastructure is very high, and often not practical in lower-income countries; even less so in sparsely populated rural areas. The steadily increasing value of copper as a commodity has also made it an irresistible target for thieves.³

Fibre optic cable infrastructure is another important connectivity technology, especially for communication backbones, but is currently only viable as a last-mile solution in very wealthy communities.

Finally, satellite-based infrastructure can be a powerful technology for delivering access in remote areas but it too is currently not cost-effective as a last mile technology.

2 Alison Gillwald and Christoph Stork *Towards evidenced-based ICT policy and regulation: ICT access and usage in Africa. Volume One 2008, Policy Paper Two* (Cape Town: Research ICT Africa, 2008) www.researchictafrica.net/publications/Towards_Evidence-based_ICT_Policy_and_Regulation_-_Volume_1/RIA%20Policy%20Paper%20Vol%201%20Paper%202%20-%20ICT%20Access%20and%20Usage%20in%20Africa%202008.pdf

3 According to South African energy minister Dipuo Peters, copper theft cost South Africa over R100 million in 2010, www.itweb.co.za/index.php?option=com_content&view=article&id=46389:cable-theft-is-murder&catid=69

4 Opera Software "State of the Web, June 2011" media.opera.com/media/smw/2011/pdf/smw062011.pdf

5 Social Bakers, www.socialbakers.com/countries/continents

6 Cisco *Cisco Visual Networking Index: Global mobile data traffic forecast update, 2010-2015* (San Jose, CA: Cisco, 2011), www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-520862.pdf

7 Safaricom, mPesa statistics, 2011, www.safaricom.co.ke/fileadmin/M-PESA/Documents/statistics/M-PESA_Statistics_-_2.pdf

This means that when talking about affordable, ubiquitous access to communication in developing countries, wireless technologies offer the most hope for effectively bridging the digital divide.

The unprecedented speed with which mobile infrastructure has spread across the world might lead one to imagine that the challenge of access has been solved. While there is an element of truth to this, consider the following facts:

- **Evidence of dramatic escalation in demand.** Across several African countries there is evidence of non-linear growth in mobile data usage. Between 2010 and 2011, Nigeria experienced a 400% growth in mobile internet users, Sudan 300%, Ghana 200%, and Kenya 75%. Zimbabwe experienced an incredible 4,500% growth in the period.⁴ Facebook and Google vie for top spot as the most popular destination on mobile phones in Africa. Africa now has over 32 million⁵ Facebook users up from an estimated 10.5 million in 2010. While data is not available as to the exact breakdown of mobile versus fixed internet use of Facebook, we do know that Facebook roughly ties with Google as the most popular mobile destination in Africa.
- **Many rural areas are still not deemed economically viable by operators.** Service delivery to rural areas remains a challenge for telecom operators. Dispersed rural populations, cost of roll-out, and lack of power infrastructure challenge the ability of operators to deliver rural access. Disparity between the connected and the unconnected steadily increases as access becomes more and more valuable with the evolution of e-money services like mPesa,⁷ market information systems, and access to government services.
- **Apparent spectrum scarcity has contributed to keep prices artificially high.** The limited amount of spectrum available to telecom operators has directly influenced the number of wireless service providers. This constraint has lessened the pressure to offer more and more competitive services with the result that people in developing countries are often paying artificially high prices for services.

This is for the *least* connected region in the world. Elsewhere, demand for bandwidth is rocketing even faster. Networking giant Cisco estimates that mobile data traffic will increase 26-fold⁶ between 2010 and 2015.

RADIO WAVES FOR BEGINNERS

Wireless communication relies on the transmission of radio waves – a form of electromagnetic radiation. The word “waves” is important. While radio waves do not rely on a physical medium for transmission, in the way that waves on a pond or sound waves do, they share important characteristics and some analogies with waves from the physical world, and can help us understand the challenges of managing wireless communication.

Legislation and regulation regarding wireless communication has evolved for one principal reason: interference. More specifically, regulation has evolved to manage the interference that occurs when two or more people transmit radio waves in the same or overlapping frequencies. If it were not for interference there would be no need to restrict the use of specific radio frequencies to specific users and applications.

So what is interference? The answer is not as simple as it appears. Imagine a still pond into which you have dropped a single pebble. It is easy to see the propagation of waves caused by the stone. Now imagine twenty people dropping stones into the same pond at the same time. Can you still see the waves caused by your stone? Unlikely. That is interference. You can no longer see your waves. Radio waves interfere with each other in a similar sort of manner. When the signals from two television stations overlap you can no longer distinguish the programme you wanted to watch. Counter-intuitively, radio waves are not destroyed when they collide with each other. They pass through each other. Thus if you had the magical ability to colour only the waves caused by your pebble, you would clearly see your waves again even though others were dropping pebbles at the same time. We can see a similar effect with sound waves at a cocktail party⁸ where there is a cacophony of sound yet we are able to focus in on the words of a single speaker. While researchers are still debating how exactly it is that we do that, the fact that we can do it is evidence that intelligent interpretation of sound waves can help us focus on what we want to hear. A similar effect is found with noise-cancelling headphones.

In the early days of wireless communication interference was an easy problem to solve. The range of available spectrum was vast and demand was comparatively small. Interference could be solved by making sure that people using spectrum in the same geographic region were allocated individual bands of spectrum that were well apart from each other in the spectrum band. This was the cocktail party equivalent of making sure that everyone is given a private room in which to have a personal conversation.

And so things might have continued to this day had it not been for the explosion of demand for wireless spectrum from broadband service providers and mobile operators. In the last fifteen years spectrum has gone from an abundant to an apparently scarce resource. But is it truly scarce? It is certainly true that demand currently exceeds supply but there is debate as to the nature of the scarcity and that debate is rooted in the nature of what spectrum is and how, as a result, it should be treated.

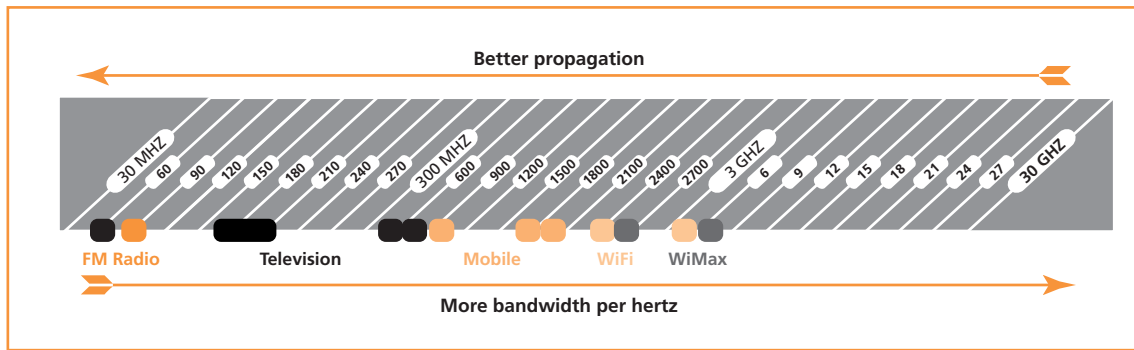
A key consideration when looking at public versus private access to resources is whether that resource is rival, i.e. does use of it by one person preclude use by another. Rival goods tend to become private property whereas non-rival goods such as solar power, for example, are public goods that do not require management. And of course there is a range of goods in between which are partially rival, such as the oceans and nature in general, which are non-rival as long as care is taken to ensure the resource is tended and not overused.

Historically, regulators have been obliged to treat spectrum as a rival good because of interference. In fact, in order to ensure the absence of interference for television broadcasters, regulators were obliged to establish spectrum frequency no-man’s-lands between television channels to reduce the chances of stray interference.

However, two increasingly powerful trends in wireless technology oblige us to reconsider how we think about spectrum and spectrum management:

- We have to acknowledge the steady increase in spectral efficiency in wireless technologies. Every year we are able to pack more data into less spectrum and cover a wider geographical area with it. This efficiency is typically expressed as *bits per hertz per km²*.

⁸ Barry Arons “A review of the Cocktail Party Effect” *Journal of the American Voice I/O Society* 12 (July 1992): 35-50 xenia.media.mit.edu/~barons/pdf/arons_AVIOSJ92_cocktail_party_effect.pdf



While spectrum is not infinite, this trend shows no immediate sign of slowing down. In fact, wireless pioneer Martin Cooper has coined a law similar to Moore's Law⁹ in which he argues that spectral efficiency has doubled every 30 months since Marconi patented the wireless telegraph in 1897.¹⁰

- Perhaps more importantly, we must consider the remarkable technological strides made in managing wireless interference. It is increasingly possible to design wireless technologies which are sensitive to other radio transmissions and which can adapt themselves accordingly by switching frequencies, adjusting power levels, etc. That is, wireless technologies are getting better and better at playing nicely with each other. This opens up tremendous possibilities to increase the efficiency of spectrum use. The range of technologies being developed is often grouped under the umbrella of cognitive radio.

A final important thing to know about wireless spectrum is that not all spectrum is created equal. At the lower frequency end of the radio spectrum, radio waves are referred to as having great propagation characteristics. This means they have better reach because they are capable of travelling through solid objects without much signal loss. Thus radio spectrum at the lower frequencies is often considered quite valuable because fewer transmitters are required to cover an equivalent area at a higher frequency. There is a trade-off though: the higher the frequency, the more data can be communicated per hertz of spectrum.

⁹ Moore's law describes the doubling of computing power every two years. Wikipedia "Moore's law" accessed 8 September 2011 en.wikipedia.org/wiki/Moore%27s_law

¹⁰ "Father of the cell phone" *The Economist* 4 June 2009 www.economist.com/node/13725793

SPECTRUM ADMINISTRATION BASICS

Having understood how radio waves behave it is essential to understand how radio communication use is governed. There are three terms that are key to understanding spectrum administration: allocation, assignment, and use.

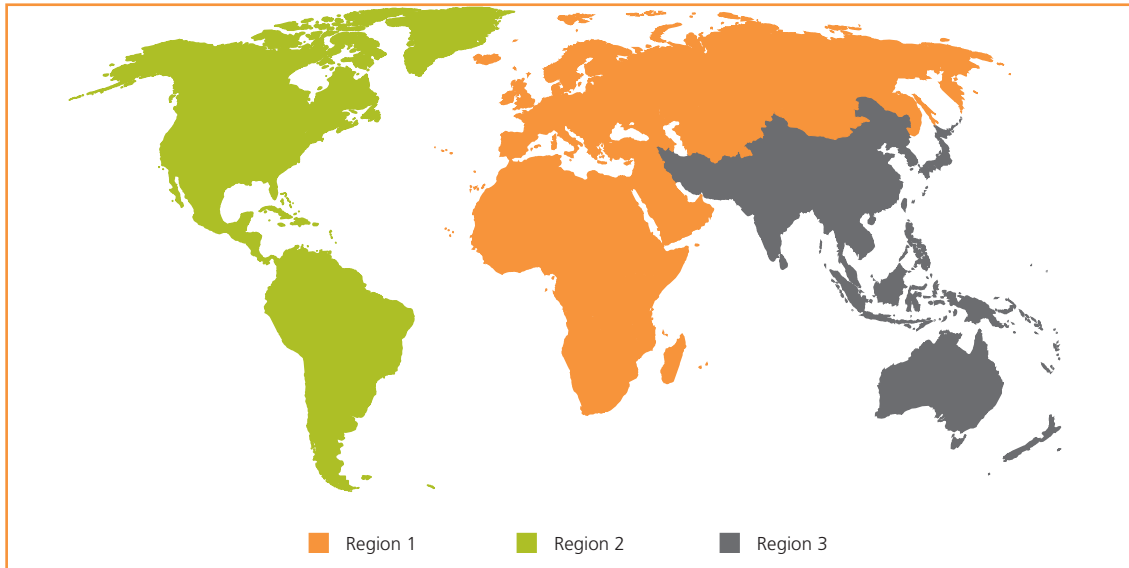
Allocation. Allocation refers to how communication regulators have determined specific frequency bands of spectrum should be used. An allocation specifies the type of radio communication that may be used within a spectrum band. The image on page 5 shows the dots that refer to bands allocated to radio, television, mobile uses, etc. Having spectrum allocation is important because, without it, manufacturers would have difficulty designing devices that work together. There is hope that in the future this may change as more and more radio communication can be controlled through software-making technology with a growing flexibility, but this is not a commercial reality in 2011. While national governments have the last word on spectrum allocation, most agreement on allocation is done at an international level.

Assignment. Within a particular spectrum band, spectrum is assigned by a national regulator to a particular user organisation. This is usually done in the form of a license to use a specific range of frequencies. Assignments of spectrum always take place within a range of allocated spectrum. There are often multiple assignments of spectrum within an allocation band. For example, spectrum allocated for mobile telephony use is usually assigned to several different companies to offer mobile services.

Use. Just because spectrum has been allocated to a particular use and assigned to specific users does not mean that it is in use. Understanding where spectrum may have been assigned but is either under-utilised or not in use at all is key to planning more efficient spectrum use. Without regulator spectrum audits of frequency use it can be challenging to establish whether spectrum is actually being used.

Finally, there is one other important distinction. While most spectrum is assigned through spectrum licenses there are also spectrum bands that have been designated for unlicensed use. This means that anyone may use this spectrum band as long as they have a device that has been approved for use in that band. Unlicensed wireless devices on the market today range from computers and phones to microwave ovens, cordless microphones, and baby monitors. However, unlicensed spectrum is still regulated spectrum. Regulations determine the behaviour of equipment within an unlicensed band. Radio power output is one of the most important things typically controlled in unlicensed bands in order to restrict the extent to which devices may interfere with each other. Low power output limits the range of devices designed for unlicensed use.

A BRIEF HISTORY OF SPECTRUM MANAGEMENT



The International Telecommunications Union (ITU) is the United Nations agency responsible for allocating global radio spectrum and satellite orbits. They develop the technical standards that ensure networks and technologies seamlessly interconnect. While the ITU dates back as far as 1865, the history of spectrum regulation and management can be traced back to the first Radiotelegraph Conference which took place in Berlin in 1906. It was attended by representatives of 29 countries and began to establish common standards for what was then called wireless telegraphy.

While every country has sovereignty over spectrum use within their borders wireless communication does not respect frontiers; hence the need for harmonisation and standardisation.

Initially concerned with maritime services in the 1920s the ITU began to develop regulations in response to the growing variety of commercial and public radio services. This led to the development of agreements on the allocation of specific frequency bands for specific kinds of service. Spectrum allocation is one of the key functions of the ITU.

However, as technologies evolved, corporate and national interests in different regions diverged and countries failed to agree on common usages for some ranges of spectrum. By 1947, this had led to the establishment of three global spectrum regions, roughly divided up by continents:

- Region 1: Africa, Europe, the Middle East west of the Persian Gulf including Iraq, the former Soviet Union and Mongolia.
- Region 2: The Americas.
- Region 3: South and Southeast Asia and Australia.

Unfortunately, what was a working compromise in the mid-twentieth century turns out to be a challenge in the globalised 21st century. Technology developed for one part of the world may not work or may actually be illegal in another part of the world. This is why a North American dual band mobile phone will not work in Europe or Africa. The harmonisation of spectrum use is an ongoing challenge for the ITU. With minor variations, countries within each region conform to the spectrum allocation for their region set out by the ITU.

As might be inferred from the above, technology manufacturers play a pivotal role in spectrum planning. Spectrum planning depends on an understanding of global technology and manufacturing trends and agreements.

Spectrum has always been treated as a national resource and as such is overseen by government bodies. In some cases that body is one organisation but more often there is one organisation to oversee government including military uses of spectrum and another organisation to oversee commercial and other uses of spectrum.

For example in the U.K. the Ministry of Defence manages military spectrum and the communications regulator, Ofcom, manages everything else. In the United States, the National Telecommunications and Information Administration (NTIA) manages all government spectrum and the Federal Communications Commission (FCC) manages commercial and other uses of spectrum.

A challenge has evolved with this division of labour in government: as demand for spectrum increases, it is in everyone's interest to make the most efficient use of available spectrum. This is a big enough challenge within a single agency but trying to coordinate spectrum reform across two independent agencies multiplies the burden.

For most of the 20th century spectrum was managed in a centrally-planned manner and the use of specific spectrum bands was tightly regulated. In the world of television broadcasting a spectrum license determined the nature of services to be delivered, the technology to use, and even the business model. However, as demand for spectrum increased and technology improved, administrators began to see the merits of adopting a "private property" approach to spectrum where spectrum might be auctioned to the highest bidder.

Economist Ronald Coase originally proposed this model in 1959,¹¹ and argued that it would create the most efficient use because spectrum would be allocated to those who valued it most. Spectrum holders would then be at liberty to define their own use as long as it fell within the boundaries of the spectrum allocation definition. This idea took some time to catch on and indeed debate continues to this day on the merits of treating spectrum as private property. Yet, in 1989 the first spectrum auction took place and more and more countries have followed suit, adopting competitive bidding as an effective means of assigning spectrum. Billions of dollars have been raised through auctions around the world.

One unfortunate side effect of the success of spectrum auctions is that they can be a popular choice for the wrong reasons, namely windfall revenue to the national treasury. However, there can be little doubt that spectrum

auctions have proven useful for the assignment of private property-style spectrum licenses in many countries.

An exception to this is the phenomenon of unlicensed spectrum and, in particular, the success of the IEEE 802.11 "Wi-Fi" standard for unlicensed use of the 2.4 and 5.8GHz spectrum bands. In 1985, the FCC in the United States authorised the use of spread spectrum communication in the ISM¹² spectrum bands. Over the next fourteen years little happened while the IEEE evolved a standard for wireless local area network (LAN) communication. Then, in 1999, the first 802.11 standard was released at 1Mb/s. This was the cue for the development of a billion dollar industry. Now Wi-Fi devices claim speeds of up to 600Mb/s and substantially less than the original devices. Market research estimates that 2012 will see over a billion¹³ Wi-Fi-enabled devices shipped.

It is hard to overestimate the impact of the 802.11 suite of open standards in the industrial, scientific and medical (ISM) bands. We think of it as normal to have Wi-Fi available in many buildings we enter. We expect devices we purchase – phones, computers, e-book readers, tablets – to have Wi-Fi capacity. Most of the recent advances in wireless communication have often first found their way into the market on Wi-Fi devices. Wi-Fi has gone from hobby technology to ubiquitous technology in little more than twenty years.

It is easy to see then how spectrum management has become increasingly challenging with the steadily accelerating pace of technology change. As technology development cycles get shorter and shorter our ability to predict the evolution of technology also shrinks. The challenge of modern spectrum management is to develop regulations that can accommodate the present and the unknown future.

12 ISM bands refer to the frequency bands for industrial, scientific and medical (ISM) applications. The use of these frequency bands for ISM applications shall be subject to special authorization by the administration concerned, in agreement with other administrations whose radiocommunication services might be affected. See www.itu.int/ITU-R/terrestrial/faq/index.html#g013

13 "Living the wi-fi high life: Wi-fi chipsets shipped will pass one billion units per year by 2012" *In-Stat* 21 September 2011 www.instat.com/newmk.asp?ID=2858&SourceID=00000652000000000000

11 Ronald H. Coase "The Federal Communications Commission" *Journal of Law and Economics* 2 (October 1959): 1-40

SPECTRUM REGULATION FOR DEVELOPMENT

We know that decreasing the cost and increasing pervasiveness of access will have a positive social and economic impact in developing countries and we know that wireless technologies hold the key to the last mile. How can we catalyse both decreased costs and increased access? What are the barriers?

Creating a level playing field

It is increasingly commonplace knowledge that telecommunications networks profit from network effects.¹⁴ The bigger the network, the higher the value it holds. This gives any incumbent telecom operator a massive strategic advantage. Even more critically, the limited amount of spectrum that has been available for mobile services has meant that the number of competitors in the market is necessarily constrained. In many countries this has resulted in a stagnation of competition and consequently unnecessarily high telecommunications costs. Making more spectrum available, in particular to new market entrants, is likely to lead to more competition and healthier markets.

Building regulatory capacity

Effective communication regulation takes resources. Most communication regulatory agencies in developing countries do not have sufficient staff and expertise to deal

pro-actively with a rapidly evolving technology and policy environment. The impact of this is two-fold. It means that appropriate regulatory policy is not deployed fast enough to cope with demand. Without sufficient human resources and sufficient capacity-building, regulatory agencies struggle to cope. On the other hand, incumbent telecommunications companies are extremely well-resourced by comparison and invest considerable resources and expertise in lobbying regulators to maintain their comfortable position.

Getting auctions right

Auctions have emerged in the last twenty years as the de facto best practice for assigning high-value spectrum bands. However, auctions are also notorious for being gamed by bidders. Over time, spectrum auction process and technology has evolved to thwart most if not all strategies for gaming auctions. In some cases a badly organised auction can be worse than simply giving spectrum away to the first person who asks. Not only can a badly run auction result in spectrum not going to the entity that values it most but it can lead to endless court challenges to the auction process, thereby tying results up in litigation such that no one benefits. Auctions can be the appropriate solution but getting them right can be challenging.

Doing the wrong thing with spectrum allocation can also have long-term cost implications. Spectrum, once allocated and assigned, can take decades to change. Manufacturers, operators and users all have a stake in the result. Getting it wrong can be costly but so can delaying. It is a difficult balance to strike.

¹⁴ The phenomenon that describes how products in a network increase in value to users as the number of users increases. For example, each new subscriber to a telephone network represents one more person you can call, thus, each new subscriber adds value to every user.

OPPORTUNITIES

Digital dividend

Countries around the world are making the transition from analogue to digital terrestrial television broadcasting. In many industrialised countries this has already happened but in most developing countries the process to date has been slow. Digital terrestrial broadcasting uses the same broadcast infrastructure as analogue broadcasting but has the advantage of being much more efficient and the potential to offer clearer reception for television viewers. To achieve the switch-over to digital broadcasting, it is not only necessary to broadcast a digital signal but each television must also have the capacity to receive that digital signal. For televisions manufactured before the last couple of years, a digital set-top box is likely required to decode the digital signal for display on an analogue television.

While the transition to digital broadcasting presents logistical, political and technical challenges the benefits go well beyond clearer reception and more channels. Arguably the biggest benefit of the move to digital terrestrial broadcasting is in the large quantity of spectrum that will be freed for other uses. Referred to as the digital dividend, plans for the use of this spectrum are a subject of much debate.

The spectrum that will be freed up through the switch-over is the range from 174-230 MHz and 470-862 MHz. This represents a massive opportunity for increasing mobile and fixed broadband services as well as broadcasting services. Up to the point of transition, this spectrum is typically in the hands of state broadcasting agencies. Many broadcasters expect that this spectrum will be retained for additional broadcasting channels. On the other hand broadband providers and mobile operators expect a substantial amount of this spectrum to be given to next-generation mobile and broadband service provision.

The upper end of this spectrum has already been targeted by the ITU for mobile use. What happens to the rest of it though has not been determined. In general there has been little public input in the debate around use of the digital dividend. It has largely been a tug of war between mobile operators and broadcasters. There is a need for public debate to ensure that digital dividend spectrum is used to serve those for whom access is still a challenge.

Television white spaces spectrum

When wireless spectrum was first allocated for television broadcast in the early part of the 20th century, broadcast and broadcast reception technology was crude by today's standards. In essence, broadband transmitters had to "shout" because the reception devices were a bit deaf. In order to cope with these loud services, regulators decided that gaps should be left in spectrum assignments as "guard" bands to prevent television signals from interfering with each other. These "guard" bands are also known as television white spaces (TVWS) because of the "white" noise signal that appears on a television in these unused bands.

Things have changed. Wireless technology has evolved to the point where it can operate efficiently within these "guard" bands without interfering with television broadcast. In the United States, last year, the FCC approved TVWS spectrum for unlicensed use. This year, Ofcom, the UK regulator, authorised TVWS trials in Cambridge.

TVWS devices can select spectrum by sensing free channels or through a centrally-managed database that can enable devices in appropriate areas. Thus, as long as TVWS devices comply with regulatory standards, they would not require a spectrum license. This opens up possibilities for entrepreneurship in rural broadband delivery and for the kind of innovation that has built a multi-billion dollar Wi-Fi on a small chunk of unlicensed spectrum.

Creating more adaptive regulation

As wireless technology becomes more and more sophisticated, we see more and more ways in which spectrum can be shared. Location, time, proximity, power-output and orientation are all factors which can create an opportunity for spectrum sharing.

The argument made for exclusive spectrum licenses is that any company willing to invest in a nation-wide roll-out of wireless infrastructure must be guaranteed an interference-free environment in order to justify the massive investment. But what if one could guarantee an interference-free environment through some combination of geo-location databases, spectrum sensing and/or other interference management technologies.

While cognitive radio still has a long way to go to achieve its full potential, it is clear that this is the direction in which wireless technology is heading. Spectrum regulation needs to make space to allow these technologies to flourish.

CONCLUSION

It is not the intent of this paper to present spectrum policy reform as the solution to affordable access in developing countries. Real access is a complex, multi-dimensional issue that requires an enabling environment, end-user capacity to make effective use of services, a healthy business environment for both infrastructure and services as well as political leadership.

However, it is true that spectrum regulation has not been well understood as a policy issue with potentially direct impact on affordability and ubiquity of access. As

a consequence, spectrum regulation has been largely ignored. It is also true that the evolution of wireless technologies has brought us to a point where alternative approaches to spectrum regulation may be realistically considered. Finally, it is true that demand for access is accelerating dramatically in the developing world.

Active policy engagement on spectrum management and regulation has the potential to stimulate competition and facilitate the arrival of affordable broadband technologies that would lead to equality of access for all.

FOCUS AREAS FOR POLICY ADVOCACY

Spectrum audits

Without the results of a comprehensive spectrum audit, it is almost impossible to effectively manage spectrum. Encourage your communication regulator and/or department of communication to carry out regular spectrum audits to better understand the opportunities for more efficient spectrum use.

Spectrum transparency

Spectrum is a public resource managed by government. Insist on transparency in spectrum assignments including all conditions of use as well as transparency in the results of spectrum audits. Necessarily this will exclude sensitive spectrum bands in use for military purposes. Make publication of spectrum assignment and use the norm which requires exceptions, not the other way round.

Set-asides in spectrum auctions

The key to lowering the cost of access is increasing competition. Ensuring that spectrum auctions have a set-aside for new market entrants will ensure that fresh ideas and fresh investment are brought into the market. The economics of telecommunications networks favour the incumbents. Policy interventions like auction set-asides are necessary to balance the playing field.

Unlicensed spectrum

The huge market success that has occurred in the unlicensed spectrum bands holds great promise for the developing world. Policy advocacy priorities here include campaigning for TVWS spectrum regulation and lobbying for lower barriers to market entry for rural, Wi-Fi-based communication service providers.

Seek allies

Opening the market through spectrum reform is likely to meet resistance from incumbent operators who currently enjoy the benefits of the closed market that is a result of lack of available spectrum. However, companies in the business of serving content of one kind or another are the natural allies of those who wish to drive down the cost of access. They are potentially powerful players in the spectrum reform policy process. For example, in the United States, both Google and Microsoft have been prominent advocates for the release of TVWS spectrum.



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