Open spectrum for development[i]

Policy brief

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1. What is the spectrum?

The electromagnetic spectrum is not a material thing. It cannot be physically handled and it is therefore difficult to say that someone can own it. Rather, the spectrum is the potential for space (not the air we breathe but the space in which that air exists) to transmit energy. It includes x-rays, visible light (both light that we produce and light that comes from the sun and other stars), radio and television signals, radio telescope signals used to explore outer space, satellite signals, cellular telephone signals, wireless internet signals and various other forms of energy. The importance of the spectrum lies not so much in what it is but rather in what it allows us to do. The spectrum is equally available everywhere in the world. While it is often characterized as something of limited quantity, it is only limited by the current capabilities of technology and the ways in which it is managed. It is a perfectly renewable resource meaning that it does not disappear when it is used.

What is commonly known as the radio spectrum is a subset of the entire electromagnetic spectrum that has historically been used for radio-based communications. This includes radio, television, cellular telephony, shortwave radio, amateur (HAM) radio, wireless internet (Wi-Fi), cordless telephones and many other communication technologies. In order to organize its uses, we divide the radio spectrum is into sections called "frequencies" that make up larger sections called "bands". When we communicate using radio technology, one device (the transmitter) creates and emits a signal (energy) that is tuned to a certain frequency while another device (the receiver) is tuned to the same frequency and receives it. Other technology then translates the signals encoded in this electrical energy into sound, video, etc.

Figure 1: Diagram illustrating radio communication

The spectrum is central to the ways in which we communicate. For decades, broadcast radio has been the most accessible media in the world due to its inherently oral nature, relatively low infrastructure costs and its ability to easily communicate over long distances to many people at once. Today, the spectrum also serves as the primary infrastructure for the cellular telephone networks that have grown exponentially around the world. In many cases, this has provided people with a telephone for the first time, enabling them connect with the larger society and economy in which they live. Similarly, the spectrum is used for wireless internet access in a variety of manners. As wireless communication and the internet become increasingly inter-connected, we will have to consider new forms of regulation and governance that reflect this new way of communicating and what it means to our communities. However, the very technologies that enable this communication are in constant development and, thus, make it particularly difficult to determine how to best regulate them.

While the communication technologies that use the radio spectrum continue to develop at a brisk pace, our general approach to regulating the spectrum has not changed much since the 1930s when the spectrum was believed to be a limited physical resource that must be regulated to a very high degree in order to assure that interference between signals does not occur. For this reason, frequencies are

assigned for specific uses and overseen quite closely by national regulators as well as an international system of governance. However, as technology rapidly changes, approaches to managing the spectrum should change as well. In order to assure broad and egalitarian access to wireless communication, policy-makers, civil society organisations, industry and users themselves should begin to consider flexible forms of spectrum regulation that will enable the spectrum to be used by everyone to their fullest potential in terms of social, cultural and economic development.

1.1 A brief history of the spectrum

Regulation of the radio spectrum was first put into practise after the 1912 sinking of the Titanic when failed rescue efforts were partially blamed on poor wireless communications. This led to the creation of a Frequency Allocation Table[1] by the International Telecommunications Union[2] (ITU). The allocation table and the Radio Regulations treaty define what uses for certain parts of the spectrum are mandated by the ITU and what uses can be mandated by national governments. From the 1940s onward, radio and television became the most widespread electronic media in the world. Two general approaches to managing the radio spectrum developed during this time. In Europe, the dominant model maintained that all control of the spectrum and of broadcast media should rest in the hands of the State. Another, developed in the United States, would see private enterprise and civil society organisations given permission to use the spectrum for radio and television broadcasting. A federal regulator would manage the spectrum and grant licenses to those entities to use it. A concept that has become integral to both of these approaches to broadcast regulation is "the common good" or the notion that because the spectrum is a naturally-occurring common resource its uses should serve to benefit humankind.

Cellular telephones were first introduced in the 1980s and have fundamentally altered the manner in which spectrum management is thought about. While the concept of the "common good" remains closely tied to broadcasting, the use of the spectrum for telephone communication has evolved with a close connection to market economics. In 1989, once cellular networks had been introduced in many of the world's richest countries, New Zealand put into practice an idea that American economists had been considering since the 1950s: they created a property rights system and began to sell the right to use the spectrum to the highest bidder.[3] Since then, auctions and property rights systems have been implemented in a number of countries around the world.

1.2 Common myths about the spectrum

A number of myths tend to dominate both conversation regarding the spectrum and its regulation. Several of these myths are presented below followed by explanations (*in italics)* as to why these myths are not necessarily true.

The spectrum is a scarce natural resource. This means that a limited number of frequencies can be used because the spectrum is limited in quantity. An example often given is the fact that there is little or no

[1]http://www.itu.int/ITU-D/tech/spectrum.../SMS4DC_AM_TM_4.pdf

[2]http://www.itu.int

[3]Foster, Adrian and John Alden. (2008). "Spectrum Sharing". Trends in Telecommunication Reform 2008: Six Degrees of Sharing. p. 83-105. Geneva: International Telecommunications Union.

remaining space for new radio of television stations in large cities in North America. In these cases, the spectrum is "saturated".

The spectrum is not scarce in the way that water or food can become scarce. Spectrum scarcity exists due to the ways in which we design and regulate technologies that use it. This is often referred to as "administrative scarcity". A number of studies have shown that the radio spectrum, in many places, is in fact underutilized. For instance, average use in the centre of Dublin, Ireland of the most often used parts of the spectrum was less than 14% in 2007. The situation is similar in urban centres in other countries.[4]

Interference is a natural trait of the spectrum and occurs when signals disrupt one another. If we were to regulate the spectrum differently than we do today, such interference would cripple our communication networks.

"Interference" occurs when a receiver cannot distinguish between two different signals, not when these signals come into contact with one another*. Historically, different uses of the spectrum have been assigned to different frequencies in order to prevent interference from occurring. New technologies are being developed that use a combination of computers and radio transmitters in order to better differentiate between signals and thus avoid interference.*

Auctions drive the most efficient use of spectrum because "the market" would not permit inefficient use. Those with the most capital to invest in acquiring the spectrum also have the necessary financial resources to assure it is used wisely.

Spectrum auctions assure that, above all, use of the spectrum is attributed to those with the most capital to invest in acquiring it. In many cases this has led to the creation of communication networks that severely limit the ability of its users to create and innovate as spectrum owners often heavily control the sort of devices that can be used on these networks and what these devices can do. This spectrum management practise has also led to the creation of a spectrum rights industry where corporations simply buy spectrum as an investment for future re-sale, impeding the ability of other people to use it.

Spectrum use requires enormous capital investment. Whether or not spectrum is acquired through an auction, the entity that acquires it will need to build extensive and widespread infrastructures in order create their communication network.

Enormous capital investment is required to build wireless communication networks as they operate today. Commercial wireless networks are typically built on a national scale, sometimes with numerous companies creating their own individual infrastructures. Just as the internet is a "network of networks," large wireless communication networks can be collaboratively built by smaller, less centralised groups. Ideas such as local small-scale ownership and regional networking coupled with innovations in spectrum management make local and participatory community-based ownership and management of wireless communication networks a real possibility.

[4]Flynn, Iarla, B. Lennett and S. Meinrath. (2008). A Technology Driven Spectrum Policy. Washington: Google/New America Foundation.

Convergence is necessary and beneficial to all. If a small number of companies own and control both communication networks and the content that is transmitted on these networks, they can assure that content will be transmitted efficiently.

Increasingly, telecommunications network providers are purchasing content producers and integrating them into their businesses. Once they become content producers, it is in the commercial interest of these companies to limit the ability for independent producers of news, arts, culture, music, etc. to freely create and communicate with their networks. Collaborative models of communication network ownership can assure that technical efficiency is developed according to local social and economic needs and capacities.

Open spectrum management

Open spectrum management is an approach to spectrum management that is, above all, based on sharing. An open spectrum policy would allow various users to utilise whatever parts of the spectrum are available without obtaining permission from anybody beforehand. Sharing the spectrum in such a way would create a "spectrum commons" and would require a simple set of rules for communicating with one another and making decisions.

2. What is the connection between the spectrum and development?

Wireless connectivity offers great potential to deliver internet and telephone connectivity in developing countries. Strategies for meeting information and communication technology (ICT) development goals in developing nations can be designed according to the various approaches to communication and to the needs and current capacity available in each locale. Most communications policy around the globe has, however, been developed according to models based on the economic, political and social realities of North American and Europe. Above all, these models are based on the premise that large private companies must build expansive national wired infrastructures. Thus, law and regulation has evolved with the understanding that these wired networks are the main communication infrastructure and that wireless networks connect through them. Such wired networks, however, do not exist in many developing countries and do not necessarily need to be built.

The use of wireless technology in developing nations can aide them in reducing the digital divide while being adapted to real infrastructural limitations. For instance, wireless technology typically uses less electricity meaning that alternative power sources can be employed. If open spectrum management is introduced with wireless technology, communities can more easily build their own communication networks. This means less of an administrative and financial burden would be placed on the central government and regulator, possibly freeing funds to facilitate the construction of these very networks. In addition, communities would have the opportunity to learn about these technologies and make direct decisions concerning their use.

Some examples:

The Open BTS project[5] in the United States has developed a small solar-powered device that creates a simple, affordable and portable cellular telephone network. By connecting it to a high-speed wireless internet connection, cellphones in remote areas are connected to the global telephone network. Built on open source software and inexpensive hardware, it should be easily adaptable to different languages and could be a practical tool for extending wireless service to remote and rural communities using the spectrum as the main link instead of a costly and invasive wired infrastructure[6]. It could also be used to connect such communities to one another where pre-existing telephone networks do not exist or are prohibitively expensive.

Between 2008- 2009, Uruguay distributed solar-powered One Laptop Per Child (OLPC) XO laptops to 100% of their primary schoolchildren who attend public schools. As well, all of the public primary schools were connected to the internet and to one another. At the same, the federal water authority installed potable water plants (for treating water and making it drinkable) in a number of remote communities, many of them without electricity. Today, parents in these communities learn to manage their own water purification systems through online tutorials they access through the laptops of their children. These laptops rely on unlicensed access to the spectrum in order to talk with one another (creating new forms of collaboration) and to share scarce internet connections.

In Vienna, Austria, FunkFeuer Free Net[7] is a community-based non-commercial wireless mesh network that covers the entire metropolitan area (2.2 million people). It is also active in the Austrian cities of Graz, Weinviertel, Bad Ischl. Guifi.net[8] is another community-based non-commercial wireless mesh network operating in Catalonia, Spain. It covers over 6,000 km of the region, providing free internet access to over 16,000 locations. This strategy relies on individuals to share their personal internet connections in order to create a shared network. Instead of each household paying for their own connection, costs and responsibility can be shared. An unlicensed portion of the radio spectrum serves as the link between all members.

3. Setting the scenario – principles explained

The administrative practises used and the capabilities of the technologies employed greatly affect the extent to which the spectrum can be used for communication. Spectrum-related communication technologies are powerful tools that can be help strengthen communities at all levels of society and play a central role in the provision of education, health care and information. They also play a vital role in local, national and international economies. Thus, regulation of the spectrum should be undertaken in the public interest, assuring equal access and opportunity for all people.

Spectrum regulation is very highly coordinated at an international level and often between neighbouring countries. Four concepts at the heart of current and future spectrum regulation are allocation, assignment, usage and the spectrum commons.

[5]http://openbts.sourceforge.net/

[6] Physically connecting a rural area to a wired network typically requires cables to be laid either underground or above ground for several kilometres.

[7]http://www.funkfeuer.at/index.php?id=42&L=1

[8]http://guifi.net/en

Allocation: This is the process by which a range of frequencies within the spectrum is attributed to be used by a certain type of technology. It is carried out by the following organizations: the International Telecommunication Union (ITU) allocates spectrum at the international level[9]; regional spectrum coordinators coordinate spectrum use among nations that share borders or are close to one another; national spectrum administrators allocate spectrum within individual nations. Allocation allows for a very orderly administration of the spectrum, facilitates international cooperation to assure interoperability of communication systems, and establishes centralized technical authority. Its rigid hierarchy and bureaucratic structure can impede the introduction of new technologies. However, the practise of allocation has historically facilitated international collaboration on wireless technology. Allocation of spectrum for "open" or "unlicensed" use at this high bureaucratic level would also signify powerful support for this technology and spectrum management practise.

Assignment: Within the allocated range of frequencies for a specific type of technology, an administrator (often a federal regulatory body) assigns specific frequencies for use by specific entities (community groups, companies, etc.). Historically, spectrum has been allocated for certain licensed uses. For instance, FM radio is restricted to one section of the spectrum, AM radio to another, analogue television to a different section and digital television to yet another. This practise was originally developed because it was believed that these different technologies functioned best within certain ranges. However, reserving sections of the spectrum for distinct uses can also impede the introduction of new technologies by groups or individuals who have the means to create this technology but not the resources to make their way through the administrative maze. Except in cases where the spectrum is unlicensed, communication devices cannot use the spectrum without permission from the regulator. On the other hand, the assignment of parts of the spectrum for unlicensed or "open" use has already led to widespread technological and social innovation through the use of wireless internet (Wi-Fi).

Usage: As technology evolves so does spectrum management. Thus, periodically, regulators engage in practises to accommodate more uses of and users of the spectrum. The most common practises are: 1) reallocation whereby a pre-existing user of the spectrum will be shifted to another part of the spectrum, often in favour of new technology that uses it more efficiently; 2) allowing the use of higher frequencies that are not yet in use; 3) improving the efficiency of the technology using the spectrum; and 4) introducing spectrum sharing.[10]

Spectrum commons: The concept of the spectrum commons is similar to the idea of grazing lands that are shared among several farmers or roads that are shared among travellers. Based on simple standards on how communications devices interact, the common resource of the spectrum is shared amongst them. In order for a spectrum commons to exist, a portion of the spectrum must be allocated as such. One example is Wi-Fi or wireless internet. The portion of the spectrum used by this technology has been allocated for unlicensed use and a variety of communication devices can use it as they please.

[9]Spectrum allocation decisions are made through negotiations amongst ITU members at the ITU.

[10] Hatfield, Dale N. (2005). "Spectrum Management Reform and the Notion of the "Spectrum Commons". South African Journal of Information and Communication. Vol 4., pgs. 1-12.

4. Governance mechanisms

National organisations: There are several approaches to national spectrum governance. In some instances, general communications policy is set by the central government (within a ministry, for instance) while a specialised body undertakes actual regulation. In other instances, general policy and regulation are both undertaken by a single entity. For citizens, it is often easier to communicate with a single entity. However, the existence of two separate entities is sometimes seen as advantageous in terms of governance, similar to the separation between lawmakers (policy-maker) and the police (regulators).

Organisation	**Examples**
Unified communications regulator: A regulator that licenses all spectrum users and communication networks. They engage with social policy, technical policy and economic policy.	Communications Commission of Kenya Federal Communications Commission (U.S.A.) Office of Communications (U.K.)
"Soft" policy regulator: A regulator that manages licensing of spectrum users and communication networks but does not control technical policy regarding the spectrum	Canadian Radio-television and Telecommunications Commission (Canada)
"Technical" regulator: A regulatory body, sometimes a department of a ministry, charged with the technical management of the spectrum.	National Frequency Management Council (Nigeria) Unidad Reguladora de Servicios de Comunicaciones (Uruguay) Industry Canada (Canada)
Ministry of Communication or other government body or agency: In many countries, a government ministry is charged with making communication policy. This policy is then further developed and enforced by the regulators described above.	Ministry of Information and Communications (Kenya) Ministry of Information and Communication (Nigeria) Industry Canada (Canada) Heritage Canada (Canada) Dirección Nacional de Telecomunicaciones (Uruguay)

International Regulatory Bodies: The importance of international regulatory bodies should not be underestimated. Because the spectrum, and thus radio transmissions, is not confined by national/geographic boundaries its use has always been coordinated by governments. The International Telecommunications Union (ITU) and World Radiocommunication Conferences are the primary venues for this coordination. Standards organizations and industry groups have evolved into powerful independent actors who play expert roles in developing and promoting new and emerging technologies.

International Regulatory Body	**Role**
International Telecommunications Union (ITU)	Specialised United Nations body that negotiates international treaties regarding spectrum use, satellite orbits, and sharing of communications infrastructure. The ITU also creates technical standards for information and technology use and development and promotes the extension of these technologies as a means of social and economic development. Membership: 192 nations, 599 private industry members, 154 civil

International Regulatory Body	Role
	society organisations.
World Radiocommunication Conferences	Held every 3-4 years, these conferences are organized by the ITU to revise, as needed, the Radio Regulations – the central international treaty regarding use of the radio spectrum and satellite orbits.
Institute of Electrical and Electronics Engineers (IEEE)	A non-profit group of almost 400,000 engineers around the world, the IEEE is the most influential standards organization with relation to the spectrum. They design, approve and promote the standards by which wireless internet access works, for instance.
Industry groups. Examples: Southern Africa Telecommunications Association[11], CTIA[12], Telecommunications Industry Association[13], European Competitive Telecommunications Association, [14], European Telecommunications Network Operators' Association[15]	Industry groups are often composed of both technology manufacturers and communication network providers. They collaborate on the creation of technical standards, but also represent their members in regulatory venues. Many of the groups listed here are sector members of the International Telecommunications Union.

5. Models and approaches to spectrum assignment

Assignment is when an entity is given permission to use part of the spectrum. There are four primary models or approaches to spectrum assignment and each has a certain number of strengths and weaknesses. Unless coupled with proper regulatory guidance and enforcement, none of these models guarantee that the spectrum will be used for the common good.

First come, first served model: *Whoever asks for a license first is given one. When few people were using the radio spectrum, this was the dominant model for spectrum assignment Where it is still practised today, licenses are often granted by executive decree.*

Strengths: Limited bureaucracy as there is no formal licensing process.

Weaknesses: Because there is no formal licensing process, this model is often accompanied by a lack of accountability and transparency on the part of licensee and of the regulator. Licenses are often granted by executive decree and thus susceptible to political and other types of interference, abuse, or corruption. Technical management of spectrum tends to be minimal.

Auctions: *Use of part of the spectrum for a specified purpose is sold or leased to the highest bidder.*

[11] http://www.sata-sec.net

[12] http://www.ctia.org

[13] http://www.tiaonline.org

[14] http://www.ectaportal.com

[15] http://www.etno.be/

Strengths: Because a license is granted to the highest bidder, bureaucracy is limited. Regulators tend to designate a part of the spectrum for a particular use and then auction it for this specific use. Auctions can generate large amounts of revenue for governments.

Weaknesses: Speculation on the monetary worth of spectrum often creates a market that small enterprises often cannot penetrate. This in turn drives the creation of monopolies or oligopolies with a tendency to control prices, content and available technology.

Comparative evaluations: *Multiple applicants will compete for a license and be compared to one another. Sometimes they are accompanied by public hearings where the general public can intervene.*

Strengths: Uses of the spectrum can be publicly evaluated; standards related to the common good can be developed, implemented and adhered to; citizens can play an active role in judging an application's worthiness.

Weaknesses: This type of method for assigning spectrum is often referred to as a "beauty contest" because an application can be made to appear to adhere to standards or satisfy the demands of citizens to a greater degree than it actually does.

Commons-based approaches: *There are a variety of methods to allocating spectrum for shared use, each differing slightly in their approach to administration and transaction (the negotiation that enables sharing). One emerging example is a model whereby a section of spectrum (such as that used by analogue television) is left open for unlicensed use instead of being assigned for a specific use. Rather than communicating through an intermediary, communication devices are designed to communicate directly with one another.*

Strengths: Limited bureaucracy; less need for massive capital investment to build large wired networks; easier to introduce new technology; greater potential for national/local/community ownership of communications infrastructure; commons-based approaches to spectrum management can be phased in gradually.

Weaknesses: Consumer technology that operates according to a commons-based approach is, for the most part, currently limited to computers. Some projects are being developed to adapt cellular phone technology to new forms of infrastructure. As interest on the part of regulators and others grows, new technology will be created to meet this interest. It is difficult to predict how the development of this technology will make up for current problems related to quality of service[16].

Other approaches: *There are a few other approaches that are not widely used but are important to note.*

Micro-payments: Under a micro-payment scheme, communication devices such as cellphones are not tied to a single network provider. Various providers are granted licenses to use the spectrum and cellphones or other devices can be configured to connect to whichever network is available, faster, or cheaper. Users pay for access in small payments rather in subscriber fees or through buying credit in advance. A strength of this approach is that it introduces diversity in to the marketplace, ideally pushing access

[16] Arjona, A., C. Westphal, J Manner, A. Ylajaaski and S. Takala. (2008). *Can the current generation of wireless mesh networks compete with cellular voice?* Computer Communications, 31 (8) p. 1564-1578.

providers to provide the best access at the best price. As with the other approaches here it would need to be accompanied with proper regulation and enforcement to assure fairness – that one access provider could not acquire a monopoly, for instance. This approach is not currently practised anywhere.[17]

Spectrum trading: Under this model, the spectrum is treated as physical property. Initially assigned to one entity or another by auction or simple purchase, it is treated as a commodity. In practise, there is rarely a requirement that the spectrum owner use it to provide communication services of any sort. Spectrum trading is practised, to some degree, in Australia, Guatemala and the United States. Proponents of this model believe that the market can more efficiently allocate spectrum to those who need it. However, it is premised on the same standard as spectrum auctions and provides spectrum to those that can best afford it. In addition, some companies have begun to buy spectrum not with the intent of using it, but as an investment for future sale.

6. Broadband or broadcast

The way we generally think of spectrum-related communications comes from the long and dominant history of broadcast radio and television. Broadcasting is the transmission of a signal over a specific frequency of the spectrum across a broad physical area. It is based on the idea that radio transmitters and receivers are simple technologies incapable of doing anything more than the two simple and separate tasks of transmitting and receiving. Broadcasting utilises a large amount of spectrum without the guarantee that any communication occurs. Think of it as somebody who has the exclusive right to yell at high volume in a field all day. Nobody else has the right to talk at that volume in that field and there is no guarantee that anybody will hear what is being said. Similarly, the fact that a radio station is broadcasting does not mean that all radios in its range are tuned to it but usually means that nobody else has the right to broadcast on that frequency. Because of the relative inaccuracy of broadcast technology, regulatory priorities tend to create "protected" buffer areas in order to prevent interference. They could, however, mandate the users and manufacturers of broadcast technology to develop more accurate communication systems, meaning that more spectrum would be available for use (more radio and television stations could be on the air, for instance). Everybody in the field could have the right to speak at once and share speaking space and, thus, dialogue could occur. Broadband technology – cellphones and other such devices – is organised much differently than broadcasting. Instead of one broadcaster using a frequency to perhaps communicate to nobody in particular, broadband is built on two premises: frequencies should be shared, and communication takes place between a transmitter and an intended receiver. Many people can share the same speaking space and communicate cooperatively. Transitioning from a broadcast approach to communication and regulation to a broadband approach can help enable more people to communicate. Such a transition is often seen as a purely technical matter and thus it is often addressed in technical and economic rather than social terms. For this reason, it is important that media practitioners, communications regulators and the general public be involved in this process and begin to consider what a transition of this sort would mean for them and their communities.

[17]Meinrath, Sascha and B. Lennett. (2009). Seven Key Options for Spectrum Allocation and Assignment. Washington, D.C.: New American Foundation.

7. Current issues and opportunities

A number of important technological debates and developments are currently taking place that are shaping the future of spectrum-based communication and the potential for introducing open spectrum management.

Digital dividend: Around the world, countries are migrating their broadcast television systems from analogue transmitters and receivers to digital ones. This is important to the current discussion for three reasons. 1) Digital broadcasting utilises the spectrum more efficiently, generally allowing for six channels in the space where one analogue channel could exist. This provides opportunity for new broadcasters to come online. 2) The spectrum freed by this digital transition can then be used for new purposes. In some countries it is being auctioned for provision of high-speed wireless internet. It could also be used to create set aside for unlicensed and unregulated public use. 3) In order for this transition to be successful, all television broadcasters will need to install new transmitters, all television consumers will need to purchase new televisions or special receivers, and new policy will need to be developed to manage the transition and the new system that will result from it. This imposes a significant financial burden on both broadcasters and consumers. It is necessary to introduce dedicated funding to ensure digital transition can occur without introducing new barriers to communication.

Television white spaces: Analogue television transmitters are very powerful and not very accurate. For this reason, there are usually a limited number of over-the-air television stations in any country and often fewer in small nations where television signals in urban centres in different countries can interfere with one another. In order for them to function correctly, these transmitters have been given a large amount of "protected" space between one another. With the use of new kinds of radio devices such as cognitive radios[18], these "protected" spaces – referred to as "white spaces"- can be used to create a spectrum commons. The United States and the United Kingdom have already begun to allow unlicensed use of these "white spaces" with broader debate occurring in the European Union[19]. Introducing open spectrum management in this way can occur immediately without affecting pre-existing communication networks.

WiMax: WiMax is a wireless communications standard designed for high speeds over long distances. While it has not been widely deployed yet, WiMax and similar technology could serve as an infrastructure for a spectrum commons as it can be implemented on a large scale without licensing spectrum to any particular entity[20]

Releasing government and military spectrum: In many countries, a huge portion of the spectrum is reserved for government and military use. For instance, in the UK, 28% of the assigned spectrum is held by the military. Several countries have already begun to negotiate the release of this spectrum for other

[18]Cognitive radios, also called software-defined radios or "smart" radios use computers in order to more accurately distinguish between radio signals.

[19]lynn, Iarla, B. Lennett and S. Meinrath. (2008).

[20]Wellenius, Bjorn and Isabel Neto. (2008). Managing the Radio Spectrum: Framework for Reform in Developing Countries. Washington, D.C.: The World Bank. Pg. 68.

uses and to consider flexible shared use of the spectrum. Unlicensed use could, for example, be generally permitted but the military could have the right to sole use during wartime[21].

8. The future

A global shift in spectrum regulation is currently under way with regulatory reforms, such as legislation that combines telecommunications with radio and television, being developed and proposed in several countries. While the most rapid developments are taking place in Europe and North America, it is important to learn from these experiences as part of a larger process to determine how wireless communications to be used more widely in development contexts. As the internet and wireless communication come closer together in both form and function, we will have to adapt our regulatory traditions to open, trusting and collaborative forms of regulation and technology use. In jurisdictions such as the United States and the UK where open spectrum management has begun to be put into practice, there tends to be both an interest by the regulator and by the government to engage with new technologies and new regulatory frameworks. At the same time, civil society plays a vital role in assuring progress is made and that it is done in the public interest. Open spectrum management is an opportunity to demystify both technology and regulation, to experiment with locally controlled forms of ownership and decision-making and to create communication systems that directly meet local needs and capacities.

9. What can you do?

Policy-makers

1) *Think about what your people's communication needs are and how they related to broader social and economic needs. What is your capacity to meet them? Consider how an open spectrum approach can help you meet these needs. Facilitate inclusive and open public discussions on this,*

2) Talk with policy-makers and civil society organisations inside and outside your country. Find out what projects are under development. Can they help you satisfy your communication needs? If so, is collaboration possible?

3) Facilitate broad and inclusive conversations with everybody in your country and encourage participation from individuals – women, men and children – as well as organisations of all kinds. Help your citizens to understand communication technology and regulation and what it means to their everyday lives. Assure they have an active role inn decision-making.

4) Support local technology development and local communication network ownership.

Civil society organisations

1) *Talk with other civil society organisations in your country. Help them identify their communication needs and determine how open spectrum can help them meet their needs.*

2) *Establish regular communication with all levels of spectrum regulation in your country. Assure that they understand your perspectives and needs and the needs of the communities you*

[21]Ibid. Pg. 69.

represent. Regulation can be a collaborative process between government and users of the spectrum.

3) *Establish collaborative relationships with technology-focused civil society organisations in your country and region. Find partners in all sectors of society (social, economic, political). Establish a diverse and united front oriented around common needs and solutions.*

4) *Hold public discussions on the spectrum and open spectrum management. Educate the public and make them an active part of your advocacy.*

Media practitioners

1) *Talk about the radio spectrum and open spectrum both in the media and among media practitioners.*

2) *Determine how the current system of spectrum regulation impedes and enables your ability to create and disseminate media. Knowing what your interests are, collaborate in advocacy with civil society organisations.*

3) *Use your media to educate the public on the spectrum and open spectrum management. Demystify technology and facilitate public interaction with the regulatory system.*

10. List of resources

Online

Open Spectrum Alliance http://www.openspectrum.eu

Open Spectrum UK http://openspectrum.org.uk

Open Spectrum Foundation http://www.openspectrum.info

Why Open Spectrum Matters, David Weinberger
http://www.greaterdemocracy.org/framing_openspectrum.html

Policy documents

Department of Communications, South Africa. (1997). Project SABRE (South Africa Band Re-planing Exercise); Band plan for the frequencies 20 MHz to 3 GHz. http://www.internet.org.za/SABRE-1.pdf

Department of Communications, South Africa. (2010). Radio Frequency Spectrum Policy for South Africa. http://www.scribd.com/doc/32278419/South-Africa-National-Radio-Frequency-Spectrum-Policy-2010

OFCOM. (2008). Managing the spectrum above 275 GHz.
http://stakeholders.ofcom.org.uk/consultations/275ghz/

Technical papers

Arjona, A., C. Westphal, J Manner, A. Ylajaaski and S. Takala. (2008). *Can the current generation of wireless mesh networks compete with cellular voice?* Computer Communications, 31 (8) p. 1564-1578. http://andreasarjona.com/docs/arjona-westphal-yla-jaaski-kristensson-mesh-vs-cellular-elsevier-comcom-2008.pdf

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[i] *Every thirty months the amount of information that can be transmitted over a wireless internet connection has the potential to double. Wireless could be the way to provide affordable broadband to millions of people currently living with poor connectivity. However the policy and regulation related to spectrum is often inefficient, secretive and ill-informed.*

APC's "open spectrum" initiative aims to provide an understanding of spectrum regulation by examining the situation in Africa, Asia and Latin America. We'll look at how spectrum is assigned, who assigns it and what policy or regulatory framework they use.

The countries under investigation in 2010 are Brazil, India, Kenya, Morocco, Nigeria and South Africa. We hope to add more to the list, funding permitting. Materials will be produced in English, French and Portuguese.

For more information www.apc.org/en/projects/open-spectrum-development