

ITU Explainer: Spectrum management

What is spectrum management?

Spectrum management refers to the allocation and regulation of use of the radio spectrum, which is part of the broader electromagnetic spectrum.

The radio spectrum has particular practical benefits in everyday life because radiowaves can be used to transmit information and to communicate. Radio, television, mobile phones, WiFi, and satellites all function by using radiowaves to transmit information. Within the radio spectrum, waves with different frequencies have different characteristics which make them more or less suitable for different purposes. Waves at the lower end of the spectrum (low band) with frequencies below 1 GHz are able to transmit information over long distances or through walls. Waves at the higher end (high band), with frequencies above 24 GHz, are able to transmit large amounts of data very quickly.

Radiowaves with the same or similar wavelengths/frequencies can interfere with each other if they cross paths,

which means that the information being carried within them can be distorted or lost. To ensure that transmissions using radiowaves do not suffer interference, the radio spectrum is managed, meaning that the different frequencies are allocated to different actors with specified geographical restraints, power levels, and levels of interference they must tolerate. This is managed at both the international and national level.

As the use of digital communications which rely upon radiowaves increases (and, in particular, as more people use wireless forms of communication like mobile phones and WiFi) demands on the spectrum are increasing dramatically. There is therefore a strong interest in making sure that it is managed effectively and in a way that promotes efficiency as well as meeting the diverse needs of the many users of spectrum.

The spectrum

The electromagnetic spectrum refers to the range of frequencies (the spectrum) of electromagnetic radiation. This electromagnetic radiation is made up of waves, of varying wavelengths, which carry energy. From shortest to longest wavelength, the full electromagnetic spectrum comprises gamma rays, x-rays, ultraviolet light, visible light, infrared light, microwaves and radiowaves. The radio spectrum refers to that part of the electromagnetic spectrum which comprises radiowaves; these are waves with wavelengths of between 1mm and 10,000km.

Waves are also measured according to their frequency. All waves travel at the same speed meaning the shorter the wavelength, the greater the number of waves that will pass through a given point during a particular period of time. The number of times a wave passes through a point in one second is called its frequency and is measured in Hertz (Hz). The radio spectrum is the part of the electromagnetic spectrum with frequencies from 3 Hz to 3,000,000,000 Hz (or 3,000 GHz).

Why is spectrum being discussed at the ITU?

Although governments can manage spectrum at the national level, there are also good reasons for international coordination and management. Radiowaves do not stop at national borders, and indeed a high proportion of transmission of information using the radio spectrum happens across national borders, often using satellites. Some transmission may even take place outside of any national jurisdiction, such as on international waters or in international airspace. As such, formal global processes and arrangements are needed to deal with these transnational issues. There are also practical benefits to global harmonisation of some aspects of spectrum management. For example, by reserving particular frequencies for emergency or disaster relief communications globally, it's easier for states to ensure clear, uninterfered communications across borders, and to coordinate responses.

There are also benefits to consumers. By harmonising the frequencies that particular mobile devices will use, phone manufacturers can develop products that will work globally, rather than needing to make different versions for different states, resulting in economies of scale and

lower prices for consumers. And with the advent of 5G, the Internet of Things (IoT), and increased use of connected devices, which may rely upon different parts of the spectrum, governments will need to release more high and low spectrum bands so that someone with an IoT device can use it in different countries. This, too, requires international coordination.

These issues first came onto the agendas of governments around the 1890s following technological developments and the consequent growth in the use of devices which used radiowaves. Governments held a series of International Radiotelegraph Conferences to agree common standards via treaties, but no permanent institution was established. These conferences were, instead, facilitated by the International Telegraph Union, which had been established in 1865 and did similar work in the field of telegraphy. In 1932, governments decided to fully merge the two processes, and to enlarge the International Telegraph Union's mandate to include radiocommunications. To reflect the change, the organisation was renamed the International Telecommunication Union and it is now the most important organisation managing spectrum at the global level.

Why should human rights defenders care?

While there are of course ways for individuals to communicate to each other without using radiocommunications, their use greatly enhances the ability for people to do so, and particularly with those who are physically far away or to larger audiences. Any kind of communication via radio, television, mobile phones, WiFi, or satellites relies on radiowaves, which means that the way that the spectrum is regulated determines whether, and how, people are able to communicate using these methods.

This has clear and obvious links to individuals' right to freedom of expression, which includes the freedom "to seek, receive and impart information and ideas of all kinds, regardless of frontiers (...) through any other media of his choice". If the spectrum is regulated and allocated in a way which limits individuals' ability to use any of these forms of communication, this seriously hampers the enjoyment of their right to freedom of expression. Conversely, the spectrum can also be regulated and allocated in a way which encourages and increases access to these forms of communication, empowering individuals and societies. Some of the ways in which spectrum management can affect human rights include:

- **Closed parts of the spectrum:** If parts of the spectrum are not made available at all by governments, whether with a licence or unlicensed (sometimes referred to as spectrum hoarding), this can limit the different options of communications across the country, potentially leaving some geographic areas without access, or with limited access. It also makes the spectrum that is available more expensive, raising costs for users. If the costs become too great, then this limits who, in practice, is able to access those particular forms of communication.
- **High costs of licencing:** Even where sufficient spectrum is licenced to enable access to different forms of communication for the entire population, if those licences are expensive, these costs will be passed on to consumers, potentially making the services unaffordable for some.
- **Poor use of licences:** Operators could use their allocated spectrum in a way that fails to ensure that individuals in the relevant geographical area are able to use the services that operate on that part of the spectrum (another form of spectrum hoarding). For example, a telecommunications company might only provide services to the wealthier and more densely

populated areas of its licence area, leaving rural areas unserved. Or a mobile phone operator may have a licence for an entire country, but then not build the physical infrastructure needed to ensure full coverage. They may even buy more frequencies than they need, with no intention of using them, making the market less competitive and leading to higher prices.

- **Insufficient unlicensed spectrum:** It is not necessary for all of the spectrum to be licenced. Indeed, it can even be counterproductive. WiFi services, for example, are generally only provided in a very small geographical area (like a single building), meaning that the the risk of interference is very small and thus negating any need to allocate and licence the spectrum on which it operates. Allowing more of the spectrum to be used by individuals and communities without the need for a licence can make it easier and cheaper for WiFi and other forms of communication (such as community networks, radio and television) to be developed and made available in particular localities, particularly in remote and rural areas where the physical infrastructure needed for broadband does not exist or is very expensive.
- **Unfair allocation of spectrum:** As well as allowing individuals to communicate, the spectrum also enables broadcasting of television and radio services. These can be powerful tools to enable individuals to impart and receive information and ideas, and therefore support the enjoyment of the right to freedom of expression. However, if only a small amount of spectrum is reserved for these kinds of services, the number of television and radio channels able to operate is limited, reducing the choice and diversity of sources of information available to individuals.

As noted above, spectrum regulation and allocation takes place primarily at the national level with governments (or regulators) determining who has access to different frequencies in different geographical areas, and for what purposes. Ordinarily this is done via auctioned, time-limited licences to use particular frequencies with set geographical restrictions. Some spectrum may also be unlicensed, meaning anyone can use particular frequencies. WiFi services, for example, are provided using unlicensed spectrum.

Despite the strong role that national governments play, the rules and recommendations that the ITU makes relating to national spectrum management can determine, or at least influence, those national laws and policies, hence the need for human rights defenders to engage at the ITU as well.

Why should human rights defenders care?

Discussions around spectrum management take place primarily within the ITU's Radiocommunications Sector (R-Sector), particularly:

- In ITU-R Study Group 1 ("Spectrum management"), where recommendations are made to ITU member states on spectrum management principles and techniques, general principles of sharing, spectrum monitoring, long-term strategies for spectrum utilisation and economic approaches to national spectrum management;
- At the World Radiocommunication Conferences, which take place every three to four years, and where the Radio Regulations are reviewed and the R-Sector's work determined. The next will take place in October and November 2019 in Sharm El-Sheikh, Egypt.

While it does not set rules and recommendations, the ITU-D Sector's Study Group 1 ("Enabling environment for the development of telecommunications/ICTs") also looks at issues related to spectrum management via its mandate to examine how to build access to telecommunications and ICTs in developing countries and, in particular, rural and remote areas (question 5/1).