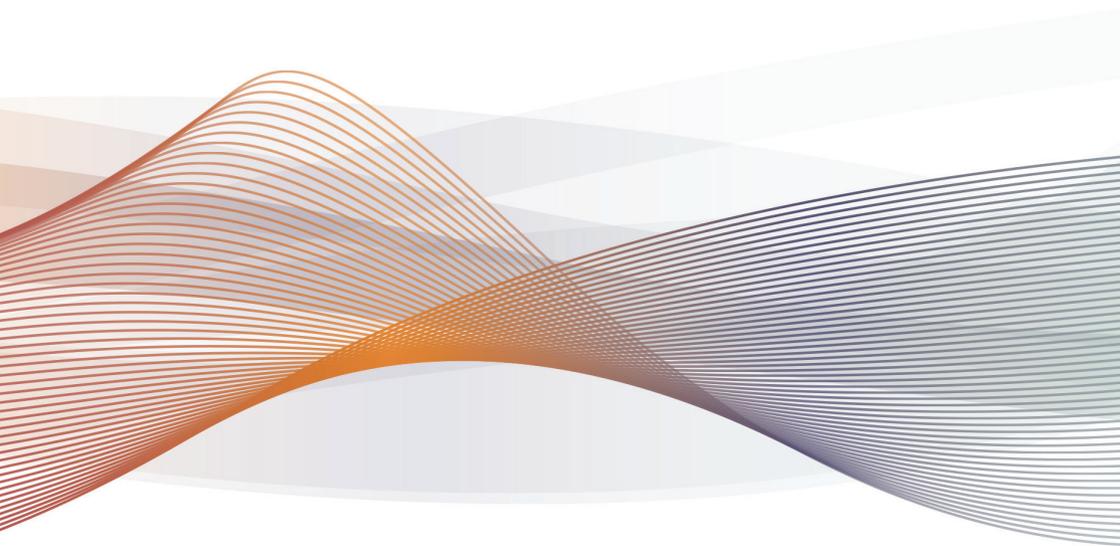

The **GSMA** spectrum primer series

The spectrum policy dictionary





The spectrum policy dictionary



These handbooks provide a general introduction to mobile spectrum, how it is managed and the challenge posed by rapidly growing data usage. They have been designed for readers who don't have a technical background in the subject. While this is only a very brief introduction to the subject, these handbooks should hopefully provide a useful overview.

The titles in this series are:

- Introducing radio spectrum
- Introducing spectrum management
- Managing spectrum for growing data
- The spectrum policy dictionary



1G

The first generation of 'cellular' mobile phone systems used in the late 1970s until the early 1990s. These analogue-based systems were replaced by 2G digital mobile systems - most notably GSM. Examples include AMPS (Advanced Mobile Phone System), NMTS (Nordic Telecommunication System) and TACS (Total Access Communications).

2G

The second generation of 'cellular' mobile phone systems which appeared in the 1990s were the first to employ digital coding. The vast majority of 2G mobile networks around the world use GSM technology. However, there are other 2G systems including D-AMPS, PDC, iDEN and most notably cdmaOne which continues to be used by some operators around the world.

2.5G

see GPRS

2.75G

see EDGE

3G

The third generation of 'cellular' mobile phone systems were the first to be designed from the outset to support high speed data services as well as voice. The most dominant system used is WCDMA which was deployed by the operators which previously used GSM. However, other systems are used including CDMA2000 (largely by operators that previously used cdmaOne) and the Chinese system TD-SCDMA.

3.5G

see HSPA

3GPP (3G Partnership Project)

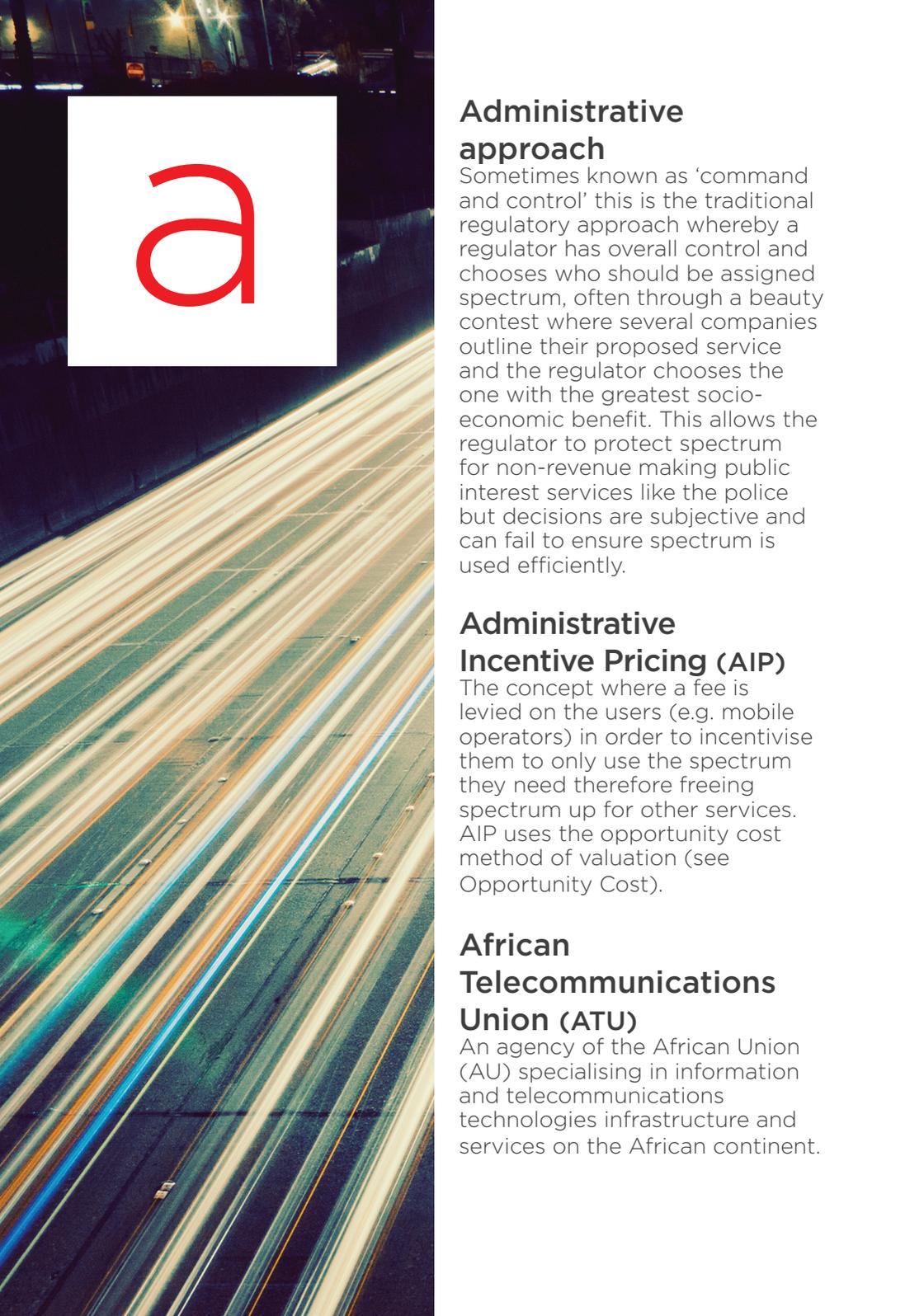
The body which defines the standards for GSM (2G), WCDMA (3G), and LTE (4G) technologies.

3GPP2 (3G Partnership Project)

The body which defines the standards for cdmaOne (2G) and CDMA2000 technologies (3G) that are sometimes referred to as the 'CDMA family'.

4G

The fourth generation of 'cellular' mobile phone technologies that support higher data rates through wider channel bandwidths and the use of Orthogonal Frequency Division Multiplexing which delivers higher spectrum efficiency. The vast majority of networks use the LTE (Long Term Evolution) system which is the fastest growing mobile technology in history although a small number use a similar but incompatible system called WiMAX. Use of the term 4G to describe LTE and WiMAX networks is sometimes controversial but the ITU decided it was an acceptable marketing term for the technologies as they present a significant advance on its IMT2000 criteria. However, the term may also be used to describe technologies which meet the ITU's criteria for IMT-Advanced (see IMT-Advanced).



a

Administrative approach

Sometimes known as 'command and control' this is the traditional regulatory approach whereby a regulator has overall control and chooses who should be assigned spectrum, often through a beauty contest where several companies outline their proposed service and the regulator chooses the one with the greatest socio-economic benefit. This allows the regulator to protect spectrum for non-revenue making public interest services like the police but decisions are subjective and can fail to ensure spectrum is used efficiently.

Administrative Incentive Pricing (AIP)

The concept where a fee is levied on the users (e.g. mobile operators) in order to incentivise them to only use the spectrum they need therefore freeing spectrum up for other services. AIP uses the opportunity cost method of valuation (see Opportunity Cost).

African Telecommunications Union (ATU)

An agency of the African Union (AU) specialising in information and telecommunications technologies infrastructure and services on the African continent.

Aggregation risk

The risk of failing to aggregate spectrum. Aggregation risk arises when a spectrum bidder needs to secure two spectrum bands to offer a particular service, but there is a risk they may only secure one which will fail to meet their need and therefore be worth less than they would otherwise have paid.

Allocation (of a spectrum band)

The services which may operate in a specific frequency band (e.g. mobile services or terrestrial TV broadcasting). This process is overseen by the ITU and reviewed at its World Radiocommunication Conference when a band may be reallocated to allow it to be used differently. This is sometimes confused with assignment which is the decision made by a national regulator to grant a band for use by a specific company (e.g. a specific mobile operator). The ITU designates allocations as 'primary' when the service has priority use of the band (this is co-primary where there are several services) or 'secondary' when the service may operate as long as it does not interfere with 'primary' services.

Arab Spectrum Management Group

The body which manages and coordinates all issues related to Spectrum Management on behalf of the Arab states in the Middle East and North Africa.

Ascending clock auction (aka Japanese auction)

Sometimes known as a 'Japanese auction', this is a method whereby the auctioneer begins at a low price and only the bidders willing to pay it proceed to the next round when the price is raised again and the process is repeated until only one remains.

Asia Pacific Telecommunity (APT)

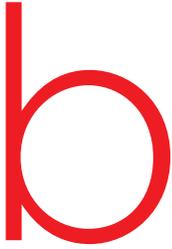
The focal point for coordination of ICT, including radio spectrum matters, on behalf of member states in the Asian and Pacific regions. The duties of the APT include the promotion and development of ICT services and infrastructure; cooperation between member states on ICT matters; and aligning approaches in preparation for major events such as the World Radiocommunication Conference.

Assignment (of a spectrum band)

The process of awarding spectrum to a particular user (e.g. a mobile operator). It is usual for the national regulator acting on behalf of the government to be responsible for the process of spectrum assignment. They use a number of techniques to allocate spectrum to particular users: auctions and beauty contests are the most common. Often the term is confused with 'Allocation'.

Auction

A method used by a regulator to assign a licence to a specific user (e.g. a mobile operator) allowing them to use a specific frequency band in a certain area, at certain times for a specific period. There are numerous auction methods (see ascending clock auction, combinatorial clock auction, Dutch auction, English auction, sealed bid auction, simultaneous (ascending) multi-round auction).



Band (spectrum band)

A discrete block of spectrum that may be allocated for use by certain services (e.g. mobile services) and assigned by a national regulator to a specific user (e.g. a mobile operator).

Base station (aka cell tower)

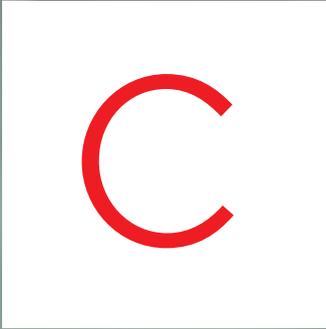
A base station is a structure that contains radio equipment which is used to link mobile devices in a specific geographical area to a mobile operator's network. A base station may provide coverage over a large area (several miles), just a few city blocks, or even a single location such as a train station or home (see heterogeneous network).

Beauty contest

The process whereby a regulator issues a spectrum licence after listening to all proposals and then choosing the one which offers the greatest benefit.

Benchmarking

Benchmarking uses the results of similar auctions in other markets to estimate the expected value of a spectrum band. The main criticism of benchmarking is that it difficult to obtain like-for-like comparisons as market conditions are seldom identical. It is one of the three methods of valuing spectrum – the others are ‘modelling’ and ‘opportunity cost’.



CDMA (Code Division Multiple Access)

A radio technology used in several mobile standards including all the main varieties of 3G (WCDMA, CDMA2000 and TD-SCDMA) and the 2G cdmaOne system. It allows individual voice and data sessions to be sliced up and spread across different frequencies enabling more efficient spectrum use.

CDMA Development Group (CDG)

An international consortium of companies — service providers, infrastructure manufacturers, device suppliers, test equipment vendors, application developers and content providers — who work together to foster the growth and evolution of CDMA2000 systems.

CDMA One

Also known as IS-95, this 2G cellular system is used by numerous operators around the world. It is based on CDMA technology (see CDMA) which forms the basis of most 3G networks.

Cellular

The method of building wireless networks that cover wide areas by using a number of relatively low-power radio base stations laid out in a hexagonal, cellular-like grid. This allows large numbers of phone calls and data sessions to be supported because frequency channels can be re-used. This means several mobile phones can use the same frequency channel without causing interference as long as they are connected to different “cells” (i.e. base stations) that are sufficiently far apart. It also means that when a user drops out of range of one base station their session can be handed over to another.

CEPT

(European Conference of Postal and Telecommunications Administrations /Conférence Européenne des administrations des Postes et des Télécommunications)

The European body which helps coordinate, and drive cooperation, between member states on matters of telecommunications technology and policy. Principal responsibilities to members include co-ordination on commercial, operational, regulatory and technical standardisation issues. Today, it comprises 48 member administrations including all of the EU countries, Russia and Turkey. The committee responsible for spectrum matters within CEPT is the Electronic Communications Committee (ECC).

Channel

The amount of spectrum used for the transmission of a radio signal. For example, a 2G (GSM) channel is 200 kHz wide, a 3G (WCDMA) channel is 5 MHz wide and a 4G (LTE) channel can be up to 20MHz wide.

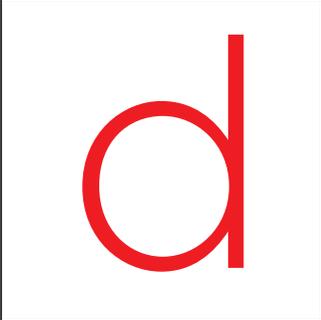
CITEL (Comisión Interamericana de Telecomunicaciones / Inter-American Telecommunications Commission)

The telecommunications/ICT advisory body for the Organization of American States. Its purpose is to promote telecommunications and ICT across 35 states in the Americas and to coordinate standardisation issues including the use of spectrum.

Combinatorial clock auction (CCA)

An auction method that uses multiple rounds with ascending bids but at the end of each round participants are allowed to bid on a different combination of licences.





Deregulation (of the telecommunications industry)

The privatisation of state-owned telecommunications monopolies. In terms of spectrum, administrations began to allow market forces to choose the best use of spectrum in some bands as opposed to the administrative approach.

Digital dividend

The portion of spectrum that becomes available when television broadcasting switches from analogue to digital TV transmission. Digital transmissions use spectrum far more efficiently than analogue allowing the services to occupy a smaller band. In Europe, the Middle East and Africa this meant the 800MHz band was made available for LTE services while in the Americas and much of Asia Pacific the same was done with the 700MHz band.

Dutch auction

An auction method where the auctioneer posts the highest price first and reduces it over time until a price which is acceptable to one of the bidders is reached.

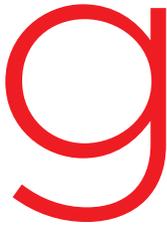


EDGE (Enhanced Data rates for GSM Evolution)

The fastest 2G data service, sometimes known as 2.75G, that enables data to be delivered at rates up to 384kbps.

English auction

An auction technique whereby the auctioneer opens the bidding with a price which is raised as bidders indicate their willingness to pay it until only one remains.



GPRS (General Packet Radio Service)

A 2G data technology used in GSM networks, sometimes known as 2.5G, that enables data to be delivered at rates of up to 56-114 kbps.

GSM (Global System for Mobile Communications but initially known as Group Spécial Mobile)

The most dominant 2G mobile network technology that was used throughout Europe and most of the world.



GSMA (the GSM Association)

The GSMA represents the interests of mobile operators worldwide. Spanning more than 220 countries, the GSMA unites nearly 800 of the world's mobile operators with 250 companies in the broader mobile ecosystem, including handset and device makers, software companies, equipment providers and Internet companies, as well as organisations in industry sectors such as financial services, healthcare, media, transport and utilities. The GSMA also produces industry-leading events such as Mobile World Congress and Mobile Asia Expo.

g



h

Harmonisation (Spectrum Harmonisation)

The use of the same spectrum for the same types of service across international borders. When a number of countries have agreed to allocate a specific block of spectrum to the same use, that spectrum is said to be harmonised across those countries. Harmonising spectrum minimises interference across national borders, increases the size of mobile markets for equipment and services thereby reducing costs, and enables international roaming.

Hertz

A unit of frequency equal to one cycle/wave per second. As most radio waves operate at high frequencies they are referred to in terms of:

- kiloHertz (or kHz), a thousand waves per second
- megaHertz (or MHz), a million waves per second
- gigaHertz (or GHz), a billion waves per second

HetNet/Heterogeneous network

A recent trend in mobile network design which uses a variety of different sized base stations that can support numerous radio standards including 2G, 3G, 4G and Wi-Fi. These include macrocells as well as small cells which are very low-power base stations that bring the full data capacity of a conventional cell to a relatively small area. These include femtocells that cover a home, picocells that cover a business and microcells that cover small urban or rural areas.

HSPA (High-speed packet access)

An enhancement to WCDMA (3G) networks that enables faster data connection speeds - and is sometimes known as 3.5G. The enhancement to download speeds (known as HSDPA) could reach peaks of 14.4Mbps but future upgrades accelerated speeds up to 42Mbps and beyond. The enhancements to upload speeds (known as HSUPA) enable speeds of around 5.76Mbps in existing devices but further upgrades could in principle reach 34.5Mbps.



IMT (International Mobile Telecommunications)

Describes the technologies that meet the standard for IMT-2000 and IMT-Advanced which include all technologies known as 3G and 4G. See IMT-2000 and IMT-Advanced.

IMT-2000

Published by the ITU, IMT-2000 specifies the criteria for 3G services and networks. Compatible technologies include WCDMA, HSPA, LTE, TD-SCDMA, CDMA2000 and WiMAX.

IMT Advanced

The ITU benchmark for the next generation of networks which seeks to set the target for a significant improvement in performance and quality of service compared with IMT-2000 (i.e. 3G) compliant systems. The criteria specify that the networks should be entirely IP-based and support data rates of 1Gbps for stationary mobile devices and 100Mbps for those which are moving. Candidate technologies include LTE-Advanced, the upgraded form of LTE, and WiMAX 2.

Interference

A situation where unwanted signals from one radio system leak into the receivers of another system thereby degrading their performance.

IS-95

See cdmaOne

ITU (International Telecommunications Union)

A specialist agency of the United Nations responsible for information and communication technologies (ICTs). This includes setting international, treaty-bound spectrum designations. The ITU also works towards developing the technical standards to ensure networks and technologies seamlessly interconnect and improves access to ICTs for underserved communities.

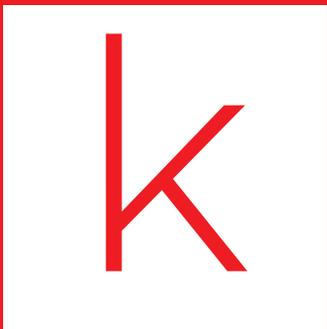
ITU-R

ITU-R is the division of the ITU that is responsible for setting international, treaty-bound radio-frequency spectrum designations. The mission of the ITU-R is to ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including those using satellite orbits, and to carry out studies and approve recommendations on radiocommunication matters. It mainly carries out its work through ITU study groups which prepare a technical framework for spectrum related topics in preparation for debate at the next World Radiocommunication Conference.



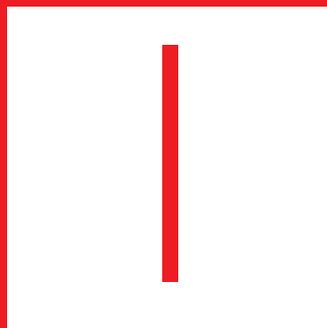
Japanese auction

See Ascending clock auction.



KiloHertz

see Hertz



Liberalisation

The removal of technology restrictions on spectrum to allow more flexible use. Spectrum liberalisation has fostered several active areas of policy research including technology neutrality, spectrum usage rights, auction incentive pricing and spectrum trading.

Licensed spectrum

A frequency band which requires a licence from the national regulator that specifies the frequency range, the geographical area and the times when it may be used. The majority of radio spectrum is licensed. Examples of services that use licensed spectrum include mobile/cellular, TV and radio broadcasts, the military, emergency services, etc.

Licence (for radio spectrum use)

A collection of usage rights for a block of spectrum that is granted by a regulator often through an auction.

LSA (Licensed Shared Access)

An approach whereby a licence owner (e.g. the military or a mobile operator) sells access to its spectrum in areas or at times when it is not being used. This may help encourage spectrum owners to use their assets as efficiently as possible and improve the availability of spectrum to those which require it.

LTE (Long Term Evolution)

The overwhelmingly dominant '4G' radio technology that supports faster data rates through improved spectrum efficiency and wider channel bandwidths. By the end of 2013 there were 260 live LTE networks in 95 countries making it the fastest growing mobile technology ever. Although the system was designed as the natural successor for 3G UMTS networks (i.e. WCDMA & TD-SCDMA) it has also been adopted by operators which deployed the alternative 3G technology CDMA2000.

LTE-Advanced (LTE-A)

An upgrade to 4G networks that enables even faster data connection speeds. It is a candidate for the ITU's proposed next generation of mobile networks detailed under the IMT Advanced criteria.





Macrocell

A base station that provides coverage over a large area as opposed to a small cell which provides coverage over a smaller area.

MegaHertz

see Hertz

Market-based approach

A regulatory approach which uses market forces to determine the most efficient distribution of spectrum. Regulators treat spectrum like any other private asset so licences are typically sold at auction and could in principle be re-sold or leased out by their owners afterwards to ensure market forces continue to ensure the spectrum is used and distributed optimally.

Modelling (the value of spectrum)

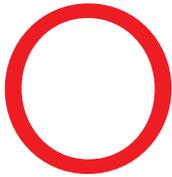
A method for calculating the value of new spectrum using the current cash value of the expected stream of revenues that the spectrum will bring in the future (less costs). The weakness is the heavy reliance on the accuracy of cost and revenue projections. It is one of the three methods of valuing spectrum – the others are ‘benchmarking’ and ‘opportunity cost’.

A close-up photograph of a young woman with dark hair, smiling broadly while holding a black mobile phone to her ear. She is wearing a grey sleeveless top. The background is blurred, suggesting an outdoor setting.

n

NRA (National Regulatory Authority/Agency)

An office of the government usually charged with administering telecommunications policy. The NRA is normally granted sufficient autonomy and power by the government to carry out this work independently. One of the primary responsibilities of the NRA is to define a particular use for a portion of the radio spectrum and to assign that spectrum to a particular operator, user or provider, in a fair, transparent and reasonable manner.



Opportunity cost (of spectrum)

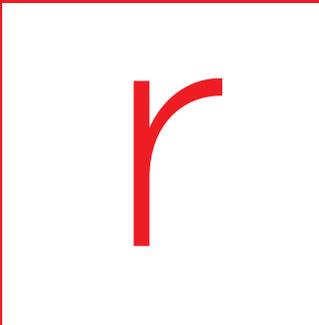
A method of valuing spectrum that assumes that the cost of purchasing a specific band should be less than the alternative method of delivering the same capabilities.

For example, a new licence will give an operator a certain amount of additional network capacity which could also be achieved by deploying a certain number of additional base stations - the value of which can be easily calculated. It is one of the three methods of valuing spectrum - the others are 'benchmarking' and 'modelling'.



Primary allocation

See allocation



Radio regulations

The regulations outline the ITU's recommendations for how spectrum bands may be used including any associated conditions. They are reviewed every 3-4 years at the World Radiocommunication Conference.

Radio spectrum

The portion of the electromagnetic spectrum below 300 GHz which, by virtue of its natural characteristics, is suitable for the propagation of radio waves. The radio spectrum is divided into a number of designated blocks, called bands, which are allocated to various categories of users for specific purposes (e.g. mobile services or TV broadcasting) and may be assigned by a national regulator to a particular user (e.g. a specific mobile operator).

RCC (Regional Commonwealth in the field of Communications)

A regional body that represents the communications interests of the Russian Commonwealth of Independent States (Azerbaijan, Armenia, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Turkmenistan, Uzbekistan and Ukraine) as well as the Baltic states which have observer status.

Refarm (spectrum)

This refers to the repurposing of assigned frequency bands, such as those used for 2G mobile services, for newer technologies, including 3G and 4G.

Reserve price

The minimum bid required to win a licence at an auction. The reserve price can materially affect the final outcome of the auction. It should be set high enough to discourage all speculative bidding but not too high otherwise it will dissuade bidders or prevent the eventual winner from being able to invest appropriately in the resulting network which could result in poor quality services.

A photograph of a person's hands holding a tablet computer. The person is wearing a light blue sweater. A white square with a red letter 'S' is overlaid on the top left of the image.

S

Sealed bid auction

An auction method whereby bidders submit the price they are prepared to pay in confidence to the auctioneer.

Secondary allocation

See allocation

Simultaneous (ascending) multi-round auction (SMRA)

An auction method where groups of related spectrum licences are auctioned simultaneously with the bidding raised until only one bidder remains for each licence.

Small cell

A small low-powered base station that provides coverage over a small area. These include femtocells that cover a home, picocells that cover a business and microcells that cover small urban or rural areas.

Spectrum

The range of different electromagnetic waves which vary according to frequency and include radiowaves, X-rays, infrared waves and visible light rays among others. In the mobile industry it tends to refer to the portion occupied by radio waves which extend from those at low frequencies such as 10kHz up to high frequencies such as 100GHz.

Spectral efficiency

A measure of how much data can be squeezed into a certain amount of spectrum. Newer generations of mobile technology such as 4G are far more spectrum efficient than earlier 2G systems. Strictly speaking it measures the number of bits of information that can be delivered per hertz of spectral bandwidth.

Spectrum commons

See Unlicensed Spectrum



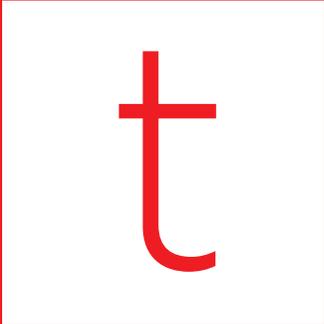
S

Spectrum sharing

The agreement between two or more operators to offer network access through their radio spectrum assets to each other's customers.

Spectrum trading

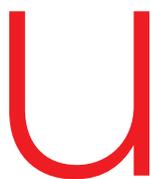
Sometimes known as secondary trading, it is the process whereby the usage rights for a licence can be traded.



t

Telecommunications Industry Association (TIA)

A trade association which represents Information and Communications Technology companies. In addition to the usual commercial activities of a trade association, the TIA is responsible for coordinating the policy initiatives and standards activities of member companies.



UMTS (Universal Mobile Telecommunications System)

The 3G technologies that form part of the GSM family of standards and include the dominant WCDMA system used in most 3G networks and the Chinese variant TD-SCDMA.

Unlicensed spectrum

A frequency band which can be used without a licence from the national regulator on the condition that the devices used meet regulatory standards in order to minimise interference. They tend to be used for a variety of radio technologies that generally only cover short distances and therefore pose limited interference issues. The most notable band is 2.4GHz which is used for technologies such as Wi-Fi and Bluetooth although other bands are used for cordless telephones, baby monitors, car key fobs and garage door openers, etc.

Usage rights

A collection of restrictions which effectively define a technology that can be used in a band of frequencies. Typically these will encompass radio transmission power levels, the areas and times when it may be used, fees and charges, and any coverage or other roll-out requirements.



W

Wavelength

The length of a single cycle of a wave — the distance in metres measured between successive identical points on a wave – for example from one positive peak to the next.

WCDMA (Wideband Code Division Multiple Access)

The dominant 3G technology used in most networks globally and often used interchangeably with the term UMTS.

Wi-Fi

An unlicensed short-range wireless networking technology that uses radio waves to provide high-speed Internet and network connections. The technology has traditionally been used in homes, enterprises and shops but is increasingly being used by mobile operators as part of heterogeneous networks.

White space

White space is used to define licensed frequency bands that are not used at a particular time and geographic location and therefore could be used for other services - normally wireless broadband. Traditionally, the focus has been on TV white space, which consists of unused spectrum in the television broadcasting bands (for example, 470-790MHz in Europe and 470-698MHz in the US). The approach relies on the availability of sufficient spectrum in a given area to offer a reliable alternative service that will not cause interference to the licence holder.

WiMAX (Worldwide Interoperability for Microwave Access)

An OFDM-based wireless communications standard that is similar to LTE but far less widely deployed. Although it was designed to be IMT-2000 compliant - making it a 3G technology - it is commonly described as 4G.

WRC (World Radiocommunication Conference)

An ITU conference held every 3-4 years to review the Radio Regulations - the international treaty governing the use of the radio spectrum. Revisions are made on the basis of an agenda determined by the ITU Council, which takes into account recommendations made by previous World Radiocommunication Conferences.

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Produced February 2014