SATELLITES & SPECTRUM
The Right Wavelength

All wireless communication services - including TV, Mobile telephone and Internet access - whether delivered by satellite or terrestrial infrastructure, are provided using frequencies that are part of the electromagnetic spectrum.

EMEA SATELLITE OPERATORS ASSOCIATION

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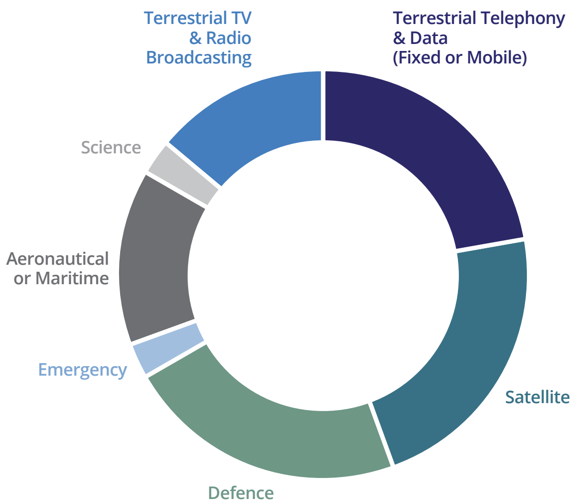
Introduction

Satellite is a wireless communication infrastructure providing broadcast, broadband & interactive services using frequencies that are part of the electromagnetic spectrum. Most are shared with terrestrial wireless systems.

The International Telecommunication Union, or ITU, is the United Nations institution whose Member States act together as global spectrum coordinators. The ITU has allocated parts of this spectrum range to specific categories of services, and has identified those frequencies best suited for transmissions via satellite. While some bands are exclusively dedicated to satellite transmission, most are shared with terrestrial wireless services. As satellites transmit concurrently across borders and continents, instantly establishing connections over thousands of kilometres, the identified frequencies must also be available concurrently across the whole satellite footprint. Overall, satellite is one of many users of radio spectrum.



The Satellite

Satellite Characteristics

A satellite is constructed from the outset to transmit via a clearly identified frequency band(s) - this cannot be changed after launch. Its coverage is always international and, depending on its distance from Earth, may be 'regional' or, in the case of geostationary satellites flying 36,000km above the Equator, may cover up to about 40% of the Earth's surface. Once launched, the satellite operates for about 15 years. At end 2016, 1459 operational satellites were in orbit.[1]

Satellite Use

Satellites come in many shapes and sizes and have many uses such as television broadcasting, distress and safety at sea, broadband communications, weather forecasting and navigation (GPS). New applications and services such as for in-flight connectivity and the Connected Car are also emerging. Modern satellites can receive and transmit hundreds of signals at the same time, from simple digital data to complex television programmes. Satellite terminals may be handheld devices for mobile satellite telephony, dishes for TV reception or broadbandInternet, VSAT terminals[2] or modems on board ships and aircraft. Satellites also provide an 'invisible safety net', upon which most of today's communications services rely for a global and secure backbone.

[1] http://www.ucsusa.org/nuclear-weapons/space-weapons/satellite-database#.WUE4uWfTXdk

[2] Very small ground equipment slightly larger than a satellite TV dish but capable of transmitting and receiving.

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The Frequency Bands

Different Frequency Bands for the Same System

Different frequency bands are suitable for different types of markets as shown below. Lower frequencies (L-, S- and C-Bands) are less affected by the heavy rainfall in parts of Africa/Asia/Latin America and can serve wide areas of the globe at a time. Higher frequencies (Ku-, Ka- and Q/V Bands) allow smaller antennas to be used with more focused service beams on regions or sub-regional areas.

S-DAB	1.467 GHz to 1.492 GHz	Satellite Audio Broadcasting to fixed & mobile units
L-Band	1.518 GHz to 1.675 GHz	Civilian Mobile-Satellite Services (two-way)
S-Band	1.97 GHz to 2.69 GHz	Satellite television & radio broadcasting and mobile BB services including in-flight connectivity
C-Band	3.4 GHz to 7.025 GHz	Fixed-Satellite television & data services (including broadcasting)
Ku-Band	10.7 GHz to 14.5 GHz	Fixed-Satellite television & data services (including broadcasting)
Ka-Band	17.3 GHz to 30 GHz	Fixed-Satellite television & data services including fixed and mobile two-way broadband services
Q/V-Bands	37.5 GHz to 51.4 GHz	Fixed and mobile high-speed broadband services including in-flight connectivity

Frequency bands used by Satellites[3]

Sharing Frequency Bands

While sharing amongst different satellite systems can be successfully achieved, it is more difficult for satellites to share with terrestrial technologies. Interference occurs when incompatible technologies and services attempt to use the same frequency bands in the same geographical area. This imposes technical limitations to ensure that harmful interference does not degrade the satellite signal, which attenuates on its 36,000km path to earth. In order to manage such activities, the use of frequencies is controlled at a governmental level through the regulation of radio-communications and licensing of wireless operators' activities. In allocating bands to specific services, national, regional and international regulators must take into account the technical limitations which prevent satellite services from moving or expanding into alternative bands. Satellite allocations must therefore be well-guarded and remain unchanged.

Satellite Industry Views on Key Spectrum Management Principles

Currently, a paradigm shift is taking place in spectrum management policies in many countries. While the traditional policy objective was to avoid harmful interference, efficient use of spectrum is now increasingly being decided with reference to models that allocate spectrum based on the belief that market forces will "naturally" select the operators and services that will bring most user benefit. However, this approach is not neutral as it discriminates against the unique physical and technological requirements of satellite, as explained below.

Technology neutrality

Technology neutrality has no legal definition but is used as a welcome competition principle that prevents the unnecessary discrimination against any technology or communications system. Yet, in the context of radio spectrum, technology neutrality has been invoked to suggest that the allocation and assignment of spectrum does not need to be technology specific anymore.
It has been suggested that technology systems or technology platforms (as defined by standards) can be employed to provide a certain service in a given use in any frequency band. Alternatively, that they can share the same bands with no single technology option favoured over others in any band.

[3] UHF (235 to 400 MHz) and X-band (7250-8400 MHz) are also used for military services.

However, in practice, technological limitations are required in order to promote sharing without causing harmful interference, potentially degrading the technical quality of the service delivered to citizens. Depending on the service, some technologies are best suited to some frequencies, and implementing strict technological neutrality often leads in practice to more burdensome regulatory procedures to ensure cohabitation between systems. In particular, extreme caution must be exercised when considering spectrum 'change of use', i.e. the interchangeability of terrestrial or satellite technologies in the same spectrum.

Service neutrality

Service neutrality implies that spectrum holders can choose the services they wish to offer in any frequency band. This concept has become attractive to some in this age of convergence between applications using digital technologies.

It should be noted that the satellite industry provides diverse applications in the same frequency bands. A concrete example of this is the provision of "triple-play" services provided in the bands used for Broadcasting Satellite Services.

In the context of Broadband for All, service neutrality takes on a particular importance. The diverse geographies of the world require the use of satellites within a basket of technologies if truly ubiquitous connectivity is to be realised.

However, as only frequency bands allocated exclusively to satellite services can guarantee the availability of the same frequencies across borders, the ITU categories of types of radio services remains critical.

Spectrum Efficiency

Satellites & Spectrum Efficiency

With increased numbers of users, higher demand, and the provision of more bandwidth-intensive services, satellite operators have invested heavily in state-of-the-art technologies that further increase spectrum efficiency:

- The same frequency bands can now be used by more signal amplifiers (called 'transponders') resulting in increased transmission capacity.
- Satellites have led the market for switchover from analogue to digital transmission, specifically in television and radio services, thus multiplying the number of channels and programs made available with the same amount of spectrum.
- Satellite operators with different orbital positions share or reuse the same frequencies between each other over the same footprint. The total capacity of each system is increased without increasing the allocated bandwidth.
- The different 'spot beams' of one satellite can "reuse" the same frequencies in a manner similar to a cellular network.
- The satellite industry has been a pioneer in trading. Orbital positions are already traded under existing commercial (contractual) law, and as wholesalers, satellite operators lease capacity to third party operators.

Co-operating across Technologies to Increase Efficiency and Reduce the Carbon Budget

By integrating satellite and terrestrial components (so-called Complementary Ground Components or CGC) to create 'hybrid' solutions for users, satellite operators can provide the same services using the same frequencies in different locations, with minimum infrastructure. This integration puts CGCs under the control of satellite operation, which is essential to avoid harmful interference.

Satellites can also significantly increase the performance of terrestrial mobile communications by maximizing geographical coverage with fewer terrestrial repeaters, increasing the reliability of the communications platforms, and combining technologies, such as Wifi/ Wimax and VSAT. This reduces the requirement to initiate the large scale build out of stand-alone terrestrial infrastructure, and so reduces the carbon budget of the network.

The European Aviation Network is one example where a mobile satellite/CGC technology solution has been implemented since 2016.

Main Lessons & Challenges for the Years to Come

Considering the unique reach of satellites and the reliance that both governments and citizens now place on them, ensuring reliable satellite access to radio spectrum must remain a political priority. The following principles are critical:

- Satellite is necessarily a global communications technology. First and foremost its functionality depends on international governance of radio spectrum, which goes hand in hand with the unique ability of this infrastructure to reach and connect millions across borders at any given time. Any political decision made or initiative taken at national or regional level that contradicts international arrangements is irrefutably and directly to the detriment of this industry sector.
- The laws of physics can neither be defied nor ignored. Satellite service providers and users alike from all countries under the footprint depend on the protection of signals that come from outer space. Furthermore, once a spacecraft has been built and launched (a process that takes an average 4 years) its specifications cannot be modified. In order to provide global and vital services, satellite depends on a secure tenure in the form of primary ITU allocation of radio spectrum and the corresponding harmonization of allocation conditions at regional level.
- There is no alternative to the harmonized bands that are used by satellites today; and these frequencies are intensively used due to the success of the satellite sector itself. Further, more harmonized frequencies for planned satellite systems (under construction) are required, and the allocation of additional satellite spectrum remains on the agenda for the next World Radio Conference (WRC).

Conclusion

Satellite coverage is always international and some bands are exclusively dedicated to satellite transmission. Satellites transmit simultaneously across borders and continents, and their allocated frequencies must be available simultaneously across the whole satellite footprint to ensure availability of the same services across and beyond the borders of Europe.

Different frequency bands are suitable for different climate conditions and types of markets. It is crucial for national, regional and international regulators to recognize that technical limitations prevent satellite services from moving or expanding into alternative bands.

Satellite access to radio spectrum must be upheld as a political priority. The satellite functionality first and foremost depends on international governance of radio spectrum, which goes hand in hand with the unique ability of this infrastructure to reach and connect millions of citizens across borders at any given time.

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Spectrum - The Lifeblood of Satellites

Securing spectrum is absolutely essential to satisfy the growing demand for consumer, critical safety and strategic services both within Europe and internationally over the 15-20 year lifespan of a satellite.

A Key Contributor To Economic Growth and Recovery

The satellite sector delivers significant employment across each of the sectors in which service is provided. Satellite operators and their supply chains, both upstream and downstream, play an important role in achieving the Sustainable Development Goals and more generally in enabling an Inclusive society.

Delivering 100% Coverage

High Speed broadband for all can only be achieved through a mix of technologies that address' citizens' needs / different geographic locations. Satellite systems represent a ready-made, spectrally efficient solution to the challenge of offering affordable, reliable, high-speed services to all citizens.

Cutting the Carbon Budget

Once launched, a single satellite can provide continuous service over as much as a third of the world for an average of 15 years. Satellites significantly reduce the building of extensive terrestrial infrastructure for coverage to be provided.

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About ESOA

The EMEA Satellite Operators' Association was formed in March 2002 to represent the interests of the industry with the European Commission, Parliament, Council and the European Space Agency as well as international organisations, national governments and regulators. ESOA's goals include ensuring that satellites benefit from the appropriate political, industrial and regulatory environment to fulfil their vital role in the delivery of communications. ESOA is governed by a Board of Directors made up of the CEO's of its Member Companies.

The activities and other details about ESOA can be found at **www.esoa.net**.

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