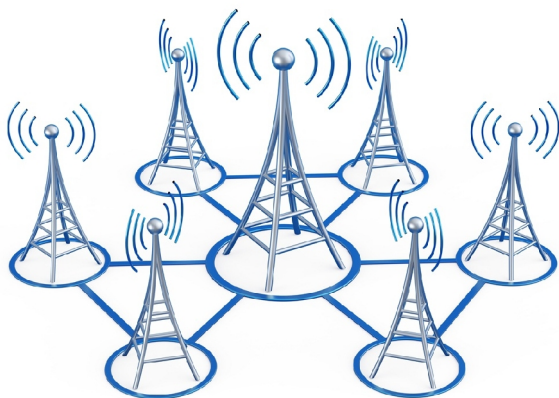# Radio spectrum
## A key resource for the Digital Single Market

**SUMMARY**

Radio spectrum refers to a specific range of frequencies of electromagnetic energy that is used to communicate information. Applications important for society such as radio and television broadcasting, civil aviation, satellites, defence and emergency services depend on specific allocations of radio frequency. Recently the demand for spectrum has increased dramatically, driven by growing quantities of data transmitted over the internet and rapidly increasing numbers of wireless devices, including smartphones and tablets, Wi-Fi networks and everyday objects connected to the internet.

Radio spectrum is a finite natural resource that needs to be managed to realise the maximum economic and social benefits. Countries have traditionally regulated radio spectrum within their territories. However despite the increasing involvement of the European Union (EU) in radio spectrum policy over the past 10 to 15 years, many observers feel that the management of radio spectrum in the EU is fragmented in ways which makes the internal market inefficient, restrains economic development, and hinders the achievement of certain goals of the Digital Agenda for Europe.

In 2013, the European Commission proposed legislation on electronic communications that among other measures, provided for greater coordination in spectrum management in the EU, but this has stalled in the face of opposition within the Council. In setting out his political priorities, Commission President Jean-Claude Juncker has indicated that ambitious telecommunication reforms, to break down national silos in the management of radio spectrum, are an important step in the creation of a Digital Single Market. The Commission plans to propose a Digital Single Market package in May 2015, which may again address this issue.

**In this briefing:**

- The issue
- Managing radio spectrum
- Governance of radio spectrum
- Radio spectrum policy in the EU
- Challenges in radio spectrum policy
- The Connected Continent Regulation
- Next steps
- Main references

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## The issue

Communication using the radio spectrum is essential for many of the applications on which Europeans depend in their daily lives, including audio and television broadcasting, mobile telephony, and wireless internet access. Use of radio spectrum is also critical in aviation and transport as well as other services such as research, space services, defence, public protection and disaster relief. The European Commission estimates that the total value of services that depend on radio spectrum is at least €200 billion annually in Europe.

Demand for radio spectrum is rapidly increasing. Mobile internet traffic in western, central and eastern Europe is predicted to increase more than ten times between 2014 and 2019. This increase is due largely to increases in the number and 'smartness' of wireless devices; to a large increase in bandwidth-hungry video content; and to growth in machine-to-machine communication as the 'Internet of Things'[1] develops. While new technologies may help increase the efficiency with which the radio spectrum is used, there is an urgent need to ensure that the regulatory management of the spectrum delivers the maximum social and economic value from the use of this inherently finite and scarce resource. In the opinion of some, radio spectrum policy plays a pivotal role in ensuring European competitiveness in the global arena.

## Managing radio spectrum

Managing radio spectrum involves by and large three different processes. *Harmonisation* is the allocation of a frequency band for a service or set of services, at a global or regional level. It is intended to minimise interference, limit cross-border conflicts,

> **What is radio spectrum?**
>
> Radio spectrum refers to frequencies of electromagnetic energy ranging from about 9 cycles per second (or 9 Hz) to 300 billion cycles per second (300 GHz). Radio frequencies are below those of many other forms of electromagnetic radiation such as visible light. Radio waves can be modulated to encode information, transmitted and then received some distance away, where the information can be decoded. Not all radio frequencies are equal: some have characteristics in terms of propagation range, building penetration, resistance to atmospheric conditions, digital bit capacity, power efficiency or antenna size that make them more suitable for certain applications. The range from 400 MHz to 4 GHz is particularly prized. Radio waves at the same frequency can interfere with each other, creating 'noise'; and stronger signals can drown out weaker ones. For these reasons, radio spectrum needs to be managed.

facilitate roaming so that citizens can take equipment across borders, and to provide economies of scale for equipment manufacturers, who can manufacture equipment knowing that it will work in a number of different markets. *Assignment* is the process whereby an authority, such as a national regulatory agency, provides authorisation, often through an exclusive licence, to a particular organisation to use a radio frequency band on its territory. The licence gives the organisation certainty that its signals will not be the victim of interference from other users and the incentive to invest in the infrastructure necessary to provide its service. Finally, *standardisation* is the designation of technologies that will provide a certain category of service, thereby promoting economies of scale in production, ease of roaming and interoperability, as well as avoiding interference.

Managing radio spectrum is a complex activity. It involves taking decisions in a rapidly changing technological environment, years in advance of the actual deployment of technology. The EU recommendation on allocating the 900 MHz spectrum to GSM mobile telephones[2] in Europe was adopted in 1987, creating very early on the

conditions that led to this European technology becoming a dominant standard world-wide. Once taken, spectrum management decisions can also be difficult, costly or time-consuming to change. For example, a satellite built with the capability of transmitting and receiving on particular bands cannot be modified after launch; re-allocating the spectrum it uses may considerably shorten its useful life. Similarly, creating a harmonised band across Europe may be expensive if military equipment and applications in one country have historically used some of those frequencies, and hence need to be replaced or adapted.

Spectrum to meet growing needs such as wireless broadband can be provided through a number of different mechanisms. There is no vacant spectrum remaining in the EU, but under-used spectrum can be reallocated to new uses, or reassigned to new operators. Bands can also be shared in various ways. Some frequencies may be designated as unlicensed, i.e. they can be used by anyone who uses equipment that corresponds to certain established technical standards. (This is the case for bands used by WiFi equipment.)

**Figure 1 – Forecast global mobile data traffic (millions of terabytes per month)**



Data source: Cisco VNI, 2015.

Other kinds of sharing include using spectrum in between other used frequencies (e.g. 'white space sharing' between frequencies used for TV broadcasting), using geolocation databases (that indicate locations or times when a particular frequency is not used) and cognitive radio (devices which can be dynamically configured to use frequencies that it senses are not being used.) Economic incentives can be used to encourage incumbents of an under-utilised band (including government or public services) to accept such types of sharing, or to trade their licences through a secondary market.

## Governance of radio spectrum

Radio spectrum is managed by a complex and sometimes overlapping series of international, regional and national authorities. At the top is the International Telecommunications Union (ITU), a specialised United Nations agency with responsibility for information and communications technologies. It has the mission (among others) of ensuring equitable, efficient and economical use of the radio-frequency spectrum for all countries in the world. The ITU allocates bands in the radio spectrum, accredits certain technologies and coordinates efforts to eliminate interference between countries, applications and terrestrial and satellite services. Every few years it organises a World Radiocommunication Conference (WRC) that provides a forum for national governments to discuss and agree on policies, standards and the use of different bands of radio frequencies. These agreements are then encoded in legally binding Radio Regulations. International cooperation is important not only because it allows people to use the same services when moving from one country to another, but because it reduces equipment costs through economies of scale, as manufacturers know that the same radio bands will be used in various parts of the world.
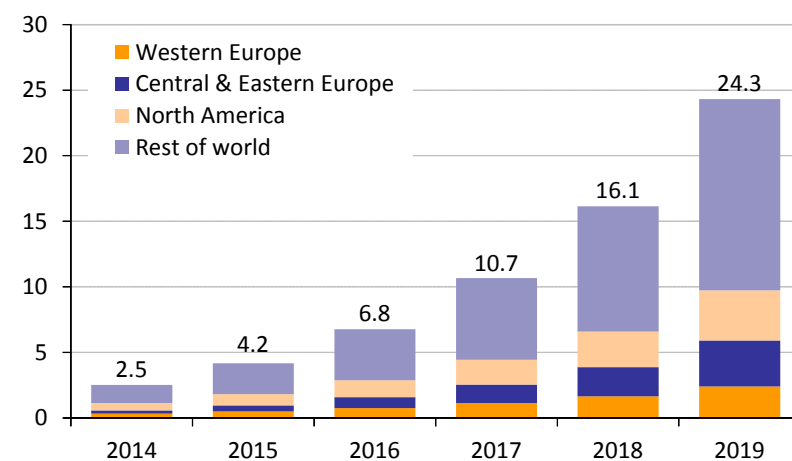
Countries also cooperate at regional level. The [European Conference of Posts and Telecommunications Administrations](#) (CEPT) is a cooperative body composed of 48 different national regulatory administrations throughout Europe. Its Electronic Communications Committee (ECC) undertakes studies, develops common policies and adopts non-binding decisions, recommendations and reports to harmonise the efficient use of radio spectrum. The ECC also works closely with European standards bodies, in particular [the European Telecommunications Standards Institute](#) (ETSI), to produce telecommunications standards for manufacturers and service providers, to ensure that they make correct and conformant use of radio spectrum for different applications.

However national-level authorities are arguably the most important bodies in terms of assigning radio frequencies. EU Member States retain the legal right to sell their natural resources (in this case, radio spectrum). While some frequency bands in a country may be reserved for public services (including TV broadcasting, police, and military and emergency services), and others reserved for unlicensed use, assigning radio spectrum frequencies to commercial applications is now usually done through a competitive auction that applies market principles in a fair and transparent fashion.[3] In a typical auction, participants bid for exclusive rights to a particular band for a given period of time. However the national authority designing the auction is able to influence the results by setting various conditions including the timing of the auction and the duration of the licence or differential treatment of market participants. They may set these conditions to take account of a particular situation in a country, to increase competition, or to maximise revenues from the auction, which typically go into the national treasury.

## Radio spectrum policy in the EU

Over the past 15 years, the EU has taken an increasingly active role in radio spectrum policy, with particular concern for the effect that radio spectrum use and management has on the internal market and the digital economy. In 2002, Council and Parliament approved a Framework Directive that set out EU and Member State competence in radio spectrum management, an Access Directive that provided guidelines for assigning spectrum, and (most importantly) the [Radio Spectrum Decision](#). The latter created an EU Radio Spectrum Policy (RSP) to provide the legal basis for the Commission to adopt decisions

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**Digital dividend**

The development of digital television technology has given rise to a major change in spectrum use throughout the world. As well as increasing the number and quality of television services, digital television has freed up a significant part of the Ultra High Frequency (UHF) band that has been used principally for broadcasting. The spectrum available for new services as a result of this switchover is referred to as the 'digital dividend'.

In Europe, the 800 MHz band (covering 790-862 MHz) was reallocated for use by mobile broadband services by 2013. Nevertheless a large number of Member States requested derogations or failed to meet the deadline. (On average only [65%](#) of all the EU-harmonised spectrum for wireless broadband band in the EU has actually been awarded, and only a handful of Member States have as yet assigned all of it.)

In addition, the 700 MHz band (from 694 to 790 MHz) for terrestrial broadcasting and wireless microphones can be made available for other purposes as a 'second digital dividend'. In 2013, the European Commission set up a High-Level Group representing both broadband and broadcast communities, under the chairmanship of Pascal Lamy, to consider use of this part of the spectrum. The group was unable to arrive at a consensus, but the chairman issued his own [report](#), calling for allocation of the band to wireless broadband by 2020 while ensuring that broadcasters can use the remaining UHF spectrum (470-694 MHz) until 2030. A public consultation will run for three months from January to April 2015, before global discussions over this 700 MHz band take place at the WRC in November 2015.

on harmonised conditions for use of spectrum bands in the internal market. The RSP seeks to coordinate spectrum management across the EU, in order to create an internal market for wireless services, to ensure efficient use of spectrum and to foster innovation. A Radio Spectrum Committee (RSC) was created to help with technical implementing measures, and a Radio Spectrum Policy Group (RSPG), to advise the Commission on broader policy issues. The RSP was revised in 2009 to increase flexibility in spectrum management.

Then, in 2012, with a view to the Digital Agenda for Europe, Decision 243/2012/EU was adopted to create a multiannual Radio Spectrum Policy Programme (RSPP), intended to increase the efficiency and flexibility of spectrum use, while at the same time promoting competition. Specifically the RSPP seeks to identify at least 1 200 MHz of bandwidth in the EU to accommodate increasing needs for wireless data traffic; allow spectrum trading in bands where flexible use has been identified; and encourage spectrum sharing to ensure efficient use of spectrum. A number of harmonised bands were identified which Member States must authorise. To help with future analysis and management, a radio spectrum inventory was created with data furnished by Member States. Most notably, radio spectrum in the 800 MHz band (790-862 MHz) – the so-called 'digital dividend' of frequencies no longer needed for television broadcasting due to the switch to digital television – was assigned to help provide wireless coverage to sparsely populated rural areas.

At international level, the EU also plays an important role in coordinating support from Member States, within WRCs, for policies which affect exclusive or shared EU competences such as information society, internal market, environment, transport, space and audio-visual policy as well as common security and defence. These positions are developed in consultation with CEPT and RSPG (the latter has already identified draft priorities for WRC-15) and then endorsed by Parliament and Council[4]. Member States are then expected to support these EU positions in discussions within the WRC.

Radio spectrum policy is not in itself a major EU policy, but it is an important building block for the Digital Single Market. Radio spectrum decisions are essential if in the future consumers are to be able to access digital services and products in an environment where demand, particularly for mobile and band-intensive video, is increasing very rapidly. In March 2013, the European Council noted the Commission's intention to report on the remaining obstacles to the completion of a fully functioning Digital Single Market by 2015. In his political priorities, Commission President Jean-Claude Juncker gave prominence to the creation of the Digital Single Market. Moreover, one of the main priorities for the 2015 Latvian Council Presidency is the digital agenda, considered to have great potential for stimulating economic growth.

## Challenges in radio spectrum policy

In the opinion of many observers, the EU is still very far from achieving a single market in electronic communications:

- There are wide variations between Member States in the prices of spectrum and of access rights, as well as in end-user costs. Member States may be more focused on extracting the maximum revenue from auctions rather than on maximising broad socio-economic welfare, or ensuring that market participants earn enough to ensure future investment.
- Each Member State awards its own spectrum licences according to its own conditions, including the timing of auctions and the duration of licences. The same

spectrum in neighbouring Member States may never be available for an operator to bid on at the same time.

- Different regulatory environments mean that new technologies are adopted at different speeds. Multi-country operators have to deploy new technology at distinct, different times which prevents them from realising economies of scale.
- Legal uncertainties arising from dealing with 28 different regulatory authorities serve to constrain investment in new generation networks.
- There are a very large number of mobile operators in the EU – more than 200 – as opposed to five or six in the US market. Some observers believe that high levels of competition and rules permitting access to infrastructure by virtual mobile operators (i.e. those who do not own wireless network infrastructure) have reduced profits that could fund investment.
- The Commission believes that telecom operators need to gain scale to become competitive globally, and to invest and expand within Europe.
- Telecommunications revenues are declining in Europe by an estimated 10% between 2008 and 2016 (compared to anticipated increases of 35% and 40% for North America and Asia/Pacific). A number of telecommunications operators in Europe are not very profitable, and hence may not have the resources to invest in infrastructure.

The current situation is believed to introduce inefficiencies, prevent the exploitation of economies of scale, discourage investment in infrastructure and slow down the deployment of new generation technology. For example, the EU has fallen behind the US in the roll-out of fourth generation (4G/Long Term Evolution) wireless infrastructure: in 2013, only 26% of EU citizens had access to 4G/LTE mobile coverage; 90% of the US population had this coverage from one provider alone. And there were large divergences between different Member States.

To correct this situation, a number of observers call for mandated, coordinated release of spectrum by all Member States, more routine renewal of spectrum licences and greater harmonisation of national policies (or a pan-European policy) that would allow operators and manufacturers to take advantage of economies of scale and scope, to speed up deployment of new wireless broadband infrastructures and to increase investment and innovation. A 2011 study for the Commission called for a more direct role for the EU and more regulatory oversight at European level. The European Commission has argued that a Digital Single Market, with greater consolidation of operators across national borders would mean lower prices, better services and greater innovation. The Commission believes that a true single market for telecommunications could increase GDP in the EU by 0.9% annually.

## The Connected Continent Regulation

**The legislative proposal**

In September 2013, the then Digital Agenda Commissioner, Neelie Kroes, proposed legislation concerning a European single market for electronic communications, the so-called 'Connected Continent' Regulation, which includes provisions relating to radio spectrum management. The Commission proposed a simplified authorisation procedure for network operators that would apply across the EU. The proposal would lay down principles for national regulators to follow, and give the Commission the power to force them to withdraw regulations which are incompatible with EU law, as well as to veto national decisions on remedies. It would also allow the Commission to establish a

common timetable and expiry dates for the granting of licences, so as to facilitate operators bidding on the same spectrum in several adjacent countries.

However the Connected Continent Regulation proposal does not call for a pan-European regulatory authority, or a pan-European licence, omissions which provoked then Competition Commissioner Joaquín Almunia to call the approach 'unambitious'.[5] According to a recent review, established national patterns in spectrum allocation are resistant to change; a strong commitment from the EU is necessary to overcome cross-country differences and achieve harmonised spectrum use across Europe. Other observers believe that the creation of a European regulator is not necessary and, given concerns about subsidiarity and proportionality, would require much time and political discussion, and would not have any immediate effect on wireless broadband deployment.

The Connected Continent proposal was adopted at first reading in April 2014 by the outgoing Parliament, with spectrum-related amendments aimed at facilitating trading or leasing licences and ensuring that licence durations were sufficient to incentivise investment. However, Member States in Council have not supported provisions relating to spectrum management. The Latvian Presidency gained a mandate to discuss with Parliament on the roaming and open internet provisions of the proposal. It has left spectrum management issues aside, suggesting that the Commission reconsider them; the Commission has yet to formally indicate how it plans to take the issue forward.

### Stakeholders' views

Organisations in the digital technology and telecommunications sectors were, in general, supportive of the Commission's proposals, though in some cases felt they did not go far enough. Digital Europe welcomed increased coordination and harmonisation of spectrum, and common timetables for spectrum assignment. The president of Nokia characterised cross-border harmonisation of spectrum and policies that allow pan-European consolidation of network operators as 'essential'. The European Telecommunications Network Operators' Association (ETNO) believes that bands for wireless broadband should be harmonised at European or worldwide level; it calls for lighter regulation and more certainty for investors. While supporting the coordination of conditions, timing and duration for band licences, Deutsche Telekom felt that without EU-wide spectrum allocation (a potential 'game changer'), the proposed legislation would not result in an EU-wide market, nor boost investment or capacity. Another company, Orange, called for a radical re-orientation and simplification of regulatory policies, including increased harmonised spectrum and an end to measures favouring new market entrants and virtual operators.

However not all stakeholders agree. The European Competitive Telecommunications Association (ECTA), which represents newer telecoms operators, warned against believing that industry consolidation would result in more investment. The Body of European Regulators for Electronic Communications (BEREC) believes that when it comes to auctioning spectrum, a bottom-up approach, where Member States share knowledge, will make the awarding of spectrum more effective and efficient. The Association européenne des radios (AER) argued that Member States should retain the freedom to assign frequencies to radio broadcasters through individual licences and for bands in which particular services are specified. While calling for greater spectrum harmonisation, BusinessEurope says that the terms of licensing and timetables should remain under national control, to guarantee that the needs of all stakeholders are taken

into account.[6] Various [broadcasting groups](#) have also reminded European decision-makers of the impact of spectrum allocation on the cultural and creative sector.

## Next steps

Commission President, Jean-Claude Juncker has made the Digital Single Market one of his priorities for the Commission's work programme. Specifically, he has [called for](#) a more ambitious telecommunications policy and for the breaking down of national silos in four different areas, including both telecommunications regulation and the management of radio spectrum. The Commission is scheduled to review the EU's telecommunications policy in the course of 2015. It has already committed itself to present a Digital Single Market package in the first half of 2015, which could possibly include a more ambitious telecommunications reform.

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## Endnotes

[1]  A development in which every-day physical objects such as appliances and machines have network connectivity and are able to communicate information about their states and environments to people and to other machines.

[2]  GSM, originally *Groupe spéciale mobile*, now 'Global System for Mobile Communications', is a second-generation standard for mobile telephony.

[3]  Other possibilities are the 'command and control' model where governments decide directly on an exclusive allocation, often based on comparative analysis of different offers known as 'beauty contests'; and a 'commons' model where no licence is required to operate, but technical specifications must be respected.

[4]  See for example, the [(Draft) RSPG Opinion on Common Policy Objectives for WRC-15](#) / RSPG, Nov. 2014, RSPG14-578(rev1).

[5]  Rebuke to 'unambitious' Kroes over telecoms reform / D. Thomas, J.Fontanella-Khan, Financial Times, 13 Aug. 2013.

[6]  BusinessEurope recommendations for a flourishing European digital economy / BusinessEurope, 2014.

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