Translation[1]

Consultation

of the

President's Chamber of the Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways (Bundesnetzagentur)

Identification of post-2016 demand for spectrum in the 900 MHz and 1800 MHz frequency bands for wireless access (Project 2016)

BK1-11/003

[1] In case of divergent interpretation of the German and the English text only the German text shall prevail.

Content

1. Introduction

Frequencies in the 900 MHz and 1800 MHz bands will be available for the nationwide use for wireless access for the provision of telecommunications services starting 1 January 2017.

These frequencies have been assigned to the network operators E-Plus Mobilfunk GmbH & Co. KG (E1 licence), Telefónica Germany GmbH & Co. OHG (E2 licence), Telekom Deutschland GmbH (D1 licence) and Vodafone D2 GmbH (D2 licence) on the basis of protected GSM licences for a limited period expiring on 31 December 2016.

The GSM licences were awarded in Germany in the 1990s. The 900 MHz and 1800 MHz frequency bands made available in connection with the licensing were reserved for Europe-wide mobile services using the GSM standard on the basis of European harmonisation. This provided a unique opportunity for the launch of pan-European mobile communications services. The GSM licensing in Germany and the simultaneous Europe-wide introduction of GSM mobile service products made it possible to make optimal use of the socio-economic potential offered by the 900 MHz and 1800 MHz bands. GSM developed into a major success for the German mobile service market with enormous macroeconomic importance. This has gone hand-in-hand with significant social utility for consumers who were offered EU-wide mobile communication services for the first time. Looking at the Europe-wide introduction, GSM's success must also be measured by its contribution to economic and social integration in the European Union.

Since then, the frequency-related regulatory restrictions on the GSM system were eliminated through the introduction of a more flexible regulatory regime. The 900 MHz and 1800 MHz bands can now also be used for broadband systems with larger bandwidths such as UMTS and LTE. In light of this, sizable socio-economic potential must once again be ascribed to the 900 MHz and 1800 MHz bands: They will be of great importance for providing consumers voice telephony, text messaging and data services for still some time to come.

Nevertheless, due to their physical propagation properties, these two frequency ranges are well-suited for providing consumers innovative mobile broadband data services (mobile Internet use) not only in rural areas but in conurbations as well. Drivers for the growing demand for mobile data services include in particular:

- New multimedia terminal equipment such as smartphones and tablet PCs
- Mobile broadband Internet services
- Cloud computing
- Video streams
- Mobile software applications (apps)
- Increased automated data exchange between terminal equipment (machine-to-machine, M2M)
- Multimedia social networks
- HD (high-definition) voice telephony

With its Broadband Strategy, the German government set ambitious targets for boosting broadband coverage: By the year 2014, a total of 75% of households are to have high-speed broadband access with transmission rates of at least 50 MB/sec. This level of high-speed broadband access is to be rolled out nationwide as quickly as possible. Thus the assignment of the 900 MHz and 1800 MHz bands is also important for creating incentives for investment and for promoting innovation and sustainable competition to the customer's benefit.

Broadband networks for electronic communications allow users to exchange information and data at high speeds. Putting synergies to use when building and expanding the infrastructure for broadband networks makes it possible to significantly increase the degree of population coverage, in an environment of competition between infrastructures and business models, through the construction and expansion of socio-economically useful infrastructures. This was accomplished, for example, with great success in Germany in the case of the rapid utilisation of the frequencies in the 800 MHz band for the provision of broadband Internet access. In this connection, optimal socio-economic effects – in other words, economic growth and the social utility of broadband infrastructures – can be achieved through the use of broadband wireless access which generates impetus not only for intermodal competition between the various infrastructures but also for synergies in connection with infrastructure investments. For this reason, access to wireless high-speed networks is a fundamental prerequisite for access to innovative broadband services and content such as mobile Internet services and infotainment (information and entertainment such as video streaming, Internet radio and Internet TV). Access to wireless high-speed networks is however also a precondition for societal developments spawned by access to products and offerings in the education (e-learning), government (e-government), health (e-health) and teleworking (e-work) fields.

Synergies can be generated in the network industries' markets through the broadband telecommunications networks' interworking with other utility networks (such as railway, road, gas, water and electricity networks). With their high penetration rates and intelligent platforms, telecommunications networks serve as the 'neural pathways' of today's information society and for this reason are an appropriate means for making other network infrastructures 'more intelligent' as well. Radio-based networks such as the existing GSM networks which use the 900 MHz and 1800 MHz bands have a 'reach' of nearly 100% of the population and are consequently already being used not only to provide services for subscribers along infrastructure such as motorways and railway lines but also for data applications which support the use and operation of network infrastructures (e.g. e-call, toll systems, smart metering for gas, water, electricity and heat consumption). For this reason, wireless broadband telecommunications infrastructures and telecommunications services can make an important contribution to the progressive development of the energy industries' distribution networks and, in turn, to the switch to sustainable energy structures in Germany (smart grid and smart metering).

In 2011, the President's Chamber invited comments on the key elements of the framework conditions for identifying demand and subsequently opened official demand identification proceedings in December 2011 in order to grant interested undertakings an opportunity to take part at the earliest possible stage in shaping the procedure for providing the 900 MHz and 1800 MHz bands. Interested undertakings had until 16 January 2012 to submit notification of their projected requirements.

The demand identification proceedings are an important step in connection with being prepared for future demand for spectrum and promoting efficient frequency usage. The notifications of demand submitted by interested undertakings are a suitable basis for the forecast decision taken by the Chamber under section 55(9), sentence 2, 1st alternative of the Telecommunications Act. From the Chamber's standpoint, this prognosis must also be based on spectrum requirements which take into account not only the notifications of demand of interested undertakings but also future market-related and technological developments. This is all the more so because this could result in the need to make additional frequencies available in order to be able to satisfy consumer-driven demand for mobile broadband, particularly in light of international harmonisation. The President's Chamber must therefore decide in full knowledge of all the facts in the course of objective, transparent and non-discriminatory proceedings whether spectrum scarcity as defined by section 55(9) of the Telecommunications Act is given.

For this reason, the President's Chamber gives all interested parties such as

- associations,
- consumer organisations,

- system and equipment manufacturers,
- service and content providers,
- institutions that conduct research and development,
- network operators

an opportunity in the form of its public consultation to put forward facts and prognoses regarding short-, medium- and long-term developments in the area of wireless access and to make statements regarding the amount of spectrum this will require. To structure this discussion, the President's Chamber has developed a list of questions. These questions revolve around market and technological developments and around the factors that determine an adequate spectrum portfolio.

The Chamber now calls on interested members of the public to comment on the key elements of demand identification proceedings. Comments should be submitted in German

by **3 July 2012**

in writing to the postal address

Bundesnetzagentur
Referat 212
Tulpenfeld 4
D-53113 Bonn

and

electronically in Word (or compatible) or PDF format (copying and printing must be possible), to the e-mail address

E-mail: referat212@bnetza.de

It is planned to publish the comments in their submitted form on the website of the Bundesnetzagentur. Therefore, when you submit your comments please declare your consent to publication and submit a version in which any trade or business secrets have been blackened.

2. Overview of the demand identification proceedings

In the frequency bands 900 MHz and 1800 MHz, the frequencies in the bands from 880.1 – 914.9 MHz (lower band), from 925.1 – 959.9 MHz (upper band), from 1725 – 1730 MHz, 1735.1 – 1752.5 MHz, 1752.7 – 1758.1 MHz, 1763.1 – 1780.5 MHz (lower band) and from 1820 – 1825 MHz, 1830.1 – 1847.5 MHz, 1847.7 – 1853.1 MHz, 1858.1 – 1875.5 MHz (upper band) have been assigned to the network operators E-Plus Mobilfunk GmbH & Co. KG (E1 licence), Telefónica Germany GmbH & Co. OHG (E2 licence), Telekom Deutschland GmbH (D1 licence) and Vodafone D2 GmbH (D2 licence) for their GSM licences for a limited period expiring on 31 December 2016 (published in the Official Gazette of the Federal Ministry of Posts and Telecommunications 23/1994, Order 259, 1994, p. 866). Consequently these bands, with a total of about 160 MHz spectrum, will become available for reassignment as from 1 January 2017.

In its decision on the flexibilisation of frequency usage rights for wireless access in the bands at 450 MHz, 900 MHz, 1800 MHz, 2 GHz and 3.5 GHz (Bundesnetzagentur Official Gazette No 20/2009, Order 58/2009, p. 3575 ff, BK 1a-09/001), the President's Chamber announced that it would decide ex officio on the future grant of the frequency usage rights in the 900 MHz and 1800 MHz bands in timely manner, i.e. approximately three years before the end of the current time limit. After an initial assessment the Chamber basically sees two options: extension under section 55(8) of the Telecommunications Act (TKG), or (re)assignment of the

frequencies under section 55 subsections (3) and (9) and section 61 TKG.

For this purpose the Chamber drafted initial key elements, which represent the framework conditions for official demand identification proceedings, and invited comments on them (Official Gazette of the Bundesnetzagentur no 13/2011, Communication no 365, p. 3446 ff). The comments received were published on the website of the Bundesnetzagentur (www.bundesnetzagentur.de). A summary and evaluation of the comments can be found in the decision concerning the ordering of the demand identification proceedings (BK1-11/003; Official Gazette of the Bundesnetzagentur no 23/2011 of 7 December 2011, Order 79/2011) of 21 November 2011.

With its aforementioned decision, the President's Chamber initiated formal demand identification proceedings for the frequency bands at 900 MHz and 1800 MHz in December 2011. Interested undertakings were asked to give notice by 16 January 2012 of their expected requirements for frequency usage as from 1 January 2017.

In this context, a picture emerges for the wireless access market that indicates there is fundamental interest in using the frequencies in the 900 MHz and 1800 MHZ bands for GSM over the medium term beyond the year 2017. There is however also interest in a medium- to long-term use of these frequency bands for innovative radio-based applications for providing customers mobile broadband network access.

Demand identification is an important step in terms of being prepared for future demand for spectrum and for promoting efficient frequency usage. When conducting its analysis, the President's Chamber does not compare on an isolated basis the amount of available spectrum with the amount of demand for particular frequencies. Instead, it assesses demand in the course of an **overall examination**, taking into account not only current frequency usage (including existing technologies and service products) but also foreseeable technological developments, innovative services and market developments in order to be able to meet future market requirements to the greatest possible extent. For example, business models with innovative radio-based applications (such as LTE - Long Term Evolution) can succeed only when sufficient frequency spectrum is available for them. The development of the internal market of the European Union (EU) and the global development of telecommunications markets are also important in the overall examination. Last but not least, efforts for international harmonisation by the International Telecommunication Union (ITU), the European Conference of Postal and Telecommunications Administrations (CEPT) and the EU have to be taken into account.

The Chamber already pointed this out in its decision ordering the institution of the demand identification proceedings (*loc. cit*., p. 23):

> "The notifications of demand provide the basis for the Chamber's forecast decision under section 55(9) sentence 2, 1st alternative, TKG. It is essential for the Chamber to base this decision on demand notifications that are rooted in objective fact and reflect the actual requirements of interested undertakings.… They can therefore only be considered after all the circumstances and requirements of the interested undertakings have been established."

Following an extensive determination of the situation, the Chamber bases its forecast decision pursuant to section 55(9) sentence 2, 1st alternate of the Telecommunications Act on all facts that are relevant for clarifying the availability of sufficient spectrum at the time of the awarding. At the same time, it takes the notifications of demand submitted by interested undertakings as well as future market and technological developments into account.

The President's Chamber must consequently come to a decision after **all** the circumstances have been established, taking particular account of relevant, objective facts, in the course of objective, transparent and non-discriminatory proceedings. In this connection, future market developments must be allowed for and foreseeable technological advances, innovative services and international developments in the area of the harmonisation of frequency usage are to be taken into account, alongside existing frequency usages including existing technologies and service products.

The procedure used follows the principles of spectrum regulation which are outlined in the Bundesnetzagentur's strategy document "Strategic Aspects of the Spectrum Regulation of the Regulatory Authority for Telecommunications and Posts":

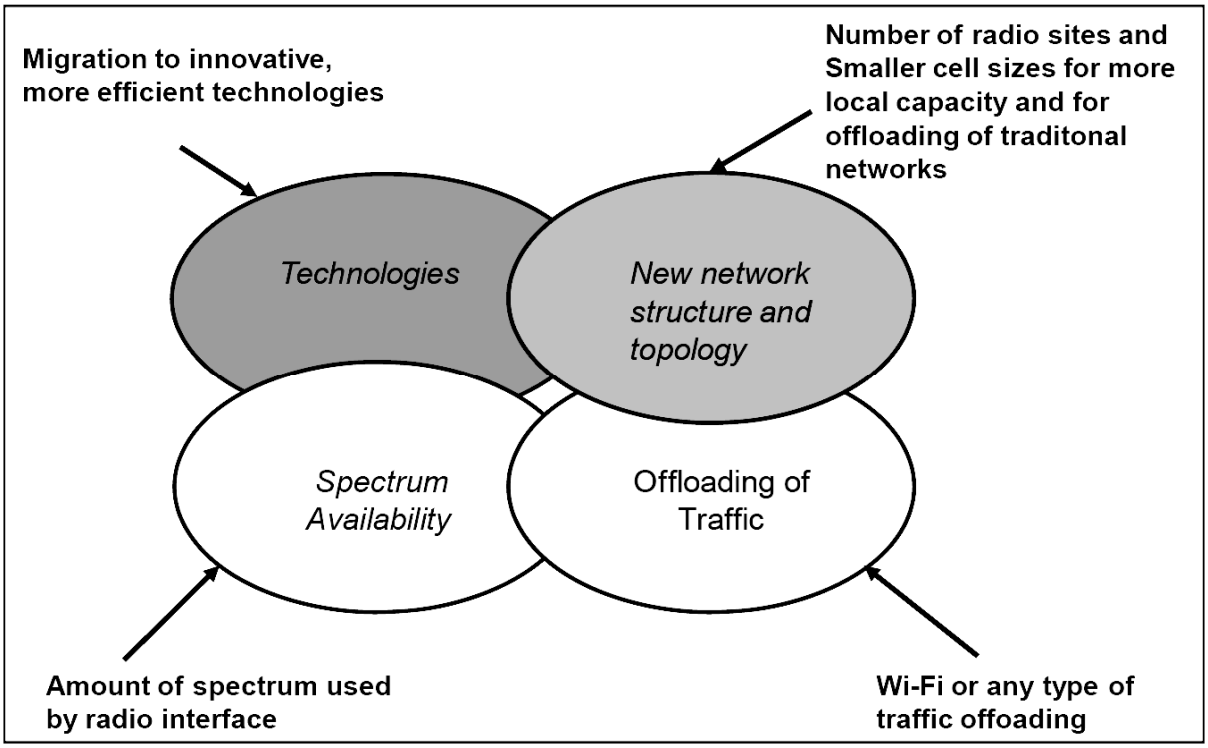
> "The basic principle applies that Reg TP bases its decisions on technology-neutral regulation in terms of enabling new and innovative technologies but at the same time the regulatory authority has to take economic and competition-related aspects into consideration. This aspect of frequency regulation will gain in importance in the future. Establishing future framework conditions for frequency applications is not merely confined to frequency-related regulatory requirements. Amongst other things, the volume of spectrum provided for use affects, for example, the question of frequency scarcity and consequently the type of award proceedings and also the frequency acquisition costs (catchword: UMTS). Before new frequency ranges are made available – especially for new applications – the impact on other existing telecommunications markets and frequency applications and a variety of questions such as substitution effects and business models need to be analysed and weighed. The configuration of technical parameters such as the maximum channel bandwidth may in certain cases determine the suppliers' technologies and the services that will appear on the market. Since it may affect the choice of network operators in a frequency range, channel bandwidth – deemed a purely technical but necessary tool for ensuring interference-free and efficient frequency use – may directly impact regulatory competition issues, e.g. promotion of the *Mittelstand*. In view of these factors, frequency regulation is of considerable strategic importance for the development of future telecommunications markets."

(Strategic Aspects of the Spectrum Regulation, p. 10. available online at www.bundesnetzagentur.de).

These two aspects must be anchored in a legal/regulatory framework and a procedural framework. However, regulatory measures on the part of the Bundesnetzagentur must remain within the parameters defined by international specifications and agreements. The following diagram offers a schematic representation of these elements of spectrum regulation:

Source: Bundesnetzagentur, Strategic Aspects of the Spectrum Regulation, p. 10

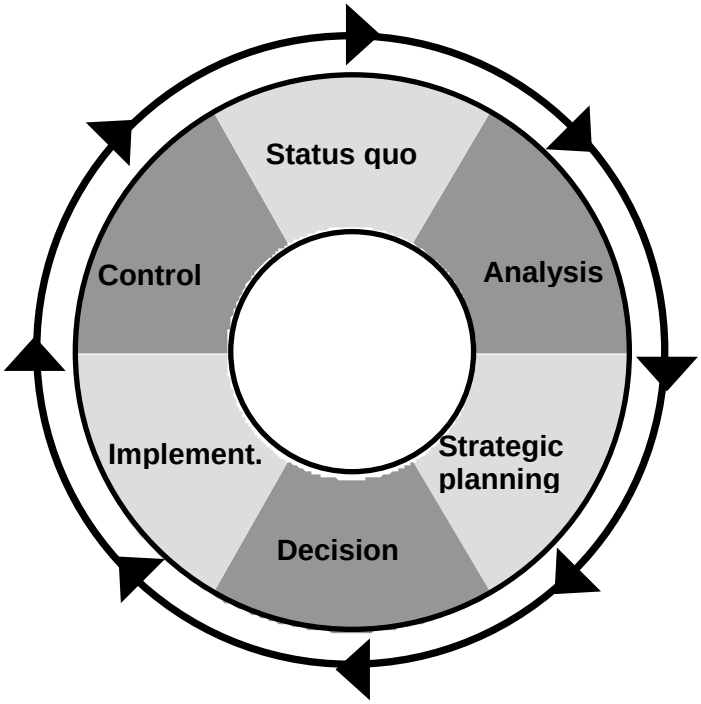
During its ascertainment of spectrum requirements, the President's Chamber must particularly include frequency-related technical aspects and assess them in the course of an overall examination that takes competitive and economic aspects into account. Frequency-related technical factors particularly include technological developments from the standpoint of spectrum efficiency (existing and new mobile technologies, network structures, offloading of traffic; see following diagram).



Source: Report ITU-R M.2243, p. 82

Given the complexity of the frequency-related regulatory measures, the rapid and dynamic changes in market conditions and ever-shorter development cycles for innovative technologies, the identification of spectrum demand cannot simply mirror prevailing conditions. The process must also incorporate foreseeable future developments as far as possible so that frequency regulation is able to cope with changing conditions in the marketplace. Consequently the rapid pace of change in market and technical developments places enormous demands on frequency regulation procedures to be as precise as possible when developing the framework for medium-term to long-term frequency usage. The Strategy Paper states the following in this connection:

> "This necessitates an ongoing adaptation process focussed on the dynamics of technological and market developments. For this reason Reg TP must constantly monitor the frequency-related regulatory as well as competitive and economic aspects of frequency regulation, determine the need for action and act accordingly in its plans and specifications. (See schematic diagram in Fig. 1-2)."



Source: Bundesnetzagentur, Strategic Aspects of the Spectrum Regulation, p. 11

For this reason, the President's Chamber considers the assessment of future market and technological developments with the participation of all interested parties – alongside its evaluation of notified requirements – to be one of its main tasks in connection with its demand identification proceedings so that frequencies are made available according to demand and need.

Therefore, with this public consultation, the President's Chamber offers all interested parties such as telecommunications forums and associations, consumer organisations, system and equipment manufacturers, institutions in the research and development field, service providers, content providers and network operators an opportunity to put forward facts and prognoses regarding short-, medium- and long-term developments in the area of wireless access and make statements regarding the frequency resources that will be required. To structure this discussion, the President's Chamber has developed a list of questions. These questions revolve around technological and market developments and around the factors that determine an adequate spectrum portfolio.

3. Analysis of the factors that determine demand

3.1. Frequencies for wireless network access

In the market for wireless network access, frequencies are used primarily to offer voice telepony services, text messaging services (SMS), multimedia messaging services (MMS), mobile data services or mobile Internet services.

In this connection, the 900 MHz and the 1800 MHz bands are currently being used primarily by GSM mobile communication systems. The four network operators E-Plus Mobilfunk GmbH & Co. KG, Telefónica Germany GmbH & Co. OHG, Telekom Deutschland GmbH and Vodafone D2 GmbH reach more than 99% of the population with their services. Due to their nationwide availability, these two frequency bands currently account for the largest amount of mobile voice telephony, short messaging and data (machine-to-machine, M2M) traffic.

With its decision dated 12 October 2009, the President's Chamber established the regulatory framework necessary for enabling existing GSM network operators to use their assigned frequencies in flexible ways, in other words, on a technology-neutral and service-neutral basis without being restricted to the GSM standard or specific radio systems, so that they are able to

offer innovative radio applications such as mobile broadband access (mobile Internet) using broadband systems such as UMTS/IMT and LTE.

Frequencies in the 800 MHz, 1.8 GHz, 2 GHz. 2.6 GHz and 3.5 GHz bands are already being used today to offer customers voice telephony, multimedia messaging services and mobile Internet access.

3.1.1. Overview of the usage of the frequency spectrum for wireless network access

In Germany, the frequency bands 450 MHz, 800 MHz, 900 MHz, 1.8 GHz, 2 GHz, 2.6 GHz and 3.5 GHz have been dedicated since 2008 to wireless access in accordance with the frequency usage plan.

On 12 October 2009 the President's Chamber handed down its decision BK 1a-09/001 on the flexibilisation of frequency usage rights for wireless access for the provision of telecommunications services in the bands at 450 MHz, 900 MHz, 1800 MHz, 2 GHz and 3.5 GHz (see Order 58/2009, Bundesnetzagentur Official Gazette no 20/2009, p. 3575). In it, the Chamber passed a resolution to lift, upon application of the assignees, the restriction on usage rights for the frequency bands 900 MHz and 1800 MHz limiting their usage to GSM technology so that network operators are able to use these frequencies on a technology-neutral basis at the soonest possible time, provided compatibility is ensured. The decision on flexibilisation also applies to the frequency bands 450 MHz, 2 GHz and 3.5 GHz.

This decision takes into account the development of the telecommunications markets which are seeing the growing convergence of services and technologies, the merging of previously separate markets, fast-growing demand for broadband connection to telecommunications networks and the extensive flexibilisation of frequency regulation.

In the course of implementing this decision, restrictions on existing frequency usage rights in all frequency bands, particularly those in the 900 MHz and 1800 MHz bands, were lifted. It is nonetheless to be expected that the bands at 900 MHz and 1800 MHz will continue to be used for GSM for the medium term even though flexible use is now possible in both bands.

This assessment is based on an expert opinion issued by Professor Dr Christoph Mecklenbräuker (Vienna University of Technology) of 25 March 2011 concerning the examination of frequencies distribution. With its economic and technical focus, this expert opinion also examined the question of how long and to what extent GSM systems are expected to be operated at 900 MHz (available online at www.bundesnetzagentur.de/Frequenzverteilungsuntersuchung). The expert opinion comes to the following conclusion (page 103):

> "GSM technology is optimised for voice and will be needed for voice and roaming in the next decade to the same extent as today, at least. A phase out is likely between 2020 and 2025. A scenario is also conceivable in which GSM is kept on at the end of its actual life in such a way that a certain level of basic service is guaranteed.
>
> Vigorous demand for mobile data services and the success of the new smartphones means that the new UMTS/HSPA+ and LTE mobile generation needs to be rolled out swiftly. The preferred successor technology to GSM will be LTE, particularly where UMTS/HSPA+ has not yet been rolled out. The 800 and 900 MHz bands will then be used by the new technologies, too.
>
> Parallel operation of UMTS 900/LTE 900/GSM 900 is possible and can deliver cost benefits for operators. Cooperation agreements among the operators – commonly known as "resource sharing" – can further advance the technology change for the benefit of the end customers and bring about appreciable CAPEX and OPEX reductions for the operators."

The following services in particular are currently being provided for customers in the various assigned frequency bands in the 800 MHz to 3.5 GHz range:

Frequency band	End of frequency usage period	Services from the customer's point of view *The bandwidths for data services and mobile Internet depend, in the individual case, on the network access that was contractually agreed.*
800 MHz	31 Dec 2025	Broadband Internet services *Usage provision 36 in the Second Ordinance Amending the Frequency Band Allocation Ordinance of 14 July 2009 (Federal Law Gazette no 41 of 20 July 2009, p. 1809)*
900 MHz	**31 Dec 2016**	**Predominantly voice telephony, short message services (SMS) and mobile data services (GSM mobile communication standard)**
1800 MHz	**31 Dec 2016**	**Predominantly voice telephony, short message services (SMS) and mobile data services (GSM mobile communication standard)**
1800 MHz	31 Dec 2025	Voice telephony, multimedia messaging services (MMS) and mobile Internet (LTE)
2 GHz	31 Dec 2020	Voice telephony, multimedia messaging services (MMS) and mobile Internet (HSPA+)
2 GHz	31 Dec 2025	Voice telephony, multimedia messaging services (MMS) and mobile Internet (HSPA+)
2.6 GHz	31 Dec 2025	Broadband data services (LTE)
3.5 GHz	31 Dec 2021	Broadband data services

The durations of the frequency assignments vary due to the staggered availability of frequency spectrum and the accordingly staggered award proceedings (in this connection, see the Overview, **Annex)**.

3.1.2. Frequencies available starting 2017

Frequencies in the 880 to 915 MHz, 925 to 960 MHz, 1725 to 1785 MHz and 1820 to 1880 MHz bands are to be provided for wireless access for the provision of telecommunications services for use as from 1 January 2017.

In particular:

In the bands from 880 to 915 MHz (lower band), from 925 to 960 MHz (upper band), from 1725 to 1785 MHz (lower band) and from 1820 to 1880 MHz (upper band), frequencies have been assigned for the protected GSM licences until 31 December 2016:

Band	Assignee	Assignments	Volume
900 MHz	E-Plus	880.1 – 885.1 MHz and 925.1 – 930.1 MHz	2 x 5 MHz
	Telefónica	885.1 – 890.1 MHz and 930.1 – 935.1 MHz	2 x 5 MHz
	Vodafone	890.1 – 892.5 MHz and 935.1 – 937.5 MHz 899.9 – 906.1 MHz and 944.9 – 951.1 MHz 910.5 – 914.3 MHz and 955.5 – 959.3 MHz	2 x 2.4 MHz 2 x 6.2 MHz 2 x 3.8 MHz
	Telekom	892.5 – 899.9 MHz and 937.5 – 944.9 MHz 906.1 – 910.5 MHz and 951.1 – 955.5 MHz	2 x 7.4 MHz 2 x 4.4 MHz

		914.3 – 914.9 MHz and 959.3 – 959.9 MHz	2 x 0.6 MHz
1800 MHz	Telekom	1725 – 1730 MHz and 1820 – 1825 MHz	2 x 5 MHz
	Telefónica	1735.1 – 1752.5 MHz and 1830.1 – 1847.5 MHz	2 x 17.4 MHz
	Vodafone	1752.7 – 1758.1 MHz and 1847.7 – 1853.1 MHz	2 x 5.4 MHz
	E-Plus	1763.1 – 1780.5 MHz and 1858.1 – 1875.5 MHz	2 x 17.4 MHz

Table 1

The following spectrum is to be made available in the 900 MHz and 1800 MHz bands as from 1 January 2017:

Band	Spectrum	Amount
900 MHz	880 – 915 MHz and 925 – 960 MHz	2 x 35 MHz
1800 MHz	1725 – 1730.1 MHz and 1820 – 1825.1 MHz	2 x 5.1 MHz
	1735.1 – 1758.1 MHz and 1830.1 – 1853.1 MHz	2 x 23 MHz
	1763.1 – 1785 MHz and 1858.1 – 1880 MHz	2 x 21.9 MHz

Table 2

The President's Chamber plans to make this spectrum, totalling 170 MHz, available at one and the same time.

There may be restrictions on the usability of the frequencies on the band edges due to the need to protect radio applications in adjacent bands (e.g. GSM-R - Global System for Mobile Communications - Rail (way), DECT – Digital Enhanced Cordless Telecommunications).

The frequency bands will be available for the assignment of frequencies for wireless access as from 1 January 2017.

The frequencies in the bands from 1710 to 1725 MHz (lower band), from 1805 to 1820 MHz (upper band), from 1730.1 to 1735.1 MHz (lower band), from 1825.1 to 1830.1 MHz (upper band), 1758.1 to 1763.1 MHz (lower band) and from 1853.1 to 1858.1 MHz (upper band) have been assigned for wireless access until 31 December 2025.

The Bundesnetzagentur plans to make the spectrum in the two bands, totalling 170 MHz, available at one and the same time:

Band	Amount of available spectrum
900 MHz	2 x 35 MHz
1800 MHz	2 x 50 MHz

Table 3

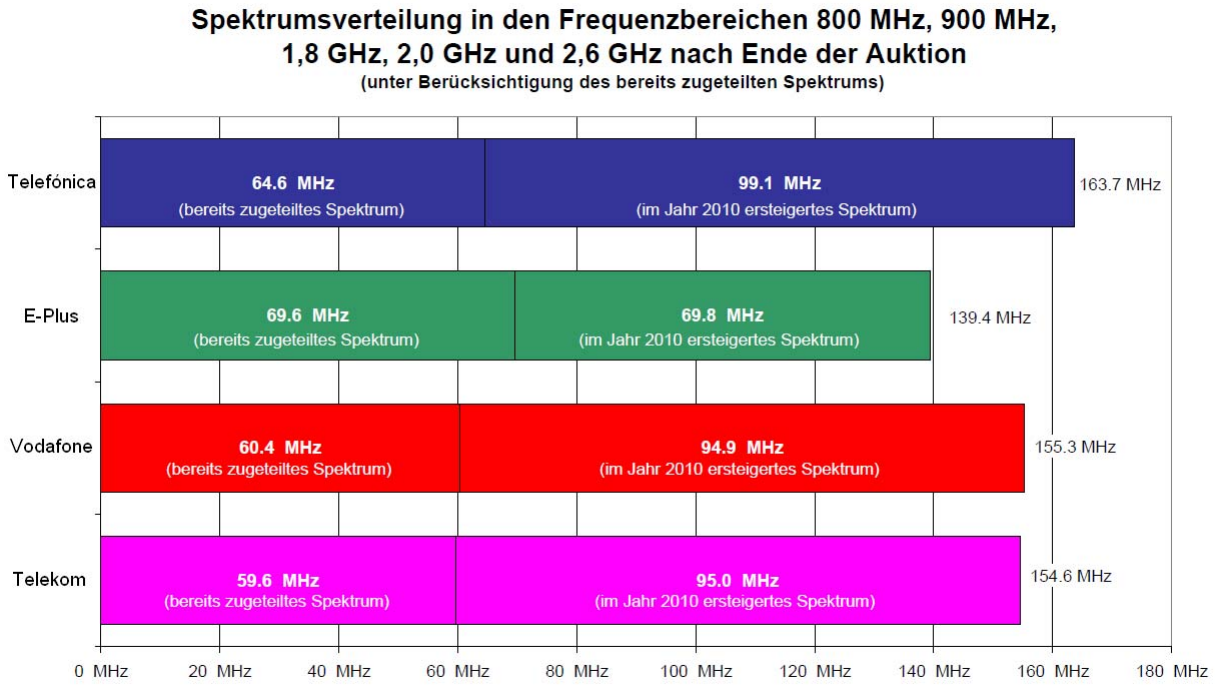
Thus the assignment procedure will give potential assignees a sufficient degree of planning certainty, making available to them spectrum both for service in rural areas and capacity spectrum. Joint award of all the spectrum available reflects the Bundesnetzagentur's practice of providing all the available frequencies, as far as possible, in one set of proceedings so as to avoid artificial scarcity.

The frequencies in the 900 MHz and 1800 MHz bands are available for use throughout the Federal Republic of Germany.

Due to their physical properties, these two bands are highly suited for offering subscribers mobile services. The frequencies in the 900 MHz band exhibit propagation properties that make them particularly suited for serving large rural regions economically and for providing indoor coverage in cities. The frequencies in the 1800 MHz band are suited particularly for carrying high capacity for providing customers large bandwidths.

3.1.3. Distribution of frequencies among the four mobile network operators

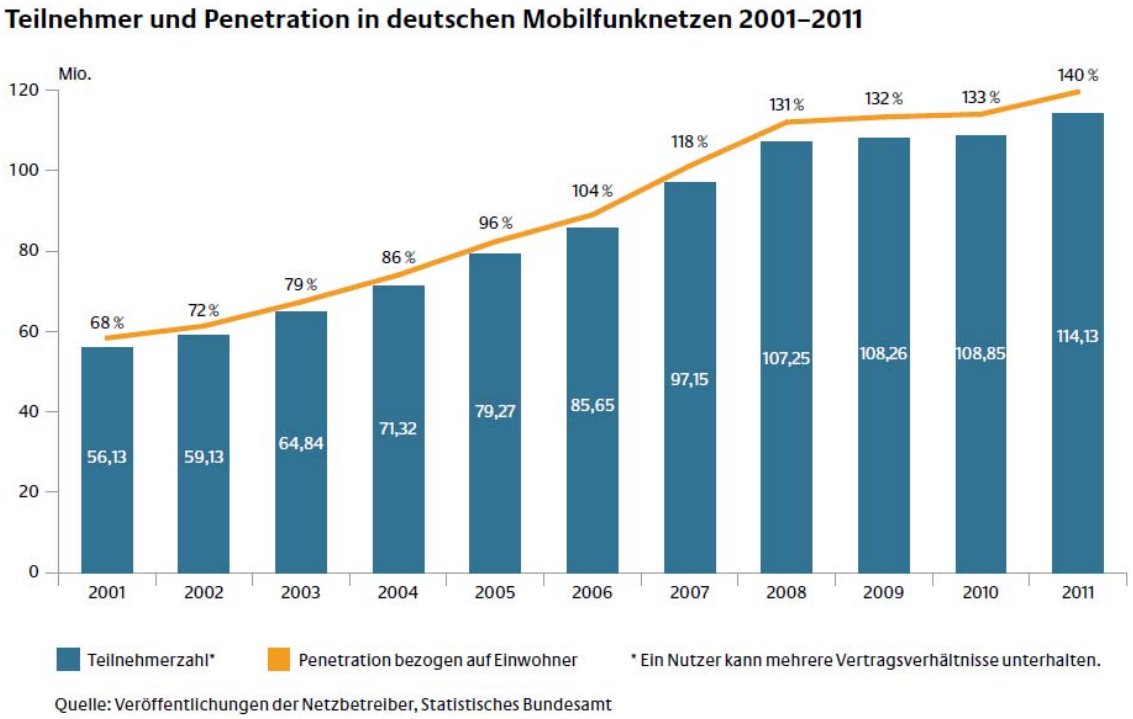
Since liberalisation began in the years starting 1990, mobile network operators have been assigned mobile communications frequencies in the bands at 900 MHz, 1800 MHz and 2 GHz in the course of award proceedings. During the spectrum auction conducted in 2010 to award frequencies in the bands 800 MHz, 1800 MHz, 2 GHz and 2.6 GHz, all four mobile network operators doubled the size of their respective initial spectrum packages so that they could develop innovative broadband services. Spectrum is currently distributed as follows:



3.2. Market for wireless network access

The German market for wireless network access (mobile communications) is marked by continuous growth, strong momentum in the area of technological developments, a broad range of services and sustainable competition to the consumer's benefit.

In light of the fast-growing number of customers who use mobile data services and given the rapid technological advances seen in the field of terminal equipment (e.g. smartphones) it can be expected that the fast-growing demand for mobile broadband services (under the heading 'mobile Internet') will generate impetus for the further expansion of high-capacity broadband networks.



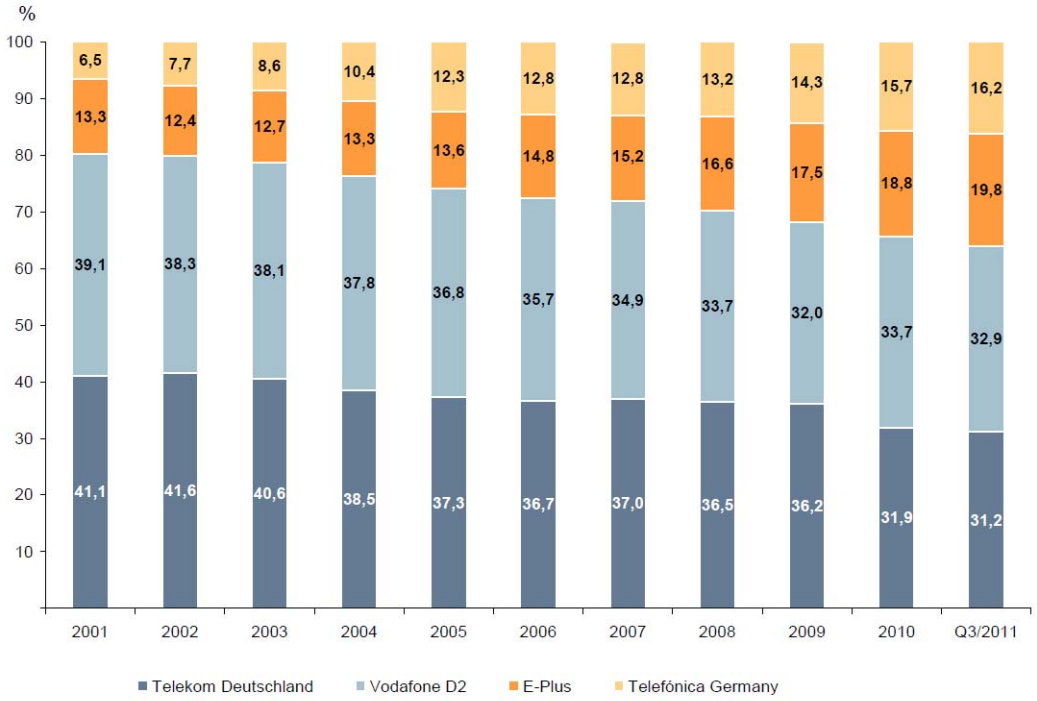
Source: Bundesnetzagentur, Annual Report 2011, p. 84

Against the backdrop of the success achieved to date in the German mobile communications market, the Chamber views the rapid pace of technological advances, the development of service products and reasonable pricing structures, and the continually-growing number of users with increasing demand for mobile broadband services as indicators for an ever-growing need for suitable frequency resources for a further expansion of the broadband networks.

A general examination of market developments over the period from 2000 to 2011 reveals a sustained trend toward rapid growth in the mobile communications market. To date, this growth has been driven by the increase in voice telephony in the mobile communications segment. There are signs that the volume of traffic in the area of voice telephony will grow more slowly in the future. However, it is already foreseeable that demand for data services, particularly broadband service products, will grow at an even faster pace than it has in the past.

The Bundesnetzagentur's Annual Report for 2011 details market intelligence and analyses of market developments in area of the mobile communications.

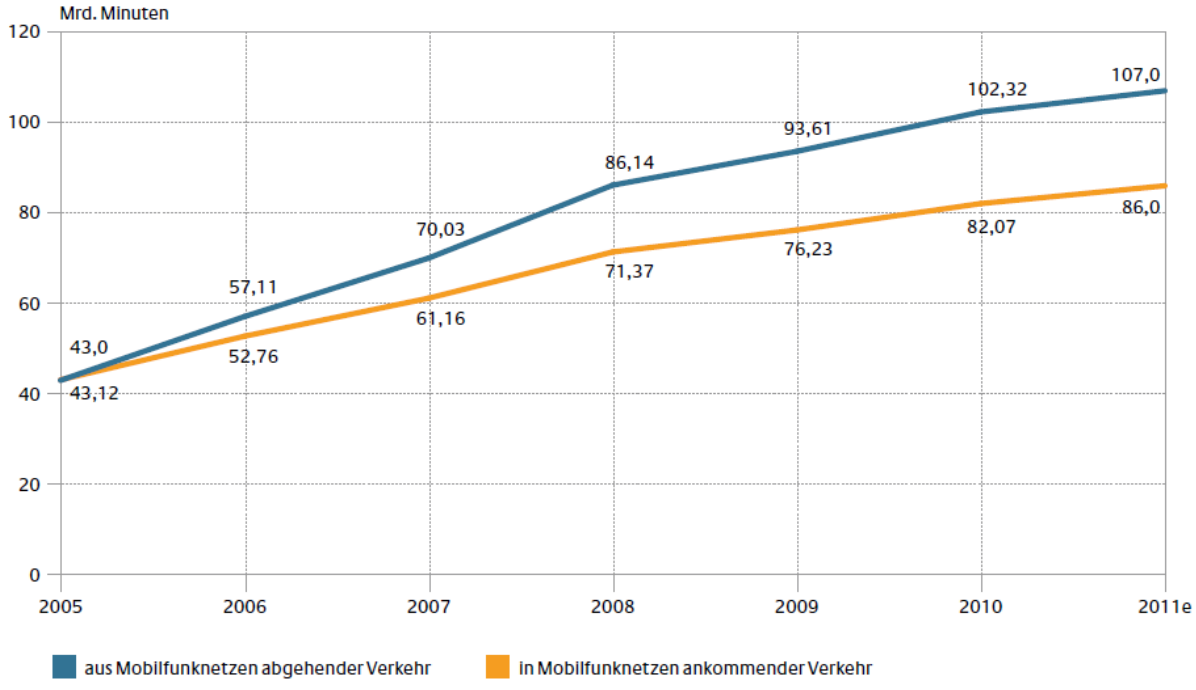
The following chart from the Bundesnetzagentur's Activity Report for 2010/2011 shows the market shares of the four mobile network operators in Germany based on their subscriber numbers for the years 2001 to 2011:



Source: Bundesnetzagentur, Activity Report 2010/2011, p. 51

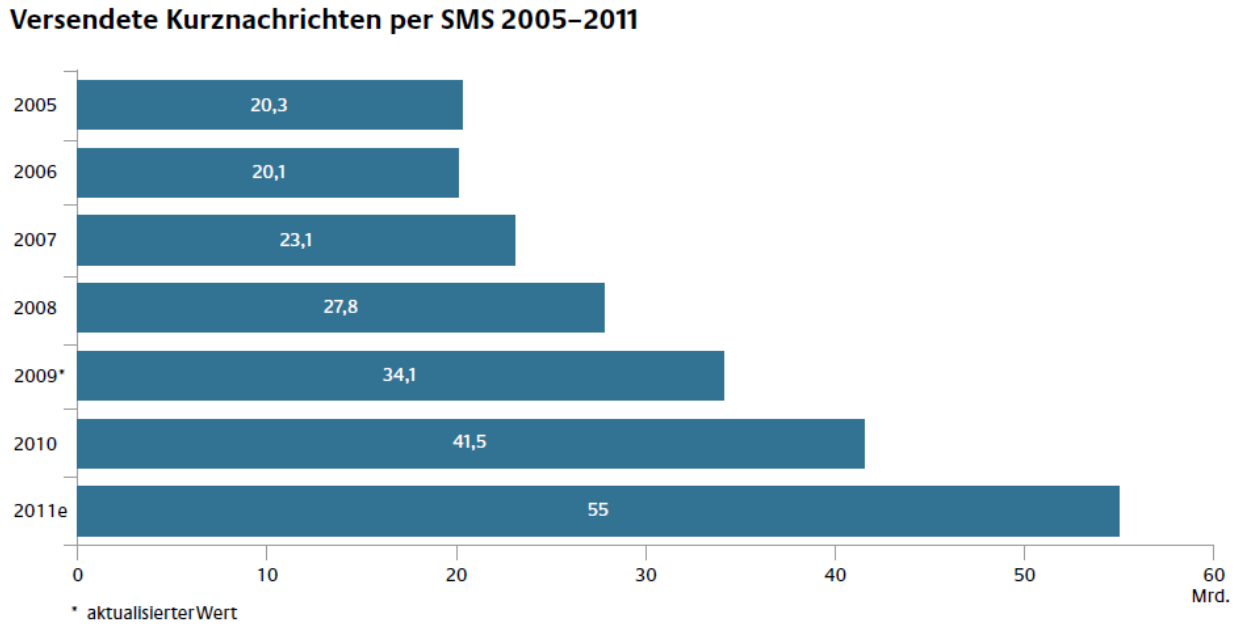
In the year 2010, the volume of outgoing voice traffic exceeded 102 billion minutes. This figure grew by approximately 5% to 107 billion minutes in 2011. In this regard, the substitution of the landline network by the mobile network can be observed in telephony behaviour, albeit only to a small extent. The volume of incoming voice traffic in the mobile segment grew by nearly 5% in 2011 to 86 billion minutes.

Sprachverkehrsvolumen im Mobilfunk 2004–2011



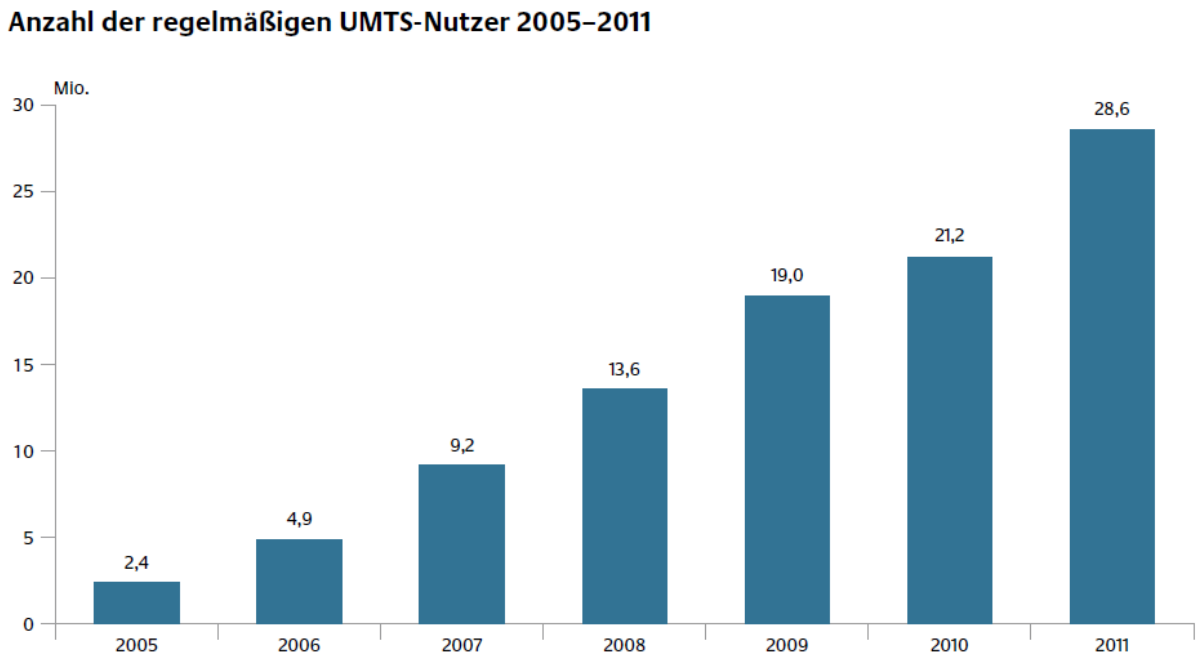
Source: Bundesnetzagentur, Annual Report 2011, p. 87

More smartphones than other mobile telephones were sold for the first time in the year 2011. Smartphones greatly simplify mobile Internet use. As a result, e-mail and other services that can be provided via a data connection have the potential to partially replace text messaging in the medium term. The number of SMS being sent still continues to grow. Some 55 billion text messages were sent in 2011. This is an increase of more than 30% over the previous year. This sharp increase is primarily due to the intensive use of flat rates.



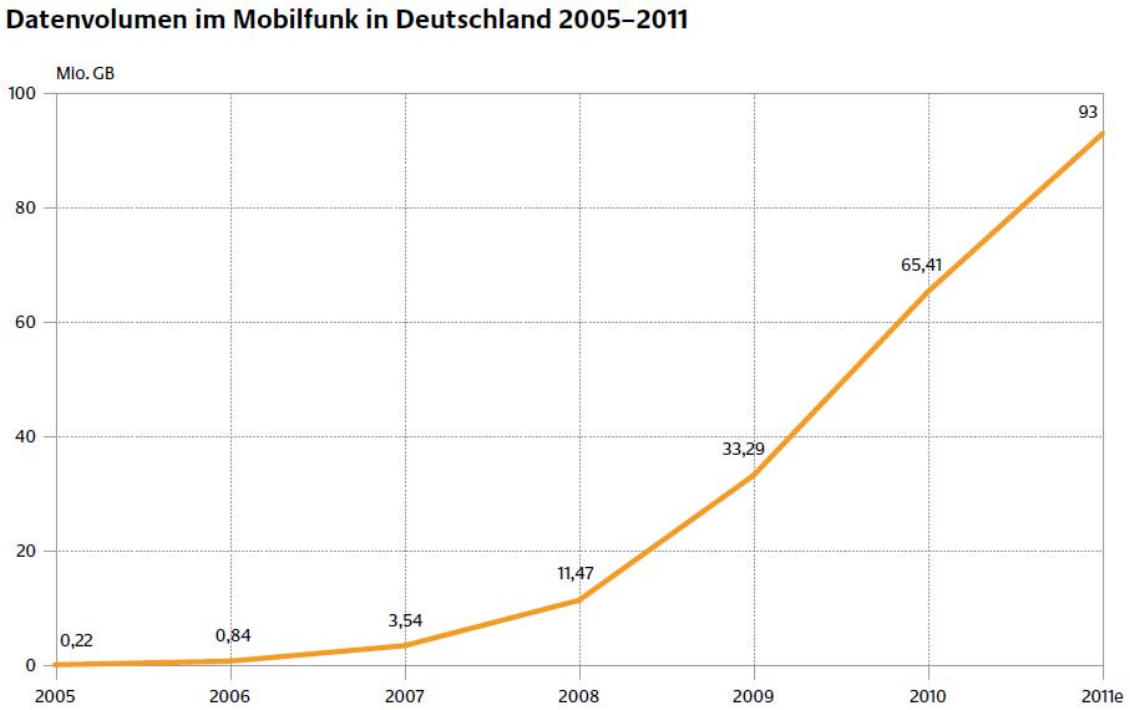
Source: Bundesnetzagentur, Annual Report 2011, p. 86

Since the number of users and the data volumes they generate are growing continually, the infrastructure must be upgraded accordingly. Germany had not quite 107,000 base stations at the end of 2009. This number had risen to nearly 126,000 by the end of the first quarter of 2011. As a result, UMTS network coverage, relative to the population, has increased in the case of all network operators. UMTS network coverage ranged between 62% and 82% in 2009. By the end of the first quarter of 2011, it had risen to 70% to 84%. Geographical UMTS network coverage ranged between 19% and 49% in 2009 and rose to 23% to 53% in the first quarter of 2011.



Source: Bundesnetzagentur, Annual Report 2011, p. 87

In addition to the continued increase in voice traffic, data traffic has also grown enormously in the mobile communications sector. The 100 million Gbyte threshold was almost reached in 2011. Data volume in this area has nearly tripled in the last two years.



Source: Bundesnetzagentur, Annual Report 2011, p. 87

c

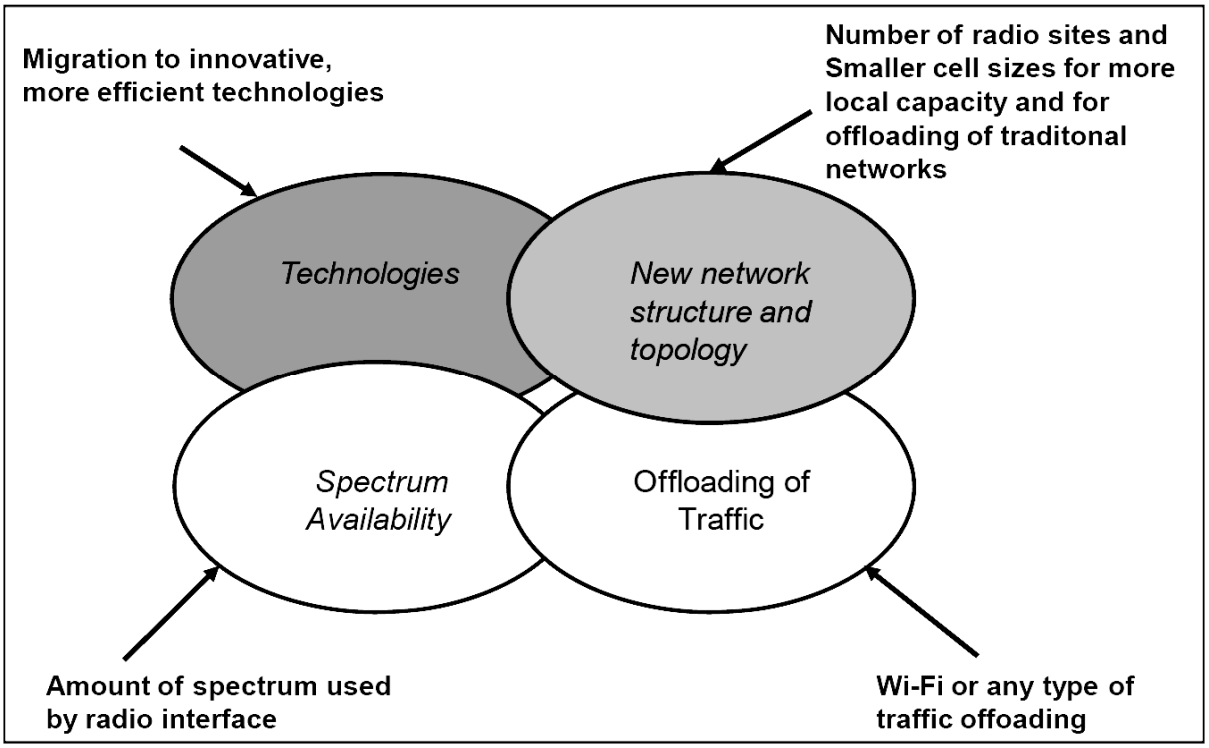
3.3. Technological developments

The enormous increase in demand for broadband data services (mobile Internet use) that has been observed to date and is expected to continue in the coming years stems from, among other things, technological advances in mobile terminal equipment. The new generations of mobile devices (such as smartphones and tablet PCs) and mobile Internet access are particularly able to serve the demand for new mobile data services.

High-speed wireless networks are an essential prerequisite for access to innovative mobile broadband services or content such as the mobile Internet or 'infotainment' (information and entertainment such as video streaming, Internet radio and Internet TV) as well as cloud computing, multimedia social networks and increasing machine-to-machine communication. The current strong and still-growing demand for services such as voice telephony and text messaging will probably continue to use network capacities too.

Realising these types of innovative services will require correspondingly large network capacity. Increases in network capacity will be influenced by technological developments in network elements and terminal equipment and by optimisations in network architecture, all of which lead to the more efficient use of existing spectrum resources. In addition, frequencies which have not been allocated exclusively for mobile communications are to be included in the considerations on the provision of further capacity. Despite this, other suitable spectrum resources might have to be made available in addition to these measures.

These factors are schematically shown in the following diagram:



Source: Report ITU-R M.2243, p. 82

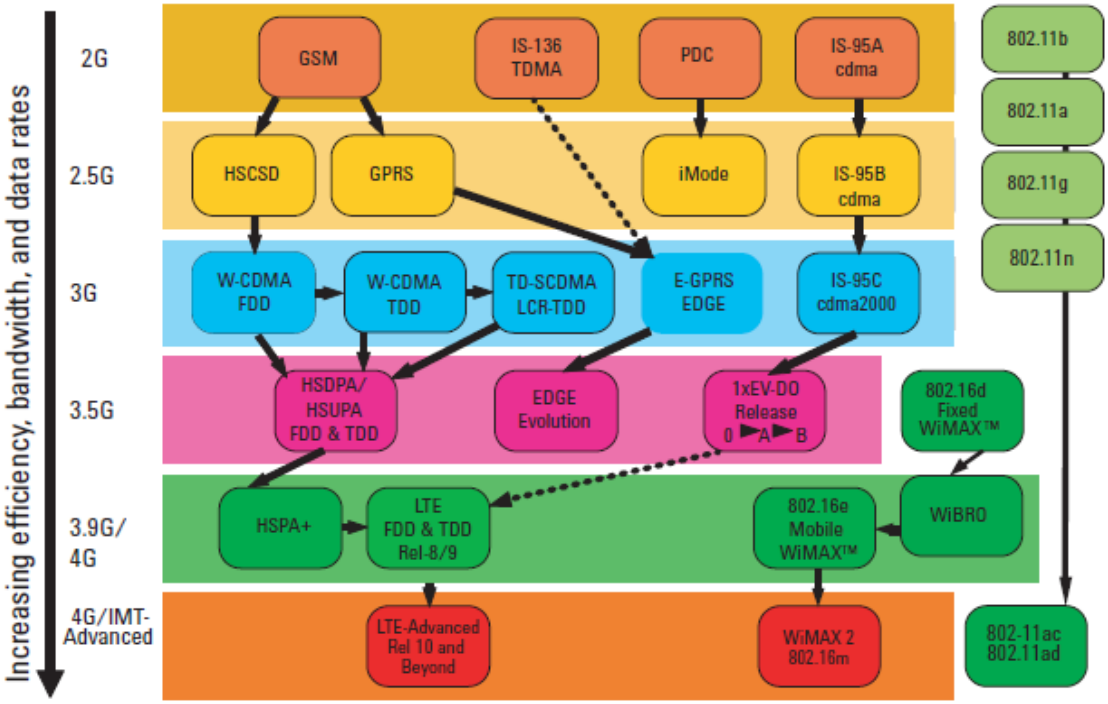
The development of mobile communications technology has been marked by ever-faster transmission rates to date. In the early days of digital mobile communications, GSM was standard for voice and data traffic transmitted at single-digit kbps rates. Today however, transmission rates in the triple-digit kbps range have already been achieved with UMTS technology. The progressive development of UMTS technology (HSPA/HSPA+, High Speed Packet Access) has already led to transmission rates in the double-digit Mbps range. Using LTE technology, it is currently possible to realise transmission rates in the triple-digit Mbps range.

The Second Monitoring Report on the Implementation of the Federal Government's Broadband Strategy (available in German online at www.bmwi.de) points out the following (p. 25) with regard to the use of LTE Advanced:

> "LTE technologies are continually developing. According to business representatives, LTE Advanced in particular will bring a marked increase in the speed of radio-based solutions. At present LTE provides approximately 100 Mbps in a cell. By comparison, LTE Advanced can, if necessary, offer 300 Mbps or more per cell. Although advances are continually being made in the development of LTE, terrestrial systems will probably offer higher speeds than radio-based solutions in the long term as well. Therefore, given the technology's current capabilities, it is not to be expected that it will make a significant contribution to blanket coverage with bandwidths of more than 50 Mbps in the next several years. In the long term however, industry experts are expecting enormous technological leaps which will prospectively also enable larger bandwidths per user."

System manufacturers and research institutions are even forecasting transmission rates in the Gbps range for the future use of LTE Advanced.

The following diagram illustrates the development of radio technologies since 1990:

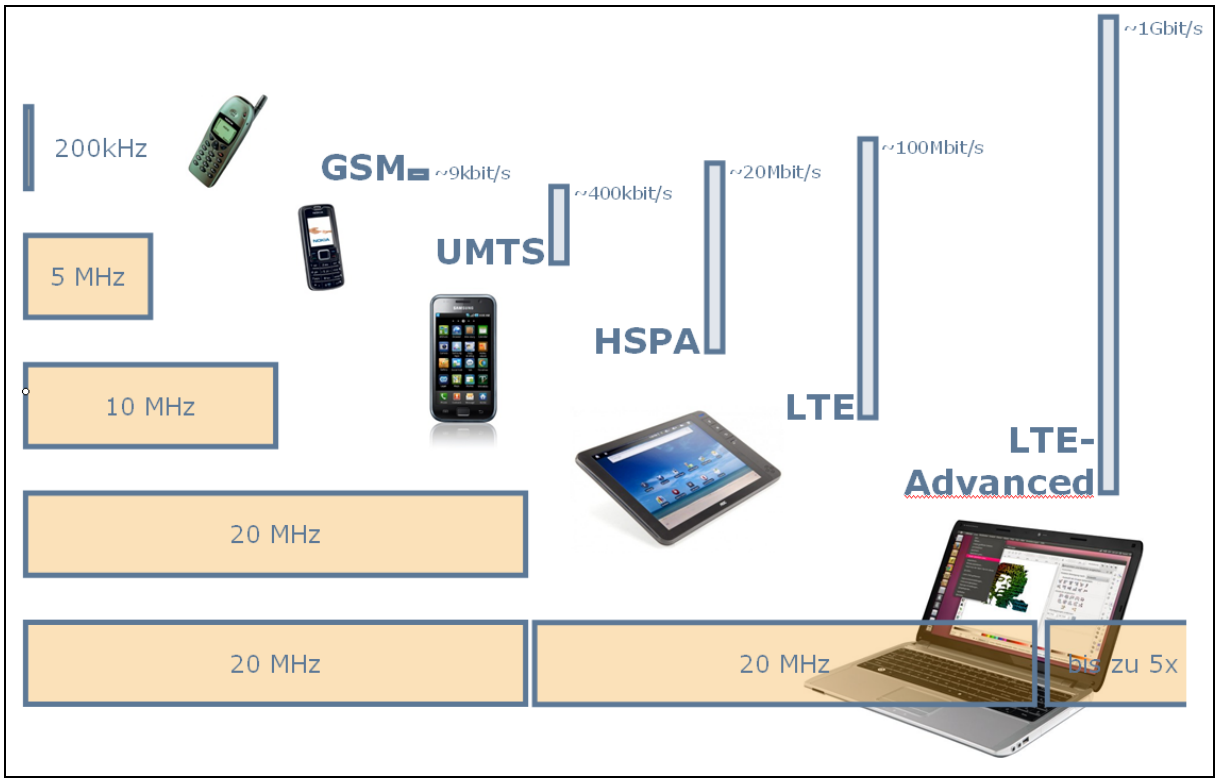


Source: Agilent Technologies; http://cp.literature.agilent.com/litweb/pdf/5990-6706EN.pdf

LTE technology is currently being phased in in Germany. Several thousand base stations using LTE technology are already operating in the 800 MHz band, just two years after the spectrum auction in 2010. Terminal equipment in the form of USB flash drives is already making broadband Internet access possible. Marketing of terminal equipment in the form of LTE-capable smartphones began this year.

Raising transmission rates – starting with channel bandwidths of initially 200 kHz for GSM and extending to transmission rates in the Gbps range for LTE/LTE Advanced – requires the availability of the necessary bandwidth / spectrum resources. GSM is based on a channel bandwidth of 200 kHz whereas channel bandwidths of 5 MHz are needed for UMTS. Past developments show that LTE will be based on channel bandwidths of 10 MHz for the time being.

LTE is flexible in its frequency usage, so it is able to use bandwidths of 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz or 20 MHz. However, satisfying growing demand for high bit-rate data services will require the use of larger bandwidths of 10 MHz or more. The advanced version of LTE (LTE Advanced) will be standardised with a bandwidth of up to 100 MHz with the LTE Release 10 (3GPP, 3rd Generation Partnership Project). In this connection, channel bandwidths of 20 MHz are a good choice for ensuring efficient frequency usage.



Five channels of 20 MHz can be bundled to achieve such bandwidths of 100 MHz. This type of bundling is also possible beyond band limits. A number of manufacturers have already launched the first LTE systems which use several LTE carriers in different frequency bands at the same time (carrier aggregation). For this reason it would appear advisable that network operators have sufficient frequency resources with block sizes of 10 MHz to 20 MHz at their disposal so that they are able to hold their own in the marketplace and offer customers broadband services that are tailored to their needs.

It is unlikely however that the development of technologies that are more frequency-efficient will be enough to satisfy the growing demand for high bit-rate data services. The ITU, for example, assumes that spectral efficiency is doubling every 30 months whereas user demand for more bandwidth doubles every 11 months (see in this connection Report ITU-R M.2243, p. 83). In the opinion of system manufacturers and mobile network operators it will be necessary to identify and harmonise further spectrum at international level on a medium-to-long-term basis – in addition to increasing frequency usage efficiency – in order to keep up with the continuing annual doubling of data volumes in mobile data networks. For this purpose, measures have already been taken at international level to identify suitable spectrum and provide it on a timely basis (ITU and Commission of the European Union, see in this connection WRC Res 232 and 233 and Decision No 243/2012/EU of the European Parliament and of the Council - Radio Spectrum Policy Programme).

The provision of higher transmission rates in line with demand can also be achieved by optimising existing network infrastructures and particularly by densifying networks through the use of smaller cell structures. For economic reasons this can be done only to a certain degree so that mobile broadband services can be offered to the public at reasonable prices, in keeping with the aim of ensuring the nationwide availability of mobile broadband services.

In addition to this, micro base stations have already been developed which are compact and easy to install and can therefore generally be used cost-efficiently as well. However, even

though it is possible to significantly increase capacity on a local basis in this way, such measures are not likely to be enough to satisfy the growing demand for broadband data services outside hot spots. Wide-area coverage with these types of small radio cells does not appear to be feasible due to the attendant network costs. Likewise, significant bottlenecks are to be expected in actual practice, given the locations needed for this and the connection of the locations of this type of small radio cell.

Additional frequencies that have been assigned on a general basis could also be used to support the provision of higher transmission rates in line with demand. For example, additional transmission capacity could be made available at hot spots (such as at train stations and airports, in cafes and hotels) using, for instance, WLAN connections. These frequencies have however been generally assigned and are therefore not available to mobile network operators for their exclusive use. In addition, this only helps to increase capacity on a local basis; nationwide solutions for meeting demand are consequently not possible.

3.4. International developments

Growing demand for mobile broadband applications can also be observed in the European context and at global level (see analyses of the CEPT, EU and ITU) and can be met by intensifying spectrum usage, progressively developing relevant technology and by making additional spectrum available. The report of the International Telecommunication Union (ITU) entitled "Assessment of the global mobile broadband deployments and forecasts for International Mobile Telecommunications" (see in this connection Report ITU-R M.2243, www.itu.int/pub/R-REP-M.2243-2011) which was adopted in November of last year underscored this demand. Based on studies conducted by various institutes and industrial enterprises, the ITU estimated how International Mobile Telecommunications (IMT) systems will influence the future development of throughput.

The increasing data rates have however not yet been transposed into demand for spectrum that covers several frequency bands. These changed circumstances will be taken into account when future frequency usage concepts are developed.

To put this into practice, the World Radiocommunication Conference 2012 (WRC-12) which ended in February 2012 added two new items to the agenda for the next World Radiocommunication Conference scheduled for late 2015 (WRC-15). These two agenda items concern the future spectrum requirements for broadband mobile networks.

Both agenda items deal with the question of whether more spectrum will be needed for International Mobile Telecommunications (IMT) and other broadband mobile applications, including the identification of medium and long-term spectrum requirements and the subsequent allocation of such spectrum on a co-primary basis. In this connection, the decision regarding implementation at national level is the prerogative of the Member States.

The second agenda item deals specifically with the frequency range below 790 MHz. This range was viewed as offering a possibility for further harmonisation on a global basis and, as a result, was identified for use in part by mobile services directly after WRC-15, particularly in Africa and the Arab states. Since usage of this frequency band by terrestrial broadcasting services, to which it has been allocated on a primary basis, varies greatly throughout the world, the needs of mobile services, broadcasting and secondary users (outside broadcasting and wireless microphones) must be taken into account.

In preparation for WRC-15, Germany has already set up a national process which is open to all interested parties (see http://ng.bmwi.bund.de).

Examinations that are already underway at European level are also to be taken into consideration alongside the global requirements for mobile broadband that are to be defined during the preparation process for WRC-15 and then subsequently identified at WRC-15. The CEPT is currently considering the possibility of refarming the 1452 – 1493 MHz frequency band which has been harmonised at European level for broadcasting services (terrestrial and satellite) and is largely unused. Applications being discussed for this band include applications of authorities and organisations concerned with public safety, connecting aircraft with

terrestrial broadband networks, and applications from the area of Programme Making and Special Events (PMSE), in particular wireless microphones, alongside public mobile services.

The subject of broadband mobile services is an important point in radio spectrum policy at EU level as well. The first European programme for radio spectrum policy (RSPP - Radio Spectrum Policy Programme; Decision No 243/2012/EU of the European Parliament and of the Council of 14 March 2012) stipulates in Article 3 that the Member States are to cooperate to support and achieve the following policy objectives:

> Article 3 (b): "Seek to allocate sufficient and appropriate spectrum in a timely manner to support Union policy objectives and to best meet the increasing demand for wireless data traffic, thereby allowing the development of commercial and public services, while taking into account important general interest objectives such as cultural diversity and media pluralism; to that end, every effort should be made to identify, based on the inventory established pursuant to Article 9, at least 1 200 MHz of suitable spectrum by 2015. That figure includes spectrum already in use;"
>
> Article 3 (c): "Bridge the digital divide and contribute to the objectives of the Digital Agenda for Europe, fostering access to broadband at a speed of not less than 30 Mbps by 2020 for all Union citizens and making it possible for the Union to have the highest possible broadband speed and capacity;"

At EU level, spectrum totalling 1025 MHz has already been made available on a harmonised basis for wireless network access (see RSPG 12-408, Annex 1).

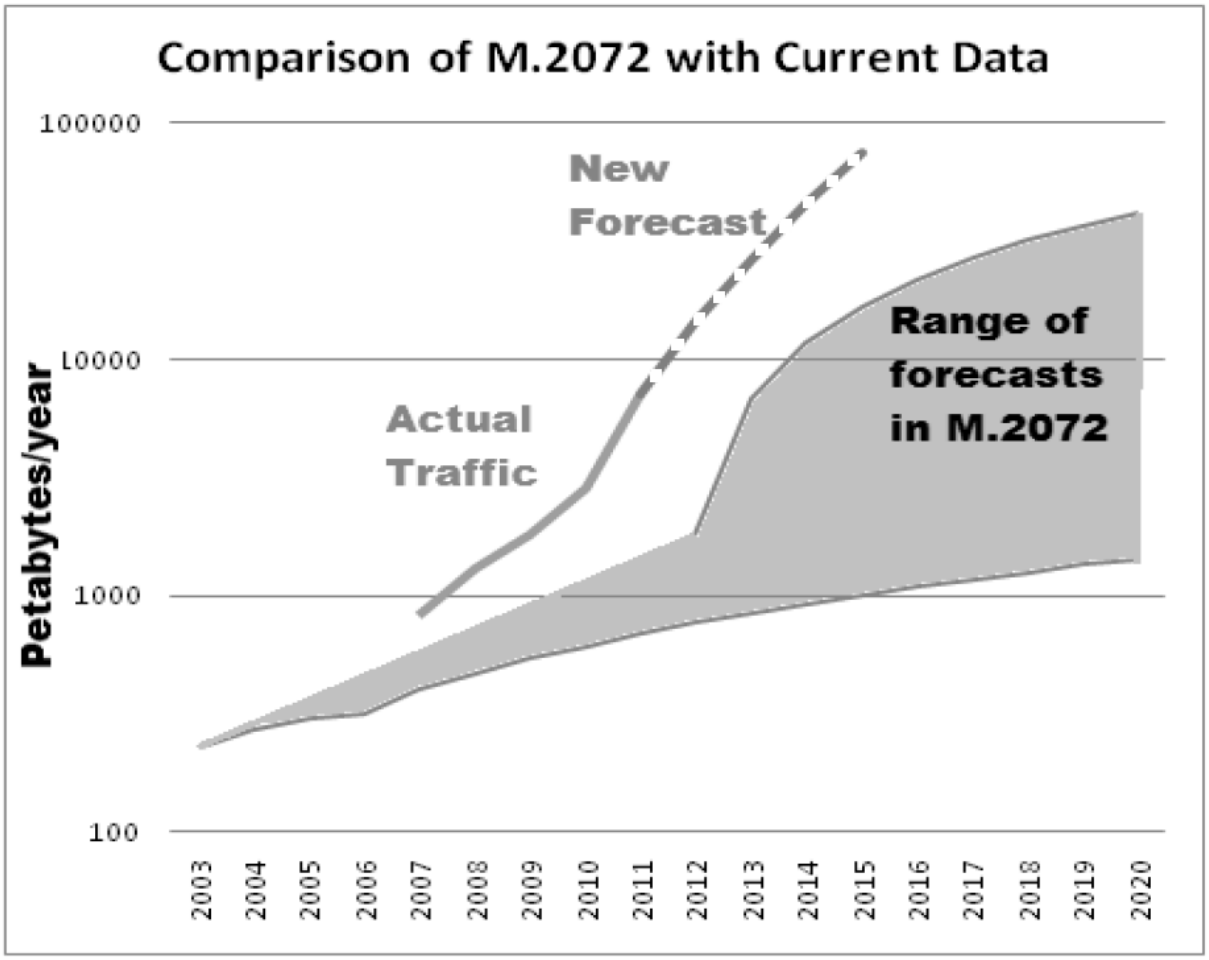
3.5. Outlook

In light of the growing demand to be expected in the market for mobile broadband applications and technological possibilities that could be identified to date for optimising network infrastructures, mobile network operators are faced with the challenge of making transmission capacity available in line with demand. Mobile network operators will particularly have to optimise their resources (e.g. network infrastructure, current frequency usage rights, technology) and adjust them to the developments outlined above.

One very influential factor in this connection is the availability of sufficient spectrum for meeting future requirements for mobile broadband data services.

Recent studies on future market developments anticipate an enormous increase in data volumes and corresponding frequency needs. In its report "Assessment of the global mobile broadband deployments and forecasts for International Mobile Telecommunications" (ITU-R M.2243, http://www.itu.int/pub/R-REP-M.2243-2011), the ITU forecasts the requirements for mobile broadband through the year 2020. As a result of the enormous success of new technologies and devices such as smartphones and tablet PCs, innovative applications and new business models and as a result of changes in the usage patterns of mobile customers, the data volumes being seen today already far exceed the data volumes predicted by the ITU in its Report ITU-R M.2072 prior to the 2007 World Radiocommunication Conference (WRC-07). The following diagram shows a comparison of the ITU's 2005 forecast of data traffic volume through the year 2020 with the actual development of data traffic and the resultant new forecast from a study conducted by Cisco on the mobile data traffic to be expected in the future (Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update 2010–2015 (2011), available at www.cisco.com).

The shaded area in the diagram shows the range of forecasts from various studies in Report ITU-R M.2072. In this comparison, the lower solid line to the left represents actual data traffic and the upper dotted line extending from it shows the forecast from the study conducted by Cisco.



Estimate of future data traffic volume calculated by the ITU in 2006 (Report ITU-R M.2072) in comparison to actual traffic and recent forecast from late 2011 (Report ITU-R M.2043)

Source: Report ITU-R M.2243, p. 15

This diagram shows that the actual development of data traffic volume up to now does indeed exceed the volumes forecast in studies to date.

This development is being driven by the use of mobile video services, social networks and cloud services, to name just a few. In this connection, the requisite transmission speeds increase in step with the demands being placed on the size of the data volumes to be transmitted. It is expected that data volumes will continue to grow very fast through the year 2015 and even beyond and that – taking technological advances such as increases in spectral efficiency into account – spectrum requirements for mobile broadband services will increase concomitantly.

At European level as well, Member States are being called upon to make sufficient suitable frequency bands available in preparation of future market developments and the growing demand for large data volumes. The Decision of 14 March 2012 of the European Parliament and of the Council (No 243/2012/EU) stipulates that all efforts are to be made to identify by the year 2015 at least 1200 MHz for broadband data communication in the European Union to support the objectives of the Digital Agenda 2020. Existing resources are to be taken into account in the process. It also calls upon the Commission and Member States to monitor developments intensively and undertake a strategic assessment of the future demand for spectrum for wireless broadband services in the European Union.

At national level, measures were already taken in the year 2009 so that broadband connections could be provided as quickly as possible in line with demand. For this purpose, the German government laid down the following conditions for investment in the rapid expansion of fixed line networks and radio networks in order to provide further impetus to this development (Broadband Strategy 2009, section 3, page 8):

> "1. Gaps in broadband penetration are to be eliminated and capable broadband access made available nationwide by the end of 2010.
>
> 2. A total of 75 per cent of households are to have Internet access with transmission rates of at least 50 MB/sec by 2014. This level of high-speed broadband access is to be rolled out nationwide as quickly as possible.
>
> …. Given their different features, the various technologies all help to achieve the targets in different ways."

The Bundesnetzagentur assigned frequencies in the 800 MHz, 1.8 GHz, 2 GHz and 2.6 GHz bands in the year 2010 on the basis of the Decision of the President's Chamber of 12 October 2009 (BK1a-09/002). In doing so, it established the prerequisites for a rapid expansion of networks for providing the public with mobile Internet access, particularly in rural areas. This was a first step toward realising the objectives of the Broadband Strategy concerning the provision of high-performance broadband access of at least 50 Mbps to the public.

The Bundesnetzagentur auctioned off a frequency spectrum of some 360 MHz in its 2010 frequency auction. This was by far the largest amount of frequency spectrum that had been made available in a single procedure in Germany. Despite this, it was not possible to meet all the forecast medium-to-long-term frequency requirements of the participating undertakings through the frequency auction.

The President's Chamber stated the following with regard to the frequency requirements of mobile telephony undertakings in its decision of 12 October 2009 on the award of spectrum in the bands 800 MHz, 1.8 GHz and 2.GHz (BK1a-09/002, *loc.cit.*, p. 3664):

> "In light of the notifications of need and announcements of interest to date, it can be established that the total 270 MHz of spectrum available in the bands 1.8 GHz, 2 GHz and 2.6 GHz is exceeded by more than 100 MHz. Particularly due to the increasing demand for high data rates, the forecast continues to be that there is currently an even greater demand for appropriate frequencies, extending beyond the original notifications and announcements of interest."

As part of the demand identification proceedings conducted in the year 2009, the President's Chamber included two studies which examined, among other things, the increasing demand for high transmission rates and the simultaneously growing frequency requirements:

- "Untersuchung der Digitalen Dividende - Grundlagenermittlung"; Arne Börnsen Consulting
- "Wirtschaftliche Auswirkungen der Digitalen Dividende in Deutschland"; Goldmedia GmbH / Mugler AG

These two studies are available online at the website of the Bundesnetzagentur:

www.bundesnetzagentur.de

The study by Arne Börnsen Consulting came to the following conclusion, among others (Study, page 8):

> "The telecommunications industry plans to use free parts of the UHF band for building a mobile broadband communications infrastructure with priority given to rural, sparsely-populated regions. The industry stated in a joint paper that approximately 167 MHz would be necessary to provide 6 Mbps for broadband communication (see III.7. Frequency Requirements for Wireless Broadband Communication Systems). In the industry's view, there will be demand for this bandwidth in the medium term.
>
> Only 72 MHz are available, however, given that channels 61 to 69 could possibly be used according to WRC-07. This would be enough for 2 to 3 Mbps. This does not

> however invalidate the requirement of some 167 MHz; rather this requirement will have to be considered by the relevant bodies at a later point in time."

Other institutions such as the Federal Association for Information Technology, Telecommunications and New Media (Bitkom; Eckpunkte Digitale Dividende, 2009; http://www.bitkom.org) also come to similar conclusions regarding forecast spectrum requirements for realising mobile broadband coverage in Germany (p. 3):

> "Frequencies totalling approximately 160 MHz from the UHF band will be foreseeably needed in Germany to build a nationwide, radio-based broadband infrastructure. The following coverage scenario provides the basis for this figure:
>
> This frequency requirement is calculated on the basis of what it would require to provide areas having no DSL infrastructure with transmission rates of 6 Mbps which will satisfy the forecast broadband requirements in such areas for the next 10 to 20 years. Frequency requirements are calculated on the basis of the anticipated number of customers in these areas in which, due to a lack of wire-based alternatives, broadband services can only be provided economically by means of spectrum from the digital dividend. The closure of these gaps in broadband coverage is however in itself not economically viable and must be incorporated into a large-scale mobile communications business model. These frequencies must therefore be made available nationwide. The outlined spectrum requirement pertains to the requirements of the telecommunications market in Germany under the assumption of one network and does not take into account the actual features of the award conditions (number of potential network operators, cooperation models and, where applicable, network sharing in rural areas)."

In its decision of 12 October 2009, the President's Chamber acknowledged the findings from the studies as follows:

> "Moreover, a claim exceeding the available spectrum below 1 GHz was made by all mobile network operators active in the market for contiguous spectrum in the 800 MHz band, particularly for the provision of broadband services in rural areas. These requirements are based on provision of 2 – 3 Mbps. With the growing demand for higher data rates, over 160 MHz are required in the mid to long-term in order for bandwidths of 6 Mbps to be realised. The requirements voiced for the 800 MHz band for rural area coverage alone exceed the available spectrum several times over. These requirements have been confirmed in a study commissioned by the Bundesnetzagentur (Report investigating the digital dividend of 29 January 2009, Dipl. Ing. Arne Börnsen, published on the Bundesnetzagentur's website, www.bundesnetzagentur.de)."

Looking at the frequency requirements for a further nationwide expansion of broadband, the Second Monitoring Report on the Federal Government's Broadband Strategy (available in German online at www.bmwi.de, p. 25) pointed out that:

> "Since the auction was only recently conducted and the first frequencies from the digital dividend (790 to 862 MHz) are just beginning to be used, sectoral stakeholders are not yet sufficiently aware of the potential of using additional frequencies from the digital dividend. This aspect must however be placed on the agenda of the World Radio Conference 2015 at an early point in time, namely at the next WRC in 2012, so that the framework conditions for providing additional frequencies from the digital dividend can be established."

One important objective of the Federal Government's Broadband Strategy is to ensure that the broadband network is rolled out primarily by telecommunications companies on a competitive and market-driven basis. The Broadband Strategy underscores that establishing more planning certainty for companies and ensuring regulation that is geared to growth and innovation are among the measures needed to create incentives for companies to undertake the additional investments that would be necessary to provide full broadband coverage.

With an eye to establishing powerful infrastructures that are able to meet the demands of the future and provide coverage in rural areas as well, the German Bundestag called upon the German government (Bundestag printed paper 17/9159 of 27 March 2012) to:

> "continue implementing the Broadband Strategy as the basis for high-speed networks and progressively develop the Strategy in line with demand and within the boundaries of current legal and budgetary means. In this connection an eye should also be kept on the lack of adequate service which still exists in some rural areas."

In keeping with the objectives of the Broadband Strategy that the additional future investments necessary to develop full broadband coverage also be undertaken, the Chamber considers it necessary that sufficient planning certainty is established for the companies involved. With this in mind, in a further step toward planning certainty, future market and technological developments must also be assessed – in addition to analysing current demand for spectrum – so that frequency resources can be supplied according to demand in the medium and long term as well. Consequently the facts and assumptions that provide the basis for such an assessment must first be ascertained.

4. List of questions

After an initial analysis of market, technology and international developments, the President's Chamber believes that demand for wireless broadband applications in Germany will continue to grow and that there will probably continue to be demand for voice telephony as well. The Chamber is aware that this assessment depends on further factors which will have to be ascertained. Corresponding assessments of frequency requirements are currently being discussed at international level as well (see Section 3.4). It must however be made clear that the forecast decision of the President's Chamber will have to be based on the frequency requirements of the German market for wireless network access.

The President's Chamber therefore calls upon interested parties to cite facts and provide assessments which could be of short-term, medium-term or long-term relevance for a robust prognosis of frequency requirements.

In the Chamber's view, the following questions in particular arise:

1. How are services expected to develop in the short, medium and long term (e.g. within a period of 5, 10 and 15 years) at user and particularly end-user level in the German market?
2. What will the subscriber and traffic trends in Germany look like in the short, medium and long term?
3. What is expected of future user patterns in terms of data volumes for the individual services?
4. What data rates per cell will be necessary in the future in order to be able to offer the demanded services while observing certain quality parameters? How many users could be serviced under these conditions?
5. What factors provide the basis for the assessments for questions 1 to 4?
6. How are the assessments underlying the ITU-R Report M.2243 judged in terms of the German market?
7. What technological developments and what performance features are expected during the forecast period?
8. What influence will these technological developments have on viable data rates and data volumes?
9. How could the technological developments in the market support the realisation of the policy objective of 50 Mbps for consumers as specified by the Federal Government's Broadband Strategy?

10. To what extent could the optimisation of existing network infrastructure contribute to realising the objectives of the Broadband Strategy?
11. What contribution could be made by the use of frequencies available under a general assignment?
12. From the market players' point of view, what regulatory conditions should be established so that network operators will be able to meet the anticipated growing demand for broadband mobile services?
13. What contribution can innovative methods and approaches such as resource sharing or cognitive technologies make?
14. How much spectrum is necessary in order to meet the forecast demand for wireless broadband services, including in rural areas?
15. Which frequency bands are considered suitable for this?

5. Next steps

After expiry of the consultation deadline and following an evaluation of the comments, the President's Chamber will, in a hearing, issue initial assessments regarding the comments received and explain the next steps in the proceedings.

The President's Chamber will reach its decision after all the circumstances have been established and following consultation with the parties concerned on the basis of objective, transparent and non-discriminatory proceedings pursuant to sections 55(9) and 61 of the Telecommunications Act.

BK1-11/003 Annex

Bonn,

Vice President H	President	Vice President F
(Rapporteur)	**(Chair)**	**(Vice Chair)**

(President's Chamber)

Annex

Spectrum use and services offered from the customers' perspective

Frequency band	Spectrum	End of frequency usage period	Services from the customer's point of view[2]
800 MHz	791 – 821 MHz and 832 – 862 MHz	31 Dec 2025	Broadband Internet services[3]
900 MHz	**880.1 – 915 MHz and 925.1 – 960 MHz**	**31 Dec 2016**	**Predominantly voice telephony, short message services (SMS) and mobile data services (GSM mobile communication standard)**
1800 MHz	**1725 – 1730 MHz and 1820 – 1825 MHz 1735.1 – 1758.1 MHz and 1830.1 – 1853.1 MHz 1763.1 – 1780.5 MHz and 1858.1 – 1875.5 MHz**	**31 Dec 2016**	**Predominantly voice telephony, short message services (SMS) and mobile data services (GSM mobile communication standard)**
1800 MHz	1710 – 1725 MHz and 1805 – 1820 MHz 1730.1 – 1735.1 MHz and 1825.1 – 1830.1 MHz 1758.1 – 1763.1 MHz and 1853.1 – 1858.1 MHz	31 Dec 2025	Voice telephony, multimedia messaging services (MMS) and mobile Internet (LTE)
2 GHz	1905.1 – 1920.1 MHz 1920.3 – 1930.2 MHz and 2110.3 – 2120.2 MHz 1940.1 – 1950 MHz and 2130.1 – 2140 MHz 1959.9 – 1979.7 MHz and 2149.9 – 2169.7 MHz	31 Dec 2020	Voice telephony, multimedia messaging services (MMS) and mobile Internet (HSPA+)
2 GHz	1900.1 – 1905.1 MHz 1930.2 – 1940.1 MHz and 2120.2 – 2130.1 MHz 1950 – 1959.9 MHz and 2140 – 2149.9 MHz 2010.5 – 2024.7 MHz	31 Dec 2025	Voice telephony, multimedia messaging services (MMS) and mobile Internet (HSPA+)
2.6 GHz	2500 – 2570 MHz und 2620 – 2690 MHz 2570 – 2620 MHz	31 Dec 2025	Broadband data services (LTE)
3.5 GHz	3410 – 3494 MHz und 3510 – 3594 MHz	31 Dec 2021	Broadband data services

[2] The bandwidths which network operators offer their customers for data services and mobile Internet may vary depending on the contractually-agreed network access.

[3] According to Provision 36 in the Second Ordinance Amending the Frequency Band Allocation Ordinance of 14 July 2009 (Federal Law Gazette no 41 of 20 July 2009, p. 1809) the frequency band primarily serves to provide mobile broadband Internet access in rural areas for the purpose of closing gaps in the provision of broadband service.