Scenarios

for

the future provision of spectrum

in the 900 MHz and 1800 MHz bands and in other frequency bands

(Scenarios Paper Project 2016)

BK1-11/003

Contents

1 Introduction

The Bundesnetzagentur is currently investigating the scope it has for regulatory action in the context of providing spectrum in the 900 and 1800 MHz bands for which usage rights will expire in 2016. Subject to an assessment of the aims of regulation and a decision involving a forecast of whether enough spectrum will be available for frequency assignments, there would seem to be, in the abstract, two basic options: extension under section 55 (9) of the Telecommunications Act (TKG) or (re-) assignment under sections 55(3) and (10) and 61 of the TKG.

The forecast decision of the President's Chamber will be based on a comprehensive investigation of all the circumstances and facts which are relevant to determining whether a sufficient amount of spectrum will be available at the time frequency is awarded. It will take into consideration both the notified requirements of interested undertakings and future market and technological trends.

With a view to ensuring that proceedings would be objective, transparent and non-discriminatory, the Chamber initiated formal demand identification proceedings for the 900 MHz and 1800 MHz bands in December 2011. In April 2012 the interested public was consulted on a list of questions relating to foreseeable market and technological trends and the factors determining fair and reasonable frequency packages (Analysis paper, Bundesnetzagentur Official Gazette no 8/2012, Communication no 275/2012, page 1150).

The bulk of the comments on the analysis paper welcomed the fact that future market trends and the demand for broadband radio-based applications were included as factors in ascertaining frequency requirements for wireless access in the 900 MHz and 1800 MHz bands as from 2017. It was felt to be necessary, in the medium to long term, to assess the various frequency bands as a whole and to take account of all available and suitable frequencies in the 470 MHz to 3.8 GHz range. Staggering a number of award or assignment proceedings at short intervals in line with successive expiry times for frequency assignments was not thought to be advisable (expiry of GSM assignments in 2016, UMTS in 2020, BWA in 2021, the 2010 auction in 2025 and possibly other expiry times (outcome of WRC-2015).The exponential growth of mobile data traffic resulting from the increasing use of mobile broadband services necessitated a frequency policy that took the long view.

For the short term, however, the market players made a point of demanding the soonest possible extension and flexibilisation of the frequencies in the 900 MHz and 1800 MHz bands for a reasonable period, regardless of the question of the scarcity of these frequencies.

The Chamber's remit for demand identification proceedings requires it both to assess the notified requirements and to tailor its decision to future market and technological trends. For this purpose the Chamber must develop a forward-looking frequency regulation strategy which will enable it to supply the market with spectrum resources not only in the short term but also in the medium to long term. The strategy must take the regulation objectives into account, giving each of them its due weight.

Various scenarios for the provision of 900 and 1800 MHz frequencies can be developed on the basis of the requirements of telecommunications law and the stated interests of the parties involved.

When assessing the scenarios, especially with a view to upholding consumer interests, it is essential to take account both of the consumer's need for nationwide mobile coverage (voice telephony in particular) and of the mounting demand for broadband mobile services. The aim of speeding up the rollout of high performance telecommunications networks, which is also pursued via the federal government's broadband strategy, means that frequency regulation

must be proactive. The principle of promoting competition is a further reason for ensuring that the frequency resources are made available in open, transparent and non-discriminatory proceedings, and that the frequencies can be, and in fact are, used efficiently. Due consideration must also be given, in the context of providing further spectrum, to the interests of broadcasters as well as non-public radio applications (eg wireless microphones) and the authorities and organisations concerned with public safety (BOS).

There is a certain tension between the stated interest in acquiring the fastest possible planning certainty with regard to the assignment of the 900 MHz and 1800 MHz frequencies due for earliest expiry, on the one hand, and the call for a comprehensive assessment of the various frequency bands and/or the inclusion of all available and suitable frequencies – suitable for both carrying high capacity and covering rural areas – for broadband wireless access, on the other. Against this background, and with a view to setting up a predictable regulatory system, it is necessary to provide suitable proceedings for the assignment of spectrum.

The regulatory issues dealt with in the written consultation on frequency requirements proved to be so complex that they needed to be tackled in greater depth at a public information meeting on 9 November 2012 (see Bundesnetzagentur Official Gazette of 5 September 2012, Communication no 614/2012). The points discussed with the interested parties covered the Bundesnetzagentur's first impressions, the conceivable conclusions to be drawn from the written comments submitted and possible scenarios for the assignment of frequencies. Because of the importance of the decisions to be taken and in order to ensure its proceedings are clearly understandable, the President’s Chamber is now publishing not just an overview of the written comments on the analysis paper received to date but also the scenarios, for the purpose of a written consultation also aimed at interested parties in the general public.

Interested parties are herewith invited to submit their comments in German, in written form, to the

Bundesnetzagentur
Referat 212
Tulpenfeld 4
53113 Bonn

and

electronically in Word (or Word compatible) or PDF format (in which case copying and printing must be possible) to:

referat212@bnetza.de.

The comments must reach the Bundesnetzagentur by

31 January 2013.

The intention is to publish the comments in their original form on the Bundesnetzagentur's website. They must consequently be accompanied by a declaration of consent to publication. If the comments contain trade and operating secrets, a version for publication, with the relevant passages blacked out, must be submitted in addition.

The next step planned by the Chamber is for a draft decision on the future award of frequency usage rights in the 900 MHz and 1800 MHz bands to be presented for public consultation. The draft will be based on the results of the demand identification proceedings and the written consultation on the scenarios. The Chamber has already indicated that it will

make its decision in timely manner, ie about three years before expiry of the current time limits.

2 Overview of demand identification proceedings

The following frequency spectrum will be made available as from 1 January 2017 for wireless access in the ranges 880 - 915 MHz, 925 – 960 MHz, 1725 - 1785 MHz and 1820 - 1880 MHz:

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

Table 1

Accordingly there will in future be spectrum to a total volume of 170 MHz available for assignment in the two frequency bands.

During the demand identification proceedings six undertakings gave notice of their frequency requirements. The following table shows the notified requirements for the two bands as a total which is, in purely numerical terms, larger than the volume of available spectrum:

Frequency band	Available spectrum	Total notified requirements
900 MHz	2 x 35 MHz	approx 2 x 55 MHz
1800 MHz	2 x 50 MHz	approx 2 x 80 MHz

Table 2

Total demand for spectrum in the 900 MHz band exceeds available supply by 40 MHz. In the case of the 1800 MHz band the shortfall of supply comes to 60 MHz.

The basic position is that notification of frequency requirements has been given by the current GSM network operators to which the spectrum is currently assigned. They are motivated chiefly by the desire to gain planning and investment certainty as quickly as possible by way of an extension of frequency usage rights and greater flexibility for the assignments. The majority of these operators expect demand for GSM mobile services to remain high in the medium term. In addition to continued GSM operations they believe there will be demand for spectrum for the operation of LTE systems, short or medium to long term depending on the frequency band.

Other undertakings have also given notice of their interest in future use of frequency in the 900/1800 MHz bands.

3 Comments on analysis paper

On 2 May 2012 the Bundesnetzagentur published an analysis paper with a view to establishing the relevant facts and the degree of corporate interest by setting up open,

transparent and wide-ranging discussions with all interested parties. The idea was to give the public the opportunity to submit factual material and forecasts on short, medium and long term developments in the field of wireless access and to make statements on the amount of spectrum that would then be necessary.

> Analysis paper, published in the Bundesnetzagentur's Official Gazette 8/2012 of 2 May 2012, Communication no 275/2012, pp 1150 ff, and on the internet (www.bundesnetzagentur.de/DrahtloserNetzzugang)

As a way of structuring the discussions the President's Chamber compiled a list of questions and invited comments, setting a deadline of 3 July 2012.

The opportunity to comment on the analysis paper was taken by thirteen respondents, prominent among them being mobile network operators, manufacturers, representatives of public broadcasting bodies and associations. Their comments were published on the Bundesnetzagentur's website: www.bundesnetzagentur.de/DrahtloserNetzzugang.

The gist of their comments on the key questions in the analysis paper was as follows:

Question 1:

"How are service trends expected to develop with regard to users, and in particular end users, on the German market in the short, medium and long term (eg for a period of 5, 10 or 15 years)?"

In essence the responses were to the effect that there would be a powerful expansion of services, driven by the convergence of landline and mobile and by the mounting use of mobile broadband-enabled devices such as smart phones and tablet PCs. On the one hand the medium-term demand for GSM-based voice telephony and M2M applications (machine-to-machine apps) would continue to be strong. On the other hand there would be growing use of mobile data services, with services with high data signalling rates, such as video services, being particularly relevant for future trends.

Question 2:

"What do the subscriber and traffic trends in Germany look like in the short, medium and long term?"

The majority of respondents expect substantial growth for both subscriber numbers and traffic volume. UMTS/LTE subscriber numbers and data volume would be driven up by brisk sales of broadband-enabled devices. One of the reasons for continued demand for GSM uses, in spite of the increasing use of broadband, was the dynamic development of M2M applications.

Question 3:

"What view is taken of future user behaviour in relation to data volumes for the various services?"

The gist of the responses was that user behaviour is driven by demand and tends to be determined by the user devices' technological possibilities existing at any given time. There

was said to be a tendency for stationary and quasi-stationary user behaviour to develop in the direction of mobile use of data, with the intensity and data volume of the use growing strongly at the same time. On the other hand some respondents pointed out that in the end the growth of data volume would be limited by the degree of willingness to pay for it.

Question 4:

"What data signalling rates per cell will be needed in future to be able to offer the services demanded without departing from specific quality parameters? How many users could then be served?"

The great majority of the respondents did not make any concrete statements about specific data signalling rates. They pointed out that data volumes per cell varied widely, depending on the number of simultaneous users of a cell, the type of device and service used and the position of the cells. Cell capacity was therefore set at a level that would fulfil customer expectations in terms of sufficient speed of data transmission.

Question 5:

"What are the factors underlying the assessments given in response to questions 1 to 4?"

Most of the respondents said that the factors basic to questions 1 to 4 are rising subscriber numbers, the increasing use of devices like smart phones, the use of second and third devices, the convergence of landline and mobile and the use of new broadband technologies.

Question 6:

"What view is taken of the assessments of the German market on which the ITU Report RM.2243 is based?"

The bulk of the respondents shared the Report's assessments, which they feel would also be true of the German market. Some however referred to points of uncertainty in the forecasts, anticipating that users' reluctance to pay for services would set limits to data traffic growth. They also drew attention to the physical limits of technological developments.

Question 7:

"*What technological developments are expected in the forecast period? Which performance characteristics will they offer?"*

The great majority of the respondents said the major technological developments would be LTE (with up to 100 Mbit/s) and LTE Advanced (with up to 1 Gbit/s or more). Other developments mentioned as relevant to the forecast period were HSPA+ / evolution, the supplemental downlink (SDL), the combination of macro-, pico- und femtocells, antenna technologies such as MIMO (multiple input multiple output), and carrier aggregation.

Question 8:

"What impact do these technological developments have on realisable data rates and data volumes?"

The gist of the comments was that LTE would enable a data rate of 100 Mbit/s per 20-MHz channel to be realised and that, by supplementing with carrier aggregation and MIMO, data rates of 300 Mbit/s to 1 Gbit/s would be possible. LTE Advanced, coupled with a possible carrier aggregation of 100 MHz bandwidth, could push the rates above the 1 Gbit/s mark.

Question 9:

"How can the technological developments on the market help the federal government to achieve the political target of 50 Mbit/s for the consumer as part of its broadband strategy?"

The basic point made was that LTE and LTE Advanced could make a substantial contribution to reaching the targets of the federal government's broadband strategy, as these technologies offered higher performance and, with a further enhancement of spectrum efficiency, formed a central component of the strategy, particularly in terms of nationwide coverage. There were also other ways of increasing capacity, for example by raising network density, or by using multi-sectoral antennas and improved antenna systems. However, the low level of acceptance by the general public meant there were limits, particularly to the achievement of greater network density. Most respondents felt that the provision of additional spectrum below 790 MHz was the best way to achieve a rapid and profitable increase in capacity. There was in addition a call for the provision of extra spectrum for wireless access. It was however also mentioned that the conceivable spectrum below 1 GHz was limited and would not on its own be enough to meet forecast demand.

Question 10:

"To what extent can the optimising of existing network infrastructure help to achieve the objectives of the broadband strategy?"

The respondents felt that there was potential for reaching the broadband strategy targets by optimising existing network infrastructure, for example by increasing network density (up to and including small cells), use of new transmission techniques (HSPA+, LTE, LTE Advanced), the corresponding further development of technology (carrier aggregation, MIMO, beam forming), use of multi-sectoral antennas at existing base station sites, the continued rollout and optimising of optical fibre networks, broadband networks (Standard DOCSIS 3.0), DSL networks (VDSL vectoring) and fixed link infrastructure. There was also a call for the provision of additional spectrum.

Question 11:

"What contribution can be made by the use of generally assigned frequencies?"

Most respondents saw little point in the blanket use of generally assigned frequencies because the use of these frequencies (eg WLAN) was dependent on the availability of a return channel and was therefore practicable at best in areas with sufficient existing (optical fibre) connections, as in towns. It addition it was not possible to offer users adequate quality on account of the small range of hotspots and the interference made likely by non-exclusive

assignment. But some respondents regarded the said frequencies as a sensible supplement and supported their use.

Question 12:

"From the point of view of market players, what regulatory conditions should be set with a view to enabling network operators to meet the expected rising demand for broadband mobile services?"

In the view of many respondents the regulatory conditions required for meeting the demand for broadband mobile services are technological neutrality and enhanced flexibility, the simplification of approval procedures for small cells, spectrum trading and infrastructure sharing, the greatest possible pan-European harmonisation of spectrum and the asymmetrical use of spectrum. In this context some of the respondents referred to the necessity of extending the existing GSM licences for the 900 and 1800 MHz frequencies.

Question 13:

"What contribution can be made by innovative approaches such as resource sharing or cognitive technologies?"

A large number of respondents welcomed the possibilities offered by the sharing of resources (eg site sharing, site support cabinet sharing, RAN sharing and/or frequency pooling). Cognitive technologies, such as white space devices or cognitive radio, were regarded by most respondents as not offering any appreciable applications as yet.

Question 14:

"How much spectrum is needed to meet the forecast demand for wireless broadband services, including in rural areas?"

Many respondents referred to the necessity of additional spectrum. Demand forecasts made in the past, particularly in ITU-R Report M.2078 of 2007, which called for 1200 to 1700 MHz for mobile broadband, had already been overtaken by events. Most respondents stressed the importance of additional spectrum, especially below 1 GHz, for coverage in rural areas, as the establishment of a large number of extra base stations was not economically feasible. On the other hand some respondents argued against the designation of additional spectrum, particularly in the context of the so-called "Digital Dividend II", on the grounds that such designation could only make a small contribution to meeting demand. A better way to provide sufficient coverage would be greater network density, which was necessary in any case.

Question 15:

"Which frequency bands are regarded as fit for the above purpose?"

In the opinion of most respondents the frequencies below 1 GHz were peculiarly suitable for meeting the forecast nationwide demand for mobile broadband, with express emphasis being placed on the 700 MHz band. The issues related to the implementation of an allocation of the 700 MHz band would have to be settled by the time of the next World Radiocommunication Conference. Some respondents also referred to the frequency bands above 1 GHz and made special mention of 1375 to 1492 MHz, 1900 to 2290 MHz, 2700 to 2930 MHz and 3400 to 4200 MHz.

4 Bundesnetzagentur open session on 9 November 2012

The Bundesnetzagentur held a public information meeting on 9 November 2012, which was attended both by interested members of the public and by undertakings which had notified the Bundesnetzagentur of their frequency requirements. The Chamber addressed the meeting on the subjects of market, technology and international harmonisation. It delivered an estimate of total spectrum requirements and defined its regulatory action parameters in the abstract.

The Chamber presented the initial scenarios for provision of the 900/1800 MHz spectrum and other frequencies, subject to the balancing of regulatory aims and the forecast decision. It then invited written responses.

5 Frequency bands for broadband rollout

The federal government's broadband strategy includes the aim of promoting broadband coverage for the population at large. By 2014 75% of households are to have connections with transmission rates of at least 50 megabit per second at their disposal, and nationwide broadband coverage is to be achieved by 2018. In awarding spectrum in the 900 MHz and 1800 MHz bands it is therefore also important to provide incentives for investment and to promote innovations of benefit to consumers as well as sustainable competition, as a way of giving the federal government's objectives long-term support. In order to achieve those objectives it will be necessary, against the background of market and technological trends, to provide further frequencies for broadband rollout on an efficient and demand-oriented basis. The statement of conclusions produced by a coalition group of members of the CDU/CSU and FDP parliamentary parties on 26 June 2012 (*Ländliche Räume, Regionale Vielfalt – Wie können wir die Zukunft gestalten?*, page 6; accessible at www.kongress-laendliche-raeume.de) draws explicit attention to the importance of providing additional frequencies below 790 MHz for coverage of rural areas:

> *"The central tasks are to improve local conditions in rural areas by ensuring that urban and rural regions have equal and fully comprehensive access to the high-speed internet and to prevent a digital divide. In order to reach the federal government's rollout objectives […] the following priorities have been set: […] Raising rollout requirements to ensure priority for coverage of rural areas at the auctioning of digital dividend II […] ."*

In its analysis of 2 May 2012 (Analysis paper project 2016) the President's Chamber made the following points on the significance of radio frequencies for meeting the growing demand for mobile broadband services (Analysis paper, loc. cit., page 1173):

"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 (eg 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."

The Chamber's analysis was to a large extent confirmed by the comments received on the analysis paper. The analysis covered market and technological trends in relation to new high-speed networks for providing consumers with nationwide broadband services and the resulting short, medium and long term demand for spectrum for service in rural areas and capacity spectrum. Against this background the respondents called for a comprehensive assessment to be made, at least in the medium to long term, of the resources required for the achievement of the aims of the federal government's broadband strategy. According to the respondents, particular consideration should be given to the 470 MHz to 3.8 GHz bands.

With regard to the spectrum needed for a further rollout of nationwide broadband the Second Monitoring Report on the Federal Government's Broadband Strategy made particular reference to the frequency range below 790 MHz (accessible at www.bmwi.de):

"(page 25) The potential for the use of further frequencies from the digital dividend is not yet firmly enough established in the consciousness of market players, the auction having been relatively recent and only a start having been made on the use of these frequencies (790 to 862 MHz). If however the conditions for the provision of additional spectrum from the digital dividend are to be created, this matter must be placed on the agenda for the next World Radiocommunication Conference but one, in 2015, and this must be done in good time, ie at WRC-2012."

It is a fundamental aim of the federal government's broadband strategy that the broadband rollout should be driven by market forces and delivered primarily by the telecommunications undertakings on the basis of free competition. It is recognised that the undertakings need incentives to embark on the additional investment required and accepted that these should take the form of greater planning certainty and a regulatory policy that is oriented to growth and innovation. The importance of planning certainty for the undertakings means that they need to know that the frequency resources will be available to them not just in the short term but also in the medium and long term. This makes it necessary to give full transparency both to the frequency bands which are already available and to the bands under consideration in the context of international harmonisation, and also to the future bands for mobile services which are currently under discussion.

The relevant frequency bands are dealt with below:

5.1 Frequency bands for wireless access in Germany

Under the frequency usage plan effective as of August 2011 the following frequencies are designated for wireless access for the provision of telecommunications services:

Frequency band	Range	Entry in frequency plan	Volume (rounded)
450 MHz	450 – 455.74 MHz	224028	2 x 5 MHz
	460 – 465.74 MHz	224064	
800 MHz	791 – 821 MHz	226002	2 x 30 MHz
	832 – 862 MHz	226003	
900 MHz	880 – 890 MHz	227011	2 x 35 MHz
	890 – 915 MHz	228001	
	925 – 960 MHz	228005	
1800 MHz	1710 – 1785 MHz	267001	2 x 75 MHz
	1805 - 1880 MHz	267006	
2 GHz	1900 - 1920 MHz	267008	2 x 60 MHz 1 x 20 MHz 1 x 15 MHz
	1920 – 1930 MHz	267009	
	1930 – 1980 MHz	268001	
	2010 – 2025 MHz	270001	
	2110 – 2120 MHz	272001	
	2120 – 2170 MHz	273001	
2.6 GHz	2500 – 2520 MHz	282001	2 x 70 MHz 1 x 50 MHz
	2520 – 2655 MHz	283001	
	2655 – 2670 MHz	284001	
	2670 – 2690 MHz	285001	
3.5 GHz	3400 – 3475 MHz	292006	200 MHz
	3475 – 3600 MHz	293003	
3.7 GHz	3600 – 3800 MHz	294003	200 MHz
		Total spectrum:	**1035 MHz**

Table 3: Frequencies designated as per frequency usage plan; effective August 2011

The following table gives an overview of the expiry date of the usage rights assigned in the various frequency bands:

Frequency band	Range	Expiry date
450 MHz	451.075 – 455.575 MHz / 461.075 – 465.575 MHz	31 Dec 2020
800 MHz	791 – 821 MHz / 832 – 862 MHz	31 Dec 2025
900 MHz	880 – 915 MHz / 925 – 960 MHz	31 Dec 2016
1800 MHz	1710.0 – 1725.0 MHz / 1805.0 – 1820.0 MHz	31 Dec 2025
	1725.0 – 1730.0 MHz / 1820.0 – 1825.0 MHz	31 Dec 2016
	1730.1 – 1735.1 MHz / 1825.1 – 1830.1 MHz	31 Dec 2025
	1735.1 – 1758.1 MHz / 1830.1 – 1853.1 MHz	31 Dec 2016
	1758.1 – 1763.1 MHz / 1853.1 – 1858.1 MHz	31 Dec 2025
	1763.1 – 1780.5 MHz / 1858.1 – 1875.5 MHz	31 Dec 2016
2 GHz	1900.1 – 1905.1 MHz	31 Dec 2025
	1905.1 – 1920.1 MHz	31 Dec 2020
	2010.5 – 2024.7 MHz	31 Dec 2025
	1920.3 – 1930.2 MHz and 2110.3 – 2120.2 MHz	31 Dec 2020
	1930.2 – 1940.1 MHz and 2120.2 – 2130.1 MHz	31 Dec 2025
	1940.1 – 1950.0 MHz and 2130.1 – 2140.0 MHz	31 Dec 2020
	1950.0 – 1959.9 MHz and 2140.0 – 2149.9 MHz	31 Dec 2025
	1959.9 – 1979.7 MHz and 2149.9 – 2169.7 MHz	31 Dec 2020
2.6 GHz	2500 – 2690 MHz	31 Dec 2025

Frequency band	Range	Expiry date
3.5 GHz	3410 – 3473 MHz and 3510 – 3573 MHz	31 Dec 2021
	3473 – 3494 MHz and 3573 – 3594 MHz, smaller frequency blocks assigned regionally or locally	up to 2022
3.7 GHz	3600 – 3800 MHz; smaller frequency blocks assigned regionally or locally	up to 2022

Table 4: Expiry dates of assigned spectrum

5.2 International initiatives and bands under consideration for broadband rollout; significance thereof for domestic situation

Concentrated efforts are currently being made at international level by the ITU (International Telecommunication Union), the CEPT (European Conference of Postal and Telecommunications Administrations) and the EU (European Union) to identify and implement new frequency bands for mobile broadband communication. On the one hand this involves the identification of new spectrum by the ITU and, on the other, the implementation of spectrum which has already been identified by the ITU but not yet introduced in Europe. As recently as 2007, expectations about the demand for broadband communication were cautious outside the CEPT. But since then a global consensus has emerged at the political level, which is finding expression in activities aimed at WRC-15 and in a host of national and regional political initiatives.

One of the aims of European spectrum policy, at EU level, is to provide consumers with broadband mobile coverage. Article 3 of the first RSPP (Radio Spectrum Policy Programme, Decision no 243/2012/EU of the European Parliament and the Council of 14 March 2012) requires Member States to cooperate in supporting and achieving the following political 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 1200 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 speed and capacity;"*

Spectrum of 1025 MHz for wireless access has already been made available at EU level on a harmonised basis (see RSPG Opinion on Review of Spectrum Use, annex 1, http://rspg.groups.eu.int/rspg_opinions/index_en.htm). The EU is therefore under an obligation to identify at least another 175 MHz by 2015.

In addition to the aim of providing mobile broadband spectrum the RSPP also furthers the spectrum interests of other applications connected with the EU's political objectives. Included among those explicitly mentioned are applications for intelligent energy networks and metering systems, for the development of innovative, interoperable solutions directed at public safety and protecting people, disaster prevention and relief systems and for PMSE users (programme making and special events); see article 8 of the RSPP. As happens with

the CEPT, the various sources of demand in some cases compete with each other for the same frequency bands. As a means of supporting the Union-wide initiatives the Radio Spectrum Policy Group (RSPG) has set up working parties for mobile broadband and for the other sectoral spectrum interests. The RSPG can be expected to deliver its opinion on the "Strategic Challenges facing Europe in addressing the Growing Spectrum Demand for Wireless Broadband" by mid-2013 and its report "Strategic sectoral spectrum needs“ by November 2013.

Some particulars:

During the 2012 World Radiocommunication Conference (WRC-2012) two items were placed on the agenda for WRC-2015, with Germany's backing (see Resolutions 232 and 233). They are aimed at the allocation of additional frequency bands to the mobile services in 2015 and the intention was to support national and international initiatives for the improvement of broadband coverage. Both agenda items are concerned with the question of allocating further spectrum to the mobile services on a co-primary basis and identifying it for International Mobile Telecommunications (IMT) and other broadband mobile applications (eg WLAN), including the identification of medium and long term demand for spectrum. A co-primary allocation by the ITU would make it possible to use the frequencies for all services to which they have been allocated on a co-primary basis and to enjoy the accompanying protection rights.

At present, as part of the first item of the agenda, proposals are being compiled for potential candidate frequency bands. Most of these are located in the 470 − 6425 MHz range, though, over and above the frequencies already provisionally allocated and identified below 790 MHz (694 – 790 MHz), the investigation is focused on the bands round 1400 MHz, above 2 GHz and in the 3400 – 4200 MHz range. The search for potential suitable bands for use by future mobile broadband applications is backed by an assessment of the spectrum requirements expected in the future for the various frequency interest groups.

The points made in Resolution 233 (WRC-12) − ″Studies on frequency-related matters on International Mobile Telecommunications and other terrestrial mobile broadband applications″− include the following:

> ″ […] *2. to study potential candidate frequency bands, taking into account the results of the studies under resolves to invite ITU-R 1, protection of existing services and the need for harmonization;* […].″

WRC-12 dealt with the frequency range below 790 MHz with a view to having the allocation, on a co-primary basis, of the 694 – 790 band for mobile services (Resolution 232) in ITU Region 1 put into effect by WRC-15. A higher degree of harmonisation was seen as possible for ITU Region 1 and thus a need to use the band for mobile services, and this led to the adoption of an agenda item for WRC-15 regarding the future use of this frequency band and the adoption of Resolution 232 (WRC-12) - ″Use of the frequency band 694-790 MHz by the mobile, except aeronautical mobile, service in Region 1 and related studies. ″ The Resolution laid down the following:

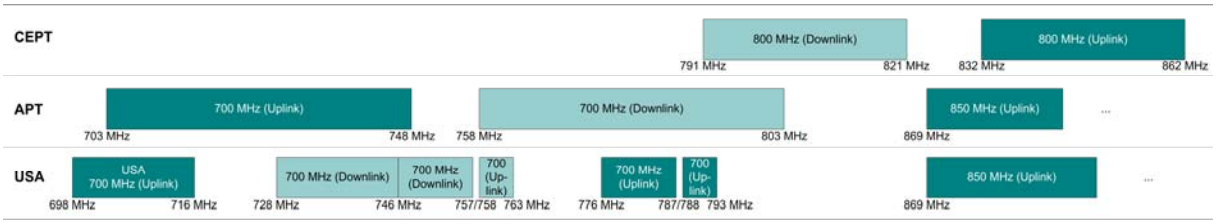
> ″*1 to allocate the frequency band 694-790 MHz in Region 1 to the mobile, except aeronautical mobile, service on a co-primary basis with other services to which this band is allocated on a primary basis and to identify it for IMT;*
>
> *2 that the allocation in resolves 1 is effective immediately after WRC-15 […].*
>
> *4 that the lower edge of the allocation is subject to refinement at WRC-15, taking into account the ITU-R studies referred to in invites ITU-R below and the needs of countries in Region 1, in particular developing countries; ″*

Use of the band is not uniform worldwide. In Europe it is used by terrestrial broadcasting, to which it has been allocated for use on a primary basis. Consequently it is necessary in Europe to take into account the requirements not only of mobile services but also of broadcasting and the secondary users also present (PMSE).

In contrast to customary practice for the allocation of spectrum at World Radiocommunication Conferences, the studies on the 694 – 790 MHz band also contain a harmonised band plan for ITU Region 1, which is therefore to be completed in time for WRC-15. This procedure was introduced with a view to implementing broadband systems as quickly as possible.

The band plan is intended to take not just international harmonisation into account but also compatibility with already existing band plans (eg USA, Asia and CEPT).

The FCC (Federal Communications Commission) has developed a 700 MHz band plan for the USA. The 700 MHz band plan of the APT (Asia-Pacific Telecommunity) is currently being applied by Asian states, but it is also being implemented in Mexico, Chile, Columbia and Costa Rica. The Policy Tracker article of 28 September 2012 ("Mexico adopts APT 700 MHz band plan“) cites the number of potential users under the FCC band plan as 400 million, based on the population sizes of the countries involved, and the figure for the ATP band plan is given as 4 billion.



Most current proposals for a band plan take a lower band edge of 694 MHz as part of their frame of reference. In addition to the actual band plan, WRC-15 is intended to lay down the technical and regulatory conditions for in-band / out-of-band compatibility and, where appropriate, the necessary international coordination procedures for the use of the band. However, prescriptions of this kind do not as a rule contain any detailed parameters (eg block edge masks). In certain cases it may also be necessary, when deciding on the band plan, to specify the frequency parameters at regional level.

It should be noted that the detailed discussions of the 694 – 790 MHz band do not preclude further proposals for allocations below 694 MHz. In this context the short to medium term band plan discussion needs to be kept separate from the discussion of long-term allocation. Initial talks on this are already being held at international level.

Apart from the requirements of mobile services and broadcasting − the current primary user −, consideration must be given to other radio applications, for example to the requirements of Programme Making and Special Events (PMSE), which is the current secondary user in the 694 – 790 MHz band. Where necessary, possible solutions should be set out. The use of part of the new mobile services allocation by PPDR (Public Protection and Disaster Relief or, at domestic level, BOS (public safety authorities and organisations)) is also being discussed at international level, and has been incorporated in some of the band plan proposals. Immediately after WRC-12, ITU-R commissioned Joint Task Group 4-5-6-7 (JTG 4-5-6-7) to carry out the required compatibility studies; a start has already been made. At the European level, Project Team D (PT-D) of the Conference Preparation Group (CPG) of the CEPT's ECC Committee has been commissioned to prepare the ground for defining the European position. The European preparations for WRC-15 will involve giving the ideas developed on both subjects greater depth and detail. Administrative bodies and undertakings

are showing strong interest, at both European and global level, in making an active contribution to shaping the future use of this frequency band.

The CEPT's Electronic Communications Committee (ECC) is already conducting investigations into frequency bands, with a view to making the bands available not just for wireless access but also for other broadband applications, such as the radio applications required by BOS, or PPDR, and other existing users, like PMSE. Here there is a certain amount of overlapping with the bands under discussion in the WRC preparations.

The following should be noted in regard to requirements for PMSE applications:

The CEPT has set up an international project team whose brief is both to analyse requirements for PMSE applications and to propose possible solutions. With a view to implementing and providing resources for PMSE the EU Commission had briefed the CEPT to analyse spectrum in the 821 – 832 MHz and 1785 – 1805 MHz bands that could be harmonised, on a binding EU-wide basis, for wireless microphones and also to analyse further demand, including requirements for wireless cameras. This work is to be completed by November 2013.

The following should be noted in regard to PPDR:

The CEPT is using an international project team to investigate spectrum requirements for broadband applications by authorities and organisations concerned with public safety (BOS). The current time frame allows for the framing of a harmonisation decision by the ECC by mid-2014. According to a study commissioned by the Federal Ministry of Economics and Technology (Harmonisation of PPDR frequencies in Germany, Europe and worldwide, dated 6 December 2010), Germany's spectrum requirement comes to 40 MHz, 25 MHz of which should be below 1 GHz. Total requirements are made up of resources needed continuously plus resources needed ad hoc and in case of disasters. Because of the necessary interoperability with the BOS systems already implemented at 400 MHz, the identification of the new spectrum should be kept as close as possible to this band.

5.3 Individual frequency bands

On the basis of domestic planning and international activities in the range of approximately 400 MHz to 3.8 GHz, individual frequency bands can be dealt with as follows:

5.3.1 694 − 790 MHz

In Germany the 470 – 790 MHz band is currently allocated to broadcasting services on a primary basis and designated for television broadcasting under the requirements of telecommunications law. Spectrum has been assigned in this band for use with DVB-T, and there have also been a number of assignments for PMSE on the basis of secondary allocation.

However, for the band from approximately 694 – 790 MHZ, WRC-15 is expected to deliver a co-primary allocation for mobile services parallel to broadcasting and an identification for IMT applications. Resolution 232 at WRC-12 (WRC-12; Use of the frequency band 694 – 790 MHz by the mobile, except aeronautical mobile, service in Region 1 and related studies) set out certain ground rules:

> "*1 to allocate the frequency band 694-790 MHz in Region 1 to the mobile, except aeronautical mobile, service on a co-primary basis with other services to which this*

band is allocated on a primary basis and to identify it for IMT;

2 that the allocation in resolves 1 is effective immediately after WRC-15 […].

4 that the lower edge of the allocation is subject to refinement at WRC-15, taking into account the ITU-R studies referred to in invites ITU-R below and the needs of countries in Region 1, in particular developing countries;"

The lower band edge (approximately 694 MHz) has not yet been finally determined and will only be laid down at WRC-15.

In addition, the channel plan has yet to be decided on (by the ECC) as well as other radio parameters for ensuring compatibility inside the band and vis-a-vis neighbouring bands. The Member States reserve the right to decide whether to implement WRC decisions.

Domestic provision of 700 MHz spectrum is conditional on the frequencies having also been allocated for mobile services in the frequency ordinance and designated for wireless access in the frequency plan. On that basis, however, a solution for BOS and PMSE will become necessary. Alongside the requirements for PPDR and PMSE already addressed internationally, the Federal Ministry of Defence has already given notice, at the national level, of requirements for military applications in connection with the provision of 800 MHz spectrum. Here too a solution will need to be found.

As regards the 700 MHz band, it should be pointed out that there are a number of regional frequency assignments for the DVB-T broadcasting service in the various channels; most of these assignments will expire in 2025.

However, the following points need to be borne in mind in relation to current use of this band for DVB-T:

According to the latest digitalisation report of September 2012, the terrestrial DVB-T service is currently used by about 12% of the approximately 37 million German households with TV. The report supplies the following statistics (for further details see *Die Medienanstalten ALM GbR, Digitalisierungsbericht 2012*, page 49, accessible at www.die-medienanstalten.de):

"Use of the terrestrial service has settled at about 11 percent in recent years and will rise to 12.5% percent this year. This means that just under 5 million households watch DVB-T, the preponderance of terrestrial use being in the urban areas […]*"*

This should be compared with approximately 45% each for satellite and broadband cable and about 5% for IPTV (for the details see *Die Medienanstalten ALM GbR, Digitalisierungsbericht 2012 - Daten und Fakten Chartreport,* page 9*).*

Terrestrial DVB-T coverage is moreover marked by extremely heterogeneous distribution over the various regions of Germany, with substantially higher use in areas of heavy and heaviest population density, while terrestrial use has in some cases become virtually irrelevant in thinly populated regions. The contracts for terrestrial distribution of the major private channels are due to expire in 2014. No final decisions have yet been taken on whether terrestrial distribution will be continued or ended. If the broadcasters decide to continue DVB-T services there will be a need for solutions covering the existing DVB-T assignments in the 700 MHz band. A possible conversion to DVB-T2 or HD television would also have to be taken into account.

Neighbouring countries show wide variations in the proportionate use of terrestrial video

broadcasting services, ranging from about 2-5% in Belgium and the Netherlands to 65% in France. It is in that light that solutions for the particular cross-border coordination agreements will have to be developed.

5.3.2 791 – 821 MHz / 832 – 862 MHz

This frequency band was assigned for the first time in 2010 for wireless access for the provision of telecommunication services. The assignments will expire on 31 December 2025 (see table 4).

5.3.3 900 MHz and 1800 MHz

As stated in the German frequency usage plan, the 900 MHz and 1800 MHz frequencies are designated for wireless access for the provision of telecommunication services.

The spectrum is currently assigned to network operators in frequency blocks of varying size. The block sizes range from 0.6 MHz to 7.4 MHz, particularly in the 900 MHz band. It is planned to adjust the channel spacing before a further provision of spectrum so as to make it available in 5 MHz blocks on a technology-neutral basis.

The spectrum usage rights previously designated for GSM in the 900/1800 MHz range are due to expire on 31 December 2016. Further spectrum to the volume of 2 x 25 MHz (paired) in the 1800 MHz band was made available for wireless access at the 2010 auction. These assignments will expire on 31 December 2025 (see table 4).

5.3.4 1452 – 1492 MHz

In ITU Region 1 the 1452 – 1492 MHz band has been allocated on an international basis to the fixed service, mobile service, broadcasting service and broadcasting-satellite service. Based on decisions taken by CEPT, the current frequency usage plan designates the 1452 – 1479.5 MHz sub-band for sound broadcasting (telecom) and the 1479.5 – 1492 HMz sub-band for satellite broadcasting (telecom). In addition the 1452 – 1477.5 MHz band has been identified for wireless microphones and comes with a reference to international developments. At present there are national assignments for satellite broadcasting for the period to the end of 2018. A query at CEPT level, however, revealed that the band as a whole was scarcely used. A CEPT project team was therefore set up and briefed to identify alternative uses.

On that basis the working group for frequency management (WGFM) decided in September 2012 to start developing a harmonisation decision for wireless access under the title "Supplementary Downlink", including the necessary technical parameters (BEM). The band plan will be based on a 5 MHz spacing. At national level, however, other terrestrial applications are to be possible as well as wireless access. The existing ECC Decision (03)02 ("on the designation of the frequency band 1479.5 –1492 MHz for use by satellite digital audio broadcasting systems“) is to be repealed.

5.3.5 2 GHz

The paired 2 GHz frequency usage rights (UMTS/IMT2000), due to expire in 2020, have been given greater flexibility at the level of the domestic frequency usage plan and can thus

be assigned for wireless access as from 2021 on a service and technology-neutral basis. The 2 GHz frequencies for wireless access, with a volume of 2 x 20 MHz, which were awarded by auction in 2010, will expire on 31 December 2025 (see table 4).

The future designation of unpaired 2 GHz frequencies for applications other than wireless access is currently under consideration at both national and international level. The frequencies' potential for new applications is already being investigated at CEPT level, with the backing of a mandate from the European Commission to the CEPT. The CEPT is focusing these investigations on BDA2GC and PMSE on the basis of shared use.

5.3.6 1980 – 2010 MHz / 2170 – 2200 MHz

On 14 February 2007 the European Commission adopted the decision on the harmonised use of radio spectrum in the 2 GHz frequency bands for the implementation of systems providing mobile satellite services (MSS) in the frequency bands 1980 – 2010 MHz and 2170 – 2200 MHz (no 2007/98/EC). Under the selection decision of 13 May 2009 the award went to the undertakings Inmarsat Ventures Limited and Solaris Mobile Limited (Decision no 2009/449/EC). Decision no 626/2008/EC imposed common conditions on the selected operators. The conditions include the requirements that all the milestones listed in the Decision must be reached within 24 months, that is, by 12 May 2011. To date the commercial operation of MSS in the Member States has not been achieved. To withdraw or suspend the frequency usage rights would require application of the enforcement provisions covering MSS under Article 9(3) of the Decision adopted by the European Parliament and the Council (Decision no 2011/667/EU of 10 October 2011), which means that the spectrum is not available for other applications, at least in the short term.

Nor is there at present any European consensus on the provision of the frequency bands for wireless access. In the Bundesnetzagentur's opinion the spectrum is highly suitable for wireless access because of the possibility of direct continuation of the existing terrestrial 2 GHz band plan.

5.3.7 2300 to 2400 MHz

Since WRC-07 the 2300 − 2400 MHz band has been identified, internationally, for mobile applications (IMT), but these have not yet been implemented at CEPT level. The band is used for wireless cameras (including those of BOS), for undertakings, eg in industrial production, and for aeronautical telemetry applications. In Germany the band is used by broadcasters and other programme producers as the core band, enabling them to meet the basic demand for spectrum for wireless cameras, regardless of short-term assignments, at any time and place.

It has already been decided to have the band investigated again by an ECC project team on the basis of maintaining and taking into account the current applications. The project team is to complete its work by the first half of 2014.

5.3.8 2.6 GHz

The 2500 MHz to 2690 MHz band has already been designated for wireless access on a national basis. The 2010 auction saw the award of frequencies to the volume of 2 x 70 MHz (paired) and 1 x 50 MHz (unpaired). The rights of use are due to expire on 31 December 2025.

5.3.9 3.4 − 3.6 GHz and 3.6 − 3.8 GHz

The frequencies in the band at 3.5 GHz have been assigned, paired, for stationary and nomadic broadband wireless access (BWA). 7 MHz was set as the basis for channel bandwidth and frequency spacing, with aggregation or subdivision of channels being possible. Since then the band has been designated for wireless access on a service and technology-neutral basis.

By decision of the President's Chamber in 2006 the frequencies in this band were awarded on a regional basis in four packages of 2 x 21 MHz (paired) each. The outcome was that the first three packages were awarded for nationwide use. The Chamber's 2008 decision ruled that the fourth package would be made available, on application, for regional or local use. It should be noted that since 1999 spectrum has also been assigned regionally for wireless local loop (WLL) in this band (in the third and fourth packages).

A modification of the technical parameters is currently under international discussion. The ECC has adopted a modified harmonisation decision, ECC/DEC/(11)06 for MFCN (mobile/fixed communications networks), which identifies the entire band at 3400 − 3800 MHz for unpaired applications and also allows paired uses in the band at 3400 − 3600 MHz, largely on the basis of existing assignment situations.

The corresponding technical usage parameters (BEM) are at present in development. It became necessary to modify them because the currently effective parameters were established for point-to-multipoint applications and are not ideal for "fully mobile" use. Furthermore, they are still based on a 7 MHz channel spacing, whereas the latest systems usually operate with multiples of 5 MHz. Decision 2008/411/EC of the European Commission is due to be modified after completion of this work, which is underpinned by a mandate from the EU Commission to the CEPT. The planned completion date is November 2013.

In the 3.7 GHz band spectrum has not only been designated for wireless access. There are also designations for satellite communications service links in the fixed-satellite service. Because of the frequencies used nationally in this band and existing adjacent uses for satellite communications, these frequencies are currently only available locally or regionally (see Order 1/2009, published in the Bundesnetzagentur's Official Gazette 3/2009).

5.3.10 Further frequency bands

Apart from the frequency bands which either have been already identified or are under specific investigation in respect of harmonisation, and for which the regulatory framework can be expected to be sufficiently stable in the foreseeable future, other bands have also been proposed, which have currently only been suggested at international level by isolated parties. These are the bands 1375 – 1452 MHz (in addition to 1452 – 1492 MHz), 2200 – 2300 MHz, 2700 – 2900 MHz and 3800 – 4200 MHz. It can be assumed that the European and global preparations for WRC-15 will see a fair number of modifications and also further proposals. These proposals will first need to be discussed at international level.

5.4 Summing up

The current assessment is that the availability of spectrum for mobile services and wireless access in the short and medium to long term will be as follows:

As from 2017 the frequencies in the 900/1800 MHz bands (previously the GSM frequencies)

will again be available for use for wireless access. These frequencies can be made available to the market in the short term with a view to ensuring the necessary planning and investment certainty for renewed use of the spectrum. Thus it will be possible for the frequencies to be employed for new, efficient technologies and innovative broadband applications in ways that make economic sense and accord with the federal government's broadband strategy.

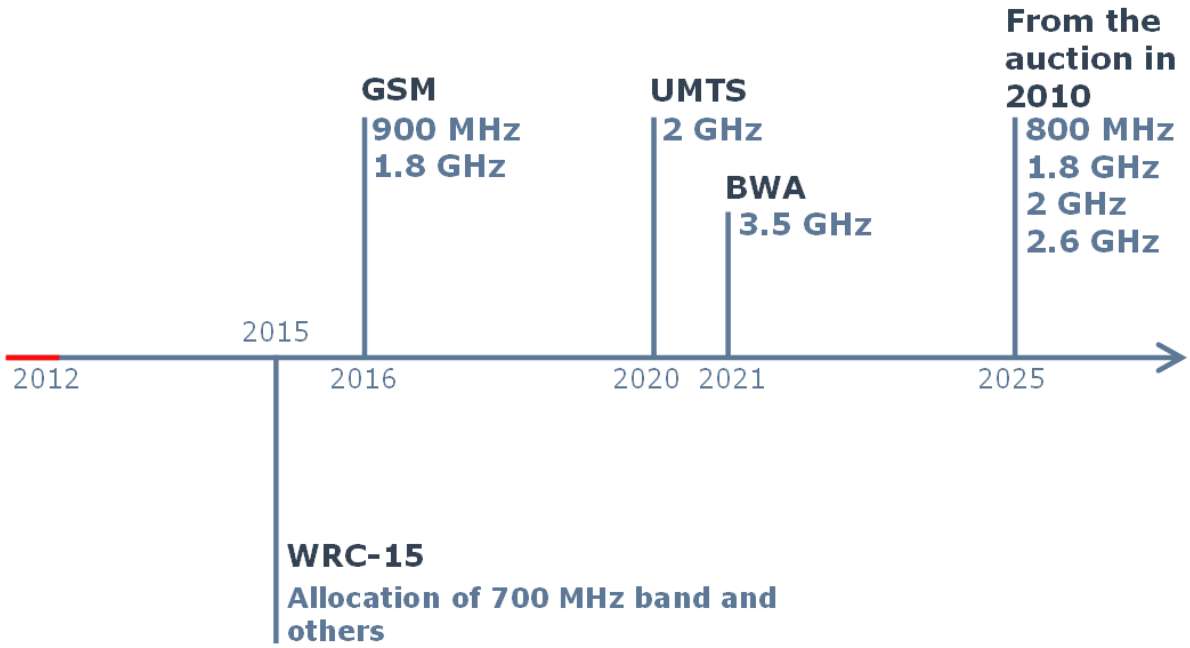
On top of that, further frequencies could be provided for wireless access at more or less the same time. The frequency bands currently under specific consideration, nationally and internationally, are 694 − 790 MHz and 1452 − 1492 MHz. According to current estimates and experience with the award of the 800 MHz frequencies it would seem entirely possible to advance the development and rollout of high-performance networks, provided spectrum is made available in timely manner and all possible means of acceleration are employed, and thus to supply consumers, including consumers in rural areas, with mobile broadband applications, as required by the broadband strategy.

In the medium term, in addition to the frequencies mentioned above, others will become available in the 2 GHz and 3.5 GHz bands. The rights of use formerly awarded for UMTS in the 2 GHz band and those awarded for BWA in the3.5 GHz band are due to expire in 2020 and 2021 respectively, and after those dates will be available for wireless access applications. These frequencies are also to be provided in timely manner to ensure market players will have the planning and investment certainty needed for renewed use.

Furthermore, alongside the frequencies already identified - such as the 700 MHz band or the 1452 − 1492 MHz band - , further spectrum will possibly be identified for wireless access. The targets laid down by the RSPP provide for spectrum of at least 1200 MHz to be made available in Europe for applications of wireless access for broadband services, so as to achieve the greatest possible broadband speeds and capacities. The 400 MHz to 6 GHz band is already under consideration at international level not only for wireless access but for other radio applications as well (such as PMSE, PPDR, etc).

In the longer term, the rights of use auctioned in 2010 for the bands at 800 MHz, 1800 MHz, 2 GHz and 2.6 GHz will again be available for wireless access as from 2026.

The figure below represents the availability time frame:



6 Scenarios

The analysis paper (Project 2016), as part of the BK1-11/003 proceedings (published in the Bundesnetzagentur's Official Gazette no 8/2012 of 2 May 2012, Communication no 275/2012 and on the website www.bundesnetzagentur.de/DrahtloserNetzzugang) gave interested parties the opportunity to present facts and forecasts on future developments for wireless access in the short and medium to long term and to set out their estimates of the spectrum volume that would then be necessary. The gist of the points made by respondents in this connection is recorded below (and published on the website www.bundesnetzagentur.de/DrahtloserNetzzugang):

Most of the respondents welcomed the consideration given to further market trends and the demand for broadband radio-based applications as criteria for identifying spectrum requirements for wireless access as from 2017 in the 900 MHz and 1800 MHz bands. In the medium to long term, they felt, it would be necessary to assess the various bands as a whole and to include all potentially available and suitable frequencies in the 470 MHz to 3.8 GHz range. Staggering a number of award or assignment proceedings at short intervals in line with successive expiry times for frequency assignments (expiry of GSM assignments in 2016, UMTS in 2020, BWA in 2021, the 2010 auction in 2025 and possibly other expiry times (outcome of WRC-2015) was not thought to be advisable. The exponential growth of mobile data traffic resulting from the increasing use of mobile broadband services necessitated a frequency policy that took the long view.

For the short term, however, the market players made a point of demanding the soonest possible extension and flexibilisation of the frequencies in the 900 MHz and 1800 MHz bands for a reasonable period, regardless of the question of the scarcity of these frequencies.

The terms of the Chamber's demand identification proceedings require it both to assess the notified requirements and to tailor its decision to future market and technological trends, so that the market can be supplied with spectrum not only in the short term but also in the medium to long term. The decision must take the regulation objectives into account, giving each of them its due weight.

Particular consideration will have to be given here to the consumer's interest in nationwide broadband coverage and the federal government's goal of accelerating the rollout of high-performance next generation public telecommunications networks. It will be necessary to ensure that decisions on these matters are taken on the basis of guaranteeing fair competition and providing spectrum via open, transparent and non-discriminatory proceedings. The key to giving the proceedings this character is the needs-oriented and efficient provision of all available spectrum in a way that will enhance the procedural and allocation efficiency.

The technical aspects of frequency regulation and the economic aspects - more precisely, principles of competition - will also have to be taken into account. The Chamber has applied the following general criteria to the provision of spectrum:

- Provision of spectrum for wireless access in 5 MHz blocks: This can be steered so as to promote the use of new technologies for supplying consumers with mobile broadband services; also to satisfy current demand for services using existing technologies.

- The frequencies are available for nationwide use and for wireless access on a technology-neutral basis.

- Expiry of spectrum usage rights: Under section 55(9) of the TKG frequencies are awarded for a specified period. To date the periods set for mobile services have been 15 and 20 years.

- Imposition of a coverage obligation under section 61(3) para 4 of the TKG.

- Where appropriate, other regulatory measures, such as the imposition of a spectrum cap in cases where the regulation objectives set forth in section 2 of the TKG make this requisite.

- Ensuring that access is granted to spectrum on the basis of equal opportunity and open, transparent and non-discriminatory proceedings.

Various scenarios can be drawn up for the provision of spectrum. The pillars they all rest on are: the requirements of telecommunications law; the demand stated by the interested companies, which in total exceeds supply; the expected medium to long term market and technological trends; and international harmonisation.

6.1 Scenarios: Overview

Scenario 1: Extension

Extension of assignments for 900/1800 MHz

Scenario 2: Award proceedings for 900/1800 MHz

Scenario 3: Award proceedings for 900/1800 MHz plus

Award proceedings for 900/1800 MHz and other frequencies available medium term in single proceedings

Scenario 4: Comprehensive award 2025

The aim is the award of 900/1800 MHz and all other frequencies for wireless access in single proceedings

6.2 Scenarios considered separately:

Scenario 1: Extension

The extension scenario corresponds to the requests of the present holders of the assignments for the soonest possible extension of spectrum assignments in the 900 MHz and 1800 MHz bands. The gist of their argument, with regard to the regulation objectives, is that an extension would do justice to consumer interests, to the commitment to ensure provision of infrastructure and to the dictates of efficient use of spectrum. They consider a period of up to about 2020/2025 to be reasonable. The extension scenario is thus based on a somewhat limited view of the future when set against market, technological and international trends.

The extension scenario sets out a conceivable regulatory option provided for in section 55(9) of the TKG. Under this section a limited-term assignment should be extended if the conditions defined for spectrum assignment in section 55(9) of the TKG are present. The main condition is the existence of a sufficient amount of available spectrum, though, under section 55(10) of the Act, an extension is not in principle ruled out when spectrum is scarce. Only last year the Federal Administrative Court decided (BVerwG judgement of 26 November 2011, 6 C 2/10) that in exceptional cases spectrum could be assigned without need of award proceedings if so required by the regulatory objectives as defined in section 2(2) of the TKG.

Taking the notified requirements as the point of departure, the plus points of the **extension scenario** that deserve special emphasis are:

- From the viewpoint of the present right holders, an extension of their assignments would be the quickest solution.
- Extension would ensure certainty of planning and investment at the earliest possible date.

On the other hand, however, the **extension scenario** would have to take the following into account:

- The extension of assignments can basically be considered when there is no scarcity of spectrum. According to the case law rulings of the Federal Administrative Court, an individual frequency assignment can, by way of exception, be considered only if the regulatory objectives cannot otherwise be achieved. On the principle of equitable and non-discriminatory access to spectrum, extension would seem to have a less secure legal base.
- The extension of the limited terms set for the current rights of use would in principle perpetuate the present fragmentation of assignments.
- Extension does not make it possible for all interested undertakings to have equitable access to spectrum resources.

Scenarios for award proceedings

The scenarios for award proceedings define the regulatory options in accordance with sections 55(10) and 61 of the TKG. Under these provisions the Bundesnetzagentur can require the assignment of spectrum to be preceded by award proceedings in the event of frequencies not being available for assignment in sufficient numbers.

Under section 61(2) sentence 1 of the TKG the basic rule is for auction proceedings to be held as required by section 61(4) of the Act unless such proceedings are unsuitable for ensuring the regulatory objectives are attained.

The terms of the forecast decision referred to in section 55(10) sentence 1, 1st alternative, of the TKG require the Chamber to investigate the relevant circumstances in depth and then take into account all the facts which will serve to identify the availability of sufficient spectrum at the time it is to be awarded. Among the factors to be considered are existing rights of use, their current technical application, foreseeable technological and market trends, and developments related to the harmonisation of spectrum use.

With regard to the availability of spectrum at the time of a possible award, the Chamber has identified the initial courses of action for award proceedings. The options here take as their parameters the requirements notified by the interested undertakings and the expiry of the spectrum assignments for wireless access and would lead to the harmonisation of further frequency bands for wireless access.

Scenario 2: Award proceedings for 900/1800 MHz spectrum

A large number of respondents call for the quickest possible decision on the renewed use of these frequencies, so as to preclude any unnecessary regulation-based uncertainty during the present market phase. The mobile operators make a particularly strong call for the fastest possible assignment and flexibilisation, in the short term, of the spectrum in the 900 MHz and 1800 MHz bands. On the other hand some respondents make the point that in the long term it is not productive for the 900 MHz and 1800 MHz frequencies to be considered in isolation. On the contrary, available spectrum should be taken as a whole, since they feel it is imperative to shape the general framework in such a way that further new and existing bands could also be incorporated in the assessment and analysis.

The 900 MHz and 1800 MHz frequencies could be made available for the short term - that is, with a sufficient time gap before expiry of the current spectrum assignments - via award proceedings conducted under sections 55(10) and 61 of the TKG .

Since frequency requirements are likely to rise because of the massive growth of demand for high-transmission-rate data services and the aims of the broadband strategy – ie nationwide provision of 50 Mbit/s services – it is clear that the scenario for the award of 900/1800 MHz spectrum tends to look at the long term for the implementation of the broadband strategy and achievement of the aim of accelerating the rollout of high-performance telecommunications networks.

What is not taken into account in this connection is that further spectrum will be available just four years after the expiry of the frequency assignments. For example, the frequency assignments auctioned in 2000 for UMTS in the 2 GHz band are due to expire in 2020. In addition, further frequency bands for mobile services above and below 1 GHz (eg the 700 MHz band or the 1452 − 1492 MHz band) are currently under discussion, nationally and

internationally, at various stages of processing. If spectrum in the various frequency bands were to be awarded separately at different times, this would mean having a series of proceedings at short intervals. Staggering the various proceedings in this manner could generate the risk of a regulation-induced scarcity, and this could affect the value of the frequencies involved. Separate awards would make it impossible to take the interdependence of values as among the various frequency bands into account. Consequently there would not be the requisite certainty of planning and investment - which is also demanded by the respondents - for the establishment and rollout of sustainable high-performance networks.

In view of the above, common ground needs to be found for the respondents' interest to have the quickest possible planning certainty with regard to the assignment of the frequencies in the 900/1800 MHz band on the one hand, and their demand for the various frequency bands to be considered together as a whole and/or to include all available and suitable frequencies – suitable for both carrying high capacity and covering rural areas – for broadband wireless access, on the other.

The plus points of the scenario for the award of 900/1800 MHz spectrum that deserve special emphasis are:

- Spectrum in the 900/1800 MHz frequencies would be awarded at an early stage in open, transparent and non-discriminatory proceedings, ie about three years before expiry of the rights of use.

- New market players would be given an opportunity at an early stage to enter the growing broadband sector.

On the other hand the scenario for the award of 900/1800 MHz spectrum would have to take the following into account:

- The relatively small quantity of spectrum would possibly necessitate a number of regulatory measures to secure the objectives of regulation (eg spectrum capping in the 900 MHz and the 1800 MHz band).

- Regulatory measures would possibly be required in order to prevent strategic bidding or collusion.

- The potential for suitable further frequency resources for nationwide broadband rollout would not be provided in time, which could jeopardise the aims of the federal government's broadband strategy for the time frame of 2018.

Scenario 3: Award proceedings for 900/1800 MHz plus

The basic idea of the scenario 900/1800 MHz plus is to include in the award proceedings frequencies which will become available in the foreseeable future, so as to enable assignment holders to acquire adequately competitive frequency packages. The scenario therefore envisages the provision not only of 900/1800 MHz spectrum but also of other frequencies, for example from the bands at 2 GHz, 3.5 GHz and, where appropriate, even 700 MHz and 1452 − 1492 MHz (see point 5.4).

Apart from the GSM frequency assignments which are due to expire in 2016, other assignments, which are also used or usable for mobile broadband services, will expire in the foreseeable future.

The assignments in the 2 GHz band which were auctioned in 2000 for UMTS/IMT 2000 will reach their date limit on 31 December 2020. Much the same applies to the 3.5 GHz band, which is also available for wireless access and most of whose assignments (1st to 3rd packages) will expire on 31 December 2021.

Moreover, according to currently available information it is highly likely that further frequency bands below and above 1 GHz will be identified for wireless access at the international level. It was decided at WRC-12 that a co-primary mobile services allocation in the 694 − 790 MHz sub-band of the 470 − 790 MHz band would come into force immediately after the next conference in 2015, and that in the period until then the globally relevant parameters for use would have to be ascertained. Like the 800 MHz frequencies assigned at the 2010 auction, these frequencies are particularly well suited to meeting the forecasted nationwide demand for mobile broadband.

The 1452 to 1492 MHz band is also currently under international consideration for wireless access via a supplementary downlink for mobile broadband. Subject to a harmonised ECC decision to the necessary effect, this would make another 40 MHz (unpaired) available for mobile broadband services.

This scenario would make a total volume of about 500 MHz available for assignment, at times staggered to match the various times of usability

Frequency band	**Spectrum in MHz**		**Availability**
900/1800 MHz (prev. GSM)	880-915/925-960 1710-1785/1805-1880	2 x 35 2 x 50	as from 2017
2 GHz (prev. UMTS)	1920-2170	2 x 40	as from 2021
3.5 GHz (prev. BWA)	3410-3494/3510-3594 poss. 3400-3600	2 x 63 or 1 x 160	as from 2022
Other frequency bands currently under consideration			
700 MHz	694-790 Lower band edge under discussion		Agenda item at WRC-15
L-Band	1452-1492	1 x 40	
	Total spectrum:	**approx. 500 MHz**	

Table 5

The two frequency bands (694 − 790 MHz and 1452 − 1492 MHz) and, where appropriate, other frequencies could be incorporated in the award proceedings if, at the time of awarding, the required legal and technical conditions have been met at a sufficiently stable level. This will be dependent in particular on agreement having been reached on amendments to the frequency ordinance and the frequency plan for the 700 MHz band.

The provision of additional frequency resources could make a contribution to attaining the political objectives of the federal government's broadband strategy. The physical propagation conditions present in frequencies below 1 GHz could bring about a further improvement of coverage especially in rural regions and thus help to achieve the federal government’s objectives.

The plus points of **scenario 900/1800 MHz plus** that deserve special emphasis are:

- No award proceedings at brief intervals and therefore no risk of scarcity resulting from regulation.
- Joint awards can give more effective consideration to the interdependence of values as between the various frequency bands.
- Implementation of frequency requirements in accordance with the various business models is made easier.
- Equitable access to frequency resources is made easier for new market players.
- Enhanced planning and investment certainty for network operators over longer periods.
- The inclusion of additional frequencies, particularly those under current international discussion, could constitute an important contribution to the achievement of the broadband objectives.

On the other hand **scenario 900/1800 MHz plus** would have to take the following into account:

- The spectrum would actually be usable/available at different times.
- A basis in planning law would have to be established for the additional frequencies for wireless access. Aside from the requirement of legal and technical stability, a solution would also have to be found for competing requirements in the frequency bands concerned (eg BOS and PMSE).

As regards the time frame the Chamber sees a number of possible options for this scenario.

Exhaustion of all available means of acceleration would create a dual option: on one hand the quickest possible award of the 900/1800 MHz frequencies and the rights of use in the 2 GHz and 3.5 GHz bands which are due to expire in 2020/2021, and on the other the inclusion in the award proceedings of further frequencies, in particular those currently under international consideration.

With regard to the frequency assignments in the 900/1800 MHz bands due to expire on 31 December 2016 the Chamber has already advised, in its flexibilisation decision (BK 1a-09/001), that decisions on the renewed use of time-limited assignments should be taken in good time before their respective expiry dates, so as to ensure the undertakings have a sufficient degree of planning and investment certainty.

To provide this certainty at the earliest possible date it would be necessary to award the above-stated frequencies before the expiry of the GSM assignments. The Chamber believes that its decisions should be taken as soon as possible, so as to ensure the interested undertakings have the required certainty for their planning and investment. This option also takes the comments on the flexibilisation decision and the demand identification proceedings into account.

Section 53(1) of the TKG empowers the federal government to stipulate frequency allocation at national level and to issue further related determinations. It is thus authorised to allocate spectrum, to transpose the relevant results of the WRC into an ordinance, which it may then

supplement as required, and to put European and national framework requirements into effect. According to the explanatory memorandum to number 49 (section 53 TKG 2012, Bundestag printed paper 17/5707, page 71), this process "is to be transparent for potential users of the frequency planning, so that economies of scale and global technological trends can be translated into business policy effect in timely manner". Under section 53(1) sentence 2 of the TKG the frequency ordinance is subject to the approval of the German Bundesrat. Sentence 3 of the same subsection requires all persons likely to be affected by the spectrum allocations to be included in the preparation.

During the process of amendment of the TKG the federal government and the federal states dealt with the question of the future use of further "previous broadcasting frequencies" (see transcript 892 of Bundesrat plenary proceedings, page 4 ff). The record shows that both bodies committed themselves to the nationwide rollout of broadband infrastructure. Their intention for the digital future is to work together on the basis of trust with a view to enabling the opportunities offered to be used in a rational manner. During a session of the Bundesrat in February 2012 the federal government issued the following statement for the record:

> *"With regard to the award – and particularly the auctioning – of frequencies which in the past were allocated to the broadcasting service, the federal government herewith undertakes to regulate, together with the federal states, the distribution of proceeds between itself and the federal states on the basis of mutual agreement before the frequency ordinance is passed to the Bundesrat for its approval. The federal government is aware that the federal states assume the proceeds will be divided fifty-fifty after deduction of the costs caused by changes."*

It is reasonable to suppose that this statement took account of a major concern of the federal states in the context of their responsibility for the frequency ordinance. Against this background it seems possible that a WRC decision will be implemented in the frequency ordinance, and that consequently a binding decision on the availability and award of these frequencies for wireless access - and thus for a nationwide rollout of broadband in Germany - can be taken in timely manner.

The Bundesnetzagentur has also identified potential for speeding up proceedings. For this scenario, the President’s Chamber could, before the end of 2013, present for discussion a draft decision on the award of spectrum in the 900/1800 MHz, 2 GHz, 3.5 GHz bands and other frequencies. The inclusion of the frequencies under discussion would be possible at such time, even if not all the decisive parameters for later, specific use had been determined. For the purposes of frequency regulation it is necessary, but also sufficient, that the spectrum to be offered can be given a specific value before it is awarded.

By taking these proactive measures the Chamber can do so much preparation of the essential phases of the proceedings that, once the conditions required under planning law have been met, the spectrum can be made available for use at the earliest possible date. The rapid award of frequencies sought by this scenario is conditional on as many activities as possible being carried out at the same time, and also on brisk and intensive collaboration by all the parties involved. It is certainly possible to speed up proceedings if all those involved act purposefully and in concert.

The effect of including the 700 MHz, 1452 - 1492 MHz, 2 GHz and 3.5 GHz spectrum in the proceedings could be to supply the market, at the earliest possible time, with planning and investment certainty as regards the medium-term availability of spectrum for broadband rollout in Germany. This would make it possible for extensive account to be taken of developments relevant to future broadband systems at an early date - thus even before expiry of the rights of use.

If the domestic allocation of the frequency bands under international consideration only takes place after completion of decision procedures at ITU and EU level, that is as a subsequent step, then the bands could only be awarded after 2015.

On the other hand this procedure would not be compatible with the time frame of the federal government's broadband strategy. The progressive passage of time brings a decline in the contribution which radio spectrum - particularly frequencies below 1 GHz - can make to the realisation of the objective of providing users throughout the country with high-bit-rate broadband connections by 2018.

It is true on the one hand that the award of spectrum, for example up to 2018, would more or less coincide with the expiry of the spectrum assignments in the 2 GHz band (UMTS) and 3.5 GHz (BWA). This course of action was also called for by some respondents in light of possible imponderables related to market and technological trends. On the other hand the earliest possible award delivers the maximum amount of foreseeability of spectrum regulation and thus creates the necessary - but also sufficient - framework for planning and investment certainty as the basis for entrepreneurial decisions.

The award of the 900/1800 MHz and other frequencies, for instance in the period up to 2018, would entail a high level of uncertainty of planning and investment with regard to renewed use after 2016. Extension of existing rights of use for the 900/1800 MHz spectrum would therefore have to be included in the process of Chamber decisions on award proceedings because - as some of the respondents pointed out - the phasing out of GSM uses is only expected as from 2020 and thus there will continue to be consumer demand for GSM services.

Against this background it is imperative, from the viewpoint of the consumer, for the renewed use of the 900/1800 MHz spectrum to follow without interruption. The President’s Chamber would therefore, if the spectrum were awarded eg until 2018, have to plan and realise the required extension of these spectrum assignments by regulatory means in the run-up to an auction.

In the case of spectrum scarcity the scope for action under the law is defined by section 55(10) of the TKG, which lays down that award proceedings may be ordered under section 61 of the Act. According to this section an extension of spectrum assignments is not in principle excluded, in the case of scarcity as well. Only last year the Federal Administrative Court decided (BVerwG judgement of 26 November 2011, 6 C 2/10) that in exceptional cases spectrum could be assigned without need of award proceedings if so required by the regulatory objectives as defined in section 2(2) of the TKG. When set against the other options that have been described for the possible timely award of the spectrum, it seems more than doubtful that an extension can meet the requirements of the objectives of regulation.

Scenario 4: Comprehensive award 2025

Scenario 2025 sets out options for translating the rights of spectrum use in the 900/1800 MHz bands into "comprehensive award proceedings". Comprehensive award proceedings would enable all the frequencies for wireless access in the range from about 400 MHz to 4 GHz to be made available together.

The aim of comprehensive award proceedings is to make the proceedings and the allocation of spectrum more efficient. The simultaneous provision of all wireless access frequencies in the range from about 400 MHz to 4 GHz (making a possible total of around 1200 MHz) would enable both the mobile operators already on the market and new market players to acquire

the best possible spectrum packages. It should also be remembered that the amount of spectrum made available can influence frequency costs. This would promote competition in the telecommunications networks and services sector, with resulting benefits for the consumer.

Under scenario 2025 the expiry dates for the assignments of spectrum provided as a single whole would also in future be set on a uniform basis. The frequencies designated for wireless access would then, depending on the expiry dates set, be made available in comprehensive award proceedings. This could result in a higher degree of planning and investment certainty for the spectrum users. It should however also be noted that the acquisition of rights of use by a market player is crucially dependent on the undertaking's economic situation at the time of the comprehensive award proceedings and on the actual results of the proceedings. The market situation which ensued would be set in stone for the full term until expiry of the relevant assignments.

The provision of all national spectrum designated for mobile use was put into effect in Switzerland in February 2012 in the course of single, comprehensive proceedings. In these proceedings frequencies which became available at various times between the auction date and 2017 were awarded with a single, uniform term ending in 2028.

Hitherto the Chamber's approach has been to make spectrum available in single proceedings, insofar as possible and required by the regulatory remit, so as to avoid a series of proceedings at short intervals. On the other hand the President’s Chamber believes that a certain staggering of the times the spectrum is provided - which also entails staggered terms of assignment validity - is more likely to enable market players to align their business models to market and technological trends.

The precondition for scenario 2025 is, first, the standardisation of the expiry dates for the rights of use, which are currently at various times between 31 December 2016 and 31 December 2025. This will also apply to possible additional frequencies which are designated for, or set to be designated for, wireless access and which are already under international consideration and discussion for the relevant applications. It would also be necessary to harmonise the dates of initial provision of these frequency bands or - if they were made available in the period up to 2025 - their expiry dates. Following that, all frequencies for wireless access could be made available, in single proceedings, on the basis of uniform time limits. Such comprehensive award proceedings would have to take place in good time before the expiry of rights of use on 31 December 2025, so as to give network operators certainty for their planning and investment. The award proceedings could conceivably be conducted by 2023.

Frequency band	**Spectrum in MHz**		**Availability**
800 MHz	791-821/832-862	2 x 30	as from 2026
900 MHz	880-915/925-960	2 x 35	as from 2017
1800 MHz	1710-1785/1805-1880	2 x 50 2 x 25	as from 2017 as from 2026
2.1 GHz	1920-1980/2110-2170	2 x 40 2 x 20 1 x 15	as from 2021 as from 2026 as from 2026
2.6 GHz	2500-2690	2 x 70 1 x 50	as from 2026

Frequency band	**Spectrum in MHz**		**Availability**
3.5 GHz	3410 – 3473 MHz and 3510 – 3573 MHz	2 x 63 or 1 x 200	as from 2022
	3473 – 3494 MHz and 3573 – 3594 MHz, smaller frequency blocks assigned regionally or locally		as from 2023
3.7 GHz	3600-3800, smaller frequency blocks assigned regionally or locally	1 x 200	as from 2023
Other bands currently under discussion			
700 MHz	694-790 (lower band edge not yet determined)		See agenda item for WRC-15
L-Band	1452-1492		as from 2019
2.1 GHz (MSS)	1980–2010/2170–2200	2 x 30 or 1 x 60	as from 2027
Other bands where appropriate			
	Total spectrum:	**approx 1200 MHz**	

Table 6

The plus points of scenario 2025 that deserve special emphasis are:

- As from 2025 no award proceedings at brief intervals of time and thus no risk of scarcity resulting from regulation.
- A collective award can give more effective consideration to the interdependence of values as between the various frequency bands.
- Implementation of frequency requirements in accordance with the various business models is made easier.
- Equitable access to frequency resources is made easier for new market players.
- Enhanced certainty of planning and investment for network operators over longer periods.

On the other hand scenario 2025 would have to take the following into account:

- In particular with reference to new frequencies available for wireless access, it cannot at present be foreseen when and under what specific conditions these frequencies will be usable. Consequently terms lasting until 2025 would possibly not in fact be appropriate for actual use, which could prevent efficient use of the spectrum.
- Equal access for new market players in the broadband sector that is now emerging would become considerably more difficult or even actually excluded.

- Risks would result for all the undertakings involved (potential newcomers and mobile operators) in terms both of competition and economics. For example, a comprehensive award would in principle require them to invest all their funds at one time (for frequency costs and network costs).

It is possible to harmonise the currently existing time limits by extending them or by auctioning with a time limit of 2025. Scenario 2025 thus allows for two different options.

The duration of the current spectrum assignments could conceivably be harmonised by extending all assignments to 31 December 2025. Additional frequency bands allocated or designated for wireless access (at present the 470 - 790 MHz band / L-band / MSS-2-GHz band are under international discussion) could be made available with a time limit of 31 December 2025.

The harmonisation of all the expiry dates by means of extension would mean the current assignment holders had varying periods of use. For example, an extension of the assignments in the 900 MHz and 1800 MHz bands which are held under the GSM licences would result in an extra assignment period of nine years. An extension in the 3.5 GHz band for broadband wireless access (BWA), by way of contrast, would mean an extra assignment period of only four years.

As was explained in connection with the extension scenario, according to the case law rulings of the Federal Administrative Court an extension in case of scarcity can only be considered, in exceptional cases, if the regulatory objectives cannot otherwise be attained.

On the other hand the time limits of the current spectrum assignments could also be harmonised by making available, at joint and collective award proceedings, all the assignments which are due to expire before 2025. For this purpose the various frequency bands would have to be given the same expiry date, namely 31 December 2025.

The spectrum at 900 MHz/1800 MHz, 2 GHz and 3.5 GHz already assigned and other frequency bands currently under international investigation and discussion for wireless access could be made available at different times owing to the existing assignment or allocation periods, though also with this procedure spectrum would be awarded jointly. Reference should be made here to the comments on the 900/1800 MHz plus scenario. Use of this procedure would thus involve awarding the 900/1800 MHz frequencies together with other frequencies.

The periods of use of the assignments due to expire on 31 December 2025 would also differ widely. For instance, there would be an assignment period of only four years in the 3.5 GHz band for broadband wireless access (BWA). If the spectrum was obtained at auction by a user other than the previous one, this would cast doubt on the establishment of network infrastructure and thus on the efficient use of the spectrum.

A convergence of spectrum usage rights by 2025 was also called for by some of the respondents. However, with short assignment periods it would not be possible to create an adequate framework of planning and investment certainty for entrepreneurial decisions.

7 The next steps

Interested parties are herewith invited to comment on the scenarios.

On the basis of the results achieved so far in the demand identification proceedings and the comments on the scenarios paper, the President's Chamber will draft the proceedings for the assignment of spectrum and present its draft for comment.

The next step planned by the Chamber is to present a draft decision on the future granting of spectrum usage rights for public consultation.