”Frequenz-Kompass”

New frequencies for further roll-out of digital infrastructures

In April this year the Bundesnetzagentur held a public consultation to examine the post-merger spectrum distribution in the 2 GHz band (http://www.bundesnetzagentur.de/mobilebroadband) resulting from the merger of Telefónica and E-Plus which shifted the distribution of spectrum between the mobile network operators.

The comments received addressed several regulatory areas of action. Individual corporate interests appeared to be closely related to questions concerning non-discriminatory spectrum distribution and the future use (re-allocation) of frequencies in the 2 GHz band. Furthermore they were also related to various aspects of access by service providers/MVNOs and new entrants.

The spectrum distribution examination and the need to incorporate this examination in an objective, transparent and non-discriminatory procedure for the provision of spectrum in line with demand suggest that the current and future frequency regulation framework for further roll-out of an efficient digital infrastructure for the society and economy should be re-assessed and structured along more forward-looking lines.

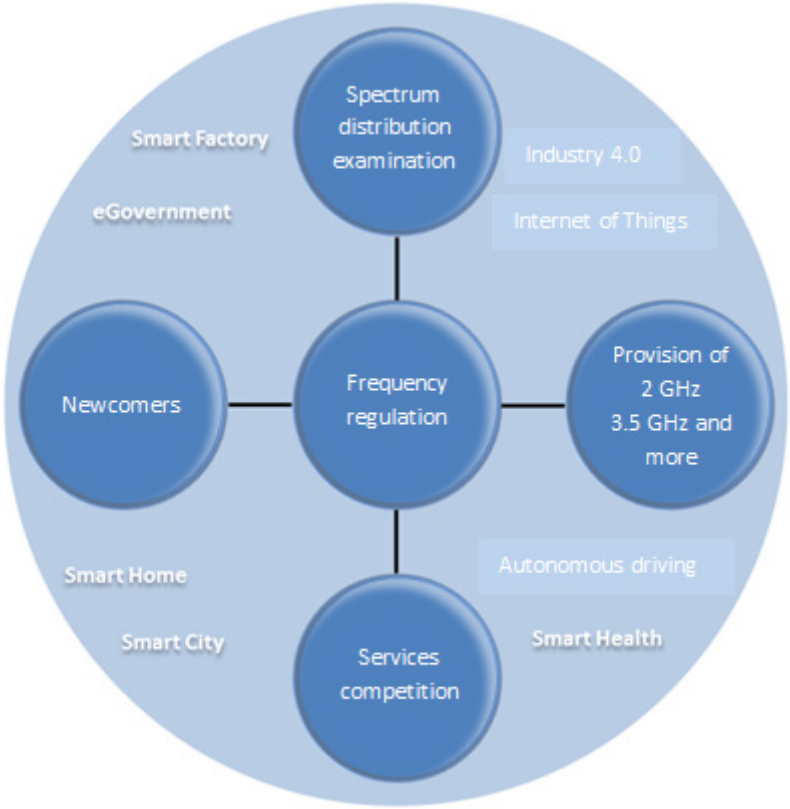
The Federal Ministry for Economic Affairs and Energy stated in its Digital Strategy 2025 that it aimed to

> *"create a viable digital infrastructure that can support the triple requirements of high capacity, broad availability and low latency."*
>
> (BMWi, Digital Strategy 2025 (Digitale Strategie 2025), p. 13)

In its guideline on network expansion (*Kursbuch Netzausbau 2016*) drawn up by the initiative "Network Alliance for a Digital Germany", the Federal Ministry of Transport and Digital Infrastructure drew attention to the fact that Germany is facing the challenge of having to create the necessary infrastructures to meet the growing demands of the gigabit society. The guideline states that the increasing convergence of cable-based and mobile applications leads to more stringent requirements regarding the appropriate provision of spectrum, especially for 5G[1].

The Bundesnetzagentur's “Frequenz-Kompass” gives assignment holders and interested parties an overview of the diversity of interests in the mobile sector and the related areas in which action is required.

[1] Cf. BMVI, Kursbuch Netzausbau 2016, p. 37



The Bundesnetzagentur has identified the following areas for action, paying special attention to the identification of spectrum demand and corporate concerns and giving due consideration to the provision of the 2 GHz spectrum in an objective, transparent and non-discriminatory manner:

Spectrum distribution examination	complete examination	objective procedure	
Provision of 2 GHz	identify requirements	identify requirements for 5G	objective procedure
Provision of 3.5 GHz and additional spectrum	identify requirements	identify requirements for 5G	objective procedure
Service providers MVNOs	identify corporate interests	evaluate access rules	objective procedure
Newcomers	identify corporate interests	evaluate newcomer rules	objective procedure

Examination of spectrum distribution

- complete examination
- objective procedure

In the President's Chamber decision on the Telefónica/E-Plus merger (BK1-13/002 of 4 July 2014, Order No. 38/2014, Bundesnetzagentur Official Gazette 13/2014 of 23 June 2014, pp. 1645 ff) the Bundesnetzagentur announced that promptly after the re-allocation of the 900/1800 MHz bands it would refocus on the 2 GHz range and – if necessary – take steps to avoid discrimination in spectrum distribution resulting from the merger.

In December 2015 after the 2015 spectrum auction the Bundesnetzagentur gave the assignment holders the chance to submit their views on the merger-related spectrum distribution, especially the 2 GHz band, from a factual, business and legal perspective. On 7 March 2016 the mobile network operators and interested parties were asked key questions on the public consultation (Communication No. 228/2016, Bundesnetzagentur Official Gazette 5/2016 of 16 March 2016, pp. 666 ff).

The responses revealed diverse corporate interests. Most respondents felt that at the time there was no need for regulatory action with regard to the distribution of spectrum. One respondent called for a redistribution of spectrum in the 2 GHz band and drew attention to the possible extension of the allocation period to 2025. Also addressed was the issue of encouraging competition at services level and the need to bear in mind the possibility of another mobile network operator (new entrant) requesting access.

Having reviewed the responses, the Bundesnetzagentur is currently of the opinion that no further clarification of the status quo is required. However, before the spectrum distribution examination can be completed, the fact that many of the 2 GHz spectrum licences expire at the end of 2020 and that this spectrum should be re-allocated in an open, transparent and objective procedure needs to be considered - an issue also raised by the respondents.

Taking future developments into account, the Bundesnetzagentur deems it expedient to consult interested parties on initial aspects of spectrum re-allocation in the 2 GHz band prior to completing the examination.

2 GHz provision

- identify requirements
- identify additional frequencies for digital infrastructures
- objective procedure

Once current rights of use expire, the paired 2 GHz spectrum will again be available in 2021:

paired 2 GHz spectrum	licence expires
1920.3 - 1930.2 MHz/2110.3 - 2120.2 MHz (2 x 9.9 MHz)	31 Dec. 2020
1930.2 - 1940.1 MHz/2120.2 - 2130.1 MHz (2 x 9.9 MHz)	31 Dec. 2025
1940.1 - 1950.0 MHz/2130.1 - 2140.0 MHz (2 x 9.9 MHz)	31 Dec. 2020
1950.0 - 1959.9 MHz/2140.0 - 2149.9 MHz (2 x 9.9 MHz)	31 Dec. 2025
1959.9 - 1979.7 MHz/2149.9 - 2169.7 MHz (2 x 19.8 MHz)	31 Dec. 2020

Most of the **paired** spectrum in the 2 GHz band is allocated to mobile network operators in UMTS/IMT-2000 licences which expire at the end of 2020. The paired 2 GHz spectrum is currently being used intensively for UMTS.

By having granted the rights of use in the frequency band presently dedicated to public mobile communication services on a technology-neutral basis, the Bundesnetzagentur has already ensured that it will be possible to allocate the spectrum for mobile communication services (including the paired 2 GHz spectrum) to 5G services.

The **unpaired** 2 GHz spectrum has been allocated as follows:

unpaired 2 GHz spectrum	licence expires
1900.1 MHz - 1905.1 MHz (1 x 5 MHz)	31 Dec. 2025
1905.1 MHz - 1920.1 MHz (1 x 15 MHz)	31 Dec. 2020
2010.5 MHz - 2024.7 MHz (1 x 14.2 MHz)	31 Dec. 2025

Use of the unpaired 2 GHz spectrum is no longer earmarked for the provision of electronic communication services and hence no longer available for this purpose at the EU and CEPT level.[2]

- **Objective procedure**

The Bundesnetzagentur aims to finalise its decision on the provision of the above spectrum allocations three years before the expiry of the licences to create planning and investment security for interested parties. The Bundesnetzagentur therefore plans to publish the key elements for the appropriate provision of spectrum for further roll-out of digital infrastructures in the course of the current year to give both current market participants and other interested parties an early opportunity to take part in shaping the procedure necessary for the non-discriminatory provision of the 2 GHz spectrum on a transparent and objective basis.

[2] Commission Implementing Decision (EU) 2016/339 of 8 March 2016, OJ L 63, 10.03.2016, p. 5-8.

3.5 GHz provision and additional spectrum

- identify requirements
- identify additional frequencies for digital infrastructures
- objective procedure

- **3.5 GHz**

The paired 3.5 GHz spectrum has been allocated as follows:

paired 3.5 GHz spectrum	licence expires
3410 - 3431 MHz/3510 - 3531 MHz (2 x 21 MHz)	31 Dec. 2021
3431 - 3452 MHz/3531 - 3552 MHz (2 x 21 MHz)	31 Dec. 2021
3452 - 3473 MHz/3552 - 3573 MHz (2 x 21 MHz)	31 Dec. 2021

The frequencies in the 3410 – 3473 MHz/3510 – 3573 MHz range are effectively allocated to FDD on a nationwide basis.

Frequencies in the range of the “fourth package” are being allocated for regional use (TDD) upon application. The way the fourth package is currently structured, two non-contiguous blocks with 20 MHz each are available in the 3.5 GHz band:

3.5 GHz spectrum (fourth package)		licence expires
3480 to 3500 MHz	3580 to 3600 MHz	31 Dec. 2022

Most of the spectrum in the 3.5 GHz band is available for flexible use and can be deployed for 5G services on a technology-neutral basis in much the same way as the paired 2 GHz spectrum. The spectrum is particularly suitable for the development of pico and micro cells at hotspots and hence for the expansion of networks designed for 5G.

In Europe the bands 3400 – 3600 MHz and 3600 – 3800 MHz have been harmonised for shared use by public mobile communication services and satellite services.

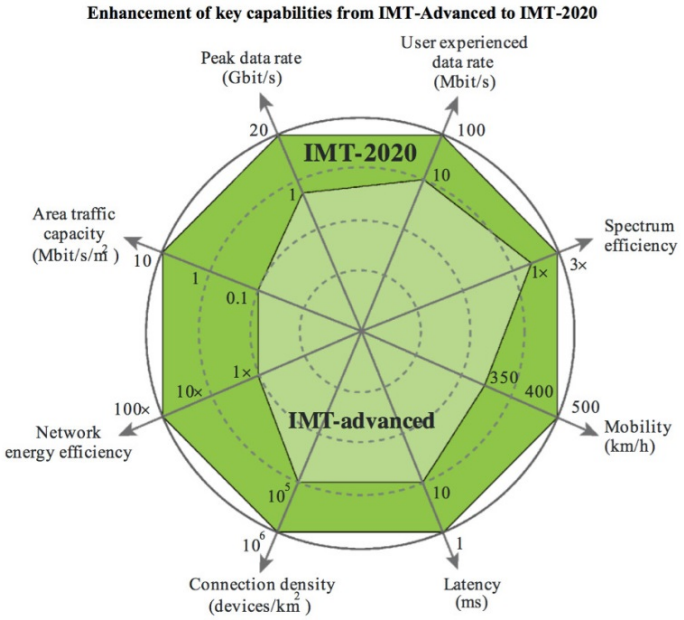
- **Additional spectrum for digital infrastructures (5G)**

In view of society's increasing mobility and its expectation to be able to use innovative digital services independent of location, it is necessary to provide the requisite resources for mobile broadband coverage. The rapid provision of additional spectrum for mobile broadband networks and applications is a vital prerequisite for the success of Industry 4.0 (smart factory), automated driving, the Internet of Things and M2M.

Developing the networks to 5G level will be of prime importance. Nationwide coverage of innovative applications in Germany will be contingent upon a mix of technology and spectrum. This approach also aims to achieve local needs-based coverage by means of highly efficient radio technology. 5G as the next mobile communications generation will offer

a low latency of 1 ms and particularly high peak data rates. It is therefore essential to adopt a forward-looking approach when examining the need for additional frequency bands (e.g. for local networks) for digital infrastructures. Spectrum **above** the bands currently used by mobile communication services could potentially be used as well.

The ITU has drawn up the following overview of the key requirements for 5G and IMT-2020 compared with those for 4G and IMT-Advanced:



(ITU; IMT-2020; Recommendation ITU-R M.2083-0 (09/2015) of 29 September 2015, p. 14)

The ITU-R's World Radiocommunication Conference 2015 took important decisions regarding the use of certain bands for 5G which form an important basis for the ongoing digitisation of many applications (e.g. Industry 4.0, autonomous driving, Internet of Things, M2M) and which have identified potential new bands roughly 30 GHz wide to be investigated for 5G in time for WRC 2019.

Apart from the goals set at WRC 2015 for WRC 2019, viz. to identify additional spectrum for 5G above 24 GHz, certain industry players at the Mobile World Congress in Barcelona in February/March 2016 called for even more spectrum to be made available, e.g. in the 28 GHz band.

The German platform „Digitale Netze und Mobilität“ (Digital Networks and Mobility) had already come to the conclusion in 2015 that wide, contiguous bands would be needed to achieve the data rates promulgated for every single 5G connection, including the areas along the cells' borders, and to be able to provide high cell capacities. Such bands are presently not available in the frequency ranges earmarked for and allocated to mobile communications. The platform went on to state that current mobile radio bands are still being used intensively and will be allocated to 5G services on a flexible basis. Yet it was recognised that there is a need for considerable additional spectrum. Apart from the short-term need for additional

mobile spectrum in the band up to 6 GHz, an issue to be discussed at WRC 2015, the platform also identified a long-term need for new spectrum above 6 GHz[3].

Ever higher frequencies will be needed in the future for sufficient spectrum to be available for dealing with the rise in data volumes and more closely meshed networks. According to the Ericsson Mobility Report published in June 2016, mobile data traffic in Western Europe is expected to grow ten-fold in the 5-year period from 2015 to 2021. For Germany this equates to a rise from 0.6 exabytes (billion gigabytes) to 6 exabytes in 2021. Cisco's Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2015–2020, released in 2016, comes to a similar conclusion.

In line with Resolution ITU-R 238 (WRC-15) the following bands are being investigated:

Candidate band	**Bandwidth**
24.25-27.5 GHz	3.25 GHz
31.8-33.4 GHz	1.6 GHz
37-43.5 GHz	6.5 GHz
45.5-50.2 GHz	4.7 GHz
50.4-52.6 GHz	2.2 GHz
66-76 GHz	10 GHz
81-86 GHz	5 GHz
Total:	**33.25 GHz**

Providing spectrum in higher bands may lead to new frequency regulation and assignment requirements as diverse network densities will prevent this spectrum from being used on a nationwide scale, at least in the short to medium term.

The Bundesnetzagentur is taking an active part in the creation of this process in European and international bodies (e.g. ITU, CEPT, RSPG, RSC). The Bundesnetzagentur currently chairs the ECC working groups on frequency management (WG FM) and compatibility (WG SE) and chairs CPG which is tasked with preparing WRC 2019.

In March the Bundesnetzagentur was actively involved in organising a CEPT workshop on M2M[4]. Similar support will be given to the CEPT workshop on 5G[5] scheduled for 2 - 4 November 2016.

The Bundesnetzagentur is also represented in the RSPG's bodies working on a European strategy focusing especially on the Internet of Things (IoT), Intelligent Transport Systems (ITS) and 5G.

The first milestones achieved with 5G aiming at the specification of the first frequency band to be made available throughout Europe in the near term are publicly available.[6] The RSPG has pointed out that the pan-European 400 MHz wide band 3400 – 3800 MHz will be available for an early implementation of 5G. Above 24 GHz, Europe will endeavour to make

[3] BMVI, final document of the focus group 5G - „Digitale Netze und Mobilität“ platform for the national IT summit 2015, p. 23
[4] http://www.cept.org/ecc/cept-workshop-on-machine-to-machine-communications-m2m/
[5] http://www.cept.org/ecc/cept-workshop-on-5g/
[6] http://rspg-spectrum.eu/public-consultations/

the band 24.5 – 27.5 GHz, 31.8 – 33.4 GHz or 40.5 – 43.5 GHz available as soon as possible. The results on all strategic issues (5G, IoT, ITS) are expected by the end of 2016.

New radio applications require comprehensive planning and trial operation for the technology to be developed before actual operation can be initiated. Especially totally new 5G applications and the implementation of Industry 4.0, autonomous driving (A9 Pilot Project), M2M and the energy transition (smart grid/smart meter) will involve a significant increase in trial operations. The Bundesnetzagentur has already made the necessary frequency resources available for these trials.

As far as critical infrastructures are concerned, especially with a view to energy supply, spectrum has already been provided for local and regional networks. This spectrum is also suitable for smart grid/smart meter applications. The Act on Digitisation of the Energy Transition will accelerate these developments.

- **Objective procedure**

It is the Bundesnetzagentur's intention that available spectrum should be made available on the market in an appropriate and timely manner so that the industry, investors and network operators can put efficient digital infrastructures needed for innovative services in place for the society and economy. In ongoing regulatory practice the Bundesnetzagentur will supply spectrum resources as needed whilst avoiding an artificial spectrum scarcity.

Service providers/MVNOs

- identify corporate interests
- evaluate access rules
- objective procedure

Under the UMTS/IMT-2000 licence terms, the mobile network operators are obliged to provide service providers with non-discriminatory access to mobile communication services. The obligation ends with the expiry of the UMTS/IMT-2000 licences on 31 December 2020.

The European Commission's Telefónica/E-Plus commitments package offers special conditions to service providers beyond 2020 (see Directorate-General for Competition, Decision M.7018 of 2 July 2014, OJ of 13.03.2015, Notice No 2015/C 086/07). It should be pointed out that the commitments basically affect the contractual relationship between the service providers and Telefónica and not the other competitors.

Bearing this in mind respondents to the consultation on the spectrum distribution examination called for more competition at the services level and more particularly access rights for service providers and MVNOs beyond 2020.

With a view to new business models, the Federal Ministry for Economic Affairs and Energy in its Green Paper referred to digital platforms as part of its "Digital Strategy 2025":

> *"III. Digital infrastructures must be made fit for the gigabit society. Regulation to date has been concerned primarily with the market shares of telecommunications firms and guaranteeing fair competition. The aim must now be to devise a regulatory*

framework that sets greater incentives for network investments in gigabit infrastructure and promotes innovations at service level."

(BMWi, Green Paper Digital Platforms (Grünbuch Digitale Plattformen), p. 10)

- **Objective procedure**

The Bundesnetzagentur plans to provide the 2 GHz spectrum and additional frequencies in a non-discriminatory, transparent and objective manner. It will also determine whether it will be necessary to address the issue of access rights for service providers and MVNOs beyond 2020.

In this context it will also examine the impact of new technological and market developments such as embedded SIMs (eSIMs).

New entrants

- identify interests
- evaluate access rules
- objective procedure

When granting new rights of frequency use the Bundesnetzagentur will also regularly ascertain and bear in mind the interests of possible newcomers and reconsider the regulatory goals from their perspective. Now that the market constellation has changed as a result of the Telefónica and E-Plus merger and only three independent mobile network operators remain, competitive issues are of paramount importance.

The European Commission had agreed to the merger on certain conditions, without actually specifying a new entrant as a minimum requirement (see Decision M.7018 loc.cit.). The merger's approval was contingent upon all the commitments proposed by Telefónica being fulfilled. To remove the Commission's concerns, Telefónica had basically formulated three components guaranteeing new competitors' access to the German mobile market and strengthening existing competitors' stance. The MNO component is intended to facilitate a new mobile operator's market entry. The component basically consists of the obligation to surrender rights of use totalling 2 x 10 MHz at 2 GHz by the end of 2020 and 2 x 10 MHz at 2.6 GHz by the end of 2025 and to offer national roaming until the end of 2025.

- **Objective procedure**

When considering the deployment of the 2 GHz spectrum in 2021, it will be necessary to examine whether, and if so to what extent, the European Commission's existing rules for newcomers in any way need to be complemented or substantiated. Emphasis should be placed on the fact that planning and investment security should be created not only for existing but for future network operators as well.

Technological and market developments need to be borne in mind when considering the possible emergence of a fourth network operator. Especially with regard to digitisation trends and the ensuing need for modern, full-scale mobile infrastructures the question arises about the extent to which newcomers could contribute to the creation of such structures.

Further action

As a first step, the Bundesnetzagentur plans to lay down the key elements for the provision of spectrum for further roll-out of digital infrastructures in line with demand and to invite comments on these elements in the course of the current year, thereby giving interested parties the opportunity to take part in this process at the earliest possible point in time.

Interested parties are herewith invited to comment on the areas of action outlined in this paper. Comments should be submitted in writing, in German,

not later than **30 September 2016**,

to the address below

Bundesnetzagentur
Referat 212
Tulpenfeld 4
53113 Bonn

and

electronically in Word (or compatible) or PDF format (copying and printing must be possible) to the following

e-mail address: referat212@bnetza.de

The responses will be published on the Bundesnetzagentur's website, in the original. Respondents are therefore asked to give their consent to publication when they submit their comments and to submit a version for publication and a version in which the confidential parts have been blacked out together with a list justifying the blacked out parts.

List of abbreviations

4G	4th mobile communications generation (LTE/LTE-Advanced)
5G	5th mobile communications generation
BMVI	Federal Ministry of Transport and Digital Infrastructure
BMWi	Federal Ministry for Economic Affairs and Energy
CEPT	European Conference of Postal and Telecommunications Administrations
CPG	Conference Preparatory Group
ECC	Electronic Communications Committee
eSIM	Embedded SIM
FDD	Frequency Division Duplex
IMT	International Mobile Telecommunications
IoT	Internet of Things
ITS	Intelligent Transport Systems
ITU	International Telecommunication Union
ITU-R	International Telecommunication Union, Radiocommunication Sector
LTE	Long Term Evolution (4G)
M2M	Machine-to-Machine (communication)
MNO	Mobile Network Operator
MVNO	Mobile Virtual Network Operator
RSC	Radio Spectrum Committee
RSPG	Radio Spectrum Policy Group
SIM	Subscriber Identity Module
TDD	Time Division Duplex
UMTS	Universal Mobile Telecommunications Systems
WG FM	Working Group Frequency Management
WG SE	Working Group Spectrum Engineering
WRC	World Radiocommunication Conference