Bundesnetzagentur

Points of Orientation

for the provision of spectrum for the rollout of digital infrastructures

20. December 2016

Contents

A. Introduction

The Bundesnetzagentur's "Frequenz-Kompass" document of July 2016 gives an overview of further procedure in spectrum management and identifies areas for regulatory action on the rollout of digital infrastructures.

Given consumers' steadily growing volumes of mobile data (high resolution video transmissions, virtual reality, etc) and ever more machine-to-machine communication (Industry 4.0, automated driving, etc), the requirements on high-speed wireless infrastructures are undergoing a process of change. Many innovative applications require, amongst other things, real-time communication, particularly high data rates and/or particularly short latency. Consumers expect to be able to use mobile services any time, any place. For this to happen, high-speed wireless infrastructures need to be in place. The industry, too, is calling for optimum frameworks to enable it to exploit the potential of digitisation at the earliest possible opportunity.

Fundamental to new technological developments, especially to 5G, the next generation of wireless mobile technology, are high-speed broadband networks.

Thus the Federal Ministry for Economic Affairs and Energy, in its Digital Strategy 2025 document, formulates its aim as follows:

> *"High-performance broadband networks are the foundation and driver of digitisation and are therefore indispensable for Germany's digital future. Without sufficient information highways, Germany cannot successfully accomplish the process of digitisation that is progressing at an ever increasing speed. For this reason we must create a viable digital infrastructure that can support the triple requirements of high capacity, broad availability and low latency."*[1]

It is incumbent on the Bundesnetzagentur to create consistent and stable frameworks, structured along forward-looking lines, for the rollout of high-speed broadband networks so that new wireless technologies for 5G may be introduced – and hence new services and applications.

Demand for high bandwidth in connection with increasing mobility and technological innovation – eg Industry 4.0, smart cities, automated driving and the Internet of Things – requires suitable spectrum to be made available.

However, the available radio spectrum is a limited resource due to the type of use to which it is put and to the state of the art. The possibility of using spectrum cannot therefore be left to the free play of market forces but needs instead forward-looking, non-discriminatory and proactive spectrum management on the part of the Bundesnetzagentur.

The aim of such spectrum management is the provision of spectrum resources that reflects market demand. Spectrum management focuses not just on today's frequency uses but also on tomorrow's technological and market developments such as 5G. Besides accommodating user interests and enabling innovative technologies the Bundesnetzagentur must also secure both efficient and interference-free use of frequencies and fair and workable competition.

In its guideline on network expansion (*Kursbuch Netzausbau 2016*) drawn up by the "Network Alliance for a Digital Germany" initiative, the Federal Ministry of Transport and Digital Infrastructure drew attention to the fact that Germany was facing the challenge of having to create the necessary infrastructures to meet the growing demands of the gigabit society.

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[1] Federal Ministry for Economic Affairs and Energy, Digital Strategy 2025, p13.

> *"The increasing convergence of cable-based and mobile applications leads to more stringent requirements regarding the appropriate provision of spectrum, especially for 5G."*[2]

The Bundesnetzagentur's "Frequenz-Kompass" document of July 2016 identified the first areas for regulatory action. The public was invited to respond by providing input that would feed into the Bundesnetzagentur's considerations.

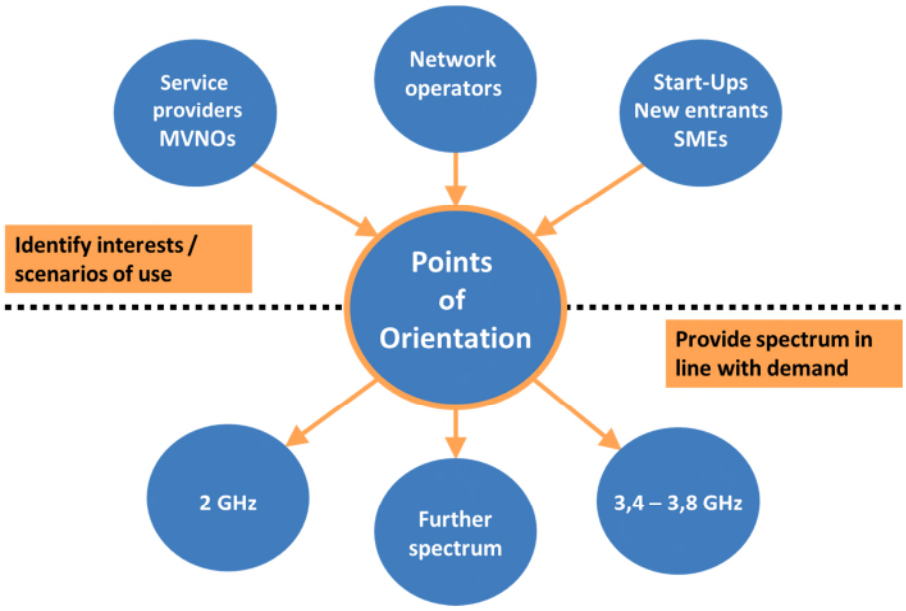
With the "Frequenz-Kompass" as the starting point the current and future regulatory frameworks for the rollout of an efficient digital wireless infrastructure for society and the economy are to be assessed and structured along forward-looking lines.

In light of the responses received the Bundesnetzagentur has now drawn up Points of Orientation for the provision of spectrum, in line with demand, from the bands at 2 GHz, 3.4 – 3.8 GHz, 700 MHz (centre gap), 26 GHz and 28 GHz for the rollout of digital wireless infrastructures.

Its approach is also consistent with the Saarbrücken Declaration made by the Federal Ministry for Economic Affairs and Energy at the National IT Summit on 17 November 2016:

> *We will strengthen the potential and the key role of 5G for the Internet of Things, Mobility 4.0, Industry 4.0 and beyond for the gigabit society as a whole through ambitious strategic measures at national and European level. We will bring all our influence to bear in the international bodies to identify and make available at an early point in time all the candidate bands for 5G in Europe.*[3]

The Points of Orientation are the means with which the Bundesnetzagentur, in objective, transparent and non-discriminatory procedures, is addressing the early provision, in line with market demand, of 5G-suited spectrum. To this end the interests of the parties concerned must be identified and suitable framework conditions drawn up. The Points of Orientation are set out for the separate candidate bands for this very reason.



[2] Federal Ministry of Transport and Digital Infrastructure, *Kursbuch Netzausbau 2016*, Area of action, Frequencies, p37.
[3] Saarbrücken Declaration of the Federal Ministry for Economic Affairs and Energy at the National IT Summit on 17 November 2016, p4.

The Points of Orientation address the following spectrum that is suitable for the rollout of 5G infrastructures and whose availability is foreseeable:

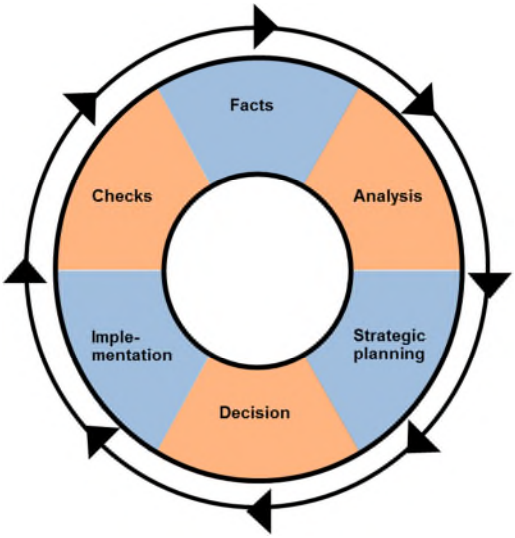
- 700 MHz (centre gap),
- 2 GHz (so-called UMTS spectrum),
- 3.4 – 3.8 GHz, and
- 26 GHz and 28 GHz.

Besides spectrum in the 2 GHz band, spectrum in the band from 3.4 to 3.8 GHz is of special interest in terms of 5G introduction. The rights of use in these bands are set to expire at the end of 2020 and 2021/2022 for the most part. The Bundesnetzagentur is looking to take a decision on the provision of this spectrum at the earliest possible opportunity in order to guarantee planning and investment certainty with regard to the rollout of digital wireless infrastructures.

But further frequency bands are also to be looked at with a view to the future. Most notably, these are the bands above those currently used for mobile communications, that is to say 26 GHz and 28 GHz.

Consideration must be given, in providing spectrum, to the interests of both the current national mobile operators and those of possible new entrants. Consideration must also be given to the interests of other users requiring frequencies such as small and medium-size enterprises (SMEs) and start-ups.

It is necessary, particularly in light of existing assignments in the bands concerned, ie 2 GHz, 3.4 – 3.8 GHz and 28 GHz, to analyse and assess the current uses and framework conditions. Under the Bundesnetzagentur's administrative practice the findings of the analysis will then be incorporated in the strategic planning for the renewed provision of spectrum:



In light of the large number of possible uses of the spectrum all interested companies are invited herewith to set out their scenarios of use for the respective frequency bands, most notably with reference to the bandwidths required and the areas for which the spectrum is to be used (eg planned services, target groups, timeframes, business models, suitable spectrum packages, etc). Comments are also invited on whether, and if so, to what extent, access rights for service providers and MVNOs should be required beyond the year 2020.

The reason for requesting such information is to draw future trends into the spectrum provision procedure as far as possible so as to give all interested companies planning and investment certainty on the basis of stable framework conditions. Other public and individual

interests such as those of the earth exploration-satellite service, satellite communications and radio astronomy must also be included[4].

Interested parties are invited herewith to submit their views. Responses should be submitted in writing, in German,

not later than **1 March 2017**,

to the address below

Bundesnetzagentur
Referat 212
Tulpenfeld 4
53113 Bonn

and

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

Email: 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.

[4] cf The space strategy of the German Federal Government, p12; viewable at: http://www.bmwi.de/English/Redaktion/Pdf/space-strategy,property=pdf,bereich=bmwi2012,sprache=en,rwb=true.pdf

B. Points of Orientation

2 GHz

1. Objective, transparent and non-discriminatory procedure

Rights of use in the 2 GHz band are set to expire on 31 December 2020 and 31 December 2025 and will be made available in an objective, transparent and non-discriminatory procedure.

2. Combined provision

Spectrum in the 1920.0 – 1980.0 MHz / 2110.0 – 2170.0 MHz band is to be provided in combination. Hence a total of 2 x 60 MHz (paired) will be available.

3. Early provision

The Bundesnetzagentur intends to decide on the subsequent use of spectrum in the 1920.0 – 1980.0 MHz / 2110.0 – 2170.0 MHz band in due time before 31 December 2020.

4. 5 MHz blocks

The spectrum is to be made available in blocks of 5 MHz. The band at 1920.0 – 1980.0 MHz / 2110.0 – 2170.0 MHz is to be made available in its entirety. Following an initial assessment the Bundesnetzagentur is assuming that it will not be necessary to stipulate guard bands to protect adjacent applications.

5. Intended use

The 2 GHz spectrum is to be made available nationwide for Wireless Access (Electronic Communications Services).

6. Contiguous spectrum

The 2 GHz spectrum is to be assigned as contiguous spectrum in each case. This may necessitate shifts in current assignments.

7. Suitable licence duration

Suitable periods with the same expiry date are to be agreed for frequency assignments in the 2 GHz band.

8. Service providers / MVNOs

The current service provider access obligation is a factor in achieving the aims of regulation. In particular, if services competition is to be sustained, regulatory measures creating legal and planning certainty for all market players (mobile operators, service providers and MVNOs) may be necessary beyond the year 2020. The Bundesnetzagentur will take a close look at the necessary regulatory action, keeping an open mind as to the outcome.

9. New entrants

The interests of potential new entrants are also to be taken into account in spectrum provision for the rollout of digital infrastructures. With a view in particular to promoting infrastructure competition the Bundesnetzagentur will take a close look at the necessary regulatory action, keeping an open mind as to the outcome.

10. Scenarios of use

The Bundesnetzagentur anticipates requirements for spectrum in the band from 1920 – 1980 MHz / 2110 – 2170 MHz for mobile broadband, most notably for 5G, beyond the term of the current assignments that are set to end in 2020 and 2025.

Both current assignment holders and other interested companies are invited herewith to set out in detail, with reference to their future business model, their interest in using this spectrum.

3.4 – 3.8 GHz

11. Objective, transparent and non-discriminatory procedure

Rights of use in the 3.4 – 3.8 GHz band are set to expire on 31 December 2021 and 31 December 2022 and will be made available in an objective, transparent and non-discriminatory procedure.

12. Combined provision

Spectrum in the 3400 – 3600 MHz and 3600 – 3800 MHz bands is to be provided in combination. Hence a total of 400 MHz will be available.

13. Early provision

The Bundesnetzagentur intends to decide on future use of the 3.4 – 3.8 GHz band at an early stage.

14. 5 MHz blocks

The spectrum is to be made available in blocks of 5 MHz or a multiple thereof. The band at 3400 – 3800 MHz is to be made available in its entirety. Following an initial assessment the Bundesnetzagentur is assuming that it will not be necessary to stipulate guard bands to protect adjacent applications.

15. Intended use

Spectrum in the 3.4 – 3.8 GHz band is to be provided for future-proof business models – most notably with a view to 5G applications (eg Industry 4.0, Internet of Things) – in line with demand. The aim is to provide adequate spectrum for all business models while accommodating the requirement of efficient use of spectrum.

16. Contiguous spectrum

Frequencies in the 3.4 – 3.8 GHz band are to be assigned as contiguous spectrum in each case.

17. Suitable licence duration

Suitable periods with the same expiry date are to be agreed for frequency assignments in the 3.4 – 3.8 GHz band.

18. Interests of SMEs / Start-ups

Given the short innovation cycles for new applications (Internet of Things, M2M, Industry 4.0, smart grid, etc) and associated business models, future technological and market developments are not yet on the horizon. The interests of small and medium-size enterprises, start-ups included, must therefore be taken into due consideration over the entire period.

19. Scenarios of use

The Bundesnetzagentur anticipates demand for spectrum for broadband wireless / 5G networks in future in the whole of the band from 3.4 GHz – 3.8 GHz.

Both current assignment holders and other interested companies are invited herewith to set out in detail, with reference to their future business model, their interest in using this spectrum.

700 MHz centre gap

20. 700 MHz centre gap

Frequencies in the band at 738 – 753 MHz (15 MHz in total) in the centre gap of the 700 MHz band are to be provided for Wireless Access (Electronic Communications Services) as a supplementary downlink (SDL).

Interested companies are invited herewith to set out in detail, with reference to their future business model, their interest in using this spectrum.

26 GHz and 28 GHz

21. 28 GHz band

The frequency assignments in the 28 GHz band are set to expire on 31 December 2020. The entire band at 27.8285 – 28.4445 GHz and 28.9485 – 29.4525 GHz will be provided, in line with demand, in an objective, transparent and non-discriminatory procedure.

Both current assignment holders and other interested companies are invited herewith to set out in detail, with reference to their future business model, their interest in using this spectrum.

22. 26 GHz band

The 26 GHz band, identified by the RSPG as a pioneer band for 5G applications, is to be looked at for provision in line with market demand (see too item 1.13 of the agenda for WRC 2019 which aims to identify frequency bands for IMT2020).

Both current assignment holders and other interested companies are invited herewith to set out in detail, with reference to their future business model, their interest in using this spectrum.

23. Interests of SMEs / Start-ups

Given the short innovation cycles for new applications (Internet of Things, M2M, Industry 4.0, smart grid, etc) and associated business models, future technological and market developments are not yet on the horizon. The interests of small and medium-size enterprises, start-ups included, must therefore be taken into due consideration over the entire period.

C. Explanatory notes on the Points of Orientation

I. Present situation

The facts in respect of 2 GHz

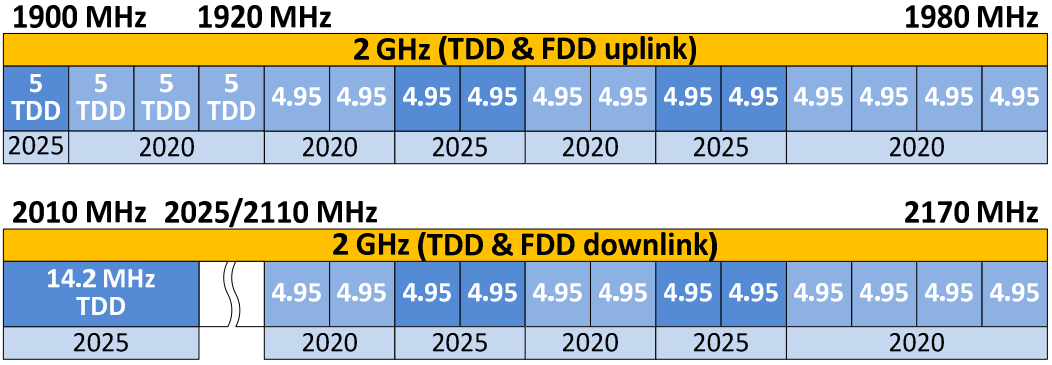
The frequency band 2 GHz (1920 – 1980 MHz / 2110 – 2170 MHz) is allocated to the mobile service.[5]

The frequency band from 2110 – 2120 MHz is additionally allocated to the space research service on a primary basis.[6]

The paired 2 GHz spectrum is assigned until 2020 and 2025 as follows:

Paired 2 GHz spectrum		Expires on
1920.3 – 1930.2 MHz / 2110.3 – 2120.2 MHz	(2 x 9.9 MHz)	31.12.2020
1930.2 – 1940.1 MHz / 2120.2 – 2130.1 MHz	(2 x 9.9 MHz)	31.12.2025
1940.1 – 1950.0 MHz / 2130.1 – 2140.0 MHz	(2 x 9.9 MHz)	31.12.2020
1950.0 – 1959.9 MHz / 2140.0 – 2149.9 MHz	(2 x 9.9 MHz)	31.12.2025
1959.9 – 1979.7 MHz / 2149.9 – 2169.7 MHz	(2 x 19.8 MHz)	31.12.2020

Overview: Current assignments and expiry dates in the 2 GHz band



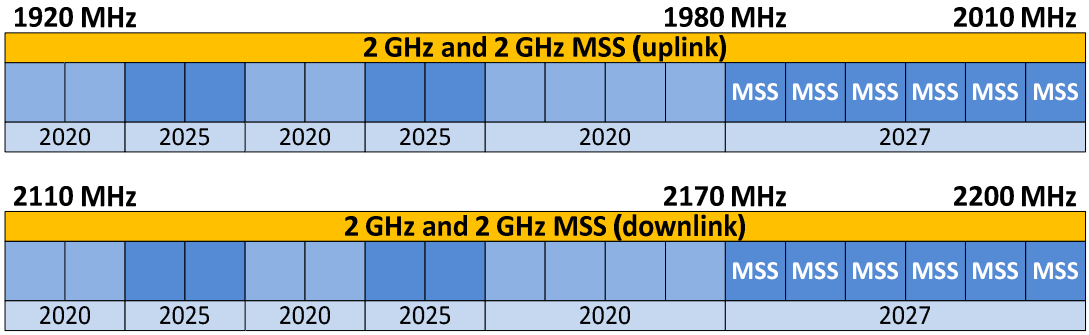
Overview: Current assignments and time periods in the 2 GHz band

[5] Frequency Plan, Entries 290 009, 291 001, 295 001, 296 001.
[6] Frequency Plan, Entry 295 002

2 GHz MSS

The frequency band 2 GHz MSS (1980 – 2010 MHz / 2170 – 2200 MHz) is allocated internationally to the mobile service, the fixed service and the mobile satellite service on a primary basis. Nationally, allocation to the fixed service has not been implemented. The national Frequency Plan identifies the bands for satellite service links[7] and, for a transitional period until mobile satellite services (MSS) begin, for wireless cameras.[8]

Some of the respondents to the "Frequenz-Kompass" consultation called for additional provision in an objective, transparent and non-discriminatory procedure of the band at 1980 – 2010 MHz / 2170 – 2200 MHz on a technology- and service-neutral basis.



Overview: Current assignments and time periods in the 2 GHz band (paired spectrum)

True, the frequency band 1980 – 2010 MHz / 2170 – 2200 MHz has been identified for IMT and the spectrum is also suited in principle for Wireless Access applications. Yet it must be assumed that the band will not be available, at least not in the short term.

The European Commission, on 14 February 2007, took a decision on the harmonised use of radio spectrum in the 2 GHz frequency bands for the implementation of systems providing mobile satellite services in the 1980 – 2010 MHz / 2170 – 2200 MHz frequency band.[9] In a pan-European comparative selection procedure two companies were identified as eligible applicants for systems providing mobile satellite services.[10] Both companies were assigned frequencies under section 55 of the German Telecommunications Act (TKG) and Title III of Decision 626/2008/EC for MSS use. The frequency assignments run until 13 May 2027.

The Bundesnetzagentur will decide in accordance with Community law on the future use of these frequencies well before their expiry date, in an objective, transparent and non-discriminatory procedure (cf "Strategic Aspects of the Availability of Spectrum for Broadband Rollout in Germany", p28[11]).

2 GHz unpaired

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

Unpaired 2 GHz spectrum		Expires on
1900.1 MHz – 1905.1 MHz	(1 x 5 MHz)	31.12.2025
1905.1 MHz – 1920.1 MHz	(1 x 15 MHz)	31.12.2020
2010.5 MHz – 2024.7 MHz	(1 x 14.2 MHz)	31.12.2025

Overview: Current assignments and time periods in the 2 GHz band (unpaired spectrum)

[7] Frequency Plan, Entries 292 002, 297 002.
[8] Frequency Plan, Entries 292 001, 297 001.
[9] Decision 2007/98/EC.
[10] Decision 2009/449/EC.
[11] Communication No 170/2013, Bundesnetzagentur Official Gazette 12/2013 of 3 July 2013, p1846ff.

At EU and CEPT level the unpaired 2 GHz bands are no longer intended for use for Wireless Access and will no longer be provided for Wireless Access purposes.

The facts in respect of 3.4 – 3.6 GHz

The frequency band 3.4 – 3.6 GHz is currently allocated to the following radiocommunication services:

- On a primary basis: fixed-satellite service (FSS) (space-to-Earth), fixed service (FS), mobile service
- On a secondary basis: non-navigational radiodetermination service, amateur service

Mobile service (Wireless Access)

The paired 3.5 GHz spectrum is currently assigned under the mobile service for Wireless Access for the provision of telecommunications services as follows:

Paired 3.5 GHz spectrum		Expires on
3410 – 3431 MHz / 3510 – 3531 MHz	(2 x 21 MHz)	31.12.2021
3431 – 3452 MHz / 3531 – 3552 MHz	(2 x 21 MHz)	31.12.2021
3452 – 3473 MHz / 3552 – 3573 MHz	(2 x 21 MHz)	31.12.2021

Overview: Current assignments and expiry dates in the 3.5 GHz band (paired spectrum)

The frequencies in the 3410 – 3473 MHz / 3510 – 3573 MHz band are assigned in effect nationwide.

In addition, frequencies in the so-called fourth package are assigned for regional use (TDD), upon application. The way the fourth package is currently structured, two non-contiguous blocks of 20 MHz each are available in the 3.5 GHz band:

3.5 GHz spectrum (4th package)		Expires on
3480 – 3500 MHz	3580 – 3600 MHz	31.12.2022

Overview: Current assignments and expiry dates in the 3.5 GHz band (4th package)

More flexible use of most of the frequencies in the 3.5 GHz band has been introduced, upon application, allowing them to be used on a technology-neutral basis for 5G services as well, once the systems for 5G are available.

In the band at 3473 – 3494 MHz / 3573 – 3594 MHz (paired) there are, moreover, still 32 unlimited regional assignments in blocks of 7 MHz for wireless local loop (WLL) as point to multipoint radio relay[12] (cf Annex 1).

The frequencies in the fourth package are currently awarded upon application for regional and local uses. They are assigned in line with Annex 1 of ECC/DEC/(11)06 for Wireless Access (TDD) in block sizes of 5 MHz. There are around 80 regional and local assignments,

[12] cf Order No 55/1998, Reg TP Official Gazette 11/1998 of 10 June 1998.

chiefly in rural areas (cf Annex 1). As a rule, the assignment holders are SMEs that use the frequencies to serve private customers, to connect industrial areas and offshore wind farms. In each case suitable separation distances are fixed in order to secure compatibility with adjacent radio uses.

Fixed-satellite service

While the reception of satellite transmissions in the band 3.4 – 3.6 GHz is possible, there is no entitlement to interference-free reception.

Protection of uses in adjacent frequency bands

The frequency band 3400 – 3410 MHz is currently envisaged as a guard band for adjacent military services (military radar).

The possibility of using this 10 MHz for Wireless Access must be clarified with the military users.

Future provision

The frequency band 3.4 – 3.6 GHz is harmonised for wireless access both under ECC Decision(11)06) and Commission Implementing Decision 2014/276/EU amending Decision 2008/411/EC. There are channel arrangements for TDD and FDD applications:

- TDD: 5 MHz block sizes; 200 MHz (3400 – 3600 MHz)
- FDD: 5 MHz block sizes; 2 x 80 MHz (3410 – 3490 MHz / 3510 – 3590 MHz)

The RSPG has identified the 3.4 – 3.8 GHz band as the candidate band for the introduction of 5G-based services in Europe (cf RSPG 16-032, "Strategic Roadmap towards 5G for Europe").

The facts in respect of 3.6 – 3.8 GHz

The frequency band 3.6 – 3.8 GHz is currently allocated on a primary basis to the following radiocommunication services: fixed-satellite service (FSS) (space-to-Earth), fixed service (FS) and mobile service.

Mobile service (Wireless Access)

Official Gazette Order No 1/2009 provides spectrum from the band 3.6 – 3.8 GHz for Wireless Access purposes.[13] Assignments for regional and local uses have been made on the basis of TDD in channel arrangements of 5 MHz. There is a current approximate total of 80 assignments in the whole of the 3.4 – 3.8 GHz band for SMEs throughout the country. Some 500 central stations are operated under these assignments.

Coordination procedures with earth stations in the fixed-satellite service are necessary in light of Wireless Access in the band 3.6 – 3.8 GHz.

Fixed-satellite service

The band 3.6 – 3.8 GHz is currently one of the ranges used for the fixed-satellite service in the space-to-Earth direction.

Notification is not required for receiving equipment used exclusively for the reception of satellite transmissions in the 3.6 – 3.8 GHz band. There is no entitlement to interference-free reception.

Under the coordination procedures for satellite earth stations with transmission components (Earth-to-space direction) in the frequency band 5.875 – 7.075 GHz and, at the same time, received power in the frequency band 3.6 – 3.8 GHz the technical parameters have been coordinated with those of Wireless Access. The satellite earth stations covered by the coordination procedures encompass some 500 frequency uses at 17 earth station sites requiring protection (cf Annex 2, Sites of the earth stations requiring protection). Protection is to be envisaged at these 17 sites in the visible portion of 76 degrees West to 80 degrees East.

The Frequency Plan states the following on this:

- Sub-plan 317:[14]

  Interference may not be caused to existing and coordinated receivers of the fixed-satellite service in the sub-band 3600 – 3800 MHz.

- Sub-plan 317:[15]

  The frequency sub-band 3600 – 3800 MHz will be available for the fixed-satellite service only to a limited extent after the introduction of Wireless Access applications for the provision of telecommunications services. Existing and coordinated receivers of the fixed-satellite service will be protected; re-planning is possible in individual cases most notably for existing sites.

[13] Order No 1/2009, Bundesnetzagentur Official Gazette 3/2009, p527f.
[14] Frequency Plan, Entry 317 003.
[15] Frequency Plan, Entry 317 002.

Future provision of 3.6 – 3.8 GHz

The frequency band 3.6 – 3.8 GHz has been harmonised for Wireless Access by means of both ECC Decision (11)06 and Commission Decision 2014/276/EU amending Decision 2008/411/EC. Channel arrangements have been made for TDD applications:

- TDD: 5 MHz blocks; 200 MHz (3600 – 3800 MHz)

The RSPG has identified the band 3.4 – 3.8 GHz as the preferred candidate band for the introduction of 5G-based services in Europe (cf RSPG 16-032, "Strategic Roadmap towards 5G for Europe").

The facts in respect of 3.8 – 4.2 GHz

The frequency band 3.8 – 4.2 GHz is currently allocated to the following radiocommunication services:

- On a primary basis: fixed service (FS), fixed-satellite service (FSS) (space-to-Earth);
- On a secondary basis: mobile, except aeronautical mobile, service.

Fixed-satellite service

Several hundred frequency uses are operated in the frequency band 3.8 – 4.2 GHz throughout the country for the fixed-satellite service. The band is currently used for the downlink (space-to-Earth). The band 3.8 – 4.2 GHz is the core band for satellite communications. Growing demand for this spectrum is foreseeable.

Fixed service

There are currently some 100 frequency assignments in the band 3.8 – 4.2 GHz for long haul radio relay communications (point-to-point) with lengths ranging from 30km to 70km. Roughly half of these assignments are of unlimited duration. Demand is growing as a replacement for radio relay assignments in the bands 6.2 GHz and 6.8 GHz.

Future use

The frequency band 3.8 – 4.2 GHz is not a band identified for IMT in the Radio Regulations. Nor is it envisaged at EU or CEPT level for Wireless Access.

It is intended to continue assigning frequencies for satellite communications and radio relay in this band. While some respondents to the "Frequenz-Kompass" consultation called for the option of envisaging the 3.8 – 4.2 GHz band for mobile communications in the long term, its future use for Wireless Access is not foreseeable in light of the development potential of satellite communications and radio relay.

The facts in respect of the 700 MHz centre gap

Following the national consensus achieved on 11 December 2014 between the central government and the federal states on use of the 700 MHz spectrum for mobile broadband and on the basis of the allocation of the 700 MHz band on a co-primary basis for use by mobile communications, decided at the World Radiocommunication Conference at the end of 2015 (WRC-15), it was possible to make this band available in Germany for broadband access. Once the TV transmitters (DVB-T) in the 700 MHz band have been moved to lower frequen-

cies in the VHF band by 2019 and some TV transmitters in neighbouring countries have been switched off, it will be possible to use the 700 MHz spectrum nationwide for mobile communications.

The German Frequency Ordinance and the Frequency Plan have been amended accordingly. Sub-plan 249A allocates the frequency band 694 – 790 MHz to the radio service "MOBILE, except aeronautical mobile, SERVICE". The intended use is Wireless Access for the provision of telecommunications services. The allocations to the broadcasting service and consequently to wireless microphones will not be continued.

In an award procedure carried out in 2015 a portion of spectrum of 2 x 30 MHz (paired) was made available in the band 700 MHz (694 MHz – 790 MHz) for nationwide use:

Uplink	Downlink	Expires on
703 MHz – 733 MHz	758 MHz – 788 MHz	31.12.2033

Overview 700 MHz band (paired spectrum)

Further frequencies can be made available for Wireless Access in the centre gap (733 – 758 MHz) of the paired spectrum awarded, although restrictions may have to be imposed in order to protect other uses.

Additionally, the Frequency Plan includes a dedication for military uses. Mobile broadband applications for authorities and organisations concerned with public safety (BOS) and the federal armed forces (Bundeswehr) are planned in the 700 MHz band beyond the bands for Wireless Access.[16]

The facts in respect of 26 GHz and 28 GHz

As developments towards the fifth generation of mobile networks progress, the frequency bands from 24.25 GHz to 27.5 GHz (26 GHz band) and from 27.5 to 29.5 GHz (28 GHz band) are to be examined now, already, with a view to options for any necessary regulatory action. The reason for early consideration of these bands is twofold. First, in the 28 GHz band assignments for the fixed service are ending concurrently with those for frequencies in the 2 GHz band at the close of 2020. And second, the debate about spectrum for 5G above 24 GHz has already begun and can be summarised as follows:

The RSPG has already identified the 26 GHz band as the "pioneer band for 5G".[17]

Respondents to the "Frequenz-Kompass" consultation have called for the 5G spectrum harmonisation activities to take account of developments in the 28 GHz band in other markets such as those of the US and South Korea, the aim being international, that is to say worldwide, harmonisation.

Satellite operators responding to the consultation want planning and investment certainty for high bit rate satellite links.

The following sets out the situation today as regards use of the entire band from 24.25 GHz to 29.5 GHz in light of the comments received in the "Frequenz-Kompass" consultation:

[16] cf Frequency Plan Entry 249A002.
[17] cf RSPG 16-032, "Strategic Roadmap towards 5G for Europe".

Use of 26 GHz

Frequencies in the 26 GHz band are designated and used as follows (cf Annex 4):

On a primary basis:

- Fixed service (radio relay):
  - Designation: 24.25 – 26.5 GHz;[18]
  - Some 160 regional assignments for point-to-multipoint radio relay in the band 24.549 – 24.773 GHz / 25.557 – 25.781 GHz and 25.025 – 25.137 GHz / 26.033 – 26.145 GHz; approx 90 percent of these are assigned for an unlimited period;
  - Some 18,000 point-to-point radio relay assignments in the band 24.801 – 24.997 GHz / 25.809 – 26.005 GHz and 25.165 – 25.445 GHz / 26.173 – 26.453 GHz; 20 to 25 percent of these are assigned for an unlimited period;
- Fixed-satellite service (Earth-to-space):
  - Designation: 24.65 – 25.25 GHz;[19]
  - No assignments;
- Inter-satellite service:
  - Designation: 25.25 – 26.5 GHz;[20]
  - The inter-satellite service is operated at heights above 400km (eg to connect the International Space Station (ISS));
- Military uses:
  - Designation: 26.5 – 27.5 GHz;[21]

On a secondary basis:

- Earth exploration-satellite service (space-to-Earth):
  - Designation 25.5 – 27.0 GHz;[22]
  - This frequency band is used at the following sites: Weilheim, Erlangen, Neustrelitz, Wettzell, Berlin, Gelsdorf and Oberpfaffenhofen (cf Annex 3);
  - At present, the following German missions are planned / carried out with the following satellite systems with a 26 GHz downlink: SARah, HRWS, Tandem-L;
- Radio applications for transport telematics:
  - Designation: 24.25 – 26.65 GHz;[23]
  - Frequency use is for a limited period. The general assignment expires on 31 December 2022;[24]

[18] Frequency Plan, Entries 404 001, 405 001, 406 001, 407 002.
[19] Frequency Plan, Entry 405 002.
[20] Frequency Plan, Entries 406 002, 407 003.
[21] Frequency Plan, Entries 408 001, 408 002, 408 003, 408 004, 408 005, 409 001, 409 002, 409 003.
[22] Frequency Plan, Entries 407 001, 408 001.
[23] Frequency Plan, Entries 404 002, 405 003, 406 005, 407 006, 408 006.
[24] cf Order No 41/2012, Bundesnetzagentur Official Gazette 14/2012 of 25 July 2012, p2371ff.

Use of 28 GHz

Frequencies in the 28 GHz band are designated and used as follows (cf Annex 4):

On a primary basis:

- Fixed service (radio relay):
  - Designation: 27.8285 – 28.4445 GHz and 28.9485 – 29.4525 GHz;[25]
  - In the frequency band 28.0525 – 28.4445 GHz / 29.0605 – 29.4525 GHz there are 56 regional assignments for point-to-point and point-to-multipoint radio relay with some 80 central stations and 700 point-to-point radio relay links;
  - Not included in the 56 regional assignments are 1,200 point-to-point radio relay assignments;
  - All the assignments expire on 31 December 2020;
- Fixed-satellite service (Earth-to-space):
  - Designation 27.5 – 29.5 GHz;[26]
  - Non-coordinated operation of earth stations in the fixed-satellite service and mobile earth stations in the frequency bands 27.5 – 27.8285 GHz, 28.4445 – 28.8365 GHz and 29.4525 – 29.5 GHz;[27]
  - As from 2020 non-coordinated operation of earth stations in the fixed-satellite service and mobile earth stations in the frequency band 28.8365 – 28.9485 GHz;[28]
  - Some 100 coordinated uses at 11 sites (cf Annex 5, Sites of the earth stations requiring protection);
- Fixed-satellite service (space-to-Earth):
  - Designation 27.5 – 27.501 GHz;[29]
  - Beacon transmissions for Ka band satellites;

On a secondary basis:

- Fixed-satellite service (space-to-Earth): 27.5 – 29.5 GHz[30]

Respondents to the "Frequenz-Kompass" consultation asked for account to be taken not just of the national situation of use but also of planning in other countries for the provision of spectrum for future 5G applications, in particular in the US and South Korea (cf Annex 4). The US plans to provide the frequency band 27.5 – 28.35 GHz for mobile communications services. South Korea plans to provide the band 26.5 – 29.5 GHz for 5G. In Europe, the band 27.5 – 29.5 GHz is currently not a candidate band for 5G.

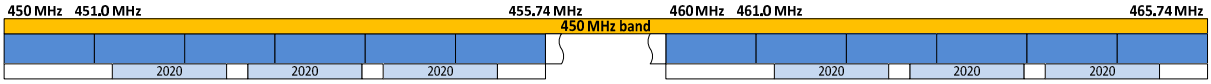
[25] Frequency Plan, Entries 410 004, 411 003, 412 002.
[26] Frequency Plan, Entries 410 002, 410 005, 411 001, 412 001, 412 004.
[27] cf Harmonisation of frequency bands in ECC Decisions ECC/DEC/(05)01, ECC/DEC/(13)01, ECC/DEC/(15)04.
[28] cf ECC/DEC/(05)01, ECC/DEC/(13)01, ECC/DEC/(15)04.
[29] Frequency Plan, Entry 410 001.
[30] Frequency Plan, Entries 410 003, 411 002, 412 003.

Further frequencies

450 MHz

The frequency band 450.00 – 455.74 MHz / 460.00 – 465.74 MHz (450 MHz band) is allocated to the mobile service and designated for Wireless Access[31] and for PMR in the range 450 – 451 MHz / 460 – 461 MHz[32].

In the sub-band 451.00 – 455.74 MHz / 461.00 – 465.74 MHz two assignment holders have three frequency assignments, each for 2 x 1.25 MHz (paired), for Wireless Access. The assignments run until 31 December 2020. Additionally, there are some 1,600 frequency assignments in the band 450 – 451 MHz and some 1,200 assignments in the band 460 – 461 MHz for the transmission of internal communications.



Overview: Current assignment situation for Wireless Access in the 450 MHz band

As matters stand at present, the frequency band designated for Wireless Access is intended in future for applications of "critical infrastructures" (for instance, energy, authorities and organisations concerned with public safety, the military). The Frequency Plan will be amended accordingly. A decision will be taken on use after 2020 well before the frequency assignments expire, in an objective, transparent and non-discriminatory procedure.

Extension in the 1.5 GHz band

The frequency band 1427 – 1518 MHz is allocated to the fixed service, the mobile, except mobile aeronautical, service and the space operation service.

The frequencies are designated as follows:

- 1427 – 1429 MHz for space operation[33]
- 1452 – 1518 MHz for wireless microphones[34]
- 1452 – 1492 MHz for Wireless Access[35]
- 1427 – 1452 MHz and 1492 – 1518 MHz for military radio applications[36]

The spectrum from 1452 – 1492 MHz was won at auction in 2015 by two companies for Wireless Access use. The rights of use for the spectrum expire in 2033.

The extensions above and below this band (1427 – 1452 MHz and 1492 – 1518 MHz) are currently used for military purposes. Even if some of the respondents called for these frequencies to be included in a spectrum provision procedure, their use in future for Wireless Access is not foreseeable at present, given this military use.

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[31] Frequency Plan, Entries 248 028, 248 064.
[32] Frequency Plan, Entries 248 027, 248 029, 248 063, 248 065.
[33] Frequency Plan, Entry 262 003.
[34] Frequency Plan, Entries 264 001, 265 003.
[35] Frequency Plan, Entry 264 002.
[36] Frequency Plan, Entries 262 001, 262 002, 263 001, 263 002, 265 001, 265 002.

2.3 GHz

The frequency band 2300 – 2400 MHz is allocated to the mobile service on a primary basis and to the amateur service on a secondary basis.

The frequencies are designated as follows:

- 2300 – 2320 MHz for telemetry[37]
- 2320 – 2400 MHz for amateur radio[38]
- 2347 – 2385 MHz for authorities and organisations concerned with public safety[39]
- 2320 – 2350 MHz and 2384 – 2400 MHz for outside broadcasting[40]
- 2333 – 2350 MHz and 2385 – 2400 MHz for wireless cameras[41]
- 2320 – 2400 MHz for military applications[42]

Since WRC-07 the frequency band 2300 – 2400 MHz has been identified internationally for IMT within a primary allocation to the mobile service; to date, however, this has not been implemented within CEPT. The band is used for wireless cameras and aeronautical telemetry applications. For broadcasting and other programme producers the band constitutes a core band in Germany, ensuring that basic requirements for frequencies for wireless cameras can be covered at any time and in any place, independently of temporary use assignments.

An ECC project group was tasked with renewed study of the band, while keeping and considering current applications. The study was completed in 2014 with the adoption of ECC/DEC/(14)02 and ECC/REC/(14)04. Implementation of the ECC Decision is not planned, however, on account of existing uses in Germany. Provision of the band for Wireless Access is possible only if current uses are continued and protected or if a substitute resource is made available. This is not foreseeable at present.

II. Considerations on the individual Points of Orientation

2 GHz

1. Objective, transparent and non-discriminatory procedure

The rights of use for frequencies in the 2 GHz band are set to expire on 31 December 2020 and 31 December 2025 and are to be made available again in an objective, transparent and non-discriminatory procedure.

- Frequencies are assigned in accordance with sections 55ff of the Telecommunications Act (TKG). Assignment is required prior to their use. Frequencies are assigned for a particular purpose in accordance with the Frequency Plan and in non-discriminatory manner on the basis of transparent and objective procedures, section 55(1) TKG.

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[37] Frequency Plan, Entry 300 001.
[38] Frequency Plan, Entry 301 002.
[39] Frequency Plan, Entry 301 006.
[40] Frequency Plan, Entries 301 001, 301 007.
[41] Frequency Plan, Entries 301 005, 301 008.
[42] Frequency Plan, Entries 301 003, 301 004.

- Spectrum in the 2 GHz band will become available again as follows:

Paired 2 GHz spectrum	Available from:
1920.0 – 1930.2 MHz / 2110.0 – 2120.2 MHz	2021
1930.2 – 1940.1 MHz / 2120.2 – 2130.1 MHz	2026
1940.1 – 1950.0 MHz / 2130.1 – 2140.0 MHz	2021
1950.0 – 1959.9 MHz / 2140.0 – 2149.9 MHz	2026
1959.9 – 1980.0 MHz / 2149.9 – 2170.0 MHz	2021

Overview: Paired spectrum in the 2 GHz band

2. Combined provision

Spectrum in the 1920.0 – 1980.0 MHz / 2110.0 – 2170.0 MHz band is to be provided in combination. Hence a total of 2 x 60 MHz (paired) will be available.

- The 2 GHz spectrum whose rights of use expire in 2020 is to be provided together with the 2 GHz spectrum whose rights of use expire in 2025.
- This combined award of spectrum will reflect the principle of simple, appropriate and prompt administrative procedures.
- Combined provision can give companies maximum planning and investment certainty, particularly with a view to the introduction of new systems and technologies, eg 5G.
- Combined provision will enable a reallocation that gives every assignment holder in this band the chance to obtain contiguous spectrum for broadband applications.

3. Early provision

The Bundesnetzagentur intends to decide on the subsequent use of spectrum in the band 1920.0 – 1980.0 MHz / 2110.0 – 2170.0 MHz as soon as possible before 31 December 2020.

- The Bundesnetzagentur is looking to take a decision on provision of the above spectrum in the 2 GHz band, the assignments for which are expiring, in good time, ie ideally three years before expiry.
- Some respondents to the "Frequenz-Kompass" consultation called for the decision on the provision of spectrum to be put back in light of the anticipated technical developments for 5G. However, the Bundesnetzagentur is seeking to give every interested company the necessary planning and investment certainty at an early stage. Hence it is giving both the current market players and other interested companies the chance to help shape the procedure at the earliest possible opportunity so that the 2 GHz spectrum can be made available in non-discriminatory manner on the basis of transparent and objective procedures.

4. 5 MHz blocks

The spectrum is to be provided in blocks of 5 MHz. The frequency band 1920.0 – 1980.0 MHz/ 2110.0 – 2170.0 MHz is to be made available in its entirety. Following an initial assessment the Bundesnetzagentur is assuming that it will not be necessary to stipulate guard bands to protect adjacent applications.

- When the 2 GHz band was provided for UMTS in 2000, guard bands were set at the edge of the paired spectrum. This was to protect, on the one hand, the adjacent TDD applications in the band 1900.1 – 1920.1 MHz (separation distance 1920.1 – 1920.3 MHz) and, on the other, military applications below the upper band (separation distance 2110.0 – 2110.3 MHz) and satellite services in the adjacent MSS band at the upper edges of the paired band (1979.7 – 1980.0 MHz and 2169.7 – 2170.0 MHz). As a result, the paired spectrum in the 2 GHz band is currently assigned in blocks of 4.95 MHz.
- The intention is to provide the entire band from 1920.0 – 1980.0 MHz / 2110.0 – 2170.0 MHz. It is not intended to stipulate guard bands to protect adjacent applications. Such protection is possible without setting guard bands beforehand. Yet it is necessary to take measures at the edges of the band to protect adjacent uses by defining suitable block edge masks.
- Spectrum in the 2 GHz band is to be provided in blocks of 2 x 5 MHz (paired). This reflects the smallest technically viable amount of spectrum for the two broadband technologies UMTS and LTE but also for future mobile communications technologies with a view to 5G applications. Smaller volumes of spectrum could result in spectrum packages that rule out the use of broadband technologies. Larger blocks, by contrast, could restrict the flexibility of future spectrum users and would make access to this spectrum more difficult.

5. Intended use

The 2 GHz spectrum is to be made available throughout the country for Wireless Access.

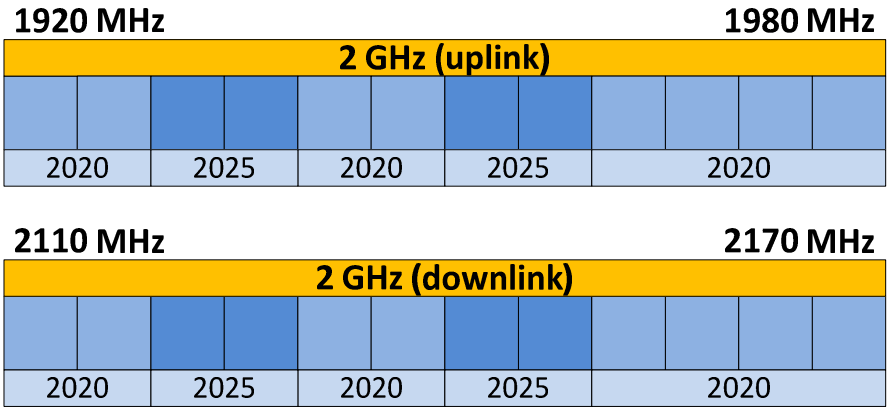
- The 2 GHz spectrum will become available again nationwide as from 2021 and 2026. The intention is to assign the frequencies nationwide, too, as from 2021 and 2026.
- The relevant frequencies in the 2 GHz band are designated for purposes of Wireless Access for the provision of telecommunications services.[43] Hence they will be provided on a technology- and services-neutral basis and will enable the deployment of various wireless technologies.
- This technology- and services-neutral provision will allow flexible deployment of the paired 2 GHz spectrum for 5G services as soon as the systems are available.

[43] Frequency Plan, Entries 290009, 291001, 295001, 296001.

6. Contiguous spectrum

The 2 GHz spectrum is to be assigned as contiguous spectrum in each case. This may necessitate shifts in current assignments.

- The spectrum is to be provided and assigned in contiguous blocks, as far as possible, so as to enable, most notably, the efficient use of wireless broadband technologies.
- Using contiguous frequency blocks is more efficient than using separate, non-contiguous blocks. Moreover, it reduces the likelihood of interference arising between adjacent frequency blocks of different operators.
- With reference to combined provision of the 2 GHz frequencies that have different assignment expiry dates it may be necessary for the frequencies assigned until 2025 to be moved before the assignment expires. This could increase the efficient use of spectrum as contiguous frequency blocks could then be used for broadband applications at an early point in time.
- The 2 GHz spectrum in question is assigned as follows:



Overview: Current assignments and time periods in the 2 GHz band

7. Suitable licence duration

Suitable periods with the same expiry date are to be agreed for frequency assignments in the 2 GHz band.

- Section 55(9) sentence 1 TKG states that frequencies are typically assigned for a limited period. The time limit is required under section 55(9) sentence 2 TKG to be appropriate to the service concerned.
- In setting the time limit the Bundesnetzagentur will take into consideration, on the one hand, the interest of assignment holders in a suitable payback period for the investments they will need to make. On the other, care must be taken that the Bundesnetzagentur's leeway for decision-making on spectrum planning issues is not unduly restricted. The time limit should therefore be proportionate so that the Bundesnetzagentur's supervisory powers are not compromised.
- The regulatory authority sets the time periods according to its best judgment. For mobile communications, licence durations have been set between 15 and 20 years thus far.

- The intention is to set a uniform expiry date for assignments in the whole of the 2 GHz band. This is to make the use of contiguous spectrum possible and to provide planning and investment certainty for the entire period of the assignments.

8. Service providers / MVNOs

The current service provider access obligation is a factor in achieving the aims of regulation. In particular, if services competition is to be sustained, regulatory measures creating legal and planning certainty for all market players (mobile operators, service providers and MVNOs) may be required beyond the year 2020. The Bundesnetzagentur will take a close look at the necessary regulatory action, keeping an open mind as to the outcome.

- The mobile licences and currently the UMTS/IMT-2000 licences include an obligation on the mobile operators to grant service providers access to mobile communications services on a non-discriminatory basis. The service providers, with their mobile communications offers, have been contributing since liberalisation began in the early 1990s to strengthening competition at services level, and have furthered consumer interest in terms of choice, price and quality. The obligation to grant service providers access will end upon expiry of the UMTS/IMT-2000 licences on 31 December 2020.
- The responses to the "Frequenz-Kompass" consultation showed a mix of interests with regard to the "Service providers / MVNOs" area for regulatory action. Some respondents said that it would be necessary to renew the service provider access obligation since non-discriminatory access to mobile services would not otherwise be guaranteed, whereas advocates of the opposite view believed that a renewal of this obligation would not be necessary.
- Service providers can sign contracts with mobile operators for access to mobile communications services without this specific obligation. That said, the current access obligation has made an important contribution to maintaining and promoting sustainable competition over the last 25 years.
- Hence before frequencies are assigned in future it will be necessary to reconsider the regulatory aspects of a service provider access obligation, account also being taken of the specific interests of the MVNOs. Imposing such a technology-neutral obligation could – as the respondents pointed out – prove a suitable way to speed penetration of the market with innovative services for the consumers' benefit, not least with a view to the introduction of 5G.

9. New entrants

The interests of potential new entrants are also to be taken into account in spectrum provision for the rollout of digital infrastructures. With a view in particular to promoting infrastructure competition the Bundesnetzagentur will take a close look at the necessary regulatory action, keeping an open mind as to the outcome.

- In connection with the provision of spectrum rights of use the interests of potential new entrants must be identified and taken into consideration and the regulatory aims weighed in light of these. Now that the market constellation has changed following the merger of the two operators Telefónica and E-Plus and there are now only three independent mobile operators nationwide, the matter of competitive aspects in the market has taken on special importance.
- The European Commission approved the merger without stipulating a new entrant as a minimum requirement.[44] Approval was, however, linked to the full implementation of a set of commitments offered by Telefónica. To allay the Commission's concerns Telefónica offered commitments, basically in the form of three components, to ensure that new competitors would have access to the German mobile market and the position of the existing competitors would be strengthened. The so-called "MNO component" is designed to facilitate the entry of a new mobile operator into the German market. It consists, in essence, of a commitment to lease spectrum assets of 2 x 10 MHz at 2 GHz until the end of 2020 and of 2 x 10 MHz at 2.6 GHz until the end of 2025 along with the possibility of national roaming until the end of 2025.[45]
- The interests of potential new entrants are to be taken into account in the Bundesnetzagentur's continuing administrative practice in carrying out objective, transparent and non-discriminatory procedures. Yet arrangements supporting potential new entrants will need objective justification in view of the principle of non-discrimination.
- The interests of the competitors in the specific procedure for the provision of spectrum are to be identified so that possible measures can be considered. To be looked at besides the interests of the existing operators is the question of specific measures that might prove necessary from the perspective of potential new entrants.

10. Scenarios of use

The Bundesnetzagentur anticipates requirements for spectrum in the band from 1920 – 1980 MHz / 2110 – 2170 MHz for mobile broadband, most notably for 5G, beyond the term of the current assignments that are set to end in 2020 and 2025.

Both current assignment holders and other interested companies are invited herewith to set out in detail, with reference to their future business model, their interest in using this spectrum.

- The 2 GHz band is currently used for the provision of UMTS services. The UMTS networks contribute to nationwide mobile broadband coverage, having, as they do in some cases, coverage requirements of over 90 percent of the population. One of the points put forward in the "Frequenz-Kompass" consultation was that 2 GHz spectrum would continue to be used in the UMTS networks for a foreseeable time.

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[44] cf European Commission, Case M.7018, Decision of 2.7.2014, C(2014) 4443 final.
[45] European Commission, Case M.7018, loc cit, recital (1359)ff.

- Requirements for spectrum for LTE can be expected to grow in the 2 GHz band as well, as a result of LTE-capable devices penetrating the market.
- The 2 GHz band can also be used for 5G services as soon as the systems are available, given the technology-neutral frequency assignments.
- New uses of spectrum by potential new entrants cannot be ruled out from the beginning in light, also, of access rights to spectrum resulting from the merger of Telefónica and E-Plus.
- The Bundesnetzagentur anticipates that the 2 GHz band will continue to be used nationwide for mobile broadband.
- With a view to the large number of possible use cases, all interested companies are invited herewith to set out their scenarios of use (eg planned services, target groups, timeframes, business models, suitable spectrum packages) for the 2 GHz band.

3.4 – 3.8 GHz

11. Objective, transparent and non-discriminatory procedure

Rights of use in the frequency band 3.4 – 3.8 GHz are set to expire on 31 December 2021 and 31 December 2022 and will be made available in an objective, transparent and non-discriminatory procedure.

- The frequencies are assigned in line with sections 55ff TKG. Each frequency use requires prior assignment. Frequencies are assigned for a particular purpose in accordance with the Frequency Plan and in non-discriminatory manner on the basis of transparent and objective procedures, section 55(1) TKG.

12. Combined provision

Spectrum in the 3400 – 3600 MHz and 3600 – 3800 MHz bands is to be provided in combination. Hence a total of 400 MHz will be available.

- The frequency bands from 3.4 – 3.6 GHz and 3.6 – 3.8 GHz are harmonised both by ECC Decision (ECC/DEC(11)06) and Commission Decision 2014/276/EU amending Commission Decision 2008/411/EC. Channel arrangements have been made for TDD and FDD applications. The RSPG has identified the entire band from 3.4 – 3.8 GHz for the initial implementation of 5G.[46]
- This combined provision of spectrum is to enable such reallocation as makes it possible for future assignment holders in this band to have particularly large volumes of contiguous spectrum for broadband applications. Placing several 5 MHz blocks in one package of contiguous blocks will increase efficient use of this spectrum.
- This may make it necessary to continue current regional and local uses for the period beyond 2022 – especially in other portions of the band from 3.4 – 3.8 GHz.

[46] cf RSPG 16-032, "Strategic Roadmap towards 5G for Europe"

13. Early provision

The Bundesnetzagentur intends to decide on future use of the 3.4 – 3.8 GHz band at an early stage.

- Respondents to the "Frequenz-Kompass" consultation called for the spectrum to be awarded in 2017/2018 and 2018/2019, as far as possible. This was important for the introduction of 5G. The Bundesnetzagentur is seeking to finalise its decision on provision of the spectrum in the band 3.4 – 3.8 GHz well before expiry of the current rights of use in order to give all interested companies the planning and investment certainty they need.
- The Bundesnetzagentur is giving both current assignment holders and other interested companies the opportunity to help shape the procedure at the earliest possible time so that spectrum from the band 3.4 – 3.8 GHz can be provided in non-discriminatory manner on the basis of transparent and objective procedures. In principle, use of the band 3.4 – 3.8 GHz is also possible for 5G services, given the technology-neutral assignments.

14. 5 MHz blocks

The spectrum is to be provided in blocks of 5 MHz or a multiple thereof. The frequency band 3400 – 3800 MHz is to be made available in its entirety. Following an initial assessment the Bundesnetzagentur is assuming that it will not be necessary to stipulate guard bands to protect adjacent applications.

- Available in the band 3400 – 3800 MHz is a total of 400 MHz in blocks of 5 MHz. The intention is to provide the whole of the frequency band from 3400.0 to 3800.0 MHz. It is not intended to stipulate guard bands with adjacent applications. Adjacent applications can be protected without guard bands being stipulated beforehand. However, to achieve protection it is necessary to take measures at the band edges to protect adjacent uses through defining suitable block edge masks.
- Spectrum in the band from 3400 to 3800 MHz will be provided in blocks of 5 MHz or a multiple thereof. This is in conformity with, on the one hand, the channel arrangement set out in ECC/DEC(11)06 and, on the other, the typical bandwidths for mobile technologies. Smaller blocks could result in spectrum packages that rule out use for broadband systems.
- Mindful of the fact that in higher frequency bands particularly high data rates – most notably for 5G applications – are to be expected, block sizes larger than 5 MHz could also be stipulated. This is particularly true with available spectrum of 400 MHz. An important factor for consideration in determining block size is the different spectrum requirements future users are likely to have. This will also yield maximum diversity of business model.

15. Intended use

Spectrum in the band 3.4 – 3.8 GHz is to be provided for future-proof business models in line with demand, most notably with a view to 5G applications (eg Industry 4.0, Internet of Things). The aim is, having regard to the requirement of efficient spectrum use, to provide sufficient spectrum for every business model.

- The spectrum in question in the band 3.4 GHz – 3.8 GHz is designated for Wireless Access on a technology- and services-neutral basis.[47] It will therefore be provided on a technology- and services-neutral basis and will enable the deployment of various wireless technologies.
- The requirement for technology and services neutrality means that the frequencies from the band 3.4 GHz – 3.8 GHz can be used flexibly for 5G services as well.
- It is intended to provide the frequencies in the band 3.4 – 3.8 GHz unpaired.
- On account of the physical properties of the frequencies in the band 3.4 GHz – 3.8 GHz and the resultant limited cell size, a large area network cannot be expected with this spectrum.
- The aim is to provide sufficient spectrum for every business model while accommodating the requirement of efficient spectrum use.
- Some respondents have called for spectrum to be provided for definable coverage areas (eg for local applications, Industry 4.0, capacity in hot spots). The frequency band 3.4 – 3.8 GHz is particularly suitable for this. The possibility of using spectrum for regional, supraregional and even nationwide business models will need further elucidation from interested companies, given the requirement of efficient spectrum use.

16. Contiguous spectrum

Frequencies in the band 3.4 – 3.8 GHz are to be assigned as contiguous spectrum in each case.

- The assignment of contiguous spectrum is designed to secure the efficient use of spectrum and the rollout of high speed next-generation networks (5G).
- Contiguous spectrum blocks can be used more efficiently than separate, non-contiguous blocks. Moreover, it reduces the likelihood of interference arising between adjacent blocks of different operators. This is true with regard particularly to the possible deployment of TDD systems.

[47] Frequency Plan, Entries 315005, 316004, 317003.

17. Suitable licence duration

Suitable periods with the same expiry date are to be agreed for frequency assignments in the band 3.4 – 3.8 GHz.

- Section 55(9) sentence 1 TKG states that frequencies are to be assigned typically for a limited period. The time limit must be appropriate to the service concerned under section 55(9) sentence 2 TKG.
- In setting the time limit the Bundesnetzagentur will take into consideration, on the one hand, the interest of assignment holders in a suitable payback period for the investments they will need to make. On the other, care must be taken that the Bundesnetzagentur's leeway for decision-making on spectrum planning issues is not unduly restricted. The time limit should therefore be proportionate so that the Bundesnetzagentur's supervisory powers are not compromised.
- Thought will also be given to setting a uniform expiry date for the whole of the 3,4 – 3,8 GHz band. This is to make the use of contiguous spectrum possible and to provide planning and investment certainty for the entire period of the assignments.

18. Interests of SMEs / start-ups

Given the short innovation cycles for new applications (Internet of Things, M2M, Industry 4.0, smart grid, etc) and associated business models, future market and technological developments are not yet on the horizon. The interests of small and medium-size enterprises, start-ups included, are therefore to be taken into due consideration over the entire period.

- In light of the planned provision of the frequency band 3.4 GHz – 3.8 GHz in Europe as the pioneer band for 5G applications, future market and technological developments, in particular, are to be taken into account.
- For innovative applications still to develop in connection with 5G it may be necessary to enable flexible, successive access to spectrum over the entire period.
- In order to develop an assignment regime that can accommodate as many business models as possible (most notably with a view to 5G; the Internet of Things, M2M, Industry 4.0, smart grid) and development perspectives for small and medium-size enterprises it is necessary today, already, to request information about use cases companies are interested in.

19. Scenarios of use

The Bundesnetzagentur is anticipating demand for spectrum for broadband wireless networks / 5G networks in future in the entire band from 3.4 GHz – 3.8 GHz.

Both current assignment holders and other interested companies are invited herewith to set out in detail, with reference to their future business model, their interest in using this spectrum.

- The responses to the "Frequenz-Kompass" consultation show more of a heterogeneous picture of possible future uses at the moment. Some of the respondents suggest providing at least the range from 3.4 GHz – 3.6 GHz for nationwide use.
- For existing local assignments and specific-area assignments there is interest both in uninterrupted continuation of the applications beyond 2022 and in the additional development potential of broadband offers.
- The demand for spectrum for mobile broadband applications is also expected to grow in the frequency band 3.4 GHz – 3.8 GHz in the medium term as a result of the penetration of the market with LTE-capable devices.
- As the preferred candidate band for the initial implementation of 5G the frequency band 3.4 GHz – 3.8 GHz will play an important part in the rapid introduction of 5G business models. The Bundesnetzagentur expects demand for this spectrum to be commensurate.
- For innovative applications still to develop in connection with 5G it may be necessary to enable flexible, successive access to spectrum over the entire period (SMEs / start-ups).
- On account of the physical properties of the spectrum in the band 3.4 GHz – 3.8 GHz and the resultant limited cell sizes a large area network cannot be expected with this spectrum.
- With a view to the large number of uses, all interested companies are invited herewith to set out their scenarios of use for the whole of the band 3.4 GHz to 3.8 GHz with special reference to the bandwidths required and the areas in which the frequencies are to be used (eg planned services, target groups, timeframes, business models, suitable spectrum packages).

700 MHz centre gap

20. 700 MHz centre gap

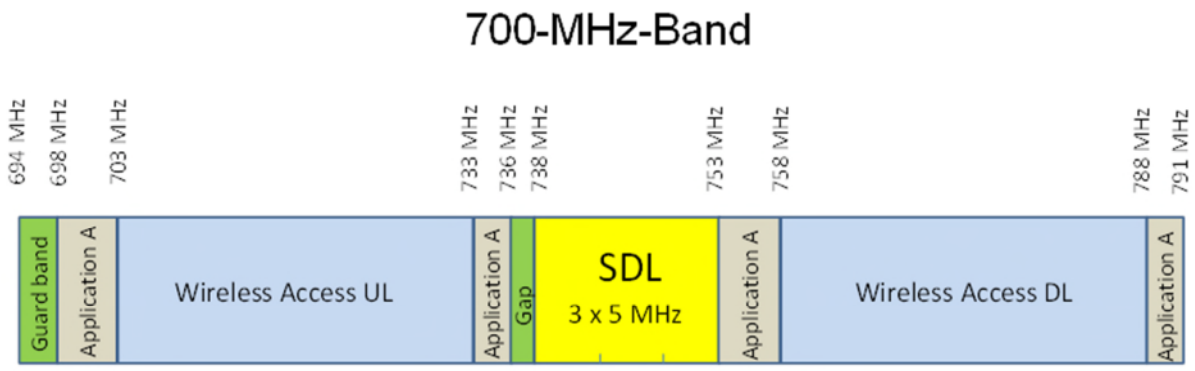
Spectrum in the band 738 – 753 MHz (a total of 15 MHz) in the centre gap of the 700 MHz band is to be provided for Wireless Access as a supplementary downlink (SDL).

Interested companies are invited herewith to set out in detail, with reference to their future business model, their interest in using this spectrum.

- Available in the 700 MHz band for Wireless Access is 15 MHz in the centre gap. This spectrum is to be provided as a supplementary downlink (SDL) in light of the limited bandwidth.
- As the SDL downlink can be used only in connection with a duplex band it is therefore intended to set the same conditions of use as in the possible corresponding bands:

5 MHz blocks and nationwide provision of the spectrum. Use of the frequency band 738 – 753 MHz can be made deploying broadband wireless technologies such as LTE or 5G using carrier aggregation.

- The chart below gives an overview of uses in the whole of the 700 MHz band:



NB: The sections denoted "Application A" are to be designated for authorities and organisations concerned with public safety.

28 GHz

21. 28 GHz band

The frequency assignments in the 28 GHz band are set to expire on 31 December 2020. The whole of the band 27.8285 – 28.4445 GHz and 28.9485 – 29.4525 GHz will be provided in an objective, transparent and non-discriminatory procedure in line with demand.

Both current assignment holders and other interested companies are invited herewith to set out in detail, with reference to their future business model, their interest in using this spectrum.

- The radio relay assignments in the 28 GHz band are set to expire on 31 December 2020 and are thus available for reassignment as from 1 January 2021.
- Spectrum in the whole of the band 27.8285 – 28.4445 GHz and 28.9485 – 29.4525 GHz is to be provided in an objective, transparent and non-discriminatory procedure in line with demand.
- The responses to the "Frequenz-Kompass" consultation showed a mix of interests as regards possible future use. Some respondents pointed out the development potential for both local, industrial 5G applications and radio relay use in the mobile operators' core networks (backhaul). Also mentioned were flexible approaches such as shared use by radio relay outside and 5G inside buildings.
- With a view to the large number of possible use cases all interested companies are invited herewith to set out their scenarios of use for the 28 GHz band with particular reference to the bandwidth required and use of the frequencies (eg planned services, target groups, timeframes, business models, suitable spectrum packages).

26 GHz

22. 26 GHz band

The 26 GHz band, identified by the RSPG as a pioneer band for 5G applications, is to be looked at for its suitability for provision in line with demand (see also item 1.13 of the agenda for WRC 2019 aiming to identify frequency bands for IMT2020).

Both current assignment holders and other interested companies are invited herewith to set out in detail, with reference to their future business model, their interest in using this spectrum.

- The 26 GHz band ranges from 24.25 GHz to 27.5 GHz.
- The RSPG Opinion "Strategic Roadmap towards 5G for Europe" identifies the 26 GHz band as the pioneer band for 5G. Yet at the same time, existing services and their potential for development are to be protected. Thus the European Commission has given a mandate to CEPT to clarify compatibility issues between 5G and existing radio services.[48]
- In this connection, respondents to the "Frequenz-Kompass" consultation called for spectrum in the 26 GHz band and in adjacent frequency bands to be envisaged for 5G under consideration of developments in other markets (eg South Korea and the US).
- The responses to the "Frequenz-Kompass" consultation showed a mix of interests in respect of future use. Some respondents pointed out the development potential for both local, industrial 5G applications and radio relay uses in the mobile operators' core networks (backhaul). Also mentioned were flexible approaches such as shared use by radio relay outside and 5G inside buildings.
- In light of the large number of possible use cases all interested companies are invited herewith to set out their scenarios of use for the 26 GHz band with special reference to required bandwidth and use of the spectrum (eg planned services, target groups, timeframes, business models, suitable spectrum packages).
- Future use of the 26 GHz band will need to take account of the earth exploration service.

[48] cf RSCOM16-40rev3

23. Interests of SMEs / start-ups

Given the short innovation cycles for new applications (Internet of Things, M2M, Industry 4.0, smart grid, etc) and associated business models, future market and technological developments are not yet on the horizon. The interests of small and medium size enterprises, start-ups included, are therefore to be taken into due consideration over the entire period.

- In light of the future provision of the 26 GHz band in Europe as the pioneer band for 5G applications it is important to take new developments, in particular, into account.
- For innovative applications still to develop in connection with 5G it may prove necessary to enable flexible, successive access to spectrum over the entire period.
- In order to draw up an assignment regime that takes account of as many business models as possible (most notably with reference to 5G; the Internet of Things, M2M, Industry 4.0, smart grid) and development perspectives for small and medium-size enterprises, start-ups included, it is necessary today, already, to request information about uses companies are interested in.

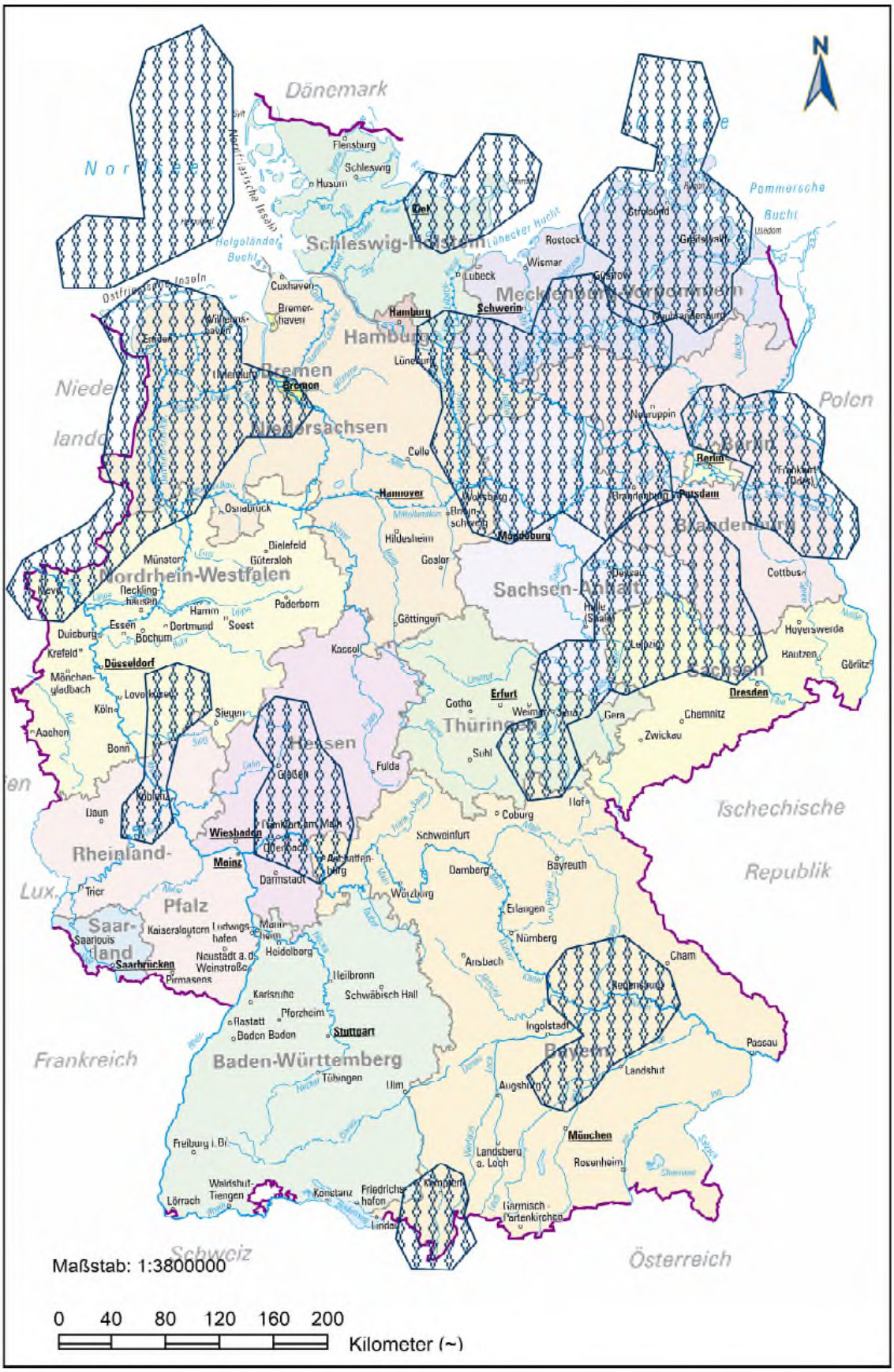
D. Further action

The Bundesnetzagentur will concretise its further action on the provision of spectrum, in line with market demand, from the bands 700 MHz (centre gap), 2 GHz, 3.4 – 3.8 GHz, 26 GHz and 28 GHz for the rollout of digital wireless infrastructures on the basis of the responses to these Points of Orientation, the interests identified and the scenarios of use.

I

Annex 1: Overview of regional uses at 3.4 – 3.6 GHz

Frequency band 3473 – 3494 MHz / 3573 – 3594 MHz: Unlimited assignments (WLL)

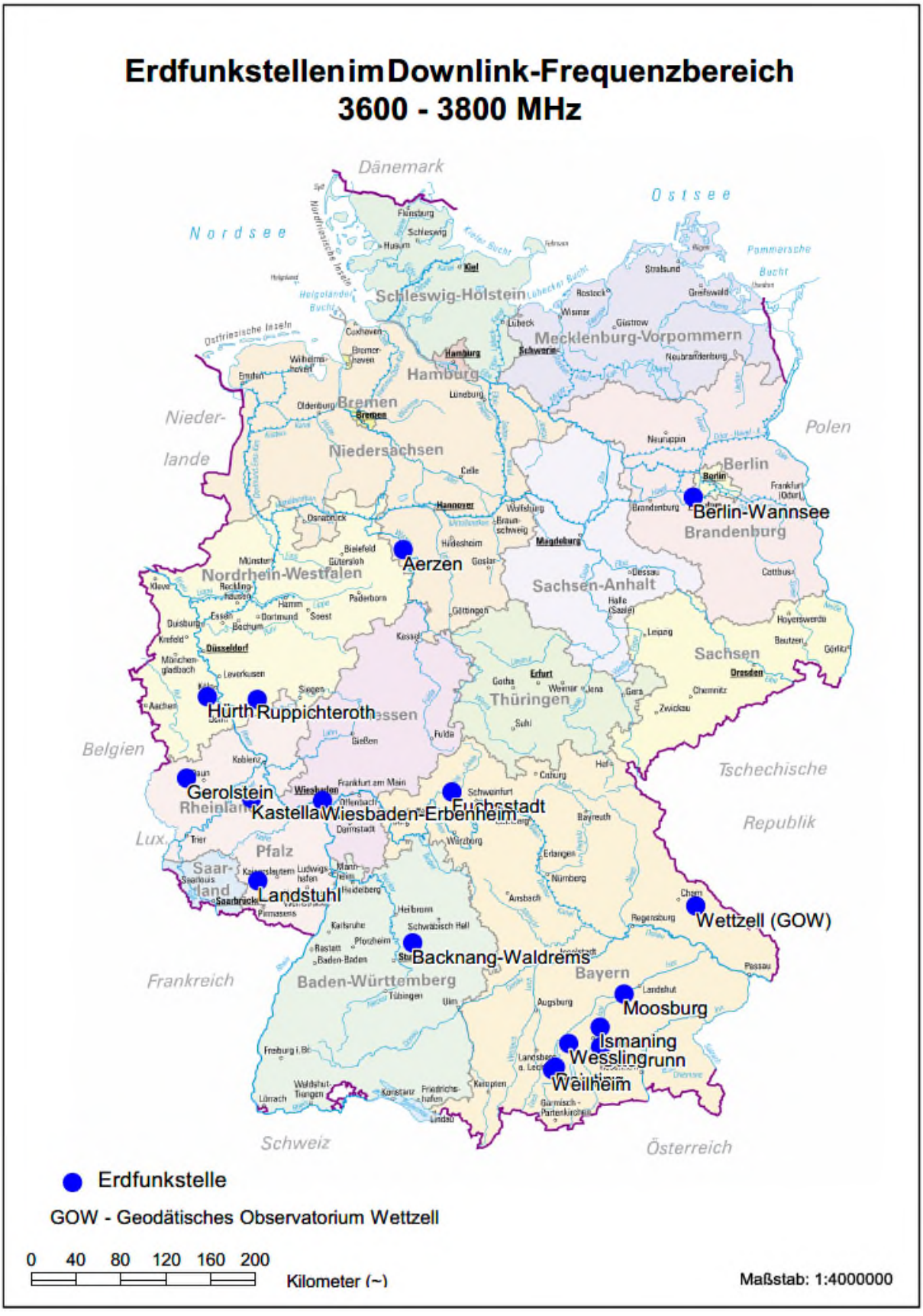


Frequency band 3473 – 3494 MHz / 3573 – 3594 MHz: Fixed-term assignments (BWA)

Annex 2: Sites of the earth stations requiring protection at 3.6 – 3.8 GHz

Earth stations with downlink frequencies (3600-3800 MHz)

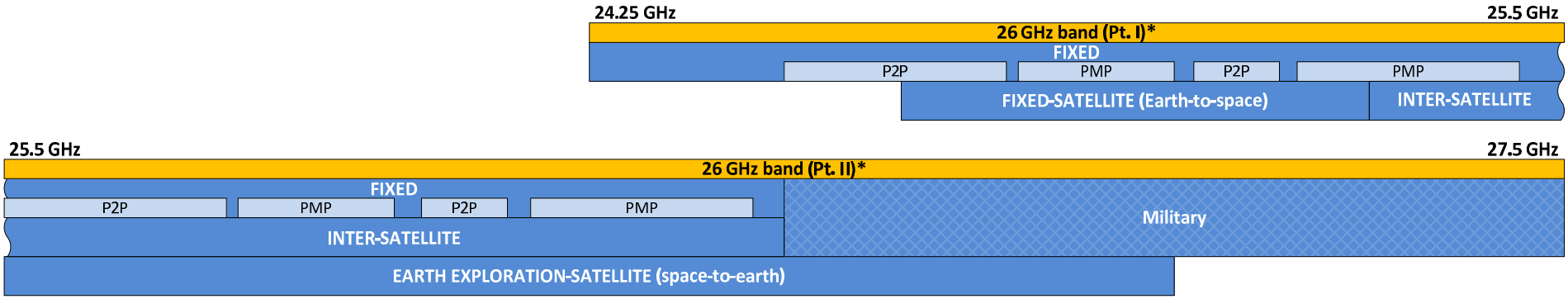
	Latitude N (WGS 84)			Longitude E (WGS 84)			Location
	Degree	min.	sec.	Degree	min.	sec.	
1	52	03	38	09	19	49	Aerzen
2	48	54	49	09	25	34	Backnang-Waldrems
3	52	24	30	13	07	35	Berlin-Wannsee
4	50	07	05	09	55	26	Fuchsstadt
5	50	12	28	06	37	12	Gerolstein
6	50	51	47	06	50	53	Hürth
7	48	12	28	11	39	42	Ismaning
8	50	03	33	07	26	05	Kastellaun
9	49	24	03	07	31	53	Landstuhl
10	48	28	00	11	57	48	Moosburg
11	48	03	05	11	39	36	Ottobrunn
12	47	53	58	11	06	51	Raisting
13	50	51	07	07	28	48	Ruppichteroth
14	47	52	49	11	04	46	Weilheim
15	48	05	10	11	16	52	Wessling
16	49	08	42	12	52	39	Wettzell (GOW)
17	50	03	01	08	18	57	Wiesbaden-Erbenheim


Erdfunkstellen im Downlink-Frequenzbereich
3600 - 3800 MHz
Dänemark
Nordsee
Ostsee
Schleswig-Holstein
Mecklenburg-Vorpommern
Hamburg
Bremen
Niedersachsen
Nieder-
lande
Polen
Berlin
Berlin-Wannsee
Brandenburg
Aerzen
Nordrhein-Westfalen
Sachsen-Anhalt
Hürth
Ruppichteroth
Thüringen
Sachsen
Belgien
Tschechische
Republik
Gerolstein
Kastellaun
Wiesbaden-Erbenheim
Fuchsstadt
Pfalz
Landstuhl
Wettzell (GOW)
Backnang-Waldrems
Frankreich
Baden-Württemberg
Bayern
Moosburg
Ismaning
Wesslingrunn
Weilheim
Schweiz
Österreich
Erdfunkstelle
GOW - Geodätisches Observatorium Wettzell
0 40 80 120 160 200
Kilometer (~)
Maßstab: 1:4000000

Annex 3: Overview of earth exploration satellite stations

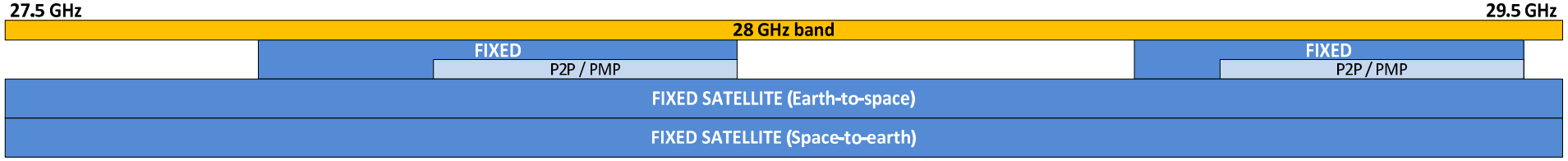
Annex 4: Overviews of the 26 GHz and 28 GHz bands

26 GHz band:

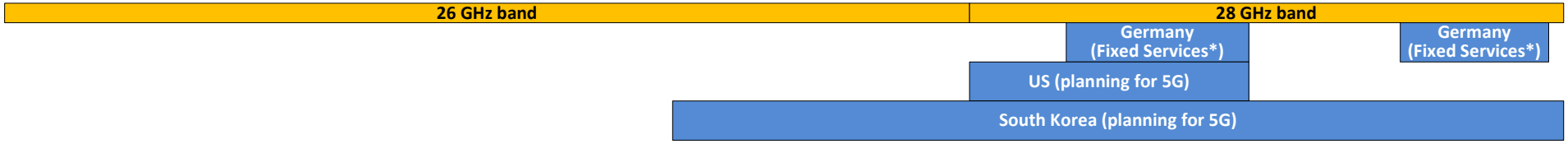


* Not including radio applications for transport telematics, as expiry date is 31.12.2022

28 GHz band:



Planning in the US and South Korea for 28 GHz:



* Assignments for Fixed Services expire on 31.12.2020

Overview from ECC(DEC)(05)01, p7:

ANNEX 1: BAND SEGMENTATION FOR FSS AND FS IN THE BAND 27.5-29.5 GHz

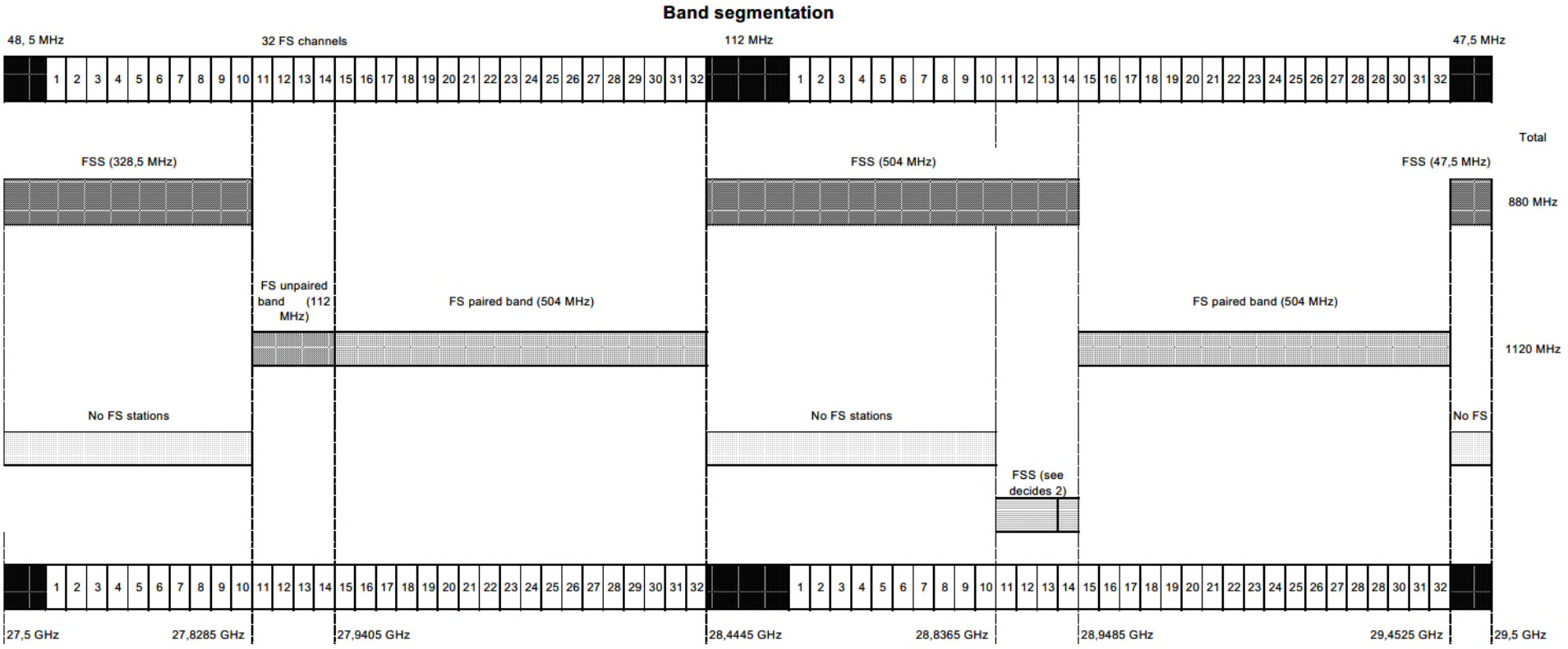


Figure: Band segmentation for FSS and FS in the band 27.5-29.5 GHz

Annex 5 Overview of the earth stations at 27.5 – 29.5 GHz

List of abbreviations

5G	Fifth generation of mobile communications
ABl.	Official Gazette (Amtsblatt)
BOS	Authorities and organisations concerned with public safety
CEPT	European Conference of Postal and Telecommunications Administrations
DVB-T	Digital video broadcasting – Terrestrial
ECC	Electronic Communications Committee
EU	European Union
FDD	Frequency Division Duplex
FS	Fixed Service
FSS	Fixed-Satellite Service
GHz	Gigahertz
GOW	Geodetic Observatory Wettzell
HRWS	High-resolution wide-swath
IMT	International Mobile Telecommunications
IT	Information technology
Ka-Band	Frequency band between 27 – 40 GHz
LTE	Long Term Evolution (4G)
M2M	Machine-to-Machine
MHz	Megahertz
MNO	Mobile Network Operator
MSS	Mobile Satellite Service
MVNO	Mobile Virtual Network Operator
PMR	Private mobile radio
RSPG	Radio Spectrum Policy Group
SARah	Satellite-based radar reconnaissance system
SDL	Supplementary downlink
SME	Small and medium-size enterprise
Tandem-L	Satellite mission for the global observation of dynamic processes on the earth's surface
TDD	Time Division Duplex
TKG	Telecommunications Act
UHF	Ultra-High Frequency
UMTS	Universal Mobile Telecommunications System
WGS 84	World Geodetic System 1984
WLL	Wireless Local Loop
WRC	World Radiocommunication Conference