



Bundesnetzagentur

Key Elements
for the rollout of digital infrastructures
and
Identification of Demand
for nationwide assignments
in the 2 GHz and 3.6 GHz bands

Contents

- A. Introduction..... 1**
- B. Steps..... 2**
 - 2 GHz 2
 - 3.4 – 3.8 GHz 5
 - 700 MHz centre gap 8
 - 26 GHz and 28 GHz 9
- C. Key Elements 11**
 - Key elements 2 GHz..... 11
 - Key elements 3.4 – 3.8 GHz 14
 - Key element Shared use of capacity and services 20
 - Key element 700 MHz centre gap 21
 - Key element Spectrum above 24 GHz 22
- D. Further action 22**
- E. Demand identification proceedings 23**
- Annex – Account of spectrum requirements 26**
- List of abbreviations..... 28**

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A. Introduction

In December 2016 the Bundesnetzagentur launched a public consultation on its document "Points of Orientation for the provision of spectrum for the rollout of digital infrastructures". The aim of the consultation was to identify and provide suitable spectrum in particular for the introduction of "5G", the next generation of mobile technologies, at an early stage.

In view of the large number of possible uses, all interested companies were invited to set out their scenarios of use for the respective frequency bands. The consultation also provided the opportunity for views on whether, and if so, to what extent, access rights for service providers and MVNOs should be required beyond the year 2020.

One of the reasons for requesting this information was 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 were to be incorporated also.

Interested parties were then invited to submit their views by 1 March 2017. In light of the responses received, the Bundesnetzagentur is assuming that all the frequencies in the 2 GHz band (originally called the UMTS band) currently assigned until the end of 2020 and the end of 2025 will be used for the rollout of digital infrastructures. The introduction of efficient new technologies will necessitate planning certainty for these still assigned frequencies, however. Hence a decision on renewed provision of the spectrum is called for as swiftly as possible.

In addition, the consultation responses show demand for spectrum in the 3.6 GHz band for both nationwide and regional use. Frequencies in this band will become widely available again as from 2022. The band has already been identified internationally for the introduction of 5G. Thus spectrum here, as well, should be provided for 5G at the earliest possible opportunity. It is important that access to the spectrum is not left to the free play of market forces but that a balance is found between the divergent interests of the nationwide and the regional user groups. The Bundesnetzagentur will ensure that all user groups obtain access to the spectrum in non-discriminatory manner.

Based on the views submitted, the Bundesnetzagentur has drawn up key elements constituting the framework conditions for spectrum provision and thus creating the basis for the formal demand identification proceedings. The Bundesnetzagentur is therefore issuing a call to interested parties to notify their requirements for spectrum in the bands at 2 GHz and 3.6 GHz provided on a nationwide basis. Its intention is to make available, for nationwide use, 60 MHz from the 2 GHz band jointly with 300 MHz from the 3.6 GHz band in one set of proceedings.

As matters stand at present, the proceedings for the provision of 2 GHz and 3.6 GHz spectrum should be completed as far as possible in 2018, in good time before expiry of the current licences, in order to give the companies concerned and other affected parties the necessary planning and investment certainty.

A draft President's Chamber decision on provision of the above-mentioned spectrum will be drawn up on the basis of the frequency requirements identified. We should point out, however, that it will not be possible to begin carrying out award proceedings directly should spectrum resources be found to be scarce. Carrying out award proceedings presupposes that further decisions the President's Chamber is required by law to take (on award conditions and award rules) have been issued for which consultation with the Advisory Council is also needed.

Frequencies in the 3700 – 3800 MHz band are to be assigned for particular areas in line with demand. The Bundesnetzagentur will provide these frequencies in a further step, that is to say in an application procedure for area-related regional/local assignments, the conditions of use included.

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Spectrum above 24 GHz – in particular the band at 26 GHz – is also to be provided for 5G at the earliest possible opportunity, in line with demand and in consideration of existing uses. The Bundesnetzagentur therefore intends to draw up an application procedure initially for the 26 GHz band.

B. Steps

The Bundesnetzagentur's "Frequenz-Kompass" document of July 2016 gave an overview of further procedure in spectrum management and identified areas for regulatory action on the rollout of digital infrastructures. It provided the starting point for assessing and structuring along forward-looking lines the current and future regulatory frameworks for the rollout of an efficient digital wireless infrastructure for society and the economy.

With reference to this the Bundesnetzagentur, on 20 December 2016, put its Points of Orientation for the provision of spectrum, in conformity with demand, for the rollout of digital wireless infrastructures up for consultation. In all, 39 responses were received.

A distillation of the responses shows the following.

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.

Essentially, the following was said on this:

The Bundesnetzagentur's intention to make available the 2 GHz spectrum in an objective, transparent and non-discriminatory procedure was generally welcomed. However, it was also stated that spectrum in the 2 GHz band should first be redistributed.

2. Combined provision

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

Essentially, the following was said on this:

The Bundesnetzagentur's intention to provide the 2 GHz spectrum as contiguous spectrum in each case was largely supported. This would create, early on, long-term planning certainty and stable regulatory frameworks that were applicable for a suitable period. The approach would make it possible to provide larger frequency blocks for the effective use of both LTE carrier aggregation and 5G technologies. It was also believed that the spectrum should be redistributed prior to renewed award.

By contrast, one respondent rejected the early, combined provision of the 2 GHz spectrum. Expiring at the end of 2025 anyway were other rights of use, for instance in the 1800 MHz and 2.6 GHz bands, which could then be awarded jointly. Forecasts of spectrum requirements stretching more than seven years into the future would be burdened by serious legal uncertainty. Moreover, inclusion was inconsistent with current administrative practice. The Bundesnetzagentur should extend the 2 GHz assignments until the end of 2025. Too early assignment would also lead to market foreclosure, the respondent believed.

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.

Essentially, the following was said on this:

Respondents were generally in favour of the 2 x 60 MHz paired spectrum in the 2 GHz band being provided jointly and in due time before 31 December 2020. Nevertheless, it was emphasised that proceedings could not be accelerated or otherwise simplified due to inclusion of the frequencies at 2 GHz that were assigned until the end of 2025.

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.

Essentially, the following was said on this:

Called for on the one hand was provision of the 5 MHz blocks without the stipulation of guard bands. Protection requirements for adjacent applications could be accommodated with CEPT's least restrictive technical conditions in the form of block edge masks (BEMs). However, it would be necessary to amend the conditions of use to reflect 5G requirements in line with the revision of the ECC Decision by ECC PT1.

Called for on the other hand was the retention or tightening up of the existing guard bands in order to protect the adjacent MSS applications. This call was made with reference to ECC Decision (06)01 which allows for a 300 kHz guard band below 1980 MHz and 2170 MHz in the current frequency assignments in Germany.

5. Intended use

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

Essentially, the following was said on this:

Nationwide provision of the 2 GHz spectrum for Wireless Access (Electronic Communications Services) was welcomed.

6. Contiguous spectrum

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

Essentially, the following was said on this:

The assignment of contiguous spectrum was welcomed by all the respondents.

7. Suitable licence duration

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

Essentially, the following was said on this:

Setting a uniform expiry date for future assignments was welcomed. While one respondent proposed that the assignments expiring in 2020 be extended until 2025, another respondent was in favour, should an auction be held, of two groups of auction products with different

expiry dates. For the 2 GHz band, assignment periods between 20 and 30 years were called for.

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.

Essentially, the following was said on this:

Some of the respondents advocated person-related, technology-neutral service provider obligations. Given the diversity of offers, service providers were an important corrective to the network operators. In the absence of an obligation, service provider agreements were not likely to be concluded.

Moreover, it was believed that the service provider access obligation should be widened to include MVNOs. This would create the basis for new, innovative services and for offers tailored more to the customer. It was precisely the MVNOs that, in the role of enabler, could act as a corrective to the network operators.

By contrast, several comments did not want service provider access obligations imposed. The view put forward was that the wholesale market had developed independently of the regulatory obligation, on the basis of market forces.

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.

Essentially, the following was said on this:

Some of the respondents were against giving special consideration to the interests of new entrants. Some pointed out that the 2010 and 2015 award proceedings had proved appropriate and successful without reservations or other rules being necessary. Measures favouring new entrants had produced negative effects in other countries or had led only to short-lived competition. Following the merger of the two operators Telefónica Deutschland and E-Plus there was no more scope for a new entrant that made any business sense. Nor had it been possible for the European Commission to find a potential new entrant. Any new entrant interests were secured by the MNO remedy. The outcome of measures for new entrants could be a scarcity of spectrum brought about by regulation.

Other respondents, by contrast, called for special measures for new entrants in the event of award proceedings. Thus part of the available spectrum would have to be reserved for them. At the same time, established MNOs would have to be obliged to provide national roaming, otherwise services could not be provided widely and extensively.

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.

Essentially, the following was said on this:

Requirements for further intensive use of the radio spectrum would continue beyond the year 2020. Even if the 2 GHz band was not a key band for 5G, the licence conditions should be modified to meet the requirements of 5G, however.

One respondent noted that other companies would have to be allowed to share use of the frequencies in question. New services were likely to emerge in the next few years in the IoT environment in particular. If the innovators were to be able to offer these services in Germany, they would have to be able to choose partners in a competitive environment. Candidates for this would be most notably the MNOs and precisely the MVNOs.

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.

Essentially, the following was said on this:

All the respondents welcomed the Bundesnetzagentur's intention to make spectrum in the 3.4 – 3.8 GHz band 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.

Essentially, the following was said on this:

In this band, respondents pointed out, large bandwidths (up to 400 MHz) were available for 5G. Generally, the 3400 – 3800 MHz band was seen as ideal for providing a combination of extensive coverage and markedly higher service quality for 5G. The 5G standardisation activities currently underway in 3GPP were looking at channel bandwidths around 100 MHz. Following the principle of European harmonisation the preference for TDD systems decided by the ECC should be implemented for the entire 3400 – 3800 MHz band (ECC/DEC(11)06). Bandwidths of 80 to 100 MHz were called for to enable the rollout of 5G networks.

Calls were made on the one hand for frequencies to be provided nationwide in order to promote the development of 5G systems and the rollout of 5G networks. Nationwide assignment of the frequencies would provide a sufficiently sound planning basis for emerging frequency requirements to be accommodated flexibly. Fragmenting the spectrum for award to a number of smaller network operators ran counter to the promotion of 5G mobile broadband services.

On the other hand, there were calls for frequencies to be made available on a regional or a local basis. Two aspects would need consideration in providing the band. First, existing regional uses would have to be taken into account. And second, as digitalisation advanced, new business models (eg in connection with Industry 4.0) were expected to emerge. That meant that requirements for spectrum to which consideration would have to be given could arise long after the decision had been taken.

It was also pointed out that regional assignments already existed in the band. As a rule, between 40 MHz and a maximum of 80 MHz had been assigned which constituted, in principle, a bandwidth suitable for 5G.

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It was noted in respect of existing regional providers that they were not reliant on the purchase of globally standardised systems on the world market. It was therefore appropriate to domicile the frequencies envisaged for local applications in the upper sub-band at 3.6 – 3.8 GHz. To avoid fragmentation of the band and to be able to realise assignments for, as far as possible, contiguous spectrum in this sub-band too, the upper band was to be envisaged for local applications. For the 3.6 – 3.8 GHz band, however, equipment for mass market offers was expected by some to be available only at a later date.

In respect of existing local and area-related assignments there was interest both in continuing the applications beyond 2022 and in additional development potential for broadband offers.

Some respondents proposed that existing uses be moved to the 3760 – 3800 MHz band and the licence duration extended at the same time. Frequency assignments not currently used for the provision of telecommunications services should be revoked immediately and consistently.

Many respondents called for the protection of satellite communications. Some proposed that future assignments for satellite communications be made in the band 3.8 – 4.2 GHz in future too and the satellite uses be shifted from the sub-band 3.6 – 3.8 GHz to this band. At least there should be a shift to the 3760 – 3800 MHz band.

13. Early provision

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

Essentially, the following was said on this:

Several respondents welcomed early provision of the 3.4 – 3.8 GHz band.

By contrast, one respondent emphasised that award proceedings should be put back as far as possible. There was currently no time pressure to launch proceedings and to set binding framework conditions that would hamper later planning and adaptation to the 5G preparation work which would then be foreseeable. One outcome, moreover, of too early assignment would be market foreclosure.

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.

Essentially, the following was said on this:

A large number of respondents were in favour of providing the band from 3400 MHz to 3800 MHz for TDD systems in observance of the channel arrangements in ECC/DEC(11)06. In future, systems with bandwidths between 50 MHz and over 100 MHz would be expected and hence assignments for contiguous spectrum were called for. Several respondents considered the provision of blocks of 10 MHz, 20 MHz or 50 MHz appropriate.

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.

Essentially, the following was said on this:

Respondents welcomed provision for Wireless Access (ECS) and TDD use. Drawing up the rights of use on a technology- and services-neutral basis meant that it was possible, now already, for the frequencies for mobile communications to be used flexibly for 5G services. Going beyond this, one respondent advocated flexible use of TDD and FDD.

Several respondents were in favour of nationwide assignments in the 3.4 – 3.8 GHz band. One respondent believed, however, that local assignments (eg for industry applications) would complement applications in very small areas.

One respondent put forward the view that the band 3480 – 3500 MHz / 3580 – 3600 MHz, already in use, should be envisaged on a technology-neutral basis for "maritime" services in coastal and offshore areas. A further 2 x 20 MHz in the band 3600 – 3700 MHz / 3700 – 3800 MHz should be provided on a technology-neutral basis for the local and regional services of small and medium-size enterprises. One respondent believed that 40 MHz in the band 3760 – 3800 MHz should be enough for local applications outside the mass market.

16. Contiguous spectrum

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

Essentially, the following was said on this:

Some of the respondents referred to the fact that the frequency band was currently (heavily) used by satellite communications or bordered on bands used in this way and that the spectrum was therefore available for new applications to a limited extent only in order to protect satellite earth stations and fixed services.

Other respondents called for large channel bandwidths of up to 100 MHz to be made available contiguously in this band. This was necessary for mobile operators if they were to achieve maximum use of the band for 5G. Fragmentation of the spectrum for award to many smaller operators ran counter to the agreed plan of promoting 5G mobile broadband services. In this connection it was important, they said, that existing assignments were defragmented on the basis of recommendations currently being drafted within CEPT.

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.

Essentially, the following was said on this:

For reasons of planning certainty a licence duration of 10 years, with the possibility of extension, should be the aim, it was believed. One respondent considered 30 years to be a suitable duration. Furthermore, the rights of use should be wholly or partially tradeable.

To give planning certainty to current regional assignment holders whose assignments expired at the end of 2022 and were actually used, it was proposed that these uses be shifted to the 3760 – 3800 MHz band and the duration suitably extended at the same time.

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.

Essentially, the following was said on this:

Several commentators welcomed consideration being given to the interests of SMEs / start-ups. From this quarter it was said that frequencies should be provided for the local and regional services of SMEs since the big network operators – unlike the SMEs – were not in a position, mostly for economic reasons, to offer special/specialised solutions. In particular, companies looking to offer IoT services would have to be able to share the relevant frequencies or be able to choose a partner in a competitive environment.

By contrast, some respondents did not consider special measures or preferential treatment for SMEs necessary. Rather, SMEs and other interested parties should contact the particular spectrum holder in order to obtain, for instance, mobile solutions tailored to their special requirements.

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.

Essentially, the following was said on this:

The considerable potential of the 3.4 – 4.8 GHz band to support Industry 4.0 was pointed out by several respondents. On the one hand, the 3.4 – 3.8 GHz band was contemplated in terms of its suitability as a whole. On the other, attention was focused mainly on the lower sub-band at 3.4 – 3.6 GHz.

Mass market 5G applications could be derived for instance in the field of smart mobility management for motor vehicles and local public transport and also for other applications in the public domain (eg waste management, street cleaning). Moreover, there was intensive discussion of innovative applications for public and personal safety, such as providing staff in the public domain with body-worn cameras, for instance. These applications made heavy demands on transmission capacity. A view put forward by one respondent was that the frequencies should be used for "maritime" services in coastal and offshore areas for specialised solutions for ports, offshore, ferries and the most diverse industry applications.

Some respondents expected demand for spectrum for local applications as well as the nationwide requirements. In technical terms it made sense to envisage frequencies from the 3.6 – 3.8 GHz band for hotspots with low transmitting power.

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.

Essentially, the following was said on this:

The Bundesnetzagentur's proposal to provide the centre gap for Wireless Access (Electronic Communications Services) as a supplementary downlink was welcomed in principle. At the same time it was pointed out that the availability of systems technology and equipment for using the frequencies in the centre gap in the 700 MHz band had still not been clarified. In technical terms it was also still unclear to what extent these frequencies could be used together with frequencies in the paired 700 MHz band at the same location. While the relevant

technical standards provided for carrier aggregation with frequencies in the 800 MHz band it was still open to question whether / when suitable systems for using the frequencies would be available. It was proposed that these frequencies not be included for the time being in the upcoming proceedings.

By contrast, some of the respondents spoke of the prominent role of the 700 MHz band for PMSE. With a view to the frequency requirements for wireless microphones the centre gap should be made available for PMSE, they said. Respondents also expressed the view that the 700 MHz centre gap should be tested for 5G-based broadcasting systems.

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.

Essentially, the following was said on this:

International harmonisation

The majority of respondents from the field of satellite communications considered this band eminently important for satellite communications on account of the great significance of satellite communications and of the space industry for Germany and in order to protect federal interests and investments, some referring to the exponential growth in use of this band. Further, they pointed out that the 28 GHz band was not one of the bands for examination under agenda item 1.13 of WRC-19, that CEPT had not supported it at WRC-15 and that it was harmonised in Europe for the development of broadband /ultra-broadband satellites.

In this connection respondents drew attention to the fact that, unlike in other frequency bands, compatibility studies had not been carried out, nor were they planned, for this band. Some comments highlighted the importance of the band for satellite communications for achieving the aims of the federal government's broadband strategy. Several respondents welcomed the Bundesnetzagentur's intention to keep the bands at 27.5 – 27.8285 GHz, 28.4445 – 28.8365 GHz and 29.4525 – 29.5 GHz available for non-coordinated earth stations. Also welcomed was the Bundesnetzagentur's plan to make the band from 28.8365 – 28.9485 GHz available for non-coordinated earth stations as from 2020. This would enable demand for fixed and mobile broadband satellite services to be better met.

On the other hand, some of the respondents referred to development of the 28 GHz band as the first high frequency band for 5G in the US and in South Korea /Asia. Moreover, measures were in place in Japan and, in the longer term, in China too to identify this band for IMT. First uses were expected in 2018. Therefore Germany should push for examination of the frequency band at European level. One respondent pointed out that there were coordinated uses, and thus uses requiring protection, at no more than 11 locations in Germany.

With regard to the radio relay uses expiring at the end of 2020 the view was expressed that opening parts of the 28 GHz band in Germany, "reserved" today for the fixed service, would create coordination problems with neighbouring countries. Moreover, such an opening would be inconsistent with the Commission's plans for 5G. There were some calls for the rights of use for radio relay to be extended.

Some respondents generally welcomed the possibility of using 28 GHz for 5G. Some expected that co-existence with services currently operated in these bands, satellite services in particular, could be achieved thanks to the propagation conditions obtaining. Use of the fre-

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quencies for integrated wireless access and wireless backhaul, networks with, for instance, outdoor CPE, mini-cells or remote radio heads (RRHs) was forecast in some comments. On the other hand, there were calls for users to be able to decide for themselves whether they wanted the frequencies for backhaul or for direct mobile radio access. Two respondents proposed that assignments in the band be made in future as area assignments instead of point-to-point assignments in order to enhance flexibility.

With regard to frequencies for 5G applications two respondents referred, amongst other things, to the frequency band at 32 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 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.

Essentially, the following was said on this:

The international activities for the harmonised provision of this spectrum for 5G applications with reference to the need for harmonised technical conditions of use to protect existing applications were welcomed in principle by all the respondents. Some also talked about the international developments with regard to 5G in the US, China, South Korea and Japan and the possible economies of scale in developing the equipment.

Some respondents, however, stressed the extensive use of the 26 GHz band for the radio relay links of the fixed service for the connection of public mobile base stations and military users' base stations, for which protection was required.

Respondents called for the provision of large contiguous frequency bands for 5G – unpaired assignments of 200 MHz or several hundred MHz per network operator.

Proposals were made by some for flexible use of the entire radio relay band for radio relay or also for 5G systems. Thus all the assignments should be made in the form of fixed PMP links. However, there were also continued calls for assignments for fixed PP links, these being essential for delivering mobile services to rural areas.

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.

Essentially, the following was said on this:

One respondent held 5G to be the basis for realising a number of as yet unknown business models and hence to offer SMEs and start-ups perspectives. Accordingly, one saw the need for exclusive allocations in the 26 GHz band for the mobile operators, this band being fundamental to the operators' 5G strategies.

C. Key Elements

Key elements 2 GHz

1. Combined provision

All the 2 GHz spectrum in the band at 1920.0 – 1980.0 MHz / 2110.0 – 2170.0 MHz will be provided in combination in good time before 31 December 2020.

Considerations:

- All the 2 GHz spectrum in the band at 1920.0 – 1980.0 MHz / 2110.0 – 2170.0 MHz will be provided in combination in an objective, transparent and non-discriminatory procedure.
- The 2 GHz spectrum is assigned until 31 December 2020 and 31 December 2025 as follows:

Paired 2 GHz spectrum	Assigned until
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

- The 2 GHz spectrum assigned until 2020 will be provided in combination with the 2 GHz spectrum assigned until 2025 in good time before 31 December 2020; a total of 2 x 60 MHz (paired) will be provided.
- The Bundesnetzagentur's aim is to give all interested companies the necessary planning and investment certainty at an early stage. The Bundesnetzagentur is therefore seeking to take a decision on provision of the above-mentioned expiring assignments in the 2 GHz band in the first half of 2018.
- Carrying out the objective, transparent and non-discriminatory procedure at an early stage entails the reallocation of existing spectrum packages. Under the reallocation of the 2 GHz spectrum every interested company has the opportunity of acquiring a suitable, non-discriminatory spectrum package in this band that is suitable for its business model. In light of the remaining duration of the licences until 2020/2025 there are no reasons of a nature or a weight that would make premature reallocation during the current duration appear necessary and proportionate.
- New entrants can take part. Additionally, new entrants have the option of obtaining available spectrum at 800 MHz, 1.8 GHz and 2.6 GHz in proceedings scheduled for the medium term from 2026. Thus spectrum will also be available for later potential newcomers.
- This approach serves the regulatory objective of the expedited rollout of high-speed next-generation public telecommunications networks set out in section 2 subsection (2) para 5 TKG (Telecommunications Act). Combined provision will give compa-

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nies maximum planning and investment certainty, particularly with a view to the introduction of new technologies, eg 5G.

- In combining this provision, the Bundesnetzagentur is aiming, in an open, transparent and non-discriminatory procedure, to align different regulatory framework conditions in a band and to avoid scarcity induced by regulation.
- Extending the existing frequency assignments to a uniform 2025 expiry date would cement the network operators' different 2 GHz spectrum packages caused by the merger. The possibility for new entrants of early access, acquiring spectrum in an open, transparent and non-discriminatory procedure, would also be ruled out.
- Accordingly, the combined award of spectrum at an early stage reflects the principle of simple, appropriate and prompt administrative procedures.

2. Intended use

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

Considerations:

- The use to which spectrum in the 2 GHz band may be put in compliance with the Frequency Plan is Wireless Access. Wireless Access is defined in the general part of the Frequency Plan as follows: *"This frequency usage serves to connect terminal equipment to wireless networks via fixed stations. Offered thus as a rule are telecommunications services."* This definition allows the frequencies to be used without restriction on a technology- and services-neutral basis under the scope of the use given in the Frequency Plan as *Wireless Access for the provision of telecommunications services*.
- Thus the environment has been created for flexible use of the paired 2 GHz spectrum for 5G services as soon as the systems are available.
- The paired 2 GHz spectrum will be provided for nationwide use. Nationwide assignment of this spectrum for Wireless Access will enable the build and rollout of networks delivering innovative mobile broadband services in rural as well as urban areas. Moreover, the regulatory objective of efficient and interference-free use of frequencies within the meaning of section 52 TKG and section 2 subsection (2) para 7 TKG can be optimally complied with through nationwide assignment since less coordination is required than for regional / local assignment.
- Nationwide provision of the spectrum carries on previous administrative practice (consistency requirement). The coverage of end customers has been seen in the band at 2 GHz (paired) to be efficiently secured by providers operating nationwide. Accordingly, to date, frequencies here have been assigned nationwide.

3. 5 MHz blocks

Provision of the 2 GHz spectrum will be in blocks of 5 MHz. Guard bands will not be stipulated.

Considerations:

- Spectrum in the 2 GHz band is to be provided in twelve blocks of 2 x 5 MHz (paired). This reflects the smallest amount of spectrum that is technically feasible for both the UMTS and LTE broadband technologies and also for future mobile technologies with a view to 5G applications. Smaller amounts of spectrum could result in packages that rule out use of broadband technologies. Larger blocks, by contrast, could restrict the flexibility of future users and would make access to this spectrum more difficult.
- The aim is to provide the whole of the band from 1920.0 – 1980.0 MHz / 2110.0 – 2170.0 MHz. There is no intention to provide guard bands to protect adjacent applications. Adjacent applications – as for instance satellite services in the adjacent MSS band – 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.
- Even if the currently valid ECC Decision ECC/DEC/(06)01 does provide for protection, it is now undergoing revision by ECC PT1. It will be necessary in any case to change the protection requirements harmonised at the time, since protection at the lower end of the band towards the TDD applications will become irrelevant if these frequencies are no longer to be used for IMT.
- All the rights of use in the band at 1920.0 – 1980.0 MHz and 2110.0 – 2170.0 MHz will be adapted to the 5 MHz channel arrangement upon provision. This will free up, at an early stage, the entire band for technologies that are currently in use and technologies that are to come.

4. Contiguous spectrum

The 2 GHz spectrum is to be assigned as contiguous spectrum in each case. Where necessary, rights of use assigned until 2025 will be shifted.

Consideration:

- Assigning contiguous spectrum enables the efficient use of frequencies and is therefore appropriate from both the technological and the regulatory point of view. Doing so might make it necessary to shift the rights of use assigned until the end of 2025 in order to achieve defragmentation.

5. Time limit

All the 2 GHz spectrum will be assigned with the same expiry date of 31 December 2040.

Considerations:

- Under section 55(9) TKG frequencies are typically assigned for a limited period. The limited period for the 2 GHz spectrum will end on 31 December 2040. Limiting the period to the close of 2040 means licence durations of 15 and 20 years.

- The licence durations of 15 and 20 years are suitable to enable investment amortisation and are also consistent with past administrative practice in providing spectrum for Wireless Access and mobile communications.
- Extending the time limit to 2050, for instance, would risk an inefficient use of the frequencies particularly in the latter part of the assignment, given the short innovation cycles in mobile communications.
- Another desired outcome of the time limit is the avoidance of multiple complex award proceedings in short succession. In the Wireless Access band 270 MHz of the spectrum is assigned until 2033. Assigning the frequencies in the 2 GHz band until 2040 therefore does not mean that these frequencies would become available shortly after the provision of other frequencies.

Key elements

3.4 – 3.8 GHz

6. Provision of the 3.6 GHz band

All the 3.6 GHz spectrum in the 3400 – 3800 MHz band will be provided in good time before 31 December 2021. A total of 400 MHz (unpaired) is therefore available.

The sub-band 3400 – 3700 MHz will be provided for nationwide frequency assignments and the sub-band 3700 – 3800 MHz for regional assignments.

Considerations:

- All the spectrum in the 3400 – 3800 MHz band will be provided for future uses in an objective, transparent and non-discriminatory procedure.
- The rights of use in the 3.6 GHz band expire on 31 December 2021 and 31 December 2022:

Paired 3.6 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
3.6 GHz spectrum (4th package)		Expires on
3480 – 3500 MHz	3580 – 3600 MHz	31.12.2022

Overview: Current assignments and expiry dates in the 3.6 GHz band

- 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.
- In addition, there are currently some 90 regional assignments in the whole of the 3.6 GHz band which will likewise expire on 31 December 2022.
- The sub-band 3400 – 3700 MHz will be provided for nationwide frequency assignments and the sub-band 3700 – 3800 MHz for regional assignments.

- The Bundesnetzagentur's aim is to provide spectrum to the greatest possible extent, in as many places as possible, over the entire period, for both nationwide and regional business models. The assumption is that 5G business models have yet to materialise. Thus it is necessary to enable flexible, successive access to the spectrum over the entire period.
- The Bundesnetzagentur intends to reallocate the 3.6 GHz band, taking account of existing uses, as swiftly as possible before the expiry dates.

Nationwide assignments

- Provision of the sub-band 3400 – 3700 MHz for nationwide assignments will deliver early planning and investment certainty for nationwide 5G rollout.
- The Bundesnetzagentur expects that the provision of 300 MHz for nationwide assignments will advance regulation of the introduction of 5G systems and the rollout of high-speed telecommunications networks. This provision will also ensure that the same frequencies are available throughout the country to the assignment holders, enabling them to roll out 5G networks in line with demand. Provision of the same frequency nationwide will also promote the efficient use of spectrum by avoiding, for instance, the need for coordination with other users. Network planning will also be facilitated.
- Holders of the nationwide assignments will therefore be in a position to meet demand for 5G applications quickly, flexibly and in accordance with market demand, thus demonstrating the role of the 3.6 GHz band as the pioneer band for 5G (cf RSPG 16-032, "Strategic Roadmap towards 5G for Europe").
- Nationwide assignments will be met in the sub-band 3400 – 3700 MHz. The 3400 – 3600 MHz band is the least restrictive as regards compatibility with other radio services, most notably satellite communications. This ensures, to the greatest possible extent, that the potential of the 3.6 GHz band can be exploited for 5G through enabling it to be rolled out rapidly, flexibly and in line with demand.
- The 3400 – 3410 MHz band will, in all probability, be subject to special conditions of use in order to protect radar in the band below 3400 MHz. Efficient use of frequencies is easier if only one assignment holder rather than many regional users has to observe the special conditions of use and coordinates use with the radar systems deployed.

Regional assignments

- Provision of the sub-band 3700 – 3800 MHz for regional assignments will allow companies to obtain large contiguous spectrum blocks of up to 100 MHz over the entire period, so that they, too, can fully exploit the advantages of this frequency band for 5G.
- Thus it will also be possible to obtain regional assignments at a later date flexibly and in line with demand. Regional business models still under development today, for instance those of start-ups, can then be implemented at this later time.
- In view of this it would not be justified to provide the whole of the 3.6 GHz band for nationwide assignments. In particular, the fact that demand exists in some business models for frequencies for operators' own autonomous telecommunications networks can then be accommodated too.
- The provision of 100 MHz for regional assignment will enable first, the rollout of 5G networks with channel bandwidths of up to 100 MHz. Second, regional networks for several frequency users with lower channel bandwidths will be possible in one region.

- A larger part of the spectrum for regional uses would, with de facto nationwide use, increase the coordination effort between the individual users and make efficient spectrum use more difficult. Furthermore, stronger demand for regional business models is not foreseeable thus far.
- Under the Frequency Plan, satellite uses by earth stations are to be protected above all in the 3.6 – 3.8 GHz band. These regionally protected areas in all probability mean fewer disadvantages for regional than for nationwide business models.
- The Bundesnetzagentur will draw up an application procedure for the regional assignments.

7. Alternate shared use as additional capacity

Alternate shared use can be made of the 3.6 GHz spectrum provided for nationwide and regional assignments.

Holders of regional assignments in the 3.6 GHz band can make shared use, as temporary additional capacity, of unused spectrum in the 3.6 GHz band provided nationwide.

Holders of nationwide assignments in the 3.6 GHz band can make shared use, as temporary additional capacity, of unused spectrum in the 3.6 GHz band provided regionally.

Considerations

- Special importance is attached to securing the efficient use of spectrum provided. The reason is that spectrum management includes securing the efficient and interference-free use of frequencies in consideration of the further regulatory objectives (section 52(1) TKG), a task which is incumbent on the Bundesnetzagentur. Thus it is especially important to prevent a situation in which spectrum resources are not used, in which they "lie idle", so to speak.
- The efficient use of the entire 3.6 GHz band can be promoted in this case by one user group being able to share the resources of the other user group as temporary additional capacity.
- In each band a specific user group has the right of first access: network operators with a nationwide business model in the 300 MHz band for nationwide assignments and network operators with a regional business model in the 100 MHz band for regional assignments. However, it is possible for one user group to share the frequencies of the respective other user group, provided this right of first access has not yet been exercised or use has not yet been made by the particular user group.

Temporary use in the 3700 – 3800 MHz band for assignment holders with a nationwide 3.6 GHz assignment

- Holders of nationwide assignments in the 3.6 GHz band can make shared use, as temporary additional capacity, of unused spectrum provided regionally in the 3.6 GHz band. Assignment is subject to the proviso that a potential user without a nationwide assignment does not commence use.
- The Bundesnetzagentur assumes that a network operator with a nationwide business model and well-developed 3.6 GHz infrastructure will be able to connect additional 3.6 GHz spectrum at reasonable cost. If the regionally available spectrum in the 3700

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– 3800 MHz band is not used at the particular place, use of such additional capacity could contribute to spectrum efficiency.

- Access to spectrum provided for regional business models will be maintained over the whole of the time. A nationwide operator additionally using regionally provided spectrum must release the frequencies as soon as a network operator with a local or a regional business model commences use.
- The nationwide operator will still have planning certainty despite having to release the additional spectrum since he will always be able to use the frequencies assigned to him nationwide for his business model.

Temporary use in the 3400 – 3700 MHz band for assignment holders with regional 3.6 GHz assignments

- Holders of regional assignments in the 3.6 GHz band can make shared use, as temporary additional capacity, of unused spectrum provided nationwide in the 3.6 GHz band.
- When a network operator with a nationwide business model does indeed use the frequencies for which he has nationwide assignment but does not, for instance, serve areas of low population density, serves them only at a later date or uses other frequencies with which to do so, it should be possible for the frequencies in these regions to be used for the rollout of regional or local networks in order to promote spectrum efficiency.
- The Bundesnetzagentur assumes that a network operator with a regional business model and well-developed 3.6 GHz infrastructure will be able to connect additional 3.6 GHz spectrum at reasonable cost. If the spectrum in the 3400 – 3700 MHz band available nationwide is not used at the particular place, use of such additional capacity could contribute to spectrum efficiency.
- This contribution to spectrum efficiency can be achieved through temporary frequency transfer (spectrum leasing). A regional network operator additionally using spectrum assigned on a nationwide basis must release these frequencies as soon as the holder of the nationwide assignment commences use at this place.
- The regional operator will still have planning certainty despite having to release the additional spectrum since he will always be able to use the frequencies regionally assigned to him in the 3700 – 3800 MHz band for his business model.

8. 5G coverage in line with demand

Holders of nationwide assignments are to enable coverage in areas of demand for 5G at the end of a suitable period after assignment and under non-discriminatory conditions.

Considerations:

- The Bundesnetzagentur expects that the provision of spectrum for 5G in the 3.6 GHz band can advance regulation of the introduction of 5G systems and the rollout of high-speed telecommunications networks. A particular matter for attention is meeting regional demand for 5G infrastructure and hence connecting regional areas in accordance with this demand.

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- 5G is to bring about, in particular, the introduction of new innovative services such as Industry 4.0 or smart city. Expected therefore is heterogeneous demand from the industry, business parks and local authorities.
- Holders of nationwide assignments are to enable coverage in areas of demand for 5G at the end of a suitable period after assignment and under non-discriminatory conditions. Assignment holders can
 - realise provision in line with demand with the frequencies assigned, or
 - lease to other users the frequencies assigned, or
 - build network infrastructures in cooperation with interested users.
- If the measures are to be economically efficient it may be necessary for users to contribute to their realisation.
- The Bundesnetzagentur can set framework conditions for this. Such framework conditions and the overall procedure should ensure, most notably, that
 1. the efficient use of frequencies is enhanced or at least maintained,
 2. the original award proceedings do not stand in the way of frequency assignment,
 3. there is no fear of distortion of competition,
 4. other legal framework conditions, especially the conditions of use and international agreements on the use of spectrum, are complied with, and
 5. the regulatory objectives set out in section 2 TKG are secured.

9. Intended use

The 3.6 GHz spectrum will be made available for Wireless Access (ECS).

Considerations:

- 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.
- The requirement for technology and services neutrality means that the frequencies in the band 3.4 GHz – 3.8 GHz can be used flexibly for 5G services as well.
- The technology-neutral designation will enable the deployment of different technologies and systems without restriction to particular standards.

10. 10 MHz blocks

The 3.6 GHz spectrum will be provided in blocks of 10 MHz. Guard bands will not be stipulated.

Considerations:

- The 3.6 GHz spectrum will be provided in blocks of 10 MHz.

- The large extent of its contiguity makes the 3.6 GHz band especially suitable for large bandwidths. The maximum possible bandwidth for LTE, 20 MHz, and the expected bandwidths for future technologies ranging from 50 MHz to 100 MHz can be realised here.
- Nationwide provision of a total of 30 blocks of 10 MHz each will offer sufficient flexibility for rights of use for broadband applications to be granted to future applicants in line with demand.
- Guard bands will not be stipulated. Future assignment holders will be required to give protection to existing adjacent applications within the spectrum they have been assigned.
- Stipulating a guard band from 3400 MHz to 3410 MHz for the protection of military radar below 3400 MHz would be inconsistent with regulatory practice and the regulatory objective of the efficient use of frequencies and is not therefore appropriate.
- The protection of existing and future earth stations above 3800 MHz can be achieved by means of suitable block edge masks. Any greater protection proving necessary could possibly be achieved by geographically restricting the future assignment holder's uses in the adjacent band.
- Measures may likewise prove necessary between assignment holders in the 3.6 GHz band to protect the respective neighbouring user.
- The Bundesnetzagentur will draw up an application procedure for the regional assignments.

11. Contiguous spectrum

Frequencies in the 3.6 GHz band will be assigned as contiguous spectrum in each case. This may necessitate shifts in assigned rights of use.

The Bundesnetzagentur intends to reallocate the 3.6 GHz band, taking account of existing uses, as rapidly as possible.

Considerations:

- The assignment of contiguous spectrum enables spectrum to be used efficiently and is therefore appropriate from both the technical and the regulatory point of view.
- The need to shift current assignments may arise if the spectrum is not to be fragmented. All affected users must be given sufficient time to prepare the measures needed to move the frequencies.
- The Bundesnetzagentur intends to restructure the 3.6 GHz band to meet the new framework conditions for early implementation of reallocation, most notably of the future nationwide assignments (5 MHz channel arrangement, contiguous spectrum, switch from paired to unpaired) in order to promote the efficient use of spectrum in this band before expiry of the current licences.

12. Time limit

The 3.6 GHz spectrum will be assigned until 31 December 2040 at the latest.

Considerations:

- The aim, particularly for the frequencies provided for regional use, is the most flexible kind of provision possible. A short duration of a few years, given demand, is to be just as possible as extensions in the case of efficient use. Nevertheless, a uniform time limit in the band is required.
- Existing uses and assignments are – if possible – to be incorporated in the new arrangements as early as possible to enable innovative applications and promote efficient use of spectrum. Providing spectrum in 2018 would allow use for a maximum of 22 years (use 2019-2040). Should use of a sub-band not be possible before 2023 this would still yield a duration of 18 years. Such durations are consistent with regulatory practice.
- Renewed provision could then take place at the same time as provision of spectrum in the 2 GHz band.

Key element**Shared use of capacity and services****13. Shared use of capacity and services**

Holders of nationwide assignments shall, on a non-discriminatory basis, enable shared use of capacity and services for the maximum diversity of business model.

Considerations:

- Telecommunications companies can act as partners (so-called enablers) of companies from other business sectors when it comes to innovative services and business models in areas such as Industry 4.0, smart factory, smart car or smart home. This applies to the incumbent nationwide mobile operators on the one hand. On the other, it is also possible for further nationwide network operators, regional or local network operators and – as put forward in the comments – mobile virtual network operators (MVNOs) and service providers to perform the role of enabler. A large number of enablers operating in competition, especially, could deliver maximum benefit in terms of choice, price and quality (section 2(2) para 1 TKG). This could be advantageous to both the consumer and the partner companies from other business sectors.
- To encourage a large number of enablers it is necessary to look at the offer of innovative 5G services as well as the level of network rollout. Here, service providers and MVNOs could both act as enablers. Service providers have played a significant part since the advent of liberalisation in the early 1990s in strengthening services competition via their mobile offers, and promote consumer interest in terms of choice, price and quality. They could do likewise in respect of penetrating the market with innovative 5G services, provided they could obtain the relevant wholesale products on wholesale terms and conditions.
- In the past, competition was shaped – also as a result of the obligation carried on from the GSM and UMTS licences – more than temporarily by the service providers' business models. Not only service providers but also MVNOs could contribute to innovative competition. If more MVNOs were active in the market, they could, as additional enablers, add diversity to the offers available. Moreover, MVNOs – unlike ser-

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vice providers – have their own infrastructure. It is conceivable therefore that they could develop business models at a deeper level in the value chain, contributing thus to competition and innovation.

- If they are to offer innovative services as enablers, service providers and MVNOs – as indeed spectrum users – need long-term planning certainty. This applies particularly if service providers and MVNOs are to promote services competition as independent providers. It is therefore conceivable that a person-related and technology-neutral obligation be imposed on the mobile operators to grant service providers and MVNOs wholesale products on wholesale terms and conditions on a non-discriminatory basis in the future too.
- The Bundesnetzagentur is examining the regulatory action required.
- Given the combination of the two measures – the use or shared use of frequencies and the guarantee of wholesale products on wholesale terms and conditions – competition between independent enablers could be fostered at different levels of the value chain. This could encourage the entry of new market players with innovative business models. Most notably, it would not rule out enablers entering the market even after provision of the spectrum assigned nationwide. And further, there is the possibility of companies from other business sectors acquiring specialist knowledge and investing in their own 5G radio networks.

Key element

700 MHz centre gap

14. 700 MHz centre gap

It is not intended to provide the centre gap in the band at 700 MHz (738 – 753 MHz) until a later date.

Considerations:

- It is not intended to provide the centre gap in the band at 700 MHz (738 – 753 MHz) until a later date. Under consideration therefore is whether the frequencies should be provided in proceedings for the renewed provision of spectrum in the 800 MHz, 1800 MHz and 2.6 GHz bands. The rights of use of this spectrum are currently set to expire in 2025. The Bundesnetzagentur will take a decision on provision of this spectrum in good time before the time limit is reached.
- The band at 738 – 753 MHz could help to deal with the increasing volumes of mobile data. Its use as a supplementary downlink might prove a suitable mechanism for handling the asymmetry between download and upload volumes.
- The proceedings in 2015 providing spectrum in the bands at 700 MHz, 900 MHz, 1800 MHz and 1.5 GHz already made 40 MHz available for the supplementary downlink. This spectrum was acquired at auction by two of the incumbent nationwide mobile operators. However, it has not yet been integrated into the existing mobile networks in light of technical development too. From the regulatory point of view it therefore appears appropriate to observe developments in the spectrum already awarded in the 1.5 GHz band before providing any further resources for the supplementary downlink.

Key element

Spectrum above 24 GHz

15. Spectrum above 24 GHz

Spectrum above 24 GHz – in particular 26 GHz – is to be provided for 5G in line with demand and in consideration of existing uses.

Considerations:

- The Bundesnetzagentur will provide spectrum above 24 GHz in line with demand. Spectrum in the band above 24 GHz is required for future 5G applications in particular.
- Looked at in terms of provision for the introduction of 5G services in the Points of Orientation and the consultation responses were the bands directly above 24 GHz, most notably
 - 26 GHz (24.25 – 27.5 GHz),
 - 28 GHz, (27.5 – 29.5 GHz) and
 - 32 GHz (31.8 – 33.4 GHz).

It was emphasised that the 26 GHz band played a prominent role, having been identified by the RSPG as the pioneer band for 5G applications. The bands at 26 GHz and 32 GHz are also candidate bands for 5G under Resolution ITU-R 238 (WRC-15).

- To enable 5G applications with high channel bandwidths the 26 GHz band, at least, is to be restructured and thus made future-proof.
- The Bundesnetzagentur expects stationary 5G applications in particular, for instance for the connection of businesses and households with high bit rate wireless access. In the same way, 5G use in respect of Industry 4.0 is expected mainly to be indoor use. In view of this, there are no concerns following an initial assessment of compatibility with other radio applications. If appropriate, uses will be regionally decoupled in order to achieve compatibility.
- Future applications must ensure that satellite and radio relay applications are protected. This involves, amongst other things, taking internationally harmonised protection requirements into account. To what extent radio relay and future 5G applications can be operated in parallel in the same frequency band will depend on the actual scenario of use for 5G and may require further study.
- Spectrum above 24 GHz – in particular the 26 GHz band – is also to be provided for 5G, account being taken of existing uses, at the earliest possible time and in line with demand. Given that existing uses in these bands are subject to specific protection requirements, assignment in the form of a general assignment does not appear feasible. The Bundesnetzagentur will initially draw up an application procedure for the 26 GHz band.

D. Further action

The Bundesnetzagentur has drawn up the above key elements representing the framework conditions for spectrum provision proceedings and thus creating the basis for the formal demand identification proceedings. In a first step the Bundesnetzagentur is issuing a call for notification of forecast demand for spectrum in the bands at 2 GHz and 3400 – 3700 MHz, provided on a nationwide basis. It is intended to provide all the spectrum in the band 1920.0

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– 1980.0 MHz / 2110.0 – 2170.0 MHz in combination with spectrum in the band 3400 – 3700 MHz for nationwide use in one set of proceedings (for more details see below under Point E.).

Spectrum in the band 3700 – 3800 MHz will be assigned for specific areas in line with demand. In a further step, the Bundesnetzagentur will provide the spectrum in an application procedure for area-related regional/local assignments, the conditions of use included.

Spectrum above 24 GHz – in particular the 26 GHz band – is also to be provided for 5G, account being taken of existing uses, at the earliest possible time and in line with demand. Given that existing uses in these bands are subject to specific protection requirements, assignment in the form of a general assignment does not appear feasible. The Bundesnetzagentur will initially draw up an application procedure for the 26 GHz band.

E. Demand identification proceedings

To guarantee an objective, transparent and non-discriminatory procedure the Bundesnetzagentur is issuing a call prior to carrying out specific proceedings for assigning spectrum in the bands at 1920.0 – 1980.0 MHz / 2110.0 – 2170.0 MHz and 3400 – 3700 MHz for a qualified account of spectrum requirements (see Annex).

Interested companies are requested to notify the Bundesnetzagentur, by 30 September 2017, of their interest in specific use of the spectrum in the bands at 1920.0 – 1980.0 MHz / 2110.0 – 2170.0 MHz and 3400 – 3700 MHz.

Participation in the proceedings to identify demand is not restricted.

Considerations:

- Available in the 2 GHz band will be 2 x 60 MHz (paired), ie 2 x 12 blocks of 5 MHz each (paired) for use for Wireless Access (ECS) nationwide.
- Available in the 3.6 GHz band will be 300 MHz (unpaired), ie 30 blocks of 10 MHz each for use for Wireless Access (ECS) nationwide.
- The frequencies will be assigned in accordance with sections 55ff TKG. Each frequency usage 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).
- Under section 55(10) sentence 1 TKG it may be ordered, without prejudice to section 55(5) TKG, that the assignment of frequencies be preceded by award proceedings based on conditions according to section 61 TKG as determined by the President's Chamber, when spectrum is scarce. The scarcity posited in the two alternatives set out in section 55(10) sentence 1 TKG can result from either the established fact of a surplus of applications (section 55(10) sentence 1 2nd alternative) or the forecast of an insufficient number of frequencies being available (section 55(10) sentence 1 1st alternative). An order for award proceedings as per section 55(10) TKG is at the discretion of the President's Chamber.
- The scarcity posited in section 55(10) sentence 1 TKG may derive from a forecast of an insufficient number of frequencies being available (section 55(10) sentence 1 1st alternative). In consideration of the wording of the law and of the connection between the two possible cases referred to in section 55(10) sentence 1 TKG the fore-

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cast just mentioned refers to demand exceeding supply at the time of assignment, to a greater number of applications being made than frequencies are available. The forecast is based on identified excess demand.

- Here, in the shape of demand identification proceedings in which the Chamber, paving the way for a decision on issuing an order for award proceedings, makes a public call for requirements for particular frequencies to be notified within a suitable period, is a tried and tested, informative, multistage procedure that takes proper account of the criteria of objectivity, transparency and non-discrimination and grants applicants equal opportunity to spectrum.
- The purpose of identifying demand is to establish whether demand is likely to exceed supply as the basis for forecasting whether the number of applications is likely to exceed the frequencies available (section 55(10) sentence 1 1st alternative TKG). The government draft explanatory notes show this to be possible if the President's Chamber concludes that frequencies are not available for assignment in sufficient number (cf government draft of section 53(9) TKG, page 109). Here the Chamber must work on assumptions that not only reflect current knowledge and experience but that are also comprehensible and take into account the regulatory objectives.
- Particularly convincing, in line with the purpose of identifying demand, are notified requirements that also cover the objective and subjective criteria for future frequency assignment (section 55 subsections (3), (4) and (5) TKG) in setting out interest in a particular use. Preconditions for assigning frequencies are that "*their efficient and interference-free use by the applicant [is] secured*" and "*their compatibility with other frequency usages [is given]*" (section 55(5) sentence 1 paras 3 and 4 TKG). Interested companies are thus called upon to set out clearly and conclusively that efficient and interference-free use by them will be secured at the time of assignment. This clear and conclusive account must cover both the subjective requirements of reliability, efficiency and specialist knowledge and presentation of a convincing concept for intended use of the frequencies for assignment (for more details see Annex).
- Showing sufficient financial capability is appropriate in light of the extremely high economic value of the spectrum.
- For efficient use of this spectrum, an aim to which the TKG is committed, it is recommended that applicants provide such accounts with reference to their business model. This is especially relevant if they already hold suitable spectrum with which to implement their business model.
- The notified requirements serve to identify whether demand will likely exceed supply and thus how to proceed in accordance with the law. The frequencies will be assigned by the Bundesnetzagentur as individual assignments only upon written application or, as the case may be, only after participation in award proceedings. The Bundesnetzagentur will issue a call to apply for rights of use shortly before holding proceedings for assigning the spectrum. All applicants declaring an interest in specific use of the frequencies in the bands at 2 GHz paired and/or 3400 to 3700 MHz at the stage of demand identification proceedings already are also required under section 55(3) and (4) TKG to submit a written application for assignment of the frequencies and accordingly to provide more detailed accounts and evidence of compliance with the legal requirements for assignment.

The Bundesnetzagentur is now issuing a call to interested companies for notification of their forecast requirements in the frequency bands at 2 GHz and 3400 – 3700 MHz, available nationwide.

Notifications are to be submitted by **30 September 2017** in German, in writing to the postal address below

**Bundesnetzagentur
Referat 212
Tulpenfeld 4
53113 Bonn**

and

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

Email: referat212@bnetza.de

A draft President's Chamber decision on provision of the above-mentioned spectrum will be drawn up on the basis on the frequency requirements identified. We should point out, however, that it will not be possible to begin carrying out award proceedings directly should spectrum resources be found to be scarce. Carrying out award proceedings presupposes that further decisions the President's Chamber is required by law to take (on award conditions and award rules) have been issued for which consultation with the Advisory Council is also needed. As stated above, award proceedings, if necessary, will be carried out in good time, that is to say in 2018.

Annex – Account of spectrum requirements

1. Interested companies are called upon to state and give an account of their spectrum requirements in the band 2 GHz (paired) and / or in the band 3400 – 3700 MHz on the basis of the key elements.
2. Participation in proceedings to identify demand is not restricted.
3. Each interested company is called upon to state its requirements once only. This also applies in respect of consortia. Undertakings that have merged under section 37 of the German Competition Act (GWB) are deemed to be one undertaking.
4. Each interested company is asked to show, in its notification of requirements, that it meets the legal requirements for a possible assignment of frequencies. A legal requirement for assignment is compatibility with other frequency usages and that efficient and interference-free use of frequencies is guaranteed by the applicant (see section 55(5) sentence 1 paras 3 and 4 TKG).

Of particular importance for this is an account of the applicant's reliability, specialist knowledge and, most notably, financial capability, an account of his frequency usage concept included; this also applies in cases in which companies already have suitable spectrum.

A notification of requirements must include the following information:

A. Details of the undertaking

- name and address
- legal form
- seat, and
- financial interests.

B. Information on reliability

A declaration whether

- a frequency assignment has been revoked in the past,
- conditions have been imposed on account of failing to honour obligations from a frequency assignment,
- legal action has been taken on account of having breached telecommunications or data protection regulations, or
- proceedings in the above cases are pending and if so, with which public authority.

C. Information on efficiency

Declarations that there will always be sufficient financial means

- for assignment of the frequencies, and
- for the build and rollout investments set out in the frequency usage concept and for operation of the wireless network, and
- how financing is to be secured.

D. Information on specialist knowledge

Declarations that the persons engaged in building and operating the wireless network have the necessary knowledge, experience and skills.

E. Frequency usage concept

Presentation of a frequency usage concept showing, in particular, how efficient use of the spectrum will be secured. Details should be given of the following, in particular:

- spectrum requirements with reference to the business model,
(presentation of a frequency usage concept; statement on the planned business model and its implementation),
- the planned services concept,
(information on the kind of services based on the wireless technology chosen), and
- business planning and its implementation
(presentation of business planning and its technical implementation; detailed statements on rollout planning and the timescale for the network build, for instance the planned dimensioning of the wireless access network, the network structure, the technical systems deployed).

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
ECC PT1	Electronic Communications Committee, Project Team 1
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
IoT	Internet of Things
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
PMSE	Programme-making and special events
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
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