Consultation

for the Award of Spectrum Use Rights in the 26 GHz and 3410–3470 MHz ranges

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Telekom-Control-Kommission and RTR-GmbH

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1 Introduction

Authored jointly by the Telekom-Control-Kommission (TKK) and RTR-GmbH (RTR), this consultation primarily addresses potential users of spectrum in the 26 GHz band and spectrum in the 3410–3470 MHz band not assigned during the first 5G auction in 2019. The consultation serves as a basis for items including the various decisions to be made by ordinance (any definitions of limitations by number pursuant to Art. 14 Par. 1 of the Telecommunications Act 2021 (TKG 2021), selection procedures pursuant to TKG 2021 Art. 15 Par. 1) and for the award procedure. The 2022–2026 Spectrum Release Plan published in February 2022 has scheduled the assignment of the above-mentioned spectrum for the first half of 2023.

The regulatory authority conducted a consultation on these bands (and others) in summer 2021.[1] Three use cases have now materialised in relation to the 26 GHz band:

- Mobile broadband
- Fixed wireless access
- Campus networks/industrial networks/private networks

For the campus networks/industrial networks/private networks use case, the spectrum use plan from the Federal Ministry of Agriculture, Regions and Tourism (BMLRT) envisages reserving 600 MHz at the lower band edge, to be assigned—as was also proposed by several consultation participants—in accordance with a real estate-based licensing model (see section 8.1).

Responses to the 2021 consultation on the Spectrum Release Plan were not unanimous as regards the question of whether the 26 GHz band should be assigned in the form of local, regional or nationwide licences. However, most consultation participants were of the opinion that the 26 GHz spectrum should be assigned over smaller-scale areas (with local licences being a particular favourite). Preferences for the 3.4–3.8 GHz band were split evenly between regional and local licences (see Table 1). Opinions were also divided concerning the question of whether spectrum should be assigned by a selection procedure (e.g. auction) or within the context of an administrative procedure.[2]

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[1] Cf. regulatory authority consultation on the 2021–2026 Spectrum Release Plan, accessible from: https://www.rtr.at/TKP/aktuelles/veroeffentlichungen/veroeffentlichungen/konsultationen/consultation_spectrum_Release_plan.en.html

[2] Cf. summary of statements from the consultation on the Spectrum Release Plan (in German), accessible from: https://www.rtr.at/TKP/aktuelles/veroeffentlichungen/veroeffentlichungen/konsultationen/konsultation_spectrum_release_plan_stn.de.html

Table 1: Award procedure options with number of times option was mentioned

Spectrum band	Nationwide licensing	Regional licensing	Regional licensing	Real estate licensing	Unlicensed use
Remaining 3.4–3.8 GHz spectrum		4	2	2	
▪ 3.x GHz (mobile services, FWA)					
▪ 3.x GHz (private networks)			2	2	
26 GHz	2	1	7	4	
▪ 26 GHz high demand areas (HDAs)		1			
▪ 26 GHz low demand areas (LDAs)			1		
▪ 26 GHz private networks			4	3	
▪ 26 GHz indoor			1		1

Source: Summary of statements from the consultation on the Spectrum Release Plan[3]

Regardless of their individual preferences for the scope of licensing, consultation participants were nonetheless unanimous in their opinion that no blanket, nationwide usage of 26 GHz spectrum was to be expected (Table 2). Most usage was instead assumed to be local, such as within hotspots, for example.

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[3] See footnote 2.

Table 2: Usage area options with number of times option was mentioned

Coverage area	<1 GHz	2.3 GHz	2.6 GHz FDD	2.6 GHz TDD	3.x GHz	3.8–4.2 GHz	6 GHz	26 GHz	42 GHz	60 GHz
Nationwide usage	1	4	3	2	2					
Regional usage (region, municipal network)		1	1		2		1	1		
Urban usage (urban regions)		1		1	1		1	1		
Hotspots (urban, suburban)		1		1	2		1	4	2	2
Local usage					1			4	1	1
Last mile/FWA (streetside, suburban, urban, towns)		1		1	2			4	2	2
Campus indoor/outdoor		3		2	4	2	1	9	2	2
Campus indoor		3		2	3	2	1	7	2	2
Specific sections							1	2		

Source: Summary of statements from the consultation on the Spectrum Release Plan[4]

The TKG 2021 envisages the use of a selection procedure to assign spectrum that is limited by number and the use of an administrative procedure to assign spectrum that is not limited by number. Limitation by number and the licence region are concepts that are closely linked together. The need for spectrum as reported in the consultation was not differentiated by area, showing that spectrum assigned nationwide certainly is—or should be—limited by number.

However, participants also noted the specific propagation characteristics of these frequencies and were very doubtful that this spectrum would be used efficiently in the event of a nationwide award. These propagation characteristics, simpler interference coordination and selective usage were all given as reasons why awarding nationwide usage rights would be less than ideal. Participants proposed assigning the 26 GHz band locally to the respective requesting parties. On assessing this consultation input, the regulatory authority has identified a local demand for spectrum that cannot be met by awarding nationwide licences. There is also an inherent risk of spectrum remaining unused in some parts of Austrian territory and therefore 'lying fallow' over the long term.

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[4] See footnote 2.

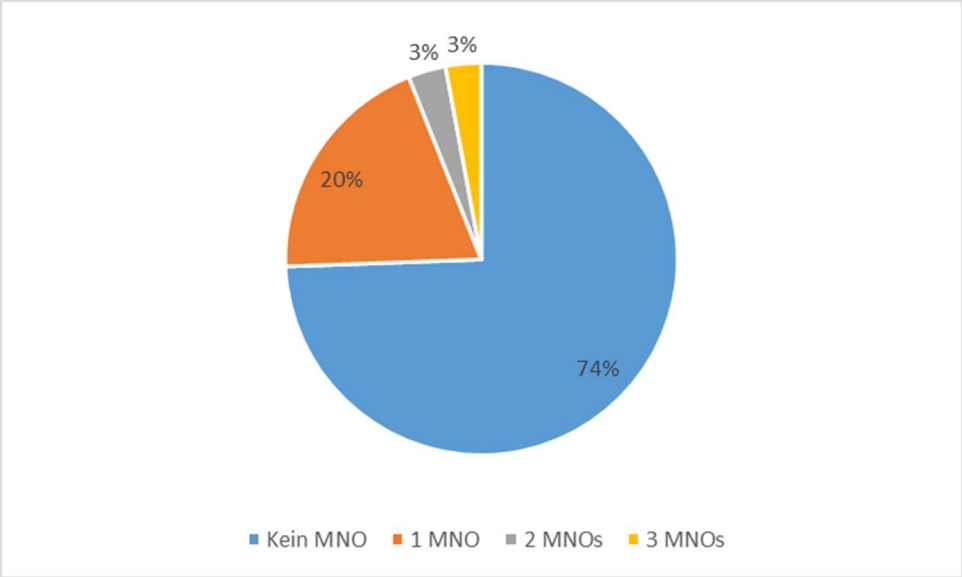

Figure 1: Proportion of municipalities with 2.6 GHz base stations and number of MNOs (source: RTR)

Usage of the 2.6 GHz band, for example, which was assigned in 2010, is primarily concentrated within urban areas (see section 4.2.2). As a consequence, this band remains unused or used by only a single network operator across much of Austria. Using geographic space as a metric, Figure 1 shows the share of municipalities in which no mobile network operator offers 2.6 GHz coverage at any site. This share is 74 per cent of the total area. Again as a proportion of total physical area, 20 per cent of municipalities have a single mobile network operator offering 2.6 GHz coverage at a site. While one might argue that sites in individual municipalities provide coverage to more than just their own community, the fact remains that the band is largely unused in rural areas. Based on its propagation characteristics, however, the 2.6 GHz band would be a much better candidate for wide-area use than the 26 GHz band. As of this writing, nationwide spectrum awards in the 26 GHz band would entail significant risk that frequencies remain unused in large parts of Austria, which would run contrary to the goal of ensuring efficient usage.

An appropriate licensing or sharing model could be applied to the use of this spectrum in these areas by third parties such as local operators. In contrast to low-frequency spectrum, the propagation characteristics for this band mean that no effects detrimental to efficient use of the spectrum are to be expected. Quite the opposite, in fact: if spectrum that would otherwise go unused could be utilised for productive third-party use, this would support the simultaneous fulfilment of several award objectives (competition driven by the removal of barriers to market entry, new business models and innovation, and efficient spectrum usage).

The opinion expressed by some consultation participants that 26 GHz spectrum should not be subject to general restrictions or limitations by number is not shared by the regulatory authority. Since the demand as reported (800 MHz per operator) significantly exceeds the spectrum available (1 GHz), operators will vie for use of the same frequencies in areas where usage is expected to be more dense (while also

accounting for geographic separation to avoid interference between operators using the same frequency).

The regulatory authority therefore proposes, as an alternative to exclusive, nationwide licensing, three separate assignment scenarios (award models) for 26 GHz spectrum, which are capable of achieving a more efficient use of these frequencies. Pursuant to Art. 10 Par. 3 TKG 2021, the regulatory authority is required to promote an effective and efficient use of spectrum, one example here being the shared use of radio spectrum by multiple users.

1.1 Model A

The first assignment scenario (model A) directly addresses the issue of limitation by number. Certain regions are defined by considering demand across geographic space. High demand areas are areas in which a higher demand for spectrum is to be expected and where it is therefore a scarce good. Pursuant to the TKG 2021, spectrum will be assigned in these high demand areas (HDAs) by means of a selection procedure (auction).

Areas in which spectrum is not a scarce good (rest of Austria) are defined as low demand areas (LDAs). An administrative assignment procedure will be used here, in accordance with legal provisions. Pursuant to Art. 10 Par. 3 TKG 2021, the most appropriate and least onerous authorisation system possible is to be applied, so as to maximise flexibility and efficiency in the use of radio spectrum. Accordingly, light licensing (a simple administrative procedure) is therefore proposed for the assignment of 26 GHz spectrum in the low demand areas. To exclude usage rivalry as far as possible, this model envisages assigning spectrum across very small geographic areas (local licensing/assignment) (see section 8.2). A comparable, geographically differentiated award model, with an auction in high demand areas and an administrative assignment procedure in the remaining (low demand) areas is being proposed in the UK by Ofcom for the assignment of millimetre wave (mmWave) spectrum (including 26 GHz), for example, and has also been selected for this type of spectrum in Australia.[5,6]

The regulatory authority is expecting mobile network operators to be the primary driver of demand for 26 GHz spectrum in high demand areas (in hotspots, for example). A demand for regional bandwidth providers can also be identified from the consultation input. Working from this assumption, licensing areas should be defined based on the regions as used for the 3.4–3.8 GHz band award in 2019. A proposal is therefore made to group together the individual HDAs within this licence region. The auction could then also be designed so as to address potential value interdependencies between the two bands to be assigned.

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[5] Cf. the Ofcom consultation on the assignment of mmWave spectrum. Accessible from: https://www.ofcom.org.uk/consultations-and-statements/category-1/mmwave-spectrum-for-new-uses

[6] On Australian assignments, cf. e.g. https://www.infrastructure.gov.au/media-communications-arts/spectrum/spectrum-allocations/26-ghz-band

1.2 Model B

The second assignment scenario (model B) is based on the assumption that usage will primarily be local and geographically heterogeneous, as expected by the participants in the consultation on the Spectrum Release Plan (varying use cases and users per area). Model B envisages using a selection procedure (auction) to assign 26 GHz spectrum (but not the remaining 3.4–3.8 GHz spectrum) in very small regions. The auction will offer larger municipalities and cities as separate regions while smaller municipalities will be consolidated into political districts. Wide-ranging rollout obligations in all regions are included, to prevent situations where spectrum is hoarded for strategic reasons. This gives local operators the opportunity to acquire frequency usage rights in areas in which larger operators have little to no need for spectrum. This award model should also be seen as a market test of current scarcity: if excess spectrum remains unused in individual regions, these frequencies could then be awarded using an administrative assignment procedure at a later point in time.

Assignment model B is especially suited to scenarios where HDAs and LDAs cannot be clearly differentiated from one another, and where value interdependencies (and interregional synergies in particular) between regions are limited. Under these conditions, potential users can make the decision to acquire spectrum in a particular region (because an MBB hotspot is located in the city, for example), regardless of whether they have successfully acquired spectrum in the other regions.

This model is unsuitable however, if significant interregional synergies exist—as with the case of an FWA operator needing to aggregate several regions to achieve an efficient minimum size.

The US 3.5 GHz auction (Auction 105) can be cited as an international example of a regional auction that also includes very small regions (based on population).[7]

1.3 Model C

Two participants in the Spectrum Release Plan consultation propose awarding nationwide usage rights for 26 GHz spectrum. Yet these consultation participants also assume that 26 GHz spectrum usage will be local or regional rather than requiring blanket coverage.

Awarding exclusive, nationwide licences for spectrum entails a high risk of spectrum in rural areas ultimately going unused despite a potential group of local users. Strategic motivations (market foreclosure) may give holders of spectrum usage rights an incentive to avoid leasing spectrum to potential users even if these holders do not themselves use this spectrum.

To prevent such a scenario occurring, model C combines the award of nationwide licences by selection procedure (auction) with measures to prevent or make it harder

[7] See https://www.fcc.gov/auction/105

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to hoard spectrum in rural areas. These measures include wide-ranging coverage obligations and/or a duty to lease spectrum (should the rights holder themselves have no use for spectrum).

This assignment model could be an appropriate solution to a situation where a clear definition of HDAs and LDAs proves impossible, and the presence of significant interregional synergies also makes model B unsuitable.

Spectrum is also to be assigned from the 3410–3470 MHz band: this involves frequencies from the 2019 award that are yet to be assigned in certain regions. The regulatory authority's opinion is that these should be limited by number (see section 4.3). Consultation participants concurred, commenting that the only sensible approach would be to assign this remaining spectrum on the same regional basis as in 2019.

1.4 Consultation questions

Question 1.1: What is your opinion of the three award models proposed by the regulatory authority? What are the pros and cons? Please give reasons for your answer.

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2 Award objectives

The regulatory authority has defined the following award objectives:

- Legal certainty
- Ensure efficient spectrum use
- Safeguard/promote effective competition
- Promote coverage
- Promote innovation and business development

Considering the specific properties of 26 GHz spectrum (frequencies that are unsuitable for wide-area usage, varying business models, lack of clarity in relation to usage), the regulatory authority is focusing this spectrum award not only on legal certainty but also on the efficient use of spectrum, and the promotion of innovation and business development. The specific aims:

- Provide optimum support for the various business models/use cases
- Ensure that spectrum does not 'lie fallow' (especially in rural areas) or remain unused if there is a potential group of users
- Choose or develop a selection procedure that is aimed at safeguarding efficiency in the event of spectrum limited by number (scarce)

Maximising auction income is expressly ruled out as an award objective. The regulatory authority also seeks to uphold climate targets and supports relevant measures for spectrum awards in the context of the award objectives.[8]

2.1 Consultation questions

Question 2.1: Which award objectives should be prioritised, in your opinion? Where could objectives give rise to conflicts? Please give reasons for your answer.

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[8] Cf. e.g. RSPG, Progress Report of the RSPG Sub Group on Climate Change, 2022. Accessible from: https://rspg-spectrum.eu/wp-content/uploads/2022/06/RSPG22-016final-Progress_report_Climate_Change.pdf

3 Spectrum bands

3.1 26 GHz band

The spectrum band comprises the 24.25 to 27.5 GHz frequency range. Consultations were previously held on this band in 2019 and 2021. Previous use of the spectrum band has already been discussed in these consultations; in terms of non-terrestrial usage, the reader is referred to these consultations (e.g. protection zone around the Aflenz earth station).[9,10] One important terrestrial usage is microwave service in the 25.081–25.445 GHz and 26.089–26.453 GHz sub-bands (referred to as the 'microwave band' in the following).

There are long-term plans to use the entire band for mobile and broadband ECS services, and to use spectrum in accordance with the following band plan, which is based on the harmonised terms and conditions of use (200 MHz blocks, orientation towards the upper band edge).

This would provide 16 blocks of 200 MHz each in the long term. The figure does not account for the 24.25–24.30 GHz range.

	Lokale Grundstücks-basierte Zuteilung											Breitband/FWA				
Block	LA16	LA15	LA14	LA13	LA12	LA11	LA10	LA09	LA08	LA07	LA06	LA05	LA04	LA03	LA02	LA01
Fu/GHz	24,3	24,5	24,7	24,9	25,1	25,3	25,5	25,7	25,9	26,1	26,3	26,5	26,7	26,9	27,1	27,3
Fo/GHz	24,5	24,7	24,9	25,1	25,3	25,5	25,7	25,9	26,1	26,3	26,5	26,7	26,9	27,1	27,3	27,5

Figure 2: Band plan for 26 GHz band

Pursuant to the Frequency Utilisation Ordinance (FNV), 600 MHz at the lower band edge is to be used within a local real estate-based licensing model for defined, small-scale geographic areas, and especially for in-house purposes (e.g. campus networks, industrial use) (24.3–24.9 GHz range). Pursuant to Art. 11 Par. 3 TKG 2021, the 26.5–27.5 GHz range is allocated for harmonised ECS bands for mobile services and broadband.

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9 Cf. consultation by the regulatory authority on the 26 GHz band and the 2300 MHz band, accessible from: https://www.rtr.at/TKP/aktuelles/veroeffentlichungen/veroeffentlichungen/konsultationen/konsult26-ghz-2300-mhz.en.html

10 Cf. regulatory authority consultation on the 2021–2026 Spectrum Release Plan, accessible from: https://www.rtr.at/TKP/aktuelles/veroeffentlichungen/veroeffentlichungen/konsultationen/consultation_spectrum_Release_plan.en.html

3.1.1 24.3–24.9 GHz frequency range

Table 3: Frequency blocks at the lower band edge of the 26 GHz band

Frequency blocks	GHz
LA14	24.7–24.9
LA15	24.5–24.7
LA16	24.3–24.5

These frequencies are not limited by number (see section 4.2.1)and are to be assigned on the basis of a real estate assignment (licensing) model. For details, please see section 8.1.

3.1.2 26.5–27.5 GHz frequency range

Table 4: Frequency blocks at the upper band edge of the 26 GHz band

Frequency blocks	GHz
LA01	27.3–27.5
LA02	27.1–27.3
LA03	26.9–27.1
LA04	26.7–26.9
LA05	26.5–26.7

Depending on whether or not these frequencies are limited by number (in a specific area), they are either awarded by means of a selection procedure or assigned by means of an administrative procedure (see section 4.2.2).

3.2 Remaining 3410–3470 MHz spectrum

The 3410 to 3800 MHz frequency range was auctioned off as part of a regional award in 2019. Some spectrum remains available as it was left unassigned in some regions: these frequencies form part of the next award.

The figure below summarises the available spectrum:

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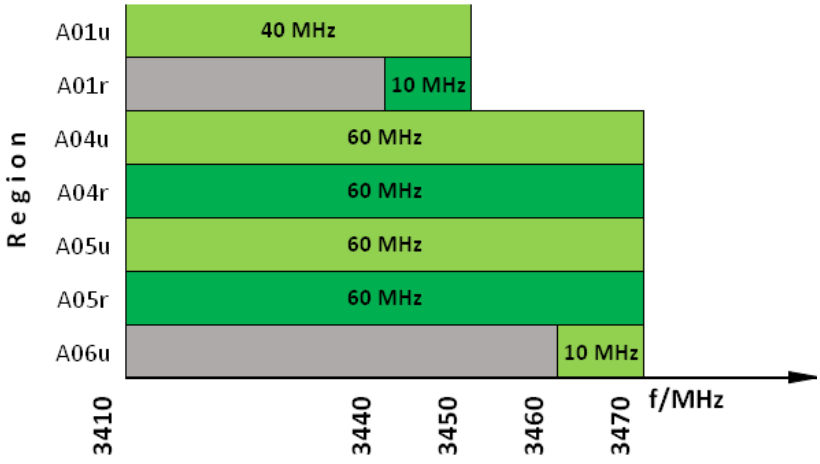

Figure 3: 3410–3470 MHz overview

The table below lists the available frequencies by region:

Table 5: Frequency blocks/bandwidth

Region(s)	Frequency range/MHz	Bandwidth/MHz
A01u	3410–3450	40
A01r	3440–3450	10
A04u, A04r, A05u, A05r	3410–3470	60
A06u	3460–3470	10

Where necessary, these frequency blocks will be designated as follows in the procedure:

Table 6: Frequency blocks in the 3410–3470 MHz band

Designation	Frequency range
LB01	3410–3420 MHz
LB02	3420–3430 MHz
LB03	3430–3440 MHz
LB04	3440–3450 MHz
LB05	3450–3460 MHz
LB06	3460–3470 MHz

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For details of the technical terms and conditions of use, please consult the frequency assignment decision, and the terms and conditions of use for this frequency range (see F1/21[11]).

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[11] See frequency assignment in procedure F1/21 (in German); accessible from: https://www.rtr.at/TKP/aktuelles/entscheidungen/entscheidungen/f1_21.de.html

4 Limitation by number

4.1 Introduction

The spectrum entrusted to the regulatory authority for assignment is envisaged for use by electronic communications systems (ECS) for mobile and broadband use. In the EU, harmonised terms and conditions of use are being developed for this spectrum, both to ensure usage free of interference and to exploit economies of scale relevant for telecommunications equipment.

Spectrum previously assigned for mobile services is within the 700 MHz to 3.8 GHz ranges. Most of this spectrum has been awarded in the form of nationwide usage rights (occasionally as regional usage rights in larger regions) by auction, primarily for use with mobile communications networks. This spectrum assignment model offers several advantages. First, it allows operators to use spectrum efficiently within their licence region (interference management) and provide (wide-area) coverage to the licence region. Second, this spectrum assignment model creates investment security for business models addressing larger geographic areas, which incur significant (sunk) fixed costs (e.g. for backbone infrastructure, marketing, sales and distribution).

Under previous legislation (TKG 2003), the competent federal ministry listed this spectrum in the Frequency Utilisation Ordinance as 'limited by number' (scarce) and thereby provided justification for tasking the regulatory authority with its assignment. This decision also had the effect of determining the award procedure (auction). Accordingly, the TKK assigned this spectrum by means of an auction. Otherwise, the spectrum was assigned by the competent federal ministry using a request procedure on a first-come, first-served basis.

On such a first-come, first-served basis, assignment follows the chronological order of requests received until available spectrum is exhausted (either at a certain site or for a certain region). If scarcity is a problem (demand exceeds availability), the risks inherent in this procedure might jeopardise the TKG's strategic targets. Such a procedure is particularly unsuited to the assessment and objective evaluation of competing spectrum demands from potential users. Assignment is simply in accordance with the chronological order.

Such an assessment and evaluation of demand is, however, fundamental to the achievement of the TKG's targets in cases where demand for spectrum exceeds availability. Decisions are required not only about the nature and number of spectrum users but also about the volume of spectrum each of these users will receive. A wide range of factors plays a role here (end customer demand, market structure, business models, trade-offs between spectrum and investments in infrastructure, etc.).Evaluation therefore requires a selection procedure oriented towards the targets set out by the TKG. This ensures that the assignment of spectrum will secure the greatest benefits for end users.

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Given the general conditions as stated, the decision to use a selection procedure could only be waived if demand for spectrum does not in fact exceed availability—a situation where demand for spectrum is so low that the frequencies cannot be considered a scarce resource. In the past, this was not to be expected to apply to ECS spectrum, on account of the rapid growth in demand for mobile (data) services. These findings were further confirmed by the results of the auction.

In the case of the 26 GHz band, spectrum is now to be assigned whose propagation characteristics may require it to be assessed differently. Usage areas are considerably smaller and wide-area usage is uneconomical. A number of users with various use cases have expressed an interest in this band. Some of these use cases require a relatively small usage area (local usage) while others are relevant only for certain regions.[12] Therefore, one cannot assume a priori that spectrum is necessarily scarce in all regions.

This section discusses whether the spectrum to be assigned as part of the next award should or should not be 'limited by number' and, if decided in the affirmative, in which regions. Pursuant to the TKG 2021, this question is to be assessed by the regulatory authority. The new legislative framework envisages a broad-based and forward-looking assessment, based on clear-cut criteria. Art. 14 TKG 2021 focusses on two key criteria here: first, the long-term disadvantages suffered by end users if spectrum for which demand exceeds availability is not awarded by means of a selection procedure (see above); and second, the facilitation and promotion of competition. The second criterion is two-fold, emphasising the competitive advantages offered by an efficient selection procedure on the one hand and the fact that scarcity must not be 'artificial' (e.g. resulting from licence regions without objective justification) and thereby act as a barrier to potential market entrants on the other.

In making its assessment, the regulatory authority is, while safeguarding competition, to consider the following criteria:

- Efficient use of spectrum
- Current and foreseeable future usages
- Foreseeable technical developments
- Duration of the expected spectrum assignment

The assessment must consider current and foreseeable types of use. The coverage and licence regions necessary for these usages have a central role to play here. The larger the licence region, the greater the expected usage rivalry and an award by selection procedure is indicated. In the worst case—the assignment of nationwide usage rights—even local usages (in Vienna and Vorarlberg, for example) become rivals for spectrum despite their geographic separation precluding interference. The licence regions necessary for the expected usages must therefore be examined. The problem of interference (see further below) and investment protection must also be

[12] See footnote 2.

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properly addressed. Establishing a wide-area mobile communications network supportive of uninterrupted mobility requires long-term planning certainty and investment protection, and therefore long-term, exclusive usage rights in larger regions. Such rights are not, in contrast, required with purely selective usage in hotspot areas.

Efficient use of spectrum constitutes another assessment criterion. In this context, the assessment must address whether efficient use of spectrum can be more readily assured with or without spectrum 'limited by number'. On the one hand, an administrative assignment procedure based on small units (local licensing) can increase usage density (multiple separate users) across a specific area, which therefore leads to more intensive usage of available frequencies. With the entry of new users, this also produces a positive effect on competition. On the other hand, licensing for separate users requires the establishment of guard bands in order to ensure usage without interference. In affected regions, spectrum can be used only to a highly limited extent or not at all, which for example in heavily populated areas is potentially detrimental for the goal of efficient spectrum usage.

The assessment as to whether spectrum is limited by number is not based on a single point in time but must consider the spectrum assignment period in its entirety. European and international frequency assignment plans must also be taken into account in the context of foreseeable future use. These assignment plans materially affect future global demand for hardware and therefore the investment decisions made by equipment manufacturers. Ultimately, these factors decide whether an ecosystem consisting of terminal equipment and devices is available in the access network for using a specific frequency. Furthermore, anticipated technical developments should also be considered in the context of foreseeable future use.

4.2 26 GHz band

4.2.1 24.3–24.9 GHz frequency range

Pursuant to the Frequency Utilisation Ordinance, this range (blocks LA14–LA16) is to be used for local, real estate-based assignment in defined, small-scale geographic areas, and especially for in-house use (e.g. campus networks, industrial use). The assignment is limited to the corresponding organisational premises and the rights of use for the spectrum are linked to (direct or indirect) legal control over the corresponding plot of land (real estate-based licensing model). See section 8.1.

These frequencies fulfil the criterion of spectrum 'not limited by number'. On account of the licensing model and the envisaged usage model, usage rivalry is non-existent or low (only in the case of simultaneous use on neighbouring plots of land). The propagation characteristics of the 26 GHz band, together with the severely restricted geographic use (e.g. company premises) and the expected wide-area usage density would argue against a 'limitation by number' for spectrum in the context of this usage type.

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4.2.2 26.5–27.5 GHz frequency range

4.2.2.1 Introduction

The need for spectrum in the 26 GHz band was surveyed during the consultation on the Spectrum Release Plan in summer 2021. Input from potential users shows that the specified demand for spectrum—without geographic disaggregation—significantly exceeds the available 1 GHz.

In the consultation, demand as follows was mentioned by several potential users:[13]

- Minimum bandwidth/demand: 400 MHz–1000 MHz
- Optimum bandwidth: 800 MHz–1000 MHz
- Maximum bandwidth: 800–1600 MHz (or unrestricted)
- Individual demand for bandwidth: 400 MHz–1600 MHz

Arguments justifying this demand included the following:

- The 5G use cases, especially eMBB and FWA, were cited as drivers for high bandwidth demand
- From a technical perspective, use of 26 GHz spectrum is allegedly less efficient compared with the use of 3.5 GHz spectrum; data transmission rates comparable with those achievable with the 3.5 GHz band would require substantially more spectrum
- The optimum volume for technical purposes would be 800 MHz
- Efficient usage would not be possible with bandwidth of less than 400 MHz (cell capacity then being under 2 Gbps was one reason cited here)

If spectrum were to be awarded as nationwide exclusive usage rights or regional exclusive usage rights across very large regions, participants saw significant usage rivalry as inevitable, noting that spectrum would certainly have to be limited by number according to the provisions of Art. 14 TKG 2021.

On the other hand, responses to the consultation have also shown that in many cases the usages to be expected in the band are more likely to be small-scale and selective, e.g. in hotspots (see following table).[14] Accordingly, steps should also be taken to assess whether smaller-scale assignment of spectrum with the aim of achieving efficient frequency usage is expedient and possible, and whether the prerequisites for limitation by number are present, and if so in which regions.

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[13] See footnote 2.
[14] See footnote 2.

Table 7: Usage area options with number of times option was mentioned (source: consultation on the Spectrum Release Plan)[15]

Coverage area	<1 GHz	2.3 GHz	2.6 GHz FDD	2.6 GHz TDD	3.x GHz	3.8–4.2 GHz	6 GHz	26 GHz	42 GHz	60 GHz
Nationwide usage	1	4	3	2	2					
Regional usage (region, municipal network)		1	1		2		1	1		
Urban usage (urban regions)		1		1	1		1	1		
Hotspots (urban, suburban)		1		1	2		1	4	2	2
Local usage					1			4	1	1
Last mile/FWA (streetside, suburban, urban, towns)		1		1	2			4	2	2
Campus indoor/outdoor		3		2	4	2	1	9	2	2
Campus indoor		3		2	3	2	1	7	2	2
Specific sections							1	2		

As a first step, consideration will be given to the expected usages and the corresponding usage areas.

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15 See footnote 2.

4.2.2.2 **Usages and use cases**

In the consultation, specific usages cited by operators included eMBB usage in hotspots, various forms of fixed wireless access (FWA) as well as usage within campus networks and on industrial premises. In-band backhauling was also mentioned, although this usage ultimately depends on backhaul connectivity to some other usage.

eMBB

Usage for enhanced mobile broadband (eMBB) is dependent on the availability of compatible smartphones. Internationally, similar end-user devices are already available for the 26.5–27.5 GHz band, not least as a result of 28 GHz band mobile services in the USA. The 26.5–27.5 GHz range is included both in the 26 GHz band to be awarded and in the 28 GHz band already in use in the US. In particular, eMBB will be deployed to meet additional demand for capacity arising over the medium term. Additional capacity can be created by utilising more spectrum, constructing additional transmission sites, increasing the number of sectors or by making use of advanced technologies such as spatial multiplexing. Unlike the situation in the 3.4–3.8 GHz band, consultation participants expect to see the short-term deployment of a large number of antenna elements (MIMO) in the 26 GHz band for beamforming but not for spatial multiplexing. To the best of their knowledge, corresponding base stations for the latter use are not yet on the market. The huge bandwidth does enable capacity increases, however. The 26 GHz band should therefore be especially suited to outdoor coverage over a relatively small area centred on the base station. Providing indoor coverage from outside will typically not be an option, as a result of significant signal attenuation by the building envelope.

In the first rollout phase, additional capacity will therefore depend critically on the number of sites together with the width of the spectrum deployed. A dense network of sites will be required because of the band's high propagation losses. Rollout can therefore be focused in particular on densely populated urban areas at existing macro sites or, alternatively, as a rollout of small cells. The expected small size of base stations means small antenna regulations are likely to apply, with an associated wayleave right to public property in return for compensation (Art. 53 and Art. 51 Par. 1 no. 5 TKG 2021). A rollout at publicly owned sites could therefore be a simpler approach, while at other sites appropriate agreements will likely be necessary with site providers, who thereby assume an enabler role.

For eMBB, the transmission power of end-user devices—and thus the radius within which they emit significant interference—will be relatively low; only the base stations will have a higher transmission power and therefore generate more wide-ranging interference.

Coverage area

In areas where eMBB will be used, it can be assumed that all MNOs will want to deploy corresponding frequencies in the 26 GHz band over the medium to long term.

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A corresponding level of usage rivalry is therefore to be expected. This suggests that spectrum in these regions can be defined as scarce. An exclusive award would give operators a corresponding degree of investment security while facilitating interference management within exclusively assigned regions, with the result that operators could make autonomous decisions about efficient spectrum usage. Current estimates suggest that regions with eMBB usage will be relatively small, however.

FWA

Use of the 26 GHz band for fixed wireless access (FWA) is associated with a number of conceivable FWA usage scenarios. The definition of potential regions with sufficiently high demand is critically dependent on an exact understanding of these usage scenarios and the associated question of whether a positive business case exists.

Various aspects need to be accounted for here, especially in light of the poor propagation characteristics.

As a first consideration, line of sight (LOS) is extremely important for usage of the band. Where no line of sight exists, usage is typically only possible within a significantly more restricted radius or indeed not at all. In an urban context, with multiple residential units in buildings, the current network of macro sites will as a rule not be able to provide coverage via LOS to homes with end-user devices installed on windows or balconies. In less densely populated areas where detached properties predominate, it will presumably be easier to establish an LOS between base stations with an appropriate height and external antennas.

The second problem is the generally high attenuation from the building envelope. In most cases, outdoor transmission sites will typically be unable to provide indoor coverage. Accordingly, an externally attached end-user device will be required for any FWA usage.

Thirdly, there is the question of whether the 26 GHz band will be used together with other bands. If indeed used in combination with other bands, a lack of 26 GHz coverage can be compensated using other bands. The 26 GHz band would be able to free up capacity in the other bands in places where coverage could be provided with this band. Sole use of the 26 GHz band could facilitate the market entry of new providers. These providers would probably need to specialise in FWA and be active in competitive niches.

The fourth aspect concerns the type of end-user device and the quality of end-user device installation. As an example, manufacturers have stated that a professionally installed parabolic antenna with high antenna gain, high transmission power and a line of sight to the base station can provide sufficiently good coverage at a distance of several kilometres. At the same time, however, this kind of usage, similar to microwave, can generate significant interference in the beam direction and therefore impact usage by others over a large area.

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As a fifth point, the base station type and current technological advances need to be considered. Important aspects in relation to radio network and capacity planning include the transmission power, the number of antenna elements as well as support for beamforming, so as to extend the range of coverage or potentially facilitate spatial multiplexing.

As regards demand for FWA usage, key factors here include alternatives available at the respective site, such as connectivity via optical fibre, coaxial cable, copper or other mobile service bands, and the potential connection speeds achieved thereby. Depending on the above, FWA may be the only usage scenario available with correspondingly high bandwidths, or it may be an alternative that exerts competitive pressure on other scenarios. FWA can also be a transitional technology that facilitates a corresponding level of connectivity until a wired optical fibre connection can be established.

Also relevant is the question of whether only one or several potential providers plan to establish FWA connectivity within a certain region. If the primary aim of connectivity via FWA and 26 GHz is coverage with bandwidth otherwise unavailable but at a relatively high cost, it is less likely that multiple providers will want to use the 26 GHz band simultaneously within a specific region. However, if connectivity via 26 GHz is possible at competitive prices even when compared with existing infrastructure, then offering connectivity via the 26 GHz band can in itself constitute competition.

For existing operators, demand for usage in the 26 GHz band for FWA (and also eMBB) at macro sites in combination with other bands will typically first arise once the bands that have superior propagation characteristics do not provide corresponding levels of capacity. One should also remember that MNOs acquired at least 100 MHz of additional spectrum as part of the 3.4–3.8 GHz band award procedure. With the use of appropriate technology (massive MIMO), capacity in this band can be further increased.[16]

Strategic demand

Regardless of the award format, i.e. a selection procedure for the awarding of exclusive usage rights or an administrative procedure (e.g. local assignment on a first-come, first-served basis), strategic demand is possible. Providers of mobile and fixed services alike may have the ability and incentive to foreclose access to this spectrum for other providers, so as to limit competitive pressure either to wired broadband services in the former case or to mobile broadband services in the latter. While this applies independently of the respective use case (eMBB or FWA as well as campus-based usages or other forms of local usage), a range of aspects may play a role for each use case in question.

[16] As of this writing, these spectrum assignments are at most three years old and coverage obligations remain the primary rollout driver, thus deployment of this band is not a good indicator of demand for capacity. The 2.6 GHz band is a better indicator in this context.

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Coverage obligations or rollout obligations included in the ancillary provisions to a frequency award may increase the costs of strategic demand and therefore accordingly reduce such demand. In the context of small-scale assignment in particular, rollout obligations may significantly increase the costs of non-usage and therefore contribute to efficient spectrum usage.

Alternatively, including caps in the selection procedure can also limit foreclosure ability. This question is addressed in section 4.5.

4.2.2.3 **Definition of high demand areas**

The following section presents the rationale followed for the definition of high demand areas. Spectrum in these regions is to be 'limited by number'.

The following is proposed for defining HDAs and LDAs:

- The first option is based on distinguishing between urban and rural regions, as previously done in the 2019 auction (3.4–3.8 GHz). At that time, the regulatory authority chose to differentiate regions with high demand for spectrum from other regions.
- The second option takes its starting point from the current use of 2.6 GHz spectrum. Unlike other frequencies currently in use (800, 900, 1800 and 2100 MHz), this spectrum does not see wide-area usage but is used only in regions with high capacity requirements. A use of these specific frequencies can therefore indicate a high demand for spectrum.
- The third option identifies HDAs by taking into account the amount of spectrum broadcast overall in the respective municipality and the amount of spectrum per square kilometre of settlement area.

4.2.2.3.1 Underlying considerations

For the definition of HDAs that follows (with the exception of urban regions in the 2019 auction), municipalities are used as the smallest possible unit.[17] Corresponding administrative data are available for municipalities. A municipality is the smallest political unit that is capable of making corresponding decisions about the rollout of infrastructure such as optical fibre, or that can influence the deployment of broadcasting sites through government decisions.[18] In the more detailed analysis provided below, mobile service sites are assigned to municipalities by their geographic coordinates. Note that the mere presence of mobile service sites in a municipality is not sufficient indication of how well the community is covered. There are municipalities with no sites but with good coverage provided from external sites, for example. Equally, significant areas within municipalities that do have internal sites may still suffer from a lack of adequate mobile service coverage.

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[17] If appropriate and where needed, adjacent grid cells of a dimension yet to be determined could be assigned to municipalities as part of defining coverage areas on a smaller scale.

[18] Potential smaller units would be grid cells or cadastral municipalities.

Future demand for spectrum in the 26 GHz band, which is decisive for the definition of HDAs, must be estimated on the basis of a forecast. Ultimately, demand for large-volume data transfers will be a major driver of demand for spectrum in general and 26 GHz band spectrum in particular. In its Communications Survey Ordinance (KEV), RTR surveys data volumes transferred for both other subscriptions, which are an indicator for eMBB, and data-only subscriptions, which are an indicator for FWA usage. To determine which regions might see a high demand for 26 GHz spectrum, data volumes per individual site or per local area unit would in fact be required. Even current data volumes and data volumes from recent years are only available from MNOs in a variety of formats not directly comparable with one another. Ultimately, data transmission rates at times of peak load (peak hours) would be required to assess demand.

Where demand cannot be observed directly, the supply side can be used as an indicator. This effectively means the local data transmission capacity, which, in a specific region, depends in particular on the number of sites (per unit of area), the spectrum deployed and the number of sectors. All of the corresponding data are collected in accordance with the Harmonised Calculation Method (HCM) Agreement. Each row essentially corresponds to a sector within a specific band and to a specific technology. The data also include the transmission frequency and therefore the band as well as the bandwidth deployed. Sites are specified to the nearest second of latitude/longitude and therefore geolocated to a resolution of 20–30 m. From the HCM data, the number of sites can be derived together with the respective number of sectors and the overall spectrum deployed per site. These are the primary factors that determine data transmission capacity within a region.[19]

Figure Figure 4 provides a general overview of capacity per local region: the map shows for all three MNOs together (FDD downlink and TDD) the spectrum broadcast per arc minute (degree of longitude/latitude), which in Austria is an area of approximately 1850 x 1240 m. This involved allocating each site identified with geographic coordinates (arc minute resolution) to such an area. This allocation does not utilise a propagation model. If all three operators deploy their entire spectrum in the 800, 900, 1800 and 2100 MHz bands, each at one site with three sectors in a single grid cell, then (35+30+75+60)×3 = 600 MHz will be broadcast. This would then be a green grid cell in Figure 4; in this case, the 2600 MHz and 3600 MHz bands would not be deployed.[20] Figure 4 uses grey cells with less than 500 MHz to represent regions with relatively low capacity. Green shading with values between 500 and 1,000 MHz indicates slightly higher capacity, while yellow grid cells with 1,000–2,000 MHz are often likely to indicate more than one site per operator or the deployment of spectrum in the 3.4–3.8 GHz range. Truly high capacity is indicated by the orange or red grid cells, with more than 2,000 and 5,000 MHz broadcast, respectively. Red grid cells in particular highlight the six largest urban areas in Austria, namely: Vienna, Graz, Linz, Salzburg, Innsbruck and Klagenfurt. Other major cities, such as Villach, Wels, St. Pölten, Dornbirn, Wiener Neustadt or Steyr, are also

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[19] Other relevant factors such as the number of antenna elements are not considered in this analysis.

[20] The 700 and 1500 MHz bands, together with their rollout, played only a very insignificant role as of late 2021, if they were indeed even deployed.

clearly visible. Hotspots such as Vienna Airport or the Red Bull Ring in Spielberg can also be recognised.

In terms of demand for 26 GHz, the figure can certainly be interpreted as showing that considerable potential for using other existing frequencies is present at the respective sites, at least in the white, grey and green grid cells. At least at these sites, demand from several existing network operators for usage of the 26 GHz band is not to be expected over the next few years. Only in 239 orange and red grid cells—equivalent to an area of around 500 square kilometres—is bandwidth greater than 2,000 MHz being broadcast. Consequently, at least one provider must be operating more than one site or a site with more than three sectors (excepting 700/1500 MHz).

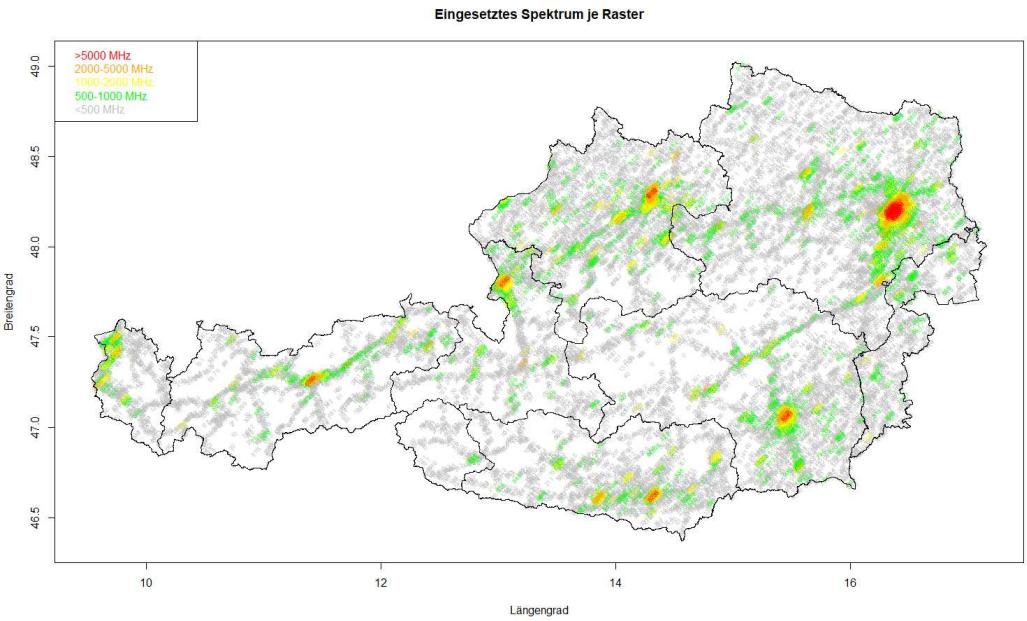

Figure 4: Deployed spectrum by grid unit (arc minute of longitude and latitude)

Figure 4 ultimately illustrates only regional differences in demand for spectrum but does not directly facilitate the definition of regions in which a high demand exists for 26 GHz spectrum. Accordingly, a number of options for defining HDAs are presented in the following. In the final analysis, the key factors for this assessment are which municipalities, which share of the population and which proportion of the area fall under HDAs. This information is presented in Table 8. This table includes all municipalities that form part of the HDAs under at least one of the options. The table lists the code, total population and area for each municipality as well as its association with an HDA under a specific option. The total population, area and number of municipalities for each option are calculated and shown at the end of the table.

Table 8: Definition of high demand areas: options and municipalities included[21]

			Option	1	2	3	2 and 3
Code	Municipality	Pop.	Tot. area	Urban regions 2019	2.6 GHz deployed at 3 MNOs	>5,000 MHz and >750 MHz per km² SA	>5,000 MHz and >750 MHz per km² SA and 2.6 GHz at 3 MNOs
90001	Vienna	1,921,050	414.9	1	1	1	1
60101	Graz	291,297	127.6	1	1	1	1
40101	Linz	206,657	96.0	1	1	1	1
50101	Salzburg	155,316	65.7	1	1	1	1
70101	Innsbruck	131,098	104.9	1	1	1	1
20101	Klagenfurt am Wörthersee	101,886	120.1	1	1	1	1
20201	Villach	63,290	135.0	1	1	1	1
40301	Wels	62,641	45.9	1	1	1	1
30201	St. Pölten	55,868	108.5	1	1	1	1
80301	Dornbirn	50,259	120.9	1	1	1	1
30401	Wiener Neustadt	46,374	60.9	0	1	1	1
40201	Steyr	37,958	26.6	0	1	1	1
80207	Bregenz	29,606	30.0	1	1	1	1
41012	Leonding	28,928	24.0	1	1	0	0
32144	Klosterneuburg	27,617	76.2	0	1	0	0
30604	Baden	25,781	26.9	0	1	1	1
41021	Traun	24,911	15.5	1	0	1	0
30101	Krems an der Donau	24,716	51.7	0	1	1	1
61108	Leoben	24,156	107.8	0	1	1	1
30502	Amstetten	23,548	51.9	0	1	0	0
62140	Kapfenberg	22,301	82.1	0	1	0	0
31717	Mödling	20,317	10.0	1	0	1	0
30740	Schwechat	20,285	44.9	1	1	1	1
41002	Ansfelden	17,472	31.3	0	1	1	1
32135	Tulln an der Donau	16,373	72.3	0	0	1	0
70357	Telfs	16,093	45.5	0	0	1	0
31719	Perchtoldsdorf	15,034	12.6	1	1	0	0
10101	Eisenstadt	14,906	42.9	0	0	1	0
70531	Wörgl	14,180	19.7	0	0	1	0
50338	Wals-Siezenheim	13,673	26.6	1	1	1	1
80215	Hard	13,629	17.9	1	0	0	0
31213	Korneuburg	13,346	9.8	0	0	1	0
31818	Neunkirchen	12,601	20.4	0	0	1	0
41225	Ried im Innkreis	12,160	6.8	0	0	1	0
31704	Brunn am Gebirge	12,038	7.3	1	0	1	0
41005	Enns	11,766	33.1	0	1	1	1
31235	Gerasdorf bei	11,587	35.3	0	1	0	0

[21] Source: RTR calculations; municipality data from Statistics Austria (as of 1 January 2021) and HCM data as of 31 December 2021.

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			Option	1	2	3	2 and 3
Code	Municipality	Pop.	Tot. area	Urban regions 2019	2.6 GHz deployed at 3 MNOs	>5,000 MHz and >750 MHz per km² SA	>5,000 MHz and >750 MHz per km² SA and 2.6 GHz at 3 MNOs
	Wien						
60669	Seiersberg-Pirka	11,553	17.4	1	1	0	0
80224	Lauterach	10,329	11.9	1	0	0	0
31725	Wiener Neudorf	9,229	6.0	1	1	0	0
70346	Rum	9,224	8.6	1	1	0	0
31716	Maria Enzersdorf	8,914	5.3	1	0	0	0
80240	Wolfurt	8,691	10.0	1	0	0	0
70411	Kitzbühel	8,259	58.0	0	1	0	0
31214	Langenzersdorf	8,171	10.7	1	1	0	0
41017	Pasching	7,677	12.5	1	1	0	0
31723	Vösendorf	7,353	10.5	1	1	0	0
60608	Feldkirchen bei Graz	6,949	11.6	1	0	0	0
61265	Schladming	6,590	211.3	0	1	0	0
60670	Premstätten	6,520	29.3	0	1	0	0
41823	Thalheim bei Wels	5,563	16.3	1	0	0	0
62047	Spielberg	5,368	29.7	0	1	0	0
60667	Raaba-Grambach	4,711	14.6	0	1	0	0
80235	Schwarzach	3,867	4.9	1	0	0	0
80220	Kennelbach	1,885	3.2	1	0	0	0
			No. of municipalities	32	37	30	20
			Population	3,317,188	3,504,819	3,448,074	3,291,149
			Municipality area	1,657.2	2,470.0	2,029.5	1,779.3

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4.2.2.3.2 Option 1

Option 1 involves defining the high demand areas according to the urban regions from the 2019 auction.

Table 9: Urban regions from 2019 auction[22]

Region	Population	Municipality area in km²	Municipalities
A01u	2,078,259	630.7	Vienna, St. Pölten, Schwechat, Langenzersdorf, Brunn am Gebirge, Maria Enzersdorf, Mödling, Perchtoldsdorf, Vösendorf, Wiener Neudorf
A02u	336,377	210.2	Linz, Wels, Leonding, Pasching, Traun, Thalheim bei Wels
A03u	168,989	92.3	Salzburg, Wals-Siezenheim
A04u	258,588	312.3	Innsbruck, Rum, Bregenz, Hard, Kennelbach, Lauterach, Schwarzach, Wolfurt, Dornbirn
A05u	165,176	255.1	Klagenfurt am Wörthersee, Villach
A06u	309,799	156.6	Graz, Feldkirchen bei Graz, Seiersberg-Pirka
Total	**3,317,188**	**1,657.2**	

The definition from 2019 is essentially based on urban areas surrounding provincial capitals, with the exception of Eisenstadt but including the largest non-capital city, namely Villach. This definition comprises 32 municipalities, about 1,657 square kilometres or almost 2 per cent of Austria's total area of 83,882 square kilometres, and 3.3 million residents or some 37 per cent of Austria's roughly 9 million residents. This option for HDAs includes the ten largest cities, as measured by population, and their surrounding areas. All cities with over 50,000 residents fall under the definition. The regions match both those of the 2019 auction as well as the regional division of remaining spectrum in the 3410–3470 MHz band. Accordingly, individual licences for spectrum in the 26.5–27.5 GHz frequency range would be awarded for six regions.[23] The advantage of this definition option is that, beyond the ten largest cities, the regions are typically contiguous areas, within which interference management will exclusively be the responsibility of the respective licence holder.[24] Cities with slightly fewer than 50,000 inhabitants, such as Wiener Neustadt, Steyr or Feldkirch, would be grouped under LDAs. In these cities, frequency assignment would be handled as part of local licensing (see section 8.2).

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22 Source: Municipality data from Statistics Austria (as of 1 January 2021) and HCM data as of 31 December 2021

23 A licence holder must not necessarily be granted exclusive rights of use (cf. section 7.7 on the shared use of spectrum).

24 Potentially with restrictions related to the shared use of spectrum (see section 7.7).

4.2.2.3.3 Option 2

Option 2 is based on the assumption that mostly 2.6 GHz spectrum, as the last available band, was previously deployed to respond to capacity bottlenecks. As this spectrum was awarded more than ten years ago, any deployment over the last few years has typically been driven not by coverage obligations but by actual demand for additional capacity. To define HDAs, the number of MNOs (one to three) deploying 2.6 GHz spectrum is surveyed per municipality. No distinction is made here between FDD and TDD spectrum, nor between outdoor or indoor usage.

Figure 5 shows the shares of the population of municipalities, categorised by size, that are provided with 2.6 GHz coverage by three, two or one MNO or none. From this, we see that municipalities with 39 per cent of the national population have 2.6 GHz sites serviced by all three MNOs. This includes all cities with more than 50,000 residents and thus their total populations as well as around two thirds of the population of cities/municipalities with 20,000–50,000 residents. Below 20,000 residents, the share of municipalities with sites from all MNOs declines rapidly. No municipality with fewer than 2,000 residents has 2.6 GHz sites from all three operators.

In all cities with more than 20,000 residents, at least two MNOs operate sites with 2.6 GHz spectrum. In towns with 10,000–20,000 residents, around 41 per cent of municipalities as weighted by population, have sites operated with 2.6 GHz spectrum by at least two MNOs. In towns with 5,000–10,000 residents, this share is only 21 per cent. The share falls to below 5 per cent for smaller municipalities.

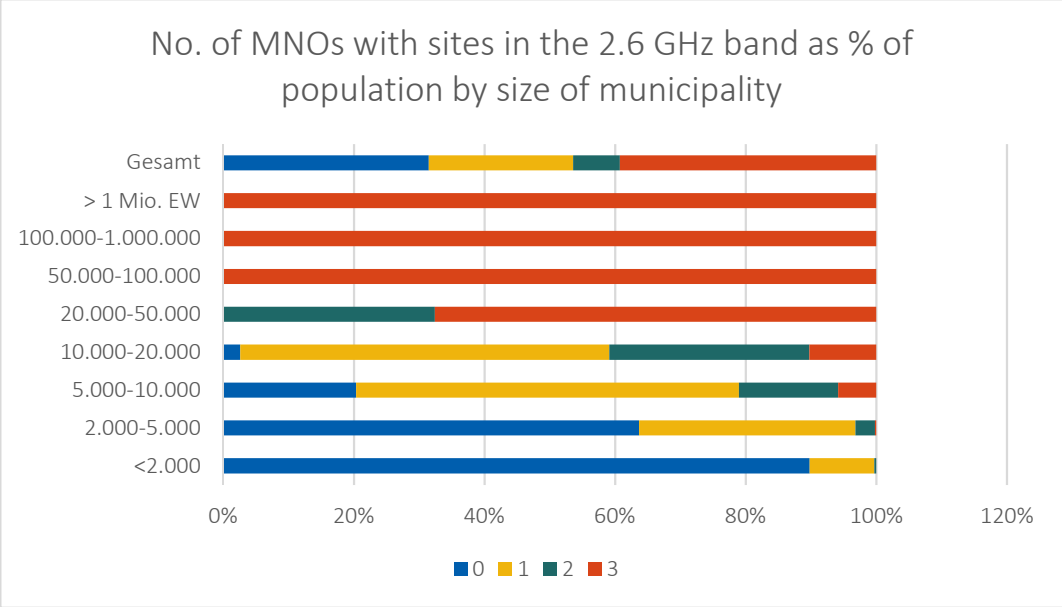

Figure 5: No. of MNOs with sites in the 2.6 GHz band as % of population by size of municipality

The definition of the HDAs in accordance with option 2 is shown in Table 8, as based on the necessary and sufficient criterion for an HDA, i.e. that as of 31 December 2021 all three operators were broadcasting 2.6 GHz spectrum in the particular municipality. This results in a total of 37 municipalities, encompassing

some 3.5 million inhabitants by place of residence or around 39 per cent of the total population of Austria. The total area of these municipalities, 2,470 square kilometres, is equivalent to around 3 per cent of Austria's total area.

Included in this option are the twelve largest municipalities in Austria, the smallest being Steyr. Feldkirch in Vorarlberg is the municipality with the largest population that is not part of the HDAs. The municipalities included are shown on the map in Figure 6. This option would therefore result in the definition of 22 noncontiguous areas as HDAs.

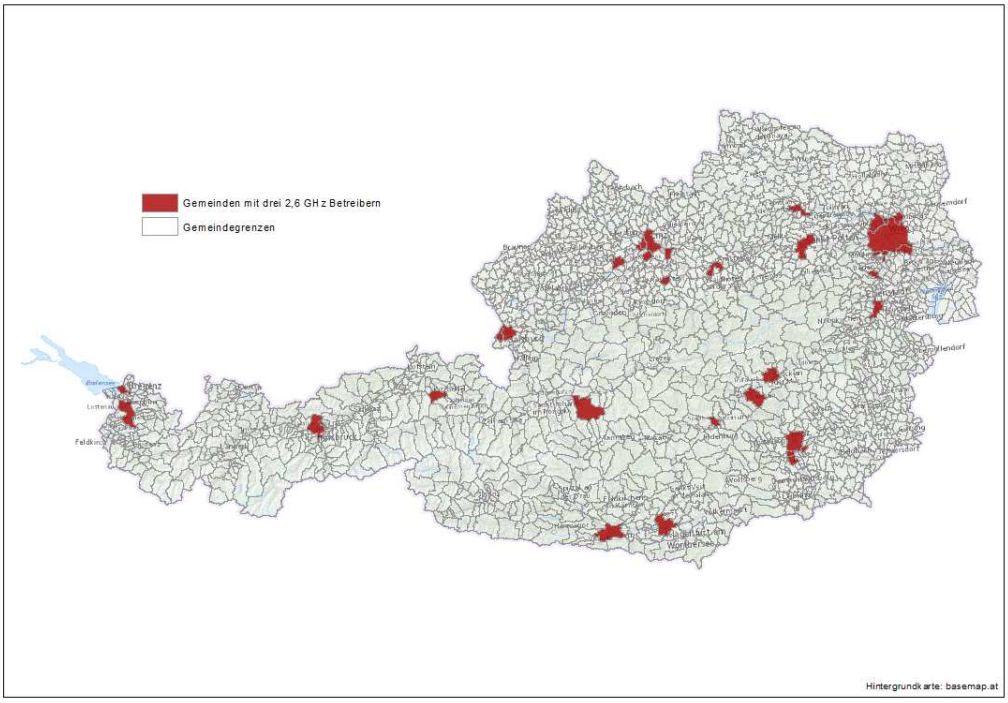

Figure 6: HDAs—definition of municipalities with three 2.6 GHz operators

The municipalities with fewer than 10,000 inhabitants that are included in this option's HDAs are municipalities adjacent to larger urban areas and/or are tourist hot spots such as Kitzbühel, Schladming or Spielberg. For municipalities with isolated commercial or tourist hotspots, however, spectrum assignment using a local real estate-based licensing model or a local licensing model for public networks may in fact be a more suitable approach (cf. section 8). Spielberg is an obvious example, where sites with high levels of spectrum usage are in the immediate vicinity of the Red Bull Ring. Spectrum assignment based on a real estate-based licensing model or based on individual sites could also provide 26 GHz coverage to the Red Bull Ring, although the municipality of Spielberg itself is unlikely to have especially high demand for 26 GHz coverage. Using a local licensing model instead of awarding individual usage rights on the basis of the municipality itself could also be advisable for other places in this option with a high level of commercial or tourist usage. Examples include Gerasdorf, Seiersberg-Pirka, Wiener Neudorf, Pasching, Vösendorf or Premstätten, where either shopping centres or leisure centres are located in the suburbs of large cities. Local (real estate-based) spectrum assignment could be

advisable to meet spectrum usage demand within enclosed buildings, since interference with other types of usage would be minimal. At 211.3 square kilometres, Schladming is the second-largest municipality by area in this option 2: here too, a high demand for spectrum is also unlikely to apply across the municipality's entire territory. Local spectrum assignment could also be advisable here.

As a sensitivity analysis, it is appropriate to define as HDAs all municipalities in which at least two operators broadcast 2.6 GHz. This approach would encompass 104 municipalities with just under 5,100 square kilometres and some 4.1 million inhabitants.

4.2.2.3.4 Option 3

Option 3 is based on the overall amount of spectrum broadcast in a municipality and the amount of spectrum per settlement area. This definition of HDAs encompasses municipalities that have sites with at least 5,000 MHz of broadcast spectrum. Accordingly, a certain minimum spectrum demand is required. The mere use of a larger number of bands at one site, such as at a shopping centre, is not typically sufficient. In addition, at least 750 MHz must be broadcast per square kilometre of settlement area. This excludes large municipalities with low population densities across the settlement area.

The municipalities defined by option 3 are shown in Table 8. This option comprises the twelve largest cities in Austria. The largest centres that are not part of the HDAs in option 3 are Feldkirch, Leonding, Klosterneuburg and Wolfsberg. Although all four cities or towns have sites broadcasting more than 5,000 MHz, broadcasts per square kilometre of settlement area are nonetheless below 750 MHz. The latter indicator also corrects indirectly for low settlement density. In the case of a low settlement density, the deployment of 26 GHz spectrum is unlikely to be a wise choice, since the band's poor propagation characteristics make it unsuitable for providing coverage across such regions.

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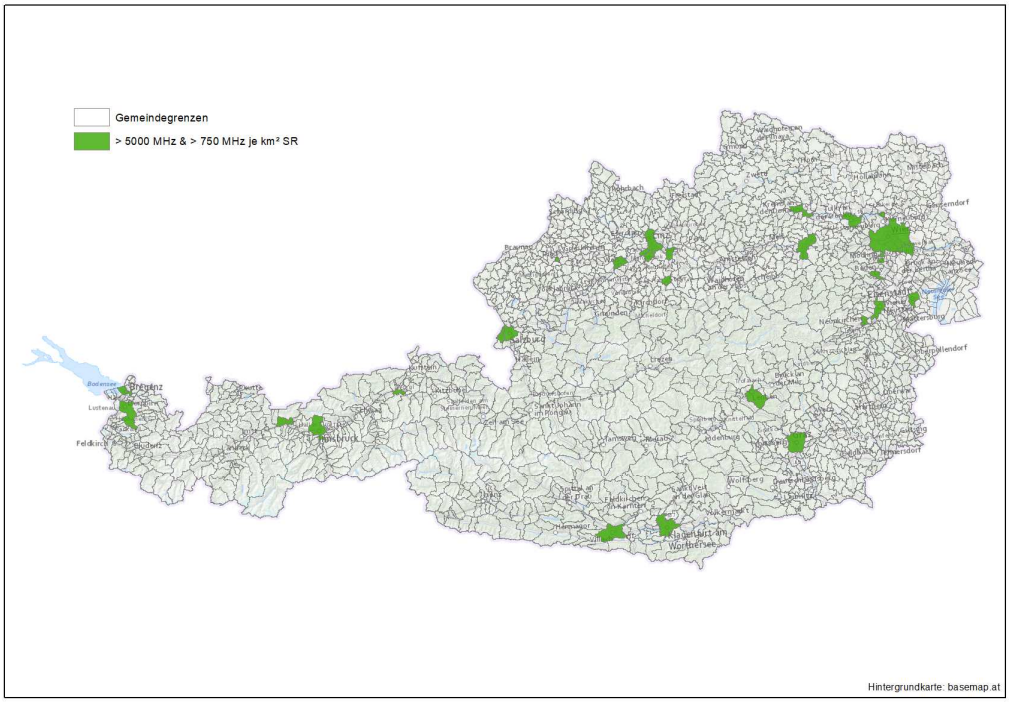

Figure 7: HDAs—definition of municipalities with at least 5,000 MHz broadcast and at least 750 MHz per km² of settlement area

Figure 7 depicts the noncontiguous areas in Austria as accordingly selected. This option encompasses many larger cities and several district capitals. This defines as HDAs a relatively large number of noncontiguous regions, which simultaneously exhibit a certain demand for spectrum in the respective settlement area. The smallest municipalities so included are centres such as Enns, Brunn am Gebirge, Ried im Innkreis or Neunkirchen. Municipalities with individual hotspots such as shopping centres or a larger settlement area without a high population density are excluded. In these places, a local assignment model could potentially ensure a more efficient use of spectrum.

Option 3 comprises a total of 30 municipalities with around 3.4 million inhabitants, and therefore 38.6 per cent of the Austrian population and 2,030 square kilometres, roughly 2.4 per cent of Austria's total area.

Using the parameters of deployed amount of spectrum, spectrum per square kilometre of settlement area and optional spectrum per square kilometre, the sensitivity analysis shown in Table 10 below can be performed.

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Table 10: Sensitivity analyses for HDA definition under option 3

Overview	No. of municipalities	km2	Population
>10,000 MHz and >500 MHz/km^2 SA	23	1,872	3,391,335
>5,000 MHz and >500 MHz/km^2 SA	**51**	**2,796**	**3,791,991**
>3,000 MHz and >500 MHz/km^2 SA	85	4,148	4,109,590
>500 MHz/km^2 SA	165	6,191	4,334,555
>5,000 MHz and >750 MHz/km^2 SA	**30**	**2,030**	**3,448,074**
>3,000 MHz and >500 MHz/km^2 SA and >200 MHz per MA	53	2,129	3,713,208
>500 MHz/km^2 SR and >200 MHz per MA	65	2,220	3,773,478

Accordingly, the required amount of spectrum broadcast per square kilometre of settled area (SA) could be reduced to 500 MHz. As a result, another 21 municipalities would become HDAs, with around 150,000 inhabitants and a further 766 square kilometres of area.

4.2.2.3.5 Concluding remarks

The rationale given by Ofcom also serves as a reference for the decision to be made.[25] Ofcom is also considering the definition of regions with high demand. Ofcom has selected urban areas with at least 75,000 inhabitants as its starting point. A small number of urban areas with high data traffic were also included in this initial selection. Urban areas in close proximity to one another were aggregated into a single urban area. The 107 areas so identified were then ranked according to base station density and peak hour traffic. From a number of options, the 40 highest-ranking urban areas is proposed as a definition of high demand areas. When using Ofcom as a reference, however, one should note that significantly more spectrum, namely 2.4 GHz, is available in the 26 GHz band, as well as additional spectrum in the 40 GHz band.

Overall, the regulatory authority is considering a relatively narrow definition of high demand areas. Another conceivable definition would be to require the criteria from both option 2 and 3 to be fulfilled. In this case, municipalities would need to meet three requirements to be defined as high demand areas, namely: all three MNOs deploying 2.6 GHz spectrum by the end of 2021, a minimum of 5,000 MHz being broadcast and at least 750 MHz broadcast per square kilometre of settlement area. Table 8 also presents this scenario of combining options 2 and 3. This option comprises only 20 municipalities with around 3.3 million inhabitants and 1,780 square kilometres of municipality area.

[25] See https://www.ofcom.org.uk/consultations-and-statements/category-1/mmwave-spectrum-for-new-uses

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At the same time, the regulatory authority is aware that a sharper definition could include adjacent municipalities, while specific hotspots, not falling under this definition, might potentially need to be included. This would require corresponding input from potential spectrum users, however.

In the regulatory authority's opinion, a final decision on areas in which spectrum is to be limited by number is also critically dependent on obtaining a sound understanding of the respective use cases, so as to be able to evaluate future usage and the scarcity of spectrum in the context of the use case and the geographic usage area. Accordingly, any need for spectrum in the 26 GHz band beyond the HDAs presented in these options should be further examined by means of specific details of the respective use cases as envisaged.

Detailed questions are presented at the end of the section. Answers will be used as further input for defining HDAs. This, in turn, will be ultimately authoritative for a decision to limit spectrum by number.

4.3 Remaining 3410–3470 MHz spectrum

The 3410–3800 MHz band was classified as 'limited by number' by the then-competent Federal Ministry of Transport, Innovation and Technology (BMVIT), and auctioned off in 2019 in the form of regional licences. A specific design was developed to minimise the risk of fragmentation in the auction, and therefore give mobile network operators active nationwide the opportunity to acquire contiguous and complete frequency blocks. As a result of this design, some spectrum remained unlicensed in regions with only weak demand from regional providers, as mobile network operators would have assumed a significant fragmentation risk if they had opted to acquire this spectrum. It cannot be concluded that this spectrum is not scarce in the affected regions. On the contrary, this scarcity was confirmed as the auction proceeded, as there was significant excess demand in all regions after several rounds.

If the spectrum to be awarded here were again put to auction, the fragmentation risk would no longer apply, since unsold spectrum would be assigned as independent, specific blocks within the band, and therefore its acquisition would present no risk of fragmentation in relation to spectrum already acquired. One may therefore assume that this spectrum is, as before, scarce. A corresponding demand was also expressed in the consultation on the Spectrum Release Plan.

Responses to the Spectrum Release Plan consultation also indicate that potential usages in this range have remained largely unchanged in the interim. Key usages named here included capacity expansions for existing operators (MBB), FWA and community networks. These usages formed the basis for the respective decisions made by authorities in the context of the 2019 auction.

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In the consultation held in summer 2021, use for private campus networks was also cited as another potential usage.[26] However, this kind of usage would require a real estate-based licensing model for local usage. The Frequency Utilisation Ordinance does not envisage such a model in this spectrum range. The consultation has revealed the following:

- There is a clear need for 'wide-area' usage of this spectrum. A local licensing model would, as a result of the propagation characteristics in this spectrum range, significantly limit or render impossible such a wide-area usage.
- Insufficient spectrum (few regions and comparatively little spectrum) is available to service the demand.
- A CEPT mandate exists with the objective of making the neighbouring 3.8–4.2 GHz band available for industrial usage.

The expected usage scenarios once again require the awarding of usage rights across larger areas (e.g. regions from the 2019 auction) in order to ensure efficient usage. It is the opinion of the regulatory authority that this spectrum should therefore continue to be limited by number.

4.4 Other ECS bands

In accordance with the spectrum use plan, all ECS spectrum for mobile services and broadband that has been assigned in the past and is currently being used is limited by number, and was awarded by auction. It is the opinion of the regulatory authority that this spectrum should continue to be limited by number. The regulatory authority is tasked with reviewing this limitation by number at regular intervals, and therefore at least before the expiry of the licences and before any reassignment of the overall band.

4.5 Consultation questions

4.5.1 On limitation by number (Art. 14 TKG 2021)

Question 4.1: Do you concur with the regulatory authority in its overall assessment regarding the question of whether spectrum should be limited by number? Please give reasons for your answer.

Question 4.2: Do you agree with the regulatory authority's opinion that the 24.3–24.9 GHz range (600 MHz at the lower band edge of the 26 GHz band) should not be limited by number, in view of the option of real estate-based assignment in defined, small-scale geographic areas, as envisaged in the Frequency Utilisation Ordinance? Please give reasons for your answer.

Question 4.3: Do you agree with the overall assessment of the regulatory authority that the 26.5–27.5 GHz range (1 GHz at the upper band edge) should only be limited

[26] See footnote 2.

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by number in areas that experience high traffic (high demand areas) and not in other areas? Please give reasons for your answer.

Question 4.4: Do you concur with the regulatory authority's assessment that the remaining spectrum in the 3.4–3.8 GHz range should be limited by number? Please give reasons for your answer.

Question 4.5: Do you agree with the regulatory authority's assessment regarding other ECS bands? Please give reasons for your answer.

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4.5.2 On the definition of high demand areas

The questions below relate only to the 26.5–27.5 GHz frequency range.

Question 4.6: Please describe each use case relevant for your business strategy (eMBB, FWA, in-band backhaul) in terms of the aspects listed in section 4.2.2. These are: planned site density and size of base stations, line of sight, handling of attenuation or outdoor-only coverage, combination with other bands (or none), type of end-user device and quality of installation, type of base station and technology deployed, available alternative infrastructure for internet connectivity and the potential bandwidth in each case, and degree of competition for connectivity via the 26 GHz band.

Question 4.7: The regulatory authority cites the non-usage of 2.6 GHz spectrum and other frequency ranges across large parts of the country in order to explain the limited demand among mobile operators for 26 GHz use of eMBB/FWA. Looking to the future in this context, are there any objections that you would raise to such an assessment?

Question 4.8: The regulatory authority proposes three options for defining the high demand areas. Do you consider the methodology applied in option 2 and 3 to be transparent and appropriate? Are any key aspects not addressed? If yes, please give details of these aspects.

Question 4.9: Which of the options for HDAs or which combination of these options is, in your opinion, most suitable for defining areas with high demand for 26 GHz spectrum as the basis for limitation by number? Which parameters of the respective option would you adjust to produce an alternative definition?

Question 4.10: How would you define the high demand areas? Describe your methodology and the factors that you would account for when doing so.

Question 4.11: Which areas are not included in the options but should, in your opinion, form part of the high demand areas? Name these municipalities or specific areas, and give details of the applicable demand and specific use case for each.

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5 Competition

Spectrum is indispensable input for mobile services and wireless networks. With exclusive assignment, the capability may therefore exist of foreclosing others from accessing spectrum or increase their cost of access. For this reason, each time before awarding spectrum it must be considered whether firstly the ability and secondly the incentive to foreclose and thirdly a corresponding negative effect on competition exists or could arise. If necessary, measures must be taken to safeguard competition. The measures must be chosen so as to effectively and appropriately solve or avoid the competition problem. The mildest form of intervention must be chosen to solve the respective competition problem.

5.1 26 GHz band

5.1.1 Input during the consultation

During the consultation on the Spectrum Release Plan, several companies refrained from commenting on the issue of foreclosure from access to spectrum at 26 GHz. One company did not see any concerns with the award of the entire 3,200 MHz in the 26 GHz band, and proposed in this case a cap of 800 MHz and a use-it-or-lose-it rule to prevent hoarding. However, reserving spectrum for verticals could reduce the amount available and thus lead to foreclosure. One participant saw a small number of use cases and thus no need to divide the spectrum into multiple segments. One participant spoke in favour of a small-scale assignment, as a large-scale award would create the risk of non-use. One participant called in general for a reservation of 400 MHz for FWA and solutions for industrial applications. Competition issues relating to the wholesale level—in particular MVNO access—were not mentioned in connection with the 26 GHz band.

5.1.2 Which spectrum is available?

The plan is to award 1 GHz in the 26.5–27.5 GHz range in an auction. It remains to be seen whether a selection procedure will be used to award spectrum only in high demand areas based on model A, in larger municipalities based on model B or nationwide (model C). However, further availability of spectrum in this band, as described below, needs to be considered.

- Firstly, 600 MHz at the lower band edge is intended for local real estate-based assignment in defined and small-scale geographic areas in order to use this spectrum in particular for in-house purposes (e.g. campus networks, industrial use). Due to such small-scale, real estate-based assignment, it is ultimately up to the property owner to decide on local spectrum use within this frequency range. In principle, the property owner does have the ability to foreclose access to this spectrum. Without the property owner's direct or indirect approval, however, no infrastructure can be installed for the radio network. In any case, the MNOs will thus be deprived of any foreclosure ability. This means that third-party providers could also enter the market within a small, real estate-based scope. Therefore, no measures to safeguard competition are needed for these 600 MHz or for their real estate-based assignment. Especially for industrial purposes, real estate-based

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use will ensure local access to spectrum. Therefore, in the context of this 'industrial use case', potential foreclosure is no longer explicitly considered in the following.

- Secondly, another 1.6 GHz is potentially available for further assignment in this band at a later point in time. This significantly limits the ability to foreclose access to spectrum in this band in the long term.

5.1.3 Potential competition challenges

In view of the above, the following potential competition challenges are being reviewed. Firstly, there is the question of whether spectrum is distributed too asymmetrical in general, i.e. in all bands for mobile services, and specifically in the 1 GHz of this band. Secondly, there is the question of whether there will be fewer than three competitors in this band after the auction and whether this is likely to have a negative impact on competition in general. Thirdly, the potential competition challenge of there being fewer than two competitors in this band is also considered in detail.

This competition analysis mainly deals with the eMBB and FWA use cases as well as, implicitly, with in-band backhauling.

With regard to the potential competition challenge of an excessively asymmetrical spectrum distribution within this band or in general, i.e. in all bands for mobile services, it needs to be seen that the band will not be decisive for competition in mobile services in the foreseeable future. This means that a theoretical possibility exists of foreclosing access to the 1 GHz to be awarded within this band. However, it will not be possible in this auction to foreclose access to the other parts of the band. An operator who buys a great deal of spectrum purely for strategic motives must be aware that appropriate measures to safeguard competition could be taken when the next lot is awarded.

Furthermore, any foreclosure would also not have the potential to significantly affect competition in mobile services as a whole. Indeed, the amount of spectrum available cannot be considered equivalent to the other bands due to the significantly differing propagation characteristics. The regulatory authority nonetheless reserves the right to reexamine this aspect as a potential source of future competition challenges in a subsequent award of additional sub-bands.

Regarding the potential competition challenge of having less than three competitors for this one GHz, it should be noted that, without measures to safeguard competition, one or two competitors could buy so much spectrum so as to prevent a third party from acquiring any more spectrum. However, it is questionable whether, firstly, this would have a corresponding effect on competition and, secondly, whether there is a corresponding incentive to foreclose spectrum or to increase the cost of access. Within the eMBB use case, the significance of the band is currently not sufficiently clear, so that a foreclosure strategy cannot be expected with a sufficiently high probability to warrant a response with appropriate competitive measures. A potential competition challenge could arise if one or two existing

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operators with sufficient influence in the respective award region, such as wired broadband providers, aim at a foreclosure strategy against FWA providers. There is an incentive in particular where foreclosure from access to this spectrum could sufficiently reduce competitive pressure on the existing infrastructure—including wired broadband or potentially also mobile broadband.[27] At least two operators would need to have an incentive for foreclosure. Such an incentive cannot be ruled out at present. One effect on competition could be that too little of the 26 GHz band becomes available for FWA uses.

From the regulatory authority's perspective, the potential competition challenge of having only one competitor in this band is very likely to trigger competition concerns. Beyond a real estate-based use of the 600 MHz at the lower band edge, in this case only one company could acquire the entire band that will soon be available. This would be the only operator that could, beyond real estate-based use, then make use of this band for the deployment within a wider area than individual plots of land. For applications that to some extent specifically require the 26 GHz band, within this (narrow) scope, any competitive pressure could then cease. Examples here include eMBB use cases in hotspots like shopping streets or FWA applications specifically in this band. A certain amount of additional competitive pressure may obviously arise through the use of other mobile telecommunications bands or in other ways, such as through the use of unlicensed spectrum or wired infrastructure.

5.1.4 Options for measures to safeguard competition in the event of scarcity

The following analysis applies regardless of the regional breakdown in the upcoming award for those areas that are limited by number. In general, the following options are being considered for the award of the one GHz in the 26.5 to 27.5 GHz range with regard to measures to safeguard competition:[28]

- Option 1: no cap
- Option 2: cap at 800 MHz
- Option 3: cap at 600 MHz
- Option 4: cap at 400 MHz
- Option 5: cap at 200 MHz

These five options are considered in light of the usual criteria relevant for regulatory measures: How effectively could the measure help contain the potential competition challenge? Is the measure the mildest form of intervention? Is the measure proportionate?

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[27] In this context, reference should be made to A1's wholesale offers. By using the price-regulated wholesale products in A1's fixed network, alternative operators have the option of routing broadband access via virtual unbundling instead of FWA. Yet A1 would also benefit from potential increased use of its wholesale offers.

[28] Reserving 400 MHz for FWA use, as suggested by one consultation participant, is not considered further. This reservation would reduce the spectrum available for eMBB to 600 MHz. In the view of the regulatory authority, there is no sufficient justification for this restriction compared to mobile services use on the basis of available information.

Option 1—no cap—addresses neither the competition challenge of having less than two effective competitors nor the potential competition challenge of less than three effective competitors. Option 1 is therefore not effective.

Option 5—a cap at 200 MHz—would effectively address all potential competition challenges. At the same time, this would prevent a company from acquiring more than 200 MHz of spectrum, with possibly an amount of spectrum that could be used more efficiently. This is less than the minimum of 400 MHz mentioned by several companies. This option cannot be classified as the mildest form of intervention and should therefore be rejected.[29]

Option 2—a cap at 800 MHz—would allow one company to acquire up to 800 MHz, while a second company could acquire at least 200 MHz. On the one hand, this would allow this one company access to as much as 800 MHz, and thus the technically optimal bandwidth as cited in the consultation. On the other hand, it was argued in the response to the previous consultation that a bandwidth of less than 400 MHz rules out efficient use. For example, the cell capacity would then be below 2 Gbps. Therefore, the regulatory authority considers option 2 as not likely to be sufficiently effective.

Option 3—a cap at 600 MHz—would allow no single company to prevent another from acquiring 400 MHz on its own. As has been mentioned several times, 400 MHz is the minimum amount of spectrum in this band. This option is effective in addressing the potential competition challenge of less than two competitors, while the potential competition challenge of fewer than three competitors could still exist. For this to happen, however, two bidders would have to have a corresponding incentive to use strategic bidding in order foreclose a third party's access to spectrum while recovering these costs later in the form of higher profits. Such an incentive seems unlikely, especially when considering that two parties would need to hold spectrum licences in this band and additional spectrum packages would be awarded at a later point in time.

Option 4 is a cap at 400 MHz. This option is effective in addressing both the potential competition challenge of less than two competitors and the potential competition challenge of less than three competitors. However, if fewer than three competitors in this band do not pose a competition challenge, this option would not be the mildest form of intervention. Rather, option 3—a cap at 600 MHz—should then be preferred.

When assessing the options, it must be considered whether a club-use model (see section 7.7.1) is applied. In this case, the acquisition of a package of 200 MHz in the respective region includes the right to use the entire spectrum of up to one GHz at one site if no other operator wants to use the spectrum assigned to them with priority. This often allows more spectrum to be used than acquired. With the additional spectrum packages that can be used locally, the minimum quantity

[29] Furthermore, because at least five independent parties interested in the spectrum are needed, a cap at 200 MHz increases the risk of too little demand, so that spectrum remains unawarded.

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required for operation could be achieved more easily, i.e. using less exclusively licensed spectrum acquired in the auction. This would reduce the minimum amount of spectrum needing to be acquired exclusively. The club-use model would thus speak in favour of additional caps. With increasing restrictions on the use of other spectrum packages due to the respective acquiring parties using the spectrum themselves, more spectrum could be acquired in a subsequent award of additional spectrum packages in the 26 GHz band.

5.1.5 Competitive analysis in low demand areas

In low demand areas, a local assignment will in each case be paired with a rollout obligation, and thus with deployment costs. A corresponding foreclosure of others can thus only take place if the deployment costs could be covered by corresponding revenues. Any higher demand should already be taken into account in the definition of the high demand areas. In some cases, there might be demand from several operators, and thus an incentive to foreclose. However, three things must be considered: firstly, deployment costs reduce the incentive; secondly, a real estate-based licence can be used alternatively for certain use cases; and thirdly, additional spectrum packages in this band will be made available later. One option would be to ensure through a cap that a second competitor could also use 26 GHz spectrum in a given area. This could be later increased in proportion to the total spectrum available if further spectrum packages are awarded. Such a cap could be considered only once further spectrum is awarded.

5.2 Remaining 3410–3470 MHz spectrum

Essentially, 40 MHz are available in the regions A01u (Vienna + St. Pölten) and 60 MHz in the western regions A04u/r and A05u/r. No competition analysis is being carried out for the 10 MHz in A06u and A01r, which are also available, as the low bandwidth is only of interest to the respective band neighbours because the available amount of spectrum cannot be used independently.

Three potential competition challenges were identified in the competition analysis prior to the 3.4–3.8 GHz auction: 1) fewer than three actual competitors in the mobile services market; 2) overly asymmetric spectrum supply; and 3) negative impact on intermodal broadband competition. None of these potential competition challenges mentioned prior to that auction has yet materialised, either during the auction or under the measures taken to safeguard competition.

In their input to the consultation, one participant requested that the 2019 spectrum caps should continue to apply. A new entrant in regions A04 and A05 could then acquire and effectively use the 60 MHz that in this participant's point of view are required. Two other participants did not see any issues relevant to competition. Another participant called for nationwide network operators to be excluded from the auction in order to promote regional structures.

A potential competition challenge in regions A04 and A05 that in the regulatory authority's point of view should be examined is the foreclosure of another

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competitor. Without any measures to safeguard competition, each of the three MNOs would be able to acquire all the remaining spectrum in the region, effectively preventing market entry in this band. It remains to be seen whether there is any interest at all in entering the market and whether there is an incentive to correspondingly foreclose the market through the strategic purchase of spectrum. If no one is interested in entering the market, no negative effect on competition is expected if a current MNO were to acquire the remaining spectrum. If an interested party does plan to enter the market, it must be examined in more detail whether there might be an incentive to foreclose, with a corresponding negative effect on competition.

The regulatory authority is considering the following options:

- Option 1: no caps
- Option 2: caps from the 2019 award

Option 1 does not provide for measures to safeguard competition. Without further input, this is the preferred option. Option 2, with the 2019 caps, would only allow H3A to acquire the 60 MHz in A04/A05. From the regulatory authority's point of view, this option is neither effective nor proportionate. A1 and TMA would be excluded from the acquisition of spectrum in these regions. In A01u, A1 would be excluded from the auction.

5.3 Infrastructure sharing

For the spectrum to be assigned within the scope of this award, the regulatory authority does not see any need to define in the assignment decision any restrictions regarding infrastructure cooperation. Firstly, this spectrum has little significance for infrastructure competition, considering the propagation characteristics and the predominantly local use in hotspots. Secondly, cooperative efforts are an important prerequisite for possible dense deployment with very small base stations (small cell deployment) and could also play a positive role in achieving climate targets.[30] Thirdly, collaborations—if they are not already provided for by a sharing model—must be reviewed by the TKK within the framework of a procedure pursuant to Art. 85 of the Telecommunications Act 2021 (TKG 2021).

5.4 Consultation questions

Question 5.1: Which of the options for measures to safeguard competition in the 26 GHz band do you prefer? Please give detailed reasons for your preference. Where applicable, explain why the ability and incentive to foreclose might exist, along with negative effects on competition or coverage. If you are a new entrant, please describe your planned business case in detail and what competitive pressure you would exert on existing operators.

[30] See RSPG, Progress Report of the RSPG Sub Group on Climate Change, 2022. Accessible from: https://rspg-spectrum.eu/wp-content/uploads/2022/06/RSPG22-016final-Progress_report_Climate_Change.pdf

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Question 5.2: Which of the options for measures to safeguard competition in the 3.4–3.8 GHz band do you prefer? Please give detailed reasons for your preference. Where applicable, explain why the ability and incentive to foreclose might exist, along with negative effects on competition or coverage. If you are a new entrant, please describe your planned business case in detail and what competitive pressure you would exert on existing operators.

Question 5.3: Do you agree with the assessment that no restrictions regarding infrastructure cooperation are required in the assignment decisions for the spectrum in question? Please give reasons for your answer.

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6 Selection procedure

6.1 Introduction

If spectrum is 'limited by number' (and thus scarce), the regulatory authority is mandated to issue an ordinance defining a selection procedure (Art. 15 Par 1 TKG 2021). A decision must be made between the competitive selection procedure on the one hand, and a comparative selection procedure on the other.

In the competitive selection procedure (auction procedure or auction), the amount of the spectrum licence fee offered determines who is awarded a spectrum licence (see also Art. 16 TKG 2021). The competitive selection procedure has become the dominant type of selection procedure for scarce spectrum over the last two decades. In practically all European countries and OECD countries, spectrum for mobile and broadband services is awarded on this basis.

The comparative selection procedure (beauty contest) was the dominant procedure in the period before it was replaced by the competitive selection procedure. The main feature of a comparative selection procedure is that several selection criteria are used to decide which company is assigned a spectrum licence. One of these selection criteria can also be the financial offer. Depending on the design and emphasis, there is a grey area between these 'pure' types of procedures.

A substantive difference between the two procedures is that in the competitive selection procedure the requirements are defined in advance in the form of binding terms and conditions of use (including coverage obligations), while in the case of usage rivalry the spectrum licence fee offered decides which applicant is awarded the contract. In the comparative selection procedure, the terms and conditions of use are partially determined by the selection process. Although this does not mean that the award objectives can be better achieved. As the second 5G auction in 2020 demonstrated, ambitious coverage targets, for example, can also be achieved within the framework of a competitive selection procedure with an appropriate design.

TKG 2021 gives priority to the competitive selection procedure over the comparative selection procedure. The latter has to be given priority only if the objectives and aspects mentioned in Art. 15 Par. 2 and 3 TKG 2021 can be better accommodated by a comparative selection procedure.

When deciding on the selection procedure, different objectives and aspects must be considered (Art. 15 Par. 2 and 3 TKG 2021). In addition to the award objectives, particular attention must be paid to the following aspects:

- Promote competition
- Improve coverage
- Ensure the necessary quality of service
- Promote the efficient use of radio spectrum, including by taking into account the conditions attached to the usage rights and the level of fees
- Promote innovation and business development

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6.2 Selection criteria

Art. 16 TKG 2021 defines how a selection procedure must be designed and the selection criteria that can be used. In contrast to the comparative selection procedure, the competitive selection procedure is defined in great detail. In a competitive selection procedure, the award objectives (competition, improvement of coverage, efficiency etc.) are taken into account in advance through the terms and conditions of use and the auction design; in the case of usage rivalry, only the spectrum licence fee offered is then used as a selection criterion (see above).

In a comparative selection procedure, the selection is made on the basis of various selection criteria. When seeking potential selection criteria, Art. 16 Par. 2 and 4 TKG 2021 specifically apply, referring in this context to the objectives of the TKG 2021 (Art. 1) as well as to Art. 15 Par. 3 TKG 2021. The objectives and aspects mentioned here are listed in the table below.

Table 11: Potential selection criteria in a selection procedure

Potential selection criteria	Competitive selection procedure	Comparative selection procedure
Promotion of competition		X
Improvement of coverage and promotion of connectivity		X
Access to networks / use of networks		X
Effective and efficient use of spectrum		X
Quality of service performance		X
Inexpensive services		X
Innovation and business development / new technologies		X
Spectrum licence fees	X	X
Economic efficiency		X

6.3 Legal requirements relating to the selection criteria

A selection procedure must be open, objective, transparent and proportionate. The criterion of openness is comparatively easy to achieve, namely by ensuring that the procedure is open to all potential participants.

In order for a selection procedure to be objective and transparent, the selection criteria must be chosen so that it is known in advance how the applications will be

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assessed (including the assessment points that a particular application will receive) and how relevant individual selection criteria are for the overall result (weighting). When wording their applications, applicants should also be able to anticipate final assessment outcomes (overall points) based on varying application options. The result of the selection procedure must be transparent and arguable. In the case of the spectrum licence fee offered, these requirements are clearly met.

For other selection criteria, this applies only to a very limited extent. For example, selection criteria such as quality of service, innovation or business development can hardly be objectified. One reason for this is that many criteria are not quantifiable. How many additional assessment points, if any, will be awarded to an operator who, in addition to broadband services, also places an emphasis on other services such as telemedicine (innovation criterion)? How many additional assessment points are awarded to a new entrant whose market entry in an oligopoly market naturally leads to an increase in competition with an existing operator (criterion of promotion of competition)? What if, at the same time, one of the existing operators loses competitive power because of facing capacity bottlenecks due to a lack of spectrum, which the operator could, however, compensate for in turn through a denser network? How are these two scenarios assessed relative to each other in terms of assessment points?

Selection criteria that at first glance appear to be fundamentally suitable to quantification may in practice be much more difficult to cast in figures. If the regulatory authority were for example to use end-customer rates as a criterion for inexpensive services, apart from the fact that in a market economy prices should reflect supply and demand, the authority would have to evaluate the future tariff plans presented by the operators in their applications. This is not practicable in view of the large number of elements factoring into rates (non-linear rates, varying services in packages and elements such as user categories, which cannot be quantified). Even quantifying the criterion of (additional) coverage encounters limits in practice, for example when the increasingly significant role of quality (availability, latency or data transmission rates under load) is taken into account. Using simply data transmission rates as a selection criterion also raises many questions in practice. It makes a big difference whether moderate minimum data transmission rates are mandated within the framework of coverage obligations or whether the data rate offered (in Austria) decides who receives a frequency: at which sites and at what times will the data rate thee measured, or which SIM card and which rate and which priority will be used as the basis for the decision and for monitoring compliance?

In addition to objectivity and transparency, award procedures must also fulfil two other legal criteria, namely the criteria of non-discrimination and proportionality. Accordingly, the selection criteria must be chosen and defined operationally in such a way that individual operators are not discriminated against in an objectively unjustified manner. The choice of selection criteria as well as their assessment and impact on the outcome must be appropriate in relation to the specified objectives of the TKG 2021.

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As shown in the following example, a selection procedure can quickly come into conflict with these two criteria. Let's assume that two operators with different spectrum portfolios are competing for a frequency. The operator with the better portfolio has, precisely because of such a spectrum portfolio, better network coverage and a network utilised below capacity, and this operator can offer customers higher data transmission rates on average. The authority chooses the two selection criteria of level of coverage and data transmission rate (quality). The operator with the better portfolio will obviously be awarded the contract, having the better prerequisites, while the additional spectrum reinforces these advantages. The argument that the result would improve quality and coverage for a significant part of the population (the first operator's customers), being the goal of the TKG 2021, ignores the fact that the selection may have broad negative impact in the longer term. This could be the case, for example, if the second operator is confronted in future with considerable capacity bottlenecks because of not being able to cover spectrum needs and thus loses competitive power, so that as a result prices rise, for example. Similar considerations can be made for a number of other selection criteria.

The situation is different with the criterion of spectrum licence fee offered, the only criterion that can be used in both the comparative selection procedure and the competitive selection procedure. This criterion is based directly on demand and is closely related to the goal of efficient spectrum use (see below).

The legal requirements placed on a comparative selection procedure restrict flexibility with regard to choosing and operationally defining selection criteria. The proportionality requirement necessitates close orientation on the objectives of the TKG 2021 in general and on the award objectives of the regulatory authority in particular. In addition, deficits in relation to these objectives must be identified (such as gaps in coverage or competition deficits).

Examples of selection criteria that could be used include:

- A higher rating would be awarded in the selection procedure for the willingness to supply coverage to a larger number of poorly served areas (criterion of coverage), if no detrimental impact on other objectives, in particular competition, is to be expected from the resulting distribution of spectrum (see example above). A prerequisite for this is that there are coverage gaps needing to be closed. In addition, the spectrum to be assigned must be principally suitable for the coverage of poorly served rural areas (e.g. coverage spectrum).
- A higher rating would be awarded in a selection procedure for a new market participant whose market entry is associated with noticeable positive impact on competition (criterion of competition). This assumes that there are competitive deficits at the level of infrastructure competition that justify positive discrimination. In addition, the assigned spectrum package must be suitable for supporting wide-area deployment.
- A higher rating would be awarded in the selection procedure for the willingness to sell wholesale services to service providers (such as MVNOs)

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and under more favourable conditions than the other applicants (criterion of competition and criterion of access to networks). This assumes that there is a corresponding competitive deficit, otherwise the selection criterion would not be proportionate.

As the second 5G auction in 2020 demonstrated, ambitious coverage targets can also be achieved within the framework of a competitive selection procedure with an appropriate design. Other objectives, including those relating to competition, can also be addressed in a competitive selection procedure, through spectrum caps, set-asides (for new entrants, for example) or access obligations. Since policymakers have given priority to the competitive selection procedure, any comparative selection procedure would need to contribute more toward achieving the (award) objectives than a competitive selection procedure would be able to. As discussed above, the legal requirements for selection procedures clearly allow significantly less freedom in this respect.

In addition to legal certainty, the TKK has made the efficient use of spectrum a central objective of the present award. Ensuring efficient and effective use of spectrum is one of the central objectives (if not the central objective) of spectrum administration (Art.°10 TKG 2021). This prioritisation also reflects the fact that the spectrum to be assigned in the present award is unsuitable for effectively addressing other important regulatory objectives such as coverage or competition (regardless of the selection procedure). This is mainly due to the characteristics of the spectrum, which does not permit use over wide areas and plays a relatively insignificant role in competition.

6.4 Efficient use and distribution of spectrum

Pursuant to Art.°10 Par.°3 TKG 2021, a key objective of spectrum regulation is to ensure the efficient and effective use of spectrum. In the present context, this means that the spectrum must be distributed among the potential users so as to ensure that the greatest possible economic benefit is achieved.

The decisions required here include not only choosing the users to receive licenses, but also how many users receive spectrum (market structure) and how much spectrum each of these users receives. The needs of potential users and their individual demands for spectrum derive from the overall demand for mobile services (in the retail and wholesale markets). Therefore, influencing factors that fall within the decision-making and information sphere of the operator (such as retail demand, market structure, business models, costs, product differentiation) play a central role in assessing needs. Such private information is not transparent for the regulatory authority and cannot therefore be sufficiently taken into account in a (comparative) selection procedure. The authority cannot sufficiently confirm the validity of the information provided by the operators. In addition, the regulatory authority has to look to the future, and would therefore have to make forecasts on how the aforementioned factors will change in future with respect to the individual market players.

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In this context, it is also important to understand that spectrum can be substituted by alternative measures. For example, operators may invest in denser network infrastructure (more sites, more sectors) instead of spectrum to expand the capacity of their mobile networks. There is then a trade-off between spectrum and infrastructure investment. An operator that has more capacity or can expand capacity more cost-effectively through infrastructure investment most likely has less demand. But that is not the only trade-off. Operators differ in relation to how they compete for customers. An operator offering products with better quality and coverage at higher prices needs to maintain more capacity and has a higher demand for spectrum.

In a selection procedure, spectrum is a scarce resource must be distributed in accordance with the principle of economic efficiency (see Art.°16 Par.°2 TKG 2021). This is only possible if the trade-off between spectrum, investment costs and network quality is optimally resolved. Economic theory shows that if the rules are properly designed, an auction procedure (competitive selection procedure) is capable of achieving an economically efficient distribution. The operator with the highest demand has the highest (intrinsic) assessment rating for a frequency (or a spectrum package). In a properly designed auction procedure, the operator with the highest (intrinsic) assessment rating tends to win the award and can make the best use of the spectrum.[31]

An auction procedure generates market prices. Market prices reflect the scarcity of the resource, encourage efficient and productive use of the scarce resource, and operators bear the opportunity costs associated with using that resource. This close connection between auction procedures, market prices, economic efficiency and efficient use is also reflected in the applicable provisions of the TKG 2021 (see for example Art.°15 Par.°3 and Art.°16).

The comparative selection procedure is not suitable for such a complex needs assessment. With a view to the future, for each frequency block (in each region) the needs of each individual applicant would have to be examined and weighed objectively against the needs of the other applicants. In doing so, the regulatory authority would also have to take into account alternative measures (network densification) and competitive strategies.

In the present award procedure, the TKK gives high priority to the goal of efficient spectrum use. Other award objectives are relegated to the background due to the low suitability of this spectrum for coverage and due to the comparatively low importance of this spectrum for competition.

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[31] See: Monopolies Commission, Telecommunications 2021: Competition in transition, 12th Sector Report, 2021 (in German only). RSPG, RSPG Report on Efficient Awards and Efficient Use of Spectrum, 2016. Cramton, P., Spectrum auctions, Elsevier Science, Amsterdam, 2002. McMillan, J., Why auctioning the Spectrum?, in: Telecommunication Policy Vol. 19, 1995. Milgrom, P., Putting Auction Theory to Work, Cambridge University Press, 2004.

6.5 Assessment and validity of offers

A necessary prerequisite for ensuring that an award procedure is factually correct and results in legal certainty is the ability to (quantitatively) assess applications and offers and to check the validity of the information.

The competitive selection procedure is based on proven market mechanisms. Monetary bids are very easy to compare. The payment obligation associated with the bids is usually made as an upfront payment and is also secured by corresponding bank guarantees. This ensures that bidders meet their payment obligations.

In the comparative selection procedure, selection criteria are chosen that often cannot be quantified, or the quantification method is criticised as being not objectively transparent and arguable.[32]Yet the ability to transparently quantify criteria (mapping to a point system) is a necessary prerequisite for an overall assessment, if this assessment is to be carried out in a legally secure manner (based on law). Why does an operator offering a certain service (such as e-health) receive more assessment points than another operator offering a different service? Why is 2 per cent more coverage more important than a higher data transmission rate? Is a higher data transmission rate with more latency better than a lower data rate with less latency? There are often trade-offs between various features. These decisions should be made by the market (and thus the customers) and not by a regulatory authority. In addition, there are often limited to checking the validity of the information provided. For example, it would hardly be possible to evaluate network utilisation if taken as a criterion for demand.

6.6 Enforcement of commitments

As part of selection procedures, applicants enter commitments. In the competitive selection procedure, bank guarantees serve to ensure that these commitments are honoured.

In comparative selection procedures, whether the commitments entered during the selection procedure are fulfilled often comes to light only years later (for instance, only 97 per cent instead of the promised 99 per cent coverage level is reached). Under the TKG 2021, it is possible to revoke spectrum licences, but as a rule it is rather problematic and impractical where commitments are only partially fulfilled. Revocation would cause significant harm to users as well. So in practice it is hardly possible to amend the distribution of spectrum ex post. This in turn creates an

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[32] In this context, the Monopolies Commission identifies risks, for example that the licence will be awarded to the applicant who by coincidence best meets the criteria of the selection procedure, which are not fully known. Another risk is that the regulator could be accused of having chosen or weighted the selection criteria in such a way as to achieve a politically desirable outcome. Refer to: Monopolies Commission, Telecommunications 2021: Competition in transition, 12th Sector Report, 2021 (in German only).

incentive for overly optimistic commitments. The procedure can create advantages for companies that accept the risk of sanctions for failing to comply.[33]

Commitments to comply with coverage obligations, for example, are also made in competitive selection procedures, but these are not usually decisive for the assignment of spectrum. Due to the spectrum licence fee to be paid, the costs of failing to comply with a commitment to an obligation are also much higher.

6.7 Design of selection procedures

Art.°16 TKG 2021 regulates the design of the selection procedure. The regulations on the competitive selection procedure are quite detailed and are heavily based on the provisions of the TKG 2003[34] governing the TKK award procedure for scarce spectrum. These rules have proven themselves—even from the perspective of legal certainty. In contrast, hardly any specific regulations to guide the regulatory authority exist for the comparative selection procedure.

Since auction procedures were first used in the late 1980s and early 1990s to award spectrum in New Zealand, Australia and the USA, spectrum auctions have become a subject of economic research. There are now a large number of relevant publications dealing with specific aspects of spectrum auctions, and there are even auction formats, such as the simultaneous multiple-round auction procedure, which have been developed specifically for spectrum auctions and have proven their worth over the years.[35,36] The design of spectrum auctions has now become a core competence among many regulatory authorities.[37]

When designing spectrum auctions, the focus is primarily on economic efficiency and the goal of efficient spectrum use (see Art.°16 TKG 2021). Based on rudimentary theory, appropriate design elements are used to ensure that specific risks potentially occurring in spectrum auctions (aggregation risks, substitution risks, fragmentation risks, winner's curse risk etc.) are eliminated or reduced. This is one of the reasons why spectrum auctions almost always have a multi-stage structure.

The regulatory authority is not aware of any corresponding research in connection with comparative selection procedures for spectrum awards. Comparative selection procedures nonetheless entail risks for the participating companies and for the awarding authority. In response to an inappropriate or overly conservative offer deriving from false expectations, a company might be awarded no, too little or inappropriate spectrum or, vice versa, companies might receive spectrum they do

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33 This is extensively documented in the literature. See for example: Monopolies Commission, Telecommunications 2021: Competition in transition, 12th Sector Report, 2021 (in German only).

34 See Supreme Administrative Court (VwGH) ruling (VwSlg 18984 A/2014) of 4 December 2014, 2013/03/0149, on the 2013 multi-band auction.

35 See for instance Milgrom, P., Putting Auction Theory to Work, Cambridge University Press, 2004.

36 Research on auctions gained much momentum with the FCC's decision in 1993 to auction off spectrum licences. Partly because of this work, Robert Wilson and Paul Milgrom received the Swedish National Bank Prize in Economic Sciences in Memory of Alfred Nobel on 10 December 2020.

37 RSPG, RSPG Report on Efficient Awards and Efficient Use of Spectrum, 2016.

not deserve.[38] The comparative selection procedures that the regulatory authority is aware of are not structured in multiple stages, companies are instead able to submit just one bid. It is also difficult to imagine how multiple selection criteria, some of them qualitative, could be taken into account in a multi-stage procedure.

6.8 Decision pursuant to Art.°15 TKG 2021

Pursuant to Art.°15 Par.°1 TKG, the assignment of spectrum 'limited by number' must be carried out in a competitive selection procedure. The regulatory authority must only choose a comparative selection procedure if it determines that the objectives and aspects of Par.°2 and 3 that must be taken into account can be better achieved by such a procedure.

The aspects mentioned in Art.°15 Par.°3 TKG 2021 which are to be taken into account are the following:

1. Promote competition
2. Improve coverage
3. Ensure the necessary quality of service
4. Promote the efficient use of radio spectrum, including by taking into account the conditions attached to the usage rights and the level of fees
5. Promote innovation and business development

In the present procedure, the primary (award) objective—in addition to legal certainty—is to ensure efficient use of spectrum. In the case of scarce spectrum (demand exceeds supply), this can best be achieved through an auction procedure. A comparative selection procedure is not suitable for assessing needs accordingly. The other objectives and aspects mentioned play a subordinate role in the present award due to the specific characteristics of the spectrum to be awarded.

If preference were to be given to the comparative selection procedure, firstly the other objectives and aspects would have to have a higher priority. This is not the case in the present procedure, not least because of the low relevance of this spectrum for competition and coverage. Secondly, the other objectives and aspects would need to be better served through a comparative selection procedure than using a competitive selection procedure. The previous spectrum auctions have demonstrated that ambitious coverage and competition goals can also be achieved through competitive selection procedures (such as supplying poorly served cadastral municipalities). The potential advantage of a comparative selection procedure might be to favour a defined objective through positive discrimination. This would be done by emphasising criteria to (significantly) increase an operator's chances of winning if that operator makes a higher contribution towards achieving this objective (e.g. a new entrant to increase competition). Apart from methodological weaknesses with regard to the assessment and validation of applications as well as the enforcement of

[38] The 3G award in Sweden is often cited as an example in the literature. For details see: Monopolies Commission, Telecommunications 2021: Competition in transition, 12th Sector Report, 2021 (in German only).

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commitments, the provisions of Art.°15 Par.°2 TKG 2021 also limit the related options required in a comparative selection procedure. Strongly emphasising individual selection criteria could be disproportionate and discriminatory, while other selection criteria are very difficult to define operationally and thus are potentially incompatible with the criteria of objectivity and transparency. Aspects such as quality of service, innovation, business development and prices should result from processes within a competitive market and not from an administrative selection procedure.

6.9 Consultation questions

Question 6.1: Do you concur with the regulatory authority's analysis of the selection procedure and its legal opinion with regard to Art.°15 TKG 2021? Please give reasons in detail for your answer.

Question 6.2: Do you concur with the regulatory authority's assessment that a competitive selection procedure (auction procedure) is best suited to sign spectrum which will be limited by number as defined in Art.°14 TKG 2021? Please give reasons in detail for your answer.

Question 6.3: If you consider a comparative selection procedure to be more appropriate, please justify in detail why this is the case in the given procedural context. Which selection criteria should be used? How should these be weighted and defined operationally? How could the selection criteria be assessed quantitatively (and modelled in a system with assessment points)? Please also explain for each selection criterion how the regulatory authority could validate the information, and how compliance with the relevant commitments could be enforced (e.g. by revoking a spectrum assignment). Please provide detailed reasons why the selection criteria you named are in line with the TKK's award objectives, the objectives of the TKG 2021 (Art.°1 and Art.°10) and the aspects listed in Art.°15 Par.°3 TKG 2021, and in particular why this can ensure efficient use of spectrum.

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7 Product and auction design

7.1 Lot structure

7.1.1 Bandwidth

The regulatory authority proposes awarding spectrum from the 26 GHz band at the principal stage of the auction in the form of five generic lots of 200 MHz. This allows competition for incremental spectrum and thereby promotes an efficient distribution of frequencies. The regulatory authority assumes that with 200 MHz blocks a single block will represent a usable bandwidth and that complementarities within a band are low (cf. the annex on the design of the auction authored by DotEcon).

In the case of the 3410–3470 MHz band, however, the regulatory authority considers it more appropriate to award this spectrum as a specific frequency block per region (cf. Fehler! Verweisquelle konnte nicht gefunden werden.). Further subdivision of what is already a small amount of spectrum (10–60 MHz) across multiple operators would not further the goal of efficient usage.

7.1.2 Geographical structure

The awarding of spectrum from the 3410–3470 MHz band will reuse the regions from the 2019 auction.[39]

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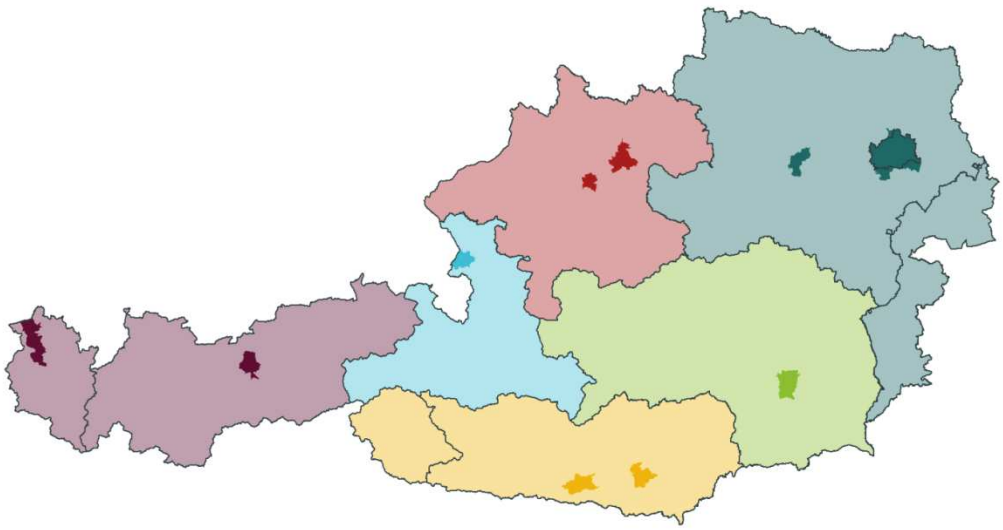

Figure 8: Definition of regions in the 2019 award

The table below describes the regions:

[39] For the exact borders of these regions, please see the tender documentation for the F7/16 award. Available from: https://www.rtr.at/TKP/was_wir_tun/telekommunikation/spectrum/procedures/5G_Frequenzvergabe_3_4-3_8GHz/5G-Auction-Tender-Documents.en.html

Table 12: Description of the 12 regions in the 2019 award

Region label	Region name	Description[40]
A01u	Region 1 urban	Vienna+, St Pölten
A01r	Region 1 rural	Vienna, Burgenland and Lower Austria except A01u
A02u	Region 2 urban	Linz+, Wels+
A02r	Region 2 rural	Upper Austria except A02u
A03u	Region 3 urban	City of Salzburg+
A03r	Region 3 rural	Salzburg except A03u
A04u	Region 4 urban	Innsbruck+, Bregenz+
A04r	Region 4 rural	North Tyrol and Vorarlberg except A04u
A05u	Region 5 urban	Villach, Klagenfurt
A05r	Region 5 rural	East Tyrol and Carinthia except A05u
A06u	Region 6 urban	Graz+
A06r	Region 6 rural	Styria except A06u

Please note that spectrum is available only in the following regions:

Table 13: Available spectrum in 3410–3470 MHz band

Region(s)	Frequency range/MHz	Bandwidth/MHz
A01u	3410–3450	40
A01r	3440–3450	10
A04u, A04r, A05u, A05r	3410–3470	60
A06u	3460–3470	10

Regions will be demarcated differently for the 26 GHz spectrum in accordance with the model chosen.

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[40] Adjoining municipalities are also incorporated into certain urban regions. Those urban regions are designated in the table with a plus sign. The detailed list of municipalities in each region can be viewed in Appendix G of the tender documentation for F7/16.

7.1.2.1 **Model A**

In Model A, a differentiation into high demand areas and low demand areas will be made for 26 GHz spectrum. Also relevant in this context is the question as to whether individual HDAs should be auctioned off individually (in separate categories) or consolidated (grouped) into larger areas.

The regulatory authority recommends consolidating the HDAs in the auction into larger regions, since demand is not expected to vary between the individual HDAs. One approach would be to group the HDAs into nationwide usage rights. However, this would have the disadvantage of being unable to satisfy demand from regional operators. In the consultation on the Spectrum Release Plan, individual consultation participants expected to see regional usage of the 26 GHz band alongside local usage and preferred the awarding of regional usage rights.[41]

Accordingly, the regulatory authority proposes grouping HDAs to reflect the regions as used for the 3.4–3.8 GHz band auction in 2019. This would also give users with regional demand the opportunity to acquire long-term licences to use spectrum in the areas within their preferred region where spectrum will or is expected to become a scarce good (i.e. HDAs). In contrast, sufficient spectrum will or is expected to be available in the LDAs.

A decision to group HDAs to reflect the regions used for the 3.4–3.8 GHz band auction in 2019 also offers advantages in relation to value interdependencies in the auction between the two bands to be awarded (see the annex authored by DotCon). In particular, this simplifies switching between frequencies from the 3410–3470 MHz band and 26 GHz frequencies in the HDAs in the corresponding region.

Various options for the definition of HDAs are proposed in section 4.2.2.3. With option 1, the HDAs are identical to the urban regions A01u, A02u, A03u, A04u, A05u and A06u. In the case of options 2 and 3, the HDAs are grouped into (up to) twelve regions. This results in the following mappings of HDAs to regions.

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[41] See footnote 2.

Table 14: Mapping of HDAs to regions

Region label	Grouped high demand areas
A01u	HDAs in Vienna+, St. Pölten
A01r	Vienna, Burgenland and Lower Austria except A01u
A02u	HDAs in Linz+, Wels+
A02r	Upper Austria except A02u
A03u	HDAs in City of Salzburg+
A03r	HDAs in Salzburg excl. A03u
A04u	HDAs in Innsbruck+, Bregenz+
A04r	HDAs in North Tyrol and Vorarlberg except A04u
A05u	HDAs in Villach, Klagenfurt
A05r	HDAs in East Tyrol and Carinthia except A05u
A06u	HDAs in Graz+
A06r	HDAs in Styria excl. A06u

7.1.2.2 Model B

In the consultation on the Spectrum Release Plan, several consultation participants expect to see a primarily local or very limited local usage of the spectrum. Demand may vary widely depending on the use case and user. Accordingly, mobile service usage is expected to be focused in urban hotspots, with FWA usage confined to small towns and rural areas.[42]

Award model B uses an auction procedure to address this heterogeneous and locally limited demand for spectrum, should a differentiation between HDAs and LDAs prove impossible, for example because scarcity is to be expected across an overly large area of Austria.

This proposal envisages awarding usage rights to 26 GHz spectrum within very small regions. Separate usage rights are to be awarded for cities and municipalities with more than 10,000 residents (optionally: 5,000 residents). The remaining municipalities will be aggregated at district level and usage rights awarded at this level. The table below gives details of the regions in question.

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[42] See footnote 2.

Table 15: Mapping of HDAs to regions

Regions	No. of regions (municipalities and cities)	No. of regions (districts)	Total no. of regions
Cities and municipalities with more than 10,000 residents	87	79	166
Cities and municipalities with more than 5,000 residents	260	79	339

This model is to be recommended in particular if strong local variations in demand are to be expected, a clear definition of high demand areas and low demand areas as planned proves impossible, and complementarities across regions (arising from locally limited usage) play little role. Strong complementarities could apply, for example, if fixed costs are pressuring an operator to acquire multiple (adjacent) regions. In this case, a model with larger regions is recommended (either model A or model C).

When combined with effective deployment obligations (section 7.8.6) also extending to rural areas, this model can also be considered a test for market scarcity. In regions with little demand, it may be the case that some or all spectrum may fail to be awarded. The remaining spectrum could then be assigned subsequently on a local basis by means of an administrative procedure (cf. section 8.2).

7.1.2.3 Model C

Two participants in the Spectrum Release Plan consultation propose awarding nationwide usage rights for 26 GHz spectrum. On the other hand, these participants also assume that usage of this spectrum will be local or regional rather than requiring wide-area coverage.[43] Awarding nationwide rights of use excludes any potential use by third parties.

Although the third model envisages the award of nationwide usage rights for the 26 GHz band, it seeks to prevent spectrum lying fallow by specifying wide-ranging coverage obligations, and/or an obligation to ensure the shared use of spectrum in response to appropriate external demand and a lack of internal demand.

7.2 Product categories

A single frequency block in the 3410–3470 MHz frequency range is awarded in seven regions. Each frequency block (each region) forms a separate product category during the auction's principal stage.

[43] See footnote 2.

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This 26 GHz spectrum is awarded in various regions, depending on the model. During the principal stage of the auction, each region forms a separate product category, each containing five generic lots of 200 MHz.

16: 26.5–27.5 GHz product categories in the auction

Model	Categories	Generic lots per category
Model A	12a	5
Model B	166–339	5
Model C	1	5

[a] There may be fewer than twelve categories, depending on the high demand areas identified.

For further details, see the annex from DotEcon.

7.3 Auction procedure

7.3.1 Auction design

An auction design document by DotEcon is presented in an annex to this consultation. This document discusses various auction formats and their suitability for the three award models A, B and C (referred to as scenario A, B and C in the annex), and also recommends a specific format. In this context, readers are also referred to earlier documents on this topic by the regulatory authority and DotEcon, which can be found on the RTR website.

7.3.1.1 **Model A**

In principle, DotEcon proposes the use of a simple clock auction to address a scenario where potential synergies between regions do exist, but these are not sizeable enough to justify a full, combinatorial format with an unavoidably greater degree of complexity. Resorting to formats such as the simultaneous multiple round auction (SMRA) or one of its variants[44] is inappropriate in this case because the specification of provisional winning bids (standing high bids) creates aggregation risks for bidders.

The risk of lots remaining unsold as a result of the reduction in demand that is always possible in a simple clock auction is to be minimised by allowing bidders to submit exit bids in addition to their clock bids, with which they are then able to acquire lots that would otherwise remain unsold. To make exit bid submissions as straightforward as possible, DotEcon recommends that these bids should be submitted for otherwise unsold lots only at the end of the clock rounds. Furthermore, the sums of money bid for these lots are subject to restrictions that are

[44] Examples include the hybrid SMRA clock format that was used in the 2020 multiband auction or the ESMRA ('clock plus') format that is being used in Canada and the USA, for example, and was also used for the last auction in Slovenia.

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comparable to those that would have applied had bids been submitted during the clock phase (such as in the 2019 auction).

A simple clock auction entails the possibility of strategic bidding with the aim of, as demand could decline at any time. Only in the case of related concerns should a procedure be selected that explicitly or implicitly resorts to specifying provisional winning bids, thus preventing bidders from submitting inflationary bids for lots that they do not in fact wish to acquire.

7.3.1.2 **Model B**

For this model, DotEcon also recommends a simple clock auction, in light of the potentially large number of product categories. To minimise the risk of unsold lots, an option to submit exit bids is also envisaged here.

A procedure with provisional winning bids would also be a feasible alternative here if there are serious concerns regarding the use of strategic bidding with the aim of price gouging.

7.3.1.3 **Model C**

This model is based on a comparatively low number of lots and a nationwide award of 26 GHz spectrum, rendering potential regional synergies irrelevant. Use of the SMRA format or one of its variants would be appropriate for this model.

7.3.1.4 **Unsold lots**

As the 2019 auction has demonstrated, a regional award format (model A or B) can result in spectrum remaining unsold in individual regions. This could indicate a lack of demand, but not necessarily.

Providing bidders with the option of submitting exit bids in a simple clock auction aims to minimise the likelihood of lots remaining unsold, for which demand existed during bidding.

Especially with award model B, however, a lack of sufficient demand in some of the (rural) regions cannot be ruled out, preventing the successful assignment of all spectrum (at reserve prices). In the regulatory authority's opinion, this could be construed as an indication that the spectrum in the affected regions is not scarce. The regulatory authority could accordingly classify this spectrum as not limited by number and assign it by administrative procedure to future interested parties (who currently have no need of it) (see section 8.2).

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7.3.2 Assignment stage and efficient, long-term band planning

The TKK typically uses a two-stage process for its spectrum auctions. As a first step, abstract frequency blocks are auctioned off in various categories (bands and regions). At this stage, bidders can decide how much spectrum they wish to acquire per category. When the auction moves into its second phase (assignment stage), bidders may then submit bids for various assignment options (specific blocks or positions in the band) compatible with the results of the first stage.

This model permits the assignment of contiguous spectrum within a band and therefore guarantees the efficient use of spectrum. In the regional 2019 auction, assignment options were also eliminated that would have resulted in band plans with significant misalignments.[45] This significantly helped national operators in particular acquire a (largely) uniform spectrum portfolio nationwide.

Although the assignment of contiguous spectrum (in a region) can be ensured during the next award, the 26 GHz band is being assigned in multiple award procedures, as a result of the later expiry of microwave usage. Accordingly, a stepwise fragmentation of assignments in the band is virtually unavoidable unless measures are taken either to correct this after the fact or avoid it entirely.

The TKG 2021 also explicitly provides for an option allowing operators to 'defragment' (Art. 20 TKG 2021) their spectrum portfolio by exchanging usage rights under some form of civil law agreement. This would be possible following the conclusion of a subsequent procedure to award additional 26 GHz spectrum. However, this does require holders of usage rights to be able to reach an agreement. As (international) experience has shown, such an agreement often proves impossible, at least without regulatory intervention.

As an alternative, the regulatory authority could, in specified situations, simply carry out the defragmentation as part of official duties, or implement a mechanism that facilitates or mandates future defragmentation. A balance would need to be struck here, though. On the one hand, bidders in the auction have the opportunity of expressing preferences for various positions within the band by submitting corresponding bids and, in some cases, bidders pay a higher price for a specific position within the band. A subsequent intervention of this kind would devalue this investment and worsen planning reliability. On the other hand, each and every undertaking also stands to benefit significantly from the assignment of contiguous frequency blocks. These pros and cons must therefore be evaluated. A key issue here is whether the benefit from the exchange of spectrum is the same for each party. What are the consequences of exchanging the block in question? Would this require investments or would only a software (re-)configuration be necessary? How easily could an operator revert to another frequency much later on? What costs could be incurred by doing so? Are other disadvantages involved—perhaps in areas bordering

[45] Cf. the auction rules for the F 7/16 procedure, accessible from: https://www.rtr.at/TKP/was_wir_tun/telekommunikation/spectrum/procedures/5G_Frequenzvergabe_3_4-3_8GHz/5G-Auction-Tender-Documents.en.html

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one another? How does this impact energy efficiency?[46]Otherwise, technical solutions are available that permit the efficient use of fragmented assignments (e.g. using carrier aggregation). The regulatory authority wishes to obtain the sector's opinion here.

In the context of the award, the regulatory authority could make arrangements to simplify reshuffling of frequency blocks at a later point in time and/or to place them on a legally secure foundation that also facilitates operator planning.

As a first step, during spectrum assignment the regulatory authority would define the usage rights so as to allow the re-assignment of specific frequency blocks following each subsequent auction of 26 GHz spectrum, if this would contribute to more efficient frequency usage. Actual reshuffling could then be handled by a separate procedure in accordance with Art. 21 TKG once the auction is completed. During the auction, however, each participant must also understand that the position in the band could change and so take this into account.

In addition, the regulatory authority could also improve planning capacity by setting out rules for determining band positions in a subsequent reshuffling procedure. As one example, the positions that result from the assignment stage of an auction (in a region) could be utilised as the basis for later rearranging the band as part of a reshuffling procedure. After the second auction, for example, the winners of the first auction could always be positioned at the upper band edge, in the order that had resulted from the assignment stage of the first auction. Conceivably, other rules could also apply. One approach possible in principle, although not easily implemented in practice, would be to give consideration during the assignment stage of a later auction to the spectrum portfolios that operators had obtained in earlier auctions.

In the context of awarding regional usage rights, the question also arises as to whether measures should be taken at the assignment stage in order to limit any potential misalignment of spectrum assignments in neighbouring regions. Such assignment options were ruled out in the 2019 auction of regional usage rights. Yet they would require a significantly more complex auction design. As a result of the specific propagation characteristics of 26 GHz spectrum and the fact that virtually no high demand area in model A is adjacent to another at regional borders, the regulatory authority considers such measures to be unnecessary for the next auction. If a great many regions are auctioned off (model B), the sheer complexity involved renders such an approach impossible.

For the remaining spectrum in the 3.4–3.8 GHz band, the packaging chosen precludes any need for an assignment stage.

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[46] The energy requirements for carrier aggregation can be reduced with wide and contiguous frequency blocks. Cf. e.g. RSPG, Progress Report of the RSPG Sub Group on Climate Change, 2022. Accessible from: https://rspg-spectrum.eu

For 26 GHz band spectrum, DotEcon recommends a sealed-bid second-price auction (minimum revenue core pricing), as has been deployed for Austrian auctions in the past. The assignment options for which a bidder can submit bids will be determined in a way that ensures each bidder can be assigned contiguous spectrum in each region. Bids will be evaluated separately for each region.

7.4 Period of use

Rights of use to the frequency blocks to be awarded within the 3410–3470 MHz frequency range will expire on 31 December 2039, and therefore at the same time as the frequency usage rights already being exercised for the 3410–3800 MHz range (assigned in 2019).

Spectrum in the 26 GHz band will be assigned until 31 December 2044, in accordance with the regulatory authority's award roadmap.

7.5 Technical terms and conditions of use

7.5.1 Synchronisation

With TDD systems, interference between neighbouring users depends on whether they synchronise their transmissions in time—'time' here referring to the time frame portions of downlink/uplink transmissions. If no synchronisation takes place, then restrictions will be needed—both in the frequency range itself and locally at usage area borders—to avoid interference between neighbouring users.

Specifying a synchronisation scheme is envisaged as part of the award. Agreement specifying other terms, applying to a locality or the frequency range of neighbouring users, are also possible.

7.5.2 Conditions of use at borders

At the borders of a high demand area (HDA) awarded as a region or part of a region through the selection procedure, definitions are required, to limit the field strength that the licence holder in the affected region may generate and to define the maximum level of interference expected.

Referring to ECC/REC/(15)01,[47] a limit of 80 dBµV/m/200 MHz[48] for synchronised operation can be derived. For non-synchronised operation, a limit of 39 dBµV/m/200 MHz results.

This limit value is to be applied at each HDA borderline.

The following sections discuss various types of borders in the award context.

[47] ECC Recommendation (15)01 as amended on 14 February 2020, see https://docdb.cept.org/download/1776

[48] All field strength values are assumed to be measured at 3 m above the ground.

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7.5.2.1 Border between regions in selection procedures

Depending on how regions and HDAs are specified in the selection procedure, two HDAs may end up lying adjacent to one another along the regional border. If this is the case, then the following rule is applied.

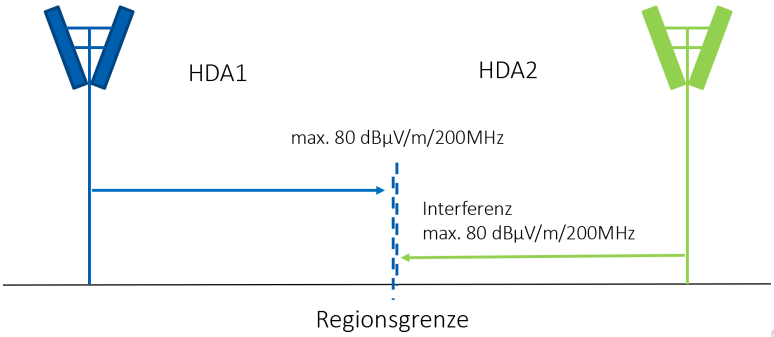

Figure 9: Border between HDA1 (blue) and HDA2 (green).

The respective users must maintain the appropriate field strength limit at the borderline. The above figure shows only the limit for synchronised operation.

7.5.2.2 Border in selection procedures—local assignment

HDAs as defined in the selection procedure lie adjacent to local assignment areas (low demand areas, LDAs). For the case that different users operate in adjacent areas, rules are required the field strength of each user's transmissions as well as interference. At the regional borderline, the spectrum licence holder for the HDA must comply with field strength values for synchronised or non-synchronised operation (the latter is not shown in the figure below). This also applies to the user in the LDA, who, in accordance with LDA rules, must maintain a minimum distance from the reference point on the border. These minimum distances are 450 m for non-line of sight (NLOS, for additional rules see the section on local assignment) and 3,000 m for line of sight (LOS, see the same section on local assignment).

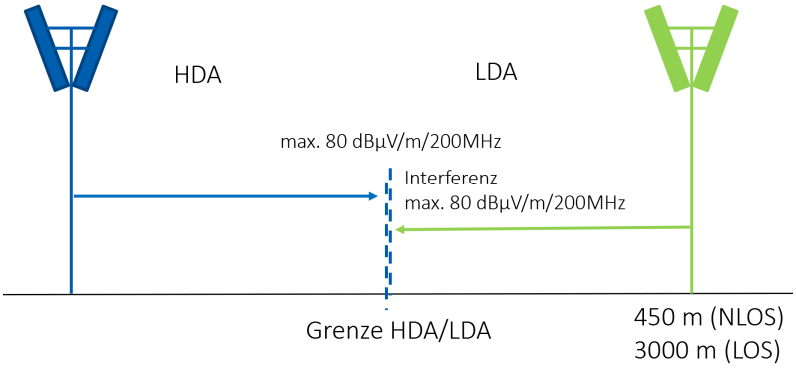

Figure 10: Border between HDA (blue) and LDA (green).

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7.6 Coverage obligations

7.6.1 Frequency range 26.5–27.5 GHz

In light of the poor suitability of this spectrum for wide-area coverage, the regulatory authority recommends a site-based coverage obligation (number of sites at which at least one base station must be erected). This coverage obligation focuses squarely on the target of preventing spectrum hoarding and ensuring a minimum level of deployment.

For this coverage obligation, a site must meet the following criteria:

- A site that is eligible for meeting the coverage obligation must have a base station capable of transmitting at a minimum level of 10 watts of electrical power per sector. The actual transmission power level can be less.
- The spectrum assigned to the operator must be used at the site.
- A site qualifies as a site within the meaning of the coverage obligation only if the frequencies transmitted there are used to connect end users.
- Base stations will be considered if located outdoors. Sites will be considered independent sites only if they are linearly at least 25 m apart.
- The spectrum holder must have actual, legal and technical control of any such base station.
- A site having an antenna system with more than one sector is still considered as only one site.
- While active sharing is not prohibited, a site is counted only for a single spectrum holder.

The number of sites depends on the regional structure (model A, B or C). A lower number of sites (approx. 25%) must be erected within two years. The final deployment obligation must be fulfilled within a period of five years.

7.6.1.1 Model A

In low demand areas, spectrum assignment is based on a local licensing model (see section 8). Base stations must be erected for the reference points applied for.

In high demand areas (HDAs), licences are awarded over larger areas. The regulatory authority proposes the following coverage obligations for HDAs:

- At least one site per HDA
- For larger HDAs, at least one site per 10,000 residents

7.6.1.2 Model B

Model B envisages awarding separate licences for municipalities and cities with at least 10,000 residents (alternative: at least 5,000 residents). The regulatory authority proposes the following coverage obligations for these regions:

- At least one site per municipality/city

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- For larger municipalities/cities, one site per 10,000 residents

In addition, separate licences will be awarded for the remaining municipalities, grouped into districts. The regulatory authority proposes the following coverage obligations for these regions (districts):

- At least one site in at least 25 per cent of the respective district's (remaining) municipalities

7.6.1.3 Model C

Model C envisages the award of nationwide licences in combination with wide-ranging coverage obligations and/or an obligation to ensure the shared use of spectrum in response to appropriate external demand and a lack of internal demand (see section 7.7.2).

For municipalities with at least 10,000 residents (alternative: at least 5,000 residents), the regulatory authority proposes the following coverage obligations:

- At least one site per municipality/city
- For larger municipalities/cities, one site per 10,000 residents

At least one site is also to be erected in at least 25 per cent of the remaining municipalities. In the event of the licence holder leasing spectrum, the sites erected by the lessee (in accordance with TKG 2021 provisions) will be counted towards the fulfilment of the obligation.

7.6.2 Remaining 3410–3470 MHz spectrum

In the regulatory authority's view, the coverage obligations attached to the 3.4–3.8 GHz band spectrum awarded in 2019 have proven their worth. Accordingly, the regulatory authority proposes applying coverage obligations analogous to those utilised in the 3.4–3.8 GHz spectrum award in 2019 (i.e. with new key dates).[49]

7.7 Spectrum sharing

Promoting the shared use of spectrum is an important goal pursued by European and national spectrum regulation.[50] Pursuant to Art. 10 Par. 3 TKG 2021, an effective and efficient use of spectrum is to be promoted, such as through the shared use of radio spectrum, whether involving similar or different usages of radio spectrum, and while complying with competition law. At the same time, all users are to be guaranteed a set of foreseeable and reliable rules for shared usage. Pursuant to Art. 13 Par. 16 TKG 2021, spectrum assignments may include ancillary provisions concerning shared spectrum usages in order to safeguard the effective and efficient use of spectrum.

[49] Cf. the tender documentation for the F7/16 award procedure. Accessible from: https://www.rtr.at/TKP/was_wir_tun/telekommunikation/spectrum/procedures/5G_Frequenzvergabe_3_4-3_8GHz/5G-Auction-Tender-Documents.en.html

[50] Cf. RSPG, 'RSPG Opinion on Spectrum Sharing – Pioneer Initiatives and Bands' (2021), accessible from the RSPG website.

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Lastly, Art. 16 Par. 6(6) authorises the regulatory authority to include in the tender conditions an option for the secondary usage of the spectrum.

In the regulatory authority's opinion, two specific models for shared use of spectrum are relevant for the procedure in question:

- *Club use model*
- 'Use-it-or-share-it' obligation or secondary usage (only for model C)

7.7.1 'Club use' model in the 26 GHz band

In the consultation on the Spectrum Release Plan conducted in summer 2021, many consultation participants cited 800 MHz (or an even higher volume) as the amount of spectrum necessary to ensure efficient usage. While larger frequency blocks permit significant increases in capacity (data transfer rates), only 1,000 MHz will be available over the short term. If exclusive usage rights were to be awarded, only one operator could use this amount of bandwidth in each region.

On account of primarily local usage in hotspots, however, it is not expected that any spectrum holder will be interested in wide-area use of this spectrum over the short or medium term. In many places and within a sizeable area centred on these places, the regulatory authority expects to see only one operator using the spectrum in the first few years after the award. Usage rivalry is expected to remain low over the short to medium term. Under these conditions, an operator would be able to use the sum total of spectrum made available without limiting another operator's usage.

When considering the longer term, the regulatory authority clearly expects to see increasingly intensive usage as well as usage rivalry (if not, the spectrum would not need to be limited by number). Over this longer period of time, however, more spectrum will be made available once the middle frequencies in the band have been cleared of FDD microwave radio use, so that several operators will be able to use broad frequency blocks within one area.

One way of offering licence holders an option for utilising broad frequency blocks, especially during this transition period, is a sharing protocol that is commonly known as the 'club use' model. This model has been deployed in the context of 26 GHz band usage, for example in Italy and Slovenia. The club use model envisages awarding only priority usage rights rather than exclusive rights. Operators who hold a 26 GHz band spectrum licence at a site (and who are club members) are entitled to use not only their own spectrum but also spectrum from other licence holders as long as they do not act in a way that causes interference to the priority user of a frequency.

As with any sharing model, this model requires coordination and consultation between the operators. The regulatory authority can assume this role or the club can manage itself. In both cases, rules should be set as part of spectrum assignment. If conflicts occur regularly, for example, an external arbitrator should be appointed (and paid for by the operators), who will then assume the role of coordinator. If

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activities are being coordinated by the authority then the distance model from section 8 can be used.

The club use model offers the following advantages:

- Low administrative barriers to the use of high bandwidths (e.g. 1 GHz) because neither a spectrum transfer procedure (Art. 20 TKG 2021) nor a procedure pursuant to Art. 85 TKG 2021 is necessary
- Advantages for operators and customers resulting from the use of high bandwidths (high capacities and data transmission rates, even with a small amount of spectrum acquired through auction)
- Positive impact on competition, since spectrum is not hoarded and blocked for strategic reasons
- Temporary solution to a lack of bandwidth until more spectrum can be provided by clearing other bands
- Potentially substitutes over the long term for failing to defragment spectrum (see section 7.3.2)
- Efficiency of spectrum usage is increased by this shared usage model for spectrum
- Avoids sunk costs in situations where because of other licence holders' internal demand an operator can no longer use their spectrum. In this situation, the operator can at least use spectrum with a priority usage right while, over the long term, spectrum will become available that permits wider blocks to be used.

These advantages must be weighed up against the administrative effort required for matters such as coordination. A further issue to consider is the fact that, in many places, the use of non-priority spectrum will eventually become impossible. In areas with very high levels of traffic, all operators will reach their capacity limits in the medium term and will want to use 26 GHz spectrum. In these areas with a high level of usage rivalry, over the medium term operators will have only limited use of spectrum for which they have no priority rights of use. The incremental award of this band is therefore a key reason why the regulatory authority is proposing this model. As soon as additional spectrum becomes available, the use of wider frequency blocks is then possible in the areas with high usage rivalry as noted.

This sharing model is only being considered for models A and B, and is unsuitable for low demand areas.

7.7.2 'Use-it-or-share-it' obligation in the 26 GHz band

Model C envisages the awarding of nationwide usage rights in combination with wide-ranging coverage obligations (and especially in rural areas) and/or combined with a spectrum sharing obligation in areas in which spectrum is unable to be utilised directly by the original licence holder.

The regulatory authority is considering two options for implementing such a use-it-or-share-it model:

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- By means of an obligation to transfer/lease spectrum in areas (e.g. in municipalities) in which the original spectrum licence holder has no internal demand. On receiving a request from a third party, the spectrum licence holder must either use their spectrum within a specified period (e.g. minimum number of base stations in the municipality within five years) or they must transfer/lease the spectrum to the requesting party. If the spectrum is neither deployed nor transferred or leased, a fine based on the costs of deployment becomes payable. In the event of a price needing to be specified for leasing, one option would be to use the price per MHz/POP (proportional to the respective area) from the award.
- Wide-ranging deployment obligations are envisaged, which also extend to rural areas (see section 7.8.6). The licence holder can also meet these deployment obligations with third-party leasing. In the event of the licence holder leasing spectrum, the sites erected by the lessee (in accordance with TKG 2021 provisions) will be counted towards the fulfilment of the obligation.

7.7.3 Band managers

Another approach would be to assign spectrum to a 'band manager': this entity would not be entitled to use the spectrum themselves but would use spectrum leasing and sharing to manage issues including the efficient use of spectrum and the fulfilment of coverage obligations in rural areas.

7.8 Consultation questions

7.8.1 Regions, lots and categories

Question 7.1: How would you respond to the regulatory authority's proposal to offer (in the HDAs) generic lots of 200 MHz from the 26.5–27.5 GHz band at auction and, for the 3.4–3.8 GHz band, to offer a specific frequency block per region from the spectrum still available in the region? Please give reasons for your answer.

Question 7.2: What is your opinion of the regional structure for model A? What is your opinion on the grouping of HDAs into the regions from the 2019 auction? Would some other grouping (other regions or nationwide grouping) be more expedient, in your opinion? In which regions do you plan to use 26 GHz spectrum? What is your opinion of how lots are allocated to product categories? What relationships exist between the two bands? Please give reasons for your answer.

Question 7.3: What is your opinion of the regional structure for model B and how lots are allocated to product categories? Can you comment on any interregional complementarities in the context of these small regions? Do any exist? Why do they exist? What is your assessment of the level of demand in rural regions? Are you interested in highly localised usages (only in one or a handful of small regions)? In which areas? Please give reasons for your answer.

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Question 7.4: What is your opinion of the regional structure for model C and how lots are allocated to product categories? Are you for or against the award of nationwide licences for the 26.5–27.5 GHz band? Please give reasons. Are you more interested in blanket, nationwide usage, or rather a regional or local usage? In which areas? Please give reasons for your answer.

7.8.2 Auction design for the principal stage

Question 7.5: How would you assess potential regional synergies in the event of a regional award? Do these synergies differ from model A to model B (and if yes, how)? Please give reasons for your answer.

Question 7.6: In relation to your answer as given to question 7.5, do you agree with the proposal to use an SCA with an option for submitting exit bids? If not, which alternative auction format would be suitable here? Please give reasons for your answer.

Question 7.7: In the event of the auction indicating that demand in individual regions is too low to award all spectrum (even potentially at the reserve price), do you agree with the authority's intention to therefore assign unsold spectrum by means of an administrative procedure (this primarily affects model B). Do you see inherent risks with this approach? Please give reasons for your answer.

7.8.3 Assignment stage and long-term band planning

Question 7.8: In drawing up band plans for the 26 GHz band, for the reasons given above, the regulatory authority sees no need to eliminate assignment options across regions as a way of avoiding misalignments (as in the 2019 auction). Do you agree? Please give reasons for your answer.

Question 7.9: Over the long term, do you consider the assignment of contiguous frequency blocks in the 26 GHz band to operators to be necessary or unnecessary (despite incremental awarding of the band)? Is an option to specify the position in the band more important than the assignment of contiguous spectrum? Please give reasons for your answer.

Question 7.10: How well do specific frequency blocks substitute for one another? What are the consequences of exchanging the block in question? Would this require investments or would only a software (re-)configuration be necessary? How easily could an operator revert to another frequency much later on? What costs could be incurred by doing so? What would be the impact of fragmentation on energy efficiency? Are other disadvantages involved—perhaps in areas bordering one another? Please give reasons for your answer.

Question 7.11: How would you assess the regulatory authority's discussion and proposals concerning long-term defragmentation, which becomes unavoidable with incremental awarding of the 26 GHz band? What are the options, in your opinion, for safeguarding contiguous frequency assignment? Please give reasons for your answer.

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Question 7.12: Do you agree with the proposal to use a procedure for the assignment of spectrum from the 26 GHz band that is identical to the procedure used for previous auctions in Austria (sealed-bid second price auction with minimum revenue core pricing)—and with the separate evaluation of bids for each region? If not, which alternative procedure would you recommend? Please give reasons for your answer.

7.8.4 Technical terms and conditions of use

Question 7.13: Which synchronisation scheme (structure as per 3GG standard for 5G) would you recommend?

Question 7.14: What constraints are necessary for non-synchronised networks?

7.8.5 Term

Question 7.15: Do you agree with the licence term as proposed by the regulatory authority? Please give reasons for your answer.

7.8.6 Coverage obligations

Question 7.16: How would you respond to the regulatory authority's proposed coverage (deployment) obligations for model A? Which (deployment) obligations would you propose for model A? Please give reasons for your answer. Please explain why this would better achieve the award objectives set by the TKK than the regulatory authority's proposal.

Question 7.17: How would you respond to the regulatory authority's proposed coverage (deployment) obligations for model B? Would you accept these obligations? Which (deployment) obligations would you propose for model B? Please give reasons for your answer. Please explain why this would better achieve the award objectives set by the TKK than the regulatory authority's proposal.

Question 7.18: What is your assessment of the proposed regulation of coverage (deployment) obligations for model C? Which obligations would you propose for model C? Please give reasons for your answer. Please explain why this would better achieve the award objectives set by the TKK than the regulatory authority's proposal.

7.8.7 Spectrum sharing

Question 7.19: Is including the club use model in the 26 GHz terms and conditions of use the right approach, in your opinion? For which part of the band (only to 26.5–27.5 GHz or also to spectrum that will be awarded in the future)? For how long (until the award of additional 26 GHz spectrum or until the end of the licence term)? What are the pros and cons of this model, in your opinion? Please give reasons for your answer.

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Question 7.20: If a club use model is envisaged, which coordination activities will become necessary, in your opinion? Who should handle coordination (and conflict resolution)? Please recommend an efficient model here.

Question 7.21: Do you consider a use-it-or-share-it model to be suitable or unsuitable for achieving the TKG's strategic targets? Please give reasons for your answer.

Question 7.22: What would be an appropriate design for a use-it-or-share-it model, in your opinion? Please give reasons for your answer.

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8 Local spectrum assignments

8.1 Local spectrum assignments for real estate-based networks

8.1.1 Introduction

Pursuant to the current consultation draft of the amended Frequency Utilisation Ordinance, 600 MHz at the lower band edge is to be used in local, real estate-based spectrum assignments (short form used in the amendment: 'assignments') for defined, small-scale geographic areas and especially for in-house purposes (e.g. campus networks and industrial use). The assignment is limited to the corresponding real estate (e.g. business premises) and the rights of use for the spectrum are linked to legal control of the real estate (real estate licensing model).

8.1.2 Available frequency ranges

The 24.3–24.9 GHz frequency range—and therefore a total bandwidth of 600 MHz—is available for local assignment within real estate-based networks. For the award procedure, this frequency range will be split into blocks of 200 MHz, designated as LA14 to LA16 in the following.

8.1.3 Restrictions on application eligibility

The owner or the user (e.g. tenant, lessee) of the property is entitled to submit applications for local, real estate-based usages. A maximum of three specific frequency blocks can be applied for per plot of real estate. The plot borders are as given in the land registry. A plot (*Grundstück*) is therefore defined as the area contained within one or more contiguous parcels (plot numbers).

An excerpt from the land registry must be enclosed as proof of authorisation to submit an application. If authorisation cannot be directly determined from the land registry excerpt, then other documentation must be submitted to clarify the circumstances. This could apply in cases where the status as shown in the land registry is not current (e.g. contracts of sale) or the applicant and the property owner are not the same individual according to the land registry (e.g. rental agreements), or in cases of shared ownership. Ultimately, as proof of the applicant's eligibility the documents submitted must allow a continuous link to be inferred between the details recorded in the land registry and the applicant personally.

8.1.4 Steps of the procedure

A website provides potential applicants with an overview of existing local assignments. Before submitting an application, applicants can therefore discover whether the plot for which spectrum usage rights will be applied for is subject to any constraints arising from existing uses of spectrum on neighbouring plots. This website aims to provide potential applicants with as detailed a picture as possible of the situation regarding local assignments, well in advance of their application.

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8.1.5 Terms and conditions of use

Successful applications for spectrum are granted a usage term of up to ten years. Applicants should specify the term required if this differs from the maximum term. Applicants may also waive their rights to spectrum before their licence expires if they no longer have a need for this spectrum.

Successful applicants pay a one-time assignment fee and an annual usage fee in accordance with the current Telecommunications Fee Ordinance (*Telekommunikationsgebührenverordnung*, TKGV).

8.1.6 Protection against interference

In the case of local assignment for real estate-based networks, the respective user must ensure that their transmissions do not cause interference to other users of real estate-based networks. To achieve this aim, these reciprocal efforts to protect individual networks take into account the minimum coverage quality required. This quality is assured by limiting the field strength at the border of the property and 300 m beyond the property border.

Network planning must account for the transmissions permitted for the user and permitted third-party interference, with provisions also being made to maintain the planned level of network quality in the event of later usage by additional neighbouring users.

The maximum field strength values permitted at the property border and 300 m beyond this border are publicly accessible, and therefore documented transparently for all involved parties.

8.1.6.1 Public accessibility of usage data

One important aspect here is the public accessibility of information about usage rights. Interested parties can then discover whether and to what degree additional usage rights can be obtained. The transparent documentation of existing usages facilitates voluntary coordination between neighbouring users and therefore a high level of efficiency.

Alongside technical parameters on usage (such as place and frequency), this usage documentation also includes the identity of the user as well as details of contact persons.

These data are made publicly available by the regulatory authority.

8.1.6.2 Block-based assignment

To facilitate efficient usage, spectrum must be awarded in blocks. The regulatory authority considers blocks with a bandwidth of 200 MHz as appropriate for assignment within a real estate-based licensing model. An individual applicant can apply for one or more 200 MHz blocks, up to a maximum of three blocks and therefore an overall frequency range of 600 MHz. Before submitting their

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applications, applicants can use the publicly accessible usage data to check frequency block availability. In the event of a conflict, assignments are made on a first-come, first-served basis.

Referring to ECC/REC/(15)01,[51] a limit of **80 dBµV/m/200 MHz**[52] for synchronised operation can be derived. For non-synchronised operation, a limit of **39 dBµV/m/200 MHz** results.

In the case of local assignment for real estate-based networks, a usage area is defined based on the property border.

Usage is based on preferential and non-preferential conditions—this distinction is explained below.

8.1.6.2.1 Assignment under non-preferential conditions

Assignment under non-preferential conditions is illustrated in the figure below:

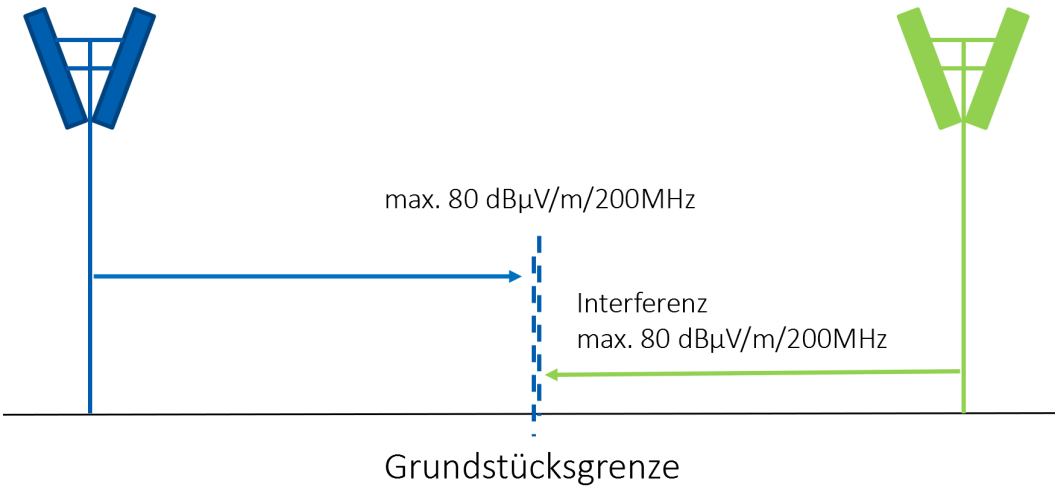

Figure 11: Property with non-preferential use on the left-hand side (blue), neighbouring user on the right (green)

For the case of assignment under non-preferential conditions, limits have been defined, applying to the licence holder's own transmissions and to third-party transmissions directly at the property line. These limits are 80 dBµV/m/200 MHz for synchronised transmissions and 39 dBµV/m/200 Hz (not shown in the figure) for non-synchronised transmissions, respectively.

[51] ECC Recommendation (15)01 as amended on 10 June 2022, see https://docdb.cept.org/download/1776

[52] All field strength values are assumed to be measured at 3 m above the ground.

8.1.6.2.2 Assignment under preferential conditions

Assignment under preferential conditions is illustrated in the figure below:

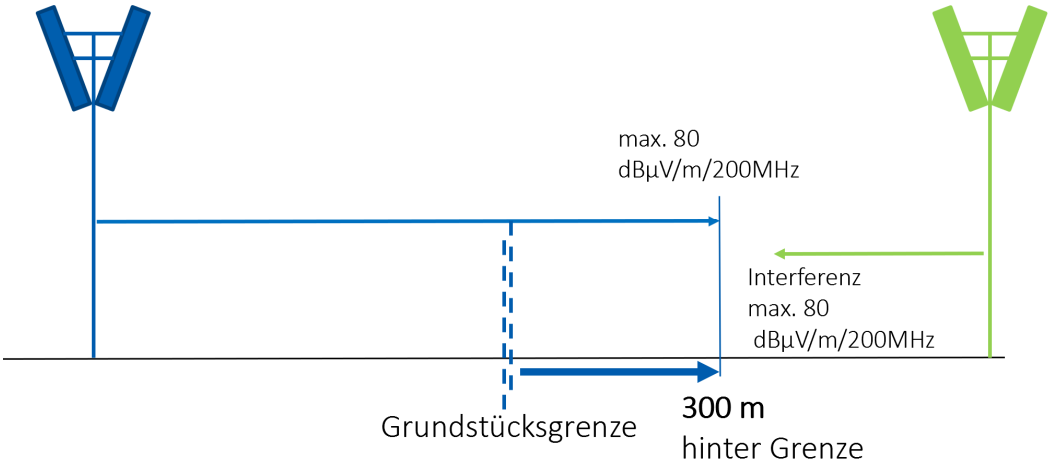

Figure 12: Property with preferential assignment for the licence holder on the left (blue), interference by a non-adjacent user (green)

In the case of a preferential channel, the limits for the licence holder's own transmissions are defined with respect to a line 300 m beyond the property line. The border for both the licence holder's transmissions and for interference by a neighbour is therefore shifted 300 m outside the licence holder's own property. This ensures better outdoor coverage on the licence holder's own property, especially in the vicinity of the property line. This means that immediate neighbours are not the closest parties to use the preferential block. In this scenario, base stations may also only be erected on the licence holder's own property. The respective limits for synchronised and non-synchronised transmissions also apply unchanged (not shown in the figure).

Depending on existing licence assignments, the 200 MHz blocks LA13 and LA15 are made available as preferential channels. Per assignment, a maximum of one 200 MHz block can be applied for as a preferential channel. This rule ensures that preferential channels are distributed fairly among applicants and that, in each case, at least one assignment is possible under non-preferential conditions. For this reason, the LA14 block is not available for assignment under preferential conditions.

8.1.6.2.3 Assignment and usage rules

A block is assignable if no assigned third-party usage is thereby constrained. Accordingly, neighbouring non-preferential usages are, at least for the central 200 MHz block, always possible on account of the limits at the property border. An assignment under preferential conditions can be made for a block of maximum 200 MHz.

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8.2 Local assignment for public networks

8.2.1 Introduction

This form of local assignment is utilised for low demand areas, which means that it affects areas in which spectrum is not limited by number (cf. section 4).

8.2.2 Available frequency ranges

The 26.5–27.5 GHz frequency range —and therefore a total bandwidth of 1,000 MHz—is available for local assignment within public networks. For the award procedure, this frequency range will be split into blocks of 200 MHz, designated as LA01 to LA05, with contiguous frequency ranges being awarded in each case.

8.2.3 Steps of the procedure

A website provides potential applicants with an overview of existing assignments. Before submitting an application, applicants can therefore discover whether an assignment is possible in principle. This website aims to provide potential applicants with as detailed a picture as possible of the situation regarding assignments and at the earliest possible stage.

8.2.4 Terms and conditions of use

Successful applications for spectrum are granted a usage term of up to ten years. Applicants should specify the term required if this differs from the maximum term. Applicants may also waive their rights to spectrum before their licence expires if they no longer have a need for this spectrum.

Successful applicants pay an assignment fee and an annual usage fee.

In the case of a local assignment for public networks, the licence holder is required to erect per reference point at least one base station operating with the assigned spectrum, within six months of the assignment date. Licence holders who fail to fulfil this deployment obligation will incur a fine of EUR 20,000. This fine also becomes due on an annual basis until the deployment obligation is fulfilled or the spectrum is surrendered. The law also empowers the regulatory authority to revoke spectrum usage rights in certain circumstances.

8.2.5 Protection against interference

A key principle of local assignment for public networks is that it should facilitate the use of spectrum by a large number of users. On the one hand, every attempt should be made to ensure that any potential user of spectrum is actually able to do so. Steps should also be taken to ensure that users can use the spectrum under defined conditions and with minimal disruption from other users.

8.2.5.1 Public accessibility of usage data

One important aspect here is the public accessibility of information about usage rights. Interested parties can then discover whether and to what degree additional

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usage rights can be obtained. The transparent documentation of existing usages facilitates voluntary coordination between neighbouring users and therefore a high level of efficiency.

Alongside technical parameters on usage (such as place and frequency), this usage documentation also includes the identity of the user as well as details of contact persons.

These data are made publicly available by the regulatory authority.

8.2.5.2 **Block-based assignment**

To facilitate efficient usage, spectrum must be awarded in blocks. The regulatory authority considers blocks with a bandwidth of 200 MHz as appropriate for local assignment for public networks. An individual applicant can apply for one or more 200 MHz blocks, up to a maximum of three blocks, so as to ensure that two users can operate at a single site.

Before submitting their applications, applicants can use the publicly accessible usage data to check frequency block availability. In the event of a conflict, assignments are made on a first-come, first-served basis.

Referring to ECC/REC/(15)01, a limit of 80 dBµV/m/200 MHz for synchronised operation can be derived. For non-synchronised operation, a limit of 39 dBµV/m/200 MHz results.

Reference points

Assignment is based on reference points, whereby a base station must be located within a tolerance radius of 30 m around a reference point. Limits for the licence holder's transmissions and for permitted levels of interference always relate to this reference point and not to the base station, which is located at a (permitted) distance from the reference point.

An individual application can encompass multiple reference points within a maximum distance of no more than 600 m from the next reference point in question, thereby enabling the construction of contiguous coverage areas consisting of multiple base stations. The maximum distance between any two reference points cited in an application must not exceed 1,800 m. Separate applications must be submitted for non-contiguous coverage areas. As a consequence, spectrum assignments and fee payments are also handled separately.

At least one base station must be erected for each reference point (see above).

8.2.5.3 **Principle specifications**

The figure below provides a summary of the principle specifications:

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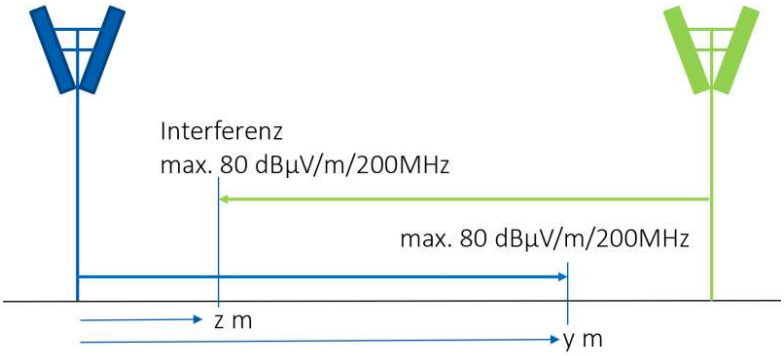

Figure 13: Principle specifications for local assignments for public networks

Within a radius of y m around the reference point, the licence holder's own transmissions (blue mast in the figure) must have dropped to a field strength of 80 dBµV/m/200 MHz in the case of synchronised transmissions or 39 dBµV/m/200 MHz for non-synchronised transmissions (not shown in the figure). Conversely, transmissions from other users (shown in green in the figure) are permitted at the given field strength at a radius of z m around the reference point. This field strength must be accounted for in network planning to ensure that the planned network quality is achieved even in the context of later usage.

Usage is also categorised either as NLOS (non-line of sight, i.e. a typical mobile service deployment), or LOS (line of sight, i.e. a typical fixed wireless access deployment).

8.2.5.3.1 Assignment rules in the case of NLOS

The figure below illustrates the specifications as made for NLOS:

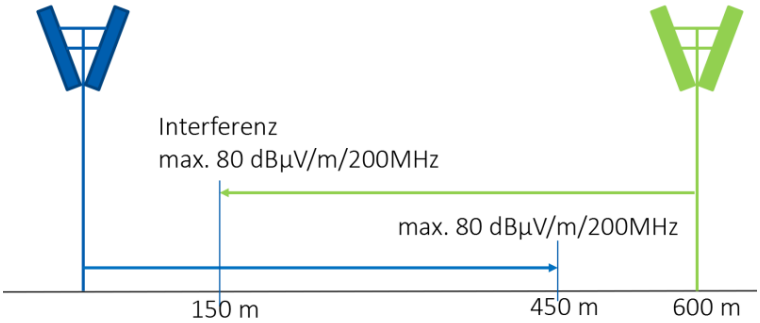

Figure 14: Local assignment for public networks with NLOS

For 'mobile network-like' use, the distance for the licence holder's own transmissions is set at 450 m, with the distance for permitted interference by third-party transmissions set at 150 m. Another type of NLOS usage is therefore possible at a radius of 600 m around the licence holder's own reference point.

The formal definition of the assignment rule is therefore as follows: a frequency block can be assigned where the field strength limit line for other users is at least

150 m distant from the applicant's own reference point (i.e. a distance of at least 600 m between these reference points in an NLOS/NLOS scenario and a distance of at least 3,150 m to the LOS station in the NLOS/LOS scenario described below).

8.2.5.3.2 Assignment rules in the case of LOS

The figure below illustrates the specifications as made for LOS:

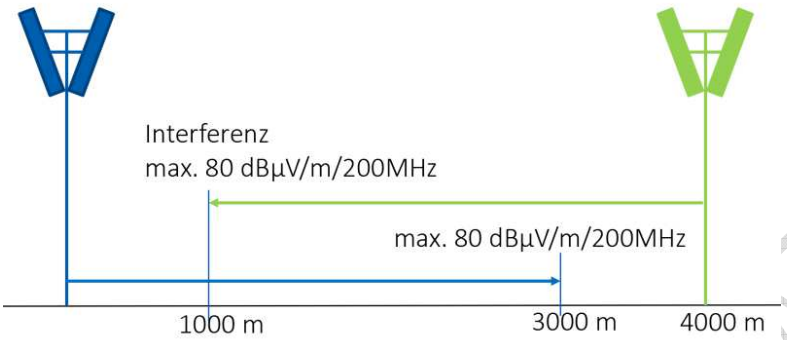

Figure 15: Local assignment for public networks with LOS

An LOS configuration is understood to mean a network deployment that requires a line of sight between the central station and subscriber terminals, which typically means a network configuration in which a subscriber-side external roof antenna is also installed. While this kind of network configuration extends the network range, it also requires extensive protection against third-party transmissions and therefore reduces assignment efficiency. For this reason, the applicant must submit corresponding technical documentation as evidence of an actual LOS configuration.

With this usage, the distance for the applicant's own transmissions is set at 3,000 m and for permitted interference at 1,000 m, in each case from the applicant's own reference point. A third-party LOS usage is therefore possible at a radius of 4,000 m around the applicant's own reference point, with NLOS usage already possible at a distance of 3,150 m.

The assignment rules described above apply mutatis mutandis.

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8.3 Consultation questions

Question 8.1: Is the proposed model suitable for your usage? Which usages are not compatible with this model? If the model is not suitable, which local licensing model would you propose?

Question 8.2: Are you planning FWA usage in low demand areas? Is the proposed local assignment model suitable for this use case? If not: please explain why it is unsuitable. Describe the specific FWA usage you have in mind. What modifications would be necessary?

Question 8.3: Are you planning eMBB usage in low demand areas? Is the proposed local assignment model suitable for this use case? If not: please explain why it is unsuitable. Describe the specific usage you have in mind. What modifications would be necessary?

Question 8.4: Are you planning to use the spectrum for local, real estate-based usage (private networks, industrial usage or campus networks)? Is the local real estate-based assignment model suitable for your envisaged usage? If not: please explain why it is unsuitable. Describe the specific usage you have in mind. What modifications would be necessary?

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9 Statements

Statements (in German or English) must be emailed by 12 December 2022 to:

tkfreq@rtr.at

Please use the cover sheet below.

RTR will publish a list of the organisations/individuals that submitted statements on the consultation.

If requested, the individual statements will be published as well.

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RTR

Cover page – Statements on the consultation for the award of spectrum in the 3410–3470 MHz and 26 GHz bands

General information

Statement submitted by:

Represented by (if applicable):

Postal address:

Email address:

Confidentiality

Please indicate whether your statement or parts thereof are confidential and if so provide reasons:

No confidential content ☐

Statement content is confidential ☐

Passages within the statement are confidential ☐ In this case we request you to additionally submit a version of the document that you consider suitable for disclosure.

RTR will in any event publish a list of the organisations/individuals that submitted statements on the consultation.

Declaration

I hereby confirm that this communication is a formal statement within the framework of the current consultation and that the statement may be published by RTR subject to any confidentiality requests indicated above. When submitting the statement by email, any standard email texts concerning the confidentiality or disclosure of email content (including any attachments) will not be considered relevant for publication by RTR.

Name: Signature:

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ANNEX 1

to the Consultation

for the Award of Spectrum Use Rights
in the 26 GHz and
3410–3470 MHz ranges

Auction Design Options

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The DotEcon report on the design of the auction ('Auction design options for the award of spectrum in the 3.4–3.8 GHz and 26 GHz bands') can be downloaded as a separate document.

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