

Summary of Statements

Submitted for the Consultation
on the 3.4-3.8 GHz
Award Procedure

NON-BINDING TRANSLATION

Vienna, am 28. November 2017

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1 Introduction

1.1 General information

On 11 January 2016 the Telekom-Control-Kommission (hereafter 'TKK') tasked RTR with beginning preparations for the award of rights to use frequencies including the 3.4 to 3.6 GHz range (award following the remaining term lasting until the end of 2019). In addition, the TKK initiated an award procedure on 26 September 2016 in response to an application of 23 August 2016 for the award of frequency usage rights for the 3.6 to 3.8 GHz range. With reference to the corresponding statements put forth in the course of the frequency consultation jointly conducted in 2016 by the Federal Ministry of Transport, Innovation and Technology (BMVIT) and by RTR, the regulatory authority recognises the expediency of awarding the entire 3.4 to 3.8 GHz range within the framework of a joint auction. The TKK has consequently resolved to merge the award procedure for the two bands, i.e. 3.4 to 3.6 GHz and 3.6 to 3.8 GHz, and to begin preparations for a joint auction. To ensure planning security for market participants, the TKK published a general roadmap in December 2016 for the future frequency awards (Spectrum Release Plan). This legally non-binding plan is intended to reflect the current assessment of future frequency awards.

The TKK currently assumes that the technical terms and conditions of use, which are a prerequisite for putting the 3.4 to 3.8 GHz range out to tender in an auction, will be available in late 2017. Accordingly, in the event of a consultation on the specific auction conditions, an invitation to tender in the second quarter of 2018 appears realistic. The auction would then be held as planned in autumn 2018. The 3.6 to 3.8 GHz frequency range could then be used immediately on assignment with legal effect and the 3.4 to 3.6 GHz range as of 1 January 2020 (once the current usage rights expire). Nonetheless, in view of a number of uncertainties, the regulatory authority reserves the right to deviate from the plan; uncertainties include: when conditions of use become available, any use in neighbouring countries, or changes to the legal framework (at the European or national level) that might oppose the plan.

RTR has used the format of a consultation on the forthcoming frequency award in the 3.4 to 3.8 GHz range to collect important feedback from the market and discuss potential approaches. This document presents a summary of participants' statements.

The content addressed below is non-binding and is therefore without prejudice to any future decisions of the Telekom-Control-Kommission.

1.2 Statements

A total of 15 statements were received, of which the following 13 companies and organisations may be mentioned by name:

- A1 Telekom Austria AG

- Camyno GmbH
- Energie Burgenland AG
- Energie Steiermark Technik GmbH
- GNK GmbH – Glasfaser Netz Kärnten (Bergmann)
- Hutchison Drei Austria GmbH
- KELAG-Kärntner Elektrizitäts-Aktiengesellschaft
- LinzNet
- Oesterreichs Energie
- Otto M. Steinmann eU
- Peter Rauter GmbH
- Salzburg AG für Energie, Verkehr und Telekommunikation
- T-Mobile Austria

The regulatory authority also invited all consultation participants to attend a hearing with the Telekom-Control-Kommission on 17 November 2017 to discuss consultation input.

2 Award goals

The TKK is focusing the award procedure on the goals listed below:

- Goal 1: Legal certainty
- Goal 2: Ensure efficient utilisation of frequencies
- Goal 3: Ensure/encourage effective competition
- Goal 4: Encourage innovation
- Goal 5: Greater connectivity and expanded coverage

Maximising auction income is expressly ruled out as a goal in awarding the frequencies, as is actively supporting new market entrants through actions such as reserving spectrum. To the extent relevant and feasible, the regulatory authority will base key design decisions on the goals listed above.

Efficient frequency use is ensured where bidders are able to acquire spectrum to meet their individual needs, and where a frequency lot is assigned to the bidder who puts the highest value on that lot and submits the highest bid for it.¹ This requires a *product design* that matches the demands of potential users, ensures fair and equal participation of all users and allows competition for incremental spectrum. This needs to be complemented by an *auction design* suited to identifying the bidder with the highest valuation. The award procedure also needs to be designed so as to largely avoid any *unnecessary fragmentation* of spectrum within a single band, as well as, where frequencies are packaged by region, the assignment of different individual spectra to different regions. *Aggregation and substitution risks* are to be minimised in the auction by using a suitable design. For example, bidders should be allowed to acquire within one of the two bands a large frequency block for 5G in all regions. Exercising such an option should not be impaired by switching barriers or aggregation risks. The regulatory authority also wishes to minimise the *number of* (implicit or explicit) *guard blocks*, for instance by encouraging synchronous operation or through suitable arrangement of compatible users within the band, while at the same time achieving a certain degree of *flexibility allowing differing business models*.

In line with the goal of efficient frequency usage, as well as to pursue Goal 5, the TKK is considering imposing *appropriate coverage requirements*. This would be firstly to ensure that the spectrum is in fact used and not hoarded for strategy reasons. Secondly, the TKK is considering requirements that would ensure the speedy introduction and propagation of 5G services.

¹ Cf. Art. 55 Telecommunications Act (TKG 2003) and ruling 2013/03/0149 of 4 December 2014 by the Austrian Administrative Court (complaint of a mobile network operator against the TKK decision of 19 November 2013, F 1/11-283).

To achieve the second award goal, the TKK will define appropriate spectrum caps to avoid any disproportionate concentration of usage rights with any one provider and to ensure that effective competition is preserved after the auction in the related downstream markets.

The TKK views the award of this frequency band as a significant contribution to introducing 5G in Austria. Through timely awarding of spectrum and a design that allows low-risk aggregation of a wide frequency block in one of the two bands (across regions), the regulatory authority is laying the groundwork for innovative efforts in the area of 5G.




3 Questions on product design

3.1 Lot size

Question 5.1: What lot sizes do you prefer (option A with 10 MHz or Option B with 20 MHz)? Please provide business and technical arguments for your preference. What lot size would you disapprove of in any case? Please provide business and technical arguments.

A clear majority of consultation participants prefer option A (10 MHz), although some of them support option A only on the condition that a regional award should nonetheless be possible and if not, these participants would support a different lot size (with regional taking priority). The results are shown in the table below. Here, lighter shading indicates a second preference. Overall, only a single consultation participant had a clear preference for a lot size of 20 MHz.

Table 1: Lot size

Options	Participants
A (10 MHz)	
B (20 MHz)	
–	

Arguments given in support of a lot size of 10 MHz include the following:

- A lot size of 10 MHz would represent a good compromise between flexibility and complexity.
- From a technical perspective, such a lot size would be a sound choice, since it is compatible with all technologies (same 5 MHz block size in both 4G and 5G).
- Option A would let bidders express their preferences more clearly and in greater detail.
- Option A would allow the spectrum offered to be divided exactly by the lot size.
- Option A would ensure identical lot sizes for bands 42 and 43 (according to 3GPP terminology for LTE), which would in turn reduce switching barriers in the auction.
- Option A would minimise the risk of unsold lots, which would improve the efficiency of frequency utilisation.
- All of the block sizes defined by the LTE standard would be covered by a lot size of 10 MHz (which would not be true to the same extent for a 20 MHz lot size).

- A lot size of 10 MHz would grant bidders greater flexibility for acquiring guard blocks for a different frame structure (non-synchronous operation).

Arguments given in support of a lot size of 20 MHz include the following:




- Reduced complexity is one argument in favour of a lot size of 20 MHz.
- The guard interval for non-synchronous operation is not a valid argument, since the provider could either way make efficient use of the amount of frequency acquired.

3.2 Product categories

Question 5.2: The regulatory authority tentatively proposes two product categories of abstract lots (per region) in the principal stage, one category of lots in the 3410-3600 Hz range and the second in the 3600-3800 MHz range. Do you agree with this proposal? How many categories (per region) would you propose? Please provide business and technical arguments for your preferences.

The results are shown in the table below. Two consultation participants support the proposal of a single product category. One participant states that the issue is currently being discussed with suppliers but does not consider it to be particularly important (light green in the table). A sizeable group of consultation participants has a clear preference for two categories. A second group of participants has a clear preference for assigning spectrum from the lower band. This also speaks in favour of forming two categories.

Table 2: Number of product categories

Options	Participants
1 category	
2 categories	
–	

Arguments offered in support of a single category include the following:

- Although there are currently differences between the bands, these would even out over time.
- The current band limit would not constitute a technical or commercial obstacle in the medium term.
- Participants are confident that 5G would permit carrier aggregation over sub-bands in the medium term. Hardware and terminal equipment capable of handling the range as a single band would be available no later than 2019. Operation across bands would therefore be feasible without efficiency losses.

- Ongoing standardisation work also has the objective of specifying the entire 3400-4200 MHz range as a homogeneous 5G spectrum.
- Existing providers in band 42 would have to replace their equipment in the course of changing over from FDD to TDD in any case, with such equipment already available for band 43.
- The earlier availability of band 43 would be balanced out by higher prices for equipment (this would even out any differences in value).
- Two categories would increase complexity in the auction and make it harder for (nationwide) providers to bid and acquire contiguous blocks. One category would allow a significantly simpler auction design. Greater complexity would not justify the effort for enabling the accommodation of the differences in value between the bands in the auction.
- Value differences between the bands could be articulated at the assignment stage. One participant expects significantly higher revenue (up to 20% more) based on the principal stage than in the previous two auctions.

Arguments given in support of two categories include the following:

- Differing schedules for the availability of the two bands
- Additional financial burden associated with switching bands (one provider cited the need to replace several hundred base stations)
- Differing economies of scale at international level with respect to system technology and terminal equipment
- The protection of investments already made and the possibility of expressing corresponding preferences in the auction (an interest in spectrum at the lower end of the lower band)

In a proposal based on the German model, some consultation participants suggest a third category, reserved for the exclusive use of regional FWA services.





3.3 Default value for synchronous operation

Question 5.3: What are your preferred uplink to downlink ratios (0-6) for synchronous operation (see consultation document)? Indicate your first and second preferences, and give reasons for them (by including traffic evaluations, for example).

- *First preference for UL/DL ratio (0-6):*
- *Second preference for UL/DL ratio (0-6):*

The results are shown in the table below (light green refers to a second preference). The mobile telecommunications industry prefers frame structure 2 (DL/UL ratio of 3:1). Of the regional broadband providers, some prefer frame structure 1 (symmetric traffic) while others prefer frame structure 2 (see the table below). Some participants also propose alternative, asymmetric frame structures.

Table 3: Number of product categories

Options (DL:UL)	Participants
3:1 (frame structure 2)	
1:1 (frame structure 1)	
2:1 (frame structure 3)	
7:2 (frame structure 4)	

Arguments presented as reasons for each configuration include the following:

- One significant argument for the frame structure preferred in each case would certainly be the individual business models, and the individual mix of traffic from private and business customers.
- To justify their preference for a symmetric DL/UL configuration, some participants cite the more favourable UL attenuation and therefore the more cost-effective provision of complete coverage and supply to rural areas.
- Another line of argument is that frame structure 2 (DL/UL of 3:1) has established itself as the standard ratio in Asia.
- One mobile network operator states that other frequencies could also be utilised for the selective boosting of UL traffic.
- One participant states that new (future) applications would require higher UL data transfer rates. Another participant asserts that there is currently no reason to suspect that major changes would be seen to the DL/UL ratio in future.
- An option to select an alternative DL/UL ratio by means of guard bands was also mentioned as highly desirable, and that there should also be the option of stipulating under private law a differing frame structure for synchronous operation with neighbours. Since such an agreement would be difficult, the suggestion is for synchronisation to be regulated by RTR.
- Another point raised is that the frame structures referred to relate to 4G and are not possible in this form with 5G. In 2018, the TTK should therefore adjust the rules in consultation with stakeholders to the findings of the 5G NR working groups.






Only one participant in the consultation spoke out explicitly against the model with two standard user types, and justified this with the risk of spectrum fragmentation posed by a regional award: that is, the regional broadband providers would purchase varying amounts of spectrum in the different regions and, accordingly, the entire range starting at the lower band limit could therefore become fragmented. This would not further the goal of efficient usage.

3.4 Geographical structuring

Question 5.4: Which types of geographical structuring do you prefer (option 1, 2, 3 or 4)? Please provide business and technical arguments for your preference. Which types of geographical structuring would you disapprove of? Please provide arguments. If you prefer option 4, you are invited to submit proposals for defining the boundaries of rural and urban regions.

The results are shown in the table below (light green refers to a second preference). The mobile telecommunications industry prefers the awarding of nationwide usage rights, while all other consultation participants prefer the awarding of regional usage rights. One group of regional broadband providers prefers option 2 (eight provinces with Vienna and Lower Austria in a single region), while another group prefers a regional model that envisages discrete urban and rural areas (option 3 or 4). Overall, however, most of these participants have no special preference for either model. One participant proposes a regional model with four regions in the event of packaging by region (option 4 but without discrete urban and rural areas). Lastly, some participants recommend a combination of options 2 and 4 with 17 regions (provinces plus cities separate).

Table 4: Number of product categories

Options	Participants
1 (nationwide rights of use)	
2 (Vienna/Lower Austria + 7 other provinces)	
3 (9 provinces + Graz + Linz)	
4 (rural and urban regions)	
Option 3 or 4*	
Alternative proposals	

* Some participants would welcome a (stronger) demarcation between rural and urban regions but express no preference in terms of options 3 and 4.

Arguments raised in support of awarding nationwide usage rights include the following:

- Nationwide-only licences would match the business model of providing mobile telecommunications services nationwide: no distinction could be made between regions or rural and urban areas, since demand peaks would arise across the entire network.
- Major significance of 5G for the national economy: Austria should take the lead here, since this would have positive effects on economic growth and employment. In view of overriding policy goals, every other usage should be subject to this goal – for the regulator to do otherwise would put it at risk and undermine its achievement.
- An alternative usage would have no significant market relevance and be of low economic importance: almost all companies affected are small businesses with modest revenue and employment figures, the market is strongly fragmented, past market development has been unstable and the business model would not offer long-term sustainability. It is argued that providers have failed to achieve significant coverage: Unlike with the LTE rollout, with broadband services they have not contributed to any improvement.
- The fact that other countries award usage rights at a nationwide level was noted, with the UK cited as an example.
- The awarding of nationwide usage rights would be in line with the award goals: Nationwide award would offer legal certainty (simpler procedure and freedom from interference between regions), permit the more efficient usage of frequencies by mobile network operators (since they would operate a far higher number of base stations in each region than regional broadband,

and 5G would be rolled out to the majority of these base stations), promote innovation (since regional structuring is associated with the risk of fragmentation, an obstacle to providing 5G services of a uniform quality nationwide), and would promote connectivity and coverage (since only the nationwide rollout of a homogeneous 3.5 GHz network would offer an economic model capable of reaching thinly populated areas).

- Risk of inefficient assignment: awarding regional usage rights would also entail a risk of national operators being unable to bid and acquire contiguous regional blocks of spectrum, which would result in inefficient frequency usage. One possible consequence could be complications to frequency coordination at regional boundaries, and poor coverage for residents and commuters in border areas.

Arguments raised in support of awarding regional usage rights include the following:

- Nationwide usage would not be a good match for the business model and customer structure of regional broadband providers. Although only 1% to 2% of the population currently has coverage, the affected households in rural areas are those who would need the services of regional broadband providers, since broadband rollout has ground to a halt. In rural areas, FTTH rollout will be minimal, it is argued, and *fixed wireless access technologies* would ideally complement the rollout of fibre optics.
- Efficiency arguments: whether or not business models (of regional broadband providers) are successful should not be decided by the regulator (by the awarding of nationwide usage rights) but by the market. It is argued that there is demand for services offered by regional broadband providers.
- Legal arguments: Awarding nationwide usage rights would discriminate against regional broadband providers and go against the principle of a level playing field for all interested parties.
- Loss of broadband connectivity: Awarding nationwide usage rights would lead to the loss of broadband connections, especially for customers in border regions.
- Obstacles to achieving TTK award goals: failure of customers in marginal areas to participate in broadband and the exclusion of certain groups of providers from the market (*cf. award goal of connectivity and coverage*), lack of equal participation for all parties (*cf. award goal of legal certainty*) and exclusion of certain business models (*cf. award goal of efficiency and competition*).

Some participants expressly reject regional models that envisage the creation of discrete urban and rural areas (options 3 and 4):

- While some regional providers are in agreement with the regulator that demand in rural and urban areas is structurally dissimilar, they simultaneously note that the corresponding options 3 and 4 would not be compatible with their business model and their customer structure.

(Accordingly, those providers propose a model with 17 regions, which combines the partitioning into urban and rural areas with a regional structure based on the provinces.)

- With the creation of urban and rural regions, guard zones would be located on the outskirts of cities and could therefore cover a larger part of the population. Up to 1.7 million residents are cited for option 4 and a guard interval of 15 km, for example.
- As well as residents in the marginal area (around Vienna, for example), commuters would also be affected.
- Concerns exist about the loss of service continuity and fragmentation of 5G services at the urban-rural boundary.

In the event of regional structuring, one mobile network operator would prefer as few regions as possible and proposes a model featuring four regions. This, it is argued, would minimise problems with frequency coordination and poorer coverage in regional border areas. Another mobile provider considers option 2 to be the only regional variant capable of fulfilling the award goals of the regulatory authority at least in part. From a technical and commercial perspective, this model would have the fewest drawbacks (*of all regional models*), as the marginal areas would be largely located in rural areas and would reduce urban/rural boundaries. This would (*compared with options 3 and 4*) offer improved service continuity and would result in less fragmentation of 5G services at the urban-rural boundary.

Some regional broadband providers support the additional proposals submitted to the consultation by the regulatory authority, whereby a stronger demarcation between rural and urban regions is envisaged – as for the auction in Ireland (options 3 and 4). In support of this, it is argued that the demand structure varies between the two types of regions. It is advisable to use frequencies for mobile services in urban areas, it is argued, while in rural areas, where there is less interest in larger operators, support should be offered to smaller operators specialising in FWA products.

3.5 Options for product design

Question 5.5: Which of the following options for product design do you prefer (A.1.1 to B.2.4)? You may also state more than one and include an order of preference (1 = first preference, 3 = third preference).

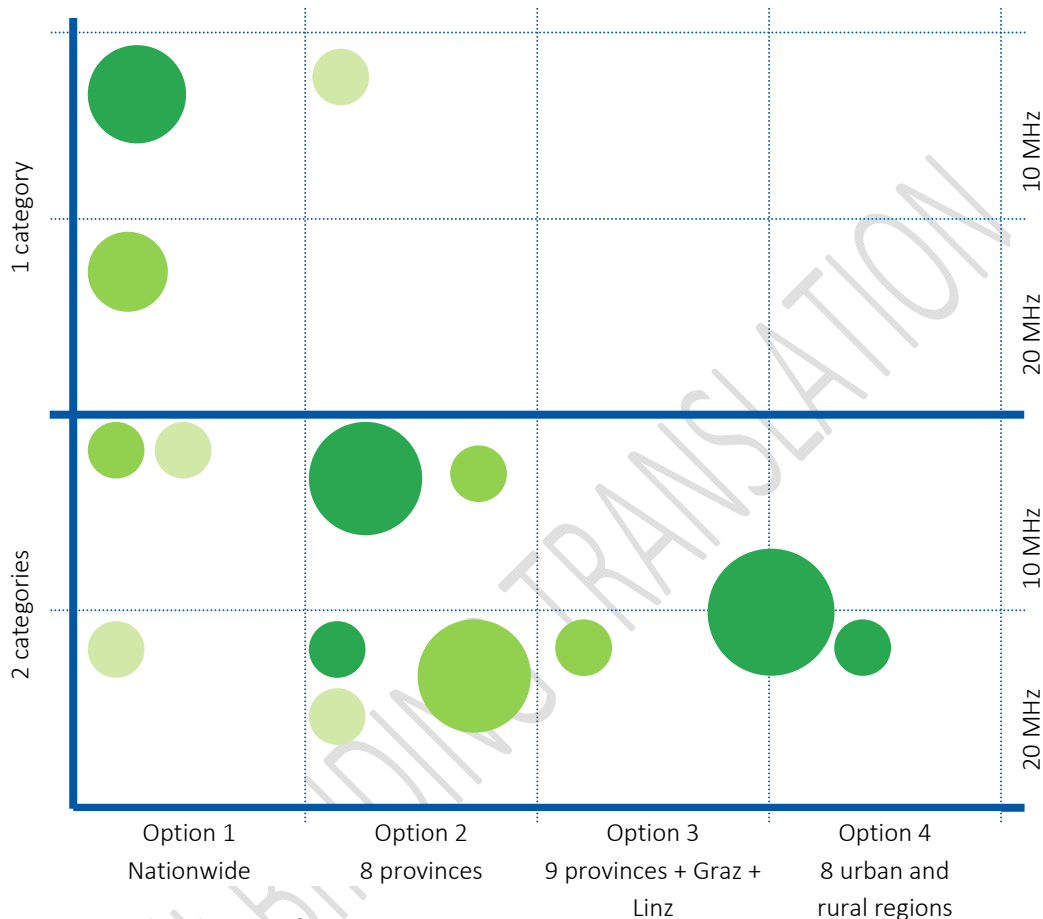


Figure 1: Product design preferences

Figure 1 offers a final overview of the preferences of consultation participants in terms of lot sizes, regional packaging and the number of categories. A darker shade of green indicates a stronger preference, and the circle size reflects the number of participants preferring a certain combination. Three relatively strong preferences can be deduced from this matrix:²

- Nationwide usage rights with a single category and 10 MHz lots
- Regional usage rights as per option 2 (eight provinces, with Vienna part of the Lower Austria region) with two categories and 10 MHz lots

² The regulatory authority double-checked unclear or inconsistent answers with the respective participant and corrected these answers as far as possible. The only combinations shown are those proposed by the regulatory authority in the consultation document.



- Regional usage rights as per option 3 or 4 with two categories, with a slight preference for 20 MHz lots(although the majority of participants in this group has no special preference in terms of lot size)

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4 Other conditions of use

4.1 Period of use

Question 6.1: What is your opinion of the proposed period of use? If you have an alternative proposal, please provide corresponding arguments.

A majority of consultation participants agree with the period of use running to the end of 2039 as proposed by the regulatory authority. Two consultation participants state this period should be the absolute minimum. One consultation participant proposes of a longer period of use running until the end of 2043, citing in support the new legal framework still under negotiation (possibly with minimum period of use of 25 years), the practical limitations in rolling out a very recent standardisation (limited hardware availability and terminal equipment penetration) and the disproportionately greater advantage entailed.

4.2 Minimum bid

Question 6.2: In the event of regional packaging, what rules should the regulatory authority follow in specifying the minimum bid? In the event of nationwide rights of use, what rules should the regulatory authority follow in specifying the minimum bid? Please provide legal and business arguments for the proposal.

Many participants cited the risks involved with high minimum bids. Supporting arguments include the following:

- Minimum bids should not be discriminatory and disadvantage smaller operators. Ultimately, the price should be determined by demand.
- The point was raised that setting the minimum bid too high would render participation impossible on account of economic constraints.
- Noting the intent of the government programme (reduction of frequency costs), frequency costs should not be too high.
- Reference is also made in this context to market developments since 2004 (a fall in ARPU and a rise in data volume paired with no comparable improvements in efficiency, lower intrinsic value versus low spectrum as a result of less favourable propagation characteristics).
- It is argued that the spectrum demand per customer has risen significantly in recent years, and compared with the initial award, frequency costs are now 23 times higher.
- The Telecommunications Fee Ordinance (*Telekommunikationsgebührenverordnung, TKGV*), it is argued, is causing market distortions and unequal conditions, since it does not account for value.
- It is argued that the sum of EUR 16 million for nationwide usage is much too high.

- In the event of a regional award, the differentiation of minimum bids by region (*as per the TKGV*) for a national operator would be problematic, since the costs for the nationwide aggregation of regional licences (*with a minimum bid as per the TKGV's regional differentiation*) would be orders of magnitude higher than the costs for an identical nationwide licence (*with a minimum bid as specified in the TKGV for nationwide usage*).

Proposed approaches to setting the minimum bid figure include the following:

- Setting of the minimum bid solely on the basis of the spectrum fees. An arbitrary approach here would create legal uncertainty and impact the auction result.
- Under no circumstances should the minimum bids be oriented on a business plan or reference values. Valuation should take place within the auction.
- The recommendation is for the minimum bid to be based on the TKGV for a nationwide usage and then pro-rated accordingly for the regions (based on a MHz per resident key or other socio-economic criteria). Any serious bidder should be able to meet this requirement.
- When setting the minimum bid, the macroeconomic potential of the region (MHz, population, number of operators) should be taken into consideration.
- In the event of a nationwide award, the TKGV should be applied.
- In the event of regional packaging, the recommendation is to set the minimum bids on the basis of a TKGV key. While this would not affect the relative price differences (*as per the TKGV*) between the types of region, this would result overall in minimum bids that would be equivalent to a nationwide usage as per TKGV (approx. EUR 16 million). A population-based weighting is rejected, since this would result in a disproportionate distortion.

4.3 Coverage requirements

Question 6.3: Which coverage requirements would you consider effective? Please provide business and technical arguments for your proposal. Please list important parameters of the coverage requirement and explain how they should be selected. How in your opinion should compliance with the requirements be verified?

One group of participants declared its general support for stringent conditions requiring early usage. Appropriate measures should be adopted in the event of non-fulfilment. Mention is made of a *use-it-or-lose-it provision* or a *use-it-or-share-it provision* (under control of the RTR), for example, which is intended to ensure the early use of frequencies in production (e.g. by a second bidder in the auction). It is argued that there is otherwise a risk of individual successful operators not utilising the frequencies in rural areas. For one participant in this group, the basic coverage recommended by the regulatory authority is feasible and attainable (with two years allowed for deployment).

One participant referred to the mature state of competition in Austria, opining that a coverage requirement would need to be enforced only to ensure frequencies do not become objects of speculation.

Reference is made to the high attenuation of the spectrum under discussion, the high level of performance necessary and the high number of locations to be installed – especially in an urban context. Accordingly, general conditions for the rollout are expected to be difficult.

Individual participants reject a specific 5G coverage requirement as presented to them in the consultation as a potentially complementary requirement. One justification offered for this is a preference for using capacity spectrum. This, it is argued, is not neutral: 5G encompasses (*alongside enhanced mobile broadband services*) many other business models such as M2M services. Another argument is that an additional 5G requirement (*for an assignment of 80 MHz and over*) would discriminate against national operators – *compared with regional operators or operators who would buy less than 80 MHz* – and would offer those not affected by this regulation the option of responding with significantly greater flexibility to changes in the market.

One group of participants suggested increasing the (basic) coverage requirement:

- One participant believes that 150 base stations (*basic coverage*) are nowhere near enough and requests a substantially larger number and short-term verification. Nor should there be any restriction of base stations to those to which customers are connected. This, it is argued, cannot be verified.
- One participant recommends a coverage obligation of 1,000 stations (nationwide) with at least 50 stations per province. The stations per province should be oriented on the purchasing power of its population.
- One participant suggests a population coverage of 35% (outdoors) after three years.
- One participant recommends increasing basic coverage to 223 locations in three years and 660 locations in five years (for nationwide usage) or a corresponding number of locations for each region, also noting that a nationwide operator should have a certain degree of flexibility in terms of the minimum number of stations in each region (at least 30% of locations in the region).

One group of participants is in agreement with the regulatory authority's proposal for five to 25 base stations per region.

In terms of the design of the coverage requirement, a few consultation participants refer to the large factor of uncertainty that would be associated with a population coverage requirement and the great effort associated with verifying the fulfilment of this requirement. In light of the above, several consultation participants support a requirement that is based (exclusively) on broadcasting systems. In this context, it is suggested that the stations used for verification should be reported regularly to the

frequency agency, and that a total bandwidth of at least 20 Mbps per 10 MHz of spectrum should be made available per base station – while also taking a 20 MHz guard band into account.

One participant requests a complete revision of the method for measuring population coverage. It is proposed that verification be done using scanner measurements with an outdoor antenna, with data speeds suggested per 100 MHz of bandwidth: 10 Mbps for downlink traffic and 1 Mbps for uplink traffic.

4.4 Sharing

Question 6.4: Which of the infrastructure sharing models could become relevant in the context of this spectrum?

Most operators do not mention any special sharing models in connection with this frequency range. One regional operator calls for the option to share the access network and spectrum. They also note the importance of a fibre optic connection, to ensure that the spectrum can be used appropriately. One mobile network operator calls for cooperation to be able to accelerate the rollout of new technology, particularly in the context of this frequency range. Also important here is equal access to infrastructure, which has limited availability.

Question 6.5: In view of the current position paper, what barriers exist to sharing and how could these be overcome?

First of all, it must be pointed out that the position paper sets barriers and limitations – primarily on sharing between existing mobile network operators.

Passive sharing

A group of regional operators and individual mobile network operators discussed passive sharing. All parties call for passive sharing to be possible at any time. The regional operators also mention the issue of compliance with the provisions of the position paper. One mobile network operator states that merging existing locations does not provide significant cost savings – in the case of future rollouts, however, synergies would almost certainly be created through sharing passive infrastructure.

Active sharing

A group of regional operators insist that there should be no regulatory limitations on active sharing. At the same time, a single member of this group points out that active sharing between regional LTE providers and mobile network operators looking to acquire 5G frequencies is not possible due to differing technologies; even between regional providers with LTE, active sharing is not currently possible due to various products from different manufacturers.

Among the mobile network operators, one finds the current active sharing provision in the position paper to be appropriate. Another sees a development from

infrastructure competition to service competition. Shared networks for legacy technology or for special applications (M2M) should be permitted. The joint operation of networks should be possible in specific zones/areas (tunnels, shopping centres, stadiums, transport routes or areas of low profitability). The impact of active sharing – also in conjunction with spectrum pooling – has been positive in certain countries (Sweden, Denmark).

Another mobile network operator makes a similar argument. They call for MORAN-based active sharing to be enabled, and propose that MOCN-based sharing with transfer or lease of spectrum should be limited to a certain maximum traffic volume. This operator suggests a distinction between existing macro networks and micro networks (indoors, lampposts), which will be increasingly established in the future. In the case of micro networks, infrastructure is often limited. The operator calls for all sharing, including MOCN-based sharing with spectrum pooling, to be unlimited. Furthermore, the (joint) use of the limited available infrastructure should be facilitated for all market participants.

Question 6.6: In view of the licence requirements (refer for example to the multiband auction), what barriers exist and how could these be overcome?

A group of regional operators as well as a single operator are demanding licence requirements that cannot be circumvented by sharing. The licensing requirement should therefore be met using a network operated directly by the provider.

One mobile network operator points to the difficulties involved in satisfying individual requirements and wishes to avoid the requirement to cover individual municipalities.

Another operator is calling for specific guidelines on sharing options and obligations. These are necessary to ensure the legal certainty of the expansion plans. It must be clear which licence requirements can be fulfilled by means of sharing. The coverage requirements of poorly served regions should be specified, and infrastructure sharing must be permitted in these areas for economic reasons.

Question 6.7: In the context of this frequency award procedure, does the requirement regarding an independently operated network limit you in any way in achieving cost-savings or in improving the quality of service? If so, please provide details.

One group of regional operators stated that the requirement for a directly operated network was in no way restrictive for them. The frequencies would be used to provide coverage as an alternative to mobile network operators, or to provide coverage in peripheral areas or areas without cable connections.

Some operators said that hardware could also be sourced from others, including IT hardware, which would be more flexible to implement as a service from a public cloud. The requirement for a directly operated network should not preclude this.

Question 6.8: What potential for spectrum sharing do you envisage? What in your view are the pros and cons of the various models? In this regard the regulatory authority is particularly interested in responses from potential secondary users.

One operator asks only that spectrum sharing be enabled for the rollout. A secondary use would not be practical.

All other operators are essentially open to a leasing model, but have different views when it comes to the details.

One group calls for compulsory leasing at prescribed costs in cases of non-use. One operator points out that this should prevent the hoarding of spectrum in rural areas. Another group believes that leasing is necessary in the long term; but that this could also be implemented under regional providers. Although local spectrum sharing with a service life which is not guaranteed is not an option for newcomers, it would certainly make sense for existing operators already having a network.

One operator only wants a market-based model and rejects all other suggestions. Another considers spectrum sharing to be possible only with limitations in terms of time and space. There should be no obligation to lease to competitors; in any event, it should be possible to restrict the usage options of competitors. Administrative processes are needed to precisely regulate uses not competing with one another; these should be specified in advance, in the tender document for the award.

5 Auction design

The following formats for the award phase were considered as part of the consultation:

- Simultaneous multi-round auction (SMRA)
- SMRA in a hybrid form, involving the use of elements from the clock auction to speed up auction progress (SMRA ch)
- Simple clock auction (SCA)
- ‘Clock plus’ variants, i.e. employing various bid restrictions to reduce the risk of unsold lots (CA+)
- Clock auction with ‘clinching’ (CAwC), format proposed by H3A in which lots are awarded early on in individual clock rounds
- Combinatorial clock auction (CCA)
- Combinatorial multi-round auction (CMRA), first used in the 1800 MHz auction in Denmark

5.1 Auction design – regional packaging

Question 7.1: In the event of regional packaging, which auction format would you prefer? Please give reasons why this format is better suited than the other formats to meeting the award goals. You may also make suggestions for key design parameters. Please provide arguments for your suggestions by referring to the award goals.

In the case of regional packaging, the CCA receives the greatest support, followed by the simple clock auction (see figure below).³

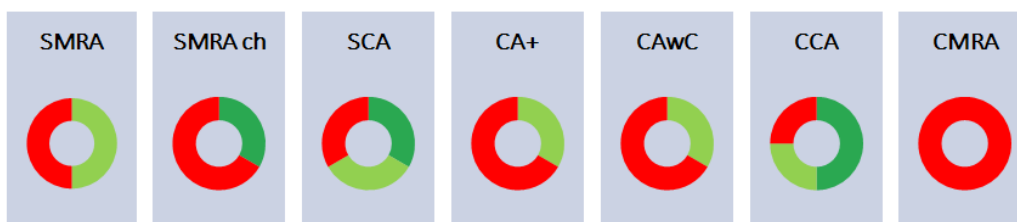


Figure 2: The following auction formats are (un-) suitable in the case of regional rights of use⁴

Some consultation participants give the following requirements for the auction design (listed with decreasing priority):

- Regional award must be possible.
- It must be possible to form two product categories.
- Lot sizes of 10 MHz must not make the procedure too complex.
- Transparency during the auction should meet certain requirements.

³ A description of each format can be found in the annex to the RTR consultation on the 3.4–3.8 GHz award procedure.

⁴ Light green refers to a second preference and dark green refers to a first preference; responses in red represents participants who oppose the procedure.

One group of participants desires a design with favourable conditions and low effort.

The following arguments, among others, are given for the CCA format:

- One participant agrees – *in the case of the present award* – with the opinion of DotEcon, that only a combinatorial procedure is suitable for regional packaging. Only a combinatorial procedure would ensure that a bidder could acquire the same size of spectrum packages nationwide and receive the spectrum at an identical position in all regions. This would avoid the disadvantages of different spectrum positions at regional boundaries. These advantages would outweigh the disadvantages of a combinatorial procedure.
- The CCA allows for the equal participation of all bidders and allows bidders to express their preferences.
- The CCA would cover aggregation risks and substitution risks and reduce the risk of unsold lots arising in the supplementary bid round.
- CCA is now a well-known format.

In terms of design, one consultation participant advocates a CCA with international rules (2013 rules but with the disclosure of the aggregated demand after each round and without the option to relax the bidding restrictions in the sealed-bid stage). One participant, considering the drawbacks of the CCA (complexity, less control over pricing and which bid is ultimately successful), suggests that RTR should counteract these by selecting a suitable design and choosing appropriate parameters (e.g. restricting switching options in order to curtail price gouging).

The following arguments, among others, are made for the SMRA and other non-combinatorial formats (e.g. SMRA ch):

- Such formats offer legal certainty because they are established and well-known formats and each bidder knows what they win and pay in each round.
- Such formats do not disadvantage bidders with budget limits (cited as a disadvantage of the CCA format).
- Such formats would not produce asymmetric prices (which could lead to problems for downstream competition and investment) and thus would not conflict with the TKK's award goals.
- Such formats would not offer an incentive for aggressive bidding behaviour (like the CCA and CMRA formats, for example).
- Such formats are not strategically complex, which would have a positive effect on the efficiency of the result.
- Moreover, even in the case of regional awarding, there would be no aggregation risks justifying in the present auction the use of a combinatorial format.

The regulatory authority believes that there may be considerable differences of opinion with regard to the meaning of aggregation risks. Some participants consider them to be significant (in the opinion of one participant, it is important to purchase packages of the same size throughout the country), while one participant sees no (relevant) aggregation risks. Some of the arguments include:

- There is no risk of interrupted frequency blocks, as generic blocks would be awarded.
- There is no significant exposure risk, since the minimum requirement is already ensured by the block size (10–20 MHz) and is small in relation to the supply and overall coverage of each mobile network operator (taking into account the caps).⁵
- There are almost no complementarities across regional boundaries, as the MNOs would use the frequencies primarily in urban areas in the centre of the region and require only few frequencies for national 5G coverage. The use of WiMax, on the other hand, is not transregional.⁶
- Bidders could control aggregation risk even in a non-combinatorial format.

In the context of regional packaging, one consultation participant proposes two new formats:

- *Simultaneous independent clock auction with clinching* for the award of regional rights of use with homogeneous products
- *Simultaneous independent simple clock auction* for the award of regional rights of use with two product categories

Both formats are characterised by the fact that switching between regions is not possible. The amount of spectrum in a given region that a bidder is allowed to bid on in one round must be less than or equal to the amount of spectrum in the region that the bidder bid on in the previous round.

The simple clock auction variant with package offers proposed in the annex to the consultation also received support. On the one hand, there is direct support for the format. On the other hand, one participant submitted an annex evaluating selected formats (*drawn up by a specialised consulting firm*) into the consultation. In summary, the authors come out against the CCA and CMRA but in favour of the simple clock auction (*with package bids*), *clock plus variants*, the hybrid SMRA or the format used in the *US incentive auction*. These formats are claimed to offer advantages, for bidders with budget restrictions and in terms of legal certainty, asymmetric prices and strategic bidding. It is noted that the minimal aggregation risks entailed in this auction can be controlled by bidders. The concern that blocks could remain unsold for strategic reasons (*to buy them at lower cost in the next auction*) is shared.

Question 7.2: In the event of regional packaging, which auction formats would you oppose? Please give reasons why these formats are not well suited to meeting the award goals.

⁵ In a statement submitted later, it is made clear that a minimum bandwidth of 100 MHz of continuous spectrum is considered necessary in order to use this frequency band efficiently.

⁶ In a statement submitted later, it is pointed out that trans-regional, continuous frequencies are important – for this reason, the regional award of frequency packages is generally extremely risky in terms of complexity and is associated with a negative impact on political and economic goals. Nevertheless, it is believed that SMRA is the right auction format even for the regional award of frequency packages.

All formats also receive negative criticism (cf. Figure 2). The following arguments, among others, are brought against the CCA and CMRA formats:

- Legal uncertainty (high uncertainty about the result in the case of CCA; the CMRA format, on the other hand, is untested)
- Disadvantages for bidders with budget limits (CCA)
- Asymmetric prices are possible in the case of CCA and CMRA formats (this, in turn, would affect downstream competition and investment).
- Both formats offer incentives for aggressive bidding behaviour.
- Both formats are strategically complex (which would adversely affect efficiency).
- As a result of the disadvantages, all major award goals would be undermined.
- The aggregation risk is of very low importance (therefore it is not necessary to use a combinatorial procedure).
- The CMRA format is highly complex (in particular, because of the potentially high number of additional bids in each round), producing undesirable bidding incentives and extremely uneven results. The format is therefore not consistent with the design goals of simplicity and risk minimisation.
- The CMRA format is new, untested, has not been sufficiently analysed and lacks theoretical underpinnings.
- The CMRA would provide additional opportunities for strategic bidding and would be prone to producing non-optimal assignments.
- The complexity of the CMRA format increases dramatically in the case of regional awarding.

An argument brought against non-combinatorial formats (such as the SMRA) is that such formats complicate the acquisition of large, contiguous spectrum blocks across regional boundaries.

An argument brought against the SCA format is that it allows for rogue bidders to make virtually risk-free bids with the intention of driving up prices, which is why it is only very rarely used worldwide. One participant rejects the SCA format by making reference to the analyses in the consultation document.

With regard to the CAwC, it is pointed out that this format has never before been used in a spectrum auction and is clearly defined for use only with a single category. The participant comes out against any sort of experiment in this context.

Based on similar grounds, one participant comes out against the SMRA ch, referring to consultation input in the UK (problems related to a minimum spectrum requirement, waivers, withdrawals, overbidding of a party's own standing high bids, and transparency).

5.2 Auction design – nationwide rights of use

Question 7.3: In the event that nationwide rights of use are awarded, which auction format would you prefer? Please give reasons why this format is better suited than

the other formats to meeting the award goals. You may also make suggestions for key design parameters. Please provide arguments for your suggestions by referring to the award goals.

In the case of nationwide rights of use, a decision must be made for preferred and rejected formats as to whether one or two product categories will be formed.

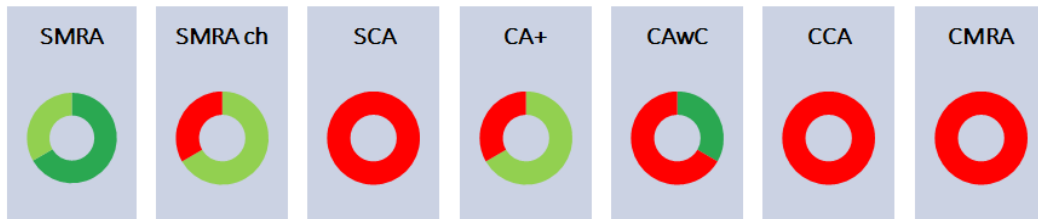


Figure 3: The following auction formats are (un-) suitable for nationwide rights of use with one category⁷

In the event that only one product category will be formed, the SMRA format receives the greatest support (cf. Figure 3). In the event that two product categories are formed, the CCA format receives the greatest support (cf. Figure 4).

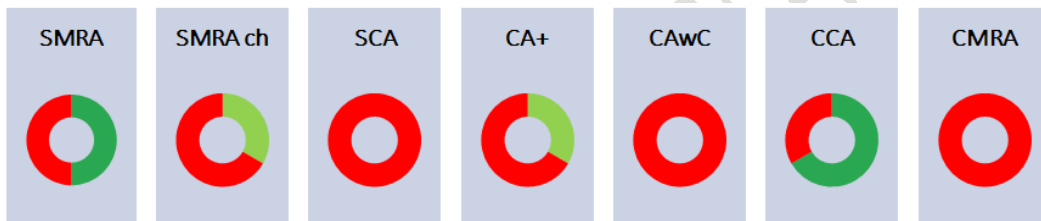


Figure 4: The following auction formats are (un-) suitable for nationwide rights of use with two categories

A majority of consultation participants indicate that they will not participate in the assignment of nationwide rights of use at the auction and once again express their support in this regard for the assignment of regional rights of use.

The arguments put forward for the SMRA format (or a related format such as the hybrid SMRA) are essentially in line with the arguments raised in favour of the SMRA (or a related format such as the hybrid SMRA) in the event of regional packaging. The same applies to the reasons why there are no significant aggregation risks (see section 5.1.).

The following arguments, among others, are given in favour of the CAwC format (for homogeneous products and thus for a single category):

- Procedure is simple and does not introduce any particular complexity.
- Bidders have full control over pricing and bidding.
- The format allows for equal participation (thanks to its simplicity). Regional operators could join a consortium.

⁷ Light green refers to a second preference and dark green refers to a first preference; responses in red represents participants who oppose the procedure.

- There is no incentive for strategic bidding.
- There is no incentive for strategic demand reduction (and, as a result, there is a reduced risk of unsold lots).
- There is no substitution risk.
- The aggregation risk was mentioned as a disadvantage. However, this is rated as small due to the sufficient number of products. Each bidder should be able to acquire a minimum amount.

The following arguments, among others, are given in favour of the CCA format (in the event that two categories are formed):

- Non-contiguous spectrum blocks in two bands cannot be used as efficiently as contiguous spectrum blocks (according to manufacturers). Such fragmentation would therefore contradict the award goal of efficient spectrum use (*award goal 2*).
- Two categories would therefore present unacceptable aggregation risks, thus justifying the use of a combinatorial format.

In this case, one consultation participant advocates a CCA with international rules (framework of rules from the 2013 multiband auction but with the announcement of the aggregated demand after each round and without the option to relax the bidding restrictions in the sealed-bid stage).

The simple clock auction variant with package offers proposed in the annex to the consultation also received support. One consultation participant introduced an annex evaluating selected formats (*drawn up by a specialised consulting firm*) into the consultation. In summary, the authors come out against the CCA and CMRA but in favour of the simple clock auction (*with package bids*), *clock plus variants*, the hybrid SMRA or the format used in the *US incentive auction*. These formats are claimed to offer advantages, for bidders with budget restrictions and in terms of legal certainty, asymmetric prices and strategic bidding. It is noted that the minimal aggregation risks entailed in this auction can be controlled by bidders. The concern that blocks could remain unsold for strategic reasons (*to buy them at lower cost in the next auction*) is shared.⁸

Question 7.4: In the event that nationwide rights of use are awarded, which auction formats would you oppose? Please give reasons why these formats are not well suited to meeting the award goals.

All formats – with the exception of the SMRA format in case of the award of nationwide rights of use with a single category – also received negative criticism (cf. Figure 2). The arguments brought here against the CCA and CMRA formats are generally the same as those cited against the CCA and CMRA formats in the event of regional packaging (cf. 5.1).

⁸ This is not taken into account in Figure 3 and Figure 4.

However, it is also argued that, in the case of an auction with two product categories, unacceptable aggregation risks would count against a non-combinatorial format (such as the SMRA). There would be a risk of ‘getting stuck’ within non-contiguous spectrum blocks in two bands.

In the case of an auction with one product category, on the other hand, there are no arguments in favour of a combinatorial format. Without different product categories and regions, there is no reason for a combinatorial procedure (*with greater complexity*).

An argument brought against the SCA format is that it allows for rogue bidders to make virtually risk-free bids with the intention of driving up prices, which is why it is only very rarely used worldwide. One participant rejects the SCA format by making reference to the analyses in the consultation document. With regard to the CAwC, it is pointed out that this format has never before been used in a spectrum auction and is clearly defined for use only with a single category. The participant comes out against any sort of experiment in this context. Based on similar grounds, one participant comes out against the SMRA ch, referring to consultation input in the UK (problems related to a minimum spectrum requirement, waivers, withdrawals, overbidding of a party’s own standing high bids, and transparency).

5.3 Auction design – assignment stage

Question 7.5: Do you agree with the regulatory authority’s conclusion that a method similar to that used in the last two auctions (2.6 GHz and multiband) should be used for the assignment procedure? If not, please give your reasons and indicate a suitable alternative procedure by referring to the award goals.

The assignment stage design proposed in the consultation document, and which was used in the last two TKK auctions (*sealed-bid second-price auction*), was consistently well received. It is noted that this design ensures that bidders receive a contiguous spectrum and thus excludes major aggregation risk. Separating the award and assignment stages would simplify the award stage.

Some reservations were raised against the possibility of forming a consortium in the assignment stage (*as in Ireland*).

Question 7.6: Do you have any comments or recommendations related to defining assignment options?

The following suggestions were made in relation to assignment options:

- The rules for minimising band position variations (as in Ireland) are supported.
- It is proposed that bidders with identical spectrum for nationwide use be placed at the ends of the respective band and all others be positioned at the middle or at the lower end of the spectrum near band 43 (as in Ireland).

One consultation participant disagrees with the priorities for determining assignment options:

- It puts too much emphasis on different user types.
- Allocation into two categories complicates the auction design: firstly, this is unnecessary, and secondly, the main focus would no longer be on creating the largest blocks possible, which is a central requirement for 5G.
- Against this background, two principles are proposed: the primary goal should be contiguous spectrum, while the second priority should be to minimise the differences in frequency coverage across regions.

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5.4 Summary

The following figure summarises the proposed auction formats according to the selected product design.

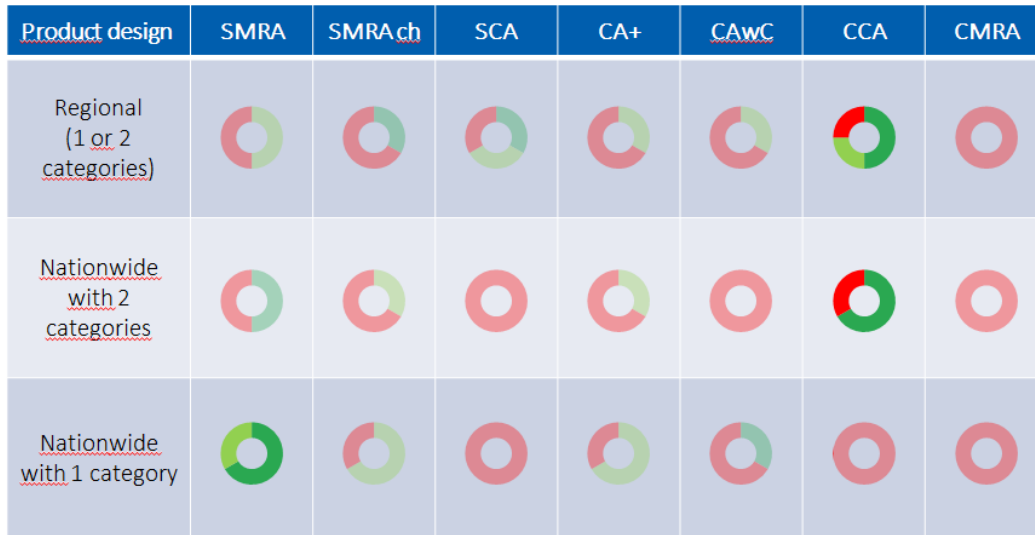


Figure 5: Summary of consultation input on auction formats⁹

In the event of regional packaging or in the event that more than one category is formed, the CCA format receives the greatest support. In the event of nationwide rights of use with one category, the SMRA comes out on top.

5.5 Measures safeguarding competition

Question 7.7: Do you agree with the regulatory authority's evaluation concerning potential competition challenges? Please provide business arguments as to why you consider these challenges to be relevant or irrelevant, referring to facts and figures to support the arguments.

A number of consultation participants disagree with the analysis of the potential competition challenges, arguing that crowding out regional broadband providers must be seen as a relevant competitive issue. They state that this competition challenge should be prevented by appropriate measures. Measures mentioned include much tighter caps as well as the reservation of spectrum for regional broadband providers, as is planned in Germany, for example. Regional broadband providers are a major factor in remote locations and for business customers. In this context, participants highlight the need to supplement the fibre optic rollout with FWA technologies and the accompanying coverage of under-served rural areas by 3.5 GHz providers.

One consultation participant sees a competition challenge not only in the context of crowding out regional broadband providers, but also in preventing newcomers. Both reinforce a tight oligopoly and favour the business model of MNOs, with the result

⁹ The CMRA format is no longer considered here.

that the spectrum would be hoarded, rural expansion would suffer, and no disruptive innovations would be possible.

Two consultation participants stress that they would agree with the regulatory authority's evaluation concerning potential competition challenges.

One participant notes that concern about intermodal competition is not just theoretical. The mismatch between traffic and operator resources confirms this.

None of the consultation participants put forward any counterarguments against the three identified potential competition challenges.

The following additional comments were made about the three potential competition challenges:

- Additional considerations on potential competition challenge 1:
 - Each bidder should be given the opportunity to purchase at least 100 MHz.
 - When using the CCA format, the maximum proportion that bidders in the 3400–3800 MHz range can purchase should be 43% (avoidance of knock-out bids); for a *clock auction with clinching*, the maximum share should be (*higher, but still*) less than 50%, as otherwise the number of products awarded for the minimum bid would be too high.
- Additional consideration on competition challenge 2:
 - To avoid strongly asymmetric frequency coverage, a cap of 40% of the total spectrum is suggested – provided this does not restrict the supply.
- Additional consideration on competition challenge 3:
 - The introduction of asymmetric caps would be justified so that a (*pure*) MNO could compete in intermodal competition with the fixed network.

Question 7.8: Of which of the eight options for measures to ensure competition are you in favour or not in favour? Please give reasons why the options meet or fail to meet the stated requirements applying to regulatory measures?

All but three consultation participants were in favour of option 8 (spectrum cap of 100 MHz) (cf. table below). Some participants believe that if it is not possible for regional broadband providers to reserve spectrum, the caps should be chosen so that at least one regional broadband provider (*in each region*) has the opportunity to acquire frequencies. With the caps currently under consideration, it is expected that the MNOs will acquire the full spectrum. At caps of 80–100 MHz, at least 90 MHz will remain for regional broadband providers. For this reason, they are clearly in favour of option 8. One participant notes that no bottlenecks for MNOs are to be expected

at caps of 100 MHz; if bottlenecks do occur it would only be in cities, where they could be remedied by frequency exchange. Given the importance of rural areas, some consultation participants suggest reserving a 100 MHz block for existing regional broadband providers, with a 60 MHz cap within this range and a 100 MHz cap for the remaining frequencies.

Table 5: Spectrum cap preferences

Cap options	Participants
1: 260 MHz for all	
2: 180 MHz for all	
3: 180 MHz for all, 140 MHz for A1	
4: 160 MHz for all	●
5: 160 MHz for all, 140 MHz for A1	●
6: 140 MHz for all	●
7: 120 MHz for all	
8: 100 MHz for all*	●●●●●●●●●●

* Some consultation participants suggest reserving a 100 MHz block for existing regional broadband providers, with a 60 MHz cap within this range and a 100 MHz cap for the remaining frequencies.

Options 4 (160 MHz for all), 5 (160 MHz for all, 140 MHz for A1) and 6 (140 MHz for all) each received the vote of one consultation participant.

The following arguments were brought against asymmetric caps:

- Symmetric caps would be sufficient to prevent competition challenges 1 and 2.
- Asymmetric caps would lead to strategic bidding and inconsistent prices in the auctions.
- Asymmetric caps would be justified only in the case of asymmetric spectrum distribution. This is not the case in Austria: each provider has a critical minimum bandwidth, while the coverage as measured by number of customers is comparable.
- According to the RTR consultation document, asymmetric caps are disproportionate.

The following arguments were made in favour of asymmetric caps:

- To avoid strongly asymmetric frequency coverage, a cap of 40% of the total spectrum is suggested – provided this does not restrict supply.
- Concern about intermodal competition is not just theoretical, but is apparent in the (high) ratio of traffic to resources.

The following arguments were made in favour of tighter caps than those suggested by the regulatory authority (140 MHz for all):

- Caps of 140 MHz increase the chance of all operators getting as large a 5G block as possible, which prevents any one provider from gaining significant market power
- Caps larger than 140 MHz would increase the risk of two bidders jointly pushing a bidder out of the market by preventing the acquisition of a sufficiently large block (*coordinated approach*).

With regard to caps tighter than 140 MHz, it was argued that these would restrict spectrum competition and indirectly lead to spectrum reservation.