APPENDIX E

NON BINDING TRANSLATION

3.4–3.8 GHz Award

Auction Rules

Draft version – February 2018

1 General information

Overview

1. Total spectrum of 390 MHz in the 3410 MHz to 3800 MHz range is to be auctioned off. The available spectrum, divided into blocks of 10 MHz each, will be auctioned off by region.

2. The auction uses the format of a simple clock auction to determine the amount of spectrum that successful bidders receive in each region (principle stage). This is followed by a sealed bidding round in which winners of spectrum submit bids for various combinations of specific frequency blocks, thereby enabling the mutually compatible assignment of contiguous spectrum to the winners of spectrum in each region (assignment stage).

3. The ***principle stage*** consists of a series of open bidding rounds (clock rounds) in which the auctioneer sets a price per frequency block in each region (clock price) and bidders specify in their bid the number of blocks they desire at the respective clock prices offered. If the demand for blocks aggregated across all bidders exceeds the supply available in at least one region, then the auctioneer increases the price per block in all regions with excess demand and holds a subsequent clock round. The clock rounds end once the aggregate demand does not exceed the supply available in any region. Bidders win the blocks they requested in the last clock round in the respective region and at the respective clock price (or alternatively, in the event of exit bids, at the lowest price specified in an accepted exit bid). If any blocks remain unawarded following the last clock round, the unsold blocks are offered in a separate sealed bidding round, in which the bidders with the highest bids are successful and win the blocks for the amount specified in their respective successful bids.

4. Applicants may take part in the principle stage of the auction procedure if they have not been excluded from the spectrum award procedure as specified in Art. 55 Par. 8 of the Telecommunications Act (TKG 2003).

5. The maximum amount of spectrum that a bidder may acquire at auction is limited by:

   a) the spectrum caps set by the Telekom-Control-Kommission (TKK) on the one hand (see also chapter **[●X]** of the tender documentation); and by

   b) the bidding restriction pursuant to paragraph 33(c) and paragraph 55 (c) as set by the security provided by the bidder (see also chapter **[●X]** of the tender documentation).

6. The *assignment stage* consists of a single sealed bidding round in which the bidders place bids for the assignment options determined for them by the auctioneer. Winning bids in the assignment stage are identified by determining the combination of bids with the highest total value that enables the mutually compatible assignment of spectrum in each region. The winners receive the actual frequency blocks contained in their respective winning bids at what are termed 'additional prices', which are calculated on the basis of a modified *second price rule*. The assignment stage of the auction procedure is open to all applicants who were successful in the principle stage and acquired abstract frequency blocks for which more than one assignment option exists.

7. The total price to be paid by a successful bidder is calculated as the sum of the bidder's successful bids during the principle stage plus the additional price.

8. The auctioneer is the TKK or a member as commissioned by that body. The TKK may also entrust the handling of the auction to members of the Telecommunications Division of the Austrian Regulatory Authority for Broadcasting and Telecommunications (RTR).

Bids and bid submission

9. All bids are submitted electronically via auction software. The process for bid submission is described in detail in the auction software user guide, which will be provided to bidders in good time before the commencement of the principle stage.

10. The submission of bids by telephone is permitted in exceptional cases only (such as in the case of technical problems occurring that prohibit bid submission via the auction software). It is for the auctioneer to decide whether such an exceptional case applies.

Collusion and cancellation of the procedure

11. Any coaction of applicants or the applicants' shareholders, whether direct or indirect, with the intent of influencing the course or result of the auction (collusive behaviour) is prohibited. Collusive behaviour on the part of applicants before or during the auction procedure can lead to their exclusion from subsequent stages of the procedure (Art. 55 Par. 9 TKG 2003). The auctioneer is entitled to take all suitable measures to prevent collusive behaviour.

12. Other potential grounds for exclusion from the procedure include threats against competitors as well as disclosure of participation in the auction, of bids, or of bidding strategies, even prior to the auction procedure.

13. In this context, reference is also made to the provisions of general competition law and to Art. 168b of the Austrian Criminal Code (StGB).

14. The TKK is entitled to cancel the auction procedure if it discovers collusion between applicants and an efficient, fair and non-discriminatory procedure cannot be conducted (Art. 55 Par. 12 No. 1 TKG 2003), or if there are other important reasons that endanger the proper and correct organisation and completion of the auction procedure. In such cases, the TKK will decide whether the procedure should be terminated in accordance with chapter **[●X]** of the Tender Document or whether a new auction date should instead be set.

2 Auction products

15.   The available frequency blocks are offered separately in the following regions (for a more detailed description of the regional demarcations, see chapter **[•X]** of the tender documentation).

Table 1: Overview of regions

Label	Name	Description[1]
A01u	Region 1 urban	Vienna and St Pölten
A01r	Region 1 rural	Vienna, Burgenland and Lower Austria except A01u
A02u	Region 2 urban	Linz and 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, Dornbirn
A04r	Region 4 rural	North Tyrol and Vorarlberg except A04u
A05u	Region 5 urban	Graz, Villach, Klagenfurt
A05r	Region 5 rural	Styria and East Tyrol and Carinthia except A05u

16.   A total of 39 blocks, each of 10 MHz of bandwidth, are available in each region. To designate the specific assignment options at the assignment stage, these blocks are numbered consecutively as L01–L39, starting at the lower end of the frequency range. Accordingly, the block with the designation A03uL01 refers to the 3410–3420 MHz frequency range in the A03u region (City of Salzburg).

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[1]   Adjoining municipalities are also incorporated into certain urban regions. The detailed list of municipalities in each region can be viewed in the Tender Document.

17. The clock prices for the first round of the auction procedure correspond to the minimum bids listed in Table 2 below for a single frequency block in the respective region:

Table 2: Minimum bids for the frequency blocks to be auctioned

Region label	Minimum bid
A01u	€ [●]
A01r	€ [●]
A02u	€ [●]
A02r	€ [●]
A03u	€ [●]
A03r	€ [●]
A04u	€ [●]
A04r	€ [●]
A05u	€ [●]
A05r	€ [●]

3 Spectrum caps

18. To safeguard competition in downstream markets, there is a limit (spectrum cap) placed on the total number of blocks that a bidder may acquire by auction in a single region.

19. The limits that apply for the clock rounds are summarised in the table below (see also chapter [●X] of the tender documentation).

Table 3: Overview of the spectrum caps applying in the clock rounds

Region label	Spectrum cap
A01u	
A01r	
A02u	
A02r	
A03u	
A03r	
A04u	
A04r	
A05u	
A05r	

20. If frequency blocks remain unawarded after the last clock round and an additional bidding round is held, it is at the discretion of the auctioneer to loosen the caps for individual bidders or all bidders. If the auctioneer decides to loosen caps, the maximum caps listed below apply in any case to the spectrum acquired by the specified bidders during the entire principle stage (i.e. clock rounds and additional bidding round) (see also chapter [●X] of the tender documentation):

Table 4: Overview of loosened spectrum caps

Region label	Spectrum cap for the entire principle stage
A01u	
A01r	
A02u	
A02r	
A03u	
A03r	
A04u	
A04r	
A05u	
A05r	

4 Principle stage

21. The principle stage consists of one or more clock rounds, possibly followed by an additional bidding round in the eventuality that unsold frequency blocks remain after the last clock round.

Clock rounds

22. A clock round is a period of time set by the auctioneer within which bidders submit their bids; a clock round may be extended by a bidder exercising a right to extend a round (see paragraph 47).

23. The scheduling of clock rounds is at the discretion of the auctioneer. In particular, the auctioneer may schedule the round duration and the time between the rounds as is considered appropriate to ensure the proper and expeditious completion of the auction. However, it is not envisaged that a clock round should last less than 15 minutes or more than two hours.

24. Clock rounds will not start before 9 am and not after 6 pm on normal working days in Austria. While no limit is placed on the number of clock rounds per day, it is not envisaged that more than eight clock rounds should be held per day.

25. The auctioneer informs bidders of the start of a clock round at least 15 minutes before the round is due to start. At the same time, the auctioneer provides each bidder with the following information:

    a) The length of the planned clock round.

    b) The clock prices for each region.

    c) The total number of frequency blocks requested by the bidder in the previous clock round.

    d) The maximum bid amount resulting from the bank guarantee provided by the bidder.

    e) The number of round extension rights remaining to the bidder.

26. At the end of each auction day, the auctioneer also informs bidders about the provisional round plan for the following day. This information is non-binding and the auctioneer may elect to hold fewer rounds than the number originally planned. The number of rounds

actually completed may also be reduced as a result of bidders exercising their round extension rights. The number of rounds held on an auction day never exceeds the number announced by the auctioneer the day before.

Clock prices

27.   In each clock round, the auctioneer sets a price per frequency block for each region (the clock price). The clock prices in the first clock round are equivalent to the minimum bids listed in Table 2. In each subsequent clock round, the clock price increases for each region in which, based on the clock bids submitted in the previous round, the total demand for frequency blocks exceeds the supply available by a price increment set by the auctioneer. Clock prices remain unchanged for regions in which there is no excess demand.

28.   The setting of price increments is at the discretion of the auctioneer. Price increments may vary across the individual regions and may be specified as a percentage increment or as an absolute increment (in addition, clock prices may, if required, be rounded up to the next multiple of EUR 1,000).

29.   The auctioneer will set the price increments so as to ensure that the auction completes in an orderly and expeditious fashion. However, the clock price will not increase from one clock round to the next by more than 15%.

30.   At the end of each auction day, the auctioneer informs bidders about the increments planned for the next auction day; this information is non-binding. Since this information is non-binding, the auctioneer may choose to set the increments at a lower level than announced if this would appear to improve the efficiency of the procedure (although such deviations typically do not lead to a situation where the clock prices rise more quickly than anticipated by the bidders based on information in advance.)

31.   If there is excess demand in at least one region, on the basis of the clock bids submitted in the respective clock round, the auctioneer announces a subsequent clock round. The clock rounds end once the demand as aggregated for the clock bids of all bidders does not exceed the supply available in any region.

Clock bids

32.   In each clock round, bidders specify the number of frequency blocks they wish to acquire for each region at the respective clock prices (clock bid).

33.   In submitting clock bids, bidders are subject to the following restrictions:

   a) For each region, the number of blocks requested may not exceed the maximum quantity applicable for the respective bidder and respective region after applying the spectrum caps (see chapter 3).

   b) From the second clock round, the total number of frequency blocks requested across all regions may not exceed the total number of frequency blocks requested in the previous clock round.

   c) The bid value of the clock bid, namely the sum of the clock prices for all blocks requested, may not be more than 200% of the security provided by the respective bidder (for other conditions governing the securities provided for bids see chapter **[●X]** of the tender documentation). Each bidder is individually responsible for increasing the security provided in good time in order to more easily meet this restriction.

Exit bids

34.   If a bidder reduces the total number of frequency blocks requested across all regions in comparison with the previous clock round, then this bidder may also place one or more exit bids in addition to the clock bid. Exit bids offer bidders the opportunity to state the concrete prices at which they reduce their demand within individual regions.

35.   Specifically, bidders may submit exit bids for each region in which they have reduced their demand, and, for each reduction step, specify the price at which they thereby reduce their demand. The maximum number of exit bids in a round therefore depends on the number of regions in which individual bidders have reduced their demand and the extent to which they have done so.

36.   The formal definition of exit bids is as follows:

   a) Let   be the number of lots in a specific region in the bidder's clock bid in round   and let p_t be the corresponding clock price.

b) For a region in which $n_t > n_{t+1}$, an exit bid is a price-quantity pair (p_e, n_e) with $p_{t+1} > {}_e \geq p_t$ and $n_{t+1} < n_e \leq n_t$ that giver the maximum price p_e at which the bidder n_e would request lots.

c) If a bidder reduces the demand in a region by m blocks, that bidder may submit multiple exit bids $(p_e^1, n_e^1) \ldots (p_e^m, n_e^m)$, for that region, whereby $n_e^i > n_e^j \implies p_e^i \leq p_e^j$, meaning that the demand expressed by the exit bids may not increase with an increasing price.

37. Within one region, exit bids may be extended by the bidder provided that:

a) the clock price in that region does not increase later in the auction; and

b) the bidder does not further reduce the bidder's demand in that region.

If a price increase occurs in a region – and therefore excess demand arises on the basis of clock bids – then all exit bids placed for that region become void. In the same way, all exit bids from bidders become void in a region in which those bidders further reduce their demand.

38. Extending an exit bid requires an explicit decision by the bidder and does not occur automatically. To further clarify this point: exit bids cannot be altered and cannot be selectively extended within a region (accordingly, if bidders have reduced their demand in a round by more than a block and subsequently placed several exit bids, those bids can then be extended only collectively but not singly.)

39. Exit bids play no part in the determination of demand and are taken into account only if excess supply is present following the last clock round in the region for which they were submitted, and only to an amount equal to or smaller than that excess supply.

End of clock rounds

40. The final clock round is the round at the end of which the demand, aggregated as the clock bids from all bidders, does not exceed the supply in any region.

41. In every region in which the demand, aggregated as the clock bids from all bidders, exactly matches the supply available, the bidders win the number of frequency blocks that they have requested. The price at which each block is awarded is the current clock price in the respective region.

42. If the demand, aggregated as the clock bids from all bidders, is less than the supply available in a region, then the following provisions apply:

43. The auctioneer decides whether the exit bids submitted or extended in the last clock round can be used to assign the excess lots. The following provisions apply here:

   a) The auctioneer considers all exit bids of a bidder that, together with the demand as expressed in the successful clock bids, result in a total number of frequency blocks that is not larger than the total number of blocks requested by this bidder in the clock round preceding the round of the oldest exit bid still valid.

   b) If exit bids from separate bidders could be considered, or if for a single bidder there are multiple combinations of exit bids which could potentially be considered, the auctioneer identifies the combination of exit bids that generates the largest overall value. If several combinations could each generate this largest overall value, the combination is decided at random.

   c) For regions in which exit bids are considered, the price at which a lot is awarded to any winner is the lowest price specified in an accepted exit bid.

44. If this does not result in the assignment of all lots and some frequency blocks therefore remain unsold at the end of the clock rounds, these are offered in an additional bidding round.

45. Examples for the clock rounds procedure and the determination of prices at which lots are awarded with exit bids are given in Appendix E-2.

Round extension rights

46. Each bidder is granted three round extension rights at the start of the clock rounds.

47. If a bidder with remaining round extension rights has submitted a clock bid for more than one frequency block in the previous clock round but does not submit a clock bid in that round within the round time set by the auctioneer, then the round is automatically extended by up to 30 minutes. While this costs the individual bidder a round extension right, the bidder thereby gains extra time to submit a bid.

48. Any round in which one or more bidders have exercised a round extension right ends no later than 30 minutes after the normal end of the round or, alternatively, when all bidders who have exercised a round extension right in that round have successfully submitted a bid.

49. Bidders who have submitted a bid during the prescribed round time may not use the additional period of time to revise their submitted bid. Bidders who have no further extension rights available and who did not place a bid in the prescribed round time may not submit a bid in the extension period. A zero bid is entered automatically for such bidders, i.e. a clock bid with zero demand in every region.

50. Each bidder may exercise no more than one round extension right per round.

Information at the end of clock rounds

51. At the end of each clock round, the auctioneer provides each bidder with the following information:

    a) for each region, whether excess demand exists and if that is the case, whether the excess demand amounts to less than five frequency blocks, lies between five and ten frequency blocks, or whether the excess demand involves more than ten blocks;

    b) if any excess supply exists in the region, the amount of that excess supply;

    c) the clock bids submitted by that bidder and the corresponding total number of frequency blocks across all regions;

    d) the value of the clock bid and the degree to which that value exceeds the bank guarantee provided by the bidder;

    e) any exit bids submitted; and

    f) the number of round extension rights remaining to the bidder.

52. At the end of the last clock round, the auctioneer provides each bidder with the following information:

    a) the number of frequency blocks awarded to the bidder in the respective region and the price at which awarded;

    b) whether unsold lots exist and an additional bidding round will therefore be held;

    c) in the event of an additional bidding round, the start time and the duration of that bidding round, plus the minimum bids applicable to each of the unsold blocks and whether spectrum caps are being loosened; or

d) otherwise, the number of frequency blocks won by all bidders in each region, as well as the date and time scheduled for the start of the assignment stage – which may not take place until after a ten-day waiting period.

Additional bidding round

53. If unawarded frequency blocks remain in one or more regions after the last clock round, then these are offered in an additional bidding round. In this case, the auctioneer may decide to loosen spectrum caps and to apply caps as given in Table 4.

54. The auctioneer sets a minimum bid per block for each region in which blocks are available for the additional bidding round:

    a) If the auctioneer decides to loosen caps, then the minimum bid is the same as the last clock price.

    b) If it is not necessary to loosen the caps, then the minimum bid is the same as the clock price for the last clock round in which all bidders together requested at least **[●number of regions * 39]** frequency blocks.

55. For each unsold block, bidders then state a price at which they wish to acquire that additional block. This price may not be less than the minimum bid. In addition, the following restrictions apply:

    a) Each bidder may place bids for as many blocks in a region as is permitted by the applicable spectrum cap.

    b) The total value of all bids submitted and the price at which lots were awarded for the blocks assigned after the last clock round may not exceed 200% of the security provided by the respective bidder. Each bidder is individually responsible for increasing the security provided in good time in order to more easily meet this restriction.

56. Bids are submitted using the auction software and must be received within the round time set by the auctioneer. There are no round extensions in this bidding round.

57. After the end of the round, the auctioneer sorts in descending order the bids received for blocks in each region. If bids of the same value are received, these are first sorted in ascending order by the number of blocks already awarded to the bidder in the region and then in ascending order by the number of frequency blocks awarded to the bidder in total,

and then at random (the approach for bids of the same value is therefore to first give preference to bidders who acquired less spectrum following the last clock round and then to bidders who have been awarded less spectrum overall). The auctioneer then accepts the highest-ranking bids that can be satisfied with the number of frequency blocks available within the region in the additional bidding round.

58. Successful bidders pay the price for their successful bids.

59. At the end of the additional bidding round, the auctioneer provides each bidder with the following information:

   a) The number of additional frequency blocks awarded to the bidder in the respective region and the winning price.

   b) The total number of frequency blocks awarded to the bidder in each region.

   c) The number of frequency blocks won by all bidders in each region in the principle stage, as well as the date and time scheduled for the start of the assignment stage – which may not take place until after a ten-day waiting period.

5 Assignment stage

60. The goal of the assignment stage is to determine how the available frequencies are to be distributed among the winners of the principle stage and which final price the winners should pay for the spectrum that they have won. The assignment stage comprises a single sealed bidding round in which the bidders place bids for the assignment options relevant to them.

Bidder alliances

61. Winners of frequency blocks may form bidder alliances to participate at the assignment stage, subject to these conditions:

     a) the total quantity of frequency blocks won by a bidder alliance during the principle stage must not exceed the spectrum cap that applies to the most limited member of this bidder alliance; and

     b) a winner may be a member of only one bidder alliance.

     The detailed provisions for forming bidder alliances and their associated rights and duties are set out in chapter **[●X]** of the tender documentation.

62. For the purposes of completing the assignment stage, bidder alliances are treated as an individual bidder or bidders and their members' frequency blocks are aggregated. This means that contiguous frequency blocks are assigned to bidder alliances within each region and that, where possible, they receive the same frequencies across regions. If several members of a bidder alliance have won spectrum in the same regions, the bidder alliance is directly responsible for distributing the specific frequency blocks in those regions among those members. The bidder alliance must notify the TKK of this distribution model, in accordance with the provisions set out in chapter **[●X]** of the tender documentation. The TKK may reject this model, as set out given in chapter **[●X]** of the tender documentation. In the event of no distribution model being proposed or the model proposed being rejected, the provisions apply as set out in chapter **[●X]** of the Tender Document. The 'leading member' of the bidder alliance, according to chapter **[●X]** of the tender documentation, is responsible for payment of the additional price.

Assignment options

63.   At the start of the assignment stage, the auctioneer uses the auction system to provide all winners of frequency blocks with a full list of their relevant assignment bid options for specific frequency blocks in each region. Together with the relevant assignment options, the auctioneer announces the start and duration of the assignment bidding round.

64.   The assignment options satisfy the following conditions:

   a)   each bidder in each region is assigned contiguous spectrum of a quantity equal to the amount of spectrum awarded in the principle stage;

   b)   bidders who have acquired an identical amount of spectrum in all regions are assigned the same specific frequencies in all regions;

   c)   for other bidders, the regional variation in the assignment of specific frequencies is minimised to the greatest possible extent in accordance with the rules set out in Appendix E-1; and

   d)   insofar as is possible, bidders who have not acquired spectrum in all regions are assigned spectrum in the range 3410 to 3600 MHz.

65.   A detailed description of the process for generating assignment options is given in Appendix E-1.

Assignment bids

66.   Assignment bids are submitted using the auction software and must be received within the round time set by the auctioneer. There are no round extensions in this bidding round.

67.   An assignment bid specifies the maximum amount that the bidder is prepared to pay for an assignment option in order to be assigned the spectrum specified in that option.

68.   Any amount (in whole euros) can be bid for the individual assignment options. The minimum bid in the assignment stage is EUR 0 for each assignment option. There is no ceiling set for maximum bids.

69.   If bidders do not submit an assignment bid for a potential assignment option designated for them, a corresponding bid of EUR 0 is generated automatically for that option. If bidders do

not submit an assignment bid before the end of the assignment round, a bid with a bid amount of EUR 0 is generated automatically for each assignment option.

Determination of winners

70. After the end of the assignment bidding round, from all bids submitted by bidders and generated automatically by the auction software, the auctioneer determines in each case the combination of bids that is able to satisfy the following conditions:

    a) Exactly one bid per bidder is considered.

    b) The assignment of frequency blocks associated with the bids is mutually compatible and spectrum is uniquely assigned. Accordingly, the assignment results in a band plan in which individual bidders are assigned specific frequencies amounting to the spectrum won in the principle stage in each region, and no frequencies are assigned to more than one bidder.

    c) The sum of bid amounts is not lower than the sum of each alternative combination of bids that satisfies the first two conditions.

71. If only a single combination of assignment bids satisfies the conditions given in rule 70, then this is the combination of successful bids.

72. If multiple combinations of assignment bids meet the conditions given in rule 70, then the combination of successful assignment bids is determined at random.

73. Individual bidders receive the frequency blocks as specified in their bid within the successful combination of bids and pay the additional price in accordance with the rules below.

Price determination

74. For each successful assignment bid, an additional price required to be paid by the successful bidder is determined. Additional prices are determined collectively for all bidders and must meet the following conditions:

    a) The additional price for each and every successful bid cannot be negative. The additional price for each and every successful bid cannot be higher than the amount bid.

b) Additional prices are those prices with the lowest total value that satisfy the condition given in rule 74 (a) , and which ensure that the combination of successful bids at the respective additional prices satisfies the conditions given in rule 70. Accordingly, additional prices are the lowest prices that successful individual bidders would have had to bid in order to have been successful with their bids.

c) If only one combination of prices satisfies the conditions given in rule 74 (a) and (b), then those prices, rounded up to whole euros, are used as the additional prices.

d) If there are multiple groups of prices that fulfil these conditions, then the combination of prices, rounded up in each case to whole euros, used as the combination of additional prices is the combination that best approximates the combination of opportunity costs as determined individually for each individual winner. The opportunity costs determined individually for a bidder constitute the lowest bid in accordance with rule 74 (a) capable of ensuring that the combination of successful bids satisfies the conditions in rule 70 if all other winners pay their original bid amount.

End of the assignment stage

75. Once the auctioneer has determined the successful additional bids and the additional prices to be paid for these bids, bidders are informed about the specific frequency assignments in each of the bands.

76. Individual bidders are also informed about the additional price they have to pay.

Appendix E-1: Process for the determination of assignment options

For each bidder, the auctioneer determines the assignment options for which this bidder is eligible. This is completed on the basis of possible band plans, in which:

- specific frequencies are assigned to each bidder equalling the amount of spectrum acquired in each region by that bidder during the principle stage, whereby these frequency assignments do not overlap;

- bidders who have acquired the same amount of spectrum in each region in the auction are assigned identical frequencies in each region;

- where bidders have acquired varying amounts of spectrum in more than one region, variation is minimised as far as possible when assigning the specific frequencies in the individual regions;

- bidders not acquiring spectrum in all regions will be placed in band 42 where possible (i.e. below 3600 MHz).

To achieve these goals, the following procedure is applied for the generation of assignment options:

- Step 1: The auctioneer identifies possible arrangements of bidders that minimise the assignment of non-identical frequencies across separate regions.

- Step 2: The auctioneer determines the band plans resulting from the possible arrangements of bidders; blocks that have not been assigned to any bidders after the end of the principle stage ('unsold blocks') may also be used here to reduce variation in the bidders' frequency assignment.

- Step 3: Where possible, the auctioneer eliminates band plans in which bidders who have acquired spectrum only in certain regions are assigned spectrum in band 43 (i.e. above 3600 MHz).

- Step 4: The auctioneer identifies the various frequency assignments for the individual bidders (for a specific bidder, these assignments may be identical across separate band plans).

In the following sections, these steps are illustrated with examples that are based on a simplified lot structure that comprises fewer regions and fewer frequency blocks than will be actually offered in the auction.

Step 1: Determining the possible arrangement of bidders

In the following, 'bidder' designates all winners of frequency blocks in the principle stage, as well as a hypothetical winner of all unsold blocks.

The 'regional variation in frequency amount' (RVF) for a bidder is defined as the difference between the maximum and the minimum number of blocks that the bidder has won in a region. The RVF is therefore zero for a bidder who has won the same amount of spectrum in all regions. For a regional bidder who has acquired blocks in only one region, the RVF is equal to the number of blocks acquired. Similarly, the RVF for a group of bidders is defined as the difference between the maximum and the minimum number of blocks that this group of bidders has won in a region.

The aggregated RVF of a subdivision of bidders into non-overlapping subsets (that is, a partitioning of the overall set of bidders into non-empty and pairwise discrete subsets) is defined as the sum of the RVF of individual subsets.

The arrangements of bidders relevant for the determination of assignment options are created by successively partitioning the set of all bidders into subsets in such a way that the partition with the lowest aggregated RVF is chosen in each step. If in one step several partitions with the same lowest aggregated RVF result, then the following criteria are applied in order to select one of those partitions:

- Criterion 1: The partition with the larger number of subsets is selected first.
- Criterion 2: Where multiple partitions satisfy that criterion, the partition having the largest subset with the fewest bidders is selected.
- Criterion 3: Where multiple partitions satisfy that criterion, a subdivision is chosen at random.

This approach creates a tree structure in which the root of the tree is the set of all bidders and the leaves of the tree are individual bidders. The possible arrangements of bidders are then derived from all possible permutations of the tree's branches.

The following example illustrates the process.

We consider four regions of twelve blocks each, and four bidders. We assume that the result of the principle stage is as follows:

	Bidder A	Bidder B	Bidder C	Bidder D	Unsold
Region 1	4	4	4	0	0
Region 2	3	3	3	3	0
Region 3	4	3	3	2	0
Region 4	3	4	3	0	2

There are 52 possible partitions of the set of all bidders {A, B, C, D, U} of which one is the set itself. Three of the remaining partitions have the lowest aggregated RVF of 2, namely: {A}, {B, C, D, U}; {B}, {A, C, D, U}; and {C}, {A, B, D, U}. Neither criterion 1 nor criterion 2 is applicable, and so a combination is chosen randomly. Let this be {C}, {A, B, D, U}.

For the set {A, B, D, U}, there are 15 possible partitions, of which one is again the set itself. Two of the 14 remaining partitions have the same lowest aggregated RVF of 3, namely: {A}, {B, D, U}; and {B}, {A, D, U}. Neither criterion 1 nor criterion 2 produces a definitive result, and so one of these partitions is picked at random. Let this be {B}, {A, D, U}.

For the set {A, D, U}, there are five possible partitions, of which one is again the set itself. Of the four remaining partitions, the lowest aggregated RVF is present in only one partition, namely {A}, {D, U}.

This produces the following tree structure:

A, B, C, D, U

C   A, B, D, U

B   A, D, U

A   D, U

D   U

This structure can in turn be used to derive the following possible bidder arrangements:

C	B	A	D	U
C	B	A	U	D
C	B	D	U	A
C	B	U	D	A
C	A	D	U	B
C	A	U	D	B
C	D	U	A	B
C	U	D	A	B
B	A	D	U	C
B	A	U	D	C
B	D	U	A	C
B	U	D	A	C
A	D	U	B	C
A	U	D	B	C
D	U	A	B	C
U	D	A	B	C

Of 120 possible arrangements of bidders, only 16 therefore remain eligible for subsequent consideration. One arrangement that is excluded is A B C D U, for example, because this arrangement would fail to take advantage of the option of placing D with A

to compensate for the differences in the amount of spectrum won by the two bidders in regions 2 and 3 and thus achieve a better balancing out of regional assignments.

One consequence of this process is that bidders who win the same amount of spectrum in all regions will always receive contiguous spectrum. Such bidders are already identified in the first partitioning step as an endpoint because they have an RVF of zero and therefore do not contribute to the aggregated RVF of a partition. Since they do increase the number of subsets, however, criterion 1 is applied and other possible partitions are preferred.
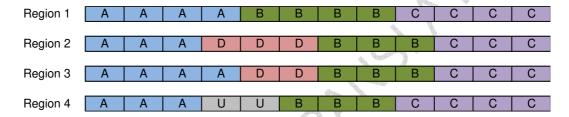
Each of these arrangements represents a band plan. The arrangement A D U B C produces the following band plan, for example:

Region 1	A	A	A	A	B	B	B	B	C	C	C	C
Region 2	A	A	A	D	D	D	B	B	B	C	C	C
Region 3	A	A	A	A	D	D	B	B	B	C	C	C
Region 4	A	A	A	U	U	B	B	B	C	C	C	C

Note that redundant band plans can be created. In this specific case, an arrangement with … D U … produces the exact same band plan as the arrangement … U D … because there is no region in which 'D winning' and 'unsold blocks' are both true. Overall, then, eight potential band plans remain after this step.

Step 2: Placing unsold blocks

A misalignment associated with a frequency assignment to a bidder is defined as the difference between the number of separate frequency blocks that the bidder is assigned across all regions and the maximum number of frequency blocks that the bidder has acquired in a single one of those regions.

If we consider the arrangement of bidders A D U B C, then the misalignment for bidders A, D and C is zero in each case, and equal to 1 for bidder B:

- Bidders A and C receive four separate frequency blocks across all regions, and win a maximum of four blocks. Since they are assigned at least four separate blocks, the misalignment here is equal to zero. The same applies to bidder D, except with a maximum of three blocks and three separate blocks.

- Bidder B receives five separate blocks assigned across all regions, and wins a maximum of four blocks: this means that the frequency assignment is one block larger than absolutely necessary. The misalignment is therefore equal to 1.

Accordingly, the aggregate misalignment associated with a band plan is the sum of the misalignments for the individual bidders in that band plan (without accounting for the fictive bidder who has been awarded the unsold lots).

For each of the band plans identified in the first step, we determine whether a redistribution (separation and division) of the unsold blocks and a placement between bidders could achieve a reduction in the aggregate misalignment; note that multiple options for the distribution of unsold blocks could exist for individual band plans. Where the aggregate misalignment of any band plans can be reduced by the redistribution of unsold lots, those band plans are replaced by others having correspondingly redistributed unsold lots.

For the above band plans, it is not possible to achieve a reduction in the aggregate misalignment by redistributing the two unsold lots in region 4.

Step 3: Excluding band plans that place regional bidders in band 43

In the next step, we determine whether it is possible to eliminate band plans that assign spectrum in band 43 to bidders that have not received spectrum in all regions.

In the above example, we can exclude four band plans that would assign spectrum in the upper band to bidder D.

Anordnung / Bandplan (Band 42 | Band 43) — Zulässig?

Arrangement 1 — ✗
Anordnung: C B A D U / C B A U D
- R1: C C C C B B | B B A A A A
- R2: C C C B B B | A A A D D D
- R3: C C C B B B | A A A A D D
- R4: C C C B B B | B A A A U U

Arrangement 2 — ✗
Anordnung: C B D U A / C B U D A
- R1: C C C C B B | B B A A A A
- R2: C C C B B B | D D D A A A
- R3: C C C B B B | D D A A A A
- R4: C C C B B B | B U U A A A

Arrangement 3 — ✗
Anordnung: C A D U B / C A U D B
- R1: C C C C A A | A A B B B B
- R2: C C C A A A | D D D B B B
- R3: C C C A A A | A D D B B B
- R4: C C C A A A | U U B B B B

Arrangement 4 — ✓
Anordnung: C D U A B / C U D A B
- R1: C C C C A A | A A B B B B
- R2: C C C D D D | A A A B B B
- R3: C C C D D A | A A A B B B
- R4: C C C U U A | A A B B B B

Arrangement 5 — ✗
Anordnung: B A D U C / B A U D C
- R1: B B B B A A | A A C C C C
- R2: B B B A A A | D D D C C C
- R3: B B B A A A | A D D C C C
- R4: B B B B A A | A U U C C C

Arrangement 6 — ✓
Anordnung: B D U A C / B U D A C
- R1: B B B B A A | A A C C C C
- R2: B B B D D D | A A A C C C
- R3: B B B D D A | A A A C C C
- R4: B B B B U U | A A A C C C

Arrangement 7 — ✓
Anordnung: A D U B C / A U D B C
- R1: A A A A B B | B B C C C C
- R2: A A A D D D | B B B C C C
- R3: A A A A D D | B B B C C C
- R4: A A A U U B | B B B C C C

Arrangement 8 — ✓
Anordnung: D U A B C / U D A B C
- R1: A A A A B B | B B C C C C
- R2: D D D A A A | B B B C C C
- R3: D D A A A A | B B B C C C
- R4: U U A A A B | B B B C C C

Step 4: Identifying assignment options

In this last step, we identify the assignment options for each bidder that are compatible with the respective band plans. In our example, these are the following options for bidder A:

Option	Blocks
1	(5–8) in R1, (7–9) in R2, (6–9) in R3, (6–8) in R4
2	(5–8) in R1, (7–9) in R2, (6–9) in R3, (7–9) in R4
3	(1–4) in R1, (1–3) in R2, (1–4) in R3, (1–3) in R4
4	(1–4) in R1, (4–6) in R2, (3–6) in R3, (3–5) in R4

Appendix E-2: Examples for clock round progress and the handling of exit bids

The following examples serve to illustrate possible auction progress and the valuation of exit bids in particular. The examples simplify the regional structure and do not use prices that reflect the actual prices.

Example 1: Clock rounds without exit bids

The following simple example illustrates clock round progress based on three bidders (X, Y and Z) and no submission of exit bids.

In clock round n, there is excess demand in regions A and B; the prices for these regions increase accordingly.

In the next round, bidder X reduces their demand in region B. Bidder Y bids for fewer blocks in regions A and B, but increases their demand in region C. Bidder Z transfers their demand from region B to region C. While there is still excess demand in A, this is no longer true for B. However, demand in C now exceeds the available supply.

In the following round, Y reduces their demand in A and C, and Z reduces their demand in C. The total demand in all regions is now the same as the available supply and the clock rounds end.

		Region (supply)		
		A (39)	**B (39)**	**C (39)**
Round n	Prices	100	50	50
	Bid X	15	15	15
	Bid Y	15	15	12
	Bid Z	12	15	12
	Total demand	42	45	39
	Excess demand?	J	J	N
Round n+1	Prices	110	55	50
	Bid X	15	13	15
	Bid Y	13	13	15
	Bid Z	12	13	14
	Total demand	40	39	44
	Excess demand?	J	N	J
Round n+2	Prices	120	55	55
	Bid X	15	13	15
	Bid Y	12	13	12
	Bid Z	12	13	12
	Total demand	39	39	39
	Excess demand?	N	N	N

The bidders win the following combinations of frequency blocks at the following prices:

	A (@ 120)	B (@ 55)	C (@ 55)	Winning price
X	15	13	15	3,340
Y	12	13	12	2,815
Z	12	13	12	2,815

Example 2: Clock round with simple exit bids

In the following example, we consider the actions of a single bidder (plus aggregated demand from other bidders, as appropriate).

In clock round n, the bidder submits a bid for 15 blocks in each region. We assume that the bids from other bidders are such that excess demand is created in regions A and C, and prices rise accordingly.

We assume that the bidder reduces their demand and in the next round bids for only 13 blocks in those two regions. The bidder has reduced their total demand and may now

submit exit bids. More precisely: the bidder may specify the maximum price at which they would be interested in 14 or 15 blocks in each region. We assume that the bidder submits the exit bids shown below.

We further assume that the other bidders make no changes to their demand. In this case, the clock rounds end, since there is no longer any excess demand in any region. In regions A and B, the aggregated demand from the clock bids exactly equals the supply. In region C, however, there is now excess supply. However, since the bidder has specified a demand for a number of blocks that balances out supply and demand, the corresponding exit bid is accepted for 14 blocks and all bidders win their blocks in this region at the price of the accepted exit bid – i.e. 53 – instead of the clock price (55).

		Region (supply)		
		A (39)	B (39)	C (39)
Round n	Prices	100	50	50
	Clock bid	15	15	15
	Bids of other bidders	26	24	25
	Total demand	41	39	40
	Excess demand/excess supply?	2	0	2
Round n+1	Prices	110	50	55
	Clock bid	13	15	13
	Others	26	24	25
	Total demand	39	39	38
	Excess demand/excess supply?	0	0	-1
	Exit bids	15 @ 103 14 @ 106		15 @ 52 **14 @ 53**

Variant A: If the bidder had not submitted an exit bid for 14 blocks, but only placed an exit bid for 15 blocks, then it would not have been possible to accept a market-clearing exit bid. In this case, the clock rounds would end with the clock prices. One lot in region C would remain unsold at the end of the clock rounds and would be offered in the additional bidding round.

Variant B: If one of the other bidders had reduced their demand for lots in region C by one block (from 13 to 12 blocks, for example) and submitted a corresponding exit bid for the additional block (e.g. 13@P), then the amounts of the exit bids would have decided which of the exit bids would have been accepted. There would now be an excess supply

of two blocks at the clock price and it would therefore be possible to accept our bidder's exit bid for 15 blocks. As an alternative, the auctioneer could also accept the exit bid of the other bidder and the exit bid of our bidder for 14 blocks. The auctioneer would do this if P was larger than 51: in this case, the value of the exit bids of both bidders for one block would be larger than the value of the exit bid of our bidder for two blocks. If P was 51.5, for example, then the auctioneer would accept the exit bids of both bidders for an additional block in each case, and all blocks in this region would be awarded for 51.5.

Example 3: Exit bids from a bidder with increased demand in other regions

In this example, the bidder reduces their demand in regions A and C while simultaneously increasing demand in region B. Overall, however, the number of requested blocks decreases, and our bidder may therefore submit exit bids – namely in every region in which they reduced demand. Not all exit bids can be satisfied, however.

We assume that the bidder submits the following clock bids and exit bids. Simultaneously, the other bidders reduce their demand, so that the clock rounds end with excess supply in regions A and C, but without placing any exit bids.

		Region (supply)		
		A (39)	B (39)	C (39)
Round n	Prices	100	50	50
	Clock bid	15	15	15
	Bids of other bidders	26	23	25
	Total demand	41	38	40
	Excess demand/excess supply?	2	-1	1
Round n+1	Prices	110	50	55
	Clock bid	14	16	14
	Others	24	23	24
	Total demand	38	39	38
	Excess demand/excess supply?	-1	0	-1
	Exit bids	15 @ 105		15 @ 52

Considering the excess supply, both of the bidder's exit bids could be accepted. As a result, however, the total number of blocks awarded (46) would exceed the number of blocks for which the bidder had submitted a bid in round n (45). The auctioneer may therefore accept only one of the two exit bids. The decision as to which bid to accept is made by considering which bid produces the greatest overall value.

If we are merely required to identify which of a bidder's several possible exit bids is to be accepted, we can focus solely on the relevant bidder and concentrate on the values as expressed by this bidder in the submission of the various exit bids. The total value of the bids of the other bidders is independent of the specific exit bid we accept; it would only act as an additive factor in the comparison and would therefore not influence it.

- The value expressed by the exit bid for 15 blocks in region A is
  $$15 \times 105 + 16 \times 50 + 14 \times 55 = 3145$$
- The value expressed by the exit bid for 15 blocks in region C is
  $$14 \times 110 + 16 \times 50 + 15 \times 52 = 3120$$

Accordingly, the exit bid for 15 blocks in region A would be accepted. One lot in region C remains unsold and will be offered subsequently in an additional bidding round.

The value of the bids accepted from other bidders is in both cases the same, namely $24 \times 110 + 23 \times 50 + 24 \times 55 = 5110$. If a total value comparison were to be made across all bidders, then this value would simply be added to the above values – but this would not alter the final decision.

This is summarised in the following table.

Exit bid		A	B	C	Value as expressed by bidder	Total value
15 A @ 105	Volume	15	16	14*	**3,145**	**8,255**
	Price	105	50	55		
15 C @ 52	Volume	14*	16	15	3,120	8,230
	Price	110	50	52		

* Clock bid only, so one block remains unsold

Example 4: Exit bids from multiple bidders

In this example, we consider the case in which multiple bidders reduce their demand and submit exit bids, although not all of these bids can be accepted. To simplify matters, we concentrate on two regions.

We assume that bidders submit the following clock bids and exit bids.

		Region (supply)	
		A (39)	**B (39)**
Round n	Prices	100	100

	Clock bid X	15	15
	Clock bid Y	15	15
	Clock bid Z	15	15
	Total demand	45	45
	Excess demand/excess supply?	6	6
Round n+1	Prices	110	110
	Clock bid X	8	10
	Clock bid Y	10	10
	Clock bid Z	12	12
	Total demand	30	32
	Excess demand/excess supply?	-9	-7
	Exit bid X	XE-A1: 13 @ 102 XE-A2: 10 @ 105	XE-B1: 14 @ 102 XE-B2: 12 @ 105
	Exit bid Y	YE-A: 14 @ 105	YE-B: 14 @ 105
	Exit bid Z	ZE-A: 15 @ 102	ZE-B: 15 @ 109

Accordingly, there is an excess supply of nine blocks in region A and of seven blocks in region B.

If we consider the various combinations of exit bids that the auctioneer could accept, the following picture emerges.

In region A, it is not possible to accept XE-A1, YE-A and ZE-A, since this would require a total of 42 blocks. Any other combination would be possible (although some combinations would leave blocks unsold). Both the combination of XE-A1 and YE-A with Z's clock bid and the combination of XE-A2, YE-A and ZE-A would assign exactly 39 blocks. The respective total values are as follows:

- XE-A1 + YE-A + Z clock: $13 \times 102 + 14 \times 105 + 12 \times 110 = 4116$
- XE-A2 + YE-A + ZE-A: $10 \times 105 + 14 \times 105 + 15 \times 102 = 4050$

Accordingly, the first combination is accepted.[2] The winning price per lot in region A is therefore 102.

In region B, it is not possible to accept exit bids from all three bidders. It would be possible to accept the exit bid from Y and Z, for example, but only in conjunction with

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[2] Every other combination that leaves blocks unsold produces a lesser value.

the clock bid from X. If we were to accept the clock bid from Y, then a maximum of XE-B1 and ZE-B could be accepted. The clock bid from Z could be accepted in conjunction with the exit bid from Y and XE-B2.

The combination of exit bids that delivers the highest value is Z clock + YE-B + ZE-B with a value of $10 \times 110 + 14 \times 105 + 15 \times 109 = 4205$, and this is accepted by the auctioneer.[3] The winning price per lot in region B is therefore 105.

The bidders therefore win the following packages at the following prices:

	A (@ 102)	B (@ 105)	Winning price
X	13	10	2,376
Y	14	14	2,898
Z	12	15	2,799

Example 5: Extension of exit bids

In this example, the bidder first reduces their demand in regions A and C while simultaneously increasing demand in region B. Overall, however, the number of requested blocks decreases, and our bidder may therefore submit exit bids – namely in every region in which they reduced demand (regions A and C). In the course of the auction, the bidder again reduces their demand – first in region B and then again in region C.

We assume that the bidder submits the following clock bids and exit bids, and, in so doing, extends their exit bids wherever possible. Simultaneously, the other bidders also change their demand. Accordingly, the clock rounds end with excess supply in all regions – but not before an additional round would first be held with excess demand in region C, however, and the size of the excess supply in region B would be reduced from the penultimate round to the last round.

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[3] All other combinations (including the combination XE-B1 + Y clock + ZE-B, which awards all blocks) produce a lesser value.

As a result of the increase in demand in region C in round n + 2, the exit bid placed by the bidder in this region becomes void. The exit bid in region A remains valid, however. Accordingly, the oldest exit bid at the end of the clock rounds originates from round n + 1, in which the bidder could have acquired up to 45 blocks (in the round prior to this one, the bidder placed bids for 45 blocks).

The bidder's last clock round comprises 39 blocks. As a result, all of the exit bids placed by the bidder can be considered, namely six blocks in total (one additional block in region A, up to four additional blocks in region B and one additional block in region C).

Considering the excess supply, however, these exit bids cannot be satisfied in their entirety. The bidder in fact wins:

- 15 blocks in region A, with an additional price for all bidders of 105 per block;
- 15 blocks in region B, with an additional price for all bidders of 51 per block; and
- 14 blocks in region C, with an additional price for all bidders of 55 per block.

This adds up to a total demand of 44 blocks, which significantly surpasses the bidder's total demand at clock prices in round n + 2 (the penultimate clock round). This demonstrates how exit bids, while not counting towards a bidder's total demand and therefore not contributing to the retention of bidding eligibility, nonetheless maintain the bidder's option to acquire spectrum in an amount that the bidder could have bought at the point in time when the oldest exit bid still valid was placed.

		Region (supply)		
		A (39)	B (39)	C (39)
N	Prices	100	50	50
	Clock bid	15	15	15
	Bids of other bidders	28	24	28
	Total demand	43	39	43
	Excess demand/excess supply?	4	0	4
n+1	Prices	110	50	55
	Clock bid	14	16	14
	Others	24	32	24
	Total demand	38	48	38
	Excess demand/excess supply?	-1	9	-1
	Exit bids	15 @ 105		15 @ 52
n+2	Prices	110	55	55
	Clock bid	14	12	14
	Others	24	23	28
	Total demand	38	35	42
	Excess demand/excess supply?	-1	-4	3
	Exit bids	15 @ 105	16 @ 50 15 @ 51 14 @ 52 13@ 53	~~15 @ 52~~
n+3	Prices	110	55	60
	Clock bid	14	12	13
	Others	24	24	25
	Total demand	38	36	38
	Excess demand/excess supply?	-1	-3	-1
	Exit bids	15 @ 105	16 @ 50 15 @ 51 14 @ 52 13@ 53	14 @ 55