Annex B—Conditions of licence

The following conditions will apply to licences in the 600 MHz band.

It should be noted that the licences are subject to the relevant provisions in the *Radiocommunication Act* and the *Radiocommunication Regulations*, as amended from time to time. For example, the Minister continues to have the power to amend the terms and conditions of spectrum licences, under section 5(1)(*b*) of the *Radiocommunication Act*. The Minister may do so for a variety of reasons, including furtherance of the policy objectives related to the band. Such action would normally only be undertaken after consultation.

1. Licence term

The term of this licence is 20 years. At the end of this term, the licensee will have a high expectation that a new licence will be issued for a subsequent term through a renewal process, unless a breach of licence condition has occurred, a fundamental reallocation of spectrum to a new service is required, or an overriding policy need arises.

The process for issuing licences after this term and any issues relating to renewal, including the terms and conditions of the new licence, will be determined by the Minister following a public consultation.

2. Eligibility

The licensee must comply on an ongoing basis with the applicable eligibility criteria in subsection 9(1) of the *Radiocommunication Regulations* and, where applicable, with the eligibility criteria for set-aside licences as defined under the Technical, Policy and Licensing Framework for Spectrum in the 600 MHZ Band (the Framework).The licensee must notify the Minister of any change that would have a material effect on its eligibility. Such notification must be made in advance for any proposed transactions within its knowledge.

3. Licence transferability, divisibility and subordinate licensing

This licence is transferable in whole or in part (divisibility), in both bandwidth and geographic dimensions, subject to ISED's approval. A Subordinate Licence may also be issued in regard to this licence. ISED's approval is required for each proposed Subordinate Licence.

The licensee must make the Transfer Request in writing to ISED. The Transfer Request will be treated as set out in Client Procedures Circular CPC-2-1-23, *Licensing Procedure for Spectrum Licences for Terrestrial Services*, as amended from time to time.

The licensee must apply in writing to ISED for approval prior to implementing any Deemed Transfer, which will be treated as set out in CPC-2-1-23. The implementation of a Deemed Transfer without the prior approval of ISED will be considered a breach of this condition of licence.

Should the licensee enter into any Agreement that provides for a Prospective Transfer with another holder of a Licence for commercial mobile spectrum (including any Affiliate, agent or representative of the other licence holder), the licensee must apply in writing to ISED for review of the Prospective Transfer within 15 days of entering into the Agreement, which will be treated as set out in CPC-2-1-23. Should ISED issue a decision indicating that the Prospective Transfer is not approved, it will be a breach of this condition of licence for a licensee to remain in an Agreement that provides for the Prospective Transfer for a period of more than 90 days from the date of the decision.

The following provision applies to set-aside licences as defined under the *Technical, Policy and Licensing Framework for Spectrum in the 600 MHz Band* (the Framework): For the first five years of the licence term, a set-aside licence is not transferable to a set-aside-ineligible entity (as defined in the Framework) with two exceptions:

1) a Subordinate Licence to a set-aside-ineligible entity may be granted in support of a spectrum sharing agreement provided that the requirements in section 5.6.3 of CPC-2-1-23 are met *and* that ISED is satisfied that the relevant entities will actively and independently provide wireless services in the applicable licence areas, based on the assessment factors set out in section 9.2 of the Framework; and

2) an exchange of equal amounts of 600 MHz spectrum within the same licence area between a set-aside-eligible entity and a set-aside-ineligible entity may be allowed, subject to the provisions of section 5.6 of CPC-2-1-23.

In all cases, the licensee must follow the procedures as outlined in CPC-2-1-23.

All capitalized terms have the meaning ascribed to them in CPC-2-1-23.

4. Radio station installations

The licensee must comply with Client Procedures Circular CPC-2-0-03, *Radiocommunication and Broadcasting Antenna Systems*, as amended from time to time.

Provision of technical information: The licensee must provide, and maintain, up-to-date technical information on a particular station or network in accordance with the definitions, criteria, frequency and timelines specified in Client Procedures Circular CPC-2-1-23,

Licensing Procedure for Spectrum Licences for Terrestrial Services, as amended from time to time.

***Compliance with legislation, regulation and other obligations*:** The licensee is subject to, and must comply with, the *Radiocommunication Act* and the *Radiocommunication Regulations*, as amended from time to time. The licensee must use the assigned spectrum in accordance with the *Canadian Table of Frequency Allocations* and the spectrum policies applicable to this band, as amended from time to time. The licence is issued on condition that all representations made in relation to obtaining this licence are all true and complete in every respect.

5. Technical considerations, and international and domestic coordination

The licensee must comply on an ongoing basis with the technical aspects of the appropriate Radio Standards Specifications (RSS) and Standard Radio System Plans (SRSP), as amended from time to time. Where applicable, the licensee must use its best efforts to enter into mutually acceptable agreements with other parties for facilitating the reasonable and timely development of their respective systems, and to coordinate with other licensed users in Canada and internationally.

The licensee must comply with the obligations arising from current and future frequency coordination agreements established between Canada and other countries and shall be required to provide information or take actions to implement these obligations as indicated in the applicable SRSP. Although frequency assignments are not subject to site licensing, the licensee may be required through the appropriate SRSP to furnish all necessary technical data for each relevant site.

6. Lawful interception

The licensee operating as a telecommunication common carrier using the spectrum for voice telephony systems must, from the inception of service, provide for and maintain lawful interception capabilities as authorized by law. The requirements for lawful interception capabilities are provided in the *Solicitor General's Enforcement Standards for Lawful Interception of Telecommunications* (Rev. Nov. 95). These standards may be amended from time to time.

The licensee may request the Minister to forbear from enforcing certain assistance capability requirements for a limited period of time. The Minister, following consultation with Public Safety Canada, may exercise the power to forbear from enforcing a requirement or requirements where, in the opinion of the Minister, the requirement is not reasonably achievable. Requests for forbearance must include specific details and dates indicating when compliance with the requirement can be expected.

7. Research and development

The licensee must invest, as a minimum, 2% of its adjusted gross revenues resulting from the use of this licence, averaged over the term of the licence, in eligible research and development (R&D) activities related to telecommunications. Eligible R&D activities are those which meet the definition of scientific research and experimental development adopted in the *Income Tax Act*, as amended from time to time. Adjusted gross revenues are defined as total service revenues less inter-carrier payments, bad debts, third party commissions, and provincial goods and services taxes collected. The licensee is exempt from R&D expenditure requirements if it, together with all affiliated licensees that are subject to the R&D condition of licence, has less than $1 billion in annual gross operating revenues from the provision of wireless services in Canada, averaged over the term of the licence. For this condition of licence, an *affiliate* is defined as a person who controls the carrier, or who is controlled by the carrier or by any person who controls the carrier, as per subsection 35(3) of the *Telecommunications Act*.

8. Deployment requirements

Licensees will be required to demonstrate to the Minister that this spectrum has been put to use to provide services as specified in table A1 within 5 years of the initial issuance of the licence, as specified in table A2 within 10 years of the initial issuance of the licence, and as specified in table A3 within 20 years of the initial issuance of the licence.

The Department will review licensees' compliance with their deployment conditions at years 5, 10 and 20. Where, at any point in the licence term, the licensee is not in compliance with its deployment conditions, the Department may invoke various compliance and enforcement measures.

These measures may include warnings, administrative monetary penalties, legal action, licence amendments, suspensions, or other measures. In certain cases of non-compliance, the Department may determine that the most appropriate course of action is to revoke the licence.

Where a licence is transferred, the requirement for the new licensee to deploy will continue to be based on the initial licence issuance date.

9. Mandatory antenna tower and site sharing

The licensee must comply with the mandatory antenna tower and site sharing requirements set out in Client Procedures Circular CPC-2-0-17, *Conditions of Licence for Mandatory Roaming and Antenna Tower and Site Sharing and to Prohibit Exclusive Site Arrangements*, as amended from time to time.

10. Mandatory roaming

The licensee must comply with the roaming requirements set out in Client Procedures Circular CPC-2-0-17, *Conditions of Licence for Mandatory Roaming and Antenna Tower and Site Sharing and to Prohibit Exclusive Site Arrangements*, as amended from time to time.

11. Annual reporting

The licensee must submit an annual report for each year of the licence term, which includes the following information:

- a statement indicating continued compliance with all conditions of licence;
- an update on the implementation and spectrum usage within the area covered by the licence;
- existing audited financial statements with an accompanying auditor's report;
- a statement indicating the annual gross operating revenues from the provision of wireless services in Canada and, where applicable, the annual adjusted gross revenues resulting from the use of this licence, as defined in these conditions of licence;
- a report of the R&D expenditures as set out in these conditions of licence (ISED may request, at its discretion, an audited statement of R&D expenditures with an accompanying auditor's report);
- supporting financial statements where a licensee is claiming an exemption based on, together with all affiliated licensees that are subject to the R&D condition of licence, it having less than $1 billion in annual gross operating revenues from the provision of wireless services in Canada, averaged over the term of the licence;
- a copy of any existing corporate annual report for the licensee's fiscal year with respect to the authorization; and
- other information related to the licence as specified in any notice updating the reporting requirements as issued by ISED.

All reports and statements are to be certified by an officer of the company and submitted, in writing, within 120 days of the licensee's fiscal year-end. Confidential information provided will be treated in accordance with subsection 20(1) of the *Access to Information Act*.

Reports are to be submitted to ISED at the following address:

Innovation, Science and Economic Development
Spectrum Management Operations Branch
Manager, Operational Policy
235 Queen Street
Ottawa, Ontario K1A 0H5

Where a licensee holds multiple licences, spectrum implementation reports should be broken down by service area. This information, including the extent of implementation and spectrum usage, is important for analyzing each licensee's individual performance against its conditions of licence. In addition, it allows ISED to monitor the effectiveness of these conditions in meeting the policy objectives regarding the band and the Department's intent that the spectrum be deployed in a timely manner for the benefit of Canadians.

12. Amendments

The Minister retains the discretion to amend these terms and conditions of licence at any time.

Annex C—Combinatorial clock auction format with Generalized Axiom of Revealed Preference based activity rule

1. ISED will use a combinatorial clock auction (CCA) format with Generalized Axiom of Revealed Preference (GARP) based activity rule for the 600 MHz licensing process. A CCA involves a bidding process that includes a price discovery stage, which is similar to the simultaneous multiple round ascending (SMRA) auction format. However, the CCA format also has attributes that remove or reduce some design concerns associated with the SMRA format. In particular, the CCA format allows bidders to bid on packages of licences instead of individual licences, eliminating the risk that bidders may win some but not all of the licences that they desire. This is particularly important given the regional nature of the licences to be auctioned in this process and the complementarities that exist between these licences.

2. The GARP-based activity rule maintains the desirable properties of the Weak Axiom of Revealed Preference (WARP) based activity rule that was used for the 700 MHz and 2500 MHz auctions. First, it provides flexibility so that a bidder can bid truthfully based on a valuation function that specifies a value for each package. Second, it allows a bidder to bid based solely on eligibility points. However, because the GARP-based activity rule is stricter, it may prevent a bidder from submitting some bids that would have been possible using the WARP-based activity rule. Thus, redefining the hybrid revealed preference/eligibility point rule based on GARP may improve incentives for bidders to bid truthfully, while supporting ISED's objectives for a fair and efficient allocation of spectrum.

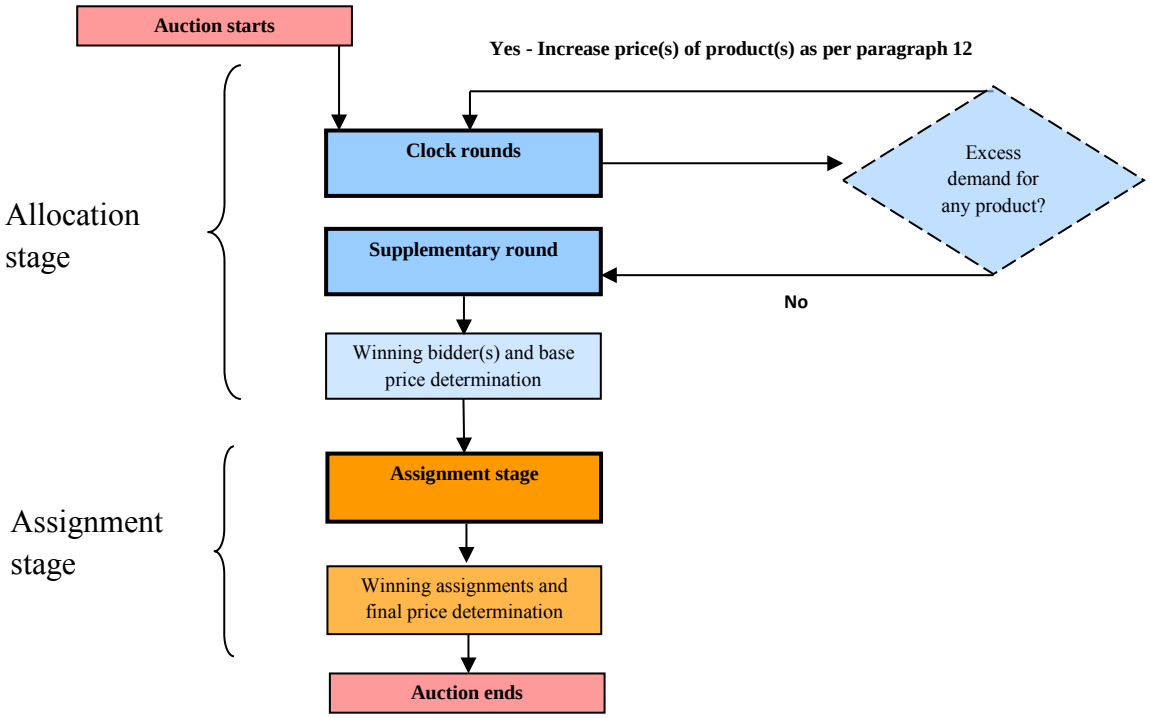
3. Upon application to participate in the auction, applicants will be required to indicate whether they are applying as a set-aside-eligible or set-aside-ineligible bidder on a service area by service area basis (and, hence, the category of product that they would like to bid for on a service area by service area basis). Set-aside eligibility will be subject to ISED approval.

4. There will be a supply of seven blocks in each of the 16 service areas. Three blocks in each of the 16 services areas will be reserved for set-aside-eligible bidders. The pairing of a service area and a category is referred to as a "product." Given that there will be two categories ("set-aside" and "open") in each of the 16 service areas, there will be a total of 32 products offered in the 600 MHz auction.

1. Overview of the CCA

5. The CCA consists of two stages: the allocation stage and the assignment stage. Figure C1 illustrates the process in each stage. In the allocation stage, the number of spectrum licences that a bidder will win in each service area, as well as the base price to be paid by each winning bidder, is determined. Where generic licences are offered, an additional stage is needed to determine the specific frequencies that will be assigned to each winning bidder. This stage is referred to as the assignment stage.

Figure C1 — CCA process



2. The allocation stage

6. The allocation stage of the auction determines the winning bidders as well as the number of licences they have won. It is divided into two phases: the clock rounds and the supplementary round. All valid bids submitted during the allocation stage are used to determine the winning packages and the base prices.

7. The clock rounds allow for price discovery, helping to reduce a bidder's uncertainty regarding the value of the licences. Bidders are able to respond to the price changes accordingly, shifting their bids to licences that continue to be consistent with their business objectives.

8. During each clock round, bidders are able to bid on only one package of licences; however, there may be other packages that they would be interested in winning. The supplementary round provides bidders with an opportunity to improve on bids that they placed in the clock rounds and/or to submit bids on packages that they were eligible to bid on, but did not bid on, during the clock rounds.

3. Clock rounds

9. The allocation stage begins with the clock rounds.

10. The licences are auctioned simultaneously over multiple clock rounds. In each round, bidders indicate the number of licences in each service area on which they would like to bid, given the prevailing prices. A bidder that is set-aside-eligible in a service area can only bid for the set-aside product in that area. A bidder that is set-aside-ineligible in a service area can only bid for the open product in that area. The bid for a product cannot exceed the product's maximum supply. Thus, a set-aside-eligible bidder's bid for a set-aside product could be for 0, 1, 2, 3, 4, 5, 6 or 7 licences, while a set-aside-ineligible bidder's bid for an open product could be for 0, 1, 2, 3 or 4 licences. This applies to bids in both the clock rounds and the supplementary round. All of the individual bids placed by a bidder in a given round are considered to be a single package bid, creating an all-or-nothing bid. The price of the package bid is equal to the sum of the bids for individual products, evaluated at the prevailing clock prices.

11. In the first clock round, the price of all licences in each product will be equal to the opening bid price listed in section 7.5 of the Framework.

12. In subsequent clock rounds:

a. The price of only the set-aside product in a service area will increase from the previous round when the aggregate demand for the set-aside product exceeds three and both of the following conditions are satisfied: (i) the aggregate demand for the open product is at most four; and (ii) the price of the set-aside product is less than the price of the open product. However, if this would result in the price of the set-aside product exceeding the price of the open product, then the price of the open product will instead be set equal to the same price that has been determined for the set-aside product. The price of the set-aside product will never be set above the price of the open product.

b. The price of only the open product in a service area will increase from the previous round when the aggregate demand for the open product exceeds four and the aggregate demand for the set-aside product is at most three.

c. The prices of both products in a service area will increase from the previous round when the aggregate demand for the set-aside product exceeds three and either of the following two conditions are satisfied: the aggregate demand for the open product exceeds four; or the prices of the two products are equal and the sum of the aggregate demands for the set-aside and open products exceeds seven.

d. If none of the conditions (a), (b) or (c) are satisfied for a service area, then the prices of neither of the products in the service area will increase from the previous round.

13. The bid increments for the 600 MHz auction will be in the range of 1-20% of prices in the previous clock round (rounded upward to the nearest multiple of one thousand dollars). Throughout the course of the auction, ISED reserves the right to adjust the bid increments to facilitate an efficient and timely auction.

14. To remain in the auction, a bidder must submit a valid bid with a value greater than zero for at least one licence in the first clock round. The last valid bid that a bidder submits during each clock round will be binding and will be considered in determining both winning packages and base prices at the end of the allocation stage. However, bidders may increase their bids from the clock rounds in the supplementary round, subject to the activity rules.

4. Conclusion of bidding in the clock rounds

15. The clock rounds will end when there is a round in which there is no product in any service area whose price is required to be incremented. This round is referred to as the final clock round. The package on which a bidder placed a bid in the final clock round is referred to as its final clock package. At this point, ISED will announce to bidders that the clock rounds have ended and that the auction will proceed to the supplementary round (see section 8 of this annex).

5. Information in the clock rounds

16. Before the start of each clock round, bidders will receive information regarding their own bids from the previous round and their own eligibility in the next round. In addition, all bidders will be informed of the aggregate demand for each service area from the previous round and the price of the product on which they are eligible to bid for the next round. Bidders will not be informed about the individual bids submitted by other bidders or about the remaining eligibility of other bidders. Information about the aggregate demand from the final clock round will be withheld.

6. Eligibility points

17. Each of the 16 service areas has been assigned a specific number of eligibility points in proportion to the estimated value of the spectrum. One eligibility point has been assigned per $48,000 in opening bid prices for each 10 MHz block of spectrum in a service area. Section 7.6 of the Framework lists the eligibility points associated with a product in each service area, as well as the population of the service area.

18. Eligibility points are used in the determination of the pre-auction financial deposits and in the activity rules applied during the auction, which influence the bids that bidders can submit. In its application, each potential bidder must indicate the total number of “points” worth of licences on which it wishes to bid and submit a corresponding financial deposit. A bidder’s initial eligibility defines an upper limit on the size of the packages of licences for which the bidder can bid. As in past spectrum auctions, bidders begin each clock round with a set number of eligibility points, which determines their maximum activity level for the given clock round. For example, a bidder with 100 eligibility points can bid on any package of licences, up to a total sum of 100

points. Subsequent levels of eligibility are based on bids in previous clock rounds.

19. Bidders will not be able to increase their eligibility points after the deadline for application changes.

7. GARP-based activity rule in the clock rounds

20. The revealed preference/eligibility point hybrid activity rule will be applied in each clock round. It comprises both an eligibility point activity rule and a revealed preference activity rule. The revealed preference component of the activity rule is based on the generalized axiom of revealed preference (GARP).

21. The activity rule has been established to promote truthful bidding throughout the clock rounds, facilitating the price discovery process and allowing bidders to make changes to their bidding strategies dynamically during the auction, in response to increasing prices. The activity rule discourages bidders from misrepresenting their true demand, as doing so will limit their ability to bid on what they really want later in the auction.

22. ISED will institute a 100% eligibility point activity requirement for the 600 MHz spectrum auction. Specifically, in each round, a bidder will be required to bid on licences totalling 100% of its eligibility points if it wishes to maintain that eligibility in the subsequent round.

23. This means that the eligibility point component considers the "size" of the package being bid on, in terms of total eligibility points, and requires bidders to bid on packages that are the same size or smaller as prices increase. When a bidder switches to a smaller package of licences (in other words, totalling fewer eligibility points) the bidder's eligibility is reduced to the eligibility points of that package.

24. Bidders are required to have eligibility points to bid during the clock rounds. If a bidder reduces its eligibility to zero, the bidder will no longer be able to bid in the clock rounds, but will still be able to bid in the supplementary round provided that it has submitted at least one valid bid with a value greater than zero during the clock rounds.

25. However, there are some shortcomings with using only an eligibility point activity rule. It may create an incentive for bidders to choose only larger packages when prices are low, rather than packages that may work better for them, so that they maintain a larger number of eligibility points for later in the auction. This could lessen price discovery. Furthermore, an eligibility point activity rule may prevent a bidder from making a desirable substitution to a package that is larger in terms of associated eligibility points, but which has become relatively less expensive. In such a case, the eligibility point activity rule would prevent the bidder from bidding on its most preferred package.

26. Under the GARP-based activity rule, a bidder is allowed to submit a bid for a package Q that exceeds its eligibility if all of its bids—starting with the last round in which the bidder had sufficient eligibility for package Q and ending in the current round with a bid for package Q—

are consistent with truthful bidding for the bidder's implied set of valuations. It is possible that these valuations would not be expressed as bids during the auction. Nonetheless, based on actual bids placed up to this point, it is reasonable that the bidder would possess such a set of implied valuations and would bid in accordance with them. Annex D provides the algebraic description of the GARP-based activity rule and annex E provides an example.

27. While a bidder may be permitted by the revealed preference/eligibility point hybrid activity rule to bid for a package larger than its current eligibility, bidding on the larger package will not increase the bidder's eligibility in subsequent rounds. Furthermore, the bidder will never be able to bid on a package with associated eligibility points that exceed the bidder's initial eligibility.

28. Using an activity rule containing both an eligibility point component and a revealed preference component will provide extra flexibility to the bidder. A bidder can continue to bid the same as it would under the eligibility point activity rule. In addition, the bidder is given some extra flexibility to bid on a larger package, provided that the larger package has become relatively less expensive, thereby allowing more opportunity for bidders to adjust their bids in response to information received during the clock rounds.

29. Compared to the WARP-based activity rule that was used in the 700 MHz and 2500 MHz auctions, the GARP-based activity rule performs a stricter test when checking whether to allow a bid on a package that exceeds the bidder's eligibility. In the clock rounds, the activity rule is stricter in two aspects. First, instead of checking only revealed preference constraints generated by eligibility-reducing rounds,[2] the GARP-based activity rule performs a test against bids in all clock rounds starting with the last round in which the bidder had sufficient eligibility to bid on the given package. Second, instead of performing revealed preference checks one by one, the GARP-based activity rule performs a simultaneous check of all relevant revealed preference constraints.

8. Supplementary round

30. The second phase of the allocation stage is the supplementary round. This is a single round process where bidders have the opportunity to place additional bids for packages of licences at prices they choose, subject to constraints based on the bids that they submitted during the clock rounds (see section 9 of this annex). Supplementary bids are critical to ensuring both that the licences are allocated to the bidders who value them the most and that winning bidders pay an amount that is sufficient to ensure that no other bidder or group of bidders was willing to pay more for the licences. The supplementary round will still be held even when all licences are provisionally allocated at the end of the clock rounds.

31. During each clock round, bidders are limited to submitting a single package bid at the announced prices for that round. However, bidders may want to increase their bids in order to reflect their own values for those packages of licences. Furthermore, bidders may be interested in

[2] All clock rounds in which the bidder does not bid on licences worth the full amount of its eligibility in that round are considered eligibility-reducing rounds.

winning other packages that they were eligible for in the clock rounds, but have yet to bid on. The supplementary round provides bidders with an opportunity to submit their best and final bids on packages that they have previously bid on and to submit new bids on the other packages that they are interested in.

32. The supplementary bids will be all-or-nothing, mutually exclusive package bids on the combinations of licences that the bidder is interested in winning. Valid quantities of licences follow the same rules as in paragraph 10 of this annex.

9. GARP-based activity rule in the supplementary round

33. The activity rule for bids on packages in the supplementary round complements the activity rule in the clock rounds, encouraging truthful bidding throughout the allocation stage of the auction by ensuring that supplementary bids are consistent with preferences expressed in the clock rounds.

34. Any bidder that placed at least one valid bid with a value greater than zero in the clock rounds will be able to submit bids in the supplementary round. However, a bidder is not required to submit bids in the supplementary round.

35. All packages of licences for which the bidder is eligible to bid are available for bidding in the supplementary round, irrespective of whether the bidder bid for them in the clock rounds. Thus, bidders will be able to improve on bids submitted during the clock rounds or to submit bids for packages of licences that they were eligible to bid for in the clock rounds but did not.

36. A bidder will be able to submit a supplementary bid for any given package of licences within its initial eligibility. However, bidders will not be allowed to submit a bid on the zero package (i.e. null set), as the only allowable bid amount is zero ($0). The limit on the number of different supplementary round packages that a bidder will be allowed to place will be announced after the bidder qualification has occurred, but will be no less than 500 different packages.

37. The bid amount of a package bid in the supplementary round must be at least the sum of the opening bid prices for all of the licences included in the package. Furthermore, if a bidder submits a package bid on a package from the clock rounds, the bid amount for that package must be greater than the bidder's highest clock round bid for that package.

38. There is no limit on the supplementary bid amount for the final clock package, which is the package that the bidder bid on in the final clock round, unless the final clock package is the zero package. The GARP-based activity rule requires that each package bid in the supplementary round must satisfy revealed preference with respect to the final clock round and all rounds (if any) in which the bidder bid for packages of a smaller size than this package.

39. The structure of the supplementary round bidding constraints guarantees that the final clock allocation will not change if there is no excess supply in the final clock round. Each winner is guaranteed to win its final clock package without making any supplementary bids. If there is excess supply, a bidder will be allocated its final clock package if its only supplementary bid is

for the final clock package, but with a bid amount that is increased by at least the value of the excess supply as evaluated at the final clock prices less the opening bid prices of the excess supply. However, because the aggregate demand in the final clock round will not be made available to bidders as they go into the supplementary round, the bidder should be motivated to bid truthfully to improve its chance of winning its most preferred package. Furthermore, the ability to ensure this allocation may be compromised if any other supplementary bid does not include, at a minimum, all of the licences contained in the bidder's final clock package.

40. The revealed preference limit in conjunction with the non-disclosure of the final clock round aggregate demand provides a strong incentive for truthful bidding during the supplementary round, encouraging bidders to bid based on their valuations rather than on any expected guarantee of winning their final clock package.

41. Note that the bid for a constraining package may itself be subject to a revealed preference limit with respect to another package. Thus, the rule may have the effect of creating a chain of constraints on the dollar amount of a supplementary bid for a package *Q* relative to the dollar amounts of other clock bids or supplementary bids.

42. See annex D for the algebraic formulation of the GARP-based activity rule and see annex E for an example.

10. Determining the winning packages in the allocation stage

43. All valid bids received from bidders in the clock rounds and in the supplementary round are considered for the determination of winning packages.

44. A reserve bid for every licence, at the opening bid price, will be included in the determination of winning bidders at the end of the allocation stage. In this process, it is as though ISED is a bidder in the auction, placing a bid on every licence at the opening bid price. The purpose of including a reserve bid for every licence is to ensure that the incremental value that a bidder would be prepared to pay for an additional licence is at least the opening bid price of that licence. The reserve bids will not be treated as a package, but rather as having been placed by different bidders so that any number of reserve bids can be selected in the winning combination.

45. A solver will be used to identify the highest value combination of valid bids subject to the requirements that each bidder wins no more than one of its packages, the quantity of open blocks allocated in a service area must not exceed four, and the quantity of open plus set-aside blocks allocated in a service area must not exceed seven. Note that it is possible to assign more than three blocks to a set-aside-eligible bidder in a service area. If there is only one combination of bids that meets the criteria, this will be the winning outcome that determines the winning packages and the winning bidders.

46. If more than one combination of valid bids has the same highest value, the tie will first be resolved by minimizing the number of "lost licences," where a lost licence is a licence that was included in the bidder's final clock package, but is not included in an alternate package that could be assigned to the bidder. The rationale for selecting the combination of valid bids that

minimizes the number of lost licences as the first tie-breaking rule is so that an allocation that is the most similar to the final clock allocation is selected.

47. If there is still a tie, the second tie-breaking rule will be to select the combination of valid bids that includes the greatest number of associated eligibility points. Note that if reserve bids are part of the winning combination, the eligibility points associated with the reserve bids will not count towards the eligibility points of the winning combination. This is to maximize the quantity of spectrum that is allocated. If, subsequently, there is still a tied outcome, the tie will be broken by a pseudo-random number generator built into the auction software.

11. Determining the base price in the allocation stage

48. The base price is the minimum amount that winning bidders will pay for their generic winning packages; it does not include the additional, incremental amount that winning bidders may pay for specific licences, as determined in the assignment stage. The base price will be determined using all valid bids submitted by all bidders during the allocation stage, as well as the reserve bids.

49. ISED will use a second-price rule to calculate the base prices such that winning bidders, individually and collectively, will pay an amount that is sufficient to ensure that there is no other bidder or group of bidders prepared to pay more for the licences. This amount will be less than or equal to the actual winning bid submitted in the allocation stage, either in the clock rounds or the supplementary round, and must be greater than or equal to the total sum of the opening bid prices for the combination of licences included in their winning package. The benefit of using a second-price rule is that it encourages bidders to bid truthfully, potentially leading to a more efficient outcome.

50. ISED will apply bidder-optimal core prices and will use the “nearest Vickrey” approach to determine the base prices. In some cases, the second price (Vickrey price) may not be high enough to ensure that there is no alternative bidder or group of bidders prepared to pay more for the licences in question, and so an additional payment above Vickrey prices may be required. In the event that such a payment is required, the calculation of the additional payment to be paid by each winning bidder will be weighted based on the relative size of its winning package of licences evaluated at the opening bid prices. Further information on the determination of base prices can be found in annex F.

12. Information at the end of the allocation stage

51. At the end of the allocation stage, each bidder will be informed of its own winning package, along with the base price that it will pay for its package.

52. At this point, bidders will know with certainty the number of licences in each product that they have won; however, given that these are generic licences, they will not necessarily know the specific frequency blocks that they have won.

13. The assignment stage

53. As generic licences will be offered, the auction will then advance to the assignment stage, where the specific assignment of the generic licences will be determined. Only bidders that have won one or more generic licences during the allocation stage will have the option to participate in the assignment stage.

54. The assignment stage will be used to determine the specific frequency blocks that winning bidders will be assigned. The assignment stage will make no distinction between bidder types (set-aside-eligible or set-aside-ineligible) in the determination of specific assignments.

55. The assignment stage will consist of a sequence of assignment rounds. In each assignment round, bidders will be presented with a set of options available to them for the products being assigned, taking into consideration the number of licences that the bidder won in the allocation stage (see section 14 of this annex).

56. The assignment rounds will be run service area by service area (or combined service area—see paragraph 57 of this annex) in descending order of population, possibly conducting a separate round for each service area. This could potentially result in up to 16 assignment rounds. This process will enable bidders to know which specific frequencies they have won in the most populated service areas prior to their participation in the assignment rounds for the other less populated service areas.

57. In support of simplifying the assignment stage and facilitating the assignment of contiguous spectrum across service areas, two or more service areas will be combined into a single assignment round when they form a contiguous geographic area and when the winners and the number of licences they have won are the same in the service areas to be combined. In the previous sentence, note that set-aside licences and open licences are treated the same; for example, if Bidder A has won two set-aside licences in service area I and has won two open licences in service area II, that will not prevent service areas I and II from being combined into a single assignment round.

58. For example, the two contiguous service areas shown in the tables below would be eligible to be combined into a single assignment round.

Table C1: Example of contiguous service areas

Service area	Blocks						
	A	**B**	**C**	**D**	**E**	**F**	**G**
Service area I	Bidders 1, 2 and 3 win 1 block; Bidder 4, 5 win 2 blocks						
Service area II	Bidders 1, 2 and 3 win 1 block; Bidder 4, 5 win 2 blocks						

One possible assignment could be:

Table C2: Example of possible assignment

Service area	Blocks						
	A	B	C	D	E	F	G
Service area I	Bidder 5	Bidder 5	Bidder 3	Bidder 1	Bidder 2	Bidder 4	Bidder 4
Service area II	Bidder 5	Bidder 5	Bidder 3	Bidder 1	Bidder 2	Bidder 4	Bidder 4

With the combined service areas, bidders will only be permitted to bid for and win assignments that would give them the exact same blocks in each service area.

59. Winning bidders do not have to place bids in the assignment stage if they do not have an assignment preference, as they are guaranteed the number of generic licences that they have already been allocated. Each winning bidder has both a right and an obligation to purchase one of the frequency range options presented to it in the assignment round at the determined price.

60. For each assignment round, a solver will be used to identify the combination of specific assignments of licences that result in the highest bid amount. In the event of a tied outcome with more than one specific assignment producing the same total value, the tie will be broken by a pseudo-random number generator built into the auction software.

61. Similar to the determination of base prices in the allocation stage, a second-price rule will be used to determine the assignment price to be paid for the assignment of specific licences such that winning bidders will pay an amount sufficient to ensure that there is no other bidder or group of bidders prepared to pay more for the licence(s).

62. The additional amount to be paid for the assignment of specific licences, known as the assignment price, is calculated for the package of specific licences bid for in the round, not for the individual licences. Given the pricing rules, the assignment price of each winning assignment stage package will be equal to or less than the corresponding winning bid amount, and could even be zero.

63. ISED will apply bidder-optimal core prices and use a “nearest Vickrey” approach to determine assignment prices. In the event that an additional payment above Vickrey prices is required, the calculation of the additional payment to be paid by each winning bidder will be weighted based on the relative size of the package it is being assigned in the given assignment round, evaluated at the opening bid prices. Further information on the determination of assignment prices can be found in annex F.

14. Assigning contiguous spectrum in the assignment stage

64. Recognizing the efficiency gains from having contiguous blocks of spectrum, ISED will assign bidders contiguous spectrum within a service area.

65. ISED will present all contiguous bidding options that are consistent with the allocation

stage winnings of a bidder, regardless of what other bidders have won. For example, a bidder that won two generic blocks in the allocation stage will have six bidding options: AB, BC, CD, DE, EF and FG, regardless of what other bidders won in the allocation stage. The bidder might not be able to win some of its bidding options if they are inconsistent with the contiguity restrictions of paragraph 64 of this annex. The purpose in presenting all contiguous bidding options, regardless of what other bidders have won, is to maintain anonymous bidding as much as possible and thereby reduce the potential for gaming behaviour in the assignment stage.

66. Further information on the process for submitting assignment round bids will be available in the information package provided to qualified bidders.

15. Information at the end of each assignment round

67. Following the end of each assignment round, after the results have been verified, participating bidders will be notified of the specific licences that they have won and the assignment price to be paid. In doing this, bidders will know their own results from one assignment round before participating in a subsequent assignment round.

16. Final price

68. At the end of the assignment stage, ISED will determine the final price that each winning bidder will be required to pay for the package of licences it has won. This final price will be equal to the base price plus any associated assignment price(s).

17. Information at the end of the assignment stage

69. Following the end of the assignment stage, winning bidders will be notified of the specific licences that they have won, as well as the final price to be paid.

18. Information after the end of the auction

70. The following information will be made publicly available following the conclusion of the auction process:

- the list of winning bidders, licences won (including category) and prices to be paid;
- the bids submitted by each bidder in every clock round, including their identity;
- the prices for each product in every clock round;
- the supplementary bids submitted by each bidder, including their identity; and
- the assignment bids submitted by each bidder, including their identity.

Annex D—Algebraic description of the GARP-based activity rules in the clock rounds and the supplementary round

1. Algebraic description of the GARP-based activity rule in the clock rounds

1. The GARP-based activity rule allows a bidder to submit a bid for a package Q that exceeds its eligibility if all of its bids—starting with the last round in which the bidder had sufficient eligibility for package Q and ending in the current round with a bid for package Q—are consistent with truthful bidding according to some set of implied valuations.

2. Algebraically, to check whether in round t a bidder is permitted to bid on a package Q_t that exceeds the bidder's eligibility, the auction system considers the last round (denoted by s) that the bidder had sufficient eligibility for the package Q_t. The bidder is allowed to bid on package Q_t in round t if there exists a set of numbers V_k for $k = s, \dots, t$ such that the following inequalities are satisfied:

$$V_j - \sum_{i=1}^{m} P_{k,i} \cdot Q_{j,i} \leq V_k - \sum_{i=1}^{m} P_{k,i} \cdot Q_{k,i}, \qquad \text{for all} \quad j = s, \dots, t \quad \text{and} \quad k = s, \dots, t,$$

where:

j and k index the rounds

i indexes the products

m is the number of products (i.e. 32)

$Q_{j,i}$ is the quantity of the i^{th} product in package Q_j of clock round j

$Q_{k,i}$ is the quantity of the i^{th} product in package Q_k of clock round k

$P_{k,i}$ is the clock price of the i^{th} product in clock round k

V_j is the bidder's implied valuation for package Q_j of clock round j

V_k is the bidder's implied valuation for package Q_k of clock round k

The inequalities above require that, for each round k, the bidder's implied valuation for the package it selected in round k minus the price for that package in round k is greater than or equal to the bidder's implied valuation for the package it selected in another round, for example j, minus the price for that package in round k. This test is conducted for all pairs of rounds up to round t.

3. The existence of numbers V_k for $k = s, \dots, t$ that satisfy the inequalities in paragraph 2 of this annex is equivalent to satisfying the GARP-based activity rule. GARP requires that the bidder's

bidding choices in rounds s, s+1, … , t correspond to truthful bidding with respect to some set of implied valuations, $v(Q)$, for every package Q. A bidder bids truthfully with respect to a set of valuations $v(Q)$ if, given the current price P_Q for each package Q, the bidder maximizes its profit $v(Q) - P_Q$ in each round.

2. Algebraic description of the GARP-based activity rule in the supplementary round

4. There is no limit on the supplementary bid amount for the final clock package unless the final clock package is the zero package. The GARP-based activity rule requires that each other package bid in the supplementary round must satisfy revealed preference with respect to the final clock round and all rounds (if any) in which the bidder bid for packages of a strictly smaller size than this package.

5. A supplementary bid, B, for the package Q satisfies revealed preference with respect to a clock round s, if the bid amount B minus the price for package Q in round s is less than or equal to the highest dollar amount bid on the package bid on in clock round s—that is, B_s—minus the price for that package in round s. Algebraically, the revealed preference constraint is the condition that:

$$B - \sum_{i=1}^{m} P_{s,i} \cdot Q_i \ \leq B_s - \sum_{i=1}^{m} P_{s,i} \cdot Q_{s,i} \, ,$$

where:

i indexes the products

m is the number of products

Q_i is the quantity of the i^{th} product in package Q

$Q_{s,i}$ is the quantity of the i^{th} product in package Q_s of clock round s

$P_{s,i}$ is the clock price of the i^{th} product in clock round s

B is the dollar amount of the supplementary bid on package Q

B_s is the highest dollar amount bid on package Q_s either in a clock round or in the supplementary round

6. The bidder is allowed to submit a supplementary bid for an amount B on a package Q if it satisfies the inequality condition of paragraph 5 of this annex for all rounds s that are the final clock round or another round in which the bidder bid for a package of strictly smaller size than Q.

Annex E—Example of the GARP-based activity rule for the clock rounds and supplementary round

1. Consider a set-aside-ineligible bidder, with initial eligibility of 200 points and a budget of $1,600,000, which is interested in ten (10) service areas associated with the following eligibility points: SA1, …, SA5 (20 points) and SA6, …, SA10 (14 points).

2. Suppose the bidder wants to bid on two open licences in each of five service areas, SA1 to SA5 (Package A). However, if the price of Package A exceeds the price of a package with two licences in SA6 to SA10 (Package B) by more than $400,000, then the bidder prefers Package B.

3. As prices increase, the bidder may be unable to continue bidding on either Package A or Package B, and will need to reduce its demand to one licence. In this case, the bidder prefers one licence in SA1 to SA5 (Package C) but will switch to one licence in SA6 to SA10 (Package D) if the price of Package C exceeds the price of Package D by more than $200,000.

4. Table E1 provides the clock round bidding history for this bidder. Round 8 is the final clock round.

Table E1: Clock round bidding history

	Prices (thousands)							**Activity (eligibility)**	**Bid amount** (thousands)
Round	**SA1**	**…**	**SA5**	**SA6**	**…**	**SA10**	**Bid (package)**		
1	$100	…	$100	$70	…	$70	2 open in SA1 to SA5 (A)	200 (200)	$1,000
2	$120	…	$120	$70	…	$70	2 open in SA6 to SA10 (B)	140 (200)	$700
3	$140	…	$140	$90	…	$90	2 open in SA6 to SA10 (B)	140 (140)	$900
4	$140	…	$140	$110	…	$110	2 open in SA1 to SA5 (A)	200 (140)	$1,400
5	$160	…	$160	$130	…	$130	2 open in SA1 to SA5 (A)	200 (140)	$1,600
6	$180	…	$180	$150	…	$150	2 open in SA6 to SA10 (B)	140 (140)	$1,500
7	$200	…	$200	$170	…	$170	1 open in SA1 to SA5 (C)	100 (140)	$1,000
8	$220	…	$220	$170	…	$170	1 open in SA6 to SA10 (D)	70 (100)	$850

5. In rounds 1, 2, 3, 6, 7 and 8, bids were within the bidder's eligibility, so revealed preference did not apply; however, in rounds 4 and 5, the bidder's activity exceeded its eligibility points.

Round 4

6. Using the GARP-based activity rule, to bid on Package A in Round 4, all of the bidder's bids, starting with the last round in which the bidder had sufficient eligibility to bid on Package A (Round 2) and ending in Round 4 with a bid on Package A, must be consistent with truthful bidding for some implied valuations. Mathematically, these revealed preference constraints are calculated as follows.

There needs to exist values $V_2, V_3,$ and V_4 such that the following inequalities are satisfied.

$$V_3 - (Price\ of\ B\ in\ R2) \leq V_2 - (Price\ of\ B\ in\ R2)$$
$$V_4 - (Price\ of\ A\ in\ R2) \leq V_2 - (Price\ of\ B\ in\ R2)$$
$$V_2 - (Price\ of\ B\ in\ R3) \leq V_3 - (Price\ of\ B\ in\ R3)$$
$$V_4 - (Price\ of\ A\ in\ R3) \leq V_3 - (Price\ of\ B\ in\ R3)$$
$$V_2 - (Price\ of\ B\ in\ R4) \leq V_4 - (Price\ of\ A\ in\ R4)$$
$$V_3 - (Price\ of\ B\ in\ R4) \leq V_4 - (Price\ of\ A\ in\ R4)$$

The first two inequalities arise because of the bid in Round 2, the next two inequalities because of the bid in Round 3, and the final two inequalities because of the desired bid on Package A in Round 4.

7. These six inequalities then become

$$V_3 - \$700{,}000 \leq V_2 - \$700{,}000 \quad \Rightarrow \quad V_3 \leq V_2$$
$$V_4 - \$1{,}200{,}000 \leq V_2 - \$700{,}000 \quad \Rightarrow \quad V_4 \leq V_2 + \$500{,}000$$
$$V_2 - \$900{,}000 \leq V_3 - \$900{,}000 \quad \Rightarrow \quad V_2 \leq V_3$$
$$V_4 - \$1{,}400{,}000 \leq V_3 - \$900{,}000 \quad \Rightarrow \quad V_4 \leq V_3 + \$500{,}000$$
$$V_2 - \$1{,}100{,}000 \leq V_4 - \$1{,}400{,}000 \quad \Rightarrow \quad V_2 \leq V_4 - \$300{,}000$$
$$V_3 - \$1{,}100{,}000 \leq V_4 - \$1{,}400{,}000 \quad \Rightarrow \quad V_3 \leq V_4 - \$300{,}000$$

8. These six inequalities are satisfied if and only if $V_2 = V_3$ and $V_3 + \$300{,}000 \leq V_4 \leq V_3 + \$500{,}000$. Since there exist values that satisfy all of these constraints simultaneously, the bidder is allowed to bid on Package A in Round 4.

Note: Given the same relative clock prices in both Round 2 and Round 3, and the fact that the bidder bid on the same package in both rounds, the revealed preference constraints associated with one of these rounds (either Round 2 or Round 3) are redundant and can be omitted. As a result, the system of six inequalities can be simplified to a system with one equation, $V_2 = V_3$, and two inequalities:

$$V_4 - \$1{,}400{,}000 \leq V_3 - \$900{,}000 \quad \Rightarrow \quad V_4 \leq V_3 + \$500{,}000$$
$$V_3 - \$1{,}100{,}000 \leq V_4 - \$1{,}400{,}000 \quad \Rightarrow \quad V_3 \leq V_4 - \$300{,}000$$

Round 5

9. Similar to Round 4, to bid on Package A in Round 5, all of the bidder's bids, starting with

Round 2 and ending in Round 5, must be consistent with truthful bidding for some implied valuation. As noted in paragraph 8 of this annex, the revealed preference constraints associated with one of Round 2 or Round 3 are redundant and can be omitted. Mathematically, these revealed preference constraints are calculated as follows.

There needs to exist values $V_2, V_3, V_4,$ and V_5 such that $V_2 = V_3$ and the following inequalities are satisfied.

$$V_4 - (Price\ of\ A\ in\ R3) \leq V_3 - (Price\ of\ B\ in\ R3)$$
$$V_5 - (Price\ of\ A\ in\ R3) \leq V_3 - (Price\ of\ B\ in\ R3)$$
$$V_3 - (Price\ of\ B\ in\ R4) \leq V_4 - (Price\ of\ A\ in\ R4)$$
$$V_5 - (Price\ of\ A\ in\ R4) \leq V_4 - (Price\ of\ A\ in\ R4)$$
$$V_3 - (Price\ of\ B\ in\ R5) \leq V_5 - (Price\ of\ A\ in\ R5)$$
$$V_4 - (Price\ of\ A\ in\ R5) \leq V_5 - (Price\ of\ A\ in\ R5)$$

The first two inequalities arise because of the bid in Round 3, the next two because of the bid in Round 4, and the final because of the desired bid on Package A in Round 5.

10. These six inequalities then become

$$V_4 - \$1{,}400{,}000 \leq V_3 - \$900{,}000 \quad => \quad V_4 \leq V_3 + \$500{,}000$$
$$V_5 - \$1{,}400{,}000 \leq V_3 - \$900{,}000 \quad => \quad V_5 \leq V_3 + \$500{,}000$$
$$V_3 - \$1{,}100{,}000 \leq V_4 - \$1{,}400{,}000 \quad => \quad V_3 \leq V_4 - \$300{,}000$$
$$V_5 - \$1{,}400{,}000 \leq V_4 - \$1{,}400{,}000 \quad => \quad V_5 \leq V_4$$
$$V_3 - \$1{,}300{,}000 \leq V_5 - \$1{,}600{,}000 \quad => \quad V_3 \leq V_5 - \$300{,}000$$
$$V_4 - \$1{,}600{,}000 \leq V_5 - \$1{,}600{,}000 \quad => \quad V_4 \leq V_5$$

11. These six inequalities are satisfied if and only if $V_4 = V_5$ and $V_3 + \$300{,}000 \leq V_5 \leq V_3 + \$500{,}000$. Since there exist values that satisfy all of these constraints simultaneously, the bidder is again allowed to bid on Package A in Round 5.

Note: Given the same relative clock prices in both Round 4 and Round 5, and the fact that the bidder bid on the same package in both rounds, the revealed preference constraints associated with one of these rounds (either Round 4 or Round 5) are redundant and can be omitted. As a result, the system of six inequalities can be simplified to a system with one equation, $V_4 = V_5$, and two inequalities:

$$V_5 - \$1{,}400{,}000 \leq V_3 - \$900{,}000 \quad => \quad V_5 \leq V_3 + \$500{,}000$$
$$V_3 - \$1{,}300{,}000 \leq V_5 - \$1{,}600{,}000 \quad => \quad V_3 \leq V_5 - \$300{,}000$$

Supplementary round

12. The following table summarizes the bidder's highest bid on each of its packages based the clock round bidding history listed above. These four bids will be carried into the supplementary round.

$$(Sup.Bid\ on\ E) - (Price\ of\ E\ in\ R7) \leq (Highest\ bid\ on\ C) - (Price\ of\ C\ in\ R7)$$
$$(Sup.Bid\ on\ E) \leq (Highest\ bid\ on\ C) - (Price\ of\ C\ in\ R7) + (Price\ of\ E\ in\ R7)$$
$$(Sup.Bid\ on\ E) \leq \$1{,}000{,}000 - \$1{,}000{,}000 + \$1{,}850{,}000$$
$$(Sup.Bid\ on\ E) \leq \$1{,}850{,}000$$

Package D with respect to Round 8

$$(Sup.Bid\ on\ E) - (Price\ of\ E\ in\ R8) \leq (Highest\ bid\ on\ D) - (Price\ of\ D\ in\ R8)$$
$$(Sup.Bid\ on\ E) \leq (Highest\ bid\ on\ D) - (Price\ of\ D\ in\ R8) + (Price\ of\ E\ in\ R8)$$
$$(Sup.Bid\ on\ E) \leq \$850{,}000 - \$850{,}000 + \$1{,}950{,}000$$
$$(Sup.Bid\ on\ E) \leq \$1{,}950{,}000$$

Without submitting a supplementary bid that increases the bid amount on any of its constraining packages, the bidder would be allowed to submit a bid on Package E up to $1,650,000.[3]

[3] Note that this limit is lower than the limit that would be calculated by the WARP-based activity rule used in the 700 MHz and 2500 MHz auctions (a limit of $1,750,000), because the GARP-based activity rule includes revealed preference constraints for more rounds. See annex D of the Consultation for details.