Auction 113 Technical Guide

1 Introduction

This technical guide details the proposed bidding procedures for Auction 113 as described in the *Auction 113 Comment Public Notice*.[1] The auction would use the "clock-1" auction format, a multiple-round auction format with bidding on specific-frequency licenses.

The clock-1 auction design proposed for Auction 113 is very similar to the design used in Auction 108.[2]

First, as in Auction 108, bidding in the clock phase will be for specific licenses rather than on generic blocks. In other words, the "supply" of each item offered in the clock phase is 1, and hence, the "clock-1" nomenclature. Accordingly, the clock rounds will determine the licenses won by each bidder and, as a result, no assignment phase is needed. Thus, the auction will consist solely of clock rounds.

Second, as in Auction 108, bidders will be permitted to submit proxy instructions. Specifically, whereas the clock price is the maximum price associated with a round, a bidder will be allowed to submit a proxy instruction indicating a price above the current round's clock price at which the bidder wants to reduce its demand for a license from one to zero. In subsequent rounds, the bidding system will then automatically submit proxy bids based on the bidder's proxy instructions.

However, there are also two key differences compared to Auction 108. First, unlike Auction 108, a "switch" bid to reduce demand for one license in a market and increase demand for another license in the same market will not be permitted.[3] Second, unlike Auction 108, a bidder will not be allowed to submit bids with associated bidding activity greater than its current bidding eligibility.[4]

Section 2 of this guide describes bidding, including proxy instructions and proxy bids. Section 3 describes the calculations for the bidding information shown to bidders. Section 4 describes how bids are processed after a round, and Section 5 describes the stopping rule. Section 6 describes the information policy, and Section 7 describes how the system sets up the next round if the stopping rule has not been met after a round. Section 8 describes how final payments and net license prices are calculated at the conclusion of the auction.

2 Bidding

The auction consists of a series of timed bidding rounds. A bidder in the auction indicates in each round its demand for licenses at the current prices. When submitting a bid, the bidder specifies a quantity and a price. Bids are processed after each round to determine the quantity of a bidder's requested demand that is applied (the *processed demand*) and the *posted price* of each license for that round. If, after the bids are processed, there is no excess demand for any license, then the auction ends and the *final price* for each

[1] *See Auction of Advanced Wireless Services (AWS-3) Licenses; Comment Sought on Competitive Bidding Procedures for Auction 113*, AU Docket No. 25-117, Public Notice, DA 25-193 (*Auction 113 Comment Public Notice*).

[2] *See Auction of Flexible-Use Licenses in the 2.5 GHz Band for Next-Generation Wireless Services; Notice and Filing Requirements, Minimum Opening Bids, Upfront Payments, and Other Procedures for Auction 108; Bidding Scheduled to Begin July 29, 2022*, AU Docket No. 20-429, Public Notice, 37 FCC Rcd 4370, 4426-43, paras. 174-236 (OEA/WTB 2022) (*Auction 108 Procedures Public Notice*).

[3] *See Auction 108 Procedures Public Notice*, 37 FCC Rcd at 4440, paras. 218-220.

[4] In Auction 108, a bidder was allowed to submit bids with associated bidding activity greater than its current bidding eligibility, up to its contingent bidding limit. A bidder's contingent bidding limit was equal to the contingent bidding percentage for the round (*e.g.*, 120%) times the bidder's eligibility for the round. *See Auction 108 Procedures Public Notice*, 37 FCC Rcd at 4434-36, paras. 199-202.

license is equal to the posted price of the last round. Otherwise, the auction will continue with a new round.

In Round 1, each bidder indicates the licenses it demands at the minimum opening bids by indicating a quantity of one for each of those licenses. After Round 1, a bidder has processed demand for each license that it bid for in the round, and the posted price of a license is the minimum opening bid for that license.

In each round after Round 1, a range of prices is associated with each license. The *start-of-round price* is the lowest price in the range, and the *clock price* is the highest price in the range. The start-of-round price for a license is equal to the posted price of the previous round for that license.

2.1 Bid Definition for Rounds After Round 1

A bid indicates a desired quantity for a license (0 or 1) at a price (between the start-of-round and the clock price, inclusive).

A bidder's processed demand after the previous round is either 0 or 1. This section describes the bids that a bidder can submit depending on its processed demand for a license.

Bid to maintain demand at the clock price. A bidder can submit such a bid if it has processed demand for the license. A bid to maintain its demand at the round's clock price indicates that the bidder is willing to buy the license at all prices in this round up to and including this round's clock price. Bids to maintain demand at prices below the round's clock price are not permitted.[5]

Bid to reduce demand. A bidder can submit such a bid if it has processed demand for the license. A bid requesting to reduce demand for a license (from 1 to 0) at price p in a round indicates that:

(1) The bidder is willing to buy the license at all prices greater than or equal to the start-of-round price and less than the bid price p;

(2) At price p, the bidder is indifferent between buying and not buying the license; and

(3) The bidder is not willing to buy the license at a price above p.

Bid to increase demand. A bidder can submit such a bid if it does not have processed demand for the license. A bid requesting to increase demand for a license (from 0 to 1) indicates that the bidder is willing to buy the license at all prices associated with this round (*i.e.*, prices that are greater than or equal to the start-of-round price and less than or equal to the clock price). A bidder submitting a bid to increase demand will specify a bid price which will be used to determine the order in which this bid is processed compared to other bids.[6] However, regardless of the bid price, a bid to increase demand indicates that the bidder is willing to buy the license at any price up to the round's clock price.[7]

[5] A bidder cannot submit a bid to maintain its demand at a price below the round's clock price. Bid prices below the round's clock price can only be used to indicate the price at which the bidder's requested demand *changes* from its processed demand from the previous round.

[6] The price of a bid to increase demand may affect the outcome of bid processing only when the bidder submits bids to increase demand for multiple licenses in the round. In the event that it is not possible to apply all of the bidder's bids to increase demand without exceeding the bidder's eligibility (e.g., because one or more of the bidder's bids to reduce demand cannot be applied), then the bid prices of the bids to increase demand may affect which of those bids are applied because the bid prices determine the order in which bids are prioritized for processing (as described in Section 4).

[7] The posted price for the current round may be above or below the bid price of a bid to increase demand that is applied during bid processing. For example, the posted price may be lower than the bid price if applying the increase allows another bidder's requested decrease at a lower price to be applied. As another example, if the bid

Bids at prices between the start-of-round price and the clock price are known as intra-round bids. As described in Section 2.3, intra-round bid prices are limited to multiples of $10 for prices below $10,000; to multiples of $100 for prices between $10,000 and $100,000, inclusive; and to multiples of $1,000 for prices above $100,000.

The possible bids for a license in a round after Round 1 are summarized in the following table.

Table 1. Possible bids after Round 1

Bid Description	Previous Round Processed Demand	Bid Quantity	Bid Price
Bid to Maintain Demand	1	1	Clock Price
Bid to Reduce Demand	1	0	Start-of-Round Price; Clock Price; or An Intra-Round Price
Bid to Increase Demand	0	1	Start-of-Round Price; Clock Price; or An Intra-Round Price

2.2 Proxy Instructions and Proxy Bids

Proxy instructions provide a means for a bidder that places a bid at the minimum opening bid in Round 1 or is maintaining its demand in a subsequent round to reduce its demand in a future round at a price of its choosing that is greater than the current round's clock price. In Round 1, a bidder is allowed to submit a proxy instruction for any license for which it submits a bid in the round. For example, if the minimum opening bid for a given license is $1,000 and the bidder is willing to purchase that license at any price up to $1,800, the bidder can submit a bid for the license at the minimum opening bid and also enter a proxy instruction specifying that it is willing to bid for the license up to the price of $1,800.

In a round after Round 1, a bidder with processed demand for a license that wishes to maintain its demand at the round's clock price is allowed to submit a proxy instruction to reduce its demand for that license to 0 at a price higher than the current round's clock price. For example, if a bidder has processed demand for a license with a clock price of $2,000, and the bidder is willing to purchase the license for a price up to $3,500, the bidder can submit a proxy instruction to reduce its demand for the license to 0 at $3,500. In a round after Round 1, a bidder will not be allowed to submit a proxy instruction for a license if its processed demand is 0 or if it submits a bid to change its demand for the license in the round.

If a proxy instruction has been submitted, the bidding system will automatically submit a proxy bid to maintain the bidder's demand for the license in every subsequent round as long as the clock price for the round is less than the proxy instruction price. In the first round in which the clock price is greater than or equal to the proxy instruction price, the bidding system will submit a proxy bid on behalf of the bidder to reduce the bidder's demand for that license to 0 at the proxy instruction price. This will be the highest price at which the system will submit a bid based on the proxy instruction.

In the case that a bid to reduce demand is not applied during bid processing, the bidding system will automatically generate a proxy instruction at the bid price and, in the following rounds, submit proxy bids on behalf of the bidder according to that proxy instruction. For example, suppose that the start-of-round price for a license is $10,000, the clock price is $12,000, and a bidder with processed demand for the

price is less than the clock price and there is excess demand for the license after the round, then the posted price will equal the clock price and thus will be higher than the bid price.

license submits a bid to reduce its demand to 0 at price $11,500. If the bid is not applied during bid processing (*e.g.*, because there were no other bids for the license in the round), then in the following rounds the bidding system would submit a proxy bid on behalf of the bidder to reduce demand for the license to 0 at price $11,500.

A proxy bid (*i.e.*, a bid that is submitted on behalf of the bidder based on a proxy instruction) is treated for purposes of bid processing and the activity rule like any other bid that is submitted by the bidder in the round.

In any round, a bidder can remove or modify any existing proxy instructions or proxy bids for the round, either through the user interface or by uploading a new bid file. The system would take the last bid submission as that bidder's bids and proxy instructions.

Example 1 – Proxy Instruction at $140,000; Clock Price Increases in Rounds 2 to 6: The minimum opening bid for a given license is $100,000. In Round 1, the bidder submits a bid for the license at the minimum opening bid and also submits a proxy instruction to reduce demand to 0 at price $140,000. This proxy instruction indicates that the bidder is willing to buy the license at any price up to $140,000. Suppose that the bidder does not submit any bids in the following rounds. Further suppose that, in Rounds 2, 3, 4, and 5, the aggregate demand for the license exceeds 1; thus, the clock price increases after each of those rounds. The following table shows the start-of-round price and the clock price for the license in Rounds 2 to 6 along with the proxy bid that will be submitted by the bidding system on behalf of the bidder in each of these rounds.

Round	Start-of-round Price	Clock Price	Proxy Bid
2	$100,000	$110,000	Bid to maintain demand at $110,000
3	$110,000	$121,000	Bid to maintain demand at $121,000
4	$121,000	$134,000	Bid to maintain demand at $134,000
5	$134,000	$148,000	Bid to reduce demand to 0 at $140,000
6	$148,000	$163,000	No Proxy Bid

We next consider a variation of Example 1 where the clock price for the license stops increasing after Round 4.

Example 2 – Proxy Instruction at $140,000; Clock Price Stops Increasing after Round 4: The minimum opening bid for a given license is $100,000. In Round 1, the bidder submits a bid for the license at the minimum opening bid and also submits a proxy instruction to reduce demand to 0 at price $140,000. Suppose that the bidder does not submit any bids in the following rounds.

This example assumes that the aggregate demand for the license exceeds 1 after Round 2, and that the aggregate demand drops to 1 in Round 3 at price $120,000. In Round 4, the start-of-round price is $120,000 and the clock price is $132,000. No other bidder bids for the license in the following rounds, so for each of the following rounds the start-of-round price is $120,000 and the clock price is $132,000. The following table shows the start-of-round price and the clock price for the license in Rounds 2 to 6 along with the proxy bid that will be submitted by the bidding system on behalf of the bidder in each of these rounds.

Round	Start-of-round Price	Clock Price	Proxy Bid
2	$100,000	$110,000	Bid to maintain demand at $110,000
3	$110,000	$121,000	Bid to maintain demand at $121,000

4	$120,000	$132,000	Bid to maintain demand at $132,000
5	$120,000	$132,000	Bid to maintain demand at $132,000
6	$120,000	$132,000	Bid to maintain demand at $132,000

Note that the system submits the same proxy bid in Rounds 4, 5 and 6. The bidding system will continue submitting a bid to maintain demand at the clock price as long as the clock price is below the proxy instruction price of $140,000. If there is no other bid for the license in the remainder of the auction, this bidder will win the license at price $120,000.

Example 3 – Proxy Instruction at $125,000; Clock Price Stops Increasing after Round 4: The minimum opening bid for a given license is $100,000. In Round 1, the bidder submits a bid for the license at the minimum opening bid and also submits a proxy instruction to reduce demand to 0 at price $125,000. This proxy instruction indicates that the bidder is willing to buy the license at any price up to $125,000. Suppose that the bidder does not submit any bids in the following rounds.

As in Example 2, we assume that the aggregate demand for the license exceeds 1 after Round 2, and that the aggregate demand drops to 1 in Round 3 at price $120,000. In Round 4, the start-of-round price is $120,000 and the clock price is $132,000. No other bidder bids for the license in the following rounds, so for each of the following rounds the start-of-round price is $120,000 and the clock price is $132,000. The following table shows the start-of-round price and the clock price for the license in Rounds 2 to 6 along with the proxy bid that will be submitted by the bidding system on behalf of the bidder in each of these rounds.

Round	Start-of-round Price	Clock Price	Proxy Bid
2	$100,000	$110,000	Bid to maintain demand at $110,000
3	$110,000	$121,000	Bid to maintain demand at $121,000
4	$120,000	$132,000	Bid to reduce demand to 0 at $125,000
5	$120,000	$132,000	Bid to reduce demand to 0 at $125,000
6	$120,000	$132,000	Bid to reduce demand to 0 at $125,000

The bidding system will continue submitting a bid to reduce demand to 0 at the proxy instruction price of $125,000 as long as the proxy instruction price is within the price range for the round (and the bidder has processed demand for the license). If there is no other bid for the license in the remainder of the auction, this bidder will win the license at price $120,000. However, if another bidder bids for the license in a later round, then the proxy bid to reduce demand to 0 at $125,000 will be applied.

Example 4 – Bid to Reduce Demand is Not Applied and Becomes a Proxy Instruction: In Round 10, for a given license, the start-of-round price is $200,000 and the clock price is $220,000. There are two bidders with processed demand for the license. Bidder 1 submits a bid to reduce demand to 0 at price $202,000, which indicates that the bidder is willing to buy the license at any price up to $202,000. Bidder 2 submits a bid to reduce demand to 0 at price $218,000, which indicates that the bidder is willing to buy the license at any price up to $218,000. No other bidder bids for the license in the round. During the bid processing for Round 10, the bid of Bidder 1 is applied, reducing the aggregate demand for the license to 1 (and setting the posted price at $202,000), whereas the bid of Bidder 2 is not applied. The bidding system will generate a proxy instruction to reduce the demand of Bidder 2 to 0 at price $218,000. Suppose that Bidder 2 does not submit any bids in the following rounds.

In Round 11, the start-of-round price is $202,000 and the clock price is $223,000. The bidding system will generate a proxy bid on behalf of Bidder 2 to reduce demand to 0 at $218,000. If there are no other bids for the license, this proxy bid will not be applied and the bidding system will enter the same proxy

bid on behalf of Bidder 2 in the following round. Suppose that another bidder (Bidder 3) bids for the license in Round 14. Then, the proxy bid to reduce the demand of Bidder 2 to 0 is applied, and the system does not submit a proxy bid on behalf of Bidder 2 in Round 15. This scenario is shown in the following table.

Round	Start-of-round Price	Clock Price	Proxy Bid
11	$202,000	$223,000	Bid to reduce demand to 0 at $218,000
12	$202,000	$223,000	Bid to reduce demand to 0 at $218,000
13	$202,000	$223,000	Bid to reduce demand to 0 at $218,000
14	$202,000	$223,000	Bid to reduce demand to 0 at $218,000
15	$218,000	$240,000	No Proxy Bid

2.3 Bidding Requirements

A bidder submits its bids for the round and any proxy instructions while the round is open for bidding.

A bidder will *not* be allowed to submit a bid or a collection of bids if the bidder's submitted activity for the round would exceed the bidder's eligibility for the round. This implies that, if a bidder's eligibility for the round is equal to 0, then the bidder will not be able to submit any bids. See Sections 3.1 and 7.1 for calculation of submitted activity and eligibility, respectively.

For a given license, a bidder may submit at most one bid and at most one proxy instruction in a round, subject to the requirements described below.

In the first round of the auction, a bidder may only submit a bid for a license at the minimum opening bid for that license and only for a quantity of 1. If the bidder submits a bid for a license at the minimum opening bid, the bidder can also submit a proxy instruction for a quantity of 0 at a price above the minimum opening bid.

For all subsequent rounds, a bidder may either submit a bid to maintain its demand for a license at the round's clock price or submit a bid to change its demand for the license at a price that is greater than or equal to the start-of-round price and less than or equal to the clock price. The bid quantity must be either 1 or 0.

After the first round of the auction, a bidder may submit a proxy instruction for a license only if the bidder has processed demand for the license and is willing to maintain its demand at the current round's clock price. To submit a proxy instruction for a license, the bidder must specify a price that is greater than this round's clock price and a quantity equal to 0. That is, the proxy instruction price indicates the price at which the bidder is willing to reduce its demand for the license to 0.

Each bid price and proxy instruction price specified by the bidder must be a multiple of $10, $100 or $1,000 according to the following requirements:

- A price below $10,000 must be a multiple of $10;
- A price between $10,000 and $100,000 (inclusive) must be a multiple of $100; and
- A price above $100,000 must be a multiple of $1,000.

3 Calculations for Bidding Information

3.1 Submitted Activity

When a clock round is open for bidding, the *submitted activity* of a bidder is calculated as the total number of bidding units associated with the licenses that the bidder indicates it is willing to buy at the clock price, given all bids that the bidder has submitted.[8] In Round 1, all licenses with bids are included in the submitted activity calculation. In a later round, a license is included in this calculation if *either* the bidder has processed demand for the license and has bid to maintain its demand at the round's clock price *or* the bidder has processed demand of 0 for the license and has submitted a bid to increase its demand to 1 in this round.

Example 5 – Calculation of Submitted Activity: License 1 has 10 bidding units and license 2 has 8 bidding units. For license 1, the start-of-round price is $5,000 and the clock price is $6,000. For license 2, the start-of-round price is $4,000 and the clock price is $4,800. Suppose that, after the previous round, the bidder has processed demand for each of these licenses. The bidder has submitted the following bids in the current bidding round:

- License 1: a bid to maintain demand for the license at the clock price.
- License 2: a bid to reduce demand to 0 at price $4,500.

After the bidder has submitted these two bids, its submitted activity is 10 bidding units. That is, only license 1 is included in the submitted activity calculation. License 2 is not included because the bidder is not willing to buy license 2 at the clock price.

3.2 Required Activity

A bidder's required activity in round t is the minimum total number of bidding units associated with the bidder's processed demand that the bidder must have after the bid processing of round t in order to maintain the same eligibility in round $t + 1$.

The required activity of bidder i in round t is calculated by multiplying the activity requirement percentage for round t by the eligibility of bidder i in round t. The result is rounded down to the nearest integer. The activity requirement percentage may change from round to round. The Auction 113 Comment PN proposes to set the activity requirement percentage within a range of 90% to 100% inclusive, and to set the initial activity requirement percentage at 95%.

3.3 Payment Information Available While the Round Is Open for Bidding

For the convenience of bidders, the bidding system will provide information about the financial exposure based on bidding during the course of the auction.

The following notation is used in this section:

- L denotes the set of all licenses.
- S denotes the set of all licenses in markets subject to the small market bidding credit cap (*i.e.*, markets with a population of 500,000 or less).

[8] The bidding system shows the submitted activity, as described here, during the bidding round. Processed activity and processed demand cannot be determined until after the round's bids have been processed, so will be made available to bidders after the round.

- $LC_{t,i}$ denotes the set of licenses that bidder i is willing to buy at the clock prices of round t, based on the bids it has submitted. In Round 1, this includes all the licenses for which the bidder has submitted bids. In a later round $t > 1$, a license is included in $LC_{t,i}$ if *either* the bidder has processed demand for the license and has bid to maintain its demand at the round's clock price *or* the bidder does not have processed demand for the license and has submitted a bid to increase its demand to 1 in this round.
- BC_i denotes the bidding credit percentage of bidder i.
- $CP_{t,l}$ denotes the clock price in round t for license l.
- $NCP_{t,i,l}$ denotes the net clock price of bidder i for license l in round t (defined in Section 3.3.2).
- $URD_{t,i,l}$ denotes the uncapped requested commitment discount of bidder i for license l in round t (defined in Section 3.3.2).

3.3.1 Requested Commitment

A bidder's *requested commitment* during a clock round t is the total bid amount calculated at the round's clock prices, given the bids that the bidder has submitted so far in round t. During the round, bids for the round will not yet have been processed, so the requested commitment is an estimate of a bidder's commitment, and the estimate is updated as the bidder submits its bids. This estimate assumes that all of the bidder's bids are applied during bid processing, which would include bids to reduce demand, and that, for each license, the posted price after the round equals the round's clock price. A bidder's commitment after the round (defined in Section 3.4.1) could be greater than its requested commitment (e.g., if a bid of the bidder to reduce demand is not applied during bid processing) or smaller than its requested commitment (e.g., if the posted price of a license for which the bidder has processed demand after the round is smaller than the clock price of the license in the round).

The requested commitment of bidder i in a clock round t is calculated by summing the clock prices of all licenses that the bidder is willing to buy at the clock prices of round t, that is:

$$\sum_{l \in LC_{t,i}} CP_{t,l}$$

Example 6 – Calculation of Requested Commitment: For license 1, the start-of-round price is $5,000 and the clock price is $6,000. For license 2, the start-of-round price is $4,000 and the clock price is $4,800. Suppose that, after the previous round, bidder i has processed demand for each of these licenses. The bidder has submitted the following bids in the current bidding round:

- License 1: a bid to maintain demand for the license at the clock price.
- License 2: a bid to reduce demand to 0 at price $4,500.

By submitting these bids, the bidder indicates that (1) it is willing to purchase license 1 at the clock price of $6,000, and (2) it is not willing to purchase license 2 at the clock price of $4,800. Thus, the bidder's requested commitment is $6,000.

3.3.2 Bidding Credit Discounts on Requested Commitment

This section describes the calculations for requested commitment bidding credit discounts in a round t. The calculations are equivalent to the bidding credit calculations for previous clock auctions (such as Auction 108) except that rounding is done at the license level for each bidder.

If bidder i qualifies for a bidding credit, the bidder's *net clock price* for license l in round t is calculated as $NCP_{t,i,l} = (1 - BC_i) \cdot CP_{t,l}$, rounded to the nearest integer.

The uncapped discount of bidder i for license l at the clock price of round t is then calculated as:

$$URD_{t,i,l} = CP_{t,l} - NCP_{t,i,l}$$

This represents the requested commitment discount of bidder i for license l in round t before applying any bidding credit caps.

The *uncapped requested commitment discount* of bidder i in round t (across all the bidder's bids) is then calculated by summing the bidder's uncapped requested commitment discounts across all licenses that it is willing to buy at the clock prices, that is:

$$\sum_{l \in LC_{t,i}} URD_{t,i,l}$$

Rural Service Provider Bidding Credit. If bidder i qualifies for the rural service provider bidding credit, then the bidder's *requested commitment discount* in round t is:

$$\min\left\{\$10 \text{ million}, \sum_{l \in LC_{t,i}} URD_{t,i,l}\right\}$$

This calculation caps the bidder's total bidding credit discount at $10 million. Note that the summation of uncapped discounts is across all licenses that the bidder is willing to buy at the clock prices.

Small Business Bidding Credit. If bidder i qualifies for the small business bidding credit, then in round t,

Its *uncapped requested commitment discount in small markets* is:

$$\sum_{l \in S \cap LC_{t,i}} URD_{t,i,l}$$

This summation is across all licenses in small markets that the bidder is willing to buy at the clock prices.

Its *requested commitment discount* (across all licenses) is:

$$\min\left\{\$25 \text{ million}, \sum_{l \in LC_{t,i} \setminus S} URD_{t,i,l} + \min\left\{\$10 \text{ million}, \sum_{l \in S \cap LC_{t,i}} URD_{t,i,l}\right\}\right\}$$

This calculation first caps the bidder's discount in small markets at $10 million, then adds the bidder's discount from all other licenses (*i.e.*, licenses that are not subject to the small market bidding credit cap) and caps the sum at $25 million.

3.3.3 Requested Net Commitment

A bidder's *requested net commitment* is equal to its requested commitment minus its requested commitment discount.

3.4 Payment Information Available After the Round Has Been Processed

After bid processing for a round, the bidding system will provide payment information to the bidder based on its processed demands and the posted prices for the round. The calculations are similar to the corresponding calculations for requested commitment and bidding credit discounts that are conducted during a round (as described in Section 3.3), except that the posted price ($PP_{t,l}$) is used instead of the clock price ($CP_{t,l}$) and the set of licenses for which bidder i has processed demand after round t ($LP_{t,i}$) is used instead of the set of licenses that the bidder is willing to buy at the round's clock prices ($LC_{t,i}$).

In addition to the notation of Section 3.3, the following notation is used in this section:

- $LP_{t,i}$ denotes the set of licenses for which bidder i has processed demand after round t.
- $PP_{t,i,l}$ denotes the posted price of license l after round t.
- $NPP_{t,i,l}$ denotes the net posted price of bidder i for license l after round t.
- $UD_{t,i,l}$ denotes the uncapped commitment discount of bidder i for license l after round.

3.4.1 Commitment

The bidder's *commitment* after a round is a dollar value that is calculated from the bidder's processed demands and the posted prices after the bid processing of the round.

The commitment of bidder i after round t is calculated by summing the posted prices of all licenses for which the bidder has processed demand, that is:

$$\sum_{l \in LP_{t,i}} PP_{t,l}$$

3.4.2 Bidding Credit Discounts on Commitment

This section describes the calculations for bidding credit discounts on a bidder's commitment after round t.

If bidder i qualifies for a bidding credit, the bidder's *net posted price* for license l after round t is calculated as $NPP_{t,i,l} = (1 - BC_i) \cdot PP_{t,l}$, rounded to the nearest integer.

The uncapped commitment discount of bidder i for license l after round t is then calculated as:

$$UD_{t,i,l} = PP_{t,l} - NPP_{t,i,l}$$

This represents the discount of bidder i for license l after round t, before applying any bidding credit caps.

The *uncapped commitment discount* of bidder i after round t is then calculated by summing the bidder's uncapped commitment discounts across all licenses for which the bidder has processed demand, that is:

$$\sum_{l \in LP_{t,i}} UD_{t,i,l}$$

Rural Service Provider Bidding Credit. If bidder i qualifies for the rural service provider bidding credit, then the *commitment discount* of bidder i after round t is:

$$D_{t,i} = \min\left\{\$10 \text{ million}, \sum_{l \in LP_{t,i}} UD_{t,i,l}\right\}$$

Small Business Bidding Credit. If bidder i qualifies for the small business bidding credit, then after round t,

Its *uncapped commitment discount in small markets* is:

$$\sum_{l \in S \cap LP_{t,i}} UD_{t,i,l}$$

Its *commitment discount* (across all licenses) is:

$$D_{t,i} = \min\left\{\$25 \text{ million}, \sum_{l \in LP_{t,i} \setminus S} UD_{t,i,l} + \min\left\{\$10 \text{ million}, \sum_{l \in S \cap LP_{t,i}} UD_{t,i,l}\right\}\right\}$$

3.4.3 Net Commitment

A bidder's *net commitment* after round t is equal to its commitment after round t minus its commitment discount.

4 Processing Bids for a Clock Round

This section describes bid processing in the clock rounds. The purpose of bid processing is to determine, at the conclusion of a round of bidding, the processed demands for all bidders and the posted prices for all the licenses.

4.1 Missing Bids

For each license for which the bidder had processed demand in the previous round, if the bidder did not submit a bid for that license during the current round and does not have a proxy instruction in place, the bidder will be deemed to have submitted a bid for that license with a quantity of 0 at the start-of-round price. For example, if the start-of-round price for a particular license is $6,000 and a bidder with processed demand for that license did not submit a bid in this round for that license and does not have a proxy instruction in place, it will be deemed to have bid a quantity of 0 at $6,000. Note that this does not necessarily mean that the bidder will have processed demand of 0 at $6,000 after the round. The missing bid will be processed just as if the bidder submitted a bid for a quantity of 0 at $6,000.

4.2 Price Points

The *price point* indicates the percentage of the distance between the start-of-round price and the clock price. Specifically, the price point of a bid is calculated as the following ratio:

$$\text{price point} = \frac{\text{bid price} - \text{start-of-round price}}{\text{clock price} - \text{start-of-round price}}$$

The result of the calculation is rounded to 10 decimal places.

For example, the 0% price point refers to the start-of-round price, the 100% price point refers to the clock price, and the 50% price point refers to the average of the start-of-round price and the clock price. As another example, if the start-of-round price is $5,000 and the clock price is $6,000, the price $5,100 corresponds to the 10% price point, and the price $5,400 corresponds to the 40% price point.

4.3 Processed Demands

Bids to maintain demand are always applied during bid processing.

Bids to change demand are prioritized for processing in the following order: by price point (from lowest to highest) across all bids, and then by bid-specific pseudorandom number (from lowest to highest). The priority ordering of bids remains the same throughout the bid processing of a round (that is, only one pseudorandom number is associated with a given bid in a round).[9]

A bid to increase demand (from 0 to 1) is applied if it would not cause the bidder's processed activity to exceed its eligibility for the round.

A bid to reduce demand (from 1 to 0) is applied if it would not cause the aggregate demand for the license to drop to 0 (*i.e.,* if this is not the only bidder with processed demand for the license).

The bid processing algorithm maintains a queue of all bids to change demand from the round that have not been applied. Whenever a bid is applied, the queue is re-tested to determine whether any bids in the queue can be applied. When a bid has been applied, it is removed from the queue; otherwise, it is kept in the queue so that it can be re-tested later. The re-testing of the queue is repeated until no bids remaining in the queue can be applied. Then the next bid from the round is processed until (1) all bids from the round have been processed, and (2) no bids in the queue can be applied. At that point, proxy instructions are generated for any bids to reduce demand remaining in the queue, *i.e.*, bids to reduce demand that were not applied (as described in Section 2.2). Then, all bids remaining in the queue are discarded.

The demands of a bidder following the processing of the bids for the round are referred to as its processed demands.

4.4 Posted Prices

Once processed demands have been determined, the posted price for a license is set based on the aggregate demand for that license. The aggregate demand of a license is the number of bidders with processed demand for that license.

The posted price of each license is determined as follows:

- If aggregate demand exceeds 1, the posted price equals the clock price for the round.
- If aggregate demand equals 1 and at least one bid to reduce demand for the license was applied, the posted price equals the highest bid price among all bids to reduce demand for the license that were applied. That is, the posted price is the price at which a reduction caused aggregate demand to equal one.

[9] Each pseudorandom number is drawn uniformly at random from the set $\{0,1,2,\ldots,2^{40}-1\}$.

- In all other cases, the posted price equals the start-of-round price (*i.e.*, the posted price of the previous round).

These rules ensure the following. First, a bidder that requested a reduction that was not applied will not pay more than its bid price for the license. Second, the posted price will be at least as high as any price at which multiple bidders still demanded the license.

5 Stopping Rule

After the bids of a round have been processed, the stopping rule is met if, for every license, the aggregate demand is less than or equal to 1. If the stopping rule is met, the auction concludes. Otherwise, the auction proceeds with a new clock round.

6 Information Policy

After each clock round, the following information will be publicly available on the Public Reporting System for each license: the aggregate demand, the posted price of the last completed round, and the clock price for the next round. The identities of bidders bidding for a specific license will not be disclosed until after Auction 113 concludes.

Each bidder will have access to additional information related to its own bidding and bid eligibility. Specifically, after the bids of a round have been processed, the bidding system will inform each bidder of its processed demand for every license and its eligibility for the next round.

After the conclusion of Auction 113, the bids of all bidders will be made available on the Public Reporting System. Bids placed according to proxy instructions will be attributed to the bidder, but the proxy instructions themselves will not be disclosed.

7 Setting Up the Next Round

If the bidding system determines that there is excess demand for at least one license, then the system sets up the next round. The system must calculate each bidder's eligibility for the next round based on the activity associated with the bidder's processed bids in the previous round. The bidding system also calculates the clock prices for the new round and, if there are any proxy instructions in place, generates the appropriate proxy bids for the round. This section provides the details of these calculations.

7.1 Processed Activity and Next Round Eligibility

A bidder's *processed activity* for a round is equal to the total number of bidding units associated with the bidder's processed demand after the bid processing of the round. Specifically, the processed activity of bidder i after round t is calculated as:

$$\sum_{l \in LP_{t,i}} b_l$$

Where:

- $LP_{t,i}$ denotes the set of licenses for which bidder i has processed demand after round t.
- b_l denotes the number of bidding units associated with license l.

An activity rule is used to require bidders to participate in each round of the auction. A bidder's eligibility in the first round is determined by the bidding units associated with its upfront payment.

A bidder's eligibility in subsequent rounds is calculated based on its eligibility in the previous round, its required activity (see Section 3.2), its processed activity, and the activity requirement percentage.

If the processed activity of bidder i after round t is greater than or equal to its required activity, then bidder i maintains its eligibility in the following round, that is, the bidder's eligibility for round $t + 1$ will equal the bidder's eligibility for round t.

Otherwise, the eligibility of bidder i for the round $t + 1$ is reduced and is set equal to the ratio of the bidder's processed activity for round t over the activity requirement percentage. The result is rounded up to the nearest integer.

Example 7 – Calculation of Eligibility: In a given round $t > 1$, the activity requirement percentage is 95%. Consider a bidder with eligibility of 10,000 bidding units in the round. The following table shows the bidding units, start-of-round prices, and clock prices for licenses X, Y, and Z, as well as the bidder's processed demands after the previous round and its submitted bids in this round.

License	Bidding Units	Previous Round Processed Demand	Start-of-Round Price	Clock Price	Submitted Bids Quantity@Price
X	6,000	1	$80,000	$88,000	1 @ $88,000
Y	4,000	1	$70,000	$77,000	0 @ $72,000
Z	3,000	0	$50,000	$55,000	1 @ $55,000

Based on the table above, the bidder has processed demand for licenses X and Y after the previous round. In this round, the bidder has submitted bids to maintain its demand for license X, to reduce its demand for license Y, and to increase its demand for license Z.

The bidder's submitted activity in this round is 6,000 + 3,000 = 9,000. The bidder will be allowed to submit these bids because the submitted activity does not exceed its eligibility for the round.

Note that the bid to maintain demand for license X will always be applied during bid processing.

This example considers two scenarios regarding whether the bids for license Y and Z are applied:

Scenario 1: There is excess demand in license Y. The bid to reduce demand in Y is applied, because this scenario assumes that there is excess demand in Y. As a result, the activity associated with the demand held by the bidder is 6,000. The bid to increase demand in Z is then applied, because that does not cause the bidder's processed activity to exceed its eligibility. As a result, the activity associated with the demand held by the bidder is now 6,000 + 3,000 = 9,000. The bidder's required activity for the round is 9,500 (that is, 95% of 10,000). Since the bidder's processed activity after the round (9,000) is less than its required activity for the round (9,500), the bidder's eligibility in the next round will be reduced to 9,474 bidding units (that is, 9,000/0.95 rounded up to the nearest integer).

Scenario 2: There is no excess demand in license Y. The bid to reduce demand in Y is not applied, because this scenario assumes that there is no excess demand in Y; thus, the bid is placed in the queue, and the activity associated with the demand held by the bidder continues to be 6,000 + 4,000 = 10,000. The bid to increase demand in Z is not applied, because applying it would cause the bidder's processed activity to become 6,000 + 4,000 + 3,000 = 13,000, which would exceed the bidder's eligibility of 10,000. Thus, the bidder's processed activity after the round is equal to 6,000 + 4,000 = 10,000 (which exceeds the bidder's required activity of 9,500). This means that the bidder maintains its eligibility at 10,000.

7.2 Clock Prices for the Next Round

The clock price of a license in the next round is calculated by incrementing the posted price from the previous round by a specified percentage.

Specifically, the clock price $CP_{t,l}$ for license l in round t is calculated as:

$$CP_{t,l} = (1 + y_t) \cdot PP_{t-1,l}$$

Where:

- y_t denotes the increment percentage for round t. The Auction 113 Comment PN proposes to set the increment percentage within a range of 5% to 30% inclusive, and to set the initial increment percentage at 10%. The increment percentage may change from round to round with advance notice.
- $PP_{t-1,l}$ denotes the posted price of license l after round $t-1$.

Results above $10,000 will be rounded up to the nearest $1,000; results below $10,000 but above $1,000 will be rounded up to the nearest $100; and results below $1,000 will be rounded up to the nearest $10.

The price increment may be capped if the total dollar amount of the increment (the difference between the clock price and the start-of-round price, that is, $CP_{t,l} - PP_{t-1,l}$) would exceed a certain amount.

Note that the clock price calculation for the next round applies to every license, regardless of whether there is excess demand for the license.

7.3 Proxy Bids for the Next Round

Once the clock prices have been determined, the bidding system will determine the proxy bids that it will submit on behalf of the bidders. The proxy bids on behalf of a given bidder will be submitted by the bidding system at the beginning of the round. Any bids (including proxy bids) and any proxy instructions can be modified by the bidder during the round.

Consider a bidder with processed demand for a given license that has a proxy instruction in place for that license.

If the proxy instruction price is within the price range for the next round, that is, between the start-of-round price and the clock price inclusive, then the bidding system will generate a proxy bid to reduce the bidder's demand for the license to 0 at the proxy instruction price.

Otherwise, *i.e.*, if the proxy instruction price is greater than the next round's clock price, the bidding system will generate a proxy bid to maintain the bidder's demand at the clock price. In this case, the bidding system will inform the bidder that it also has a proxy instruction in place for future rounds.

Example 8 – Proxy Bid to Reduce Demand: For a given license, the start-of-round price is $100,000 and the clock price is $115,000. A bidder with processed demand for the license has a proxy instruction to reduce demand at $108,000. Then, the bidding system will submit a proxy bid to reduce the bidder's demand at $108,000.

Example 9 – Proxy Bid to Maintain Demand: For a given license, the start-of-round price is $100,000 and the clock price is $115,000. A bidder with processed demand for the license has a proxy instruction to reduce demand at $140,000. Then, the bidding system will submit a proxy bid to maintain the bidder's demand at $115,000 (the clock price). The bidding system will also inform the bidder that it has a proxy instruction to reduce demand at $140,000.

8 Final Payments and Net License Prices

A bidder with processed demand for one or more licenses at the time the stopping rule is met will become the winning bidder for those licenses. The *final price* for a license is equal to the posted price for the final round, and the *final payment* of a winning bidder is equal to the net commitment of that bidder after the final round. See Section 3.4 for the definitions of commitment, commitment discount, net commitment after a round, and uncapped commitment discount in small markets.

Because the discount and the final payment for a winning bidder with a bidding credit apply on an aggregate basis, rather than for individual licenses, the bidding system will also calculate a *net price* for each license won. Such individual prices may be needed in the event that a licensee subsequently incurs license-specific obligations, such as unjust enrichment payments.

For a license won by a bidder that does not qualify for a bidding credit, the net price is simply equal to the final price of the license.

For a license won by a bidder that qualifies for a bidding credit and did not exceed its cap(s), the net price is equal to the net posted price of the license for the bidder after the final round. (See Section 3.4.2 for the definition of net posted price.)

For a bidder that qualifies for a bidding credit and exceeded its cap(s), net license prices are calculated by apportioning the bidder's discount to the licenses it won in proportion to the uncapped commitment discount for each individual license, as described below.

To describe the net license price calculations for a bidder that qualifies for a bidding credit and exceeded its cap(s), we use the following notation:

- S denotes the set of all licenses in markets subject to the small market bidding credit cap (*i.e.*, markets with a population of 500,000 or less).
- $LP_{T,i}$ denotes the set of licenses for which bidder i has processed demand after the final round (*i.e.*, the set of licenses won by bidder i).
- $PP_{T,l}$ denotes the posted price for license l after the final round (*i.e.*, the final price).
- $D_{T,i}$ denotes the commitment discount of bidder i after the final round (*i.e.*, the bidder's overall final discount).
- $UD_{T,i,l}$ denotes the uncapped commitment discount of bidder i for license l after the final round.

See Section 3.4.2 for the definition of a bidder's uncapped commitment discount for a license after a round.

A bidder i that qualifies for the small business bidding credit is considered to have exceeded the small market bidding credit cap if its uncapped commitment discount in small markets after the final round exceeds $10 million.

If bidder i qualifies for rural service provider bidding credit *or* if the bidder qualifies for the small business bidding credit and did not exceed the small market bidding credit cap, then the net price of a license l won by the bidder is determined by the following formula:

$$PP_{T,l} - \frac{UD_{T,i,l}}{\sum_{k \in LP_{T,i}} UD_{T,i,k}} \cdot D_{T,i}$$

That is, the bidding system calculates net prices by apportioning the bidder's discount to licenses in proportion to the uncapped discounts of the licenses that the bidder won.

Each license calculation is rounded down to the nearest dollar and then the slack due to rounding down is distributed to licenses (one dollar at a time) based on descending order of final prices. Ties are broken based on ascending lexicographic order of license ID. License ID is defined as the market ID, followed

by a hyphen and the frequency block; for example, CMA105-G is an AWS-3 license for frequency block G in CMA105.

If bidder i qualifies for the small business bidding credit and bidder i exceeded the small market bidding credit cap, then the $10 million discount that applies to small markets is apportioned to licenses won by the bidder in markets subject to the small market bidding credit cap proportionally to the uncapped discounts of those licenses. The remaining discount (*i.e.*, $D_{T,i} - \$10 \text{ million}$) is apportioned among the licenses in markets not subject to the small market bidding credit cap proportionally to the uncapped discounts of those licenses. In particular:

- The net price of a license l in a market that is subject to the small market bidding credit cap is determined by the following formula:

$$PP_{T,l} - \frac{UD_{T,i,l}}{\sum_{k \in S \cap LP_{T,i}} UD_{T,i,k}} \cdot (\$10 \text{ million})$$

- The net price of a license l in a market that is not subject to the small market bidding credit cap is determined by the following formula:

$$PP_{T,l} - \frac{UD_{T,i,l}}{\sum_{l \in LP_{t,i} \setminus S} UD_{T,i,k}} \cdot (D_{T,i} - \$10 \text{ million})$$

For each license, the calculation is rounded down to the nearest dollar. The slack due to rounding down is then distributed (one dollar at a time) to licenses based on descending order of final clock prices. Ties are broken based on ascending lexicographic order of license ID.

In the case of a small business that exceeded the small market bidding credit cap, the apportioning of discounts and the distribution of any slack is done separately for the licenses in small markets and for the licenses not in small markets.