



PUBLIC NOTICE

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DA 17-733

Released: August 4, 2017

TECHNICAL GUIDE ON PROPOSED BIDDING PROCEDURES FOR THE CONNECT AMERICA FUND PHASE II AUCTION (AUCTION 903)

AU Docket No. 17-182
WC Docket No. 10-90

1. The Rural Broadband Auctions Task Force, Wireline Competition Bureau, and Wireless Telecommunications Bureau today release a guide that provides technical and mathematical detail regarding the proposed bidding, assignment, and support amount determination procedures for the Connect America Fund Phase II Auction (Auction 903).

2. This guide is intended to supplement the bidding procedures the Commission proposed in the *CAF II Auction Comment Public Notice*.¹ To provide additional clarity to potential bidders—many of which may have never participated in a Commission auction—the Commission directed the Wireline Competition and Wireless Telecommunications Bureaus to release a technical guide containing further details of the proposed bidding procedures and specific examples of how the procedures would operate in practice.²

3. The guide, which is entitled *Technical Guidance: Bidding Procedures and Bid Processing Algorithms*, is attached herewith as Appendix A.

4. For further information concerning this proceeding, contact the offices listed below:

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¹ *Comment Sought on Competitive Bidding Procedures and Certain Program Requirements for the Connect America Phase II Auction (Auction 903)*, Public Notice, FCC 17-101 (Aug. 4, 2017) (*CAF II Auction Comment Public Notice*).

² *Id.* at paras. 4, 71.

APPENDIX A

Technical Guidance

Bidding Procedures and Bid Processing Algorithms

1 Introduction

This document details the proposed process for bidding and bid processing as a supplement to the proposed procedures described in the *CAF II Auction Comment Public Notice*. This introduction provides an overview of the proposed process.

A bid in the CAF Phase II auction indicates that the bidder agrees to provide service to locations in the eligible census blocks associated with an area (a census block group) at the performance tier and latency specified in the bid, in exchange for support, provided that the bid is assigned during bid processing and identified as a winning bid in a public notice announcing the close of the auction, and the support is authorized after post-auction long-form review. The Commission has established weights for each of the performance tier and latency combinations available for bidding in the auction. A reserve price will be announced for each area based on the methodology adopted by the Commission after consideration of comments received regarding the methodology proposed in the Comment Public Notice. Bidders will bid for support based on a percentage of the reserve price, and before each round, the auction system will provide bidders with the base clock percentage for the round, which will determine the range of percentages at which bidders can place bids during the round. Given the bid's percentage, the reserve price, and the performance tier and latency weights, a bidder will be able to use the implied support formula to calculate the annual support amount corresponding to its bid.

As proposed, the auction will be conducted in successive rounds of bidding. The base clock percentage will be decremented in each successive round. A bidder will submit a bid during a round at the base clock percentage or at another percentage between the base clock percentage and the prior round's base clock percentage. Once a round concludes, the bidding system processes the bids. The budget is said to clear in the first round in which an estimated aggregate cost of bids at the current round's base clock percentage is less than or equal to the budget. This round is referred to as the "clearing round." When processing bids for the clearing round, the bidding system first will determine which bids are assigned for which areas, and then will use a second-price rule to determine a support payment for each assigned area that is at least as large as the implied support amount corresponding to the bid.

After the clearing round, bidding rounds will continue so long as any area is contested (i.e., included in multiple bidders' bids at the round's base clock percentage). Once the budget has cleared, bids for areas at a round's base clock percentage that are not assigned in that round carry forward to the following round. After each round, the bidding system checks whether any bids for any additional areas can be assigned. A round is deemed to be the final round if the budget has cleared and there are no contested areas (at the round's base clock percentage).

Section 2 describes how the implied support amount is calculated given a percentage, the reserve price for a geographic area, and a performance tier and latency combination. Section 3 describes bidding for geographic areas. Section 4 describes the activity rules and other bidding procedures. Section 5 describes carried-forward bids. Section 6 describes the bid processing. Section 7 describes calculations for information that will be provided to the bidders during and after a round. Section 8 provides an illustrative example.

2 Price Points and Implied Support Amounts

The base clock percentage of round 1 is set one decrement lower than the opening base clock percentage. In round 1, bidders can submit bids at any price point (with up to two decimal places) that is greater than or equal to the base clock percentage of round 1 and less than or equal to the opening base clock percentage. In any later round, bidders can submit bids with any price point (with up to two decimal places) that is greater than or equal to the round's base clock percentage and less than the previous round's base clock percentage.

For a given area and a given performance tier and latency combination, the annual support amount corresponding to a price point PP is calculated using the following formula:

$$\text{Implied support} = \min \left\{ R, \left(\frac{PP - (T + L)}{100} \right) R \right\},$$

where:

- R denotes the area's reserve price;
- T denotes the tier weight; and
- L denotes the latency weight.

We refer to this support amount as the *implied support amount* for the given area and performance tier and latency combination. Implied support amounts are rounded to the nearest cent.

The implied support for an area at a given performance tier and latency combination is equal to the reserve price as long as the price point (the base clock percentage or an intermediate percentage) is greater than the sum of the performance tier and latency weights plus 100.³ Once the price point falls below $T+L+100$, the implied support for the performance tier and latency starts to be reduced from the reserve price.

Example 1:⁴ Consider an area with a reserve price of \$200.

- For a tier weight of 0 and a latency weight of 0, the implied support at the 140% price point is \$200 (i.e., the reserve price, since $\{(140-0)/100\} * 200$ is greater than 200, or equivalently, 140 is greater than $(0+100)$). The implied support at the 75% price point is \$150, since $\{(75-0)/100\} * 200$, or $(.75 * 200) = 150$, is less than 200.
- Similarly, for a tier weight of 45 and a latency weight of 0, the implied support at the 140% price point is \$190 and the implied support at the 75% price point is \$60.

Example 2: Consider an area with a reserve price of \$160.

- For a tier weight of 65 and a latency weight of 0, the implied support at the 170% price point is \$160 (i.e., the reserve price, since $\{(170-65)/100\} * 160$ is greater than 160, or equivalently, 170 is greater than $(65+100)$). The implied support at the 140% price point is \$120, since $\{(140-65)/100\} * 160$, or $(.75 * 160) = 120$, is less than 160. Similarly, the implied support at the 100% price point is \$56, since $\{(100-65)/100\} * 160$, or $(.35 * 160) = 56$.

Figure 1 illustrates the implied support amounts for various tier and latency weights as a function of the

³ Whole percentages are expressed as whole numbers, rather than as decimals. For example, a price point or base clock percentage of 75 percent is written as 75, not .75. A price point of 50.5 is one-half of one percent larger than 50.

⁴ The examples in this document are for illustration only and do not reflect estimates or expectations of auction outcomes.

price point, for an area with a reserve price of \$200 (left panel) and for an area with a reserve price of \$160 (right panel).



Figure 1

3 Bidding for Geographic Areas

3.1 Bid for a Single Area

A bidder can submit a bid for support for a specific area (census block group) by specifying a performance tier, a latency, and a price point percentage. If that bid is assigned during bid processing and identified as a winning bid in a public notice announcing the close of the auction, and the bidder is authorized to receive support during post-auction application processing, the bidder will then have the obligation to provide service to that area at the specified performance tier and latency in return for support greater than or equal to the support amount implied by the bid percentage (using the implied support formula). Because a second-price rule is used, the support payment to the bidder may be higher than the support amount implied by the bid percentage.

Example 3: Consider a bidder that is bidding to provide service with a tier weight of 45 and a latency weight of 0, for an area with a reserve price of \$200. Suppose that the previous round’s base clock percentage was 80% and the current round’s base clock percentage is 75%. If this bidder submits a bid at the 77.5% price point and the bid is assigned during bid processing, the bidder will have the obligation to provide service at the specified performance tier and latency, and will receive a support amount of at least $\$65 = \left(\frac{77.5-45}{100}\right) \200 .

Example 4: Consider a bidder that is bidding to provide service with a tier weight of 45 and a latency weight of 25, for an area with a reserve price of \$300. Suppose that the previous round’s base clock percentage was 130% and the current round’s base clock percentage is 120%. If this bidder submits a bid at the 128% price point and the bid is assigned during bid processing, the bidder will have the obligation to provide service at the specified performance tier and latency, and will receive a support amount of at least $\$174 = \left(\frac{128-(45+25)}{100}\right) \300 .

3.2 Bid for a Package of Areas

A bidder may also submit package bids. Package bids may be assigned partially if it is not possible for the system to assign them in full. To submit a package bid, the bidder specifies a price point, a list of areas and a minimum scale condition in terms of a percentage that indicates the bidder's lowest acceptable partial assignment.⁵ The bidder also specifies the performance tier and the latency for each area in the bid. With such a package bid, the bidder is offering to provide service to any subset of the specified list of areas, each at the support amount implied by the price point of the bid and the performance tier and latency that the bidder indicated for the area, as long as the subset is large enough that the sum of the implied support amounts for the subset is at least, for example, 70% (or another percentage no greater than the Commission-defined maximum) of the sum of the implied support amounts for the whole package, and subject to the rules of carried forward bids (see Sections 5 and 6.3).

As described above, a bidder is allowed to include, within a single package bid, census block groups with different specified performance tier and latency combinations. Note, however, that a bid to provide a given performance tier and latency combination will apply to all the locations in a particular census block group. That is, a bidder cannot bid to provide different levels of service to different locations within a single census block group.

Example 5: Consider a bidder that submits a package bid for areas 1, 2, 3, and 4 at a price point of 75% with a minimum scale percentage of 80%. We also assume that the bidder chooses the same tiers and latencies for each of the four areas. The following table shows the reserve price for each of these four areas, and the weight of the tier and the latency that the bidder selected for each of those areas in its bid. The last column of the table shows the implied support for each area at the 75% price point.

Area	Reserve Price	Tier Weight	Latency Weight	Implied Support at 75% Price Point
1	\$120	15	0	\$72
2	\$140	15	0	\$84
3	\$160	15	0	\$96
4	\$200	15	0	\$120

The sum of the implied support amounts for the whole package is $\$72 + \$84 + \$96 + \$120 = \$372$. For a subset of the areas in the package to be assigned, the total implied support amounts for the subset must be at least 80% of \$372, or \$297.60. If the package bid cannot be assigned in full, the bidder can be assigned areas 2, 3 and 4, because the sum of the implied support amounts is $\$84 + \$96 + \$120 = \300 , which is more than 80% of \$372; that is, the subset meets the scale condition. On the other hand, the bidder cannot be assigned only areas 1, 2 and 3, because the sum of the implied support amounts is $\$72 + \$84 + \$96 = \252 , which is less than 80% of \$372; that is, the subset does not meet the scale condition.

Example 6: We now provide a variation of Example 5, where the bidder submits a package bid but specifies mixed performance tier and latency combinations for different areas in the bid. Consider a bidder that submits a package bid for areas 1, 2, 3, and 4 at a price point of 75% with a minimum scale percentage of 80%. The following table shows the reserve price for each of these four areas, and the weight of the performance tier and latency that the bidder selected for each of those areas in its bid. The last column of the table shows the implied support for each area at the 75% price point.

⁵ The Commission has proposed 80 percent as the Commission-defined maximum of the minimum scale percentage. See *CAF II Auction Comment Public Notice* at para. 92.

Area	Reserve Price	Tier Weight	Latency Weight	Implied Support at 75% Price Point
1	\$120	0	0	\$90
2	\$140	0	0	\$105
3	\$160	15	0	\$96
4	\$200	15	0	\$120

The sum of the implied support amounts for the whole package is $\$90 + \$105 + \$96 + \$120 = \$411$. In this example, the bidder now cannot be assigned only areas 2, 3 and 4, because the sum of the associated implied support amounts is $\$105 + \$96 + \$120 = \321 , which is less than 80% of $\$411$; that is, the subset does not meet the scale condition.

3.3 Proxy Instructions

A bidder is allowed to submit a proxy instruction to bid for a single area or a package of areas by indicating a price point that is below the current round's base clock percentage. A proxy instruction is interpreted as a permission for the auction system to automatically bid for that area or that package of areas on behalf of the bidder as long as the percentage in the proxy instruction is less than the previous round's base clock percentage. If the percentage in the proxy instruction is less than the current round's base clock percentage, the system will submit a bid at the current base clock percentage. If the proxy percentage is between the current and the previous round's base clock percentages, the system will automatically bid at the price point of the proxy percentage. This will be the lowest price point at which the system will submit a bid based on the proxy instruction.

After the budget clears, bidding for some areas may carry over to subsequent rounds. Proxy instructions for those areas will continue to apply as long as the proxy percentage is less than the prior round's base clock percentage. Specifically, the proxy instructions will continue to apply to unassigned areas in a package bid that was only partially assigned. That is, the price point percentage specified in the proxy instructions will apply to bids for the individual remainder areas.⁶

A proxy bid (i.e., a bid that is submitted on behalf of the bidder based on a proxy instruction) is treated like any other bid that is submitted by the bidder in the round for purposes of bid processing and the activity rules. Thus, in the following sections, a bidder's submitted bids in a round refers both to the bids that were submitted by the bidder in the round and to any proxy bids submitted automatically based on the bidder's proxy instructions.

A bidder will be able to revise or cancel its proxy instruction while the proxy instruction is still in effect provided that (1) a bidding round is open, and (2) the area (or the areas in case of a package bid) has not yet been assigned.

Example 7: In round 8, the base clock percentage is 90%. The bidder submits a proxy instruction for area 1 with a proxy percentage of 72%. Suppose the bidder does not bid in the following rounds. The following table shows the base clock percentages of the following rounds and the proxy bids that will be submitted by the bidding system on behalf of the bidder.

⁶ As described in Section 4.2, once the budget has cleared, remainders of partially-assigned packages can only be bid as individual areas.

Round	Base Clock Percentage	Price Point of Proxy Bid for Area 1
9	85%	85%
10	80%	80%
11	75%	75%
12	70%	72%
13	65%	No Proxy Bid

Example 8: The bidder has submitted a proxy instruction with a proxy percentage of 72% for the package of areas 1, 2, 3, 4, and 5 with a minimum scale percentage of 80%. In round 8, the base clock percentage is 90%. Areas 1, 2, and 3 are not contested at the base clock percentage and thus are assigned to the bidder (the minimum scale percentage is assumed to be met). Areas 4 and 5 are contested. In the following round 9, when the base percentage is 80%, there is a proxy instruction for area 4 and a separate proxy instruction for area 5, both with a proxy instruction percentage of 72%. The proxy instruction will continue into round 10 at a base clock percentage of 70% if areas 4 and/or 5 are still contested.

4 Bidding Procedures

A bidder submits its bids for a round while the round is open for bidding.

The price point of a bid can have up to two decimal places. For instance, 80% or 80.52% is allowed, but 80.574% is not allowed. Similarly, the minimum scale percentage associated with a package bid can have up to two decimal places.

A bid is permitted to include as few or as many areas as are available in the auction and have not yet been assigned subject to the requirements of Section 4.1 and the activity rules described in Section 4.2.

4.1 Bidding Requirements

The following bidding requirements apply:

- i. If a bidder submits multiple bids within a round, each area can be in only one bid, including package bids;
- ii. All the areas in a package must be in the same state;
- iii. A bidder can only bid on areas that are in states that the bidder selected on its application and for which it qualified;
- iv. A bidder can only bid for a performance tier and latency combination that it selected on its application for a given state (and for which it qualified);
- v. The price point in a bid must be greater than or equal to $T+L+1$, where T is the tier weight and L is the latency weight. In other words, the implied support amount must be at least one percent of the area's reserve price to be acceptable. If all price points associated with a round are less than $T+L+1$, bids for that performance tier and latency are no longer accepted; and
- vi. The minimum scale percentage indicated for a package must not exceed a limit to be announced by public notice with the final bidding procedures, e.g., 80%.

The bidding system will not accept bids that violate one or more of requirements i-vi listed above.

Example 9: If $T+L=0$, a bid for that performance tier and latency will be accepted only if the price point is greater than or equal to 1%. As another example, if $T+L=90$, a bid for that performance tier and latency will be accepted only if the price point is greater than or equal to 91%.

4.2 Activity Rules

A bidder's *activity* in a round equals the sum of the implied support amounts across all the bidder's bids submitted in the round.⁷

Example 10: The base clock percentage in a round is 75% and the base clock percentage in the previous round was 80%. Areas 1 and 2 have reserve prices of \$200 and \$100, respectively. A bidder submits a bid for area 1 at the 78% price point and a bid for area 2 at the 75% price point (both bids specify a performance tier weight of 0 and a latency weight of 0). Thus, the implied support amounts of these bids are \$156 and \$75, respectively. Then, the bidder's activity in the round equals $\$156 + \$75 = \$231$.

Activity rules limit a bidder's activity in a round based on its bidding in the prior round, as follows:

If the budget has not yet cleared:

- A bidder's activity cannot exceed its activity from the previous round; and
- The bidder's activity from areas that the bidder did not bid on at the previous round's base clock percentage cannot exceed the maximum switching percentage (to be announced by public notice with the final bidding procedures, e.g. 10%) times the bidder's activity at the previous round's base clock percentage.

Beginning in the first round after the clearing round:

- No switching is allowed. A bidder can only bid for an area, performance tier, and latency combination for which it was bidding at the previous round's base clock percentage.
- Any package bid is acceptable only if it is the same as or a subset of a package bid submitted by the same bidder at the previous round's base clock percentage. That is, subdividing packages is permitted, while combining packages is not; and
- Remainders of partially-assigned packages can only be bid as individual areas.

Once the budget has cleared and no switching is allowed, the bidder's activity in a round is guaranteed to be less than its activity in the previous round, because the base clock percentage descends from one round to the next and the bidder is not allowed to bid at the previous round's base clock percentage.

Before the budget clears, the activity rules limit overall activity (for all areas and all performance tiers and latencies). In addition, the maximum switching requirement limits a bidder's ability to bid for areas for which it did not bid at the previous round's base clock percentage. As a result, a bidder's overall activity in the current round may be limited if the bidder did not bid for a sufficient number of areas at the base clock percentage of the previous round. For instance, if the bidder did not submit any bids at the previous round's base clock percentage, the bidder will not be able to submit any bids in the current round.

The maximum switching percentage does not apply to changes in the performance tier and latency specified for an area for which the bidder bid at the previous base clock percentage. However, the overall activity rule may limit the feasibility of changing to bid on a performance tier and latency combination

⁷ This includes any proxy bids that were submitted on behalf of the bidder based on its proxy instructions.

with a lower weight, because activity—that is, total implied support—is not permitted to increase from round to round. With such a change in performance and latency, the increase in implied support corresponding to the lower weighted T+L may outweigh the decrease in implied support from a lower base clock percentage, with the result that activity would increase from one round to the next. Conversely, a bidder may freely change from the Gigabit performance tier, for example, to a lower service level, since that only decreases the activity.

A bidder is allowed to change the minimum scale percentage of a package bid in any round.

Example 11: Suppose that the base clock percentage of round 12 is 75%. Consider a bidder who submits the following bids in round 12:

- A package bid for areas 1, 2, 3 and 4 at the base clock percentage (i.e., a price point of 75%) with a minimum scale percentage of 80%; and
- A bid for area 5 at a price point of 78%.

The following table shows the reserve price for each of these five areas, and the weight of the performance tier and latency that the bidder selected for each of those areas in its bid. The last two columns of the table show the price point at which the area is bid and the implied support for the area at that price point.

Area	Reserve Price	Tier Weight	Latency Weight	Bid Percentage	Implied Support
1	\$120	0	0	75%	\$90
2	\$140	0	0	75%	\$105
3	\$160	15	0	75%	\$96
4	\$200	15	0	75%	\$120
5	\$100	0	0	78%	\$78

The bidder’s activity for round 12 is $\$90 + \$105 + \$96 + \$120 + \$78 = \489 , whereas its activity at the base clock percentage is $\$90 + \$105 + \$96 + \$120 = \$411$.

Suppose that the budget has not yet cleared by round 12, the base clock percentage of round 13 is 70%, and the maximum switching percentage is 10%. Then, the bidder’s activity in round 13 can be at most \$489 and its activity from areas other than 1, 2, 3, and 4 can be at most 10% of \$411, that is, \$41.10.

For instance, the bidder can submit the following bids in round 13:

- A package bid for areas 1, 2, 3 and 4 (with the same performance tier and latency as in round 12) at the base clock percentage (i.e., a price point of 70%) with a minimum scale percentage of 80%; and
- A bid for area 6 with a reserve price of \$70 for tier weight 15 and latency weight 0 at the base clock percentage (i.e., a price point of 70%)

The following table shows the implied support for each area in these bids:

Area	Reserve Price	Tier Weight	Latency Weight	Bid Percentage	Implied Support
1	\$120	0	0	70%	\$84
2	\$140	0	0	70%	\$98
3	\$160	15	0	70%	\$88
4	\$200	15	0	70%	\$110
6	\$70	15	0	70%	\$38.50

These bids are allowed because the following conditions are satisfied:

- (1) The activity is \$418.50 which is less than the bidder's activity in the previous round (i.e., \$489); and
- (2) The activity from areas on which the bidder did not bid at the previous round's base clock percentage (i.e., area 6) is \$38.50 which is less than \$41.10.

In this example, the bidder would not be able to submit a bid for area 6 with a tier weight 0 (instead of 15) and latency weight 0 because in that case the activity from area 6 would be \$49, which is greater than \$41.10.

5 Carried-Forward Bids

Once the budget has cleared, a bid for an individual area at the base clock percentage that was not assigned carries forward to the next round at the same percentage. If a package bid at the base clock percentage was not assigned because it did not meet the minimum scale condition, then a bid for the entire package carries forward to the next round. If a package bid at the base clock percentage meets the minimum scale condition but some areas do not get assigned because they are contested, then a separate bid for each unassigned area in the bid carries forward to the next round.

By definition, all carried-forward bids will be at the previous round's base clock percentage. Because a bidder can only specify price points that are less than the previous round's base clock percentage, all bids that are submitted in a round will be at price points that are less than the price points of carried-forward bids.

Example 12: The budget cleared in round 8. In round 10, the base clock percentage is 85% and the bidder submits a package bid for areas 1, 2, 3, 4, and 5 at a price point of 85% with a minimum scale percentage of 60%.⁸ If, during the bid processing for round 10, the bid does not meet the scale condition, then the package bid for areas 1, 2, 3, 4, and 5 at a price point of 85% with a scale percentage of 60% carries forward to round 11. Alternatively, if during the bid processing for round 10, the bid meets the scale condition and areas 1, 2, and 3 are assigned to the bidder, then the following two bids carry forward to round 11: a bid for area 4 at a price point of 85%, and a bid for area 5 at a price point of 85%. Note that in round 11, bidders can only specify price points that are less than 85%.

6 Bid Processing

6.1 Bid Processing for Rounds Before the Clearing Round Has Been Determined

In the early rounds of the auction, before the budget has cleared, bid processing consists of calculating the aggregate cost at the base clock percentage and checking whether the budget has cleared. The budget clears in the round when the aggregate cost at the base clock percentage is less than or equal to the budget. The aggregate cost at the base clock percentage is calculated as described below.

Aggregate cost at base clock percentage. The aggregate cost at the round's base clock percentage is the sum of the support amounts implied by all bids submitted in the round at the base clock percentage, summing all areas that are part of at least one bid at the base clock percentage and counting each area once. The bidding system calculates the most expensive scenario based on the following: If an area is included in bids of two or more bidders at the base clock percentage, then the most expensive of the performance tier and latency combinations that are bid for that area at the base clock percentage is

⁸ Since the budget cleared in round 8, this implies that the bidder was bidding on the package {1, 2, 3, 4, 5} or a superset of this package in rounds 8 and 9.

included in the calculation, i.e., the implied support of the combination for which the sum of the tier and latency weights is lowest.

Example 13: Suppose that the round's base clock percentage is 75%. Consider an area with a reserve price of \$200 and assume that two bidders bid for that area at the base clock percentage. For one bid, the implied support is \$150 (because the bidder is offering gigabit service with low latency). For the other bid, the implied support is \$60 (because the bidder is offering the baseline tier with low latency). Then the amount of \$150 will be used when calculating the aggregate cost at the round's base clock percentage.

If it is determined that the budget clears in the round, bid processing proceeds as described in Section 6.2 below.

6.2 Bid Processing for the Clearing Round

If bid processing after a round indicates that the budget has cleared in the round (i.e., the round being processed is the clearing round), the bidding system: (1) first determines which areas are assigned to each bidder (assignment determination); (2) then calculates the *clearing price point* as the highest price point in the round at which the aggregate cost adjusted for the assigned areas and the second-price rule is less than or equal to the budget (clearing price point determination); and (3) finally determines the payment for each assigned area using a second-price rule (support payment determination). The assignment determination, the clearing price point determination, and the support payment determination are described below.

Assignment determination. *First*, the bidding system considers all bids at the round's base clock percentage and checks which areas in those bids are assigned. An area is assigned to a bidder if (i) the area is uncontested (not bid on by another bidder at the round's base clock percentage) and (ii) in the case of a package bid, the uncontested areas in the package bid are sufficient to meet the minimum scale percentage for the bid.

Then, the bidding system processes all other bids from the round in ascending order of price point, breaking any ties randomly. An area in such a bid is *available to be assigned* if the area has not previously been assigned and if it did not receive any bids at the round's base clock percentage. The areas that are available to be assigned in the bid are assigned if (i) for a package bid, the areas in the bid that are available to be assigned are sufficient to meet the minimum scale percentage, and (ii) the aggregate cost at the price point of the bid (given all areas that have already been assigned in the round) plus the cost of the areas in the bid that are available to be assigned is less than or equal to the budget.

Specifically, the bidding system calculates the *aggregate cost at a given price point*⁹ p as the sum of:

- (i) For all areas that were bid at the base clock percentage and have not yet been assigned, the support amounts implied by the base clock percentage, counting each area once and using the most expensive scenario; i.e., if an area is part of bids by two or more bidders at the base clock percentage, then the most expensive (lowest weighted) of the performance tier and latency combinations that are bid for that area at the base clock percentage is included in the calculation;
- (ii) For all areas that have already been assigned and that received no other bids (except from the bidder to which they were assigned) at less than p , the support amounts implied by p ; and

⁹ The concept of aggregate cost at a price point takes into account the areas that have been assigned and the fact that a second-price rule is used.

- (iii) For all areas that have already been assigned which received other bids at less than p , the support amount implied by the greater of the price point bid by the bidder to whom the area is assigned and the lowest price point at which any other bidder bid for the area.

As the bidding system considers the bids in ascending price point order to determine whether the budget is sufficient to support another assigned bid, it uses an estimate of the maximum possible cost of assigning support for the areas that are still contested (using (i) above). For areas that were assigned at lower price points, it estimates their cost using the current price point ((ii) above) unless it has already determined that the support for the bid would be capped by another bidder's bid price point (as considered in (iii)). As the currently considered price point p increases, the aggregate cost at p increases, and at some point in this process, the estimated aggregate cost of support to assigned and still-contested areas reaches the budgeted amount. The bidding system stops assigning bids when the additional cost of assigning the next bid would exceed the budget. See Section 8 for an example of how the aggregate cost at a price point is calculated.

Clearing price point determination. When the assignment determination process concludes, all areas that are assigned in the round have been determined. The bidding system then calculates the *clearing price point* as the highest price point (that is a multiple of 0.01%) in the round at which the aggregate cost is less than or equal to the budget. The clearing price point will always be greater than or equal to the price point of any bid from which one or more areas were assigned in the round. See Section 8 for an example of how the clearing price point is calculated.

Support payment determination. For areas assigned to a bidder in the round that received no other bids at less than the clearing price point, the support payment is the amount implied by the clearing price point. However, for areas that also received bids from other bidders at less than the clearing price point, the support payment is the amount implied by the greater of the price point bid by the bidder to whom the area is assigned and the lowest price point at which any other bidder bid for the area. That is, support payments will be calculated using a second-price rule.

Example 14: In round 6, the base clock percentage was 110% and the following bids were submitted:

- Bidder 1 submitted a bid for area 1 at 110%
- Bidder 2 submitted a bid for area 2 at 110%
- Bidder 3 submitted a bid for area 3 at 114%
- Bidder 4 submitted a package bid for areas 2, 3, 4 and 5 at a price point of 116% with a minimum scale percentage of 75%.

Suppose that the budget clears in this round and that the clearing price point is 117%. Further, suppose that the package bid of bidder 4 does not meet the scale condition, and thus bidder 4 is not assigned any areas. Then:

- Bidder 1 is assigned area 1 and the support payment is the amount implied by 117% (i.e., the clearing price point)
- Bidder 2 is assigned area 2 and the support payment is the amount implied by 116% (i.e., the bid percentage of bidder 4)
- Bidder 3 is assigned area 3 and the support payment is the amount implied by 116% (i.e., the bid percentage of bidder 4)

Example 15: In this example, the setup is as in the Example 14 except that the bid percentage of bidder 4 is lower than the bid percentage of bidder 3. In this case, the support amount of bidder 3 is determined by the bid percentage of bidder 3, not of bidder 4.

Specifically, suppose that in round 6, the base clock percentage was 110% and the following bids were submitted:

- Bidder 1 submitted a bid for area 1 at 110%
- Bidder 2 submitted a bid for area 2 at 110%

- Bidder 3 submitted a bid for area 3 at 114%
- Bidder 4 submitted a package bid for areas 2, 3, 4 and 5 at a price point of 112% with a minimum scale percentage of 75%.

Suppose that the budget clears in this round and that the clearing price point is 118%. Further, suppose that the package bid of bidder 4 does not meet the scale condition, and thus bidder 4 is not assigned any areas. Then:

- Bidder 1 is assigned area 1 and the support payment is the amount implied by 118% (i.e., the clearing price point)
- Bidder 2 is assigned area 2 and the support payment is the amount implied by 112% (i.e., the bid percentage of bidder 4)
- Bidder 3 is assigned area 3 and the support payment is the amount implied by 114% (i.e., the bid percentage of bidder 3)

6.3 Bid Processing for Rounds After the Clearing Round

For rounds after the clearing round, bid processing consists of checking whether any additional areas can be assigned in the current round and identifying the appropriate support amounts for any such areas. In addition to processing the bids submitted in the round, the bidding system will process bids that carry forward from the previous round (see Section 5). The bidding system first processes all the bids submitted in the round, in order of ascending price point, and then processes the carried-forward bids.

The assignment and support payment determination for the bids submitted in the round are similar to Section 6.2, except that the clearing price point is no longer relevant. In particular:

Assignment determination for bids submitted in the round. *First*, the bidding system considers all bids at the round's base clock percentage and identifies the areas in those bids that can be assigned. An area is assigned to a bidder if (i) the area is uncontested (not bid on by another bidder at the round's base clock percentage) and (ii) in case of a package bid, the uncontested areas in the package bid, including the area being assigned, are sufficient to meet the minimum scale percentage for the bid. *Then*, the bidding system processes all other bids that were submitted in the round in ascending order of price point, breaking any ties with pseudo-random numbers. An area in such a bid is *available to be assigned* if the area has not previously been assigned and if it did not receive any bids at the round's base clock percentage. If the bid contains a single area (i.e., is not a package bid) and the area is available to be assigned, then the area is assigned to the bidder. In the case of a package bid, the areas in the package bid that are available to be assigned are assigned if the areas in the bid that are available to be assigned are sufficient to meet the minimum scale percentage.

Support payment determination for assigned areas in bids submitted in the round. For areas assigned to a bidder in the round that received no other bids by other bidders in the round, the support payment is the amount implied by the previous round's base clock percentage. For areas that also received bids from other bidders in the round, the support payment is the amount implied by the greater of the price point bid by the bidder to whom the area is assigned and the lowest price point at which any other bidder bid for the area.

Assignment and support payment determination for carried-forward bids. All carried-forward bids are at the base clock percentage of the previous round. The bidding system will use pseudo-random numbers to determine the order in which carried-forward bids are processed. When considering a carried-forward bid for a single area (i.e., not a package bid), the area is assigned to the bidder if it is available to

be assigned,¹⁰ and the support payment for the area is the amount implied by the base clock percentage of the previous round. When considering a carried-forward bid that is a package bid, the bidding system checks whether the minimum scale condition is met, taking into account that one or more areas in the package bid may already have been assigned in the round. Specifically, the system checks whether the implied support of the areas that are available to be assigned plus the support payment¹¹ for any areas in the bid that have already been assigned is greater than or equal to the minimum scale percentage for the bid times the sum of the implied support amounts for all areas in the bid at the previous round's base clock percentage. If this condition is satisfied, then the areas in the carried-forward bid that are available to be assigned are assigned and the support payment for each such area is determined by the base clock percentage of the previous round.

The bidding system also checks whether any areas remained contested at the round's base clock percentage. If there are any such contested areas, the auction proceeds to a new round.

Example 16: In round 7, the base clock percentage was 100% and the bidder submitted a package bid for areas 1, 2, 3, 4, and 5 at that price point with a minimum scale percentage of 75%. The budget cleared in round 7, but that bid did not meet the scale condition and thus carried forward to round 8. In round 8, the base clock percentage was 95% and the bidder submitted a bid for areas 1 and 2 at that price point. The bidder did not submit any bids for areas 3, 4, and 5 in round 8. During bid processing of round 8, the bidding system determined that the bidder is assigned areas 1 and 2, each with a support amount of \$98. Suppose that at the time that the carried-forward bid is processed, only areas 3 and 4 are available to be assigned. Areas 1 and 2 have already been assigned to the bidder. Area 5 has either been assigned to another bidder or it received one or more bids at the round's base clock percentage; in either case, it is not available to be assigned.

The following table provides the amounts that are used to check whether the carried-forward bid meets the scale condition.

Area	Reserve Price	Tier Weight	Latency Weight	Implied Support at 100%	Amount Used to Check if Carried-Forward Bid Meets Scale Condition
1	\$100	0	0	\$100	\$98
2	\$100	0	0	\$100	\$98
3	\$100	0	0	\$100	\$100
4	\$100	0	0	\$100	\$100
5	\$100	0	0	\$100	None (Area not available to be assigned)

In this example, the carried-forward bid meets the scale condition because:

$$\$98 + \$98 + \$100 + \$100 \geq (75\%) \cdot (\$100 + \$100 + \$100 + \$100 + \$100)$$

6.4 Identification of Winning Bids for Post-Auction Purposes

When the auction concludes, the winning bids and the support amounts for each of those bids in dollars will be announced to the public by public notice. A bid for an individual area that is assigned is considered a winning bid. For package bids, winning bids are defined as follows:

If, during the bid processing of a round, the bidding system determines that a package bid submitted in that round meets the minimum scale condition, then all areas within that bid that are assigned to the

¹⁰ An area is *available to be assigned* if the area has not previously been assigned and if it did not receive any bids at the round's base clock percentage. The same definition is used for the processing of the bids that were submitted in the round.

¹¹ This is the second-price payment that was determined when the submitted bids were processed.

bidder at that time constitute a winning bid.

If, during the bid processing of a round, the bidding system determines that a carried-forward package bid (i.e., a package bid submitted in the previous round) meets the scale condition, then the bidding system determines the winning bid(s) depending on whether the areas in the carried-forward bid that are available to be assigned are sufficient to meet the scale condition. This distinction is needed in the case that the bidder has already been assigned some areas that are in the carried-forward bid (as in Example 16).

Recall that a carried-forward bid meets the scale condition if the implied support of the areas that are available to be assigned plus the support payment for any areas in the bid that have already been assigned to that bidder is greater than or equal to the minimum scale percentage for the bid times the sum of the implied support amounts for all areas in the bid at the previous round's base clock percentage (see Section 6.3). The winning bids, in the case of a carried-forward package bid, are determined according to the following rules:

- If the implied support of the areas in the carried-forward bid that are available to be assigned is greater than or equal to the minimum scale percentage for the bid times the sum of the implied support amounts for all areas in the bid at the previous round's base clock percentage, then the areas that are available to be assigned in the carried-forward bid constitute a winning bid and any areas in the carried forward bid that were already assigned to the bidder constitute one or more separate winning bids.
- Otherwise, all areas in the carried-forward bid that are assigned to the bidder in the round will constitute one winning bid.

Example 17: In round 9, the base clock percentage was 90% and the bidder submitted the following bids:

- A bid for area 1 at 90%
- A package bid for areas 2, 3, 4, and 5 at 92% with a scale percentage of 60%

Suppose that the bidder is assigned areas 1, 2, 3, and 4 in this round. Then, the bidder will have the following two winning bids from this round: {1} and {2, 3, 4}.

Example 18: Consider Example 16 where the scale percentage of the carried-forward bid is 75%. The carried-forward bid meets the scale condition because:

$$\$98 + \$98 + \$100 + \$100 \geq (75\%) \cdot (\$100 + \$100 + \$100 + \$100 + \$100)$$

However, without including the payments for areas 1 and 2 (which have already been assigned to the bidder) the carried-forward bid does not meet the scale condition because:

$$\$100 + \$100 < (75\%) \cdot (\$100 + \$100 + \$100 + \$100 + \$100)$$

Thus, all areas in the carried-forward bid that are assigned to the bidder in the round will constitute a single winning bid, namely {1, 2, 3, 4}.

Example 19: Now consider a variation of Example 16 (and Example 18) where the scale percentage of the carried-forward bid is 40%. Then, the carried-forward bid meets the scale condition even without including the payments for areas 1 and 2 (which have already been assigned to the bidder) because:

$$\$100 + \$100 \geq (40\%) \cdot (\$100 + \$100 + \$100 + \$100 + \$100)$$

In this case, the bidder will have the following three winning bids from this round: {1}, {2}, and {3, 4}.

7 Information Available to Bidders

7.1 Bidding Information Available During a Round

This section describes the information that will be provided to a bidder during a round about its bidding in the round.

Information that is provided during rounds up to and including the clearing round:

Activity. Equal to the sum of the implied support amounts across all the bidder's submitted bids in the round.¹²

Activity at the base clock percentage. Equal to the sum of implied support amounts across all the bidder's bids in the round submitted at the round's base clock percentage.

Number of areas in bids. The number of areas in the bidder's submitted bids in the round.

Number of areas in bids at the base clock percentage. The number of areas in the bidder's bids in the round submitted at the round's base clock percentage.

Maximum activity. The maximum activity that the bidder is allowed to submit in the round, which according to the activity rules is equal to the bidder's activity in the previous round.

Maximum activity in new areas. The maximum activity that the bidder is allowed to submit in the round for areas for which it did not bid at the previous round's base clock percentage. According to the activity rule, this is equal to the maximum switching percentage times the bidder's activity at the previous round's base clock percentage.

Information that is provided during rounds after the clearing round:

Assigned support. The annual support across all areas that have already been assigned to the bidder. As described in Sections 6.2 and 6.3, the annual support for an assigned area is based on a second-price calculation and will be greater than or equal to the implied support at the bid percentage.¹³

Implied support for carried-forward bids. Equal to the sum of implied support amounts across all areas that are in a carried-forward bid. The price point used for this calculation is the base clock percentage of the previous round. An area that is part of a carried forward bid is included in this calculation regardless of whether the bidder has submitted a bid for that area at a lower price point.

Implied support for bids submitted in the round. Equal to the sum of implied support amounts across all of the bidder's submitted bids in the round. Carried-forward bids are not included in this calculation.

Implied support for bids at the base clock percentage. Equal to the sum of implied support amounts across all of the bidder's submitted bids in the round at the round's base clock percentage.

¹² This includes any bids generated in the round on behalf of the bidder based on any proxy instructions still in effect.

¹³ Assigned support is based on provisionally winning bids. Provisionally winning bids become winning bids when identified as such in a public notice announcing the close of the auction. Winning bidders must be authorized to receive support during post-auction application processing before support can be disbursed by USAC.

Number of areas in carried-forward bids. The number of areas in carried-forward bids. An area that is part of a carried forward bid is included in this count regardless of whether the bidder has submitted a bid for that area at a lower price point.

Number of areas in bids submitted in the round. The number of areas across all of the bidder's submitted bids in the round. This count does not include areas that are only in carried-forward bids.

Number of areas in bids at the base clock percentage. The number of areas across all the bidder's submitted bids in the round at the round's base clock percentage.

7.2 Round Results

This section describes the information that is provided to bidders on the results of bid processing for a round.

For rounds before the clearing round, each bidder is informed about:

- The aggregate cost at the round's base clock percentage, which provides an indication of how near the budget is to clearing; and
- For each area, whether the number of bids at the round's base clock percentage was 0, 1, or greater than 1.

For the clearing round and any subsequent rounds, each bidder is informed about:

- The areas it was assigned in the round (if any) and the associated support amounts;
- For each area, whether the area has been assigned;
- For each area that has not been assigned, whether the number of bids at the round's base clock percentage was 0, 1, or greater than 1.

Before a new round begins, all bidders are informed of the new round's base clock percentage.

8 Illustrative Example

We illustrate the mechanisms of the bid processing with a simple example. The setup and outcome are intended to be illustrative, rather than realistic or typical.

The budget is \$5,000. The maximum switching percentage is 10%.

There are 5 areas. The following table provides the reserve price for each area.

Area	Reserve Price
1	\$2,000
2	\$2,000
3	\$1,000
4	\$1,000
5	\$200

There are 2 bidders. Bidder 1 (B1) always submits bids with tier weight 0 and latency weight 0. Bidder 2 (B2) always submits bids with tier weight 15 and latency weight 0. The opening base clock percentage is set at 115%.

The following table provides the base clock percentage, the bids of each bidder, the aggregate cost at the base clock percentage and the assignments (if any) for each round. For a given bidder and a given round, each row represents a separate bid. The areas in a package bid are included in brackets. All package bids

have a scale percentage of 50%. A round-by-round explanation follows the table.

Round	Base Clock	Bids of B1 (weight = 0)	Bids of B2 (weight = 15)	Aggregate Cost at Base Clock	Assignments
1	105%	{1, 2, 3} at 105%	1 at 105% {2, 3, 4} at 105%	\$5,900	
2	95%	{1, 2, 3} at 95%	1 at 95% {2, 3, 4} at 95%	\$5,550	
3	90%	{1, 2, 3} at 90%	{2, 3, 4, 5} at 90%	\$5,400	
4 <i>clearing round</i>	85%	{1, 2} at 85% 3 at 88%	{2, 3, 4, 5} at 85%	\$4,940	B1 is assigned: \$1,728.40 for 1 B2 is assigned: \$714.20 for 3 \$714.20 for 4 \$142.84 for 5
5 <i>final round</i>	80%	2 at 80%	2 at 82%		B1 is assigned: \$1,640 for 2

Round 1

The base clock percentage is 105%. Bidder 1 submits a package bid for areas 1, 2, and 3 at the base clock percentage. Bidder 2 submits a bid for area 1 and a package bid for areas 2, 3, and 4; both bids are at the base clock percentage.

The following table illustrates how the aggregate cost at the round’s base clock percentage is calculated. The second column lists the implied support amounts based on the bids of each bidder submitted at the base clock percentage. The aggregate cost is calculated by taking the maximum of these implied support amounts for each area and then summing over all areas.

Area	Implied Support at 105% for B1	Implied Support at 105% for B2	Maximum
1	\$2,000	\$1,800	\$2,000
2	\$2,000	\$1,800	\$2,000
3	\$1,000	\$900	\$1,000
4		\$900	\$900
5			\$0
Aggregate Cost at 105% (Base Clock Percentage for Round 1)			\$5,900

Since the aggregate cost at the base clock percentage exceeds the budget, the budget does not clear in this round.

Round 2

The base clock percentage is 95%. Bidder 1 submits a package bid for areas 1, 2, and 3 at the base clock percentage. Bidder 2 submits a bid for area 1 and a package bid for areas 2, 3, and 4; both bids are at the base clock percentage.

The following table illustrates how the aggregate cost at the round’s base clock percentage is calculated.

Area	Implied Support at 95% for B1	Implied Support at 95% for B2	Maximum
1	\$1,900	\$1,600	\$1,900

2	\$1,900	\$1,600	\$1,900
3	\$950	\$800	\$950
4		\$800	\$800
5			\$0
Aggregate Cost at 95% (Base Clock Percentage for Round 2)			\$5,550

The aggregate cost at the base clock percentage is \$5,550, which exceeds the budget (\$5,000). Thus, the budget does not clear in this round.

Round 3

The base clock percentage is 90%. Bidder 1 submits a package bid for areas 1, 2, and 3 at the base clock percentage. Bidder 2 submits a package bid for areas 2, 3, 4, and 5 at the base clock percentage. Bidder 2 is allowed to bid on area 5, because its activity from area 5 is \$150 which is less than 10% (the maximum switching percentage) times the bidder's activity at the previous round's base clock percentage (\$4,800 = \$1,600 + \$1,600 + \$800 + \$800).

The following table illustrates how the aggregate cost at the round's base clock percentage is calculated.

Area	Implied Support at 90% for B1	Implied Support at 90% for B2	Maximum
1	\$1,800		\$1,800
2	\$1,800	\$1,500	\$1,800
3	\$900	\$750	\$900
4		\$750	\$750
5		\$150	\$150
Aggregate Cost at 90% (Base Clock Percentage for Round 3)			\$5,400

The aggregate cost at the base clock percentage is \$5,400, which exceeds the budget (\$5,000). Thus, the budget does not clear in this round.

Round 4

The base clock percentage is 85%. Bidder 1 submits a package bid for areas 1 and 2 at the base clock percentage, and a bid for area 3 at 88%. Bidder 2 submits a package bid for areas 2, 3, 4, and 5 at the base clock percentage.

The following table illustrates how the aggregate cost at the round's base clock percentage is calculated.

Area	Implied Support at 85% for B1	Implied Support at 85% for B2	Maximum
1	\$1,700		\$1,700
2	\$1,700	\$1,400	\$1,700
3		\$700	\$700
4		\$700	\$700
5		\$140	\$140
Aggregate Cost at 85% (Base Clock Percentage for Round 4)			\$4,940

The aggregate cost at the base clock percentage is \$4,940, which is less than the budget (\$5,000). Thus, the budget clears in this round. In other words, round 4 is the clearing round.

Assignment determination. The bids at the base clock percentage are considered first:

- Bidder 1 bid for the package of areas 1 and 2 with a scale percentage of 50%. Area 2 is contested, because bidder 2 also bid for that area at the base clock percentage. The package bid

- without area 2 meets the scale percentage, and thus area 1 is assigned to bidder 1.
- Bidder 2 bid for the package of areas 2, 3, 4, and 5 with a scale percentage of 50%. Area 2 is contested, because bidder 1 also bid for that area at the base clock percentage. The package bid without area 2 meets the scale percentage, and thus areas 3, 4, and 5 are assigned to bidder 2.

The bid of bidder 1 for area 3 is the only bid at a higher price point. Area 3 cannot be assigned to bidder 1 because that area has already been assigned to bidder 2.

Clearing price point determination. The clearing price point is the highest price point (that is a multiple of 0.01%) between 85% and 90% at which the aggregate cost is less than or equal to the budget. The aggregate cost at a price point PP between 85 and 90 is the sum of the terms shown in the third column of the table below:

Area	Status	Implied Support for Calculation of Aggregate Cost at Price Point PP	Notes
1	Assigned to B1	$\left(\frac{PP}{100}\right) (\$2,000)$	This is the implied support for B1 at PP
2	Contested	\$1,700	This is the implied support for B1 at the base clock percentage (85%)
3	Assigned to B2	$\left(\frac{\min\{PP, 88\} - 15}{100}\right) (\$1,000)$	If $PP \leq 88$, this is the implied support for B2 at PP If $PP > 88$, this is the implied support for B2 at 88%
4	Assigned to B2	$\left(\frac{PP - 15}{100}\right) (\$1,000)$	This is the implied support for B2 at PP
5	Assigned to B3	$\left(\frac{PP - 15}{100}\right) (\$200)$	This is the implied support for B2 at PP

The lower price point that is a multiple of 0.01% such that the aggregate cost is less than or equal to the budget is 86.42%. Areas 1, 3, 4, and 5 are assigned in the round. The support payments are determined from the third column in the table above, substituting 86.42 for PP.

Area 2 is contested, so the auction proceeds with a new round.

Round 5

The base clock percentage is 80%. Each bidder can only bid on area 2 in this round, because that is the only area that the bidder bid on at the previous round’s base clock percentage and has not yet been assigned. Bids for area 2 for each bidder carry forward to round 5 at 85%, the previous round’s base clock percentage.

Bidder 1 submits a bid for area 2 at the base clock percentage (80%). Bidder 2 submits a bid for area 2 at 82%. These bids are considered by the bidding system in addition to the carried forward bids. Area 2 is assigned to bidder 1. The support payment is determined by the 82% price point.

After round 5, there are no contested areas and the auction concludes.