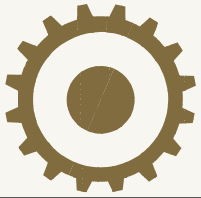


The background features three stylized gears. A large tan gear is on the left, a blue gear is at the top right, and a yellow gear is at the bottom right. The text is centered in the middle of the page.

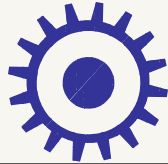
BUILDING A SPECTRUM AUCTION SYSTEM



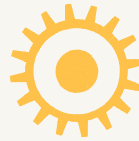
**1995 FIRST
AUCTION**



**BID ENTRY
CHANGES**



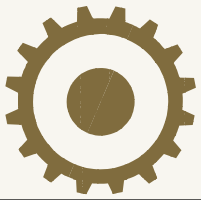
**NEW BID
INCREMENT
CALCS**



**WEB BASED
BIDDING**



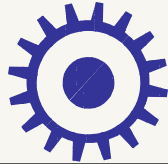
NONPACKAGE BIDDING



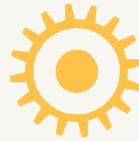
1995 FIRST AUCTION



BID ENTRY CHANGES



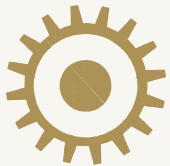
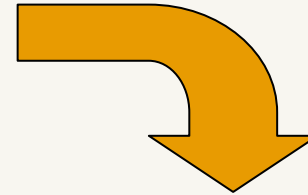
NEW BID INCREMENT CALCS



WEB BASED BIDDING



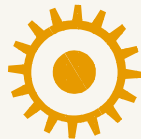
NONPACKAGE BIDDING



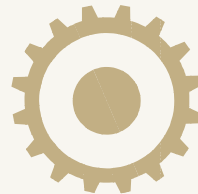
ANNOUNCE AUCTION 31 DESIGN



TIE BREAKING



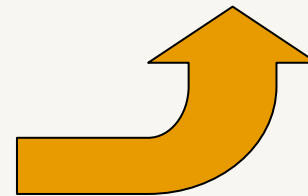
SMOOTHED ANCHORING PRICING

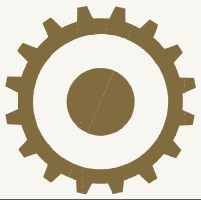


CORE REDESIGN



PACKAGE BIDDING

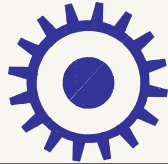




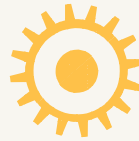
1995 FIRST AUCTION



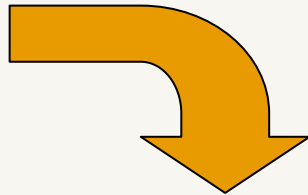
BID ENTRY CHANGES



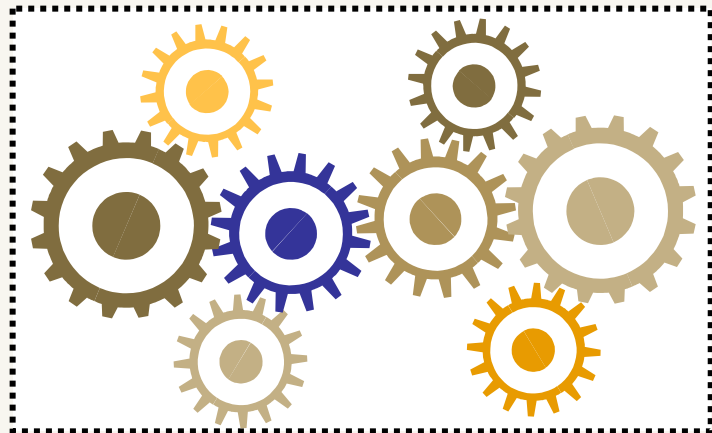
NEW BID INCREMENT CALCS



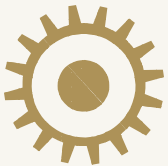
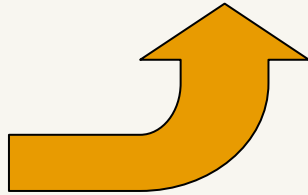
WEB BASED BIDDING



ISAS



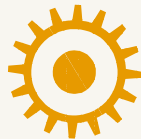
INTEGRATED SPECTRUM AUCTION SYSTEM



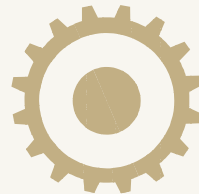
ANNOUNCE AUCTION 31 DESIGN



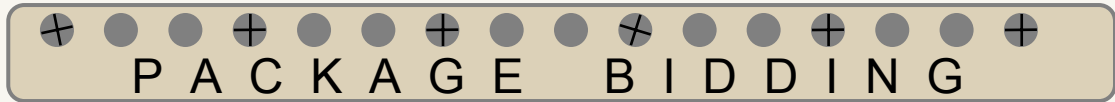
TIE BREAKING



SMOOTHED ANCHORING PRICING



CORE REDESIGN





**ISAS PACKAGE
BIDDING
AUCTION
DESIGN**

Auction Mechanism

ISAS

- Simultaneous Multiple Round
- Activity and Eligibility Rules
- Closing Rules:
 - Discretionary
 - 1 or 2 Round Simultaneous

AUCTION 51

- Simultaneous Multiple Round
- Activity and Eligibility Rules
- Closing Rule:
 - 2 Round Simultaneous

Package Creation

ISAS

- Bidders can create any combination of two or more items subject to:
 - Items were selected on application form
 - Current eligibility
- Bidders can create a similar package from one of its existing packages

AUCTION 51

- Bidders can create any combination of two or more items subject to:
 - Items were selected on application form
 - Current eligibility

Bidding Language

ISAS

- XOR
 - *All* bids of a bidder are mutually exclusive
- A bidder can win *at most one* of its bids

AUCTION 51

- XOR of OR
 - Bids of a bidder are mutually exclusive *between rounds*
- A bidder can win any non-overlapping combination of bids placed in the same round

Minimum Acceptable Bids

ISAS

- Minimum opening bid amount if not bid on
- MAB of an individual item is its *current price* plus a percentage
- MAB percentage calculated using smoothing
- MAB of a package is the sum of the MABs of the items in the package
- Fixed MAB percentage for global package (optional)

AUCTION 51

- The MAB of an item or package is the greater of:
 - Minimum opening bid amount of the item/package
 - Bidder's previous high bid on the item/package plus x%
 - Current price estimate of the item/package plus z%
- CPE of a package is the sum of the CPEs of the items in the package
- Fixed MAB percentage for global package (optional)

Increment Bids

ISAS

- Variable number of increment bid amounts allowed
- Increment calculated as a fixed percentage of the MAB
- Increment bid amounts calculated as $MAB + k * \text{increment}$

AUCTION 51

- Variable number of increment bid amounts allowed
- Increment calculated as a fixed percentage of the MAB
- Increment bid amounts calculated as $MAB + k * \text{increment}$

Placing Bids

ISAS

- Click-box
- Simultaneous submission
- Limited by current eligibility
- Bid removals allowed within the same round
- Bid import function

AUCTION 51

- Click-box
- Simultaneous submission
- Limited by current eligibility
- Bid removals allowed within the same round

Activity Calculations

ISAS

- Maximum bidding units a bidder can win considering:
 - Current provisionally winning bids
 - New bids made in the round
 - Old bids where the previous bid amount is \geq to the current MAB
- Calculation requires a sort

AUCTION 51

- Maximum bidding units a bidder can win considering:
 - Current provisionally winning bids
 - New bids made in the round
 - Renewed provisionally winning bids
- Calculation requires an optimization problem to be solved

Activity Reqs & Waivers

ISAS

- Required activity calculated each round as a fraction of the bidder's current eligibility
- Waivers can be applied either proactively or automatically or both

AUCTION 51

- Required activity calculated each round as a fraction of the bidder's current eligibility
- Waivers applied automatically

Eligibility Reduction

ISAS

- Bidder's not meeting required activity will have their eligibility reduced
- Bidder's can elect to reduce their eligibility
- Reduced eligibility is calculated to bring a bidder in to compliance with its activity requirement

AUCTION 51

- Bidder's not meeting their required activity will have their eligibility reduced
- Bidder's can elect to reduce their eligibility
- Reduced eligibility is calculated to bring a bidder in to compliance with its activity requirement

System Parameters

ISAS

- Number of packages created
- Number of bids submitted in a round
- Number of considered bids in the auction
 - Limits number of combinations that can be bid on but not the number of bids placed

AUCTION 51

- Number of packages created

Provisionally Winning Bids

ISAS

- Considered bids:
 - For each bidder, the highest bid made on each of its items/packages
 - FCC bids on each item
- Maximize revenue subject to constraints
- Ties broken randomly using selection numbers
- No withdrawals

AUCTION 51

- Considered bids:
 - For each bidder, all bids made in the auction
 - FCC bids on each item
- Maximize revenue subject to constraints
- Ties broken randomly using selection numbers
- No withdrawals

Last and Best Bids

ISAS

- No provision for last and best bids

AUCTION 51

- Two sets of last and best bids
- Last and best bid sets are mutually exclusive
- Etc...



Ideas for Enhancements

- ☀ Interface customization
- ☀ Sophisticated system help
- ☀ Package creation tool
- ☀ Bidding tool
- ☀ Final proxy round

