



Introduction to spectrum auctions

A presentation for the GSMA Members Annual Spectrum Seminar

Richard Marsden

Vice President

Armenia, Colombia

22 September 2011



Spectrum Auction design

Introduction to spectrum auctions



- Prior to late 1990s, most countries assigned spectrum through beauty contests or direct award
- Auctions have since supplanted beauty contests as dominant assignment mechanism, for various reasons including expected outcome efficiency and relative robustness to legal challenge
- Initially, most auctions used the SMRA format (simultaneous multiple round ascending auction) pioneered by US FCC
- Since then, there has been a considerable amount of innovation in response to specific issues encountered in a variety of contexts, including
 - Changes to activity rules to help bidders manage risk and encourage ‘honest’ valuation-based bidding
 - Use of generic lots to facilitate contiguous assignment necessary for mobile broadband
 - Use of package bidding to manage aggregation risk
- This presentation compares some of the traditional and new auction formats

Some Recent Auction Formats



- Multiple Round Auctions
 - 1: Simultaneous Multiple Round Auction (SMRA)
(Canada, Germany, Spain, United States)
 - 2: Simultaneous Multiple Round Auction with Switching
(Norway, Sweden, Finland)
 - 3: Combinatorial Clock Auction (CCA)
(Denmark, Ireland, Netherlands, Austria, UK, Switzerland)

- Sealed Bid Auctions
 - 4: Combinatorial Second Price Auction
(Portugal, Ireland)
 - 5: Combinatorial First Price Auction
(France, Hungary)

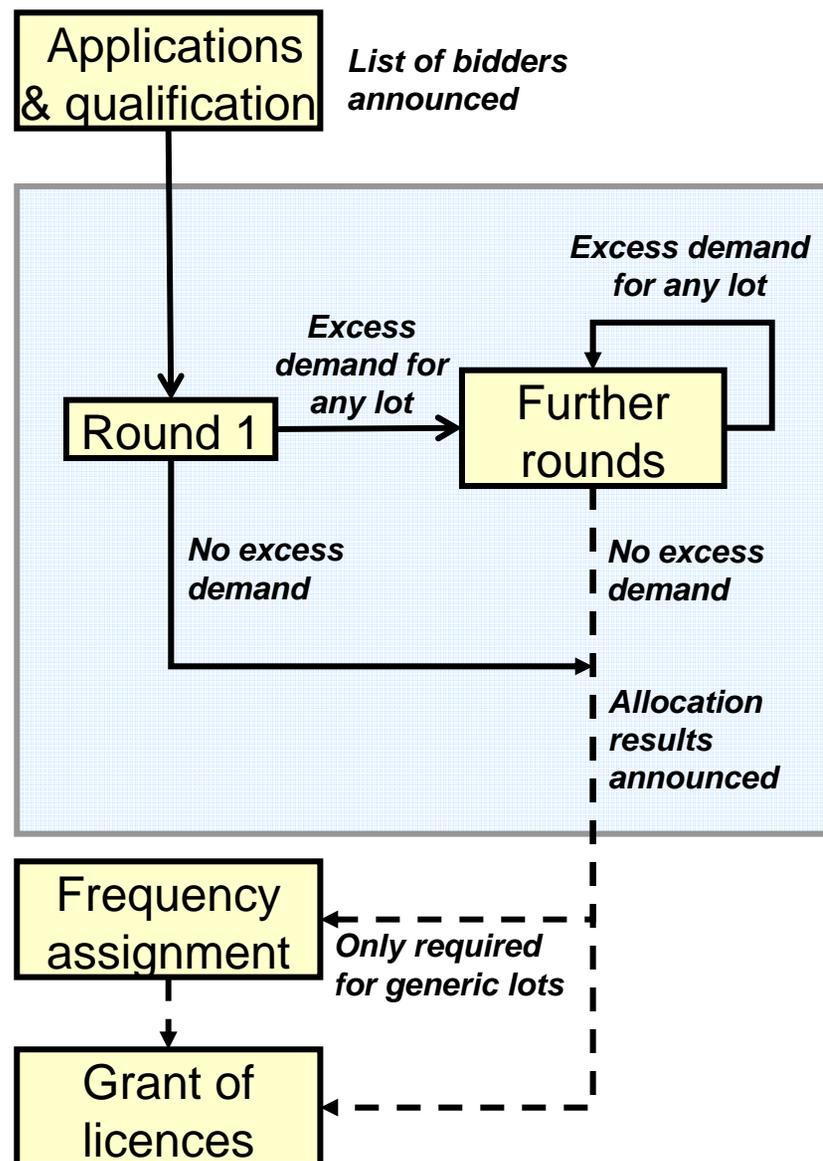
There are many variations borrowing features from one or more of the above

Simultaneous Multiple Round Auction (SMRA)



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- Key rules:
 - ascending prices for each spectrum block
 - standing high bidders
 - auction continues until no more bids are placed
- Workhorse of the spectrum auction world
- Can be implemented with:
 - Specific lots; or
 - Generic lots



SMRA – some observations



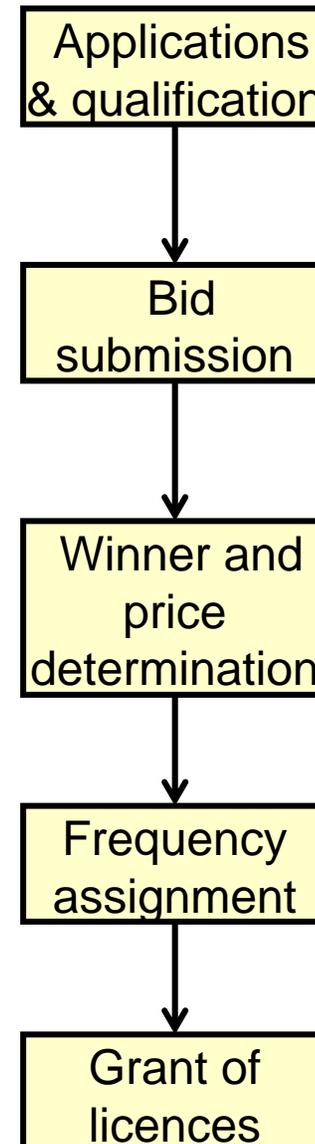
- The basic SMRA is a format that is simple for bidders to understand
 - It is best implemented using software for online bidding
 - Works best for substitutes; bidders may face aggregation risk if lots are complements
- Implementation has raised concerns in more complex spectrum packaging environments:
 - Can be vulnerable to gaming (e.g. demand reduction, signalling etc..)
 - Bid strategy can be rather complex if there are many lots
- Concerns can at least partially be addressed by changes to detailed rules, such as:
 - Changing activity rules to manage aggregation risk (e.g. staged activity rules or 'switching' rules)
 - Restricting transparency, to make coordination amongst bidders difficult
 - Spectrum caps and set asides to prevent/promote particular allocation outcomes
- These changes to detailed rules may themselves introduce other concerns, such as increased complexity and loss of market autonomy

Sealed Bid Auctions



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- **Key rules:**
 - bids are submitted in a single bidding round
 - no price revelation or opportunity to improve bids
 - winner and price determination following bid submission
- **Two main options for pricing rule:**
 - First price (pay your bid)
 - Second price (pay based on opportunity cost of denying other bidders)
- **Formats are becoming more sophisticated:**
 - Combinatorial bidding to mitigate aggregation risks
 - Generic lots to simplify bidding



Applications sometimes merged with bid submission to prevent identity of participants leaking

Bid submission is usually anonymous, and may be by manual or electronic delivery

May require algorithms to solve if bid options are not straightforward

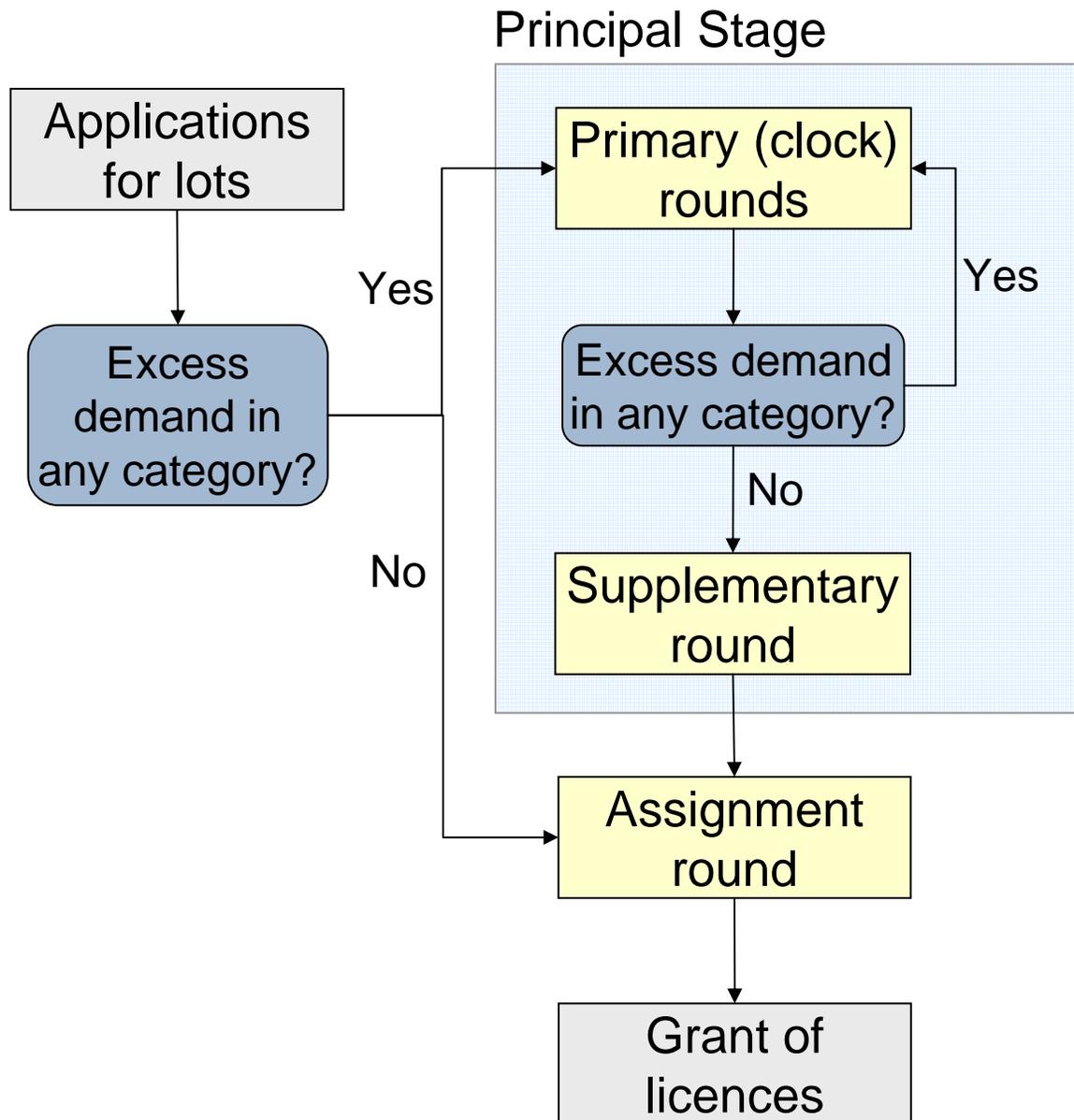
Required if generic lots are used (which is typical for auctions with many lots)

Sealed Bids – some observations



- Multi-round alternatives have been preferred to sealed bids for spectrum, owing to:
 - Lack of price discovery
 - Strategic complexity for bidders (in a first-price setting)
- However, they appear to be making a resurgence for a number of reasons:
 - First price sealed bids may attract participation, as uncertain strategy for incumbents may create an opportunity for entry
 - New combinatorial formats can cope with complex spectrum packaging situations
 - May be easier to introduce ‘multi-attribute bids’ (price, coverage etc), with bids ranked by ‘score’ instead of price alone
 - Low cost alternative to a multi-round process
- Advantages and disadvantages of a sealed bid may vary greatly across bidders and contexts

The CCA format



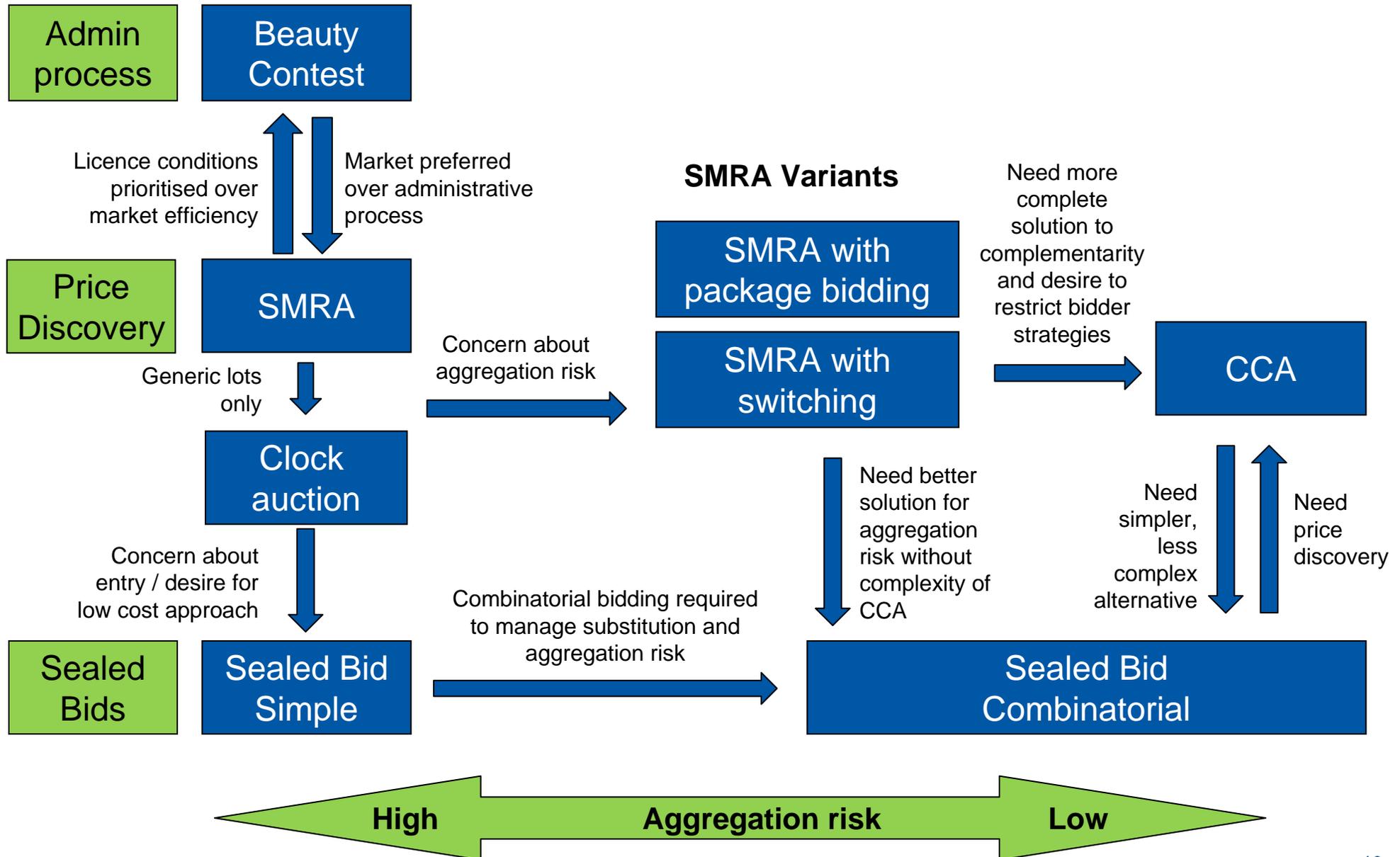
- Practical multi round package bid format developed in UK and now widely used in Europe
- Key features:
 - Ascending clocks for each category of lots
 - Usually implemented with generic lots
 - Package bidding
 - Second-price rule
 - New 'relative price' activity rule

CCA – some observations



- Developed as a multi-round alternative to the SMRA which:
 - Eliminates aggregation risk
 - Greatly reduces scope for gaming behaviour
 - Supports ‘simple’ bidding strategies
 - Maximises efficiency of outcomes (based on bids submitted)
- Popular with North European regulators owing to its flexibility:
 - can deal with multiple bands
 - ensures spectrum contiguity
 - allows for spectrum floors and other constraints
- However, as with any format, there are also concerns:
 - auction rules are much more complex to understand than the SMRA
 - winner and price determination with many lots may be opaque
 - requirement on bidders to value all plausible packages is onerous
 - bidders with budget constraints may be unable to follow simple strategy
- Format has not yet been adapted to auctions with many regional lots

How the formats fit together



Is increased auction complexity justified?



- With switch to complex activity rules and/or combinatorial formats, some critics have suggested that auctions are getting too ‘complex’
- What do we mean by ‘complexity’ of auction format?
 - Conceptually complex (is the auction format difficult to understand, e.g. bidder optimal core pricing in the CCA)
 - Complexity of bidding strategies (is the bid a complex function of the bidder’s value, e.g. shading in first price versus second price auctions)
 - Complexity of valuation analysis (e.g. price discovery in SMRA versus sealed bid combinatorial auction)
- Not straightforward to rank auction formats in terms of complexity – changes to detailed rules may also greatly impact types of complexity
- Should we prefer conceptually complex auction formats which encourage simple straight forward bidding, or conceptually easy auction formats with complex gaming/strategy opportunities for bidders?
- Answer may vary depending on spectrum band and government objectives

The best auction format will depend on local conditions



- In any spectrum award, there are a broad range of objectives for an NRA/Government, including:
 - Promoting an efficient outcome
 - Encouraging downstream competition
 - Encouraging competition (i.e. participation) in an auction
 - Revenue generation
 - Other policy goals e.g. roll-out/coverage
 - Having a well run, reasonably quick and legally robust process

- There is no single ‘best’ auction format
 - there is no obvious correlation between auction formats and auction outcomes
 - each format has different attributes, making them more or less attractive to the government and particular bidders for each award
 - appropriate auction format may depend on existing market structure (and whether government aims to change it)

Bidder perspective



- From a bidder perspective, the choice of detailed rules may matter as much or more than the auction format, especially:
 - The spectrum packaging
 - Spectrum caps and/or set asides
 - Terms and conditions associated with licences (e.g. coverage)
 - The pricing rule
 - Activity rules and transparency
- Ideally, a regulator will:
 - consult first on its high level approach and then on the detailed rules
 - be responsive to reasoned arguments based on its statutory objectives
- However, if regulators are in a hurry, they may bypass such steps!
- Early engagement is important if you want to influence a process

Concluding Remarks



- Auctions for radio spectrum are here to stay
- There are many different formats, and no single best approach
- The right approach depends on the local situation
- Detailed rules, including packaging, may matter as much as the choice of format
- If you want to have some influence over the design...
 - get engaged with the regulator as early as possible ..
 - and check in regularly, even if no auctions are imminent



Thank you!

Richard Marsden

Vice President

NERA – New York City

+1 212 345 2981

Richard.Marsden@nera.com