



Planning and organising a spectrum auction

Meeting of the CEE Regional Working Group

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- Morning sessions:

- I: Key inputs into decision making - **Richard Marsden**
- II: Auction formats & case studies - **Richard Marsden & Soren Sorensen**
- III: Implementing an auction - **Richard Marsden & Soren Sorensen**
- IV: Conclusion for the region - **All participants, roundtable discussion**

- Afternoon sessions:

- V: Using online software to run spectrum auctions - **Mike Abernethy**
- VI: Introduction to the mock LTE auctions - **Soren Sorensen**
- VII: Participation in mock LTE auction - **All participants**

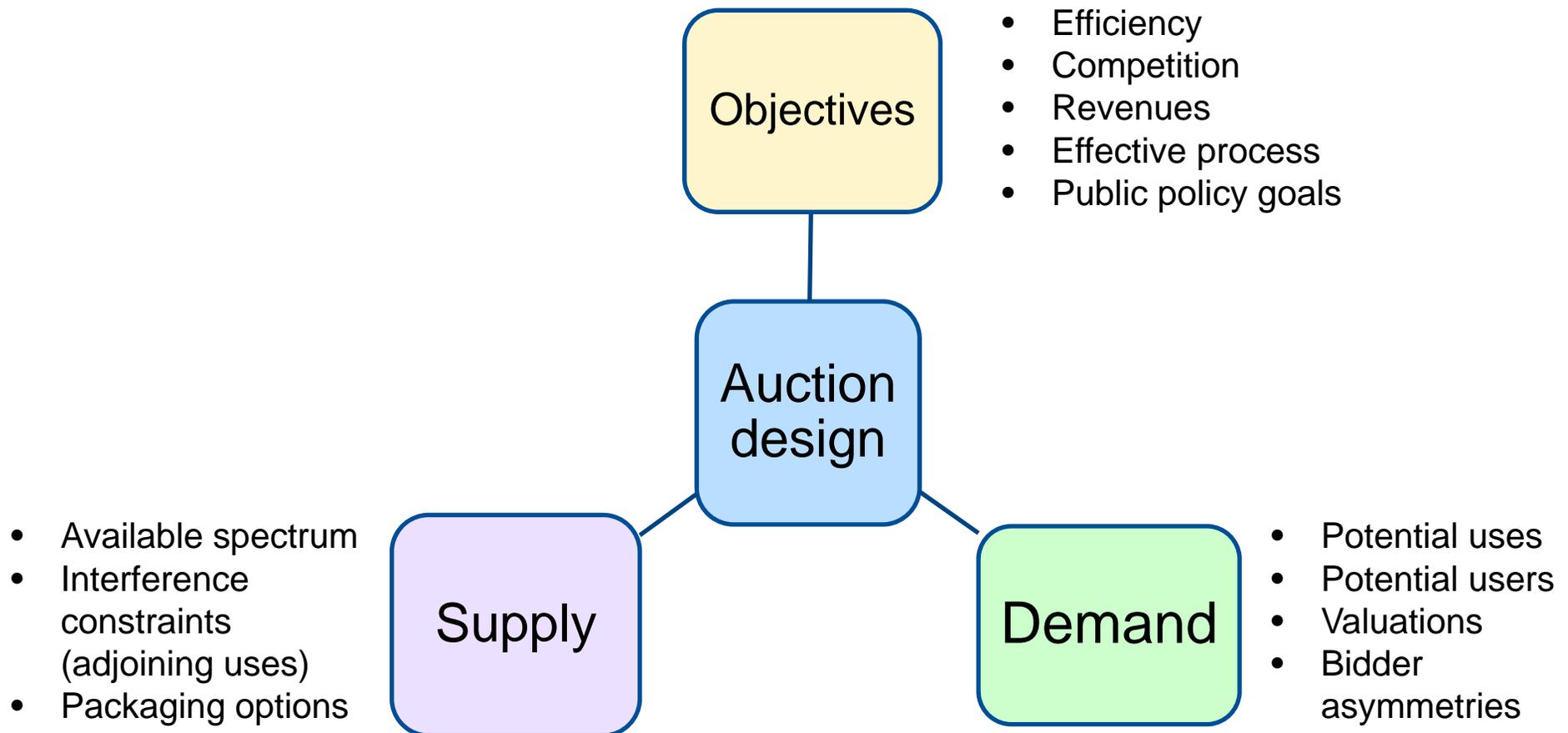


Session I

Key inputs into decision making

Key inputs

- For any spectrum auction, regulators should consider THREE key inputs into both spectrum packaging and auction design:



Government objectives

- Governments typically have multiple objectives for spectrum awards
- Some objectives may conflict, so regulators may have to prioritise
 - Efficiency vs downstream competition?
 - Revenues vs policy objectives?
- Some objectives may be very sensitive to design decisions
 - Auction participation
 - Revenues



Supply / packaging of spectrum

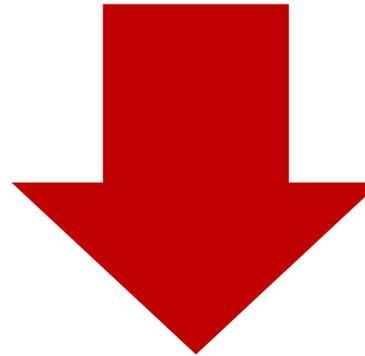


- For most regulators, this is largely pre-determined:
 - Bands fixed by international agreement and global/regional market developments
 - May be local interference issues that affect value / availability of some spectrum
- Regulators still have discretion over lot size, but
 - General trend towards smaller lots to give bidders more flexibility
 - Larger lots may limit competition, which may be bad for efficiency and revenues
- With proliferation of mobile bands, key question for regulators is whether to link new releases and refarming

One award or multiple awards?

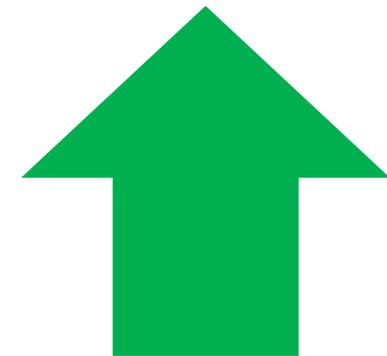
- Recent trend towards inclusion of multiple frequency bands in the same award
 - 800 MHz
 - 2600 MHz
 - Expiring licences at 900, 1800 and 2100
 - Unused frequencies at 900, 1800 and 2100
- Mixed approach across Europe:
 - Separate: Austria, Sweden, Denmark, Finland
 - Together: UK
 - Together with other bands: Germany, Spain, Switzerland

Separate awards



Linkages across 800 and 2600 bands are limited
Timing of availability of bands may vary
Lower exposure to regulatory error / less uncertainty for bidders
More complex award design

Bidders can express synergies across bands
Potential to attract entry?
Opportunity to set direction of industry in a single process
Regulatory cost savings?



Single award

Question: Has the trend towards combined awards gone too far?

Demand for spectrum



- Understanding demand is key to ensuring a successful spectrum auction
- Key issues to understand:
 - How much spectrum do incumbents need for business continuity / future growth?
 - What minimum does an entrant need to build a viable business case?
 - Which bands are critical for rolling out specific technologies?
 - What balance of sub-1GHz and higher frequency bands do operators require?
 - To what extent are relative demands and valuations predictable across bidders?
- As the mobile market matures, regulators increasingly face two related challenges:
 - Modest and predictable participation
 - Bidder asymmetries
- Under these conditions, there is often tension between objectives (e.g. efficiency vs revenues)

Efficiency and revenues



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Promoting competition and broadband availability



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Session II

Auction formats

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



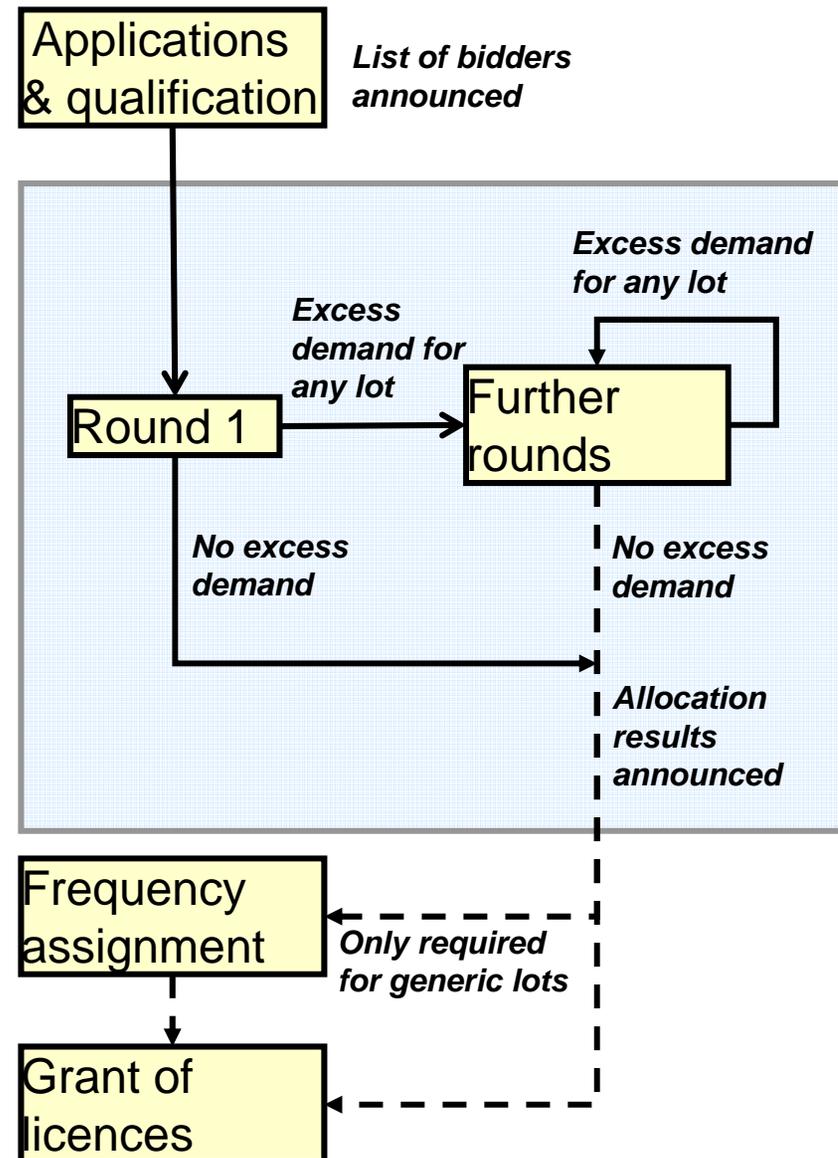
- Multiple Round Auctions
 - 1: Simultaneous Multiple Round Auction (SMRA)
(Canada, Germany, Spain, United States)
 - 2: Simultaneous Multiple Round Auction with Switching
(Norway, Sweden, Finland)
 - 3: Combinatorial Clock Auction (CCA)
(Denmark, Ireland, Netherlands, Austria, UK, Switzerland)

- 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)

- 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

- 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
& qualification

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

Bid submission

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

Winner and price determination

May require algorithms to solve if bid options are not straightforward

Frequency assignment

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

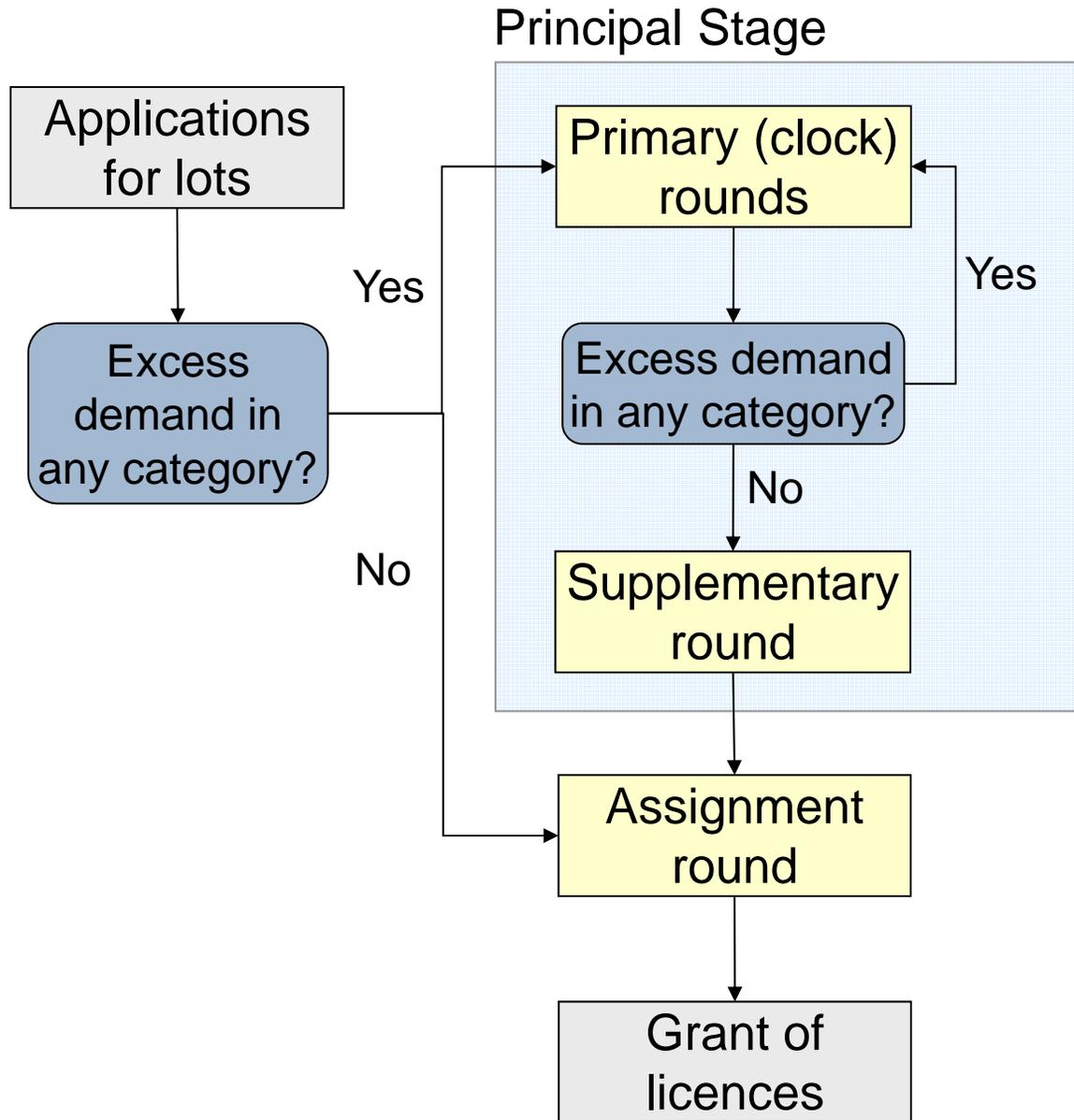
Grant of licences

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

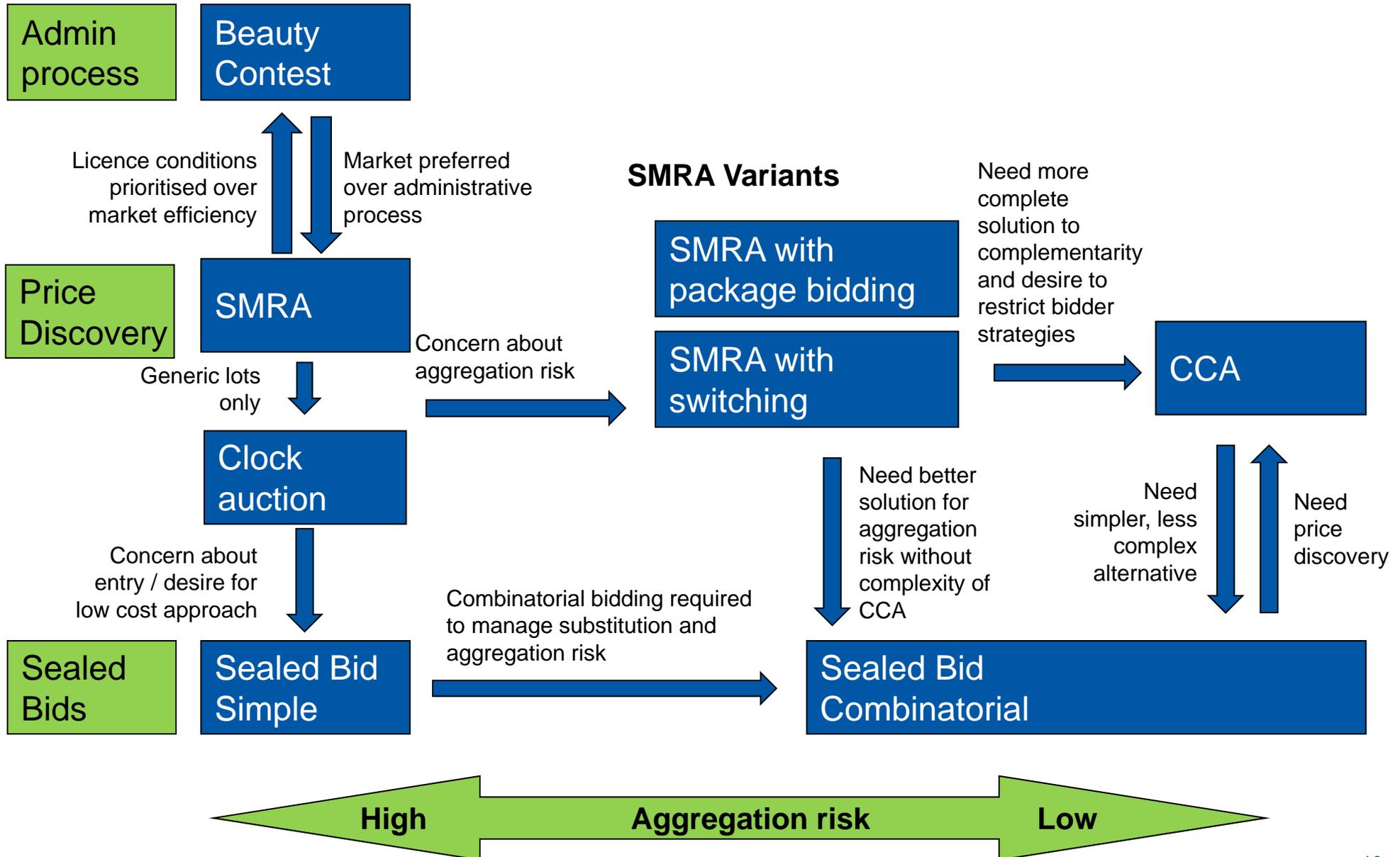


- Practical multi round package bid format developed in UK and now widely used in Europe
- Key features:
 - Ascending clocks for each category of lots
 - Usually implemented with generic lots
 - Package bidding
 - Second-price rule
 - New 'relative price' activity rule

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
 - Prices can vary hugely across bidders and outcomes may be considered ‘unfair’
- 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

Conclusion: The best auction format will depend on local conditions



- In any spectrum award, governments have a broad range of objectives and local demand conditions vary
- 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)
- Detailed rules, including packaging, may matter as much as the choice of format
- **Be very careful when adapting orthodox formats – even small changes can have unexpected impact!**

Questions



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- Any questions?



Case studies

Case studies of recent auctions



- Spain – orthodox SMRA with generic lots, and mix of national and regional lots



- Sweden – SMRA ‘with switching’ to ease aggregation risks, and novel approach to rural coverage



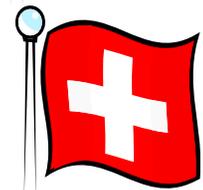
- India 3G – Bespoke clock auction design with regional lots and apparent emphasis on achieving high revenues



- United States 700 MHz – Complex band plan; early and awkward attempt at combinatorial bidding



- Denmark 2.6 GHz – Orthodox CCA, achieved solid revenues despite modest competition



- Swiss multi-band – Another CCA but with huge amount of spectrum, high but uneven prices

Spanish 800MHz, 900MHz & 2.6GHz auction



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Spanish auction - outcome



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Sweden 800MHz auction



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Sweden 800MHz - outcome



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India 3G auction



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India 3G - outcome



- Auction attracted 9 bidders – all 2G incumbents
- Intense competition drove total revenues to over \$15bn
- No bidder won 3G spectrum in all 22 regions
- Some controversial aspects of auction:
 - Advisors incentivised to maximise revenues (this goal placed above efficiency of outcome)
 - Closing rule may have led to some bidders paying more than necessary to secure target regions
 - Bidders very exposed to aggregation risk across regional footprints
 - Rules may have encouraged leading bidders to focus on the biggest regions at expense of pursuing national footprints

US 700 MHz auction



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US 700 MHz - outcome



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Ireland 26GHz auction



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Ireland 26GHz auction - outcome



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Denmark 2.6GHz - format



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Denmark 2.6GHz - outcome



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Swiss multi-band 2012 - format



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Swiss multi-band 2012 - results



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Lessons from the case studies



- Wide variation in auction formats and rules used for recent spectrum auctions
- Governments have great flexibility to tailor rules to specific lot structures and policy goals
- Auctions can be used as a complement or alternative to administrative decision making, e.g.
 - Sweden – using bidding to secure budget for rural rollout
 - Ireland – using the market to decide P2P / PMP split
- Auction design can be used to manage complexity for bidders, but this may be very difficult if lot structures and licence terms are complex (e.g. US 700MHz)
- Choice of packaging, format, rules and reserve prices can have huge impact on participation, competition levels, and relative position of incumbents and entrant bidders

Questions



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- Any questions?



Session III

Implementing an auction

The award process



- Full process can be completed within 6-12 months
- Possible to complete in 3-4 months by cutting steps
- In practice, awards often take > 12 months, owing to challenges:
 - Public policy intervention
 - Unresolved border interference
 - Legal challenge



- For major awards, there are typically two key documents:
 - Information Memorandum
 - Describes the available spectrum, licence terms, application process and auction rules
 - Requires multi-disciplinary skills to draft: economic, law, engineering and project management expertise
 - Official regulations
 - Legal document giving authorisation for the award (requirement for detail on process and auction varies)

- In some countries, there is no requirement for these two documents to be separate

Managing consultation processes



- For major auctions, we would recommend two periods of consultation:
 - An initial consultation on high-level decisions: packaging, licence terms & auction format
 - A final consultation on the draft information memorandum, covering detailed licence terms, procedures & auction rules
- This approach provides flexibility for regulator
 - Consultation responses (especially confidential responses!) often provide useful information about industry thinking and needs
 - Opportunity to study potential for new entry / technology changes
 - Industry has stake in process, which may reduce threat of legal challenge

Setting reserve prices



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Valuation



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Detering bidder association and collusion



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Application, qualification and bidder training



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Location of bidders / Software



- There are two broad approaches:
 - Remote bidding using secure, online bid software
 - Co-locating bidders, which facilitates manual bidding
- Most regulators prefer the online approach:
 - Secure online software readily available and cost effective
 - Lower participant costs
 - Bidders much prefer remote bidding, as communication with management easier
 - Co-location of bidders may encourage collusion (as bidders cannot avoid meeting)

We strongly recommend remote bidding & online software

Hiring a consultant



- We recommend you use consultants to:
 - Undertake valuations and benchmarking
 - Identify auction format, draft auction rules and advise on process
 - Provide software to run the auction

- Our suggestions:
 - Seek consultants with experience of:
 - Multiple spectrum auction formats
 - Working with governments & bidders
 - Look for flexibility on adapting formats to local conditions in your country
 - Don't fix the rules before hiring help!
 - Set realistic budget (should still be small fraction of revenues)

Concluding comments



- There are many aspects to implementing a spectrum auction
- Much can be learned from experience in other countries:
 - Borrow from best practice
 - Avoid mistakes made elsewhere
- ... and from consultants who worked for government and bidders in those countries

Questions



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- Any questions?



Session IV

Roundtable debate on conclusions for the region

Questions for participants I



- One award or multiple awards?
- Do you have any constraints on releasing new spectrum (800 and 2600 MHz)?
- Are you considering linking forthcoming awards to refarming of 2G spectrum?

Questions for participants II



- What are your objectives for forthcoming awards?
 - Does revenue matter?
 - Does new entry matter?
 - Do you have broadband roll-out objectives?
- Are you concerned about bidder asymmetries?

Questions for participants III



- Are you considering using an auction to award spectrum?
- What auction formats are you considering?
- Which approaches by other countries to you most admire and why?
- When do you plan to schedule your award(s)?



Thank you!

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