Determining the criteria for successful spectrum auctions

2 July 2013

Stefan Zehle, MBA

CEO, Coleago Consulting Ltd

Tel: +44 7974 356 258

stefan.zehle@coleago.com

coleagoconsulting

Agenda

1. About Coleago Consulting
2. The case for spectrum auctions
3. Spectrum auction formats and rules
4. Setting appropriate reserve prices
5. Conclusion

About Coleago Consulting

A specialist telecoms management consulting firm

Coleago offers specialist advisory services to the telecoms industry

Spectrum Valuation and Auctions	Strategy and Business Planning	Interconnect & Accounting Separation
Due Diligence	Business Transformation & Cost Reduction	Digital Content & Media
Marketing & Customer Management	Improving Network Performance	Training

Coleago has carried out over 60 spectrum consultation, valuation, auction and beauty contest licence projects

Current projects

- Canada - 700MHz
- New Zealand - 700MHz
- Paraguay - multi-band
- Oman - 800MHz & 2.6GHz

Completed in 2013

- Myanmar – greenfield
- Australia – 700MHz & 2.6GHz
- UK – 800MHz & 2.6Ghz
- Sri-Lanka – 1800MHz

Completed in 2012

- Belgium – 2.6GHz
- Netherlands – multi-band
- New Zealand –1800MHz spectrum trading
- Switzerland – multi-band
- Russia – 700MHz & 2.6GHz
- Pakistan – 2.1GHz valuation
- Bangladesh - 2.1GHz valuation

The case for spectrum auctions

Spectrum auctions are objective and in theory allocates a scarce resource to whoever values it the most

The process of awarding spectrum has become more sophisticated over time

1990's: Beauty contests

- Widely used outside the US for GSM licences
- Difficult to administer, bureaucratic
- Open to dispute and vulnerable to corruption

2000's: Auctions

- Transparent process (no subjectivity)
- Policy objective: maximise economic efficiency
- Theoretically whoever values spectrum the most will produce the greatest social good

But allocating spectrum on the basis of private valuations may be at odds with the public good

"The key goal of any auction is to guide goods to those who value them the most. Spectrum auctions help identify the highest value use and users."

New Zealand Ministry of Business, Innovation and Enterprise - May 2013

"The private value for incumbents includes benefits gained by preventing rivals from improving their services.

The value of keeping spectrum out of competitors' hands could be very high. However, this 'foreclosure value' does not reflect consumer value."

US Department of Justice, *Ex Parte* Submission before the FCC - April 2013

Policy objectives determine auction format and rules

Policy objectives may differ between countries

- Maximise immediate revenue generation from a spectrum auction
- Make spectrum available to mobile operators as cheaply as possible
- Increase mobile broadband access in rural areas
- Increase competition at MNO or MVNO level
- Ensure the rapid evolution of a connected society to deliver long-term economic benefits by making best use of a scarce resource

Very large variations in prices paid are due to different auction rules, formats and levels of competition

2.6GHz FDD prices paid in auctions

Country	Year	€/MHz/pop	Commentary
Hong Kong	2009	0.252	5 bidders for 3 blocks
Sweden	2008	0.130	5 bidders for 4 blocks; one new entrant
Denmark	2010	0.164	4 bidders; 2nd price auction, tight caps
Norway	2007	0.036	2 operators plus Craig Wireless
Germany	2010	0.028	4 operators and 140MHz & other spectrum was auction at the same time
Finland	2009	0.004	3 operators and 140MHz; single TDD block sold for 50% higher price than FDD
Netherlands	2010	0.001	3 operators and two cablecos; low spectrum caps, and 2nd price rule

Spectrum auction formats and rules

While the CCA format has gained favour it is expensive to execute

Three main formats for auctioning multiple spectrum lots

SMRA *Simultaneous Multi-Round Ascending auction*	• Bid on specific blocks of interest (between minimum and maximum set by auctioneer for each block) • 'Standing high bids' for each lot in each round • Auction ends when there is no excess demand • 'First price': pay what you bid
CCA *Combinatorial Clock Auction*	• Bid on packages of generic lots rather than on individual lots • Pay 'second price': minimum needed to win and to avoid 'unhappy losers' • Separate assignment round for positioning in the band • Also pay 'second price' for assignment
Clock + *'First price' CCA*	• Bid on packages rather than individual lots • Exit bids allowed (between last and current clock prices) • First price: pay what you bid • Auction ends when there is no excess demand • Separate assignment process (auction or administered)

SMRA auctions result in a fragmentation risk

Auctioning specific blocks of spectrum in parallel may lead to non-contiguous allocations

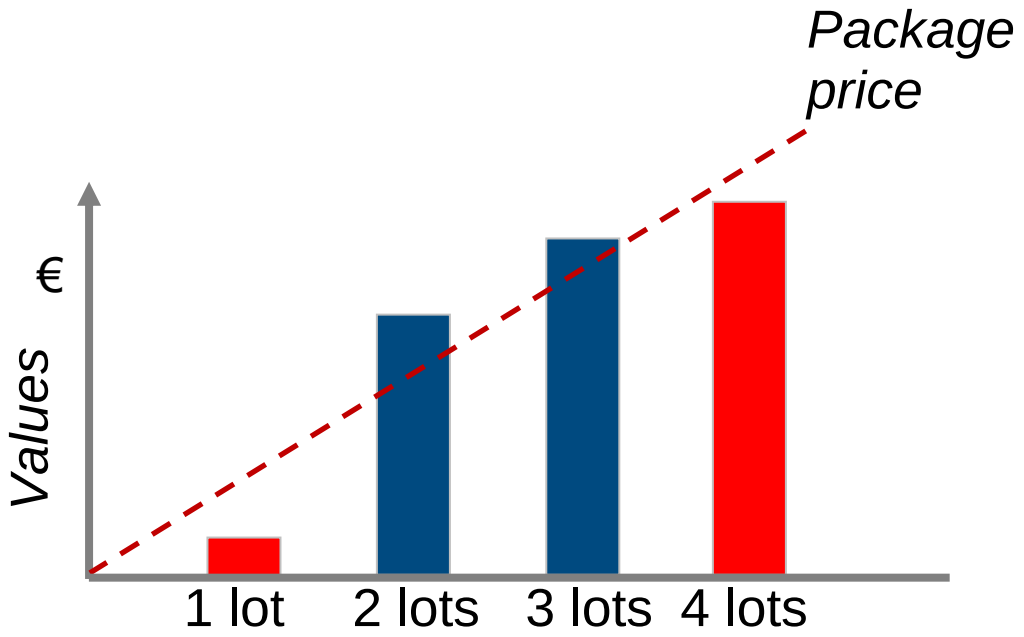
- Key drawback of regular SMRA
- Threatens ‘technical efficiency’
- Vulnerable to anti-competitive bidding (e.g. attempt to isolate individual blocks)

Example: Bidders B2 and B4 have contiguous allocations, while B1 and B3’s allocations are fragmented, creating significant problems for them

SMRA auctions lead to exposure risk

Risk of being stuck with an unwanted subset of the target package

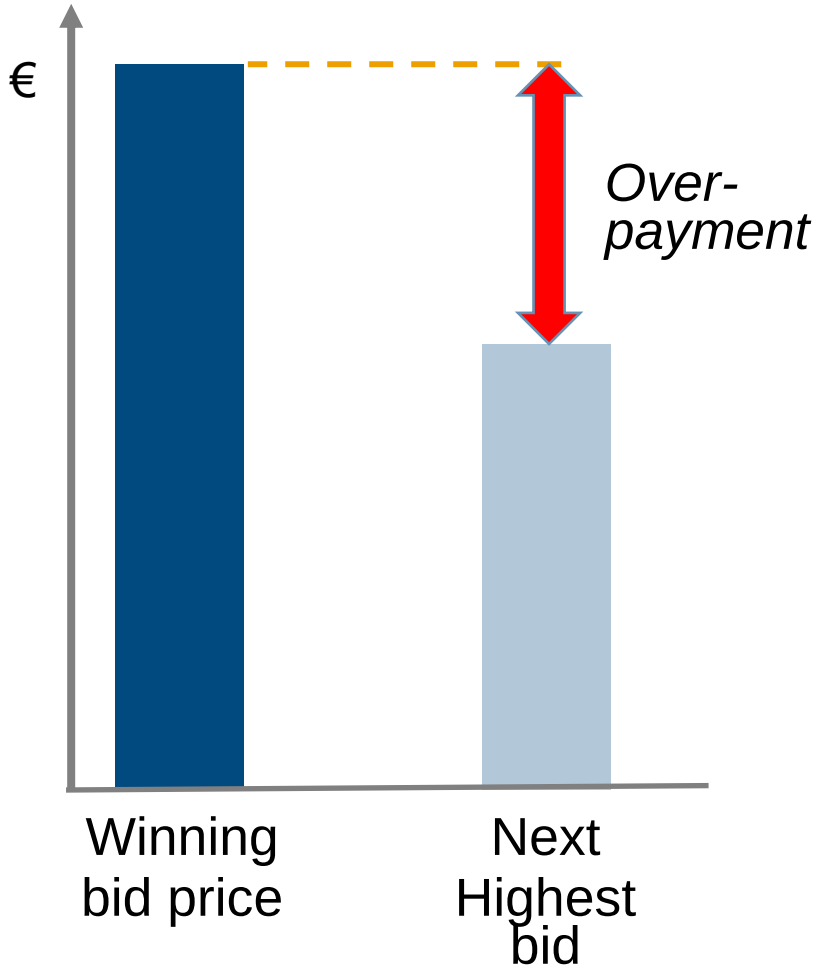
- Potential value destruction: paying more than the final package is worth
- Key drawback of SMRA
- Package bidding (CCA and Clock+) avoids this: either win entire package pursued or nothing at all



Example: SMRA in a single band

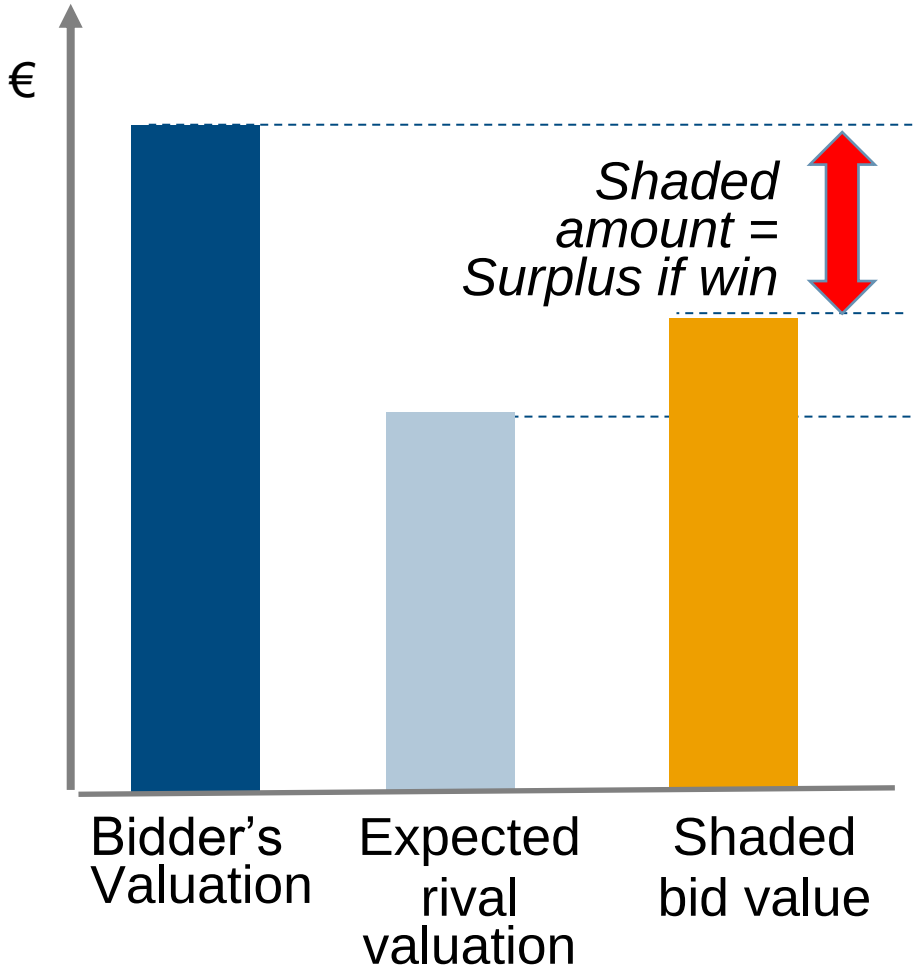
- A package of 2 or 3 lots is still profitable at current prices
- But one may ultimately be outbid
- And be left with a single, unprofitable lot on which one is Standing Highest Bidder

‘Winner’s curse’ arises when a bidder pays more than would have been necessary to win



- Typical of first-price, sealed-bid auctions
- In the first Brazilian spectrum auction in Bell South paid more than twice as much as the next highest bid for the Sao Paulo Metro licence
- Can also occur under SMRA and Clock+: pursuing a large package and failing can drive up the price for the smaller package ultimately secured

To avoid the winner's curse, bidders may 'shade' their bids



Demand moderation strategies in SMRA and Clock+ auctions are analogous to bid shading

- SMRA and Clock+ invite a tacit 'negotiation' between rivals
- The faster participants settle on the final allocation, the less everyone pays
- But there is a risk to allocation efficiency: by reducing demand too much, a bidder could miss out on a larger package that it should otherwise have won

The Second Price Rule eliminates the winner's curse …

Example1: Second Price Auction for a single lot

	Bid for 1 lot	2nd price	
Bidder A	€40	-	
Bidder B	€50	-	
Bidder C	€1000	€50	← *Winner*

- Bidder C wins (highest bid amount)
- But only pays the "opportunity cost" (amount the auctioneer could have sold the lot for if Bidder C were absent)

- Whoever values the resource most highly wins (economic efficiency)
- "2nd price" rule: pay no more than the minimum required to win
- Incentivises truthful bidding: no penalty for bidding full 'walk-away value'
- No unhappy loser: Bidders A and B would not have been prepared to pay more than the price paid by Bidder C

…but this comes at a cost: a 2nd price auction for multiple lots can lead to significant pricing differentials

Example2: Second Price Auction for 2 identical lots

	Bid for 1 lot	Bid for 2 lots	2nd price
Bidder A	€60	€75	€40
Bidder B	€60	€100	€15
Bidder C	€10	€20	-

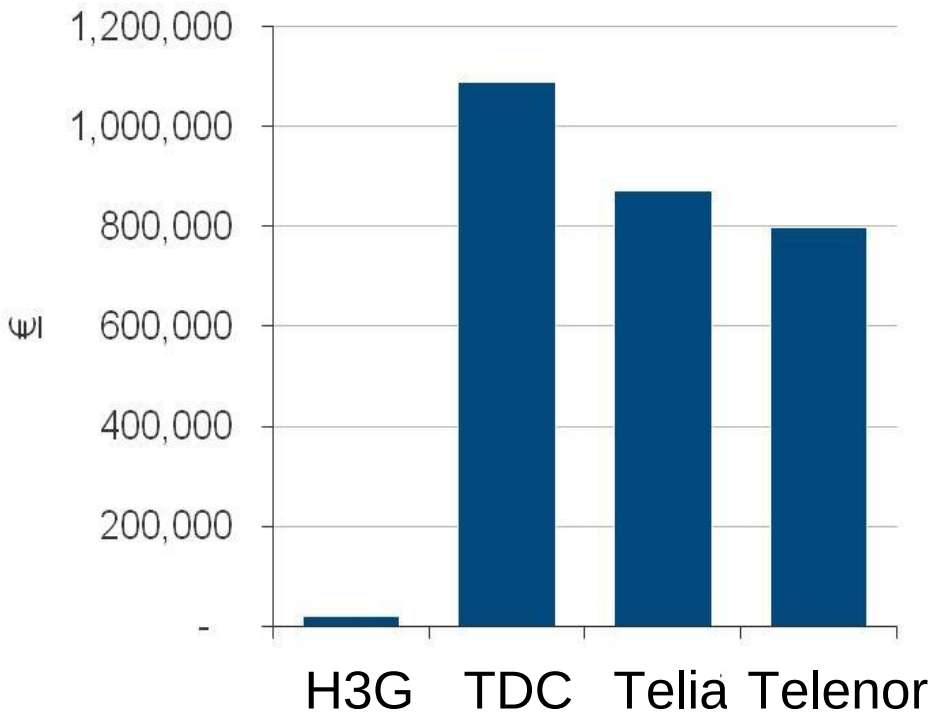
Bidder A and B pay each other's marginal bid values for an extra lot

- Allocating 1 lot to bidder A and B maximised bid value and is therefore winning
- The "2nd price" (or Vickrey price) is the opportunity cost imposed by each bidder
  - If Bidder A were absent, the auctioneer could have sold its winning lot to Bidder B for €40 (the extra that B would pay for an additional lot = €100-€60)
  - If Bidder B were absent, the auctioneer could have sold its winning lot to Bidder A for €15 (the extra that A would pay for an additional lot = €75-€60)
- No-one has any grounds to contest the outcome: neither Bidder A nor B were prepared to pay more to win an extra lot, and Bidder C was not prepared to pay this price for any lots

Real Example: impact of second price rule in the Denmark CCA based 2.6GHz auction in 2010

- Hutchison paid €0.9 million for 2x10 MHz of FDD plus 25 MHz of TDD
- The other bidders who acquired 2x20 MHz FDD paid ~20x more per MHz
- This dramatic outcome was a product of a second price combinatorial auction with tight spectrum caps:
  - TDC, Telenor and Telia's prices reflected Hutchison's bid value for an additional lot of 2x10MHz FDD
  - Hutchison's 2x10MHz FDD could not have been sold to anyone else, hence the 2nd price was the reserve price

Prices paid per MHz



While CCA offers attractive features, it also poses significant problems for participants

Embarrassing outcomes	• A bidder may win an inferior package yet pay a higher price than its rivals (even when following an optimal bid strategy)
Low transparency	• Allocation and price exposure are uncertain, and there is no opportunity to react to unexpected outcomes
Lack of control over outcome	• Forecasting the impact of bids is difficult. In theory, a strong bidder could be knocked out by a group of weaker bidders, despite being a "last man standing" in the clock phase
Stakeholder management	• It is difficult to communicate the risks to key stakeholders and protect the bid team from post-auction criticism in the event of unfavourable outcomes
Auction execution	• It's expensive! Managing complex bid decisions during a live auction is difficult, with limited time-intervals between rounds; this calls for robust processes and auction support tools.

Summary – key characteristics of the main auction formats

Design Principle	SMRA	CCA	Clock+
Supports simultaneous award of spectrum in multi-bands	✔✔✔	✔✔✔	✔✔✔
Exposure and fragmentation risks	✘	✔✔✔	✔✔✔
Flexibility over the use of specific or generic lots	✔✔	✔	✔
Transparency of bidders and bids	✔✔✔	✔✔	✔✔
Certainty over lots awarded	✔✔✔	✘	✔✔✔
Certainty over prices paid	✔✔✔	✘	✔✔✔
Avoids ‘winners curse’	✘	✔✔	✘
Avoids adverse price asymmetries	✔✔✔	✘	✔✔✔
Simplicity and ease of presentation and transparency of results	✔	✘	✔✔✔
Promotes all spectrum being sold	✔✔	✘	✔

Auction rules may matter more than auction formats

Rules are set to prevent gaming and, vexatious bidding while ensuring that all spectrum is sold efficiently

- Spectrum packaging
- Spectrum caps
- Spectrum set-aside
- Activity rules
- Provision of information
- Bid increments
- Spectrum trading
- Reserve prices

Setting reserve prices in spectrum auctions

High reserve prices can lead to outcomes that ultimately deliver less societal value

Policy objectives and implications for spectrum auctions in a mobile broadband dominated market

Access to mobile broadband	• LTE deployed in as many bands as possible to use spectrum efficiently • Rural LTE coverage
Affordable mobile broadband	• LTE lowers the cost per bit, but only if devices can use it • Harmonised devices with multiple LTE bands
Competition in urban and rural	• Allocate spectrum to multiple operators • Avoid technology barriers to competition

Consider in the context of a) current spectrum holdings in all bands and b) technology deployment within these bands.

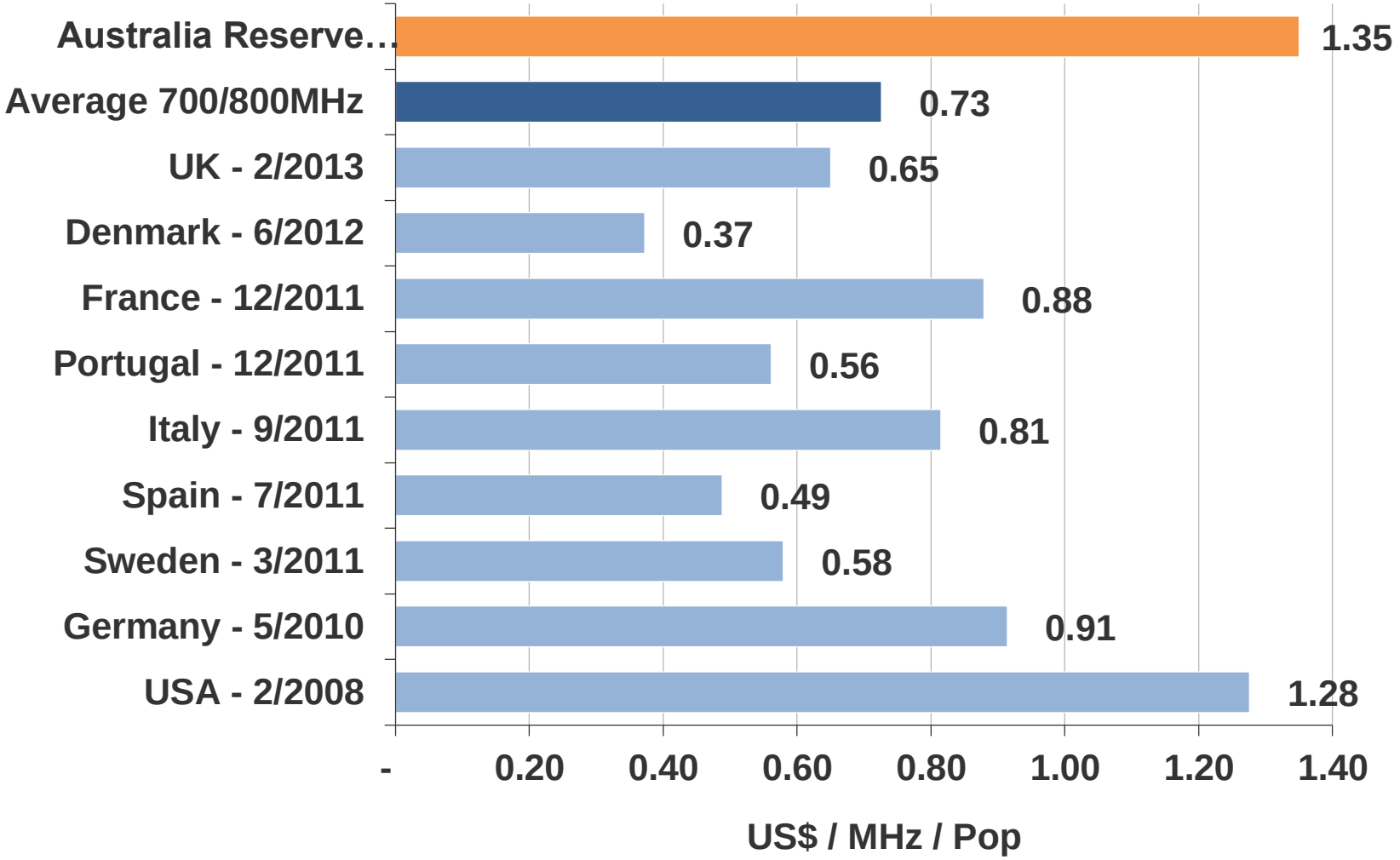
The rationale for freeing up the digital dividend spectrum

- The economic benefits of freeing up spectrum for mobile broadband are well documented.
  - Potential gains run into $ billions, i.e. are measured in % of GDP.
- The cost of moving TV broadcast is more than offset by the economic gain that would be generated if the spectrum is used for mobile broadband.
  - This implies that the spectrum is actually used.
- Part of the incremental economic gains comes from lower prices for consumers.
  - Implies that operators can deploy 700MHz LTE cost effectively
  - Implies competition to drive down prices

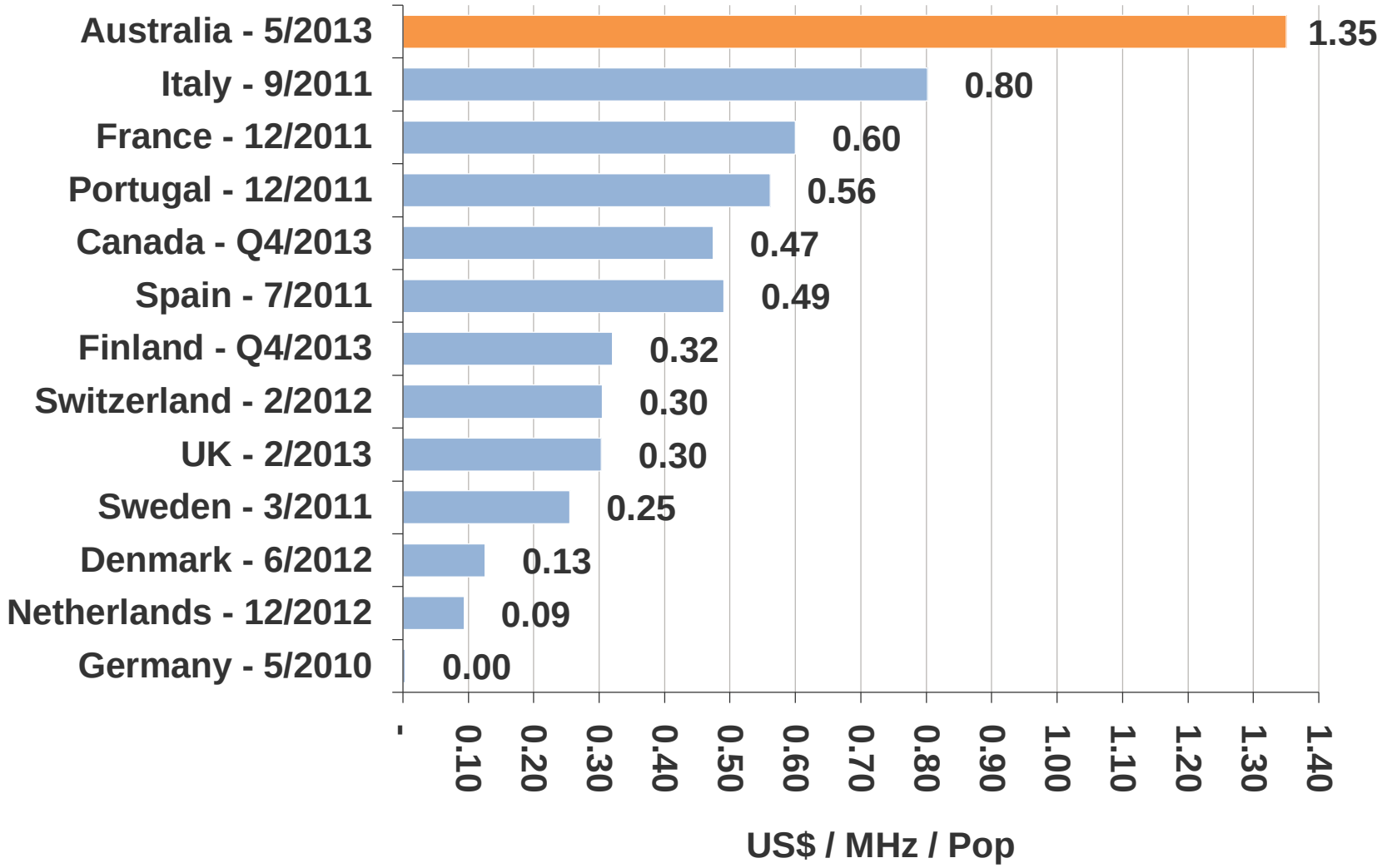
The Australian APT 700MHz auction in this context

Potential gains?	Between AU$ 7bn and AU$10bn
Is the spectrum is actually used?	2x15MHz of 2x45 unsold
Can operators deploy the 700MHz band as cost effectively?	Only Telstra obtained 2x20MHz, can deploy at lowest cost, Optus obtained only 2x10MHz
Is there competition to drive down prices?	One operator, Vodafone, did not obtain any spectrum and the leading operator Telstra increased its competitive advantage, thus reducing competition

700/800MHz auction prices paid vs. Australian reserve



700/800MHz auction reserve prices compared



Lessons learned from the Australian 700MHz auction

High reserve prices are not a good approach to spectrum auctions

- They have a market distorting effect
- Regulators might do not achieve their policy objectives
- Even if a large amount of money is raised up-front this may reduce overall economic value in the long term

The societal value of allocating spectrum

- The return to the community from spectrum auctions goes well beyond any direct payment made to government for spectrum.
- Implicitly all governments recognise the trade-off between spectrum fees and wider goals.
- Otherwise they would simply auction off monopolies which would undoubtedly bring the highest direct receipts.

Setting high prices for spectrum is problematic

Hazlett and Munoz, "What Really Matters in Spectrum Allocation Design", 2010

"[T]he ratio of social gains [is of] the order of 240-to-1 in favour of services over licence revenues…Delicate adjustments that seek to juice auction receipts but which also alter competitive forces in wireless operating markets are inherently risky. A policy that has an enormous impact in increasing licence revenues need impose only tiny proportional costs in output markets to undermine its social utility.

In short, to maximise consumer welfare, spectrum allocation should avoid being distracted by side issues like government licence revenues."

Competition is now the main concern in auction design

- Wireless markets are mature. At the maturity stage of the industry life cycle we can expect consolidation but not new market entry, at least at network level.
- Ensuring competitive markets with the existing number of operators becomes a policy goal.

- "*In a highly concentrated industry with large margins between price and incremental cost of existing wireless broadband services, the value of keeping spectrum out of competitors' hands could be very high".* Submission of the United States Department of Justice before the Federal Communications Commission (April 11, 2013)

Competition considerations in auctions

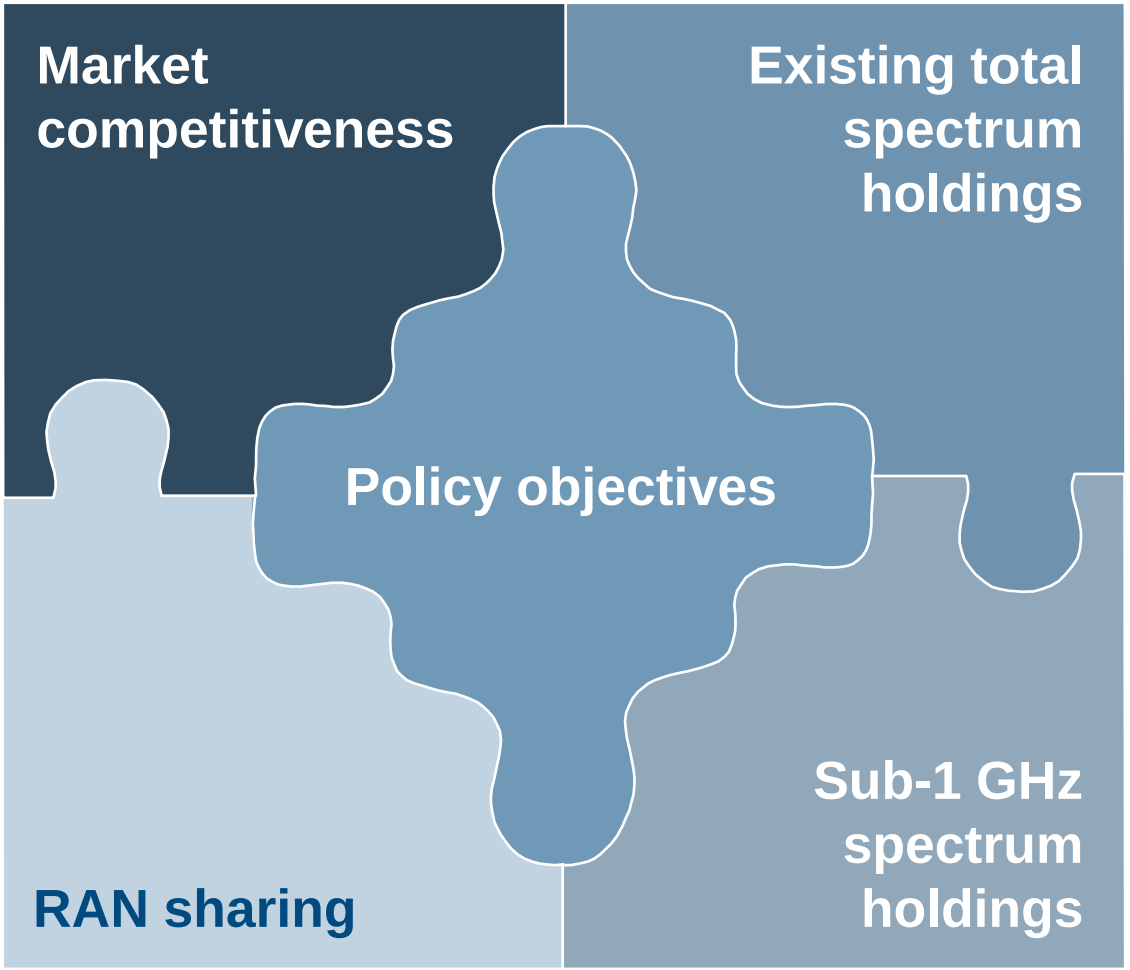
In an LTE world large contiguous spectrum holdings confer particular competitive advantage

- Allocate spectrum in a manner which does reduce competition while at the same time maximising the benefit of a wide band
- High reserve prices favour strong bidders and are detrimental to competition
- In spectrum auctions spectrum floors and caps may be appropriate

Conclusion

Auction format and rules should be designed according to the situation at hand

Considerations for spectrum auction format and rules



Supply of Spectrum

Spectrum auction design

Demand for Spectrum
Number of operators in a market

Questions?

Stefan Zehle, MBA

CEO, Coleago Consulting Ltd

Tel: +44 7974 356 258

stefan.zehle@coleago.com

coleagoconsulting