

Spectrum Auction Design

3,4-3,8 GHz Auction in Austria

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Disclaimer

- The conclusions expressed in this presentation reflect my best professional judgment and do not necessarily convey the views of TUM.
- Any use made of this document by any person for any purpose, or any reliance placed on its contents are the sole responsibility of such person.
- Recommendations for the Austrian market require in-depth knowledge of the competitive situation in the Austrian market that are not available to me. Also, the SCA auction rules are new and not all relevant rules are known to me at this point.
- I only intend to discuss general lessons learned from past auctions and problems that could occur with a specific auction format and therefore need attention. These issues might not be an issue in the specific Austrian spectrum auction market and my comments should not be interpreted as an argument for or against a specific auction format for the upcoming Austrian spectrum auction.

In theory we know how to design efficient auctions



William Vickrey
Nobel prize 1994

**VCG is the unique and
strategyproof mechanism!
(Green and Laffont, 1979)**

**If bidders only maximize
payoff and don't care about
anything else ...**

BUT, assumptions are violated in the field

Bidders do not always maximize payoff

- Budget constraints (Nisan & Dobzinski, 2012; Janssen et al., 2017)
- Principal-agent problems within firms (Bichler & Paulsen, 2017)
- Value uncertainty and interdependencies (Bichler & Goeree, 2017)

Non-linear and personalized prices violate “equal treatment of equals”

- Swiss auction 2012

Fully combinatorial auctions lead to a significant missing bids problem

- Bichler et al., 2013 and 2014

Allocative externalities often matter

- Bichler, Gretschko & Janssen, 2017

Does the 2-stage CCA solve these problems?

Bidders do not always maximize payoff

- CCA inherits problems of VCG
- ... and makes **spiteful bidding** a real issue (Bichler et al. 2011, Janssen et al. 2016, etc.)
- There are **many (also inefficient) equilibria** even for pure payoff maximizers (Janssen et al. 2016, Levin & Skrzypacz 2016)

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Allocative externalities often matter

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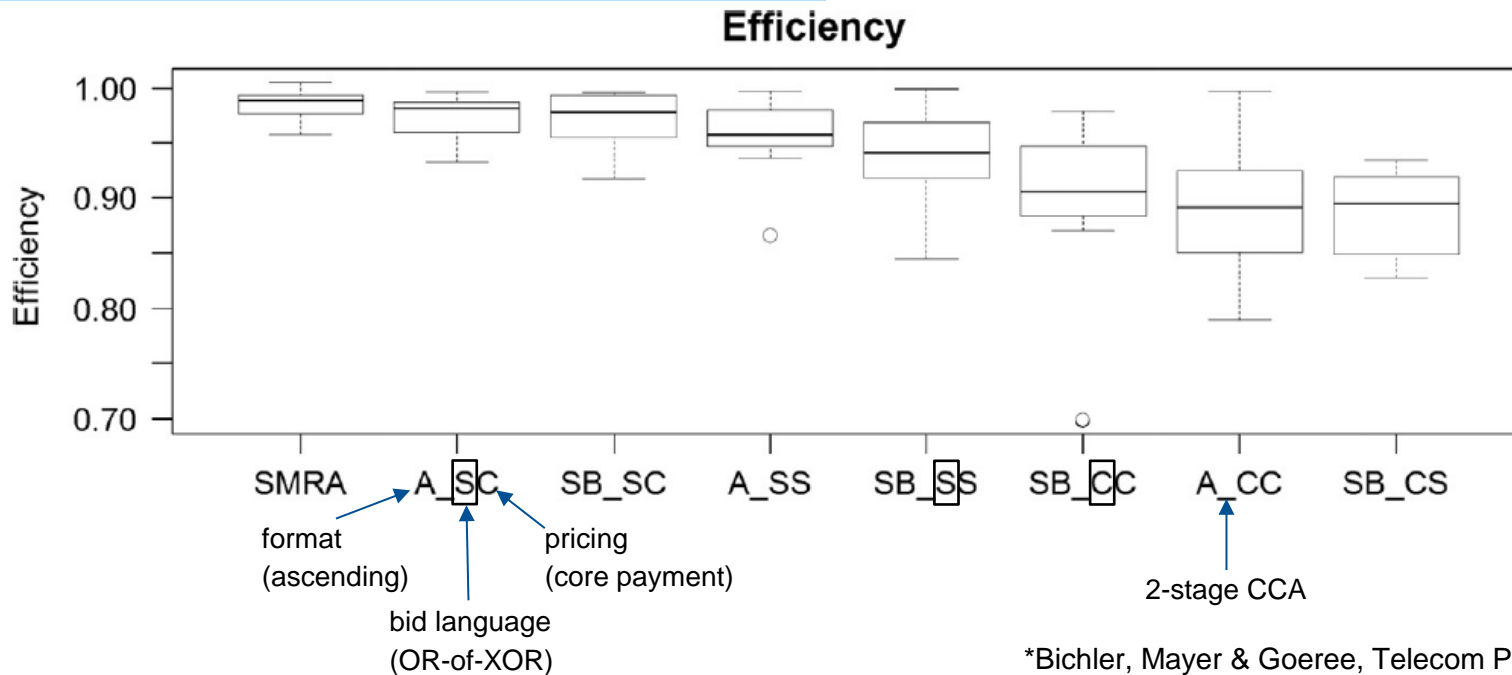
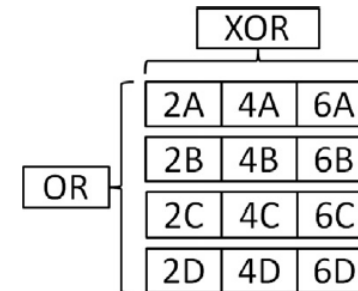
Simple auctions for complex sales*

Bid language:

- Complex: 2400 possible package bids (7^4)
- Simple: 12 bids in an OR-of-XOR language

Pricing

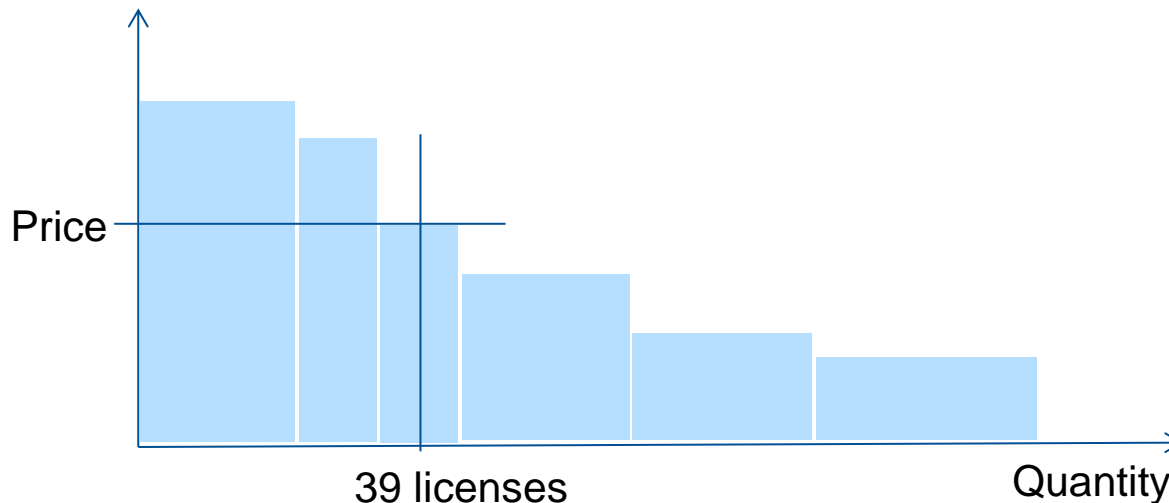
- Complex: Core pricing
- Simple: Pay-as-bid



*Bichler, Mayer & Goeree, Telecom Policy, 2014

The Austrian auction design in 2018

- **A simple clock auction (SCA)**
 - 39 licenses in 10 regions
 - One price clock per region with package bids across regions
 - Exit bids within regions
- Efficiency with (1) **truthful bidding**, (2) **additive valuations**, and (3) **an appropriate activity rule**
 - *Next I will discuss extreme cases where these assumptions are violated*



(1) Non-truthful bidding (demand reduction)

A real-world example: The German 1999 GSM Auction (SMRA)

- Four bidders (Telekom/Mannesmann/Viag/E+)
- Very high initial bids by Mannesmann in round 1

R1	36.36 M	36.36 M	36.36 M	36.36 M	36.36 M	40.00 M	40.00 M	40.00 M	40.00 M	40.00 M
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- Telekom understands this as an invitation to reduce demand
- Tacit collusion: $36.36 + 10\% = 40.00$

R2	40.0 T	40.0 T	40.0 T	40.0 T	40.0 T	40.0 M	40.0 M	40.0 M	40.0 M	40.0 M
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- *SCA makes signaling harder (than in SMRA), but demand reduction is still possible.*

(2) Super-additive valuations

	Linear ask prices				Bundles					
	P(A)	P(B)	P(C)	...	A	B	C	...	A-Z (26)	...
v_1					6					
v_2									78	
v_3									79*	
$t=1$	1	1	1	...	1_1				$26_{2,3}$	
$t=2$	2	2	2	...	2_1				$52_{2,3}$	
$t=3$	3	3	3	...	3_1				78_3	
$t=4$	4	3	3	...	4_1					

- An „extreme“ example, where bidders 2 and 3 are interested in „national“ coverage (all 26 licenses), while bidder 1 only needs license A.
- Bidders 2 and 3 drop out in round 4 and need to bid in an additional (first-price) sealed-bid round having exposure risk.

(3) Eligibility-based activity rule*

Example:

One eligibility point per license X, Y, Z

Values	X	{Y,Z}
	10	8

Price X	Profit X	Price {Y,Z}	Profit {Y,Z}
€1	€9	€1	€7
€2	€8	€1	€7
€3	€7	€1	€7
€4	€6	€1	€7

Revealed preference activity rules could avoid these problems.

*assumption of this activity rule is based on information by DotEcon for the Norwegian auction

Some issues in the SCA that demand discussion*

- Uniform pricing satisfies „equal treatment of equals“
 - But provides incentives for demand reduction (and inefficiency)
- Limited transparency makes demand reduction harder
 - But can create problems in the presence of significant allocative externalities (compared to a German-style SMRA)
- Unsold items can be an issue with superadditive valuations
 - Exit bids might not address the problem sufficiently well
- Eligibility-points rule might prevent switching to packages with higher profit

*these issues might not constitute a problem in a specific competitive environment

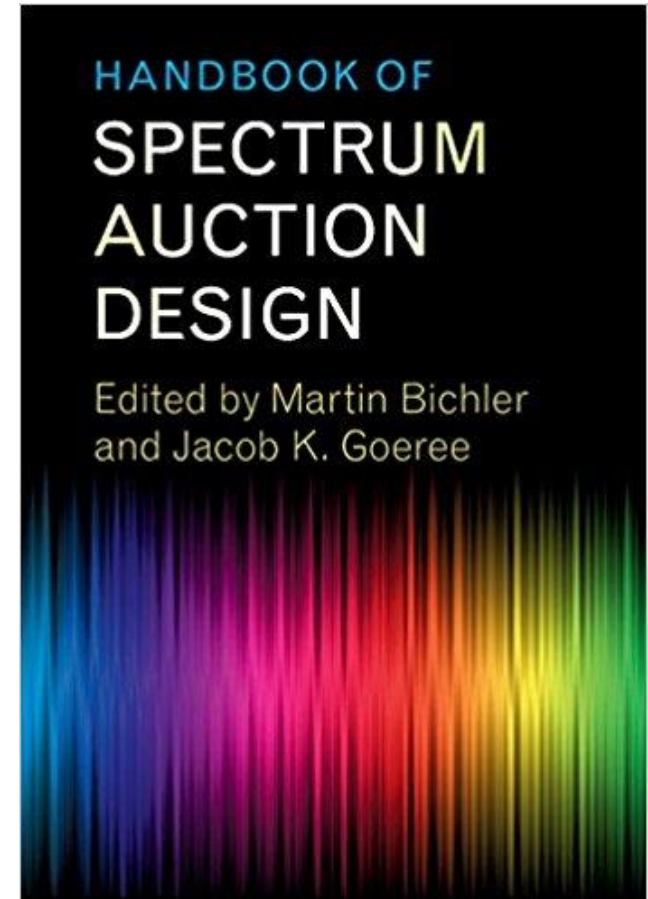
Alternative spectrum auction formats

Non-linear and personalized prices

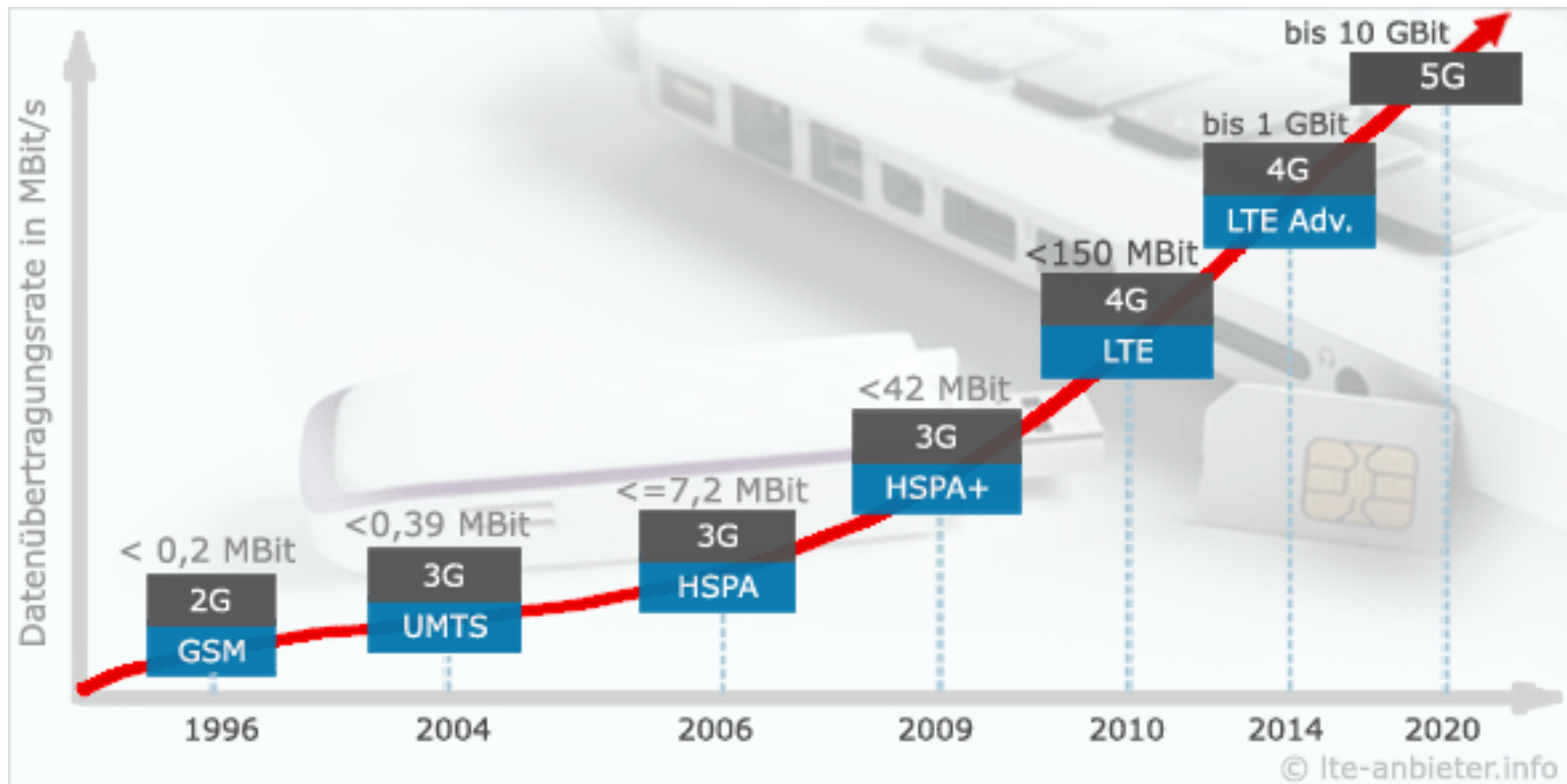
- VCG
- Two-stage CCA (as used in Austria 2013)

Linear (item-level) and anonymous prices

- SMRA (used world-wide)
- SCA (proposed for Austria and Switzerland)
- CMRA (used in Denmark)
 - Multiple bids per round
 - Revealed preference activity rule
 - Winner determination via optimization
- HPB (used in the USA)
- Clock auction w/o package bidding
- Package bidding w. pseudo-dual prices
- Etc.



Thank you!



Source: lte-anbieter.info