

Forward Auction and Closing Rules

Phil Haile, Yale University

comments based largely on sections of

“Design of the FCC Incentive Auctions”

by Yeon-Koo Che, Phil Haile, and Michael Kearns
(on behalf of AT&T)

Forward Auction and Closing Rules

Milgrom-Ausubel-Levin-Segal (“MALS”) Proposals

- Forward Auction: clock auction w/generic licenses
 - ▶ big improvement over SMR: simplicity, transparency, more competition, improved price discovery, less scope for manipulation
- “Closing Trial”: let forward clocks continue when net revenues fall short.

Some Concerns

Forward Auction

- exposure risk
 - ▶ geographic complementarities
 - ▶ value of frequency contiguity
- “overflow problem” (later)

Closing Trial

- limited competition between forward and reverse bidders for licenses on the margin.

Our Main Proposals

1. Clock Package Auction

≈ add hierarchical packages to the MALS clock auction
(hierarchy=old idea, but works especially well with clock design)

2. Two-Sided Closing Trial

≈ let clocks continue in both forward and reverse sides

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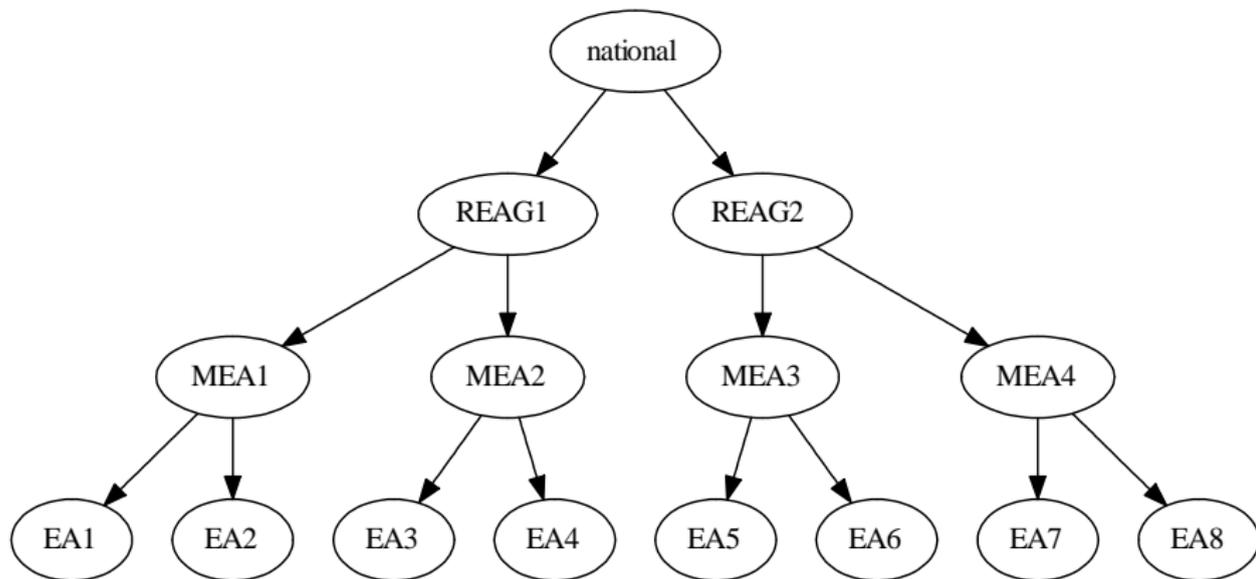
Clock Package Auction (“CPA”)

- objects for sale:
 - ▶ generic EA licenses
 - ▶ generic packages: hierarchical or related structure
- ascending price clocks for each object
- “bid” = vector of quantities demanded at current prices
- prices rise on objects with excess demand
- package prices:
 - ▶ typically additive
 - ▶ superadditive “when necessary”
- auction ends when no excess demand.

Key Details

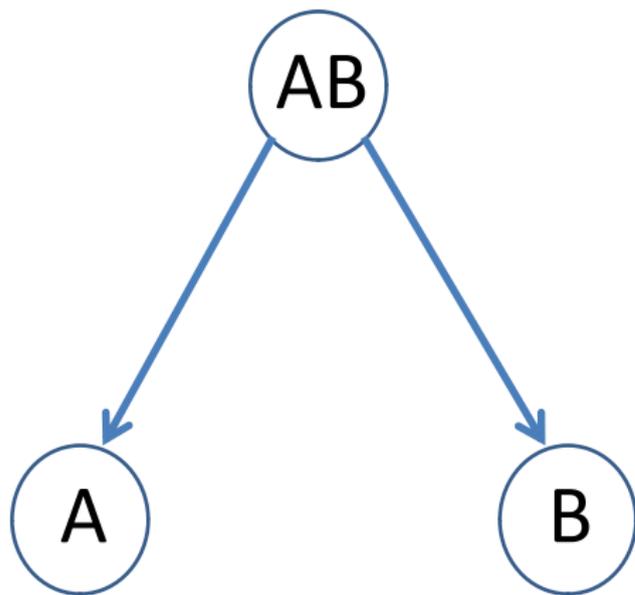
- (1) What Packages Offered
 - (2) Calculation of Excess Demand
 - (3) Package Pricing Rule
- (most of rest identical to MALS proposal)

Objects for Sale

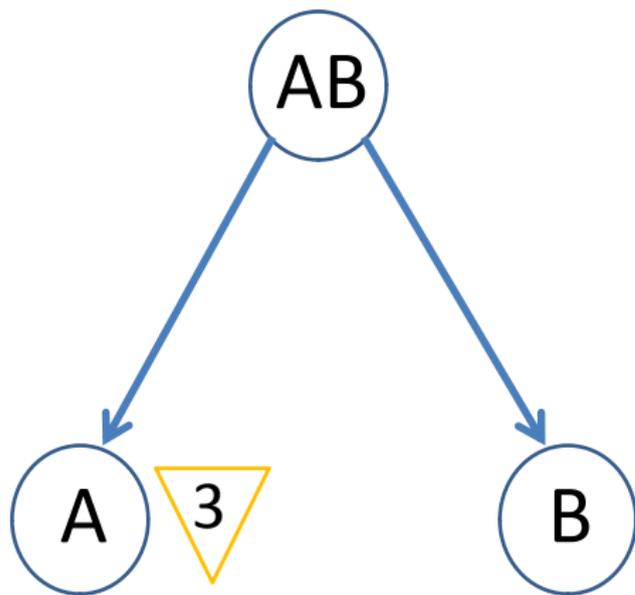


generic EA licenses, and generic hierarchical packages
(would add about 60 objects to 172 EAs)

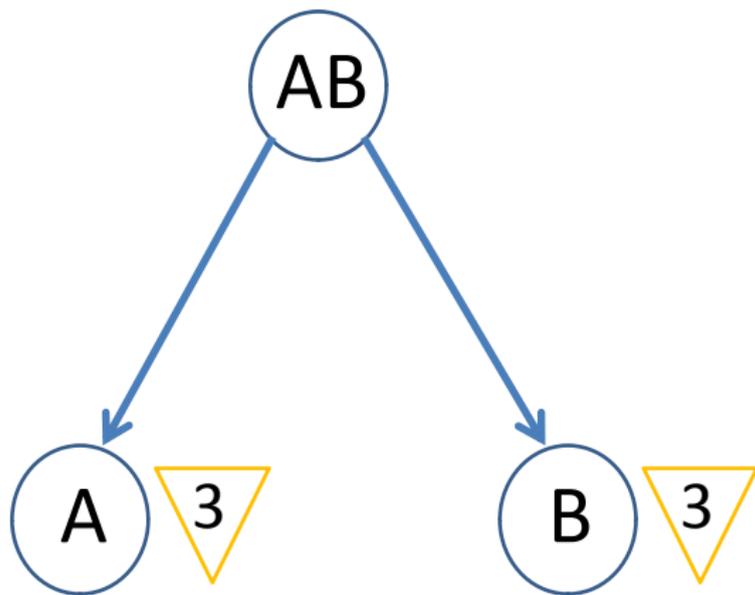
Objects for Sale (Simplified)



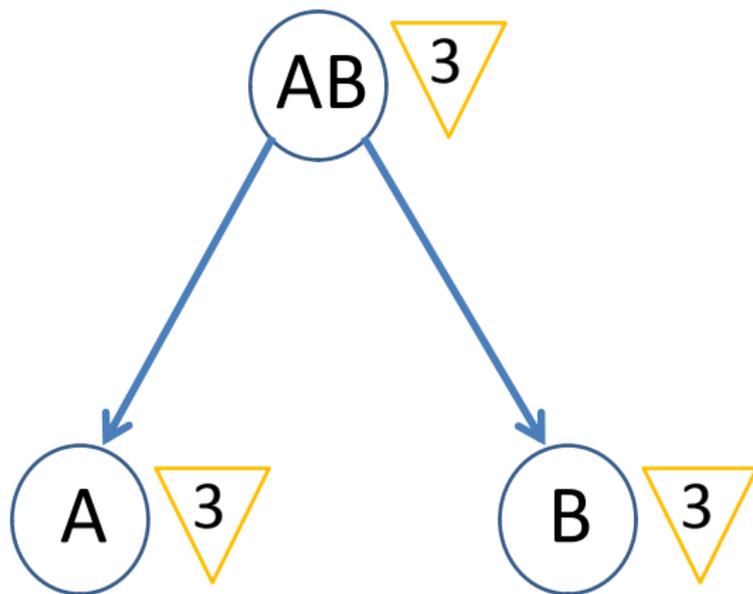
Feasible Supply



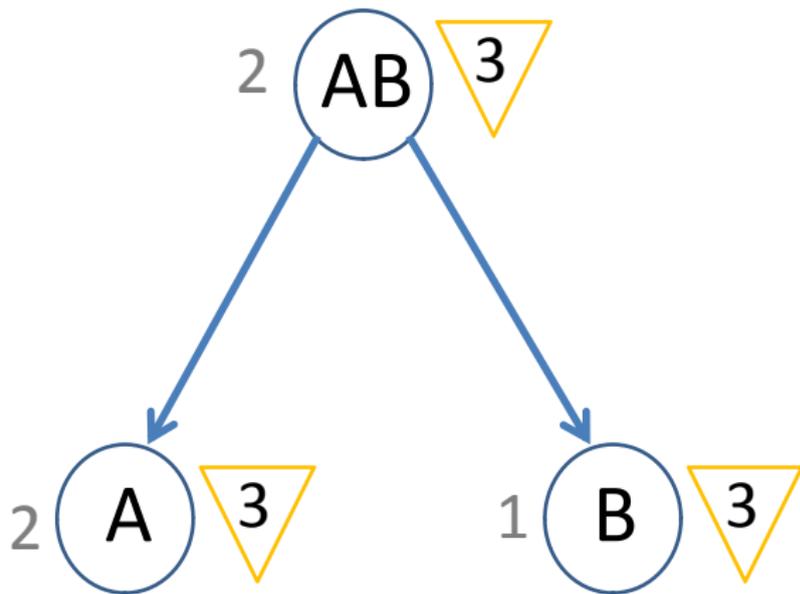
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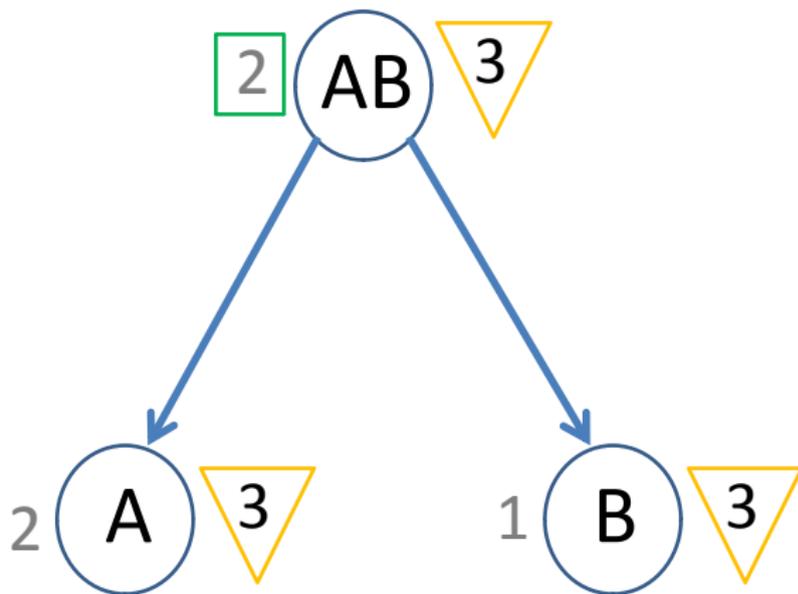
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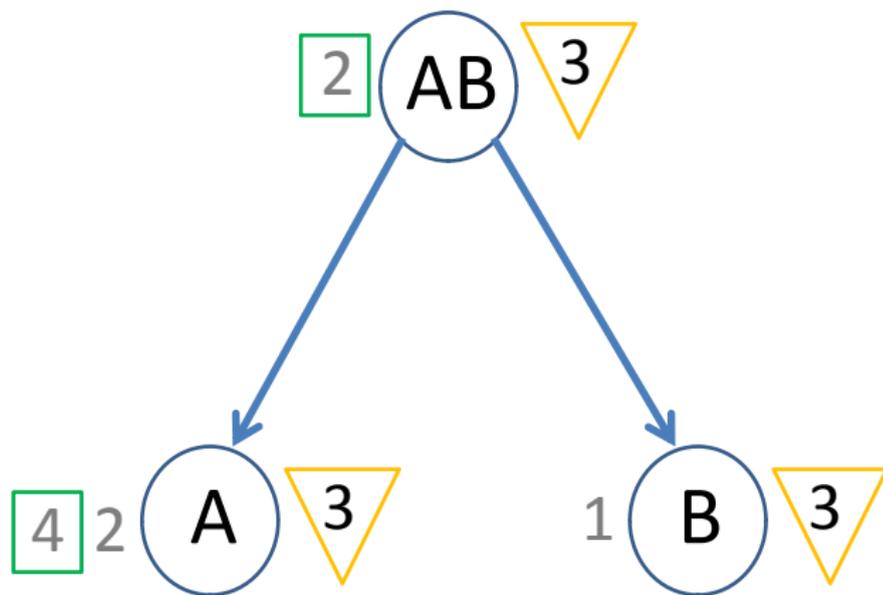
“First-Order Demand”



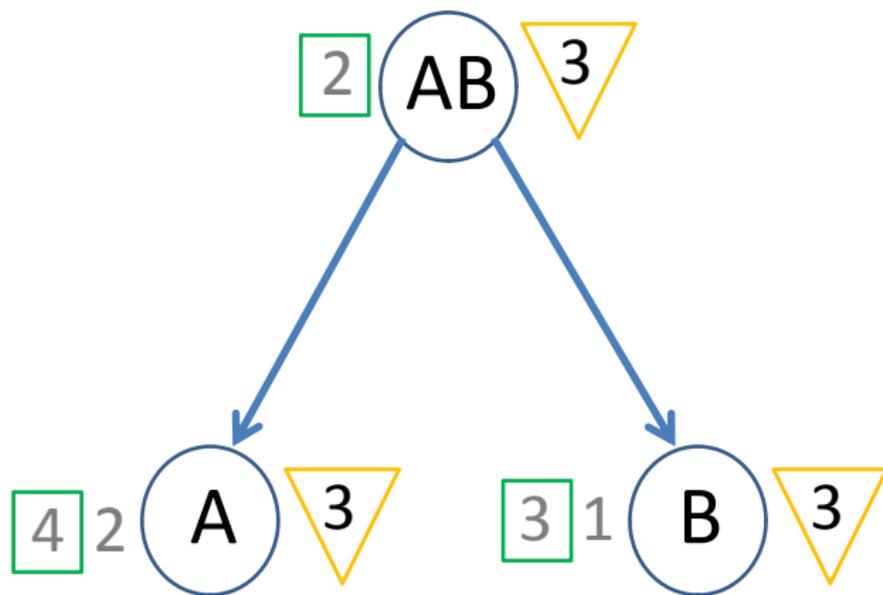
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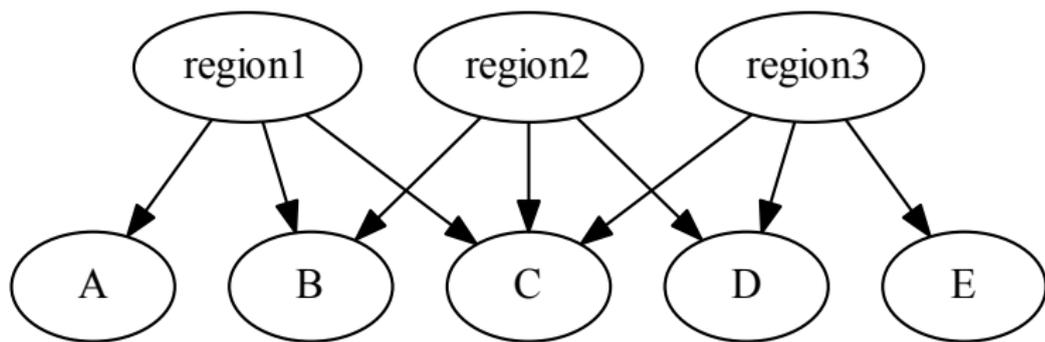


Total Demand: Demand Flows Down



Excess Demand Without Ambiguity

Strict hierarchy (“tree”) natural but not essential: need that there is no more than one directed path from a package to any one of its descendents (“multitree”).



Price Adjustments Flow Up

Assume bid increment is percentage δ

- start at lowest tier of graph (EA objects)
 - ▶ if object j in excess demand: $p'_j = (1 + \delta) p_j$

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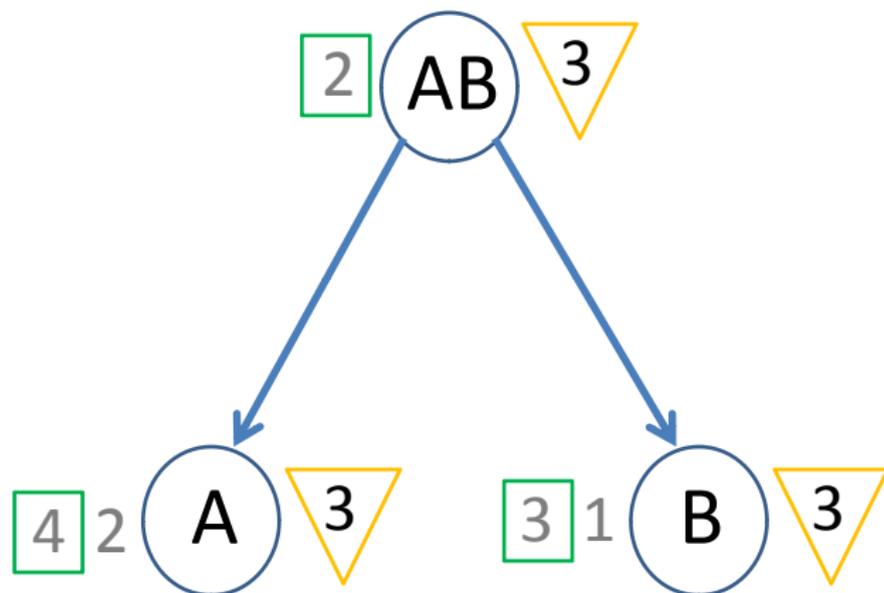
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 - ▶ if object j in excess demand: $p'_j = (1 + \delta) p_j$
- then to next lowest tier, consider object k :
 - ▶ let χ_k denote k 's "children" in directed graph
 - ▶ IF $p'_j > p_j$ for some $j \in \chi_k$, let $p'_k = \max \left\{ p_k, \sum_{j \in \chi_k} p'_j \right\}$
 - ▶ ELSE IF k in excess demand, let $p'_k = (1 + \delta) p_k$
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- continue through top tier.

Price Adjustments Flow Up



p_A rises, p_B does not, p_{AB} rises (unless already above $p'_A + p_B$).

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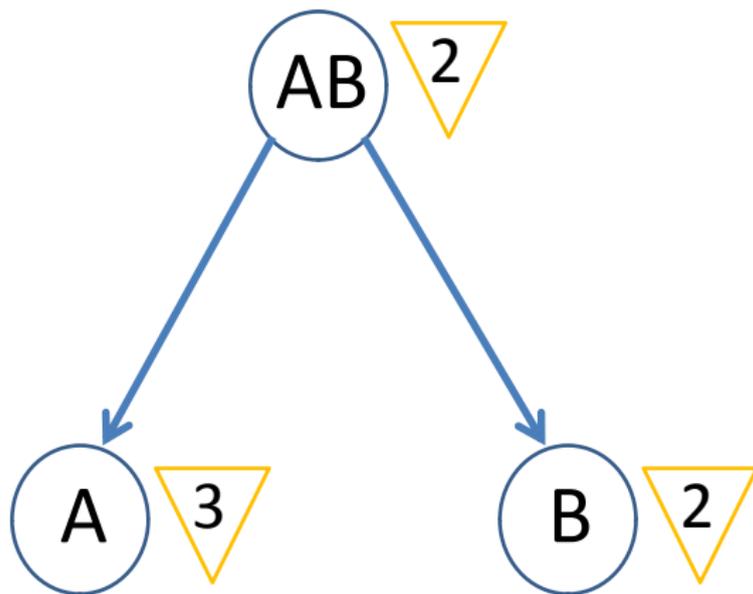
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3. no threshold problem
4. no overflow problem.

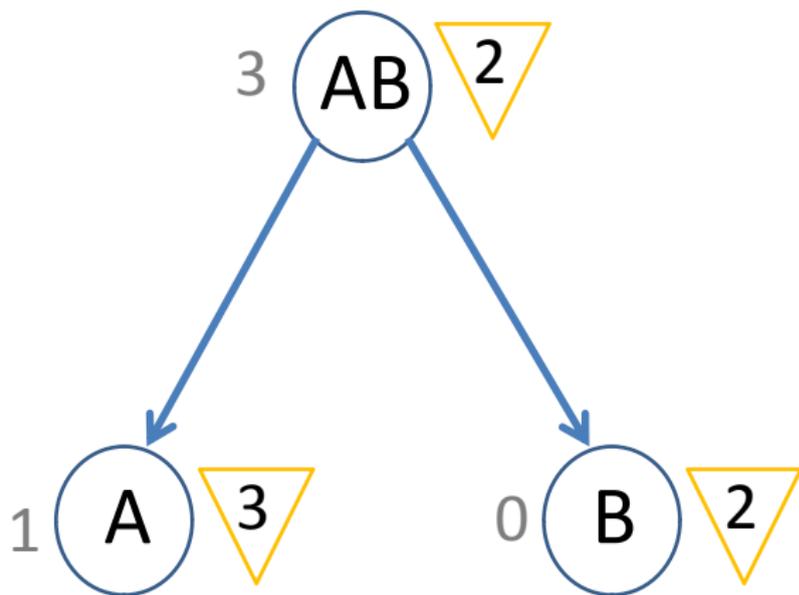
No Threshold Problem

- in other designs, threshold problem can arise when
 - ▶ demand for a package in *conflict* with demand for smaller objects contained in the package
 - ▶ package price exceeds sum of prices of the smaller objects
 - ▶ bidders for the smaller objects don't raise their prices
- in CPA,
 - ▶ package price typically additive; and even when not. . .
 - ▶ *conflict* \implies smaller objects in excess demand \implies their prices *will* rise.

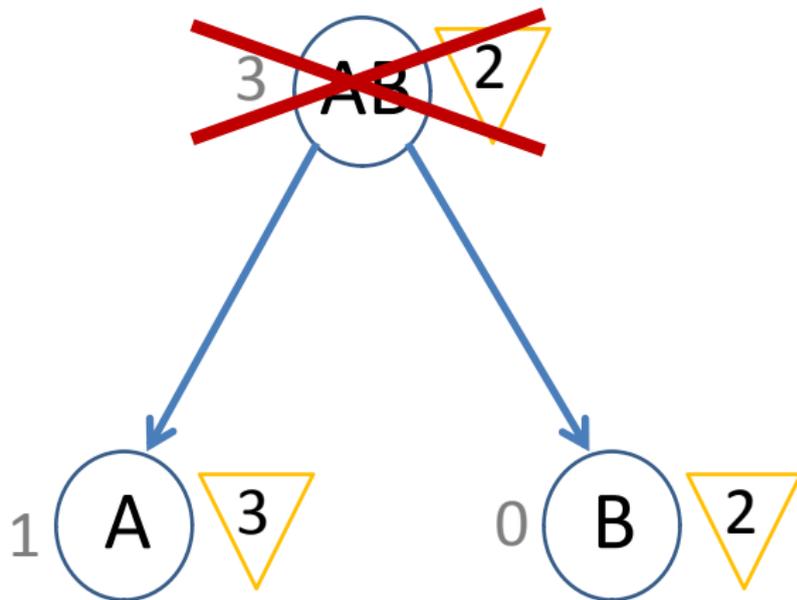
The Overflow Problem without Packages



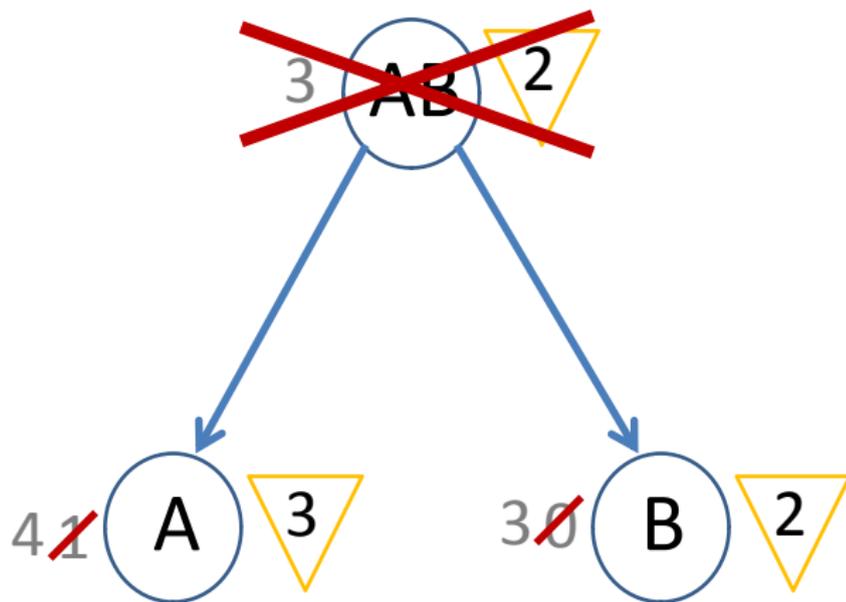
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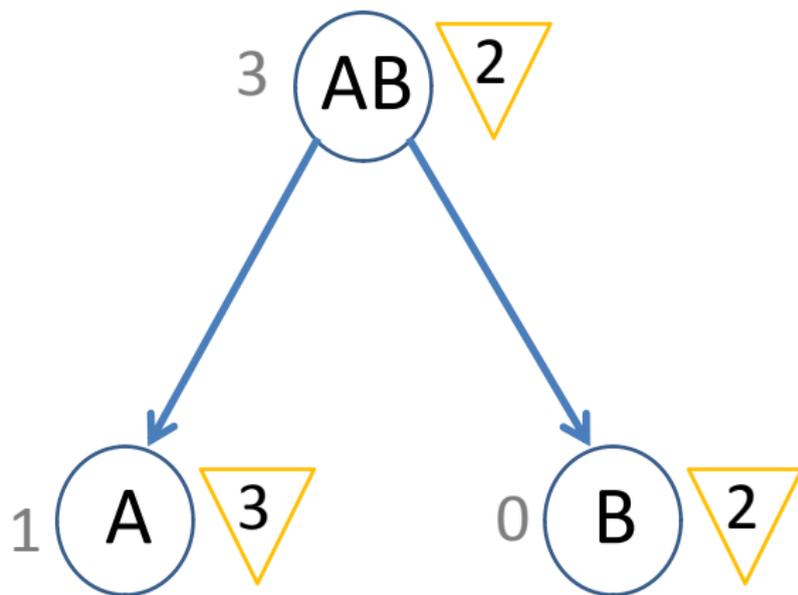
The Overflow Problem without Packages

Absence of package bidding allows (forces) too much demand for packages to “flow down” to the smaller objects they contain.

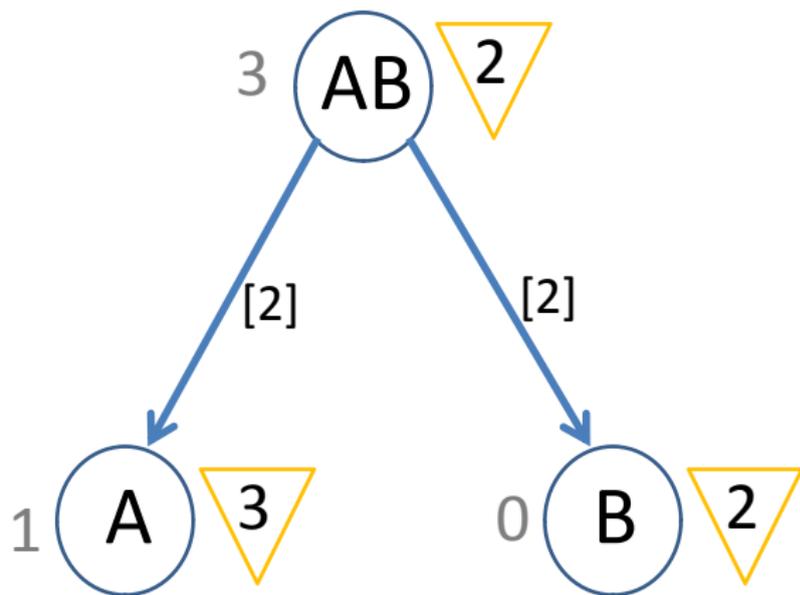
Bidders for small objects can face rising prices even when their demands are not a source of scarcity.

This disadvantages bidders for small objects and may lead to misallocation or undersell.

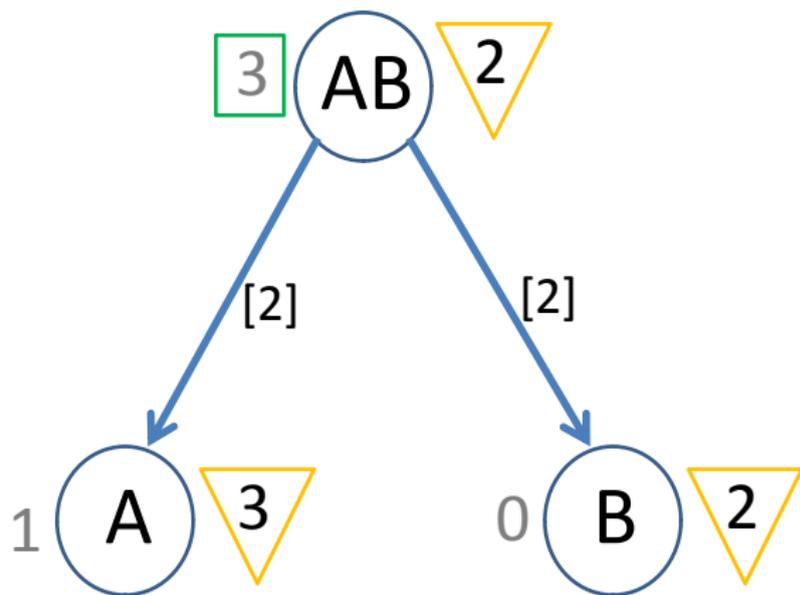
No Overflow Problem in CPA



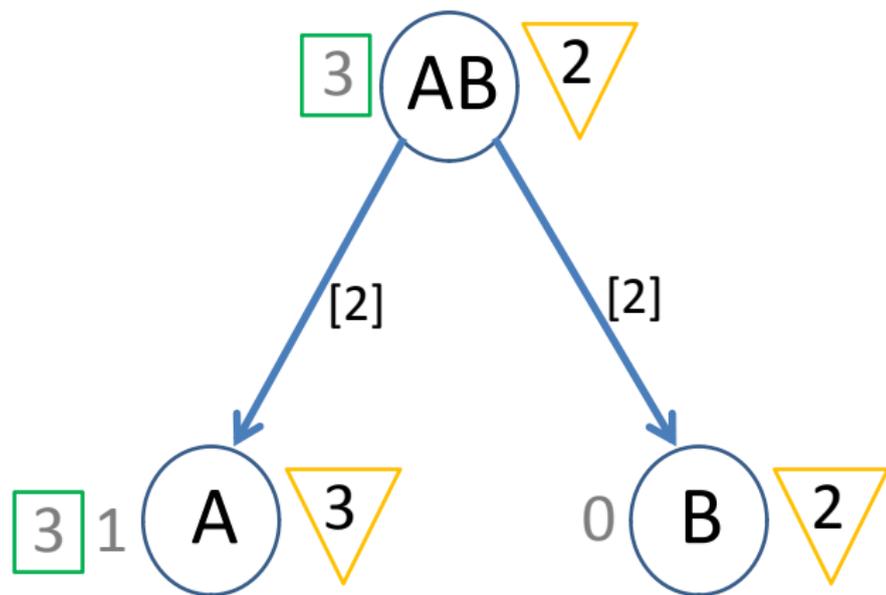
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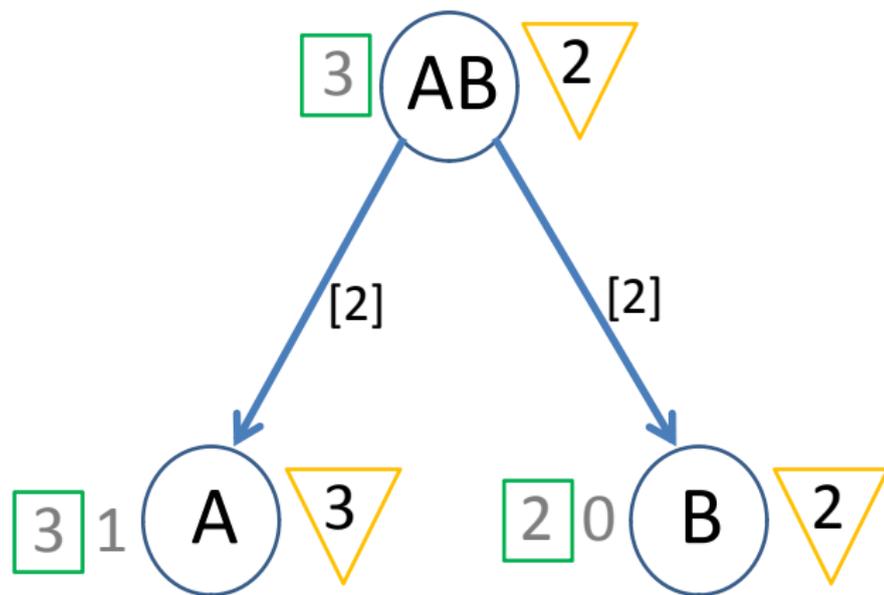
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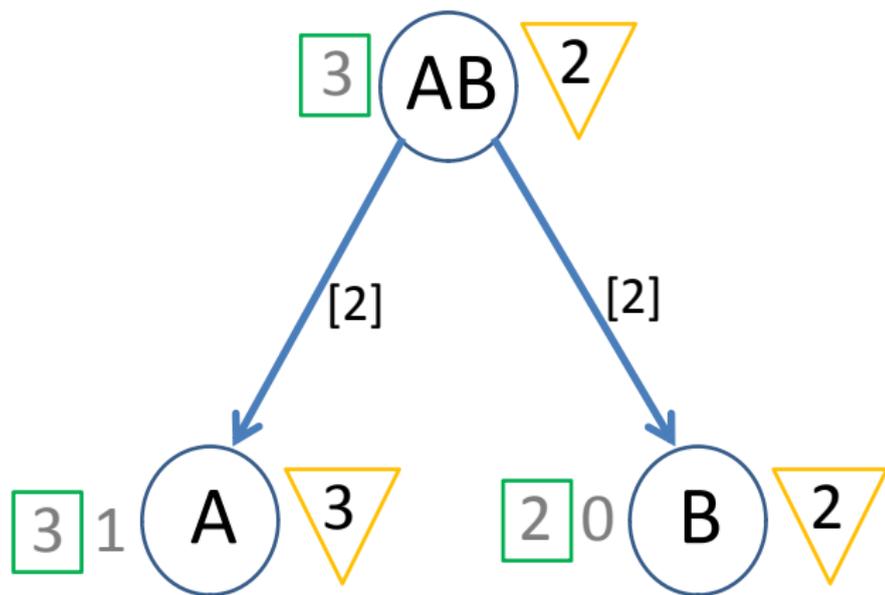
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Superadditive Package Prices



Simulations

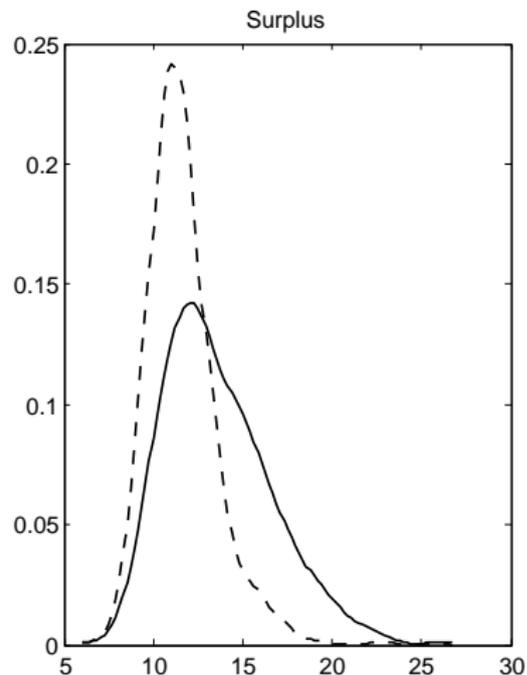
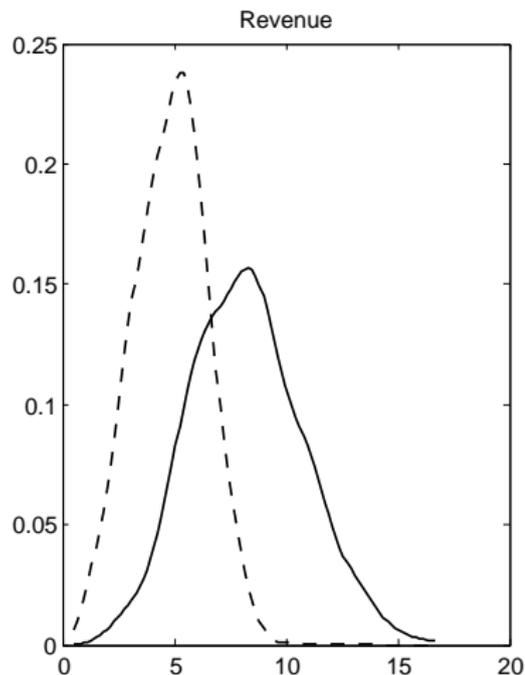
- goal of auction = efficiency (revenues)
- CPA has many advantages, but no strict dominance between CPA and MALS
- simulations to examine likely outcomes.

Simulation Design

Details in our Appendix A, more simulations underway

- 3-tier hierarchy: EA-Regional-National
- local bidders, regional bidders, national bidders
- random: participation, EA valuations, complementarities
- straightforward bidding in CPA
- “conservative straightforward bidding” in MALS auction.

Distribution of Outcomes



dotted curve = MALS, solid curve = CPA.

Outcome Summary Statistics

	Revenue		Surplus		% Units Sold		Surplus/Optimal	
	CPA	MALS	CPA	MALS	CPA	MALS	CPA	MALS
Mean	8.2	4.8	13.6	11.6	96.8%	99.7%	97.2%	84.3%
Std	2.5	1.6	3.0	1.9	5.1%	1.5%	4.4%	11.1%
Median	8.1	4.9	13.0	11.4	100%	100%	100%	85.5%
q25	6.4	3.7	11.4	10.4	93.3%	100%	95.0%	76.5%
q75	9.9	5.9	15.4	12.6	100%	100%	100%	94.2%

Summary

Clock Package Auction (CPA)

- small change to MALS design, potentially big gains
- retains benefits of clocks and generic licenses
- still simple for bidders and FCC
- no bias against bidders seeking large coverage areas (eliminates/limits exposure risk)
- no bias against bidders seeking small coverage areas (eliminates overflow problem, avoids threshold problem)
- simulations suggest substantial gains in revenue and efficiency.