



Traffic-Driven Dynamic Spectrum Auctions

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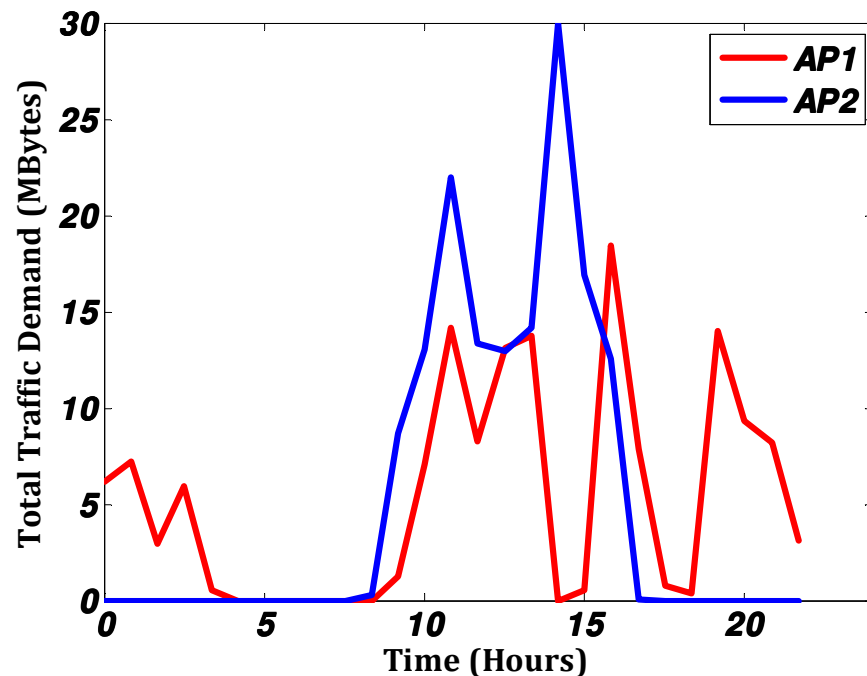
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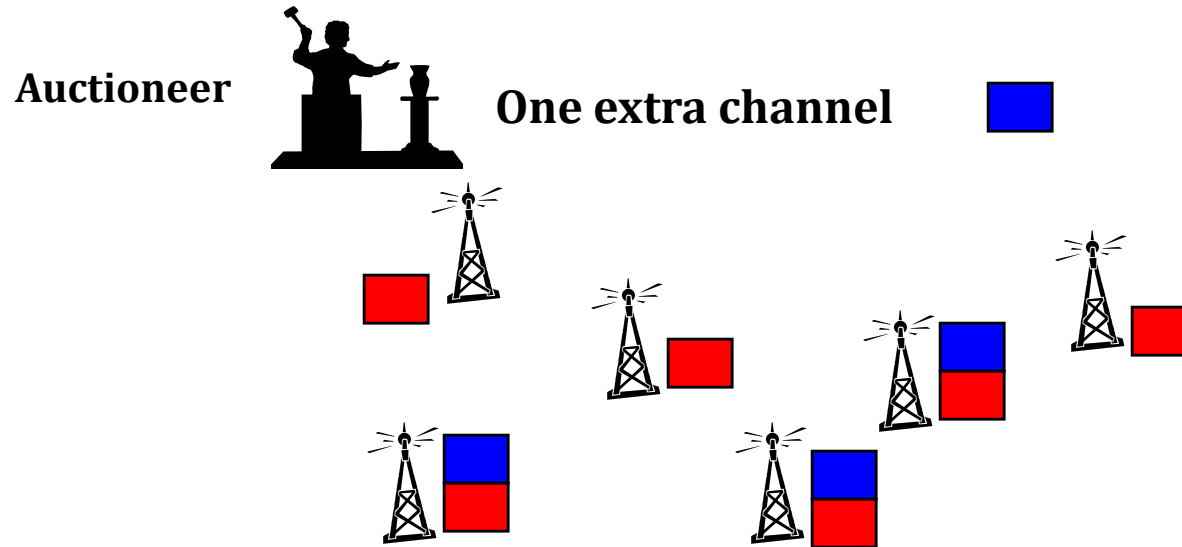
Increasing Traffic Dynamics

- Spectrum usage should adapt to traffic demands
- Crowded unlicensed spectrum band.....
- Utilize unused spectrum pieces from legacy spectrum owners



From Dartmouth Campus WiFi Traces

What if Add One More Channel?



■ Spectrum Auction

➡ Pricing based on market demands

➡ Good for distributing scarce resources

Dynamic Spectrum Auctions



Goal:

Investigate the System Performance

- Dynamic spectrum auctions based on **real traffic traces**
- Examining various **bidding strategies**
- Investigating the choice of **auction cycles**

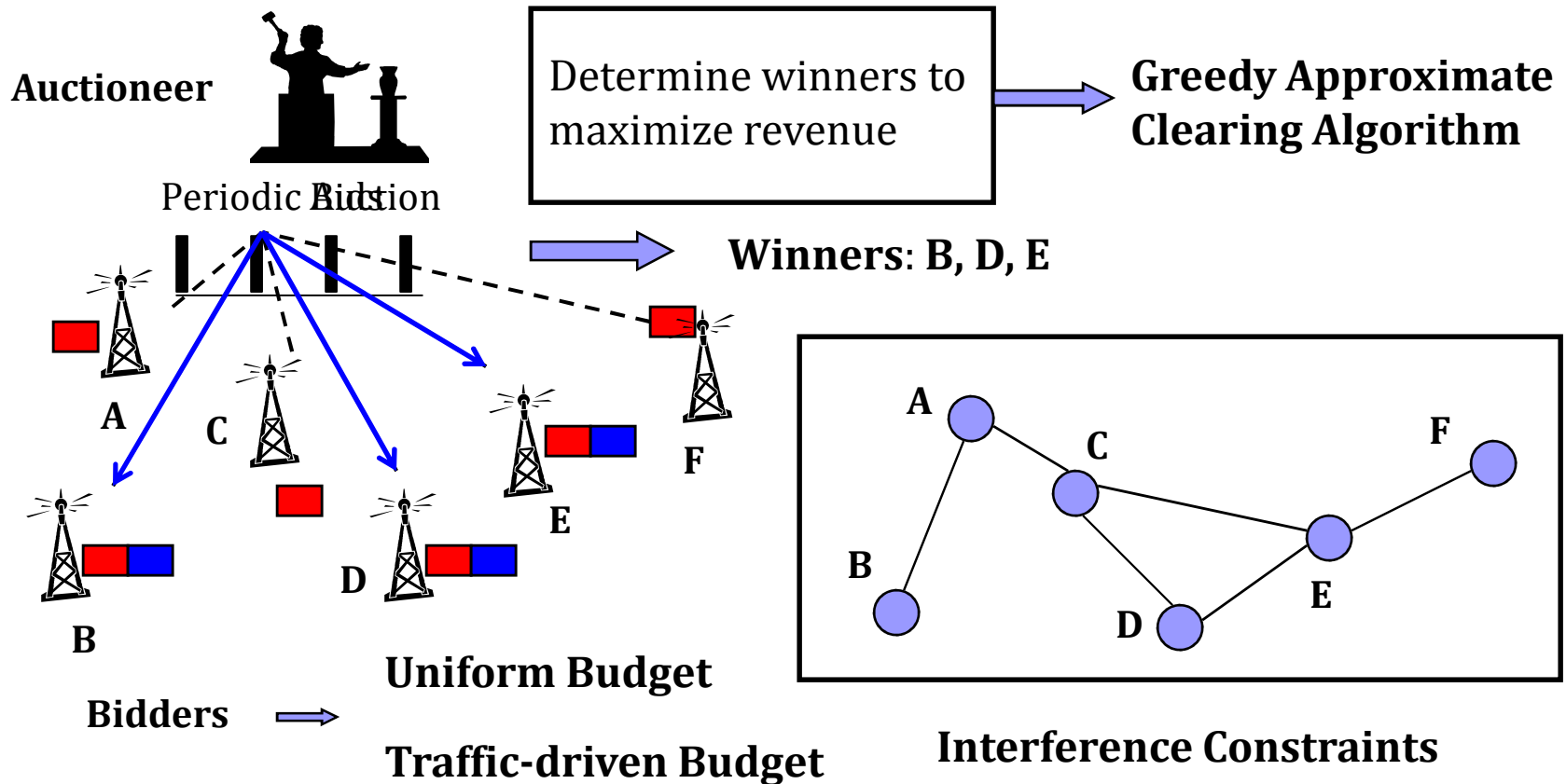


Outline

- Motivation
- Dynamic spectrum auction design
- Experiments
- Conclusion
- Related work

Design of Dynamic Spectrum Auctions

The Channel for Auctioning ■





Experiments

- 28 APs
- One baseline channel, one channel for auctioning (2Mbps)
- CRAWDAD traces (Feb. 12, 2004) for simulating traffic dynamics
 - Aggregate the packets within each 5 minute-Interval based on the auction cycle

- Evaluation metrics

- Bidder satisfaction $S(i)$ at auction interval i

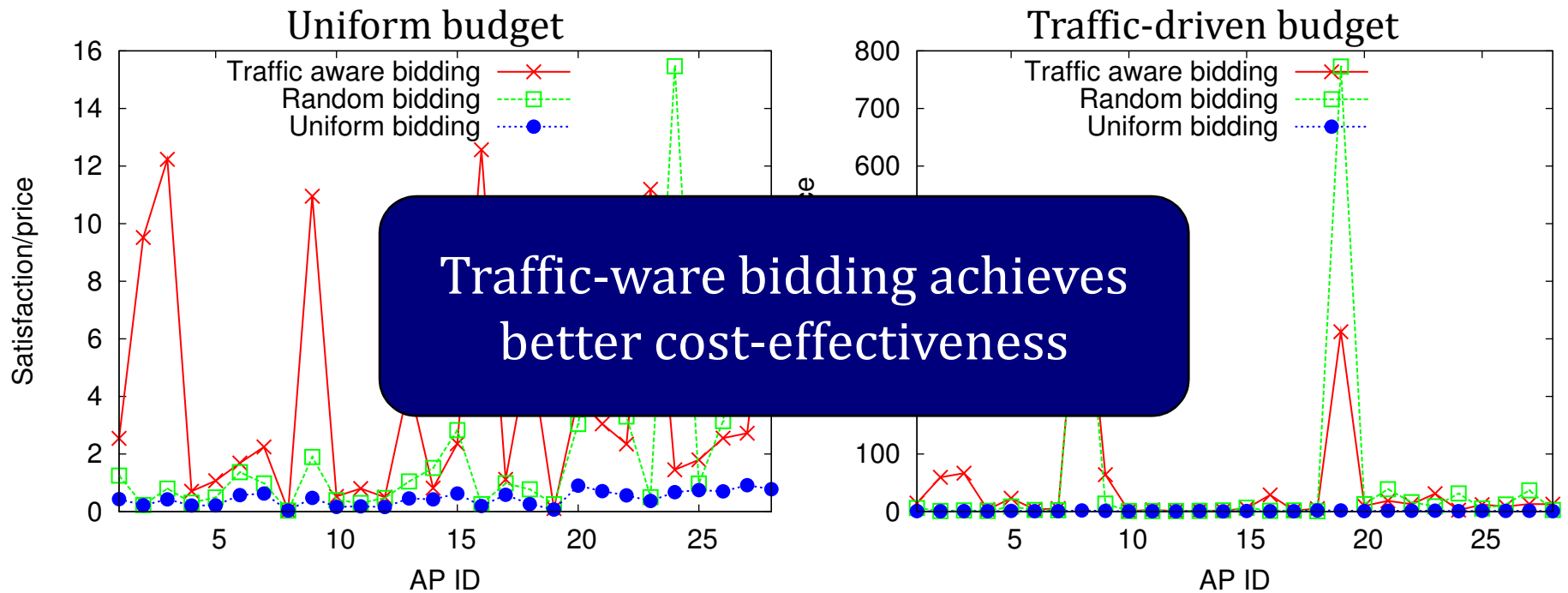
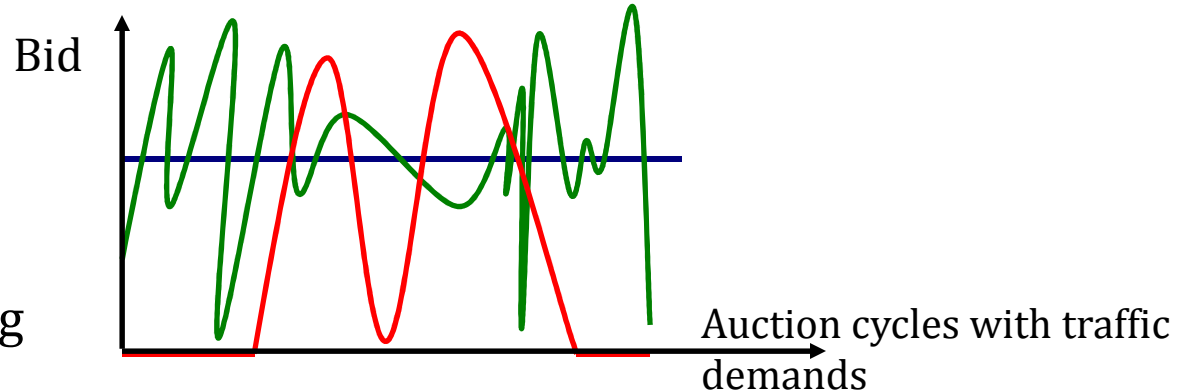
$$S(i) = \frac{\text{\#Packets sent}}{\text{\#Total traffic demand}}$$

Satisfaction per price for cost-effectiveness : $S(i) / Price(i)$

- Throughput

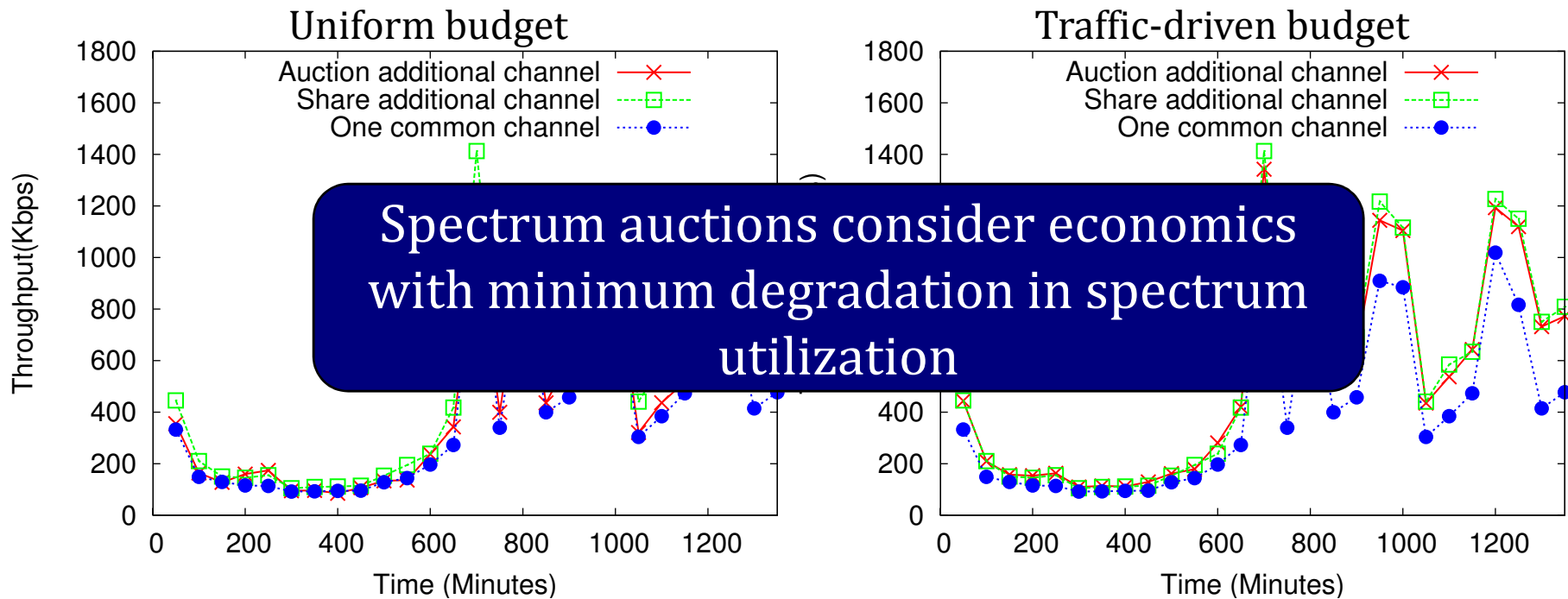
Impact of Bidding Strategies

- Bidding strategy
 - Uniform bidding
 - Random bidding
 - Traffic-aware bidding



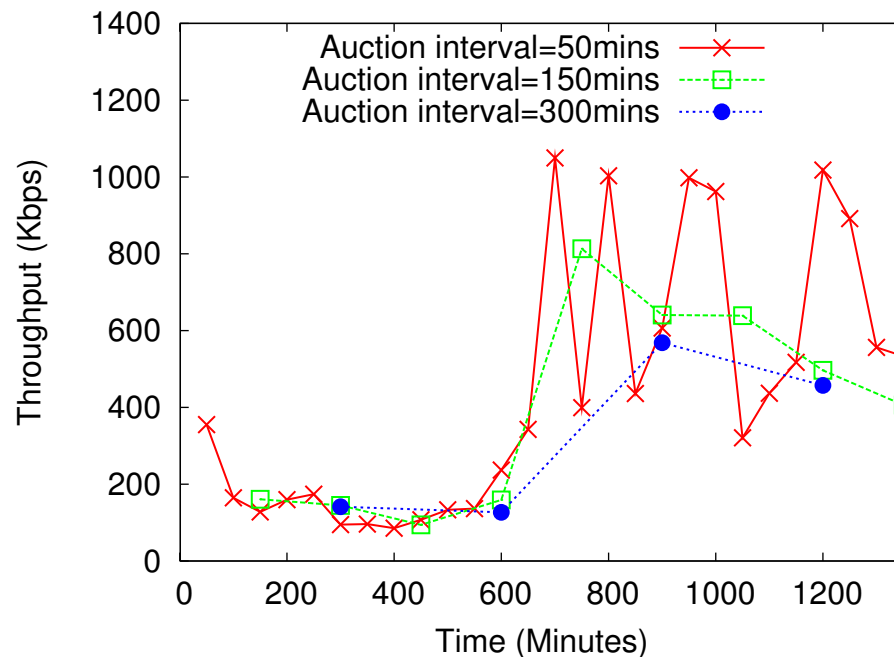
Auction Efficiency

- Option 1: Share baseline channel
- Option 2: Add one channel through auction
- Option 3: Add one channel through sharing

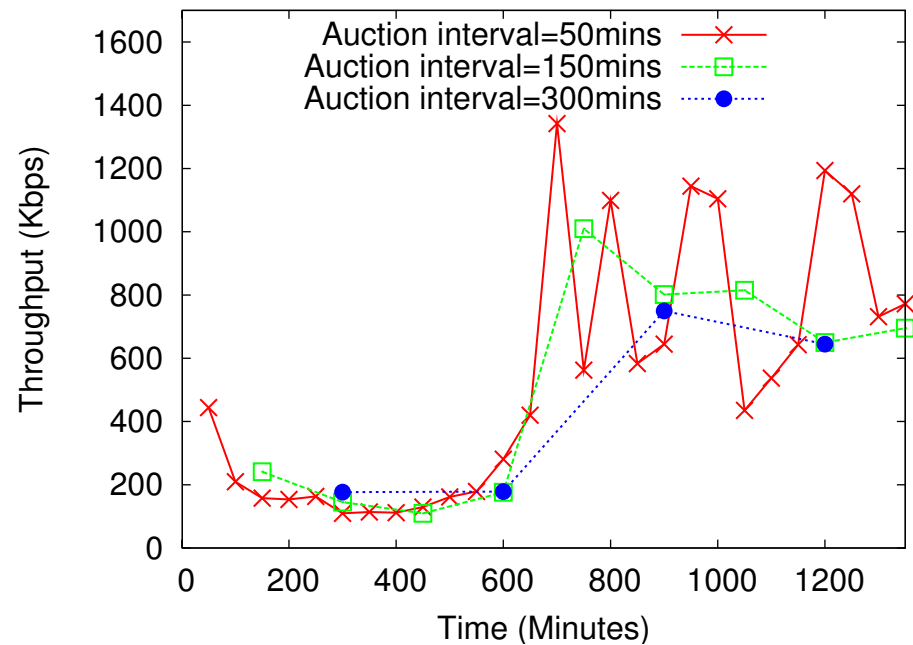


Large vs. Short Auction Cycles

Uniform budget



Traffic-driven budget



We need to choose auction interval carefully to utilize spectrum efficiently with affordable complexity



Conclusion

- Evaluate the *performance* of dynamic spectrum auctions using *real traces*
- Findings
 - Dynamic spectrum auctions consider economics without loss in spectrum utilization
 - Traffic-aware bidding is cost-effective particularly for users with bursty traffic
 - Auction cycles should be chosen carefully to efficiently utilize spectrum with affordable complexity



Related work

- Spectrum auctions

- Transmission power auction[Huang04,05]
- Spectrum channels auction[Gandhi07]

- Spectrum pricing

- Demand responsive pricing[Ileri05]
- Cellular networks[Buddhikot05]
- Hybrid pricing[Ryan06]



Thank you