Untangling Header Bidding Lore

Some myths, some truths, and some hope

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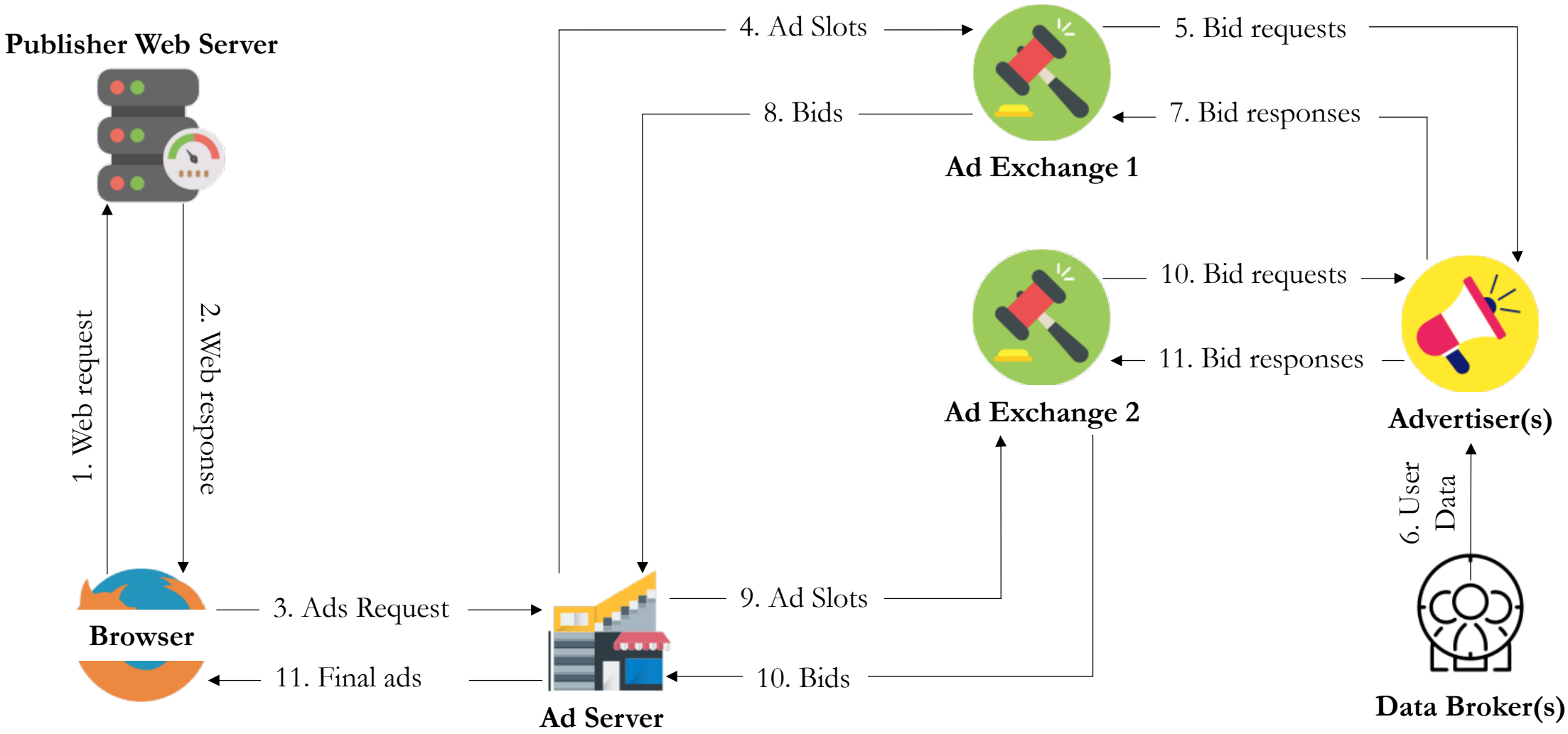
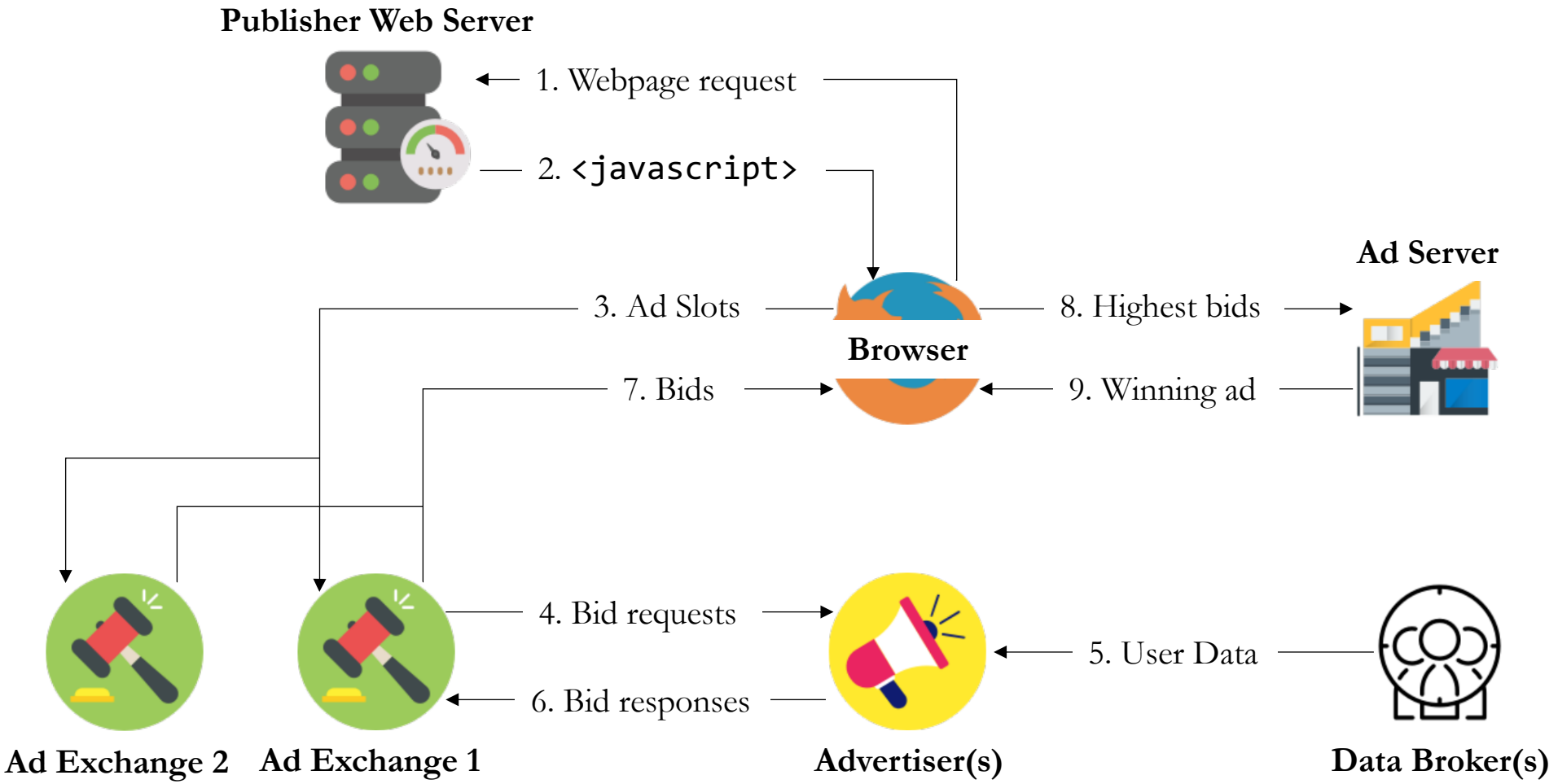
How (traditional) Real-Time Bidding Works



How Header Bidding Works



Header Bidding Background

- Started in 2013 to take wrestle control back from big players (Google)
  - Waterfall model used to favor particular exchanges
  - Parallel process guarantees fairness for all
  - May increase revenue because more buyers can bid
- 80.2% adoption among top 1K publishers
- Online advertising is a $300 billion industry
- Latency-critical process

Previous work

- Only one measurement study on header bidding:
  - Scraping instead of real user data
  - Single vantage point
  - Unrealistic bids
  - Less focus on latency

"~~Non-Viable Performance Overheads~~"

Using real data and a deeper dive into latency, we show that latency overheads are not fundamental

What was measured? How?

Browser extension[1] for Firefox and Chrome measures:

- Prebid.js library logs for ad slots, exchanges and bids
- PerformanceTiming API for timing breakdown of bid requests and responses
- WebExtensions API for IP addresses of ad exchanges
- Domain name of page visited
- Users' city-level location

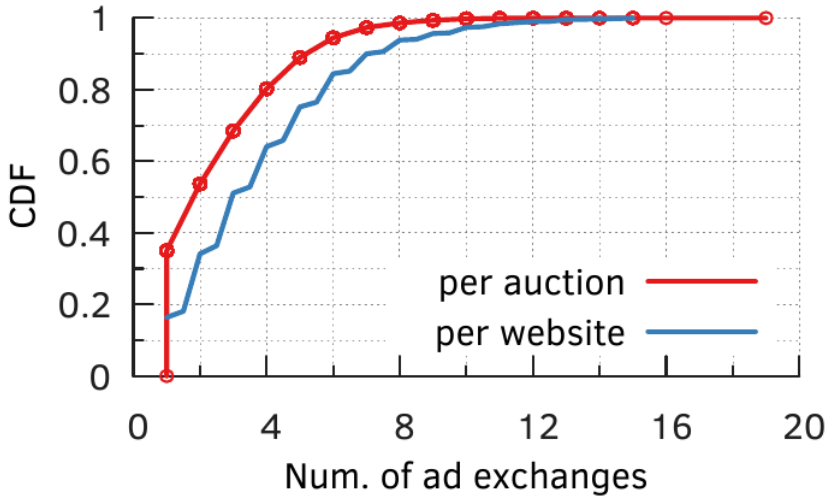
Privacy of users considered – IRB review

Attribute	Value
Users	≈ 400
Duration	8 months
Cities	356
Countries	51
Websites	5,362
Ad exchanges	255
Page visits	103,821
Auctions	393,400
Bids	462,075

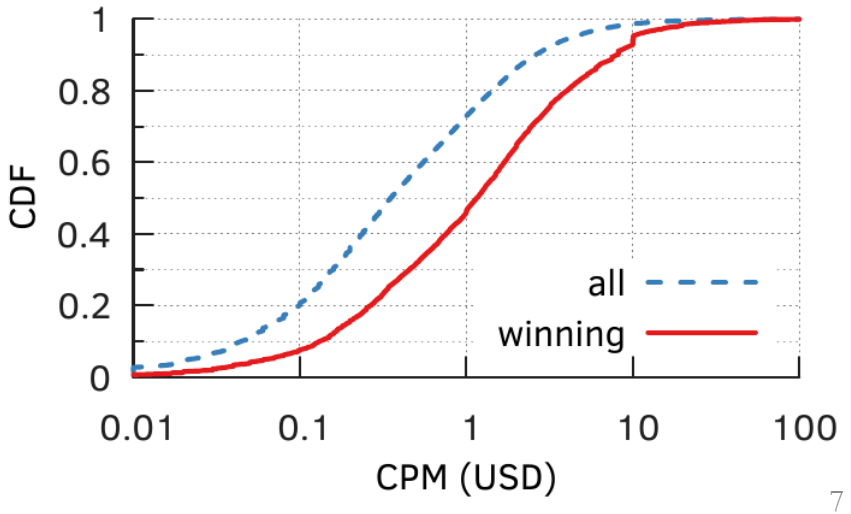
1. Extension source code and dataset available: https://myadprice.github.io

The Revenue-Latency Tradeoff

- Does it make sense to contact as many exchanges as possible?
- Publishers are conservative: ~60% contact at most 4 exchanges



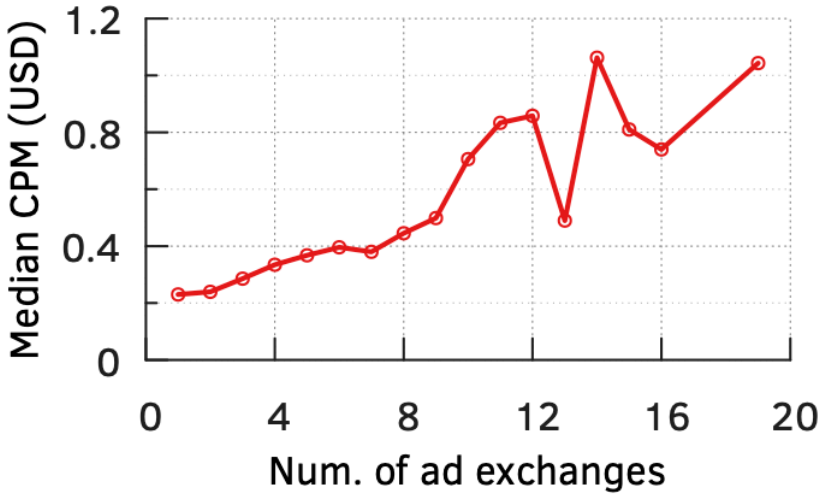
- All bids are not the same
- Median winning CPM is $1.15, while median non-winning is $0.35

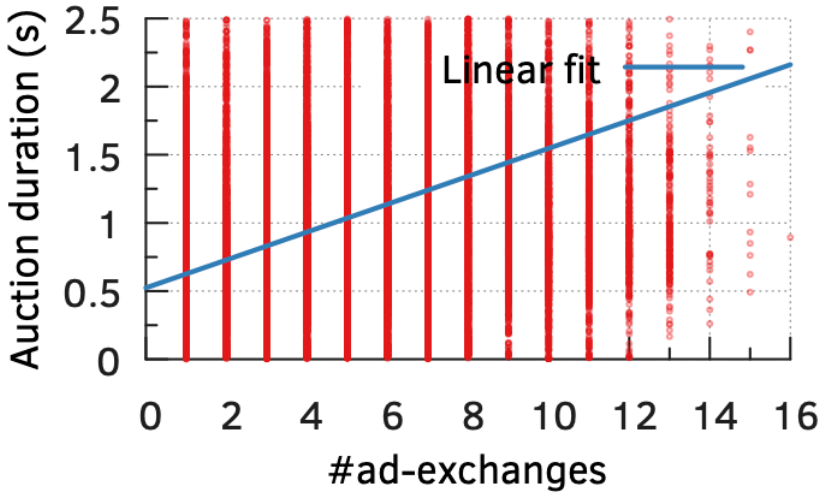


The Revenue-Latency Tradeoff

- Contacting more exchanges increases CPM for an ad slot
- Going from 1 to 8 exchanges doubles median CPM

- But also increases auction duration
- Delay in showing ads = bad user experience, perhaps lower click rate

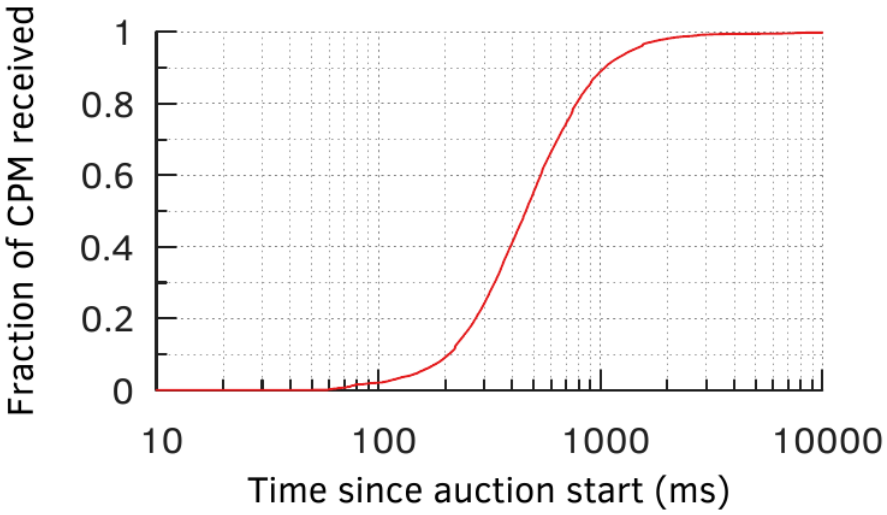


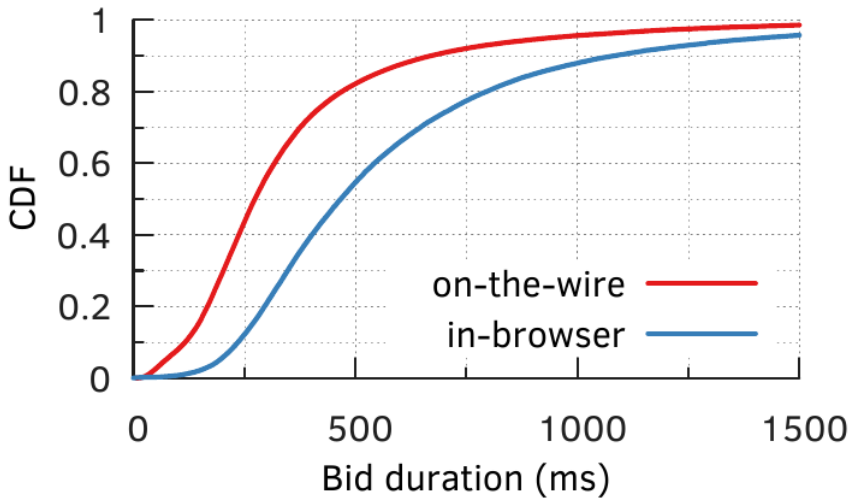


Latency Breakdown

- Time wasted on waiting for bids that will probably not alter the auction result

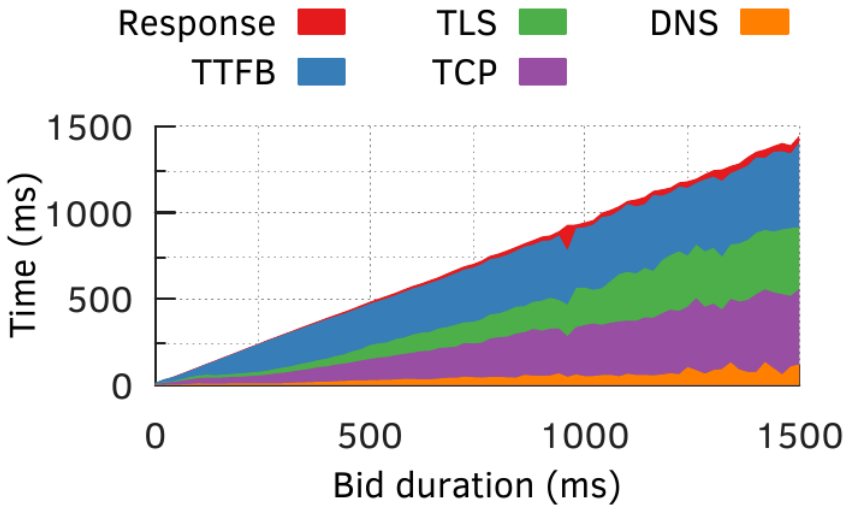
- Prioritizing other content, inefficient JavaScript implementations, even synchronous.
  - Contributes 174ms in the median





Latency Breakdown

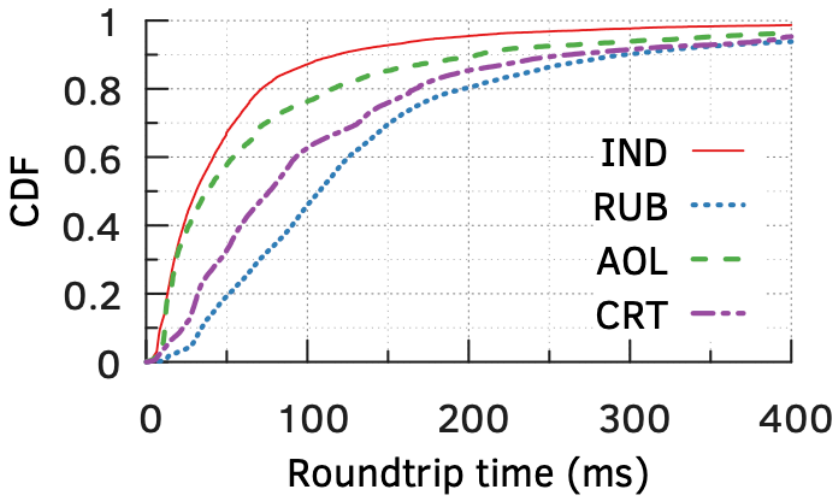
- 60% requests made on pre-existing, persistent connections
  - median duration is 230 ms
  - Time To First Byte (TTFB) dominates
- For the 40% non-persistent
  - median duration is 352 ms
  - TCP and TLS handshakes are 38% in the mean
  - Lack of support for low-RTT protocols. TLS 1.3 (11.4%), QUIC (6.6%), TCP Fast Open (76% but tricky)



Exchange Infrastructure

- Distributed deployments:
  - Index Exchange (IND): 88
  - Rubicon (RUB): 20
  - (AOL): 20
  - Criteo (CRT): 20

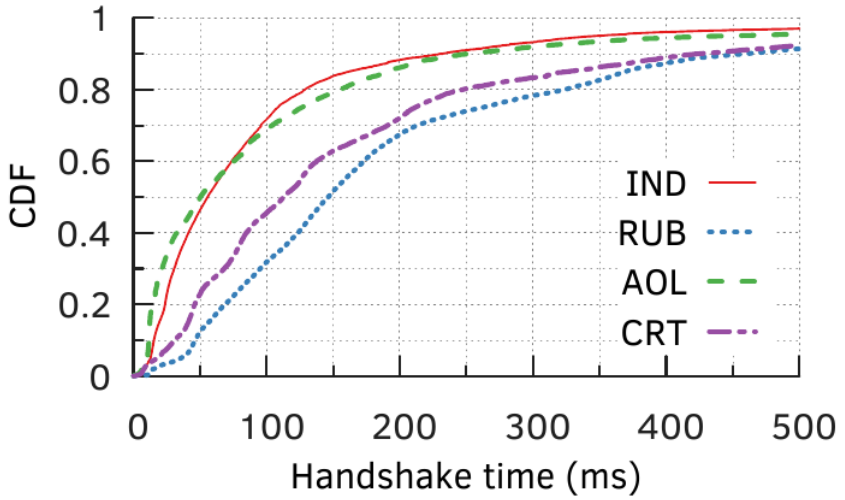
- Sometimes bad routing by ad exchanges
  - Large RTTs
  - Large variation in RTTs for users in the same city against one exchange

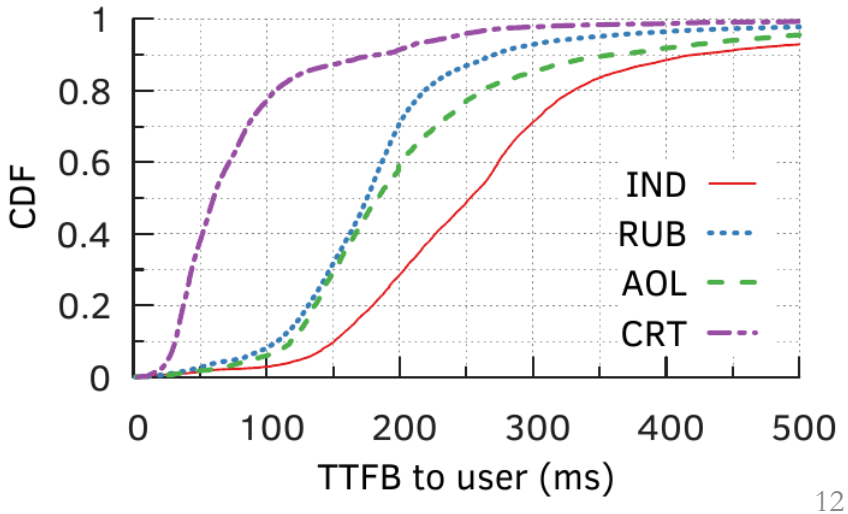


Exchange Infrastructure

- CRT, AOL gain in handshake time by supporting TLS 1.3

- TTFB dominates for most auctions
  - CRT has huge advantage
  - IND suffers
  - Unknown reasons, no visibility





Conclusions

- The revenue-latency tradeoff is valid
- Inefficiencies at the implementation and infrastructure levels
- Exchange-side auctions can be optimized
- Low RTT protocols and enhancements should be adopted

- Header bidding latency is not a fundamental problem

Future Work

- Increase measurement coverage
  - From ad exchange perspective
  - Revenue comparison with traditional real-time bidding

- Privacy-preserving advertising
  - Browser is in control
  - Store targeting information locally, send with ad requests
  - Like Privad, Brave Ads

Thank you!

Questions?