Untangling Header Bidding Lore
Some myths, some truths, and some hope

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How (traditional) Real-Time Bidding Works

1. Web request
2. Web response
3. Ads Request
4. Ad Slots
5. Bid requests
6. User Data
7. Bid responses
8. Bids
9. Ad Slots
10. Bids
11. Bid requests
12. Bid responses
13. Final ads

Publisher Web Server

Ad Server

Ad Exchange 1

Ad Exchange 2

Advertiser(s)

Data Broker(s)
How Header Bidding Works

1. Webpage request
2. `<javascript>`
3. Ad Slots
4. Bid requests
5. User Data
6. Bid responses
7. Bids
8. Highest bids
9. Winning ad

Publisher Web Server
Ad Server

Ad Exchange 1
Ad Exchange 2
Advertiser(s)
Data Broker(s)
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

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<thead>
<tr>
<th>Attribute</th>
<th>Value</th>
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<tr>
<td>Users</td>
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</table>

1. Extension source code and dataset available: [https://myadprice.github.io](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?