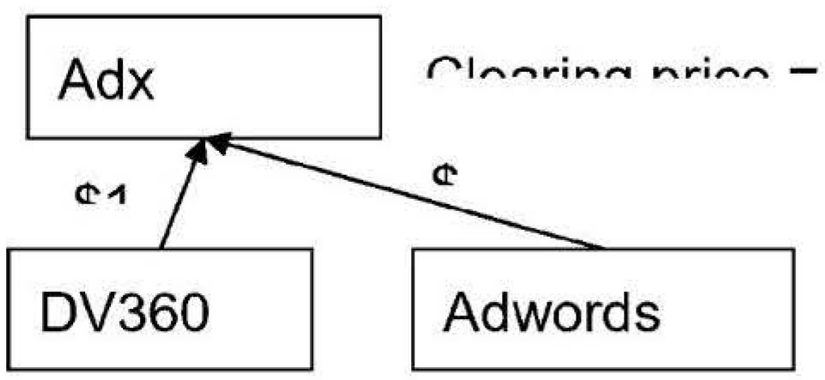
AdX/AdMob first price bidder - for perf

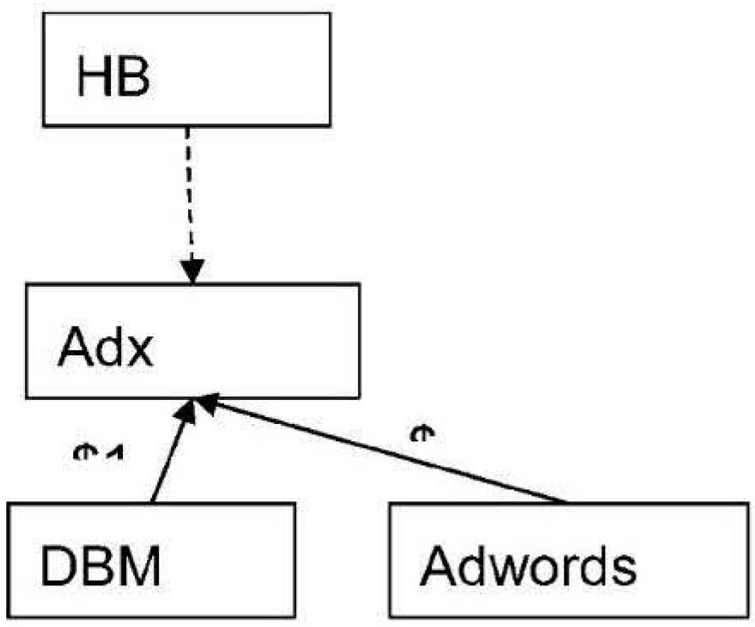
Background

Display advertising consists of three major stakeholders: sellers (publishers such as NY Times), buyers (advertisers such as Pepsi Inc.), and ad exchanges. Akin to stock exchanges, ad exchanges connect buyers to sellers.

Google owns AdExchange (AdX) and AdMob that connect advertisers to publishers. On these exchanges, several buyers participate - this includes real-time buyers (RTBs) and Google's owner buyside products, namely, GDA (Adwords) and DV360. Currently these exchanges run a second-price auction where the highest bidder wins but pays the bid of the runner-up. Second-price auctions are "incentive compatible", meaning buyers can bid their true value without worrying about the bids submitted by the competitors.



Similar to AdX, there are several non-Google-owned exchanges denoted 3rd party exchanges (3PEs). A new type of auction called the header-bidding auction originated a few years ago where all these exchanges would first come up with a winner using a first-price auction, and send that winner as their representative to AdX.



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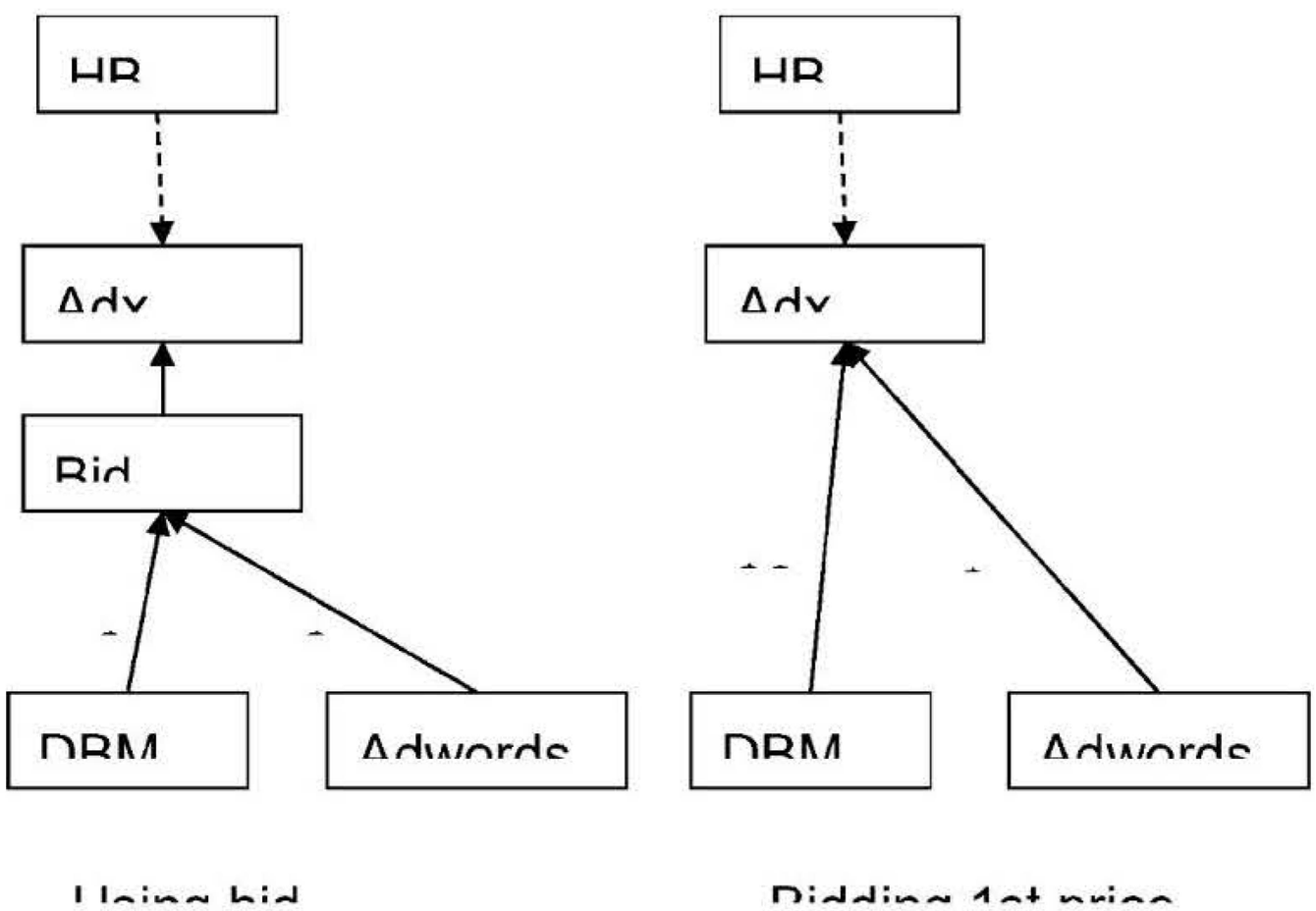
A big question here was how should the AdX auction winner be compared to the header bidding (HB) winner. For many years, AdX used what is called the "last look" mechanism, where if the AdX auction winner bids higher than the HB bid, that advertiser will win and they have to pay at least the HB bid. So, in the above example, Adwords wins and pays $2. This mechanism has been considered as "unfair" in the industry in favor of AdX buyers. As a result, AdX is being pushed to give up last look, as has already happened in certain segments (exchange bidding).

In the absence of last look, the way the HB bid is compared to the AdX winner is different. Now, the AdX internal auction is first run and the runner-up bid is compared to the HB bid. This can be thought of as a simple way to compare what AdX auction would have paid the publisher to what the HB is willing to pay the publisher. In the above example, Adwords will now lose the auction since the runner-up ($1) is less than the HB bid of $2.

This is a bad outcome for Adwords because Adwords' bid was $4, but lose to the HB whose willingness to pay was smaller because we use the runner-up bid to compare. Whether Adwords now wins overall is also at the mercy of what other competitors are bidding in the HB auction!

Consequently, Google buyers have long asked AdX/AdMob to provide a way for their bids to be directly compared in first-price terms to the HB bid. This and other reasons outlined in go/first-price-for-perf pushed AdX/AdMob to decide to move to a first-price auction in September 2019. In this world, buyers were offered two choices: (a) submit first-price bids (b) submit second-price bids that get translated to first-price using the runner-up as described above (and illustrated below). In either case, AdX will give up last look (i.e, the HB bid can not in any way factor in the bids computed by Google buyers).



If Adwords and DV360 stayed on the bid translation path, the results were catastrophic!

Impressions	Google Profit	Value Clamped	Revenue
261,654,698	78,564	478,752	301,080
197,433,779	52,363	282,126	185,780
5.64%	-6.69%	-17.50%	-13.61%
[5.42, 5.85] %	[-8.41, -4.97] %	[-17.99, -17.01] %	[-14.10, -13.13] %

Overall
(AdX web)

Impressions	Google Profit	Value Clamped	Revenue
180,679,965	39,652	227,622	135,659
116,364,550	25,561	118,227	66,242
-9.83%	-9.75%	-27.28%	-31.64%
[-10.04, -9.63] %	[-13.10, -6.40] %	[-28.26, -26.30] %	[-32.51, -30.76] %

Impressions	Google Profit	Value Clamped	Revenue
53,943,564	32,051	189,741	128,195
128,195			
42,753,302	19,676	123,761	82,365
10.96%	-14.06%	-8.68%	-10.05%
[10.69, 11.23] %	[-14.35, -13.76] %	[-9.00, -8.37] %	[-10.34, -9.76] %

On AdX web, Adwords would lose 30% revenue and DV360 would lose 10% revenue. This comes from the loss of competitiveness from giving up last-look and having to use the runner-up bids, as described earlier. So, we needed to build smart bidding that directly comes up with the optimal first-price bid!

Basics of smart bidding

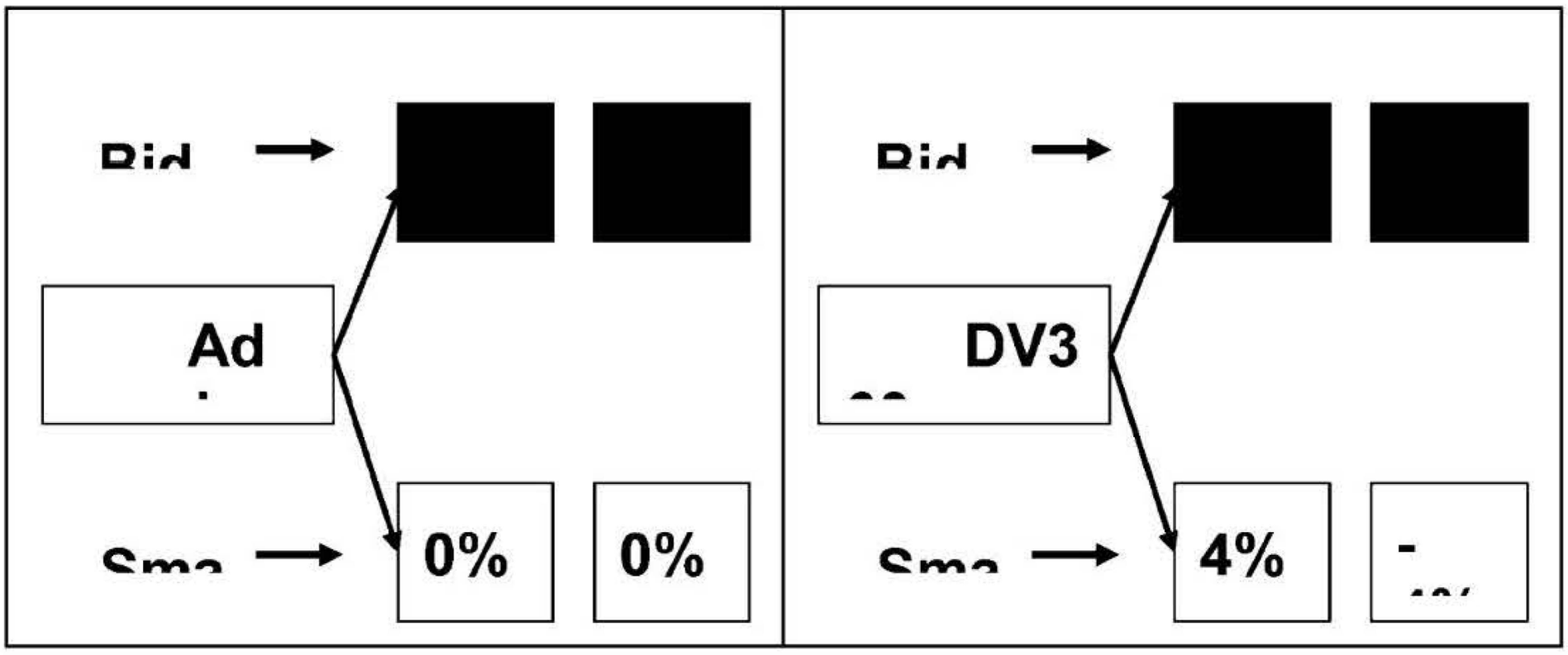
The main drawback of the bid translation approach is that the runner-up bid gets compared to the HB bid, and Google buyers have no control over this. In the above instance, suppose we knew that the HB bid was $2, Adwords could choose to bid $2.01 to win this auction at the cheapest possible price. This information is, however, not available at auction time. AdX/AdMob run a transparent 1P auction where the auctioneer shares the highest_other_bid (HOB) with every buyer after the auction is run. For instance, for Adwords that number would be $2. For DV360, that number would be $4. Thus the buyer can use this information to predict the HOB for future auctions. Mathematically, the optimal bid is determined by maximizing advertiser surplus, which is the difference between the value the advertiser derives and the amount of money that advertisers need to pay for it, but there are several bidding components that need to be built along with the surplus maximizer (described in the next section).

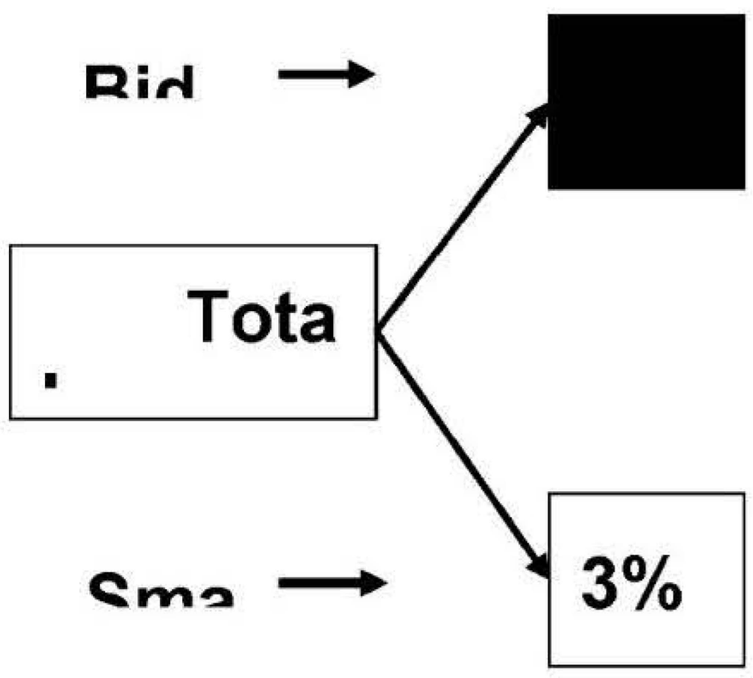
Difficulty

- The AdX migration to first price involves several bundled changes on the sell-side: auction change to 1st price, new unified pricing rules, last-look removal, anonymous branding type deprecation, loss of existing sell-side reserve price optimization, among others. All these changes impact the buy-side and need to be factored in the bidder development.
- Last-look removal put the buyers in a deep-hole from which to recover. As explained above, in the first-price world without last look, using bid translation costs 30% revenue for Adwords and 10% revenue for DV360. The smart bidder needs to be smart enough to recover this loss.
- There was no guarantee that the bidders could be developed in a way that's good for all the advertisers, publishers and Google.
- The smart bidder involves several components as described below, and each of these components is a large project in itself. All of these needed to be developed simultaneously and aggregated.
    - Surplus maximization to determine the optimal bid: First-price bid is the one that maximizes the advertiser surplus = advertiser value - payout.
    - Predicting competition using HOB data: We need to predict the full distribution of competition, not just the point estimate.
    - Risk-averse bidding to trade-off surplus and advertiser value: If surplus maximization ends up being too conservative, we need to be more risk averse.
    - Floor-aware bidding: The floors set by the publishers is used by the bidder.
    - Preserving incentive-compatibility for buyers: We need to set the right incentive so that upstream advertisers can continue to submit second-price bids. The smart bidder will lower it appropriately and send it to the first price auction.
    - Margin constraint for Adwords: Adwords needs to take 15% buy-side margin with per-publisher constraints.
    - Experimentation framework
    - Development of an auction simulator to iterate on the bidding technology
- We needed intricate auction and bidding code changes to serve all the involved models and real-time first-price bids.
- The team of about 10 engineers and data scientists worked on this project on the buy-side, and were in constant discussions with around the name number of sell-side engineers that were driving the sell-side auction migration work.

Impact

The smart bidder was built and successfully deployed on Sep 25, the same day AdX migrated to first-price auctions. The bidder recovered from the -30% hole for Adwords to get to neutral revenue, and from the -10% hole for DV360 to get to +3% revenue. In the first-price world, some non-Google buyers continue to bid very high. The net effect of all these was an overall AdX web wide non-budget constrained revenue increase of +3%.


Bid
Ad
0%
0%
Bid
DV3
4%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