EXHIBIT 28

PUBLIC

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF VIRGINIA
ALEXANDRIA DIVISION

United States of America, *et al.*,
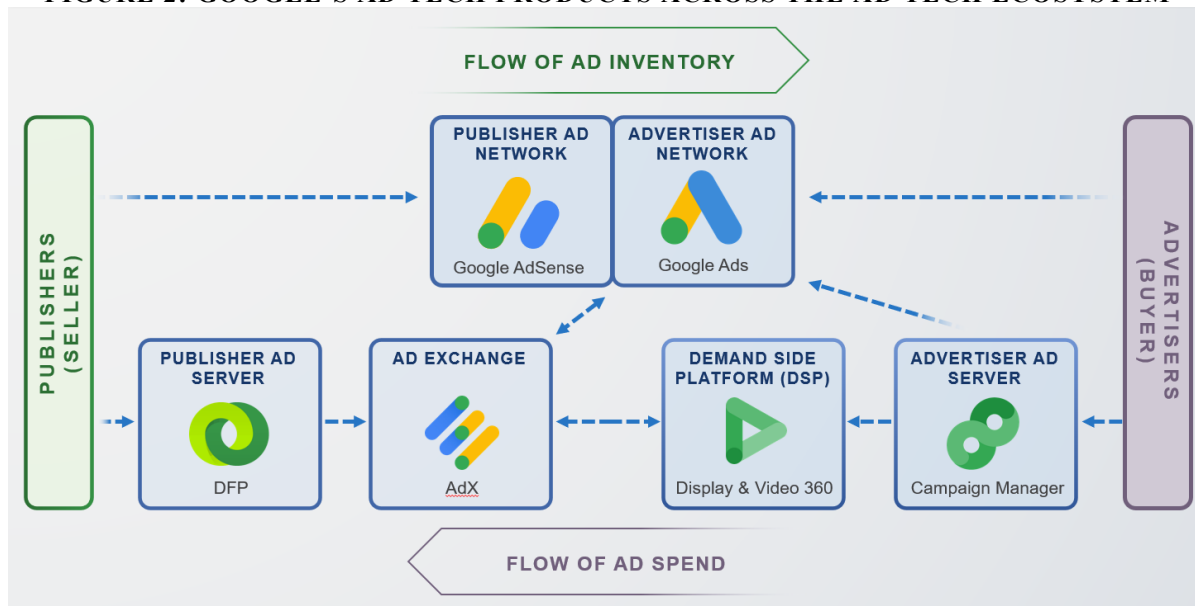
Plaintiffs,

v

Google LLC,

Defendant.

Case No. 1:23-cv-00108

HON. LEONIE H. M. BRINKEMA

EXPERT REPORT OF

RAMAMOORTHI RAVI, PH.D.

DECEMBER 22, 2023

FIGURE 2: GOOGLE'S AD TECH PRODUCTS ACROSS THE AD TECH ECOSYSTEM

Source: Lee Report, Section II.B., Figure 18, adapted from GOOG-DOJ-02427435, at -261. (03/13/2018) (Flowchart entitled "Display Ads Landscape") and GOOG-DOJ-AT-01510462, at -469, -471 (06/15/2020) (Flowchart entitled "What is 'Ad Tech'?").

30.   Starting with the sell side, **DoubleClick for Publishers ("DFP")** is Google's publisher ad server.[51] Google acquired the ad tech company DoubleClick in 2008.[52] As part of the acquisition, Google obtained DFP, which was a major PAS at the time.[53] Publishers use DFP to manage, sell, and serve their display ads. DFP charges a fixed fee per impression, based on volume; publishers' rates drop after reaching certain thresholds.[54] I describe key details of how DFP facilitates the sale of ad inventory in more detail in Section III.A.

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[51]   *See* Lee Report, Section II.C.1.; *see also*, *GOOG*-DOJ-AT-02199478, at -482 (06/2019) ("Publisher tools [:] Within Google publisher advertising stack, all above mentioned components (Ad server, Ad Exchange and SSP) are part of Google Ad Manager platform. (Formerly called DFP - DoubleClick For Publishers).").

[52]   *See* Lee Report, Section VII.; *see also,* "Google Closes Acquisition of DoubleClick," Google Press, March 11, 2008, https://googlepress.blogspot.com/2008/03/google-closes-acquisition-of_11.html ("Google inc. (NASDAQ: GOOG) announced today that it has completed its acquisition of DoubleClick, a company that offers online ad serving and management technology to advertisers, web publishers and ad agencies.").

[53]   PASs include Equativ, AppNexus, and Kevel. *See* "Solutions to Earn," Equativ, accessed December 21, 2023, https://equativ.com/solutions/earn/ ("SSP + Ad Server [:] Increase Revenue while retaining control"); *see also*, "What Is Appnexus?" Gourmet Ads, accessed December 21, 2023, https://www.gourmetads.com/programmatic/appnexus/ ("Gourmet Ads, uses the Appnexus SSP as our primary Supply Side Platform/ Sell Side and Ad Server"); *see also*, "Introduction to Kevel," Kevel, accessed December 21, 2023, https://dev.kevel.com/docs/understanding-kevel ("For publishers, this server-to-server setup means you are not constrained by the limitations of client-side ad code, and can integrate different ad formats.").

[54]   *See* Lee Report, Section II.D.

31. **AdX** is Google's ad exchange, acquired alongside DoubleClick in 2008.[55] Similar to other ad exchanges, AdX is an online, auction-driven marketplace where ad impressions are bought and sold in real time. In June of 2018, Google announced that it had combined DFP and AdX under a single platform named Google Ad Manager ("GAM").[56]

32. When publishers have impressions that they want to sell via a real-time auction, within GAM, publishers can employ DFP to send ad requests to AdX. Specifically, publishers must use Google's DFP to solicit real time bids for their impressions from AdX.[57] While there are technically other ways in which publishers can reach Google demand sources without using DFP,[58] non-DFP access to AdX has distinct disadvantages. For example, **AdX Direct** is a channel by which publishers can contact AdX to auction off inventory without using DFP, but AdX Direct does not allow publishers access to real-time bids.[59]

33. When it runs an auction, AdX collects bid responses from bidders and filters them against publisher defined rules. These bids come from Google's own buy-side products (Google Ads and DV360), as well as third-party "authorized buyers"[60] and "network bidders."[61] Afterwards, AdX

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[55] *See* Lee Report, Section VII.

[56] *See* Lee Report, Section IV.D.2.; *see also*, Jonathan Bellack, "Introducing Google Ad Manager," Google Ad Manager, June 27, 2018, https://blog.google/products/admanager/introducing-google-ad-manager/ ("That's why, for the last three years, we've been doing more to bring DoubleClick Ad Exchange (AdX) and Double Click for Publishers (DFP) together into a truly unified platform. Today's DoubleClick has also evolved beyond our roots in the web to become an ad platform for the next generation of content, from mobile applications by developers like King, to multi-platform video from publishers like Cheddar. With these changes, we needed to new name that better reflects how our platform helps you earn more and protects your brand, wherever your audience is engaging and however advertisers are looking to work with you. As we announced today, that name is Google Ad Manager.").

[57] *See* Lee Report, Section VII.; *see also,* GOOG-DOJ-AT-02199478, at -500 (06/2019) ("Google Ad Manager is the only way to access Google Ad Exchange as a publisher.").

[58] *See* Appendix G for more detail on the ways non-DFP publishers can access Google's demand sources.

[59] *See* Lee Report, Section VII.C.3.; *see also*, Appendix G.

[60] Authorized Buyers include non-Google ad networks and DSPs, as well as DV360 and Google Ads. *See* "How Authorized Buyers Work with Google Ad Manager," Google Ad Manager, accessed December 21, 2023, https://admanager.google.com/home/resources/how_authorized_buyers_work_with_google/ ("Who are Authorized Buyers?[:]The most common buyers include ad networks…trading desks…[and] demand-side platforms."); *see also*, GOOG-DOJ-06875317, at -322–323 (06/20/2018) ("Context in which we've used 'Ad Exchange'[:]…Ad Exchange as a demand pool…New Naming convention[:]…Authorized Buyers") and -329 (05/09/2018) ("DBM & GDN are considered Authorized buyers (their customers are not considered authorized buyers)").

[61] *See* Lee Report, Section II.E.4. and Section II.C.2.

line item that initially required 500 impressions over five days, and suppose the advertiser placed ads for 400 impressions within the first day. In that case, Google could set a low tCPM, diverting impressions at relatively low prices to other demand sources, but still be confident that DFP could still fulfill the guaranteed contract over the remaining four days. Conversely, if DFP was behind schedule, it would set a high tCPM, and only accept extremely lucrative bids in lieu of trying to fulfill the guaranteed deal.

76. The traffic scale of Google's DFP allowed it to compute these opportunity costs accurately to provide AdX more opportunities to win high-value impressions via EDA. I discuss the importance of this in Section IV.

77. Previously, if there were an impression that matched the direct sales channel, DFP would automatically match the impression with an advertiser.[163] Under EDA, however, AdX had the chance to win the impression through an auction instead. As in DA, non-AdX exchanges had limited participation in these EDA-triggered AdX auctions, with their average prices potentially serving as price floors in the auctions.[164] In fact, non-AdX exchanges, whose average prices were already non-competitive with AdX's real time bids for remnant inventory, would have had even slimmer chances in these auctions for high-valued direct inventory.[165]

III.A.2. Google's Waterfall and Dynamic Allocation Are Suboptimal in Matching Impressions to Advertisers that Valued Them Most

78. Compared to a standard first-price or second-price auction, the waterfall process employed by Google is inefficient from a theoretical standpoint, in the sense that the buyers with the highest

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chooses reserve price based on campaign progress, available inventory left, historical bids, etc to make sure all guaranteed campaign goal[s] can be met while maximising revenue.

[163] "DFP and Dynamic Allocation," Internet Archive, accessed September 23, 2014, https://web.archive.org/web/20140923122553/https://support.google.com/dfp_premium/answer/3447903?hl=en ("When a visitor stops by your site, an AdExchange line item is eligible to serve to the impression, as are a number of standard line items. The best standard line item is at priority 10. If enhanced dynamic allocation were not enabled, Ad Exchange would not be called because the standard line item is higher (numerically lower) than priority 12, and so would serve without a call to Ad Exchange.").

[164] *See* Section III.A.1.a and Appendix C.3.

[165] Note that Google initially distinguished between DA and EDA but merged the two terms and began referring to EDA as DA. Since EDA was an extension of DA and Google stopped distinguishing between the two terms, I will refer to both simply as DA through the remainder of the report. *See* GOOG-DOJ-05782415, at -431 (09/23/2019) ("Dynamic Allocation was improved in March 2014 (to create Enhanced Dynamic Allocation, now simply referred to as Dynamic Allocation)".

valuations do not always win. This contrasts with the auction mechanisms described in Section
II—for example, if there were only a single second-price auction in which every buyer
competed, the buyer with the highest value would always win. In the waterfall system, however,
it is statistically inevitable that certain impressions will be won by buyers who *do not* provide the
highest value.

79. Because Google allowed AdX to use its real-time bids to compete with historical average prices
at other exchanges, AdX could win impressions even if bidders on rival exchanges may have
been willing to pay higher prices in real-time. While this was beneficial to AdX, it is not
beneficial to buyers and sellers more generally. That is, advertisers using exchanges other than
AdX could not win auctions even if they would have bid more than the AdX winner, because
they were denied an opportunity to bid. Furthermore, this meant that Google's Dynamic
Allocation was not set up to maximize revenue for publishers.

80. The potential harm to publishers was acknowledged internally at Google.[166] Consider the
following simplified example adapted from a 2016 email exchange between Google
employees.[167] Assume that historically, the average bid Google's DFP received from Pubmatic (a
non-AdX exchange) was $1.00. Also assume AdX and Pubmatic each have a single bidder,
unique to their respective platforms.

    a. In the DA setup, AdX would use this $1.00 as the price floor for an auction. If AdX's
    advertiser bid was $2.00, then she would win the auction and pay the reserve $1.00.
    Pubmatic would not have the chance to bid.

    b. In contrast, in real-time competition where both exchanges' advertisers submit their bids into
    a single second-price auction, AdX's advertiser still would bid $2.00. If Pubmatic's

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[166] GOOG-DOJ-14156104, at -105 (09/16/2016) ("The "unfair advantage" [of EDA] comes from historically third-party exchanges cannot compete with AdX through EDA on the similar footing. Pre-Jedi we allow DFP publishers to put in only the "average payout" on the DFP line item that represents the opportunity cost of the third-party exchange. Publishers lose every time the third-party exchange has higher payout than the average").

[167] GOOG-DOJ-14156104, at -105 (09/16/2016) ("For example, DFP publishers get on average $1 from Pubmatic. With EDA on we set the reserve price at $1, and any AdX buyer including GDN can win over the query as long as they bid more than $1. This transaction happens before we actually call Pubmatic and get their actual bids. If Pubmatic is willing to pay $3 on the query, publishers leave $2 on the table. That's why HB is introduced to counter EDA (because HB wil[l] actually call Pubmatic first in the header and get their $3 bid before calling DFP, and publishers do not lose the opportunity), and why we build Jedi.").

advertiser were to bid $3.00, then he would win the auction. Pubmatic's advertiser would pay the second-highest bid of $2.00.

81. In this simple example, the DA setup led to $1.00 less in revenue for the publisher. The example also illustrates that in the DA setup, the buyer who valued the impression the most (i.e., the Pubmatic advertiser with a real-time bid of $3.00), did not win the impression. Conversely, in a head-to-head competition between exchanges, the Pubmatic advertiser would have won the impression because his valuation was higher.[168]

82. In general, Google's DA setup could lead to a suboptimal outcome where impressions were won by advertisers who did not have the highest valuations. Google recognized this advantage for its own buyers and that AdX would lose more auctions without it. [169] The corollary to this is that under the DA setup, advertisers on non-AdX exchanges were harmed to the degree that they won fewer impressions than they would have if they had been able to submit real-time offers.

83. Note that this was not just a theoretical problem. Indeed, Google's internal documents identify header bidding ("HB") as a market response to Google's DA allowing real-time bids in the first auction only from AdX.[170] For example, in an internal email thread from 2018, a Google employee explained that "[p]ublishers felt locked-in by dynamic allocation in DFP, which only gave AdX ability to compete, so HB was born."[171] The same email also noted that "HB gives

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[168] Note that this also applies not just to bid amounts, but also to the fees charged by different exchanges. For example, if advertisers bid the same amount at two exchanges in direct competition, the exchange with lower fees would win. However, in the sequential nature of the waterfall, Google had the opportunity to clear the auction if another exchange had lower fees.

[169] GOOG-DOJ-04830048, at -048 (09/05/2017) ("Our buyers enjoy a competitive advantage from dynamic allocation because they receive first look on inventory, which inherently provides higher CPMs (from which Google benefits on the rev share). Launching AdX into a non-DFP server destroys this competitive first look advantage and would most likely lead to AdX (1) losing access to overall queries, and (2) losing access to the *highest-value* queries. From there, it becomes a self-fulfilling prophecy in that less-valuable inventory begets lower CPMs, publishers react by decreasing inventory access, which begets even lower CPMs.") (emphasis in original).

[170] For an explanation of Header Bidding and its history, *see* Appendix C.4; *see also*, GOOG-DOJ-04004392, at -394 (08/16/2018) ("Header bidding has given other Networks and SSPs per-query pricing access to Ad Manager inventory, increasing competition and delivering publishers 30-40% lift in programmatic revenues.").

[171] GOOG-DOJ-05276794, at -794 (03/16/2018) ("Publishers felt locked-in by dynamic allocation in DFP, which only gave AdX ability to compete, so HB was born.").

130. To disincentivize multi-calling, Google Ads proposed "turning off" its bid adjustment program on those domains.[261] Based on its internal results, Google Ads noted that the change would result in publishers going from receiving bid subsidies to being net funders of the pool.[262] Note the program also capped bids to be no higher than the 99th percentile of eCPMs on mediating domains.[263] Google launched this refinement of the program on October 26, 2016.[264]

131. This iteration of the program targeting multi-callers appears to have succeeded in pushing 112 of 144 publishers Google had identified as engaging in multi-calls to end the practice.[265] Note, however, that several publishers also *started* multi-calling during the program.[266]

III.B.5. Google Ads' Current Dynamic Revenue Sharing Leverages its Scale and Data to Disadvantage Rivals and Ad Tech Participants

132. Following AdX's move to first-price auctions in 2019, Google Ads continued to use a modified version of its dynamic revenue sharing program. Many of the distortions created by its initial program persist, just in a modified form to suit the new AdX auction rules. Google Ads continues to run its initial mini-auction as a truthful auction to secure the top two bid amounts it

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[261] GOOG-AT-MDL-009839146, at -149 (09/23/2016) ("We propose to turn off Bernanke on these [multi-calling] domains.").

[262] GOOG-AT-MDL-009839146, at -149 (09/23/2016) ("Note from these numbers that these domains are net consumers of pool. So, turning Bernanke off here will cause this extra pool to be automatically reinvested on non-mediating domains.").

[263] GOOG-AT-MDL-009839146, at -150 (09/23/2016) ("The proposed candidate uses a 99 percentile ecpm determined on web_property * domain as the cap on that web_property * domain.").

[264] GOOG-AT-MDL-001391593, at -593 (06/07/2017) ("GDN is going to start making changes to its buying algorithm when it detects multiple calls made in series, for a single ad request…Launch targeting October 26, 2016 [DONE]."); *see also*, GOOG-AT-MDL-008842383, at -386 (08/05/2023) ("Global Bernanke was subsequently updated in October 2016. This updated, relating to the detection and management of multiple calls, was sometimes referred to internally as 'Bell v.2'.").

[265] GOOG-AT-MDL-002468416, at -418 (04/27/2017) ("Effect in the past several months: there are 144 pub in the list of six months ago, 32 pub are still in the latest list, 112 pub don't use multiple calls any more.").

[266] GOOG-AT-MDL-002468416, at -418 (04/27/2017) ("61 new pubs are using multiple calls (we don't know how many would have started doing this in the absence of the previous launch) – we need to continue to reach out to pubs.").

Moreover, Google continued running 0.1% background experiments to collect data to train the pWin model.[426]

194.   Both Poirot and Marple are active as of 2023.[427]

III.D.3. Google's Bid Shading Projects Helped Delay AdX's Move to First-Price Auctions by Insulating AdX from Competition

195.   It was not a coincidence that the rise of header bidding in 2017 coincided with the launch of Project Poirot. Given that publishers moved to header bidding, exchanges had strong incentives to move towards first-price auctions,[428] and many major exchanges had moved to the first-price format by 2017.[429] Indeed, the academic literature indicates that once exchanges begin competing simultaneously, as in the header-bidding setup, they have an incentive to move to first-price auctions.[430] However, once exchanges move to first-price auctions, exchanges lose

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[426]   GOOG-DOJ-AT-02242745, at -749 (07/29/2021) ("To collect the training data, we set up a series of 0.1% background experiments with constant bid adjustment multiplier… through these background experiments, we collect auction outcomes and query features used in the pWin model.").

[427]   GOOG-AT-MDL-006218271, at -290 (01/06/2023) ("Project Poirot launched on 19 July 2017…globally and is still active today… Project Marple launched on 12 September 2018…and is still active today.").

[428]   Stylianos Despotakis, R. Ravi, and Amin Sayedi, "First-Price Auctions in Online Display Advertising," *Journal of Marketing Research* 58, no. 5 (2021): 888–907, at 889 ("This move [towards first-price auctions] came about in a variety of ways, including the introduction of "soft floors" that were set by the ad exchanges. While the publisher supplied a reserve price with the request for bids, called the "hard floor," each ad exchange would set another, higher value as a soft floor and change the rule of the local auction in the following way: if there were at least two bids above the soft floor, they participated in a regular second-price auction; with only one bid above the soft floor, the soft floor then served as the clearing price; with all bids below the soft floor but some still above the hard floor, the bids participated in a first-price auction. Note that by setting the soft floor sufficiently high, the auction format is effectively converted from a second-price to a first-price auction. Indeed, several exchanges such as AppNexus advised advertisers to bid in soft-floor auctions just as they bid in first-price auctions (Gubbins 2017). The lack of transparency about the values of the soft floors set in these auctions led to such intermediate formats being quickly replaced by the more transparent first-price format with a reserve price").

[429]   Stylianos Despotakis, R. Ravi, and Amin Sayedi, "First-Price Auctions in Online Display Advertising," *Journal of Marketing Research* 58, no. 5 (2021): 888–907, at 889 ("Since its introduction, header bidding caught on very rapidly and became the mainstream format of publishers by the end of 2016…Before header bidding was introduced in the display advertising marketplace, the auction format for selling display ads was the well-established second-price format…However, in early 2017, right after the introduction of header bidding, several ad exchanges began experimenting with a first-price auction format instead.").

[430]   Stylianos Despotakis, R. Ravi, and Amin Sayedi, "First-Price Auctions in Online Display Advertising," *Journal of Marketing Research* 58, no. 5 (2021): 888–907, at 899 ("Under waterfalling, an exchange could use its position in the waterfall sequence to differentiate itself from other exchanges. When exchanges use second-price auctions, they can use their set of the advertisers to differentiate themselves from other exchanges…However, the combination of header bidding and first-price auctions puts exchanges in direct

their differentiation since the ultimate winner is the highest bidder among all exchanges. As a result, competition among exchanges becomes fierce so that they likely engage in a "price war," cutting their fees significantly."[431]

196. Notably, it took two more years for Google's AdX to finally move to a first-price format, making it the last major exchange to do so.[432] This slow transition goes against the prediction of the academic literature that the economic forces in competitive markets would push exchanges to adopt the first-price auction format when they compete for the same impression head-to-head as in the header-bidding setup. During this over two-year period, instead of having AdX adopt the first-price auction format, Google used other means to dry up header bidding, including Poirot, as explained above.

197. Poirot was a particularly effective response to header bidding.[433] For example, Google credited Poirot with reducing spend on other exchanges, while increasing DV360's spend on AdX by 7 percent.[434] Furthermore, around the start of 2017, over 50 percent of DV360 spend was on 3PE (i.e. less than 50 percent was on AdX), compared to 35 percent in 2019.[435] In 2018, when Poirot was in effect, Google noted that DV360's AdX bids were higher than 3PE bids 93 percent of the

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competition.…[T]he move to first-price auction was necessary for an exchange to survive in the short run after the publishers adopted header bidding").

[431] Stylianos Despotakis, R. Ravi, and Amin Sayedi, "First-Price Auctions in Online Display Advertising," *Journal of Marketing Research* 58, no. 5 (2021): 888–907, at 899 ("While the move to first-price auction was necessary for an exchange to survive in the short run after the publishers adopted header bidding, after taking its effect on advertisers' choices of exchanges into account, our results show that the move will lower the exchanges' equilibrium buyer-side fees in the long run. This is consistent with several industry reports indicating a steep decline in exchange fees since the adoption of first-price auctions.").

[432] Stylianos Despotakis, R. Ravi, and Amin Sayedi, "First-Price Auctions in Online Display Advertising," *Journal of Marketing Research* 58, no. 5 (2021): 888–907, at 889 ("After Google's move to first-price auctions in 2019, all major exchanges now use first-price auctions to sell display advertising impressions, when a publisher sends the request for bid to multiple exchanges."); *see also,* Jason Bigler, *"*An Update on First Price Auctions for Google Ad Manager," Google AdManager, May 10, 2019, https://blog.google/products/admanager/update-first-price-auctions-google-ad-manager/.

[433] GOOG-TEX-00085512, at -512 (03/16/2018) ("Our response to HB has been a multi-pronged effort, which includes a few projects…3. First-Price Auction Defenses in DBM…3. Poirot has actually been quite effective").

[434] GOOG-TEX-00085512, at -512 (03/16/2018) ("3. Poirot has actually been quite effective, resulting in DBM spending 7% more on AdX and reducing spend on most other exchanges.").

[435] GOOG-DOJ-11733552, at -553 (01/24/2020) ("DV360 three years ago[:] 3PE accounted for over 50% of DV360 spend"), and -578 (01/24/2020) ("DV360 spend on 3PE[:]" graph shows ~35% of Revenue going to "Exchange Traffic" (3PE) vs. ~65% going to "AdX Seller[s]" and other Google supply sources in 2019).

III.E. Google's Publisher Pricing Rules Took Away Publishers' Ability to Diversify from AdX towards Other Exchanges

209. In 2019, along with the move to the first-price auction on AdX, Google implemented "Unified Pricing Rules" (UPR), which took away the ability of publishers to set different floors for different exchanges and demand sources.[470] Prior to that change, publishers often used this ability to exercise more control over which exchanges or demand sources could win impressions under certain circumstances.[471] Google's removal of this functionality helped AdX capture more scale from rivals, despite being an unpopular move among publishers.[472]

210. In Section III.E.1, I first describe the various reasons for why publishers may set different price floors across exchanges and why they might want to assign higher price floors for AdX in particular. In this section, I also describe AdX's motivations for wanting to and eventually removing publishers' ability to set differential price floors across exchanges. In Section III.E.2, I describe how Google's strategic and simultaneous implementation of "Uniform Pricing Rules" (UPR) and transition to first-price auctions allowed Google to mitigate the loss of its valuable last look feature, which it abandoned at the same time.

III.E.1. Google's New Publisher Pricing Rule Disadvantaged Publishers by Removing their Ability to Set Differential Price Floors Across Exchanges and Demand Sources

211. As explained in Section II.C.2, publishers set price floors in many auctions, equal to the minimum price they are willing to accept to place an ad on their page. If, for example, a publisher sets a price floor at $0.50 for an impression, and receives bid offers of $0.20 and $0.30 from advertisers, the publisher would not sell this impression to any advertiser, and the impression would go unfilled.

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[470] GOOG-DOJ-03226088, at -089 (06/25/2019) ("And on April 18th, we announced Unified Pricing Rules (UPR) in Open Beta…100% of Ad Manager traffic will move to First Price in late July. Unified Pricing Rules will apply to all non-guaranteed inventory."); *see also*, GOOG-DOJ-03857848, at -848–849 (04/19/2019) ("[AdExchanger claim] Under the new rules, publishers can't set rules at a platform level. [How to respond]…Unified pricing rules will not allow floor prices to be set for one of these demand sources individually").

[471] *See* Section III.E.1 below.

[472] *See* Section III.E.2 below.

212.   Before September 2019, publishers in DFP could set different price floors for different exchanges and demand sources.[473] For example, publishers might choose no floor for header bidders, but might choose to accept bids from AdX only if they beat $0.50. In this case, if a header bidder submitted an offer of $0.20, and AdX submitted an offer of $0.30, the AdX bid would be rejected, while the $0.20 header-bidding offer would be accepted. Thus, publishers could divert traffic away from exchanges and channels they did not prefer (by setting high price floors for those exchanges) toward the exchanges they did prefer (by setting lower price floors for those exchanges).

213.   There are several reasons publishers may want to do this.[474] One key reason is that publishers prefer to diversify the demand sources they sell inventory to—in particular, publishers often wanted to reduce their dependence on AdX, even if it meant they collected less revenue overall.[475] Other reasons include sending inventory to exchanges with lower revenue shares,[476] seeking out higher-quality or more suitable ads,[477] and diverting traffic to particular exchanges to increase revenue[478] (e.g., by meeting quantity thresholds[479]). Google documents from 2019 show

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[473]   GOOG-DOJ-03857848, at -848–849 (04/19/2019) ("[AdExchanger claim] Under the new rules, publishers can't set rules at a platform level. [How to respond]…Unified pricing rules will not allow floor prices to be set for one of these demand sources individually.").

[474]   GOOG-DOJ-11692120, at -121–122 (04/18/2019) ("Why is buyer floor useful? ('laughs…I'll tell you'): RevShare by buyers…'We can give you 1,000 reasons why we want buyer rules'").

[475]   GOOG-DOJ-07957145, at -176 (12/2018) ("Pubs set higher floors on AdX for a variety of reasons…[including] Perceived pub benefit of revenue diversity (not relying solely on Google for revenue)"); *see also*, GOOG-TEX-00124787, at -802 (07/09/2018) ("Pubs have been willing to tolerate some revenue loss in exchange for reduced dependence on Google as a whole."); *see also*, GOOG-DOJ-04425512, at -512–513 (02/14/2017) ("Pubs are also rationale [sic] when they decide to diversify their source of revenues. It helps them to keep Google at bay and put pressure on us (similar to any industry)…We also have to account for the 'trust' component of fairness. some pubs just aren't comfortable with putting to (sic) much of their business in our hands.").

[476]   GOOG-DOJ-11692120, at -120–121 (04/18/2019) ("NOTES: Unified 1st Price Auction Event (NYC)…**Why is buyer floor useful? ('laughs…I'll tell you'): RevShare by buyers**.…Concession for RevShares: different priorities are needed. Taking control from us is going to be [sic].") (emphasis in original).

[477]   GOOG-AT-MDL-003573260, at -261–262 (02/10/2021) ("Reason for higher floors[:] Ad quality, seen several examples of AdWords ads that wasn't [sic] suitable for their sites[.] Protections not catching these").

[478]   Vox's Ryan testified that UPR would limit the revenue potential for Vox's deals with non-AdX exchanges. *See* Deposition of Ryan Pauley (Vox), August 23, 2023, 25:13–19 ("Q: Okay. So let me see if I can go back. So what impact, if any, would UPR have on Vox's deals with exchanges other than AdX? A. Limit revenue potential would be my general assessment.").

[479]   *See* GOOG-AT-MDL-007366628, at -655 (04/2020) for an example of a tiered payment structure with incentive thresholds ("OA Rev Share Tier[:] Year 1[:] 80% up to $2M / month[,] 82% from $2M - $4M / month").

number indicates a high priority ranking. Line items for direct sales have generally been given a higher priority relative to line items for indirect sales.[623] For example, guaranteed line items (which include "Sponsorship" and "Standard" line items) were the highest priority, typically ranking 1-10, and were called first. These were followed by the lower priority line items, including AdX and remnant line items, typically ranking 12-16.[624]

C.2   Google's Waterfall and Dynamic Allocation

268.   Dynamic Allocation was an existing feature of DFP when Google acquired DoubleClick in 2008.[625] In this setup, DFP first "ignored" AdX in the ad selection process, and if it selected a line item with a priority equal to or lower than AdX (i.e. a remnant line item, as opposed to a guaranteed line item), Dynamic Allocation triggered a real-time auction in AdX.[626] Internal documentation from 2011 describes the following process for Dynamic Allocation (DA):[627]

   a.   The publisher makes an ad request to DFP.

   b.   DFP picks the best eligible non-guaranteed line item to fill the impression.

("Ad Manager sample situation[.] Name[:] LI1 – Sponsor…LI2 – Standard…Rate[:] 5.00$ CPM[,] 7.00$ CPM").

[623]   GOOG-DOJ-AT-01917966, at -982–984 (06/03/2020) ("Evolution of Ad Server Decision-Making (simplified)[:] Pre-2007: Waterfall[.] Guaranteed / Direct[:] Fixed contract terms[,] Remnant / Indirect[:] Negotiated/historical price & publisher price floor[,] House…2014: Enhanced Dynamic Allocation[.] Guaranteed / Direct… Remnant / Indirect… AdX… House"); *see also*, GOOG-DOJ-AT-02199478, at -495–496 (06/11/2019) (["Winning Line Item: Sponsor[.] Explanation: Both the Sponsor and Standard campaign are on target with delivery[.] Sponsor has an higher priority (4 vs 8)").

[624]   GOOG-AT-MDL-008842393 at -397 (08/04/2023) ("Guaranteed line items (which include 'Sponsorship' and 'Standard' line items) were typically priority 1-10, AdX line items were typically priority 12 and competed with other line items at priority 12-16.").

[625]   GOOG-DOJ-05782415, at -431 (09/23/2019) ("Dynamic Allocation (allowing the ad exchange function of Ad Manager, AdX, to compete based on real-time bids) was an existing feature of DFP (now Ad Manager) when Google acquired DoubleClick in 2008.").

[626]   GOOG-DOJ-11899169, at -219 (11/09/2011) ("[Describing Dynamic Allocation's process as, firstly,] DFP goes through its normal ad selection process, ignoring Ad Exchange for now[.] If it selects an ad booked at a priority at or below AdX, an AdX auction is triggered."). Such lower-priority line items included Network, Bulk, Price Priority, and House line items. *See also,* GOOG-DOJ-03601149, at -155 (12/15/2011) ("Line item type[:]…Sponsorship…Standard – high…Standard – medium (DEFAULT)…Standard – low…AdX/AdSense…Network…Bulk… Price priority…House[.] Priority[:]…4…6…8…10…12…12…12…12…16[.]").

[627]   GOOG-DOJ-03601149, at -156–162 (12/15/2011) (A series of slides documenting the operation of Dynamic Allocation).

c.   If the best matching line item is at or below the priority level of AdX, it triggers an auction in AdX for that impression. In that AdX auction, DFP passes the value CPM of that best, matching line item as a floor to AdX. This value CPM is the historical average CPM delivered by each SSP/Exchange for that line item.[628].

d.   The highest bidder of the AdX auction wins the impression if they clear the floor set in (c). Otherwise, the DFP-selected line item from (b) wins and selects the creative and payment for the impression.

e.   If AdX won the impression in step (d), the clearing price is set to either the second highest AdX auction price, or the floor set in (c) (whichever is higher).

C.3   "Enhanced" Dynamic Allocation

269.   In March 2014, Google extended DA to compete for inventory sold through direct channels,[629] which it referred to as EDA. The updated process proceeded as follows:[630]

a.   The publisher makes an ad request to DFP/Ad Manager.

b.   Ad Manager finds the best, eligible guaranteed line item and calculates a "temporary CPM" (tCPM) for that guaranteed line item.

c.   Ad Manager finds the best, eligible remnant line item with the highest CPM.

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[628]   GOOG-DOJ-AT-01917966, at -983 (06/03/2020) ("2007: Dynamic Allocation (pre-Google Acquisition)… One common formula for setting the value CPM is to divide total revenue from the remnant line item over a given period by total impressions sent by the ad server to that line item to calculate the average CPM").

[629]   GOOG-DOJ-05782415, at -432 (09/23/2019) ("Prior to March 2014, Dynamic Allocation did not allow AdX or remnant line items to compete at all with guaranteed line items, to ensure that the guaranteed line items served."); *see also,* GOOG-DOJ-05782415, at -432 (09/23/2019) ("Enhanced Dynamic Allocation allows AdX and remnant line items (and more recently, Exchange Bidders) to compete with guaranteed Ad Manager line items.").

[630]   GOOG-DOJ-05782415, at -432–434 (09/23/2019) ("The Enhanced Dynamic Allocation process works as follows:…Step 1: A publisher makes an ad request to Ad Manager. Step 2: Ad Manager finds the best guaranteed line item eligible to serve for the ad request and calculates a temporary CPM based on the line item's current delivery. Step 3: Ad Manager finds an eligible remnant line item with the highest CPM. Step 4: Ad Manager calls Authorized Buyers and Network Bidders to find ads which can beat the temporary CPM of the guaranteed line item or the CPM of the remnant line item. If Exchange Bidding is enabled, Ad Manager will also call Exchange Bidders during this step. Step 5: Ad Manager selects the line item with the highest CPM to serve an ad, protecting the value of guaranteed inventory in all cases.").

code was contained in what is knowns as a webpage "header," which led to the name "header bidding."[639]

273. This allowed real-time bidding for all exchanges simultaneously, in contrast to the sequential calls in the waterfall process described above. These winning HB bids were typically the highest offers received, meaning that the HB wrappers typically acted as first-price auctions.[640] As a result, exchanges bidding into HB wrappers were incentivized to switch to holding first-price auctions themselves. To see why, consider an exchange that has received two bids, $b_1 > b_2$. If the exchange were holding a second-price auction, it would submit the highest bidders' advertisement, and offer to pay only b_2. However, if a rival exchange were submitting to the same header-bidding wrapper, and received a high bid of b_3, but instead held a first-price auction, it would submit the bid of b_3 directly to the header-bidding wrapper. In situations where $b_1 > b_3 > b_2$, the first exchange would lose the auction, despite having a bidder that was willing to pay more than b_3 for the impression. As a result, and as I show in my own academic work, header bidding provides incentives that push ad exchanges toward holding first-price auctions, rather than second-price auctions.[641]

274. After soliciting bids from exchanges in the header-bidding auction, publishers forwarded the winning HB offer to DFP. Depending on the publisher's preferences, the impression could either be sent to AdX for another real-time auction, using the winning HB bid amount as a reserve

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[639] Deposition of Christopher LaSala (Google) Day 1, August 16, 2023, 329:5-15 ("Q. Are you familiar with header bidding, Mr. LaSala. A. I am. Q. What was it? A…. It was the ability to put exchanges in competition with each other by loader up the header of a page with different tags for different exchanges. Hence, how it got its name.").

[640] GOOG-DOJ-09429825, at -825 (03/16/2018) ("all HB is by definition first price").

[641] Stylianos Despotakis, R. Ravi, and Amin Sayedi, "First-price Auctions in Online Display Advertising," *Journal of Marketing Research* 58, no. 5 (2021): 888–907, at 898 ("In this article, we propose a simple model of RTB in display advertising to analyze the evolution to selling mechanisms in this market and the consequences for advertisers, publishers, and exchange platforms. We show that, when exchanges were using second-price auctions and advertisers' exchange affiliations were unchanged, the publisher's revenue when using header bidding is always higher than waterfalling; this result explains the rapid adoption of header bidding by publishers in recent years.").

price,[642] or it could be sent into DFP as a guaranteed deal for a direct sales channel.[643] Whether

the bids went through direct or indirect sales channels after arriving in DFP depended on how the

publishers implemented HB.[644] A simple example is presented in Figure 12.

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[642]   GOOG-DOJ-15277215, at -221 (05/05/2016) ("2. Header container makes callouts to 3p buyers to fetch real-
time prices (rtp)[.] 3. Header container makes a DFP ad request with the highest price set as key-value targeting
for 3p buyer lineitem (LI)[.] 4. DFP matches 3p buyer LI and calls AdX via EDA with the reserve price set to
'valueCPM' of matching 3p buyer LI; AdX wins if it beats the reserve price, otherwise 3p buyer LI containing
3PAS creative wins").

[643]   GOOG-TEX-00121384, at -390 (10/2016) ("2 Flavors of Header Bidding[:] 1. Guaranteed buy-outs…Few Line
Items, usually booked at Guaranteed level[,] Breaks EDA - no fair competition…2. Close to Real-Time Pricing
Remnant…Passes real-time (approximate?) pricing to Price Priority Line Items…Fair AdX competition"); *see
also*, GOOG-TEX-00107198, at -200 (10/12/2015) ("What is header bidding[:] Technology allows Retargeters
and SSPs to pass information into DFP via key values…Ensure publishers who want to implement HB do it
properly in DFP[:] Not preventing AdX from competing[,] Hence not hurting their yield") and -218 ("SSPs
Header Bidding[:]…Reasons / Logic[:] DFP ad serving logic considers remnant line item CPMs which to-date
have been based on historical averages. **Header bidding simulates the dynamic allocation callout attempting
to inject real-time or near real-time prices.** More accurate remnant prices should increase yield…Common
Implementation[:] HB @ Price Priority Line Item - P12 > recommended implementation[,] HB @ Remnant
Line Item - Modified Priority P4-11 > can negatively impact direct sales[,] HB @ Standard Line Item - P6-10 >
effectively defeats the purpose [of] header bidding and can limit competition through EDA[,] HB @
Sponsorship Line Item - P4 > effectively defeats the purpose [of] header bidding and breaks EDA") (emphasis
in original).

These slides indicate that HB allows 3rd party exchanges to pass bids targeting sponsorships, standard, and
lower priority non-guaranteed inventory to Google's ad server. In certain instances where EDA was blocked
(e.g., contracts with 100% sponsorship), the winning HB bid would not be required to compete in an AdX
auction and the particular impression could be won by a 3rd party exchange without Google having the
opportunity to bid for it.

[644]   GOOG-TEX-00107198, at -218 (10/12/2015) ("Common Implementation[:] HB @ Price Priority Line Item -
P12 > recommended implementation[,] HB @ Remnant Line Item - Modified Priority P4-11 > can negatively
impact direct sales[,] HB @ Standard Line Item - P6-10 > effectively defeats the purpose [of] header bidding
and can limit competition through EDA[,] HB @ Sponsorship Line Item - P4 > effectively defeats the purpose
[of] header bidding and breaks EDA").

FIGURE 12: HOW HEADER BIDS ARE PASSED TO DFP
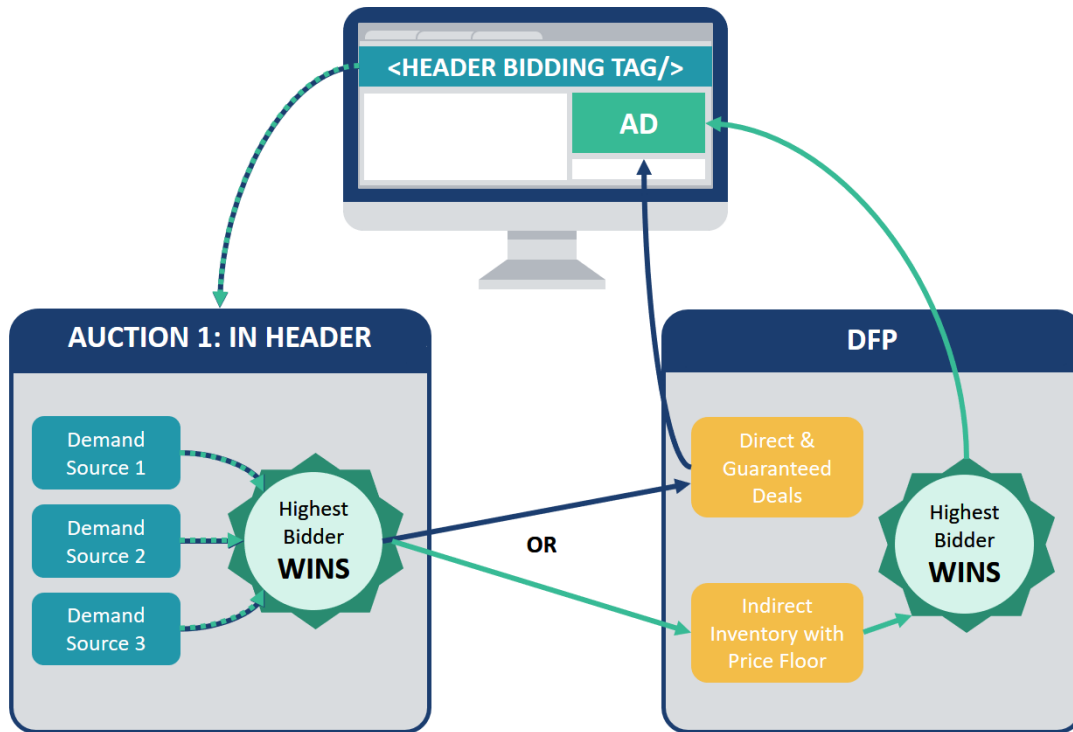
Source: Adapted from the figure at "Ad Exchange for Header Bidding," OKO, March 14, 2019, https://oko.uk/blog/ad-exchange-for-header-bidding.

275. When HB resulted in bids that competed with AdX, DFP used the bids as potential reserve prices in the auctions, a practice that has been described as providing AdX a last look at those bids.[645] AdX used this information to implement their Dynamic Revenue Sharing (DRS) programs, under which AdX selectively decrease its fees so that it could beat more price floors as well as other bids on AdX.[646]

276. However, when HB resulted in bids that were passed into Google's DFP as direct contracts, the practice could either limit or entirely block competition from AdX through DA.[647] Recall that

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[645]   GOOG-DOJ-AT-00573309, at -310–311 (09/12/2019) ("Web publishers on the other hand have started using header bidding which allows them to pit AdX against 3PEs in a 1P auction…To remove this disadvantage 'last look' was implemented which allowed AdX to look at the highest 3PE bid and beat it by 1¢."); *see also,* GOOG-DOJ-03850107, at -107 (05/01/2017) ("We got rid of last look for Exchange Bidding, which means a price from another SSP can no longer be a floor in our auction.").

[646]   *See* Appendix E.

[647]   In particular, if header bidding was implemented as a "100% Sponsorship" line item type, AdX could not compete for the impression at all. *See* GOOG-DOJ-14156104, at -105 (09/16/2016) ("For 100% sponsorship, yes, EDA will be blocked, while DFL can compete if publishers allow it (opt-in model)."); *see also,* GOOG-

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DA did not initiate an auction in AdX for certain high priority guaranteed line items or, more broadly, for any guaranteed line items if publishers opted to disable the feature. The downside of not allowing AdX to bid was the potential of missing out on higher bids from an advertiser on Google's platforms who did not participate in header bidding. To address this, Google introduced a program called "DFP First Look," which I describe below in Appendix C.6.a. Basically, DFP First Look further extended DA to allow AdX to compete with high-value header-bidding line items. Note that AdX still enjoyed the last look advantage for these impressions.

C.5   Exchange Bidding (Also Known As Open Bidding)

277.   Google recognized that header bidding was a competitive threat to its business.[648] In order to protect themselves, Google launched multi-pronged responses to header bidding soon after publishers started adopting it. One of the major changes implemented by Google was entering into partnerships with other exchanges to run simultaneous auctions. That is, for a fee, Google allowed other exchanges to bid in real time against AdX at the top of the waterfall. This program was known as Exchange Bidding ("EB"), also referred to as Open Bidding ("OB")[649] and as

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TEX-00107198, at -218 (10/12/2015) ("Common Implementation[:]…HB @ Standard Line Item - P6-10 > effectively defeats the purpose [of] header bidding and can limit competition through EDA[,] HB @ Sponsorship Line Item - P4 > effectively defeats the purpose [of] header bidding and breaks EDA").

[648]   GOOG-TEX-00085512, at -512 (03/16/2018) ("The problem isn't so much that DBM [DV360] is buying HB inventory -- the problem is that HB exists :)"); *see also*, GOOG-DOJ-15277215, at -218–219 (05/05/2016) ("It turns out that getting **per-query bids from exchanges** *dramatically increases yield*, so pubs are clamouring for this functionality. **'Header bidding'** is a DFP hack that makes this possible…Exchange Bidding allows DFP publishers to get per-query bids from non-AdX exchanges without the hack…If we do nothing, pubs will adopt header bidding en masse") (emphasis in original).

[649]   GOOG-AT-MDL-008842393, at -400 (08/04/2023) ("Open Bidding became generally available in April 2018 (as Exchange Bidding)....In mid-2019, Exchange Bidding for Ad Manager inventory rebranded as Open Bidding.").