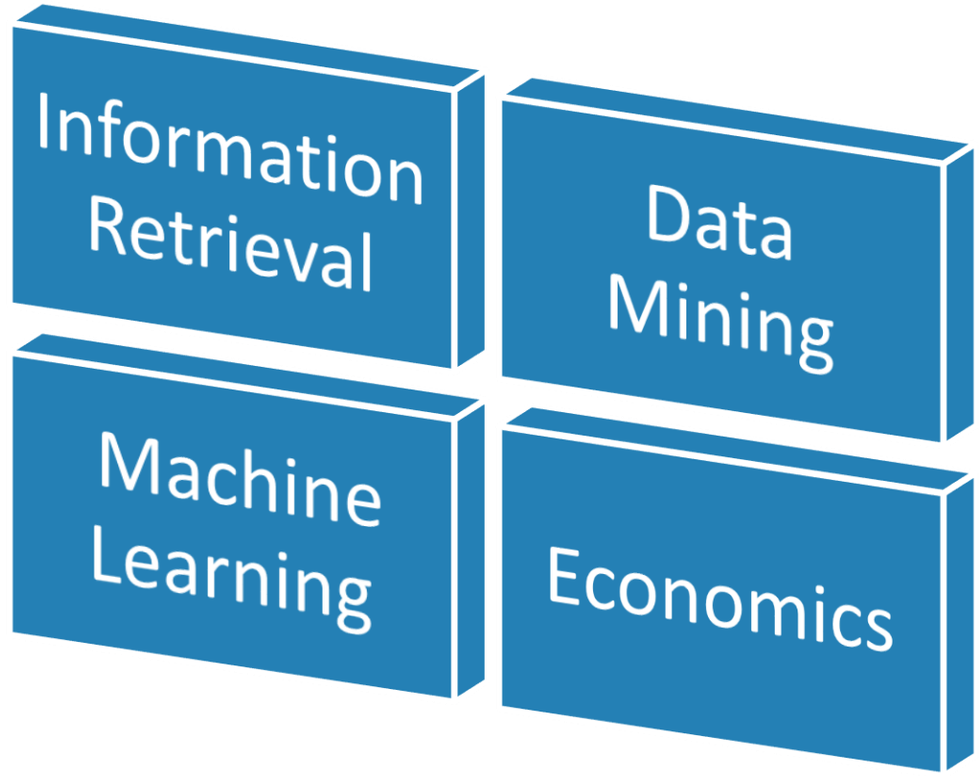
Display Advertising with Real-Time Bidding and Behavioral targeting

主讲：石恩名

Introduction

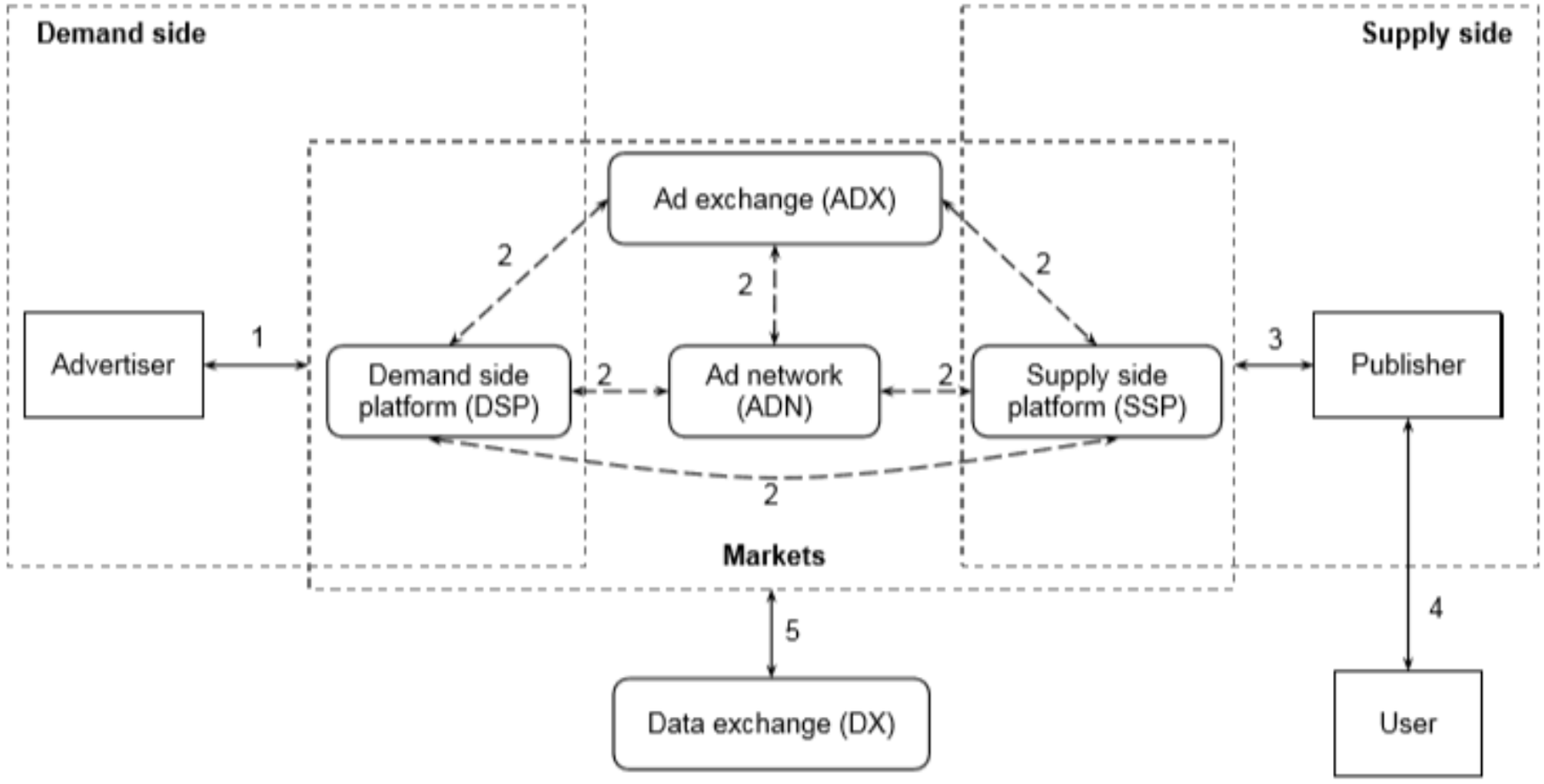
RTB has fundamentally changed the landscape of the digital media market by scaling the buying process across a large number of available inventories among publishers in an automatic fashion. It also encourages user behaviour targeting, a significant shift towards buying focused on user data rather than contextual data.



中国程序化广告生态圈


中国程序化广告技术生态图
China Programmatic Advertising Technology Landscape
RTBChina
MARKETER 广告主
DSP
Ad Exchanges & SSP
Trading Desk & Tech
Verification
Data Suppliers & Data Management
Programmatic Creative
Measurement & Analytics
"DSPAN" (DSP + Ad Network, Hybrid)
Programmatic TV
PUBLISHER 媒体
CONSUMER 消费者

HOW RTB WORKS?



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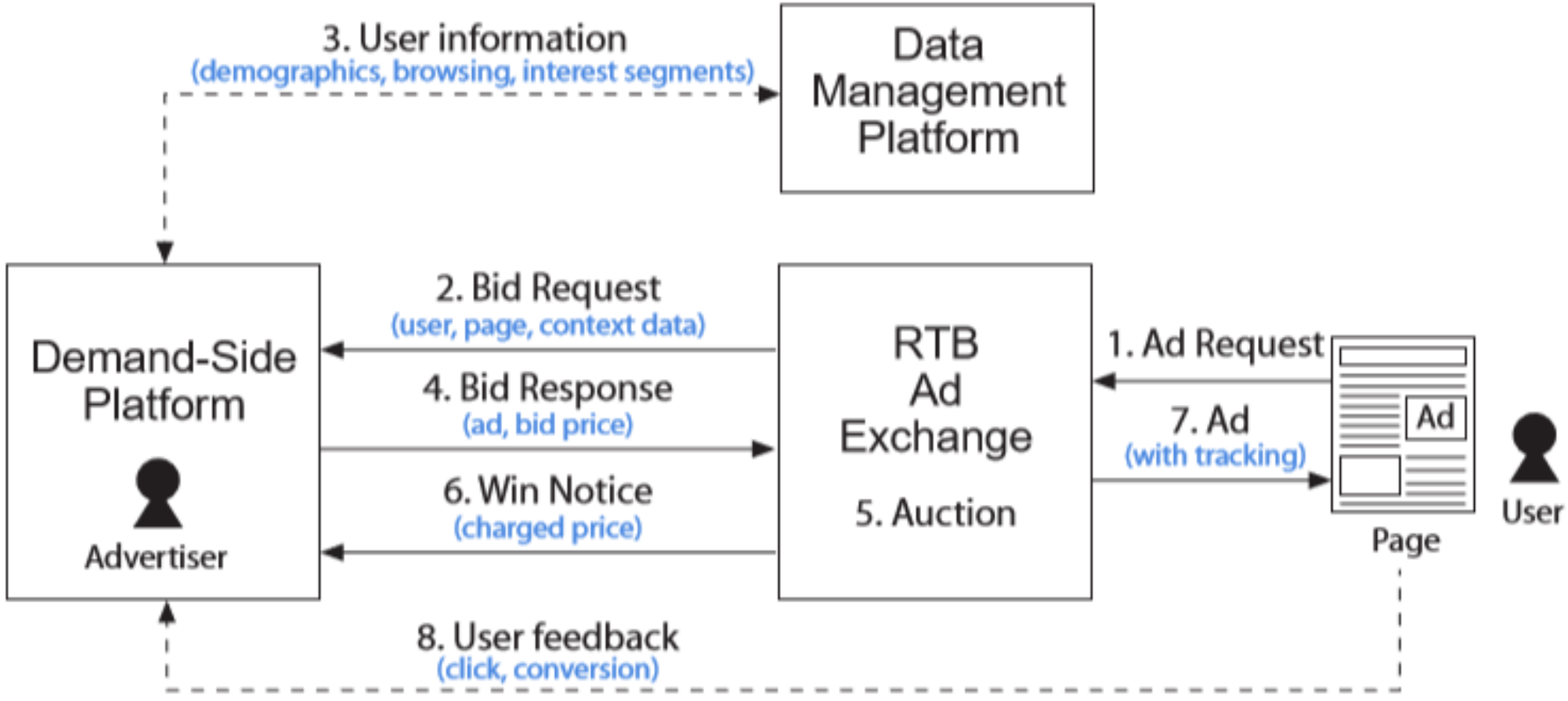
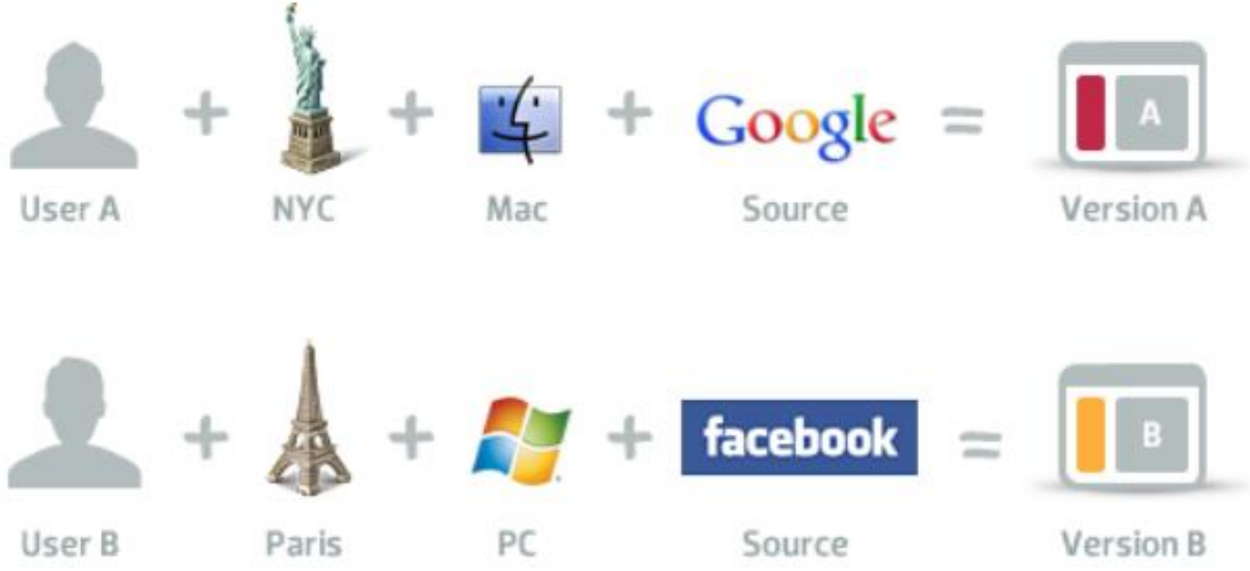


What is behavioral targeting?

- **Behavioral targeting comprises a range of technologies and techniques used by online website brands, publishers and advertisers aimed at increasing the effectiveness of marketing and advertising using user web-browsing behavior information. Behavioral targeting uses information collected from an individual‘s web-browsing behavior to select advertisements to display.**



DSP流程

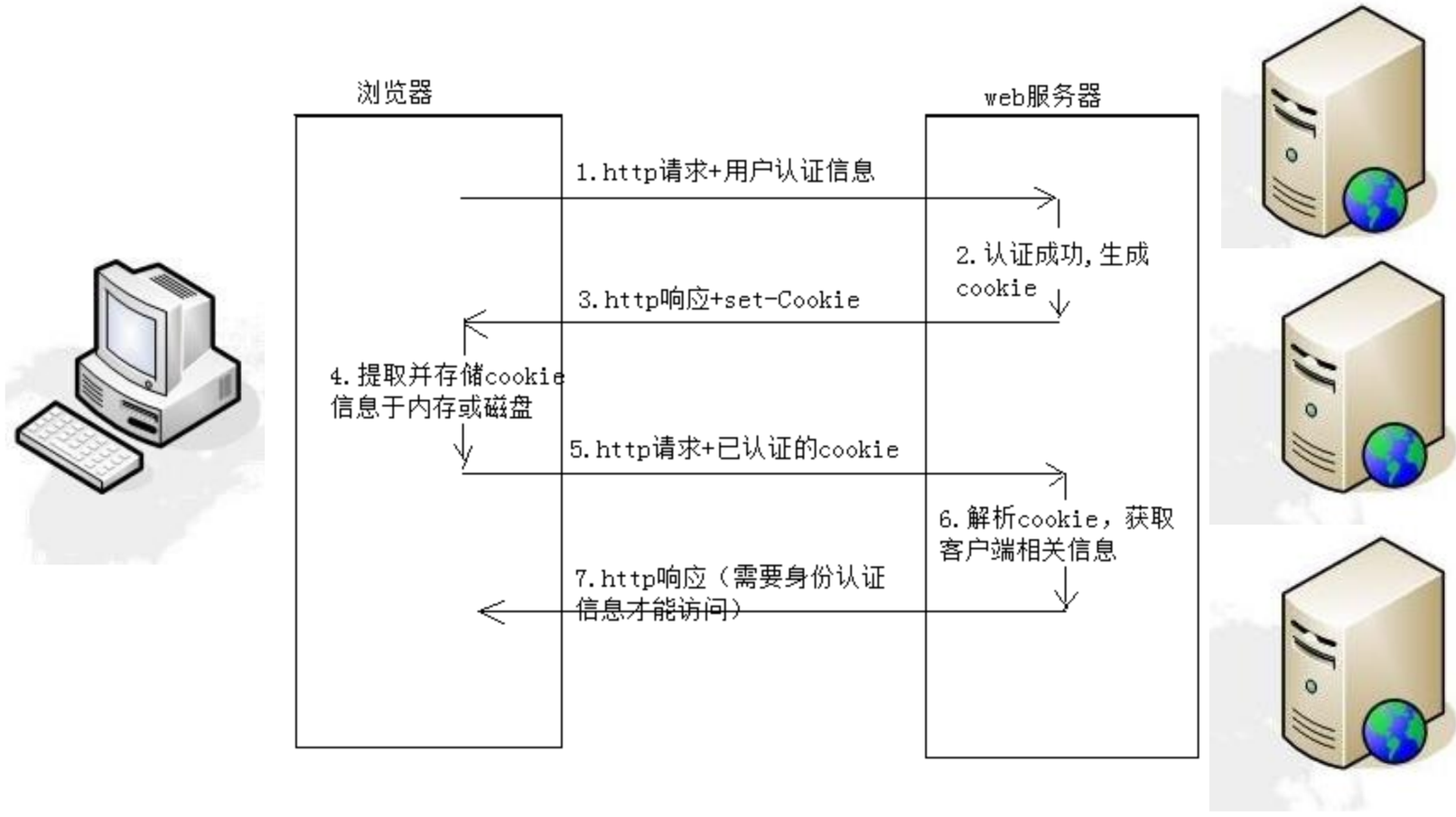
- 追踪用户行为
- 受众选择
- 通知exchange
- Segment管理
- 进行实时竞价
- 展现广告
- 追踪转化

User tracking

Advertisers would re-target users who have previously visited their websites but have not initially converted. Retargeting ads: keep ads in front of the users even after they leave the advertiser's website.

cookie

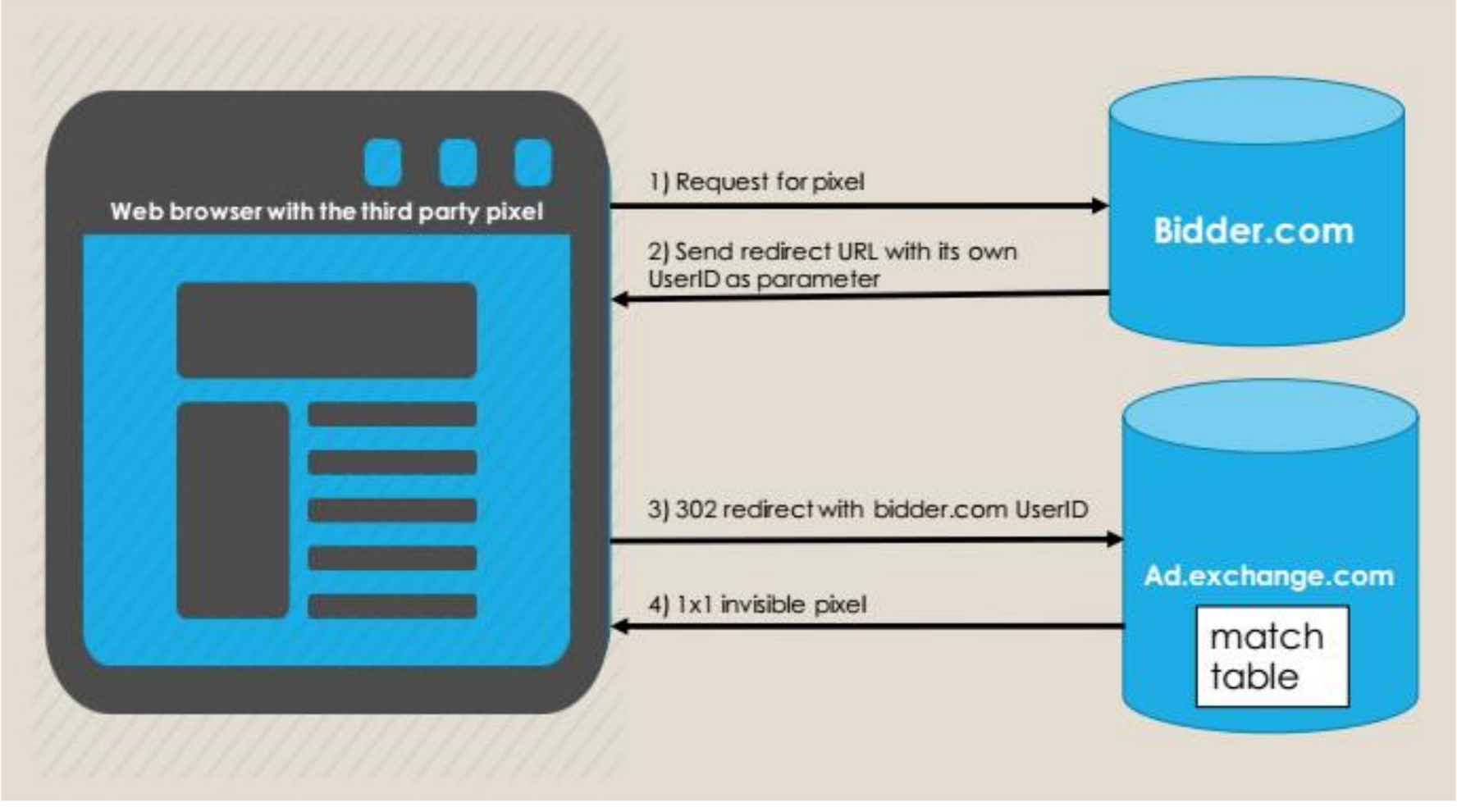
- **An HTTP cookie is a small piece of data sent from a website and stored on the user's computer by the user's web browser while the user is browsing.**



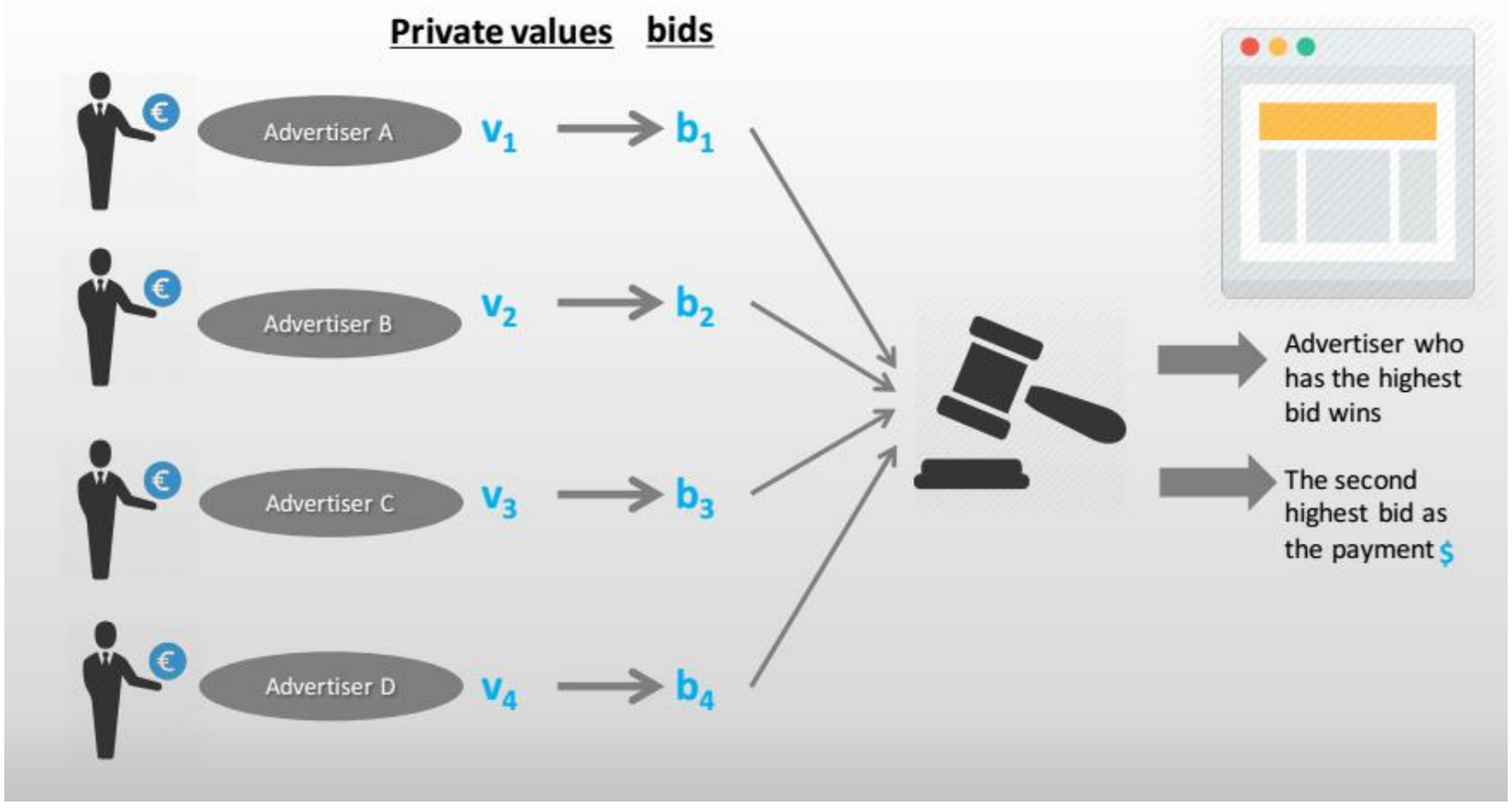
Cookie syncing

Cross-origin resource sharing (CORS)

Cookie syncing



The second price auction in RTB



Suppose Advertisers A, B, C, and D, based on their valuations, place bids as $10, $8, $12, $6 CPMs respectively. Advertiser C would win the auction with the actual payment price $10 CPM.

Winning Probability

$$\underbrace{q_x(\boldsymbol{x})}_{\text{winning impression}} \equiv \underbrace{P(\text{win}|\boldsymbol{x}, b_{\boldsymbol{x}})}_{\text{prob. of winning the auction}} \cdot \underbrace{p_x(\boldsymbol{x})}_{\text{bid request}},$$

RTB Major Topics

- **User response prediction**
- **Bid landscape forecasting**
- **Bidding algorithms**
- **Revenue optimization**
- **Statistical arbitrage**
- **Dynamic pricing**
- **Ad fraud detection**

Bid Landscape Forecasting

- Bid landscape forecasting（竞价愿景预测）是指对于给定的一个广告计划，预测出不同价格能够竞价到的流量的分布。
- 模型：
- Tree-based log-normal model
- Censored linear regression
- Survival Model

Tree-based log-normal model

- 1. Assumed the winning price z follow a log-normal distribution.

$$p_s(z;\mu,\sigma) = \frac{1}{z\sigma\sqrt{2\pi}} e^{\frac{-(\ln z-\mu)^2}{2\sigma^2}},$$

- 2. Use gradient boosting decision trees(GBDT) to predict the mean E[s] and standard deviation Std[s] of winning prices of each sample s based on the features extracted .

$$\mu_s = \ln \mathbb{E}[s] - \frac{1}{2}\ln\left(1+\frac{\mathrm{Std}[s]^2}{\mathbb{E}[s]^2}\right),$$

$$\sigma_s^2 = \ln\left(1+\frac{\mathrm{Std}[s]^2}{\mathbb{E}[s]^2}\right).$$

$$p_c(z) = \sum_{s\in S_c} \pi_s \frac{1}{z\sigma_s\sqrt{2\pi}} e^{\frac{-(\ln z-\mu_s)^2}{2\sigma_s^2}},$$

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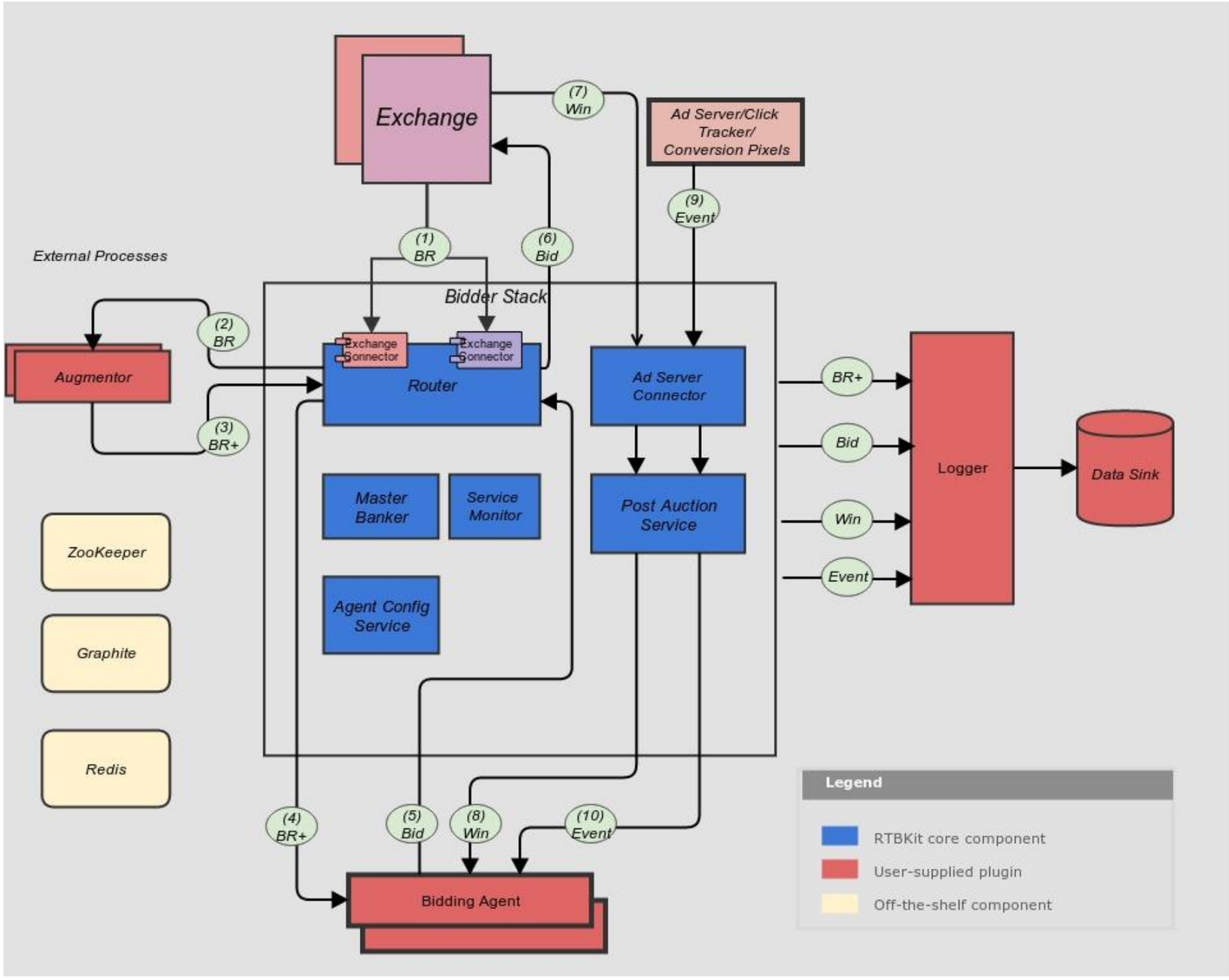
RTB framework



RTB framework

- **Router**

This is the central component of the RTB stack. It performs the following functions:

- Receives bid requests from the various exchanges

- Filters them for the bidding agents

- Augments them with extra information (by calling the augmentors)

- Mediates between multiple bids

- Ensures real-time guarantees are met

- Guarantees we do not overspend

RTB framework

- **Post-Auction Service**

- Receives bids from the router that have been submitted to the exchange
- Receives notifications of wins, impressions, clicks and visits

- **Master Banker**

This is the component that manages budgets associated with campaigns.

- Authorizes spend given by bidding agents
- Keeps track of budgets for each campaign
- Tallies up the spend for each campaign

RTB framework

- **Agent Configuration Service**

- Responsible for broadcasting each bidding agent's configuration to everything that needs to know about it

- The type of information that they broadcast

  - What bid requests to send
  - How to send them
  - What creatives are available
  - Who to charge for ads that are bought
  - How to identify conversion events

- Avoids the agents having to separately manage their configuration with every service they talk to

- AgentConfigurationListener class provides a way to automatically stay up to date

RTB framework

- **Service Monitor**

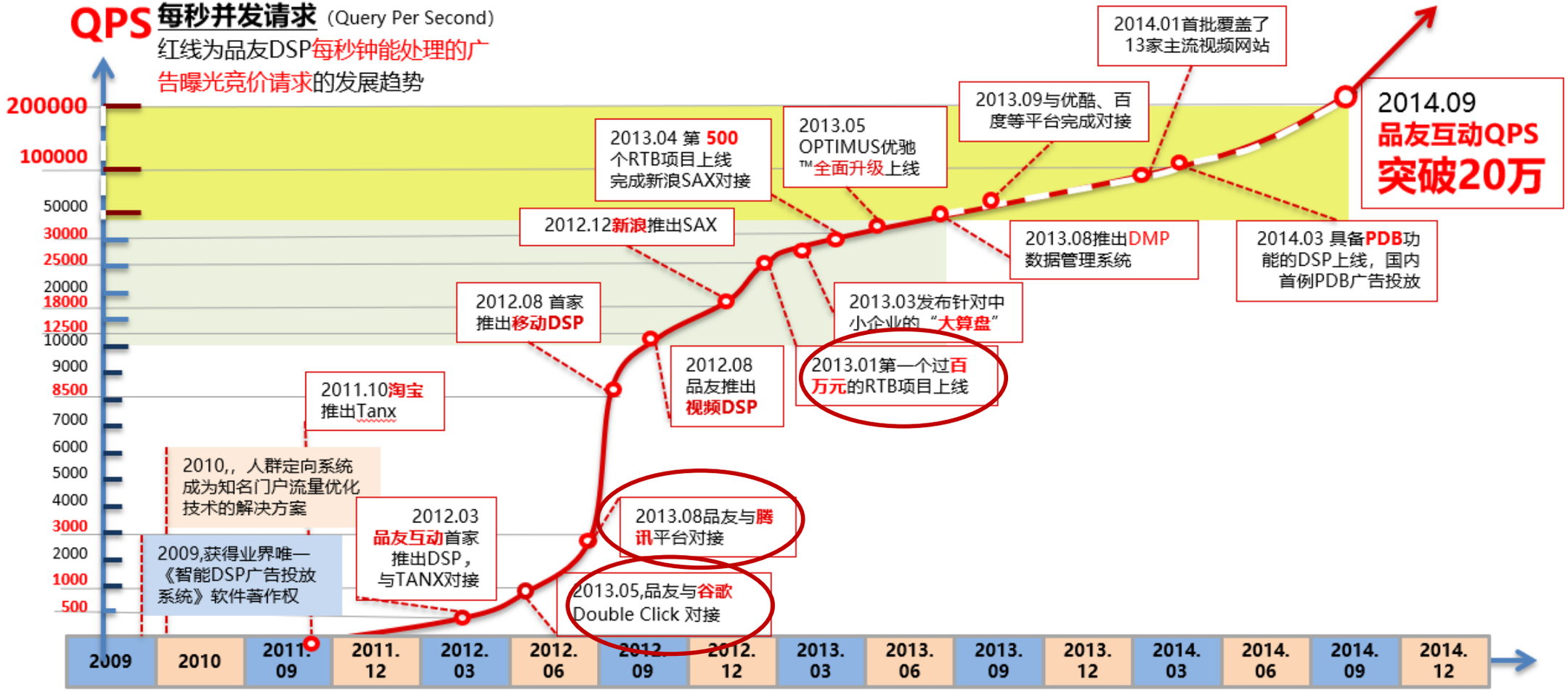
- Checks that all processes are working correctly and provides authorization to the router for bidding on auctions at regular intervals

- Without an explicit authorization the router will drop nearly all bid requests

- Will cut off bids under the following conditions

  - No wins coming in from a given exchange
  - No impressions for a given ad server
  - Spend is exceeding reasonable levels

QPS


QPS 每秒并发请求 (Query Per Second)
红线为品友DSP每秒钟能处理的广告曝光竞价请求的发展趋势
200000
100000
50000
30000
25000
20000
18000
12500
10000
9000
8500
7000
6000
5000
4000
3000
2000
1000
500
2009
2010
2011.09
2011.12
2012.03
2012.06
2012.09
2012.12
2013.03
2013.06
2013.09
2013.12
2014.03
2014.06
2014.09
2014.12
2009,获得业界唯一《智能DSP广告投放系统》软件著作权
2010,，人群定向系统成为知名门户流量优化技术的解决方案
2011.10淘宝推出Tanx
2012.03品友互动首家推出DSP，与TANX对接
2012.08 首家推出移动DSP
2012.12新浪推出SAX
2012.08品友推出视频DSP
2013.04 第 500 个RTB项目上线 完成新浪SAX对接
2013.05,品友与谷歌Double Click 对接
2013.08品友与腾讯平台对接
2013.05 OPTIMUS优驰™全面升级上线
2013.01第一个过百万元的RTB项目上线
2013.03发布针对中小企业的“大算盘”
2013.08推出DMP数据管理系统
2013.09与优酷、百度等平台完成对接
2014.01首批覆盖了13家主流视频网站
2014.03 具备PDB功能的DSP上线，国内首例PDB广告投放
2014.09 品友互动QPS 突破20万

RTB平台申请门槛

基本信息	对象	与 BES 对接的第三方 DSP。
	评估时间	2015 年 4 月 1 日起，每月 review。
	信息维护和沟通	由运营维护 DSP 的签约开始时间、签约完成时间、开始测试时间、测试通过时间、正式上线时间、每月消耗概况、违规处罚情况。
准入说明	说明	①初次对接 BES，公司具有合法工商注册，有固定 RTB 投放的客户，有进行程序化交易的技术能力，已和国内知名 AdX 完成对接并正式投放，月均消费至少 1W 以上； ②已对接 BES 流量（PC），希望对接新产品线（mobile/ video），根据消费情况、技术参数、消费预算，运营决定对接优先级。
对接流程	商务流程	DSP 和 BES 签署《保密协议》，《合作合同》，进行预充值（首次 2w）。
	技术流程	商务流程完毕后，DSP 按照百度提供的技术文档（文档可以在签署《保密协议》后，运营直接提供）开发，开发完成后，开启测试账号，进入技术对接，测试通过后，开启正式账号。
清出政策	评判标准	对接速度： 商务流程完毕，技术开发完毕，开启测试账号，开始对接测试，20 个工作日内，未对接完成，终止合作，且半年内不再对接。 备注：开启测试账号前，不回答技术问题，请在技术文档或帮助中心《百度流量交易白皮书》寻找答案。
		消耗规模： 对接完成，从第三个月开始：月消费不足 1 万，停止合作，半年内不再对接；连续三个月总消费不足 5 万，锁定账号，重新评估，决定是否开启或者终止合作。
清出流程	线下确认	运营每月梳理 DSP 合作信息表同步到 inside 团队； 确认需要清出的 DSP 名单； 与 DSP 进行线下沟通说明，无异议后正式走清出流程。
	线上流程	①运营锁定 DSP 账户； ②运营给 DSP 发清出通知，含签约开始时间、签约完成时间、开始测试时间、测试通过时间、正式上线时间、消费数据，违规记录，说明清出原因； ③inside 变更合同发给法务，财务，客户，终止合同；
合作限制	限制条件	①被清出的 DSP，半年内不开启合作。 ②主动终止合作的 DSP，一年内不开启合作。

百度Ad Exchanges平台
申请条件

公开竞价RTB

面向对象：与腾讯ADX对接公开竞价RTB的所有外部DSP。

准入说明：

1）初次对接腾讯ADX，公司具有合法资质且在腾讯审核通过，有固定的投放客户，具备公开竞价投放的技术和运营能力，通过腾讯评估，月均消耗50,000元以上。

2）已完成对接腾讯ADX，有新的流量对接需求的，根据消费情况、技术能力、运营水平决定对接优先级。

对接流程：

1）商务流程：与腾讯ADX签订《框架合同》，《保密协议》，付保证金200,000元（可退还），预充值100,000元（用于抵扣投放消耗）。

2）技术流程：腾讯ADX向DSP提供测试账号，DSP根据技术文档进行开发和联调（详见ADX技术文档和对接流程指引）。

合作门槛：

1）对接能力

开始对接联调测试后，应在15个工作日内完成，如未完成对接，终止合作，半年内不再对接。

对接中，DSP技术人员应具备阅读对接文档和自主解决问题的能力，如有问题，先通过对接文档解决，无法解决的，由腾讯技术人员解答。

2）投放规模

对接完成新的DSP开启投放后，投放前3个月为磨合期和考察期，前3个月月平均投放金额须达到20,000元，不达标的第4个月起，锁定账号，终止合作，预充值不退还；从第3个月开始，每月投放金额须达到50,000元，每半年评估一次，不达标的，锁定账号，终止合作。

3）投放运营

投放过程中，DSP运营人员应了解ADX前台界面的功能，包括但不限于查看各类报表数据、诊断工具、账期、账单等。

投放过程中，DSP运营人员应熟练使用ADX界面提供的运营工具，能够对投放中的问题进行初步排查和处理。

ADX账期为三个月，DSP应在三个月内完成付款并提供付款凭证给媒介人员，逾期未付款的记违规一次，且流量自动暂停直至付款完成。当年违规超过3次的，年底锁定账号，重新评估，决定是否续签合同或终止合作。

清出流程

外部流程：

ADX运营人员给DSP发清出通知，含合作开始时间、测试开始时间、测试通过时间、投放开始时间、消耗数据、违规记录、清出原因。

内部流程：

相关信息同步给法务、财务，检查所有账款是否全部结清，退还保证金。

腾讯Ad Exchanges平台
申请条件

Conference

DSP系统技术架构参考[https://baijiahao.baidu.com/s?id=1577775342448076518&wfr=spider&for=pc]

小米程序化广告交易平台（MAX）的架构实践[http://www.infoq.com/cn/presentations/the-architecture-of-the-millet-programmatic-exchange-platform]

Display Advertising with Real-Time Bidding (RTB) and Behavioural Targeting[https://arxiv.org/abs/1610.03013]

Behavioral Targeting: the most underused technique in today’ s marketing[https://vwo.com/blog/behavioral-targeting/]

Wikipedia HTTP cookie[https://en.wikipedia.org/wiki/HTTP_cookie]

DSP基础算法与模型研究[http://blog.jobbole.com/108921/]

THANK YOU