AdLedger

Digital advertising overhaul using blockchain and smart contracts

Value proposition

Ad Ledger offers ALT (AdLedger Token) as a means of payment for advertising services. ALT shall be used by:

- advertisers - to significantly reduce costs of media buying and get access to transparent market as well as analytics of service quality.
- publishers - to get increased revenues by concluding transparent contracts and working directly with advertisers.
- service providers - to decrease costs of integration with other partners and limit responsibilities for ad services.
- quality providers - to get standing customer flow and decrease costs of integration with other market players.

Introduction

Digital advertising is coming closer to a dead-end. The market is loaded with bots and malvertising and this not only ruins budgets of advertisers but also undermines credibility of publishers.[1] And the worst thing is that middlemen, who have become key figures on the market lately, not simply ignore, but thrive on this situation, because the fraudulent traffic helps them increase their revenues by up to 50%.[2]

There are three main problems that require urgent solutions now. Those are:

Advertising Fraud.

USD8.2b of total advertising budgets goes corrupted[3]. Fraud may constitute up to 60% of advertising budget, depending on service provider. One of reasons for growth of ad fraud is that publishers' revenue from ads is decreasing.[4] As a result they do not have enough funds to create content of good quality and retain their audience.

Willingness of publishers to increase their revenue also results in adding aggressive ads like popups and popunders on websites, what makes visitors feel irritated and becomes an additional incentive to install AdBlock[5]. Adobe research shows that 26% of desktop users choose to block their online ads. This triggers the development of ad fraud and prevents the development of the digital advertising market because ads do not reach final users.

On the other side there are advertisers, who are often unable to solve the problem using their own resources. Advertisers have only two ways of dealing with ad fraud:

1. creating an internal ad fraud department;

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[1] IAB US benchmarking study, 2015. *What is an untrustworthy supply chain costing the US digital advertising industry?*, November 2015 [online] p. 2-3

[2] Kaiser Fung, 2015. *Why Fraudulent Ad Networks Continue to Thrive,* Oct 28, 2015. Harward Business Review, [online] https://hbr.org/2015/10/why-fraudulent-ad-networks-continue-to-thrive

[3] IAB US benchmarking study, 2015. *What is an untrustworthy supply chain costing the US digital advertising industry?*, November 2015 [online] p. 2-3

[4] Jack Simpson, 2015. *40% of publishers describe their digital ad revenue as shrinking or static*. Econsultancy, Oct. 2015. [online] https://econsultancy.com/blog/67028-40-of-publishers-describe-their-digital-ad-revenue-asshrinking-or-static/.

[5] Mimi An, 2016. *Why People Block Ads (And What It Mwans for Marketers and Advertiserts)* July 13 2016, HubSpot Research [online] https://research.hubspot.com/reports/why-people-block-ads-and-what-it-means-for-marketers-and-advertisers

2. working with a company that specializes in ad fraud detection.

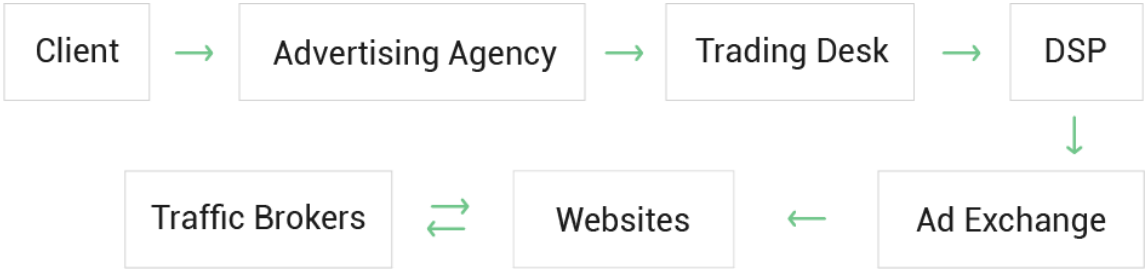
First one is costly, second is impossible for SMEs: the likes of Whiteops, IAS and MOAT, i.e. the companies that are dealing with traffic fraud detection, have a high preference for working with large businesses and charge a lot.

Middlemen.

At the moment the market of online advertising is being regulated by thousands of different middlemen such as DoubleClick, AdSense EPOM etc[6]. They get a major part of campaign budgets just for connecting publishers and advertisers and providing targeting opportunities. Their fee can constitute up to 55% of the total ad campaign budget[7]. Most publishers do not even know the initial price advertisers pay for clicks or impressions. And it may happen so that the prices for clicks and impressions grow, because fees of middlemen increase, and income of publishers remains on the same level, or even gets lower.

Another thing is that the automatization of ad placement leads to complexification of the industry, with much more intermediaries. A simple Client - Advertising Platform - Publisher relationship that used to exist before has evolved into something like this (Figure 1):

Figure 1:Industry value chain



Source: Kalkis Research[8]

As it can be seen of the figure above, the number of intermediaries in this chain is very big and every middleman is taking fees for services, that automatically increase their budgets.

Some time ago clients could go to a major newspaper operating in a particular region of their interest, have the ads published in a specific edition thereof and know the audience that will see that ads. Now the process involves the participation of several intermediaries and ads are often shown to irrelevant or even unreal audience.

Transparency.

The automation of the process, and its complexification, has gradually removed transparency. The advertisers are hiring more and more middlemen. Intermediaries are

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[6] Mathew Ingram, 2017. *How Google and Facebook Have Taken Over the Digital Ad Industry*. Fortune (Jan. 2017). [online] http://fortune.com/2017/01/04/ google-facebook-ad-industry/.

[7] IAB PwC, 2015 *IAB Programmatic Revenue Report 2014 Results,* July 2015 [online] http://www.iab.com/wp-content/uploads/2015/07/PwC_IAB_Programmatic_Study.pdf

[8] Barauskas S., Gondard P., 2016 *Google : End Of The Online Advertising Bubble,* April 19, 2016. Kalkis Research [online] https://kalkis-research.com/google-end-of-the-online-advertising-bubble

raising their fees, without the advertisers' awareness[9]. Moreover, asymmetry of information limits advertisers' knowledge of what they are actually buying. Advertisers have no other option but to trust the information about campaign performance,provided by ad agencies. And publishers, as mentioned above, do not know what they are worth and do not have enough funds to create traffic of good quality and attract real audience. The whole situation leads to lack of trust on the market.

AdLedger: A solution to problems of digital advertising

The current state of things urges for a decision, where the power of middlemen will be lower, the level of transparency will be higher and ad fraud will stop being a bane for advertisers. Present trends show that the market is held in hands of 10 middlemen, which altogether account for 75% of online advertising, and all players have nothing to do but follow their rules[10].

In order to restore trust of advertisers and publishers, the market requires a new protocol, where parties will operate independently from each other, will be free to select the conditions on which they are ready to work and the results of their work will indicate whether or not they are trustworthy parties.

AdLedger offers a solution that allows advertisers reduce middlemen fees to 5% and have all impressions checked by anti fraud systems with the help of blockchain.

Blockchain technology is suitable for advertising because it helps to:

- Reduce costs of advertising

By concluding direct contracts with publishers, middlemen services will start working as it was initially planned

Currently the costs of advertising look as follows:

Figure 2: Allocation of Revenues between Publishers and Advertisers

Source: IAB[11]

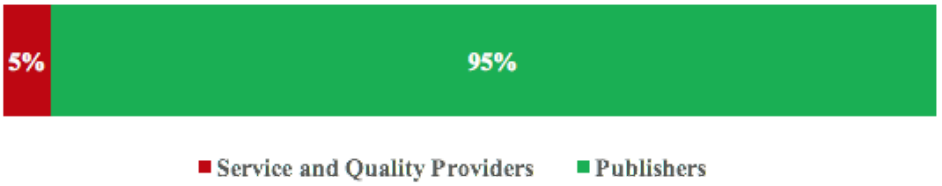
AdLedger protocol allows to allocate costs in a way that will allow publishers get 95% and the remaining 5% will be distributed between service companies, responsible for delivering impressions and quality control services that will be in charge of controlling the quality of clicks and impressions.

Figure 3: Allocation of Revenues between Publishers and Advertisers with AdLedger

[9] Barauskas S., Gondard P., 2016 Google : End Of The Online Advertising Bubble, April 19, 2016. Kalkis Research [online] https://kalkis-research.com/google-end-of-the-online-advertising-bubble

[10] IAB PwC, 2017 *IAB Internet Advertising Revenue Report 2016 Full Year Results,* April 2017 [online] https://www.iab.com/wp-content/uploads/2016/04/IAB_Internet_Advertising_Revenue_Report_FY_2016.pdf

[11] IAB PwC, 2015 *IAB Programmatic Revenue Report 2014 Results,* July 2015 [online] http://www.iab.com/wp-content/uploads/2015/07/PwC_IAB_Programmatic_Study.pdf



The model of cost allocation described above automatically reduces online advertising costs for advertisers because the reduction of middlemen fee will allow to reduce the initial bid price, however the income of publisher will still be higher.

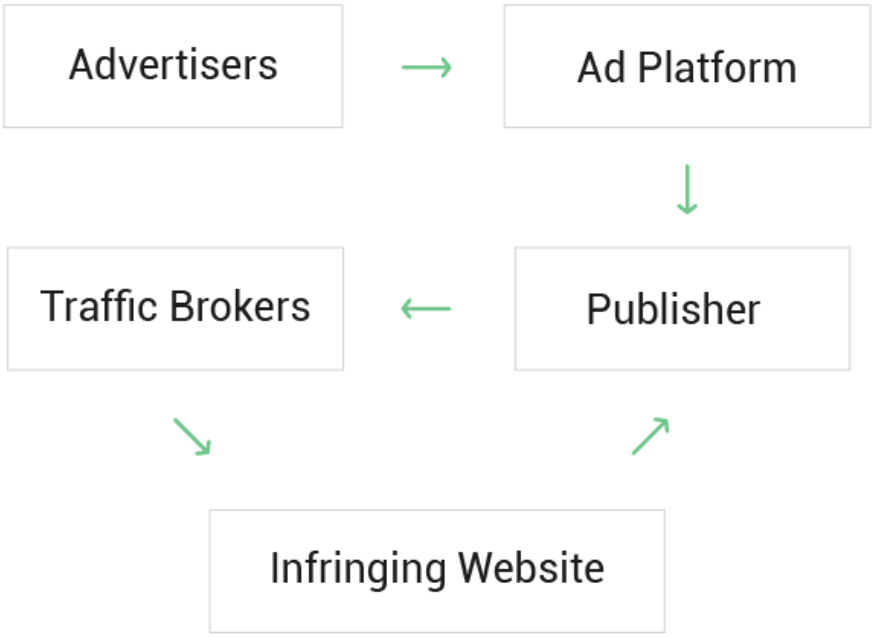
- Combat ad fraud

The ecosystem of digital advertising is complex now. There are more and more intermediaries taking part in the process and knowledge of advertisers of where they get traffic from is very limited.

Moreover, the publishers, willing to increase their audience, use services of traffic brokers and get visitors of poor quality from unknown sources. This process is usually referred to as traffic arbitrage. Traffic arbitrage, is when you buy traffic for your website at a low price so you can sell it to another firm at a higher price[12]. That indicates that not ad networks or advertisers, but also publishers are unaware of what audience they get.

Currently ad fraud is happening as described below (Figure 4):

Figure 4: How Ad Fraud is Happening



Source: Kalkis Research[13]

[12] Anon. Understanding Traffic Arbitrage: 10 Things You Should Know. [online] http://clicktapconvert.com/understanding-traffic-arbitrage-10-things-should-know/

[13] Barauskas S., Gondard P., 2016 *A Real Life Example of Google's Implication in Ad Fraud and Traffic Laundering,* May 11, 2016. Kalkis Research [online] https://kalkis-research.com/real-life-example-google-implication-ad-fraud-traffic-laundering

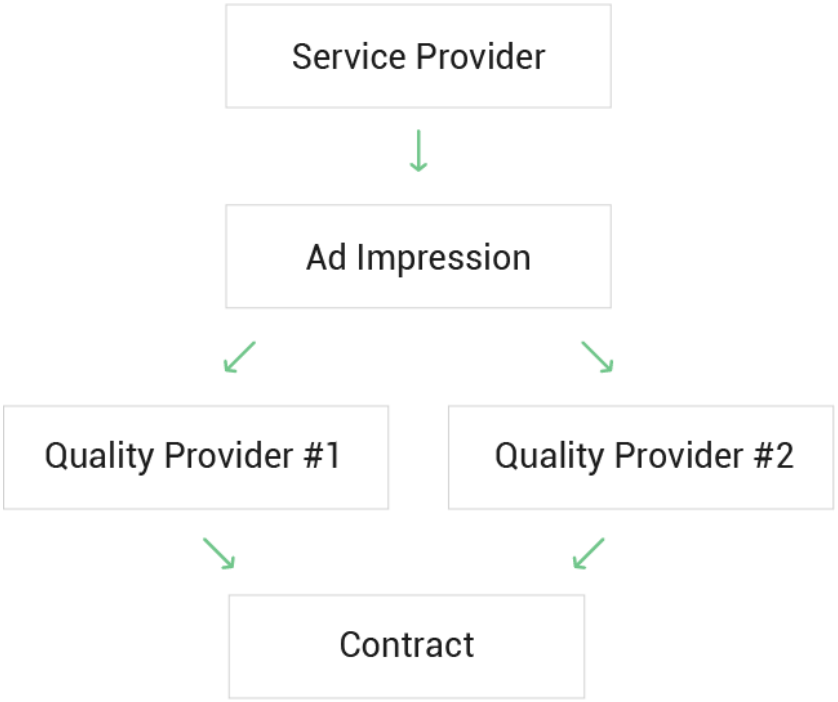
A scheme described above is a very simplified depiction of how the traffic fraud occurs. There are following steps in the process:

1) Advertiser creates a campaign in the ad network.
2) Publishers show the ads to the audience they have and get clicks and impressions for that.
3) Willing to generate more revenue, publishers use services of ad brokers and buy traffic from unknown sources at a cheap price.
4) Traffic brokers cooperate with infringing websites that are never approved by major ad networks, and the ads of publishers is displayed on those websites.
5) Fraudulent traffic from infringing websites is sent to publishers. As a result, the ads of advertisers get fraudulent clicks and impressions including bot traffic.

Naturally all major advertising companies have their own statements regarding fraud and take appropriate measures against that. However, these measures usually come down to banning shady websites, rather than controlling the sources, from which legitimate websites get traffic.[14]

The reduction of fraud may be achieved by advertisers if they hire an anti-fraud company. Still this is only a partial solution to this problem, because one anti-fraud company is unable to detect all bogus traffic, especially taking into account that new fraud types appear every day. Hence, traffic should be analyzed from few different angles.

Figure 5: Combating Ad Fraud with AdLedger



[14] Lohmann F., 2013. *Report: How Google fights piracy,* September 10, 2013. [online] https://publicpolicy.googleblog.com/2013/09/report-how-google-fights-piracy.html

AdLedger offers the evaluation of traffic quality based on consensus of fraud filters (Figure 5). Even within a single ad campaign advertiser will have an opportunity to select several fraud filters to check ad impressions either simultaneously or consecutively.

- Evaluate parties to the system

When starting an ad campaign with an ad network, or even directly with a particular publisher, advertisers are usually buying a cat in the sack, because they are unaware of what quality the traffic is. It may be so that the website looks credible, has very good content, but half of its audience, or even more, is referred from unknown sources.
As a solution to credibility, AdLedger offers to evaluate the market players. Each participant of the system will have a rank, resulting from performance in previously concluded contracts. The ranks will be stored on blockchain and will be open to everyone. They will depend on criteria, laid down in the table below:

Table 1: Criteria for ranking parties

Participant	Criteria
Publisher	- Total volume of traffic served - Number of quality providers that have analyzed traffic - Evaluations by quality providers - Total number of advertisers and ad campaigns that were run on website - Number of advertisers' complaints on traffic quality
Advertiser	- Total ad budgets - Total number of quality providers used - Total number of ad campaigns ordered - Total number of publishers involved
Service Provider	- Total volume of traffic served - Number of quality providers that have analyzed the traffic - Complaints from other parties to contracts
Quality Provider	- Total volume of traffic analyzed - Total number of advertisers, that have used the service - Total number of publishers analyzed - Complaints from advertisers on the results of evaluation - Complaints of other quality providers involved in analysis of the same traffic

The Technology

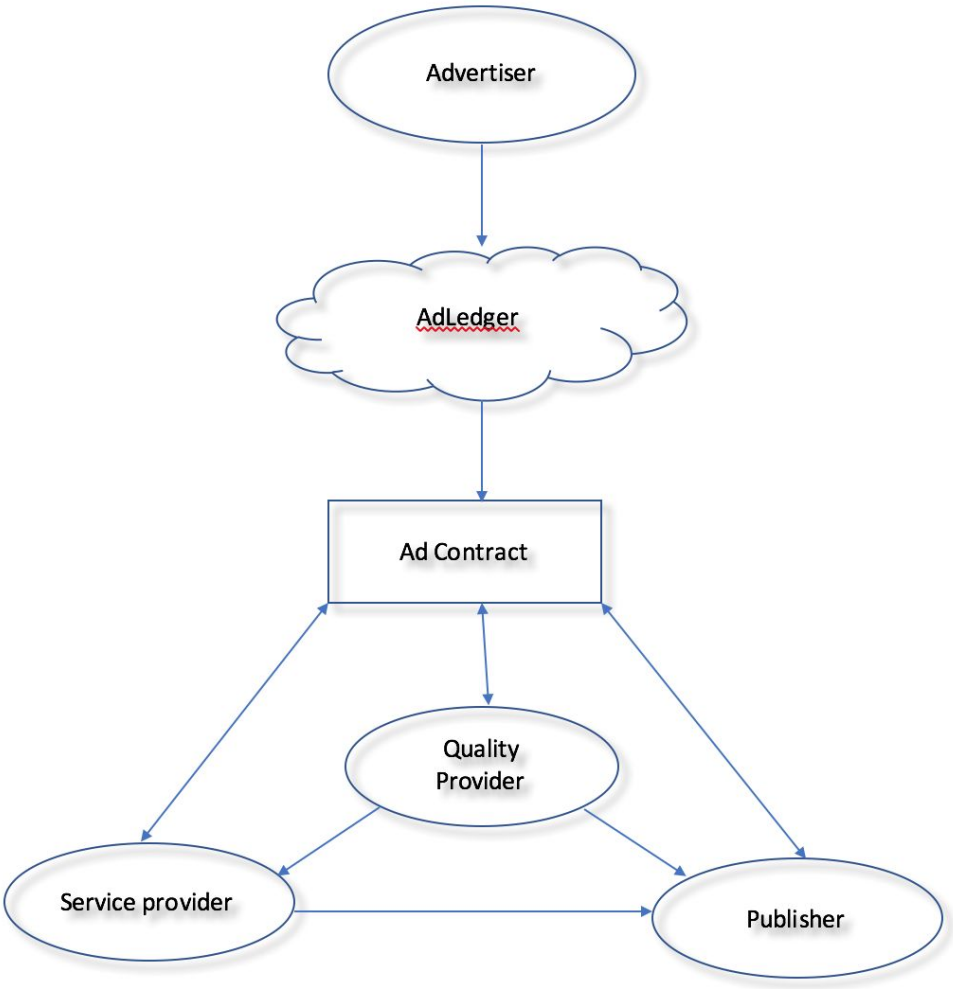
AdLedger will operate as a platform responsible for making contracts as well as the contract itself, responsible for gathering and proceeding statistics and ranks.

AdLedger Fabric is a distributed ledger of data on authorization, contracts and it may create new contracts and close the old ones. Anyone can conclude a contract with AdLedger Fabric. However two types of such contracts may be distinguished:

- Safe (should have quality provider involved in the advertising process. The quality provider status can be gained as a result of consensus decision of existing parties. These principles shall be described below).
- Unsafe (may be concluded by any party at any period of time. Shall be used only for the purpose of execution and transfer of funds and will not be taken into account when defining a rank of any party)

The protocol will work in the following way:

Figure 6: AdLedger Ecosystem



Advertisers create a contract in a partnering ad platform or by using their software. In the contract they are free to select any publishers they want to work with, any service provider

and any or few quality providers. Advertisers also select targeting settings of their preference, pricing model and the bid. All parties that were mentioned in the contract also see it and decide whether to accept or deny it.
As long as the contract has been accepted by all parties, the advertising campaign starts. Impressions are shown on publisher websites, mentioned in the contract. The task of service provider in the process is to deliver statistics and serve the impressions in accordance with the settings of advertisers. Quality providers are responsible for checking the traffic served and making reports on its quality. The contract may have one or few quality providers that will check the traffic through different filters. The more quality providers are involved in the contract, the more accurate the evaluation of traffic is. Traffic quality may be checked either simultaneously or consecutively, depending on the settings selected by advertisers. As soon as the contract is finished it and provided that advertisers have no claims to its fulfillment, the contract is marked as completed.
In the end of this process every participant gets a rank in the system. These ranks will be open for anyone. Any user will have a possibility to have a look at the history of ratings after each contract as well as the average evaluation.

Defining the rank
Rank will be represented as a real number between 0 and 100. Players start off from the rank equal to 1 and it will be easy for them to reach out some decent level when beginning the campaign for the first time. Later, increasing rank will require much more effort and good reputation as a result of fulfillment of previous contacts, what will promote the players to be honest and reliable. On the other hand, complains from other parties cause quick rank depreciation, what would make the fraud and manipulation within the network inefficient. It means that the “good reputation” will tend the rank asymptotically to 100, but the “bad one” to 0.
Having that, the rank function will be modelled as the piecewise exponential and linear functions combination:

$$F(X) = \begin{cases} e^{k_1 X} & X \leq 0 \\ linear & 0 < X < \alpha \\ 100(1 - e^{k_2 X}) & X \geq \alpha \end{cases}$$

k_1 and k_2 are positive coefficients, α-threshold depends on k_1 and k_2 such that $F(X)$ will be increasing.
X is an argument the rank value is dependent on and it can also be represented as a real function $X = f(x)$.

Naturally is to assume that the updated rank depends on the previous states, but such dependency is fading out in time. For that reason the following weighted dependency model is used:

$$f(x_n) = \left(w_0 \cdot g(x_n) + \sum_{j=0}^{k} w_j \cdot f(x_{n-1}) \right) \cdot \frac{1}{\sum_{j=0}^{k} w_j},$$

the weights w_j may be defined as $w_j = b^{-j/r}$ what describes the reducing impact effect leveraged by parameters $b > 0, r > 0$ of the past k states in the course of time. The function

$g(x)$ is the target function constructed from the Table 1, x_j are the points in history of the updated rank.
The target function can be linearly split by the constituents provided in the Table 1 with certain coefficients α_j : $g(x_n) = \alpha_1 \cdot g_1(x_{1,n}) + ... + \alpha_m \cdot g_m(x_{m,n})$.

Let's describe target function's constituents $g_j(\cdot)$ in the moment $x = x_n := x_{\cdot,n}$ for every party.

- **Publisher:**

  $g_1(x_1) = ln\left(\frac{x_1}{1000 \cdot p} + 1\right)$,

  $x_1 = x_{\cdot,1}$ is a total volume of traffic served in terms of impressions,

  p is a calibration parameter.

  For every i^{th} quality provider we can define a quadruple $\left(q_i,\ r_{q_i},\ ev_{q_i},\ c_{q_i}\right) = \left(q_i(n),\ r_{q_i}(n),\ ev_{q_i}(n,a),\ c_{q_i}(n,a)\right)$ at fixed point of time n:

  q_i is i^{th} quality provider,

  $r_{q_i} \in (0, 100)$ is a rank of the quality provider q_i,

  $ev_{q_i} \in (0, 100)$ is an evaluation value of current advertiser a by the quality provider q_i,

  $c_{q_i} \in \{0, 1\}$ is a possible complain about current advertiser a by the quality provider q_i.

  $g_2(x_2) = \frac{\sum_i q_i \cdot r_{q_i}}{\sum_i q_i \cdot 100}$,

  $g_3(x_3) = \frac{\sum_i ev_{q_i} \cdot r_{q_i}}{\sum_i r_{q_i}}$,

  $x_2 = x_{\cdot,2}$ and $x_3 = x_{\cdot,3}$ are variables dependent on the quadruple $\left(q_i,\ r_{q_i},\ ev_{q_i},\ c_{q_i}\right)$,

  $q_i \equiv 1$.

  $g_4(x_4) = ln(a \cdot x_4 + 1)$,

  $x_4 = x_{\cdot,4}$ is a total number of advertisers/ad-campaigns,

  a is a calibration parameter.

  $g_5(x_5) = C_1 \cdot C_2$,

  $x_5 = x_{\cdot,5}$ is a variable dependent on the quadruple $\left(q_i,\ r_{q_i},\ ev_{q_i},\ c_{q_i}\right)$,

  $C_1 = \frac{\sum_i c_{q_i} \cdot r_{q_i}}{\sum_i r_{q_i}}$ is a weighted complains level (dependent on rank of complaining party),

  $C_2 = abs\left(\sum_i c_{q_i}\right)$ is a total number of complains.

Therefore the target function for publisher rank evaluation can be represented as follows[15]:

$$g(x_n) = g(x_{1,n}, x_{2,n}, x_{3,n}, x_{4,n}, x_{5,n}) = \alpha_1^p \cdot g_1^p(x_{1,n}) + \alpha_2^p \cdot g_2^p(x_{2,n}) + \alpha_3^p \cdot g_3^p(x_{3,n}) + \alpha_4^p \cdot g_4^p(x_{4,n}) + \alpha_5^p \cdot g_5^p(x_{5,n})$$

$$= \alpha_1^p \cdot ln\left(\frac{x_{1,n}}{1000 \cdot p} + 1\right) + \alpha_2^p \cdot \frac{\sum_i q_i(n) \cdot r_{q_i}(n)}{\sum_i q_i(n) \cdot 100} + \alpha_3^p \cdot \frac{\sum_i ev_{q_i}(n,a) \cdot r_{q_i}(n)}{\sum_i r_{q_i}(n)} + \alpha_4^p \cdot ln\left(a \cdot x_{4,n} + 1\right) + \alpha_5^p \cdot \frac{\sum_i c_{q_i}(n,a) \cdot r_{q_i}(n)}{\sum_i r_{q_i}(n)} \cdot abs\left(\sum_i c_{q_i}(n,a)\right)$$

- **Advertiser:**

  $g_1(x_1) = ln\left(a_1 \cdot x_1 + 1\right)$,
  $x_1 = x_{\cdot,1}$ is a total ad budget,
  a_1 is a calibration parameter.

  $g_2(x_2) = \frac{\sum_i q_i \cdot r_{q_i}}{\sum_i q_i \cdot 100}$,
  $x_2 = x_{\cdot,2}$ is a variable dependent on the quadruple $\left(q_i,\ r_{q_i},\ ev_{q_i},\ c_{q_i}\right)$,
  $q_i \equiv 1$.

  $g_3(x_3) = ln\left(a_3 \cdot x_3 + 1\right)$,
  $x_3 = x_{\cdot,3}$ is a total number of ad-campaigns ordered,
  a_3 is a calibration parameter.

  $g_4(x_4) = ln\left(a_4 \cdot x_4 + 1\right)$,
  $x_4 = x_{\cdot,4}$ is a total number of publishers involved,
  a_4 is a calibration parameter.

The target function for advertiser rank evaluation:

$$g(x_n) = g(x_{1,n}, x_{2,n}, x_{3,n}, x_{4,n}) = \alpha_1^a \cdot g_1^a(x_{1,n}) + \alpha_2^a \cdot g_2^a(x_{2,n}) + \alpha_3^a \cdot g_3^a(x_{3,n}) + \alpha_4^a \cdot g_4^a(x_{4,n})$$

$$= \alpha_1^a \cdot ln\left(a_1^a \cdot x_{1,n} + 1\right) + \alpha_2^a \cdot \frac{\sum_i q_i(n) \cdot r_{q_i}(n)}{\sum_i q_i(n) \cdot 100} + \alpha_3^a \cdot ln\left(a_3^a \cdot x_{3,n} + 1\right) + \alpha_4^a \cdot ln\left(a_1^a \cdot x_{4,n} + 1\right)$$

- **Service Provider:**

  $g_1(x_1) = ln\left(a_1 \cdot x_1 + 1\right)$,
  $x_1 = x_{\cdot,1}$ is a total volume of traffic served,
  a_1 is a calibration parameter.

  $g_2(x_2) = \frac{\sum_i q_i \cdot r_{q_i}}{\sum_i q_i \cdot 100}$,
  $x_2 = x_{\cdot,2}$ is a variable dependent on the quadruple $\left(q_i,\ r_{q_i},\ ev_{q_i},\ c_{q_i}\right)$,
  $q_i \equiv 1$.

Similarly as for every i^{th} quality provider we defined a quadruple $\left(q_i,\ r_{q_i},\ ev_{q_i},\ c_{q_i}\right)$, we can define a triple consisting of ("party","rank","possible complain"):

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[15] Note that *superscript "p" in formulae is not a power, but an index refers to "publisher". The same holds thereafter for "a" - "advertiser", "s" - "service provider", "q" - "quality provider".*

for publishers - $(p_i,\ r_{p_i},\ c_{p_i}) = (p_i(n),\ r_{p_i}(n),\ c_{p_i}(n,s))$ and advertisers - $(a_i(n),\ r_{a_i}(n),\ c_{a_i}(n,s))$ [16]. Then in the same way as above we can get the pairs quantifying the complains (C_1^p, C_2^p), (C_1^a, C_2^a), (C_1^q, C_2^q):

$g_3(x_3) = C_1^p \cdot C_2^p + C_1^a \cdot C_2^a + C_1^q \cdot C_2^q$,

$x_3 = x_{\cdot,3}$ is a variable dependent on the tuples $(q_i,\ r_{q_i},\ ev_{q_i},\ c_{q_i})$, $(p_i,\ r_{p_i},\ c_{p_i})$, $(a_i,\ r_{a_i},\ c_{a_i})$.

The target function for service provider rank evaluation:

$$g(x_n) = g(x_{1,n}, x_{2,n}, x_{3,n}, x_{4,n}) = \alpha_1^s \cdot g_1^s(x_{1,n}) + \alpha_2^s \cdot g_2^s(x_{2,n}) + \alpha_3^s \cdot g_3^s(x_{3,n})$$

$$= \alpha_1^s \cdot ln\left(a_1^s \cdot x_{1,n} + 1\right) + \alpha_2^s \cdot \frac{\sum_i q_i(n) \cdot r_{q_i}(n)}{\sum_i q_i(n) \cdot 100}$$

$$+ \alpha_3^a \cdot \left[\frac{\sum_i c_{p_i}(n,s) \cdot r_{p_i}(n)}{\sum_i r_{p_i}(n)} \cdot abs\left(\sum_i c_{p_i}(n,s)\right) + \frac{\sum_i c_{a_i}(n,s) \cdot r_{a_i}(n)}{\sum_i r_{a_i}(n)} \cdot abs\left(\sum_i c_{a_i}(n,s)\right) + \frac{\sum_i c_{q_i}(n,s) \cdot r_{q_i}(n)}{\sum_i r_{q_i}(n)} \cdot abs\left(\sum_i c_{q_i}(n,s)\right) \right]$$

- **Quality Provider:**

$g_1(x_1) = ln(a_1 \cdot x_1 + 1)$,

$x_1 = x_{\cdot,1}$ is a total volume of traffic analyzed,

a_1 is a calibration parameter.

$g_2(x_2) = \frac{\sum_i a_i \cdot r_{a_i}}{\sum_i a_i \cdot 100}$,

$x_2 = x_{\cdot,2}$ is a variable dependent on the triple $(a_i,\ r_{a_i},\ c_{a_i})$,

$a_i \equiv 1$.

$g_3(x_3) = \frac{\sum_i p_i \cdot r_{p_i}}{\sum_i p_i \cdot 100}$,

$x_3 = x_{\cdot,3}$ is a variable dependent on the triple $(p_i,\ r_{p_i},\ c_{p_i})$,

$p_i \equiv 1$.

$g_4(x_4) = C_1^a \cdot C_2^a$,

$x_4 = x_{\cdot,4}$ is a variable dependent on the triple $(a_i,\ r_{a_i},\ c_{a_i})$,

$g_5(x_5) = C_1^q \cdot C_2^q$,

$x_5 = x_{\cdot,5}$ is a variable dependent on the quadruple $(q_i,\ r_{q_i},\ ev_{q_i},\ c_{q_i})$

The target function for quality provider rank evaluation[17]:

$$g(x_n) = g(x_{1,n}, x_{2,n}, x_{3,n}, x_{4,n}, x_{5,n}) = \alpha_1^q \cdot g_1^q(x_{1,n}) + \alpha_2^q \cdot g_2^q(x_{2,n}) + \alpha_3^q \cdot g_3^q(x_{3,n}) + \alpha_4^q \cdot g_4^q(x_{4,n}) + \alpha_5^q \cdot g_5^q(x_{5,n})$$

[16] "s" is a reference to current service provider

[17] "a" is a reference to current advertiser, "q" is a reference to current quality provider

$$= \alpha_1^q \cdot ln\left(a \cdot x_{1,n} + 1\right) + \alpha_2^q \cdot \frac{\sum_i a_i(n) \cdot r_{a_i}(n)}{\sum_i a_i(n) \cdot 100} + \alpha_3^q \cdot \frac{\sum_i p_i(n) \cdot r_{p_i}(n)}{\sum_i p_i(n) \cdot 100} + \alpha_4^q \cdot \frac{\sum_i c_{q_i}(n,q) \cdot r_{q_i}(n)}{\sum_i r_{q_i}(n)} \cdot abs\left(\sum_i c_{q_i}(n,a)\right)$$

$$+ \alpha_5^q \cdot \frac{\sum_i c_{q_i}(n,q) \cdot r_{q_i}(n)}{\sum_i r_{q_i}(n)} \cdot abs\left(\sum_i c_{q_i}(n,a)\right)$$

In the beginning, the rank allows participants to reach certain level quickly. After that gaining every point to the rank will become much harder what will encourage the players to value their current state continuing to provide high quality services. All sorts of manipulation inside the network would not be efficient if any counterparty starts to complain. That effect can be achieved by calibration of parameters so that the arisen penalty induces heavily depreciation of the rank value and the tag of “bad reputation” will appear in history. More ranked players will have stronger impact while complaining or evaluating the other parties. It means that the players regulate each other what imposes them to follow the rules striving to provide a high quality service.
Such handy classification will show the real situation within the network making it autoregulated and efficient. The future development assumes automation of rank function parameters calibration so that the effectiveness of the rank evaluation system constantly improves.

Participating in the system
The protocol shall be open for everyone, and there will be no restrictions if publisher, advertiser or service provider wants to join it. However, in case with quality providers, verification will be needed to join the system.
A new quality provider will have to be verified by at least 3 other quality providers, that are already parties to the system. First quality provider will be BitMedia, and the second and third one will have to be approved by it. Later, anyone will be entitled to approve other candidates.
However, parties may also deny in access to the protocol. In this case, there should be more approvals of the quality provides. For instance, if a quality provider has 1,2 denials and 3 approvals, then he can be approved. If there are 3 or more denials, then the same amount of approvals +1 is needed.
This procedure is needed to reduce the possibility of manipulations with ranks or with traffic quality in AdLedger and also make it inefficient.

Roadmap
Aug 2014 - Started Developing BitMedia Ad Server
Dec 2014 - Ad network serving about 5k impressions/minute
Sep 2016 - Ad network serving about 25k impressions/minute
Jan 2017 - Started the idea development of decentralized ad network based on contracts
Jul 2017 - First AdLedger WhitePaper Draft
Sep 2017 - Launched AdLedger Website
Oct 2017 - AdLedger alpha contract release
Nov 2017 - AdLedger demo and first contracts
Dec 2017 - AdLedger token sale phase 1
Feb 2018 - AdLedger beta release of protocol
Mar 2018 - Integration with early-adopters ad services
May 2018 - AdLedger token sale phase 2
June 2018 - AdLedger token listing
Aug 2018 - AdLedger brand awareness
Dec 2018 - Step into global ad space, proceeding with integration

Competitive Landscape

Currently there are few companies developing blockchain based projects for digital advertising. The main problems that these companies have defined and are trying to solve are:

- ad fraud;
- consumers' privacy;
- poor campaign results reporting;
- high middlemen fees;

Company name	*General description of the idea*	*Limitations*
AdEx	In AdEx it was planned that users will have their profiles stored on blockchain and will have control over the ads shown to them. In accordance with their point of view, it will improve targeting options.	● Too much information to store on blockchain; ● Users will not be interested to create a profile for themselves and select the ads they would like to be shown.
Brave (Basic Attention Token)	The idea of BAT is making a browser that would measure users' attention and block agressive ads.	● No information regarding the ways publishers and advertisers may interact with each others; ● High level of competition on the market, hence, attracting audience will be very difficult; ● No clear anti-fraud solution.
AdChain	AdChain plans to establish a database of publishers with specific domains. Thess domains will indicate that the source is validated by AdChain. Members of the blockchain will be responsible for the control over the quality of traffic and approval of publishers.	● No metrics for defining fraud were outlined; ● Probability that the principle of consensus will not be used objectively; ● Protocol is limited to specific number of publishers, approved by the chain.
qChain	qChain strives to improve communication between publishers and advertisers and enable advertisers to work with separate publishers, not with ad networks and as a result reduce fees of intermediaries.	● Communication with each publisher does not have any sense for advertisers with medium and big budgets; ● Problem of ad fraud is not taken into account.

All of these platforms provide cumbersome solutions to the problems they have raised. Some try to create a new product on the old market and some solutions are too difficult to

implement in real life. AdLedger is not trying to reinvent the wheel. We want to change the existing order of things and not force people to using another alternative to already existing things.