A1 Exchange

Arweave Analysis

May 25, 2019

Version 1.0.0

1 Overview

Arweave (AR)

Arweave connects miners with spare disk space to users that need permanent data storage. The platform provides provably dependable on-chain storage with its novel consensus algorithm named "Proof of Access".

Any data such as a web page archive or a PDF document could be stored forever on Arweave. Arweave could also host static or dynamic web applications.

Website
arweave.org

Paper
arweave.org/files/arweave-lightpaper.pdf

Explorer
viewblock.io/arweave

Blockchain
Arweave

Consensus Mechanism
Proof of Access & Proof of Work

Algorithm
SHA-256

Genesis Date
June 8, 2018

Maximum Supply
66,000,000 AR

Current Supply
66,000,000 AR including locked tokens

2 Summary

Arweave is a new on-chain storage platform, designed to overcome the scalability, data availability and cost issues that exist in on-chain data storage.

Arweave's mission is to create a permanent, decentralized and uncensorable information archive on the internet. This separates Arweave from most blockchain storage solutions. As the team puts it Arweave is meant to be a "browsable sister network to the internet". [1]

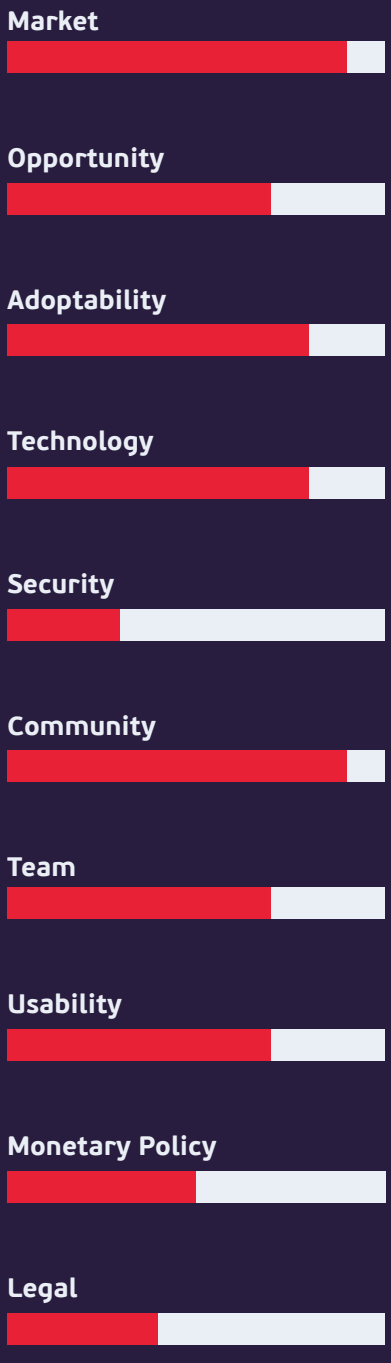
The project went for an initial coin offering (ICO) in June 2018. Arweave is running since June 2018 as well. There are now over 200 thousand blocks mined on its mainnet.

Although Arweave is still under heavy development, it is a usable product right now. To demonstrate a use case for the project, we have archived most of the references in this paper on Arweave, including the reference to its lightpaper above.

In order to be able to store data and run web applications on it forever, the project introduces a couple of novel technologies. These are examined meticulously throughout this document.

Arweave has earned above average scores from all analysis sections except security and legal. It is a promising project, but comes with some risks. Nevertheless, the project earned an A1 Rating of BBB even with the drawback of these two below average section scores.

A1 Rating: BBB



3 Analysis

3.1 Market

What does this project aim to solve? Why will people use it? If they have competitors who are they and how do they compare to this project?

Infrastructure for a truly permanent information archive is a problem that is yet to be solved. Information in any form or medium is subject to potentially irreversible loss. While current centralized data storage solutions are able to provide efficient and cheap service, the ephemeral nature of the data that's being hosted is still there. This boils down to a couple of fundamental issues regarding the data that is hosted on current centralized solutions such as Amazon S3, Dropbox or Google Drive:

- Single point of failure
- Alterations or modifications of the data
- Censorship

These problems combined create a lack of permanent, trustless and censorship free data archival solution on the internet.

Arweave was designed to overcome these problems in such a way that:

- It does not have to compete with established protocols such as HTTP.
- It is able to create a redundant and cheap environment to permanent data storage and retrieval.
- It is decentralized and trustless by design.

By designing a solution that is low cost, requires no maintenance and is permanent, Arweave is building what they call "the Permaweb". [2]

In the Permaweb, users could store files, web pages, and web apps permanently and publicly. Combined with strong client-side encryption, private data could be stored on the Permaweb as well.

Even if the Permaweb allows hosting interactive content as well, we decided to assess only cloud storage as Arweave's target market. However, this is a huge market in itself. According to a report by Markets and Markets, the total cloud storage market was USD 25.1 billion in 2017 and was expected to grow to USD 92 billion by 2022.[3] It would be wrong to assume that Arweave targets the entire cloud storage market. We think its strongest vertical would be permanent cloud storage.

It is harder to find information regarding the permanent cloud storage market. A startup called Forever is offering permanent storage of photos. It was founded in 2012 and raised at least USD 17.6 million in two funding rounds. [4] The startup seems to be displaying healthy growth, employing a team of 55 people in March 2018.

Another comparison that could help assess the market value of permanent cloud storage is the non-profit "Internet Archive: Wayback Machine" service. The service has been online since 1996. According to their latest publicly available 2017 IRS Form 990, they were storing 35 Petabytes, averaged more than 1,000,000 daily users and acquired USD 17.8 million in revenues.[5] The Internet Archive is globally ranked as the 239th most popular website by Alexa, with 19.2 million unique US visitors reported. [6]

A similar blockchain project Filecoin raised USD 205 million for its ICO on top of USD 52 million from reputable investors back in 2017.[7] These examples could help evaluate investor expectations from a blockchain based file storage service.

3.1.1 Competition

The goal of Arweave is to build a decentralized and permanent storage layer on top of the internet, not replace it entirely. Since Arweave is a unique project, it doesn't have direct competitors. However, we will compare it to similar classes of solutions.

Centralized Cloud Storage Services: Centralized storage is arguably cheap and fast. This is mostly due to the sheer power and capital of the companies that provide these services. For example, Amazon has dozens of data centers all across the globe, allowing reliable and low latency access to data at a cheap cost. [8]

Having the necessary tools to compete with such giants is an absolute must. While permanent and trustless data storage are important selling points, in the real world, people will always have a tendency to use the easiest and cheapest solution. Arweave tries to address this problem by building a mechanism that allows data to be permanently stored at low-costs while enabling free and fast retrieval of data.

In a world where most people have little regard for concepts like "privacy" or "decentralization", projects must align their design to work well with the status-quo. On the other hand, however small it may be, there is a market for these features as well. [10]

Permanent Cloud Storage and Archival Services: Services such as Forever and Internet Archive are almost indefinite cloud storage services. Arweave has a few advantages over such services:

- It is decentralized. The service is less likely to become unavailable due to legal or sustainability issues.
- The content is less likely to be removed on a case by case basis.
- It allows any kind of data, albeit with a size limit.

Data Archiving: Existing solutions have no guarantees that data won't be lost or destroyed. Arweave is able to act as a permanent archive for data to be stored safely. This is an extremely valuable tool in many fields. Arweave points out to three of these potential areas:

- Legal: 50% of U.S Supreme Court opinions contain dead links.[11]
- Journalism: Sources may disappear from the web. [12]
- Research: 98.4% of links don't work after 20 years. Verifiable research is possible by archiving web citations on Arweave. [13]

Decentralized Storage Solutions: Decentralized storage technologies such as IPFS, Filecoin, Sia Tech and Storj could be considered as competition to Arweave in decentralized storage of information. [15] [16] [18] [17] In the context of storage services, Arweave differs from these projects via its payment model. IPFS is free to use but IPFS nodes are not incentivized to keep 3rd party data. Decentralized storage solutions on top of blockchain such as Filecoin, Sia Tech or Storj keep the uploaded data available in return of regular payments, hence they are contract based. If the incentives of miners and users are aligned, permanent solution offering of Arweave could have a market from governments to businesses, Dapps to end users.

Decentralized Web Technologies: Arweave allows hosting permanent web pages and applications just as it allows storage of files. The value proposition of this is being able to deploy permanent and uncensorable websites.

Users are able to host permanent websites on the Arweave network. Websites hosted on Arweave are able to read and write data on the blockchain, therefore enabling dynamic web applications to run on Arweave.

Some of the dynamic web applications on Permaweb are listed on ArweaveApps, which is a dynamic web application itself. [14] The list contains 10 applications on 22 May 2019 from a Q/A platform to an identity service.

There are some established decentralized censorship-resistant platforms such as Freenet, I2P, Dat and ZeroNet on the internet. [19] [20] [21] [22] These projects purpose is to protect their users and hosters anonymity. They all have their closed networks, similar to Arweave.

Arweave has the upper hand over decentralized web technologies through long term data availability. All four of the listed projects above provide availability of their popular content by caching the visited webpages on the visitor's computer. For instance, if a webpage is not visited by anyone and the hosting node shuts down, it is lost forever.

It is only possible to guarantee continuity of a webpage with an upfront payment of AR tokens, rather than the need to serve it or assume the content's popularity. A webpage hosted on the Permaweb will be available as long as the Arweave network survives.

Market Score: 9 / 10

Arweave gains a point for its unique value proposition. The huge core market for Arweave and the potential additional markets also add 1 point each. If Arweave were, in fact, to compete with existing storage solutions, decentralized or not, it has strong grounds for obtaining a place in the market, hence gains another point.

3.2 Opportunity

> Does the potential reward justifies the risk? What makes this project an opportunity for A1 Exchange right now?

3.2.1 Product-Market Fit

Even though Arweave has many potential markets, we will evaluate a potential product-market fit for storage solutions in this section.

Most established storage solutions offer cheap and fast access to data. Arweave is able to not only offer what the current market does but to offer them in a decentralized manner, which results in many more additional use cases and opportunities.

In this sense, Arweave has the potential to establish a firm position in the market, creating a wide array of new possibilities in how we store and make use of information.

Most blockchain projects don't have real solutions to their challenges and only have promises of solutions behind their complex architectures and use of buzzwords. This does not seem to be the case for Arweave. The project already addresses most of the potential challenges such as cost, reliability and security on reaching its product-market fit.

Arweave lays out a firm ground for Permaweb and its further advancement. The platform has the necessary properties to compete with existing centralized and decentralized solutions.

Opportunity Score: 7 / 10

Arweave has managed to identify real use cases and ship a working product, adding one point to its score. Despite being an early stage project Arweave has laid out solid fundamentals to build and improve upon, adding another point.

3.3 Adoptability

> How can this project reach mass adoption? Why is it appealing to the end user in terms of user experience? Is it easy to pick up or understand? Are there mechanisms in place for increasing adoption?

Arweave's focus on API's, integrations with other protocols and software is one of the key elements that drive its adoption. By enabling a convenient space for developers to focus on building alternative products and services, Arweave has the potential to increase its userbase without diverting too many resources on explaining and marketing Arweave.

Mail applications, browser plugins and many other user-oriented applications built on Arweave could potentially open Arweave to the masses. Arweave allows developers to build apps that deliver a simple and seamless user experience.

3.3.1 Barrier of Entry

It takes a couple of minutes to create a wallet and store data on Arweave. Newcomers can simply download the Arweave wallet Chrome plugin, launch their wallet and store files directly from the wallet interface.[23] The Arweave wallet offers a user-experience similar to Metamask. Users don't need to download and run executable binaries, wait to sync up with the network or spend hours trying to initialize a wallet.

Not only that getting started with Arweave is very simple, users are also incentivised to create a wallet and receive 1 AR for free. They have prevented malicious actors from earning free AR easily by applying rules on IP addresses and authenticating with a Google account. 1 AR is enough to archive around 8 megabytes, or 3 average web pages on Permaweb.

Currently, Arweave has no wallet implementations other than the official Arweave wallet Chrome plugin.

3.3.2 Mining

Mining on Arweave is also relatively easy compared to most projects. The mining software can be run on all major platforms (Windows, Linux, macOS) without any apparent issues.

The A1 research committee has tested the mining software on a Linux system. It took about roughly 5 minutes to build the software from source, and 15 minutes to join the network and start mining. There were no errors or issues raised at any point.

3.3.3 Data Archiving

Arweave offers a permanent archiving system for data. Anyone who has AR tokens can upload and store files on the Permaweb permanently. This creates opportunities for many use cases that can be built on Arweave.

3.3.4 Serverless Permanent Web Hosting

Since Arweave's protocol allows free retrieval of data, permanent websites can be hosted on Arweave without the need of additional server-costs or maintenance. This is only possible by using Arweave, any market interest on this will help adoptability of Arweave.

3.3.5 Developing Applications

It is relatively easy for developers to build and deploy applications that run on Arweave. The extensively prepared documentations allow developers to pick-up and start building applications on Arweave without hassle, not to mention the libraries and SDKs published for convenience. [24]

Arweave seems to be fully aware of how developer friendliness, 3rd party tools, and applications are indispensable components on the path to adoption. The team puts a lot of time and effort into in-house application development and encouraging others to develop on their platform. [25]

3.3.6 Integrations

The team is constantly searching and promoting new integrations via hackathons and community projects. One of the most notable ones is Zapier, a service for automating tasks. The Zapier integration for Arweave allows for non-developers to easily build applications that run on Arweave. No programming required.

Arweave has a few projects built on its platform. Some of the most notable ones are:

- Weavemail: An e-mail client built on Arweave.
- Chronolock: Proving documents existed at a point in time by "locking" it chronologically into the blockweave.
- Zapier: The Arweave integration with Zapier allows users to chain together actions on other services such as new tweets on Twitter. Arweave could trigger another service or could be triggered a service with Zapier rules.

Adoptability Score: 8 / 10

Blockchains and decentralized networks are complicated technologies such that most people don't understand them or struggle using them. In such a space, Arweave gains a point for its low barrier of entry for user onboarding. Arweave also gains a point for solving a unique problem of data loss, which could drive adoptability. An additional point is added for Arweave's ability to seamlessly integrate with existing software and services.

3.4 Technology

> What is the current progress and how does the codebase look so far? Is the technology properly outlined and explained?

3.4.1 Codebase

The Arweave codebase was built from scratch in Erlang. Erlang is a programming language that was developed by Ericsson and open sourced in 1998 [26]. While Erlang is a general-purpose language, it was designed to be the perfect tool for a software category pioneered by the telecommunications industry: Distributed and resilient applications.

Erlang excels in areas that also concerns Arweave's architecture:

- Distributed databases such as blockchains.
- High-performance web services and API services such as Arweave's APIs and developer tools.
- Long-running daemons such as mining and node software.

With features such as no-downtime updates, fail-recover schemas and lightweight processes Erlang is a solid choice for Arweave. [27]

However, there are also some aspects to Arweave where Erlang isn't very good at:

- Computation-heavy tasks such as cryptographic operations such as hashing and verification.
- String operations such as parsing, transforming data.

Arweave has worked-around these issues by adding Erlang NIFs to the project. Erlang NIFs are for calling C code in Erlang projects to remedy areas where Erlang lacks efficiency.

The pace of software development at Arweave is quite healthy. [28] Their code-base is very well structured and clean. Overall the project is very well documented with many examples and tools created for developers who want to build on Arweave.

The project's main codebase consists of:

- Arweave Server: Node, mining and wallet operations.
- App Developer Toolkit: Developer tools for building apps on Arweave.
- Arweave Testing Framework: A testing kit.

3.4.2 Proof of Access

Arweave uses a hybrid consensus model (PoW/PoA) (Proof of Work/Proof of Access) to verify blocks. Proof of Access is a novel verification method introduced by Arweave which ensures block validity while allowing a scalable on-chain storage solution. This hybrid model incorporates "Nakomoto Consensus" where finality is probabilistic.

Proof of Access was designed to negate the shortcomings of typical PoW systems, in which storing all previous blocks is required in order to generate or validate a new one. [1]

In order to form a valid blockchain structure, the PoA algorithm incorporates data from a randomly but deterministically chosen previous block, called the "recall block". Nodes do not require to store the entire blockchain except the last block and are able to participate in the network.

Miners are required to keep a dynamically set global percentage of all the blocks to be able to participate. However, miners have an incentive to store as many blocks as possible as the probability of having access to a randomly selected recall block increases as more blocks are stored.

When a miner finds a valid hash, they distribute the new block along with the recall block and the recall block's hash to the network. This enables other nodes in the network to independently verify the validity of the new block even if they do not have a copy of the recall block.

3.4.3 Blockweave

Blockweave is Arweave's blockchain data structure. As mentioned before, Arweave does not require the entire blockchain to be stored by nodes for network participation. In order for nodes to verify new blocks, a list of all previous block hashes is stored by nodes, without storing the block data itself. Alongside this information is a list of active wallet addresses. This allows nodes to verify transactions without processing the block in which the transaction was included.

This structure allows for nodes and miners to join the network and participate in mining almost immediately. It's important to note that these features are optional, nodes are able to verify the entire chain if they wish to do so.

3.4.4 Blockshadows

In traditional blockchains, whenever a new block is mined, the entire block is distributed to all the nodes in the network. This is known to significantly increase the time and work required to reach consensus in the network.

Arweave introduces "Blockshadows" to overcome such latency. Blockshadowing is a form of sharding that allows nodes to reconstruct a full block by storing a subset of the actual data. This way, peers do not have to transmit full block data in order to reach a global consensus.

3.4.5 Wildfire

Arweave's incentive design, "Wildfire", ensures fast, free and reliable access to data.

Wildfire creates a ranking system that is local to each node. This ranking system is based on how quickly and reliably data is distributed between peers across the network. Peers have an economic incentive to maintain a good rank in the network as low ranking peers are dropped from the network and cannot earn mining rewards.

As a positive side-effect, this mechanism enables the creation of a network topology that establishes the most efficient routes for global data distribution. Nodes that allow low-latency data transmission are prioritized in route selection.

3.4.6 Data Availability

An important question regarding Arweave is "How does Arweave make sure data doesn't disappear?". As mentioned before nodes are not required to store all blocks. If that's the case, what guarantees that the block containing specific data is available in the network at all times (permanency)?

Arweave's incentive mechanism is designed to ensure that nodes are financially encouraged to store as many blocks as possible in order to increase their mining power. This means that storing rare blocks is even more important as fewer nodes have access to that block. This gives nodes that have rare blocks an advantage over the nodes that don't have those blocks.

Given that:

- Replication rate is 0.5, i.e. miners are required to store some 50% of the blocks
- There are 200 miners in the network
- There are 200,000 blocks in the blockchain

The probability calculation of a single block not being available on Arweave would be: $0.5^{200} = 6.223 \times 10^{-61}$. [29] In the worst case scenario of miners randomly shuffling all of their blocks for every 10 minutes, the probability of losing a single block in a year is as low as $365 \times 24 \times 6 \times (6.223 \times 10^{-61}) = 3.27 \times 10^{-56}$. Then, probability of losing any block is 200,000 times this probability, if we assume that blocks are stored randomly by the miners: $200,000 \times 3.27 \times 10^{-56} = 6.54 \times 10^{-51}$.

To put this probability into perspective, let's have a look at Amazon's durable data storage solution. AWS Glacier is "designed to provide average annual durability of 99.999999999% for an archive". [9] A durability claim of 99.999999999% allows up to 0.000000001% probability of losing data, which is 10^{-11}.

Therefore, data on Permaweb could be at least 10^{39} times more likely to be available in a year than data on AWS Glacier. In comparison, the Sun is less than 2×10^{30} times a kilogram. [30]

3.4.7 Scalability

Arweave, by design, ensures high data availability without compromising on its scalability. Nodes can participate and verify transactions without maintaining full blocks. Nodes are able to effectively reconstruct and verify blocks with arbitrary size.

It's also important to point out Arweave's main focus isn't developing a highly scalable network. Arweave's goal is to deliver a product with an actual use case at relatively low costs. The current design supports up to 5,000 transactions per second which already puts Arweave in a better position than most blockchain networks.

Technology Score: 8 / 10

Arweave gains 1 point each from its, great technology selection, solid incentive mechanism and unique approach to network consensus.

3.5 Security

How is consensus achieved in this network? How secure is this network? What is the hash rate dispersion between miners?

Arweave uses a hybrid PoW/PoA consensus mechanism where finality is probabilistic (Nakomoto Consensus). The PoW mechanism requires CPU heavy operations and uses the SHA-256 algorithm for hashing.

A theoretical attack outlined in Arweave's whitepaper is "storage pools", where a large portion of miners collude to maintain a single copy of the blockchain which they all access to retrieve recall blocks. Arweave solves this via a clever game-theoretical design where selfish behaviour acts as a risk-offsetting function to the network. As mentioned in the Data Availability subsection of the Technology section, Arweave's design incentivizes nodes to maintain rare blocks for competitive advantage.

Similar game theoretical designs that make collusions infeasible were studied and proposed by many industry researchers. [31]

Nodes in the network are encouraged to behave friendly through the reputation mechanism in Arweave. Nodes are required to maintain a good reputation score amongst their peers in order to efficiently collect rewards from the network. On the other hand, nodes with low reputation scores are banned from the network.

3.5.1 Content Policy

In order to prevent the network from hosting illegal or copyrighted content, Arweave has a data blacklisting mechanism where nodes have the option to blacklist certain data and nodes. If a piece of data is blacklisted by more than 51% of the nodes, that data is removed from the network altogether.

This is something that might raise some questions and controversy since there's a possibility that this system might be abused or misused. It's quite obvious that there must be some sort of mechanism to prevent dangerous content. However, calling such a system "censorship-free" seems to be open for debate.

The Arweave lightpaper does not expand on this topic at the moment, only explaining how the blacklisting mechanism functions.

Security Score: 3 / 10

We deduce points due to Arweave's content policy mechanism being prone to attacks. Although Arweave's Proof of Access mechanism is a unique approach to consensus, it has not been thoroughly tested and proven to be reliable in a security context yet. Therefore we deduce another point for its unproven consensus approach.

3.6 Community

Is there a community? Who contributes to this and why? Is controlled by a corporation or is it open source? Is the team engaged with the community and do they provide timely updates?

3.6.1 Initial Coin Offering

The core team of 3 raised an ICO of USD 8.7 million in June 2018 in 4 days by hitting their target cap. The sale price was 0.73 USD per AR at the time. [32] The sale was registered in Germany. [33] US and Chinese citizens were not allowed to participate in the ICO, although no KYC was required. The team issued a whitelist sale and hand picked 1,800 participants among 30,000 applications according to their blog post after their fundraising. [34] Among them were the following institutional investors: 1kx, JD Capital, Arrington XRP Capital, KuCoin Capital, Connect Capital, iAngels, Signum, Factblock, GBIC, Bixin, Nirvana, AlphaBlock, Coefficient Ventures, Block0, Columbus, Juno Capital, 160 Capital, QCP Capital, One Block, Chainfund Capital and TLDR.

3.6.2 Community Support

Despite having a relatively small community, discourse and participation regarding Arweave and its development seems to be very active.

At the time of this writing, there are 800 members on their developer oriented Discord server, 550 followers on Medium, 3,600 followers on Twitter, but a whopping 11,000 members on Telegram.[35] [36] [37] [38]

It is best to take these numbers with a grain of salt. However, Arweave community invests in using and building on the platform. This is facilitated by the team's proactive efforts. For instance, their sponsorship of ETHParis gave fruit to 2 new projects on the platform. [39] [40]

3.6.3 Engagement

The official Medium account posts interesting content around a weekly basis. The team is active much more frequently on both Discord and Twitter.

The content they publish span from the fundamentals of their market to use cases, from technical posts to newsletters.

Community Score: 9 / 10

We add points for Arweave being a whitelisted high demand ICO. There were institutional investors involved in the ICO which adds another point. Strong community participation in developing the platform further was observed. The team seems to be handling community management pretty well, trying to help and onboard users, answering every question thrown their way. Therefore gaining 2 more points.

3.7 Team

> Who is building the project? What is their track record? Is it possible for this team to deliver on their promises?

Arweave's "About Us" page doesn't list its team members. Therefore, we had to go through their ICO records and LinkedIn profiles to list down their team.

The project is under a UK private limited company named Minimum Spanning Technologies Limited. [41]

The company was co-founded by Samuel Williams and William Jones from the UK on 28 July 2017. [42] [43] They were both computer science PhD candidates from the University of Kent at the time.

On October 2017, India Raybould joins the team as the Chief Coordinating Officer.[44]

On 8 July 2018, William Jones resigned from his role of Director from the company. On a following report from 12 September 2018, Samuel Williams has ownership of shares and voting rights of "75% or more". [41]

Out of the 5 employees listed at the time of ICO, 2 haven't mentioned Arweave on their LinkedIn, 2 left the project shortly after the ICO and only Kyle Beckles continues to be working as a developer. [45] [46] [47] [48] [49]

The project seems to have grown its team after their ICO. Apart from the people mentioned above, Arweave Linkedin company page is currently associated with 2 developers, 2 more developers also working at other places, a head of operations, a community manager, a marketing advisor and a consultant. [50] [51] [52] [53] [54] [55] [56] [57] [58]

The project was accepted to and graduated from Techstars's Berlin Branch, a prestigious seed accelerator. [59] Techstars has more than 10,000 mentors and 300,000 alumni. [60] The accelerator's acceptance rate is around 1%.[61] The CEO Samuel Williams is actively mentoring at Techstars according to his LinkedIn profile.

Team Score: 7 / 10

The project was co-founded by two computer science PhD candidates, William Jones, who earned his doctorates degree and Samuel Williams, who is currently running the project as the CEO. We add a point for the founder's academic credentials. However, we deduct a point for at least 75% of the company being controlled by one person. The Arweave team is relatively diverse and crowded which adds another point. The project also successfully graduated from the Techstars accelerator program, providing them with strong networking opportunities, therefore awarding another point.

3.8 Usability

> Does the project represent something of value? Why would people use it? How easy is it to use?

Arweave uses its native currency Arweave token (AR) as a medium of exchange inside the Arweave network. The token derives value from its utility within the network. These utilities include submitting information to the Arweave blockchain, rewarding miners for maintaining and securing the network and disincentivizing the propagation of spam. Therefore, Arweave token mechanics are designed to represent the value of the Arweave network and its utility within the network.

3.8.1 Permanent Data Storage

Users require to pay in AR to store data on the Arweave blockchain. These payments are then rewarded to the miners that store and maintain the data through a reward pool. However, querying and retrieving data from the network is free of charge.

3.8.2 Simplicity

Using Arweave to store and query data is very simple and requires no understanding of the technical background. Users can simply install the Arweave Chrome extension, which acts as a wallet and an interface to the Arweave network. Data can be pushed to the Arweave network in a matter of minutes using the simple and well-designed interface. There isn't any lengthy wait required such as a complicated setup or network synchronization.

Usability Score: 7 / 10

Arweave displays a solid value proposition and firm reasoning behind its design, gaining 1 point. Arweave is very simple and easy to use, providing a seamless user experience, which adds another point.

3.9 Monetary Policy

How much of the supply is controlled by the founders? How dispersed is the economy? How inflationary or deflationary is the economic model?

3.9.1 Token Distribution

The Arweave network has a fixed supply of 66,000,000 tokens. The team conducted an ICO with a hard cap of USD 8.7 million, which is rather low compared to most ICO projects.[32] The project had a single seed investor and additional investments from multiple organizations during the public ICO, in which the hard cap goal was met.

The token price during the ICO was 1 AR = USD 0.73.

Arweave's ICO phase token distribution is as follows:

- Seed Sale 10.8%
- Strategic Sale 7.1%
- Private Sale 19.5%
- Public Sale 1.1%
- Advisers 2.9%
- Team 13.0%
- Ecosystem 19.1%
- Reserve 26.5%

The tokens reserved to the team is locked for 5 years with the vesting of 20% every year, meaning 20% of the locked tokens are released every year for 5 years. The first batch of team tokens will be unfreezed on June 2019 according to this claim.

3.9.2 Economic Assumptions

Arweave does not have a fixed rate of block rewards. When data is pushed on the Arweave network, the storage fee is added to the reward pool, which is then distributed to the miners at each block.

If the storage prices stay the same, no new data is being stored on the Permaweb, and the value of AR would drop, there would be no miners running Arweave forever. There must be some assumptions made to claim that what is sent to Arweave will stay on Arweave forever. However, from our limited research, these vital assumptions are not clear.

The team is eager to distribute rewards reserved to builders and pioneers. These pioneers put their efforts toward getting Arweave running and growing by building applications on Arweave, developing software tools or finding new use cases.

Monetary Policy Score: 5 / 10

The assumptions for the longevity of the platform are not properly outlined and explained, we deduce a point for the lack of transparency in this regard. Tokens reserved to the founders are locked with vesting periods, we have added a point for this investor protection measure.

3.10 Legal

How does it look from a legal perspective? Is it possible for governments or authorities to crack down on this? Would the legal establishments support or hinder the project?

As with all permissionless systems, Arweave does not have direct control or oversight over the data that's stored on the network. Although the liabilities and legal conjectures remain unclear at the moment, Arweave nodes have the ability to blacklist certain data and malicious peers. This means that nodes are free to choose the data they are hosting on their drives. As mentioned in the Content Policy subsection of the Security section, if the majority of the network rejects hosting certain data, that data is democratically removed from the Arweave network for good.

However, the mere risk of storing some blocks with illegal content could hold back some nodes and miners. To put things into perspective, researchers from RWTH Aachen University found that 274 of the 1,600 files stored on the Bitcoin blockchain contained illegal content. "Our analysis shows that certain content, eg, illegal pornography, can render the mere possession of a blockchain illegal,". "Although court rulings do not yet exist, legislative texts from countries such as Germany, the UK, or the USA suggest that illegal content such as [child abuse imagery] can make the blockchain illegal to possess for all users." [62]

Legal Score: 4 / 10

The issue regarding, hosting illegal data poses legal liabilities for nodes and the platform. Although this is a common issue in permissionless networks, Arweave's main selling point is hosting data at low costs and providing reliable access to data which is at risk of being negated by these types of problems. Therefore we deduce a point.

4 Conclusion

A1 Rating: BBB

A1 Ratings are determined by following our methodology described in the next section.

Breakdown of the scores and their arithmetic average is provided below:

Section	Score
Market	9
Opportunity	7
Adoptability	8
Security	3
Technology	8
Community	9
Team	7
Usability	7
Monetary Policy	5
Legal	4
Average	**6.7**

Averaging all the scores of Project, we arrive at a numeric A1 Rating of 6.7, which corresponds to an A1 Rating of BBB.

Listing

A1 Rating of BBB allows a project to be listed on A1 Exchange.

Consequently, A1 Exchange has decided to list Project on AR / BTC market.

Analysis Versions

This analysis has been published on May 25, 2019.

Updated versions of this analysis will be made available on `http://a1.exchange/analyses/arweave`.

All versions of this analysis could be retrieved from the following repository: `https://github.com/A1Exchange/a1-exchange-analyses`

5 Methodology

A1 Exchange research committee analyses cryptocurrency projects for listing the deserving ones on A1 Exchange. To be able to select the projects with the highest potential benefit to A1 Exchange, we follow standardized procedures, as described in this section, to ensure consistent analyses and ratings. Our methodology is developed to be systematic, and rigorous to maintain the high quality of A1 Exchange analyses and their comparability across different projects.

To fulfill our commitment to transparency to our users, and to get feedback on our decision making, we publish these reports with the public.

5.1 Resources

The analysis process starts by obtaining information about the project. The projects considered for A1 Exchange are usually in their early stages, which makes it difficult to find objective secondary resources on them if any. Therefore the research committee usually consumes primary resources while preparing analyses.

Primary resources mostly consist of papers and content written by the project team.

These resources may include public conversations on Telegram, Discord, Slack, Gitter, and email groups. In case the resource of a public conversation used in the analysis could not be referred through a URL, the citations include the relevant quotations with the available information such as channel name and date.

In many cases, we are forwarding our questions to the team of the project or other parties. These conversations could affect the analyses, but not cited unless explicitly allowed.

The research committee conducts a reasonable investigation of data accuracy and fact-checking. However, to a certain extent, A1 Exchange relies on information it receives from sources to be credible.

5.2 Analysis Topics

Projects are rated under the following topics: Market, Opportunity, Adoptability, Security, Technology, Community, Team, Usability, Dilution, and Legal. These topics are determined to cover all aspects for a project to be worthy of being listed on A1 Exchange.

Projects are given a rating for each analysis topic. These ratings are used to calculate A1 Rating and A1 Exchange's decision on listing the project.

Each topic rating starts at a baseline rating of 5 and goes up or down from there. A rating of 5 is average. Any rating above 5 should be considered above average, whereas only ratings below 5 are below average.

Ratings are decided unanimously by the research committee and explained in detail for how they vary from the baseline under their topics.

5.3 A1 Rating

A1 Exchange rates projects with the following letter ratings: AAA, AA, A, BBB, BB, B, CCC, CC, C, D, and E. These ratings correspond to number ratings from 10 to 0. Since obtaining a rating of 10/10 or even 9/10 is very unlikely for a project in our rating methodology, A1 Ratings are given as letter ratings.

A1 Rating is calculated by taking the mean average of the ratings from analysis topics and rounding the average using half round up method to the nearest integer. Then, A1 Rating is derived from the integer numeric rating.

Only if a project's A1 Rating is AAA, AA, A, or BBB, the project is eligible to be listed on A1 Exchange.

As with everything else in A1 Exchange analyses, A1 Ratings do not constitute investment advice. For more information, read the **Important Disclaimers** section below.

5.4 Updates

A1 Exchange ratings are typically monitored on an ongoing basis. We accept feedback and recommendations for our analyses. Feedback for our analyses through our public GitHub repository issues is welcome. [63]

Analyses are subject to scheduled reviews typically a year after the last update.

Changes in our methodology are applied to both the new and the existing analyses. A review of existing analyses will be completed within six months after a methodology change.

Upon an analysis review, the project's ratings could be updated. In case the A1 Rating falls below the listing threshold, the project could be delisted from A1 Exchange, following the delisting procedure.

6 About A1 Exchange

Our vision with A1 Exchange is being the platform only for the best cryptocurrency projects and traders. In order to make this possible, we have several processes that we execute before listing a new project. We focus on the fundamentals when choosing a new project to list on the platform.

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