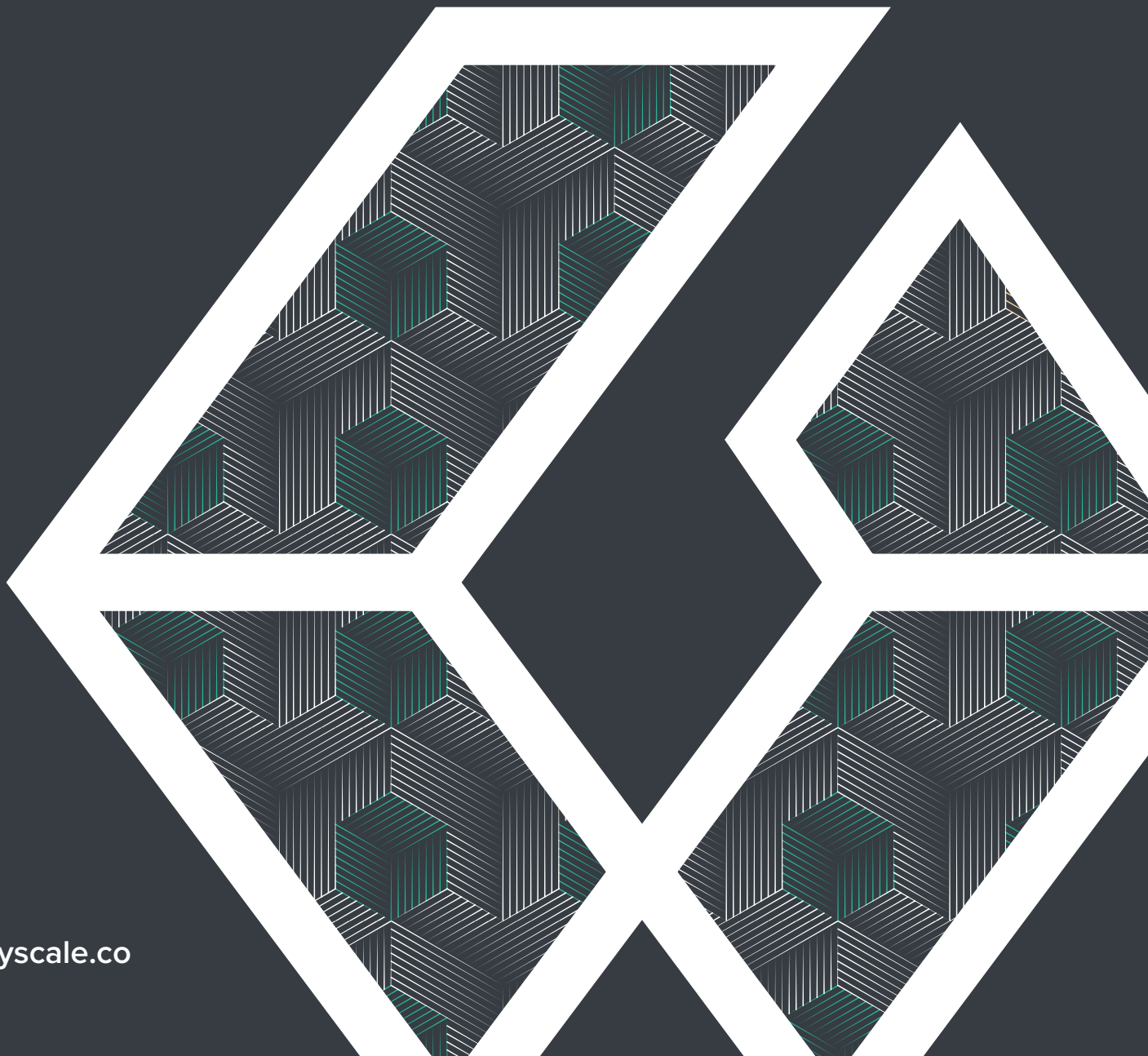


# An Introduction to Filecoin



# An Introduction to Filecoin

Filecoin is a decentralized storage and distribution network that aims to take on the \$46 billion dollar cloud storage industry.<sup>1</sup> Filecoin connects customers and data storage providers from around the world to achieve an efficient and robust marketplace for data storage needs. This market is growing quickly as video streaming becomes more common, digital resolutions increase, and more connected devices come online.

## Cloud Storage Background

Amazon Web Services became the first widely-used cloud computing platform, allowing people to store and process data from anywhere in the world. End-users no longer needed to purchase and deploy hardware, freeing up developers to create software with more flexibility and creativity than ever before. While cloud storage is now integral to the internet, more than 70% of the cloud computing market is controlled by Amazon, Microsoft, Google, and Alibaba.<sup>2</sup> Amazon alone controls 45% of the cloud infrastructure market.<sup>3</sup>

These companies may very well represent central points of failure. If for some reason their services are interrupted, every government, company, and user relying on them may fail to operate as intended. In some cases, mission critical infrastructure would fail without access to these cloud services.

The world has also witnessed immense power being accumulated by cloud computing providers. They currently have the power to decide who is allowed to use their services and what type of data is permitted.<sup>4</sup> Technology companies have become modern day utilities and are increasingly being co-opted as political tools. In contrast to allowing these companies to become the arbiters of truth, Filecoin has emerged as a censorship-resistant, market-based solution.

1. Sneha Korad Rachita Rake, Vineet Kumar, "Cloud Storage Market Statistics: 2027," ALLIED MARKET RESEARCH (April 2020), <https://www.alliedmarketresearch.com/cloud-storage-market>.

2. Angus Loten, "Pandemic Tech Spending in China Lifts Alibaba's Cloud," The Wall Street Journal (Dow Jones & Company, September 10, 2020), <https://www.wsj.com/articles/pandemic-tech-spending-in-china-lifts-alibabas-cloud-11599730202>.

3. Naomi Eide, "AWS Captures 45% of Worldwide IaaS Revenue. That's Only Part of the Story," CIO Dive, August 7, 2020, <https://www.ciodive.com/news/Gartner-IaaS-PaaS-2019-AWS-Microsoft/583082/>.

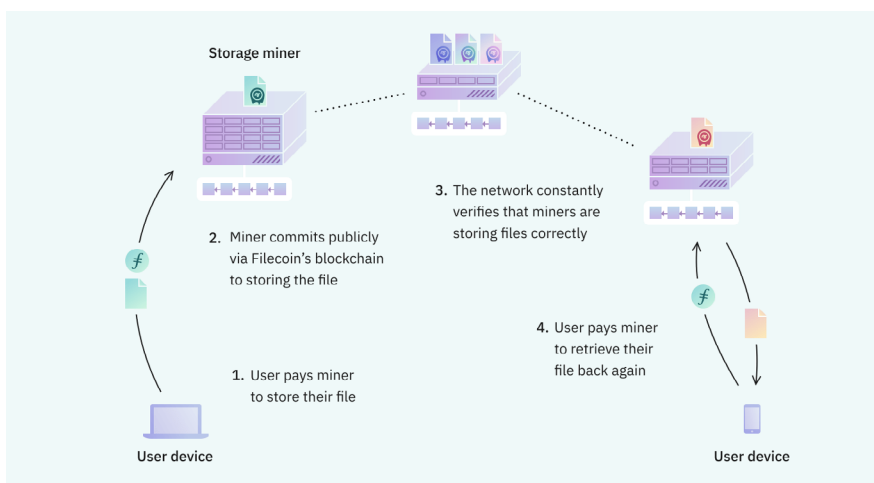
4. Paul Mozur, "Joining Apple, Amazon's China Cloud Service Bows to Censors," The New York Times (The New York Times, August 1, 2017), <https://www.nytimes.com/2017/08/01/business/amazon-china-internet-censors-apple.html>.



## Filecoin's Approach

Filecoin provides an open, decentralized network that can potentially fix the pitfalls of the current centralized cloud infrastructure. Clients (end users) and miners (storage or retrieval) negotiate for a mutually beneficial storage rate. Clients pay storage miners to hold their data. Storage miners then store this data using mathematical proofs to verify completeness, accuracy, and privacy. Retrieval miners, which can also play the role of storage miners, are then paid to retrieve and deliver data whenever the end user needs it. This creates a marketplace where miners can sell their services and clients can bid on whatever solution best suits their needs. As a result, the Filecoin network is censorship-resistant, cost-effective, and robust.

FIGURE 1: WHAT IS FILECOIN?<sup>5</sup>



It's important to remember that Filecoin is a nascent protocol. An avid user of Google Drive might not be immediately intrigued by the first generation of applications built on Filecoin. However, it's reasonable to expect that innovation on Filecoin will outpace innovation on closed-source storage platforms. **Open-source innovation allows for spontaneous development from multiple channels with co-development from the end users (users from any geography can collaborate and build), which in closed systems are typically passive recipients of the product. Similar to how the internet separated itself from the intranets of the 1990s, it is difficult to predict the innovation that will take place on an open file storage protocol.**

For example, we might imagine an application that stores data on Filecoin, the permissions of which are controlled by a group of users rather than a single company. By changing this ownership dynamic, this group could facilitate integrations that may be unlikely under a corporate ownership

<sup>5</sup> "What Is Filecoin?," Filecoin Docs, October 9, 2020, <https://docs.filecoin.io/about-filecoin/what-is-filecoin/>.





model. This is exactly what we have seen in the Ethereum ecosystem in the last year – informal partnerships have developed between protocols, applications, and users, leading to new products that otherwise would not be possible. This same type of open innovation may lead to an explosion of development and usage on Filecoin.

## Applications using Filecoin

The community has begun building promising applications and tools for using Filecoin.

Textile is a network tool for developers to connect to—and build on—Filecoin through a collection of APIs and libraries.<sup>6</sup> Textile aims to make the development experience familiar to those that are already familiar with data services like Amazon S3.

Slate is a file-sharing network that allows users to store files on Filecoin through an easy-to-use interface.<sup>7</sup> Through this interface, images, audio, and video can be shared with friends in what feels like a DropBox-Instagram hybrid. Using Slate, non-technical users can also create data storage deals with miners to gain an understanding of the variables that affect storage costs on Filecoin.

Additionally, a number of decentralized applications have chosen to host their websites on IPFS, a data storage precursor to Filecoin, to mitigate against the fragility and censorship potential of centralized applications. Augur, Haven, Origin, and Audius are well-known examples of decentralized applications using IPFS to data storage.<sup>8</sup>

## Defining Characteristics

- **Decentralized** - The Filecoin network is supported by over a thousand miners around the world.<sup>9</sup> Similar to the way Bitcoin uses economic incentives to be one of the most secure global networks, Filecoin aims to be a robust protocol for file storage by reducing the need for centralized service providers.
- **Censorship-Resistant** - Filecoin is operated by a large network of miners that provide storage capacity and computational resources. By relying on this decentralized network, Filecoin provides censorship-resistant storage that is foundational to building a fully decentralized digital ecosystem. With Filecoin, anybody can participate in censorship-resistant file storage. This is especially important as technology companies struggle to meet the demands of an increasingly polarized political environment.

6. "Textile - A Network of Applications, Connected through Interoperable Data, Where Data Is Owned by the Users.," [textile.io](https://www.textile.io/), <https://www.textile.io/>.

7. "Slate," Slate, <https://slate.host/>.

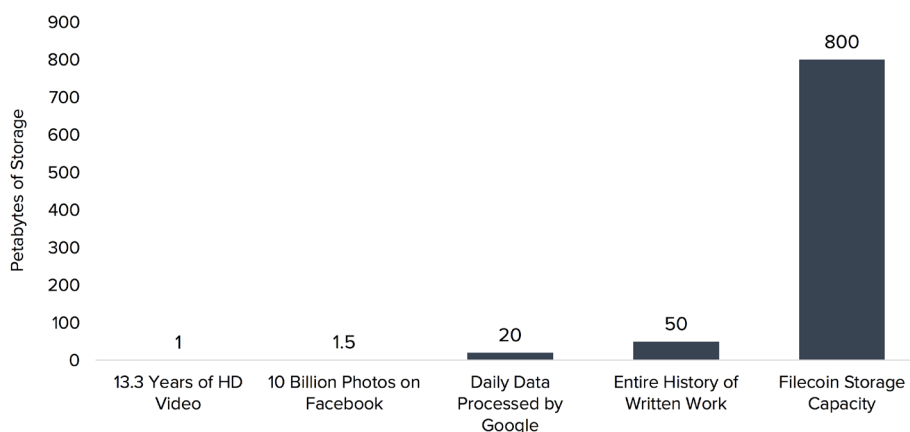
8. "Usage Ideas & Examples," IPFS Docs, November 27, 2020, <https://docs.ipfs.io/concepts/usage-ideas-examples/>.

9. "Filecoin Blockchain Explorer," Filecoin Blockchain Explorer, accessed February 10, 2021, <https://filscan.io/>.



- **Cost-Effective** - Filecoin removes middle men to create an efficient, transparent, and cost-effective peer-to-peer marketplace for storage. Filecoin does not determine prices – buyers and sellers of storage are free to negotiate. **While storage prices vary by deal, Filecoin has allowed customers to store data for as low as 3% of the cost of Amazon’s services.**<sup>10</sup> In the same way Airbnb, Amazon, and eBay disrupted brick and mortar, Filecoin aims to provide a more efficient market for storage.
- **Robust** - Centralized storage is a single point of failure. Through the wide network of miners, users can store data among different providers to ensure their data is always available. And with mathematical proofs, users can verify that their data is stored as intended. At the time of writing, over 650 storage providers have collectively contributed nearly 800 petabytes (a petabyte equals one million gigabytes) of storage capacity to the network. For comparison, the 10 billion pictures on Facebook cumulatively require approximately 1.5 petabytes of storage.<sup>11</sup>

FIGURE 2: FILECOIN STORAGE CAPACITY COMPARISON<sup>12</sup>



- **Verifiable** - Rather than trust a third party cloud storage service, clients can verify the integrity and location of their data with the cryptography of the Filecoin protocol. The network introduces two novel proofs - Proof of Replication (PoRep) and Proof of Spacetime (PoSt).<sup>13</sup> PoRep verifies that a piece of data has been replicated to a uniquely dedicated physical storage space. PoSt verifies that this piece of replicated data is stored properly over time. These proofs together are the glue of Filecoin’s economic system.

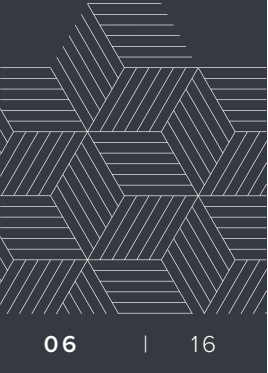
10. "Easy Filecoin Deal Metrics," FilStats, accessed October 20, 2020, <https://filstats.com/>.

11. Infographics Guy, "How Much Is a Petabyte Infographic," Infographics Showcase, March 7, 2019, <http://www.infographicsshowcase.com/how-much-is-a-petabyte-infographic/>.

12. See footnote 11.

13. Juan Benet, David Dalrymple, Nicola Greco, "Proof of Replication," July 27, 2017, <https://filecoin.io/proof-of-replication.pdf>





- **Open participation** - Anyone can buy or sell storage services from anywhere in the world. This open participation on Filecoin creates a free market that may allow for more efficient pricing and more spontaneous innovation. There are no restrictions to who can use Filecoin or what can be built on Filecoin.
- **Open-source** - Filecoin's code is viewable on the internet and is free for anyone to access, contribute to, or copy. This is an important characteristic for building trust in open networks.
- **Offline-data transfer** - Filecoin allows users to transfer very large datasets offline to a storage miner, while still verifying the deal on-chain. The client passes a unique identifier describing the data, which the miner then has to match with the verified data for the deal to go through. This is an important characteristic for enormous datasets that can cost hundreds of thousands of dollars to broadcast and could take months to transfer.
- **Governance** - Filecoin uses an informal governance system similar to Bitcoin and Ethereum. Upgrades are submitted through a Filecoin improvement proposal that anyone can submit.

## FIL Token Use

Having established a baseline for the current state of the storage market, Filecoin's approach, and the list of characteristics that make Filecoin unique, it's worth exploring the use of Filecoin's token, FIL.

FIL is used both as a medium of exchange and as collateral on the Filecoin network. Most important is the consideration of FIL as collateral on the network. In order to contribute storage capacity, miners must lock up FIL. **As demand for storage on the network increases, so too does the demand for FIL. Investors can think of FIL as a taxi medallion – the value of the taxi medallion is proportional to the amount of money a driver can earn in a year. As the opportunity for revenue on the Filecoin network grows, so too should demand for the FIL.**

As previously mentioned, data storage needs are growing exponentially as more of our lives take place in the digital world. Market research firms estimate that the cloud storage market could triple by 2025.<sup>14</sup> Additionally, investment research firms estimate that the value of AWS alone currently exceeds \$500 billion.<sup>15</sup> This is an enormous market that is growing rapidly. Filecoin brings a novel approach to decentralized data storage that could take market share from its centralized counterparts. If it succeeds in this goal, FIL will be an integral piece of the file storage economy, allowing providers to tap into a vast network of cloud storage customers.

<sup>14</sup> "Cloud Storage Market," Market Research Firm, <https://www.marketsandmarkets.com/PressReleases/cloud-storage.asp>.  
<sup>15</sup> Eric J. Savitz, "Amazon Web Services Is Worth Half a Trillion Dollars, Analyst Estimates," Barron's (Barrons, May 28, 2019), <https://www.barrons.com/articles/amazon-stock-web-services-worth-half-a-trillion-dollars-51559060451>.



FIGURE 3: SUMMARY OF FILECOIN STATISTICS

As of October 20, 2020

|                      |  |
|----------------------|--|
| Inception of Network | 10/15/2020   |
| Cost of Storage      | \$.022 USD/GB/year                                   |
| Cost vs Amazon       | 12.29x cheaper (Amazon S3 Standard (\$.276/GB/year)) |
| Storage Capacity     | 609.18 PiB   |

## A Brief History of Filecoin

In 2014 Juan Benet founded Protocol Labs, the team behind Filecoin. The team initially released the Interplanetary File System (IPFS) in 2015, which has since served billions of files in a peer-to-peer file sharing system.

Filecoin and IPFS are complementary. IPFS allows users to store and transfer content through a peer-to-peer network.<sup>16</sup> If a user wants the data to persist on IPFS, a node on the network needs to maintain or “pin” it. However, IPFS does not incentivize storage of data, which means users either have to provide their own nodes or rely on peers to altruistically store their data. Despite its success to-date, storage on IPFS has run without economic incentives. **Filecoin and the FIL token are the economic layer that facilitates a market between storage providers and clients.**

## Token Sale

In one of the largest token sales of its time, Filecoin raised a total of \$205.8 million through private and public investments.<sup>17</sup> The public sale raised \$153.8 million and was hosted on Coinlist, a platform created by Protocol Labs for digital asset companies to run their token sales. The private sale raised \$52 million and included notable funds such as Digital Currency Group<sup>18</sup>, Boost VC, and Y Combinator.<sup>19</sup> In total, the sale included over 2,100 investors in more than 50 countries and pioneered a financial instrument called the Simple Agreement for Future Tokens (SAFT).<sup>20</sup> This instrument allowed Filecoin to raise money with the promise of distributing tokens upon the launch of their functioning network, which occurred on October 15, 2020.

16. “IPFS and Filecoin,” Filecoin Docs, November 5, 2020, <https://docs.filecoin.io/about-filecoin/ipfs-and-filecoin/>.

17. Protocol Labs, “Token Sale Completed,” Filecoin, <https://filecoin.io/blog/sale-completed/>.

18. Digital Currency Group, Inc. is the parent company of Grayscale Investments, LLC.

19. “Crypto Research, Data, and Tools,” Messari Crypto News, accessed October 20, 2020, <https://messari.io/asset/filecoin/profile>.

20. “The SAFT Project,” The SAFT Project, <https://saftproject.com/>.



FIGURE 4: **TOKEN SALE DETAILS**<sup>21</sup>

|                           |                   |
|---------------------------|-------------------|
| Date                      | 09/07/2017        |
| Instrument                | Filecoin SAFTs    |
| Pre-Sale Price            | \$0.75 USD/FIL    |
| Average Public Sale Price | \$1.12 USD/FIL    |
| Total Sold                | 200,000,000 FIL   |
| Total Raised              | \$205,800,000     |
| Total Supply              | 2,000,000,000 FIL |

### Allocation Details

Filecoin has distributed FIL tokens among founding members, investors, and miners with a variety of vesting schedules to bring long-term oriented entities to the network. Investors' allocations are distributed linearly for a maximum of three years depending on contract terms. The Protocol Labs team, which was responsible for building Filecoin, and the Filecoin Foundation, which is responsible for ongoing initiatives, will receive FIL tokens on a linear schedule over six years.<sup>22</sup> The remainder of the tokens are allocated to miners and will be distributed according to a 6-year half life in which the rate of distribution is halved once every 6 years. This is similar to the 4-year half life associated with Bitcoin's distribution. Token distribution details are outlined below.

FIGURE 5: **FILECOIN ALLOCATION**

| Group                     | Amount | Vesting Period  |
|---------------------------|--------|---|
| Filecoin Foundation       | 5%     | 6 years, linear vesting   |
| Protocol Labs             | 15%    | 6 years, linear vesting   |
| Investors                 | 10%    | 1 year minimum (advisor pre-sale),<br>6 month minimum (public sale) |
| Storage Mining Allocation | 55%    | 6 year half life distribution                                       |
| Mining Reserve            | 15%    | 6 year half life distribution                                       |

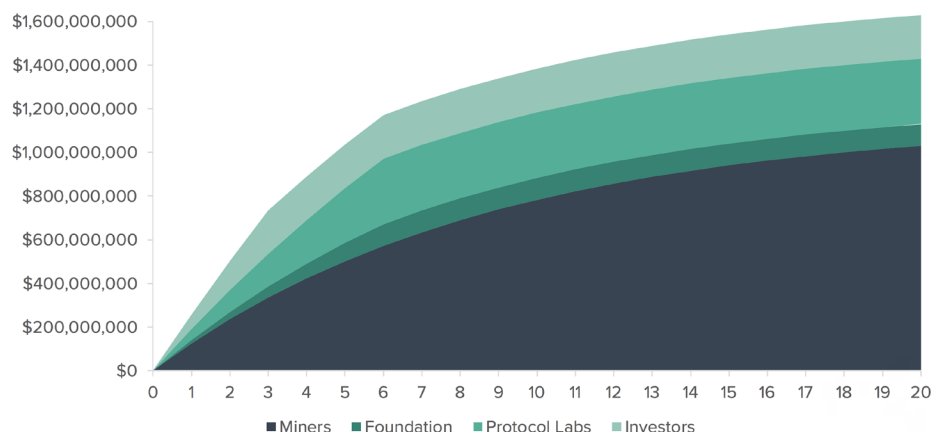
21. "Filecoin Sale Economics", [https://coinlist.co/assets/index/filecoin\\_index/Filecoin-Sale-Economics-e3f703f8cd5f644aecd7ae-3860ce932064ce014dd60de115d67ffe9047fa8e.pdf](https://coinlist.co/assets/index/filecoin_index/Filecoin-Sale-Economics-e3f703f8cd5f644aecd7ae-3860ce932064ce014dd60de115d67ffe9047fa8e.pdf)

22. JD Alois, "Filecoin Foundation Says Tech Luminaries Will Help Project Succeed," Crowdfund Insider, October 22, 2020, <https://www.crowdfundinsider.com/2020/10/168288-filecoin-foundation-says-tech-luminaries-will-help-project-succeed/>.





FIGURE 6: FIL DISTRIBUTION<sup>23</sup>



## Filecoin Network Mechanics

There are five main actors in the Filecoin ecosystem:<sup>24</sup>

- **Clients** pay miners to store and retrieve data.
- **Developers** upgrade the network and build applications on top of the protocol.
- **Retrieval miners** deliver files to clients on-demand.
- **Storage miners** store files for clients and help maintain the Filecoin blockchain.
- **Token holders** make FIL valuable by using it as a medium of exchange and as collateral in the Filecoin ecosystem.

## Mining Economics

To initiate mining, storage providers need to commit FIL tokens as collateral so that when that miner is ready to provide storage, it can be penalized for poor performance. Once the minimum collateral requirements are met, the miner can start minting blocks, making deals with clients, and earning rewards for their work. In addition to the protocol collateral requirements, additional collateral may be negotiated between the miner and client for any particular deal.

There can be multiple types of miners on the Filecoin network. Filecoin provides both storage and content delivery services. Content delivery efficiency is correlated with delivery distance so retrieval miners will be more focused on location than storage miners as they need to reduce latency by being more closely located to the end client.

23. "Filecoin Sale Economics", [https://coinlist.co/assets/index/filecoin\\_index/Filecoin-Sale-Economics-e3f703f8cd5f644aec7ae-3860ce932064ce014dd60de115d67ffe9047ffa8e.pdf](https://coinlist.co/assets/index/filecoin_index/Filecoin-Sale-Economics-e3f703f8cd5f644aec7ae-3860ce932064ce014dd60de115d67ffe9047ffa8e.pdf)

24. Protocol Labs, "Filecoin's Cryptoeconomic Constructions," Filecoin, <https://filecoin.io/blog/filecoin-cryptoeconomic-constructions/>.



## Rewards

Filecoin storage miners receive rewards based on their storage power, which is a measurement of how much useful storage capacity a miner is providing to the network. Similar to how hashrate works on Bitcoin, miners receive block rewards proportional to their storage power relative to the total storage power provider on the Filecoin network. Storage power also increases based on the quantity, quality, and time commitment stored data. This incentivizes miners to participate in business development to bring the highest quality data to the network.

To ensure that a miner is reliably storing the data for the agreed upon time period, miners commit FIL and a portion of their accrued block rewards as collateral. If the miner goes offline for a short period of time, they may lose a portion of their locked funds. If the miner goes offline for a substantial period, they could lose all of their locked funds. If there is an error, the miner can self-report for a lower penalty than if the chain is the first to catch the error.

Rewards for retrieval miners are determined by the response times by miners for a particular request. Miners that are located close to end users and have low-latency, high bandwidth connections are well-suited to quickly retrieve files and earn fees as a result.

## Potential Risks

- **Competition** - Filecoin is a nascent protocol that is competing against giants of the cloud storage industry, such as Amazon, Microsoft, and Google. While Filecoin presents some competitive advantages relative to centralized solutions, it will still be a challenge to overcome the network effects these businesses have built. Additionally, other projects with their own digital currencies such as Arweave, Sia, and Storj are competing to be the leading decentralized storage providers.
- **Decentralization** - There may be risks associated with the level of decentralization of the Filecoin network. If too many miners are located in the same jurisdiction, they could be targets of censorship or weakened by natural disaster, diminishing the security and power of the network.
- **Network economics** - The security of the Filecoin network is largely reliant on the economics of the system incentivizing productive behavior and penalizing unproductive behavior. If the economics cease to be attractive to either miners or clients, the security and resiliency of the network fall apart.





- **Volatility** - Token volatility also has the potential to affect Filecoin economics and the security of the network. When token prices fall dramatically, miner profits will likely fall in tandem. Currently, mining is a function of Filecoin distribution and client deals. Client deals are less likely to be affected by Filecoin volatility since clients and miners accrue costs in fiat currencies. The Filecoin distribution algorithm however, is less elastic. In similar fashion to what occurs on the Bitcoin network, when prices drop we might expect low margin miners to shut down operations.
- **Token Distribution** - At the time of writing, approximately 1% of the total supply has been distributed. As more tokens are distributed to investors, team members, and miners, Filecoin tokens may incur additional sell-side pressure resulting in lower prices.
- **Regulatory** - The SEC has stated that certain digital assets may be considered “securities” under the federal securities laws. To date, the SEC has only identified two digital assets, Bitcoin and Ethereum, for which it does not intend to take the position that they are securities. As a result, any other digital asset, including FIL, is at risk of being deemed a security, which may have material adverse consequences for such digital assets. Furthermore, FIL’s initial manner of sale closely resembles that of certain digital assets sold in ICOs and found to be securities, which may increase the risk of FIL being deemed a security.

## Summary

Filecoin is a novel implementation of a decentralized storage network that competes with the likes of Amazon, Microsoft, Google and Alibaba. With more activity occurring online, the \$46 billion dollar storage market is expected to grow to over \$220 billion by 2027. With nearly 800 petabytes of storage capacity, Filecoin shows early promise of becoming the cloud storage backbone of the decentralized web movement. Further, as more applications and users rely on Filecoin for their cloud storage needs, demand for FIL may increase as miners compete for storage contracts.



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- **MARKET ADOPTION**  
It is possible that digital assets generally or any digital asset in particular will never be broadly adopted by either the retail or commercial marketplace, in which case, one or more digital assets may lose most, if not all, of its value.
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