Oort[1]: The Web3 Data Infrastructure at Internet Scale

Oort Founding Team

[1]Oort was formerly called “Computecoin Network.”

I. Executive Summary

1) Overview:

   Oort is a scaling solution for Web3 storage infrastructure, with the goal of transitioning billions of Web2 users to Web3.

2) Problem Summary:

   Web2 users who currently rely on cloud infrastructure like AWS are looking for Web3 solutions that offer greater privacy, reliability and affordability. However, existing Web3 storage infrastructure lacks scalability, is difficult to use, and offers a limited range of services. As a result, massive adoption of Web3 has not taken place in the vast majority of fields.

3) Solution Summary:

   Like a Layer 2 that helps scale applications on Ethereum (Layer 1), Oort, which contains a bundle of solutions, is the first "Layer 2" working to scale Layer 1 storage infrastructure such as Filecoin, Storj and Arweave. Our native decentralized edge network, supported by the original Olympus blockchain protocol, enables SQL database, dynamic resource allocation (storage, compute and bandwidth), fast file indexing and searching, and content distribution, all decentralized for internet-level scalability.

4) Highlights:

   a) First-mover advantage: Oort was the first to build a scaling solution to Web3 data infrastructure. Continuous research and development since 2018. Technologies backed by academic publications and two U.S. patents.
   b) $2M+ revenue since November 2021 (first testnet launch).
   c) Strong execution team with core members from world-renowned organizations, such as Columbia University, Qualcomm, AT&T, J.P. Morgan, etc.
   d) Strong client acquisition network: 40+ enterprise partnerships (e.g., Storj, iPolloverse) and 15+ top-ranked universities (e.g., MIT, Harvard, Univ. of Chicago).

II. Introduction

The emergence of Web3 marks an historic turning point. It ushers in a new era in the history of the web, one defined by a radical transfer of access, ownership and governance from today's crop of Internet giants to the Internet's very users. Oort is leading the change. Oort's decentralized data infrastructure has the potential to beat the centralized providers at their own game, delivering users fast, low-latency and affordable access to high-performance data solutions, regardless of their needs or the scale of their application. Meanwhile, Oort's built-in consensus mechanism will safeguard the ecosystem's security and intelligently allocate resources across the network's nodes to ensure the highest performance and the most seamless user experience. This is what Oort is capable of.

A. Failure of massive adoption

Before we can realize our vision of revolutionizing Web3 data infrastructure, we need to overcome a handful of challenging, but conquerable, obstacles as discussed below.

1) Not user-friendly

   Usability is a critical prerequisite to mainstream adoption. But the fact of the matter is that Web3 is simply not user-friendly. The vast majority of the world's population would find onboarding alone difficult, annoying, and off-putting – to say nothing of actually using the decentralized web. Web3's complicated user experience has prevented people outside of the crypto community from seeing how Web3 can actually generate revenue, benefit the world, and simply make life easier. We need a set of tools that simplifies the current workflows in the decentralized world and facilitates new workflows, so that Web3 is no longer limited to trading. Web3 should be able to cover all of the needs of all of its users.

2) Scalability and performance

   Scalability is vital to a useful, high-performance Web3 infrastructure. To compete with Web2 cloud services providers, Web3 infrastructure must have Web2-comparable capacity and performance to handle enormous volumes of data with guaranteed privacy. For instance, video-streaming and other data-intensive applications hosted on decentralized networks will need to store and retrieve cold as well as hot data (respectively, data that's seldom accessed and frequently accessed data stored in a database) to facilitate frictionless user experiences. Currently, decentralized networks can't host hot data at internet scale. This is a serious

problem. Clients and users across industries and domains need on-demand, reliable access to data in real time. No support for hot data means no video streaming or other kinds of content delivery where speed is everything.

B. Oort overview

In summary, the current Web2 data infrastructure is expensive, has no privacy, and risks single point failure. Billions of Web2 users are looking for alternatives. Begun as a research project in 2018, Oort is founded on the conviction that Web2 users will start migrating to Web3 en masse once the above problems are solved.

Oort is a data infrastructure for the next billion Web3 users. Featuring a user-centric design, Oort offers full-service decentralized data solutions that billions of Web2 developers and users can quickly master without knowing a thing about Web3. Oort is realizing this goal in two ways. First, Oort offers Web2-native user experience. For instance, Oort provides Web2-compatible APIs, such as AWS S3 API and SQL API, for the development of Web3 decentralized applications. This allows Web2 developers to transition to Oort with no learning curve. Second, Oort has built a Layer 2 scaling solution: a decentralized edge network powered by the original Olympus protocol. As a result, Oort gives developers and users fast and easy access to decentralized storage resources from any place, at any time and any scale. Apps hosted on Oort thus enjoy Web2-comparable performance and user experience.

Oort has crossed many significant milestones. Our first testnet, Dome-A, was a success. Dome-A wrapped up in early 2022, and the second testnet, Huygens, is still ongoing. We developed a set of in-house developing tools and became open-sourced. Meanwhile, we began to build a developer community through initiatives such as hackathons and bounty programs. We grew a community 130k members strong across more than 30 countries, and Oort has already seen several impressive dApps built on the platform.

III. Oort System Architecture

Oort's system architecture is shown in Fig. 1. Oort sits in the middle between the application layer and the native Web3 storage layer, which includes Data centers, Filecoin, Arweave, Sia and other infrastructures. We see Oort as a Layer 2 solution for Web3 storage. Like Layer 2 solutions to Ethereum, Oort aims to enhance user experience and make decentralized storage scalable.

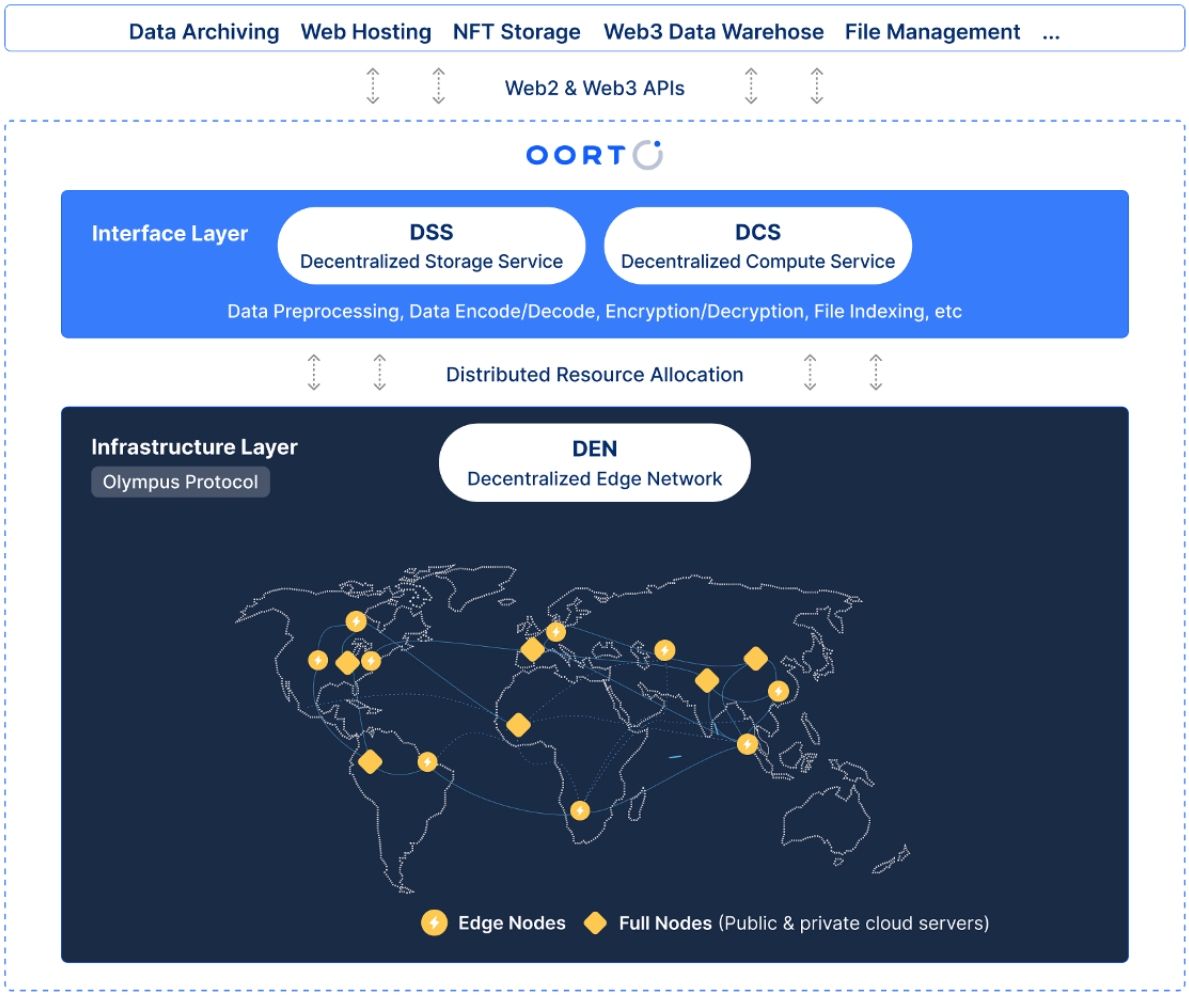

Fig. 1: Oort System Architecture. The interface layer is consist of two software modules: decentralized storage service (DSS) and decentralized compute service (DCS). This layer is a gateway for applications to access the underlying decentralized storage resources. The infrastructure layer is a decentralized edge network which is consist of a large number of peer-to-peer linked physical nodes around the globe running the Olympus protocol. This layer optimizes the resource allocation in a distributed manner to cache data and provide database service for applications relying on hot data.

By combining the interface layer and the infrastructure layer in Fig. 1, Oort ensures that Web3 storage can achieve Internet-level scalability and Web2-comparable performance. Specifically, the data from the applications will be first processed in the interface layer (DSS/DCS), followed by the infrastructure layer (DEN), and then eventually stored in Layer 1 storage infrastructure.

- The interface layer (DSS/DCS) is the gateway for applications to access the decentralized storage resources, DSS/DCS provides Web2 compatible APIs, including AWS S3 APIs, for

data access; and includes SQL APIs for database access. With this compatibility, if one feels more comfortable on Web2 experience, the user can still enjoy traditional user login pages, billing and payment system, and drag and drop files in Oort. When a file is to be stored, it first undergoes pre-processing in DSS/DCS including encryption, encoding, sharding and indexing. This makes the file easy to access/search and ensures that the file is reliably cached in DEN. For example, to achieve a required reliability of a file storage by adding redundancy to the original file, a file is encoded using Reed-Solomon error correction codes at a desired code rate or a rateless fountain codes such as LT-code, depending on the use case of the application. The encoded file is broken into pieces and then, according to the result of resource allocation algorithms, distributed into DEN nodes. Even if some DEN nodes containing the file pieces are offline, due to the advantage of coding technique, DSS can recover the file from the remaining proportion of the nodes.

- DEN is a peer-to-peer physical network linked by edge devices (edge nodes) and cloud servers (full nodes) running the Olympus protocol. This layer optimizes the resource allocation in a *distributed* manner to cache data and provide database service for applications relying on hot data. DEN is crucial to ensure the scalability of the Layer 1 decentralized storage network. The Olympus protocol is the native blockchain in DEN. It uses Directional Acyclic Graph (DAG) as its underlying data structure to achieve high transaction rates and low latency. Olympus is also one of the first public blockchains to implement smart contracts on DAG. The PoH consensus protocol, a collection of *distributed algorithms* for resource authentication and allocation, versifies the DEN nodes and incentivizes DEN nodes to cache the data in an optimal way. For instance, DEN nodes will cache files in zones that end users can access with low latency, a key requirement for real-time video streaming. The PoH consensus protocol, one of key innovations in Oort, will be discussed in greater detail in later sections.
- Finally, if needed, the data will be stored to Layer 1 to ensure the data's immutability. Oort, as a Layer 2 solution, will collect and deliver (if needed) the proof-of-storage or proof-of-replication of the files provided by the underlying Layer 1 infrastructures. This requires the information exchange between Oort and the Layer 1 Web3 storage protocols such as Filecoin and Arweave. Sending data to Layer 1 could be one time action or intermittent actions. For example, a metaverse game's database is cached in DEN in a distributed manner for fast access and easy-to-scale. This database is futher sent to Layer 1 infrastructures on

a daily basis for the backup purpose.

In what follows, we briefly discuss the key technologies that empower Oort's superior performance and the growth of Oort ecosystem: *PoH consensus protocol*, *interoperability of Olympus protocol* and *decentralized file indexing*.

A. PoH consensus protocol

The key to implementing a highly scalable decentralized system is a well-designed resource authentication and management system. Resources typically refers to any physical elements (e.g., bandwidth, storage space) that execute tasks. At first, the resource contributed from the DEN nodes and Layer 1 storage nodes has to be authentic, which is the foundation for any decentralized network. For instance, any virtualization technology that forfeit the capacity of resources should be disallowed. Secondly, for the sake of efficiency and fairness, resources in a highly scalable system should always be supplied to users with higher utility. However, these are difficult problems in a decentralized environment due to the lack of global information. From a game-theoretic point of view, the nodes will schedule resource based on their local knowledge and with their best personal interest. Therefore, the outcome can not be socially optimal, thus limiting the network scalability.

To deal with this problem, the Oort team invented PoH consensus protocol, a collection of decentralized algorithms, for resource authentication and allocation. In particular, as one of the first practical solution to the long-standing computing science problem "verifiable computing", the PoH consensus protocol first verifies that no nodes are cheating on the resource they contribute. Next, the PoH consensus incentivizes the selfish nodes to act as to optimize the social goals. For example, in the case that a node receives a file downloading task, a block (a group of transactions) in the PoH consensus protocol is generated once all the pieces (one transaction for each file piece transfer) of the file are received by the node. The reward will be proportionally shared by the nodes who contributed the pieces. With PoH consensus, the nodes are incentivized to cache frequently accessed files in proximity and to be deployed in a zone with high and reliable bandwidth. If all nodes were independently working towards this goal, the topology of the DEN and the scheduled contents in DEN will be optimized in a decentralized manner.

B. Interoperability of Olympus protocol

Olympus protocol is designed to support chain interoperablity, which enables Oort to integrate Layer 1 Web3 storage protocols such as Filecoin and Arweave easier, and partner with most of the Layer 1 public blockchains for freely data transfer in applications.

Chain interoperability in Olympus protocol is achieved by its unique data structure of the ledger, as shown in Fig. 2. Olympus protocol is split into two layers - the *Consensus layer* and the *Parachain layer*. The consensus layer runs the top consensus of Olympus, which is a low-complexity and low-latency type of BFT consensus. The reader should read the Olympus yellowpaper to learn more about the consensus layer. For now, the parachain layer contains two Olympus' native chains, one is an EVM-compatible chain to allow developers migrating and deploying Ethereum smart contracts in Oort with zero learning curve, and the other is a chain implementing the PoH consensus protocol. Blockchains with different consensus algorithm, such as Binance Smart Chain, Solana, Filecoin, Arweave etc., can be added to the parachain layer.

The messages in the consensus layer are called *blocks*. A block connect to previous blocks and forms a DAG. The Olympus consensus determines a linear order of the blocks, though they are tangled. The order of the blocks are marked on Fig. 2 as an example. Each block in parachains is linked from a block in Olympus, and then the order of the transactions among the parachains are subsequently determined, which is the fundamental step of implementing chain interoperability.

To understand how the chain interoperability can benifit Oort, on one hand, the cross-chain feature allows Oort to adopt any popular payment methods in the crypto space. Oort users don't have to be aware of the existence of different tokens in different Layer 1 storage protocols such as Filecoin and Arweave. The tokens will be automatically purchased and consumed by the cross-chain protocol in Olympus. On the other hand, the cross-chain feature enables the developers to build applications on Web3 data in a much broader scope. Data as an important asset in Web3 can be easily transferred or exchanged across different blockchains in Oort. Many novel applications, such as Web3 data marketplace and data warehouse, will be built by developers as they explore the infinite opportunities brought by Oort.

C. Decentralized File indexing

As one fundamental function in data infrastructure, the decentralized file indexing technology organizes data in Oort and provides APIs for quick query, scalable analysis, and sharing of the

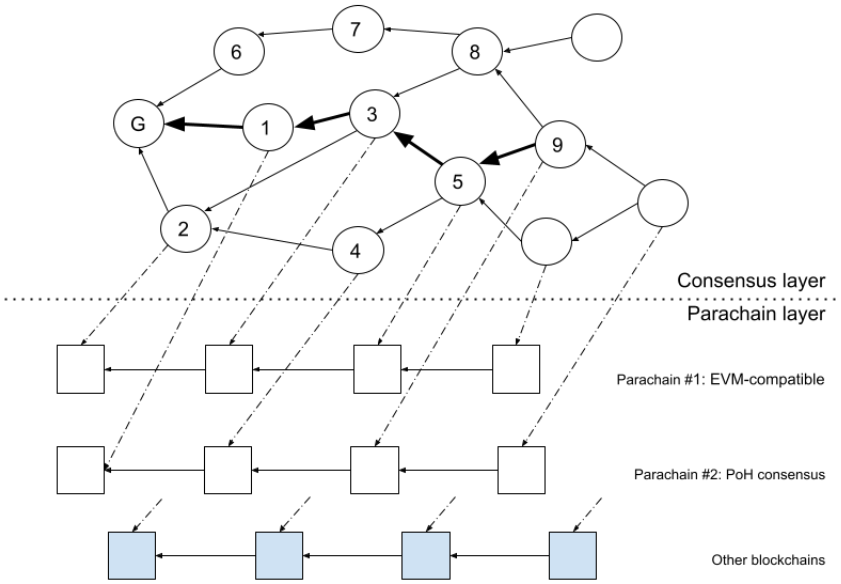

Fig. 2: Chain interoperability in Olympus

data. Until now, rare applications have been built on Layer 1 storage as they have to rely on centralized indexing solutions requiring high costs for physical hardware, unfeasibly fast internet connections, and computing power. Oort's DEN provides computing power to build file indexing as a Layer 2 service for all contents in the underline Layer 1 storage. Developers can use the APIs to build sophisticated data analysis applications or even a data warehouses on Oort. This will satisfy the growth requirement from Web3 as there is a huge demand from developers and the community to store, manage, maintain and use data in Web3. Meanwhile, it is necessary to provide this services to Web2 users so that they can migrate their applications' service to Web3.

Oort's decentralized file indexing function supports storing structured and semi-structured data and provides rich indexing capabilities including secondary index, composite indexes, full-text index and etc. The Oort data gateway, as the primary entry point, supports CQL/JSON/REST/GraphQL APIs to help developers manage and access their data in Oort. The indexing function is the bottom layer of organizing, managing, or even monetizing Oort data. We are allowing the community to add extra features on it. For example, machine learning technology can be applied on training and executing powerful models on structured data. For business clients, high-speed streaming insertion API can also be built for real-time analytics, making latest business data immediately available for analysis.

IV. Competitive Landscape

To the best of our knowledge, Oort is the leading Web2-user-friendly scaling solution to Web3 storage infrastructure, with the objective of on-boarding the billions of Web2 users to Web3. Considering the scalability and the ease of use for Web2 users, as shown in Fig. 3, Oort's differentiation from other Web3 storage projects, such as Filecoin, Storj and Crust is very straightforward. Yet rather than compete with other Web3 storage projects, we have opted to establish close partnerships with them.

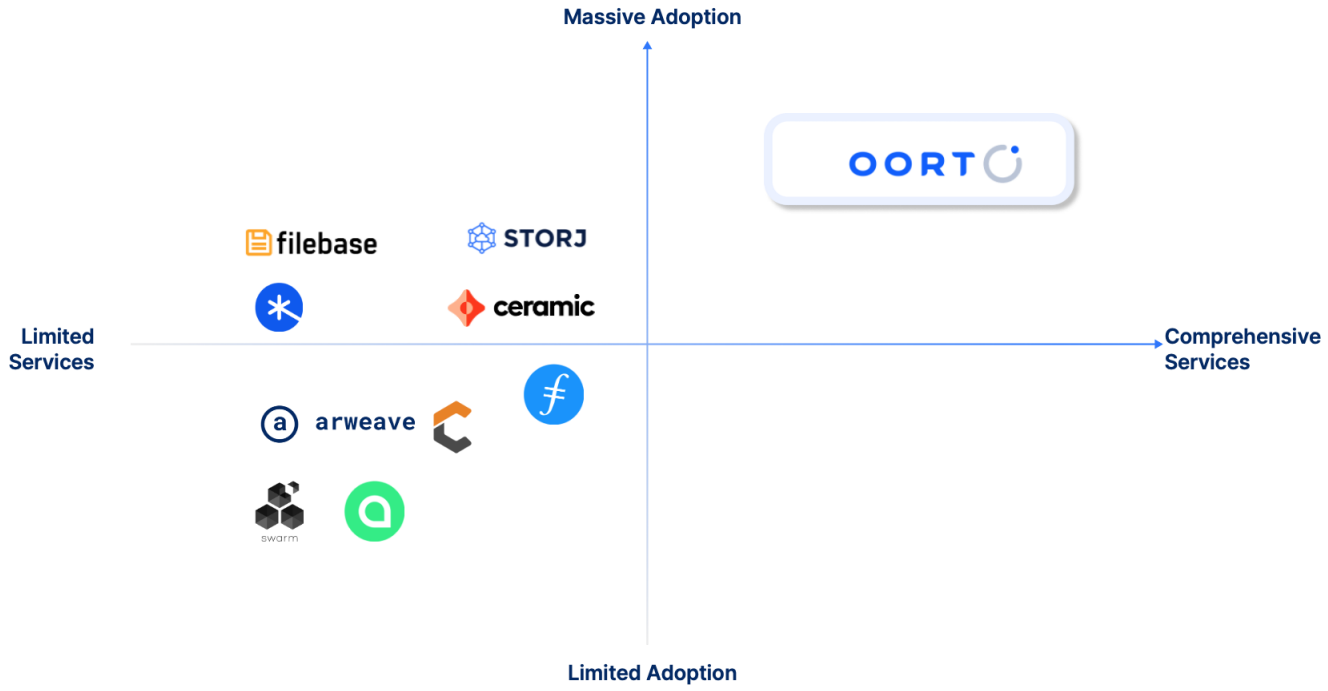

Fig. 3: Competitive landscape

V. Business Model

A. *Who are the clients?*

Our scaling solution to data infrastructure enables us to serve nearly any Web2 and Web3 client, regardless of size. As the Web3 community is far from mature, we target two types of clients to quickly generate revenue.

1) Web3-native projects: By definition, all Web3-native projects need decentralized data solutions for their web3 products, from their project websites to databases. Based on our

experience securing this category of client, the client acquisition cost involved is extremely low and the on-boarding process is fast.

2) Web2 enterprises transitioning to Web3: These companies are highly motivated to extend their business to Web3. The educational cost for these clients is lower than that for others who know nothing about Web3. Our founding team's well established track record and reputation put us in a strong position to secure these clients.

B. The Revenue Model

1) Service Pricing: Our primary business is to provide scalable Web3 data solutions to our clients. We will offer pay-as-you-go pricing to enterprise clients and a subscription-based model for individual users. The price is on average $50\% - 80\%$ off compared to that of Amazon S3. The big savings come from leveraging the idle bandwidth in our DEN network.
2) Licensing Fee: The providers, nodes in our decentralized edge network (DEN), are charged an annual $\$60$ licensing fee for their connection to DEN. Note that the benefits they earn from providing their resources to our network will be far greater than the licensing fee.

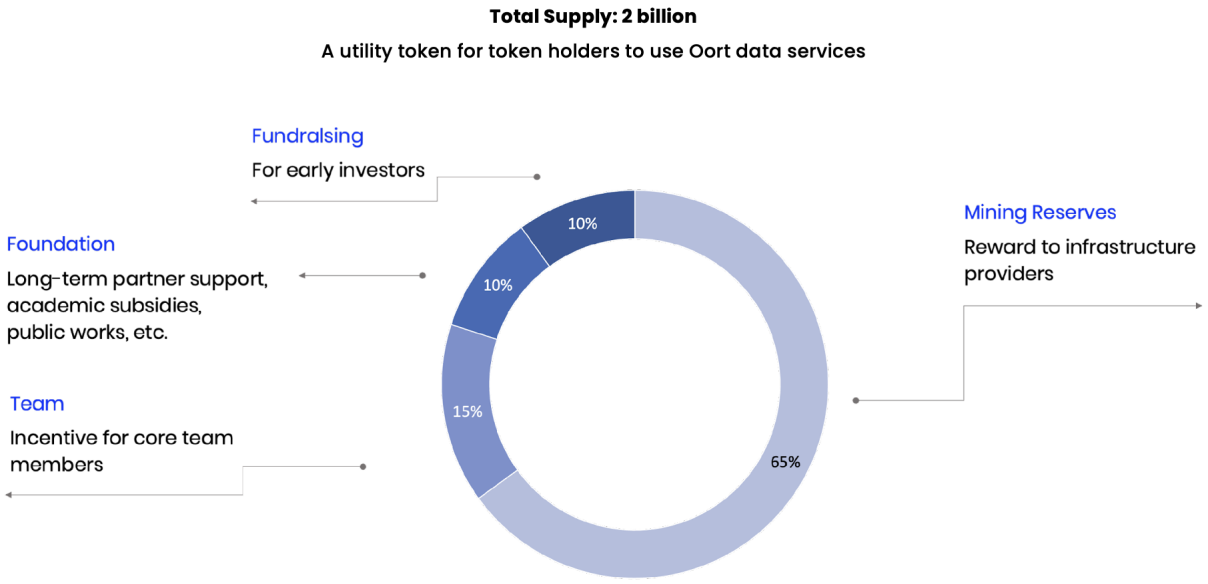

Fig. 4: Token Allocation.

VI. The Tokenomics

Oort utilizes the utility token native to the Oort ecosystem. The utility token is used for service payment, staking, governance. The token allocation is illustrated in Fig. 4.

1) Service Payment: Users can always pay fiat currency (via credit card) for different services in the Oort ecosystem. However, a discount is usually given to the users who use Oort utility tokens for service payments.
2) Staking: Oort offers two ways for token holders to stake tokens:
   a) Stake tokens with staking pools. One can delegate tokens to node providers via Oort bonding pools. Node providers will use staked tokens as mining collateral. As a result, you will receive a share of mining rewards from the provider.
   b) Become a node provider. Stake tokens as mining collateral.
3) Govenance: Governance is one of the primary functions of the Oort ecosystem. Users submit proposals and vote on topics like network parameters, slashing mechanisms, and service fees. A proposal must be submitted with a certain amount of deposit, which is fully refundable once the proposal passes. If the proposal fails to pass, deposits will be distributed to the mining rewards pool for node providers.

The Oort Foundation will use up to 30% profit to regularly buy back and burn its utility tokens to reduce the total token supply on a quarterly basis and thus gradually and continuously increase token value. The token burning cap is 40% of the total token supply.

Fig. 5: Selected partners and collaborators.

VII. Partners and Friends

Our team's track record and reputation have helped us build a very strong ecosystem of partnerships. These partners include top universities in the U.S., legacy Internet giants, innovative Web3 projects, data centers and media platforms around the world. Our partnerships have significantly enhanced our branding, user acquisition, fundraising and system development. A sample list of our partners is listed in Fig. 5.

VIII. Publications

Academic Papers:

1. C. Li, L. Zhang and S. Fang "EntrapNet: a Blockchain-Based Verification Protocol for Trustless Computing", IEEE Journal Internet of Things, 2021.

2. H. Wu, A. Ashikhmin, X. Wang, C. Li, S. Yang and L. Zhang, "Distributed LDPC Coding Scheme for Low Storage Blockchain Systems", IEEE Journal Internet of Things 7 (8), 7054-7071, 2020.

3. "Cost-Efficient Hardware Spoofing Detection in Decentralized Shared Computing Network", Submitted to Sigmetrics.

Patents:

1. C. Li, L. Zhang and S. Yang, "Methods and Apparatus for Performing Distributed Computing using Blockchain", US16/274,178, Aug. 31st, 2021 (Granted).

2. C. Li, L. Zhang and S. Yang. "Methods and Apparatus for Verifying Processing Results and/or Taking Corrective Actions in Response to A Detected Invalid Result", S.N. 16/370,629, April. 6th, 2021 (Granted).

Built by innovators, for innovators.