

Meson Network

The next generation distributed network with faster cheaper
and more stable service

Daqnext Foundation

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Overview

With the evolution of the Internet, stream media such as video, live streaming, short video have entered mainstream and experienced exponential growth. More and more people spend an increasing chunk of their time on entertainment using stream media. In 2020, due to the impact of COVID-19, popular demand for online entertainment has risen to an unprecedented level. Short video platforms such as Tiktok has a daily active user population of over 600 million in August, 2020, Netflix global subscriber population has surpassed 180 million in March, 2020, Taobao top streaming sales channels have created a record of having a live audience of over 100 million. Behind such an impressive demand for stream media, is the equally impressive cost of bandwidth.

In order to guarantee the viewing experience of users from all across the world, traditional internet companies tend to use content delivery network(CDN) to speed up content delivery. At Amazon's early time, it once reported for its website to have an additional visiting time of 1s, it needed to have an additional sales revenue of \$1.6 billion USD. In the era of stream media, users have become more sensitive about content consumption experience, data transmission volume has grown tenfolds and hundredfolds, the demand for higher video quality has been also rising considerably. According to the prospectus of Kuaishou, its short video platform had doled out 2.52 billion Chinese Yuan (\$388m USD) to pay for bandwidth and server cost. Thanks to the explosion of stream media, a new era of CDN market has also been growing with tremendous speed.

Existing third party CDN solution providers such as Akamai, Cloudflare, AWS and AlibabaCloud all employ centralized IDC server houses distributed around the globe to speed up content delivery and charge an expensive price. Akamai and Cloudflare, two of the major providers that solely focus on the CDN market, are worth \$15-20 billion USD each, general cloud service platform AWS has a market capitalization of over \$1.5 trillion USD. At the same time, be it servers rented or hosted in IDCs by cloud service provider, or even household wifi bandwidth, there is a significant percentage of bandwidth that is idle at any given point in time. Many have hardware configuration and network service environment that are at the same level or even better than those of CDN solution providers. Based on this, we propose "Meson Network" to break the monopoly of CDN market, releasing more market value to end users and decrease the cost of enterprise CDN.

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1. Background

Video streaming platforms such as TikTok, Youtube, Instagram, Twitch and Netflix greatly improve the diversity and quality of entertainment life online. For instance, the fastest growing short video platform TikTok achieved an app downloading volume that surpassed that of Facebook, Instagram, Snapchat and Youtube. According to Prior Data, as of November, 2019, the total number of TikTok app downloads had surpassed 41 million. In 2020, with the sudden arrival of COVID-19, online entertainment applications have exploded in visiting volume, in January 2020, TikTok had achieved a monthly download volume of 7.7 million in the US, and became the most downloaded non-game app, a YOY increase of 28.3%; in February, TikTok download volume exceeded 6.4 million, still the number one spot in the US non-game application market; in March, total usage time for TikTok exceeded 600 million hours. In the same season, TikTok had a total number of downloads on IOS and Google Play exceeding 315 million times, the most downloaded app in a season of all time.

In August 2020, Data presented by TikTok showed its daily number of active users had exceeded 600 million. According to the November 2020 prospectus of TikTok's competitor Kuaishou: Kuaishou's number of daily active users has exceeded 300 million in China, a YOY increase of 110%. Other than short video, live stream platforms have also experienced extraordinary growth. Taobao is a classic example of e-commerce sales platform, during its highest user activity period in its November 11 event, there are over 100 million users online at the same. Other platforms such as Twitch and Douyu have paid a huge fee for bandwidth to ensure high quality user experience. Therefore, bandwidth intensive applications such as stream media applications are storming the world, and to ensure user experience, huge sum of money has to be paid to CDN solution providers around the world.

	Year ended December 31,			Six months ended June 30,	
	2017	2018	2019	2019	2020
	RMB'000	RMB'000	RMB'000	RMB'000 (Unaudited)	RMB'000 (Unaudited)
Revenue sharing to streamers and related taxes	4,395,623	10,396,086	18,149,248	8,690,619	9,788,097
Employee benefit expenses	740,539	2,399,656	4,364,197	1,837,288	3,501,104
Promotion and advertising expenses .	1,264,725	4,077,084	9,422,745	2,863,981	13,284,834
Outsourcing and other labor costs	40,592	173,620	274,733	104,184	205,600
Depreciation of property and equipment	84,186	828,980	1,405,313	559,103	1,375,582
Depreciation of right-of-use assets . .	24,085	325,831	692,228	250,591	704,900
Amortization of intangible assets . . .	7,229	24,774	62,842	25,889	51,039
Bandwidth expenses and server custody costs	807,902	1,830,875	2,650,623	1,195,147	2,519,088
Payment processing cost.	269,338	488,770	642,155	319,986	434,807
Professional fees	27,857	51,176	58,700	24,517	40,836
Auditor's remuneration					
— Audit services . . .	2,146	1,938	4,371	764	1,651
— Non-audit services	79	3,411	289	371	339
Tax surcharges	42,343	141,916	326,337	136,231	224,612
Credit loss allowances on financial assets . .	—	1,040	22,298	7,140	7,922
Others	86,314	313,053	615,373	199,741	1,101,465
	<u>7,792,958</u>	<u>21,058,210</u>	<u>38,691,452</u>	<u>16,215,552</u>	<u>33,241,876</u>

Figure 1.1: Kuaishou HKEX Prospectus

2. Introduction to CDN and Existing Concepts

2.1 What is Content Delivery Network(CDN)

CDN is a cost effective and reliable solution to the user experience and access problems brought by an exponential explosion of content delivery, storage and distribution. CDN is a new web infrastructure that is made up of accelerator nodes that are distributed geographically. These service nodes will store your business content according to some caching strategies. When a user initiates a request for your business services, the request will be routed to the service node closest to the user so responses can be as quickly as possible, and delays can be minimized, effectively improving user experience and service usability.

2.2 Why CDN

2.2.1 Increasing Access Speed

Traditionally, most enterprises only deploy their servers in a few regions, which could not meet the need of servicing a global or even a national audience due to the complexity of regional networks, not to mention the complexity of a global network. Having a limited number of nodes that are topologically concentrated simply cannot guarantee access quality across the network. Because services provided by modern internet companies naturally cater to a national or even an international audience, this accessibility problem has become ever more critical to businesses. As users become further and further away from servers rooms, the time it takes to transmit information becomes longer, network uncertainty becomes bigger. CDN is a highly effective solution because CDN nodes can be deployed all around the world, and data can be cached in these nodes. This significantly improves access speed an accessibility of online services even in a massive and highly complex network.

2.2.2 Decreasing Network Usage Cost

Using CDN solution can greatly reduce the cost of R&D and network fees.

2.2.3 Security Against Attack

When an enterprise exposes its own servers' source IP addresses to end users, it makes itself extremely vulnerable to attacks such as DDoS that will damage the stability and security of its online services. Using CDN can hide the source IP addresses and protect the servers from DDoS.

2.3 The Current State of Growth of the CDN Market

The CDN market has a size of \$23B USD, while growing at a fast and accelerating rate.

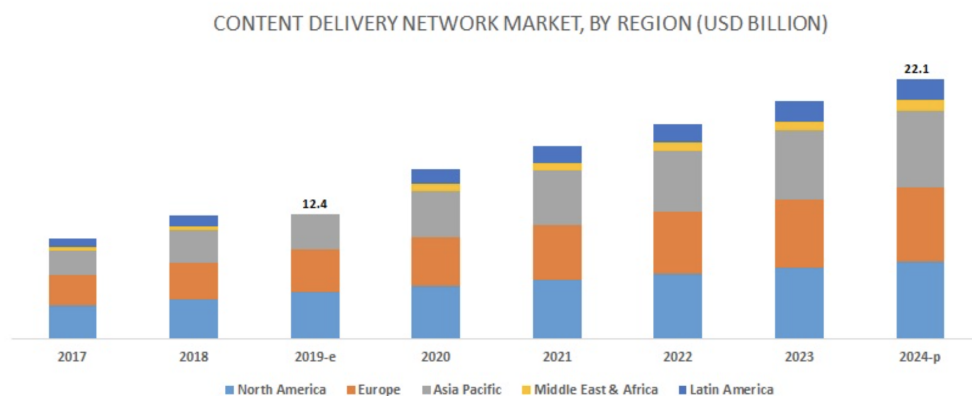


Figure 2.1: <https://www.t4.ai/industry/cdn-market-share>

2.4 Future Development Directions for CDN

With the continuous deployment and improvement of network edge computing capabilities as 5G era arrives, network operators are increasingly deploying MEC CDN to maximize return on computing resources and take advantage of the similarity between edge computing and CDN and the similar suitability of deployment locations.

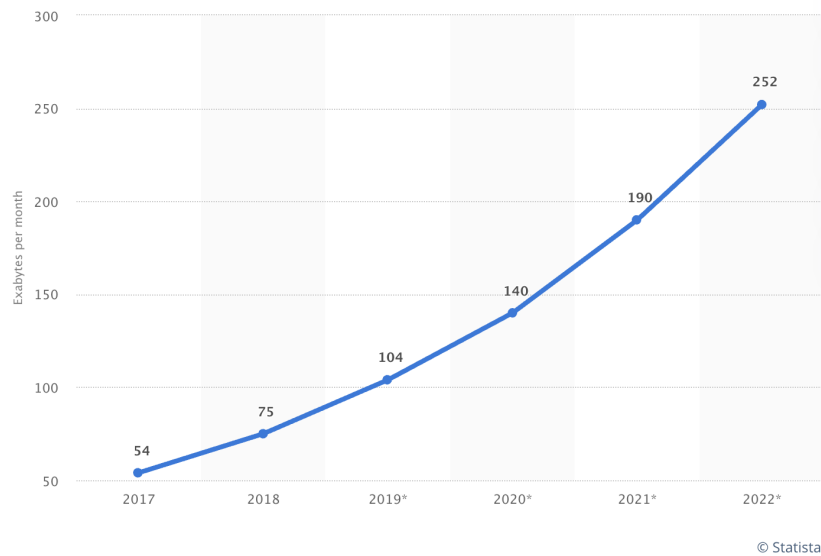


Figure 2.2: <https://www.statista.com/statistics/267184/content-delivery-network-internet-traffic-worldwide/>

According to relevant research data, more than 72% of total internet traffic will go through CDN by 2022, an increase of 28% from 2017. This shows that the CDN market will maintain high growth and gradually become the dominant solution for the increasing demand on higher speed delivery of content in the 5G and Web 3.0 era.

With the a accelerating growth of new network infrastructure such as 5G, IoT and Web 3.0, CDN and experience delivery network (EDN) will also continue to improve the access volume, speed and quality of online services and networks through the provision of highly stable content delivery and edge computing products. Therefore, better CDN products will be able to quickly obtain market share in the current expansion and mass adoption phase of the CDN market.

3. The Problems Meson is Solving

3.1 Breaking Monopoly

Nowadays, so many companies are using CDN services that top CDN solution providers like Akamai and Cloudflare have reached market capitalization of over tens of billions of US dollar. With the explosion of stream media, future demand for CDN will only get larger and larger. However, many companies do not have a lot of choices when it comes to CDN solution providers. The market price has been more or less fixed, and market profit has been shared by several CDN giants. Looking from the supply side, there is a wealth of idle bandwidth that can offer CDN network resources and hardware comparable to those offered by CDN giants, thus there exists a significant quantity of invested bandwidth resources that have not been optimally monetized. Meson provides an opportunity to break the monopoly of CDN giants, on one hand, we provide a network provision standard for bandwidth resources to be connected, on the other hand, we release the extra value that is been kept behind locked door by CDN giants so far.

3.2 Saving Sunk Cost

With the rapid expansion of the global cloud computing industry, a large number of cloud service and peripheral service vendors have emerged. Looking at the structure of the industry chain, there exists several types of agents in the sector:

- 1) Renters or owners of servers inside IDC host rooms;
- 2) Users of general cloud computing platforms;
- 3) Enterprises that possess their own servers.

At the business level, no agents can guarantee the full use of their computing resources, so at many points in time, a significant amount of computing power sits idle for any of the actors in the cloud computing industry. If

the overall scheduling has been well optimized, then the proportion of idle resources is reasonable, and the cost would be relatively low. Otherwise, if growth had not been as good as expected, then it is highly probable that a significant portion of computing resources will be idle and wasted. These are the sunk costs.

Let us then take a look at the common household's daily bandwidth usage. On a weekday, an ordinary user usually works for 8 hours and sleeps for 7 hours. the home internet may only be used 8 hours a day for work, and even with entertainment activities after work accounted for, the average idle rate of household bandwidth still exceeds 2/3 on a usual working day. Regardless of the high idle rate, users still need to pay a fixed bandwidth fee for their subscribed internet services. These are the sunk costs.

Server resources can be categorized into computing resources, storage resources and bandwidth resources. Computing resources are the most easily utilized. For instance, a lot of servers or computers are used for mining ETH and XMR by contributing computing power to the network. This is a typical case of monetizing idle computing resources. however, cryptocurrency mining predominantly uses computing resources to secure the network, bandwidth resources have not been utilized equally by the market and there exists a sea of untapped cheap bandwidth resources. Therefore, we propose an effective solution for monetizing idle bandwidth and storage resources via a specialized CDN network.

3.3 The Lack of Closed Blockchain Business Loops

In the current state of the blockchain world, many projects could be greatly hyped in a short period of time, but most of them disappeared or became silent before long. The reason for such phenomena is that most of their business models are not closed loops, meaning they need to rely on stimulating constant speculation and price appreciation in order to get more and more buyers of their token. This inevitably leads to collapse of the token price and of the project that needs token price appreciation to stay relevant.

Meson has a clearly viable commercial closed loop business model. It is able to generate more profit as its server resource network becomes larger. Combine this with an effective blockchain based token economic design will allow us to connect idle server resources to those who need cheap and reliable server resources. We believe this closed loop ecosystem is able to become a front-running CDN solution that will create extraordinary value for both

the providers and the users of Meson. We seek to utilize tokens as basic incentive legos to drive the contribution of server resources to the network, as well as continuous development and optimization of products, ultimately helping Meson evolve into a sustainable growth economy.

4. Meson

4.1 Design Philosophy

We adhere to the following principles in designing Meson:

Simplicity: The architecture and communication components should be as simple as possible, so that the average engineer can effectively implement the defined specifications with ease and introduce the protocol through their applications and works. We would not add overly complex optimization schemes unless absolutely necessary.

Open: the protocol does not impose any restrictions, any terminals that comply with the specification and requirements of the protocol can join the network. The network behaviors are not restricted. Users can use the resources within the network as long as they pay the necessary fees stipulated by the protocol.

Modular: The Meson design is modular. Each module should be as independent and decoupled from each other as possible so that one module would not have a significant impact on the other.

Ease of use: End users only need double click on a program in Windows or copy paste a command line in Linux in order to join the network. Generated return should be displayed visually, alongside the contribution and withdrawal of server resources. User friendliness has always been an important tenet for Meson.

4.2 Network Roles

We hereby define several roles and functions in the network

- Terminal: A terminal node that joins the CDN network to store data and respond to service request in order to gain revenue.
- Router: Responsible for allocating and scheduling network requests.
- Hunter: Responsible for finding bugs and vulnerabilities in terminals by sending requests to terminals in order to evaluate their reliability and integrity. It submits information about problematic or at risk terminals to the council to receive high bounty rewards after verification.

- Council: Responsible for governance and oversight.
- Client: Ordinary Internet users
- Business User: Customers who have a need for the CDN network.

4.3 Protocol and Information

The core functions of the terminal is to carry out data caching, deletion and response services, as well as providing heartbeat packets and local configuration information to ensure the Core can perceive the existence of the terminal. In addition, if the terminal is down, the integrity of the files needs to be self-checked and updated when the terminal is restarted. Since the terminal code is open sourced in the design, there exists the possibility of malicious actions, thus it is necessary to do spot checks and verifications on data and transmission.

In view of the above functions, the terminal needs to include the following basic operations

- save/cache file(s) (originURL, verified hash, TTL)
- delete file (file hash)
- get file (file hash)
- heartbeat
- hardware configuration
- index of local cached files
- shards spot check

4.4 Transmission Verification

The key to CDN is data transmission acceleration. Under a certain level of total system resources, it is ideal for terminals to store as much cached files as possible, while also moving frequently requested files to be cached at locations close to the requester. After a terminal is started, it will start to cache files. When a certain threshold is reached, the terminal will delete files that have low request frequency. The deletion operation is initiated by the terminal, and verified by the dispatcher. Alternatively, Deletion operation can also be directly made by the control terminal. When assigning caching tasks, the control needs to know the remaining storage space of the terminal and whether it has the ability to continue to cache files so as to optimize network efficiency.

Since terminal code is open sourced, users may perform malicious actions, thus the network requires transmission verification for security. Meson uses

spot checks and bounty hunters as means of verification and checks against potential attackers. The malicious behaviors of users can be divided into two categories: Modify data or decline to store corresponding data.

When dealing with maliciously modify data, the scheduling module has a hash check of the data source and randomly stores part of the fragmented data. The system will randomly check the data stored in the terminals according to certain proportions and weights. If it is found that the data returned by the user is different from stored data, then the user will be punished with a fine.

For attacks that involve not storing data, we propose the defense of random checks by the system on one hand, and the introduction of bounty hunters on the other hand. When hunters request terminal services, if the data is missing or damaged, the hunter can submit information directly to the council and obtain rewards after verification. If terminals are found to be malicious, their tokens will be confiscated and distributed to the cheated parties according in order to disincentivize destabilizing factors in the network.

4.5 Reliability and Redundancy

A key feature of CDN is its ability to keep content online even when faced with common network problems such as hardware failures and network congestions. By means of load balancing internet traffic, using intelligent failover, and maintaining servers across many data centers and locations, CDN can avoid network congestions and resist service interruptions.

Data centers can use load balancing to distribute incoming requests to available server pools to ensure traffic peaks are handled in the most effective manner. Load balancing can increase data processing speed and optimize server capacity usage. Proper balancing the load of incoming traffic is a key component in mitigating peak traffic during periods of atypical internet activities (such as when a website encounters an unusually large number of visitors, or when a distributed denial of service attack occurs). Using load balancing can also help make swift and effective changes when the supply of server resources fluctuate significantly up and down. If a server fails and a failover occurs, the load balancer will redirect the traffic allocated to the failed server and redistribute it proportionally to the remaining servers. This will decrease the possibility that a hardware failure will interrupt traffic, thereby providing flexibility and reliability to the entire network. When a new server comes online, the load balancer will offload other servers proportionally and increase the utilization rate of the new hardware. Leveraging software-based load balancing services, CDNs can quickly expand load bal-

ancing capacity without encountering bottlenecks when using physical load balancing hardware.

Making use of the Anycast routing method to transmit internet traffic to a specific terminal helps Meson reduce response time and prevent any terminals from becoming overwhelmed in the event of abnormal demands such as DDoS attacks. Thanks to Anycast, multiple computers can share the same IP address. When the request is sent to the Anycast IP address, the router will direct it to the nearest computer in the network. If the entire network fails or is unable to cope with a large amount of communication due to other reasons, the Anycast network can respond to service interruptions similar to how a load balancer transmits communication across multiple servers: data is transferred from the failed location and routed to another functioning terminal.

4.6 Economic and Governance Model

4.6.1 Token Incentives

Meson uses blockchain tokens as a means of providing and changing incentives. In BitTorrent network, users would contribute their upload bandwidth to get a better download speed, but in many cases, they would exit the network(close the software) after the download is completed. At this time, the network is idle, but because there is no download needs and no other incentives, users will not continue to be on the network after their downloads. The main problem with the original BitTorrent network is that there is only the possible exchange of similar resources, if users want more download bandwidth, they have to provide upload bandwidth in exchange. however, once they have fulfilled their download needs, the exchange ceases and that decreases the overall networking effect of BitTorrent. Now, if the exchanges can be manifolds, not just an exchange of bandwidth, but also with tokens and other value stores, users will be much more inclined to be on the network even without download need.

The tokens are distributed to network terminals as rewards for providing server resources. Users can evaluate the expected return of contributing resources based on their hardware situation. The role of hunters is to constantly look for cheating and malicious behaviors in the network. If hunters discovered such behaviors, they can submit relevant information to the council and pledge a certain amount of tokens on their claims. If the council confirms the claim, the terminals in question will be punished. Otherwise, the tokens pledged by hunters will be deducted as punishment. If Meson adopted a DAO

governance model, then holding tokens can initiate proposals and participate in voting, including joining the council and having a claim in dividend from protocol revenue.

The main profit generator of Meson is the provision of CDN services to businesses. Since the cost of running a terminal node is mostly a sunk cost, node operators can safely contribute resources for a profit so long as attention cost is minimal and no additional cost is incurred. Due to the standardization at the protocol level, users can join and exit at will without much hassle, making it easier to form a super-large-scale distributed CDN network. The effect of the network is proportional to the square of the number of nodes, so the Meson network has the potential to grow very rapidly. Because of token incentives, terminal nodes would voluntarily join the network. The more nodes, the higher the network effect capacity and value, leading to more demand and a higher price tag for our CDN services. The controller transfers fees paid by the CDN users to server resources contributors through the repurchase and destruction of tokens, aligning the interest of the investors, users and the protocol as a whole.

4.6.2 Governance Model

In order to make sure the continuous evolution and development of the network, Meson allows its token holders to vote to modify various parameters of the protocol. Anyone can submit a proposal to initiate a token vote, not just the token holders.

Changes to protocol variables are unlikely to take immediate effect after they pass voting. If the community decided to immediately adopt the governance results, then these changes will likely take place at the latest in 24 hours. This period gives token holders the opportunity to act, and if necessary, trigger a shutdown mechanism to oppose malicious governance proposals (for instance, making significant changes to the proportion of revenue distribution, which would likely hurt the interest of some token holders).

Council plays the role of maintaining order and stability in the network. Council members run the verification code in the Trusted Executive Environment (TEE). The council also inspects malicious behavior reports submitted by hunters in order to determine and carry out penalties. Members enter councils through a voting process, they also need to pledge/take tokens in order to take up a seat. The implementation of all proposals and actions is supervised by the council, such as carrying out punishment and handing out rewards.

4.7 Our Customers and Business Goals

Business service customers include all small, medium and large size internet companies

Any internet companies or platforms need CDN acceleration to ensure optimal user experience. Amazon's example of one second service disruption would cost it \$1.6 billion in sale is a testament to how critical stability and easy accessibility have become for online services. Even very small service access disruptions may incur significant loss on the service providers. The commercial goals of Meson in this consumer segment are

- 1) Extremely stable global acceleration;
- 2) Extremely fast global acceleration;
- 3) Significantly lower cost of acceleration service;
- 4) On click access without the need of any SDK or client installation.

4.8 Comparison with Filecoin

Filecoin proposed a scheme for storing data, but because the official design route puts too much emphasis on encryption algorithms and ignores the nature of commercial profitability, this design leads to the actual use of storage costs far higher than the storage prices of third parties such as AWS. In essence, it cannot form a closed loop of commercial competitiveness and profitability, and thus cannot be used for commercial purposes at a large scale.

On the other hand, Meson is not used for file storage but for file acceleration. Compared with storage, accelerated services have greater commercial value. the initial goal of designing Meson is to create a commercially viable closed loop business model, leveraging on service price that is significantly lower than traditional CDN providers. Both the economic model and the distributed approach to transmission are fundamentally in service to real business interests.

4.9 Comparison with BitTorrent

BitTorrent is a transmission method based on traditional P2P client. it is made for householder users in mind. This transmission requires the user to install the client or the SDK. However, since all network nodes are based on household clients, acceleration in the network will be relatively unstable. Commercial users tend not to use this service because of the non-universal nature of the integrated SDK and reservations about the uneven performance.

In sum, BitTorrent is in essence a household P2P network that provides storage and acceleration services.

In addition, the native BitTorrent network has problems on the incentive layer. Because the the resources exchanged are the same (contribute upload bandwidth to obtain download bandwidth), many users are not sufficiently motivated to provide services to the network after their own download tasks have been finished, resulting in greater overall uncertainty.

Meson draws on the advantages of BitTorrent while seek to solve the problems associated with BitTorrent. Meson aims to attract idle IDC resources in order to create the next generation CDN distributed protocol that takes advantage of a more reasonable incentive model to develop the cheap, highly stable and fast.

5. Applications

5.1 Large scale commercial CDN

Early data center users were motivated by token incentives to join the network. They seek to make revenue from their idle server resources, or at least save a portion of their sunk costs, thus their contribution enabled low cost but good quality service. In addition, CDN buyers will begin to pay to test the network due to cost and other considerations. The revenue from fees will be used in the repurchase of token, which strengthens the incentive effect and attracts an increasing number of users to the network. The effect of geometric growth will make the network exponentially more capable, which further entices businesses to use the Meson network and provides positive feedbacks to the nodes.

5.2 Edge Node CDN Access

With the adoption of infrastructure such as 5G, which has the traits of low latency and large bandwidth, a large number of edge nodes can serve as terminals for CDN service provision. IoT services, even smartphones, can join the network to earn revenue, in the process forming a large-scale distributed CDN network.

5.3 Idle Resource Access

Providing a way to monetize idle bandwidth.

6. Conclusion

We are in a great era of continuous technological advancement and progress. As more and more things obtain an information and data side, the demand for better internet speed and capacity has grown higher and higher. The end user experience has become a key area to invest in for many companies, with CDN at the forefront. However, at the same time, I also noticed that the solutions of many centralized vendors are not only costly, but also have the problem of performance instability. With the improvement of existing terminal node data processing capabilities, networks and storage, the basic conditions for establishing a new generation of CDN networks have gradually matured. Since the each type of terminal nodes serve different functions, such as coping with peak traffic, creating redundancy, testing and idle, there are many differences in their maintenance costs. Therefore, it is hoped that a set of agreements can be formulated so that users can choose to join the CDN network and use token to motivate users. Since the network is distributed and the cost is determined by the terminal nodes, it can provide a CDN service network with a relatively reasonable price and a reliable architecture. The rapid growth of the CDN market can bring significant positive incentives to the network, thus creating a reliable business model and ultimately create better experience for end users.