White Paper for Application

Hawk Network Team
2019/04

Distributed Intelligent Internet of Things
Table of Contents

Preface: Introduction to Hawk Network

1. Distributed Intelligent Internet of Things with High Availability
   1.1 What is Distributed Intelligent Internet of Things?
   1.2 Technical Characteristics of Distributed Intelligent Internet of Things
       1.2.1 Distributed Database Technology
       1.2.2 Edge Computing Technology
   1.3 More Credible Internet of All Things
       1.3.1 Blockchain Technology Used to Safeguard User Assets and Data
   1.4 How Can Hawk Network Empower the Internet of Things?

2. Multi-party built-in distributed travel network
   2.1 Sharing travel industry analysis
   2.2 Comparison of multiple shared travel modes
       2.2.1 Advantages of sharing scooters
   2.3 Market Analysis of Shared Scooters
       2.3.1 Analysis of Bird and Lime in Unicorn Enterprise Sharing Scooter
   2.4 Problems in the shared travel field
       2.4.1 Great risks brought about by concentrated investment
       2.4.2 Excessive operating costs and transaction costs
       2.4.3 Lack of network ecological effects
   2.5 Hawk and travel companies build a smart travel network
       2.5.1 Localization Diversified Inputs Reduce Risk
       2.5.2 Localization operations reduce costs
       2.5.3 Multi-party collaboration activates network effects
       2.5.4 Decentralized shared scooter (BHK DApp)
3. Technical Framework

3.1 Hawk Network architecture

3.2 Core Blockchain layer
   3.2.1 Distributed Shared Ledger
   3.2.2 Consensus Mechanism (UPOS)
   3.2.3 Elliptic Curve Cryptography

3.3 SDK/API Layer
   3.3.1 Smart Contract Systems
   3.3.2 User ID
   3.3.3 Modules

3.4 Service Layer

3.5 Application Layer

4. Token Economy

4.1 Hawk Network’s Token Economy Model

4.2 Mining Calculation and Operating System

4.3 Sales Plan of HAWK Tokens

4.4 Distribution of HAWK Tokens

5. Hawk Network team and partners

5.1 Hawk Network Team

5.2 Core members

5.3 Advisory Team

5.4 Partner

6. Hawk Network Roadmap

7. Disclaimer and other Legal Statements
Introduction to Hawk Network

Hawk Network refers to the technical infrastructure of the world’s leading distributed intelligent Internet of Things, which integrates edge computing, big data and blockchain technology. It aims to provide enterprises with lower access costs and a more efficient and trusted Internet of Things. Taking intelligent hardware as its base, artificial intelligence as its core, big data technology as foundation, and blockchain distributed ledger to balance its ecosystem and production factors, Hawk Network intends to ultimately achieve the goal of enabling global Internet of Things.

Black Hawk Knight (a.k.a. BHK) is the first application on Hawk Network. BHK aims to provide users with decentralized shared electric scooters for intelligent short-distance travel in cities. The hardware performance of BHK scooters is superior, and its energy efficiency ratio is 60% higher than that of similar products. It is planned to be distributed across over 50 countries and regions around the world. This distribution strategy adheres to the ideology of decentralization of blockchain, and all BHK corporate investors around the world will share the dividend brought by scaling up the entire distributed travel network through distributed ledger technology. Meanwhile, BHK Intelligent Scooter is also a super mining device-riding scooter mining, which not only conforms to the concept of having a green planet under sustainable development, but also belongs to a community incentive model.

By innovating the technological scheme and economic model, Hawk Network applies edge computing, user digital identity UID and multiple encryption technology to make devices, users and enterprises unimpeded in Hawk Network, thus ensuring the security of assets and data; HAWK Token is the value exchange medium of Hawk Network, and will be applied in various scenarios, such as payment, mortgage, financing, transaction and circulation of distributed Internet of Things. In short, Hawk Network uses blockchain technology to empower the traditional Internet of Things, and achieves a new generation of distributed intelligent Internet of Things. While HAWK Token is the master key of Hawk Network, it can be said that an era of intelligence and perception of all things has arrived.
1. Distributed Intelligent Internet of Things with High Availability

1.1 What is Distributed Intelligent Internet of Things?

The Internet of Things (a.k.a. IoT) is called the third revolution of the world information industry after computers and the Internet. At present, many countries are spending huge sums of money on research and development. The IoT is a new technology system that combines multiple information technologies. The concept of IoT was put forward by the Auto-ID Laboratory of MIT in 1999. By installing tiny identification devices on air conditioners, automobiles, electronic instruments, thermometers and other equipment, information like position and state of objects can be known at all times, thus achieving intelligent management. The concept of Auto-ID is supported by wireless sensor networks and radio frequency identification technology. At the 1999 International Conference of Mobile Computing and Networking held in the United States, it was put forward that the IoT is another development opportunity facing mankind in the next century. On November 17, 2005, at the World Summit on the Information Society (WSIS) held in Tunisia, ITU published ITU Internet Report 2005: Internet of Things, which formally put forward the concept of "Internet of Things". The report stated that: The omnipresent "Internet of Things" communication era is coming, and all objects in the world can actively exchange information through the Internet. Radio Frequency Identification (RFID), Wireless Sensor Network (WSN), Nanotechnology and Intelligent Embedding Technology will be more widely used. In 2009, IBM put forward the concept of "smart earth", embedded sensors and equipment into various application scenarios such as a power grid, railway, bridge, tunnel, highway, building, water supply system, dam, oil and gas pipeline, and achieved smart state through the intelligent processing. In summary, the Internet of Things refers a huge intelligent network that connects various information sensing devices and systems, such as sensor networks, radio frequency tag reading devices, two-dimensional code devices, global positioning system and other wireless self-organizing networks based on machine-to-machine (a.k.a. M2M) communication mode to Internet through various access networks.

Internet of Things Architecture

![Figure 1-1 Architecture of Internet of Things](image-url)
Distributed Intelligent Internet of Things (DIIOT) is an IoT that uploads all sensor data through precise calculation to the blockchain for data interaction. Blockchain uses distributed storage instead of a traditional centralized storage. Distributed storage has the advantages of data consistency, high availability and fault tolerance. In distributed systems, availability refers to the concept of independent failure. When one or more nodes fail, the rest of the system is completely unaffected and can continue to run. Consensus algorithm can be used immediately to achieve use upon connection so that the information processed by the system can always be used by users. Similarly, all hardware devices in the distributed intelligent IoT are accessed by different devices, and a certain number of edge calculations are carried out at the device end for data processing, and then the data is uploaded to the chain for verification according to the computing requirements. In this process, no one can modify the data entry of the equipment alone, this can ensure the transparency, fairness and distributed characteristics of data entry.

1.2 Technical Characteristics of Distributed Intelligent Internet of Things

It is believed that distributed intelligent Internet of Things has two core features, namely, edge computing and distributed data technology. The device and data are connected by blockchain technology. In the near future, when large-scale 5G network is launched, the whole distributed intelligent IoT will be unprecedentedly developed.

1.2.1 Distributed Database Technology

Distributed Data Base (DDB) is a combination of traditional database technology and network technology. In recent years, with the rise of blockchain technology, the concept of distributed database technology has new meaning, not only that in tradition: a distributed database is physically scattered on the nodes of the computer network, but logically belongs to the same system of data collection. It has the characteristics of local autonomy and global sharing, data redundancy, data independence and system transparency. Distributed database management system supports the establishment, use and maintenance of distributed database. It is responsible for managing local data, data communication, distributed data and data dictionary. The penetration and integration of database technology and network communication technology, artificial intelligence technology, object-oriented programming technology and parallel computing technology has become the main characteristics of the current development of database technology.

The system of Internet of Things (IoT) database management presents severe data storage challenges in various fields. The distributed database technology is discussed
According to the definition of Edge Computing Consortium (ECC), Edge Computing is an open platform that integrates network, computing, storage and application core competencies on the edge of the network near to the source of objects or data. It provides edge intelligent services to meet the key needs of digital industry in the aspects of agile connection, real-time business, data optimization, application intelligence, security and privacy protection.

1.2.2 Edge Computing Technology

According to the definition of Edge Computing Consortium (ECC), Edge Computing is an open platform that integrates network, computing, storage and application core competencies on the edge of the network near to the source of objects or data. It provides edge intelligent services to meet the key needs of digital industry in the aspects of agile connection, real-time business, data optimization, application intelligence, security and privacy protection.
Edge computing is another new computing model after distributed computing, grid computing and cloud computing. We believe that edge computing takes cloud computing as core, modern communication network as way, and massive intelligent terminals as frontier. By optimizing the allocation of resources, it makes computing, storage, transmission and application services more intelligent, with complementary advantages and deep coordination of resource scheduling capabilities. Its concept contains rich meaning and can be analyzed from several aspects.

1. **Edge computing is a global computing model, which covers the center and edge**

   Edge computing consists of two parts: firstly, the marginalization of resources, including computing, storage, caching, bandwidth, services and other resources, extends the original centralized resources in depth and provides high reliability, high efficiency and low latency user experience close to the demand side; secondly, resource globalization, which means that the edge serves as a resource pool instead of the center providing all resources. The edge computing fusion centralized computing model achieves the goal of complementary advantages, coordination and unification through the coordination between the center and the edge.

2. **Edge computing requires global collaboration to achieve efficient computing performance**

   Edge computing should be considered globally, not only at the edge of the network, but also in collaboration with cloud computing centers and data centers located in the center. Their collaborative computing, parallel processing and network transmission optimization shall be all considered globally in order to obtain the optimal processing efficiency.

3. **Edge computing is an intelligent computing model, which can provide dynamic services according to demand dynamically**

   Edge computing is an upgrade of the three-tier structure of cloud, network and end, and an important step toward intellectualization. Edge computing usually has the ability of situation perception. By context-perception business scenarios, user needs, computing scale, storage size and so on, the situation can be targeted, and dynamically configure resources according to user needs, thus making the computing model more intelligent.

4. **Edge computing makes Central Intelligence expand to front-end intelligence, and intelligent collaboration will be future development trend**

   To some extent, edge computing moves intelligence to edge. Many front-end intelligent terminals can handle complex processing tasks independently and can process valuable raw data collected by equipment in real time. The realization of edge network intelligentization is to optimize, coordinate, configure and manage business, performance, security and other indicators by means of intelligent management and control. In addition, front-end intelligence is a form of edge computing, which greatly optimizes and improves the key parameters of AI, such as perception distance, perception type, processing speed and transmission delay.
In summary, when the edge computing is mature, the traditional network structure model of the Internet of Things is changed. Using edge computing technology, after local calculation at the front end, the computational pressure on the blockchain is greatly reduced, which makes the calculation on the chain more efficient.

1.3 More Credible Internet of All Things

According to Hawk Network, only integrating distributed database technology, edge computing technology and blockchain technology, can the Internet of Things be called a more trusted distributed intelligent network different from the traditional Internet. This network not only greatly improves the operation efficiency of the traditional IoT and reduces the computing cost, but also is a highly perceptive and secure trusted network.

Blockchain is a kind of distributed ledger that uses cryptography technology to encode the effective information in the system. Blockchain can make every transaction real and effective. It must reach a consensus on the ownership of digital assets and make such digital assets unable to be tampered with and deleted. Thus, data entry must complete the consensus, as blockchain security is more demanding than that of other systems. In recent years, there have been many major security incidents in blockchain development. In August 2010, hundreds of millions of Bitcoins were created out by exploiting integer spillover vulnerabilities. In May 2016, there were also funds for technology development communities and decentralization of blockchain entrepreneurs organized by many scientific and technological teams, which found vulnerabilities and terminated the project.

Secure and trustworthy at blockchain level include: firstly, has trustworthy computing resources. Blockchain is developed on the basis of Internet. Computing resource networks must be credible. Secondly, has controllable transaction data. Decentralization is an ideal state. It should not be completely controlled by either party, which is equivalent to the influence of arbitration. We should ensure that blockchain data such as Bitcoin can be stored and transmitted safely and trustfully. Thirdly, has reliable trading process. In the course of the transaction, it shall be true and credible, and cannot be forged. Trusted computing can solve the security of blockchain. The so-called “secure and trustworthy” emphasizes the promotion of secure and trustworthy network products and services. We should consider the security reasons, not because of vulnerabilities, subsidize vulnerabilities. Instead, the IT hardware and software involved in daily life are composed of many logic, which are divergent and inexhaustible. Therefore, the task can be accomplished by combining relevant logic to accomplish the task. When all the smart hardware and devices in various fields are linked through edge computing and blockchain computing, a truly trusted Internet of All Things comes into being.
1.3.1 Blockchain Technology Used to Safeguard User Assets and Data

1. IoT and blockchain

The idea of applying blockchain technology to the field of Internet of Things has existed for some time. In fact, Blockchain technology seems to be an appropriate solution to IoT at least three aspects: big data management, security and transparency, and the convenience of service exchange between interconnected smart devices.

2. Large Data and Record Preservation

IoT is essentially linked to large data. With the increasing number of IoT units installed, the consumption habits and behavior patterns data collected in the Internet of Things have multiplied. How to deal with this huge data has become a problem that must be solved. In this case, some people think that "there is no
Blockchain technology can be further used to solve security and identity problems related to IoT. One of the biggest challenges in securing the Internet of Things is identity. More specifically, how do we ensure that millions or billions of smart devices connect and communicate safely with each other is the goal of the research on Hawk Network.

3. Security

Blockchain technology can be further used to solve security and identity problems related to IoT. One of the biggest challenges in securing the Internet of Things is identity. More specifically, how do we ensure that millions or billions of smart devices connect and communicate safely with each other is the goal of the research on Hawk Network.

1.4 How Can Hawk Network Empower the Internet of Things?

How does blockchain technology become a new generation of infrastructure that balances decentralization, security and performance? How does blockchain combine with Internet of Things to form a trusted Internet of Things? From the current point of view, the IoT is a trigger point in the future. The IoT fits naturally with blockchain in many aspects. Objectively speaking, the combination of the IoT and blockchain has other challenges besides the distributed data storage and edge computing mentioned above. The combination of the IoT and blockchain is extremely complex. To face billions of devices with different computing power, it is required to solve the problems of interoperability, security, privacy and incentives of heterogeneous systems.

Hawk Network has clear steps to solve these problems one by one. The goal is to make billions of devices in the Internet of Things safely accessible to blockchains and to achieve interoperability between devices and data. Ultimately, in order to achieve a real landing, ultra-large-scale Internet of Things equipment must achieve fast, low-cost transactions, and can protect privacy, meet the equipment interconnection of heterogeneous systems, and encourage more nodes to enter, increase deployment scale, and reduce operating costs. To solve these problems, Hawk Network implements a three-step approach.

1. **UPOS consensus algorithm is more suitable for distributed Internet of Things**

Hawk Network adopts UPOS (User Proof of Stake) consensus mechanism. UPOS is designed to solve the drawbacks of traditional DPOS (Delegated Proof of Stake) consensus mechanism. For example, the representative nodes of block generation in DPOS mechanism are relatively fixed, which is difficult to meet the needs of complex blockchain architecture in the Internet of Things. The
improvement of UPOS is to propose a random rotation mechanism of proxy rights and interests consensus. Through cryptography technology, a group of nodes are randomly selected from the dynamic node pool to generate blocks. At the same time, the communication complexity of PBFT is optimized to improve transaction throughput. One of the advantages of Random Rotation Agency Equity Consensus Mechanism is that it adapts to Hawk Network’s master-sub-chain architecture, and can support complex block-chain architecture by dynamically partitioning the pool of proxy nodes to ensure the efficient and safe operation of the mainchain and subchain elastic architecture.

2. Main sub-chain structure to achieve cross-chain interoperability, submission efficiency

Because of different scenarios and requirements, in order to achieve communication between heterogeneous systems, Hawk Network does not adopt a common chain applicable to all nodes, but allows heterogeneous devices to form an internal network first, and finally connect to a large backbone network to achieve connectivity with other networks. Hawk Network adopts chain-in-chain architecture to solve the interconnection problem of heterogeneous networks. There is a single main chain, and there are many different subchains on the main chain. Applications and devices running on different sub-chains are different, and can be customized to solve the heterogeneity of the Internet of Things. Through the chain-in-chain approach, the sub-chains of different scenarios serve different needs. For example, sub-chains running on devices with weak storage can use Mimble-like Wimble architecture to reduce storage; subchains focusing on payment scenarios may not need to run smart contracts. These different chains need to transmit digital assets and states. Cross-chain protocols can achieve interoperability between chains. Of course, it also needs to consider the impact on cross-chain performance and security implications.
3. Trusted Computing Environment Empowers the Internet of Thing

Hawk Network has improved the technology of Internet of Things to make it portable, trustworthy and support large anonymous collections. Subsequently, on the premise of depending on trusted computing environment, cryptographic tools will be used to implement lightweight privacy protection intelligent contracts. Thus, the Internet of Things can be empowered with blockchain and edge computing technology. Once the technology is mature and the problems of performance, interoperability, cost, privacy, security and so on are solved, trusted Internet of Things has a high probability of becoming the next trigger point of the blockchain. Therefore, it can promote the development of the IoT, make the IoT to eventually become the mainstream, and ultimately bring more convenient, safe and credible services to people through technology and incentive mechanism.

Next, this paper will introduce the first application of Hawk Network Distributed Intelligent Internet of Things -- the technology and business paradigm in the field of intelligent travel, to further illustrate the application prospects and directions of Distributed Intelligent Internet of Things.
2. Second, multi-party built-in distributed travel network

2.1 Sharing travel industry analysis

As of January 2018, the total valuation of the five largest shared travel service platforms for Didi, Uber, Lyft, Grab and Go-jek reached $129 billion. According to Bloomberg News, in 2017, the global mobile travel company financing scale reached 28 billion US dollars. In China, the amount of financing in the shared vehicle sector reached 76.259 billion yuan, while the value of the Moby, ofo and Harrow bicycles in the shared bicycle sector were US$2.7 billion, US$2.8 billion and US$2.316 billion, respectively.

As the birthplace of shared travel services, the market demand is very strong, the giant Uber is valued at 100 billion US dollars, Lyft is valued at 15.1 billion US dollars, and also produces electric scooters unicorns with a valuation of more than 2 billion dollars, such as Bird and Lime. According to the distance, we divided the three areas of short-distance travel (distance 5 miles or less), medium and long-distance travel (5 to 15 miles) and long-distance travel (15 miles or more) to analyze the overall situation of the shared travel industry. Short-distance sharing is mainly about 5 miles and less, which accounts for 60% of American travel needs, including shared bicycles, electric bikes and electric scooters.
2.2 Comparison of multiple shared travel modes

To solve the last mile of shared electric scooters, just as e-commerce giants pay great attention to the last mile of logistics and distribution, shared travel also meets people's various travel needs, and shared electric scooters meet people from home to subway stations or The subway station to the company's last mile travel demand. In the three modes of shared travel, the advantages of sharing an electric scooter are obvious – flexible, less physically exhausted, and comfortable to travel. With the daily commuting needs of home and company or home and school, the shared commuter needs to directly meet the travel needs from home to the company, but the higher the price is very low; the shared bicycle can meet the medium distance home. The company's travel needs, but the disadvantage is that physical exertion is high, and the travel comfort in summer and winter is low; the comparison of the three modes is shown in the following table:

<table>
<thead>
<tr>
<th>Mode</th>
<th>Travel demand</th>
<th>Advantage</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shared car</td>
<td>Home to company</td>
<td>Meet long-distance travel needs</td>
<td>High unit price</td>
</tr>
<tr>
<td>Shared bicycle</td>
<td>Home to company</td>
<td>Meet the medium distance travel needs</td>
<td>High physical exertion</td>
</tr>
<tr>
<td></td>
<td>Home to subway station</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Subway station to company</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sharing electric scooter</td>
<td>From home to subway station</td>
<td>Meet short-distance travel needs</td>
<td>Travel distance cannot be too long</td>
</tr>
<tr>
<td></td>
<td>Subway station to company</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>company</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 2-2 share the three kinds of travel patterns Comparative

2.2.1 Advantages of sharing scooters

On the whole, sharing electric scooters has two advantages:

First, the operating costs are low. One of the drawbacks of shared bicycles is that, over time, bicycles will be piled up in subway stations, residential quarters or business districts with a relatively large population. Everyone has this kind of experience. When you want to use a bicycle, it is always difficult to find a car. In the subway or community door where you don't need a bicycle, there are always rows of bicycles. In order to make the bicycle more dispersed, it can only rely on the bicycle operation platform to use the:
truck to manually evacuate the bicycle, and transfer the gathered bicycle to other unpopular areas, which undoubtedly increases the operating cost of the platform. The operating costs of sharing electric scooters are relatively low. To share the electric scooter to solve the charging problem, people are encouraged to take the electric scooter home to charge, and will receive certain rewards after charging. After charging is complete, people only need to put the electric scooter in the designated position. As a result, the community user charging the electric scooter actually acts as a scooter regional dispatcher, and because the charging person is sufficiently dispersed, the scooter will be redistributed relatively evenly throughout the city every morning.

Second, the frequency of use is higher. The profitability of the platform depends on five factors: unit price, daily usage, operating cost, maintenance cost, and vehicle scrap rate. In addition to the advantages of sharing bicycles in terms of operating costs, shared electric scooters have advantages in terms of daily usage. The average daily usage times and the travel distance are inversely related. The shorter the travel distance, the more the corresponding travel tools are used, because there are more short-distance travel scenarios. For example, bicycles can meet the medium-distance travel demand from home to subway station, so whether it is near the home or near the company's short-distance travel demand, you can use electric scooters to meet, such as nearby dining, bank ATM cash withdrawal, convenience store shopping, pharmacy buying Medicine, etc. In addition to seasonal constraints, bicycles are also gender-constrained. Women who wear professional attire or skirts are not convenient to ride a bicycle. There is no such concern in sharing electric scooters, so the potential users sharing electric scooters are wider.

Figure 2-3 Electric scooters have become the first choice for short distance travel
2.3 Market Analysis of Shared Scooters

According to market research firm Grand View Research, the global electric scooter market was valued at $14.8 billion in 2015. It is expected that the increase in greenhouse and carbon emissions and the increase in environmental awareness will help to adopt electric scooters for the next eight years. The demand for electric scooters has led to a fundamental shift in the existing vehicle landscape in the areas of design, development, power distribution and power infrastructure. The role of governments in India, China and Japan in developing vehicle charging station standards and regulations is expected to have a positive impact on regional growth.

In 2015, the Asia-Pacific electric scooter market accounted for more than 77% of the industry. North America will become a prominent region during the forecast period. By 2025, California's goal of reaching 1.5 million zero-emission vehicles is expected to boost demand for electric scooters in the region. If the shared car solves most of the problems in transportation, then the electric scooter is like the shared bicycle of the year, to solve the "last mile". From San Francisco to San Jose, from Berkeley to Oakland, and even to Santa Monica in South Carolina, despite the regulatory barriers in cities – electric scooters and their respective services are still rapidly penetrating every corner of the global market. Earlier this week, Lime entered Madrid and launched hundreds of electric scooters in the Spanish capital. About a week ago, its rival Bird launched in Paris and plans to bring electric scooters to Tel Aviv. The start-ups of these two electric scooters have become unicorns in this year's travel field. As Bird expands into the international market, it is worth noting that rival Lime has been operating its bicycles and scooters outside the United States for some time. In December last year, Lime brought bicycles to many European cities, and in June, Lime brought her motorcycles to Paris. Lime also recently raised $335 million in prize money and has partnered with transportation giant Uber. Bird and Lime are by no means the only companies working in this field, but they are the two companies that raise the most money. Bird raised $415 million in funding, while Lime raised $467 million. Bird and Lime are also the only two American scooters to go international.

2.3.1 Analysis of Bird and Lime in Unicorn Enterprise Sharing Scooter

Shared electric scooters are sought after by capital. At present, there are two head companies sharing electric scooters in the United States, namely Bird and Lime. The two companies have a large amount of financing, because of the participation of the weight capital, Bird has received $300 million in financing led by Sequoia Capital, with a valuation of $2 billion; Lime has received Uber and Google parent company Alphabet. $335 million in financing, allegedly valued at $1.1 billion.
Currently, Bird is mainly engaged in the operation of electric scooters. Lime is a company that operates and shares bicycles. Lime provides three types of services: shared bicycles, shared electric vehicles and shared electric scooters. Although the business is different, the business model of sharing electric scooters is basically similar. Users must be at least 18 years old and need a driver's license. California requires a helmet to be worn on an electric scooter. When using it, just like sharing a bicycle, download the app and scan it with the QR code. For the fee, Bird charges a starting price of $1 and 15 cents per minute. General electric scooters can reach speeds of up to 15 mph, and can last up to 15 to 20 miles (about 24 to 32 km). Therefore, the profitability of sharing scooters is very good, as can be seen from the enthusiasm of capital. After the baptism of shared bicycles, sharing scooters will be the next wave of distributed investment.

<table>
<thead>
<tr>
<th>Company</th>
<th>Founder</th>
<th>Founding time</th>
<th>Headquarters</th>
<th>Latest financing quota</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bird</td>
<td>Travis VanderZande</td>
<td>2017</td>
<td>Santa Monica, California</td>
<td>300 million US dollars</td>
</tr>
<tr>
<td>Lime</td>
<td>Brad Bao</td>
<td>2017</td>
<td>San Mateo, California</td>
<td>335 million US dollars</td>
</tr>
<tr>
<td>Skip</td>
<td>Mike Wadhwa Sanjay Dastoor</td>
<td>2018</td>
<td>San Francisco, California</td>
<td>25 million US dollars</td>
</tr>
<tr>
<td>Spin</td>
<td>Euwyn Poon</td>
<td>2016</td>
<td>San Francisco</td>
<td>8 million US dollars</td>
</tr>
</tbody>
</table>

Figure 2-4 American shared electric scooter unicorn

### 2.4 Problems in the shared travel field

At present, representative shared travel companies, whether it is China's Didi or Uber in the United States, stay in the shared travel version 1.0, and users and users do not achieve true peer-to-peer communication, they must pass a centralized platform, A transaction can only be made after a unified assignment. This will not only bring a lot of hidden dangers to all users participating in the platform trading, but more importantly, as a platform operator sharing the travel, the cost is high and the risk is huge.
Existing shared travel platforms focus on purchasing and placing resources. Although the cost of centralized procurement of hardware equipment may be relatively low in terms of unit price, large-scale purchases will bring financial astronomical figures. At present, there is no real profit for sharing travel companies. In addition to the fierce competition in the field of travel, many companies continue to subsidize users and drivers, resulting in huge fiscal deficits. In the blockchain era, we have to doubt the persistence of this centralized, sporty and subsidized-driven business model. At the same time, it is necessary to reconsider this approach to bring huge investment risks.

2.4.1 Great risks brought about by concentrated investment

Traditional travel companies must build huge technical and operational teams because of their centralized investment model and operations in multiple cities around the world. Such a travel sharing platform requires a lot of human resources to maintain normal operations. For example, China's Didi has a team of tens of thousands of people, resulting in huge operating costs. In addition, one of the main profit methods of Didi and Uber is to draw commissions for every successful transaction on the platform. From the public data, the commission ratio ranges from 20% to 40%, according to the market conditions of each city. This fee is mainly drawn automatically from the driver's income. However, in the sharing economy trading session, in order to maintain the platform's own profitability and achieve operational indicators, the centralization platform is more balanced in increasing the revenue of its own platform and user loss, limiting the user's own idle resources to participate in value generation. Link to improve the threshold for service providers to join. This phenomenon is more common in some industry unicorn companies, because these companies have a large market share, they dare to constantly try and challenge the user's acceptability of price and service quality, so that transaction costs Greatly improve.

2.4.2 Excessive operating costs and transaction costs

Professor Zeng Ming, the education chief of the University of Lakeside, clearly pointed out that the fundamental challenge Uber faces is the lack of network effects. Uber does not have a "demand-side network effect." Facebook, WeChat, Taobao, etc. are very typical demand-side network effects, users actively spread, helping enterprises to obtain new users close to zero cost. The more users, the more students, relatives, friends, colleagues, etc. are drawn into the network, and the value of the network is naturally growing. Although Uber has no network effect, it has a clear platform economy. There are many ways to define the platform economy. One of the simplest criteria is whether it is an online marketplace that
accomplishes more efficient matching of multiple related resources. Uber intelligently matches passengers and drivers, and it undoubtedly builds an online travel service market. However, as the Internet penetrates into various fields, users become more and more sinking, and the network effect becomes more and more important and important. In the whole travel field, the migration cost of users such as Dib and Uber is very low, and where the price is cheap. Where to go, there is no way to form an ecosystem, and there is no collaboration and trading scenario between users and users. Therefore, it is impossible to form an ecological effect that has more industry thresholds.

**2.5 Hawk and travel companies build a smart travel network**

The essence of the blockchain is an autonomous peer-to-peer trading network. The nodes of the network can be ordinary users or industrial enterprises. Only multi-party consensus, through the technology of smart contracts and distributed ledger books, can realize the ecosystem network that everyone can participate in multi-party construction. The tamper-proof, decentralized and fully autonomous ecology that everyone can participate in is consistent with the nature of the shared economy. The sharing economy is a peer-to-peer business model that will be in a more advanced state with the application of the blockchain. The ideas behind community autonomy will inspire people around the world to participate and benefit from the development of the Hawk Network.

**2.5.1 Localization Diversified Inputs Reduce Risk**

The Hawk Network will build a decentralized blockchain IoT network. Rather than a traditional centralized network, intermediaries will be cut off during peer-to-peer transaction settlement between users and service providers, and we expect transaction costs to be reduced by nearly 20%. During the transaction, when the user orders or purchases a service (such as booking a room), the Hawk Network token will be used as a transaction certificate. Users may need to freeze a certain amount of tokens as deposits, which will be released upon completion of the transaction. The entire transaction process will be handled by smart contracts and cross-linked hosting technology to ensure authenticity, legitimacy and compliance. By using HAWK to trade users and merchants, we will be able to achieve real-time billing and eliminate the risks and costs associated with common payment methods on existing platforms.

**2.5.2 Localization operations reduce costs**

The Hawk Network will fully realize localized investment and operations, and all IoT devices or travel hardware will be purchased by the eco-enterprise and then connected to the network. For example, for scooters used for travel, business users purchase a certain number of scooters and then launch them in the local city. The advantage of localization is that business decision makers are familiar with local policies and laws,
better understand the usage habits of local users, and can quickly and easily maintain equipment. In this mode, in the near future, users can use various services in different occasions to bring them a smoother experience.

2.5.3 Multi-party collaboration activates network effects

The Hawk Network records user and service provider data on blockchains such as identity information, asset information, transaction records, and comments on different services. Instead of storing and accessing data in a centralized database, we store and extract data through a distributed storage scheme with a private key, which means that the data is not tampered with and can only be accessed by the owner. Based on the authenticity and non-tamperability of all user and asset data in the Hawk Network ecosystem, Hawk Network will form a multi-win cooperative network with car owners, riders, community partners, etc.

An ecosystem of other hardware partners. This ecology is a positive ecological model that is interdependent and mutually motivating. This collaborative relationship is positive, not a traditional competitive relationship. When this collaborative system is launched, it will show a very large wealth effect.

2.5.4 Decentralized shared scooter (BHK dApp)

BHK (Black Hawk Knight) is the first application on the Hawk Network, which aims to create a distributed intelligent travel platform that uses the underlying technology of the Hawk Network blockchain to connect intelligent hardware, travel service providers, and riders. Together, and through a decentralized thinking and community ecological gameplay, to establish a fully peer-to-peer collaboration network, BHK will form a multi-winning decentralized shared scooter travel platform in the future.

Figure 2-5 BHK DApp page schematic
3. Technical Framework

Hawk Network’s overall product structure can be divided into four layers: core blockchain layer, API / SDK Layer, service layer, and application layer. The Hawk Network platform uses a middleware technology that combines innovative blockchain technology with traditional database technologies to enable the creation of tables similar to traditional databases on the blockchain, enabling rapid conversion of platform data between local databases and blockchain. Only by using this technology can we ensure that complex data and historical reviews within shared economy applications can be stored intact, well-structured and quickly on the blockchain. The Hawk Network platform adopts the same properties that all blockchain data cannot be tampered with, including service providers’ transaction records, historical reviews, and other structured data to ensure legitimacy.

3.1 Hawk Network architecture

Figure 3-1 Hawk Network architecture
3.2 Core Blockchain layer

3.2.1 Distributed Shared Ledger

Hawk network is deploying a decentralized peer-to-peer distributed storage technique by applying a DHT (Distributed Hash Table) based distributed storage protocol, with data being indexed by file content (Hash) instead of a file path (URL). Large files will be partitioned into fixed-size data chunks and distributed across multiple nodes. Each file fragment is indexed by a hash value, which is stored in the distributed hash table of each node. When the user needs to extract the complete file, The Kademlia DHT algorithm [4] will retrieve the file fragments from the distributed storage network, and reassemble it into a complete file. Each server node does not have a complete file or even a full fragment index from one file. Therefore, if a single server is compromised by hackers, they cannot obtain complete file data.

The customer’s sensitive data, track data with core values and unstructured data on the platform, including avatars and photos, are all stored on a distributed storage network. The data hash index will also be saved on the blockchain. Comparing the hash later can identify the authenticity of the data.

One of the main problems with this kind of system is the need to balance between redundancy and reliability. This conflict is resolved through implementing token incentives and backbone nodes. Users can choose reliability for files, low-reliability files can be stored and accessed for free or minimum cost. Highly reliable files will be provided by stable and reliable services from backbone nodes.

Computer System

```java
public class Block { // Block
{
    public uint Version; // version
    public UInt256 PrevBlock; // Connected Block
    public UInt256 MerkleRoot; // Hash value of the transaction list
    public uint Timestamp; // timestamp
    public uint Bits; // reserved field
    public ulong Nonce; // random number
    public UInt160 NextMiner; // bookkeeper of next block
    public byte[] Script; // signature
    public Transaction[] Transactions; // transaction list
}
```

3.2.2 Consensus Mechanism (UPOS)
The Hawk Network blockchain will adopt a unique consensus algorithm, namely Byzantine Fault Tolerance - User Proof of Stake - UPOS (with Byzantine Fault Tolerant User Benefit Certificate), The UPOS consensus mechanism is a decentralized consensus algorithm that meets the performance requirements of the shared economy 2.0 ecosystem and maximizes user rights. The core principle of this algorithm is that all users who hold HAWK tokens or have legitimate transactions in Hawk Network Dapp (such as U-Bicycle riding) have Hawk Network blockchain super nodes on the Hawk Network blockchain. The voting rights, users will continue to generate block producers by voting.

1 Block production and fork processing

The Hawk Network blockchain system will be designed to produce one block every 0.5 seconds, and at a certain point in time, only one block producer (node) will be authorized to produce the block. If it is not generated within the predetermined time, the block is skipped. When one or more blocks are skipped, the blockchain will have an interval of 0.5 seconds or more, which is an infrequent event and does not affect the production process of the entire blockchain.

When the Hawk Network performs blockchain production, it produces 126 out of blocks as a round (a total of 21 nodes, each of which produces 6 blocks). Before the start of each round, 21 different block producers were selected based on the results of the Hawk Network User vote. The production order of the selected producers is arranged in the order agreed by the producers of 15 or more (the process is automatically completed by the program).

If a producer misses a block for various reasons (such as network latency, system bugs, etc.) and has not produced any blocks in the past 24 hours, it will be temporarily kicked out of the block production queue until the producer The Hawk Network blockchain informs that it intends to reproduce the block. By eliminating unstable and unreliable production nodes, the number of missing blocks is minimized, ensuring safe and efficient network operation.
To some extent, there is no bifurcation in the UPOS blockchain, because in the production process of the Hawk Network blockchain, producers are peer-to-peer cooperative rather than competitive. If a fork occurs, the consensus program will automatically switch to the longest chain. The working principle is that under the UPOS consensus mechanism, the new block addition speed of the forked chain is positively correlated with the number of producers in the chain. That is to say, the blockchain fork with more producers will grow much faster than the producers, because the producers will have fewer blocks in the forked chain. In addition, any block producer is not allowed to produce blocks on both forks at the same time, and if the system finds that the block producer does so, it will be automatically cleared. The digital cryptographic signature and timestamp of each block by the block producer will be used for system troubleshooting.

By requiring all producers to sign all blocks, the Byzantine fault tolerance mechanism is added to the UPOS as long as no producers sign two blocks with the same timestamp or the same block height. Once 15 producers have signed a block, the block is considered irreversible. If a Byzantine producer signs two blocks of the same time stamp or the same block height, the system generates cryptographic evidence of its infidelity. In this model, an irreversible consensus should be reached within 1 second.

2 UPOS block verification process

When a round of block producers is determined by voting, they can negotiate the order of the blocks themselves, so that witnesses with lower network connection delays can be adjacent to each other, which can greatly reduce the network delay between witnesses, so that the 0.5 second block speed is guaranteed.

In order to ensure that nothing is lost, any witnesses will be skipped due to network delays. Each witness of UPOS will continuously produce six blocks, that is, each witness is responsible for 3 seconds of block production. There is a case where the last one or two of the 6 blocks may be skipped by the next witness due to network delay or other accidents, but the first few of the 6 blocks will have enough time to pass to the next one witness.

UPOS transaction confirmation time, each block is broadcasted immediately after production, and the block producer waits for 0.5 seconds to produce the next block, and will receive confirmation results from other witnesses for the previous block. The production of the new block and the receipt of the confirmation of the old block are carried out simultaneously. In most cases, the transaction will be confirmed within 1 second. Once more than two-thirds of the witnesses confirm, the block production result will be irreversible. This process means that the production of one block is completed and continue to the next. Wheel production
3 Transaction confirmation time

In the standard UPOS blockchain, block producers will be 100% engaged. After an average of 0.25 seconds after the broadcast, the transaction can be determined to be 99.9% determined.

Based on UPOS, asynchronous Byzantine fault tolerance is added to the Hawk Network for faster irreversibility. The asynchronous Byzantine fault-tolerant algorithm can achieve an irreversible 100% acknowledgment within 1 second.

4 Transaction certificate

Hawk Network requires that each transaction must include the hash of the most recent block header. This hash has two purposes:

1. Prevent a large number of duplicate transactions on the forked blockchain
2. Make the system aware of whether the user is on the forked blockchain

Over time, all users eventually confirm the blockchain directly, which makes it difficult to forge counterfeit chains, and counterfeiters cannot migrate transactions in the legal chain.

5 Node voting rule
Users with Hawk Token and Hawk Network transaction records can vote for block producers, specifically:

- Hawk Network requires that each transaction must include the hash of the most recent block header. This hash has two purposes:
- A transaction can cast 30 votes, the cheating transaction will be cancelled, and the user will be canceled for 24 hours.
- Each time 126 blocks are produced, one vote is counted, and according to the votes obtained, 21 block producers are selected for the next round of block production;
- Robot voting via API calls will be allowed;
- If the new round of voting does not produce results, the producers of the previous round will continue to produce.

### 3.2.3 Elliptic Curve Cryptography

Hawk Network uses ECC (Elliptic Curve Cryptography) to sign digital assets to ensure the security of every transaction. The public key can be calculated from a known private key. ECC is widely regarded as the most powerful asymmetric algorithm given the key length, which has been fully exercised in the bitcoin network.

**ECC:Secp256k1(7)**

Elliptic-curve cryptography (ECC) is an approach to public-key cryptography based on the algebraic structure of elliptic curves over finite fields. ECC requires smaller keys compared to non-ECC cryptography (based on plain Galois fields) to provide equivalent security. Elliptic curves are applicable for key agreements, digital signatures, pseudo-random generators and other tasks. Indirectly, they can be used for encryption by combining the key agreement with a symmetric encryption scheme.

The elliptic curve refers to a homogeneous equation:

\[ Y^2 + a_1 xy + a_3 y = x^3 + a_2 x^2 + a_4 x + a_6 \]

The combination of numbers and shapes, determined by the plain curve, where the coefficient
The elliptic curve domain parameters over $F_p$ associated with a Koblitz curve secp256k1 are specified by the sextuple $T = (p, a, b, G, n, h)$ where the finite field $F_p$ is defined by:

$$a^i (i = 1, 2, 3, \ldots 6)\text{is defined in a domain, is a number field which can be rational, irrational or complex. Which one is used in the ECC cryptosystem is defined in the finite field} F/(p^f).$$

A special point called the infinity point and all the points on the ellipse form a set together with a defined addition operation to form an Abel group.

Each point on the curve must be non-singular. So-called “non-singular” or “smooth” in mathematics means that there is a tangent at any point on the curve.

This is a graph of secp256k1’s elliptic curve $y^2 = x^3 + 7$ over the real numbers. Note that because secp256k1 is actually defined over the field $Z_p$, its graph will in reality look like random scattered points, as seen on Figure 3-4. Secp256k1 refers to the parameters of the ECDSA curve, and is defined in Standards for Efficient Cryptography (SEC). Secp256k1 was almost never used before Bitcoin became popular, but it is now gaining in popularity. Most commonly used curves have a random structure, but secp256k1 was constructed in a special non-random way which allows for especially efficient computation. As a result, it is often more than 30% faster than other curves if the implementation is sufficiently optimized. Unlike the popular NIST curves, secp256k1’s constants were selected in a predictable way, which significantly reduces the possibility that the curve’s creator inserted any sort of backdoor into the curve.

**Technical details**

As excerpted from Standards for Efficient Cryptography 2 (SEC 2): [7]
\[ p = FFFFFFFFF FFFFFFFFF FFFFFFFFF FFFFFFFFF FFFFFFFFF FFFFFFFFF FFFFFFFFF FFFFFFFFF FFFFFFFFF FFFFFFFFF FFFFFFF2F \]
\[ = 2^{256} - 2^{32} - 2^9 - 2^8 - 2^7 - 2^6 - 2^4 - 1 \]

The curve \( E: y^2 = x^3 + ax + b \) over is defined by
\[
\begin{align*}
a &= 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000 \\
b &= 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000007 
\end{align*}
\]

The base point \( G \) in compressed form is:
\[
G = 02 \text{BE667E F9DCBBAC 55A06295 CE870B07 02BFCDB 2DCE28D9 59F2815B 16F81798} 
\]

And in uncompressed form:
\[
G = 04 \text{BE667E F9DCBBAC 55A06295 CE870B07 02BFCDB 2DCE28D9 59F2815B 16F81798} \\
\phantom{G =} 483ADA77 26A3C465 5DA4FBFC 0E1108A8 FD17B448 A6855419 9C47D08F FB10D4B8 
\]

Finally the order \( n \) of \( G \) and the cofactor are:
\[
\begin{align*}
n &= FFFFFFFFF FFFFFFFFF FFFFFFFFF FFFFFFFFF FFFFFFFFF BAAEDCE6 AF48A03B BFD25E8C D0364141 \\
h &= 01 
\end{align*}
\]

**Properties**

Secp256k1 has characteristic \( p \), it is defined over the prime field \( \mathbb{Z}_p \) Some other curves in common use have characteristic 2, and are defined over a binary Galois field \( \mathbb{F}_{2^n} \) \( \mathbb{F}_{2^n} \), however secp256k1 is not one of them.

As the constant is zero, the \( ax \) term in the curve equation is always zero, hence the curve equation becomes
\[ y^2 = x^3 + 7. \]
3.3 SDK/API Layer

3.3.1 Smart Contract Systems

Hawk Network's smart contracts include transaction processing and storage mechanisms, as well as a complete state machine for accepting and processing various smart contracts, transaction storage and state processing are done on the blockchain. Transactions mainly contain data that needs to be sent and the descriptions of said data are referred to as events. After the transaction and event information is passed to the smart contract, the resource status in the contract resource set will be updated, triggering the smart contract to perform state machine judgment. If the trigger condition of one or more actions in the automatic state machine is satisfied, the contract is automatically executed by the state machine according to the preset information.

According to the trigger condition contained in the event description information, the smart contract system automatically sends out preset data resources and events including trigger conditions from the smart contract when the trigger condition is satisfied. The core of the entire smart contract system is that all the transactions and events handled by the smart contract are still exported as transactions and events. The smart contract is just a system of transaction modules and state machines. It does not generate smart contracts, nor does it modify smart contracts, it only exists to a set of complex digital promises with triggering conditions that can be properly implemented according to the participants' will.

1. Smart contract construction and execution

1) Multiple users participate in formulating a smart contract.
2) The contract is spread through the P2P network and stored on the blockchain.
3) Smart contracts embedded within the blockchain are automatically executed.

2. The following steps describe in detail the process of phase 1 “Multi-User Participation in Formulating a Smart Contract”

A. The user must first register on the blockchain. The blockchain returns a pair of public and private keys to the user, the public key is used as the account’s address within the blockchain, and the private key is the only way to manage the account.

B. Two or more parties, based on need, agree on a contract that includes the rights and obligations of both parties, these rights and obligations are programmed in machine language. The contract is signed by both parties with their private key to ensure the validity of the contract.

C. The signed smart contract will be transmitted to the blockchain network along with its content.
3. The following steps describe in detail the process of phase 2 "Contracts are transmitted through the Hawk Network and stored on the blockchain"

A. The contract transmits across the entire blockchain network through p2p communication. Each node receives a copy. The verification node in the blockchain first saves the received contract into memory and waits for a new round of consensus to trigger and process the contract.

B. When consensus arrives, the verification node will pack all the contracts saved in the most recent period together into a set, calculate the Hash value of the contract set, and finally assemble the Hash values of the contract set into a block structure, spreading to the entire network. Other verification nodes will receive the hash of the contained contract collection and compare it with their own saved contract set. Sending a self approved contract set to other verification nodes, through this multiple rounds of transmission and comparison, all verification nodes eventually agree on the latest set of contracts within a specified time.

C. The latest contract set will be transmitted to the entire network in the structure of blocks. As shown in the following figure, each block contains the following information:

- Hash value of the current block
- Hash value of the previous block
- The timestamp when consensus was reached
- Other descriptive information.

The most important piece of information in the blockchain is a set of contracts that have reached consensus. The node that receives the contract set will verify each contract and its participants' signature and the verified contract will be written on the blockchain.

Figure 3-6: Schematic diagram of smart contracts within blockchain blocks

4. The following steps describe the process of phase 3, “Built-in Blockchain Smart Contracts Auto-execute”

A. The smart contract periodically traverses the state machines and checks their current status, transactions, and trigger conditions contained in each contract one by one. The conditionally satisfied transaction is then pushed into the queue to be verified and awaits consensus, transactions that do not satisfy the trigger condition will remain on the blockchain.

B. The events in the most recent verification process will be transmitted to each verification node. Like common blockchain events or transactions, the verification node first performs signature verification to ensure the validity of the events. Verified events will enter the pending consensus set to wait for the majority of verification nodes to reach consensus. Once reached, the events will be successfully executed and notify the user.
C. After the event is successfully executed, the state machine of the smart contract will determine its status. After all the events included in the contract are sequentially executed, the state machine marks the status of the contract as completed and removes it from the latest block. It will otherwise be marked as “in progress” and continue to be saved in the latest block for the next round of processing until it is marked as completed. The entire event and its status are processed and completed by the smart contract system built into the blockchain core. It is fully transparent and tamper-proof.

5. To achieve a more transparent ecosystem our platform will adopt a variety of methods to support the sharing economy service providers in developing DApps and smart contracts including:

- Blockchain virtual machines that support C++ and Solidity languages programming.
- Convenient SQL commands within our smart contract storage system, due to our blockchain database storage features.

3.3.2 User ID

The Hawker's digital identity UID is the unique identity of the user in the Hawk Network ecosystem. The identity includes the following four aspects: user account, user rights, user credit, and user data. The Hawk Network user ID is designed to correspond to a UID for an account. Therefore, in order to save network resources, in principle, Hawk Network does not recommend users to open multiple accounts. Users can often use unique accounts to increase their user rights, credit and data enrichment, so that the Hawk Network ecosystem can provide more targeted services. The specific architecture of the Hawk Network's UID is shown below. We will implement the modules shown step by step.

The account management module is responsible for the identity authentication of the user account, including the registration, login, logout process and account related private key processing. When the account is registered, identity information such as the
username and password used by the original user will be mapped to the Hawk Network blockchain address. After the account is logged in, the service request related to the blockchain can be sent. For the case where the transaction confidentiality is high, the user can select the processing irrelevant to the blockchain address, so as to prevent different transactions of the same user from being repeatedly recorded in the block. Thereby improving the security of the user and the confidentiality of the transaction.

3.3.3 Modules

1 Basic service management module

The basic service is deployed on all blockchain nodes to verify the validity of the service request and record a valid request after reaching consensus. For a new service request, the basic service adapts and analyzes the interface first and then performs authentication processing. After the transaction or contract is signed and encrypted, it is added to the block and broadcasted to achieve consensus between nodes. If consensus is achieved, it will be added to the next block.

2 User Management module

Our user management module is responsible for managing the identity information of all blockchain participants, including maintenance of public and private key generation, key storage management, and maintenance of the relationship between user's real identity and their blockchain address. With authorization, it also supervises and audits certain transactions.

3 Smart contract management module

Our smart contract module is responsible for the registering of contracts and managing the trigger conditions and execution. After the user programs the contract and broadcasts it within the blockchain, the contract signed by both parties will be executed if the conditions written within, are met.

4 Transaction mechanism

A transaction is the activity of changing rights of assets or contracts. Hawk Network has designed several types of transactions and all of them contain an input list, output list, signature list and transaction type related data.
To create a new user issued asset, the user can define the type, name, total amount and the administrator account for specific assets. Creating assets requires consumption of a certain number of tokens as additional service charge.

- Contract transaction: specifies all participated transactions and can determine whether they are required to confirm acceptance according to asset type of each transaction. The counterparty may choose to accept (sign) or reject (ignore).

- Agency transaction: not specifying counterparty, but appointing an agent. This agent is responsible for matching the counterparty of each transaction. The "superconducting transaction" is achieved through this transaction type.

The data structure of the superconducting transaction is as follows:

```java
public class Order // order ticket
{
    public Uint256 AssetId; // Asset
    public Uint256 ValueAssetId; // price unit
    public Uint160 Agent; // agent
    public Fixed8 Amount; // total transaction volume
    public Fixed8 Price; // transaction price
    public Uint160 Client; // client
    public TransactionInput[] Inputs; // transaction input
    public byte[][] Scripts; // signature list
}
```

## 5 Credit Rating System

What is a traditional credit rating model?

In the case of FICO [8], credit scores are dependent on five dimensions: Payment history, number of accounts, length of credit card usage, type of credits, and number of new accounts.

Enterprise Credit Report Systems are alike, they all contain information such as bank credit reports, tax reports etc. The data based on credit rating models share one common flaw, reliability of the rating depends on the reliability of its model. Credit information is not direct but indirect data.

How do we perform credit rating through blockchain; User consensus + Coin Days Destroyed [9]
All we need is raw transaction data because blockchain transactions deal with the direction of time, so the marginal cost of repeated consumption is no longer zero, it's proportional to coin days destroyed. Coin Days Destroyed is a very important concept in blockchain. For any given transaction it is calculated by taking the number of coins in a transaction and multiplying it by the number of days since those coins were spent. If someone has 10 coins they received 100 days ago and they spend it today, then 1000 coin days have been destroyed.

Using coin days destroyed as the weighting factor for credit evaluation can prevent cheaters to repeatedly transfer tokens between two accounts to increase credit. This can also prevent intentional negative reviews since higher coin days destroyed means higher weight of a transaction in the credit evaluation.

When a cheater with two trading accounts tries to give himself a high credit score by transferring coins between accounts repeatedly within a day, only the first transaction will count, as the total weight of coin days destroyed for all transactions the cheater performed almost equals to the amount of the first transaction in the final credit evaluation. This will also be the same for the users that have malicious intent and try to use small value transactions to purposely create bad ratings. It will have little to no effect on the user’s credit.

The weighted model refers to the credit evaluation score obtained by the user multiplied by the coin days destroyed of the transaction to get the user’s final credit score. The model is as follows:

\[ R_{n} = \sum_{i=1}^{i-n} R_{i} * W_{i} \]

\[ W_{i} = C_{i} * D_{i} \]

\[ R_{i} \in \{-1,0,1\} \]

\[ i, W_{i}, C_{i}, D_{i} \in (0, +\infty) \]

\( R_{n} \) = a user’s final credit score.

\( R_{i} \) = the credit score a user obtains when the i transaction is done.

\( W_{i} \) = coin days destroyed of i transaction.

\( C_{i} \) = the value of i’s transaction

\( D_{i} \) = the period of time between i transaction and the last transaction before it.
In addition, Hawk Network also introduces credit data from third-party credit rating agencies as part of the "user credit pass" ecosystem. It is responsible for providing a reliable AI algorithm to get the user information from Hawk Network’s DApps to obtain a reliable data analysis result thus achieving a reliable credit output and HAWK as a reward.

3.4 Service Layer

1 Account Management Module

Our account management module is responsible for the identity authentication of the user's account, including the registration, login, and logout process, along with irrelevant private key processing of the account. When the account is registered, the identity information such as the username and password used by the original user is mapped to the Hawk Network blockchain address. After the account is logged in, blockchain-related service requests can be sent. For situations with a high degree of transaction confidentiality, the user may choose irrelevant processing with the blockchain address, so that different transactions of the same user are not repeatedly recorded in the block, thereby, improving user security and transaction confidentiality.

2 Policy Management Module

Our policy management module includes "policy configuration", "data security", "access control" and "regulation and audit", which are responsible for permission control and management of user data, private key system, nodes joining and exiting, and data access. It also includes audit permission, account delegation permission, node consensus permission and data access permission. The audit permission is to provide the auditing function for the supervisory authority with control over data scope and access permission, linking users who are not relevant to transactions on the shared ledger. The account delegation permission is used to control the access to the user account through delegation. Consensus permission manages the access permission of newly joining nodes. Access permissions are used to manage the client's data query from the blockchain.

3 Smart Contract Management Module

Hawk network smart contract can be categorized into two types: standard contracts and custom contracts. Standard contracts include relatively simple logic, such as asset consistency check, automatic deal closure, multi-party mutual confirmation transfer, and automatic maturity settlement. User customized smart contracts support customized configuration and added business logic to existing contract templates, which also support complex programmed contracts that run in a separate environment.
Smart contracts are processed in four procedures

1) Contract registration: The contract, along with its contents signed by participating parties will be broadcasted through the Hawk network and stored on our blockchain after consensus is reached.

2) Contract trigger: After the contract is registered, the contract execution can be triggered by an external condition being reached, such as timing, event, transaction, etc.

3) Contract Execution: Contract execution refers to the complete process of running the contract code in a separate environment, including building a mirror environment for the contract, where code is executed, and consensus is reached after the state changes and consensus exception is handled.

4) Contract termination: The contract will be terminated or cleaned up if it has been executed, expired or business logic change is made. The process of cleaning up requires a multi-node consensus before it can be completed.

3.5 Application Layer

Open platform for enterprise level providers

Through API or SDK on Hawk Network’s open platform, enterprises in the sharing economy can build DApps or simply migrate their existing app onto Hawk Network. After completing registration as a third-party operator they will receive value-added services which include the ability to obtain new customers and tokens.

Our open platform will provide services that include the use of smart contracts, automatic split payments, key data on chain inquiry, UIP, user credit ratings and a series of marketing functions.

Through Hawk Network’s data analysis system we can achieve the following goals

- Sharing companies can access the platform, integrate resources across the platform, and cooperate with others to achieve win-win results, thus developing a more competitive and valuable ecosystem.

- Companies can update their company database, uploading user data and delivering valuable contents.

- Integrate company’s online software and offline hardware to grow into a complete ecosystem.
• Through data analysis, breach penalty, information encryption and enterprise alliance sub-systems, it supports various business scenarios, expanding Hawk Network ecosystem and increasing users’ engagement.

• Transparent accounting and data management systems and improving the company’s credibility by publishing and executing necessary actions such as data analysis, automatic split payment, incentive schemes, key data inquiry and HAWK token transfers.

• Improved data collection capabilities as well as more accurate data analysis to produce user reports including; daily application, application environment, personal data models.

• Better data evaluation, structural improvements and a reduction of operating costs.

• Through Hawk Network’s wallet sub-system: Provide companies and users with improved account information management for a better utilization of their HAWK tokens.

• With gateway access to smart hardware/shared products censors, it integrates user’s data along with big data analysis thus improving the user experience.
4. Token Economy

4.1 Hawk Network’s Token Economy Model

Hawk Token Circulation Model Design

As the official digital currency of Hawk Network, HAWK is of great market potential, which can be quantified. As mentioned earlier, by 2020, the market volume of global shared travel will reach 520 billion US dollars. Within it, a centralized platform as a medium can make about 30% of the profits. As business grows, more applications can be implemented and more data can be collected. Credit assessment and technical services will become more valuable in the market. HAWK is not only the digital currency, but also the basic passport of the whole distributed Internet of Things ecosystem of Hawk Network.

- **Value in exchange**: HAWK circulates in all DAPPs above Hawk Network as the general equivalent of various transactions.
- **Purchase of Internet of Things Equipment**: HAWK can be used as a certificate to purchase assets from suppliers (electric scooters, smart devices, etc.).
- **Data Contribution Award**: If users decide to contribute their data to ecosystem development, they will be rewarded by
- **Value added service**: HAWK can be used to pay for services such as API/SDK provided by Hawk Network.
- **Community award**: HAWK will be awarded to community contributors, such as third-party developers, community operators and community promoters.
• **User incentives:**
  By rewarding loyal users to use Hawk Network ecosystem services and products, users and business customers are encouraged to develop the ecosystem and create value.

• **Cost:**
  All costs will be charged in HAWK, such as transaction costs from shared services and DEX.

• **Advertising:**
  HAWK can also pay for advertising through the Hawk Network advertising system.

4.2 **Mining Calculation and Operating System**

Hawk Network's mining is divided into two parts. Both owners and cyclists can benefit from mining. As mentioned above, Black Hawk Knight is both a scooter and a blockchain super miner. For owners, as long as the software provided by hawk network is connected to the network, HAWK Token can be obtained by mining every day. The number of mining is positively correlated with the number of miners owned by owners. At the same time, hawk network has a set of computer system, which can guarantee 1 million mining vehicles to run for more than 10 years. (the service life of mining tools is three years). Users’ bicycle riding mining is calculated according to the number of orders and mileage to motivate users to use Hawk products online and offline to solve travel problems.

![Figure 4-2: Running Diagram of Hawk Network System](image-url)
1. Calculating formula of owner’s mining: \[ C = \frac{N_1 \times X}{N} \]

**Among them:**
- \( N_1 \): Number of mining bicycles owned by the owner
- \( X \): The total amount that can be mined on the day (calculated by the system)
- \( N \): The total number of mining bicycles connected to the system on the same day

Settlement every 24 hours.

2. Formula for calculating user cycling mining: \[ C_1 = \left( \frac{T_1 - 60}{L - 300} \right) \times N \times P \]

**Among them:**
- \( T_1 \): Current order riding time (\( \geq 60 \) seconds): no charge for cycling less than 60 seconds
- \( L \): Cycling mileage (\( \geq 300 \) meters): no charge for mileage less than 300 meters
- \( N \): number of rides (integer of \( \geq 1 \))
- \( P \): unit price (US cents)

No charge, mining is 0, settlement in every 24 hours.

### 4.3 Sales Plan of HAWK Tokens

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hard Cap</strong></td>
<td>$30 million</td>
</tr>
<tr>
<td><strong>Total Token Issuance</strong></td>
<td>20,000,000,000 HAWK</td>
</tr>
<tr>
<td><strong>Initial circulation rate</strong></td>
<td>20% of total tokens</td>
</tr>
<tr>
<td><strong>Public placement price</strong></td>
<td>1Hawk = $0.0067</td>
</tr>
<tr>
<td><strong>Number of public placement</strong></td>
<td>2,000,000,000 HAWK (10% of total tokens)</td>
</tr>
<tr>
<td><strong>Public placement lock-up time</strong></td>
<td>No lock</td>
</tr>
<tr>
<td><strong>Private placement round of enrollment</strong></td>
<td>400,000,000 HAWK (2% of total tokens)</td>
</tr>
<tr>
<td><strong>Private placement round price</strong></td>
<td>1HAWK=0.0067 USD</td>
</tr>
<tr>
<td><strong>Private placement unlocking period</strong></td>
<td>Unlocked in 6 months</td>
</tr>
<tr>
<td><strong>Seed round issue ratio</strong></td>
<td>200,000,000 HAWK (1% of total tokens)</td>
</tr>
<tr>
<td><strong>Seed round issue price</strong></td>
<td>1HAWK=0.0008 USD</td>
</tr>
<tr>
<td><strong>Seed round unlocking period</strong></td>
<td>Unlocked in 6 months</td>
</tr>
<tr>
<td><strong>Token type</strong></td>
<td>ERC-20</td>
</tr>
<tr>
<td><strong>Token distribution</strong></td>
<td>30 days after the public placement</td>
</tr>
</tbody>
</table>

Figure 4-3: Sales Plan of Hawk Network IEO Token
4.4 Distribution of HAWK Tokens

Figure 4-4: Hawk Network Token Distribution

- Ore pool: 49.00%
- Foundation: 15.00%
- Team: 13.00%
- Public offering wheel: 10.00%
- Ecological stimulation: 10.00%
- Private placement round: 2.00%
- Seed round: 1.00%
5. Core team and partners

5.1 Hawk Network Core Team

Hawk Network’s core team has many years of experience in Internet operations and was established in October 2018. Since then, Hawk Network has been recruiting outstanding technology developers for the Internet of Things and travel. At the same time, the team has been looking for partners around the world and has reached strategic cooperation with outstanding companies in the distributed economy.

Derrick Fu
Hawk Network President
- U-Bicycle Co-founder and CMO Founding team member of the DianPing.com
- In 2007, he joined the DianPing.com and was responsible for the group purchase project
- Former National Director of New City Development
- National Cooperation Director and Film Division
- Cat Eye Film Platform Business Director

Faye Tone
Hawk Network Senior Vice President
- U-Bicycle co-founder and CPO
- Formerly Senior Project Manager of Jiuding Capital
- China UnionPay Senior R&D Engineer
- Leading real estate platform room, many product directors
- Senior Product Director, Ctrip Global Travel Network
  General Manager of Jimei Film Industry Center

Marico Wu
Hawk Network Senior Vice President
- U-Bicycle co-founder and CBO
- Blockchain and senior practitioners of digital assets
- Explorer in the shared economy
- Cross-disciplinary entrepreneurs
- Former head of the group buying business of the review group
- Design Director of Gordon Education Group

Gary Xiong
Hawk Network CTO
- Blockchain early developer
- Good at blockchain technology architecture design
- With more than 10 years of excellent R&D management experience
- Former Senior Technical Director of Spring Airlines
- Lordless Senior Technical Consultant
- CEO of Yingluo Technology Group
Louis Liu
Hawk Network CSO
- Korea Kakao blockchain invited judges
- EOS Hackathon Award-winning guest
- Distributed economics researcher
- Former director of technology
- Senior Product Director, FLB Platform
- Jonkon Consulting Group Strategic Consultant

Chris Massot
Hawk Network Director of operations
- HootSuite Certified Professional
- The alacrity Foundation Canada Marketing Consultant
- Carmanah Senior Manager
- Acquisition Group Marketing Consultant
- Strathcona Hotel Supervise

5.2 Advisory Team

Ray Valdes
CTO ConsenSy

Jonathan Ha
Co-Founder & CEO
Red Pulse

Ding’an Fei
Managing Partner
Ledger Capital

Henry Wu
Venture Partner
Ledger Capital

Richard Wang
Partner
Draper Dragon

Kenneth Hsia
Partner
Badwater Capital

JC Xu
Partner
Badwater Capital

Aaron Choi
Vice President BTCC

Kong Huawei
Chief Scientist ZJ Capital

Frank Zheng
Secretary General WBO
5.3 Partner

Hawk Network is committed to enhancing the value of its platform by extending the ecosystem. Hawk Network will work with global partners to build a smart IoT ecosystem.

With Korean social giant KAKAO Achieve strategic cooperation users are 50millions

Klaytn is owned by KAKAO blockchain platform, monthly users are 50millions

Work closely with ALIPAY to promote shared travel solutions

China Unicom provides hardware supporting solutions on the Internet of Things

Partner with Southeast Asia’s leading Grab to customize a localized shared travel ecosystem

Partner with TransLink, Canada’s leading transportation brand, to facilitate our offline operations. Partner with Amazon Cloud for node deployment

World blockchain organization WBO provides perfect solutions for cities through big data and smart traffic management
5.4 Investment institutions
6. Hawk Network Roadmap

Oct 2018
Project research and project

Dec 2018
Complete project planning and overall design
Complete the relevant underlying technology selection
Research and docking intelligent hardware interface

Feb 2019
Complete economic model design
The first edition of the white paper was drafted
The first DAPP application BHK presale official online line

Apr 2019
Complete the edge calculation technology demonstration
Complete the Intelligent IoT Gateway Agreement
Complete technical architecture

Jun 2019
HawkNetwork starts underlying coding
Open private fundraising
Start global channel promotion
Community Partner Recruitment
Recruitment of city partners

Oct 2019
Open IEO Global Meetup
The first Dapp is online
The first equipment started mining
Top exchanges start trading HAW
7. Disclaimer and other Legal Statements

Disclaimer

1) For enthusiasts of Hawk Network, please read the whitepaper and related instructions on our official website carefully. Please be sure that you understand blockchain technology and realize that there's potential risk in buying tokens on Hawk Network. We would urge you to fully assess your financial situation before investing.

2) This project may fail due to its legitimacy, market demand, technical or other uncontrollable reasons out of our control. Please be prepared that any of these circumstances may cause all funds you invested in this project to become worthless.

3) There are risks associated with the buyer's credentials. If any third party obtains the purchaser's login credentials or private key they may be able to directly control the buyer's HAWK. To minimize risks, the purchaser must protect his / her electronic devices against unauthorized access requests or access to the device contents.

4) Blockchain technology has become a target of supervision in all major countries in the world and Hawk Network or HAWK may be affected if the regulatory authorities act against it. If the state limits the use and sales of digital tokens, the HAWK may be restricted, causing the project to be blocked or even terminate Hawk Network's development.

5) Please be aware of some non Hawk Network application risk that we may incur. With the development of the HAWK platform, third-party based applications may appear. The official Hawk Network platform may directly compete with these third-party applications, and may also have a negative impact on its value.

6) It is possible that Hawk Network applications launch without being used by many individuals or organizations, implying that the public has no interest in developing these relevant distributed applications, which might have a negative impact on the value of HAWK and Hawk Network applications.

7) The general carelessness and laziness on the internet might prevent anyone from reading this part while you could have won 100 HAWK being the first non Hawk Network person to discover it. An optional personal hug is included.
8) Any malicious attempt by hackers, other organizations or countries to disrupt Hawk Network applications or HAWK functions, including server attacks, Sybil attacks, malware attacks, or consistent attacks could result in serious damages and value loss for the Hawk Network platform and HAWK token.

9) The Hawk Network application includes a series of open source software. Third parties could intentionally or unintentionally push code with bugs which could be implemented into the Hawk Network platform, therefore, damaging the core framework itself. This could result in a loss of HAWK.

10) The rapid development of cryptography or science and technology such as the development of quantum computers brings the risk of cracking encryption or Hawk Network's monetary platform. This could lead to the loss of HAWK.

11) As with other decentralized cryptosystems and cryptocurrency, the blockchain that we plan to develop for Hawk Network applications is also vulnerable to mining attacks. This includes but not limited to, double spend attacks, high calculation force ratio attacks, "self-interest" mining attacks and excessive competitive attacks. Any successful attack is a risk to Hawk Network's platform and HAWK value. Although Hawk Network's system security is very hard to crack, the mining attacks mentioned above are real.

12) Unlike bank accounts or other financial institutional accounts, there will not be Hawk Network account insurance or any other blockchain insurance. In any case, there will be no open individual organization to cover your loss, however, companies such as the FDIC or private insurance companies might provide a guarantee for the buyer.

13) There is the possibility of Hawk Network dissolution. This could occur due to various reasons, including the volatility of NEO, ETH, or HAWK's own price, the development of the Hawk Network application, the possibility of a disruption in the business relationships or the possibility of a claim of intellectual property. Hawk Network is likely to be directly impacted in the event of a major attack or a direct dissolution.

14) If the Hawk Network platform were to fail this could result in normal services that would normally run daily, to stop. This could lead to the loss of user's HAWK.

15) Crypto tokens are a new and untested technology. In addition to the risks referred to in this white paper, there are also some risks the Hawk Network team may not have stated. Throughout this journey we may uncover various potential risks that could affect Hawk Network, please be aware.
**Nation specific**

1) Residents of the United States
The provision and sale of this contract are not based on the revised U.S. securities act of 1933 [12] or the securities registration act of some states. This product shall not be provided, sold or otherwise transferred, mortgaged or applied in any other way without the act and the applicable national securities law, without the effective registration of the declaration or the breach.

2) Residents of Canada
The securities product holder shall not trade such securities in any province or region unless the securities legislation permits it.

3) Residents of the United Kingdom
In the UK, this file is only distributed to (only involving the related investment activities), and only for: (1) investment professionals (refer to the revised financial services and markets act 2000 (2005 financial promotion rules) (5) of article 19 definition (hereinafter referred to as FPO)); (2) an individual or entity described in article 49 of the FPO; (3) experienced investors with experience certificates (refer to the meaning of section 50 (1) of FPO); (4) other legally transmitted persons (all such persons are regarded as "relevant personnel"). This document is not authorized by the authority, and the non-relevant personnel shall not take any action according to this document, nor should it rely on this document. The condition of your acceptance and retention of this document is to assure the company, its directors, and staff that you are relevant.

4) Residents in the People's Republic of China.
Unless authorized by the securities law of the People's Republic of China or other laws and regulations. Residents do not have the right to sell directly or indirectly within the People's Republic of China territory (excluding Hong Kong, Macao, and Taiwan region)