GenkiCell

# Decentralized Health Data

# Trading System

www.Genkicell.io

# ABSTRACT

In general， one’s health refers to a global concept, which was upgraded based on the change of social needs and disease spectrum as also with the development and progress of modern society. It centers on human production and life scenarios, focusing on several facts that may have negative effects on human health. At the same time, one’s health changes the traditional health management mode which refers to disease discovery, diagnosis, and treatment mode into a new self-diagnosis mode which pays more attention to disease prevention. In addition, the new self-diagnosis mode also has a broad concept including actions which meet the health needs for societies such as big data analysis, IOT services, artificial intelligence, etc. Our team has committed itself to combine all these actions and advanced technologies by blockchain technologies to achieve a new healthcare system: data is collected from the terminal of IOT services, mangled to be credible and finally become valuable and applicable. The source for health data is extremely broad scoped; however, during the process of application of those data, some issues exist: How to filter the valid data effectively and standardize it? How to call sensitive data? How to reasonable distribution of the great health resources? How to reduce the cost of data acquisition for academic and business organizations? In addition, for users, how to help users achieve the maximum convenience of self-health management? Is there a revolutionary way to completely solve those problems as well as increase the benefits of participants in the great health industrial chain?

Genkicell chain technology can end that. It is a global technology which refers to the blockchain-based decentralized health data trading system that originated from Japan. Genkicell chain collects and stores healthcare information using any healthcare device, IOT terminals, and individuals under the guidance of a double-blind structure [8] to protect the privacy of data. At the same time, through smart contracts, each of the users who participates in the activities of Genkicell chain will achieve maximum benefits. Users who have been part of the data credibility process on Genkicell chain will be recorded and rewarded, and users who demand data will have to pay for it by using their rewards.

# CONTENT

# CHAPTER 1. BACKGROUND

## 1.1 The Size of The Health Market in The World

As one of the world's biggest emerging industries, the healthcare industry has already achieved more than seven trillion dollars in 2014, of which about three trillion dollars were from the United States and about five hundred billion dollars from Japan (WHO, 2015). China occupied about a six hundred billion market (Health Development Planning Commission, 2017). As the size of the health market in the world is rapidly increasing, from the consumer’s point of view, the proportion of countries’ expenses on hospitals and great health is too much. (WHO, 2015). According to a report by the Institute of Medicine (IOM), about ⅓ (one-third) of the expenditure in response to great health expense was wasted, instead of improving the great health environment. These wastes include unnecessary services like public administration, expensive fees for diagnosis, great health fraud and a diseased disease prevention system (IOM, 2012). That is to say, many social groups who lack medical knowledge, or do not have a good sense of what is great health and how the great health system works, may have the tendency to seek great health services blindly. In response to this situation, the amount of great health resources will be inefficiently occupied, and health frauds will appear. More seriously, meeting with unbalanced and unmatched great health services becomes the major reason for the deterioration of health conditions, also as the result of unbalanced great health resources. Considering all these problems and situations which the great health system is facing, we also focus on the experimental revolution for great health which has rapidly occurred in different countries, such as the NHS system in UK, National Health Insurance system in Japan, and China's new medical reform policy. This new great health system involved such important points such as the grading diagnosis and pharmaceutical separation in order to achieve a sane great health system.

## 1.2 Overview of One Health Industry Bottlenecks

From our visible and recognizable IoT device database to invisible health records and public health data, etc., each kind of database forms a corresponding data silos. Moreover, the databases contain massive, time-consuming, non-standardized, complex structural data which is difficult to use in practical applications.

### 1.2.1 Collect Sources of Self-Diagnostic Data

In general, we disagree with non-professional users to determine the health status through self-perception, whether from their own medical knowledge or the experience of facing problems. However, there is a need to develop a more rigorous source of data collection in order to cultivate people's knowledge of medicine, or train AI-assisted cognitive systems for people. Both of them must have more rigorous sources of data collection. Otherwise, it will affect the relevance of data categories and symptoms.

We combine the existing business and conclude in practice that IoT terminals and sensors are one of the best sources of original trusted data. Because each person has very different personal conditions, including gene, lifestyle, physical characteristics, and so on. Even with the same blood pressure, blood glucose data may not mean the same thing.

Gathering polymorphic, time-sensitive, detailed data helps optimize overall sign data. Health testing IoT terminals provide each health sign information, while other smart devices provide others living information which makes it easier to assist in determining the accuracy of health information.

### 1.2.2 Processing Difficulties of Massive Complex Data

Usually, the data of a social group is distributed and stored in various organizations. The data contains various kinds of one’s health information such as digital information and video information. And the rate of information generation is increasing day by day. Even though there are algorithms to defragment the large amount of fragmented information, the data is still raw, unsupported, and non-standardized. Besides, there is still not enough time for collating complicated information, and the data can only be shelved when the time comes to use it.

Therefore, we use blockchain technology to identify and classify EMR and PLHR data through distributed standardized judgment in mass judgment nodes, screening and optimizing data, making the data structure in line with EHR applicable standards, and constantly improving the signature library. Thus, in the data application, reducing various types of costs in the effective data reduces the data use cost. Users and nodes at the same time can get benefits, and the value sharing in the chain can be realized.

### 1.2.3 Non-uniform Identity Information and Non-Standardization Data

One health service provider brings in data from many sources. Even HIS systems used by hospitals have dozens of completely different standard formats. In the background of cross-regional, cross-sectoral, and cross-cultural level, the parties that data owners are neither trust nor willing to share data, and the interests of user groups will eventually be harmed.

Blockchain technology has revolutionized this issue. It achieves data callable, standardized, and improves the consistency of the data without infringing upon the interests of all parties due to its characteristics of distributed records, not tampered with, consensus mechanisms and other technical features.

### 1.2.4 Sensitive Data Usage and Privacy.

For individuals, their own healthcare data stored in major institutions may contain a large amount of sensitive information, and users do not have the right for using of authorize or modification of such data; they even have no idea about data browsing history. The consequences of these situations are predictable and very serious. In the meantime, several enterprises and institutions themselves would drive the process of R&D and commercialize it under the condition of using a certain amount of data, which results in a large amount of processed value data. These figures are as valuable to other agencies as they are sensitive for themselves.

In terms of user privacy protection, we use the IPFS file storage system to provide a layer of Hash encryption for the mounted storage of user data. Hashing encryption is unidirectional and unique, and the different contents will produce different ciphertexts (Lamport, 1979). So, it can effectively guarantee the uniqueness of data storage address. We use an extra hash encryption method to encrypt the index of the chain as we record the block information data, thus ensuring that the privacy of health data is absolutely safe.

## 1.3 Opportunities

### 1.3.1 Chronic Diseases Caused by An Aging Population.

The ageing of the population is a common problem facing all countries, and the problem of chronic disease management and provision for the aged is becoming more and more difficult. The reality is that there are not enough human resources to be able to undertake the daily care needs. Because of high costs and other problems, this contradiction is very hard to alleviate.

We envisaged using intelligent IoT devices as health management assistants to ease this discrepancy by providing daily light services through artificial intelligence to provide cognitive assistance, risk warning, and more. At the same time, we encourage service providers to provide online one-to-many healthcare advice services. In fact, we always use blockchain technology as the base of technology, and big data serves as the basis for AI training. Moreover, on the basis of small data of regional users, we can accurately make risk early warning and many personal services for aged users.

### 1.3.2 Medical Fraud

The uneven distribution of medical resources in the world is generally acknowledged. Healthcare problems caused by a lack of suitable resources due to the asymmetric information and misleading misinformation can be found everywhere. Moreover, the user cannot find detailed information of healthcare on the Internet. Also, the information may misguide the user with persuasive advertising. In the meantime, even though there is a reciprocal evaluation mechanism between the patients and the health service providers, both parties often fail to obtain a fair evaluation of each other and therefore the evaluation does not have a reference value.

The blockchain is transparent and its technical characteristics cannot be changed so that each evaluation is based on some weight factors, and more useful references can be used for patients, ensuring that we can get more matching health resources and avoid inferior resources to purify the one health service system.

### 1.3.3 Risk of Using Medicine

Every year, hospitals and other medical service agencies handle tens of millions of prescriptions. In the circumstance of a substantial number of user base, it is very difficult for medical workers to accurately prescribe medicine and follow-up. In the face of possible drug use risks, such as: drug dependence, drug allergy, drug side effects, dosage, and other issues, the inability of medical practitioners to ensure accurate medicine use under existing medical condition is undoubtedly a great risk to the user.

The healthcare service providers would have known about the risk information of drug user in using the medicines in ways of purchaser's purchasing behavior records, social psychological information, and physical conditions after the drug through the blockchain. The chain would collect and analyze the big data with high performance of computing power. The service provider can effectively analyze each user's situation, help users to use drugs more safely, and reduce unnecessary medical expenses.

### 1.3.4 Internet Security Challenge

The healthcare industry is known for its strict compliance policies and regulatory oversight because of the needs to ensure data security and privacy while new cybersecurity threats have created new hurdles and left the new digital workflow deployment in a dilemma. Nowadays, healthcare systems, pharmaceutical companies, and device manufacturers require a secure, trusted, and connected healthcare IT ecosystem that manages healthcare data and advances value-based healthcare. A study done by IBM Security and the Ponemon Institute in 2017 found that data leakage costs for healthcare facilities increased by about $380 per case compared to a 10% drop in other industries. As a result, cybersecurity has become a big concern to the medical facilities and technology companies. Last year, for example, Johnson & Johnson warned their patients that "OneTouch Ping" insulin pump was vulnerable. The U.S. Food and Drug Administration recently unveiled a cybersecurity loophole for the St. Jude Medical cardiac assist device. With the proliferation of interconnected medical devices, the possibility of medical devices being attacked, regardless of whether the devices are networked or not, needs more attention of medical device original equipment manufacturers (OEMs).

Unlike existing security systems, blockchain-based systems operate in a distributed network consensus that uses built-in encryption techniques to ensure that records of all digital events cannot be modified or attacked at all. These unique blockchain features may provide additional layers of trust to minimize cyber-security threats to HIT systems, interconnected medical devices, and embedded IT systems. This new blockchain technology empowers healthcare systems, medical device OEMs and healthcare technology companies with more reliable and secure device identity management strategies, promote IoMT (Internet of Medical Things) applications and improve patient privacy while providing patients possible medical data access.

### 1.3.5 Medical Data Exchange and Interoperability

Health and medical data exchange is complicated. The growth of digital trends requires good interoperability of medical data in order to encourage medical collaboration. It is important to understand that interoperability is not only an exchange of information, but also the ability of two or more systems or agencies to trust each other and share the responsibility and information (Culver, 2016). So, the real challenge of interoperability for medical data goes beyond the technical level and to more fundamental concepts like the lack of a trusted framework and integrity with existing HIT systems. As a result, the lack of trust in digital workflows leads to a variety of different HIT systems and centralized medical data management models despite the growing use of EMR / EHR systems and digital medical solutions.

These trends have become an important part of new solution deployments, such as bringing new interoperability approaches of the blockchain. The unique capabilities of this technology provide a trusted workflow that cannot be tampered with, with a "single source of trust" to ensure the integrity of medical data exchange, minimize cyber-security threats, and improve healthcare data management applications (Brodersen et al., 2016). Blockchain sharing platforms can potentially centralize medical data interaction while ensuring access control, authenticity, and integrity of the protected healthcare information exchange (Ivan, 2016). Moreover, the deployment of blockchain (as an additional layer of trust and security) on existing HIT systems can minimize administrative inefficiencies by replacing traditional trustee administrators or registry owners in existing medical data exchanges.

## 1.3.6 Health Care Consumerism and Self-quantification

Digital healthcare solutions have created a wealth of personalized medical and lifestyle data that underlines healthcare consumerism. Nowadays, consumers are still recipients of medical data, therefore they want to actively participate in different levels of medical care. For example, a recent Frost & Sullivan study found that about 69% of U.S. consumers track their own health symptoms. About 41% determined to change their physician if they could not access their health records and 74% of patients wanted follow-up care for customized alerts and news feed.

However, most healthcare consumers believe that primary care cannot be effectively interacted with given the existing patient management programs in large healthcare companies. They barely have real-time access to personalized medical options outside the clinic, referral support, and compliance warnings. This raises different kinds of serious issues, such as patient data ownership, HIT system access and privacy, and emerging data medical solutions. In addition, interoperability and trusted workflow are the key to future success in this multi-layered digital patient interaction.

Blockchain is an open source tool with a peer-to-peer data sharing network model that provides identity management capabilities, predefined user access, increased patient control over medical data coverage, and patient engagement reliability (Ekblaw, Azaria, Halamka, & Lippman, 2016). Moreover, permanently storing encrypted patient health data in a non-tampered blockchain system can provide a single, simplified patient data visualization (Linn & Koo, 2016), allowing consumers to selectively share anonymous personal health data for research, rewarding positive health behaviors and other compliance programs directly with tokens and other incentives.

## 1.3.7 Value-based Care

The digital democratization goal of the healthcare model is value-based which requires health care providers to better utilize healthcare IT standards and improve healthcare interoperability. New prospects for health care are now not only about access, quality, and affordability, but also about predictable, preventable, and result-based healthcare which promotes social and financial inclusion. While pressure on global regulatory hurdles and health care costs is rising, blockchain technology can bring new economic advantages, such as: eliminating expensive intermediary services, automating transactional services in the medical process (such as claims identification, bill management, revenue cycle management, pharmaceuticals supply chain, and other medical contract processes). Blockchain-based distributed ledgers make cost-effective business relationships easier to create: basically, tracking any value and trading without a centralized control point. The blockchain system will deliver new result-based healthcare and compensation models in the healthcare process, which will save the industry billions of dollars.

### 1.3.8 Precision Medicine

Pharmaceutical companies are under increasing pressure of drug prices adjusting. According to industry estimates, the drug abuse amount is as high as 300 billion U.S. dollars per year, including those patients with certain genetic types that are immune to drugs, fail to meet the desired results, and have dangerous side effects. Therefore, the pharmaceutical industry must shift from a large-scale to a patient-centered drug development model for future targeted therapies. The concept of precision medicine may change the mode of care.

The goal is to integrate personalized health data, both direct and indirect, and protect the health and well-being of individuals. However, personalized medical data is the "holy grail" for precision medicine but not the only one that faces the unique health data interoperability, privacy, security, and ownership challenges (Koo, Charles, & Yuh-Ming Shyy, 2005). In addition, the existing legal and ethical framework for health data exchange is based on radically different medical and research processes that pose serious challenges for the seamless exchange of data between population genomics research and comprehensive research facilities (Peterson, Deeduvanu, Kanjamala, & Boles, 2016). Due to the pharmaceutical industry bets on non-tampered records of interviews and blockchains in precision medicine could eliminate the costs and burdens of clinical trial data alignment enables interoperability and comprehensive research facilities, blockchain technology with the ubiquitous security infrastructure enables seamless health data exchange to facilitate unprecedented industry collaboration, including practitioners, academics, researchers and patients, to promote innovation in medical research and large-scale genome-wide population research and the development of precision medicine (Brodersen et al., 2016).

## 1.3.9 Weakness of Healthcare Data Industry Chain

Good and sustainable business models can drive more efficient circulation of data. However, in the field of healthcare data, the profits generated from the circulation of data are fully obtained by the central organization due to the issue of data ownership, while the data owner (patient or user) is not rewarded. In the business model that owners do not benefit from, there is obviously a lack of legitimacy that prevents them from sustaining long-term growth. For the organization, in order to guard against legal and moral hazard and maintain data monopoly, many centralized data storage institutions choose to archive the data. For the community as a whole, the repetitive investment in medical equipment and the repetitive collection of medical data have taken an alarming toll. These kinds of behaviors can cause a huge waste of medical resources. Statistically, it is currently very weak for actual application ability of healthcare data due to the problems of data silos and data dynamics.

At present, centralized healthcare data resources store large amounts of data. Obviously, the ownership of healthcare data belongs to patient or users, and the organization only can use the data carefully after authorization with privacy keeping. The data analysis and application need a large number of different sources of data and their right of use. However, data demanders would spend staggering amounts to legally access large amounts of data; however, they might have some problems about potential ethical risks and unsuitable sources (Kuo & Ohno-Machado, 2018). Therefore, the blockchain technology can achieve the overall industry-driven. Data providers transfer the data to the data handler after receiving the appropriate incentives from data handler. The data handler then not only ensures the processing of credible and classified data but also receives data demanders' rewards from selling processed data through the blockchain. The whole transactional process can be traced back to ensure that data sources are valid.

# 1.4 GenkiCell Definition and Vision

The literal translation of GenkiCell is vitality cell. GenkiCell is a hypothetical cell that can solve any major health problem. The essence of GenkiCell Blockchain Technology is a one health data exchange platform. Blockchain technology makes data encryption on this platform more reliable and offers diverse health data services to physicians, patients, users of smart devices, research institutes, and hospitals.
GenkiCell aims to provide an open, low-cost, secure, reliable, decentralized health data application and exchange platform for healthcare industry，which is able to share business resources among stakeholders.

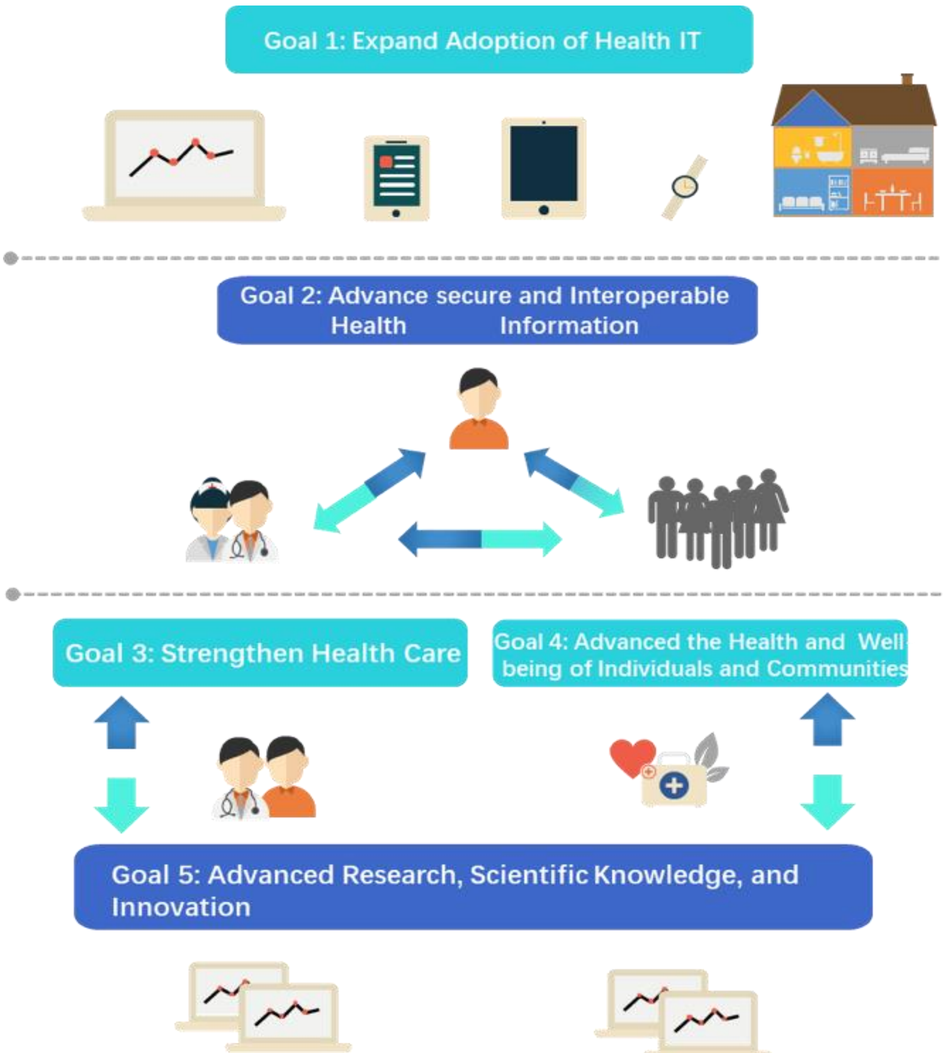
1. GenkiCell would access and call each authorized database securely, both IoT devices and existing organizational database. The chain would access and call the database after authorization without changing the current global health data storage system.
2. Genkice proposed personal life health records (PLHR)—a series of personal health information files made up of multi-dimensional information sources in life. Users can upload their own health data or upload it automatically by using the corresponding |OT device on the basis of authorization, forming an anonymized PLHR. This PLHR is characterized by time continuity, multi-dimension, and comprehensiveness, and the user can be authorized Use the data to obtain the corresponding authorized revenue.

3. The user initiates a diagnosis request based on the PLHR with the related authorization. The distributed diagnosis service provider makes health advice under the guidance of independent diagnosis and weight model. Each transaction will form a standardized case for AI training. Each service provider will receive rewards for credible processing of one health data.

4. GenkiCell would increase efficiency of regional medical associations and transregional medical alliance services through blockchain technology to optimize and mobilize relevant idle resources. Healthcare service providers can provide services according to PLHR quickly and accurately, even cross-border one health services. And users could receive the most suited healthcare service with lower cost. Both users and one health service providers will receive ratings in the transparent blockchain.

5. GenkiCell hopes that more research institutes and business organizations can gain a large amount of anonymized and credible data at a lower cost while content providers for licensing

benefit through smart contracts. These data can be used for training one health artificial intelligence systems, the source of illness study, and the tracking of drug side effects, etc. It can also be used for developing some advanced analytical technique such as the healthcare cognition decision support of users' self-diagnosis system or identification of pathological feature assistant system or system of an early warning and response system for epidemic prone diseases and so on.




Genkicell Chain realizes the data access for Internet of things by using the blockchain technology. In addition, the daily physical signs, environmental space, medical information and other data obtained through the technology will assist the medical institutions to realize long-term care and timely effective intervention for users' health condition. When the data has been tagged, the data transfer can be realized through medical association and other forms to improve the ratio of fixed customer for medical institutions. Therefore, Genkicell will strive to realize the transfer of value data between individuals, medical institutions and commercial institutions and the common benefits of users in the ecosystem.

## 1.5 GenkiCell's Application Theory

Blockchain is a new application mode that combines technologies such as distributed data storage, point-to-point transmission, consensus mechanism, and encryption algorithm. The combination of blockchain technology and one health can give full play to its advantages of being safe, reliable, transparent in transaction, and accurate in use, and at the same time it is in line with the decentralized one health data framework (Kobayashi, Otsubo, & Imanaka, 2015). It can be said that the blockchain technology, as the underlying technology, can reshape the value of one health data, and bring innate autonomy. In the traditional one health data system, medical and health agencies act as a hub to collect and store a large number of medical data and information and form a centralized network. The mutual trust problem between the agencies results in data loneliness. In addition, the center of data storage, in order to ensure data security, spend a lot on data security service costs; thus, in the blockchain-based health data system, the information will be securely stored in the network nodes distributed at the same time, so that data authorization, delivery, and sharing will be safe and transparent.

According to Donald Knuth analyst, big data has the characteristics of 4V: volume of data, value growth and processing, variety of data structure, low value density, and high value of application. In addition, one health data also has: long-term preservation, space-time, semantic, and privacy. At the same time, because of these characteristics, it also has to face these problems: data authenticity, privacy protection, authorized use, data silos, large volume of low value, and trust issues.

One health data is stored on distributed nodes, pointing to the content itself through a cryptographic hash which will be in the form of a transaction, indicating the owner of the data and is unable to be tampered with in the blockchain, thus solving the huge amount of data storage costs and the traditional central servers' security issues. Due to the distributed storage of the data itself, we divide the complete data into multiple pieces and store them in each node, so that the clear text of data is desensitized, and the user's privacy is guaranteed. At the same time, due to the distributed file storage, the transaction of data will be used as the data authorization. The owner's digital signature is seen as a permission of the data authorization. The nodes storing the file fragments will uniformly transmit the data to the authorized parties while ensuring data security and preventing fraud. A unified form and natural language analysis system based on the application layer will help the rapid access and transfer of data in different systems and systems under the current medical system.

Data can be tagged by multi-parties, which will determine the authenticity of the data, and the number of the multi-parties present the value of the data. At the same time the tagging same as a classified to increase the value of the density. When a user keeps using the one health service in a public key account, the corresponding PLHR will gradually be generated in the Genkicell chain. The consensus within the blockchain forms a one health network for the low-cost trust transfer between different nodes (e.g., organization, individual, company, etc.). Using the chain function achieves rapid authorization for using and collecting data and improves data mobility. The asymmetric encryption combined with public-private key can initially desensitize the data source so as to ensure the data provider's privacy security (LaFever, 2016). Blockchain provides a cost-effective, open, and transparent system of value for one health data transactions.

According to the design of Genkicell, all healthcare services can be purchased in Genkicell one health services platform (for example: medical insurance service, pharmaceutical service, health care services, health assessment, medical diagnostics, pet disease treatment, etc.) because of the existence of PLHR; the timings of all service purchased and individual healthy statements relationship will be able to be traced, which will help to make the health service results transparent, rationalize service price, and reduce the service agent (Price et al., 2015). Because of fast authorization that can be implemented, Genkicell technology can connect virtual resources with real resources and maximize the activity and efficiency of data assets with high-speed, flexible, and cross-border transactions.

In addition, IoT healthcare devices or IoMT devices will be based on the local consensus and sub-regional consensus, which will improve the efficiency of the decision-making and used for initial processing of the raw data. Because of the tagged data, medical AI is able to be trained at low cost; mature data models and AI will handle the explosive growth of data more easily.

One health data with blockchain in the future will have the following features: the data under the multiple data supplement, credible confirmation for data, traceability authorization, privacy and safety of data, transparent transaction and information, cheapdata, high-speed flow, and sharing.

# CHAPTER 2. SYSTEM DESIGN PRINCIPLE

Relying on the above research and application theory, the principles of our technical design are as follows:

**Validity and reliability of data：** The data can be trusted with two aspects: first, the tagged data must be reliable enough; second, data from the data provider must meet the requirements of the originator and it must be veritable and effective.

**Data security and can be tagged：** Only properly tagged data can be recorded into the main chain, and its own mechanism will effectively filter noise of the data in the main chain. In the process of being tagged, the data is protected in the transmission process through the restriction of the mechanism itself.

**Independent tagging process：** In the process of tagging, each tagged result is not visible between the individual mark units to ensure that the tagged process is unable to interfere and cheat. At the same time, in order to improve the credibility of the marking process, the weight of the behavior evaluation of each node needs to ensure the balance of fairness and efficiency in the process of multi-party participation through algorithm control. (The algorithm details will be discussed in the below)

**Node value system：** Trusted node sign to prove the accuracy of the node degree will increase the weight of the node in the system, thus the tagging activity of high reliability node will have more authority in the future. It will reduce the possibility that the majority of people are malefactors and to do an error tag into the block. At the same time, the system will reward the nodes of credible work to ensure the healthy development of the ecosystem.

# CHAPTER 3. TECHNICAL SOLUTIONS

## 3.1 GenkiCell Architecture

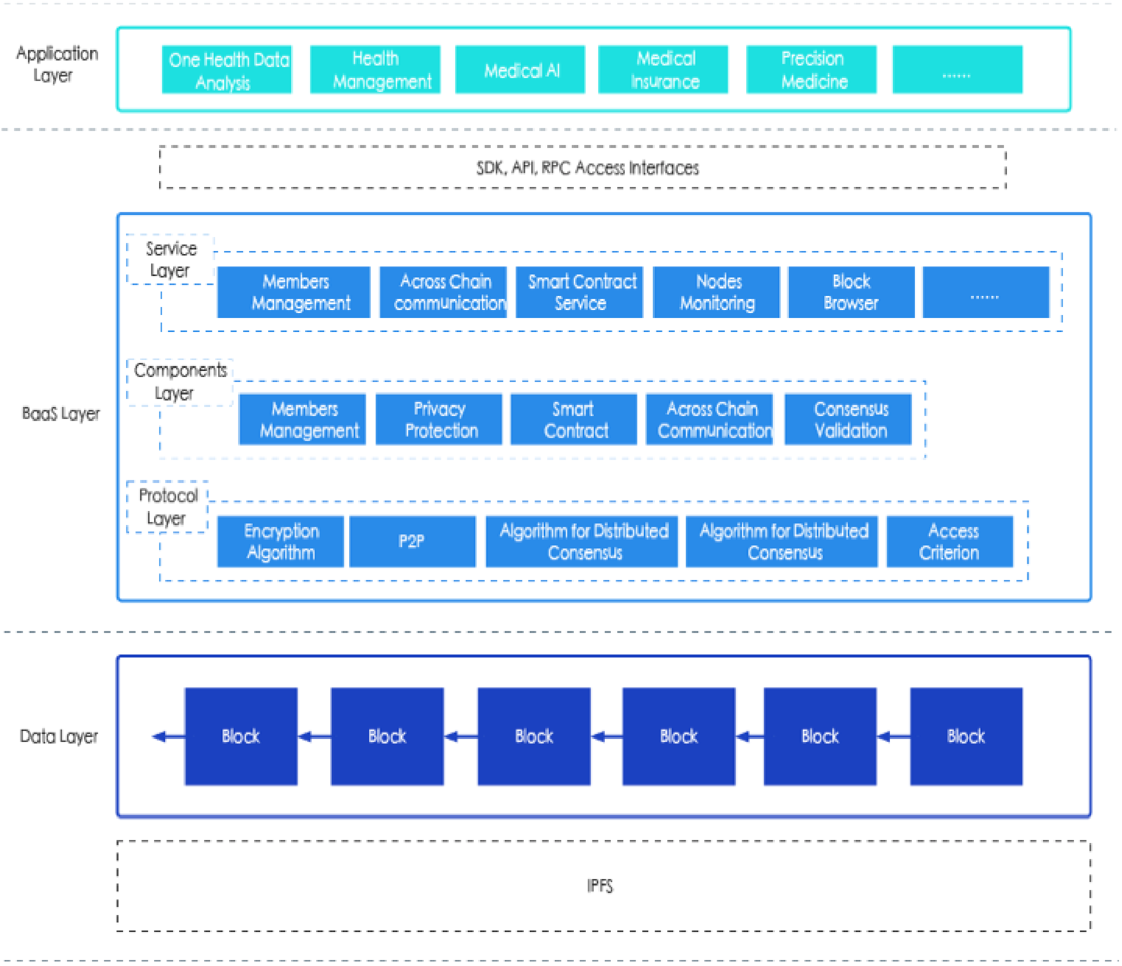
GenkiCell consists of three layers: application layer, BaaS layer, and data layer.

First of all, the applications run at application level, containing all of the major health industry data. The application's main purpose is to complete the data collection process; at the same time, however, researchers of natural language processing, artificial intelligence, and wearable devices can manage the data input and output via the platform.

Second, the task of the BaaS layer is to interact with the data layer and provide an open available interface to the application layer. In order to decouple the modules, the BaaS layer itself is split into the following three parts:

- Service Layer: This layer mainly contains the various modules closely related to the business, and directly serves the interface implementation open to the upper layer.
- Component Layer: This layer provides an abstract logic operation for the service layer, which is invoked by the service layer.
- Protocol Layer: This layer implements the underlying protocol logic, interacts with the data layer, and decouples it from the business details.

Third, the data layer task is mainly to save the existing data. Existing data includes user measurements and the markup result by trusted nodes. The data and the results of the markup and the transaction data pass a special mechanism called the Merkle tree. The security of data is guaranteed by means of an asymmetric encryption. It also ensures that large data mounted on the side chain can be queried quickly.




## 3.2 IPFS Data Storage

GenkiCell will use the InterPlanetary File System (IPFS) technology to store and distribute data in system. Because IPFS has a high transmission speed, high reliability, and no storage upper limit, IPFS itself is extremely suitable for storing one health related data. In the data tagging process, IPFS's hash address mechanism guarantees the reliability of the file.

IPFS is a peer-to-peer distributed hypermedia distribution protocol designed to create a network transport protocol for persistent distributed storage and shared files (Agorise, 2018). It provides universal addressable space for all contents, including Git, self-supporting file system SFS, BitTorrent, and DHT. It is also considered to be the most likely replacement for HTTP's next-generation Internet protocol (Finley, 2016). It is a content addressable equivalent hypermedia distribution protocol, and nodes in the IPFS network form a distributed file system.

IPFS replaces the traditional domain-based addressing with content-based addressing, and users do not need to care about the location of the server, regardless of the name and path of the file store. We put a file in the IPFS node and it will get the only encrypted hash value based on its content. The hash value directly reflects the contents of the file, even if only one bit is modified, and the hash value will be completely different. When IPFS is requested for a file hash, it will use a distributed hash table to find the node where the file is located, fetch the file and validate the file data.

IPFS is a general-purpose infrastructure that has little storage limitations. Large files are cut into smaller chunks and can be downloaded from multiple servers simultaneously. The IPFS network is an unfixed, fine-grained, distributed network that is well adapted to the requirements of the content distribution network.

The file system can be accessed in a number of ways, including FUSE and HTTP. Adding local files to the IPFS file system is available to the world. The file index is based on its hash, so it is good for caching and can increase the speed of transmission.

# CHAPTER 4. CONSENSUS MECHANISM

According to the transaction characteristics of Genkicell, an innovative consensus mechanism is considered, which refers to Weighted Delegated Proof of Stake (WDPoS) to maintain the unity of each node's data.

The DPoS algorithm uses witness to solve the centralization problem. In total, there are N witnesses who sign the blocks, which are generated by the voting using the blockchain network (Buterin, 2018). DPoS is more democratized than the rest of the system due to the decentralized voting mechanism. DPoS does not completely remove the need for trust. The trusted subject that represents the entire network to sign the block will ensure the correct behavior without bias in the protection mechanism. In addition, each signed block has a proof that the previous block was signed by the trusted node. By reducing the number of acknowledgments required, the DPoS algorithm greatly increases the speed of transactions. By trusting a small number of trustworthy nodes, unnecessary steps in the process of signing the blocks can be removed.

Because of Genkicell function at the same time, we hope the honest working nodes are rewarded and, at the same time, to reduce the number of tokens, gradually reduce the influence of credit after cold start, make honest effective work into consideration. In the so-called innovative WDPoS, which is designed to improve on the existing DPoS and add a weight (W) factor, for each witness, there will be a weight system for the previous historical behavior authoritative certification, done in the number of more and more correct and the higher the behavior, the system will give the node a corresponding reward. During each follow-up witness, the higher weighting node will gain additional priority by weighing it.

## 4.1 consensus mechanism

Because GenkiCell's complete transaction consists of a limited set of single sub-transaction or multiple sub-transaction, we decided to use the innovative WDPoS consensus mechanism to maintain the unity of data in each node.

### 4.1.1 DPoS overview and improvement approach

DPoS algorithm used Witness mechanism to solve centralized. There are N witnesses to a signature block, and these witnesses are elected by the main body of the blockchain network.

With the use of decentralized voting mechanism, the DPoS system is more democratic than others. DPoS doesn't completely remove to the requirement of trust. The trusted subject that represents the entire network to sign the block ensures that the behavior is correct and unbiased under the protection mechanism. In addition, each signed block has been trusted previously the node’s block proof of signature. By reducing the requirement of confirmation, the DPoS algorithm greatly improves the speed of the transaction. By trusting a small number of integrity nodes, it can remove unnecessary steps in the block signature process. Due to the robustness of DPoS, it is hard to break. We will make innovations on the basis of the existing DPoS and make it more suitable for the big health ecosystem.

**Improvement strategies based on historical behavioral weight:**

Since DPoS can't completely remove the requirement of trust, and there are no clear election rules in the voting process, we make the following improvements to DPoS. Weighted Delegate Proof of Stake, referred to as WDPoS, is aimed at the existing (DPoS) mechanism to improve and update the factor of Weight (W), where each registered witness’s history of the work behavior will be counted in weighting system certification. As the node completes the increase of the correct behavior, the system will give the corresponding node the reward for weight lifting. For improving the motivation of the correctness tagging, each side of the tag result will be verified and only the correct node will get user’s prepaid fee awards. In addition, the correct one will get the corresponding GenkiCell credit increase, and the higher credit will gain a higher weight in the subsequent judgment verification process. In the subsequent completion of the consensus process, the higher weight of the node will gain additional priority benefit by weighting. The mechanism by which same as proof of work is proven will gradually reduce the unsubstantiated trust requirement, which will reduce the trust requirement of DPoS.

### 4.1.2 Distributed consistency algorithm implementation.

Bitcoin is voted by hashing power, with a high hashing power and easy to win. DPOS mechanism is through assets accounted for (equity) to vote, the power of the more people joined the community, people in order to maximizing self-interest will vote for relatively reliable nodes, more safety and decentralization. However, it still relies on other people's choice, and WDPoS will automatically select the honest and reliable node according to the historical reliability of the node, and further improve the stability of the whole system. The whole mechanism needs to complete the following process:

(1) Register the delegates and start recording the behavior of the node.

(2) Maintain circulation and adjust the trustee's weight coefficient.

(3) Circulate new blocks and broadcast to the whole network.

1. Registered trustees.

The registered delegates must use the client software, so this function needs to interact with the node, which means the client will call the node API.

2. Evaluation node

The logic of all such transactions affects the reliability weight of the nodes. Here is a reminder that this feature is a function that ordinary users have, and that any ordinary user has the right to vote and the weight coefficient, so put it in the account management module.

3. Block round

Block cycles are the basis of other cycles, but the code here does not contain any key information such as blocks, transactions, etc. The implied correlation is the time stamp of information such as block and transaction. As long as you know any timestamp, other information can be easily calculated using the method here.

4. Round

For safety, the GCL stipulates that the delegates have to change after every regular round to ensure that the unstable or evil nodes are removed in time. At the same time, new nodes can have a chance to prove their reliability. In addition, the system will randomly search for new delegates to produce a new block, but each delegate has a chance to generate a new block (and reward) and broadcasting to the network within a round, and that every node and the currency through work proof mechanism (PoW) competition for broadcasting rights, compared to simplify a lot.

At the same time, the GCL project adopts a modular design and support pluggable consensus algorithm according to the specific application scenario/type that can easily and quickly switch to the consensus of other algorithms, including PoS, Raft, and Pbft algorithm, make the consensus of the mechanism itself can upgrade further iteration when appear limitations.

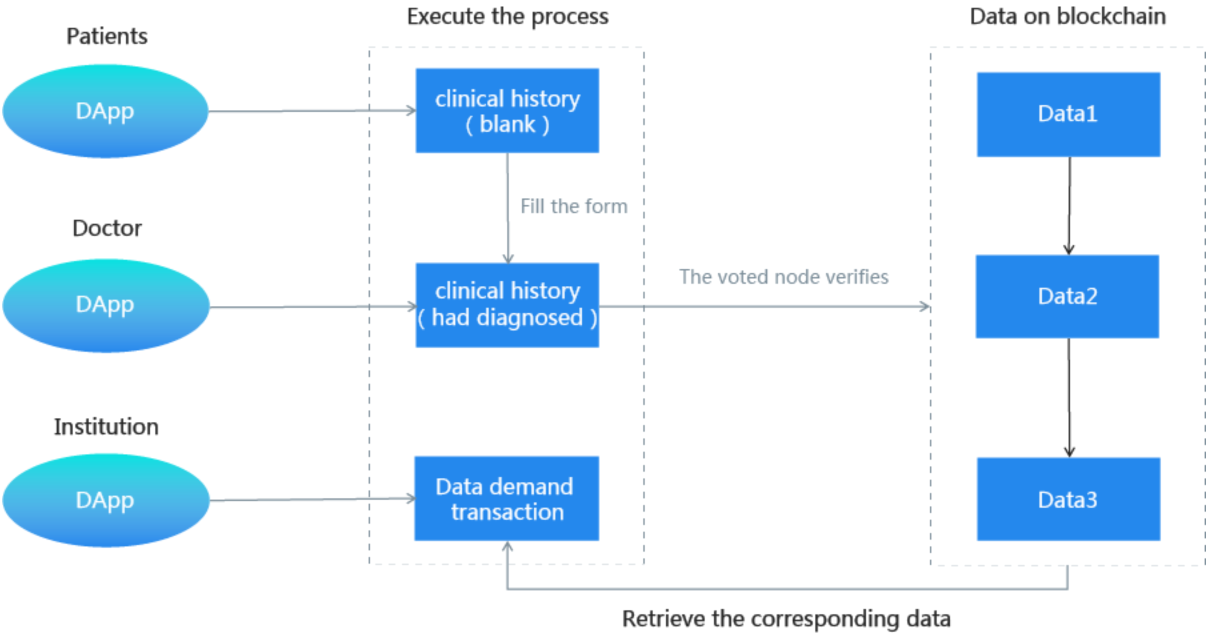
## 4.2 Smart contract

In the implementation of core ledger, GCL virtual machine can be built as the execution environment of smart contract, which can realize intelligent control logic for network application layer framework. In theory, the GCL virtual machine should have Turning complete, which can realize arbitrary logic and have a high degree of certainty. It is ideal for situations where there is a high level of certainty. In addition, the virtual machine compiles the intermediate language of JS bytecode into the instruction of the blockchain virtual machine, so that the developers of smart contracts don't need to learn new languages; they can write smart contracts in the familiar JS and other programming languages, and quickly integrate into the world's million developer community. The participating parties of the shared platform will be easy to operate and maintain, providing the operability of intelligent contract editing and lowering the threshold of access.

The virtual machine will be combined with the upper-level advanced language parsing and transformation to support the basic application of the virtual machine. The external interface of the virtual machine is realized through the customized API operation, which can be flexible to interact with the accounting data and external data. This mechanism achieves the high performance of the native code execution when the smart contract runs. At the same time, it also realizes the universal virtual machine mechanism which supports different block chains.

## 4.3 Operation process

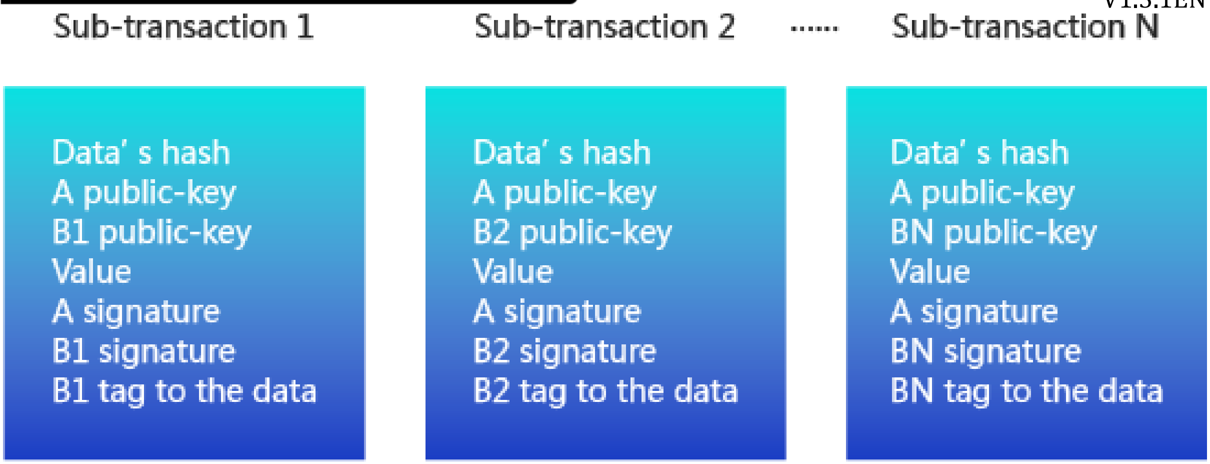
The core part of the whole GCL process can be summarized as data tagging process and data collection process, as shown in the figure below. Through the DApp, patients can carry out the procedure of medical treatment. An application for a case is presented in the whole process, and then the final result is determined by a collection of conclusions from one or more doctors. The final diagnosis will be recorded on the chain after verification of the consensus mechanism and completing the deduction and distribution of GCL token. For the collection process, the relative automation level is higher, and the organization can directly release the transaction demand. The data of the chain is collected directly through the smart contract, and the organization can directly complete the data collection work by paying the corresponding token.




## 4.4 Tagging Data Process

Each of Genkicell transactions is a finite set that consists of one or several sub-transactions For the convenience of explanation, the sponsor of transaction, the token owners and demand data tagged are called A. The token recipient, the party that marked the data is called B. The nodes that are responsible for transmitting information and witnessing become C.

The sub-transaction order consists of the following: A's account public key address, hash of the data, the value of the transaction, the public key address of the account of B, the data's tagging by B, the digital signature of A, Digital signature of B.




The hash of the data will indicate the location of the data to be marked in the distributed storage network and is considered as a classification that this sub-transaction belongs to it.

A's public key identifies ownership of the data and shows the address of the payment token.

B's public key indicates that the hash of the data is retrieved from the address of the receiving token.

A's signature guarantees the information integrity of the sub-transaction and the right of permission that A allows B to download the to-be-marked data on the distributed storage network.

B's signature guarantees the integrity of the tagged data tag.

The value represents the number of tokens in the transaction after the transaction is successful.

A fills in the contents that include:

- A’s public key address
- Data’s hash
- Transaction value
- Credit to participate in the request
- The number of participants in B

According to the credits of participatory members, the sub-transactions will be filled in by A. The system divides the online nodes into A (transaction initiators), B (the participants who achieve satisfying credit), C (witnesses who do not meet the condition of credit, but participate in transmission and witnessing), the eligible B's account public key fill in the sub-transaction.

After A initiates a request for tagging data, the system will form many sub-transactions that depend on the number of sub-transaction based on the number of B's (N). The information is contained on this statement of sub-transaction:

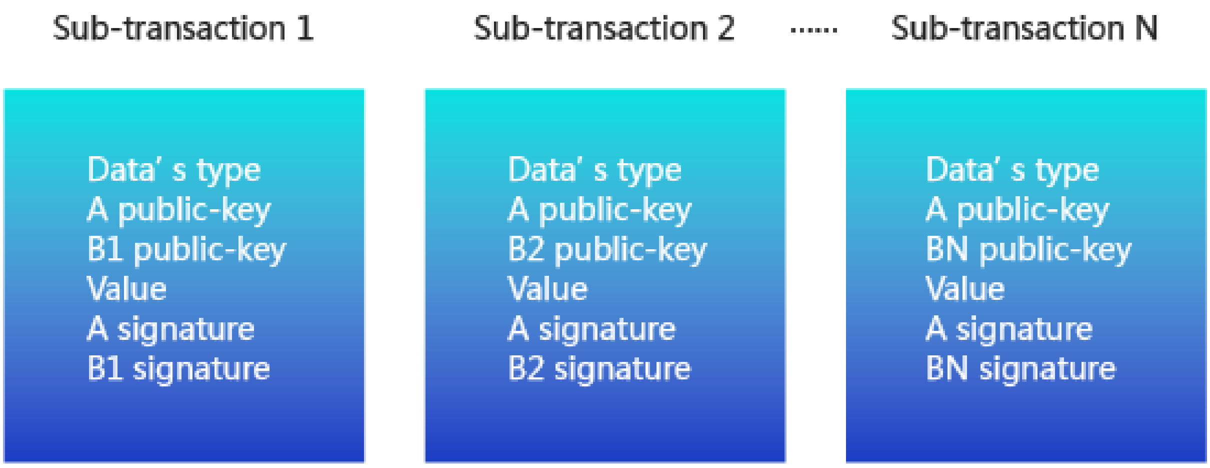
- Hash to be marked data
- A's public key
- B's public key
- Transaction Value
- A's signature

After the completion of this part, the sub-transaction (at this moment, the signature of B and the tagging from B is blank) is transmitted from A to B and C through P2P. C obtains the transaction and sends data to B, the sub-transaction at this time can be regarded as an authorization for data transfer. B tags the data and fills the judgment in the sub-transaction after B has received the data from C nodes, and then the complete sub-transaction will be sent to C and A. When the BN completes the sub-transaction (Nth), all C nodes begin to gradually receive all completed sub-transaction for this request and then wait for the consensus. According to a set of weight algorithm, the calculation of which marker is successful. The correct mark gets a credit score and the transaction succeeds, while the error mark reduces one credit score and the transaction fails. If there is a sub-transaction that is not completed, wait and connect with the corresponding B, when the waiting time exceeds the average completion time of other sub-orders (N is greater than 51%), B’s credit score reduces 1, The B’s mark seems to be wrong.

## 4.5 Data Collecting Process

For the convenience of explanation, the sponsor, the token owner, and the demand collecting data are called A. The token recipient, the owner of the data, are called B. The nodes are responsible for transmitting information and witnessing become C.

The sub-transaction consists of the following: A's account public key address, data type, value contained in the transaction, B's account public key address, digital signature of A, and digital signature of B.




The data type will indicate the location of to-be-collected data on the blockchain (also based on the public key of B) and is considered as a classification that this sub-transaction belongs to it.

A's account public key address identifies the direction of transferred right, and the address of the payment tokens.

B's account public key address identifies the owner of the to-be-collected data and the address of the receiving token.

A's signature guarantees the information integrity of sub-transaction.

B's signature ensures that B gives a permission that A can download the data from the distributed storage network.

The value represents that B obtains the number of tokens after the transaction is successful.

The process is as follows:

- A fills in the content:
- A’s account public key address
- The categories of data
- Transaction Value
- The number of participants in B

According to the category of data, the system divides the online nodes into 3 types: A (transaction initiator), B (the owner of data), C (witness who does not satisfy the category, but just participates in transmission and witnessing), The eligible B's the account public key to be filled into the sub-transaction.

After A initiates a data collecting request, the system will form N sub-transactions based on the number of B's (N). The information contained on this sub-transaction:

- data categories
- A's account public key
- B's account public key
- Transaction value
- A's signature

After completing the contract, A transmits the sub-transactions (at this moment, the signature of B is blank) to B and C through P2P. C is a witness and sends the sub-transactions to B, and B will sign the transaction confirming that the owner has granted the permission to A. C to obtain the transaction which has been signed by B to send data to A, the transaction sub-orders at this time can be regarded as a transfer authorization. When the Nth B completes all orders, all C nodes begin to gradually receive all completed orders for this request. Then wait for the consensus to finish and then transfer the data to A.

## 4.6 Normal Trading Process

For the convenience of explanation, we will not only launch the trader, but also the token owner side as A. The side of the token recipient is called B. The party responsible for transmitting information and witnessing becomes C.

The transaction order is made up of the following parts: A's account public key address, the value of the transaction, the account public key address of B, and the digital signature of A.

A's account public key address indicates the address of the payment token.

B's account public key address indicates the address of the receiving token.

A's signature guarantees the information integrity of sub-transaction.

The value of the bill of exchange represents the number of tokens obtained for the transaction after the transaction is successful.


The process is as follows:

A fills in the contents: A's account public key address, and B's account public key address.

At this point B, C have become witness nodes.

The system will form N sub-orders based on the number of Bs (N). The information contained on sub-transactions is:

- A's account public key

- B's account public key
- Transaction value
- A's signature

After the completion of this part, A will send the sub-transactions to C and B and wait for the consensus. The transaction will be completed after the consensus.

## 4.7 Weighting Algorithm

The model is based on the weighted data of similar data markers to determine the correctness of the diagnosis, which can decrease the misdiagnosis and deliberate cheating in the data tagging process. In the diagnosis process, GenkiCell introduced the correctness data marking mechanism, which is, counting all the data marking results and allocating non-integer multiple votes according to their weight coefficients so that the entire weighting system can effectively resist the hacking and prevent fake data to affect the credibility of the data. In the end, the result will be considered as valid if and only if the total number of diagnoses times weight exceeds 51%. Otherwise, the diagnosis is considered ambiguous or belonging to hard-to-mark data, and the order assignment data tagging process has to be redone. Until the user abandons the data mark or mark the data with the correct tag, the tagged data can be entered into the block.

According to each node's tagging of data (A1, A2...An), the previous transactions of each node are called, and the following four types are obtained:

1) The node is tagged as A, and the correct tag is A, and the tag is correct.

2) The node is tagged as B, and the correct tag is A and the tag is error.

3) The node is tagged as A, and the correct tag is B, the tag is error.

4) The completion time of the node is over, and the correct tag is A.

For this transaction：
N1: The number of times the node correctly tagged the answer.

* count of situation (1) above

N2: The number of times for overtime

* count of situation (4) above

N3: The number of times for the error tag

* count of situation (2) + (3) above

The credit calculation formula of each node in the current transaction is:

$$\alpha_i = 1 * n_1 + (-1) * n_2 + (-1) * n_3$$

α: Credit of each node

n: Total number of nodes

Calculate the credit average of each node:

$$\overline{\alpha} = \frac{\alpha_1 + \alpha_2 + \ldots + \alpha_n}{n}$$

Because the derivative of the arctangent function is 1 / (1 + $x^2$), the growth rate of the curve increases with the increase of the random credit value in the early period. When the credit value reaches a certain value, the growth rate will gradually decrease. This effectively reduces the weight of agencies with low credit ratings and prevents institutions with excessive credit ratings from dominating the voting results.

X: The results of nodes

$$\beta_i = \frac{arctan(\alpha_i - \overline{\alpha})}{\pi} + \frac{1}{2}$$

Since there are n nodes involved in this transaction, we will have n results: x1, x2, ... xn.
After that, all βs of the same marking result are added

P: the total number of all the results after merging the same category.

$$\begin{bmatrix} x_1 & x_2 & \dots & x_n \end{bmatrix}_{1*n} \begin{bmatrix} \beta_1 \\ \beta_2 \\ \dots \\ \beta_n \end{bmatrix}_{n*1} = \sum_{i=1}^{n} \beta_i x_i$$

$$= \sum \beta x_1 + \sum \beta x_2 + \dots + \sum \beta x_p \quad (p \leq n)$$

$$= \omega_1 x_1 + \omega_2 x_2 + \dots + \omega_p x_p$$

**For each marker, the probability formula is**：

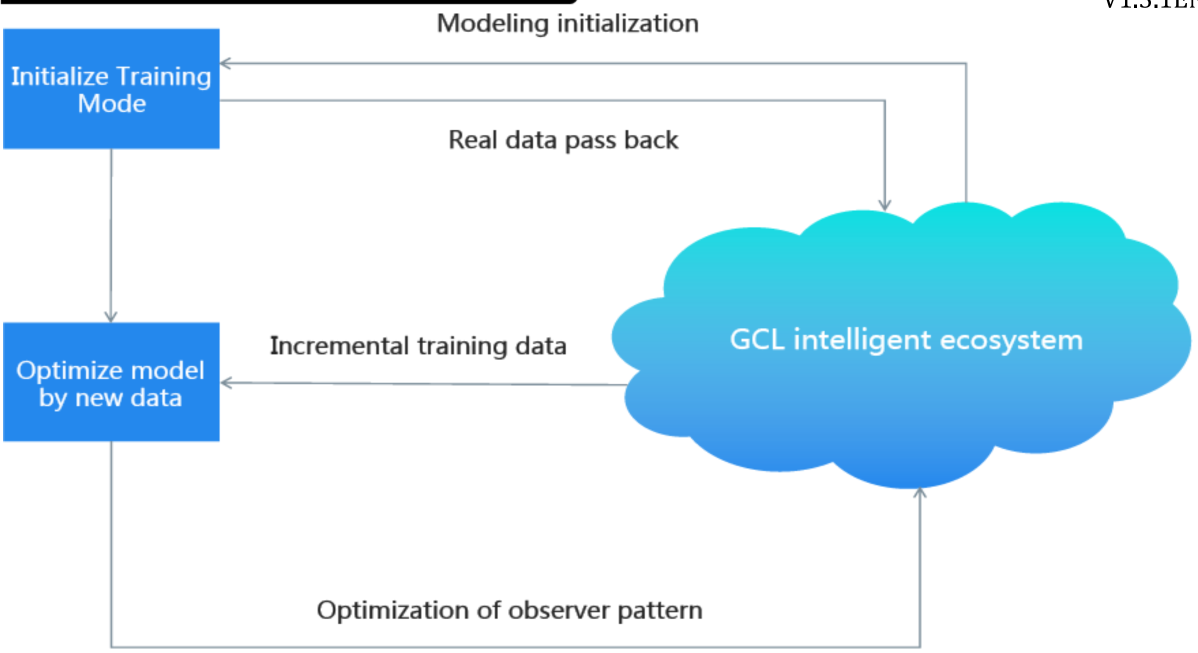
$$\frac{\omega_i}{\sum_{i=1}^{p} \omega_i} = \frac{\sum_{x_i} \beta}{\sum_{i=1}^{n} \beta_i}$$

$$= \frac{\sum_{x_i} \left( \frac{arctan(\alpha_i - \overline{\alpha})}{\pi} + \frac{1}{2} \right)}{\sum_{i=1}^{n} \left( \frac{arctan(\alpha_i - \overline{\alpha})}{\pi} + \frac{1}{2} \right)}$$

when the node has a more than 51% probability of the tag, the node is considered to have done the correct tagging work.

### 4.7.1 Intelligent diagnostic machine.

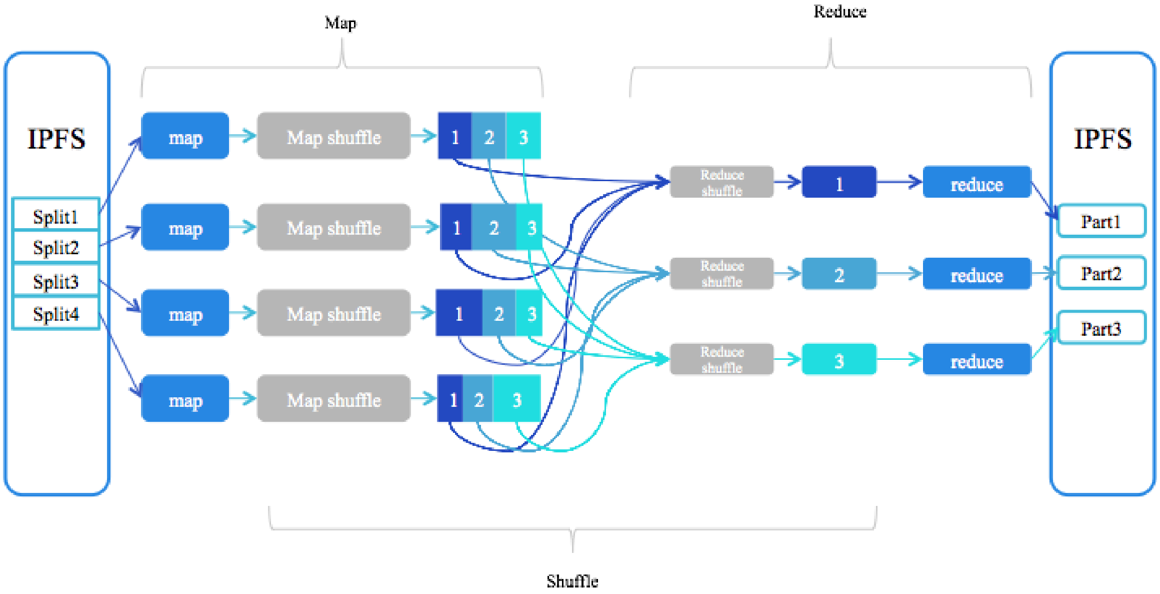
Based on the above service logic, organizations with relevant artificial intelligence technologies can use the data from the chain to train their own intelligent diagnostic models to gain reward. With the data of the growing on blockchain, these institutions by collecting relevant data can constantly train more accurate diagnosis model of AI, and a more accurate model itself can bring with model agency a steady stream of income.




## 4.8 Analysis of GCL Great Health Data

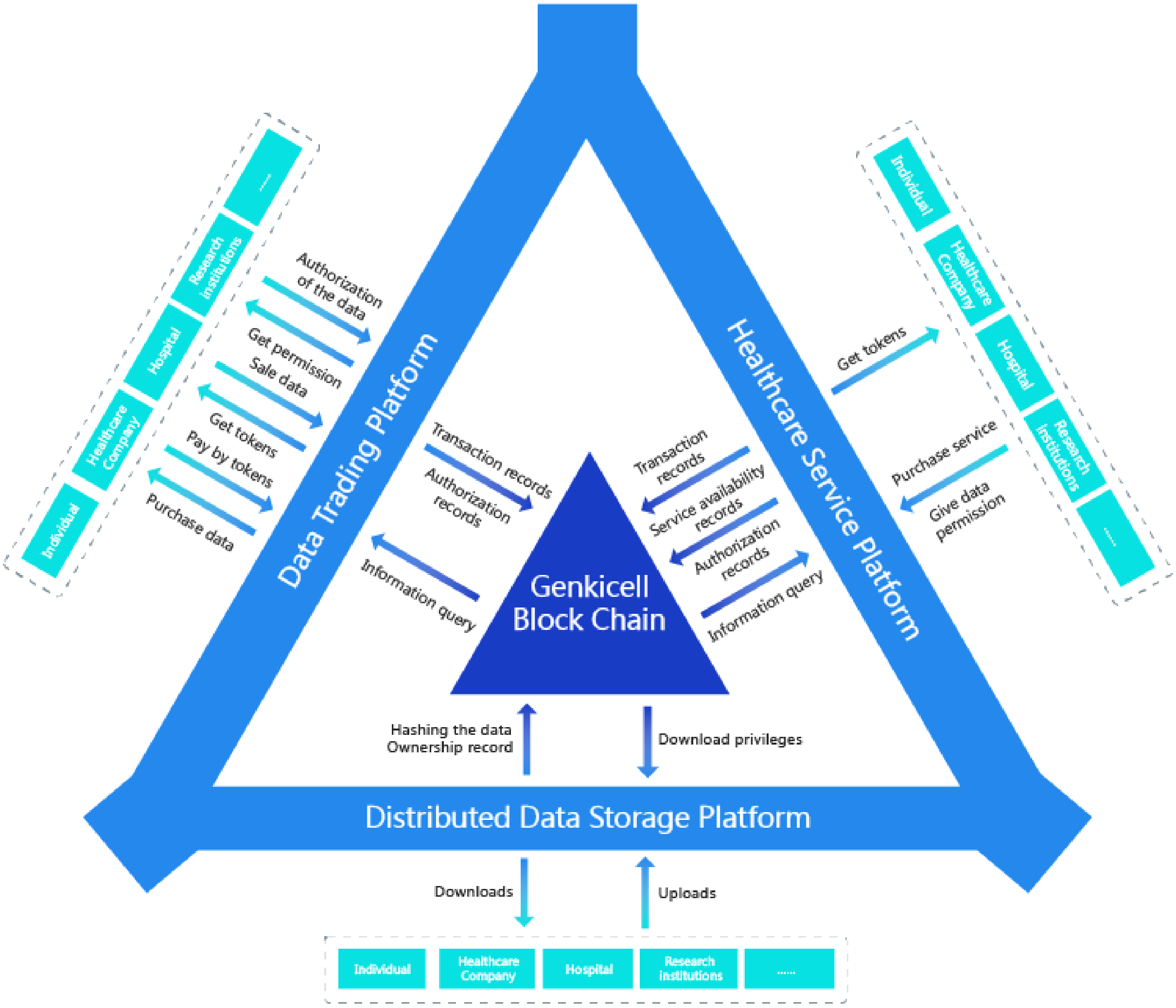
Due to the large volumes of data and the Variety characteristics of the data, GCL simplifies the middle process of large-scale health data processing and helps provide data analysts with sufficient convenience. GCL helps individuals and small research institutions solve the problem of massive data processing while reducing the corresponding scientific research costs by addressing the needs of large-scale data collection and authenticity verification and data standardization for individual researchers.

For personal users who do not have expensive servers and can also perform massive data collection and data analysis through GCL's platform. GCL hopes to provide all users with a more efficient and inexpensive data acquisition and data analysis environment. Even without an expensive server, high-speed and stable data processing and analysis can be achieved by sharing the computing power of idle nodes. In addition,GCL-based distributed nodes not only processing preliminary tags and data services on the chain, but also users can submit requests for data processing through Dapps. GCL will adopt cloud services to distribute the big data processing computing services to each active node by Map-Reduce for processing and then send the results to users via the Dapp.thus this service providing researchers with great convenience.


Map
Reduce
IPFS
Split1
Split2
Split3
Split4
map
map
map
map
Map shuffle
Map shuffle
Map shuffle
Map shuffle
1 2 3
1 2 3
1 2 3
1 2 3
Reduce shuffle
Reduce shuffle
Reduce shuffle
1
2
3
reduce
reduce
reduce
IPFS
Part1
Part2
Part3
Shuffle

# CHAPTER 5. BLOCKCHAIN AND TOKEN ECOSYSTEM

GenkiCell technically belongs to the category of one health blockchain, so the decision of choosing to use the smart contract mode matches new diagnosis, treatment process, and data collection process, while satisfying the requirement of selling the tagged data. For example, the data will satisfy the requirement of insurance institutions and various disease research institutions.




## 5.1 GenkiCell Token

GenkiCell will be based on GenkiCell token and GenkiCell credit as the value transfer intermediary and ecosystem internal evaluation. GenkiCell credit will not be negotiable and will serve as a value factor for the incentive mechanism as part of the internal evaluation of the ecosystem. GenkiCell token is negotiable and is the link of value transmission in the ecosystem.

### 5.1.1 GenkiCell token

We intend to issue a constant number of digital certificates GenkiCell token, or GenkiCell. Each GenkiCell corresponds to a corresponding large health digital asset.

GenkiCell can be traded, adding value to the growth in demand from the growth in the number of users' demand for one health services and the number of research institutions that have accumulated it in aggregate.

The GenkiCell Token will be applied to three basic scenarios:

1. Purchase of health services.

2. Collection of health data.

3. Long-term storage of data.

GenkiCell token is traceable based on blockchain technology. All data are managed based on distributed ledger. The data is real, reliable, and can be traced back. The GCL token will serve as the value transport intermediary and ecosystem’s pillar between the participants of GenkiChain, with a total of 2.4 billion in pre-mine process and 600 million in block rewards process.

GCL agreed that: In each block, a special transaction is set up, which generates a certain number of new tokens for the node’s incentive, and then the number of incentive tokens be halved each year until the process of block rewards ends. In addition, with the reduction of the block rewards, the incentive pools that support the internal ecosystem will be distributed in the process of irreversible block production. The incentive pool will rely on the user to store data and data transfer costs. GCL in the incentive pool will be distributed according to the contribution proportion of the participants, among which the incentive mainly includes the following contributions: contribution storage space and credible work. The contribution storage space factor will be determined by the amount of data stored in the total network and the bandwidth contribution, and the trusted work factor is determined by the transaction value of completing the package.

GenkiCell's token use includes and is not limited to:

- Rewarding and encouraging ecological participants to provide computing power to ensure the normal operation of the network.
- The cost of formulating smart contracts and implementing smart contracts.
- The settlement certificate of both parties.
- Data storage consumption

### 5.1.2 GenkiCell credits

GenkiCell credit is the basis of an internal evaluation of an ecosystem, and it exists as a value factor under an incentive mechanism. GenkiCell is the basic variable in the weight model and fully reflects the degree of work credit and work level of the node. It is mainly derived from nodes to tag the correct answer in the data marking process. There are two main ways to express it.

Embodiment of total amount: represents the overall level of competence and the degree of the node’s reliability.

The embodiment of the tagging classification: represents the accuracy or success rate of the node for the purpose of this classification and is the embodiment of the superiority of the ability in this classification.

GenkiCell credit will affect two main processes in the ecosystem:

- The weight of the results in the future data marker.
- The weight of the voting witness in the consensus process.

With the gradual improvement and development of GenkiCell's one health value ecosystem, this value factor will provide convenience for different participants in the ecosystem and generate corresponding service scenes.

GenkiCell will form an evaluation system for one health diagnosis services for different institutions or individuals. It indirectly presents the level of the unit's health service. At the same time, according to the tagged data of each disease, the International Classification of Diseases will be updated. It is helpful to improve and standardize the standard of disease diagnosis, control the quality of clinical pathway, and help the development of clinical epidemiology. In addition, it can form a disease spectrum and track it, and provide investment and development orientation for one health enterprises and funds.

## 5.2 Products Based On GenkiCell

5.2.1 Wallet and Data Management App

In the Genkicell network, users in different geographical areas can use the APP to conduct daily health check, data authorization, automatic data upload management, data backup, smart device management, and service purchase. At the same time, the statistics and analysis of the individual's physical condition can also be used for medication reminding, cross-border diagnosis, doctor-patient interaction, health service appointment, and insurance purchase. In the future, APP will support various smart homes, control and capillary-level data analysis and management through artificial intelligence. In addition, the app is also an APP that helps users in the ecosystem to manage their passport assets. The wallet can create new accounts, implement Genkicell transfers and other future Genkicell ecology passes, import and export private keys, and view Genkicell usage and transaction history.

5.2.2 Big Health Data Analysis and Collection Platform

When users increase the number of authorizations through the data management app, research institutions and individual researchers will reduce the time to collect data through this platform. At the same time, the data has a high degree of extensiveness and credibility. In addition, various ecological products that rely on Genkicell will effectively eliminate data entry problems caused by inconsistent data formats and reduce research time costs. In addition, researchers can publish data analysis tasks through the platform to reduce the high cost of data processing and analysis due to the 4V feature of healthy big data, which will effectively reduce the researchers' efforts in processing large-scale multidimensional health data. The equipment restrictions brought by this will effectively reduce the funding of scientific research institutions.

5.2.3 Large Health Service Tracking Analysis Platform

Genkicell and its partners provide a wide range of tracking services for health service tracking. Whether it is smart health equipment management, chronic care tracking, user distribution and portrait, drug efficacy and adverse reaction tracking, and more. Effectively help partners to improve the quality of health services, rational allocation of resources and reduce the cost of getting customers.

5.2.4 Large Health Service Cognitive Assistance System

Genkicell platform interoperates with medical, environmental, food, medicine, scientific research and other systems, establishes a complete and healthy data ecology, and relies on the PLHR data authorization and medical health data analysis system research results of medical users, connecting with AI artificial intelligence service providers improve doctors' diagnostic efficiency and treatment plan design.

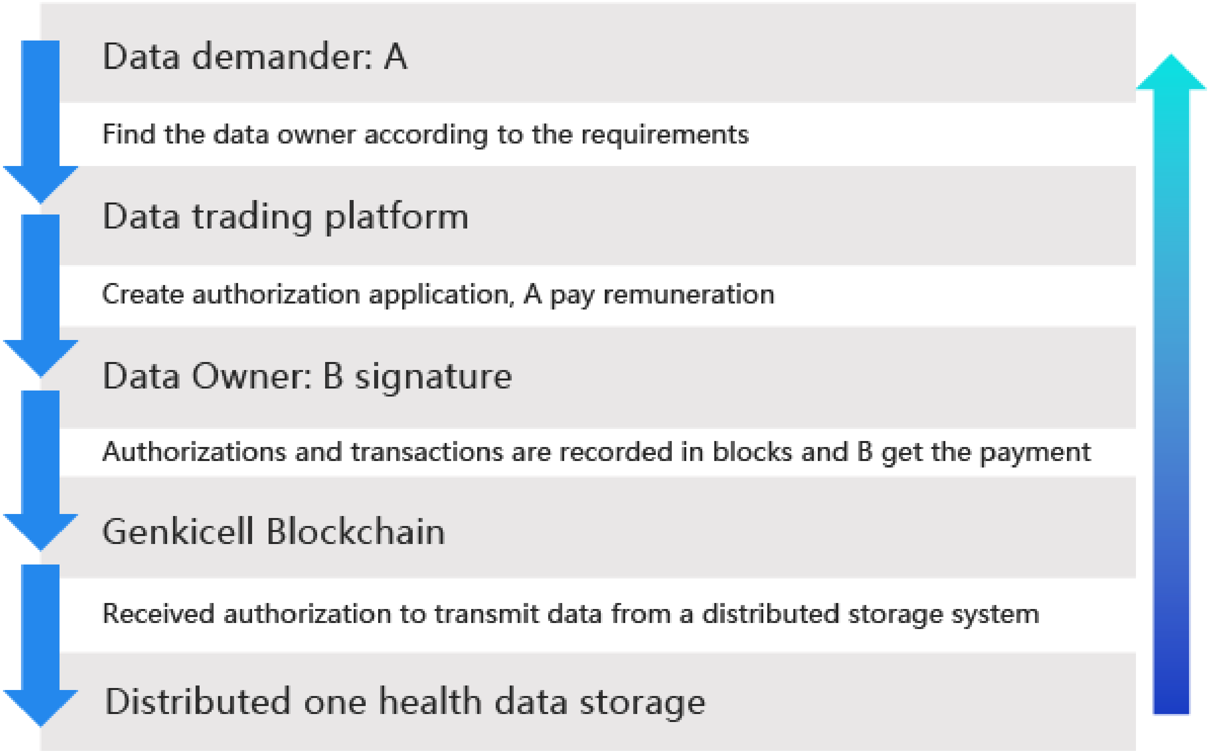
5.2.4 Token Exchange

Because the GenkiCell network will cover the whole world, all the users located in different countries can do exchange trading between legal tender and GCC via official exchange. We will open exchanges in Hong Kong, Singapore, Japan, Thailand, and South Korea first.

## 5.3 User Scenarios

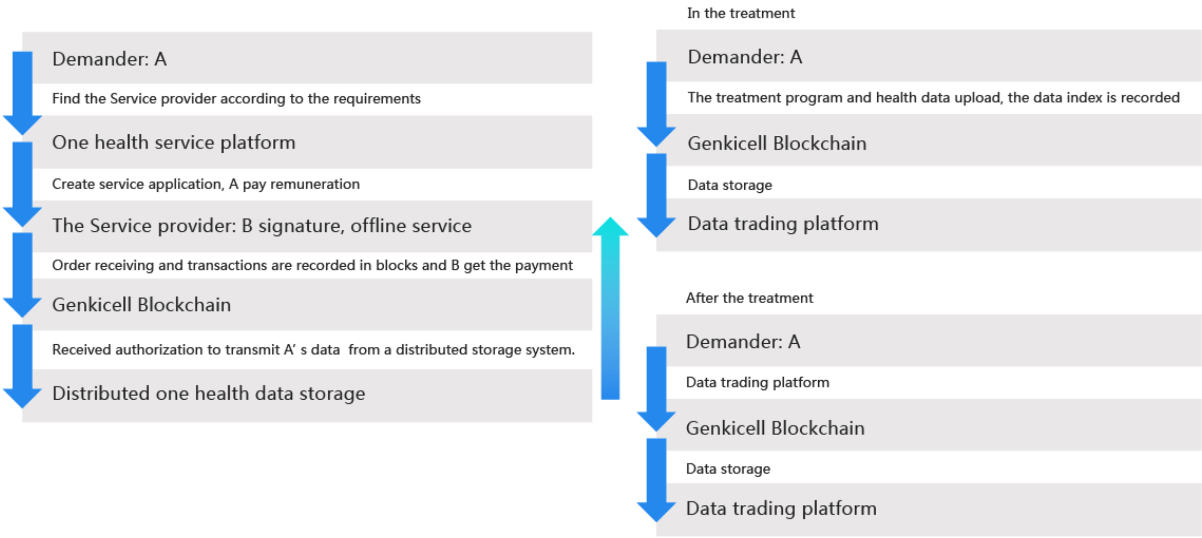
### 5.3.1 Data authorization

The health data trading platform built on the block technology relies on asymmetric encryption technology to ensure the transparency of the whole transaction process while ensuring the privacy of data. Because the data in the chain is hard to roll back, the problem of tampering in the data transfer is eliminated. GCL has a unique structure to ensure the data owners demand for data authorization quickly, at the same time, depending on the consensus system, will effectively solve the current lack of a trusted digital workflow has brought various HIT system and centralized management mode of medical data, so as to solve the current one health problem of trust in medical data transfer, break the data silos. In order to realize the data digitization and data interoperability in the one health ecosystem, the real value service system is generated.



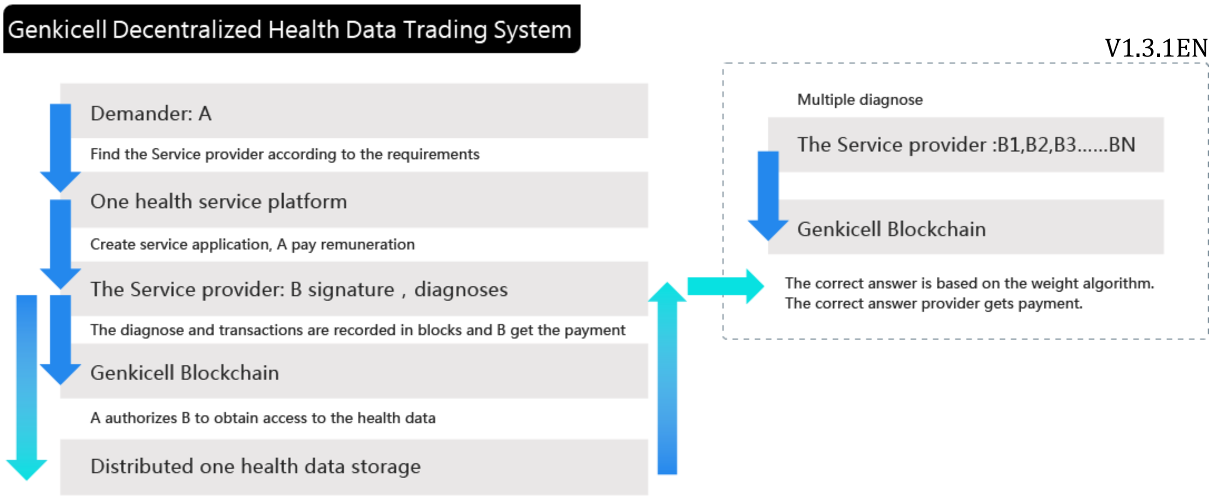

### 5.3.2 One health service

Depending on the blockchain technology, service demander (anonymous) and service provider’s purchase behavior will be recorded in the block. The whole process will be a transparent medical trade, which, at the same time, guarantees the privacy of each side. The changes of health data during the service period will ensure the rights and interests of the demander in the service, reduce the information asymmetry, and reduce the occurrence of medical disputes and medical accidents. The function will improve the data in the data flow between the ordinary users and large health service providers and mutual trust, and the service after a certain period of time of health data can be considered as the therapeutic effect of evaluation, forming the skill levels of service catalogue. At the same time, the skills of the quality service provider will increase. Genkicell strongly promotes health service to digitalize and the democratization process, support mode, based on the value of health services, and at the same time will use the form of digital medical standards to provide precision medical basis. It is in order to provide the patients with personalized medical service route after the diagnosis, build the hierarchical medical network, and accelerate the efficiency of dual referral.



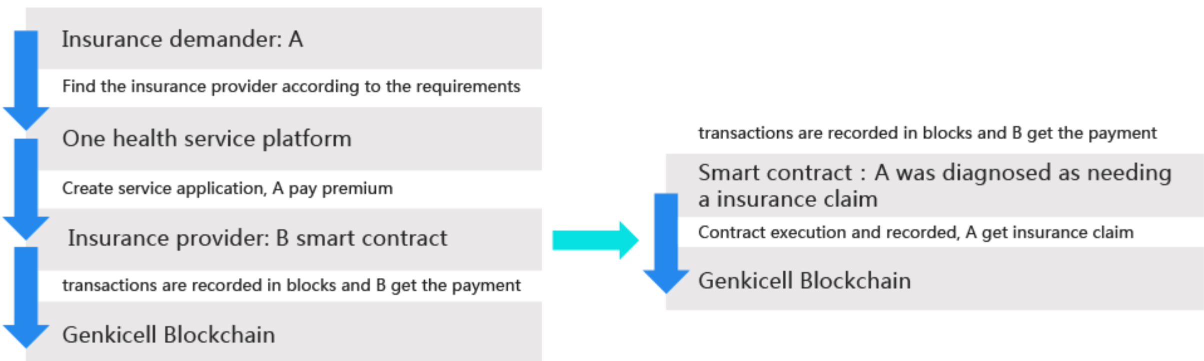

### 5.3.3 Global diagnosis

GenkiCell optimizes the service efficiency of the medical consortium and the medical community through the blockchain technology, mobilizes the relevant idle resources, and even the cross-border diagnosis and treatment services. It reduces the cost of one health and benefits to provide the most matched health services. In addition, the diagnostic level directory of the service side under difficult problems can be formed through multiple diagnoses. Genkicell will invite more medical institutions to participate, with the increase of multidisciplinary major health agencies across national borders. The effective treatment of difficult diseases and accurate diagnosis will be implemented, the need for diagnosis or treatment advice agencies will be able to launch data tagging request, according to the demand of the initiator, and the world within the scope of the agency will be able to give advice and treatment plan.




## 5.4 Medical insurance

Through smart contract, GenkiCell can automatically carry out medical insurance audit and settlement according to medical big data. The audit process of insurance claims will be replaced by the de-trusty blockchain technology. Insurance service providers can use smart contracts to automatically carry out insurance claims according to the medical data (medical records and insurance consumption records) submitted to the chain. In addition, personal medical "big data" can also achieve personalized and customized precision insurance.

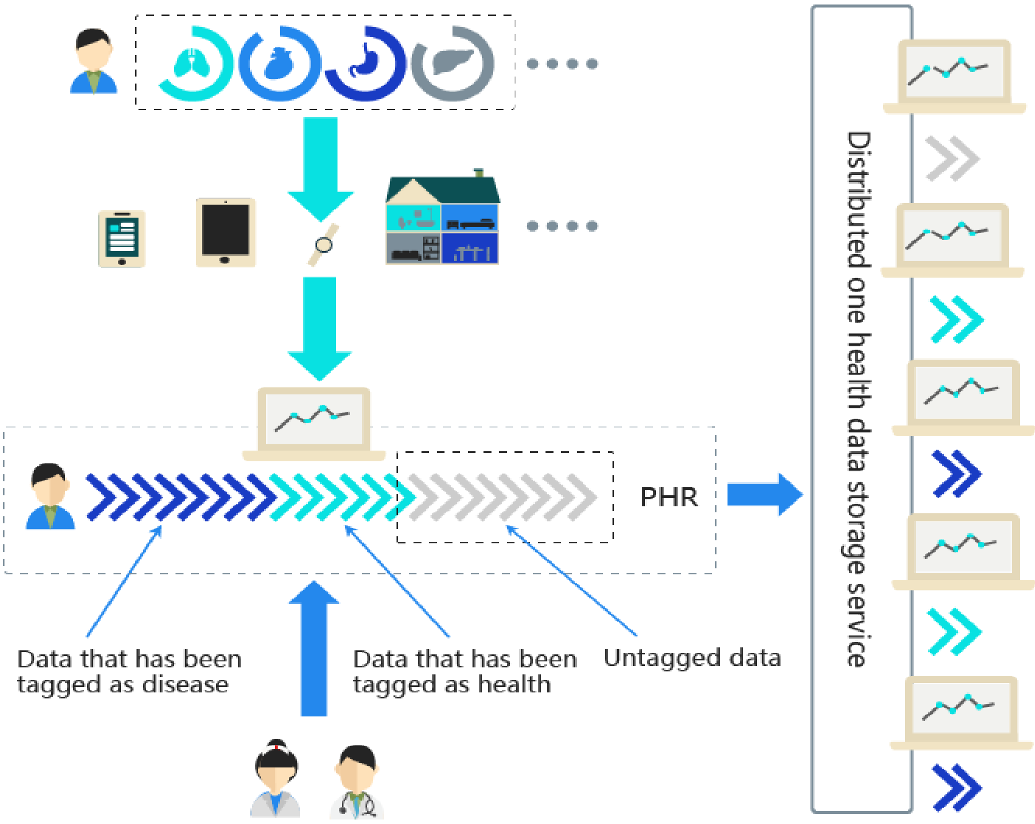



## 5.5 PLHR

The distributed data storage technology, which relies on IPFS, stores fragmented data in individual nodes. Compared with the existing centralized storage mechanism, the data storage cost is reduced, and the data security is guaranteed. In addition, depending on the fragmentation processing of the data, each storage node cannot know the data content and ensure data privacy. At the same time, GCL's unique structural guarantee data can only be consulted if the request is authorized by the data owner.

Users can, through the Internet of things device, upload the health data or data set. Moreover, after getting one health service, all data will be recorded and stored in the user name to a distributed one health data services to form the anonymous PLHR. The PLHR will have time continuity, high density of value, and strong characteristics of data integrity . This will effectively meet the needs of current health self-quantification and help to form effective and timely interaction with individual and health service providers. In terms of research institutions, data integrity and consistency is greatly increased, will promote healthy track cross sectional study and research in the field of, for example: medicine clinical research, correlation research, disease and health research, epidemiological status quo of the research, etc.

Future PLHR records will be the trajectory and trend of a person from birth, all health conditions, illnesses, diagnoses and treatments, medications, and returns. Though PLHR can represent multiple-drug resistance, medical history, drug reactions, etc. to make a clear judgment, at the same time, it can also be used for the patient to make a prediction of the emergence and development of the health, disease, and prevent the possibility of disease.



# 5.6 Other scenarios

The development of AI has greatly enhanced our data processing capabilities. With the medical data community constantly growing, the AI in medical research companies will be able to process medical big data across international and cross-sectoral industries. A larger sample can significantly accelerate the development of new medicines, so as to benefit more lives. Since the concept of smart one health has become popular and the imbalance in supply and demand of one health resources has become more serious, smart one health, as a supplement of normal illness, can solve the imbalance between supply and demand of one health resources and supply uneven distribution problem.

However, smart one health relies on artificial intelligence technology. To achieve a certain degree of accuracy, machine learning in artificial intelligence plays an important role. Supervised learning as one of the biggest part of machine learning has been widely used and applied in different areas. At present, the biggest bottleneck is the need for a large amount of training data to obtain results. The centralized artificial marking not only takes time and effort, but also contains a large amount of noise data, which affects the training results of the final intelligent model. In order to improve the accuracy of data, we use the instinct of individual profit-taking as the driving force through the design of a game mathematical model similar to the prisoner's dilemma to maximize the accuracy of the data. Improving big data infrastructure under the blockchain technology, our effective data will take healthcare and medical AI to a new level.

Precision medical treatment is a milestone of medical concepts and technologies. In the future, medical services will make greater use of the PLHR to choose the most effective treatments for individuals instead of using the general methods of diagnosis and treatment.

Accurate medical diagnosis is a revolution in modern medical concepts and technology. Future medical services will be more likely to use "big data" of personal health to choose the most effective treatment for individuals, rather than the rough use of general methods for diagnosis and treatment. As the real health data of Genkicell increases, the data value of personal medical data will also greatly increase. We may even delineate the health curve of each person and make effective predictions for timely prevention before the disease occurs.

# CHAPTER 6 SUMMARY

We have come up with a health data tagging and statistical data collection system without the need for third-party trust. The system can effectively avoid the diagnostic process for the results of influence each other by using encryption structural design, so as to ensure the validity of the data taggers. The system also encourages all parties to provide more correct and abundant tag results through the design of the reward and punishment mechanism of marking correctness. The correct data generated through the above tags can be purchased through the system by institutions that need to collect data. The pricing and rewarding of the whole system is defined and automatically implemented by the algorithm, which provides incentives to all parties of the system, thus ensuring the orderly flow of the entire economic system.

# CHAPTER 7 TEAM AND COUNSELORS

## Shota Awada

**CEO, Master of Ritsumeikan University**

The inheritor of Toridoll consortium, in 2009, he joined Synergy Marketing for engaging in business of cloud service, enterprise customer management system and network marketing strategy. Also, he provides a superior service for a number of Japanese and overseas hospital customers with services of data storage, management, and analysis.

In 2003, ANDA Co, Ltd., was established and entered the China market. During the period of his tenure as director, he was responsible for the overall business and marketing of the company and participated in the Urban Policy Forum. During his tenure, he also actively expanded transnational business cooperation which the experience of the business makes he was versed in professional proficiency of To Customer-side, Business-side as well. At the same time, he has huge cooperation resources in Japan.

In 2017, he cooperated with Japan Lotte Co., Ltd. to participate in cross-border health-care services, and at the same time cooperated with several of Japanese firms to expand and drive R&D and produce the IoT health equipment.

In the same year, the CEO, Shota Awada found the JCDA (Japan Care Dance Association) with Mr. Nakamura Shuichi (former Chief of Board of elderly health of Ministry of Health, Labor, and Welfare of Japan), Mr. Yasuo Otani (former Cabinet councilor of Japan and Chief Secretary of Ministry of Health, Labor and Welfare) and Mr. Takashi Uji (former NTT Corporation Senior Executive Vice President). Also, he has served a tenure as the member of a council of which he took charge of overall management.

## Yoshinobu Shijo

**CTO Master of Osaka University**

He originally served as the CTO of Last Roots, which is the subsidiary of SBI Virtual Currency Corporation, a financial consortium of Softbank. He has independently designed, developed, and issued a listed cryptocurrency, c0ban. At the same time, he has created a dedicated JPY/C0ban currency trading platform.

He is a member of the Japan Genius Technology Association.

## Keichiro Yoshida

**COO MBA, Peking University**

He was the 7th President of the Japanese Students and Scholars Association of Peking University. After graduation, he joined Nomura Securities Co., Ltd, where he successively served as a senior analyst. Then, he became the partner of venture capital In Japan, and was responsible for M&A work in Japanese medical projects. He also has a rich management experience in health care projects, and he is proficient in the languages of China, Japan and the English. In addition, he has a strong personal relationships with the political circles of China and Japan.

## Sasaki Daisuke

### CRO

A Former Director of Finance at Mizuho Bank, which is one of the three largest banks in Japan, he moved on to Mizuho Securities Risk Control Department to supervise the fund's review of listed companies. He was awarded Mizuho Bank's Sales Excellence Award in 2011 and won the Mizuho Bank Corporation's Corporate Excellence Award in 2012. In 2013, he was appointed as Mizuho Bank's bond advisor to Softbank Group. In the same year, he dispatched funds of 200 billion yen. After 2015, he was conferred the position of President of Mizuho Securities. Independently, after the award, the company set up its own investment consulting company. During the year, it dispatched 10 billion yen of funds and provided customers with high-quality risk control services.

## Shinada Satoshe

### Consultant of Japanese Policy Research

He became a politician who served as the secretary of the former Minister of Home Affairs, Yutaka Sato, and accumulated a series of contacts in the political circles. After 2006, he independently established a consulting company to provide various information services to famous companies such as Tokyu Corporation and Cyber agent Group.

## Shinichi Fujii

### Media Operations Specialist

After the founding of DR Co. Ltd. in 1992, he has been engaged in advertising agency for many years. He has for many years been engaged in advertising agency and advertising planning business. He also has deep relationships with Japanese large-scale artist firms, television stations, and publishing houses. His company's average annual income is 7.5 billion yen. In 2017, he retired from his company to join our team.

## Charles Li

### Consultant of Market Operations

He graduated from the political and economic department of Waseda University, a well-known private university in Japan, and was the head of the former Greater China Area and the United States Area of Corporate Venture Capital. He is mainly responsible for the investment and operation of blockchain, artificial intelligence, and health. At the same time, he is also responsible for the implementation and management of Japan Tobacco’s health project with NASA.

**JCDA**

Japan aging’s society of care and medical research association

Japan care dance association

Director：Nakamura Shuichi

Member of the director（part）：Shota Awada, Yasuo Otani, Takashi Uji, general corporate judicial person Medical Care Policy Research Center, etc.

This organization is mainly designed to research solutions to chronic diseases brought about by the aging society and to use artificial intelligence and IOE (internet of everything) to prevent and detect diseases.

Mr. Nakamura, chairman of JDCA, served as Chief of Board of elderly health of Ministry of Health, Labor, and Welfare of Japan. He has worked in the medical and health industry for many years, being committed to promote the progress and development of the health industry. Mr. Yasuo Otani served as a national research and development corporation and a director of the Japan Medical Research Institute. In his early years, he served as a Cabinet councilor of Japan, the Equal Employment and Children's Family Director of the Minister of Health, Labor and Welfare, Chief Secretary of Minister of Health, Labor and Welfare Minister, etc. positions consecutively. Mr. Takashi Uji once served as an NTT Corporation Senior Executive Vice President for a long time and has a strong influence in the information technology industry.

# CHAPTER 8 GCL ALLOCATION RULES

After our team discussion, the following distribution plan was determined:

**Public exchange：30%**

The tokens will have a 10% proportion in the public exchange in the form of

ETH to GCL.

**Angel investment：10%**

10 percent of the tokens will be issued to the world's top investment institutions for the GCL.

**Foundation community development：10%**

10 percent of the tokens will be the community building of the Genkicell Chain foundation, which will be used for business development, media coverage, technical community construction, education cooperation, etc.

**Team hold：10%**

The initial team will have10% of the tokens award, and the freeze and thawing scheme will be shown below.

**Mine generated：40%**

This 40% of the tokens will be retained as a mining reward.

| Ratio | Quantity | Allocation plan |
|---|---|---|
| 30% | 1,800 million | Public exchange |
| 10% | 600 million | The world's top investment institutions |
| 10% | 600 million | Foundation community development reservation. |
| 10% | 600 million | The initial team hold |
| 40% | 2,400 million | Mine generated |
| Total | 6,000 million | |

The team's GCL release plan is as follows.

| **Stage** | **Release rate** |
|---|---|
| **2019/1/1** | 2%，120 million GCL tokens |
| **2020/1/1** | 2%，120 million GCL tokens |
| **2021/1/1** | 2%，120 million GCL tokens |
| **2022/1/1** | 2%，120 million GCL tokens |
| **2023/1/1** | 2%，120 million GCL tokens |

# CHAPTER 9 DEVELOPMENT PLANNING

| | |
|---|---|
| 2017.Feb | 1. Genkicell Chain project start |
| 2017.Jun | 1. Bigdata collection for healthcare and corporate with Healthcare IOT consortium |
| | 1. First version of whitepaper for Genkicell finished and start registration process in Japan |
| 2018.Jan | 1. Corporate with JCDA, and start the experiment for preventive medicine with blockchain technology based on big data |
| 2018.Mar | 1. Genkicell Whitepaper v1.3 series release<br>2. Start the Pre-round exchange of token |
| 2018.Apr | 1. Accomplish Pre-round exchange roadshow<br>2. Fulfil construction of official website<br>3. Strat the login planning of Japan's financial department. |
| 2018.Jun | 1. Accomplish roadshow and advertising campaign<br>2. Start the public exchange of token |
| 2018.July | 1. Complete the public exchange program.<br>2. log in relevant exchanges of selection |
| 2018.Q3 | 1. Further introduction of talents.<br>2.Organise and convene a series of academic closed-door meetings (one health + blockchain)<br>3. Organize the development community<br>4. Start initial research and development<br>5. The related information of the project will be released |
| 2018.Q4 | 1. Preliminary architectural design and construction<br>2. Build business logic related code<br>3. Promote discussions with medical institutions and research institutions for GCL<br>4. Research and development of wallets<br>5. The related information of the project will be released<br>6. Establish the block chain research laboratory with the first-class universities in Japan |

| | |
|---|---|
| 2019.Q1 | 1. Cooperate with related artificial intelligence structure<br>2. Build the module of related intelligent medical care.<br>3. Main chain development completed, enter the test period<br>4. The related information of the project is released |
| 2019.Q2 | 1. Repair related problems and bugs<br>2. The main chain development is expected to complete on-line and open source code |

# CHAPTER 10 DISCLAIMER

This document is intended for the purpose of conveying information only and does not constitute an opinion concerning the purchase or vending of project shares or securities. Any similar proposal or offer will be conducted under a trustworthy clause and subject to applicable securities laws and other relevant laws. The above information or analysis does not constitute investment decisions or specific recommendations.

This document does not constitute any investment advice, investment intention, or solicitation of investment in the form of securities.

This document does not constitute nor is it to be construed as providing any buying or selling actions, nor any actions of invitation to purchase or vend any form of securities, nor any form of contract or commitment.

Examples of all benefits and profits in this document are for demonstration purposes only, or represent industry averages, and do not constitute a guarantee of the results of user engagement.

Genkicell Block Chain noticeably states that the relevant intended interested parties have an explicitly understanding of the risks of the Genkicell Block Chain platform. Once the investor participates in an investment, he understands and acknowledges the risk of the project, and is willing to accept and bear all the corresponding results or consequences.

Genkicell Block Chain expressly state that it is not responsible for any direct or indirect losses caused by participation in the Genkicell

1) The reliability of all information delivered by this document.
2) Any errors, negligence, or inaccurate information resulting from it.
3) Or any behavior resulting from it.

GCL is a digital license that uses the Genkicell Block Chain platform as one of its usage scenarios. GCL is not an investment. We cannot guarantee that the GCL will appreciate, and it may be valueless under certain circumstances. Given the unpredictable circumstances, the objectives outlined in this white paper may change. Although the team will strive to achieve all the objectives of this white paper, all individuals and groups purchasing GCL will be at their own risk.

GCL is a digital license that uses the Genkicell Block Chain platform as one of its usage scenarios. Exchanging behavior of GCL token has to abide by the national laws and regulations, all individuals and groups of GCL purchaser should be aware of the local laws and regulations. Temporarily not accept China at present, American nationality, in Japan and the Japanese nationality people exchange personal investment.

This document is based on the final version, which will be updated periodically according to the market and project process.

# CHAPTER 11 RISK WARNING

As an innovative investment model, digital asset investment may have numerous risks. Potential investors should cautiously evaluate the investment risk and the bearing capacity of their own risks. Exampled risk factors including but not limited to are illustrated below.

1) Risk of token sales market

As the market environment of the token is inextricably linked with the entire digital currency market, such as the overall market conditions downturn, or the existence of other uncontrollable factors. It may cause even the token itself to have a worthy prospect, but the price is still in the condition of chronically undervalued.

2) Risk of regulatory effect

Since the development of blockchain is still in its early stage, and it is not clear how the current policy will be implemented to some extent, these factors may have an uncertain impact on the investment and liquidity of the project. The blockchain technology has become the main target of supervision in all major countries in the world. If the regulatory organization intervenes or exerts influence, the GCL chain application or Genkicell Block Chain may be affected. For example, if the laws and regulations restrict the usage and trades of token, the Genkicell Block Chain may be limited, hindered or even directly terminate the development of Genkicell Block Chain applications and Genkicell

3) Risk of competition factors

With the development of information technology and mobile Internet, digital assets represented by “Bitcoin” have gradually emerged, and various decentralized applications continue to emerge, and the competition in the industry is becoming increasingly fierce. However, with the continuous emergence of other application platforms and continuous expansion, the community will face continuous operating pressure and certain market competition risks.

4) Risk of private key loss issues

After the purchaser's token is extracted to his digital wallet address, the only way to manipulate the content contained in the address is the purchaser's relevant key (ie, the private key or wallet password). The user is personally responsible for protecting the relevant key for signing the transaction that proves ownership of the asset. The user acknowledges and accepts that if his private key or password is lost or stolen, the obtained GCL associated with the user's account (address) or password will not be restored and will be resulted in permanently lost. The best way to securely store login credentials for the buyer is to store the key in one or more places for secure storage and it is preferably not to store it on a public computer.

5)Risk of hacking or theft problems

Hackers or other organizations or countries have the possibility to attempt to interrupt the Genkicell Block Chain application or Genkicell Block Chain in any way, including but not limited to denial of service attacks, Sybil attacks, raids attacks, malware attacks, or consistency attacks.

6) Risk of uninsured loss concerns

Unlike bank accounts or other financial institution's accounts, there is generally no insurance coverage in GCL accounts or related blockchain networks. In any case of loss, there will not be any public individual organization to cover your losses to a large extent.

7）Risk of systematic difficulties

The resulting risk of fatal defeat in open source software or a large-scale failure of the global network infrastructure. Although some of these risks would be significantly reduced over time, such as fixing loopholes and breaking computational bottlenecks, other risks remain unpredictable, such as political factors or natural disasters that may cause partial or global Internet disruption.

8) Risk of unrecognized marketing or lack of user

First, the GCL should not be regarded as an investment. Although the GCL may have some value after a certain period of time, if the GCL chain is not recognized by the market and resulted in lack of users, the value may be very small. Due to any possible reasons, including but not limited to the failure of business relationships or marketing strategies, the follow-up marketing of the GCL chain platform and all co-financing funding may not be successful. If this issue arises, there may be no follow-up followers or few followers without this platform. Obviously, this will be very unfavorable for this project.

9) Risk of application failure

The GCL chain platform may fail due to various aspects known or unknown (such as large-scale node downtime) and cannot provide services normally. In severe cases, the user may lose the GCL.

10) Risk of the application or product fails to achieve its own or the purchaser's expected

The Genkicell Block Chain application is currently in the development stage. Before the release of the official version, a relatively large change may be made. Any Genkicell Block Chain itself or the purchaser may not reach the expectation or imagination of the function or form (including the participant's behavior) of the GCL chain application or Genkicell Block Chain. Any wrong analysis or a design change may lead to this situation.

11) Risk of other unforeseen causes

The cryptography-based token is a new and untested technology. In addition to the risks mentioned in this white paper, there are also some risks that founding teams have not mentioned or did not anticipate. In addition, other risks may also appear suddenly, or in a combination of several already mentioned risks.

# REFERENCES

Agorise. (2018). *c−ipfs : IPFS implementation in C. Why C? Think Bitshares Stealth backups, OpenWrt routers (decentralize the internet), Android TV, decentralized Media, decentralized websites, decent.* *GitHub*. Retrieved 5 October 2017, from https://github.com/Agorise/c-ipfs

Brodersen, C., Kalis, B., Leong, C., Mitchell, E., Pupo, E., Truscott, A., & Accenture, L. (2016). Blockchain: Securing a New Health Interoperability Experience.

Buterin, V. (2018). *Slasher: A Punitive Proof-of-Stake Algorithm - Ethereum Blog*. *Ethereum Blog*. Retrieved 19 October 2017, from https://blog.ethereum.org/2014/01/15/slasher-a-punitive-proof-of-stake-algorithm/

Culver, K. (2016). Blockchain Technologies: A whitepaper discussing how the claims process can be improved. In *In ONC/NIST Use of Blockchain for Healthcare and Research Workshop*. Gaithersburg, Maryland, United States: ONC/NIST.

Ekblaw, A., Azaria, A., Halamka, J., & Lippman, A. (2016). A Case Study for Blockchain in Healthcare: “MedRec” prototype for electronic health records and medical research data (p. 13).

Finley, K. (2016). *The Inventors of the Internet Are Trying to Build a Truly Permanent Web*. *WIRED*. Retrieved 19 February 2018, from https://www.wired.com/2016/06/inventors-internet-trying-build-truly-permanent-web/

Hazard, J., & Hardjono, T. (2016). *CommonAccord: Towards a Foundation for Smart Contracts in Future Blockchains*. *W3.org*. Retrieved 19 February 2017, from https://www.w3.org/2016/04/blockchain-workshop/interest/hazard-hardjono.html

Ivan, D. (2016). Moving toward a blockchain-based method for the secure storage of patient records. In *In ONC/NIST Use of Blockchain for Healthcare and Research Workshop*. Gaithersburg, Maryland, United States: ONC/NIST.

Kobayashi, D., Otsubo, T., & Imanaka, Y. (2015). The effect of centralization of health care services on travel time and its equality. *Health Policy, 119*(3), pp. 298-306. http://dx.doi.org/10.1016/j.healthpol.2014.11.008

Koo, Charles, C., & Yuh-Ming Shyy. (2005). *Medical records data security system. U.S.*

Kosba, A., Miller, A., Shi, E., Wen, Z., & Papamanthou, C. (2016). Hawk: The blockchain model of cryptography and privacy-preserving smart contracts. In *In Security and Privacy (SP)* (pp. 839-858).

Kuo, T., & Ohno-Machado, L. (2018). *ModelChain: Decentralized Privacy-Preserving Healthcare Predictive Modeling Framework on Private Blockchain Networks*.

LaFever, G. (2016). *Blockchain and big data privacy in healthcare*. *Iapp.org*. Retrieved 19 February 2018, from https://iapp.org/news/a/blockchain-and-big-data-privacy-in-healthcare/

Lamport, L. (1979). Constructing digital signatures from a one-way function. In *Technical Report SRI-CSL-98*. SRI International Computer Science Laboratory.

Leftwich, R. (2016). *The Path to Deriving Clinical Value from FHIR | InterSystems Corporation*. *InterSystems Corporation*. Retrieved 19 September 2017, from http://www.intersystems.com/library/library-item/path-deriving-clinical-value-fhir/

Linn, L., & Koo, M. (2016). Blockchain for health data and its potential use in health IT and health care related research. In *In ONC/NIST Use of Blockchain for Healthcare and Research Workshop*. Gaithersburg, Maryland, United States: ONC/NIST.

Peterson, K., Deeduvanu, R., Kanjamala, P., & Boles, K. (2016). A blockchain-based approach to health information exchange networks. (pp. 1-10). In Proc. NIST Workshop Blockchain Healthcare.

Price, M., Bellwood, P., Kitson, N., Davies, I., Weber, J., & Lau, F. (2015). Conditions potentially sensitive to a Personal Health Record (PLHR) intervention, a systematic review. *BMC Medical Informatics and Decision Making*, *15*(1). http://dx.doi.org/10.1186/s12911-015-0159-1

Raval, S. (2016). *Decentralized applications: Harnessing Bitcoin's Blockchain Technology*. Sebastopol: O'Reilly.

Rawat, A., Papailiopoulos, D., Dimakis, A., & Vishwanath, S. (2016). Locality and Availability in Distributed Storage. *IEEE Transactions On Information Theory*, *62*(8), pp. 4481-4493. http://dx.doi.org/10.1109/tit.2016.2524510

Satoshi Nakamoto. (2008). *Bitcoin: A peer-to-peer electronic cash system*.

Shrier, A., Chang, A., Diakun-thibault, N., Forni, L., Landa, F., Mayo, J., & Hardjono, T. (2016). Blockchain and Health IT: Algorithms, Privacy, and Data. In *In ONC/NIST Use of Blockchain for Healthcare and Research Workshop*. Gaithersburg, Maryland, United States: ONC/NIST.

Underwood, S. (2016). Blockchain beyond bitcoin. *Communications of The ACM*, *59*(11), pp. 15-17. http://dx.doi.org/10.1145/2994581

van Panhuis, W., Paul, P., Emerson, C., Grefenstette, J., Wilder, R., & Herbst, A. et al. (2014). A systematic review of barriers to data sharing in public health. *BMC Public Health*, *14*(1). http://dx.doi.org/10.1186/1471-2458-14-1144

Yang, J., Li, J., & Niu, Y. (2015). A hybrid solution for privacy preserving medical data sharing in the cloud environment. *Future Generation Computer Systems*, pp. *43-44*, 74-86. http://dx.doi.org/10.1016/j.future.2014.06.004