LEDGIS

My Private Blockchain

LEDGIS

Whitepaper V1.5

www.ledgis.io

CONTENTS ,

1. Introduction

Data is an economic asset for innovative growth in the era of the 4th industrial revolution, and it is expected to bring new vitality to the national data economy in combination with advanced data processing and analysis technology. However, with the advancement of information technology and data processing technology, the amount of personal information collected to use various services has increased, and the data processing process has become more complex, but the discussion on data utilization is centered on enterprises only, which has brought about some problems of alienating individuals who are the actual owners of information among the members of the 4th industrial revolution era.

If the concentration of information power, where individuals, the owners of data, can neither access their information nor intervene in the data processing process, continues to intensify in the future, “Data Colonialism”, where giant data companies monopolize all the values and profits created by data and a few of the privileged have both wealth and power, will become a reality.

With the concerns about the realization of "data colonialism" as described above, regulations on giant internet platform operators are being actively discussed, mainly in the US and EU. The US, which has big platform companies such as Apple, Amazon and Google, has proposed the Competition and Antitrust Law Enforcement Reform Act (CALERA) and is preparing for applying to strict regulations such as strengthening penalties and increasing fines.

Based on the General Data Protection Regulation (GDPR), the EU is strongly promoting regulations on market monopoly by preventing platform operators from monopolizing data. The reason why the EU strongly enforces the regulations on data monopoly by platform operators is that the revenue sources of giant internet platform operators are concentrated on user data and advertising revenues using the data. Platform operators provide users with services free of charge. In return, they collect information from users and resell users' attention in the form of advertisements. Therefore, strict regulations on platform user data are enforced on the grounds that strong regulations must be applied to those activities to guard against data monopoly and prevent market monopoly.

With the recent advent of the “data economy” era, examples of applying blockchain technology to various industries can be seen in other countries and companies around the world as well as Korea. In order to settle down the blockchain technology, it is necessary to take an in-depth approach not only to the blockchain technology development but also to the following issues related to decentralization.

- Self-control on their data as the owner of information (SSI; Self Sovereign Identity)
- Platforms which connect operators centered on individuals rather than companies
- Realization of MyData through the distribution of personal data in decentralized infrastructures

Accordingly, LEDGIS Blockchain will provide the next-generation blockchain platform in the era of data sovereignty, which solves both the structural limitations of existing platform-oriented businesses and the decentralization issues that blockchain solutions must overcome; which utilizes the SSI (Self Sovereign Identity) data management technology and allows individuals to control their own, as an alternative technology for realizing the actual right to informational self-determination; which builds a business platform of connecting operators centered on individuals; which, all in all, speeds up the popularization of decentralized blockchain technology.

2. Problems with Existing Service Platforms

In the modern society where a variety of information is pouring out day by day, we have to face the uncomfortable truth as much as we enjoy the advantage of being able to get more information than we need anywhere anytime. As the trend of strengthening digital-centric platforms continues, a lot of information, from knowledge to privacy, is being handled within online platforms, and sensitive information such as privacy is also being used through various platforms.

Although the IT-based platform economy grows and the amount of data collected for the economy increases exponentially, the network and data management systems themselves haven't changed a lot. The existing platform companies still prefer centralized networks, which causes side effects to maintain the system that does not conform to the current data management requirements like the issue of monopoly in the information market through realizing the economies of scale, the moral hazard in the process of handling sensitive information such as privacy, and the violation of the right to informational self-determination occurring in the process.

2.1 Centralized Network

Centralized networking is a cost-saving method for many enterprises to manage their networks by consolidating all services on one powerful computer. While this method has advantages such as cost reduction and maintenance convenience over the method of operating multiple servers, the central server can be damaged and the entire network can be stopped, or data manipulation and theft may occur, since an intruder can have access to the entire network via the central server.

The centralized network architecture has grown centered on large-scale centralized data centers where numerous servers are clustered together over the past decades. Centralized cloud computing technology (i.e., Google Drive, Apple iCloud) made it possible to access and operate the network efficiently, but it could not solve the problems such as network delays and different privacy compliances in different countries due to using remote data centers.

Most of the existing service platforms are running on centralized systems in which their operators have the monopolies on authorities and responsibilities for information management and transaction approval. This structure is not only managed by the central server, but also involved with third parties (e.g., banks, governments) for transaction when making in-app payments. Since the existing centralized architecture must obtain the trust from third parties, it has such problems as follows.

- Damage to inter-organization trust within enterprises caused by internal issues
- Damage to users caused by outside hacking or computer errors
- Lots of resources and costs required for IT infrastructure and security to protect users
- Compliance by financial supervision institutions such as the Korea Securities Depository under the Financial Investment Business and Capital Market Act and the Korea Financial Telecommunications and Clearings Institute under Article 32 of the Civil Act.

2.2 Monopolization of Information by Platform Companies

In order for data to be actively used and distributed, someone must provide the infrastructure. Since platform operators are directly playing this role, it has been easy for the operators to monopolize and control information, and assuring the reliability of data helps the operators a lot in becoming a direct controller of the data. If data cannot be trusted, the value of the data itself is damaged, and the data without value is useless. For this reason, platform companies and institutions have been responsible for ensuring data reliability and distributing data in order to provide their respective services smoothly, and the platform operators' right to monopolize and control over data has become an unavoidable reality.

As the influence of internet platforms is increasing, the effect of information monopoly acts as a barrier to new entries and competitors. A meaningful quantity and quality of data are required to provide services, but if a specific operator monopolizes and controls such data, it becomes a barrier to entry. These barriers to entry bring about a user lock-in effect to the specific giant platform operators, and the platforms with more users will be able to collect and utilize more data and eventually monopolize the data.

2.3 Moral Hazard of Platform Companies

With the advancement of IT technology, companies and industries are actively utilizing personal information to attract customers and pursue profits by providing customized services for each individual as well as daily information. For example, a platform operator who collects name, gender, age, contact information and so on, gathers the details browsed through personal log-in. With the personal data and information, the platform operator can meet the customer's needs by preferentially exposing items of interest in shopping or by providing coupons for the items.

However, in recent years, the moral hazard of IT companies is very serious when they deal with users' personal information. IT companies, domestic and overseas, continue to collect personal information or provide it to third-parties without users' consent. According to the Personal Information Protection Commission, IT platform operators provide personal information to third-parties without users' consent, or collect the personal information of children under 14 without the consent of a legal representative, and there is a controversial case of collecting personal information such as phone number on a search portal and using it for job advertisements. This is because each IT company tends to ignore the importance of personal information and use it without care and discipline.

2.4 Violation of the Right to Informational Self-determination

With the rapid progress of informatization, the collection and use of personal information is greatly increasing, and in proportion to this, the need for protecting the basic rights related to personal information is rapidly increasing so that the personal information protection has become an important topic in modern society. The right to informational self-determination, which is in response to the need, is the right for individuals to decide for themselves when, to whom, and to what extent their personal information may be known and used.

Therefore, according to the above right, these issues related to personal information are recognized as problems for IT companies around the world to work on, not just for platform operators: whether or not individuals, as the owner of personal information, accurately recognize the scope of personal information usage, and then consent to the use of personal information; to what extent the scope and authority of personal information usage goes for which the platform operator has obtained consent; secure management of personal information in use and post-disposal.

3. Solutions

As described in the previous chapter, Blockchain is the next-generation technology that can resolve the problems of existing platforms, and it is evaluated as a core technology that will lead the 4th industrial revolution along with Artificial Intelligence, Big Data, and IoT. That is because it can overcome the negative effects of information monopoly and profit monopoly of present giant platform operators. The blockchain platform is expected to be the one with a sustainable ecosystem where multiple participants can perform their respective roles and receive rights and profits as decentralized governance. Since the advent of Bitcoin, the blockchain technology has gone through numerous trials and errors and has undergone an improvement process, now it's ready to compete with existing network systems, and after going through the stage of convergence with various traditional industries, it is expected to become a major technology for network infrastructure in the near future.

However, even if such technology is built into a service platform used in practice, there are still many obstacles to overcome in order to be used in the real world. As the fields of technological application expand, the major problems of the existing blockchain ecosystem are: ① there is a limit to the elasticity that can respond to trend changes, and ② it also has a high barrier to entry which makes the introduction of blockchain difficult, and lastly, there is a discussion about the sustainability of the coin economy a key element of the blockchain.

Due to those problems, blockchain-based service platforms took a lot of time and went through many trials and errors. Therefore, LEDGIS Blockchain would like to provide a smooth experience in using blockchain platforms for both users and service providers within the platforms by systematically approaching each matter as follows.

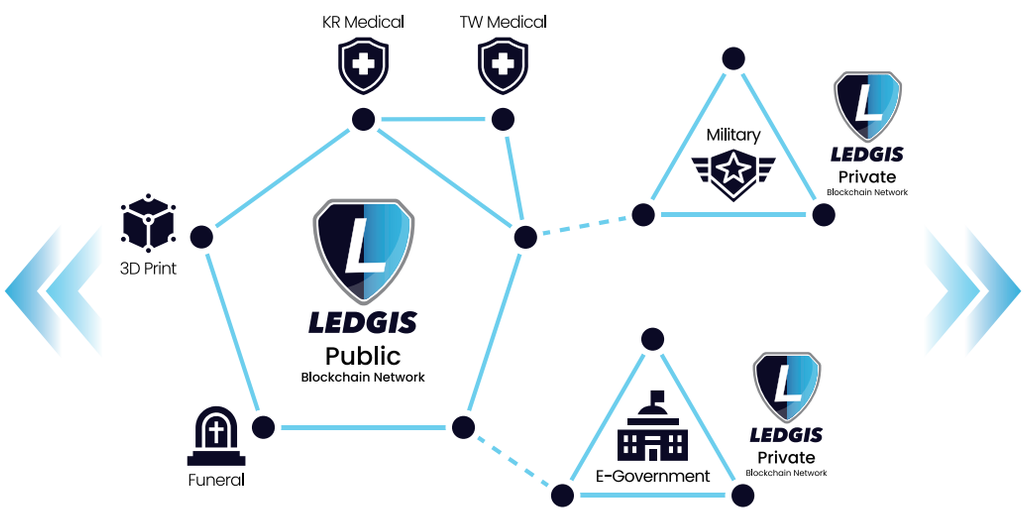
3.1 Overview of LEDGIS: My Private Blockchain

"My Private Blockchain" is our slogan that contains the vision of LEDGIS, and represents our dream for the new era in which data sovereignty is guaranteed. LEDGIS Blockchain is a user-centric blockchain service platform preventing platform operators from monopolizing users' personal information data (Self Sovereign Identity or SSI), allowing users to experience various DApp services at a high speed of over 3,000 TPS, and implementing a sophisticated coin economy that rewards participants to the degree of their contributions to the ecosystem. In addition, it's a next-generation decentralized blockchain platform that can guarantee personal data sovereignty and realize the SSI by providing distributed storage and management services for sensitive information through DIDs (which is recognized as international standard) and IDHs (Decentralized Data Encryption Storage/Sharing Solution) which are recognized as international standards.

LEDGIS is designed with the goal of overcoming the limitations of blockchain listed in the previous chapter, and it is a highly optimized DPoSS consensus algorithm-based blockchain platform which has such features as follows.

A. Advanced technologies required in the data industry era

1) Ecosystem in which anyone can participate without chain boundaries: LEDGIS, a mainnet blockchain, is a platform that can be applied to both public and private chains. It simplifies the procedures of creating a new node, thereby keeping the network participation process simple so the IN/OUT of new nodes can be frequent and free. This can lower the entry barriers for new users and service providers and promote the adoption of blockchain technology in each industry.

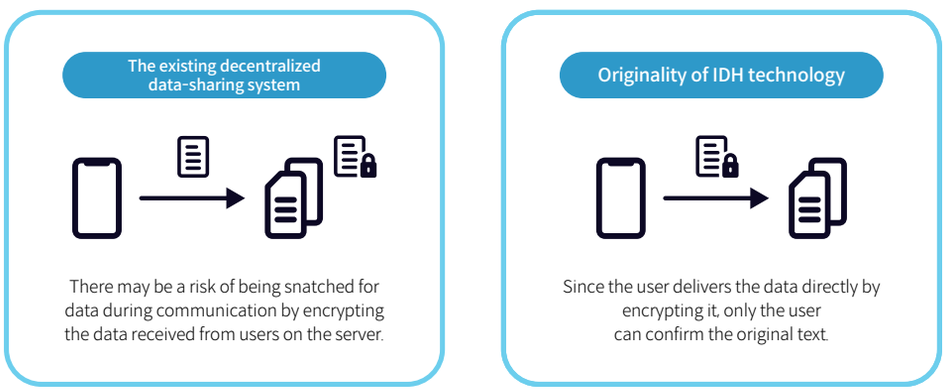


<Figure 3.1> LEDGIS Ecosystem

2) Decentralized Identity Authentication (DID): Unlike the existing identity authentication method, DID (Decentralized Identifier) is not controlled by a central system and is a technology that allows individuals to have complete control over their information.

The existing DID services focus on registering publicly available personal information on the blockchain and then specifying the usage or scope of personal information when needed, but the services have a problem that they focus only on the proof of ownership and the prevention of forgery. And the reception of a large amount of data or the most important private key management is not discussed yet, however, LEDGIS DID has the technology and know-how for the Advanced DID Service Framework that can solve the existing problems.

3) Blockchain technology for large data transaction (IDH): LEDGIS has built an Identity Data Hub (IDH) to manage large data. The IDH has been recognized for the data reliability and security for large amounts of data. Data stored in IDH cannot be known to anyone except users, so only the user can access the data. In addition, since the third-party intervention, a characteristic of blockchain, is not possible, it has the advantage of solving the information leakage problem. What's more, since the entire data transmission between a sender and a receiver is encrypted, it is possible to prevent the risks of hacking in advance, and since the identity verification is applied in the private and public key structure and DID, it is impossible to decrypt the transmitted data by anyone other than the data owner or authorized personnel.



<Figure 3.2> Originality of IDH Technology

4) Decentralized Encryption Wallet: The encryption and decryption technology of wallet is an asymmetric encryption using a hash function, and the public key is used to decrypt the private key encryption. Private key management is very important because decryption is performed using the private key. Currently, private keys are being actively discussed. However, there are some alternatives to the storage and loss prevention of private keys (e.g., separate wallets for storing private keys) but no alternative to the private key itself.

The existing private key method is a password made up of combinations of randomly extracted numbers and letters (for example, 0x5914bb231516210d25c24dc61 b96f63b30e22f78011 f691259c038b504e23fd4) which is not possible to memorize, and it is necessary to back up or protect it because it is absolutely impossible to reissue the private key when lost. To improve the inconvenience of private key management, LEDGIS Wallet provides the convenience to easily manage the accounts and account keys of users.

The LEDGIS Wallet has been developed as a "hierarchical deterministic' wallet that infinitely generates tree-structured keys with a single seed phase, and the seed syntax consists of 12 mnemonic code words (random English words with sequence separation). So, it has the advantage of being easy to remember or store compared to the existing seed consisting of a combination of numbers and letters.

Existing DID service	LEDGIS DID
Scale of the limited data source	Securing the confidentiality & integrity with the whole ranges of encryption and large scales of transmission and reception from the applied IDH technology of LEDGIS Blockchain ※Having patent technology
Possibility of invasion of confidentiality and integrity of original data	
Higher risk of losing personal key (the combined seed for numbers & characters)	Low possibility of loss with mnemonic code mode

* 1(relevant patent 1) : Blockchain-based DID service, Untact large-scaled document approaching blockchain system combined with IPFS-based data sharing technology and personal key distributing storage technology (Application number: 10-2020-0056781)

* 2(relevant patent 2) : Blockchain & HPFS-based encrypted data sharing system (Application number: 10-2019-0124223)

<Table 3.1> Strong points of LEDGIS DID

B. The feasibility of popularizing blockchains

1) Problem-free TPS verified in actual use cases: LEDGIS has got excellent test reports from the KOLAS certification which evaluates in four categories: transaction throughput per second (3,000 TPS), transaction processing time, transaction and block transmission/reception time, and establishment of a demonstration environment, and its stability was verified through real service cases that supported sending and receiving large data such as photos and videos within the actual blockchain platform in conjunction with distributed storage systems.

2) Removal of transaction fee (Gas Fee) for low cost: LEDGIS, not an Ethereum-based blockchain but its own mainnet blockchain, has no transaction fees so that it can lower the barriers to entry for various service providers and users to participate in the blockchain ecosystem.

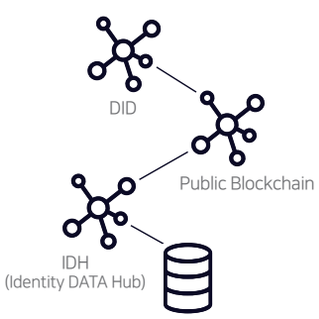
3) User-friendly interface: The goal of LEDGIS is to popularize blockchains. In a way to pursue the goal above, IBCT provides the same level of user experience as web/mobile apps so that users cannot notice the blockchain technology but can realize that the blockchain is a technology they are facing in real life, not a difficult future-oriented technology.

C. The sustainable token economy

1) Creation of a decentralized crypto ecosystem: A decentralized service platform forms a blockchain network among multiple platform operators. When cloud-based IDH storages are operated and individual-centric data of the operators are accumulated, the amount of data will continue to increase. New platform operators will participate in the decentralized service platform to utilize personal information and secure more users, as a result, the network effect aforementioned will occur. Since independently-operated platforms have relatively less users and less amount of available data compared to the decentralized service platforms, it would enable the formation of a wider blockchain network as more platform operators participate in the decentralized network. Just as the network expansion speeded up remarkably since the advent of the Internet, the blockchain network and decentralized service platform ecosystem will continue to expand.

2) Intensifying the data economy: As the blockchain ecosystem expands, it will accelerate the use of cryptocurrency in more platform services, and as the frequency of smart contract use in the blockchain network increases, its transparency will be secured. When the transparency in execution becomes possible, the effect of collaboration between platform operators will appear, and that will lead to more benefits to users.

- **Start with personal sensitive information (biometric information, financial information) and expand to ownership and transaction information (contract, ownership, intellectual property rights, etc.)**
- **Only paying for created personal information, platform operators participate in blockchain nodes**
- **Construct a decentralized platform between service platform operators**
  - **Install DID/IDH/Blockchain nodes according to platform service contents**
- **Personal data accumulated on the decentralized platform are linked/used among service platform operators (after individual approval)**
  - **Financial information (card number) → Fast payment**
  - **Identity information → Quick user authentication without registration, access control, etc.**
  - **Contract information → Quick link service provided**
  - **Education history information → Training completion and other educational services**
- **"Network effect" between service platforms**



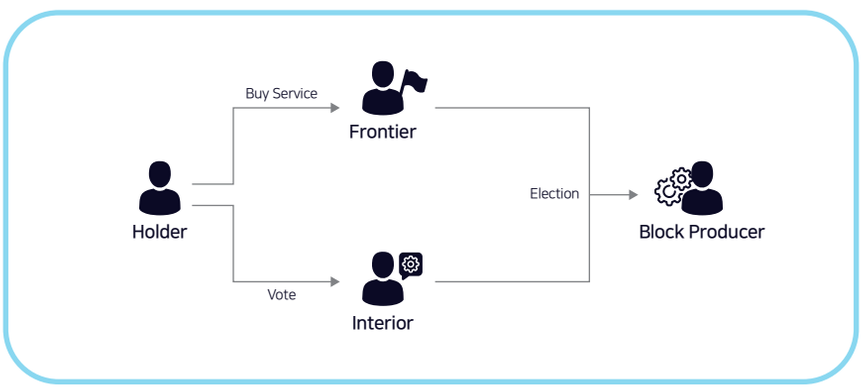
<Figure 3.3> Network effect between service platforms

3.2 Mainnet Governance of LEDGIS

The mainnet governance of LEDGIS is composed of DPoSS (Delegated Proof of Stake Service) consensus algorithm, DNS (Domain Name Service) based blockchain account system, KYC account registration system, LEDGIS account authority management system, blockchain shared resource system, arbitration system, and referendum system.

3.2.1 DPoSS Consensus Algorithm

The DPoSS consensus algorithm is an algorithm that selects block producers based on the service usage rate and the stake delegation through voting. Of the total block producers, 2/3 (two thirds) are Frontier and 1/3 (one third) are Interior.



<Figure 3.4> DPoSS consensus algorithm

A. Frontier

Frontiers are block producers who operate high-quality services such as DApps in the LEDGIS mainnet ecosystem. They can get usage fees from coin holders who use services of the DApps operated by Frontiers and can receive Block Reward and Contribution Reward. As they get their service quality improved and popular, they can maintain more token holders and can get elected as a block producers based on the amount of DApp token purchase, that is, the amount of sales in the blockchain. This will create a virtuous cycle that activates the mainnet ecosystem and increases the value of LEDGIS coin.

B. Interior

Interiors are block producers who set and implement policies for the network as well as protect and help members of the blockchain ecosystem. Interiors are elected through voting by LEDGIS coin holders, and the elected Interiors get Block Reward and Vote Reward. Other Frontiers and Interiors, who were not elected as block producers, can be rewarded with LEDGIS coins through Contribution Reward based on each service usage and through Vote Reward based on the quantities of voting participation.

There are a total of 21 block producers and two thirds of them are Frontiers who must get a business account as a block producer who operates DApps, and they can be registered as a Frontier candidate through the regfrontier action. The issuance requirement for a business account is that if a business operator runs a normal DApp service, it can get a business account issued through the permission of LEDGIS. When executing the regfrontier action, a transfer ratio, which is a conversion ratio between LEDGIS coin and DApp token, must be entered to determine the service price, and previously entered transfer ratios can be changed through the change ratio action. After the Frontier candidate registration, the candidate can be elected as a block producer based on sales volumes generated through the buy-service action of KYC account users, and the sales volumes of DApp token are determined by the buy-service action on the LEDGIS system contract. At this time, the following conditions are applied to prevent an illegal candidate from becoming a block producer through malicious abusing.

1. Only KYC accounts can affect Frontier's service weight.
2. During 4 weeks since the buyservice action of the KYC account, another buyservice action is not reflected in the service weight of the Frontier.
3. The reflected service weight is managed by a sliding window and has an expiration period of 30 days.
4. After 4 weeks since the buyservice action of the KYC account, another buyservice action is reflected in the service weight of the Frontier.

<Table 3.2> Conditions to prevent abusing

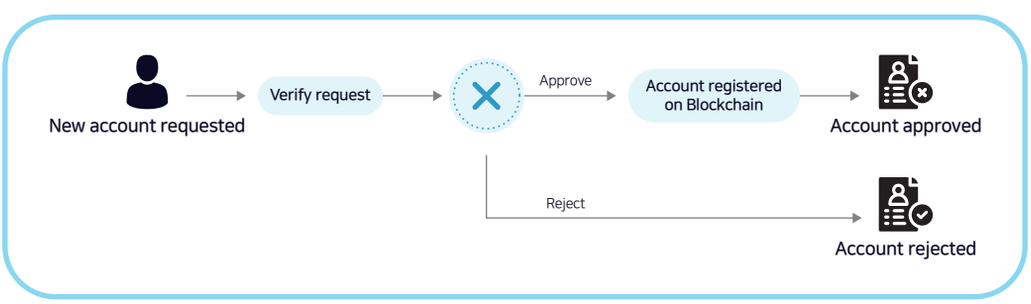
One third of the block producers are Interiors who are generic block producers that don't have to operate DApps, and anyone can be registered as an Interior candidate through the reginterior action. Vote Weight, which affects the selection of interior block producers, is determined by the amount of coin stakes of users who participate in voting, and the vote weight decreases as time passes after voting. Voting is done through the voteproducer action, and there is a voting proxy system called Proxy, so participants can delegate the vote weight to the Proxy they want by using the voteproducer action. Only KYC accounts can be registered for Proxy using the regproxy action. The KYC accounts are real-name accounts or business accounts, and the KYC account and registration system will be dealt with in the next section. Frontier, Interior, and Proxy can deactivate their roles through the unregprod and unregproxy actions, respectively.

3.2.2 DNS-based Blockchain Account System and KYC Account Registration System

All accounts on the LEDGIS mainnet are provided as DNS (Domain Name Service) so that users can identify them easily. The naming, which represents the address of an account, consists of 1 to 12 letters using the characters of 'a-z' and the numbers of '1- 5'.

- General account (anonymous) address: 1 to 12 letters using characters 'a-z' and numbers '1-5'
- General account (real name) address: 1 to 10 letters using characters 'a-z' and numbers '1-5' and suffix 'p' (ex, alice.p)
- Business account address: 1 to 10 letters using characters 'a-z' and numbers '1-5' and suffix 'c' (ex, apple.c)

For the domain accounts that can be issued from the LEDGIS account, the 1-10 letter rule applies and they can be used as a domain. For example, if you are issued an abc account, you have the right to create sub-accounts of up to 12 letters in total, such as a.abc, a123.abc, and korean 23.abc from the abc account. The figure below shows the schematic of the KYC account registration system.



<Figure 3.5> Diagram for KYC account registration system

3.2.3 LEDGIS Account Authority management System

All accounts of LEDGIS have a right to execute smart contracts. By default, owner and active authorities exist, and arbitrary authority can be added additionally. The owner authority is the highest authority, and has the right to execute smart contracts and the right to change a right assigned to an account. In case of active authority, it has the right to execute smart contracts except for the authority change right. In the authorities, it is possible to link a specific smart contract action to an authority through the linkauth action and set it to execute the smart contract action linked with the authority. Authorities can generally be set based on the PKI-based LEDGIS key, and there is a threshold to an authority. As for the threshold value, it is possible to set weight for each key, and when the threshold value set by a set of the keys is reached, the corresponding authority can be used.

In addition, authorities can be set not only with the key but also with the authority of account. Suppose, for example, that a service authority is added by setting a threshold value of 10 to the test1 account, a weight of 5 to the active authority of test2, a weight of 5 to the active authority of test3, and a weight of 10 to the active authority of test4. Then, if the transfer action of led.token is linked to the service authority of test1 through linkauth, the transfer action of test1 can be executed by multising the active authority of test1 and the active authority of test2. Also, the weight for the active authority of test3 is 10, so the transfer action of test1 can be executed with the authority.

3.2.4 Blockchain Shared Resource Management System

A blockchain consists of multiple nodes, and all members share and use the hardware of each node. Therefore, the concept of shared resources appeared, and the resources are referred to as CPU, NET, and RAM in LEDGIS.

- CPU : CPU bandwidth, CPU processing time according to the transaction processing in blockchain
- NET : Network Bandwidth, bandwidth usage according to the transaction size in blockchain
- RAM : Data storage for managing the state value[1)] of accounts in blockchain

3.2.5 Arbitration System

Moderators can use the account freezing function to protect KYC-certified coin holders' accounts from malicious attackers. For example, when the key of a staked KYC-certified account in the blockchain is hacked and leaked by an attacker, the attacker will attempt to unstake and send LEDGIS coins to the outside. Unstaking takes 3 days. If a request is received from the coin holder within this period and confirmed, arbitrators can freeze the coin holder's account to protect the holder's assets from the attacker. In addition, arbitrators have the authority to punish block producers, so it is possible to keep the system safe by preventing malicious block producers from threatening the blockchain ecosystem, such as collusions to raise ranks through abusing.

3.2.6 Referendum System

KYC-certified coin holders can freely propose blockchain policies. If more than 15% of all the KYC accounts participate in voting and more than 2/3 of the voters approve the proposed policy, arbitrators will review and implement the policy. The implemented policy is transferred to the block producer and reflected in the blockchain governance.

1) State value: A state value that reflects values of the asset data such as smart contract, coin, and token stored in an account, and values of the transaction such as account data used in DApps

3.3 LEDGIS Blockchain Architecture

3.3.1 LEDGIS Blockchain System Recommended Specifications and Costs

A. Physical Server

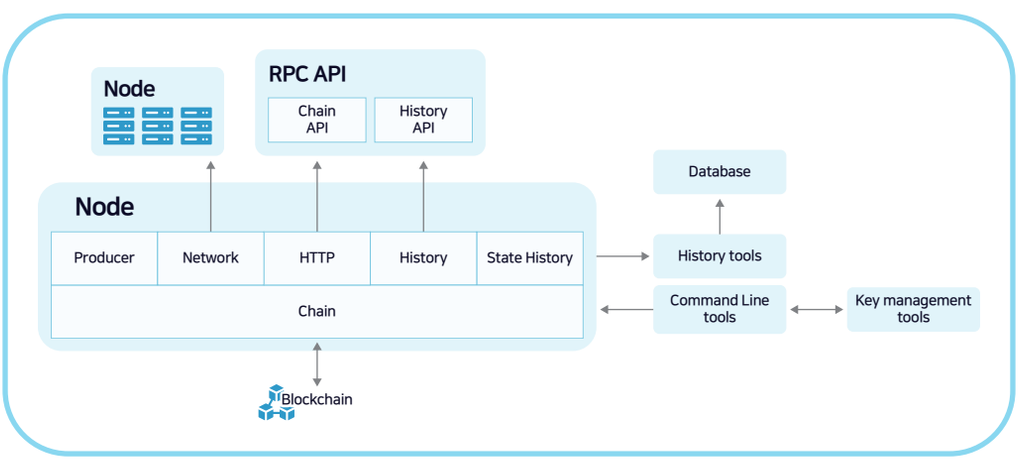
- 16-core CPU
- 64GB RAM
- Static IP address with a bandwidth of 300Mbps
- 1TB SSD Storage

B. Cloud Based Server (based on AWS)

- AWS EC2-m4xlarge instance
  - 16-core CPU
  - 64GB RAM
  - Fee: $0.8 per hour
- AWS EC2 Elastic Block Storage - SSD 1TB
  - Fee: $0.1 per hour

3.3.2 LEDGIS Blockchain Architecture

In the LEDGIS blockchain, nodes are connected through P2P, and each node consists of several modules. To use the configured blockchain, tools such as History tool, Key management tool, and Command line tool are provided.



<Figure 3.6> LEDGIS Blockchain Architecture

A. Node

The node is a program driven by the LEDGIS blockchain node, and it is driven by a combination of various modules. Each module has options to configure, so you can use the module's functions by configuring the options in detail along with the settings of module when running the node. Depending on modules, there are also the modules that provide RPC APIs.

1) Chain Module: This is the most core module among the node modules and has the function of processing and aggregating data in the chain and storing blocks. The data of chain refer to the current state information of the blockchain such as current account information, block information, smart contract information, and a block producer list. Blocks are stored after being divided into irreversible blocks and reversible blocks, and RPC APIs are provided in the module to inquire information about stored chain data and blocks, and transactions are sent to the chain.

- Set the size of memory for storing chain data
- Set the size of memory for storing modifiable blocks
- Set the number of threads used for processing and aggregating chain data
- Set all the blocks to regenerate using existing chain data when running a node
- Delete the previous block and chain data when running a node

2) Producer Module: This is the module with which nodes can create and confirm blocks. In the LEDGIS blockchain, the block producers elected through the DPoSS consensus algorithm create blocks according to a schedule and propagate the created blocks to other nodes. A propagated block becomes an irreversible block when it is confirmed by more than 2/3 of the block producers. Therefore, the block producer node must use the modules that can create and confirm blocks.

3) Network Module: This is the module that handles P2P[2)] connections between nodes and their management, and the transmission and reception of blocks. The connection is made by TCP communication, and when the module is executed, the IP and Port are set to configure the endpoint for the connection. When a connection request message containing node information such as chain ID and network version comes to the configured endpoint, it determines whether the connection is possible or not. It manages the list of connected nodes, and periodically sends messages to the nodes in the list to check whether or not a response is received, and periodically manages the connection status.

- Maximum number of connectable nodes
- When to synchronize blocks
- Set the cycle to manage connections
- Limit the number of connectable nodes

2) P2P stands for Peer to Peer which means that nodes are directly connected to each other without a central server.

The last option is the ability to limit the number of nodes that can request a connection, and it can be used when building a private blockchain. The method of limiting the connection uses an asymmetric key, and if the node with the private key of the key is registered in the list through the setting of the public key option of the asymmetric key possessed by the node that will allow the connection, the node with the private key of the corresponding key is processed to be able to connect. If the key is not registered or is not in the list, the node will be rejected and the block cannot be received.

4) HTTP Module: If you have the HTTP communication protocol and SSL certificate, it provides the HTTPS communication protocol, and includes the function of providing an endpoint that can make HTTP requests to the node and handling errors for HTTP requests. Most of the processed HTTP requests are RPC APIs, and this module must be required to provide RPC APIs from other modules. This module can configure HTTP communications in detail with the following options.

- Set Access-control-allow-origin
- Set Access-control-allow-headers to set the headers to be included in the request
- Set Access-control-max-age to set the maximum time during which a request can be cached.
- Limit the maximum body size of a request

5) History Module: It performs the function of storing the history data of the block chain. The historical data to be saved are actions and authorities, and are stored as read-only. Actions are stored once in the action table, and once more stored in the account-specific table so that actions by account can be easily inquired. Authority checks out the types of action (whether the authority is changed or new) when an action is executed, and continuously updates and stores it. The data stored in this way can be inquired through the RPC API, and the options that can be set for the module are as follows.

- You can save your favorite data through filtering by setting the action title, the account for action execution.

6) State History Module: It stores the history data and chain data of the blockchain, and provides an endpoint to connect to and read the file. The data saved here is similar to that saved in the History module and the Chain module, but it is more subdivided and the storage method is different. Existing modules are stored in memory and can be inquired by using the RPC API, but this module is provided as an endpoint and can be stored in the database as an interface of specific history tools. The options of the State History module are as follows.

- Delete all existing data files and start
- Decide whether to save chain data
- Decide whether to save history data

B. History Tool

It provides a function to store the chain data and history data of the blockchain in the database. It is used in conjunction with the State History module of the node. It connects to the endpoint of a State History module and save the saved data in the database. Available databases are Rocks DB and Postgre SQL. The database to be used can be determined through the module setting when the History Tool is executed, and the History Tool can also be set up for data storage using options. The options are as follows.

- Save after a specific block
- Save up to a specific block
- Save with or without specific transactions

C. Key Management Tool

It is a tool that provides a function to manage keys. Action execution in the LEDGIS blockchain uses authorities. These authorities are mapped to keys or other authorities. Since key storage is a very important part, the Key Management Tool provides the function of a wallet to store keys. The main function is to store the key and use the key to sign. The key management tool can be controlled using the RPC API provided by the tool.

D. Command Line Tool

It is a command line tool that helps users to use the blockchain easily. In order to actually access the blockchain to inquire data or execute actions, the RPC APIs must be used, and the key management tool must also be operated using the RPC APIs. The tool makes it easy to use these RPC APIs with commands so that such tasks as blockchain key management, blockchain data inquiry, and action execution can be executed with commands. In addition, the signature required for executing the action in the corresponding tool is made using the key of the Key Management Tool aforementioned.

3.3.3 API

The LEDGIS blockchain platform provides the following APIs so that DApps and users can easily access information and execute smart contracts.

A. Account Information API

When users use the blockchain, information about their accounts is very important. Through the account-related API set, users can check various information such as the balance of coins held by the account, their account authorities, and resource usage.

B. Transaction API

Through the transaction-related API set, users can use various transaction-related functions, such as generating a transaction or confirming the transaction that has occurred.

C. Block Production API

Block producers who create blocks can set or check options (maximum transaction time, last block creation offset, etc.) of the blocks they create. By making a blacklist in the form of a list, transactions of accounts that have an adverse effect cannot be included in the block, and block producers can manage various functions related to block production by using the block production-related API set.

D. Node-to-Node P2P Connection API

Blockchain participating nodes are connected through P2P. By using the node connection-related API set, nodes can establish or terminate P2P connections with other nodes, and the information of currently connected nodes can be known.

E. DApp Support API

In addition to the APIs provided by the blockchain platform, there are more APIs that help DApps obtain more and detailed information. The DApps using these APIs can reduce development costs and time.

F. CDT (Contract Development Toolkit)

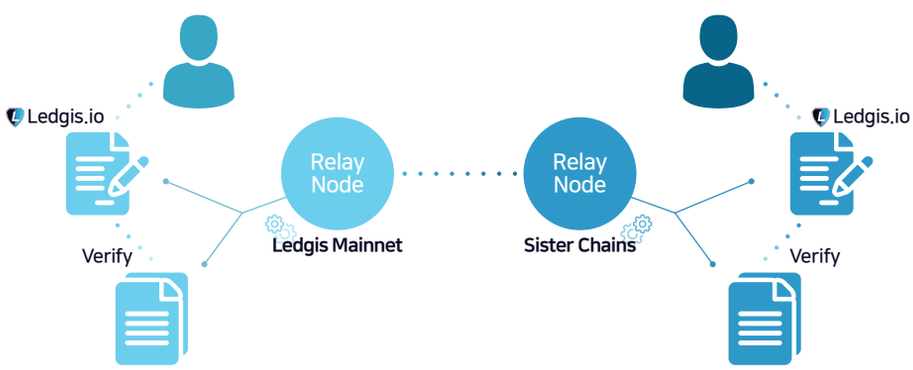
CDT is a contract development toolkit, a tool set for smart contract development, which facilitates the contract creation on the LEDGIS blockchain platform.

3.4 LEDGIS Blockchain Core Features

3.4.1 IBC(Inter Blockchain Communication)

The LEDGIS blockchain platform provides the IBC function to support communication between different blockchains. The IBC of the LEDGIS block chain consists of the structure shown in the figure below, and the IBC operation process is as follows.

① A transaction occurs using the IBC contract on the mainnet and the transaction is stored in the IBC contract table.
② When the block containing the stored transaction becomes an irreversible block, the relay node of the mainnet transmits the transaction related information to the relay node of the sister chain.
③ The received relay node calls the IBC contract of the chain to verify and execute the transaction.
④ The executed transaction is processed and recorded in a block, and when the block becomes an irreversible block, the relay node of the sister chain transmits the transaction to the relay node of the mainnet again.
⑤ The relay node of the received mainnet calls the IBC contract to delete the transaction stored in the existing table, and the entire process is completed.



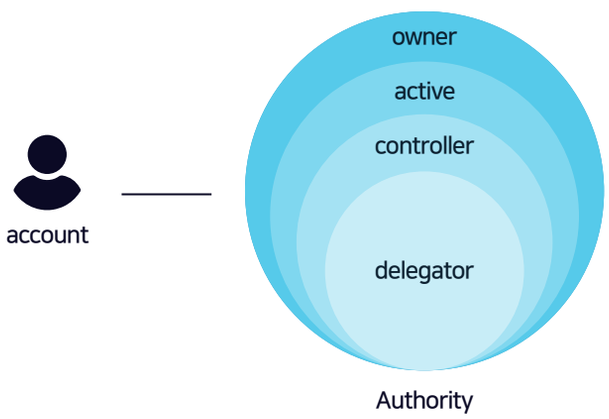
<Figure 3.7> Structure of LEDGIS Blockchain IBC

3.4.2 LEDGIS DID(did:lit)

The DID identification system of the LEDGIS Blockchain, did:lit (LEDGIS Identity Transformation), re-established the DID system for the purpose of use. It has become possible to realize system authentication and authorization by using authentication, assertionMethod, capabilityDelegation, and capabilityInvocation.

A. User Blockchain Accounts and Authorities

The did:lit identification system can authenticate users through did. DID authentication is a method of proving to the party that the user controls and trusts the DID. The DID Document of the did:lit system verifies that the user has the right to control and modify the DID document through the controller item. The DID controller is mapped to a user account, and the account must have controller privileges and delegation privileges. The controller authority is involved in the overall modification of the DID document, and the delegation authority is the authority used to grant the authority to the function. The figure below is the authority mapped to the user account.



<Figure 3.8> User Authorities Mapped to Accounts

B. Credentials - Authentication

Users can ask the issuing authority holding their personal data for a notarized document proving the user's qualifications. The issuing authority collects the user's data (Claim) and creates a credential (a set of claims). The issuing authority signs the credential with the private key corresponding to the assertionMethod public key registered in its DID Document to deliver the credential to the user. The user verifies the signature with the public key of the issuing authority registered in the blockchain to verify the signed credential, the Verifiable Credential.

The user creates a verifiable presentation to deliver the necessary information to the verifier. At this time, the user signs the verifiable credential using the authentication key registered in his DID Document. The verifiable presentation contains the signature of the issuing authority and the signature of the user.

It verifies the signature of the issuing authority and user through verifiable credentials and presentation verification. Through the above process, the integrity of data can be verified, and non-repudiation of the signature of the issuing authority and user is also possible.

C. Proof of Authority - Authorization

The did:lit identification system can grant authorization to resources through did. It is possible to grant an authorized subject the authority to perform an operation. You can specify the data allowed to access and the actions that can be performed with the data. Resources can be broadly divided into programs and functional units of programs. By utilizing the capabiltiyDelegation and capabiltiyInvocation of the DID Document, it is possible to delegate or utilize the capablility (key, token to access the resource), which is the access authority to the resource. In addition, users can delegate or transfer functionality via capabilityDelegation. The capabiltiyInvocation is used to prove that a legitimate authority has been granted to activate a delegated function.

The access control principle emphasizes the Principle of Least Privilege. In other words, it grants only minimal privileges to the user. By not granting more privileges than necessary, the potential for misuse can be reduced, so even if the system is attacked, damage can be minimized. In DID-based capability control, anonymity is guaranteed because authorized users are identified by DID, and by subdividing the function, it is possible to realize the minimum authority with DID, and data integrity can be guaranteed because the granted authority information is signed/verified based on the key.

Category	DID Document Attribute	Description
Authentication	assertionMethod	Attributes that the issuing entity uses in signature by combining the information for users
	authentication	Attributes that users use when passing verifiable presentations to validators
Authorization	capabilityDelegation	Attributes used by users to delegate or transfer certain functions of the system
	capabilityInvocation	Attributes used by the user to whom the function has been transferred to activate the function

<Table 3.3> DID Document attribute used for authentication/authorization

3.4.3 Decentralized Data Sharing System (IDH: Identity Data Hub)

Identity Data Hub is a decentralized data sharing system based on Lit DID and Lit Resolver. Based on DID, only authorized users can access data, and since it is directly encrypted and stored on the user's device, integrity and confidentiality are guaranteed. In addition, by applying the Lit DID system that complies with the W3C standard, it is designed to be compatible with both the Lit DID and other DID systems that comply with the W3C standard.

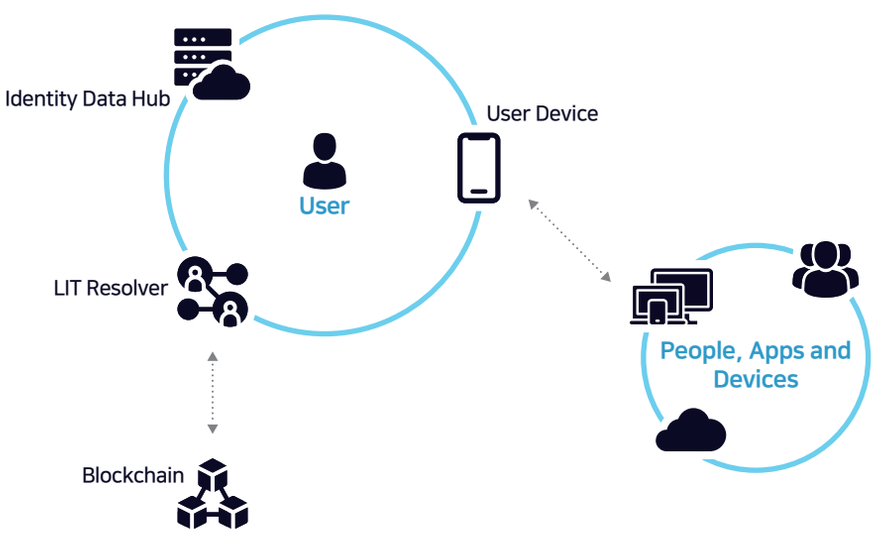
DID-based user data management
Only authorized users can access the data

Ensuring data integrity and confidentiality
Encrypted and stored directly on your device

Compatible with other DID systems
Compatible with other DID systems that comply with W3C standards

<Figure 3.9> Identity Data Hub Features

Users can safely store and manage their personal data through Identity Data Hub, and can freely share their data with other users or receive data from other users. Since all these actions are made based on the user's authority, it can be used in a safer environment than other data sharing systems.

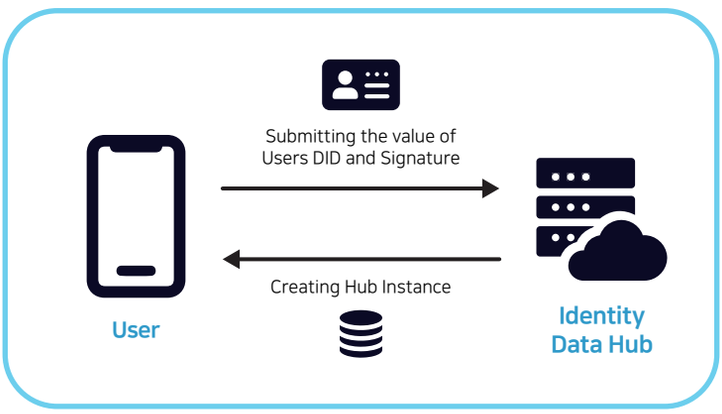


〈Figure 3.10> Identity Data Hub Structure

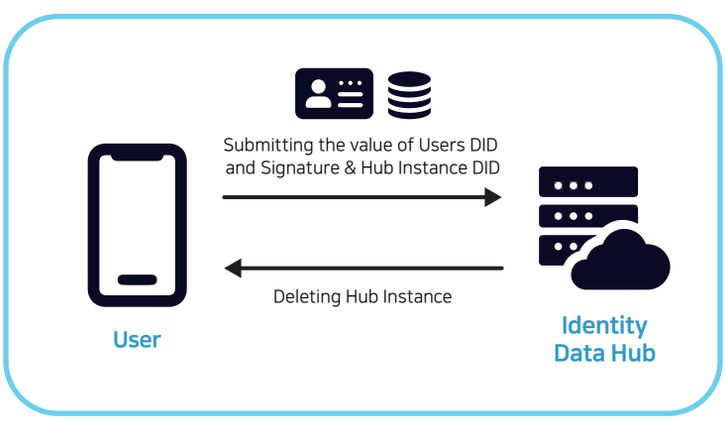
The role of Identity Data Hub can be divided into Hub Instance, Collection, and Permission, and they create user-specific storage or store, inquire, and share data.

A. Hub Instance

Identity Data Hub can create and delete Hub Instances, and all users can manage data only by creating Hub Instances. Users must authenticate their identity using their DID when requesting creation or deletion of Hub Instance. A user can create and own one or more Hub Instances, and when the Hub Instance is deleted, all data in the storage is deleted.



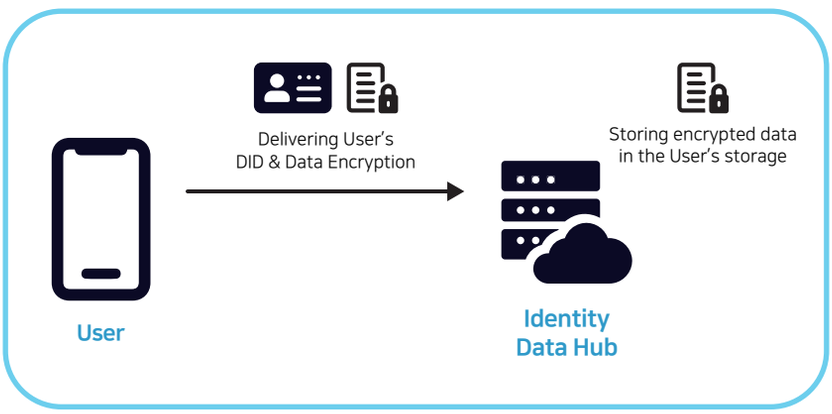
〈Figure 3.11〉 Hub Instance Creation



〈Figure 3.12〉 Hub Instance Deletion

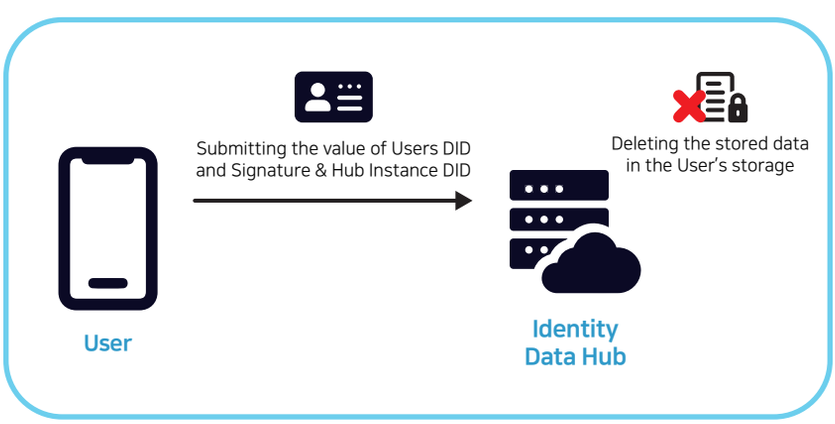
B. Collection

Identity Data Hub can perform functions to store, delete, and retrieve data. The Collection interface is used for data storage, deletion, and inquiry, and the user must have a Hub Instance and must authenticate his or her own DID.

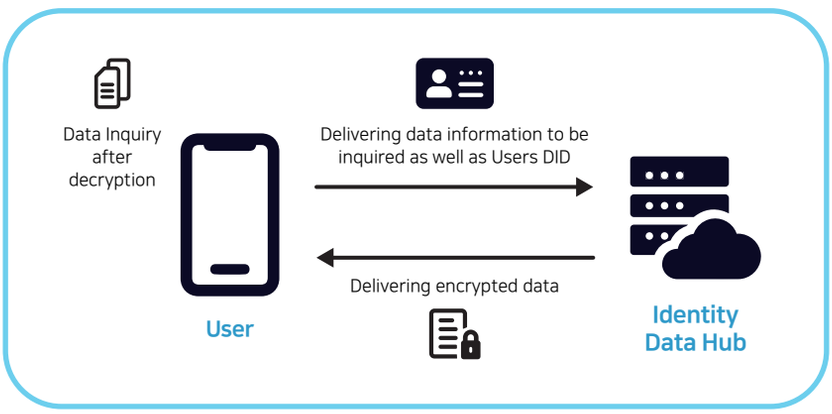


<Figure 3.13> Data Saving

When data is stored, the user directly transmits the data after encryption, so there is less risk of the original data being stolen by a third-party during transmission, and since it is also stored encrypted in the storage, the confidentiality of the original data is guaranteed even if the data is leaked due to a problem in the storage.



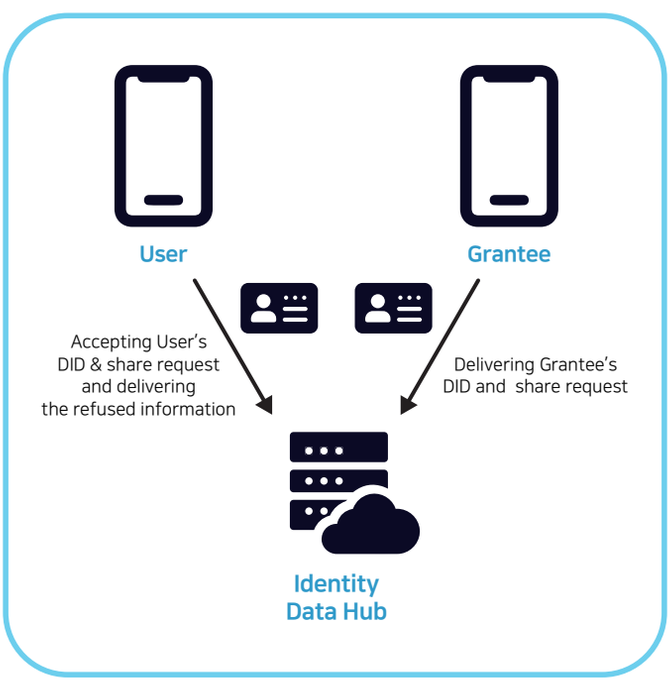
<Figure 3.14> Data Deletion



<Figure 3.15> Data Inquiry

C. Permission

Identity Data Hub can perform functions to share data. Both the user who receives the share and the user who wants to share must own the Hub Instance.



<Figure 3.16> Data Sharing Request and Confirmation

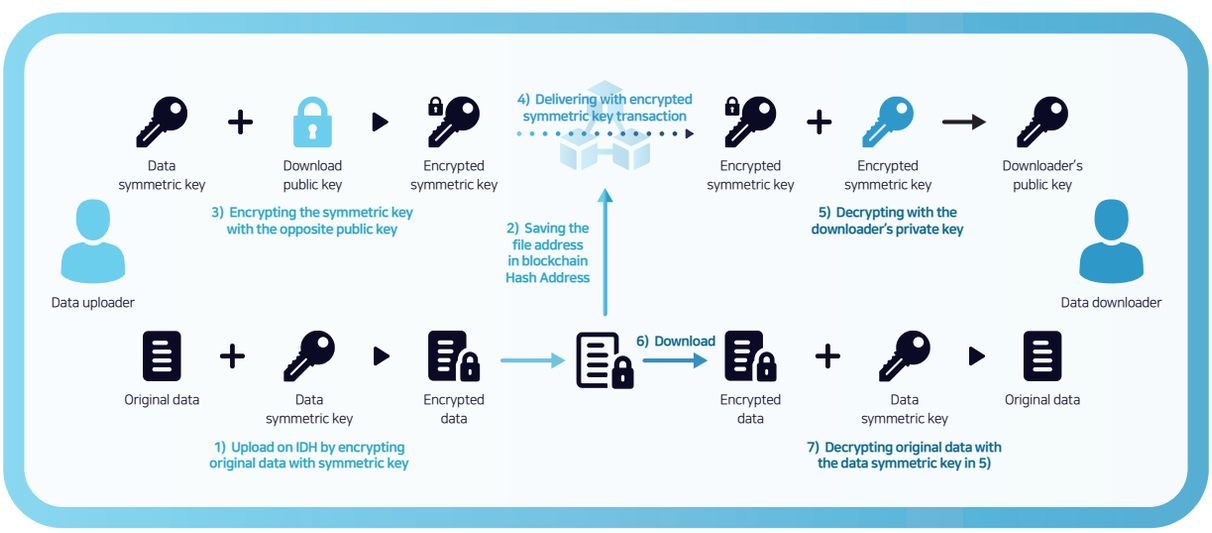
Through this process, users can process data such as storing and sharing data based on DID, and it is also possible to solve the problem of processing large amounts of data that cannot be solved with the existing DID.

3.4.4 Sharing Encrypted Data

Since the information stored in the block chain is diverse, the fields in which the block chain can be utilized are also very wide. These blockchains are divided into public blockchains and private blockchains according to the right to access or the scope to participate.

- **Public Network** : Provides a function to prevent forgery and falsification of data, and reliability of information can be secured because blocks are shared by an unspecified number of people. However, since the information can be viewed by all users in the network, there is a disadvantage that sensitive information requiring security cannot be recorded and shared inside the network.
- **Private Network** : It has the advantage of high security for sensitive information because network participants are restricted and there are only a small number of authorized participants. However, since there are few network participants and the decision is made by a specific minority, it has a disadvantage that reliability may be somewhat lowered.

LEDGIS provides the ability to share encrypted data via IDH to grant the advantages of both public and private networks. It creates a data encryption key, encrypts data using the key, and provides a wallet to store and use the encryption key so that users can conveniently manage the key. In addition, by encrypting data using the public key of share object, it provides a function of sharing data only for a specific user with the corresponding private key.



〈Figure 3.17〉 Large Encrypted Data Transmission Technology of IDH

3.4.5 LEDGIS Wallet

Participants in the blockchain must enter the user's private key each time they want to generate a transaction within the network. Such a device impairs the user's convenience and raises concerns about key loss. In order to improve the usability of blockchain participants, LEDGIS provides LEDGIS Wallet, a mobile-only wallet so that users can store keys in their wallets and access the blockchain even in a mobile environment.

The LEDGIS wallet encrypts and stores the private key with the user's biometric authentication information, and when the user generates a transaction within the blockchain network through the LEDGIS wallet or other DApp, it provides convenience and security to users by providing keys and generating transactions through simple biometric authentication and entering PIN number.

3.4.6 LEDX (LEDGIS Block Explorer)

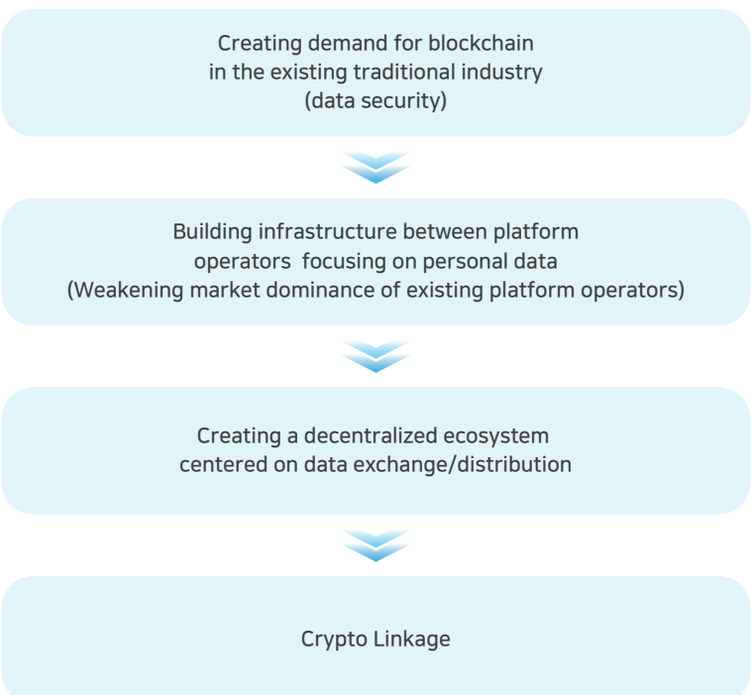
The LEDGIS blockchain platform currently provides a blockchain explorer, LEDX, for information provision, discovery, and blockchain utilization of the current blockchain. The most important feature of LEDX is usability. Since LEDX is used more by general users than developers, we have improved UI/UX so that user can easily find desired information and participate in blockchain ecosystem despite the lack of deep knowledge. The main features of LEDX are as follows.

- **Creating KYC account :** It is designed so that users can easily enter the blockchain network by applying many processes for creating a block chain similar to website KYC membership registration and providing an easy way to create a blockchain account.
- **Search :** Easily search for desired information among your account information, transaction information, and block information
- **Monitor :** Organized around necessary information so that the current LEDGIS block chain status can be monitored at a glance
- **ab configuration :** Organized mainly on functions that users mainly use and need, such as remittance.

3.5 LEDGIS Platform Expansion Plan

The step-by-step strategy for building the LEDGIS decentralized platform is as follows.

- **Phase 1 (demand generation)** : Currently, Blockchain for Data Security
- **Phase 2 (Formation of a flexible decentralized platform)** : Introduction, (Self Sovereign Identity) infrastructure expansion
- **Phase 3 (DATA blockchain ecosystem)** : Growth, 'LEDGIS DATA' decentralized ecosystem completed
- **Stage 4 (LEDGIS Crypto Linkage)** : Maturity, LEDGIS 'On Chain'



3.5.1 Phase 1: Blockchain for DATA Security

Current: Non-Cryptocurrency DATA Solutions

Existing block chain technology is only at the level of crypto ecosystem and anti-counterfeiting technology, but LEDGIS block chain has a level of technology that can improve data security through DID/IDH and control data based on SSI (Self Sovereign Identity). Applicable fields are as follows.

- Payment (using user sensitive information such as biometric information such as face, vein, and fingerprint)
- Finance (non-face-to-face account creation, card, insurance, credit rating)
- Authentication (access, user authentication, contract)
- Data (ownership, autonomous driving, medical, health, contract, intellectual property, etc.)

3.5.2 Phase 2: SSI(Self Sovereign Identity) Infrastructure Expansion

Introduction stage: Formation of a flexible decentralized platform structure between service platforms

It starts with personal sensitive information (biometric information, financial information) and expands to ownership and transaction information (contract, ownership, intellectual property rights, etc.). This is the time when platform operators can participate in blockchain nodes only by paying for the generated personal information.

In the introduction stage, it is possible to configure a decentralized platform between service platform operators, and install DID/IDH/Blockchain nodes separately according to the platform service contents. In addition, the personal data accumulated in the decentralized platform can be linked and used between service platform operators after approval from the individual who is the information subject, and a 'network effect' between service platforms can be expected.

Financial Information (card number)	⇨	Introduction of a simple and fast payment system
Identity Information	⇨	Fast user authentication without registration process, access control, etc.
Contract Information	⇨	Provide quick connection service
Education History Information	⇨	Completion of training and application of other training services

3.5.3 Phase 3: ‘LEDGIS DATA' Decentralized Ecosystem Completion

Growth: Formation of flexible decentralized platform structure between service platforms

In the growth period, 'individuals' with data ownership are recognized as the owners of the service platform, and the market power and position of existing platform operators are weakened. At this time, individuals can store and reuse their data at no cost, and as the amount of data increases in the future, related services such as AI agents are expected to be activated. The individual who is the subject of information, is available for data ownership, authentication, status information (validity), and history management, which will result in activating data transaction, emerging a new market of data distribution including its activation.

3.5.4 Phase 4: LEDGIS 'On Chain' Expansion

Maturity: Linking with LEDGIS Crypto Ecosystem

In the maturity stage, a coin ecosystem such as coin mint/distribution suitable for the characteristics of service providers is built, which is used in the data distribution and utilization process. In addition, smart contract-based digital services have been upgraded to provide deposit, escrow, and non-face-to-face payment functions, and LED coin will become a key currency within the service, which will contribute to the platform operator business. Small and medium-sized enterprises (SMEs) can participate in the LEDGIS blockchain platform to obtain the benefits of solving the problem of liquidity of funds, differentiating services and reducing costs. Through this, the service value of service platform operators in LEDGIS will be internalized in the LED coin and a virtuous cycle will be possible through value realization.

<Figure 3.18> LEDGIS Ecosystem Virtuous Cycle

4. Coin Economy

LEDGIS is a blockchain platform that owns an independent network, and the coin used in the LEDGIS blockchain is called 'LED'. In the LEDGIS ecosystem, LEDGIS platform coins and DApp tokens exist. DApp tokens are used when using DApp services within the LEDGIS ecosystem and can be purchased with LED coins.

4.1 LED Coin Functions

- **Use of network resources :** It is possible to purchase and use CPU, NET, and RAM resources within the blockchain platform. In addition, participants who own resources can participate in REX through vote participation or delegation of authority, and these actions guarantee additional direct and indirect profits.
- **Voting :** It is possible to participate in policy making in the block chain through vote participation and delegation of authority.
- **REX :** Supports leasing and renting of resources among participants in the blockchain.
- **Spender designation :** Spender is a function that a participant can designate a poxy who manage the tokens the participant owns on behalf of Himself or herself. The participant can delegate to the poxy the authority
- **Stake/Unstake (deposited state/non-deposited state) :** 72 hours must elapse to return the staked coin to the state of unstake.

4.2 LEDGIS DApp Token Types

A. General Token

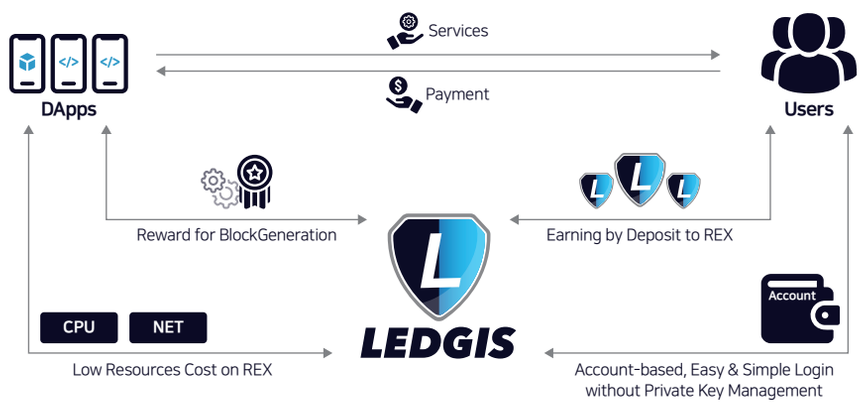
A general token is an LEDGIS blockchain platform token, and a token for each DApp is issued according to the contract and is used as a general DApp token. All issued tokens have the same value as fungible tokens.

B. NFT (Non-Fungible Token)

NFT is a token with a unique value for each token, and does not support compatibility between tokens, and is issued by entering token information and name together. Due to their characteristics, NFT tokens are used as a medium of ownership of digital assets in DApps in various fields such as quality assurance and real estate.

4.3 Participant Reward System

The core of coin economy is the participant reward system. Through the reward system, it is possible to revitalize the ecosystem and ensure sustainability by encouraging the influx of new participants into the ecosystem and providing reasonable and sufficient rewards according to their roles to the most prominent participants. LEDGIS has a reward system that is elaborately designed to motivate the active participation of all members of the ecosystem, such as coin holders, individual users and DApp service providers, and to contribute to the activation and expansion of the ecosystem.



<Figure 4.1 > LEDGIS Ecosystem Service Flow Chart

A. User (coin holder)

Users contribute to the activation of the LEDGIS ecosystem by using DApps. Because the frontier is elected based on the level of service usage by users, the behavior of using the service is considered to be contributing to the ecosystem and a portion of the amount used for the DApp service is returned as a payback type of reward.

When a KYC-certified token holder purchases Frontier's service, 5% of the service purchase amount will be paid back from the Frontier account that purchased the service. At this time, the payback is provided only to the KYC account and is only paid once every 4 weeks[3]. In addition, you can contribute to the ecosystem by electing the interior through the exercise of the voting right obtained by staking the LED coin you have. Anyone restricted to participating in the vote or delegating the authority to the Proxy can use REX'S, resource rent service.

3) Related to the frontier selection process described in the previous chapter, that is because the period during which one buyservice action can affect the service weight of the frontier is limited to 4 weeks to prevent malicious abusing.

B. DApp Operator

Any DApp operator in the LEDGIS ecosystem has the right to become a Block Producer (BP), and a DApp that attracts many users by providing quality services becomes a BP. ① The DApp operator can receive the payment for the service usage from the coin holder who purchased the DApp service.

C. BP (Block Production Node)

Frontier and Interior can get rewards between contribution reward and vote reward according to their service usage. Block producers can get 0.9% of contribution reward out of the issued amount, while 0.3% of vote reward.

Reward	Coin Inflation
Frontier Reward	0.9%
Interior Reward	0.3%
Block Generation Reward	0.3%
LOSA Program	0.5%

<Table 4.1> LEDGIS Mainnet Coin Inflation

5. LEDGIS Ecosystem

LEDGIS Blockchain possesses DID, IPFS, and key management technology, and IDH, a decentralized data storage, has been built and operated in Jeju Island. Based on LEDGIS mainnet blockchain technology, it provides ① LEDGIS Enterprise establishment/operation, ② DApp Services, ③ decentralized service platform, ④ B2B solution service.

5.1 LEDGIS Enterprise Establishment/Operation

Within the LEDGIS Blockchain ecosystem, we are developing, building, and operating blockchain services linked with the administration, local governments and affiliated organizations.

- **Blockchain platform for defense business support :** Selected as a pilot company for the 2019 public-leading blockchain pilot project by the Ministry of Science and ICT, It has been successfully built (December 2019) and is expected to be applied to other institutions.
- **Blockchain-based REC transaction system :** A small-scale power brokerage business is a business that sells REC (Renewable Energy Certificates) on behalf of photovoltaic power generation companies in the electricity market for solar power generation companies of 1MW or less, contributing to business' convenience and profit improvement. It provides blockchain technology to support solar power generation operators to issue and sell REC tokens, promoting an energy blockchain service that can generate profits even before REC sales.
- **Blockchain-based railway type certification prototype :** The LEDGIS block chain was selected for the "Railway Blockchain Core Basic Research" project being promoted by the Logistics Technology Research Team at the Korea Railroad Research Institute. It has been implemented to maintain the safety of data generated in the process of design compatibility inspection, conformance inspection, and vehicle type test inspection and transparently manage approval inspection history (August 2020). Starting with the development of this prototype, the LEDGIS blockchain technology is expected to spread throughout the railway industry, such as railway passenger service, logistics service, vehicle and infrastructure maintenance and procurement.

Defense Acquisition Program Administration	2019. 12	Establishment of defense project bidding system with self-developed technology
Ministry of SMEs and Startups TIPS	2019. 11	Selected as TIPS for the first time in the blockchain industry
National Police Agency Public Security Policy Research Institute	2021. 08	DID-based technology development MOU for autonomous driving data management
Bucheon/Korea Information Society Agency	2021. 10	Establishment of monitoring systemusing AI, DID, and CCTV images

<Table 5.1> Current Status of LEDGIS Enterprise Field

5.2 DApp Services

As of October 2021, DApps in various industries such as medical, manufacturing, education, sports, and fintech are being developed/provided within the LEDGIS ecosystem, and BaaS is divided into LEDGIS Blockchain On-boarding which provides nodes for DApp operators and Decentralized Identity Verification Services such as LEDID, LEDGIS DID.

- **JJIN** : A real estate transaction platform that applies DID and NFT technology to prevent false sales and information forgery
  - http://www.restandard.net/
- **Cueney** : A sports platform that records billiard game results on the block chain and uses tokens to pay for billiards video/goods
  - https://play.google.com/store/apps/details?id=com.cuesco.cueny
- **CarWashKing** : An 020 platform to view/share real-time consultation/reception and service use history of mobile car wash service
  - https://www.sechawang.com/
- **Battle Tube** : An entertainment platform that applies a coin payment system for an audition program through blockchain-based online voting and content within the platform
  - http://www.battletube.org/
- **Celloud** : A fractional investment platform that provides P2P transactions by digitizing real assets other than financial products with NFT based on smart contract technology
  - http://www.celloud.co.kr/

<Figure 5.1> BaaS Guide for using BaaS Service

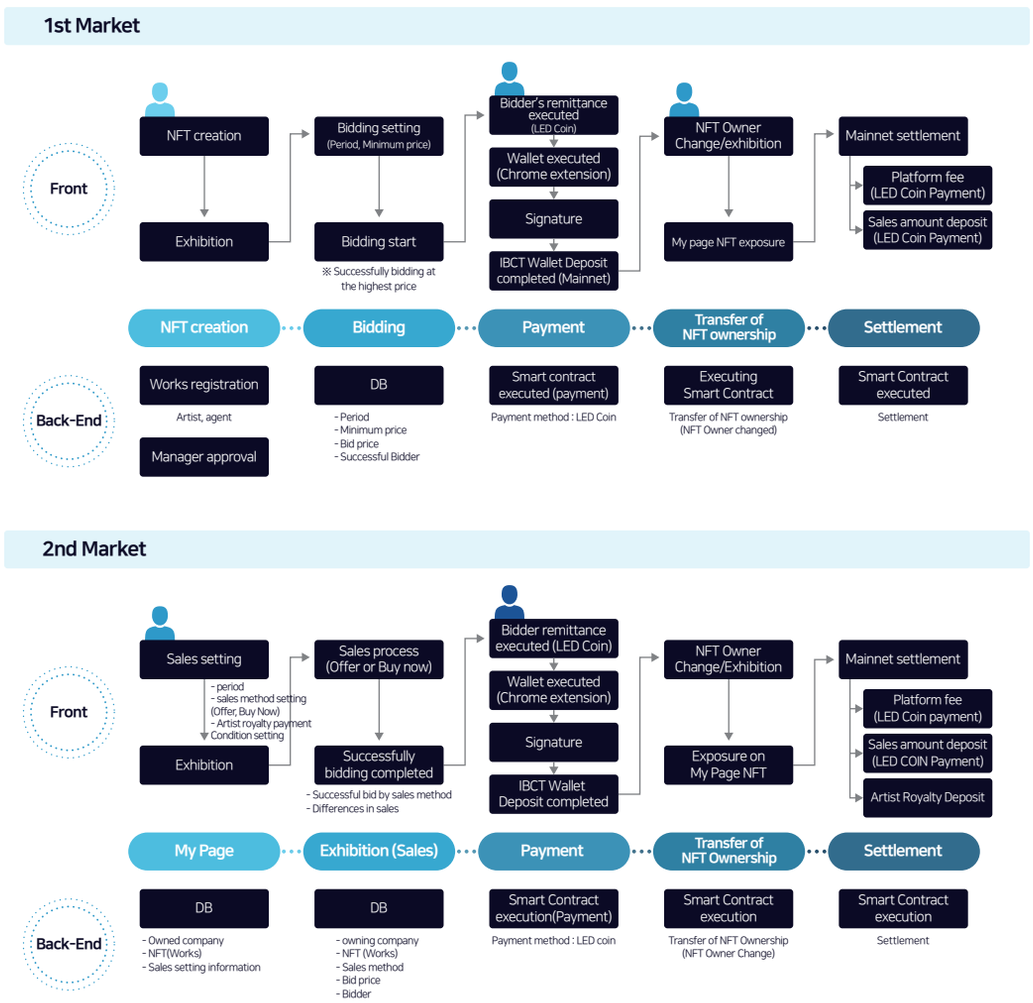
5.3 Decentralized Service Platform

A. Real Collection

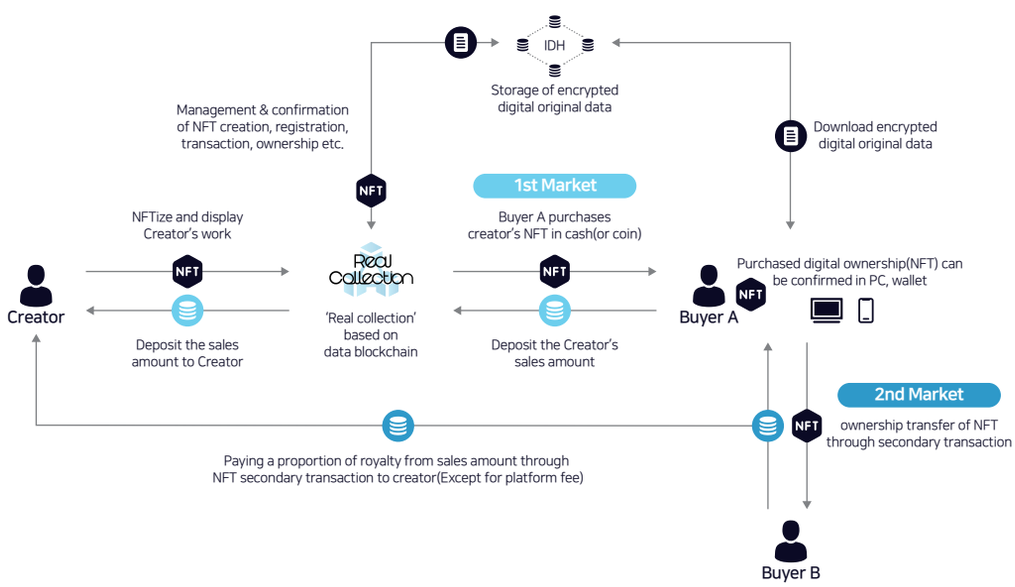
'Real Collection', a premium NFT platform based on art content such as pop art and graffiti, is a decentralized NFT trading platform that converts IP such as pop art and graffiti into NFT and enables free P2P transactions between creators and buyers with application of blockchain-based smart contract technology.

The business models of the NFT market include ① primary market (Creator-Buyer) transaction method, ② secondary market (P2P) transaction method, ③ split (NFT fragment) transaction method, and ④ DeFi (decentralized finance) service. Details can be found below.

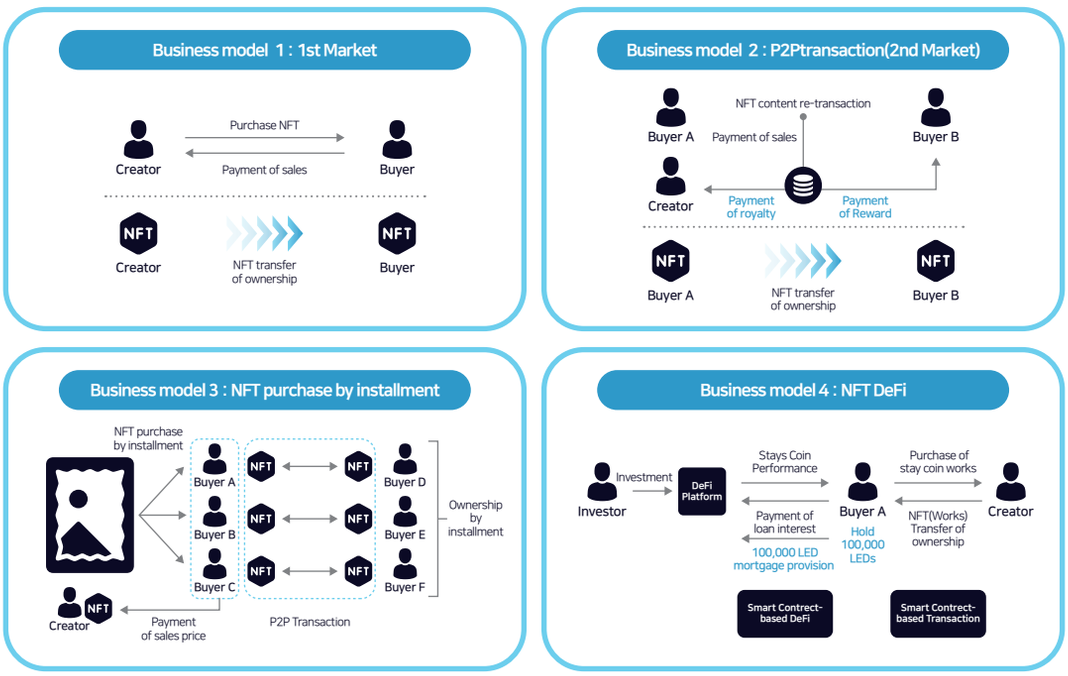
- **NFT types to be issued :** A digital NFT original (1 copy) and each NFT edition (100 copies) are to be issued.
- **Primary market trading method :** Bidding method, in which the highest price is the principle, and only the first primary transaction is available. (Creator → Buyer).
- **Secondary market trading method :** NFT market participants can trade in the offer method or the buy now method in a 1:1 transaction method.
- **Fractional (NFT fragment) transaction method :** It is issued by dividing into digital data blocks so that it may increase access to high-priced IP content that is difficult for one buyer to purchase. Each NFT piece is recognized as a divided ownership, and it is distributed through the primary and secondary trading methods within the Real Collection platform.
- **DeFi service :** Participants who own NFTs can borrow virtual assets (cryptocurrency) using their NFTs as collateral within the DeFi platform linked with Real Collection. DeFi investors can make interest earnings other than the principal, and NFT owners can use decentralized financial services using their NFTs as collateral.
- **Artist royalty payment method :** Royalty is paid according to times of transactions, and the royalty payment ratio is 7-10%.



<Figure 5.2> Primary·secondary Transaction Process of Real Collection

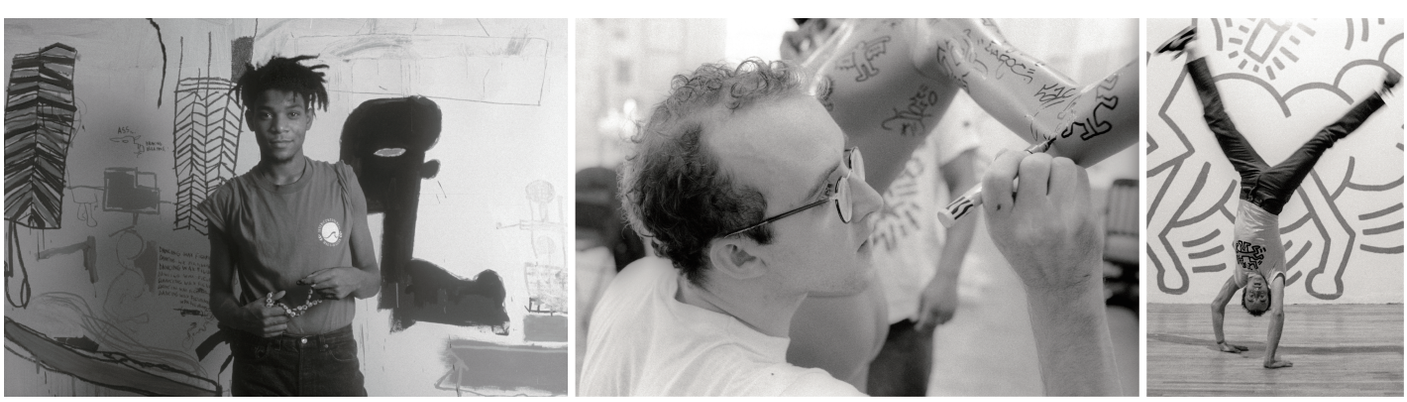


<Figure 5.3> Decentralized service platform, Overview chart of Real Collection



<Figure 5.4> Decentralized service platform, real collection BM

Real Collection aims to build a premium NFT market through high-quality IP (Basquiat, Keith Haring, etc.). To this end, the representative works of world-famous pop art artists such as Liquinones, Futura 2000, and Choi Dong-yeol, as well as the lost works of first-generation graffiti artists such as Basquiat and Keith Haring, are restored and NFTized. In addition, RealCollection will discover up-and-coming artists in New York East Village, digitalize their work and release in NFT market.



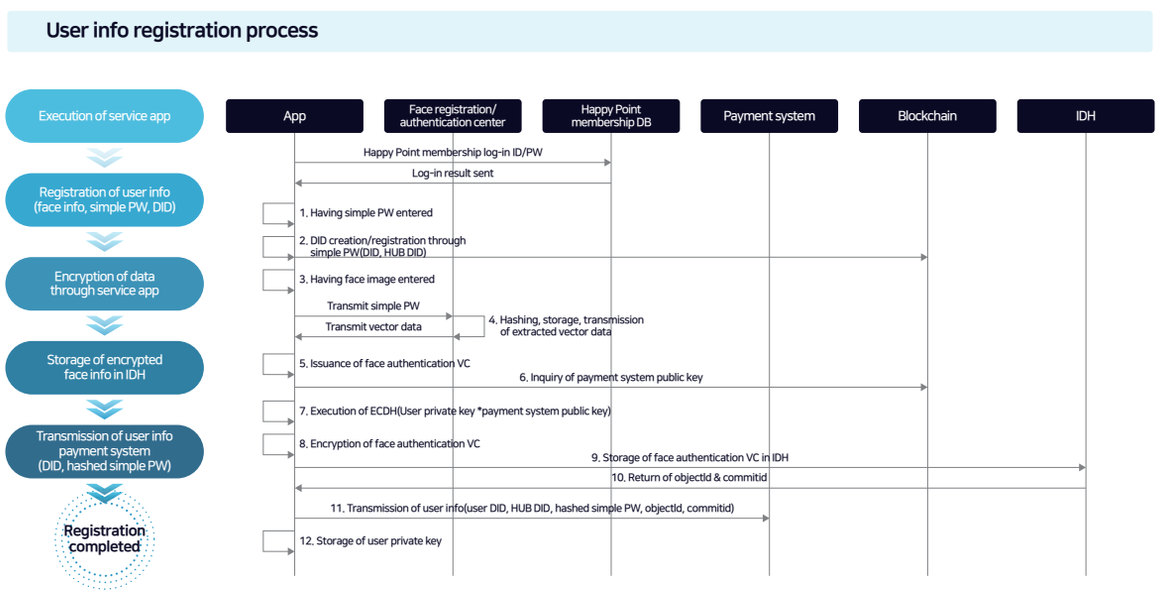
<Figure 5.5> The main IP of Real Collection

5.4 B2B Solutions

A. DID/IDH-based decentralized data sharing and security solution

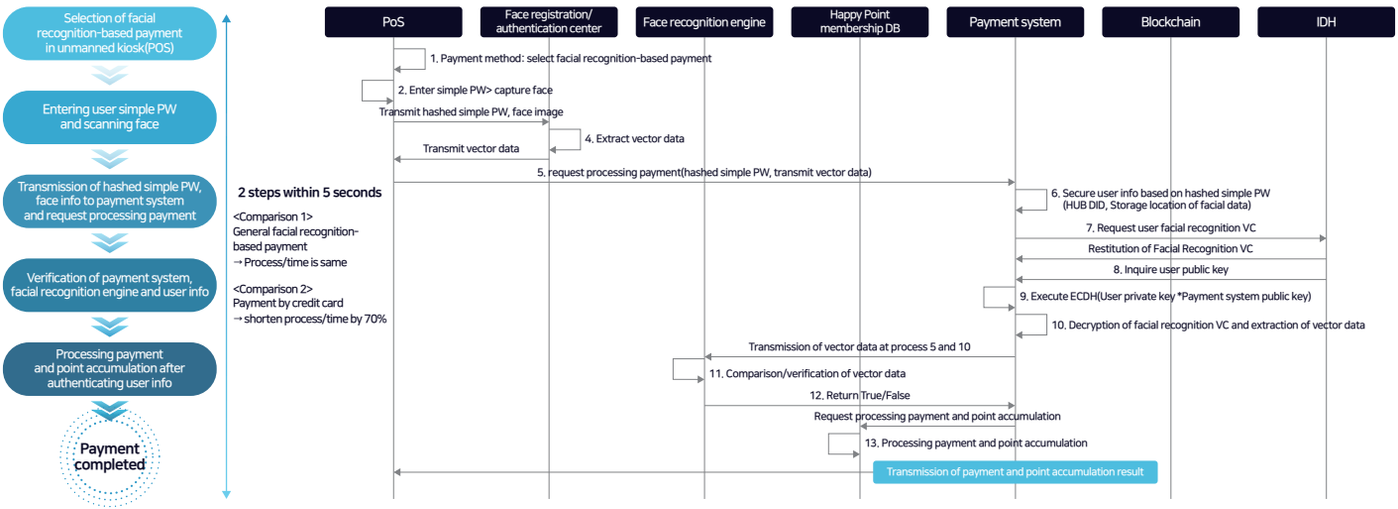
LEDGIS has developed a B2B solution that combines facial recognition biometric authentication and blockchain technology by applying self-sovereignty (DID) and end-to-end encrypted storage (IDH) technology of personal data to the existing traditional industry, and intends to link it to the service. The solution-related field is a DID-based facial recognition payment service.

- **PoC at the headquarters of a mid-sized F&B group in Korea :** Starting with a cafe in the headquarters of a mid-sized group in November 2021, PoC of the blockchain-based facial recognition payment service is in progress and will be commercialized after the PoC is completed.
- **US OTT set-top box in-app payment system :** We are working towards supplying a blockchain-based facial recognition payment solution for OTT in-app payment to US OTT set-top box suppliers.
- **Golf course of domestic conglomerates :** Facial recognition payment solution was supplied to golf courses of large companies in Korea.



<Figure 5.6> User info registration process

Facial recognition-based payment



<Figure 5.7> Facial recognition-based payment process

6. Road Map

2018 Q1

- Corporation founded
- Developed Singapore FX TOKEN & Settlement Contract Platform

2018 Q2

- Korean Association of Realtors Blockchain Consulting & Design
- China x-net clean Blockchain Consulting

2018 Q3

- Hunimal Blockchain Design & Development

2018 Q4

- Ministry of Science and ICT Specialist Training Course (Providing Blockchain Education Platform)

2019 Q1

- Chosen as Blockchain exemplary pilot company by Ministry of Science and ICT in 2019

2019 Q2

- Obtained TBC Excellence Technology Business Certification (Part of Blockchain Technology)
- Attracted Investment of TIPS operator, Actner Lab
- Obtained the certification of Venture business

2019 Q3

- Launched LEDGIS Testnet & LEDX Launching
- Started MISBLOC Project
- Started Togabe project
- Signed agreement with KAIST Delta Joint Research Institute

2019 Q4

- Launched LEDGIS Mainnet, LEDGIS Mobile Wallet
- Started Taiwan 020 Medical Blockchain Service Development
- Started TIPS Development, Chosen as TIPS in Blockchain Part for the first time
- Started CAD Drawing Transaction Service Development based on SungChang ID&D Blockchain
- Completed Blockchain platform establishment, for the Defense Acquisition Program Administration, KOLAS test certification(blockchain platform)
- Chosen as O2O platform development project based on blockchain by Ministry of SMEs and Startups

2020 Q1

- Organized LEDGIS Alliance
- Developed & supplied MISBLOC Anapatalk

2020 Q2

- Developed and supplied SungChang ID&D Blockchain-based CAD Drawing Transaction Service
- Launched Hope Breeze Donation Platform 'Mark'
- Chosen as Global IP Star Corporation by Korea Invention Promotion Association(KOIPA)
- Chosen as International Intellectual Property Right Dispute Response Strategy Support Business by Korea Intelletcual Property Protection Agency(KOIPA)

2020 Q3

- Attracted series A investment by NH Investment Securities
- Supplied test bed for Ministry of Science and ICT Blockchain PoC Assignment
- Completed Sensitive Information Storage Service(KAVE) Test Flight Development
- Developed & supplied Blockchain based railroad Reality Certification Proto-type

2020 Q4

- Developed DID application prototype
- Launched LIT(LEDGIS Identity Transformation) Service
- Sensitive Information Storage Service(KAVE) Launching
- Launched Gold buying Distribution management Trust Platform(Gold Train)
- lLaunched, Billiards Record management & Payment Platform
- Developed medical data MyData Service prototype
- Chosen as Military service substitute Corporation by Military Manpower Administration
- Awarded the Grand Prize of Blockchain Competition by Korea Blockchain Enterprise promotion Association (New Technology Part)

2021 Q1

- LEDGIS Coin listed on GoPax
- Established Bucheon DID Intelligent Monitoring System

2021 Q2

- Released LEDGIS CORE IBC Plugin Module
- Released LEDGIS V2.0
- Established DID Data Hub Center in Jeju Island
- Registered DID Technology as International Standard
- Released real estate service DApp based on LEDGIS blockchain which prevents false offering

2021 Q3

- Signed MOU with Police Science Institute to develop technology which verifies the effectiveness of responding service to autonomous driving-related laws and regulations
- Signed MOU with Ghost Pass, established biometric authentication-based DID payment platform & developed effectiveness certification technology
- Signed contract for development of webtoon DApp based on LEDGIS
- Signed contract for development of real estate DApp which prevents false offering based on LEDGIS NFT
- Signed contract for development of DApp which holds audition to discover potential star
- Signed contract for development of customized education system platform DApp

2021 Q4

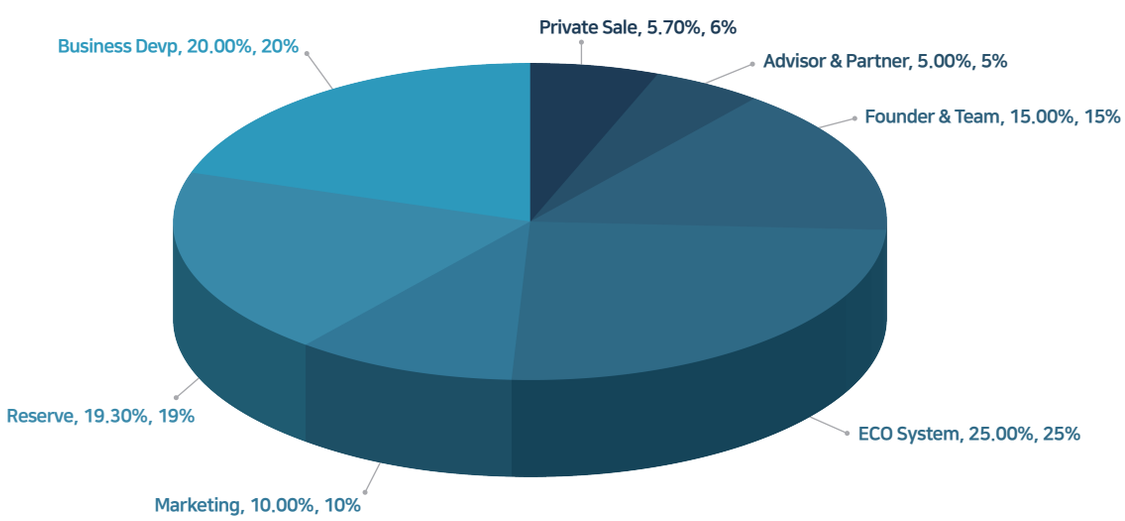
- Applied coin linkage system on real estate NFT transaction platform 'JJIN'
- Launched LEDGIS On-chain Ecosystem
- Completed establishment of intelligent monitoring system for Bucheon city
- SPC Group Blockchain-based Facial Recognition payment Service PoC
- Released Art content-based NFT transaction platform 'Real-collection'

2022 Q1

- Opening secondary market of art content based NFT transaction platform 'Real Collection'
- SPC Group Blockchain-based Facial Recognition payment Service Commercialization
- Starting R&D Business relevant to National Police Agency Security Policy Institute MOU
- Obtaining the order of Intelligent monitoring system establishment business for local government
- signing three DApp contracts

7. Token Distribution Project

- Total : 1,000,000,000 LED (100.00%)
  - The Year 2021: 495,000,000 LED (49.50%)
  - The Year 2022: 749,000,000 LED (74.90%)
  - The Year 2023: 803,000,000 LED (80.30%)
  - The Year 2024: 857,000,000 LED (85.70%)
  - The Year 2025: 895,000,000 LED (89.50%)
  - The Year 2026: 925,000,000 LED (92.50%)
  - The Year 2027: 955,000,000 LED (95.50%)
  - The Year 2028: 985,000,000 LED (98.50%)
  - The Year 2029,June: 1,000,000,000 LED
- Private Sale: 57,000,000 LED (5.70%)
  - 25% for 1st month, 10% per month after.
- Advisor & Partner: 50,000,000 LED (5.00%)
  - 1 year lock up, vest thereafter.
- Founder & Team: 150,000,000 LED (15.00%)
  - 1 year lock up, vest thereafter.
- ECO System: 250,000,000 LED (25.00%)
  - vested 1 % per month.
- Marketing: 100,000,000 LED (10.00%)
  - vested 2% per month.
- Reserve: 193,000,000 LED (19.30%)
  - 6 months lock up, vest thereafter.
- Business Devp: 200,000,000 LED (20.00%)
  - 6 months lock up, vest thereafter.



8. Team & Advisor

Martin Lee
CEO

- Completed doctoral course in IT media convergence engineering
- Formerly worked at R&D institution under MST, MIC and MOTIE

Mark Lee
Director

- Master of Business Administration
- Formerly worked at KT&G Sangsangmadang, JD Solution, etc.
- Currently) Director for Strategy & Planning at IBCT

Janghong Choi
General Manager

- Master of Computer Engineering
- 19 years of experience in Blockchain S/W Development
- Currently) In overall charge of R&D Blockchain Core Development at IBCT

Rockfeel Kim
General Manager

- Formerly worked at KT&G Sangsangmadang, etc.
- 20 years of experience in UI/UX planning at Innotree, Hyundai Livart, LotteOn, etc.
- Currently) General Manager for UI/UX planning at IBCT

Dongwook Kim
General Manager

- Completed Oxford Blockchain Strategy course
- Formerly worked at Samsung SDS Strategic Planning/Home Network Group
- Currently) In overall charge of LEDGIS Business at IBCT

Hyung Jung Kim
Advisor

- Professor of Cyber Defense at Cybersecurity Department of Korea University

Hyun Sang Um
Advisor

- Professor of computer engineering at Engineering College of Seoul National University

Won H Cho
Advisor

- LawFirm D'light Lawyer/Patent Lawyer Blockchain & ICO/STO

9. Business Partners

방위사업청 | 중소벤처기업부 | 대한민국 국방부 Ministry of National Defense | 국방기술품질원 DTaQ Defense Agency for Technology and Quality

TIPA 중소기업기술정보진흥원 | KISA 한국인터넷진흥원 | KIDICO 재단법인 한국디지털융합진흥원 KOREA INSTITUTE OF DIGITAL CONVERGENCE | NAVER CLOUD PLATFORM

NH투자증권 | ActnerLAB | KAIST 델타연구센터 | HYOSUNG

D'LIGHT 법무법인 디라이트 | SUNY Korea Stony Brook University Graduate Degree Programs | ORACLE | 일간스포츠

Uway | 디지털과 내가 연결되는 순간 DIGITAL INSIGHT | 중앙일보

희망브리지 전국재해구호협회 | 한국철도기술연구원 | BITBERRY | MONSTER CUBE

EID Engineering Industrial design Data | CUESCO | BU 백석대학교 | GHOST PASS

10. Legal Notification

Only the individual or corporation with sufficient comprehension and knowledge as well as experiences can participate in LEDGIS Coin (LED) private sales and public sales.

Members and persons involved under the "operating company" shall do their best for succeeding in the project, but they must keep in mind that the project might be failing or LED itself might be of no use.

In particular, though the main participant observes the project schedule suggested on the road-map and launches the service, the project might not satisfy the expectation due to insufficient public attention or altered external environment

Therefore, the individual & the corporation who are participating in LED's private sales and public sales must keep in mind that this project shall contain serious investment risk. If they don't deserve to take the risk of it, they should not participate in coin buying.

LED shall neither have any kind of right nor be used for the speculative trading except for using within LEDGIS Blockchain Service and DApp Service

LED neither provides any kind of right from which you can receive possible income at present or in the future, nor guarantees any kind of ownership against any object.

LED neither provides ownership or ruling power, nor does any kind of right to have an impact on this project.

All the information provided in this document shall be for explaining the project with no legal binding force.

All the documents provided from the "Operating company" shall not contain any opinion, recommendation, prospect and advice relevant to investment.

LED sales do not solicit for securities subscription under the specific jurisdiction, and is not applied to securities regulations.

In addition, as for the information provided through site or white paper during the period of LED private sales, or public sales, we notify that it may be amended or altered afterwards. Furthermore, the content of this white paper is not perfect version and can be modified without separate announcement.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Institute of Blockchain
Technology and Service


LEDGIS

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