IoT Chain

A high-security lite IoT OS

White Paper

Contents

Chapter I Project Background

1. What is IoT?

Based on the internet, traditional telecommunication network and other information carriers, IoT (Internet of Things) is the network that enables interconnection between all ordinary physical objects which can be located independently. IoT has three key features: the equalization of ordinary objects, interconnection of automatic-management terminals and intellectualization of pervasive services. Through IoT, all the things can be connected to the internet for information exchange and communication to achieve the goals of intellectualized recognition, location, tracking, monitoring and management.

There are two implications of IoT. First, the internet is still the core and foundation of IoT, which is extended and expanded on the former. Second, the user-end of IoT has extended to information exchange and communication between all things, namely the thing to thing interconnectivity. IoT has been applied widely in network convergence by means of communication perceptive technologies such as intelligent perception, recognition and pervasive computing. Consequently, IoT has been called the third wave of the world's information industry development following the first and second waves of computer and internet respectively. Since IoT is an expansion of the internet, it should more correctly be referred to as business and application rather than network. Hence, innovation of application is the core of IoT's development and creation centered on user experience is the soul.

2. Market scale of IoT

Since the development policies of IoT were brought up by America, European Union and China in 2009, IoT has been developing at a rapid pace. Traditional enterprises and IT magnates have all made efforts to engage with IoT, which has penetrated rapidly into many fields, such as the manufacturing, retail, and service industries and public utilities. Currently, IoT is on the eve of an explosive growth on a large scale. According to the *2016 China IoT's Market Scale and Development Trend*

issued by Wulian Zhongguo, the global IoT market scale had already reached 62.4 billion dollars in 2016, with a year-on-year growth of 29%. In 2018, the figure is expected to reach 103.6 billion dollars. From 2013 to 2018, the compound growth rate will be 21% and the number of newly-increased IoT devices will rise from 1.691 billion in 2015 to 3.054 billion in 2019 (See Figure 1).

Figure1: 2013-2018 Global IoT Market Scale and Growth Rate

More and more articles and devices are being connected to IoT. According to Gartner, despite the global population being 7.5 billion, the number of global IoT devices is forecased to increase from 6.4 billion in 2016 to 8.4 billion in 2017, representing a 31% growth rate. The number of IoT devices will exceed the sum total of PC, tablet PC and smart phones in 2018 and reach at total of 20.4 billion in 2020 (See Figure 2).

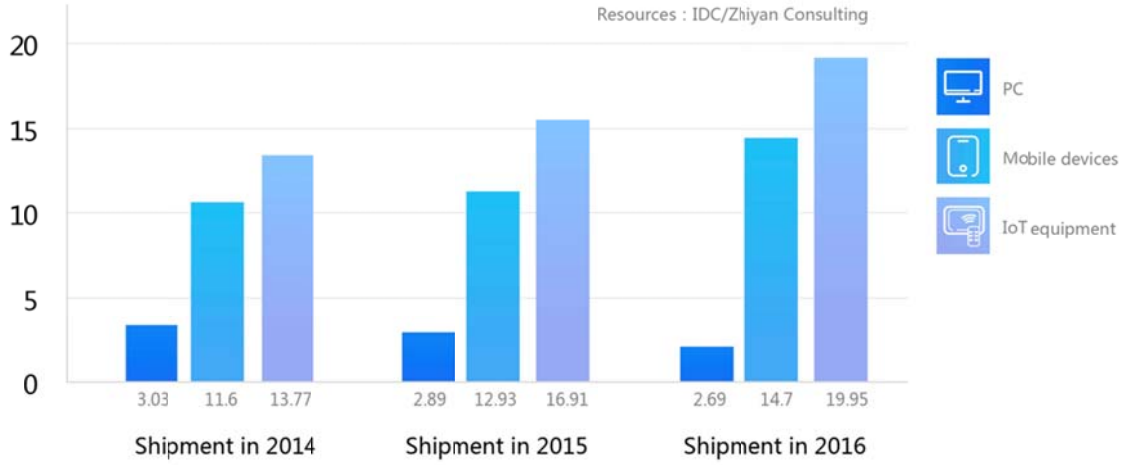

Figure 2: 2014-2016 Global IoT Market Scale and Growth rate

According to IHS Markit, most articles will be intellectualized by 2025. In the future, everything will be interconnected, from a cup to a house, and IoT will spread across every aspect of our life (See Figure 3).

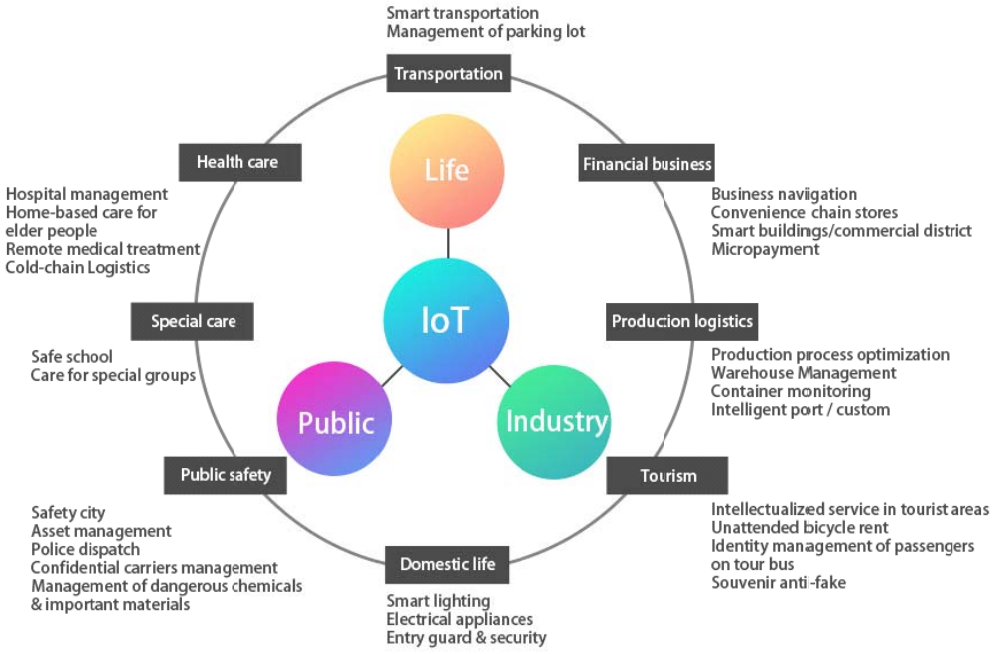

Figure 3: Application fields of IoT

In 2016, the global expenditure on IoT technical products and services enterprises has reached 120 billion dollars and this number will increase to 253 billion dollars in 2021, representing a 16% annual growth rate. Pure IoT technical services expenditure as a subset of this expansive growth will reach 143 billion

dollars with 17% annual growth rate. Based on an assumption of a 20% annual growth rate, Asia will have the fastest growth and comprise an estimated 35% of worldwide IoT expenditure in 2021.

3. Challenge

Challenge 1: Traditional attack techniques damage IoT devices wantonly

【Challenge】The Botnets of Things created by Mirai was entitled as one of the Ten Breakthrough Technologies in 2107 by *MIT Technology Review.* According to the statistics, the Botnets of Things have infected more than 2 million IoT devices, for example, the cameras. The DDos attack launched by this made the network of American DNS service provider Dyn break down and users could not visit several popular websites such as Twitter and Paypal during a short period. Afterwards, more botnets appeared, including the one that hijacked the IoT devices to mine Bitcoins and the http81, which has larger scale and is more active.

Centralized management structure cannot prove its innocence and individual private data leak has happened occasionally. For example, in May, 2017, the People's Daily Online once reported that 266 cameras in Chengdu were enforced for webcast.

At present, the security model based on closed source (often called "security through obscurity") has exposed its potential safety hazards and will be abandoned gradually and be replaced by a new security model, "security through publicity". To realize this, it is necessary to upgrade the model to open source software. Though the current open source systems are still vulnerable to accidents and are of low availability, they are less prone to government interference and other targeted attacks. Therefore, the open source systems will play an important role in home automation as well as networking of vehicles and other devices.

【Solution】IoT Chain (ITC) has adopted the asymmetrical encryption. As long as the private key is kept properly, the data cannot be cracked even if it's collected. At the same time, all the nodes in ITC are equal, which protects the users' privacy. Moreover, based on the character that blockchain cannot be tampered, the manufacturers and service providers will not be able to tamper with users information.

Challenge 2: High cost of centralized architecture

【Challenge】Even before the revenue of IoT reaches market expectation, the costs of IoT are still extremely high. Most exiting IoT solutions require huge investments: apart from the commission for intermediaries of these services, building and maintaining the infrastructure related to centralized cloud and large-scale server clusters represent a significant capital outlay.

Unfortunately, current IoT solutions fail to meet the service supply and continually miss customer's expectation. In the past, the cost and revenue of the IT industry were always consistent. A large-scale server, during its long lifespan, would receive long-term service since the manufactures and the buyers have signed support contract. For personal computers and smartphones, athough there is typically no high-profit support plan, this is generally not a major issue due to their relatively short lifespan.

However for IoT, the equipment manufactures typically work on small margins to the extent that they don not generate enough profits to support and maintain the equipment for an extended period. Meanwhile, it will require a huge sum of money to serve hundreds of billions of smart devices, let alone the high maintenance fees associated with a centralized server for distributing and updating software.

The operating costs of WeChat servers for 600 million users have reached above

300 million Yuan per month. Now there are 4.9 billion devices online, the annual operating costs of servers will be 29.4 billion Yuan and the number is still increasing rapidly every year.

【Solution】The future ITC shall have tens of thousands of nodes and they will be absolutely adequate to meet the needs of IoT data storage with a combination of blockchain's distributed ledger technology. Thanks to the de-centralization of blockchain, there is no need for highly-intensive computer clusters. Both technologies have dramatically reduced the operating and maintaining costs of the whole IoT.

4. Solutions

(1) The concept of blockchain

Blockchain is an important concept introduced with Bitcoin and its essence is a decentralized database. In a narrow sense, blockchain is a sort of chain-data structure where data blocks are linked in accordance with time sequence. It is also a distributed ledger which cannot be tampered or counterfeited under the protection of cryptology methods. In a broad sense, blockchain technology is a brand new distributed infrastructure and computing paradigm which uses chain-data structure to verify and store data, uses distributed node consensus algorithm to generate and update data, uses cryptology methods to guarantee the safety of data transmission as well as data access and utilizes smart contract composed of automatic script code to program and operate data.

In a more colloquial way, blockchain technology enables everyone to take part in the bookkeeping. There is a database behind every system and if we regard the database as a large ledger, the person in charge of bookkeeping is quite important. Under the current technical situation, the person who owns the system is responsible for the bookkeeping. For example, Tencent is in charge of the bookkeeping of WeChat and Alibaba is in charge of Taobao. In the blockchain system, everyone will have the chance to be involved in the bookkeeping process. During a specific period of time, if there is any change in the data, everyone in the system can participate in bookkeeping. The system will select the fastest and the most qualified user to write his record on the ledger and then distribute the updated ledger copies to other users in the system as backup. Therefore, everyone in the system will have a complete ledger. This kind of bookkeeping method is called the blockchain technology.

(2) The advantages of blockchain technology

The idea of everyone in charge of bookkeeping has brought obvious advantages:

1. High security: The basic architecture of blockchain is immune to traditional internet attacks. The feature of IoT's information encryption and secure communication is security through publicity, and this will help protect users' privacy. Management of identity access and multi-party consensus will contribute to the recognition of misbehaving nodes and prevent malicious nodes from accessing or destroying the network. The structure based on chain data will be conducive to building electronic evidence which can be verified and traced.
2. Low costs: The features of decentralization, multi-centers and weakening centralization will reduce the operating costs of centralized architecture.

(3) The barriers to blockchain application

Objectively speaking, although blockchain has many distinctive merits, there are still quite a few barriers to its widespread application. Using Bitcoin as an example:

1. Resource consumption: Bitcoin's POW (Proof of Work) is consensus mechanism with high resource consumption, while most IoT devices have problems associated with low computing and network capability as well as short battery life.
2. Data expansion: With the growth of blockchain, comes the question of "Can IoT devices provide enough storage capacity?". Currently, Bitcoin needs 100 G physical storage space, and that number keeps increasing. If blockchain technology were widely used, the associated demand for storage space would be enormous.
3. Performance bottleneck: The limit speed of a traditional Bitcoin trade is 7 transactions per second and it will take approximately one hour to write in the blockchain plus the time for consensus confirmation. This will lead to feedback and warning delays, which is not infeasible for delay-sensitive industrial IoT.

4. Partition tolerance: The industrial IoT emphasizes that the nodes should be “always online” but it happens all the time that ordinary IoT nodes fail and rejoin the network back and forth. This will generate network shocks which consumes a lot of network bandwidth and may even cause “network partition”.

All of the above stated issues are not immediately obvious when the blockchain is used on a small scale, but they will be big headache in large-scale applications. So how can we solve these problems?

Chapter II Project Exposition

1. Brief introduction

Due to the centralization design of traditional IoT architecture, the users' behavioral data is stored on the central servers controlled by merchants. Thus, the users' data is prone to be leaked out and the users' privacy as well as safety will face severe threats.

The blockchain has provided decentralized ideas and technology, which are very suitable for the self-service, self-maintenance, self-transactions and shares between machines in IoT industry [1]. But there are still some key problems to be solved when applying the blockchain technology in IoT, such as the form of consensus, quick and efficient payment processing on small amounts and the protection of data privacy. For these challenges, IoT brings its own solutions including PBFT, SPV, DAG, CPS cluster technology, big-data-analysis smart contract ChainCode to name a few.

ITC adopts the main chain of PBFT consensus, the DAG network, which supports high performance by nature, as side chain and the multi-tier architecture to build an IoT operating system which is safe, decentralized and can support high levels of concurrency.

2. Technical architecture

(1) PBFT

One of the core problems of Blockchain is establishing consensus between nodes. Different consensus algorithms will create different performance. ITC applies the PBFT consensus algorithm to achieve main chain consensus (See Figure 4). Practical Byzantine Fault Tolerance (PBFT) is a state machine replication algorithm based on the consistency of message passing [2]. Through three stages, namely pre-prepare, prepare and confirm stage, this algorithm provides a fault tolerance of (N-1)/3 (N is the total number of nodes) on the premise of ensuring the activity and safety [3].

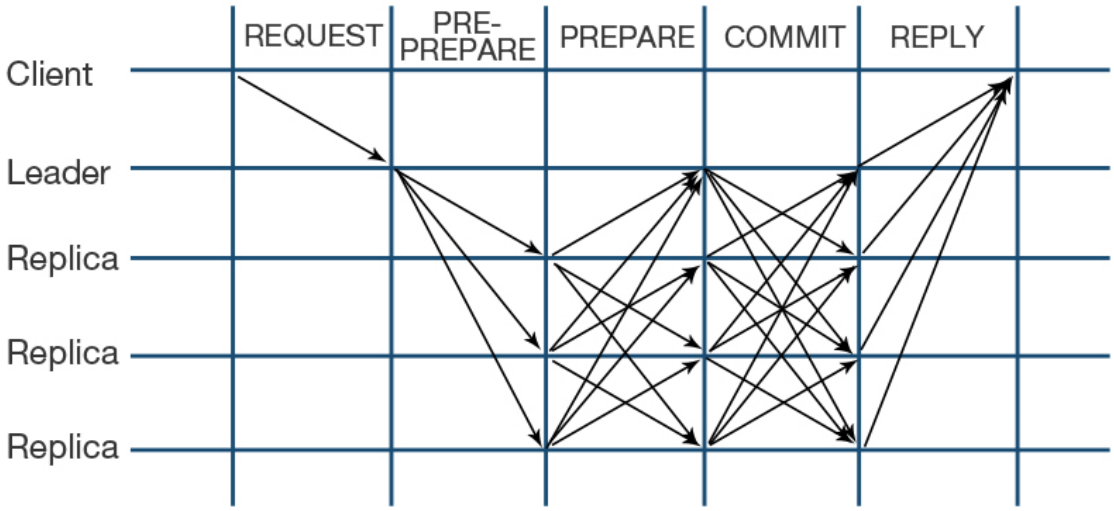

Figure 4: The process of achieving consensus of PBFT algorithm

Though using PBFT algorithm may cause some losses in the extensibility of nodes, both extensibility and performance needs can be balanced by adjusting the weight. The blockchain technology based on PBFT consensus algorithm has already been applied in the digital currency of Central Bank of China, Bumeng Blockchain and IBM'S hyperledger. Recently, the HoneyBadgerBFT consensus protocol has been proposed, which is said to have realized asynchronous BFT protocol [4].

By adopting PBFT consensus protocol, ITC has greatly improved the main chain's processing performance on the premise of achieving consensus of the main chain's decentralization.

(2) DAG

Bitcoin has recently had a hard time with the SegWit expansion solution. Owing to the linked-list data structure of blockchain itself, Bitcoin's transaction performance has become worse and transaction fees are increasing. DAG is a distributed architecture without any block and it applies Directed Acyclic Graph architecture [7] (See Figure 5) instead of the heavy linked blockchain structure. Compared with Bitcoin's longest-chain consensus, DAG changes this into the heaviest-chain consensus mechanism, confirming a new deal through transaction weight and partial consensus among nodes, which binds proof of work with each deal skillfully. This not only solves the current problem of centralization of

Bitcoin's mining but also greatly improves the whole distributed network's throughput capacity, thereby lowering the transaction costs. After extensive analysis, we believe that DAG will become the basic data structure for the next generation's blockchain.

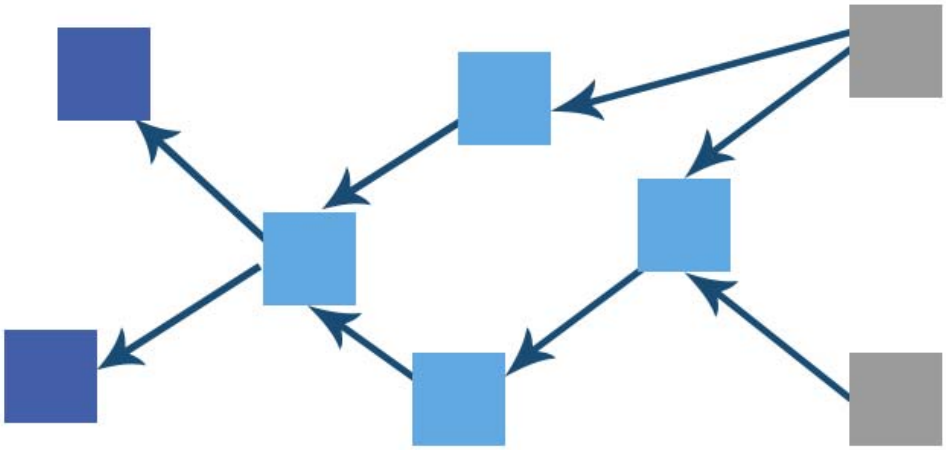

Figure 5: DAG topological structures

In the DAG network, in order to start a transaction, the node needs to do simple proof of work and pack several unconfirmed transactions into its own transation. When new child transactions confirm the parent transactions, partial consensus will be established. The more nodes that are related to the parent transaction, the easier it will be for the transaction to be confirmed. All transactions issued by these nodes form this Directed Acyclic Graph set. The confirmation of a new transaction is determined by the former transaction's weight. By optimizing the node selection algorithm and setting the transaction weight, the over dispersion of DAG and hashrate attack of illegal transactions can be avoided to protect high efficiency and security of transactions on the chain. ITC adopts DAG's data structure to solve performance problems. On the one hand, the transaction performance can be improved. On the other hand, ITC can resist quantum attack.

The DAG's twisted structure can naturally suit the IoT's message passing mode and can bring extremely high performance for ITC and satisfy blockchain's decentralization and safety at the same time. ITC applies distributed POW and POS ideas —different IoT devices nodes can adopt different security levels according to their requirements — to satisfy various scenes in IoT ecosystem.

(3) SPV

SPV （Simple Payment Verification） is a technology which can conduct payment verification without maintaining complete blockchain information as long as the blocks' headers are preserved. This technology cannot only reduce the cost of blockchain payment verification but also reduce the overhead on users. The design principle of SPV was first introduced in Nakamoto's Bitcoin: A Peer-to-Peer Electronic Cash System [5]. Taking Bitcoin as an example, payment verification can be conducted if the nodes preserve all blocks' headers. If not, payment verification cannot be accomplished independently, but necessary information of payment verification can be obtained from other nodes of the blockchain to finish transaction payment verification and get the number of verified transactions in the whole blockchain network [6] (See Figure 6).

ITC nodes use SPV technology to solve the data expansion problem of major network and DAG. Improving payment verification efficiency is the key method to ensuring the whole network's performance.

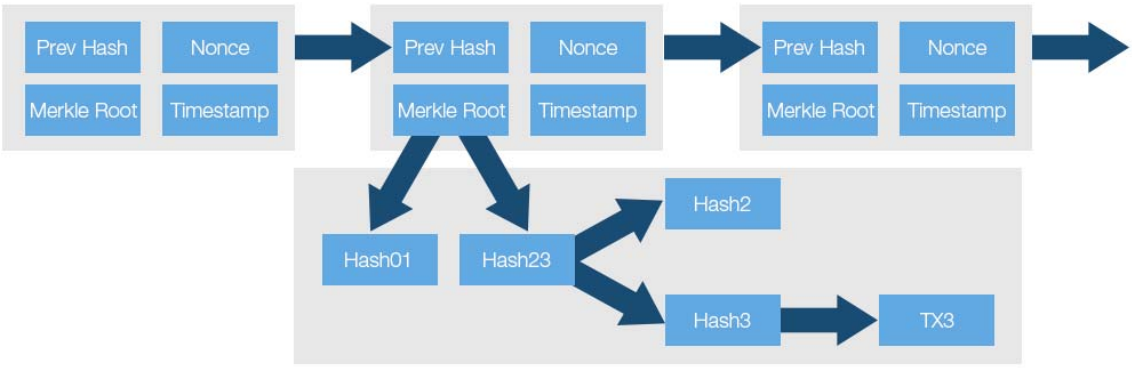

Figure 6: SPV verification principles

(4) Security Big-data Intelligent Analysis—Smart Contract ChainCode[1]

ITC will become the most abundant data ecosystem in the generation of IoT and generate large amount of data based on smart devices and users' behavior. Currently, the users' data are monopolized by magnate companies and often leveraged and violated in business models that abuses users' data privacy, such as advertisement recommendation and information reselling.

[1] ChainCode was first brought up by IBM and it refers to smart contract mentioned on Ethereum.

In ITC, users' data belong to themselves. Any company who intends to do big-data analysis or algorithm model training of advertisement recommendations will need to submit Chaincode to ITC.

Using a probability model algorithm such as hyperloglog bloomfliter and zero-knowledge proof, we can provide the necessary interface api for ChainCode data analysis. With the restriction and assignment of these interfaces, contracts submitted to ChainCode cannot steal the users' initial data but can obtain aggregated data used for smart business decision.

After execution of ChainCode, the companies need to pay ITC token to users who then provide the data according to the data value. In this way, ITC provides a big-data analysis ecosystem where both users and companies win.

(5) CPS[2]

An "ITC + Intelligent analysis platform" big-data value-creation system will be required if traditional production system is to be transformed into smart factories producing intelligent products. To meet this command, smart systems focused on the Cyber Physical System (CPS) have emerged. In essence, CPS is a multi-dimensioned smart technical system based on big data, network and mass computation. Through core technologies including intelligent sensing, analyzing, mining, assessing, predicting, optimizing and cooperation, CPS can integrate computing, communication and control for deep collaboration to realize a profound integration between physical space and cyberspace involving the object's mechanism, environment and community [8].

The architecture of ITC refers to CPS cluster and builds the CPS technical system structure on networks of five levels, including connection, conversion, cyber, cognition and configuration). On this system architecture, pluggable and independent blocks of network communications, data analysis and value transfer can improve the stability of IoT's ecosystem in ITC and make it more intelligent (See Figure 7).

[2] CPS refers to the architectural design for the IoT ecosystem of ITC rather than specific technical details.

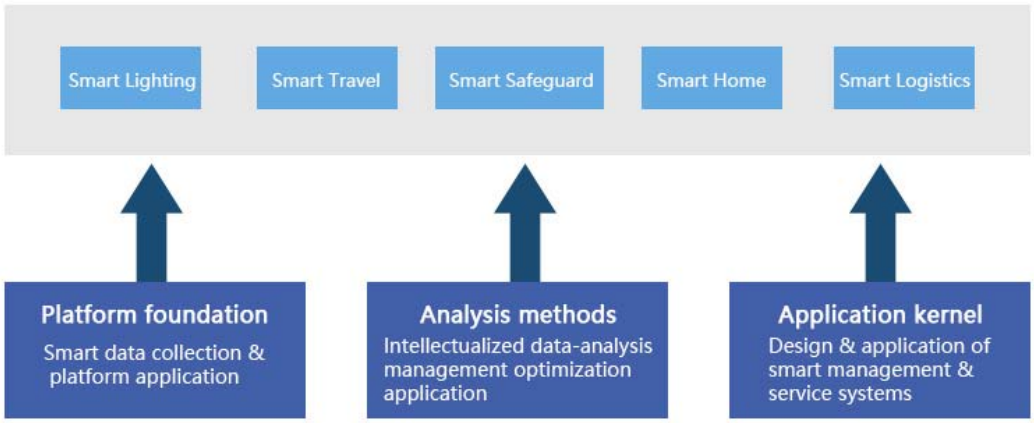

Figure 7: The interactive network of CPS technical system

In summary, with the application of SPV technology in nodes, the PBFT consensus algorithm in the main chain as well as a reference to the CPS IoT layered architecture and an innovative combination of DAG technology with main chain, ITC has achieved a the big-data analysis ecosystem which can satisfy IoT's high-concurrency explosive usage scenarios, providing an intelligent data analysis API and produce a win-win situation between users and customers on the premise of safety as well as decentralization.

Compared with traditional blockchain, ITC has distinctive advantages in system configuration and transaction performance (See Chart 1).

Chart 1 Comparative analysis of ITC performance

	Traditional blockchain	ITC
CPU	Core Duo Quad 2.4 GHz	0.08 GHz
RAM	8 GB	0.002 GB
Hard Disk	1 TB	0.012 GB
Transaction confirmation speed	Bitcoin 10 minutes Ethereum 10 seconds	Millisecond（Figure 8、9）

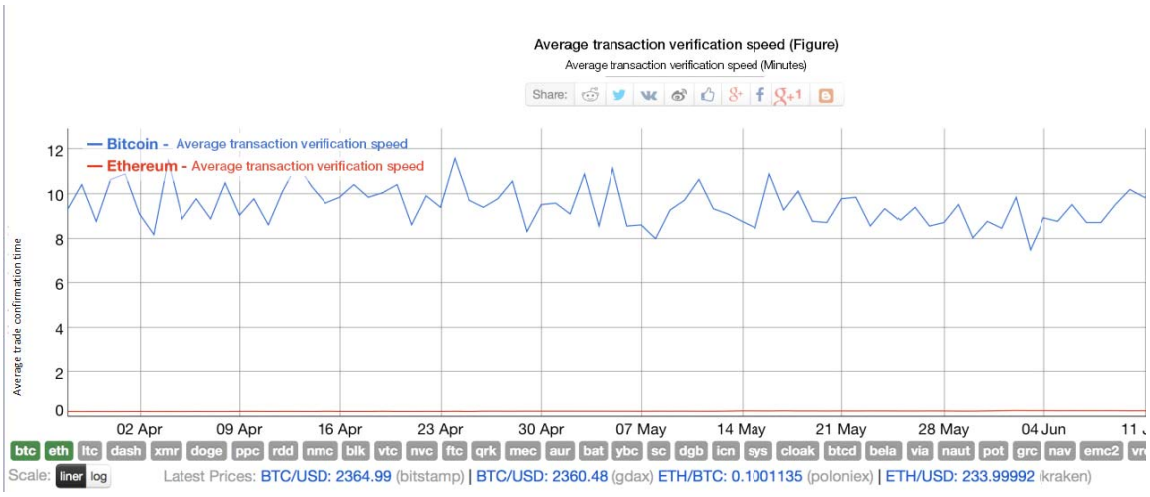

Figure 8: Comparison between transaction confirmation speeds of different technologies

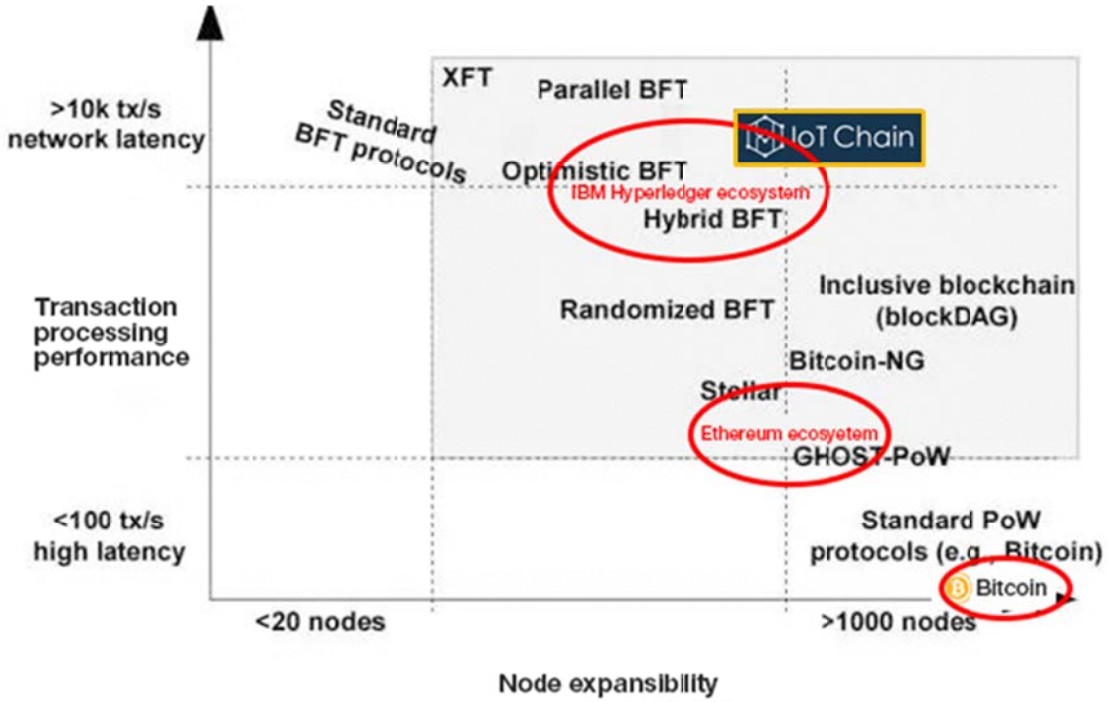

Figure 9: Performance Analysis of ITC execution efficiency

ITC designs following platform architecture (See Figure 10):

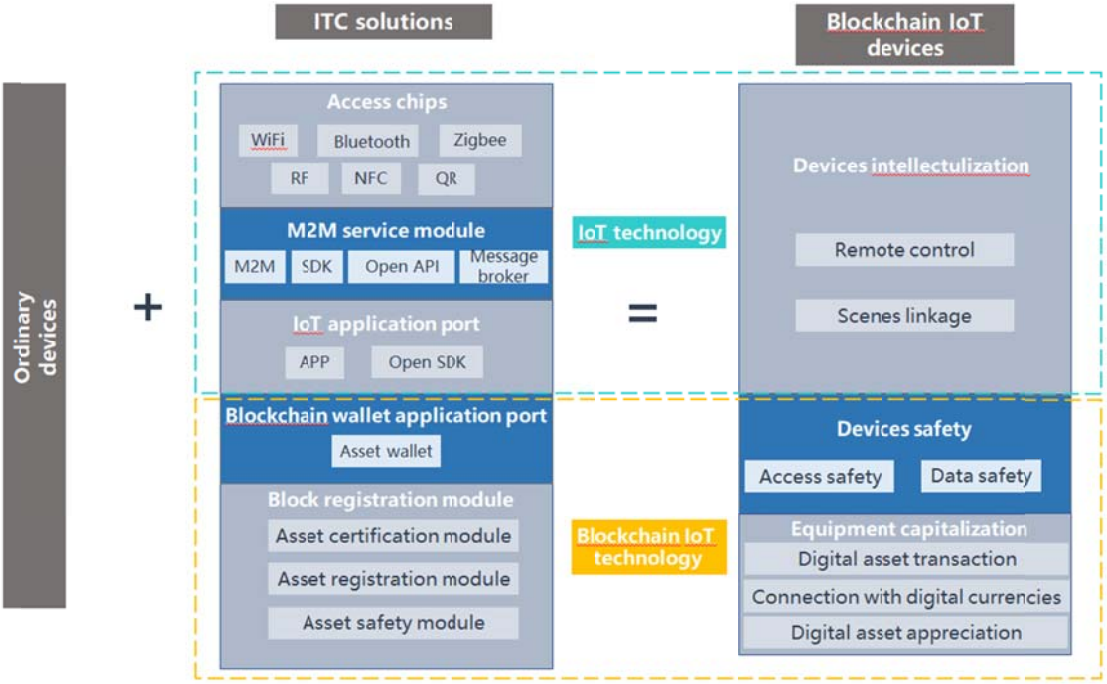

Figure 10: Architecture of ITC platform

Under this architecture, the safety and usability of the project platform has been greatly improved (See Figure 11):

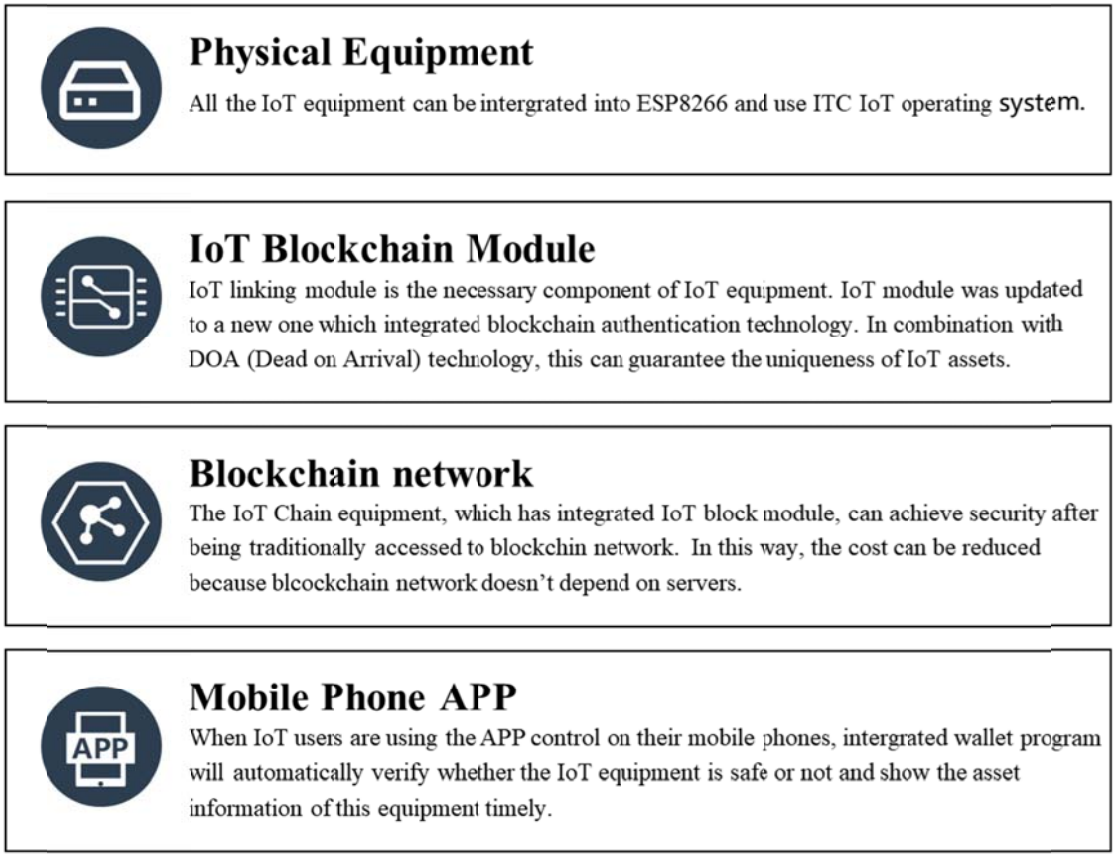

Figure 11: Users' usage scenario

3. Our Architecture

The largest basic architecture of IoT is intelligent lighting devices and their nodes are globally distributed. The latest market research report issued by the world's second largest market research and consulting company Marketsand Markets points out that by 2020, the scale of the intelligent lighting market will reach 8.14 billion dollars and the compound annual rate of growth from 2015 to 2020 will be 22.07%.

According to Ericsson's prediction, global IoT's connection scale will rise to 50 billion yuan by 2020. Intelligent furnishing is one of the most possible pivot of building IoT and making it penetrate into ordinary users. As the most common entry-level intelligent furnishing appliance, intelligent lighting devices will likely gain greatest benefits with the development of 5G.

Shanghai Zhuonian Software Research and Development Co., Ltd. is a major provider of IoT technology for leading global smart light companies. It has a solid foundation and track record of successfully operation and delivering ITC projects. Compared with projects of this nature however, our ITC project has remarkable technical superiorities (See Chart 2), which will ensure the success of our project and mission.

Chart 2 Comparison with similar project

	IoT Chain	IOTA	SLOCK.IT	IBM-ADEPT	A Chinese Project
Supporters	**Ordinary Single-chip Microcomputer**	Self-developed by customers	Ethereum specialized computer	Customized based on customers' demands	Pasting RFID label
Risk of being tampered before going on chain（上链）	**No risk**	No risk	No risk	No risk	Quite high risk
Service mode	**Non-perceived update**	Customers self-develop IOTA adapation protocol	Provide Ethereum computers to users	Customized based on customers' demands	Unknown
Do the customers need to develop by themselves?	**No**	Yes	Yes	Yes	Yes
Resolved problems	**IoT centralization/IoT security/physical asset digitization/ equipment share**	M2M micropayment efficiency/ micropayment without service charge	Physical equipment share	Customized based on customers' demands	Physical assets datafication
Basic blockchain technology	**Decentralized main chain based on PBFT consensus in combination of DAG**	Tangle based on DAG	Ethereum	Hyperledger	Unknown
Targeted applying fields	**Sharing economy/ safeguard/smart home/industrail IoT**	Smart electronic appliances/ industrail IoT	Smart lock	Multiple industrail IoT fields	License plate trade/Asset digitization trade

4. Product planning

Currently the IoT ecosystem is a centralized intelligent device system and ITC is a P2P node network in essence. Within this network sufficient numbers of nodes are an essential element in order to ensure the whole network's stability. Nodes can be divided into normal type and non-normal type. Normal-type nodes refer to devices which remain open but their operational capability is not utilized. But for non-normal devices, once they are open, they will start operating. To avoid power wastage and inefficiency caused by POW, we need to find more stable normal-type nodes.

Taking lighting as an example, the rotation of earth brings us day and night, and light is necessary at night. In modern societies, light comes from lighting equipment which is a normal-type device of huge amounts and can be used to maintain ITC's

stability. For instance, when using Zhuonian lighting cloud products, the users need to log in to the application to control the lights. Users cannot use lighting devices until the central server authorizes both the user and the device.

Our technical scheme (See Figure 12 & Figure 13) updates the original intelligent lighting system and utilizes backend verification network as well as ownership to ensure the system will use ITC's blockchain technology to verify. Thus, we can guarantee that our intelligent lighting system will be safer, faster and more stable and efficient than any previous system.

Figure 12: IoT lighting structure of Zhuonian blockchain

Figure 13: Applications of blockchain IoT lighting

To be more specific, the schedule for research and development of our project as well as product development are as follows (See Figure 14)

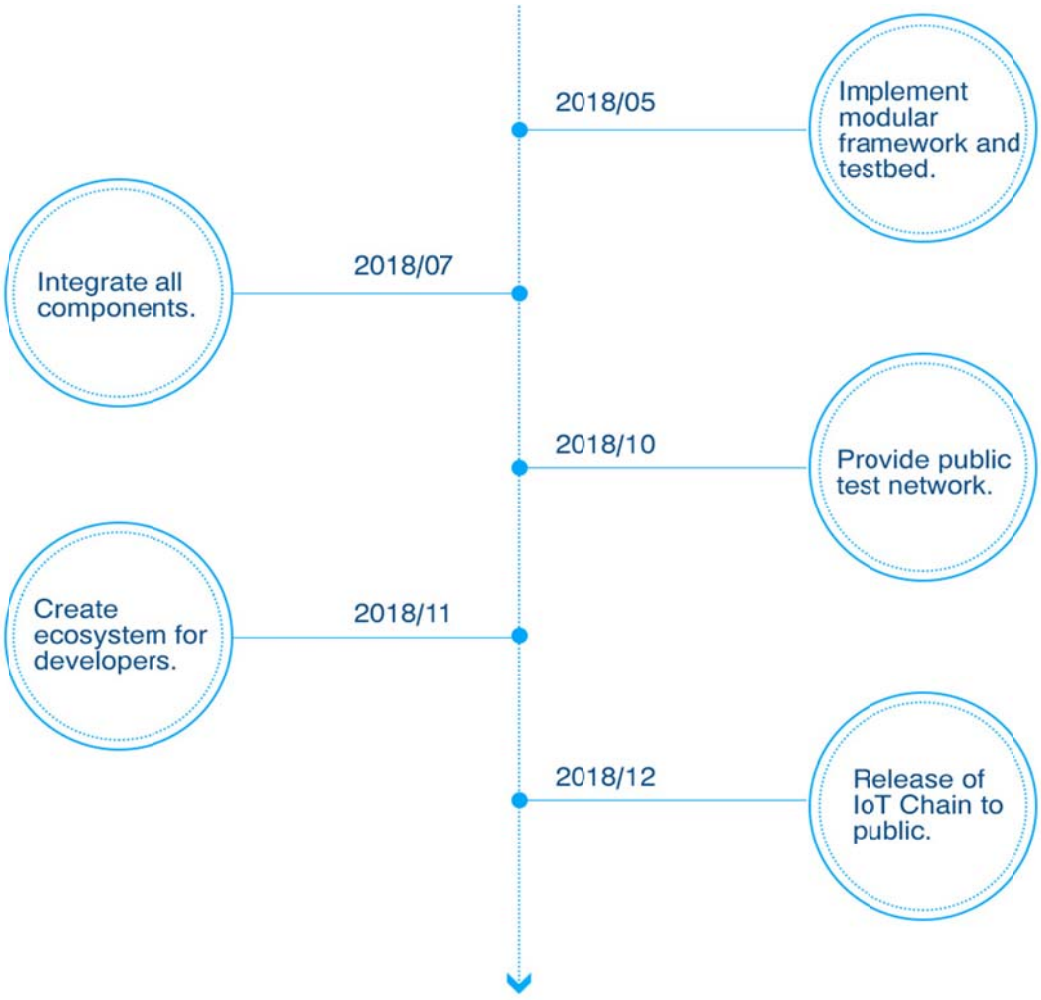

Figure 14: Technology R&D schedule and product development strategies

5. Cooperative partners

In view of the affirmation of the future development prospects of ITC's solutions, and in the future jointly developing ITC products based on blockchain technology, the following companies have signed framework agreements with the ITC team:

【Lierda Kesi Science & Technology Group Co.,Ltd】

As a state-level high-tech enterprise providing embedded networking solutions for the Internet of Things, Lierda focuses on embedded microcontroller technology and wireless RFID technology for the Internet of Things. After several years of investment, Lierda took the lead in domestic research to develop a new industrial structure led by embedded micro-control technology and Internet of Things technology, and achieved a series of core technologies and independent intellectual property rights.

【Gizwits IoT Technology Co., Ltd】

Gizwits is one of the largest IoT development platforms and hosting services in the world, and a strategic partner of Espressif. Gizwits offers developers tools to quickly add connectivity capabilities to their products and access them on the smartphone and the cloud. Founded in 2006, Gizwits has become one of the most advanced IoT technology platforms, servicing nearly 1,000 enterprise customers. The platform offers free hosting for makers and hobbyists, who can also choose to upgrade to commercial grade IoT services when they are ready to turn their devices into commercial grade products. The platform supports both public and private cloud deployment. Gizwits works with Amazon AWS and Microsoft Azure, allowing developers to launch IoT products globally. As of August 2016, Gizwits powers over 6 million online devices, and has a growing community of over 50,000 developers. It was listed as one of the top 50 global IoT startups by Forbes Magazine, and was named one of the top 50 most innovative companies in China by Fast Company magazine.

【Shanghai Ximo Communication Technology Co., Ltd】

Ximo Co.,Ltd is an innovative enterprise that specialized in providing services in global Internet, smart home areas and solutions, Ximo is an intelligent home furnishing manufacturer that devoted to the integration of research, production and sales. At present, it has several intelligent home furnishing manufacturing bases and dozens of offices in China.

Ximo intelligent home furnishing is integrated with intelligent light system, intelligent safe-protection system, intelligent security systems, intelligent video system, intelligent curtain system, mobile phone remote video monitoring system, etc., to provide intelligent solutions for the whole house by such means as timing, scene and linkage to name a few.

The team of Ximo intelligent home furnishing is committed to creating a high quality household life style supported and delivered by a combination of humanity and technology. Users can take care of their daily life at any time via remote control

with mobile APP., which it can provide a safer, enjoyable and more efficient household system management experience for users.

【Comen Electronics Technology CO., Ltd】

Comen is a High-Tech enterprise that integrate Research & Development with the manufacture of intellectual products. Comen focuses mainly on the production of wall switches, power outlets, wireless remote controls, surge protectors, multifunctional sockets and other related products.

Comen has ten-year experience in electronics manufacturing and a proven track record of success, with the majority of products awarded TUV/GS, ITS/GS, KEMA, CE,UL approval standards. Comen also has numerous business relationships with European, America, North America and South Africa companies.

【Wuxi Balas Lighting Electronics Co., Ltd.】

Wuxi Balas Lighting Electronics Co., Ltd is a specialized manufacturer of different kinds of lamps, with a strong research & development focus on production capability. Wuxi Balas has earned a high reputation in its specialized field. The company's products all have gained national patents because of their new style, elegant color, good quality and competitive price. These products, have a large potential market, and hugely popular both domestically and in overseas markets, enjoying particular success especially in Asia, the USA and European. Sincerely we cherish any communication and co-operation from friends in different fields and any suggestion or idea from you will be highly appreciated.【Norra Technologies Co., Ltd.】

Norra Technologies Co., Ltd. is a new creative company, established in 2010 by someone graduated abroad. Through continuous innovation, we have established a machine-to-machine (M2M) communication advantage in real-time monitoring systems, such as smart-cities, environment monitoring and manufacture monitoring. With strength in image processing based sensor devices, secure communications and web server technology, Norra has gained a rising position in the era of Internet of things. Our products and solutions have served numerous companies and are highly praised and valued by our customers.

Norra's vision is to make M2M communication green, reliable and secure. By combining innovative ideas and expertise in the information sharing field, we aim to make the dissemination and use of information more efficient and faster without relying on direct human intervention. We have a good network of cooperation with universities and institutes, such as the Q2S of NTNU in Norway, Pri-SDL of Chinese Academy of Science, HKR in Sweden to name a few. We provide embedded hardware & software, sensor networks, image processing algorithms, secure communication and information sharing applications.

Chapter III Team Members

The team members of our project are all senior experts in smart hardware and algorithm field with rich experience in starting up business. Besides, we have employed industry elites as project consultants. The members are:

【Core Team】

CEO: Xie Zhuopeng

Xie Zhuopeng is a senior entrepreneur and expert in IoT field. He has been engaged in the smart hardware field for four years and has extensively studied blockchain technologies for three years. Xie has deep insights in smart hardware and recognized as an expert in his field, is regularly invited to speech at summits focusing on smart hardware. Xie has participated in designing smart lighting architecture for several lighting companies both domestically and abroad and has been engaged in numerous projects to design smart hardware architecture.

CTO: Ding Ying

Ding Ying has worked on the development of chip's firmware for 12 years. Ding has experience in digital imagery, 3D model retrieval, compression algorithm processing of audio and video and financial software of bank card. Ding has a deep understanding of chip's hardware, embedded software structures and encryption algorithms.

CFO: Zhao Tan

An MBA from MIT Sloan School of Management, CPA of China, Singapore and FCCA of UK. Zhao was APAC treasurer in a large multi-national company, responsible for FX hedging, upkeep of bank infrastructure (JPM), supply chain finance roll-out (DB), cash management, in-country funding strategy and financial risk management. He was selected into J.P.Morgan APAC Client Advisory Council in 2017.

Major Programmer: Liao Dongnian

Liao has been engaged in the smart hardware field for four years and was a lead in designing the smart lighting architecture of the world's top-one lighting company. He has studied blockchain technology for three years and mastered java, C++, ruby, mqtt and blockchain.

Major Programmer: Hu Yasheng

Hu has been engaged in the smart hardware field for four years and started to do research in blockchain IoT technology in 2013. Previously Hu had participated in researching and developing the IoT architecture design of an international famous brand and was also previously a technical manager of the installment business department of Tongcheng Tourism Petty Loan.

【Consultant Team】

Liang Ran： As an expert in blockchain technology, Liang mainly studies the issue and transaction of assets in blockchain. He co-edited the *ChinaLedger Whitepaper* as well as *China Blockchain Technology and Application Development Whitepaper* issued by MIIT and he is the judge of MIIT First China Blockchain Development Contest. Also, he is the co-founder of RippleFox (RippleFox is China's biggest Ripple and Stellar's gateway and the leader of Chinese community of both Ripple and Stellar.

Zhou Shuoji: Zhou is the founding partner of FBG and he is an expert in digital currency transaction as well as an active investor in blockchain field. As one of China's early pioneer practitioner of blockchain technology and the opinion leader of China digital currency community, Zhou has started and managed two digital-currency private transaction funds.

Ma Zhiwei: Vice president of Opple Lighting Co., Ltd (603515). After Opple's going public, it became the world's largest lighting company with more than 30 million yuan market value.

Ji Xinhua: Master of Shanghai Jaitong University and winner of first prize of Shanghai science and technology advancement. Ji took part in establishing standards for Unionpay credit cards' encryption chips and for Central Bank's digital currency.

Sheng Wenjun: Founder of Telink. He got his bachelor, master and doctor

degree from Tsinghua University. Telink gained Intel strategic investment and is also the cooperative partner of IoT.

Qiu Haiyi: Founder and general manager of High-Flying. High-Flying is the distributor of Ai chips and the only IoT enterprise invested by Baidu. The annual turnover of High-Flying is about 150 million yuan.

Chapter VI Token Model

ITC is an acronym for IOT onchain tokens, which is the lifeblood of the decentralized IOT networking operating systems.

ITC is a measure of the value circulation in the ecosystem of IoT Chain. Anything involving the use of smart devices, ownership, and the value of the content ecosystem on smart devices, requires ITC billing.

The following two points ensure that the demand for ITC in the ecological environment continues to grow.

1.Every smart device that joins the ecosystem of the universe must have a built-in ITC. As more and more smart devices join the IoT Chain system, the demand for ITC will continue to rise.

2. In the IoT Chain system, data sovereignty belongs to users. In the era of big data, there will be a steady stream of big data analysis needs, and each big data analysis request will need to consume ITC and be allocated to users according to each user's data contribution. With the sound development of the data ecosystem in IoT Chain, the demand for ITC will continue to grow.

References

[1] Bahga A, Madisetti V K. Blockchain platform for industrial Internet of Things [J]. J. Softw. Eng. Appl, 2016, 9(10): 533. Castro M, Liskov B. Practical Byzantine fault tolerance[C]//OSDI. 1999, 99: 173-186.

[2] Castro M, Liskov B. Practical Byzantine fault tolerance[C]//OSDI. 1999, 99: 173-186.

[3] Cachin C. Architecture of the Hyperledger blockchain fabric[C]//Workshop on Distributed Cryptocurrencies and Consensus Ledgers. 2016.

[4] Miller A, Xia Y, Croman K, et al. The Honey Badger of BFT Protocols[C]// ACM Sigsac Conference on Computer and Communications Security. ACM, 2016:31-42.

[5] Nakamoto S. Bitcoin: A peer-to-peer electronic cash system [J]. 2008.

[6] Jia Chang, Feng Han. Blockchain: from digital currency to credit society [J]. 2016. Beijing, CITIC Publishing House

[7] People on nxtforum.org (2014) DAG, a generalized blockchain. https://nxtforum.org/proof-of-stake-algorithm/dag-a-generalized-blockchain/ (registration at nxtforum.org required).

[8] Lee J, Bagheri B, Kao H A. A cyber-physical systems architecture for industry 4.0-based manufacturing systems [J]. Manufacturing Letters, 2015, 3: 18-23.