Overview and Thoughts on Standardization of China's Blockchain Technology

LI Ming[1], YANG Jingjing[2], DING Xiaowei[3]

[1]China Electronics Standardization Institute, Beijing 100007, China
[2]School of Business, Nanjing University, 163 Xianlin Road, 210023, China
[3]School of Information Management, Nanjing University, 163 Xianlin Road, 210023, China
liming@cesi.cn, dingxiaowei@nju.edu.cn

Abstract. As an emerging technological field, Blockchain has developed rapidly in recent years. However, its overall development is still at a premature stage. Due to the lack of standards, a series of problems have surfaced, arresting the further development of this industry. Therefore, standardization of Blockchain technology is called for in order to solve these problems. By reviewing the international and domestic status quo of Blockchain standardization, this article identifies the problems that need to be solved under current situation, and then provide our methods for standardizing the Blockchain technology with reference to the Systems Engineering Methodology.

Keywords: Blockchain, Distributed Ledger Technology (DLT), Standardization, Systems Engineering.

Since 2016, the innovation and entrepreneurship in the Blockchain field has become an active pursuit of various industries. *White Paper on China Blockchain Technology and Application Development (2016)* released by the China Blockchain Technology and Application Forum (CBD-Forum) in October 2016 clarifies the basic concepts, main features, key technologies and areas of applications of Blockchain. Meanwhile, Blockchain was also enlisted for the first time in the national Thirteenth Five-Year Plan for National Informatization.

1 International Work on Blockchain Standardization

In 2016, the international Blockchain standardization work started at the earliest. At that time, organizations traditionally involved in the Blockchain standardization work in the world include ISO, IEEE, ITU, W3C etc.

1.1 ISO

In April 2016, the Australian Standards Association submitted *a New Field of Technical Activity* (NFTA) proposal to the ISO. It proposed the establishment of a new Blockchain technical committee under the ISO to develop Blockchain standardization for

interoperability, terminology, privacy security, auditing and other related areas. The proposal was adopted in September 2016 and the ISO appointed the Australian Standards Association as the secretariat of the ISO/Blockchain and DLT Committee. In March 2017, the Office of the National Standardization Administration officially recognized China Electronics Standardization Institute as ISO/TC 307 technical counterparts in China.

The ISO/TC 307 Technical Committee held the first and second plenary meetings in April and November 2017 respectively. In the two plenary sessions, WG1(Foundation Working Group), SG2(Use Cases Working Group), WG2(Security, Privacy and Identity Working Group), SG5(Smart Contract Working group), SG6(Governance of Blockchain and Distributed Ledger Technology Systems Working Group) and SG7(Interoperability of Blockchain and Distributed Ledger Technology Systems Working Group) were established. Chinese experts mainly participated in the research work of reference architecture, classification and ontology in the basic working group WG1, completing the reference architecture research report with experts from the United States, Britain, Russia and other countries. They also actively shared the contents China's *Blockchain reference architecture* in relation to the role, sub-role, activity and functional structure, contributing our domestic standardization results to the international standard pre-research, and actively undertook the work of joint editing the reference architecture of international standards, classification and ontology technical specifications. In the WG2, by participating in research on privacy and personal information protection, security risks and vulnerabilities, we have gained a comprehensive understanding of the current regulatory tools for Blockchain technology in various countries. This will help China develop a set of complete and highly applicable security privacy and identification standards. In future work, SG6 will complete a Blockchain and DLT Governance Guide research report to explain the relationship between the strategic implementation of the Blockchain (including business goals, market, benefits) and Blockchain users or stakeholders, and provide a reference model for system lifecycle management and consensus. As more and more public and private organizations adopt Blockchain and DLT solutions to support organizational work, the need for interaction between these solutions will increase significantly in the future. Therefore, the SG7 under TC 307 will conduct further research on inter-chain and inter-system interoperability solutions, providing a standard framework for facilitating interaction between different technologies while reducing and managing the technical and business complexities within and across industries.

In May 2018, ISO/TC 307 held its third plenary meeting. The meeting discussed 10 international standards under research (Fig.1.), including the latest developments and work plans, new work proposals in various fields and issues related to networking with other international standards organizations. By September 2018[11], ISO/TC 307 has in all 39 active members with 13 observers. In addition, the meeting decided to establish a Convenors Coordination Group to promote new working projects such as governance guidelines, interoperability, and to promote networking with multiple organizations or to form joint working groups.

1	ISO/AWI 22739 Blockchain and distributed ledger technologies Terminology
2	ISO/NP TR 23244 Blockchain and distributed ledger technologies Overview of privacy and personally identifiable information(PII) protection
3	ISO/NP TR 23245 Blockchain and distributed ledger technologies Security risks and vulnerabilities
4	ISO/NP TR 23246 Blockchain and distributed ledger technologies Overview of identity
5	ISO/AWI 23257 Blockchain and distributed ledger technologies Reference architecture
6	ISO/AWI TS 23258 Blockchain and distributed ledger technologies Taxonomy and Ontology
7	ISO/AWI TS 23259 Blockchain and distributed ledger technologies Legally binding smart contracts
8	ISO/NP TR Blockchain and distributed ledger technologies Overview of and interactions between smart contracts in Blockchain and distributed ledger technology systems
9	ISO/NP TR 23576 Blockchain and distributed ledger technologies Security of digital asset custodians
10	ISO/NP TR 23578 Blockchain and distributed ledger technologies Discovery issues related to interoperability

Fig. 1. 10 Standards under study[11]

According to the analysis of the ISO/TC 307 Special Business Strategic Plan Working Group, international standardization work contributes a lot to the global economic and social development. The development and deployment of Blockchain applications lacks standardized guidance and evaluating methods for security, reliability, and interoperability. In response to these challenges, international standardization work is needed to help countries and industries reach consensus. It will provide solutions to the common challenges to different industries, and truly realize the sharing of technology and experience, laying the foundation for large-scale application of Blockchain. According to *ISO/TC 307 Strategic Business Plan*, the committee's goal is to develop a set of international standards and technical specifications by 2021, which includes terminology, reference architecture, security, issues related to interoperability and so on[9].

1.2 IEEE

Institute of Electrical and Electronics Engineers (IEEE) is an international association of electronic technology and information science engineers. IEEE has initiated the following Blockchain projects:

- C17-012 Supply chain technology and implementation
- P2418 Standard for the Framework of Blockchain Use in Internet of Things (IoT)
- P825 Guide for Interoperability of Transmissive Energy Systems based on Electric Power Infrastructure
- P2418.2 Standard Data Format for Blockchain Systems
- P2418.3 Standard for the Framework of Distributed Ledger Technology (DLT) Use in Agriculture(Preparing)
- P2418.4 Standard for the Framework of Distributed Ledger Technology (DLT) Use in Connected and Autonomous Vehicles (CAVs)[12]

On July 27, 2018, experts from China Electronics Technology Standardization Institute and IEEE successfully held the first meeting of the IEEE P2418.2 project (Standard Data Format for Blockchain Systems) in Beijing.

1.3 ITU

The International Telecommunication Union (ITU) standardization department has established a focus group for Distributed Ledger Technology (FGDLT). In accordance with its charter, the group will take into account the ongoing activities of ITU, other standards development organizations, forums and groups to develop a standardized route map for interoperable distributed ledger-based services[6].

ITU's current work items include:

- Security architecture for DLT
- Security capabilities and threats of DLT
- Privacy and security considerations for using DLT data in identity management
- Security assurance for DLT
- Security threats and requirements for digital payment services based on DLT
- Security services based on DLT
- Security threats to online voting using DLT[14]

1.4 W3C

The World Wide Web Consortium (W3C) is a non-profit international standardization organization whose member organizations work together to set network standards. They launched a Blockchain community group and current work includes:

- Generate message format standards for Blockchain;
- Guidelines for the use of stocks including seeds, public and private Blockchain, side chains and CDNs;
- Research and evaluate new technologies and new uses, such as inter-bank communications[13].

2 China's Blockchain Standardization Work

2.1 Background of China's Blockchain Standardization

In order to give full play to the role of standardization in the allocation and guidance of market resources and to promote the advanced layout of standardization work, China Electronics Standardization Institute has carried out the standardization work of Blockchain under the guidance of State Administration for Market Regulation and State Standardization Management Committee and relying on the standard working group under the Forum of Blockchain Technology and Industry Development. First, the Institute carried out research work on the Blockchain standard system and proposed the standard system of Blockchain and Blockchain application to provide guidance for the development of subsequent standards. Second, in accordance with the principle of "Emergency First, Mature First", the Institute developed and issued the two standards *Blockchain Reference Architecture* and *Blockchain Data Format Specification*, actively promoting group standards to be transformed into national standards and industry standards.

2.2 2016.10 White Paper on Blockchain Technology and Application Development in China (2016)

The *White Paper on China's Blockchain Technology and Application Development (2016)* was compiled by the China Electronics Standardization Institute, with a focus on the Blockchain standardization roadmap and the Blockchain standard system framework. the Blockchain standards are divided into five categories: Basic Standards, Processes and Methods, Trusted and Interoperability, Business and Applications, Information Security.

2.3 2017.5 Blockchain Reference Architecture

Blockchain, Reference Architecture is the first Blockchain standard in China and is a group standard jointly compiled by members of the China Blockchain Technology and Industry Development Forum Board. Based on this standard, the *Information Technology Blockchain and DLT Reference Architecture* has been approved as the first national standard in the Blockchain field. This is an effective practice of transforming the existing group standard into a national standard with conditional availability. Meanwhile, *Blockchain Reference Architecture* was enlisted in the 100 Group Standard Application Demonstration Project and the 2017 China Standardization Most Concerned Standard by the Ministry of Industry and Information Technology in 2017.

2.4 2017.12 Blockchain Specification for Data Formats

Blockchain Specification for Data Formats is the second Blockchain group standard jointly compiled by members of the China Blockchain Technology and Industry Development Forum Board. It provides the data structure, data classification and interrelationships of Blockchain technology, and data format requirements for data elements. It is intended to provide a reference of data format for organizations using Blockchain to build Blockchain system, and for the intermediate service organization in the construction process of Blockchain system. It also guides the Blockchain service organization to establish the Blockchain system data structure. The release of this standard helps to provide a reference for the data structure design of Blockchain systems and a unified data standard for Blockchain industry applications.

2.5 2018.3 Proposal for the Establishment of National Blockchain and DLT Standardization Technical Committee

According to the preparation application, the organizational structure of this committee will be based on the organizational structure of TC 307. The detailed professional areas of the proposed national standards are as follows:

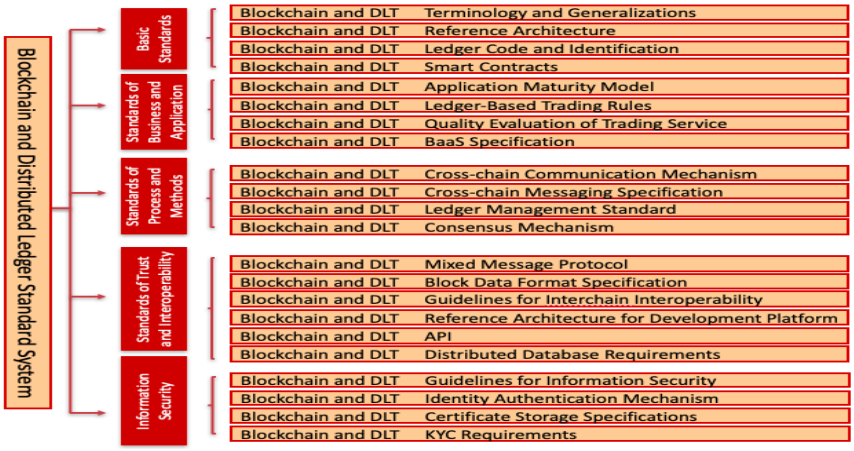

Fig. 2. Blockchain and distributed ledger standard system[5]

3 Thoughts on the Standardization of Blockchain

3.1 Methods of Blockchain Standardization

Study the Standard Architecture according to Systems Engineering. Systems engineering deals with large and complex systematic issues based on system ideas and methods that includes both quantitative and qualitative measures. Both the design and establishment of a system and the management of a system can be regarded as a kind of engineering practice, collectively referred to as systems engineering. The basic methods of systems engineering are: system analysis, system design and comprehensive evaluation of the system (performance, cost and time, etc.), using the system ideas and methods both quantitative and qualitative ones to deal with the problems of large complex systems.

Hall three-dimensional structure, also known as Hall's systems engineering, is a systems engineering methodology proposed by American systems engineering expert Hall (Alfred Daniel Hall) in 1969. The three-dimensional structure Hall's model vividly describes the framework of systems engineering research. Every stage and step can be further developed into a hierarchical tree system.

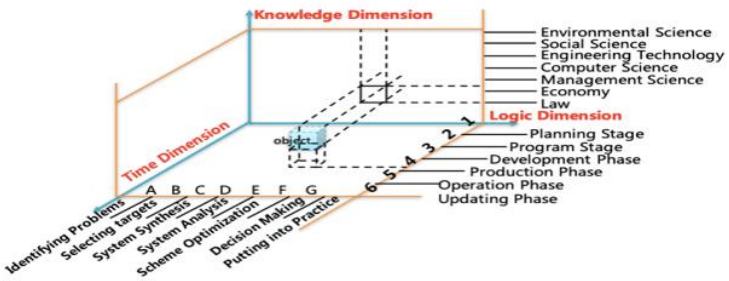

Fig. 3. Systems engineering-3D structure graph

Analyze the Standard Architecture with Reference to International Standards and Best Practices. We should refer to the best international practices, draw on the industry's general methodology and important ideas to promote the integrity and operability of the standard system's research results.

Establish a Standard Architecture Based on National Standards and Industry characteristics. The standard system framework is based on national standards and combines the relevant practices of the industry. The national standards that can be referred to are as follows：

- GB/T13016 *Principles and Requirements for the Compilation of Standard System Tables*
- GB/T13017 *Guidelines for the Compilation of Enterprise Standard System Tables*

Knowledge Dimension - Standard System Framework. The knowledge dimension refers to the various professional and managerial knowledge required to accomplish the goal. The reference model contains sets, domains, and classes, which summarize the relevant content from the perspective of standardization through strategy and business, and decompose layer by layer with modular ideas. The standard system framework corresponds to the reference model of the standard system, mainly showing the knowledge domain covered in the standard system and through the standard system hierarchy, the standardized objects are organized and systematically composed into a systematic tree structure.

Logical Dimension -Implementation Method.

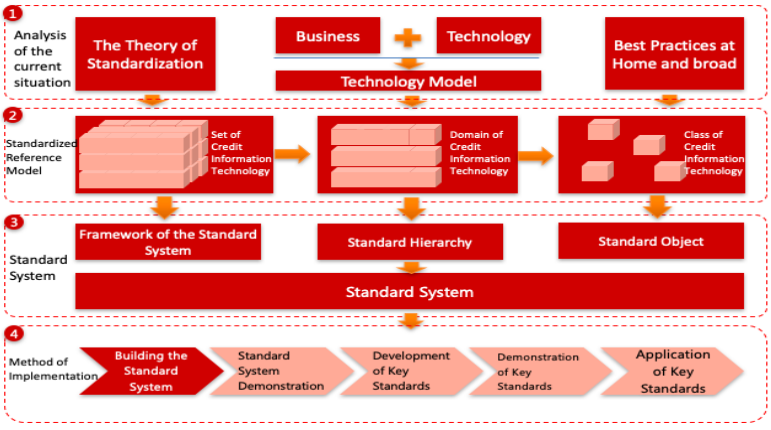

Fig. 4. Project implementation methodology

- Current Situation Analysis: Through the analysis of business status and information technology development, combined with the best practices both at home and abroad,

we should carry out the analysis of the status quo under the guidance of standardization theory;

- Establish a standardized reference model based on the status quo analysis and build a standard system framework;
- Establish a standard system based on the standardized reference model and the standard system framework, and establish a standard system table at the same time;
- Take the standard system as the starting point, design the implementation path of the standard system, and illustrate the development, demonstration and application process of key standards.

Time Dimension - Implementation Method. In the process of implementing the standard system, we need to:

- Clarify the objectives and principles of the implementation of the standards system, based on strategic and business needs,
- Accord to the principle of "Urgency First" and address key and urgent issues in the process of implementing the standard system, and gradually put in place the necessary standards.
- Formulate relevant elements such as personnel, resources, and technology to ensure that the information standard system is implemented as originally planned.

The procedure of implementation path is shown in the figure:

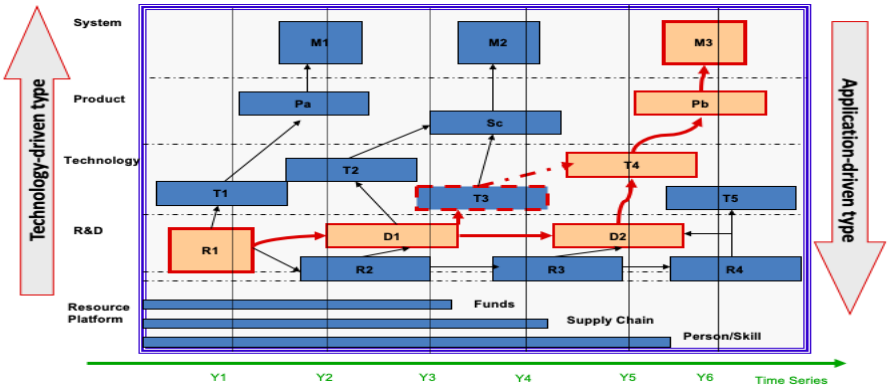

Fig. 5. Project implementation time series

3.2 The Work Plan of Standardization

In the future, China's standardization work will be primarily focused on Blockchain and DLT standards system. Taking into consideration the trend of Blockchain technological development and applications, we should provide orientations for the work of standardization that not only directly reflect the characteristics of the Blockchain, but also guide and standardize Blockchain-related technology and product development including service design, deployment and delivery. Moreover, it will effectively address issues such as data exchange, information security and privacy protection to

guide the establishment and formulation of specific standards. In addition to developing specific standards, the following work will also be carried out based on the results of standardization:

- Carry Out Standard Verification and Application Pilot Programs.

Relevant organizations should timely summarize the effective practices and the acquired experiences of the pilot organizations of each standard. The interaction between provinces and cities should be strengthened to form a joint force. Ensure the application of key standards and support Informatization and Software Service Industry Department to organize exchange meetings on standard verification and application pilot programs. Moreover, they will accelerate the research and development to achieve wider application, fostering new modes and new formats such as BaaS, distributed data storage, and big data transactions, and promoting the integration of Blockchain and industry applications.

- Accelerate the Construction of Independent Open Source Communities.

China should construct independent open source community operation mechanism, promote the entry and application of advantageous projects of various forms such as development competition, hackathon, and excellent project contest, and cultivate a group of internationally competitive technology projects at the base level. Through the promotion of establishing incubators and demonstrating application, we expect to build a development platform for all and application solutions that are application-oriented and conform to the reference architecture standards.

- Carry Out Various Forms of Training on Standardization.

Based on the results of standard development and application research and in conjunction with local governments such as Jiangsu, Wuxi and Hangzhou and relevant associations, relevant organizations should continue to organize training camps for Blockchain developers and entrepreneurs, and provide sufficient talents for the construction of open source communities. Meanwhile, we should invest in the training of high-end development and entrepreneurial talents in order to enhance our capabilities to independently research and develop core Blockchain technologies. By accelerating the industrialization of Blockchain and solving the talent problem, we can secure a sound development path of Blockchain development and applications.

- Participate In and Lead International Standardization Work.

We should actively participate in Blockchain standardization activities of ISO and strengthen international exchanges and cooperations in this respect. Making full use of our advantage of having completed two documents of group standards *Blockchain Reference Architecture* and *Blockchain Specification for Data Formats*, the research group should continue to compile better working reports, strengthen international communication and update China's standards. We will fulfill our duties in joint editing and classifying Blockchain and DLT reference architecture international standards and specifying ontological technical standards. In the mean time, we will keep track of and participate in the work of international standardization in smart contracts, Blockchain governance, interoperability and other related fields, so as to better promote China's technologies and standardization results to the world, and increase China's influence in international Blockchain standardization.

References

1. Ministry of Industry and Information Technology of the People's Republic of China: White Paper on Blockchain Technology and Application Development in China (2016).
2. Ministry of Industry and Information Technology of the People's Republic of China: China Electronics Standardization Institute: Blockchain Reference Architecture (2017).
3. Ministry of Industry and Information Technology of the People's Republic of China: China Electronics Standardization Institute: Blockchain Specification for Data Formats (2017).
4. ZHOU Ping, TANG Xiaodan: Current Condition and Development Trends of Blockchain Standardization, Information Technology & Standardization, 18-21(2017).
5. Ministry of Industry and Information Technology of the People's Republic of China: Application for the preparation of the National Technical Committee for Professional Standardization (2018).
6. Anjum, Ashiq; Sporny, Manu; Sill, Alan: Blockchain standards for compliance and trust, IEEE Cloud Computing 4(4):84-90(2017).
7. Vincent Gramoli, Mark Staples: Blockchain Standard: Can We Reach Consensus?, http://gramoli.redbellyblockchain.io/web/doc/pubs/blockchain_standards.pdf
8. David Hyland-Wood, Shahan Khatchadourian: A Future History of International Blockchain Standards Running Head Suggestion: Future Blockchain Standards, The Journal of The British Blockchain Association, Vol 1, Issue 1, pp 1 – 10(2018).
9. ISO/TC307 Committee: Strategic Business Plan ISO/TC 307, https://isotc.iso.org/livelink/livelink/fetch/2000/2122/687806/ISO_TC_307__Blockchain_and_distributed_ledger_technologies_.pdf?nodeid=19772644&vernum=-2
10. Standards Australia: Roadmap for Blockchain Standards, Mar 2017, https://www.standards.org.au/getmedia/ad5d74db-8da9-4685-b171-90142ee0a2e1/Roadmap_for_Blockchain_Standards_report.aspx
11. ISO Homepage, https://www.iso.org/committee/6266604.html, last accessed 2018/10/04.
12. IEEE Homepage, https://ieeexplore.ieee.org/document/8328731/, last accessed 2018/10/04.
13. W3c Mission: https://www.w3.org/Consortium/mission, last accessed 2018/10/05.
14. European Commission: ITU Blockchain standards, 2017