Exploring the Application of Blockchain Technology in the Field of Electricity Marketing

Cheng Yang[1,2] and Yanping Li[1,2(✉)]

[1] State Grid Blockchain Technology (Beijing) Co., Ltd., Beijing, China
yangcheng@sgec.sgcc.com.cn, liyanping1996@hotmail.com
[2] State Grid Blockchain Technology Laboratory, Beijing, China

Abstract. In order to fully implement the strategic deployment of the State Grid Corporation of China to build a world-class energy Internet enterprise, it is imperative to accelerate the digital transformation of marketing services. Based on the ideas of optimizing the existing business process, protecting user data privacy and promoting data sharing, we designed the idea of data uplinking based on the scenarios of signing electronic contracts, collecting electricity bills from customers and tracing equipment quality in the power marketing scenario to effectively improve the security and sharing ability of the platform and promote the construction of the power marketing system with the characteristics of business integration and data sharing. Through the construction of the existing system, the data in the existing power marketing related business system can be collected, solidified and shared, and the automatic calculation of these large data flows can be realized through the construction of blockchain-based smart contracts, so as to support the company to respond to the decision. The data collection and processing system based on block chain can also optimize the existing storage resources of the business system and improve system performance.

Keywords: Electricity Marketing · Block Chain · LawTech · Wisdom Regulation · Smart Contract · Traceability Information Management System · Automatic Processing

1 Introduction

As the reform of the national electricity system gradually deepens, the digital economy accounts for a rapid rise in the proportion of the national economy. In order to better serve the economic and social development and promote the reform of the electricity market, to address the special nature of electricity data information involving users and national privacy and security, as well as the existing electricity marketing system cloud storage environment where the data is easily copied and tampered with, to prevent lost in historical data and data sharing information security limitations and various resulting problems, this paper will study the basic concept of blockchain technology and the underlying support scheme of data security storage in the power industry scenario proposed by Zhejiang Electric Power. The concept proposes that by using the characteristics of

D. Qiu et al. (Eds.): ICBBEM 2022, AHIS 5, pp. 195–205, 2023.
https://doi.org/10.2991/978-94-6463-030-5_22

blockchain technology, such as anti-forgery, anti-tampering, traceability and improvement of efficiency, we can optimize the signing of electronic contracts, collection of user's electricity bills and traceability of equipment quality in the scenario of electricity marketing. It can effectively solve the problems of multi-body cooperation and data sharing and integration in electricity marketing business and improve the efficiency of upstream and downstream cooperation.

2 Materials and Methods

In recent years, under the guidance of China's strategic goals in the new era, the current social and economic development, people's living standards continue to improve, and the power system optimization business environment requirements gradually increased. State grid company adhering to the "customer-centric" service concept, attaches great importance to the digital, network and intelligent development. We fully application of "big cloud content wise chain" and other advanced technology, promote the depth of fusion energy transformation and information technology. According to the customer experience and optimized by the digital transition, support management decisions, assigned to ecological development [6].

2.1 The Application Status of Blockchain in the Energy and Power Industry

Blockchain is currently considered as the next big wave after the Internet, and as an infrastructure, it will bring great opportunities for change to all industries. For the electricity industry, blockchain has good adaptability and business scalability, which can effectively improve the level of intelligence in the energy supply chain, security and transaction management.

2.2 Current Situation of Electric Power Marketing Service System

In the new period, the State Grid is faced with multiple customer demands, deepening power reform, rapid changes of Internet technology, and rapid development of the energy market. The electricity marketing 1.0 system is designed based on traditional IT architecture, planned with traditional electricity service as the main line, and deployed and built based on the province as a unit, with problems such as difficulty in hardware and software platform expansion, difficulty in emerging business support, and difficulty in cross-professional data sharing.

With the rapid development of new businesses and rapid changes in demand, the original fixed customized system business function architecture cannot quickly respond to new businesses and new needs. Moreover, as the electricity enterprises transform to market-oriented businesses, reach and sense the internal energy dynamics of customers and analyze potential demands, the traditional data architecture cannot fully explore the value of data and meet the data service needs of different users. With the collision of enterprise thinking and Internet thinking, and the integration of new businesses and stock businesses, the existing demand is difficult to be solved by the simple upgrade on the marketing 1.0 architecture, and it is urgent to adopt the new technology of "the

intelligent chain of cloud shifting of things" to reconstruct the architectural system of marketing information [7]. Through the agile iteration of system and rapid innovation of service products, we support the implementation of customer-side energy Internet strategy.

With the COVID-19 reality turning into a norm, off-site, remote online business gradually becomes the new development trend. As a result the preservation of the contract signing, service application, and reminder letter of payment in the process of electricity marketing business promotion is now more crucial than ever. In the meantime, with the State Grid Corporation enhancing the quality of service requirements, the realization of the disclosure and transparency of information on the life of the power grid equipment on the chain, the process of curing important information deposited becomes an important means to enhance the credibility of electricity grid enterprises and the improvement of the electricity business environment.

2.3 The Application of Block Chain Technology in Electricity Marketing System

The application of blockchain technology in the field of power marketing can establish an open, transparent, efficient and trustworthy window, realize the solidification of important information for storage, improve the efficiency of marketing business processing [1]. Meet the management requirements of the whole process of business trustworthiness and visibility, and establish a trustworthy system of the State Grid Corporation for customers. The following will list a few blockchain technology features in the field of electricity marketing applications to explain.

2.3.1 The Application of Credible Blockchain Platform

With the adoption of fabric-based alliance chain technology, we build a trusted blockchain platform, formulate the rules for access to the main side chain, nodes and applications of the State Grid, guarantee access security and data security through secure and credible main side link access and data interaction, support external node access, and enhance the credible data sharing capability of the new energy business model [3]. Meanwhile, the nodes on the chain includes large central enterprises, government agencies, and authoritative identification institutions, which can provide credible endorsement and authority for the data on the chain of the system to achieve internal institutional efficiency and external integration development.

2.3.2 The Application of Smart Contracts

A smart contract is a computer protocol that is disseminated, verified and executed in an informational way. In the process of on-chain depositing of electronic evidence, electronic evidence consistency is achieved through electronic signature, hash verification, judicial block chain cross-chain and trust guarantee. It realizes the automatic processing of traditional contracts in the form of computer instructions, realizes that all transactions are openly visible and the rules are open and transparent, and it fully circumvents the cheating behavior that may be caused by the manual execution of the chain. At present, after more than ten years of development, the marketing business of State Grid can

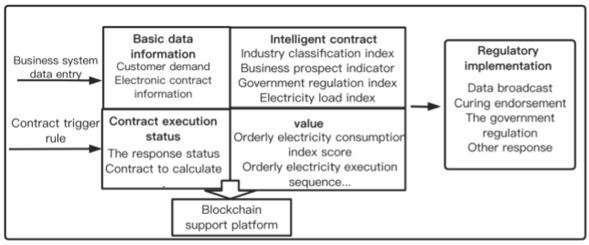

Fig. 1. Blockchain smart contract execution process.

effectively sort out the business rules and realize the automatic execution of the contract content when the departure contract conditions are met by the blockchain technology section for high-value and low-frequency businesses.

2.3.3 The Application of Timestamp

In a blockchain system, a timestamp is the complete and verifiable temporal data that proves the existence or occurrence of data. Each new block is timestamped and written into the block when it is generated, and is incorporated into the hash at the same time in the process of calculating the hash value, thus forming an enhancement of the previous timestamp. Timestamp technology based on blockchain can effectively guarantee the flow of data information security and traceability. By putting key business data of power marketing on the chain for storage, its occurrence status and flow process are recorded on the blockchain, so data traceability can be carried out according to the records to meet the social and national regulatory and audit requirements (Fig. 1).

3 Results and Discussion

Compared with the traditional data storage platform, the electronic data storage mode based on blockchain has the advantages of high stability, high reliability, traceability and auditability due to the use of blockchain as the underlying technology. From the perspective of electric power marketing, blockchain technology has more typical applications in enhancing user experience, optimizing business processes and strengthening enterprise supervision. The following is a brief description of blockchain application ideas in the field of electric power marketing through the scenarios of electronic contract signing, collection of electricity bills from customers and equipment quality traceability.

3.1 Power Marketing System Optimization Based on Data Mining and Block Chain Technology

The optimization of electric power marketing system is an effective way to solve the data sharing link of different marketing related subsystems. During the operation of the system, the blockchain technology is used to realize the highly shared and efficient transmission of data information, The generated data is processed in the form of distributed database. In the construction of block chain system based on store marketing, data in

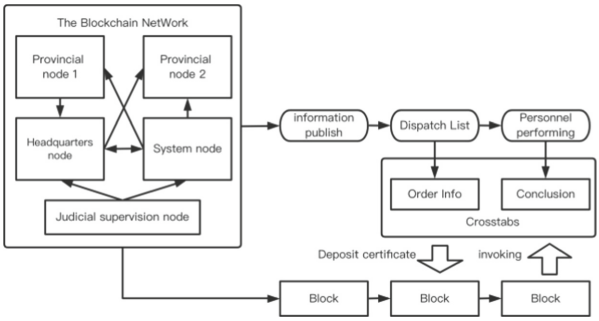

Fig. 2. System data flow diagram based on block chain.

the system can be effectively protected through the application of encryption methods such as state secret algorithm [2]. Only the system with corresponding permissions can obtain the data plaintext, and members on other nodes can only broadcast and share the hash data. In this technology involved, We can greatly meet the current stage of power marketing information system operation security. When we focus on the enterprise and government, regulators, we were build the effective sharing of information, legal science and technology to play a block chain tamper-resistant, judicial endorsement and other technical advantages. To achieve the national grid company headquarters department, the province (city) chain collaboration, solve the problem of data barriers between departments, such as multilateral mutual trust, promoted orderly electricity by means of security data compliance compliance public execution (Fig. 2).

3.2 Blockchain-Based Electronic Contract Signing is Safe, Efficient, Transparent and Reliable

The existing signings of electricity marketing business contracts are mainly through the use of computers or mobile operation terminals by account managers who sign electricity supply and consumption contracts and smart payment agreements with customers during visits or business acceptance.

With the advancement of online business processing, after the customer manager finishes the contract, the contract text, approval time and customer manager information will be uploaded and stored, and the contract can be pushed to the customer through online channels such as online State Grid APP and 95598 websites, and the push time and contract content will be uploaded and stored. After the customer views the connection contract in the process display module, the customer information, viewing time and contract content are once again uploaded and stored. Customers sign the contract page to use the electronic seal for stamping, and the customer information, stamping time and contract content are uploaded and stored a final time and the contract text is returned to the marketing system for storage.

At the same time, it can realize strong authentication of the identity information of the user of the seal based on blockchain, and provide a more secure login method than the username password. It provides the service of authorizing multiple operators for enterprises; it can uplink the users, time and contract text that invoke electronic signature

in the process of handling business, forming the unchangeable seal record recognized by both electricity supply companies and users, which can fully solve the mutual trust problem of electricity companies and customers.

3.3 Blockchain-Based Electricity Bill Collection Protects Privacy, Reduces Cost and Increases Efficiency

The existing collection of electricity bills are mainly through telephone collection, external collection methods, all with a relatively low efficiency. The emergence of long-term high amount of bad debt of electricity customers seriously affects the flow of funds of the power grid company, and it is impossible to stop the loss in time through alarm blackout and other operations due to some users' industries.

By introducing blockchain technology, after generating electricity bill reminder letter in marketing systems, the information of account managers, generation time and electricity bill reminder letter information will be uploaded to the chain for storage. After pushing bill reminders information to customers through online state network and SMS, the pushing time and bill reminder information will be uploaded to the chain for storage. While customers open online state network or SMS to read electricity bill reminder information, the monthly status information of customers will be obtained through the interface, and the high-voltage customer information, reading time and bill reminder information are uploaded and stored, forming a tamper-evident bill reminder record [5]. If the customer uses the electronic signature to confirm the online network, the account manager does not need to deliver the notice of electricity bill suspension on site. 95598 customer specialists can also check whether the chain information such as the letter of electricity bill reminder and the notice of electricity bill suspension is sent, and judge whether to issue a complaint work order, so as to reduce the pressure on the grassroots level for bill collection, while maximizing information security. In addition, it breaks the geographical restrictions of the traditional collection industry, facilitates records collection information in the whole process while forming irrefutable evidence, and is simultaneously incorporated into the credit system of the power grid to provide a basis for subsequent business development.

3.4 Blockchain-Based Device Traceability is True, Objective, Honest and Efficient

With the increasing marketization of electricity grid construction, the diversification of the main body of electricity grid construction, diversification of the project contracting mode, the project management are becoming increasingly complex, bringing new challenges to the digital development of power grid construction. In particular, there are significant shortcomings in the implementation of the main responsibility of all parties in electricity grid construction, project risk prevention and control, equipment quality supervision, and the establishment of market credit mechanism.

Through the chain of the whole process information such as production and manufacturing, new product testing, spare parts management installation and operation, and quantity and value traceability of the materials and equipment related to power grid construction, we have realized the penetration of production, installation and operation, and testing data. By building an industrial alliance chain with raw material suppliers,

component manufacturers, powered equipment manufacturers and calibration manufacturers, the relevant parties can immediately obtain the corresponding information after the equipment production is completed and out of storage, such as the relevant production and calibration links notification, realizing that the power supply company has strengthened the management of the equipment production stage through equipment quality traceability. We also adopt processing measures and improvement plans to facilitate the control and evaluation of meter product quality, realize the regulator's record and supervision of the power grid construction process, guarantee the fairness, openness and impartiality of transactions, and promote cleaner and more efficient power grid construction [4]. We also realize the customer's data inquiry and traceability of equipment quality through multiple stages of equipment quality such as production, testing, installation and operation, and enhance trust in the meter quality of power supply companies, which can promote data sharing, build integrity system, optimize business processes, reduce management costs and enhance synergy efficiency.

3.5 Electronic Data Based on Blockchain is Subject to Judicial Recognition

Current block chain technology is used to carry out the electronic data storage card has won industry recognition and judicial field, but more is to explore the third party electronic data storage block chain card platform technology development, the electronic data of judicial appraisal Suggestions for determining legitimacy, authenticity, relevance of the main electronic data reference, need has the legal qualification authentication institutions and expert witnesses receive entrust, Carry out under the premise of ensuring the compliance of the appraisal process. Electronic data at present stage judicial authentication in the whole process management was not able to provide judicial authentication work from aspects of material gain, appraisal process and judicial appraisal report solidifying management plan or system, can provide the whole process for electronic data judicial authentication work, the traceability of control and support, and improve the electronic data judicial authentication opinions participation in the proceedings, Effectively guarantee its probative power (Fig. 3).

When the blockchain-based business system is connected with judicial service institutions, technical personnel need to develop electronic data transmission interface. On the premise of ensuring the network environment and the cleanliness of the storage device, the third-party electronic data storage platform calls the interface based on the authorization of the client, and adopts data push mode. The information supporting the subject information of forensic electronic evidence, real-name authentication information, identity certificate information, business behavior information and the summary of up-chain evidence storage in the verification platform is packaged and sent to the judicial authentication platform, which stores the data in the third-party electronic data storage platform based on block chain.

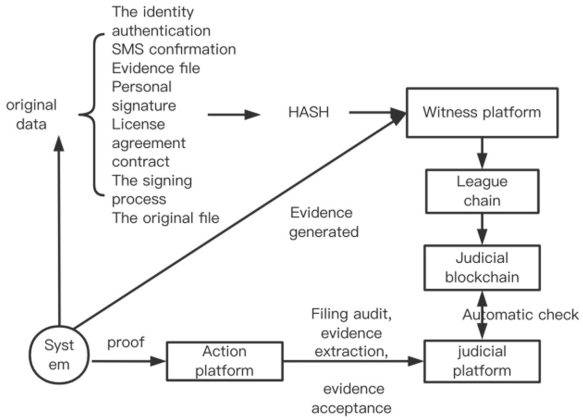

Fig. 3. The data in the judicial evidentiary business.

Table 1. Electronic data collation requirements.

Check item	integrity	compliance	…
The main information			
Real-name authentication information			
Identity certificate information			
Business behavior information			
Blockchain storage address			
Summary of blockchain storage			
The hash algorithm			
…			

3.6 Design of Electronic Data Automatic Verification Rules Based on Block Chain

When the data platform of the judicial expertise Center receives the data provided by the business system, the system can automatically develop the verification algorithm in accordance with the data verification algorithm constructed internally to verify the integrity and compliance requirements of electronic data as evidence. By analyzing the material package provided by the third-party electronic data storage platform, the evidence is classified to check whether it meets the standard requirements of the identification center. The verification comparison is shown in the following Table 1.

Through the automatic verification function of data items, the appraiser can intuitively see whether the electronic data meets the requirements of the Center's specifications. The evidence marked with "$\surd$" indicates that the items marked with "X" have no relevant items or the contents of relevant items are not in compliance with the verification. Hash value matching means that the system server background uses the same Hash

Table 2. The content item of the test comparison.

Check item	integrity	consistency	compliance
item 1	√	√	√
item 2	√	√	√
item 3	√	√	√
item 4	√	√	√
item 5	√	√	√
…			

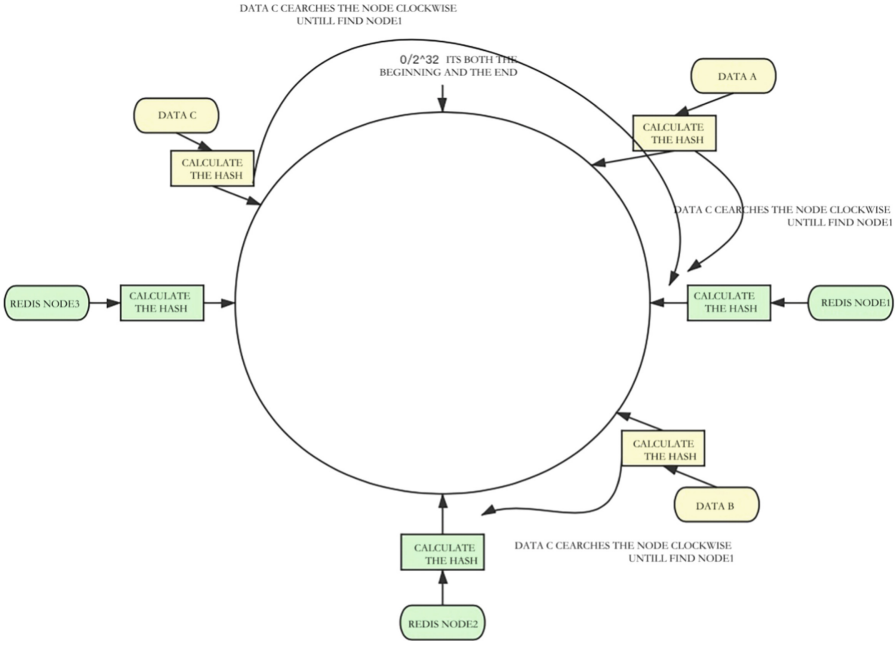

Fig. 4. Hash consistency comparison algorithm.

to match the Hash value obtained by the blockchain storage summary or the blockchain storage address (Table 2 and Fig. 4).

In the process of electronic data retrieval, the key fields contained in the rules can be matched by high-performance text matching algorithm to improve the retrieval of case associated data. By storing the matching state of pattern string set and text string as bit vector, the process of updating bit vector by bit operation is the matching process (Fig. 5).

S1. By maintaining a container in which all characters that have been successfully matched are recorded as “u” in the pattern string, this container is also used as a bit

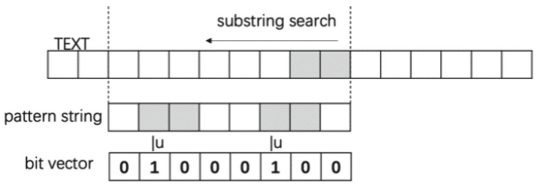

Fig. 5. Bit vector detection scheme.

vector:

$$D = d_m d_{m-1} \ldots d; \tag{1}$$

The container default is 1^m (m is the number of characters in the pattern string);

S2. Construct auxiliary table B, which records the position of a character in the pattern string with bit development;

S3. When the first character "u" is read, the second and sixth bits in the pattern string (from left to right, starting from 0) contain "u1", the second and sixth bits of the container are set to 1 accordingly.

S4. When reading the second character "u2", if the first and fifth bits are "u2", then the first and fifth bits are set to 1. If the first bit is not "u2", only the fifth bit is set to 1.

S5. Query secondary table B during update, get mask $B[t_j]$ of new character "t_j" and move left one bit.

$$D^t \leftarrow (D\&B[t\_j]) \ll 1 \tag{2}$$

If the length of machine word is w, the length of text string is N, the number of pattern string is R, and the shortest pattern string length is M, then the time complexity of the algorithm is O(n[mr/w]) and because of the bit parallel technology, the algorithm has faster matching speed, less memory consumption, and better reference locality. And it is easy to extend to more complex pattern strings. After a large number of data tests, it is found that the more times of overall training, the better the more basic test data, the better.

4 Conclusions

At present, new technologies such as "the intelligent chain of cloud shifting of things" have become the core driving force for the transformation and upgrading of traditional business and the vigorous development of new business models. The integration and innovation of new generation information technology and marketing business will become a new growth point for the company in the future. The promotion of business processes and lean management has become an irresistible trend. Through the exploration of the application of blockchain technology in the field of electricity grid construction, the optimization and adjustment of the existing service system can effectively improve the quality and efficiency of electricity marketing business services, and can enhance the effectiveness of the relevant government departments and society to regulate the

enterprise, and effectively enhance the corporate image and credibility. At the same time, through the interface form to obtain the judicial identification of electronic data, a survey commissioned and acceptance of the whole process of supervision. By identifying the implementation process and the appraisal report on the chain will cure way in promoting electronic data as the authority of the judicial electronic evidence at the same time, further enhance the credibility of the electronic data of judicial identification.

Acknowledgements. This paper thanks to the State Grid Co., Ltd. (1200/2021-72005B) for the funding of the State Grid Headquarters Management Science and Technology Project, which is applicable to the business scenarios of State Grid.

References

1. Duan Y., 2019. Feasibility study on the application of blockchain technology in electronic data forensic authentication 129–135.
2. Tang Xiao., 2017. Analysis of Power marketing information Platform based on Data Mining and Block chain Technology [J]. China New Communications, 201,23(24):19–21.
3. Wang Ling-Yu, FU Hong, Yang Yun, LIU Jun., 2021. Power marketing data storage mechanism based on block chain [J]. Journal of Chongqing University, 201,44(08):156–164.
4. Wei Y N, Rong Y J. & Liu X., 2019. Analysis of the application prospect of blockchain technology in supply chain management[J]. Tendering and procurement management 000(003):43–44.
5. Wu J J, Chang J and Wang W S., 2021 Reflections on the application of blockchain technology and industrial layout in the electricity industry[J]. China Electricity Enterprise Management, (01):80–81.
6. Yunnan Electric Power Company., 2020. Block chain for power grid construction digital empowerment yunnan Power Technology. 48 (05): 48.
7. Zhao Y S. & Liu H H, 2014. Research on the application of big data technology in power industry Telecom science 030(001), 57–62.