Construction and Practice of Public Service Platform Based on Trusted Blockchain

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Abstract. In recent years, the digital economy has experienced the era of digital economy 1.0, the era of all-round electronization brought about by the rise of personal computers, and the era of 2.0, the era of all-round data brought about by the popularity of the Internet and mobile Internet, and entered the era of 3.0, the era of "digital right economy". In the era of digital rights economy, all aspects of social and economic life will create new ecology and models. Digital identity and digital governance, digital asset transaction circulation, digital payment and settlement, and digital industry integration constitute the core sector of digital rights economic development. Blockchains has become the preferred model for establishing digital identity and governance due to its characteristics of multi-party co-governance, distributed storage, transparent rules, and permanent and true data persistence. This paper proposes to solve the problem of economic governance derived from the era of digital economy by building a blockchain service platform. The main achievements of this paper are to create new business models, actively explore the deepening application of blockchain technology in the field of energy and power, break through data barriers, activate data value, develop digital economy, and promote data fusion and data resource integration in the field of energy and power.

Keywords: Blockchain, digital economy; Electronic signature; Internet Plus; Renewable energy; distributed transaction; Virtual power plant.

1. Introduction

State Grid Electronic Commerce Co., Ltd. (State Grid Financial Technology Group) (hereinafter referred to as "State Grid e-commerce company") is a wholly-owned subsidiary of State Grid Co., Ltd., which was established in January 2016 with a registered capital of 1 billion yuan. It is committed to creating the largest domestic energy e-commerce platform with outstanding competitiveness, and becoming the world-class energy digital comprehensive service and Platform operator. State Grid Xiongan financial technology group was established around the two business areas of e-commerce and Internet finance. At present, nine platforms have been built, including e-treasure, State Grid mall, State Grid e-commerce finance, photovoltaic cloud network, business travel cloud, central enterprise e-commerce alliance and cross-border business, comprehensive energy services, big data credit, mass entrepreneurship and innovation. As of August 31, 2019, the number of registered users of e-commerce platform is 241 million, there are 116500 high-quality suppliers settled in the platform, with the annual turnover exceeding 500 billion yuan.

In order to ensure the healthy and safe development of the power on Internet plus business, in 2019, the State Grid e-commerce company focused on the market pain problem, and built the most authoritative
public service platform of trusted blockchain\cite{1} in the field of energy in China. It created a number of typical power business application scenarios with new demonstration effects, such as new energy cloud, renewable energy consumption, supply chain finance and so on. It opened up the upstream and downstream industry chain. It promotes trust transmission among financial institutions, industrial units and suppliers, improves collaboration efficiency, creates an open and cooperative energy blockchain industry ecosystem, and provides strong support for the company to optimize business environment, promote renewable energy consumption. In May 2019, the public service platform of trusted blockchain for power Internet plus business was selected to pilot the demonstration project of network security technology of Ministry of industry and information, and built an industrial application demonstration project of energy blockchain\cite{2}. The second chapter introduces the main research background, which is based on the trend of integration of energy revolution and digital revolution. The third chapter introduces the main method is to combine blockchain with different business models. The fourth chapter is the research results of this method in reality, and the fifth chapter is a summary of this method.

2. Background
In 2019, SGCC(State Grid Corporation of China) deeply grasped the trend of deep integration of energy revolution and digital revolution, took the initiative to adapt to the requirements of power reform and state-owned enterprise reform, accelerated the construction of a world-class energy interconnection enterprise with global competitiveness, and required to carry out the application research of new technologies such as blockchain. The essence of blockchain technology is a technology system composed of distributed data storage, point-to-point transmission, consensus mechanism, encryption algorithm, smart contract and other technologies\cite{3}. It’s open, shared and collaborative technology form is highly consistent with the company strategic goal of building a world-class energy Internet, which can effectively solve many problems such as data accommodation, equipment security, personal privacy, rigid structure and multi-agent cooperation in the process of power grid construction. It’s an inevitable requirement for the company who want to build a world-class energy Internet enterprise, to carry out the construction and practice of the public service platform for the trusted zone blockchain of power oriented "Internet plus" business, combine with the advantages of the platform of the State Grid e-commerce company, expend the commercial operation scope of the blockchain, and establish the "block chain plus " business mode, which is based on the blockchain technology as the core, supporting multi industry and multi domain applications.

China pays high attention to blockchain technology and increases support for blockchain industry year by year, encourages exploration and Research on the combination of blockchain technology and practical application scenarios to serve the real economy. In 2016, the State Council issued the 13th Five-Year Plan for national informatization, which takes blockchain as a strategic frontier technology, and clearly proposes the need to strengthen the innovation, test and application of new technologies such as blockchain. In May 2018, General Secretary Xi Jinping delivered a speech at the meeting of academicians, noting that block chain as a new generation of information technology should accelerate the application of breakthrough. In June 2018, the Ministry of industry and information technology issued the action plan for the development of industrial Internet (2018-2020), encouraging the application research of emerging cutting-edge technologies such as edge computing, deep learning, and blockchain in the Industrial Internet. In January 2019, the state Internet Information Office issued the regulations on the management of blockchain formation services, further strengthening regulatory constraints and promoting the ecological development of blockchain industry. At present, State Grid e-commerce company, State Grid Shanxi, Zhejiang, Henan electric power company, State Grid Information & Telecommunication Co., Ltd. and other units have successively carried out blockchain technology research and application work, and actively explored blockchain technology platform architecture, data governance and other aspects. To carry out the construction and practice of trusted blockchain public service platform for power "Internet plus" business, actively respond to the strategic deployment of rapid development of emerging industries in China, and promote the standardized development of internal and external blockchain technology application market, is an urgent need for SGCC to perform the social responsibilities.
3. Methods
Taking the protection of the healthy and safe development of the Internet plus business as the fundamental starting point, the State Grid e-commerce company focuses on the market pain problem, designs the unified service framework of the trusted blockchain, proposes a reliable electronic signature scheme based on the identity authentication chain, and builds a company level trusted blockchain public service platform. By building an important link to promote mutual trust between upstream and downstream industries, building an open, reliable and secure full-service service platform, and leading a dynamic and efficient data exchange mode for multiple parties to share, we will comprehensively assist in the construction of "hub", "platform" and "sharing" enterprises. State Grid e-commerce company innovated business model and operation mechanism due to the rich scene resources and business advantages of the power industry, and built a blockchain product service system that conforms to the company’s development strategy and has the characteristics of SGCC, formed a batch of typical power business application scenarios with demonstration effect, promote the commercialization of the company’s blockchain emerging business, and accelerate the industrial transformation and upgrading.

3.1. Overall Construction
By building a public service platform for blockchain, deepening internal services, expanding market space, providing trust foundation for data resource confirmation, opening, circulation, trading, traceability, we will promote the in-depth application of blockchain technology in key areas such as energy trading, photovoltaic cloud network, supply chain finance, electronic bills, network security. First, innovate the business model of platform blockchain. Gather internal and external high-quality resources, innovate the design of blockchain business model, promote the application of judicial certificate keeping, energy trading and data sharing businesses on the chain, and provide a safe, reliable, convenient and efficient blockchain overall solution to solve the pain point of energy Internet enterprise construction[4, 5]. Second, build a hub type blockchain operation mechanism. With users as the center and security as the guarantee, we will explore cross chain mutual trust technology, enhance the platform’s public service capacity, promote the deep integration of blockchain technology and energy power business, establish a blockchain operation mechanism for power and service society, and promote the stable and rapid development of blockchain business. Third, create a shared blockchain industry ecology. Optimize the top-level design of blockchain business, expand the application scenarios of blockchain, vigorously, promote the research and application of relevant standards and specifications of blockchain, build a national blockchain experimental base at a high level, and build an energy blockchain application demonstration project.
3.2. Focus on Market Pain Points

3.2.1. Investigation and Analysis. Electricity Internet of Things\textsuperscript{[6, 7]} is faced with difficulties in data accommodation, poor trust transmission and other development problems, due to its large scale and complex interconnection chain, and the lack of trust foundation covering the whole process of data resource confirmation, opening, circulation, transaction, traceability, etc. The specific performance is as follows: First, it is difficult for electronic data to obtain evidence. The inherent characteristics of electronic data make it vulnerable to attack or deliberately hide, delete and modify. Traditional data access and transmission methods are difficult to achieve electronic data security. Second, the transmission of data trust is poor. Data assets lack of effective right confirmation mechanism, data value protection ability is insufficient, data trust cannot be transmitted continuously, and information transmission in the whole process of energy ecology is not smooth. Third, it is difficult to integrate data resources. Information platforms among different enterprises are relatively independent, and data such as human resources, materials, and finance can not be directly integrated and shared. The problem of data accommodation is prominent. Fourth, the lack of security in digital contracts. Due to the lack of data sharing and trust, the authenticity of digital contracts such as electronic contracts cannot be guaranteed, the settlement agreed in electronic contracts cannot be completed automatically.

3.2.2. Design a Trusted Blockchain Service Framework. State Grid e-commerce company has designed a unified service framework for trusted blockchain, and proposed a reliable electronic signature scheme based on identity authentication chain, which provided a solid trust foundation for the core business of "Internet plus".

(1) Design a trusted blockchain unified service framework for full service scenarios
By constructing a unified service framework of trusted blockchain composed of core organization nodes, basic service platform and trusted service capability, Internet plus business is guaranteed to be fully credible.

(2) Construction of lightweight and reliable electronic signature identity authentication system
In order to solve the problem of identity validity verification of power business participants, State Grid e-commerce company innovate and integrate the cutting-edge technologies such as blockchain, electronic signature\textsuperscript{[8]} and domestic password, and propose a lightweight and reliable cloud electronic signature scheme\textsuperscript{[9]} based on identity authentication chain\textsuperscript{[10]}. This solution can effectively solve the problem of authenticity of identity authentication of both parties of blockchain transaction by tracking the whole process of key request, decryption and signature verification of electronic signature, the whole signature behaviors such as signer, signature time and signature place are constructed Process traceability mechanism.

(3) Build judicial level blockchain certification service capacity
Through the breakthrough in the identity authentication technology of reliable electronic signature, the company’s trusted blockchain has passed the recognition of Beijing Internet court. As the first central enterprise directly connected to the "balance chain" of Beijing Internet court, effectively solving the problem of difficult electronic data storage and identification, and greatly improving the evidence of electronic data Effectiveness and judicial trial efficiency.

(4) Build a basic service of data fusion based on the whole life cycle mark
Extracting the hash value of user accounts, forms, files, protocols and other business files and store them on the chain based on the data fingerprint\textsuperscript{[11]}. According to the data consistency problem in different business scenarios, this paper uses a method of uniquely marking and recording each blockchain and related storage node of data traversal, which can break through the life cycle mark of data generation, transmission, storage and destruction, and build a strong consistency at the bottom of the data. Based on the blockchain public service platform, the access rules for blockchain interworking are formulated to ensure the uniqueness of data application among different blockchains, solve the problem of cross chain data mutual trust, and promote data fusion and data resource integration in the energy industry.
3.3. Clear Business Requirements

Through four steps of analysis and identification, comprehensive classification, matching mapping, induction and summary, the blockchain technology application demand analysis and applicable scenario design are carried out to create core business advantages and market competitiveness.

Figure 2. Analysis of blockchain business requirements and applicable scenarios.

(1) Analysis and identification. The system analyzes the key links in the construction of the power Internet of things\(^1\)\(^2\), the related business processes of upstream and downstream enterprises and the core customer needs, carries out the business pain point identification and cause analysis\(^3\), and corresponds the business pain point with the cause.

(2) Comprehensive classification. In the process of actual business development, different business pain points may be caused by common causes. Therefore, it is necessary to classify and summarize the business pain point causes identified in the first step to obtain several types of pain point causes.

(3) Match mapping. Match the business pain point reason category with the application value of blockchain, analyzes the matching degree between different application scenarios and blockchain technology, map the application characteristics of the business pain point reason category with the blockchain system architecture and data level, and study the application value and value realization method of blockchain technology.

(4) Summarize. On the basis of summarizing the applicability of blockchain and business application scenarios, the paper comprehensively analyzes the difficulty of technology implementation and the cost-benefit ratio, and puts forward the company’s blockchain application scenario proposal.

3.4. Innovative Business Model

Innovative business models through blockchain technology help companies complete transformation.

Figure 3. Blockchain business model design.
3.4.1. Optimize Energy Trading Mode. Using blockchain technology, collect distributed and centralized new energy power generation data to meet the company’s business needs such as peak cutting and valley filling[14], orderly power consumption, demand side response. Strengthen the market influence of individual consumers and energy suppliers[15], make consumers directly have a high degree of autonomy to purchase and sell energy, realize automatic power purchase and sale services[16].

3.4.2. Build Trust Transmission Mechanism. Through blockchain technology to build a new type of high security and high automation distributed trusted authentication system, complete the unique trusted mapping of identity inside and outside the industry, ensure the credibility of data source identity, avoid the links of multi-party authentication and verification, reduce the cost of trust.

3.4.3. Realize Data Fusion and Sharing. Comprehensively carry out data access conversion and integration, unify data standards, break professional barriers, tap professional collaboration efficiency, protect user data privacy with password algorithm, complete data right confirmation[17], and realize data traceability and supervision on the premise of ensuring data security.

3.4.4. Open up the Upstream and Downstream Industrial Chain. Through the blockchain consensus algorithm to ensure that the data can not be tampered with, to ensure the authenticity of multi-party transaction information, to eliminate the concerns of financial institutions on enterprise information flow. Through the programmable intelligent contract[18], we can guarantee the execution of transactions according to the contract, control the risk of performance, improve the risk control ability of the capital end and the approval efficiency of financial institutions, and reduce the financing cost of small and medium-sized enterprises[19].

3.4.5. Develop Basic Service Components. Develop basic service components of blockchain, provide standard blockchain cloud services to the outside world, and help small and medium-sized micro enterprises to quickly go up the chain with the mode of commercial operation services, reduce their operating costs, and improve enterprises Comprehensive competitiveness.

3.4.6. Promote Online Businesses Development. Make full use of the advantages of multi business integration and convenient application of blockchain public service platform, realize the collection of users and various business resources, promote the transfer of business form from weak business connection to strong data connection, comprehensively support the Internet development of the company’s business.

3.5. Create Typical Business Scenarios

3.5.1. New Energy Cloud. State Grid e-commerce company has built the largest "science and technology + service + finance" new energy cloud[20] in China by integrating the whole new energy industry chain resources and relying on the trusted blockchain public service platform. Through the reliable cloud electronic signature technology to verify and confirm the user’s identity information and contract content when signing the contract, and store the user’s identity information, contract content and other key information and processes on the chain.

3.5.2. Guarantee Mechanism of Renewable Energy Consumption. State Grid e-commerce company has innovatively constructed the renewable energy[21] consumption guarantee mechanism relying on the trusted blockchain public service platform. Through the calculation formula of the weight of the responsibility of elimination, the weight of the responsibility of elimination, the green card of electric power trading and other information on the chain and other ways, effectively ensure the authenticity of the data, can not be tampered with, so that the market subjects actively assume their own responsibility of elimination.
3.5.3. Integral Exchange. Based on the unified integration system of State Grid Corporation of China, it is upgraded to an open and comprehensive unified integration and exchange system on the basis of the original customer points exchange. The integration is digitized by using the blockchain technology. Different platforms on the blockchain share the same set of integration account books. The transaction forwarding and routing functions between the original payment gateway and the third-party payment gateway and the integration system are replaced by the distributed network.

3.5.4. Supply Chain Finance. Based on the trusted blockchain, build an alliance platform for all parties to share information, record and trace key information and data, and provide functions such as chain deposit, data encryption, credit confirmation\cite{22}, tracking and traceability for important bill information such as accounts receivable, accounts payable and contract information generated in supply chain transactions.

4. Results
State Grid e-commerce company has given full play to the platform advantage, sharing mechanism and hub role of grid enterprises in the energy supply system, open up the upstream and downstream industrial chain, promote the trust transmission among financial institutions, industrial units and suppliers, promote the interconnection of everything in the power system, human-computer interaction, and build an open and cooperative energy blockchain industrial ecosystem. Strengthen the foundation of trust and optimize the business environment. Based on the judicial level trusted zone chain, it provides a solid trust foundation for the power Internet plus business data resources to be right, open, circulated and traded. The innovation expands the external business of energy trading, energy finance, judicial storage, network security and other supporting businesses, and fully supports the marketing target of "Internet plus" business, which is one way of running the electricity, and does not run at all. The people’s cost of doing business has improved the business environment and promoted high-quality economic development.

The public block service platform of trusted block chain for power Internet plus business combines the new energy cloud and green card transaction with the blockchain technology, It improves the efficiency and service level of the whole business of the power grid business, reduces the operation cost and the transaction cost of the intermediate business, and effectively promotes the renewable energy electric power. It is of great strategic significance for accelerating the construction of a clean, low-carbon, safe and efficient energy system to implement the responsibility and promote the development and utilization of renewable energy. In the aspect of new energy cloud application, through the blockchain cloud signature technology, the complex authentication process is eliminated, and the online signing service with legal effect is provided on the premise of nearly zero cost, saving about 10 million yuan of identity certificate fee for millions of photovoltaic grid connected signing users every year. In terms of renewable energy consumption, through the implementation of various market responsibilities such as government
departments, power grid enterprises, power users., the close connection between the implementation of the market subject’s consumption responsibility weight and the power transaction is realized, which provides the basic guarantee for the green card transaction, avoids false reporting and fraud, and effectively promotes the development and utilization of renewable energy.

5. Conclusion
State Grid e-commerce company takes the initiative to adapt to the development trend of energy production and consumption revolution, and strengthens the core technology research, and actively promote the practical application and integration and innovation of blockchain technology in the fields of trusted authentication, energy trading, financial risk control, new energy cloud, renewable energy consumption, digital currency, will promote the energy technology revolution and industrial upgrading. At present, the company has applied for 30 invention patents related to blockchain, obtained 5 software copyrights and published 28 papers. In May 2019, the project of "public trust service platform for Internet plus" business, which is the only public chain of services for the power grid, is the only innovative case of applying the block chain to the power industry. It has been selected to the Ministry of information technology and network security application pilot demonstration project, promoting the application deployment of advanced technology of network security in the power industry, supporting the development of electric power "Internet plus" network security, and promoting the electric power's network security practice has played an active exemplary role in building an industry-class energy blockchain application demonstration project. On September 18, 2019, the project of "building and application of public service platform for trusted block chain" for "power Internet plus" business passed the technical appraisal of the China Electrical Engineering Society successfully, and the result of the appraisal reached the international advanced and leading level in the whole project.

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