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Design of Network Media's Digital Rights Management Scheme Based on Blockchain Technology

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Abstract- There exist many unsolved problems in the traditional digital rights management of network media. For example, in the traditional management system it is hard to guarantee the quality of media works, to protect the copyrights, to find the effective profit model and so on. To solve these problems, we propose in this paper a network media's digital rights management scheme based on blockchain. Blockchain is a technology that makes use of cryptographic algorithm, hash chains and consensus mechanism to implement consensus, irreversibility and traceability for online data. The proposed scheme can use these functionalities of blockchain to implement the effective production management, copyright management, transaction management and users' behavior management for network media. Furthermore, our proposed scheme can predictively provide an important support for the network media platform to build a sustainable development of benign ecological environment.

Key words-network media, copyright, smart contract, blockchain

I. INTRODUCTION

The Internet is called the "fourth media" following the three traditional media such as newspapers, radio and television. According to the data released by the Chinese Internet Network Information Center (CNNIC), Chinese netizens has reached 710 million in June 2016; Internet penetration rate has reached 51.7%; and Chinese mobile phone users has reached 656 million. The devices used to connect to the Internet are various. At present, with the advent of the mobile Internet era and the popularity of social video applications, China network media market is meeting a huge opportunity, and the development momentum is irresistible.

A feature of the Internet era is the rapid development of network information. It may take only a few minutes or less to spread from a news event to the media with mass of information. For example, about the accident of Tianjin Binhai New Area explosion, the reports reached 44 thousand, the WeChat reached 60 thousand and the discussion reached 4.6 million in less than two days. Such a scale will easily catch the attention of the world. The first published messages in the Interne are videos shoot by netizen from different angles. Though these videos are not professional reports, they play important roles for people making accurate judgement for the disaster. The era is a fast-tempo society, and people are more inclined to short, adaptable and fast media transmission model. Micro-film, network songs, photo works and network novels are favorite network media for young people, and they spread and transfer these media in the Internet every day. The interactivity of network media is also a reason that people love this kind of media. Each netizen can issue his/her opinion aiming at a special topic in the Internet and can upload his/her original works to the Internet, which will greatly improve the society influence of network media.

However, due to the lack of effective support of information technology, Chinese network media industry also has the following several problems. First, easy to obtain network information causes the network media works plagiarism phenomenon serious, which means that the intellectual properties of digital network media are easily to be violated. Though sharing media should not be looked as plagiarizing, and sharing media on the network platform play an important role on improving the influence media, but respecting original works should be the first principle in the development of network media. Second, the threshold of publishing network media is too low, which leads to the qualities of network media being uneven. A large number of crude works and works violating the socialist mainstream values bring the negative effects to the network media market. Third, the margin for the channel to make profits is narrow. At present the network media market is too

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dependent on advertisement. For example, issuing advertisement is main profit model for Youku and Tudou. Though all of network media platform tried various payment models to explore the diversity of profit models, the Chinese netizen already got used to watch videos freely, and how to implement payment model is the first problem for the development of network media platform. Forth, regulation does not reach the designated position. Many contents of transferred media are false, and many contents have obvious vulgar tendency. Some network media platforms look network media as a tool to improve attentions and produce many low quality works, which seriously damages the healthy development of the network media. Fifth, the network media platforms cannot control the copyright transactions of network media, which will introduce great risks for these transactions.

At present, the existing copyright registration service platforms have the following two categories. The first category is China copyright protection center that is the comprehensive copyright management society agency established by China. The center has high reliability and can provide many copyright services. But the cost of the center's services is high and the charges are opaque. For example, the registration fee of each micro-film is about 2000-3000 yuan, and at the same time the process of registration is very long and procedure is tedious. The second category is the network registration platform. For instance, the fees of Pigsy Intelligence Property Website are lower than those of the China copyright protection center, and each network media work is charged 498 yuan with a simpler procedure. However, the platforms like Pigsy Intelligence Property Website do not have primary business, and cannot form scalable operation to maintain a long period development.

Now digital media data occupy half of network traffic. When the media data (such as video, audio, pictures, text and other data) communicate in the network, they all need to be protected. How we can use IT technology to address the protection, how we develop the supervision and profit model of network media, and how we promote healthy, rapid and sustainable development of network media industry are the important problems needed to be solved.

To address the above problems, this paper combines the blockchain technology and the network media platform, and makes use of blockchain's features, such as non-repudiation, traceability and other characteristics to provide supporting services for network media platform. Our proposed scheme can implement distributed storage, data encryption and transaction monitoring for copyright information of digital media.

The rest of the paper is organized as follows: Section II presents the principle of the blockchain technology; Section III describes the application scenarios of blockchain; The proposed digital rights management scheme is given in section IV. Section V concludes the paper.

II. BLOCKCHAIN TECHNOLOGY AND MODEL

A. Blockchain technology

Blockchain is the core technology of Bitcoin, and decentralization is a remarkable feature of it. It uses methods of digital encryption, time signature, distributed consensus and economic incentive to implement trusted transactions and trusted cooperation among untrusted parties. The recent research shows that blockchain is an effective solution to address problems such as high cost operation, low efficiency and unsecure data storage. With the rapid development and popularization of Bitcoin, the research and application exploration of blockchain present an explosive growth. Now, blockchain is believed as the fifth disruptive innovation following mainframe, personal computer, Internet, mobile and social network, and it is considered as the forth milestone of the credit evolution following consanguineous credit, precious metal credit and currency credit [1]. It can be predicted that blockchain is the rudiment of the next Internet, and it will remodel the human society drastically as Internet did, and finally blockchain will promote the present information Internet to the credit Internet.

The rapid development of blockchain and its successful application in Bitcoin already attracted wide attentions from various organizations, such as government agencies, financial institutes, high-tech enterprises and capital markets. In January 2016, the British government takes blockchain as national strategy, and the government released the blockchain Research Report [2]. The report actively promotes the application of blockchain in the financial and government affairs. At about the same time, People's Bank of China held a digital currency seminar, and in the seminar related organizations discussed the feasibility of using blockchain to release virtual currency and improve the efficiency, convenience and transparency of financial activities. In December 2015, NASDAQ (National Association of Securities Deal Automated Quotations) took the lead in building a stock exchange platform, Linq, based on blockchain, and this event becomes a milestone of the decentralized stock market. Professional audit companies such as Deloitte Touche Tohmatsu and Ernst & Young organized researching teams of blockchain to improve the auditing service quality. R3CEV already developed a BaaS (blockchain as a service) based on the cloud platform of Microsoft Azure, and signed the blockchain cooperation contracts with almost 60 financial institutes to establish the blockchain standards in bank industry. Up to date, $1 billion have been invested to blockchain industry in capital market.

B. Blockchain model

The infrastructure model of the blockchain technology is shown in Figure 1. In general, the blockchain system consists of data layer, network layer, consensus layer, incentive layer, contract layer and application layer.

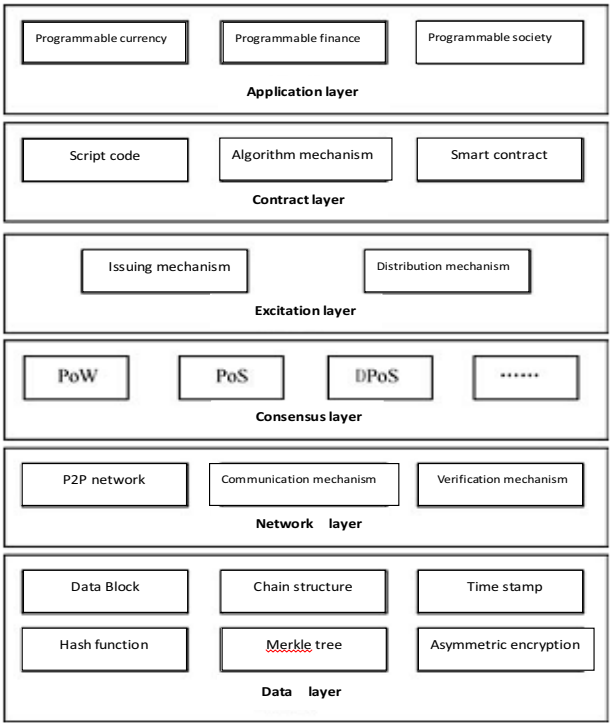

Figure 1. A Basic Framework of Blockchain

Among them, the data layer packages the underlying data block and related data encryption and time stamp technology. Network layer includes distributed networking mechanism, data dissemination mechanism and data authentication mechanism, etc. Various consensus algorithms of network nodes are packed in consensus layer. The incentive level integrates economic factors such as economic incentives and distribution mechanism into blockchain. Contract layer is the main package of various types of scripts, algorithms and intelligent contract, and it is the basis of blockchain programmable characteristics. Application layer is used to various application scenarios and cases of blockchain.

In the model the chain block structure based on the time stamp, the consensus mechanism between the distributed nodes, the economic incentives based on the consensus mechanism and flexible programmable intelligent contract are the most representative innovative features of the blockchain technology.

III. BLOCKCHAIN APPLICATION SCENARIOS

Based on the unique design of blockchain, the system has features such as high redundant distributed storage, unaltered and unforged data, autonomous decentralized smart contracts, secure privacy protection and so on. This makes the blockchain technology not only can be successfully applied to the field of digital encryption currency, but also has a wide range of applications in the economic, financial and social systems. According to the present application situation of blockchain technology, the paper summarizes the main application scenarios of blockchain as digital currency, data storage, data verification, financial transactions, asset management and the election. In the following the paper first gives an overview of five applications except digital currency and three blockchain application modes.

Data storage: High redundancy storage (each node stores a copy of the data), decentralization, the characteristics of high safety and privacy protection make blockchain particularly be suitable for the storage and protection of important data privacy, and it can avoid the large-scale data leakage in data center because of attacks or improper privilege management mechanism. Similar to Bitcoin transactions, in blockchain data can be calculated by a hash algorithm and the hash value will be integrated into a hash tree in blockchain. The reliability and the security can be guaranteed by consensus mechanism and asymmetric encryption technology. Multi-Signature technology of blockchain can be used to configure data access rights flexibly, for example, an entity should obtain 3 people's private keys in 5 people before it accesses a special data. At present, using the blockchain to store personal health data (such as electronic medical records, gene data) application is a promising scenario. In addition, storing all kinds of important electronic documents (video, pictures, text, etc.) as well as human thought and consciousness also has certain application space [3].

Data verification: The data on the blockchain have time stamps, and are verified and recorded by consensus mechanism among blockchain nodes, which cause these data cannot be altered and forged. The applicaiton scenarios of blockchain include notarization and auditing. For example, the blockchain can permanently store all kinds of licenses, registration tables, certifications and so on released by government agencies, and provide a suit of methods and workflows to verify the existence and validities of data [4].

Financial transactions: The blockchain is suitable for the financial market. Blockchain can produce credits automatically in a decentralized system, and then build a financial market without any credit endorsement. It makes blockchain implement the "Financial Disintermediation", which means a disruptive revolution to the business model of intermediary agencies such as the third part payment and fund custodians.

In the field of Internet Finance, blockchain is also an available technology, and has been applied to some of domains such as network lending, Internet Insurance, store crowd-funding and so on. In addition, the fields of securities and bank industries are the important application scenarios of blockchain. Traditionally, the completing transactions of stocks needs the cooperation among Central Clearing Agency, banks, securities companies and Exchanges, while when we use blockchain to build smart contract for stocks exchange, it will avoid the fussy centralized settlement process, and the efficiency will be greatly improved, and the cost will reduced dramatically. At the same time, the real-time transferring is another feature of blockchain, which makes banks implement more rapid and secure interbank transferring than traditional SWIFT system, and it is just the reason why R3CEV, NASDAQ and banks invest funds to research blockchain technology.

Asset management: blockchain has a wide application prospect in the field of asset management, and can achieve tangible and intangible assets' rights confirmation, authorization and real-time monitoring. To intangible assets, based on the characteristics of time stamping technology and non-tampering, the blockchain technology can be applied to the protection of intellectual property rights, domain name management, integration management and other fields. To tangible assets, by combining the technology of Internet of Things, blockchain can assign uniquely identifies for these assets, and use the uniquely identifier to put assets on the blockchain to form "digital intelligent assets". Thus, we can use blockchain to implement autonomous management of assets. For example, when the house, vehicles and other physical assets are put on the blockchain, we can use the authentication mechanism of blockchain to implement the issuance and recovery of assets automatically, and it will promote the business of house rent and vehicles rent to implement autonomous exchanging of assets. In addition, combing the assets' identifying technology, blockchain can provide services such as supply chain management and production traceability.

Voting: The voting is a representative application scenario of the blockchain in political affairs. Based on blockchain's features such as the distributed consensus verification and irreversibility, it can implement low-cost and efficient implementation of political elections, corporate shareholders vote and other applications. At the same time, the blockchain also supports individual users to vote on specific topics. For example, by recording the user's voting on a particular event, you can apply the blockchain to the gaming and forecasting market, such as [5]; And by recording the user's voting score and suggestions on specific products, we can achieve the "social manufacturing" model of mass users' design products.

Trusted Internet of Devices: Blockchain can be applied not only in virtual things in the Internet, but also physical things connected to the Internet to build trusted internet of devices, such as Internet of Things [6], Cyber-Physical Systems, Robert as a Service [7], and Autonomous Decentralized Systems [8]. These systems are often used in mission critical scenarios where distributed trust and data provenance are required [9].

According to the actual application scenarios and requirements, the blockchain technology has evolved three application modes, namely the public chain (Public Blockchain), alliance chain (Consortium Blockchain) and private chain (Private Blockchain). The public chain is a complete decentralized blockchain, and each node in the Internet can take part in reading, writing, validation and consensus on the blockchain, and obtain economic incentives according to PoW (Proof of Work) or PoS (Proof of Stake) mechanism. Bitcoin is the representative of the public chain. Alliance chain is the part decentralized blockchain, and is suitable for an organization or an alliance comprised of multiple entities. In the operation of alliance chain, the consensus mechanism is controlled by some pre-defined nodes, for example when generating a block, 5 out of 10 pre-defined nodes will confirmation the validation of the block. The private chain is a centralized chain, and it is suitable for the auditing or management in special organizations. In private chain the writing operation is controlled by inner pre-defined nodes, while the reading operation can be open to part of the public according to various situations. Here, it is important to note that alliance chain and private chain may not comply entirely with the blockchain model given in section 2 because of different degree of decentralization. For example, a high degree of centralized blockchain may not need economic incentive to reach consensus.

IV. THE DIGITAL RIGHTS MANAGEMENT SYSTEM OF NETWORK MEDIA DATA BASED ON BLOCKCHAIN

Above analyses of the technological advantages of blockchain show that blockchain is suitable for the management of network media. And in this section we use blockchain to design a digital rights management scheme for network media, and this scheme will cover production management, copyright management, transaction management and user's behavior management. As shown in Figure 2, the scheme adopts the private blockchain technology. The private blockchain interacts with the network media platform to receive transaction data from application layer. In order to reach a consensus for these data, few trusted nodes in the private blockchain communicate with each other, and record these data on the blockchain after a consensus reached. In addition, because all of transaction data are stored in each trusted nodes, the scheme will build a robust distributed system.

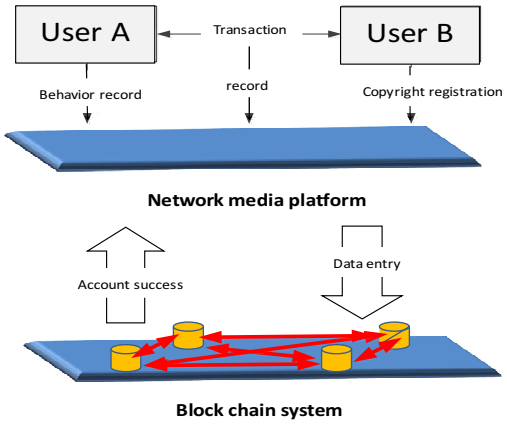

Figure 2. The copyright management system of network media data based on blockchain

A. *Production management*

Production management includes data storage and building smart contracts.

In essence, blockchain is a distributed database, and can be used in the fields of decentralized data storage, data transmission, and data consensus. When we use blockchain to construct the digital right management for network media, we can easily monitor actions such as uploading, browsing, forwarding. At the same time, when we add the information of copyright and transactions into the blockchain using the

technology of hash chain and time signature, we can build a proof of these data [10] and guarantee their irreversibility. The principle can be shown in Figure 3.

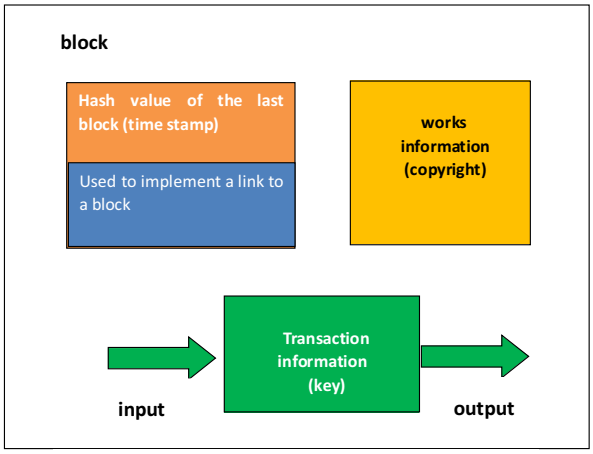

Figure 3. Local information storage schema of blockchain

In addition, smart contracts are programs built by programming language and running on blockchain. Using smart contracts, we can deal with copyright information and implement transactions of copyrights automatically. The procedure can be seen in Figure 4. When we deploy a smart contract on blockchain, the contracts will be form digital commit. And when the preset condition is satisfied, the smart contract will be executed in real-time, and interest paying and profit sharing will be completed automatically.

Using smart contracts in the digital right management system provides the effective guarantee for autonomous management of production crowd funding, actors recruiting, media uploading and billing. Because the smart contracts run automatically, it can greatly improve the efficiency of transactions. Besides, the execution of smart contracts does not need the human intervention, and it will not only reduce the human cost, but also decrease business fraud and reduce the enforcement cost.

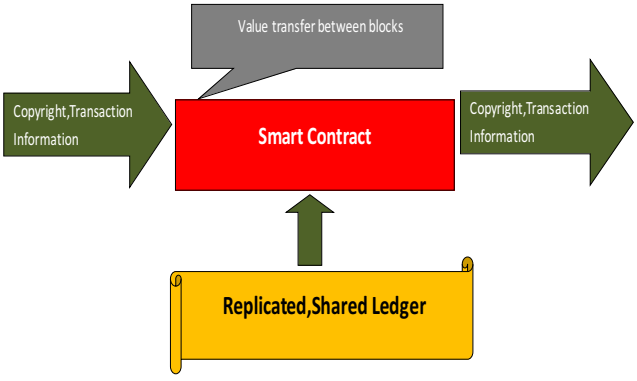

Figure 4. Intelligent contract model

B. *Copyright information management*

Using blockchain in network media platform can implement the low-cost copyright confirmation for online digital works such as music, micro-firm, firm script and so on, and it will not only enhance the stickiness of the content providers and the user to the platform, but also provide a strong support for solving copyright disputing. Thus, when we merge blockchain with the network media platform, originators of digital works can safeguard their own interests better, and be more attracted by the platform. In addition, because the copyright confirmation based on blockchain has features such as convenience and permanency, the network media management can be transplanted to other application scenarios such as copyright confirmation, copyright notarization, crowd funding, certificate authentication, intellectual property right protection and so on.

A good network media platform not only requires to control of copyrights, but also to maintain the qualities of media works. Simply pursuing the click-through rate is unable to promote the development of network media industry. In order to maintain the operation, the network media platform needs to buy media works from the originators, pay copyright fees to them, and put these works into blockchain. On the other hand, the platform depends on the click-through rate and advertisement to obtain profits and improve awareness. Thus, the network media platform needs to make use of blockchain to trace and supervise the qualities of network media works. We believe that both of the network media platform and the originators are limited rational, and when they focus on their benefits decision respectively, there exists a game relationship between them. Therefore, we can use evolutionary game model theory [11] to build a game payoff matrix, shown in Table 1, to analyze the game relationship and present the interaction between network media and originators. The analysis contributes to researching the effective mechanism that can guide development of two parts' behaviors to an 'idea' model, and then can be to improve the qualities of network media works.

TABLE 1 Game payoff matrix

Original author	Excellent	vulgar
Network media platform	Control	Not control

C. *Transaction management*

Transaction management is used to record the transactions among customers and between customers and the network media platform. The platform can obtain profits by collecting fees from these transactions. The platform uses blockchain to record transactions, thus all of transactions can be traced and queried, and all of transaction should be signed before copyrights of media works being transferred.

Once the transaction forms are created, they will be broadcasted around the network of the private blockchain system, and the trusted nodes in the private blockchain create a block for these transactions and calculate a hash value of

the block, and then these trusted nodes put the block and its hash value on the blockchain to form a unified distributed ledger. In addition, the payment mechanism is also built by blockchain. Its advantage is that the payment is based on a peer-to-peer model and does not concern the three-part which will improve the payment efficiency and reduce the payment cost.

Using blockchain to implement the management of transactions has much superiority: (1) Each trusted node in the private blockchain has a transaction ledger, which guarantees the reliability of the transactions' storage. (2) All of participants can trace each transaction on the blockchain in real time, and it ensures that the recorders could not fake the transactions. (3) The signature technology associates with data on the blockchain, and it will decrease the fraudulent transaction. (4) The transactions are linked by the hash chain, it not only makes the transactions be easily traced, but also can avoid the adversary to tamper with transactions. In all, merging the blockchain into the network media management platform can implement the secure, efficient, low-cost recording of transactions, and promote the innovation of supervision model and profit model of network media platform.

The process of popularizing blockchain to network media platform should proceed in three phases: The first phase is using distributed database and data encryption to guarantee the reliability of transactions. The second phase is that using smart contracts to complete transactions automatically. The last one is that introducing virtual currency to implement transactions.

*D. **User behavior management***

The blockchain on the network media platform also supports voting on specific issues. Using blockchain the platform can record the customers' forwarding, comments and other actions in real time and know the voting and suggestion for special works in time. It allows the platform to master the direction of public opinion effectively. In addition, the platform can count up the effect of advertisement to predict the market prospects accurately. Then it will promote the platform to build a sustainable ecosystem for network media platform, and become a sink of investor, content provider and customer and a position forwarding the social positive energy.

V. CONCLUSION

Blockchain is a technology that synthesizes crypto-graphic algorithm, hash chains and consensus mechanism, and it can be used to provide services such as consensus, irreversibility traceability for online data. Based on these services, In this paper, we proposed a digital rights management scheme for network media. In the scheme, we used consensus mechanism to complete copyright confirmation in real time, used smart contracts based on blockchain to implement real-time transactions, and used digital signature and hash chains to guarantee the reliability of the transactions. Furthermore, based on these services we can also implement the innovation of profits model and supervision model, which will greatly promote the development of network media. We predicted that our proposed digital rights management scheme for network media would open a new era for network media business.

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