



Discussion on the Influence of 5G and Blockchain Technology on Digital Virtual Assets

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Abstract. In recent years, digital virtual assets such as virtual currency, digital copyright, equipment and game currency in electronic games have been inseparable from people's lives. However, for the protection of digital virtual assets, relevant research at home and abroad is in the preliminary stage of exploration. Digital copyright confirmation, secure transactions and traceability of digital virtual assets are also facing severe challenges. 5G network has the characteristics of high speed, ubiquitous network, low power consumption, and low latency. It aims to realize the interconnection of everything. Blockchain technology has the characteristics of decentralization, non-tampering, de-trust, and openness, and aims to realize mutual trust of everything. Blockchain can assist 5G network to ensure data security, privacy, and trust. 5G network can also make up for the deficiencies of blockchain technology. Cross fusion of 5G network and blockchain technology can optimize business models and improve network information security. This paper discusses the influence of 5G network and blockchain technology on digital virtual assets in depth.

Keywords: Digital virtual assets · 5G · Blockchain · Cross fusion

1 Introduction

Digital virtual assets refer to digital and non-materialized network assets, including virtual currency [1, 2], digital copyright [3, 4], and equipment and game currency in online games [5]. These virtual assets can be converted into real assets [6, 7] under certain conditions. At present, a variety of virtual assets are defined as citizens' legal property by law [8, 9]. However, digital virtual assets, with the characteristics of virtualization, networking and openness, are easy to be attacked, so they are particularly difficult to protect.

As the latest mobile communication network, 5G network has the following characteristics. (1) High speed. Compared with the widely used 4G network, 5G network can reach 10 GB/s at the fastest, which is several hundred times of 4G network, so the transmission rate has been greatly improved. People's sense of experience will also be greatly improved with the increase of transmission rate. For some new applications, such

as AR/VR, Internet of Vehicles, etc., it is not restricted. (2) Ubiquitous network. As the name implies, the ubiquitous network requires a wide range of networks, because only by realizing the comprehensive coverage of the network can it be possible to mine and realize richer services. Ubiquitous networks mainly include deep coverage and extensive coverage. For example, the network of each room in the house is different. The network in the bathroom may be a little bit worse, and some elevators and underground garages are not connected to the Internet. The advent of 5G can cover all the bad parts of the network. Extensive coverage refers to the need for extensive coverage in all parts of society, such as places with few people, mountains or grasslands, where network coverage is rarely carried out. If full coverage is carried out later, it will be useful for monitoring air quality, environment, and earthquakes. Mudslides and so on. (3) Low power consumption. 5G networks are designed to realize the interconnection of everything and have high requirements for power consumption. If 5G can reduce power consumption, it will be of great value for promoting the popularization of Internet of Things (IoT) applications. (4) Low latency. The normal communication between people can accept a delay of 140 ms, but for some 5G application scenarios, such as unmanned driving, industrial automation, etc., this delay is far from adequate. The lowest latency of 5G can reach 1 ms, or even lower. (5) Internet of Everything. At present, the devices that need to use the network are not limited to mobile phones and computers. There are also various devices that can be worn, shared cars, and smart home appliances. If networked, these devices can be managed uniformly and in real time.

On November 1, 2008, Satoshi Nakamoto published the paper *Bitcoin: A Peer-to-Peer Electronic Cash System* [10], and blockchain technology was born. Since blockchain technology has its own security properties, it can be applied to many industry problems, but there are also technical shortcomings. The emergence of 5G can just make up for these shortcomings. Blockchain technology can also provide a lot of support for 5G network in terms of ensuring data privacy, trust, and security. Therefore, 5G network and blockchain technology can be cross-integrated and mutually empowered.

The 5G+ blockchain model makes a great contribution to the security management of digital virtual assets, and can realize the security and control of the platform. The security of digital virtual assets includes identity authentication, registration, and secure storage. It is necessary to trace the source of digital virtual assets and establish a secure transaction mechanism for digital virtual assets.

2 Blockchain Technology

In July 2016, Gartner released the 2016 emerging technology maturity curve, as shown in Fig. 1. Blockchain technology is considered to be a bright new star, and it is now in a period of expansion. It is expected that it will fully land in the next 5–10 years and become the mainstream technology of society.



Fig. 1. 2016 emerging technology maturity curve

2.1 The Concept of Blockchain Technology

In essence, blockchain technology is a database, only decentralized and able to record previous transactions. It uses programming technology to realize all valuable information to itself, such as marriage certificate, ownership and birth certificate, etc. Of course, this information needs to be represented by code. The blockchain is divided into many blocks, and each block is actually a ledger. From the perspective of logical value, blockchain technology coincides with the thinking of the ancients. In ancient China, due to the low level of productivity, it was necessary to rely on neighbors to trust each other, exchange goods and consume on the spot, which was very similar to the core of blockchain technology. Therefore, blockchain technology is not so much to establish a new trust model, as it is to complete the previous mutual trust.

2.2 Characteristics of Blockchain Technology

As shown in Fig. 2, blockchain technology mainly includes the following four characteristics.

Decentralization. The Internet, which is familiar to the public, is centralized, but in this case, if the central node is attacked, the entire system will be severely damaged. Since the hidden dangers of centralization are relatively large, the researchers changed their minds and used decentralization to solve the problem, so blockchain technology appeared. Blockchain technology is different from the past. Using distributed recording, storage and peer-to-peer communication, it distributes permissions equally to each node on the chain and maintains a shared platform in a decentralized manner. In this mode, if someone attacks the platform or wants to manipulate the platform maliciously, it is impossible to happen. No matter which node is attacked, the operation of the whole system will not be affected.

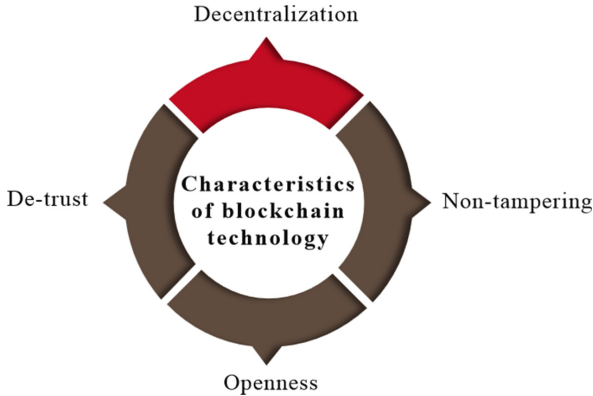


Fig. 2. Characteristics of blockchain technology

De-trust. In the well-known Internet, all transactions must first be trusted, or must be guaranteed by a reliable and credible third party. However, blockchain technology introduces a consensus algorithm, and the transaction rules of the entire system are open and transparent. Any transactions between nodes must be conducted in accordance with the rules of the consensus algorithm, and both parties must also conduct transactions within the specified time and scope. In this way, a certain node cannot deceive another node, so both parties to the transaction do not need any trust, nor need a third party to intervene.

Non-tampering. Blockchain technology uses a hash algorithm. For original data such as text, pictures, music, video, etc., it can be corresponded to specific numbers to form a hash value. If any of these nodes are tampered with, the hash value changes so that it can be easily identified. Therefore, as long as the original data is verified and then added to the blockchain for storage, tampering with one node has no impact on the whole system. There is another possibility that someone has manipulated more than 51% of the nodes, which will affect the entire system, but if a lot of human and financial resources are spent to attack more than 51% of the nodes, the benefits that can be brought are far less than the cost already spent. So the attacker will not do such a thankless thing. It can be seen that the security and stability of blockchain technology are particularly high.

Openness. Openness mainly includes the following three points. (1) The openness of accounts. The distributed accounting method has resulted in every historical record being made public, and everyone can verify the relevant historical records. (2) The openness of the organizational structure: In the blockchain system, the economic logic at the bottom of the company is open, which can also be called an open source economy. (3) Ecological openness: The bottom layer includes open accounts and an open organizational structure, and building an open ecology is the ultimate goal of the blockchain, which can make the efficiency of value transfer higher and higher and the cost lower and lower.

2.3 Smart Contract Based on Blockchain Technology

A smart contract is triggered by a Bitcoin transaction on the blockchain. It is a set of codes stored on the blockchain. This set of codes can read and write data in the blockchain [11], and can automatically execute what has been written for the contract content Good procedure. Networked digital virtual assets are the primary condition for the execution of smart contracts. The smart contract does not require third party intervention. When the conditions in the computer language are met, the program will automatically execute and produce results. The most common vending machine in life is based on smart contracts. Merchants sell goods through vending machines. Buyers select the goods to be purchased and put in the corresponding currency to trigger the built-in program of the vending machine and provide corresponding goods. If the buyer's currency does not match the product information or if the buyer inputs counterfeit currency, the vending machine will automatically refuse to provide the product.

3 Cross Fusion of 5G Network and Blockchain Technology

Blockchain technology and 5G network have obvious advantages, but there are also shortcomings. Combining the two can greatly promote digital virtual assets.

3.1 The Role of Blockchain Technology in Promoting 5G Network

The 5G network has high speed, low latency, and wide coverage, but data security, lack of trust in virtual asset transactions, and privacy protection are problems that must be solved by 5G network, and blockchain technology can just solve these problems.

Blockchain Technology Can Ensure Data Security and Privacy Protection in 5G Network Application Scenarios. The high-speed characteristics and massive connections of 5G network determine that computing and storage will be undertaken by edge computing nodes and smart terminals, which have higher requirements for data security and privacy protection capabilities. Blockchain technology has the characteristics of decentralization, non-tampering and de-trust, so it is naturally suitable for data security and privacy protection. Blockchain technology is a representative technology of cryptography application. It can reconstruct the security boundary of the network, establish a trust domain between various network devices, and enable each network device to achieve mutual trust, interconnection, and security. In addition, with the decentralized feature, there is no need to worry about the phenomenon of central equipment being attacked or tampered with, and there will be no theft of information by the administrator of the central database.

Blockchain Technology Can Help 5G Network to Carry Out Network Construction Faster. In network construction, first of all, the utilization of spectrum resources can be improved. Secondly, intelligent contract can automatically execute the protocol and rules between points, which can make network resources available in real time. Users can also cash in their idle traffic through smart contract technology, which can promote 5G development.

Mobile edge computing is based on the advancement of 5G network, which can aggregate various idle resources through blockchain technology to build a powerful resource pool. The resources distributed on each node can also be optimally deployed, which can improve efficiency, save costs. Blockchain technology is traceable to transaction records and cannot be tampered with, so as to ensure the fairness and justice of transactions, so that users can actively participate, and the application scenarios of mobile edge computing will also be widely deployed.

Blockchain Technology Can Help 5G Network Realize Point-to-Point Value Exchange. Application scenarios such as unmanned driving and smart cities are the key deployment targets in the 5G network operation process. Adding blockchain technology to these application scenarios does not need to be certified by a central organization, and each node directly performs identity authentication and distribution on the chain. In this way, point-to-point value circulation can be realized, the transaction efficiency of terminal equipment has been greatly improved, and transaction costs can be reduced.

3.2 The Role of 5G Network in Promoting Blockchain Technology

Blockchain technology itself is built on the network infrastructure, but after so many years of development, it has not been popularized or implemented. In the final analysis, the front-end technology like 5G network is not mature.

5G Network Can Improve the Transaction Rate and Network Stability of Blockchain Technology. As we all know, the transmission rate of the 5G network is much higher than 4G, and the data transmission rate is as high as 10 GB per second, which can make the transaction of blockchain technology faster. The 5G network delay is also lower. The delay refers to the time interval between data transmission and reception. Of course, the delay is lower and it is more capable of real-time communication. Blockchain is a distributed point-to-point communication, which results in changes on any node and real-time updates on other nodes, so real-time synchronization of data is very important for blockchain. In addition, the high rate of the 5G network can just meet the huge IoT transmission needs, and the low latency can also improve the computational efficiency of the consensus algorithm. The 5G network can also increase nodes, so that the blocking time of the blockchain will be shorter, and the scalability of blockchain technology will also be promoted.

5G Network Can Provide More Data on the Chain for Blockchain Technology. The 5G network aims to realize the interconnection of everything, and there will be more data on the chain. Relying on the high-speed transmission of 5G, blockchain technology can provide more stable services for the traceability of commodities and distributed point-to-point transactions.

4 Digital Virtual Assets

4.1 The Development of Digital Virtual Asset Protection

In 1998, the United States took the lead in the world in promulgating the Digital Millennium Copyright Act (DMCA) [12, 13], which made detailed provisions on the protection of digital copyright. In 2014, the US State of California legislated digital virtual currency as legal currency in California, and the US Internal Revenue Service also announced the legalization of encrypted digital assets in the same year [14]. In February 2015, the European Central Bank released the *Virtual Currency System*, which showed that it had confirmed the legitimate use of virtual currency [15].

According to a 2015 iResearch report [16], the loss of online literature piracy in China's publishing industry was as high as 10 billion yuan, while the loss of digital media such as digital images, music and video has reached an inestimable level. In 2016, large virtual currency transactions [17] such as Silk Road, MT.Gox and Bitstamp were all attacked by malicious attacks, resulting in hundreds of millions of dollars of bitcoins being stolen by hackers. Similar incidents emerge one after another, which has dealt a severe blow to digital virtual assets.

In recent years, the research on the protection of digital virtual assets has drawn close attention from the international academic frontier [18–20]. The protection of digital virtual assets first attracted the attention of the United States in 2013, and the United States raised it to the level of national strategy. In 2018, Ziegeldorf team of RWTH Aachen University in Germany proposed a new bitcoin efficient decentralized hybrid algorithm [21], which combines the anonymity and non-deniability of threshold cryptography to greatly improve the ability to resist malicious attacks.

During China's "Twelfth Five-Year Plan" period, the development of digital virtual assets is relatively rapid, which have become an important wealth of society. In 2015, the "13th Five-Year Financial Plan" was released to showcase the research results of digital currency. In general, there is no systematic research on the protection of digital virtual assets in the world, and it is still in the preliminary stage of exploration.

4.2 Characteristics of Digital Virtual Assets

Virtuality. Unlike traditional assets, digital virtual assets are invisible and intangible. In reality, users only have the right to use them, and ownership does not belong to individuals.

Limited Space. The value of digital virtual assets is limited to the virtual architecture built by operators. If you change a server or change an environment, these digital virtual assets have no value.

Limited Time. If the operator shuts down, the server is attacked, or the player voluntarily gives up, the digital virtual assets owned by the player will also lose value.

Limited Number. The number of digital virtual assets in online games is not unlimited. Pets, characters, props, etc. are all programs written by game developers, and they are all limited in number.

Transactional. After the two parties of the transaction reach an agreement, the operator can change the relevant parameters of the game account, and the digital virtual assets can be traded, transferred, and given away.

Quantifiable. Digital virtual assets have standards provided by operators, and many offline transactions have their own standards. Many private websites provide exchange rates between virtual currencies and real currencies.

5 The Effect of 5G+ Blockchain on Digital Virtual Assets

5.1 5G+ Blockchain Endows Digital Virtual Assets with New Features

As shown in Fig. 3, it is new features of digital virtual assets endowed by 5G+ blockchain technology.

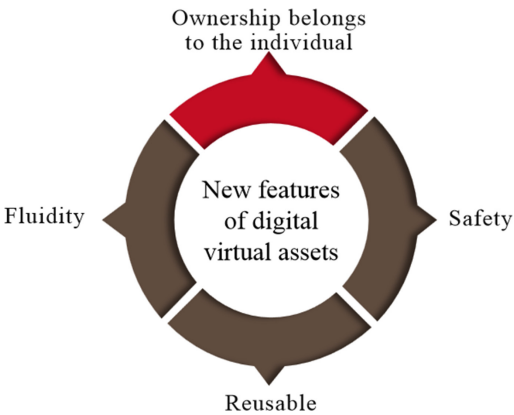


Fig. 3. New features of digital virtual assets endowed by 5G+ blockchain technology

Ownership Belongs to the Individual. Take electronic games as an example. In the past, the characters, skins, and props purchased by players in the game were all called virtual items, but in electronic games based on blockchain technology, players called them digital virtual assets. The difference between the two lies in the ownership. In traditional games, although these skins, props, etc., are bound to the player's account, these data are stored on the game manufacturer's server. If someone read the terms of use of the game carefully, he will find that game players only have the right to use these virtual items, not ownership, and ownership still belongs to the game manufacturer. If one day the game manufacturer announces that the game will be removed from the shelves, the player's virtual items cannot be returned. However, in electronic games based on blockchain technology, the ownership belongs to the player. Even if the game is removed, it will not affect the items owned by the player. These data will always be stored on the blockchain, and the 5G network will ensure that the huge data are all on the chain.

Fluidity. Traditional games have relatively closed environments, and player transactions can only be done inside the game. There are also many game developers who do not allow players to trade in order to avoid the chaos caused by player transactions and the cost of their own operations. But players can also trade by buying and selling game accounts. Based on the peer-to-peer transaction of blockchain technology, players can also conduct transactions outside the game, just as simple as our usual mobile phone transfers, transferring virtual assets from one blockchain address to another. And as long as the players reach a consensus, transactions can also be conducted between different games. The high-speed characteristics of 5G networks can also ensure fast and accurate virtual asset transactions.

In traditional games, if the player wants to abandon the game, all the virtual assets in the game must be discarded. However, in the blockchain-based electronic game, the player can sell the digital virtual assets to other players before giving up. This will not cause a lot of losses, even some limited assets, players can also receive more benefits. However, this also affects the profitability of game manufacturers in a certain sense. But in this mode, game manufacturers can also earn a lot of income by charging transaction fees.

Safety. Compared with distributed servers, hackers are more willing to attack centralized servers, so traditional digital virtual assets cannot be fully secured. In addition, some accounts, virtual equipment purchased at a high price, and rare items obtained through hard work are often hacked and resold to other players, so the scarcity of digital virtual assets will also decrease.

It can be seen from Bitcoin that blockchain technology can ensure the safe transactions and safe storage of digital virtual assets. In the distributed ledger of blockchain technology, each node will have a “ledger” of digital virtual assets, which records every transaction and ownership of digital virtual assets. If hackers want to maliciously tamper with the data, they must attack 51% at the same time. In theory, the network node cannot be completed. Even if it can be completed, the cost will be far greater than the benefits that can be obtained, and the gain will not be worth the loss.

Reusable. After the digital virtual assets are fully chained using the 5G network, because the data is linked to each user’s blockchain address, the developer can obtain the player’s data and use it for secondary use. Such a game can easily produce a derivative game, thereby generating a game ecology. Players’ equipment can be used in different games, and different games can also be traded, so that players have different games Experience.

5.2 Application of 5G+ Blockchain in Confirmation of Digital Copyright

Starting from the date of completion of the work, digital copyright automatically belongs to the completion of the work, without the need for certification by other institutions. But authors can use their real name, pseudonym, or anonymity in digital copyright. In the process of dissemination of the work, if a third party wants to obtain the digital copyright authorization from the anonymous author, it will be difficult to find the author, and the third party may give up using the digital copyright, or it may directly infringe

the copyright without the author's permission. Although the country has established a corresponding registration system, individuals and small businesses may not be able to bear the registration fee of up to thousands of dollars, and the need to register the true information of the copyright owner hinders the registration of anonymous authors.

5G and blockchain technology can start from the author's creation, stamp the updated data at each stage, and form a blockchain in the order of time to ensure the integrity and non-tampering of the data. Often the author is the first person to access the file. Stamping can confirm the author's identity, and the identity corresponds to a specific network ip and public key. Third parties who want to be authorized can contact the file through the network ip and public key. This can also hide the true identity of anonymous authors. In addition, the cost of each registration is minimal, as low as 0.4 yuan, which can be completed in an instant and is more acceptable to the author.

5.3 Application of 5G+ Blockchain Technology in the Secure Transaction of Digital Virtual Assets

Digital virtual assets can take advantage of the non-tamperable feature of blockchain technology to generate a confirmation certificate for each transaction. Before the buyer and seller make a transaction, firstly confirm whether the digital virtual assets issued by the seller are legal and the ownership belongs to the seller, and each node of the blockchain needs to synchronize the right certificate. If it is found that the seller is not authorized and it is a malicious pirate, it will be detected that it does not match the confirmation certificate, so the buyer can seek legal protection for protection. In this model, sellers do not have to worry about theft of digital virtual assets, and buyers can also find genuine virtual assets.

Digital virtual assets can be combined with adaptive digital watermarking algorithms to add digital watermarks to every asset. If you want to trace the source of the data of digital virtual assets, you only need to extract the digital watermark. Based on the classifier model, it is possible to perform abnormal classification detection on the transaction records of digital virtual assets. And then the group intelligent algorithm is utilized to realize the tracking of abnormal transactions of digital virtual assets such as virtual currency, digital copyright and online games.

6 Concluding Remarks

At present, the protection of digital virtual assets such as virtual currency, digital copyright, and online games is a key issue to be solved urgently. The cross integration of 5G network and blockchain technology can give digital virtual assets some new characteristics, including ownership of individuals, liquidity, security and reusability. In addition, 5G+ blockchain technology can also help digital copyright confirmation, secure transactions and traceability of digital virtual assets.

References

1. Guo, J., Chow, A.: Virtual money systems: a phenomenal analysis. In: Proceedings of the 2008 10th IEEE Conference on E-Commerce Technology and the Fifth IEEE Conference on Enterprise Computing, E-Commerce and E-Services, pp. 267–272. IEEE, Washington (2008)

2. Bek-Thomsen, J., Jacobsen, S.G., Christiansen, C.O.: Virtual money. *Scand. J. Soc. Theory* **15**(1), 1–5 (2014)
3. IEEE Spectrum Staff: Talking about digital copyright. *IEEE Spectr.* **38**(6), 9 (2002)
4. Voyatzis, G., Pitas, I.: Protecting digital image copyrights: a framework. *IEEE Comput. Graphics Appl.* **19**(1), 18–24 (1999)
5. Castronova, E.: On virtual economies [EB/OL] (14 October 2002). https://papers.ssrn.com/sol3/papers.cfm?abstract_id=338500. Accessed 09 June 2018
6. Eyal, I.: Blockchain technology: transforming libertarian cryptocurrency dreams to finance and banking realities. *Computer* **50**(9), 38–49 (2017)
7. Wang, C.: Liquidity and market efficiency in cryptocurrencies. *Econ. Lett.* **168**, 21–24 (2018)
8. Phillip, A., Chan, J.S.K., Peiris, S.: A new look at cryptocurrencies. *Econ. Lett.* **163**, 6–9 (2018)
9. Urquhart, A.: Price clustering in Bitcoin. *Econ. Lett.* **159**, 145–148 (2017)
10. Jagdeep, S.: Syscoin: a peer-to-peer electronic cash system with blockchain-based services for e-business. In: *Proceedings of 2017 26th International Conference on Computer Communication and Networks (ICCCN)*. IEEE Press, Piscataway (2017)
11. Gideon Greenspan: Beware of the impossible smart contract, blockchain news (12 April 2016). <http://www.the-blockchain.com/2016/04/12/beware-of-the-impossible-smart-contr-act/>
12. The Digital Millennium Copyright Act of 1998-U.S. Copyright Office Summary [EB/OL]. (19 December 1998). <http://www.copyright.gov/legislation/dmca.pdf>. Accessed 09 June 2018
13. Rockman, H.B.: The Digital Millennium Copyright Act of 1998(DMCA)—An Overview, pp. 405–418. *Intellectual Property Law for Engineers and Scientists*. Wiley, Hoboken (2004)
14. Assembly Bill No. 129 [EB/OL] (28 June 2014). http://leginfo.legislature.ca.gov/faces/bilINavClient.xhtml?bill_id=201320140AB129. Accessed 09 June 2018
15. Mikolajewicz-Wozniak, A., Scheibe, A.: Virtual currency schemes—the future of financial services. *Foresight* **17**(4), 365–377 (2015)
16. Karame, G.O., Androulaki, E., Capkun, S.: Two Bitcoins at the price of one? Double-spending attacks on fast payments in Bitcoin. In: *Proceedings of the 2012 ACM Conference on Computer and Communication Security*, pp. 906–917. ACM, Raleigh (2012)
17. Kaushal, P.K., Bagga, A., Sobti, R.: Evolution of Bitcoin and security risk in Bitcoin wallets. In: *Proceedings of the 2007 IEEE International Conference on Computer, Communications and Electronics*, pp. 172–177. IEEE, Jaipur (2017)
18. Zhang, D., Liu, Z.: A four stages protocol designed to protect copyright in digital museum. In: *Proceedings of the 2010 Second International Workshop on Education Technology and Computer Science*, pp. 327–330. IEEE, Wuhan (2010)
19. Webster, J., Romanik, M., Webster, C.: Protecting digital assets: legal protections do not equal practical security. *IT Prof.* **17**(6), 56–59 (2015)
20. Liu, X.L., Lin, C.C., Yuan, S.M.: Blind dual watermarking for color images' authentication and copyright protection. *IEEE Trans. Circuits Syst. Video Technol.* **28**(5), 1047–1055 (2016)
21. Ziegeldorf, J.H., Matzutt, R., Henze, M., et al.: Secure and anonymous decentralized Bitcoin mixing. *Futur. Gener. Comput. Syst.* **80**, 448–466 (2018)