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Web3 Chain Authentication and Authorization Security Standard (CAA)

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Abstract:
Web3 is the next evolution of the internet, which uses blockchains, cryptocurrencies, and NFTs to return ownership and authority to the consumers. The potential of Web3 is highlighted by the creation of decentralized applications (dApps), which are more secure, transparent, and tamper-proof than their centralized counterparts, allowing for new business models that were previously impossible on the traditional internet.
Web3 also focuses on user privacy, where users have more control over their personal data and can choose to share only what they want. The emergence of Web3 represents an exciting new frontier in blockchain technology, and its focus on decentralization, user privacy, and trustless systems has the potential to transform the way we interact with the internet.
Web3 authentication is required for enhanced security, increased privacy, and simplified user interface. Traditional login procedures and an authorization flow using web3 authentication work together seamlessly. However, there are several challenges associated with Web3, including scalability and regulatory issues.
Chain Authentication and Authorization (CAA) is a multi-layer security mechanism that allows users to choose the security layer that suits them, just like a heavy iron chain, where the user and CAA developers act as blacksmith and form their security protocol that suits them. CAA is a solution to the challenges associated with Web3 authentication and authorization, and it focuses on creating a secure and decentralized authentication and authorization system that is scalable, flexible, and user-friendly.

Keywords: web3, blockchain, Authentication, Authorization, Cyber Security, Decentralized Apps.

I. Introduction:

Around 1990 until 2004, Berners Lee's invention, now referred to as "Web 1.0," underwent its initial development. Web 1.0, also known as the read-only web, was primarily made up of static websites that were controlled by businesses [1]. There was almost no user involvement, and people hardly ever created content.

Social media platforms' introduction in 2004 marked the start of the Web 2.0 era [2]. As the internet evolved, it transformed into a dynamic platform where users could not only access information but also contribute to it. Instead of simply offering static material, businesses began creating interactive platforms where users could generate and exchange content, as well as communicate with one another. With more and more people joining the online world, a few dominant businesses emerged, controlling a significant portion of the internet's traffic and overall value. Additionally, the Web 2.0 era brought about the advertising-based business model, allowing companies to generate revenue by displaying ads to users, even though the content was created by the users themselves, who were not compensated for their contributions

Gavin Wood, a co-founder of Ethereum, came up with the concept of "Web 3.0" immediately after Ethereum launched in 2014 [3]. Gavin proposed a solution to address a common worry among early adopters of cryptocurrencies, which was that the existing Web required too much trust. Essentially, many people felt that the Web we currently know and use relies heavily on our belief in a small group of private companies to act in the best interest of the public. The term "Web3" has emerged as a way to describe a new and better internet that addresses these concerns. In essence, Web3

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uses blockchains [4], cryptocurrencies, and NFTs to return ownership[5] and authority to the consumers [3]. By looking at the evolution of Webs we can say that Web 1.0 was read only, Web 2.0 is read-write, and Web 3.0 is read-write-own.

The emergence of Web3 is a promising development in the realm of blockchain technology. Web3 represents a shift towards a more decentralized and trustless internet, where applications and services are run on decentralized networks and governed by smart contracts. The potential of Web3 is highlighted by the creation of decentralized applications (dApps), which run on decentralized networks such as Ethereum and are governed by smart contracts. These dApps are more secure, transparent, and tamper-proof than their centralized counterparts, allowing for new business models that were previously impossible on the traditional internet [6] [7].

Web3 also focuses on user privacy, where users have more control over their personal data and can choose to share only what they want. This is made possible by technologies such as zero-knowledge proofs and decentralized identity systems [8]. Furthermore, Web3 has the potential to revolutionize the way we conduct financial transactions by enabling blockchain-based payment systems that settle transactions instantly and at a lower cost than traditional payment systems [9][10].

However, there are several challenges associated with Web3, including scalability and regulatory issues. Scalability is a key challenge as current blockchain networks such as Ethereum can only handle a limited number of transactions per second, which could limit the growth of Web3 applications. Solutions such as sharding and layer-two scaling solutions are being developed to address this challenge [11]. Another challenge is the regulatory environment, as Web3 applications become more mainstream, regulators are likely to take a closer look at them. It remains to be seen how regulatory frameworks will evolve to accommodate Web3 applications [12].

Potential of Web3 is significant, and ongoing research and development will be critical to its success. The emergence of Web3 represents an exciting new frontier in blockchain technology, and its focus on decentralization, user privacy, and trustless systems has the potential to transform the way we interact with the internet [6 – 8].

Although Web3 authentication sounds sophisticated, it is really a login mechanism [13]. For user authentication, Web2 websites employ email and passwords, but Web3 apps use crypto addresses [13] [14]. Specific blockchains power Web3 webpages, applications, and other services. Users must be able to securely connect to these crypto networks. Users are able to connect to a specified network with Web3 authentication. Users are permitted to connect to the network and communicate with other authenticated users after authentication. Therefore, every web3 DAPPs needs this authentication.

By bringing cutting-edge methods to manage and commercialise content, assets, and identities, Web3 wallets [15] [16] are establishing new benchmarks for the internet sector. Users using Web3 wallets can access currency using hardware or software, connect to decentralised applications, gather NFTs, and create on-chain applications. They are far more adaptable than conventional wallets. Although wallets don't really store cryptocurrency, they do contain the information needed to access it.

Web3 authentication is required for enhanced security, increased privacy, and simplified user interface. Traditional login procedures and an authorization flow using web3 authentication work together seamlessly. The mapping between each account's public address and the web3 authentication authorization route should also be completed. This permission flow, however, might not be the best option for everyone. Since the authentication must be done. User may have authentication app. Without a web3 authorisation tool like MetaMask, this authorization flow is inoperable [17]. Users may find it difficult to obtain this application, and its creation can be highly expensive.

Although web3 authentication is fairly easy to build, all aspects of authentication, such as signup, authentication routes, databases, etc., need to be changed.

II. Chain Authentication and Authorization (CAA)

What are the Chain Authentication and Authorization (CAA)? A multi-layer security mechanism focus on an environment where the user get the choice to choose the security layer for them just like the heavy iron chain, where the user and CAA developers act as blacksmith and form their security protocol that suits them [18] [19]. One can create the chain of security structure from basic to really advanced military grade, level 1 to level 5, with the help of the Web3 we can create the cross chain security protocol where user can interact multiple chains by using the CAA and they can Securely transfer funds, use CAA for their account login, interact with Dapps etc.

The process of identifying and analyse the authentication and authorization is depends on the interaction of the user with the environment, It depends on Decentralized Applications what kind of authentication and authorization mechanism the service provider want to provide to user and number of options available to user in the mean to use the

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Dapps.

Chain Authentication and Authorization (CAA) is a multi-layer security mechanism that allows users to choose the security level that suits them, just like a heavy iron chain. The user and CAA developers act as blacksmiths to form a security protocol that is tailored to their needs. CAA provides a chain of security structure ranging from basic to advanced military-grade, level 1 to level 5, with the help of Web3, enabling users to create cross-chain security protocols and interact with multiple chains using CAA. Several studies have been conducted on the use of CAA in blockchain technology, with most focusing on its implementation, effectiveness, and usability. In a study by Li et al. [20], CAA was found to be an effective authentication mechanism for Web3 applications, providing secure access to decentralized applications and enhancing user privacy. Another study by Xu et al. [2] proposed a hybrid CAA mechanism that combines blockchain-based authentication with traditional password-based authentication, enhancing the security and usability of the system. The scalability of CAA has also been studied by Liu et al. [22], who proposed a hierarchical CAA mechanism for large-scale blockchain networks. The study found that the hierarchical CAA mechanism was effective in reducing the computational overhead and enhancing the scalability of the system. The interoperability of CAA has also been explored, with several studies proposing cross-chain authentication protocols using CAA. A study by He et al. [23] proposed a cross-chain authentication mechanism that allows users to securely access multiple chains using CAA. Another study by Zhang et al. [24] proposed a cross-chain authentication protocol that enables secure communication between different blockchain networks. Privacy concerns in CAA have also been investigated, with studies proposing privacy-enhancing mechanisms for CAA. In a study by Wu et al. [25], a privacy-preserving CAA mechanism was proposed using homomorphic encryption, enhancing the privacy of user information in the authentication process. The usability of CAA has also been studied, with several studies proposing user-friendly authentication mechanisms using CAA. A study by Huang et al. [26] proposed a mobile-based CAA authentication mechanism, enhancing the usability and accessibility of the system for mobile users. Another study by Chen et al. [27] proposed a user-centric CAA mechanism that allows users to choose their authentication methods based on their preferences and needs.

Security Analysis:

Chain Authentication and Authorization (CAA) is a multi-layer security mechanism that allows users to choose the security level that suits them, just like a heavy iron chain. The user and CAA developers act as blacksmiths to form a security protocol that is tailored to their needs. Several studies have analyzed the security of CAA in the blockchain technology environment.

In a study by Han et al. [28], the authors proposed a security analysis framework for CAA. They evaluated the security of CAA in terms of confidentiality, integrity, and availability, and identified potential vulnerabilities and attacks that could compromise the security of the system. They also proposed countermeasures to enhance the security of CAA, including the use of multi-factor authentication and biometric-based authentication.

Another study by Liu et al. [29] analyzed the security of CAA in cross-chain transactions. The authors proposed a security model that identifies potential attacks and vulnerabilities in cross-chain transactions using CAA. They also proposed countermeasures to enhance the security of the system, including the use of multi-factor authentication and the integration of secure communication protocols.

A study by Gao et al. [30] evaluated the security of CAA in decentralized finance (DeFi) applications. They identified potential security threats and vulnerabilities in DeFi applications that use CAA for authentication and authorization. They proposed countermeasures to enhance the security of the system, including the use of secure communication protocols and multi-factor authentication.

In another study by Yan et al. [31], the authors evaluated the security of CAA in blockchain-based smart home systems. They identified potential security threats and vulnerabilities in the system, including attacks on user privacy and identity theft. They proposed countermeasures to enhance the security of the system, including the use of secure communication protocols and biometric-based authentication.

Finally, a study by Li et al. [32] analyzed the security of CAA in the context of blockchain-based supply chain management systems. The authors identified potential security threats and vulnerabilities in the system, including attacks on the integrity of the supply chain data and unauthorized access to sensitive information. They proposed countermeasures to enhance the security of the system, including the use of multi-factor authentication and secure communication protocols.

Overall, these studies show that CAA is a secure authentication and authorization mechanism for blockchain technology, but it is not immune to potential security threats and vulnerabilities. It is important to implement appropriate security measures and countermeasures to enhance the

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security of the system and protect user privacy and sensitive information.

Study	**[28]**	**[29]**	**[30]**	**[31]**	**[32]**
Security Analysis	Security framework	Security model	Evaluation of DeFi apps	Security threats in smart home systems	Security threats in supply chain systems
Security Aspects	Confidentiality, integrity and availability	Potential attacks and vulnerabilities in cross-chain transactions	Potential security threats and vulnerabilities in DeFi applications	Potential security threats and vulnerabilities in blockchain-based smart home systems	Potential security threats and vulnerabilities in blockchain-based supply chain management systems
Proposed Countermeasures	Multi-factor authentication and biometric-based authentication	Multi-factor authentication and integration of secure communication protocols	Secure communication protocols and multi-factor authentication	Secure communication protocols and biometric-based authentication	Multi-factor authentication and secure communication protocols

Usecase:1

The hardware wallet should include a fingerprint scanner for secure access. Upon successful fingerprint authentication, the wallet will generate a request and transmit it to the CAA server, along with details such as the user's computer make, location, and IP address. The CAA server will then cross-check these details with previous logs, and if they match, proceed with the next step of verification and validation. In the event of any discrepancies, the CAA server will prompt the user with additional questions to further validate their identity

The CAA process requires the user to provide their password and secret information. If all the necessary steps are completed successfully, the CAA system will take a picture of the account holder as well as the person who is accessing the account with the appropriate permissions. These pictures should match the uploaded pictures by the users during the setup of the CAA system. The Figure 1 depicts the use of CAA in hardware wallet.

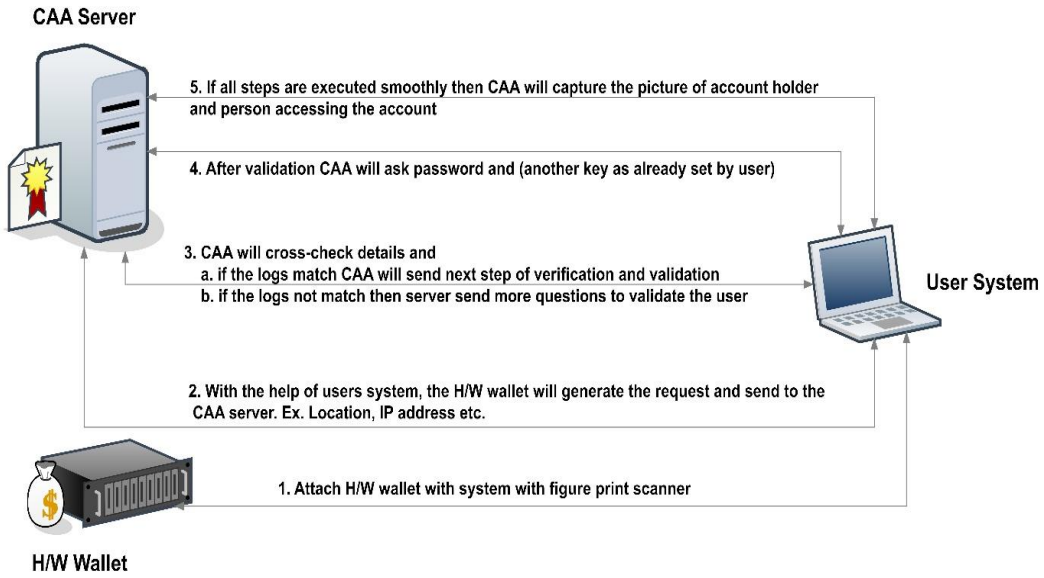

Figure 1: Hardware Wallet

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Use case 2:

Decentralized applications are becoming increasingly interactive, providing a more engaging user experience. However, users face potential security risks when they interact with these applications, as they typically need to connect their wallets and engage in transactions. As we have discussed earlier, how CAA provide a high level of security to hardware wallets. Now, let's explore how a CAA process can offer a secure environment for users when interacting with decentralized applications.

After logging into the wallet, if a user wishes to interact with Dapps' smart contract, a digital signature popup will appear on the screen. The user must press the button on the popup to sign the digital signature. Once the user has completed this step, the process will continue to the next step of CAA.The trust rating of the protocol and Dapps will then appear on your screen. The Figure 2 depicts the use of CAA in Software Wallet and Decentralised Applications.

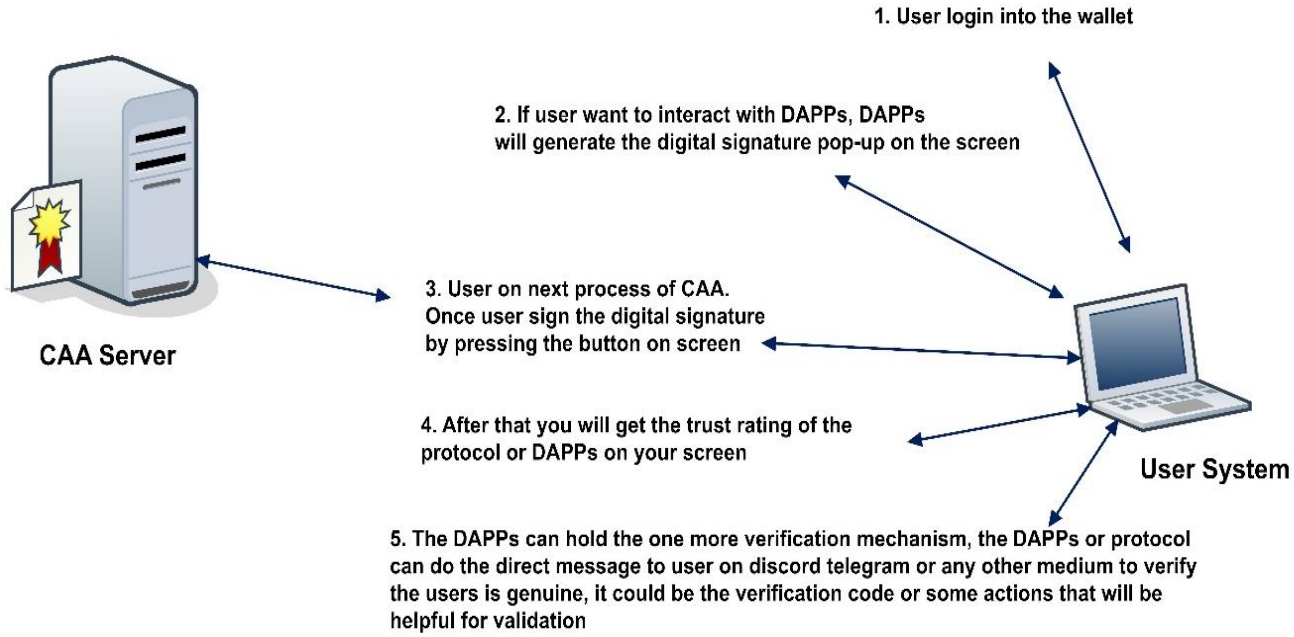

Figure 2: Software Wallet and Decentralised Applications

Dapps (decentralized applications) and protocols can implement an additional verification mechanism by sending direct messages to users on platforms like Discord or Telegram to confirm their authenticity. This process may involve providing a verification code or completing specific actions to validate their identity.

Dapps have the ability to control and manage the databases of users wallets and also to cross-check user identities. With the help of Artificial Intelligence (AI) advancements, there is the potential for even more progress in this area. For example, a user could submit an empty transaction, and the AI could analyse the wallet's balance and transaction history to determine whether it is a smart contract or a user wallet.

Even Dapps and protocol owners might set requirements for the list of transactions you must have in order to interact with or login to the protocol or Dapps.

Use Case 3:

Blockchain technology can also be used in agricultural sector to facilitate, supply chain management. Many a times we are not sure about from where exactly we are getting agro products. To check the genuinity of the products, blockchain technology is required. Using web3 authentication and authorization users of the agricultural sector can be registered to use the system.

Producers such as farmers or wholesalers will send their products to quality check personnel. Products will be pre-processed to ensure the quality. Nutritional aspects of the products are stored in the blockchain. Then producers will transfer these products with the nutritional data to the retailers. From retailers' products may transfer these products to secondary users. With the help of such supply chain product will be finally transported to the consumers i.e. end users or nutritionist. Tracking of such products with all the details like origin of the products, nutritional value, legal retailers, transportation, secondary users etc. can be

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done using provided QR code. The Figure 3 depicts the use of CAA in Agriculture sector.

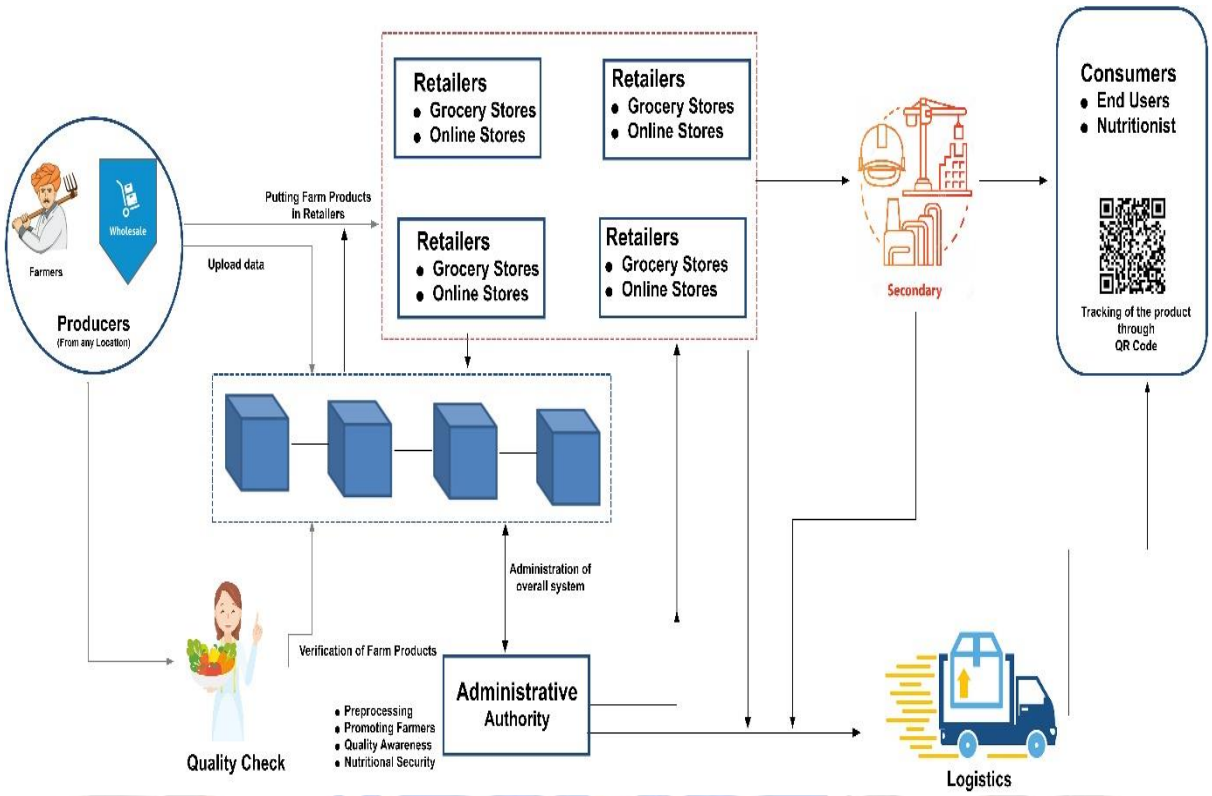

Figure 3: Agriculture Sector

III. Conclusion

Web3 refers to the next generation of the internet, which uses blockchain, cryptocurrencies, and NFTs to empower users with ownership and authority over their data and content. It represents a shift towards a more decentralized and trustless internet, where applications and services are run on decentralized networks and governed by smart contracts. Web3 has the potential to revolutionize the way we conduct financial transactions and interact with the internet.

Web3 authentication is a login mechanism that uses crypto addresses instead of email and passwords. Web3 wallets are also establishing new benchmarks for the internet sector by bringing cutting-edge methods to manage and commercialize content, assets, and identities. However, there are several challenges associated with Web3, including scalability and regulatory issues.

Chain Authentication and Authorization (CAA) is a multi-layer security mechanism that allows users to choose the security layer that suits them. It involves users and CAA developers working together to form their own security protocol, just like a blacksmith forms a heavy iron chain.

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