



Ethereum and Its Future: A Review of Cryptocurrency

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Abstract: The use of Ethereum and its application is increasing day by day and by people, therefore, moving towards the cryptocurrency things of the scheme. As the scheme of technologies increases, the hackers and the threats increase together, so protecting your privacy and data also becomes vitally important nowadays. While the blockchain system is a very protective and secure environment it gives you control as many people think only about bitcoins there are many currencies and tokens which use the same system and provide you the same security and application and even more as the future of Ethereum is bright and it can be used in the system which has more vulnerabilities in the present days. As we research Ethereum we get to know about the uses and threats we are missing and applications to protect it.

Keywords - Ethereum, Blockchain, Application of Ethereum, Threats, Security, Ethereum 2.0.

I. Introduction

Vitalik Buterin, Gavin Wood, and Joseph Lubin created Ethereum, an open software blockchain network. The Ethereum Virtual Machine serves as the backbone for a wide range of distributed applications as a decentralized platform that enables smart contracts (dApps). Ether (ETH) is the second-largest blockchain token by market capitalization after Bitcoin, and it is the cryptocurrency token that permits transactions between participants in the Ethereum network[2].

A. History of Ethereum

Because of his study and work in the Bitcoin community, Vitalik Buterin first outlined Ethereum in late 2013. Shortly after, Vitalik published the Ethereum white paper, in which he explains the technical design and justification for the Ethereum protocol and smart contract architecture in great detail. Vitalik Buterin publicly unveiled Ethereum during the North American Bitcoin Conference in Miami, Florida, USA, in January 2014.

Around the same time, Vitalik began collaborating with Dr. Gavin Wood, and the two eventually co-founded Ethereum. Gavin published the Ethereum Yellow Paper, which served as the technical specification for the Ethereum Virtual Machine, in April of 2014. (EVM). The Ethereum client has been built in seven programming languages (C++, Go, Python, Java, JavaScript, Haskell, Rust) by following the comprehensive specification in the Yellow Paper, resulting in superior software overall[2].

B. How Ethereum works

The blockchain application age has just begun. Ethereum is positioned to become the de facto blockchain platform for the development of decentralized apps. We saw in earlier chapters that public blockchain applications aren't only for cryptocurrency, and the possibilities are only limited by your creativity! Ethereum has already made advances in a variety of industries, and it is ideal for both public and private blockchain use cases. Ethereum has already established itself as a gold standard for blockchain platforms, and it must be thoroughly understood to foresee how practical decentralized apps might be constructed with or without Ethereum. Thanks to Ethereum, it is now feasible to create blockchain applications with only a basic understanding of cryptography, game theory, mathematics, or complicated code, as well as computer science principles[1][4].

C. From Bitcoin to Ethereum

Bitcoin pioneered blockchain technology in 2009. People believed in the potential of blockchain after Bitcoin withstood. The application cases have now expanded beyond banking and finance to include supply chain, retail, e-commerce, healthcare, energy, and government. This is attributable to the fact that many types of blockchain have emerged, each of which addresses a specific business challenge. Nonetheless, public blockchain platforms such as Ethereum allow various decentralized use cases to be created on the same Ethereum open blockchain platform.

Bitcoins allowed for decentralized peer-to-peer cryptocurrency transactions. People discovered that blockchain could be used for anything of value, not only cryptocurrencies, to transact and maintain track of it. People began to wonder if the Bitcoin network might be utilized for other purposes. To give an example, "proof of existence" is a use case in which the hash of the document is injected into the Bitcoin public blockchain so that anybody can subsequently verify that the document existed at some point in the past. The Ethereum blockchain technology was established by Vitalik Buterin, and it has the potential to ease exchanges of not only money, but also shares, properties, digital content, automobiles, and a variety of other assets with inherent worth[10][14].

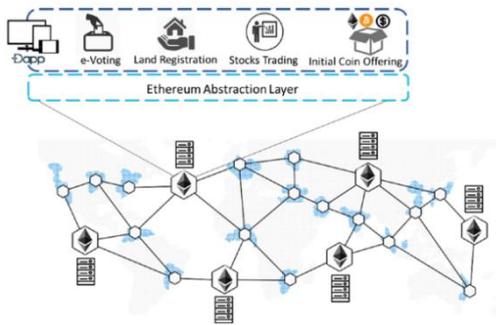


Figure 1: Multiple decentralized applications on one Ethereum platform[10].

D. *Ethereum as a Next-Gen Blockchain*

Our developer community has either attempted to construct multiple decentralized apps using a completely new blockchain or is attempting to alter Bitcoin Core to expand the scope of functionality. The goal is to make it easier to deploy many blockchain apps on the Ethereum network rather than having to create separate blockchains for each one. Ethereum allows for the quick creation of interoperable decentralized apps while also assuring complete security. Ethereum does this by constructing an abstract foundation layer, as discussed in the preceding section[4].

The language is comprehensive, allowing anybody to create smart contracts that can perform nearly any programming task. Also, unlike Bitcoin, where everything is done in the form of a transaction and there is no internal permanent storage for scripts, Ethereum is state-designed and keeps track of account states. DApps are Ethereum's term for decentralized apps.

DApps are programs that operate without downtime, fraud, or any type of regulation on Ethereum, a worldwide distributed system with no centralized server. A DApp for a peer-to-peer electronic currency system like Bitcoin is simple to create on Ethereum. DAaps is a token on Ethereum. To put it another way, «code» is inserted as a payload inside transactions, which are subsequently delivered to the Ethereum network's mining nodes[5].

When approval is attained, the completed transaction is transformed into a block and becomes a permanent part of the blockchain. Developers may build whatever solution they want and deploy it on the Ethereum network. This is done entirely by the network, which also validates and generates outputs. The network would not be viable if it did not have any charges.

Each blockchain transaction has a gas cost associated with it, and creating some junk code and deploying it to the Ethereum network might be costly.

II. APPLICATIONS OF ETHEREUM AND D-APPS

Ethereum is the second most used cryptocurrency and second most valuable cryptocurrency by market cap. Ethereum was invented by a Russian-Canadian Teenager Vitalik Buterin. Vitalik Buterin was very interested in the cryptocurrency scene and wanted his token and then Ethereum came into play. Ethereum right now is working on the process of proof of work which involves multiple miners to verify/validate the work before the work/job is accepted.

There have been developments happening to Ethereum and soon this will transition into proof of stake where the nodes are supposed to stake a few of the Ether whoever has the most stake gets the job and if the miner gives out the wrong output a deduction is made in the staked Ether this is the next version of Ethereum which is known as Ethereum 2.0.

A. *Applications of Ethereum*

- Ether is the cryptocurrency of Ethereum which can be used to make peer-to-peer payments using Blockchain technology [5].
- Ethereum has a feature called smart contracts which helps you to develop different kinds of smart contracts and deploy them [5].

- D-Apps (Decentralized Applications) are the applications that are built on the Blockchain these apps are decentralized so the power of the application doesn't rest on a single node or a person[5].
- DAO (Decentralized Autonomous Organizations) are allowed by Ethereum to make decisions for the democratic purpose one good example would be e-voting as it is decentralized and is highly impossible for anyone to make changes.
- An application that is used to make road tax payments using multiple cryptocurrencies this application stores the road tax paid on the blockchain so there wouldn't be any problem in the future[11].
- There are a lot of freelancers in India and most of them depend on centralized freelancing websites as the middle man between the employer and the freelancer these websites are centralized so these websites can be manipulated very easily by the middleman so using Blockchain technology a contract is made which cannot be manipulated in any way[12].

B. D-Apps (Decentralized Applications)

The application's power or database is not centralized or controlled by a centralized server, node, or person.

Example-

When a centralized application like Instagram is opened the page will call the API to access the data and that data is gotten from a centralized database.

The same when done in a decentralized application and when logged in the same way that the app (Instagram) calls in a smart contract-based API to get the data from the Blockchain network, here the smart contract is getting the same information from the blockchain rather than the conventional way of getting it from a centralized server or a database. Blockchains are not centralized networks they are decentralized networks in which the miners validate the transaction that is happening using a smart contract on the Blockchain network.

Without a doubt, the blockchain notion is a game-changing concept. It is the technology that underpins bitcoin and many other cryptocurrencies. Although most people's attention is focused on blockchain as cryptocurrencies, it will attempt to replace the present system of currency, which is a very sluggish and old approach, by using it in everyday services to make payments online without the involvement of a third party. Because blockchain is a zero-trust network, it can be a highly effective instrument for a variety of services if people are willing to believe in it and invest in it. The Ethereum blockchain is powered by smart contracts, which are self-executing apps that come with a security cost. This zero-trust network has the potential to replace many of the hotly disputed processes and activities in our daily lives. One of our main concerns is the security of an electronic voting system. Because blockchain is an immutable and append-only ledger, it cannot be tampered with while being completely visible [13].

D-Apps run on a distributed peer-to-peer network. An application is only considered a D-App if it is an open-source application, and it should use public Blockchain base currency or token to run the application and not private Blockchain base currency or token to run the application [5].

Advantages of D-Apps are No Downtime, No Data misuse of the user, Quick and easy to deploy, Usable without a frontend.

The disadvantages of D-Apps are Immutable, might be difficult for future upgrades. Compute resources of the miners has to be shared with other D-APPS.

C. Challenges

- Recursive function calls that result in unexpected behavior and may lead to miscalculation of funds and leads to huge gas utilization. A good example of this is the attack that happened in the Ethereum network during its early stage leading to the creation of Ethereum Classic and Ethereum[15]
- The dependence of multiple transactions on the same contract can lead to a vulnerability within the transactions if they are not executed in the right order. This is because miners control what transactions are executed and their final state depends on how the miner orders them[15].
- Since all the transactions within the blockchain are recorded and can be publicly accessed, it is possible to access a user's private information by analyzing transaction history[15].

D. COMPARISON BETWEEN ETHEREUM AND OTHER CRYPTOCURRENCY

Over the past decade, the number of active users in the Ethereum network has increased significantly surpassing major cryptocurrencies like litecoin and Binance. While it is behind bitcoin in terms of the number of active addresses it is likely to change in the coming years. The reason for this rise is the features Ethereum provides. While bitcoin tries to just provide a currency for exchange, Ethereum provides a platform for its users which includes its Virtual Machine for running distributed applications in the

chain, the creation of custom tokens backed by the Ethereum currency which can significantly improve the speed of transactions (Raiden Networks), A well-documented programming language for building distributed apps and a large number of tutorials for creating applications on the blockchain. Another major reason for its growth is they actively try to make the network more accessible to new users by putting mechanisms in place to allow users with consumer-level hardware to participate in the network as miners and earn cryptocurrency. Due to its sheer size in terms of market share, it has started to set standards for running applications on the blockchain and many emerging and existing blockchains rely on the Ethereum network to run their applications. All of this has made Ethereum a leading player in the development of web 3.0 allowing a new generation of businesses and entrepreneurs to kickstart their ventures in the new generation of the internet [10].

COMPARISON OF ACTIVE ADDRESS OF CRYPTOCURRENCY

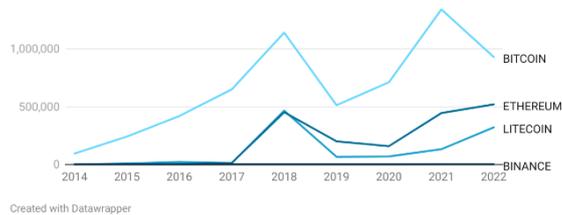


Figure 2: comparison of active addresses throughout the years [10].

E. Threats and Security

- Data is Everywhere, and its value is immensely growing, also Technology has developed enough such that we generate tons of data every single second. The value of data is so much that every enterprise has started using them to grow their business and profits. The business worth of information has never been more prominent than it is today. And at the same time, cyber security threats are being performed by individuals with harmful intent that their goal is to steal this valuable information or data, and cause damage to or disrupt the computing systems [6].
- Threats could occur from many sources, and all those sources could be broken down into three groups – the human factor, the technological factor, and the natural disaster factor. The human factor – threats being performed by the individuals who either are authorized or unauthorized to the information. Human threats include the use of improper settings or parameters when software is installed. Intentional and malicious technical threats that typically involve the use of technical devices to cause trouble, which include software bugs intentionally added to computer programs, malicious software that modifies or destroys data – such as viruses, worms, and Trojan horses, back doors that allow unauthorized access to a system, eavesdropping programs are designed to copy and transmit communicable theft, vandalism of the hardware, disruption, accidental or intentional errors. People's security breaches can occur intentionally or unintentionally. Insider security breaches occur, unintentionally as a result of simple negligence, inattention, or a lack of education. System administrator errors, operator errors, and programming errors, Theft is a crime in which an attacker obtains personal or sensitive information from a victim through hypocrisy or fraud, and then uses that information such as passwords, ID numbers, credit card numbers, or social security numbers, and misuses them to act fraudulently in the victim's name. This private information could be used for a variety of illegal purposes. The term vandalism describes the purposeful act of damaging or destroying another person's property without their permission. The act of intentionally breaking or destroying computer hardware is known as computer or hardware vandalism. Cyber vandalism includes Hacking a website, deliberately causing harm or destruction to a digital object, posting fake news, and reviews, Cheating or creating bots to cheat in online gaming, Posting fake news on a social network, Post a virus or other malware for others to download unknowingly. Technological Factor - Unintentional, innocent, or negligent technical threats that include software bugs and system configuration errors, such as a virus or other information, network spoofing, and denial of service Password cracking, email hijacking, packet replay, and packet modification are all examples of cyber-attacks. Natural Disaster Factor - These can best be thought of as threats caused by Nature - floods, earthquakes, tornadoes, temperature extremes, hurricanes, and storms are all examples [6].
- Threats are of many types - including malware, social engineering, man in the middle (MitM) attacks, denial of service (DoS), and injection attacks. Malware is nothing but software that is intended to damage or disable the systems, devices, and networks and can cause harm to them, and even in malware there are several types like a virus, worm, trojan horse, spyware, adware, and ransomware where viruses are intended to damage a device by corrupting the information, reformatting your hard disk and completely shutting down your system or device, worms are into spreading over computer networks by making use of the operating system vulnerabilities, spyware is designed to track down our browsing and internet activities and adware being known for its advertising software that displays unwanted advertising on your computer screen, and ransomware is a malware designed to deny a user or organization access to files on their computer. Cyber attackers encrypt these files and demand a ransom payment for the decryption key, putting businesses in a position where paying the ransom is the simplest and cheapest way to regain access to their data. Social engineering involves those malicious activities that are accomplished through human interactions such as by baiting, scareware, pretexting, phishing and spear-phishing where baiting is a type of social engineering attack in which a scammer uses a false promise to lure a victim into a trap which may steal personal and financial information or inflict the system with malware, Scareware involves victims being bombarded with false alarms and fictitious threats, Phishing involves a process of attempting to acquire sensitive

information such as usernames, passwords, and credit card details by masquerading as a trustworthy entity using bulk email, SMS text messaging, or by phone which creates a sense of curiosity in a person's mind, Spear phishing is an email or electronic communications scam targeted towards a specific individual, organization or business, and Pretexting is a type of social engineering attack that involves a situation, or pretext, created by an attacker in order to entice a victim into a vulnerable situation and dupe them into divulging personal information, particularly information that the victim would not normally divulge outside of the pretext. A man-in-the-middle attack (MitM attack) is a cyberattack where an attacker relays and possibly alters the communication between two parties who believe they are communicating directly which allows the attacker to relay and possibly modify communication between two parties who believe they are speaking directly to each other. This allows the attacker to relay communication, listen in on conversations, and even change what each party says. Denial-of-Service (DoS) attack is an attack meant to shut down a machine or network, making it inaccessible to its intended users which could be accomplished by flooding the target Whether it's interacting with traffic or sending it information that causes a crash. And during an injection attack, an attacker can provide malicious input to a web application (inject it) and change the operation of the application by forcing it to execute certain commands[9].

- Data security is a subset of information security that is concerned with ensuring the safety of your data. There are several potential threats to the data you're storing as your reliance on computers grows. Data can be lost as a result of a system failure, or it can be corrupted by a computer virus or altered by a hacker. An overwritten or deleted file can be caused by a simple user error. Plus, lost devices such as a tablet or smartphones can see your data fall into the wrong hands. Data must be secure to Ensure Business Continuity, Avoid Data Breaches, and prevent unauthorized access. Data can be secured in many ways such as by Backing up your data, making use of strong passwords, taking care of systems or devices when working remotely, being aware of suspicious emails, installing anti-virus and malware protection, making sure that our Wi-Fi is secure, locking your screen when we are away from our desk, keeping on top of who has access to what, by not keeping our data for longer than we need it, and by disposing of the old IT equipment and records securely[7].

III. literature review

A. Factors affecting Cryptocurrency Prices: Evidence from Ethereum

Authors

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Due to the massive growth of Bitcoin among the masses, the cryptocurrency market has seen major growth in terms of users and services that the powered by blockchain technology. Aside from Bitcoin, Ethereum is a cryptocurrency that is fast gaining popularity and has started to dominate the cryptocurrency space. However, just like any physical currency the prices of these cryptocurrencies keep fluctuating, this fluctuation can be due to several factors that can be mainly classified as factors within the cryptocurrency market or factors affecting the economy of the world. Among the factors within the cryptocurrency market, it is found that the price of Ethereum can mainly be affected by the other cryptocurrencies like bitcoin, Litecoin, and Monero, since these cryptocurrencies compete with each other they release features and mechanisms that impact their userbase and network which in turn affect the prices of these currencies. Secondly, the global economy has a significant impact on the value of Ethereum this is because Ethereum and other cryptocurrencies are either directly or indirectly backed by global currencies and amongst these currencies, the US dollar and EURO have the main influence since the value of USD/EUR goes down then it affects the exchange rate of these cryptocurrencies bringing down their value.

B. The scalability challenge of Ethereum: An initial quantitative analysis

Authors

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Concerns about permissionless Blockchain networks' scalability are a major roadblock to their widespread adoption. It is critical to analyze current implementations and enhancement recommendations within a single cohesive evaluation methodology to address this issue. To address this problem, we can take a three-step approach to understand this problem in the context of Ethereum, a popular Blockchain implementation. To begin, it maps the underlying components of Ethereum onto a layered architecture based on the ISO/OSI model, allowing for a better understanding of its provisioning structure. Second, it leverages the AKF Scale Cube to assess the benefits and drawbacks of the current Ethereum specification, as well as current upgrade ideas, to rationalize the scalability issues. In the final step, the Ethereum implementation was evaluated using a synthetic benchmark by executing a smart contract in a private environment. The result of this process indicates that Ethereum prioritizes security over scalability however this issue can be reduced by the implementation of plasma and sharding that can improve load balancing and better improve the performance of the network.

C. Evaluation of Ethereum End-to-end Transaction Latency

Authors

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The migration of the internet from Web 2.0 to Web 3.0 is a significant step in the overall progression of the internet. Due to this many businesses have started to look into the establishment of their services in the blockchain. Ethereum has become one of the big players in empowering these businesses thanks to the platform it provides for creating and executing distributed applications. While it has addressed many of the problems in building and maintaining distributed applications one major problem which persists is the

latency of transactions. Due to the nature of the blockchain, there is a certain level of latency in the creation of transactions at the client end it getting recorded in the blockchain. This is a major setback for many businesses who want to establish a service on the blockchain that deals with an enormous amount of transactions. In the context of Ethereum, it comes down to how transactions are processed. In short, Ethereum used proof of work to write transactions to the blockchain which was expensive in terms of transaction fees because there was a limit on how many transactions it can process per second, however in recent years it has completely migrated to proof of stake mechanism which drastically improved number of transactions it could process per second and it reduced the transaction fee which has made it more accessible to both consumers and businesses alike for as a viable platform for hosting online services.

D. ETHEREUM ANALYSIS VIA NODE CLUSTERING

Authors

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Ethereum provides decentralized Ethernet virtual machines to handle peer-to-peer contracts through its dedicated cryptocurrency Ether as an open-source public blockchain with smart contract capabilities. And, as the world's second-largest blockchain, Ethereum's transaction data is rapidly growing. These data can be analyzed to help researchers better understand Ethereum and identify attackers among its users. However, at this time, the majority of Ethereum data analysis is based on statistical characteristics of Ethereum nodes, with no analysis of transaction behavior between them.

IV. FUTURE OF ETHEREUM

Since the release of Bitcoin in 2009 many blockchain technologies have been created each aimed to solve some problems that bitcoin phases. The saturation of choice of technologies available is very vast either for better or worse. Over the years many of these decentralized networks have grown or perished due to many reasons. Among the networks that have grown over the years and gained attraction from the masses, one of the main names that stand out is Ethereum. Ethereum along with bitcoin has become a popular name when referring to cryptocurrency. While they both are similar in the nature that they follow the same fundamental principles they both differ widely in terms of their functionality and feature set. While bitcoin is currently the most valued cryptocurrency in the market, Ethereum is showing significant growth with no sign of stopping. One of the main reasons that constitute its growth is that it was created to provide a platform for running decentralized applications and allow users to create and run their transactions through smart contracts all of this powered by its currency. Over the years it has added newer functionality through new versions of its currency. To understand how far it has come we should look at the various major releases of Ethereum[7].

A. Ethereum 2.0

Ethereum as a network has seen a significant amount of growth since its launch and due to this an overhaul of the network is much needed to accommodate new nodes that join the network. Right now the major concern many stakeholders have is in regards to scalability and the increasing cost of transactions in the network. Ethereum 2.0 aims in changing this by introducing a variety of new mechanisms to improve the efficiency of the networks some of the most notable mechanisms include

- **Sharding:** In this mechanism, the entire Ethereum network would be split into multiple parts and each part is independent with its own set of nodes whenever a new transaction has to be processed, all the nodes in the network have to process it since it can be processed by nodes of a single shard. In the current version of the network, a new node has to download the entire ledger to become part of the network and since the ledger size of the network is above 1TB it significantly reduces the number of nodes that can join the network. Sharding would improve this situation by requiring new nodes to only download part of the ledger and would allow users to access blockchain clients on small-scale devices like smartphones or laptops.
- **Proof of Stake:** Proof of stake is a mechanism for creating new blocks in the network and validating them. In this system, users can stake a part of their cryptocurrency to become validators whose responsibility is to create new blocks and validate new blocks they did not create. In this system, a validator is chosen at random to validate a block and is rewarded a part of the staked cryptocurrency for their work. It is much more energy-efficient and allows more nodes to participate and get rewarded in the process thereby preventing the network from being more centralized.
- **Plasma:** The idea of plasma is to create a framework allowing the Ethereum main network to create sub-chains or child blockchains that in turn have child blockchains. These chains can be created to work differently and are independent of other chains. This would overall reduce the congestion of the main network since a large portion of the work can be processed by child chains than the main chain.
- **Raiden Networks:** These are networks outside of the actual blockchain that allows transactions to take place before recording them on the main chain. It allows the users to convert some of their cryptocurrency into tokens that can be used in the Raiden network. This allows for fast transactions with cheaper transaction fees since it only requires fewer transactions to be recorded in the main chain[8].

B. Future Applications of Ethereum Smart contracts

- It is useful for processing financial transactions such as providing online insurance, processing direct money transactions between two users, and providing and tracking loans. While these applications are presently only available through centralized services such as bank servers. Decentralized applications built using smart contracts can provide these services with better performance and better security [15].
- Smart contracts are useful in creating market prediction applications. Their con and immutability make them most suitable for making real-time market prediction applications[15].
- It can be used in the field of IoT to develop security services and devices, such as smart locks that can only be opened when the right passphrase is given or by connecting a physical key that contains a private digital key that unlocks the lock [15].

V. ACKNOWLEDGMENT

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Conclusion

With the huge developments in Ethereum 2.0, the network has started to address some of its major flaws and as of today, the Ethereum 2.0 network called the Beacon chain is currently up and running alongside the current chain. It has addressed the problems with proof of work that only allowed certain nodes that dominate the network by replacing it with proof of stake that would make the platform accessible to a larger number of users. It would be without a doubt that Ethereum would soon overtake its major rival bitcoin both in terms of popularity and market cap very soon. It has consistently launched updates and releases for its future version in various phases and is expected to launch in June of 2022.

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