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Blockchain for Web 3.0: The Technology Redefining the Internet

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Abstract

Technology is in the hands of Tech-Giants whether it's you ordering your daily needs from applications or using enterprises solutions for growing your business companies like Google, Microsoft, Meta, Amazon, Zomato etc. have set their monopolies in the market by using data. They have created a cycle by using this data for forging ads on our faces. This is all happening because we use Traditional architecture which Client-Server architecture (Centralized architecture) where we clients use resources of the server (Organizations) instead of which they charge for some platform fee and if its free it comes on the cost of our privacy. We surf web for getting even smallest information such as reaching to a location, gift ideas, educational content, entertainment content etc. and all this gets stored to a server located somewhere miles away from you without you having any idea. To stop all this, we have to start decentralizing things for which we can use Blockchain which act as a distributed data storage system where data is divided between the users who use that data and no involvement of any server or organization. This decentralized implementation in browsing is called Web 3.0 where information is shared between users without any involvement of browser engines.

Keywords: Web 3.0, Blockchain, Decentralizing services, Smart Contract, NLP.

1. Introduction

'Data' this particular word is trending in any industry right now whether its banking, IT, Healthcare etc., jobs such as data analyst and data scientists are being paid more than ever for using data to achieve business objectives and boost profits. Every organization wants more and more data which helps them to target their customers whenever they want and however they want. But how do they get this data from? The answer is the consumer itself; IT solutions bring convenience to everything from making payments in minutes sitting at home to ordering daily grocery at home everything has been made so convenient for the user that we don't even think about how dangerous it is to give your data to a 3rd party application they can get attacked, they can sell your data, they can misuse your data but we don't give it a second thought.

Recently there have been many data breaches which attacked valuable information of users such as Central Tickets which is a theater ticketing platformin London reported data breach in their system of approximately 1 million users where their database was compromised by the hacker. Other than that Cisco a multinational technology company which develops and sells networking hardware software got hit by a major breach where hackers stole confidential data and source codes. Game Freak the studios behind Pokemon video games faced a massive data breach where hacker stole data thousands of Employees data. Famous and addictive social media platforms such as Instagram, Facebook are under investigation of EU (European Union) for violating Digital Markets Act.

All this is happening because these organizations have monopolized the market with their products compelling users to use them anyhow such as if you want to get information Chrome, if you want to order products Amazon, for chatting Whatsapp, for socializing Instagram; everything is being handled by them cause of the convenience they give but not on the cost of our privacy and this is the reason we need to introduce Web 3.0 where there is no centralization of services meaning that we still will be able to make payments , we still will be able to chat and socialize but now on a complete decentralized web where there is no entity in between the users instead the data is distributed between the users itself with the help of blockchain which maximizes the security and integrity of data. In this paper we will

see how Blockchain can be used to reshape the future of internet and how is it safe for everyone using internet.

1.1. Introduction to Web 3.0

We have been using the second version of World Wide Web (WWW) where the first version had some plain static web pages second version was way more dynamic and highly interactive where we saw applications such as Facebook, Twitter etc. But now Web3.0 the emerging technology, the aim of this technology is to decentralized web where the users are not depended on the servers to be able to get the information instead, they share all their data securely with each other. This is possible with the help of Blockchain technology where the information is stored in the ledger and the ledger is stored in a block and all the blocks are connected with each other using hash of their previous block.

1.2 Features of Web 3.0

Artificial Intelligence Integration- AI will become the cognitive layer of Web 3.0 where machines will be trained on deep learning algorithms to understand online content. (Goswami et al., 2024) (Goswami et al., 2023) (King & World Economic Forum, 2022)

- Self-Learning Models: Here AI will continuously learn from **decentralized** user data which we call as reinforcement learning, based on which it will provide recommendations. This is important because the recommendations are not being decided by some centralized entity but by the user itself.
- NLP (Natural Language Processing) will be used to understand and decode the linguistics and understand online communication. (Patel & Goswami, 2021) (Darji & Goswami, 2024)
- Personalized Content Curation: NLP will help parsing user's request even if they are vague and not correctly phrased still it will suggest highly relevant data because of previous behavior patterns. (Patel & Goswami, 2021) (Darji & Goswami, 2024)

AI powered Recommendation engines are already being used such as Netflix Recommendation Engine (NRE) which suggests content based on viewer activity, the reason of integration of AI in web 3.0 is because tech companies have used AI to extract values from users and gain insights but because of this the users will become owners. AI will help them to gain better search results even before user has asked it do so which will save time and is

secure because data is being used by their personal AI model which is trained by their data and there is no centralized server where this data is going.

Decentralization: Web 3.0 introduces decentralization of information, where in Web 2.0 user requests a particular information through a 3rd party search engine this is exactly opposite. In web 3.0 information will still be exchanged between two entities but not through any service provider instead directly to each other with the help of Blockchain technology.

Figure 1. Web 3.0

Participation without authorization: With the decentralization users will be able to participate without needing any permission from a central authority. Because Web 3.0 is based on Blockchain technology which works on public and private keys and no user identity is required the Web will be full of anonymity of personal data. This does not bring any risk also because these keys are traceable.

Blockchain Fundamentals

Web 3.0 is solely based on blockchain technology so let's understand how Blockchain works. Blockchain is nothing but a collection of Ledger. A ledger is where the data or a transaction is store think of it as a diary where one keeps their accounts, ledger is exactly like that but electronically stored in a Block now a block has a capacity until which it can store data after which the further ledgers are stored in other block and all these blocks are connected with each other by the hash value of previous block and this is why it is called Blockchain.

1.3 Working of Blockchain

The whole purpose of the blockchain technology is to remove any centralized authority controlling user data and therefore the structure of a blockchain network is similar to Mesh topology where all the nodes(users) are connected with one another and all the decisions are

made by all the nodes present in the blockchain network. (Goswami et al., 2024) (Goswami et al., 2023)

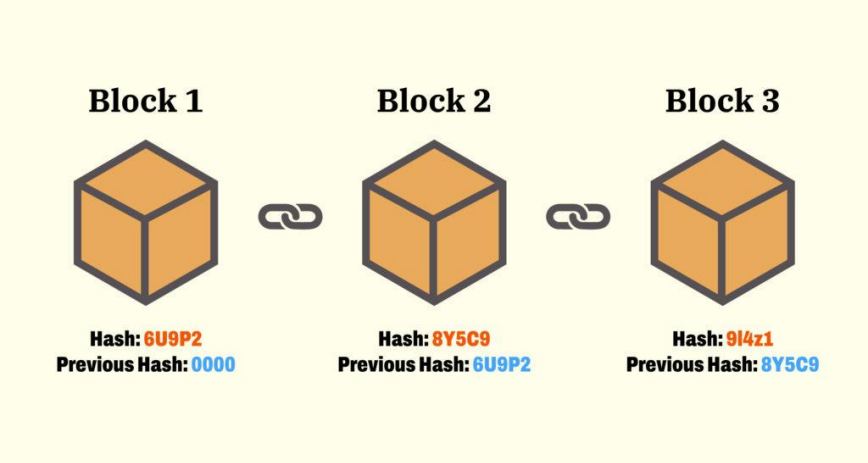

Figure 2: Representation of Blockchain network.

Blockchain works on transaction and consensus mechanisms.

- Flow of a transaction:

  Ask for transaction- Transaction request is sent to all the nodes present in the network.

  Verification- All the nodes verify or we can say validates the transaction requests.

  Mining Process- Where the new block is added in the networking Transaction Over.

- Consensus:

  This is a general agreement sent by all the other nodes after validating the transaction request. There are various types of Consensuses such as

  Proof of Work: Where one gets reward for adding a block in the blockchain by guessing the correct nonce number after which all the other nodes verify that and send consensus.

  Proof of Stake: Here all the nodes put their cryptocurrency on stake the highest stake wins and adds the block into the blockchain.

  Proof of Burn: Here all the nodes put their cryptocurrency but not on stake they will not get it back once given the currency will be lost forever even if lost.

Proof of Elapsed Time: Here all the nodes are given random time by their TEEs (Trusted Execution Environment) the node with the lowest time gets activated sooner and can add a block in the blockchain.

Example:

Imagine a blockchain network which incorporates A, B, X, and Y and X would like to remit an amount of 50 rupees to Y. To begin with, X makes a transfer request and informs A and B that it wants to sue an amount of 50 rupees in a particular transaction. A and B would settle this matter by succeeding in verifying the transaction details. In the case that X is willing to transfer 50 rupees, then it must also possess 50 rupees and this is verified during the processes verifying the transactions. When they have been approved, the transaction is then entered into the sequence of transactions maintained on the ledger this will house one of the blocks. Following this, the ever-expanding current blockchain in use on the network will acquire this block so that all the updated algorithms of the ledger are common to all. This process makes the system quite secure and decentralized as it is not one authority that verifies the transactions but rather all the participants in the network.

2. Role of Blockchain in Web 3.0

Blockchain is a decentralized approach towards services, where all the data is stored in ledgers which build up blocks which are connected with one another forming a blockchain. Currently web 2.0 is controlled by centralized authorities such as Google, Microsoft etc. they control the data and use that data to manipulate users and therefore Web 3.0 which uses decentralized approaches using blockchain technology. (Goswami et al., 2024) (Goswami et al., 2023)

- Blockchain-Powered Infrastructure:
  - Decentralized DNS(DDNS): Work of DNS is to convert domain names into IP address and vice versa however this is all handled by a centralized organization which is Internet Corporation for Assigned Names and Numbers (ICANN). But in Web 3.0 domains can be managed on Blockchain which is Ethereum Name Service (ENS) replacing the controlling of a centralized organization.
  - Content-addressed systems: Currently we use URLs (Uniform Resource Locator) for accessing files and resources however with Blockchain approach we can use

Interplanetary File System (IPFS) where files are fetched based on hash(content) rather than location.

Example: Let's say you own a video file that you wish to save and distribute: A traditional web paradigm would see you uploading the video to a specific server which provides you with a hyperlink. When using IPFS instead, one uploads the video and the system creates a content hash specific to the video which can be used to refer to the video (for example QmYHnX…). You can then share this hash with anyone. Anyone who wants to access the video can use the hash to retrieve it from any node that has stored the video, regardless of its original location. (Waqas, 2024)

- Peer-to-peer communication in Web 3.0: Protocols such as Hyper-Text Transfer Protocol (HTTP), Hyper-Text Transfer Protocol Secure (HTTPS) are backbone of internet but in Web 3 we will use Peer to peer protocols approach:
  - Distributed File Storage and Communication: In web 3.0 client-server model will be replaced by distributing data across multiple nodes in the network therefore here node act as both client and server and fetch data from other nodes in the network. (Laguna, 2024) (King & World Economic Forum, 2022)

- P2P protocols:
  - BitTorrent: BitTorrent splits the file to multiple nodes in small chunks which allows users to download chunks from multiple users simultaneously which is more efficient and removes censor or shutdown data as its not relying on a single source.
  - Swarm: It is same as BitTorrent but is used in Ethereum Blockchain. (Laguna, 2024) (King & World Economic Forum, 2022)

- Decentralized Identity (DID): Currently for authentication purposes we use centralized authorities such as Google, Facebook etc. which stores users' personal data such as usernames and password which is very risky because all the things are linked to each other and even a small breach can risk all the information of the user therefore we will use DID for Self-Sovereign identity (SSI). (Laguna, 2024) (King & World Economic Forum, 2022) DID works on cryptographic keys (Public and Private keys). Public key is recorded in the blockchain network and private key is kept with the user itself.

Instead of using usernames and password users store their credentials such as Driving license, diplomas etc. in their digital wallet. When the user wants to access a service such as bank or website etc., they provide a signed proof of their DID, the service verifies their identity by the public key they have stored because the credentials encrypted with private key can be decrypted with the public key.

Example: In order to create your DID, you can use your MetaMask wallet or port which ensures that your identity is securely managed in a decentralized way. Whenever you wish to enter the healthcare platform, your wallet will use a private key for signing a proof to confirm that you own the requested DID.

The healthcare platform authenticates the proof directly and solely based on the user's public key on the blockchain and not on any private information or third-party platforms like Google or Facebook.

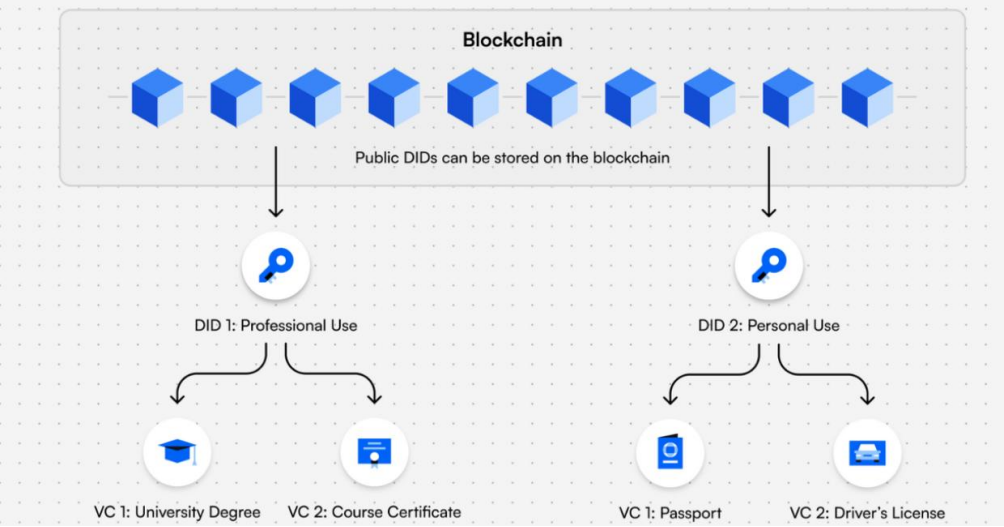

Figure 3: Decentralized Identities.

- Tokenization and Crypto economics: Websites and apps rely on ads, subscriptions in order to operate. Web 3.0 brings the approach of Cryptocurrencies and token where the customers can make payments in form of cryptocurrency and security tokens which can be converted to cryptocurrency. (Kumar, 2023) (DID, 2023)

  - DAO (Decentralized Autonomous Organization): Which is a group of token holders where decisions are made collectively by token holders using tokens.

Example: The deployment of a Dao can also make payment easier by automating contributions or salary payments within a decentralized environment. For instance, in a Dao, which oversees a decentralized platform, freelancers or contributors would submit their inputs to the Dao. Therefore, as soon as members of the token community approve the work through a vote, the contributor automatically gets paid through the smart contract and no one needs to be in charge of the transaction. This is very efficient, transparent and fair in the reporting of the company's funds.

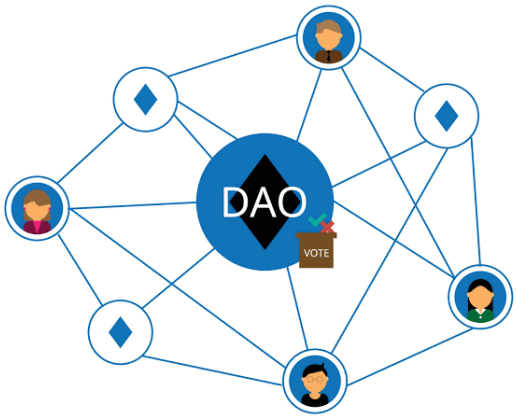

Figure 4: Representation of DAO.

- Decentralized Storage: Currently we use centralized cloud storage providers such as AWS, Google, Azure etc. but with Web3.0 we can use decentralized storage where we can use storage solutions such as File coin or Story allowing users to rent the unused storage in decentralized market and because a blockchain network provides redundancy there is no single point of failure. Other than that, because of encryption it enhances security and privacy.

- dApps: Currently, in Web 2.0, Facebook, Google, Twitter and similar web-centered applications operate on a centralized web architecture. Such companies manage the platform, host user data on their maintenance servers, and do all the work behind the curtains. The users have no option but to rely on such centralized services as they are necessary for the work of the internet. These services are susceptible to failure, censorship and affect the privacy of data. In Web 3.0, the operational concept of dApps (Decentralized Applications) is different.

Instead of self-contained programs dependent on central servers, these apps are built on decentralized networks such as Ethereum where their operation is facilitated by smart contracts. These applications are stored on the blockchain to ensure that they are not run by a single entity hence they are operated and controlled from many nodes (computers).

- Uniswap: A decentralized finance (DeFi) platform through which users can exchange different cryptographic currencies. In such exchanges, trust is provided by smart contracts, users have their funds in a decentralized manner, thus more privacy and control.

- Decentraland: A virtual reality application wherein users can trade and sell digital land and assets to one another. These activities are also recorded on the blockchain which allows users to exert full control over their virtual possessions and assets.

- Smart Contracts: For a while in this paper, you would have seen smart contracts but what are they? They are nothing but conditional programming through which we can bring automation in blockchain. Or we can say they are used for programming in blockchain where a set of conditions is already made according to which the network takes decision on its own.

3. Legal and Regulatory Issues

Legal and Regulatory Issues in Web 3.0 focus on the changing legal environment surrounding blockchain technologies, which function differently from traditional systems. (DAO, 2024)

Legal Frameworks for Blockchain Technologies in Web 3.0: Blockchain operates on decentralized networks, often lacking a central authority. Current legal systems, which depend on centralized regulation and oversight, find it challenging to adapt. Governments are in the process of creating new legal frameworks to support decentralized technologies, addressing aspects such as smart contracts, ownership rights, and dispute resolution.

Global Regulatory Trends and Implications: Countries are taking varied approaches to blockchain regulation. For instance: Some nations, including the U.S. and EU, are formulating regulatory standards for cryptocurrency, DeFi, and NFTs, with the goal of safeguarding users and curbing fraud. Conversely, regions like China have enacted stricter regulations, prohibiting certain blockchain applications such as cryptocurrencies. These differing strategies pose challenges for global businesses operating in multiple jurisdictions, complicating compliance efforts.

Challenges with Digital Identity, Data Ownership, and Liability: Digital Identity: In Web 3.0, users manage their own identities through blockchain-based systems (e.g., self-sovereign identity), which poses challenges to existing regulations regarding identity verification and fraud prevention.
Data Ownership: Blockchain empowers users with ownership of their data, but this raises questions about the applicability of data laws. Who bears responsibility for data misuse or breaches when there is no central authority?

Liability: In decentralized systems, establishing liability can be problematic. If a smart contract malfunctions or fraud occurs, it's often unclear who is legally accountable since no single entity oversees the system.

4. Conclusion

Web 3.0 is expected to be built on blockchain technology, drastically changing online operations by means of security, decentralization improvement, and user empowerment. Unlike the centralized models of Web 2.0, Web 3.0 makes use of blockchain technology to provide individuals with data ownership, enable peer-to--peer exchanges, and offer open, trustless networks.

Significant breakthroughs like as decentralized finance (DeFi), non-fungible tokens (NFTs), and decentralized autonomous organizations (DAOs) illustrate the revolutionary potential of blockchain in this new internet epoch. Blockchain enhances transparency, security, and privacy via immutability and encryption, undermining conventional power systems and transforming online interactions.

Notwithstanding its challenges—namely scalability difficulties, regulatory concerns, and energy consumption—blockchain persists in its evolution, with continuous improvements tackling these obstacles. As blockchain advances, it will facilitate a more egalitarian, user-focused, and democratized internet, positioning Web 3.0 as a crucial milestone in digital development.

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