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Recent Advancement in Blockchain: A study

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Abstract: **With technological innovation occurring at an ever-increasing rate, block chain has become one of the hottest new Internet trends. Because it is a distributed and decentralised database, blockchain has restored the definition of trust—providing security through cryptography and consensus mechanism without needing any third party. Hence the aim of this study is to provide an overview on the concept of blockchains, historical development, and application of Block chain in real life. In addition, the working of interlinked blockchains (blockmesh), their merits and applications are discussed. This will be useful to clarify the uses and usage of blockmesh in our daily lives. Finally, a slight peek in the past of the block chain would also be discussed to show the exponential growth in the blockchain technology.**

Keywords: Blockchain, Bockmesh, Applications, Historical Development.

I. INTRODUCTION

The blockchain is the technology behind the cryptocurrency bitcoin, 1st described by its creator Satoshi Nakamoto in his white paper "Bitcoin: A Peer-to-Peer Electronic Cash System" [1, 2]. While the system is adequate for the majority of transactions, it still has its flaws. Because financial institutions cannot avoid mediating disputes—and sometimes lose those mediations—transactions are not always completely non-reversible. Because of its cost, mediation increases transaction costs. This means that the minimum practical transaction size is significantly higher than it would be without mediation and so eliminates many transactions between parties where one person provides a service to another but neither can guarantee payment in advance [3].

The following elements are included in the block header:
(i) **The block**: version defines the set of rules that will be used to generate a hash for the next block [5].
(ii) **Block hash:** this is the result of hashing all transactions within a block and adding it to blockchain [4, 5].
(iii) Timestamp: the time right now in seconds since 1-1-1970[5].
(iv) **nBits:**nBits is a value set by miners that specifies the number of leading 0s needed in order for the hash to be considered valid.[5].
(v) A nonce (or number used once) is a variable length field that gets incremented with each hash calculation [5].
(vi) **Block hash:** a value created by running data from the block through an algorithm that outputs 256 bits [5].

Web3 denotes the third generation of the internet that will enhance user experience, security, space and time complexity, etc. Web3 provides a wealth of chances for innovative goods, start-up businesses, and established businesses alike. It has the ability to bring in a new internet age that changes how people connect with one another and acts as a platform for companies. As more projects are completed, there will be less opportunity for latecomers to get involved [1].

II. HISTORICAL DEVELOPMENT OF BLOCKCHAIN

The history of blockchain goes back to 1991 when two research scientists, Stuart Haber and Wakefield Scott Stornetta were working on finding a practical way to keep the backup of digital documents. Later, in 1992, to collect more documents within a single block they used the concept of Markle trees that enhanced the model's efficiency and in 1993, for protection against spam and other internet abuses Proof of Work (PoW) mechanism was introduced. Proof of Work concept is the use of a technique used by blockchains to verify the accuracy of a block being added to the blockchain. By 2004, a cryptography expert, Hal Finney introduced the concept of reusable proof of work (RPoW). According to RPoW, the system can create a RSA signed transferrable token using non fungible or non exchangeable hash cash based on PoW system. This mechanism solved the problem of double spending. Hence, keeping the ownership of the RSA signed token registered on the trusted server. While other nodes (devices or people can verify and keep the blocks integrated [6-10].

It is generally accepted that the 1st implementation of modern day Block chain Technology (BT) was created by Satoshi Nakamoto. In 2008, the paper "Bitcoin: A Peer-to-Peer Electronic Cash System" was published by a person or group of people who identified themselves as Nakamoto. In this document, they hypothesised that direct online payments from one party to another could be made without using an intermediary 3rd party like PayPal. The paper proposed "a payment system that works without trust."[11]
In 2009, Satoshi Nakamoto created the 1st block (now called genesis block), earning 50 Bitcoins. In 2012, the developers started innovating new apps using blockchain technology. Decentralised operations implement being procedures and validate them on a blockchain. The difference is that this attestation is unrecoverable, inflexible and thus extremely good for auditability [12, 13]. As "a decentralised platform that runs smart contracts," Ethereum debuted blockchain in 2013. Blockchain, according to the article, "allows developers to produce requests, store debt or pledge registries, move money in accordance with instructions given in the past (like a will or a futures contract), as well as numerous other effects that haven't been built yet, all without a mediator or counterparty threat." While Ethereum is a technology that businesses are adopting to create new programmes, Bitcoin is only a kind of money. One of the earliest BT outside of currency expansions [11]. In 2015, the concept of smart contracts was launched which supported verified blocks to be the part of blockchain. They might be written entirely in computer code, be a

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traditional contract that has been codified, or take the form of a hybrid that combines aspects from both computer code and traditional contracts. A public, consortium, or private blockchain can all support the programming of smart contracts. [12]. In 2017, the US government approved the use of Bitcoin as a digital asset. In 2018, companies like Google, Facebook, etc. banned the advertisement of cryptocurrencies on their platforms. In 2020, Fintech giant PayPal started dealing with cryptocurrencies. In 2021, NFTs or non fungible tokens (digital assets) and other web3 applications came in trend. While fungibility, or the capacity to be exchanged for one another, is a crucial component of any money, non-fungibility is the opposite because each commemorative is distinct and can't be divided or mixed with other commemoratives (Merriam-Webster, 2018; Voshmgir, 2018). This also has counter accusations for tracking the power of commemoratives as each NFT needs to be tracked independently. The ERC-721 standard specifies that every NFT has an encyclopaedic ally unique id, is transmittable, and can voluntarily include metadata [14]. In 2023, the Indian government announced 30% taxation on digital assets. Because of these updates, blockchain has gotten much attention from developers to trigger them into building a new generation of internet.

Figure 1: graphically represents the evolution of blockchain and certain developments on it.

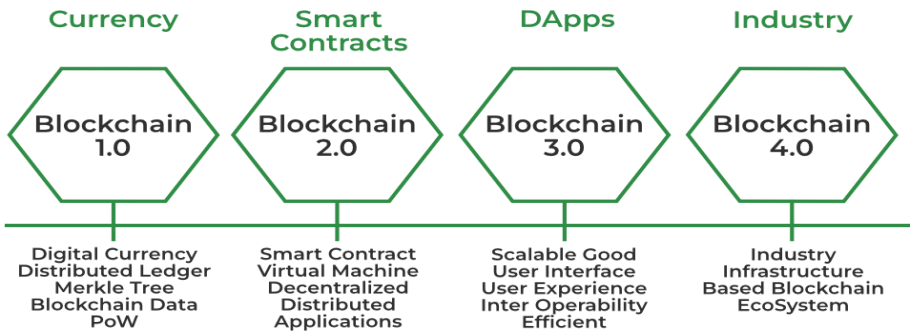

Figure 1: Evolution of Blockchain technology

A. *Privacy and security in block chain*

Deals are collections of data that include a timestamp and the specifics of the sale. Both can be modelled as strings or computer figures. Each row in a table with three columns represents a unique sale in a blockchain. The first column stores the sale's timestamp, the second column stores its details, and the third column stores a hash of the current sale's details plus the hash of the previous sale [2]. The hash chained storehouse, digital hand, and commitment agreement for adding a new block to the encyclopaedia allied chained storehouse are three basic and significant characteristics that are supported by the blockchain perpetration in Bitcoin. The Bitcoin blockchain can help both the double spending problem of bitcoins and stop the retrospective revision of any sale data in a block after the block has been successfully committed into the blockchain by an elegant combination of a suite of popular security methods, such as Hash chain, Merkle tree, digital hand, with agreement mechanisms [8].

B.Core Concept of Blockmesh

Blockmesh offers a special method of block bonding. Every block keeps a number of hashes of its parent blocks, which are the latest blocks in the local chains of the new block's participants. The protocol's work is broken down into two stages: (a) the stage of participant interactions; and (b) the phase of adding the produced blocks. Decentralised block mesh is shown in Figure 2**.**

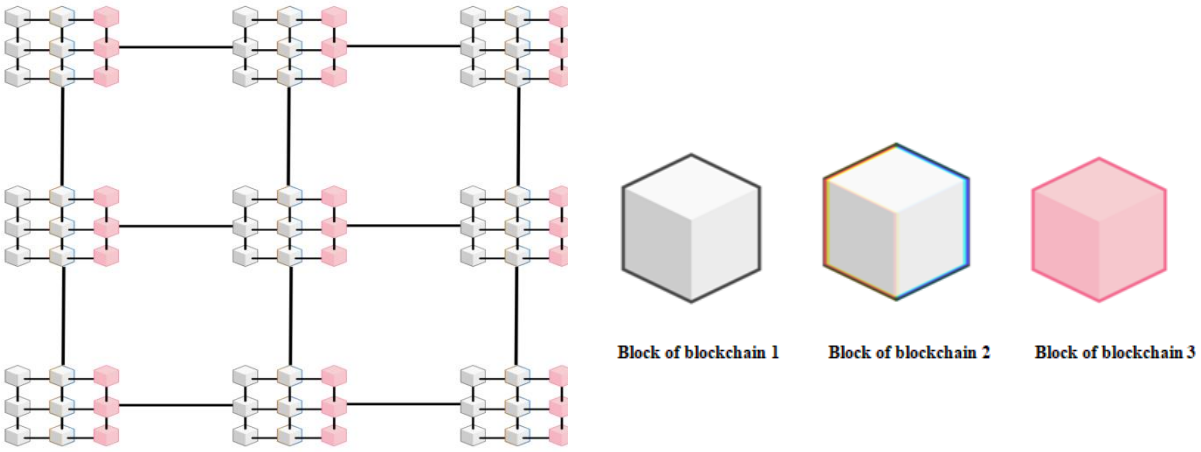

Figure - 2: Decentralised block mesh

In a **centralised system**, the blocks are added by a central authority. As an example, when a person goes to a service centre the data can be stored in the form of a block added to a blockchain that consists of previous data of the service done of a vehicle, where the blockchain is being governed by the company

providing its services to the customer. This helps in monitoring any illegal, criminal or offensive activity on the platform. It can also be used on social media platforms to avoid controversies. In today's period centralisedblockchain apps can be seen like decentralised finance where the price charts of crypto or market are updated. Internet of Things technology is also considered decentralisedblockchain based innovation where connections are eer to peer and are operated by the user. (Figure 3).

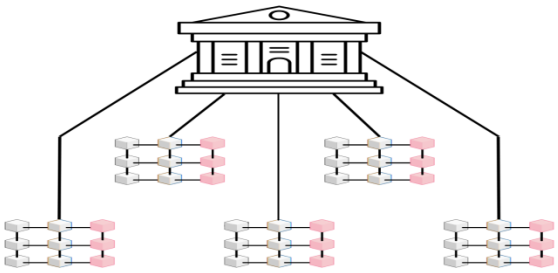

Figure - 3: Centralized block mesh (Different blocks represents different block chains)

In a **hybrid system**, the authority over the blockchain is both in the hands of an institute or organisation and an individual. In this system, the block is added using a mutual agreement between the organisation and the individual. For example, for selling a product the Represents the central authority seller and buyer should be in mutual agreement. It can be used as a block. In this system both the institution and the user have authority over the data that has a great benefit for transparency as well as accuracy over data.(Figure 4).

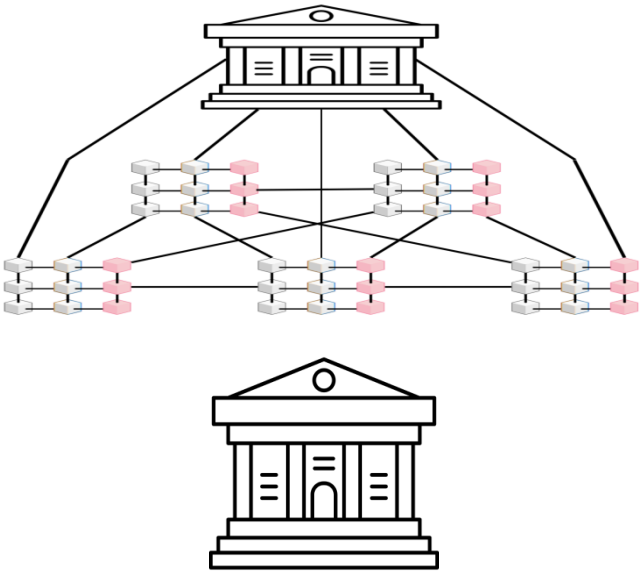

Figure - 4: Hybrid blockmesh

III. WORKING OF BLOCKMESH

The working of a blockmesh is really simple. Since, it is the interlinking of blockchains, the parent blockchain can be said as the genesis chain. Other blockchains' consecutive blocks will be linked to the consecutive blocks of other blockchains. Where the data being stored will be of a single core entity or a single person. Whenever a new blockchain is linked to the being mesh, the position of the birth block of the newest blockchain can be linked to the blocks in the middle or the last block of the parent blockchain. This solves the problem of chancing the time of creation of the new blockchain. When a block is added in any of the blockchain, all he blockchains are added with a block that might contain the data that was stored in the former block with streamlined time. Multiple blocks with the same party cannot be added within a work cycle due to the block adding mechanism and block connection [9].

The blockmesh can be updated on the basis of a common aspect like time. Due to this the structure would grow (updated) in a two dimensional form. Thus, it will form a mesh-like structure of blockchains. The working of blockmesh might require a prompt or a set of instructions to update desired blockchain, for which we may require an initialisation app (or Dapp) to configure changes. In the above section, where we discussed the different systems on which a blockmesh can be executed, the working mechanism of blockmesh varies with it.

For a decentralised system, new blocks might be added by majority votes. As in a decentralised system, peer to peer connection is present, the other block meshes verify the addition of blocks in a blockmesh. In this system the space complexity is low as only one blockmesh would be stored on a single device. But it may affect time complexity because it may require time to get verified by other peers.
In a centralised system, a central authority would have all the rights to add blocks in the blockmesh. Hence, it would have an impact on privacy as the hashes of the blocks would be created and block meshes would be monitored by them (central authority). This system would have lower

time complexity so it verifies the adding blocks in the best case. Whereas it may have a higher space complexity which would eventually require more and more space.

The hybrid system would give benefits from both space and time complexity. In this system, the block might be added by an individual but the data or blockmesh might be stored at a central place. This has another advantage of privacy as the hash if the blocks would be created by the data provider's device and is added to the blockmesh by the central authority in their own space.

A. Advantages of using Blockmesh

Basically, blockchain is an underpinning specialized frame which enables the druggies to inclusively maintain a dependable database in a decentralised manner. The advantage of tamper- proofing is achieved by the unique date structure and data writing medium of blockchain [10]. It also plays a significant role in the field of cyber security, artificial intelligence and machine learning [11-16].

After understanding the concept and working of blockmesh, various benefits or advantages can be observed. Advantages of blockchain might also be found here because blockmesh is the next innovation in blockchain technology. Following are the pros of blockmesh:

1. Both internal and external information breaches may result in data leaking, either designedly (e.g., data theft by interferers or sabotage by bigwig bushwhackers) or inadvertently (e.g., accidental exposure of profound information by workers and mates) [10].
   The privacy of the user would be at top most priority as there would be very less chances of tampering a block i.e. data of the blockmesh, hence providing a safer experience to the user.
2. To tamper a single block, there would be a very large number of blocks to go through as compared to normal blockchain. Thus, there would be more minimal chances of an infiltrator to carry on tampering data blocks of the blockmesh.
3. A uniform way of storing multiple data sets on a single platform can be executed which will provide faster response time and also enhance user experience.
4. Fetching data of an individual would be a lot easier for the central authority. This application can be used to prove a person's innocence in a lawsuit or an investigation.
5. The data would be more secure as cyber attacks like data breaching could be prohibited from happening.
   Due to the agreement algorithm, Blockmesh is defended from the conduct of evil guests (e.g. member- bumps). They can induce and add invalid blocks to their original chain, but it cannot distress the system, since only storehouse- bumps can authorize and add a block to the main chain [17].
6. Blockmesh also improves transparency of smart contracts and enhances high accuracy of data being stored.
7. Blockmesh can also help in innovation of more reliable, secure and also fast responsive decentralised applications that may transform the world into a new fast technology era.
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9. A stoner's ID index is determined by computing the hash value of the stoner's public key. On the one hand, the hash value is unrelated to the stoner's true identity, protecting the specific personal data about the stoner. However, the calculation of the hash value is invertible, making it impossible for an enemy to determine a stoner's public key from their public stoner address and impossible to determine a stoner's private key from their public key. Thus, blockchain achieves the thing of conserving stoner obscurity and sequestration [10, 18].

This benefit can be seen in a blockmesh as the blockmesh technology is the next innovation of the BT (Figure 5).

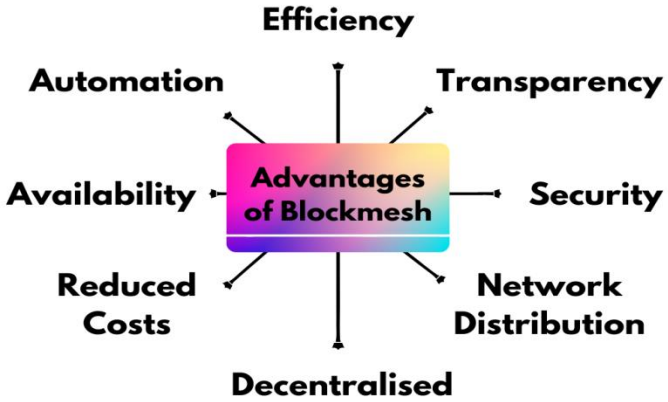

Figure5: Advantages of blockmesh

IV. APPLICATIONS OF BLOCK MESH

Blockmesh can have it's applications in many ways and are as follows:

1. **In personal life**- Blockmesh can be used to store data regarding personal life. For example, there can be multiple blockchains like, vehicle data, real estate data, travel and tour data, etc [18].
2. **In professional life** - Companies can use the concept of blockmesh to store data of their employees in a more sorted manner. As an example, if we take multiple blockchains like one for attendance, one for

promotion, one for increment, one for switching companies, etc. all can be interlinked and can form a blockmesh being updated on the basis of date or any other common aspect.

3. **Academic life** - educational institutions can use this concept to record data of their students. In this scenario interlinked blockchains are on the basis of results, event participation, etc [19-22].
4. **Financials** - financial institutions may use it to store account holder's data in a more organised way. This may include account creation as genesis block and further updates as different blockchains for different activities.
5. **Service / product based companies** - Companies or corporations may use it to collect customer's data such as reviews, order history, account updates, etc. as interlinked blockchains.
6. **Public record** - Police and law can use this concept to secure a witness', murderer's or cases' data in the form of blockchains. In this application the whole blockmesh can be named as the case, because just like different episodes of a crime, the blockchains are also linked to each other.

In addition the potential applications of blockchain in fields of mechanical engineering like thermal spray coatings, additive manufacturing, and renewable energy are surprisingly diverse and promising. Here's how these seemingly disparate realms intersect:

(a) Thermal Spray Coatings:

Traceability and Authentication: Blockchain can track the provenance of materials used in thermal spray coatings, ensuring authenticity and quality control. This becomes crucial for high-performance or safety-critical applications [23].

Smart Contracts and Maintenance: Embedding sensors in coatings and linking them to blockchain smart contracts can trigger automatic maintenance alerts when specific wear or degradation metrics are met, optimizing service schedules and reducing downtime [24-26].

Intellectual Property Protection: Blockchain can securely store and share intellectual property (IP)relatedto coating compositions, processes, and equipment, protecting innovations and fostering collaboration [27-35].

(b) Additive Manufacturing:

Secure Design Sharing and Collaboration: Secure platforms based on blockchain can facilitate the sharing of 3D design files and manufacturing knowledge without compromising IP, enabling collaboration between designers, manufacturers, and suppliers [36-46].

Quality Control and Certification: Integrating blockchain with additive manufacturing workflows can track critical process parameters for each printed part, providing verifiable proof of quality and compliance with specific standards [47].

Distributed Manufacturing and Traceability: Blockchain can enable secure and transparent distributed manufacturing networks, where parts are printed locally using shared designs and verified materials, improving supply chain efficiency and resilience [48-50].

(c) Renewable Energy:

Peer-to-Peer Energy Trading: Blockchain can facilitate secure and efficient peer-to-peer energy trading, allowing individuals and communities to sell excess solar or wind power directly to each other, bypassing traditional monopolies.

Microgrid Management and Grid Resilience: Blockchain-based microgrid management systems can optimize energy distribution and storage in localized grids, enhancing resilience and reliability, especially in remote or disaster-prone areas.

Carbon Offset Tracking and Verification: Blockchain can be used to track and verify carbon emissions reductions achieved through renewable energy projects, providing transparency and credibility in carbon offset markets [51-57].

V. CONCLUSION

In conclusion, BT has seen significant growth since its commencement in 1991, with the creation of a new generation of the internet known as web3, and the development of decentralised operations or Dapps. BT offers enhanced security and sequestration, as well as a decentralised, peer- to- peer connection. The concept of blockmesh, which involves interlinked blockchains, can be enforced in a decentralised, centralised, or mongrel system. While decentralisedblockmesh offers translucency and eliminates the mediator, centralized blockmesh can cover conditioning to help illegal or obnoxious geste, and mongrel blockmesh involves both an organisation and existent. Overall, BT has proven to be a protean and innovative technology with a wide range of operations in different diligence.

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