Working Principles, Application areas, and Challenges for Blockchain Technology

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Abstract

How might Blockchain technology support our business? is one of the more commonly inquired topics in the Blockchain technology industry. It makes perfect sense that businessmen, professionals, innovative leaders, digital advisers, and finance experts would all be keen to learn more about distributed ledger technology and its real-world commercial uses for it within their respective companies. You might be wondering what all the attention is about with tech giants like Alibaba and IBM embracing Blockchain applications and submitting Blockchain patents in addition to the terms "Bitcoin," "Blockchain," and "cryptocurrency" plastered across the front pages of newspapers as Blockchain development becomes a mainstream technology trend. It can be challenging to comprehend how using Blockchain can assist your company with all the media hype.The most significant Blockchain use for enterprises is the capacity to communicate, receive, and verify safe data as well as secure transactions between parties without necessitating a high degree of confidence. Due to the distributed and decentralized nature of blockchain, it can provide enterprises with new hope. The study examines several Blockchain applications in a variety of industries, including banking, estate development, supply-chain management, academia, and energy.

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I. Introduction:

To understand Blockchain let's take an example if one person wants to send money to his partner's account. You will often transfer money from your account to your partner's account, but sometimes

errors can occur and the money might not even deposit and instead return to your account. What may be an area of concern?Why did that transaction get failed? There might be any factor for this like the customer's accounts being hacked or there can be technical problems at the bank that cause the trouble or you have reached the transfer limit of the day thus you can't perform the transaction. Crash money may now raise a concern to which the response is that Bitcoin is a kind of cryptocurrency. The question of what cryptocurrency is now emerging is.Cryptocurrency, then, is a kind of digital currency that can authenticate the transfer of funds from one party to another, control the introduction of new modules, safe banking transactions, and preserve the sanity of the transaction. Transactions using cryptocurrency are safe and protected, and most relevantly, they are not controlled by any centralized authority. As a result, we may not even need banks. The basic benefit after the evolution of cryptocurrency is low transaction cost and the removal of intermediates. Because the more the middle man more the cost will be added to transactions. Today there are several cryptocurrencies available in the market like Bitcoin, Litecoin, Ethereum, Nem, Monero, Ripple, Z Cash, and Dash these are a few names but a hundred thousand which are involved on daily basis. Now Bitcoin uses a technology named Blockchain.

Blockchain is incredibly popular now a day. But what Blockchain is? How are they used and what problems do they solve? Like the name indicates. Blockchain is a continuously thriving list of records (blocks) that are associated with each other and that accommodate information and secure using cryptography. Every block is digitally signed and hashed.This approach was originally designed to timestamp digital documents so that they could not be backdated or altered and was first reported in 1991 by a team of researchers. It remained unutilized until Satoshi Nakamoto modified it in 2009 to produce the virtual currency known as Bitcoin. A distributed ledger that is accessible to everybody is called a blockchain. One of its numerous characteristics is that it is quite difficult to change data after it has been recorded inside a blockchain. Then how does Blockchain function?

II. Important Blockchain concept and Working:

First of all, we have to understand what a block contains. A block contains

1. Data of Block
2. Hash of current Block
3. Hash of the previous block.

Depending on the type of Blockchain, a block may also include different types of data. For instance, the bitcoin Blockchain keeps data about the sender, recipient, and coin count. Each block has a common has to value just like a fingerprint.It serves as a block's unique identification code and can be used to identify any of a block's contents. A block's hash is determined after it is formed, and if the block is modified, the hash will likewise be modified. The hash of the previous block is the third component of the block. This method builds a Blockchain that is extremely secure and constructively generates a chain of blocks. For example,if there are 3chains of blocks.

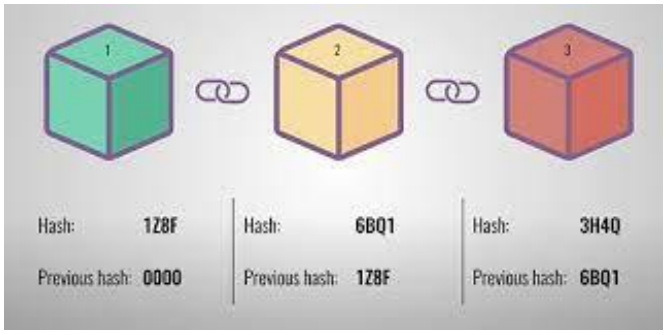

Fig:1 3 Blocks of data

Each block contains its hash as well as the previous block's hash. Block number 3 points to block number 2, and block number 2 points to block number 1.

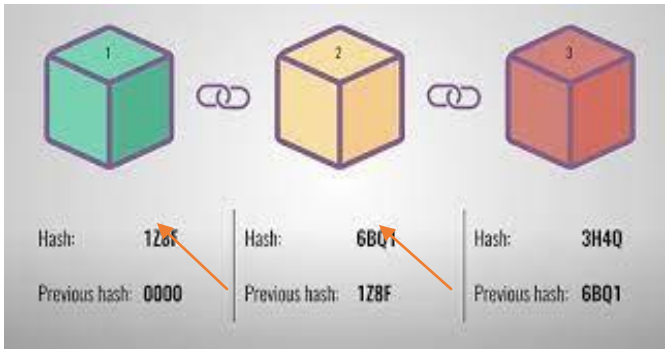

Fig:2 Blocks are pointing to the previous hash

However, since it is the first block and there is no previous block, the first block cannot refer to the previous block. The Genesis block is the first block. Now, block number two is being tampered with. This has an impact on the speed of block number 2. It will transform. As a result, block 3 and all succeeding blocks will no longer store a valid hash of the prior block, rendering them invalid. As a result, changing just one block invalidates all the others.

III. Types of Blockchain:

Blockchain can be classified into 3 categories:

1. Public
2. Private
3. Hybrid

Public Blockchain:

Each peer owns a copy of this permissionless, non-restrictive distributed ledger technology. In other words, the Blockchain is accessible to anyone on the network who has an internet connection. This user can do mining operations, which are complex calculations needed to verify transactions and add them to the ledger, and has access to both historical and current records. Because the source code is typically open source, no copy of the transaction may be made on the network, and anybody can check the transactions. Example: Bitcoin, Ethereum.

Private Blockchain:

A single organization is in charge of a private blockchain. It works in a confined setting, like a closed network. Although this Blockchain is far smaller than public Blockchain technology, it performs the same duties in terms of centralization and peer-to-peer connectivity. Within a company or organization, these are frequently run on a little network. Permission Blockchain and company Blockchain are two additional words for them, as opposed to being accessible to everyone who wishes to contribute processing power. These blockchains are modifiable according to the blockchain owner's desires. These are frequently used in organizations to keep private information. Example: Hyperledger.

Hybrid Blockchain:

This Blockchain is a combination of Public and Private Blockchains. Here nodes can be divided into two parts where some nodes are public and some are private. Some nodes are allowed to take part in transactions and some of them control the consensus process. Example: Ripple

IV. Applications and Challenges of Blockchain:

As Bitcoin and cryptocurrencies have gained attention, the application has broadened their area to other technologies also. Many organizations are started to study its potential. This technology is

uncomplicated at its root. But Blockchain has immeasurably more capability than just its uses for cryptocurrencies. Below we are discussing different industries in which Blockchain technology can be used.

1. Blockchain in Financial Sector:

The most broadly used application of Blockchain is in the field of Finance because it assures transparency between different trading parties. It frequently registers business transactions and amplifies the security of transactions. Mainly banks, investment funds, insurance companies, and real estate falls into this category. Nearly all financial institutions work with the help of third parties which act as a mediator between the two parties. Every transaction is transcripted in blocks and then it can validate by parties for its credibility.By this it is detecting the money exchange movements, it becomes easy to detect any hoax or money laundering. Mediators' needs can have eliminated by using Blockchain technology. Blockchain can also enhance the modern form of financing. Crowdfunding can also be amelioratedby adopting Blockchain technology.There are so many advantages to implementing Blockchain technology but there are also some challenges there. Here are some challenges:

1.1 **Challenges in Finance Sector**

1)Modification of Data*:*To make changes in data is not so easy.Banks change their data very frequently especially data that is related to the transaction. The Blockchain system faces difficulty in these frequent changes in data that is related to transactions. The operations related to data entry are also long.

2)Cost of Initiation, Implementation, and Maintenance: The starting price of constructing Blockchain technology is immense. It needs all information about its hardware and software technology that is necessary for its implementation. Those companies whose budget is not so much, may not afford its implementation. So, such small companiescan't secure their transaction using Blockchain. Maintenance is also expensive.

3)Lower Cost of Business: With Blockchain consensus mechanisms and smart contracts, automatic transfer of funds can be triggered when the agreed set of conditions is met. This reduces the amount of time the capital is tied up in a transaction. There is no involvement of a third party so the transaction fee is also reduced.

2.Blockchain in Education

Nowadays education system is continuously changing and moving towards digitization of the educational environment.Population increase will be a major problem for the education sector, according to HolonIQ, a global provider of market analytics in the education space. With somewhat more than 500 million students today, there will be 2.7 billion pupils globally by 2035. (Spies, Brothers, 2020). The number of pupils will continue to rise and this trend will not cease. The Internet also changes the traditional classroom model. More than 32% of students joined the online course. Students also use the internet for joining study groups, search relevant topics, and enhance their network. Not only the student but faculty also turn to the Internet and social media. But the Internet is a good tool for gathering information and connecting but not for making and observing values. Almost all schools, colleges, and universities store information in form of paper records or servers. But this method of storing information can lead to hacking or information can be misplaced. These are the challenges that can handle by the use of Blockchain technology.

Making a robust Digital Education Ecosystem (DEE) that includes a wide range of academic activities such as content creation, instruction, evaluations, grading, attendance tracking, achievements, certificates, degrees, and diplomas is important for several reasons. Stakeholders can be added to DEE, including employers, employees, and mentors. If digitization will increase, there will be a need for a fool-proof system that can provide security and can track students' activities. That should provide any kind of information to stakeholders. A good solution to this problem is Blockchain.

2.1 Challenges in Education

Some of the benefits from Blockchain that the education sector expects to harness are:

1)Scalability: The "slow speed Blockchain transactions" difficulty is how Alammary, et al. (2019) define the scalability challenge. The education system contains a vast amount of student data. If that data is stored in blocks in Blockchain technology, then block size becomes larger due to the huge amount of student data and if the size of blocks increases the amount of time to check peer-to-peer transactions will also increase. So, scalability is a challenge in the education field if Blockchain in education is adopted on a wide scale. Other challenges may be Proof of work, consensus protocol, and waste of electric energy.

2)Market adoption challenge*:*Due to a lack of technical knowledge and expertise in handling student data on a blockchain platform, many educational institutions are hesitant to utilize blockchain technology. Traditionally, many educational institutions have kept records on paper that are solely accessible by staff members. Therefore, a crucial first step in fostering market acceptance in higher education across the globe is increasing knowledge of and educating academic governance bodies on the advantages, deployment, and maintenance of blockchain-in-education solutions.

3) Immutability: Certificates can be faked, credentials can be weak, and education may not be accredited. once transaction records like transcripts, attendance sheets, assessment records and results, certificates, credits, and other records of achievement are created, they with Blockchain, are permanently stored and cannot be modified or deleted. A block in the Blockchain includes the transaction data, a timestamp, and a cryptographic hash of the previous block.This means that once transaction records like transcripts, attendance sheets, assessment records and results, certificates, credits, and other records of achievement are created, they are permanently added to the Blockchain in chronological order as a block. These blocks cannot be modified or deleted, once they are added to the Blockchain.

3. **Blockchainin Energy**

As the global economy moves from the industrialization age to the information age, the need for energy has reached unparalleled heights. According to the most recent United Nations estimates, the population of the world as of January 2019 is 7.7 billion. A sizeable number of these people across the world have access to lighting, transportation, communication devices, computers, and other electrical and electronic devices and conveniences, which is possible only by utilizing energy. With economic growth and continuous improvement in the standards of living, the world's energy consumption is estimated to increase by almost 50% by 2040. Energy supplies mainly come from fossil fuels like crude oil, coal, and gas; as well as nuclear power and renewable sources like solar, hydropower, and others. However, fossil fuel is the most important energy source accounting for 70% of electricity generation as published by the World Energy Council. To meet the challenges of rising energy demand and global emissions, it is no surprise that the innovators of the energy sector are speculating on Blockchain technology as a solution

3.1 Challenges in Energy Sector

The main concerns impacting the Energy Sector that needs to be addressed are:

1) Energy Inefficiencies*:* Countries mainly rely on centralized power plants that generate electricity which moves through a complex system of substations, transformers, and power lines. Power is transmitted over long distances and distributed to the homes of consumers through high-power transmission lines. This complex system is called a grid. The transmission over long distances causes power losses to an extent estimated to be between 8-15%. Transmission and distribution losses vary from country to country as well. In some countries, the loss is between 30-60%, attributed to electricity thieves and other factors. These losses not only hit our electricity bill but also indirectly contribute to carbonization as approximately 40% of global CO, emissions are emitted from electricity generation through the combustion of fossil fuels.

In addition, if the energy supply and demand are not balanced in the grid, it can damage the infrastructure and cause safety issues like fire and human causalities. Blockchain is expected to help make enhanced, modern, and optimized power grids.

2) Environment and Climate Changes: Our air, water, and land have an environmental influence from all types of electrical generating. Environmental harm from fossil fuels like coal, oil, and natural gas is much greater than that from renewable energy sources like wind, solar, geothermal, biomass, and hydropower.The global energy sector is responsible for two-thirds of all the greenhouse gases emitted into the atmosphere as reported by the International Energy Agency From unstable climate change to poor water and air quality, pollution, and disease, our natural habitat is under threat. It is time for our energy system to evolve in response to these environmental challenges. Blockchain technology enables the production and distribution of electricity more efficiently, thereby reducing both the number of greenhouse gases emitted and other forms of air pollution.

4.Blockchain in Real- Estate:

What was traditionally considered a 'pen and pencil' business has now begun increasing to the global market with better and long-term consequences. The real-estate market currently faces several issues related to housing affordable rising rates and the economy, many of which cannot be addressed with Blockchain. However, it cannot be denied that Blockchain does have quite a few applications that can be of measurable value to the real-estate sector

4.1 Challenges in Real-estate

All the problems of real estate can't be solved with the help of Blockchain. It can only deal with some common problems which the field of real estate is facing.

1) **Tedious paperwork***:*Every transaction in traditional real estate was completed with the help of complicated and time-consuming paperwork. Due to this customers were distracted from their main objective and ended up with money loss.
2) **A large number of Intermediaries***:* In traditional real estate work, mainly trust is in human beings. If two parties want to do business in real estate with each other or if they want to finalize a deal, they have to involve a third party at any level of their dealing to build trust in that process. This challenge is also solved by Blockchain technology.

5.Blockchain in Supply Chain

The planning and management of all sourcing, procurement, conversion, and logistics management operations are included in supply chain management, according to the Council of Supply Chain Management Professionals (CSCMP).Supply Chain Management (SCM) combines the management of supply and demand within and across businesses to create a high-performance business model that fosters competition: Due to the varied nature of the entities and data, manual paperwork, reconciliation issues, and middlemen/intermediaries, it is difficult to identify points of failure. If the components fail, the brand bears the consequences, Blockchain technology the stakeholders a permanent and auditable digital record of the state of the product at each crucial step along the chain. Transparency can also help streamline the v chain operations. Retailers and suppliers could benefit from greater insight into the manufacturing process of the goods and ensure that all the required standards have b met, such as health and safety requirements.

5.1 Challenges in Supply Chain

Some of the key challenges in SCM that can be addressed by Blockchain technology are

1) Provenance Tracking: It's crucial to know the provenance of every component in a complex machinery system, such as an aircraft or a life-saving drug, through supply chain management. This includes the manufacturer, production date, and even the manufacturing equipment program. Blockchain can store all component provenance information, which can be accessed by each

manufacturer in the production process including the owners, the producers, maintainers, and government regulators.

2) High Costs: The cost drivers that can shoot up the supply chain costs are procurement costs, inventory costs, transportation costs, and cost of quality. The supply chain involves various participating entities. Cross-country procurements may not be dealt with directly by the company but s procurement partners or officers. This increases the procurement costs to include not only the price of the product but also the costs related to the workforce resource like salaries training, etc. In transportation, faster delivery may mean higher costs and sometimes penalties due to late or non-delivery. Inventory costs money as well as storage space and the cost of warehouse staff. Most companies buy inventory via bank loans. So, unused and obsolete inventory puts a strain on the enterprises' resources. Also, to maintain the quality level of products, trained experts need to be hired for quality checks at various points. Using the Blockchain to track a product in real-time throughout the supply chain lowers the overall cost of transferring goods. Better tracking, monitoring, and recording using Blockchain technologies mean more accurate planning in transportation needs, avoidance of delays, faster payments and settlements, better inventory control, assessments and quality checks recorded on the Blockchain, and removal of intermediaries that are an overhead on the supply chain.

Conclusion:

Blockchain is a vastly growing technology in today's scenario. People, organizations, and governments should familiar with all pros and uses of Blockchain technology. From this research, it is clear that this technology can be applied in various fields but challenges are also there which cannot be ignored. Future research should point to solving these challenges effectively. Government should pay attention to these challenges/drawbacks and should form new rules for Blockchain technology.

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