DISTRIBUTED LEDGER TECHNOLOGY (DLT): THE BEGINNING OF A TECHNOLOGICAL REVOLUTION FOR BLOCKCHAIN

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***Abstract*—In recent years there are lot of thrills spinning around BLOCKCHAIN technology. Blockchain initially released in 2008 by Satoshi Nakamoto as a fundamental technology for the first ever global decentralized cryptography based digital currency known as BITCOIN. Todays in tech world every person and industry discussing about blockchain, and they feel blockchain technology changed the world like open source software change. Every industry wants to use and explore blockchain technology in different application like trading, supply chain, healthcare etc. Blockchain is a revolutionary technology but the question is from where this technology invented. In this paper author will discuss about distributed ledger technology which is known as parental technology of blockchain. This paper will break the myth that distributed ledger and blockchain both are the same technology, and will tell that every DLT is not blockchain but blockchain is a DLT. This paper presents the comparison of different DLT's and blockchain. In this paper author discuss different type of potential application area where DLT is very helpful. In the end of paper author present future research direction for blockchain and DLT with some challenges.**

Keywords- Blockchain, Distributed Ledger, DAG, Hashgraph, Holochain

I. INTRODUCTION

World heard a lot of bells recently revolving everywhere – Distributed Ledger Technology[1]. If any person has been undertaking with blockchain and cryptocurrencies, that person must've previously heard about DLT. The DLT implementation is undeniably one of the imaginative inventions of till now. Subsequently then, the technology travels a very long way, progressed into something and deliver much more values than before. By permitting scatterings of information over the network with more transparency, DLT did certainly change the internet. Primarily, this skill was only planned for digital currencies and transactions, but now researchers and tech world found countless possible use cases that can transform our lifestyle and world for good.

Though, there's still several misperceptions everywhere for distributed ledger technology. Many of us misunderstand DLT implementation with blockchain technology. A blockchain is a new open source technology who attract whole the business world and technology experts to research, to explore and to understand the potential of this technology in different areas[2]–[4]. Blockchain initially released in 2008 by Satoshi Nakamoto as a fundamental technology for the first ever global decentralized cryptography based digital currency known as BITCOIN. A blockchain is a transparent and immutable globally distributed ledger, distributed databases, who have global agreement by all its users[5]. DLT is not only blockchain but it is much more than blockchain and remember every DLT is not blockchain but every blockchain is DLT[6].

A. Revolution of Blockchain

1) Distributed ledger defined: A distributed ledger is a form of digital database that is updated and held by every member independently in a large network space. In this type of ledger there's isn't any central authority to broadcast the records to every member. Instead, all the nodes will hold the ledger and construct it independently. But in that case, the nodes on the network will need to have access to the transaction lists and giving out their own conclusion before adding it on the distributed ledger.

2) The difference: Blockchain vs distributed ledger: Table 1 show difference between blockchain and distributed ledger.

3) Different types of DLTs and working: There are many different kinds of DLTs, and every individual of them have different methods to work. This paper is discussing five type of DLTs namely Blockchain, Hashgraph, Holochain, DAG, TEMPO. To understand the key differences amongst them, it is the necessity of time to compare them. Figure 3 shows comparison of different type of DLTs. Figure 1 gives the brief introductory description of all the five different type of DLTs.

After getting the introduction of five DLTs, it's time to know how these blockchain works? All the five blockchain work on different kind of methods. Working of all five DLTs depends upon how the manage distributed ledger. Fig 2 shows brief working of five different type of distributed ledger.

4) Features of different DLTs and platforms: Author discussed about different type of DLTs and their working in previous sections. In this section author will discussed about different type of DLTs with their features and available real

TABLE I
DIFFERENCE BETWEEN BLOCKCHAIN AND DISTRIBUTED LEDGER

ATTRIBUTES	BLOCKCHAIN	DISTRIBUTED LEDGER
DEFINATION	Anybody can consider DLT as the parental technology of blockchain. It is a type of DLT each node in the network has its own copy of the ledger. Whenever a new transaction perform and verified all ledger got updates	It is a decentralized database, means it is distributed across the the various computer knows as nodes. Every computer or node has to maintain a ledger, & if any data modified then ledger gets modified. This modification at every computer takes place autonomously.
BLOCK STRUCTURE	It shows data as a chain of blocks. This type of the data structure is not a genuine data structure type for DLT	It is a kind of database which distribute across the globe on a different node. We can represent data in any type of structure.
SEQUENCE	All the blocks in blockchain follow a specific sequence.	DLT not have a specific sequence. Different type of DLT follow different sequence
POWER HUNGRY CONSENSUS	Blockchain uses different types of proof-based consensus and they all need high power consumption	DLT does not need any kind of the consensus that's why they are need low power consumption.
REAL-LIFE IMPLEMENTATIONS	Wide range of application in many enterprises and government running on a blockchain.	DLT usages and project is under development for different kind of application.
TOKENS	Different type of blockchain platform use a different kind of token and currency on the network.	There is no need to have any kind of currency or token on the network.

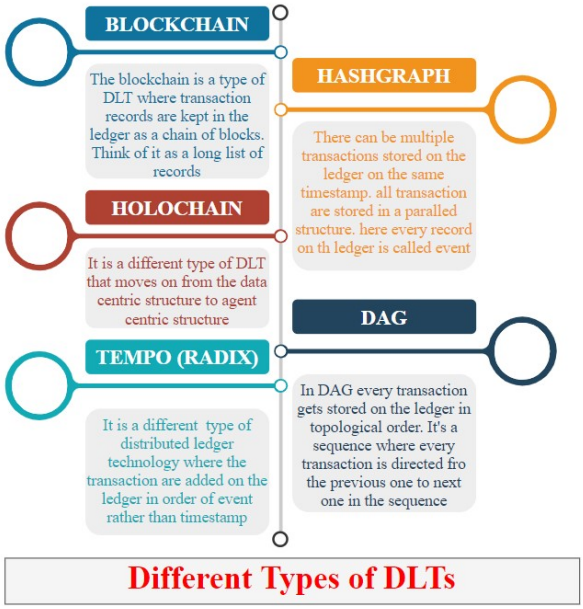

Fig. 1. Different types of DLTs

time platform in market on which many organization working. Table 2 shows complete details about features and platform for different DLTs.

5) Comparison of different types of DLTs: Blockchain initial comes in highlights in 2009 just after the bitcoin invented by Satoshi Nakamoto, the first digital crypto currency. In the last few years distributed ledger and blockchain found very

TABLE II
FEATURES OF DIFFERENT DLTS AND PLATFORMS

DLTS	FEATURES	DESCRIPTIONS	PLATFORMS
BLOCKCHAIN	Immutability	nobody can't change or alter the ledger in blockchain which makes the system immutable	Ethereum, Hyperledger fabric, codra
	Enhanced Security	it is impossible to hack this DLT due to decentralized nature & encryption by cryptographic	
	Faster Settlement	comparatively its faster than typical payment system, but gets slower in bigger networks	
	Consensus	it supports a vast range of consensus protocol which helps the node to make right decision	
DAG	Near Infinite Scalability	its depends upon the user for validation more the user less the validation the time which makes this system near to the infinite level of scalability	IOTA, Byteball
	Micro and Nano Transactions	for validation previous the transaction makes this a Nano & micro transaction friendly	
	Quantum-Resistance	its use one time signature for quantum resistance	
	Parallel Lined Transactions	after completion of validation every transaction parallel lined	
HASHGRAPH	Enhanced Fairness	due to high level of fairness this DLT susceptible to influencers	Hedera Hashgraph, NOIA, MINGO
	Unique Data Structure	orderly method I use in this network to log down every gossip sequence	
	Random Gossip	its use random gossip protocol about to know with another no in the network to spread every information to every node.	
	Virtual Voting	I this DLT every node have a copy of Hashgraph which enables the computer or node to predict what other nodes in network would want	
HOLOCHAIN	Energy Efficient	different nature to maintain the ledger makes the system more energy efficient in comparison to others	HOLOCHIN
	True Distributed Ledger	true distributed ledger means every node maintain their own ledger	
	User Empowerment	Users Control their own data in this kind of DLT	
	Agent-Centric	in this kind of DLT every node can validate autonomously without any kind of consensus	
TEMPO	Sharding	every computer or node have a shard or small information about the global ledger with a unique ID	RADIX
	Gossip Protocol	nodes broadcast all the information in the network with synchronize manner	
	Logical Clocks	this DLT use sequences of transaction rather than timestamp to reach a consensus	

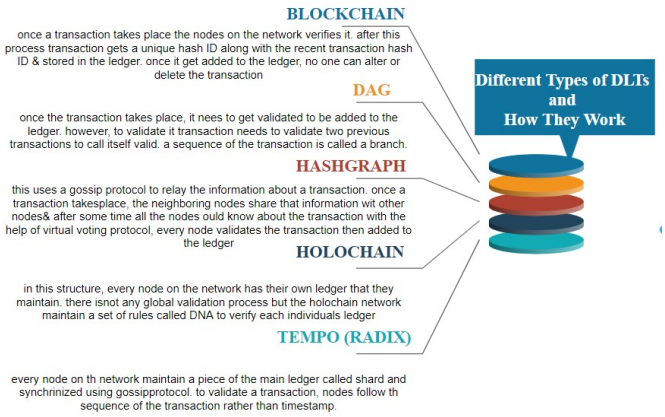

Fig. 2. Working of different type of DLTs

useful in serval real time use cases beyond the powering of cryptocurrencies.

Although, some systemic and technological scaling problems and inefficiencies directed to developers and organizations to considering for solutions beyond blockchain. To find the solution of problem related to blockchain, researcher find some ingenious and novel and developments like Directed Acyclic Graph (DAG), Holochain, Tempo, and Hashgraph. In core, the idea is to retain the prime aim of blockchain alive to face of some new different and unpredicted difficulties.

The arrival of the innovative solutions, one who majorly vary from blockchain constructed on different data structures, bring new idea and discussion about which distributed network is good in different application and areas. To keep this in mind, this section discusses the limitations and strengths of different distributed ledger network.

In precise, this section will compare Holochain vs Hashgraph vs Blockchain vs Dag as shown in figure3.

CATEGORIES	BLOCKCHAIN	HASHGRAPH	DAG	HOLOCHAIN
• MINING	Participants have the ability to mint new tokens via different consensus mechanisms	Nodes create consensus through Virtual Voting	The previous transaction validates the succeeding to achieve consensus	Nodes run on individual chains hence miners not needed to validate transactions
• TRANSACTIONS PER SECOND	Highly limited in terms of scalability and TPS	Unique consensus mechanisms reduce computational burden hence high scalability and high TPS	Unique data structure via directed acyclic graphs ensures that scalability and TPS are high	Each node processes its own ledger hence limitless scalability and TPS
• DATA STRUCTURE	Data structured in blocks in order of transactions which are validated by miners in the ecosystem	Virtual voting and Gossip about Gossip ensures that transactions are validated by the majority	Data structure follows the directed acyclic graph mechanism where each transaction is independent	Data is distributed among various nodes on the platform hence there is no problem of network congestion
• VALIDATION OF TRANSACTIONS	Miners have the power to postpone a transaction or cancel it entirely	Validation of transactions is as per consensus	The success of present transaction relies on its ability to validate two previous transactions	Nodes process their own ledgers hence there is no need for miners
• TIME OF LAUNCH	Went public in 2008	Available for public use as of August 24 2018	NXT is the first platform utilizing DAG, and it came out on November 9, 2015	Alpha 1 product released on May 26, 2018
• NETWORKS RUNNING ON THE PLATFORM	Bitcoin and Ethereum are the most popular networks built on blockchain	Swirlds and NOIA are the only networks on Hashgraph	NXT, Tangle, and ByteBall are the most popular networks using DAG foundation	Holochain network is the best-known network on this platform

Fig. 3. Blockchain vs Hashgraph vs DAG vs Holochain [101Blockchain]

II. Potential Application Areas of DLT

Distributed ledger technologies (DLT) and blockchain get more attention from a wide range of participants because of their prospective as a transformative power across different industries. While many may sack this interest as hype we have faith in DLT is an extremely influential technology that should not be underrated. Regardless of generally finance-related interest in blockchain technology, the areas of DLT application are not restricted to the financial services business. Along with many banks and FinTech startups, non-financial companies have been giving attention and observing for ways to leverage the chances that DLT opens in the field of trading, govt. services, healthcare etc. Figures 4 shows some potential application area for blockchain and DLT with use case.

	USE CASE 1	USE CASE 2		USE CASE 1	USE CASE 2		USE CASE 1	USE CASE 2
Healthcare	Offers better clinical support with secure data	Speed up diagnosis & protects patient information	Govt. Services	Can provide a secure transparent election system	Offers smart cops & upgrade the law department	Transportation	Ensures better upgradation for Smart Cars with more accuracy	Securely connect passengers with better quality transport
Legal contract	Offer protection for legal contracts & documentations	Streamlining property information & validating inheritances	Supply Chain	Can securely track and monitor luxury goods	ensures logistic based processes	E-commerce	Securely connect user with better merchandisers	Promote fairness in the digital marketplace
Entertainment	Streamlining entertainment channels & ensuring better artist value	Providing higher-end technology for gaming	Global Payment	Offer faster transaction worldwide with full security	Provide digital and cryptocurrency	Cybersecurity	Provide a higher level of online security	Offers better firewalls and blacklists system
Manufacturing	Enable smart manufacturing system with security	Optimizes time, speed and reduce cost	IOT	Provide a secure platform for internet of things kind of services	Offer a better ecosystem to deal with operational challenges	Trading	Ensures a safe platform for cryptocurrency trading	Provide a very high level of security for your assets

Fig. 4. Application area for DLTs and Blockchain

III. Some Challenges of DLTs and Blockchain Technology

The DLT and blockchain technology is still developing, and there are serval legal and regulatory concerns, which have to be resolved. It is still not clear which application of blockchain is deliver the good advantages in comparison to the existing technology. It is still not clear where we use blockchain and where should not use. These kind of challenges divided into legal and technological based challenges, some of them given below:

A. TECHNOLOGICAL BASED

1) Lack of maturity: : Blockchain is still in developing stage and there are some serious issues about resilience and robustness, especially in the cases of large transactions, where we can feel lack of availability for standard software and hardware, and also lack of highly skilled professional.

2) Scalability and transaction speed:: permission less blockchain faces this kind of issues in the terms of verification speed of block and transaction volume. Bitcoin is the best example for permission less blockchain and it can process only 4-8 transaction per second. It happens due to limitation in size of block in megabyte.

3) Integration and interoperability:: there are lots of blockchain system available in the market. One blockchain ledger system need to be integrated and interoperable with other blockchain ledger, it becomes necessary when these ledger are introduced at financial system. Cost of the integration must be less.

4) Governance:: As we know there is no central entity or authority in blockchain system. And in the absence of any central entity or centralized infrastructure, it's very difficult to ensure the effective governance.

5) Cybersecurity:: in this world, not a single software is free from some technical vulnerabilities. Past history shows this. DAO attack on Ethereum blockchain shows that any type of vulnerabilities can be exploited in smart contract. In permission less blockchain system a single user can use more power of computing to behave badly and other user can't use ledger normally. One can use traditional attacking system such as distributed denial of service (DDOS) attack which is somehow successful at some level in past. Many researcher and academician working in the field of quantum computing to break the cryptographic methods. What will happened, if future development in quantum computing able to do this. Despite these different concerns bitcoin blockchain is not compromised till date.

B. LEGAL BASED

1) Regulatory and industry standard:: Governing screening and progress of industry principles are needed but they are still in initial progress phases. Few governing bodies across the globe are dynamically reviewing the technology, but targeted governing outlines for blockchain are yet to materialize.

2) Legal clarity over ownership:: In a settlement and payment system, there are some specific issues which belongs to how the transaction is finalized in blockchain environment. In addition, there are some issues related to cross border blockchain system jurisdiction for underlying transaction and data. Governing permission less, open blockchain system is complicated in comparison of closed or permission blockchain system, as there are no single legal authority in control.

3) KYC and CDD:: Full form of CDD is Customer Due Diligence and KYC full form is Know Your Customer. For using blockchain in financial system, it will need to observe KYC and CDD requirement to stop financing terrorism and money laundering

C. OTHER CHALLENGES

1) Privacy:: public blockchain system, such as bitcoin or litcoin, is open for whole the world. Any participant can join or leave the network at any point of time, and network is visible for all the participants in the whole network, although data is encrypted and user identity is hidden, still a privacy is challenge in public blockchain.

2) Environmental:: permission less blockchain or public blockchain use PoW consensus algorithms which uses a very large amount of electricity for a huge quantity of computing processing is mining.

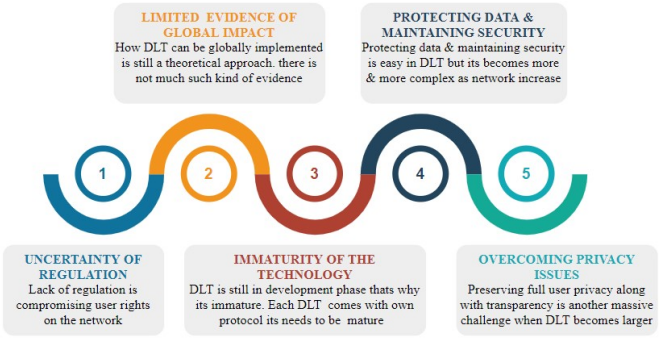

Fig. 5. Challenges of DLTs and Blockchain

IV. FUTURE OF DLT

you should be doubting, that what will be the forthcoming of novel technique is? Let's sheen some sunlit on feasible results. If DLT continues thriving like this, then we would possibly see a lot greater strengthening in phrases of today's incorporations. It means, in todays scenario, there are many agencies like IMB, Microsoft, Google etc, who already trying to develop some tools to offer distributed ledger technology services for user in different application areas. This technology will change the typical way to interact or communication of data in tech world. However, if high end technical agencies can simply control the limitation this technology have the potential to drive the global economy. Data is the biggest assets of any organisation, and DLT are inventing to offer a distinguished method to accumulate them in a chronological method. The web is transferring our life, and with the contribution of DLT we will be in a position to have finest manage above our data on web.

So, there would be a cryptocurrency market on the growth very soon. some possible use of DLT is given below:

- Administration systems based on DLT
- Necessity for the crypto based banking system.
- Full clearness and transparency in trades.
- Ecosystem joining diverse social chains.
- Security procedures based on DLT

V. CONCLUSION

By the discovery of distributed ledger technology, a different kind of revolution started in the field of information gathering and communication. By the Using of this tech, we can collect both dynamic data and static data sequences. DLT can permit the user to go outside the usual or old fashion database system and exploit this new innovation daily life applications. It is not about to collect the information but it's about how to use that information or how to utilize that collected information to grow economy. A better DLT with additional proficiency and productivity is yet to be developed. In this paper author discuss about blockchain which is widely used DLT but it is Obvious it will take time to make making this new technology perfect. Till then world can expect for better and enhanced consequence soon.

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