Distributed Ledger

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Distributed Ledger Technology & its Significance

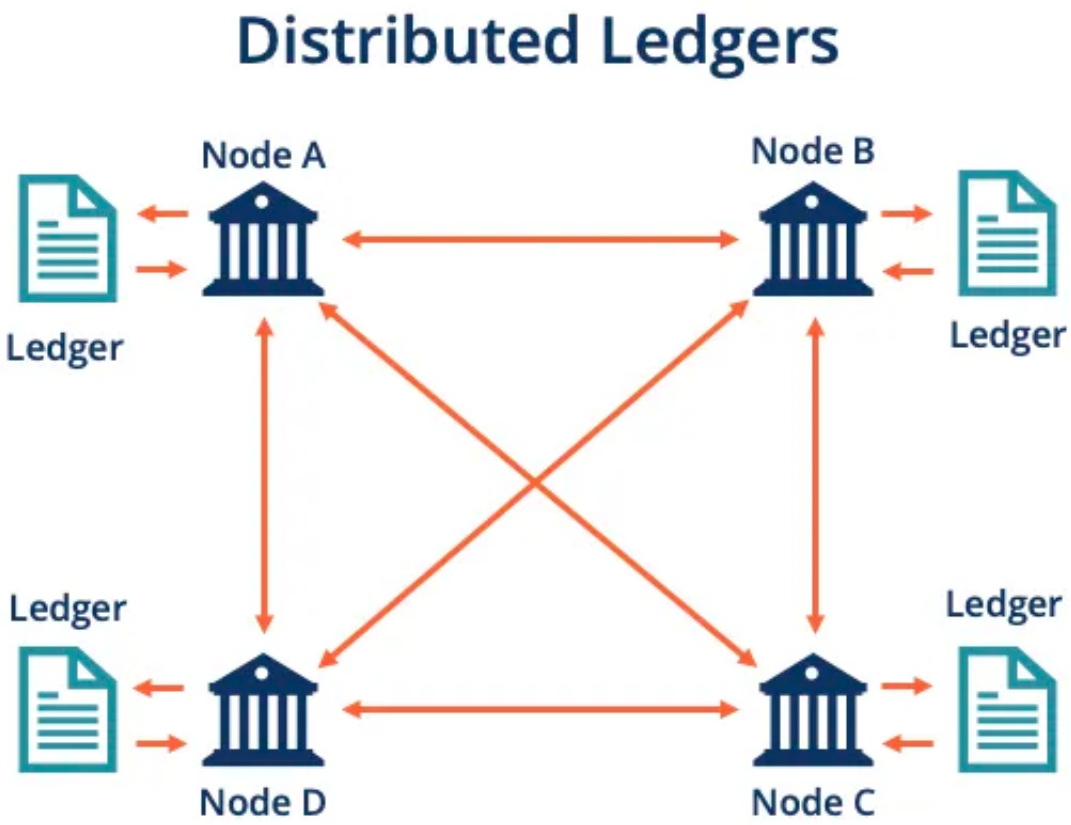
Distributed Ledger

The purpose of this assessment is directed at gaining a deep insight into this

state-of-the-art area fueled by distributed ledger technology potentially used to keep track of transactions around the world, be they financial, legal, business or any other activity that needs scalable and secure record keeping. Definition: A system comprising independent networks aimed at recording, replicating, sharing, and synchronizing digital data and information globally is referred to as a distributed or shared ledger (Hilary, 2022). Data dissemination in a distributed ledger is predicated on peer-to-peer computing in addition to consensus algorithm. These two features enable a decentralized approach that is not limited by having a single controller which can't keep up with the growth of transactions across the internet. In this way, the technology replicates ledger data across each and every node via autonomous updates. The absence of central administration and utilization of cryptography make the distributed ledgers immutable and secure – i.e. the data cannot be changed which makes it a great record-keeping technology. A diagram of distributed ledgers is shown in Figure 1.

The emergence of distributed ledgers can be traced back to 2008 with the publication of Satoshi Nakamoto, providing a peer-to-peer methodology and, thereby, resolving the complication of double-spending (Nakamoto, 2008). Afterwards, the modifications adopted by Vitalik Buterin to Nakamoto's work in 2014 further ameliorated the technique, making it more comprehensive, merchantable, and swift (Buterin, 2014). These developments are the harbingers of evolution and growth in the field of distributed ledgers.

Figure 1: Distributed Ledgers



Distributed Ledger Technology

Various interpretations of distributed ledger technology (DLT) have been developed over time. As per Tasca and Tessone, DLT's modus operandi is based on consensus protocol along with the additional attributes pertaining to decentralized, transparent, secure, and immutable environment (Tasca and Tessone, 2017). According to the World Bank, dispersed documentation of the data covering multiple associations classifies as a DLT (Krause et al., 2017). Thus, systematic elucidation of DLT accounts for a digital ledger that is capable of enabling a web of self-governing partakers in an effort to build a consensus-based configuration in the vicinity of authorized arrangement concerning cryptographic and validated proceedings (Scharfman, 2022).

DLT systems are categorized as either permission-less or permissioned depending on the fundamental distinctions between the two which are illustrated below.

	Permissioned DLTs	Permission-less DLTs
Centrality	There is external management and command to a degree.	In this case, there is no principal administration.
Accessibility	User-specific permission to the system is guaranteed.	Access to network is public.
Trust Level	Requirement of high-level trust among users is inevitable.	Trust is not a prerequisite in this scenario.
Availability	In this regard, ledgers are open and transparent to specified levels.	The aspects of transparency and openness of the ledgers are conspicuous among all users.
Safety and Security	Access control policy related to DLTs in small-scale networking ensures security.	Safety via wide-area distributive strategy in large-scale networking is maintained.

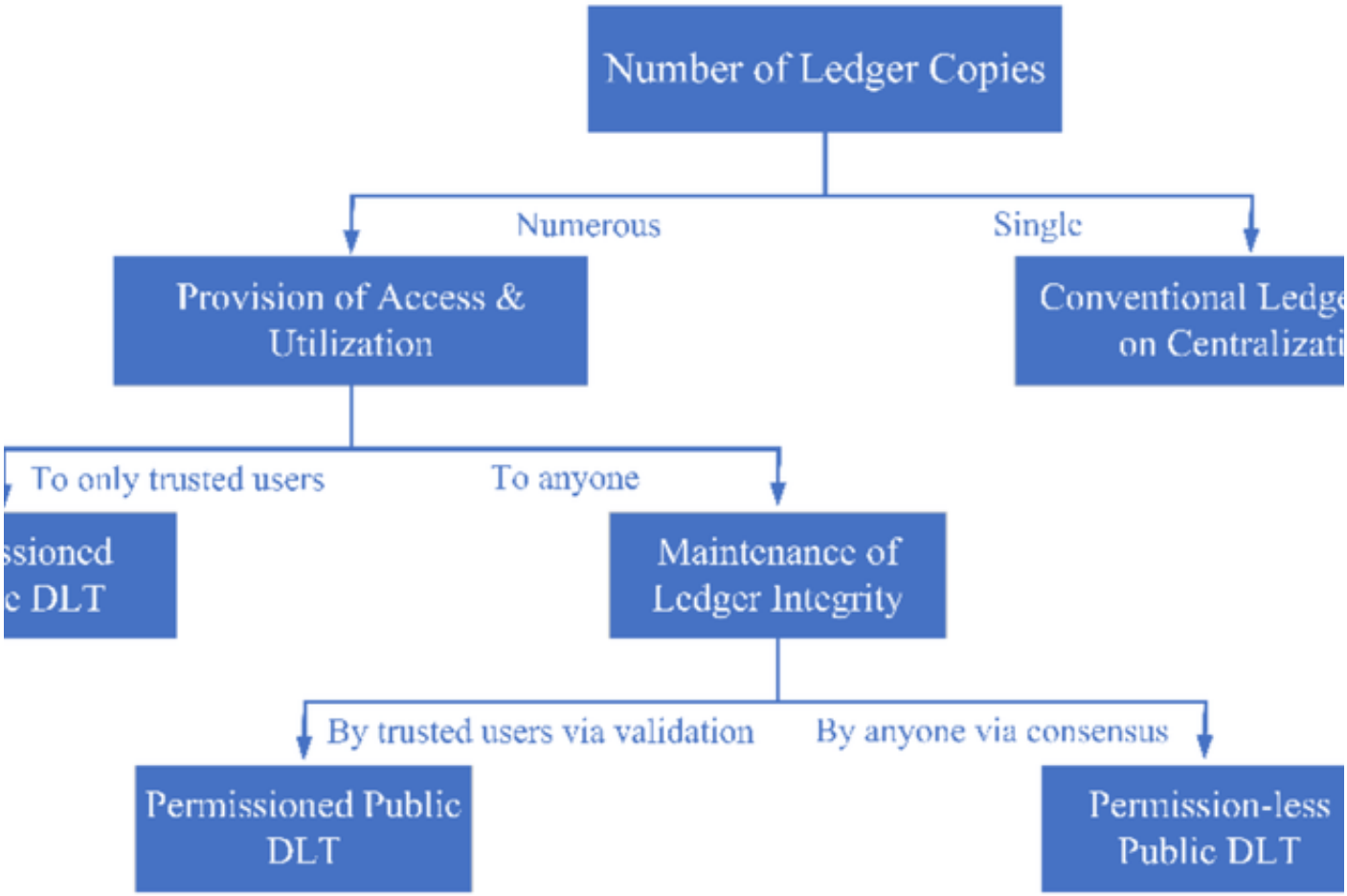
Swiftness	High-speed transaction process legitimizes increased transaction volume.	Slow transaction process limits transactions.
Identification	ID confirmation is usually necessitated via controller.	Incognito or anonymous identification is evident in such a ledger.
Consensus-based Process	Diverse consensus mediums with low difficulty-level are probable.	Consensus algorithm based on the proof-of-work model with high-level difficulty is needed.
Resource	Any kind of asset can be represented.	Inherent digital assets are generally implemented.
Ownership Legitimacy	Considerable legitimate clarity atop proprietorship is the hallmark of such technology.	Lawful considerations above the absence of possessions are existent in this case.
Instances	Hyperledger Fabric, R3's Corda, Ripple	Ethereum, Bitcoin

Thus, in view of the above-mentioned details, a DLT structure comprises 3 key layers which are categorized as:

- Protocol Layer: In this layer, the overall operation of the configuration is determined with the help of software-based standards.
- Network Layer: Protocol implementation contingent on interlinked participants and programs is conducted in this level.
- Data Layer: This layer is tasked with the phenomenon of propagating data and information via the complex arrangement.

The characteristics associated with a structured, systematized, and methodical DLT are, hence, described below.

- Distributed documentation and record-keeping
- Multilateral concord
- Autonomous authentication
- Discreet detection of tampering with evidence
- Tamper-resistant



Advantageous Features of DLT

DLTs are pragmatic and preferable as compared to centralized general ledger technologies owing to the following rationales.

Decentralized Technology along with the Absence of Intermediary

In DLTs, the occurrences of direct and uninterrupted transference of digitized assets or values linking 2 counter-parties are realized. Moreover, the decentralization approach leads to disintermediation which, in turn, compiles a cost-effective, scalable, and time-saving solution.

Transparent and Auditable Network

Owing to the presence of replicate distributed ledgers to each and every user, modifications are only possible based on the mutual consensus, thereby,

actualizing real-time propagation throughout the nexus. Thus, encryption in addition to lack of centralization minimizes cyberattacks and excludes costs of reconciliation.

Upgraded Cyber Resiliency

As opposed to centralized ledger technology, DLT is relatively less prone to cyberthreats on account of its shared or distributed essence.

Automated and Programmable Platform

DLTs are capable of automatically enabling, executing, controlling and documenting legitimately pertinent events after satisfying pre-agreed stipulations known as smart contracts. The smart contracts are software which is run to check that the transaction has met all criteria in the smart contract. The participants benefit by having the transactions correct when they are needed, saving the time, money, and headaches associated with finding errors much later during an audit – after the damage is done.

Immutable and Verifiable Chain

The technologies incorporating distributed ledgers are good at providing certified and inflexible audit trails in connection with archives, thereby, preserving the genuine recordkeeping.

Efficient and Speedy

With the omission of mediators, the transaction handling by DLTs is substantially accelerated along with the additional advantage of increased efficiency due to the lack of errors and reduced reliance on slow manual processes.

Cost-effective Configuration

Because of the non-existence of reconciling in DLTs, the capability of dispensing a low-cost and economic infrastructure is significantly enhanced. In accordance with the research-based findings, DLT has the ability of saving the fiscal sector

single-handedly about $15 to $20 billion a calendar year (Santandar Report, 2015).

Blockchain vs DLT and Cryptocurrency

Blockchain and DLT are not same. These 2 terms are different in the sense that blockchain is classified as a specific kind of distributed ledger. So not every distributed ledger falls under the category of blockchain. Accordingly, DLT can be deemed a parent technology of blockchain. The proliferation in the utilization of blockchain can be recognized from the fact-finding that blockchain-based marketplace is anticipated to grow from $500m in 2018 to ~$16bn in 2024 (Industry Growth Report, 2018). This is currently driven by blockchain's use in cryptocurrencies.

The main differences between DLT, blockchain and cryptocurrency are tabulated below.

	Distributed Ledger Technology (DLT)	**Blockchain Technology**	**Cryptocurrency**
Definition	A DLT is a decentralized database distributed across different nodes autonomously together with the data updates occurring at each node to make sure that data is not lost	Blockchain is one of the DLTs in which each and every node acquires replicate ledger whose data points are revised upon the addition of each new	Cryptocurrency is construed as a digital currency where verification and maintenance of transactions are engineered via decentralization and cryptography (Berentsen and

	or updated incorrectly (Scharfman, 2022).	entry (Gad et al., 2022).	Schar, 2018).
Block Configuration	A distributed ledger comprises a database distributed across several nodes without the need of block structure. The data can be represented as related to discrete ledgers.	The data in blockchain is represented in the form of chain of blocks.	See Blockchain since cryptocurrencies use blockchain.
Consensus-based Mechanism	Distributed ledgers do not require consensus. Because of decentralization and peer-to-peer design, they do require a mechanism to ensure that data is the same at each node.	Blockchain-based technologies require proof of work or proof of stake to validate transactions as part of their peer-to-peer consensus design. This ensures that there is a huge cost to deter malicious take overs and attempts to	Cryptocurrencies, i.e., Bitcoin, Ethereum 1.0, use proof of work which is resource-intensive, whereas, Ethereum 2.0, Cardano, uses proof of stake which is energy efficient and therefore much more scalable.

		corrupt the data.	
Sequential Pattern	In case of DLTs, there is no need to adopt a particular data sequence as in blockchain.	Every single block in the blockchain technology is sequenced in a definite order.	See blockchain
Tokenized Assets	There is no need of tokens in DLTs.	Scores of blockchain-based environments demand tokenized money.	See blockchain
Real-life Uses	There are relatively fewer instances of real-life implementations of non-blockchain DLTs.	Blockchain-based platforms are being employed by a plethora of public as well as private organizations.	Cryptocurrency – with a monetary value – is an exchange medium like the US dollar.

As far as the dissimilarities between journal and ledger are concerned, the following Table 3 sheds light on the context. Distributed ledger technology focuses on the ledger but it generally includes the Journal's purpose as shown below.

Journal	**Ledger**

A logbook containing records of every single transaction is known as a journal, and the process is called journalizing (Peprah et al., 2022).	A ledger is a record keeping system capable of enabling the transfer of every transaction to a separate account, and the procedure is identified as posting. It enables reconciliation of accounts (Peprah et al., 2022).
Transactions are recorded sequentially.	Its transactions are registered account-wise.
It is an account of first or original entries.	It is composed of a book of secondary entries.
A journal is a chronological-based	A ledger is an account-based record of how journal

archive.	transactions are tracked to accounts.
The trial balance cannot be prepared from the journal.	The trail balance preparation is possible from the ledger.
The preparation of balance sheet directly is not possible from the journal.	With the help of ledger balances, the preparation of balance sheet is possible.

Competing DLTs

In light of the DLT-based systems, there are many technologies arising in this field. A list of competing DLTs along with their description is outlined below.

- Blockchain: Blockchain is a type of DLT capable of facilitating the procedure of recording transactions in addition to tracking either tangible or intangible assets.
- Hashgraph Technology: Hashgraph is a DLT that is considered as an alternative to blockchain, and utilizes a gossip about gossip protocol.
- Directed Acyclic Graph (DAG): A DAG is another DLT aimed at recording data. It is a data modelling as well as structuring tool, having vertices and edges, where transactions are represented by vertices and the direction of flow by edges. In order to validate previous transactions, it utilizes new transactions.
- Holochain Network: Holochain is an advanced DLT having nearly infinite

scalability due to the absence of a global consensus mechanism.
- Tempo (Radix): An ultra-modern DLT providing the advantages of timestamp is characterized as Tempo.
- IOTA Tangle: Developed by the IOTA Foundation, Tangle is a novel DLT which is precisely created for the Internet of Things.
- SIDEchain DLT: A private DLT that is purposely designed for the global securities market, and incorporating the benefits of enhanced security and scalability.
- Corda: Corda is a permissioned and scalable peer-to-peer DLT that is deployed to build application programs aimed at fostering and delivering digital trust among users.
- Ripple's XRP Ledger: XRP Ledger is a permission-less, decentralized, and open-source DLT capable of settling transactions within 3 to 5 seconds.
- Hyperledger Fabric: A permissioned DLT containing module-based configuration and offering plug and pay constituents.

Competing DLT Providers

DLT providers in various real-world fields are explained below.

- The Everledger Platform: Everledger is a digital transparency firm that provides technological solutions to uplift transparency in the global supply chain.
- Sygnum Bank: Sygnum is a digital asset banking solution that employs DLT focused at methodically and thoroughly embedding digital resources in bank regulation.
- Verisart: By making use of Bitcoin, the digital platform Verisart is meant for certifying and verifying artwork and collectables.
- Ripple: Ripple is a real-time payment protocol that uses the XRP Ledger in an effort to ensure safe and secure global transactions.
- Tokeny Solutions: Tokeny Solutions enables corporations functioning in privatized sector to take advantage of DLT in addition to complying with standards.
- Billion Group: Billion Group's Unified Enterprise DLT System is a high-performance blockchain adhering to regulatory compliance and is

applicable to digital transactions, data and information, and identity and access management.

- IOTA Foundation: IOTA Foundation – a non-profit enterprise and developer of Tangle – is designed as the basis for a world-wide protocol.
- CoreLedger: CoreLedger is a blockchain infrastructure provider that assists in building tools as well as services for wide-ranging projects.
- Finhaven Technology: Finhaven is a financial services and technical solutions provider based on DLT and digital security.
- ChainTHAT: ChainTHAT is an enterprise solution company that utilizes DLT, blockchain and smart contracts aimed at allowing insurers to safely associate peer-to-peer with enhanced rate, formally assured data quality, and considerable functional capability.
- Symbiont Assembly: Symbiont Assembly is a blockchain-based and high-level secure environment deployed to build and run decentralized programs, i.e., smart contracts.
- Axoni: Axoni is an innovative industry that provides services related to DLTs, business applications, enterprise infrastructure, and workflow automation.

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