UNIT – 1

CENTRALIZED SYSTEMS

We start with centralized systems because they are the most intuitive and easy to understand and define.

Centralized systems are systems that use client/server architecture where one or more client nodes are directly connected to a central server. This is the most commonly used type of system in many organizations where a client sends a request to a company server and receives the response.

Decentralized system

A decentralized system is an interconnected information system where no single entity is the sole authority. In the context of computing and information technology, decentralized systems usually take the form of networked computers. For example, the Internet is a decentralized system, although it has become increasingly centralized over time.

These are other types of systems that have been gaining a lot of popularity, primarily because of the massive hype of Bitcoin. Now many organizations are trying to find the application of such systems.

In decentralized systems, every node makes its own decision. The final behaviour of the system is the aggregate of the decisions of the individual nodes. Note that there is no single entity that receives and responds to the request.

Example –

Bitcoin. Let's take Bitcoin for example because it is the most popular use case of decentralized systems. No single entity/organization owns the bitcoin network. The network is a sum of all the nodes who talk to each other for maintaining the amount of bitcoin every account holder has.

Characteristics of Decentralized System –

Lack of a global clock: Every node is independent of each other and hence, has different clocks that they run and follow.

Multiple central units (Computers/Nodes/Servers): More than one central unit which can listen for connections from other nodes

Dependent failure of components: one central node failure causes a part of the system to fail; not the whole system

Scaling –
Vertical scaling is possible. Each node can add resources (hardware, software) to itself to increase the performance leading to an increase in the performance of the entire system.

Architecture of Decentralized System –

peer-to-peer architecture – all nodes are peers of each other. No one node has supremacy over other nodes

master-slave architecture – One node can become a master by voting and help in coordinating of a part of the system but this does not mean the node has supremacy over the other node which it is coordinating

Limitations of Decentralized System –

May lead to the problem of coordination at the enterprise level – When every node is the owner of its own behaviour, it's difficult to achieve collective tasks

Not suitable for small systems – Not beneficial to build and operate small decentralized systems because of the low cost/benefit ratio

No way to regulate a node on the system – no superior node overseeing the behaviour of subordinate nodes

Advantages of Decentralized System –

Minimal problem of performance bottlenecks occurring – The entire load gets balanced on all the nodes; leading to minimal to no bottleneck situations

High availability – Some nodes (computers, mobiles, servers) are always available/online for work, leading to high availability

More autonomy and control over resources – As each node controls its own behaviour, it has better autonomy leading to more control over resources

Disadvantages of Decentralized System –

No regulatory oversight

Difficult to know which node failed – Each node must be pinged for availability checking and partitioning of work has to be done to actually find out which node failed by checking the expected output with what the node generated

Difficult to know which node responded – When a request is served by a decentralized system, the request is actually served by one of the nodes in the system but it is actually difficult to find out which node indeed served the request.

Applications of Decentralized System –

Private networks – peer nodes joined with each other to make a private network.

Cryptocurrency – Nodes joined to become a part of a system in which digital currency is exchanged without any trace and location of who sent what to whom. However, in bitcoin, we can see the public address and amount of bitcoin transferred, but those public addresses are mutable and hence difficult to trace.

Benefits and costs

For businesses and organizations, the benefits of a decentralized system include failure tolerance and redundancy, at the cost of additional management complexity. In any information technology organization, decentralization must be balanced with centralization when designing a networked system, to optimize this cost-benefit balance.

Decentralized vs. distributed systems

A decentralized system is distinct from a distributed system. A decentralized system generally has multiple authoritative nodes, each of which serves a subset of the total end users. In a distributed system, however, there are no end users, because every node on the network communicates with every other to behave as a single unit.

In cryptocurrencies

Decentralized systems have gained widespread attention with the advent of blockchain technologies, such as those used in bitcoin and other cryptocurrencies. These systems leverage the properties of cryptography and Markov chains to provide consensus about the financial transactions that occur in the system. The result is a verifiable distributed ledger of transactions, removing the need for a centralized banking authority. Note that although the ledger is distributed to all cryptocurrency users, the cryptocurrency system itself is decentralized.

Disintermediation

Disintermediation is defined as reduction in the use of intermediaries between producers and consumers, for example by investing directly in the securities market rather than through a bank.

Historically, in the case of the financial industry, every transaction has required a counterparty in order to process the transaction. By definition, disintermediation goes hand in hand with disruption; after all, we are removing the middlemen and changing (in some cases, radically) the business model and incentive economies pegged to mediation. With the examples above, we have seen a wave of disruption that can be accredited to digital technologies. These technologies, in turn, have been driven by marketing insights and by the desire to provide a rich user experience. The latter has been a primary driver for adoption of these disruptions in the marketplace.

Blockchain, as a technology, aims to catapult this disruption to new heights with the introduction of trade, ownership, and trust into the equation. Blockchain databases and records represent an emerging technology pattern that can radically improve banking, supply chains, and other transaction networks, giving them new opportunities for innovation and growth while reducing cost and risk.

Fundamentally, blockchain addresses three aspects of the transaction economy:

1. Trade – Goods, and services traded across web of consortia or partner networks (e.g., Interledger). What's traded can be anything that is of value, such as a property, currency, reputation, or even identity. This would imply not just digitization of the assets, but also a reputation and validation system that is attached to the economies that surround the 'Value of Things'.
2. Ownership – The ownership of digital goods and services needs to be validated by a system that is playing by the rules, and by a network that is trusted by the users and yet based on a trust less system. This implies a complex set of mathematically validated algorithms that provide a vehicle (consensus or mining type activity) to guarantee the ownership associated with the 'Thing of Value'.
3. Trust –A system of trust in the network ensures that the system itself is trust less. That is, the system can store and validate ledger entries but is not centralized, nor can any single entity get control of the system. The term 'trust web' is often used to describe such a system.

Blockchain promises systemic security as a trust currency. Economic transactions on a distributed ledger can be programmed to record virtually anything of value: your identity, a will, a deed, a title, a license, intellectual property, and also almost any type of financial instrument. The technology landscape and the ecosystem are quite fragmented, as they are still emerging (and I promise to discuss those in future posts). The following are some notable concepts:

1. Technology behind the trust system – Consensus, mining, public ledger
2. Secret communication on open networks – Cryptography and encryption
3. Non-repudiation systems -Visibility to stacks of processes

Industries that rely on intermediaries include (but are not limited to) the following:

1. Insurance – Property and casualty, auto, life
2. Health care – Electronic healthcare records, healthcare information systems
3. Financial Services – Consumer/retail banks, investment banks, brokerage, etc.
4. Transportation and logistics – Services associated with supply chains, including exports, imports, logistics, and related services such as finance, fund transfers, contracts, and Forex.
5. Retail and real estate – Trade of durable and non-durable goods, which relies on huge margins and delays consumed by a system of intermediaries established centuries ago.

These are all scrambling to understand disintermediation. Many are involved with and invested into the rapidly growing ecosystem of blockchain companies, at times classified under the umbrella term of financial technology, or FinTech. I guess one way to keep up with disruption is to understand and disrupt one's own industry, moving on to newer business models that thrive on disintermediation.

Disintermediation is the investment magnet for blockchain-related ideas, riding on the success of the business and underpinned by peer-to-peer and crowdsourcing models. The promise of blockchain for enterprise goes beyond its role as an industry disruptor. It also has tremendous potential to improve existing business processes, as well as to improve efficiencies in existing transaction systems, leading to exponential cost saving for the enterprise and the end consumer. I like to draw the analogy of the impact of information dissemination due to the internet serving as an information network. Blockchain technology promises a similar explosion in trade, ownership, and trust, as the tenets of both technologies rely on principles of distributed governance and rules established for a time-tested protocol.

Contest-driven

In the method involving competition, different service providers compete with each other in order to be selected for the provision of services by the system. This paradigm does not achieve complete decentralization. However, to a certain degree, it ensures that an intermediary or service provider is not monopolizing the service. In the context of blockchain technology, a system can be envisioned in which smart contracts can choose an external data provider from a large number of providers based on their reputation, previous score, reviews, and quality of service.

This method will not result in full decentralization, but it allows smart contracts to make a free choice based on the criteria just mentioned.

Framework and eco-system

1. Hyperledger Fabric