

Leveraging Blockchain – Corda Architecture

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Abstract

Blockchain technology is a Distributed Ledger Technology (DLT) where the digital information is stored across multiple computers and not centralized. Each system stores a copy of DLT to avoid single point of failure. Blockchain stores the information in blocks. All copies are validated and updated simultaneously. There are four main types of blockchain, they are Private / Permissioned, Public / Permissionless, Hybrid and Consortium. Corda is a distributed ledger open-source platform, it was introduced by R3 consortium (R3CEV LLC). It is not a public blockchain, based on agreement network and Peer to Peer (P2P) connections. No native cryptocurrency. Tech stack platform based out of JVM written in Kotlin.

Index terms

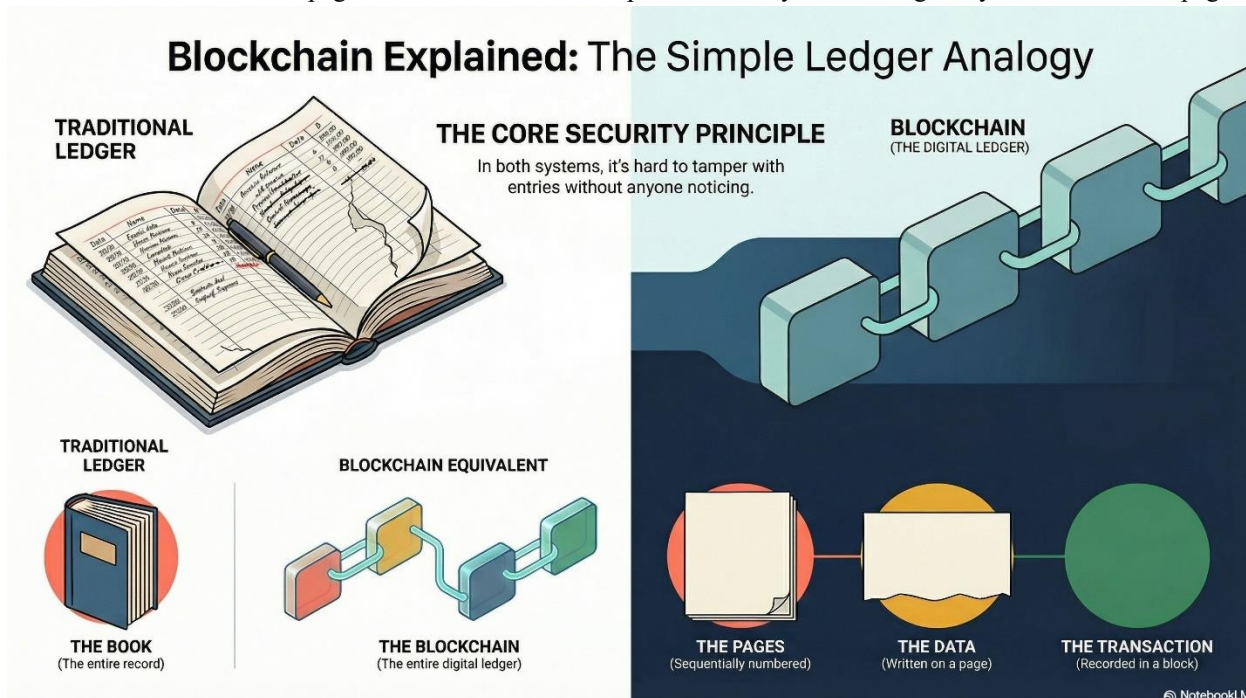
Corda, Blockchain, DLT, Public, Private, Hybrid, Consortium, JVM, Kotlin, Peer to Peer, Distributed, R3CEV

Introduction

It is an open-source platform of a distributed ledger; it is one among the advanced platforms to enable and implement the blockchain mechanism on enterprise. The feature of Corda supports industry standard protocols for communication like AMQP, JDBC etc. Messages are shared with TLS encryption and sent over AMQP 1.0. Sender should know the identity of the recipients. It supports lot of consensus mechanisms. Transactions are validated by the parties involved in the transaction rather than the broader pool of parties. As Transactions details are maintained privately, increasing scalability. Uniqueness is maintained with validation over peer to peer. Data is shared on a need-to-know basis. NO broadcasting of message. NO native cryptocurrency. Support various consensus algorithms.

Blockchain analogy with traditional book-based ledger. In book-based ledger the pages are referenced based on page numbers and the page numbers will be sequential order. Here book is blockchain, data in page is a transaction and pages are referred to the

blocks, and it is linked with page number. It is hard to tamper without anyone noticing. Easy identifiable with page missing.



Blockchain definition according to blockchaincouncil.org “**Blockchain is a consensus-based secure decentralized public/private database which stores information immutably over a peer-to-peer network**”

Features of Corda

Corda framework supports smart contract with following features scalability, privacy, transaction inevitability along with immutability and authentication. Scalability of Corda which allows new node online in parallel to running nodes. Privacy is obtained by partial visibility of data, key randomization & transactions tear-off. Removes the double spending problem with which transaction inevitability is attained. Receiver knows who the sender of the message and the connection is peer to peer the authenticity enabled. Immutability is attained the old transaction can't be altered and new versions of them can be published by flagging the old transaction as historical.

Advantages and Disadvantages

Authenticated Peer-to-Peer communications directly, no global broadcasting and data is shared on need to known basis. Supports multiple consensus algorithms based on need. Runs parallel which increase the number of transactions per second. It uses the unspent transaction output UTXO model.

It does not provide solutions for general problems, It is mainly used for financial solving problems. Less data resources as it is relatively new technology. It do not support cryptocurrency. Permissioned vs Permissionless – Corda is made permissionless, then node can join effortlessly but it can't be verified. It is made permissioned more secure as it need permission to join from doorman which make it as centralization which is not the nature of blockchain. Point to Point vs Global as message is shared to specific node so private information is secure comparatively to the global broadcasting and public. Corda uses UTXO model on which the transactions are dependent on previous transactions, which is a time-consuming task but it allows the update on parallel basis. If it uses account model transactions can't be done in parallel as it maintains the state. It doesn't use robustness so it must start from beginning, which is flexible and time to market will increase.

Different from other blockchain platforms

BitCoin 

Globally known as cryptocurrency and digital payment system. It is the first decentralized digital currency whose ledger is maintained by blockchain publicly. It was released as open-source software in 2009. Peer to Peer in nature and transactions takes places between users without any intermediary. Network node verifies these transactions and stores in public distributed ledger called blockchain. Written in C++

Ethereum



Initiated by Vitalik Buterin late 2013, it is an opensource platform based on blockchain techniques. Funded by public crowdsale during July-August 2014 by buying Ethereum value token (Ether) . Written in Solidity, Javascript, Python

HyperLedger



HYPERLEDGER

Hosted by The Linux Foundation along with the leader in finance , IOT, supply chains , manufacturing. It is cross-industries blockchain technology. It act as a operating system for micro currencies , data-sharing networks, market places and decentralized digital communities. Written in GoLand, Java



It is a Distributed ledger open source platform. It is not blockchain , no message broadcasting and no native currency. Founded by R3 consortium(R3CEV LLC). Written in Kotlin, JVM platform

Corda Architecture

Key components of Corda Architecture are CorDapp, Flow Framework, Notary Services, Custom Service Loader, Node, Message Broker, RPC, Service Hub, Vault, Identity, Transactions, Time-window, Key Management, Network Map, Consensus, Storage, States.

Network Map: It is a document , cached and distributed across network. Server distribute the parameter file that define the values for various settings which all nodes in network need to agree on to remain in sync. Published index of IP addresses of nodes registered in network.

Notary Service: to provide uniqueness consensus attestation for transactions to prevent double spends.

Vault: It contains data extracted from the ledger relevant to owner node in form or relational model.

States: Immutable object that represents the facts which are known by one or more nodes at a specific point of time.

RPC: Used to interact with the node's owner

Service Hub: rich set of services present on nodes

Node: A JVM runtime with a unique identity which runs corda services and CorDapp. Which contains two interfaces layer of network to interact with other nodes and RPC which is used to interact with owner nodes.

CorDapp: which is built on corda platform and runs on nodes.

Transactions: Proposal to update the ledger.

Identity: represents legal identities or services identities.

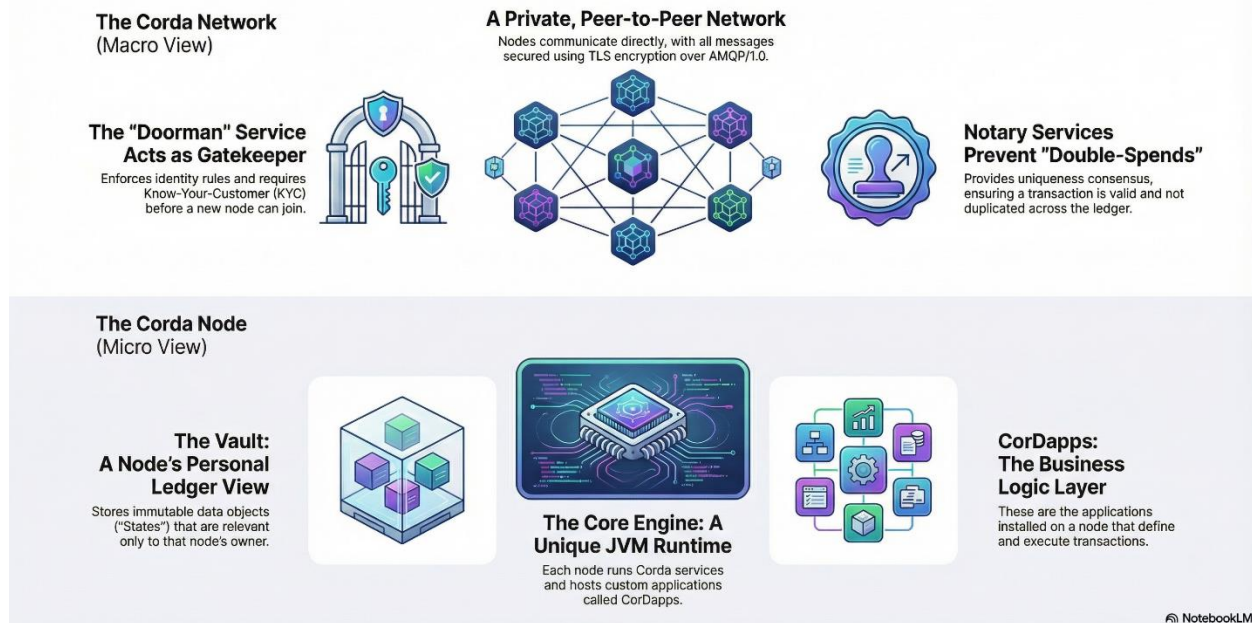
Time-window: time within which particular transactions claim to occur.

Network: P2P network of nodes, authenticated in nature. Each node host CorDapps and Corda services. Each Corda network contains Doorman service which is responsible for enforcing the identity management protocol to that allow nodes to join the network. Messages are TLS encrypted and transferred over AMQP/ 1.0 .

Doorman: Doorman enforces rules regarding the information which nodes must provide. KYC (know-your-customer) must be completed before admitted to network. After getting required information from node, which will provide a root-authority-signed TLS certificate from permissioning service.

Network Services: Corda Network provide two services, Notary and Oracle respectively. Notary services are a pluggable service, and it can be one or more. It can either run on network or node. Oracle service primary activities is to sign the transactions after confirmation of the state of fact and treated to be true. It can be zero or more.

Deconstructing Corda: A Look Inside the DLT Architecture



Node architecture:

Core components are Node Database (Persistence Layer and The Vault), Storage services (Transactions, Attachments, Flow checkpoints), Network Interface, RPC interface, Service Hub, CorDapp provider.

Node Database:

Data are stored in relational model which can be queried and worked.

Persistence Layer – Stores the node's owner information.

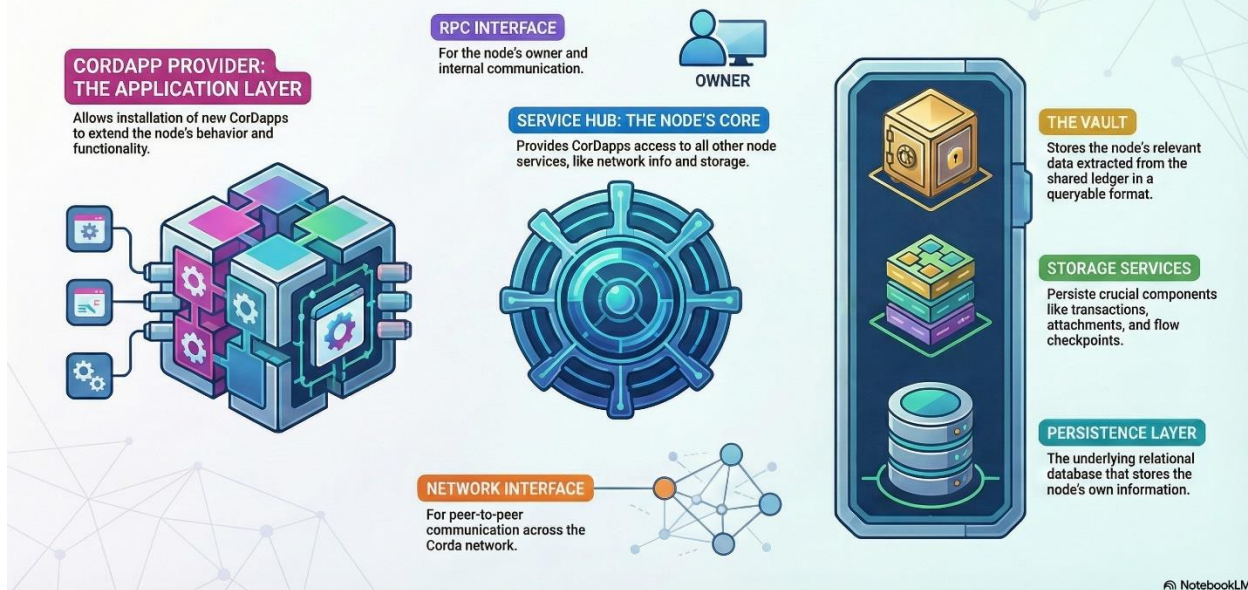
Vault – stores the relevant data extracted from the ledger.

Network Interface – manage the communications throughout the network. Nodes to nodes communication are handled by themselves. Owner of nodes won't interact directly with other nodes.

Service Hub - a node contains rich set of services which are primarily used during flow execution to update the ledger. Some of the key services provided are accessing Vault and Persistence layer, Information of self-node and other nodes in network and services offered by them. The current time track of the node and nodes private and public key pair's accessible.

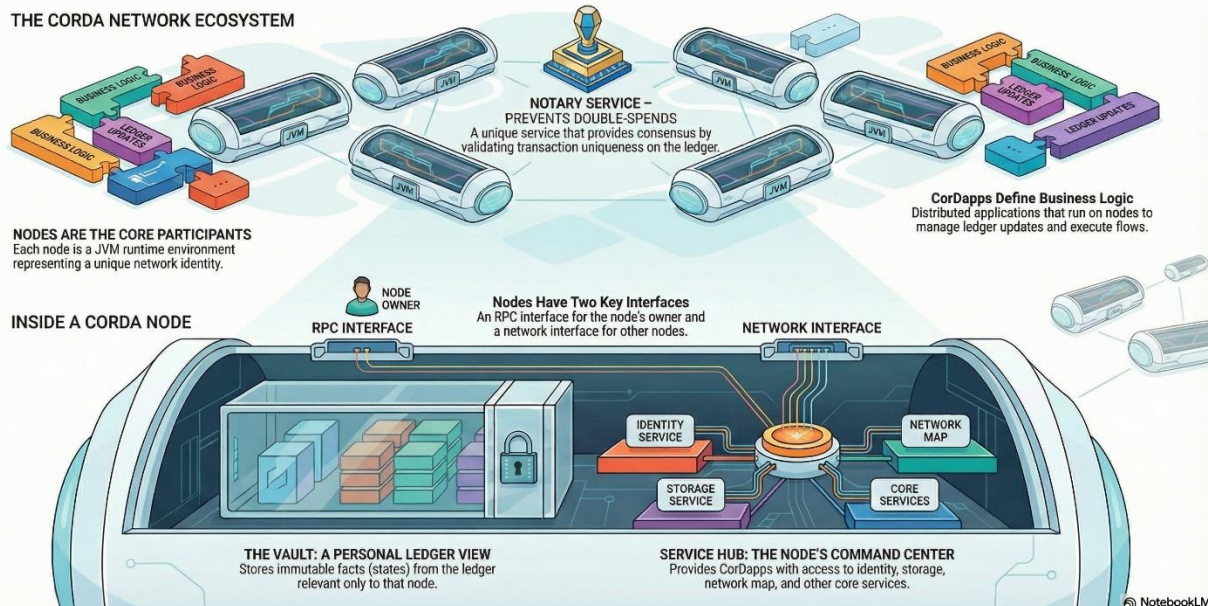
CorDapp Provider – nodes behavior are extended by installing the CorDapp on the provider. It is used to handle some common task like transactions retrieval and attachments from counter parties and broadcasting of ledger updates for recording by counter parties .

Inside a Corda Node: A High-Level Architecture



Anatomy of a Corda Network

THE CORDA NETWORK ECOSYSTEM



Examples

Within financial markets, Corda can be used to automate trading and settlement processes and reduce the need for reconciliation. Banks overnight reconciliation of inter-bank transactions and financial asset management, DvP (delivery versus payment). Financial Market Infrastructure (FMI) accelerate the settlement process by removing the risky reconciliation processes. FinTechs - building of solutions for the digitalizing of traditional assets, such as bills of lading, letters of credit, and precious commodities in order to increase efficiencies and reduce business risk.

Conclusions

Corda was originally designed as a DLT for the financial services industry. Corda can be applied in other industries too where multiple parties need workflow managing transactions, shared view of distributed data i.e. I see what you see. It can be Insurance, Supply chain, Health care.

References

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