HYPERLEDGER
BLOCKCHAIN TECHNOLOGIES FOR BUSINESS

Turbo:
An Introduction

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ABSTRACT

A token based distributed framework that powers artificially intelligent systems' Deep learning, payment and transactional capabilities.

INTRODUCTION

Artificial Intelligence has evolved over many years, and the adoption of Artificial Intelligence based systems is still growing at a slower pace across various Industries.

However, due to the fragmented nature of the AI researches that happen, the systems with machine learning capabilities haven't reached their full potential yet. Now, this is about to change.

The Token based Artificial Intelligence Distributed Machine network as we know it, aims to overcome the hurdle by sharing its intelligence through Interledger protocols thereby powering some of the futuristic applications using Enterprise-grade fault tolerant distributed ledger technology as it's foundation.

ABOUT HYPERLEDGER

Hyperledger is an open source collaborative effort created to advance cross-industry blockchain technologies.
It is a global collaboration including leaders in finance, banking, Internet of Things, supply chains, manufacturing and Technology. The Linux Foundation hosts Hyperledger under the foundation.

Background

Bitcoin

Blockchain technology was first introduced with the release of the Bitcoin White Paper by Satoshi Nakamoto in 2008. The Bitcoin blockchain was designed to create a peer-topeer electronic cash system with no central issuer. Approximately every 10 minutes, the nodes on the network come to consensus on a set of unspent coins, and the conditions required to spend them. This data set, known as the 'unspent transaction output', or UTXO, set, can be modified by submitting transactions to the network that replace one or more UTXOs with a new set of unspent transaction outputs. In order to ensure that all nodes on the network come to consensus on this dataset, the Bitcoin protocol leverages a set of transaction validation rules and a novel consensus mechanism known as proof-of-work which allows for permissionless and anonymous participation in the consensus protocol.

Ethereum

In 2013, Vitalik Buterin published a White Paper that expanded on the blockchain concept by viewing the Bitcoin protocol as a state transition system. State machine replication is a technique used to create fault tolerant services through data replication and consensus, and was first introduced by Leslie Lamport in 1984. The goal of the Ethereum protocol was to create a 'decentralized application platform' that would enable developers to deploy 'smart contracts' that would run on the Ethereum state machine. 'Smart contracts' are state transition functions that take the current state of the ledger and a transaction, and produce a new ledger state. These 'smart contracts' could be used to not only dictate the logic required for the transfer of Ethereum's native currency, Ether, but could also be used to manage arbitrary key-value stores. These key-value stores are most often used to represent the ownership of other assets such as financial securities, land titles, and domain names.

Distributed Ledgers

Since the release of Ethereum, a variety of other 'distributed ledgers' implementations have been created to meet the needs of the enterprise. These distributed ledger implementations include software that expands upon existing protocols (e.g. Bitcoin - MultiChain, Chain, Blockstream and Ethereum - Quorum) and creates entirely new implementations (Corda and Fabric). These implementations deviate from public blockchains to address limitations in existing protocols such as throughput, security, efficiency, usability, and confidentiality. Some distributed ledgers differ substantially from their blockchain predecessors as a result of changes to the underlying networking, journalling layer, smart contract, and consensus layers; some even going so far as to not include 'blocks' or a 'chain'

Related Technologies

- Peer-to-peer networking
- Event driven databases
- Replicated state machines
- Distributed databases
- Replicated logs
- Consensus algorithms

About Hyperledger Working Group (WG)

Business blockchain requirements vary. Some uses require rapid network consensus systems and short block confirmation times before being added to the chain. For others, a slower processing time may be acceptable in exchange for lower levels of required trust.
Scalability, confidentiality, compliance, workflow complexity, and even security requirements differ drastically across industries and uses. Each of these requirements, and many others, represent a potentially unique optimization point for the technology.

For these reasons, Hyperledger incubates and promotes a range of business blockchain technologies including distributed ledgers, smart contract engines, client libraries, graphical interfaces, utility libraries, and sample applications.
Hyperledger's umbrella strategy encourages the re-use of common building blocks via a modular architectural framework.

This enables rapid innovation of distributed ledger technology (DLT), common functional modules, and the interfaces between them. The benefits of this modular approach include extensibility, flexibility, and the ability for any component to be modified independently without affecting the rest of the system

All Hyperledger projects follow a design philosophy that includes a modular extensible approach, interoperability, an emphasis on highly secure solutions, a token-agnostic approach with no native cryptocurrency, and the development of a rich and easy-to use Application Programming Interface (API).

The Hyperledger Architecture WG has distinguished the following business blockchain components:
- **Consensus Layer** - Responsible for generating an agreement on the order and confirming the correctness of the set of transactions that constitute a block.
- **Smart Contract Layer** - Responsible for processing transaction requests and determining if transactions are valid by executing business logic.
- **Communication Layer** - Responsible for peer-to-peer message transport between the nodes that participate in a shared ledger instance.
- **Data Store Abstraction** - Allows different data-stores to be used by other modules.
- **Crypto Abstraction** - Allows different crypto algorithms or modules to be swapped out without affecting other modules.
- **Identity Services** - Enables the establishment of a root of trust during setup of a blockchain instance, the enrolment and registration of identities or system entities during network operation, and the management of changes like drops, adds, and revocations. Also, provides authentication and authorisation.
- **Policy Services** - Responsible for policy management of various policies specified in the system, such as the endorsement policy, consensus policy, or group management policy. It interfaces and depends on other modules to enforce the various policies.
- **APIs** - Enables clients and applications to interface to blockchains.
- **Interoperation** - Supports the interoperation between different blockchain instances.

In this document, we will explore consensus. The goal of consensus is to generate an agreement on the order and to validate the correctness of the set of transactions that constitute the block.

Consensus

Consensus is the process by which a network of nodes provides a guaranteed ordering of transactions and validates the block of transactions. Consensus must provide the following core functionality:
- Confirms the correctness of all transactions in a proposed block, according to endorsement and consensus policies.
- Agrees on order and correctness and hence on results of execution (implies agreement on global state).
- Interfaces and depends on smart-contract layer to verify correctness of an ordered set of transactions in a block.

Comparison of Consensus Types

Consensus may be implemented in different ways such as through the use of lotterybased algorithms including Proof of Elapsed Time (PoET) and Proof of Work (PoW) or through the use of voting-based methods including Redundant Byzantine Fault Tolerance (RBFT) and Paxos. Each of these approaches targets different network requirements and fault tolerance models.

The lottery-based algorithms are advantageous in that they can scale to a large number of nodes since the winner of the lottery proposes a block and transmits it to the rest of the network for validation. On the other hand, these algorithms may lead to forking when two “winners” propose a block. Each fork must be resolved, which results in a longer time to finality.

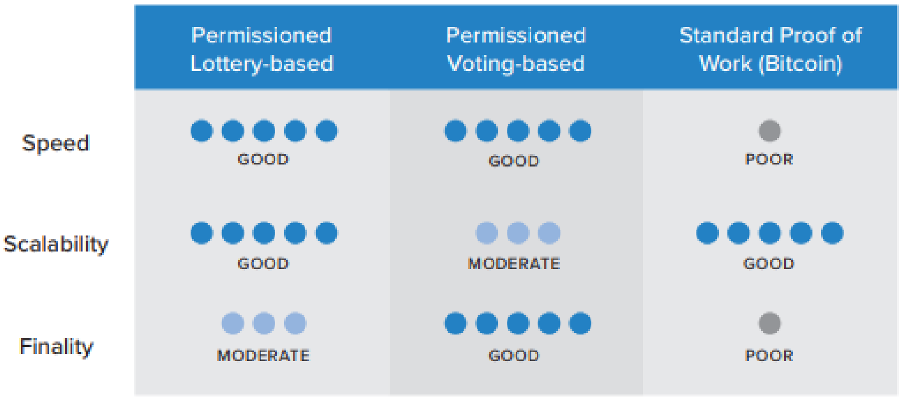
The voting-based algorithms are advantageous in that they provide low-latency finality. When a majority of nodes validates a transaction or block, consensus exists and finality occurs. Because voting-based algorithms typically require nodes to transfer messages to each of the other nodes on the network, the more nodes that exist on the network, the more time it takes to reach consensus. This results in a trade-off between scalability and speed.

The operating assumption for Hyperledger developers is that business blockchain networks will operate in an environment of partial trust.

Given this, we are expressly not including standard Proof of Work consensus approaches with anonymous miners. In our assessment, these approaches impose too great a cost in terms of resources and time to be optimal for business blockchain networks.

Table 1 offers an at-a-glance view of the main considerations and pros and cons of different business blockchain approaches to reaching consensus.

TABLE 1. COMPARISON OF PERMISSIONED CONSENSUS APPROACHES AND STANDARD PoW



	Permissioned Lottery-based	Permissioned Voting-based	Standard Proof of Work (Bitcoin)
Speed	●●●●● GOOD	●●●●● GOOD	● POOR
Scalability	●●●●● GOOD	●●● MODERATE	●●●●● GOOD
Finality	●●● MODERATE	●●●●● GOOD	● POOR

Consensus Properties

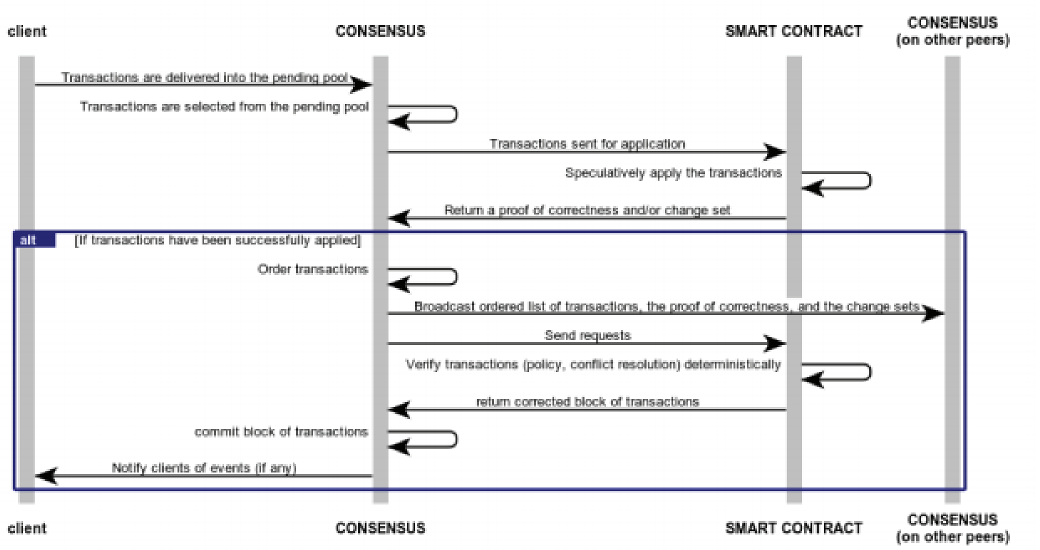
Consensus must satisfy two properties to guarantee agreement among nodes: safety and liveness. Safety means that each node is guaranteed the same sequence of inputs and results in the same output on each node. When the nodes receive an identical series of transactions, the same state changes will occur on each node. The algorithm must behave identical to a single node system that executes each transaction atomically one at a time.
Liveness means that each non-faulty node will eventually receive every submitted transaction, assuming that communication does not fail.

Consensus in the Hyperledger Frameworks

Because business blockchain requirements will vary, the Hyperledger community is working on several different consensus mechanisms as well as implementation approaches to ensure modularity.

Apache Kafka in Hyperledger Fabric, RBFT in Hyperledger Indy, and Sumeragi in Hyperledger Iroha use a voting-based approach to consensus that provides fault tolerance and finality within seconds.
PoET in Hyperledger Sawtooth uses a lotterybased approach to consensus that provides scale at the cost of finality being delayed due to forks that must be resolved.

FIGURE 1. GENERALIZED HYPERLEDGER CONSENSUS PROCESS FLOW


client
CONSENSUS
SMART CONTRACT
CONSENSUS (on other peers)
Transactions are delivered into the pending pool
Transactions are selected from the pending pool
Transactions sent for application
Speculatively apply the transactions
Return a proof of correctness and/or change set
alt
[If transactions have been successfully applied]
Order transactions
Broadcast ordered list of transactions, the proof of correctness, and the change sets
Send requests
Verify transactions (policy, conflict resolution) deterministically
return corrected block of transactions
commit block of transactions
Notify clients of events (if any)
client
CONSENSUS
SMART CONTRACT
CONSENSUS (on other peers)

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What is a Token?

In the present context, a token is a digital currency that is generated as a reward for each decisions made or a transaction verified.

What is Token backed Artificially Intelligent Distributed Machine Network?

Token Based Artificially Intelligent Distributed Machine Network is a distributed network of Artificially Intelligent systems that continually learn together over a connected network and make decisions based on a common consensus. For every valid consensus, a token is awarded to the participating systems.

The problems, scenarios and decisions arrived are stored across the entire network, so newer systems can just plug into the network and automatically be aware of the scenarios.

The other aspect of TAIDMN is the seamless token based payments feature it offers among the different systems that are present within the network.

The platform is also known as HYPERLEDGER **TURBO**

Key features:

The Token based Artificially Intelligent Distributed Machine Network has these advantages, which makes it one of the well designed AI platforms.

- Based on Hyperledger blockchain
- Build Artificial Intelligence powered applications
- Faster Cognition and Learning by AI
- Payments from Machine to businesses
- Automatic and speedier insurance settlement
- Token based reward system
- Token storage (wallets)
- Connected Intelligence Network
- Interledger protocol
- Based on Fault Tolerant Distributed Consensus systems
- Hyperledger logs
- Faster transaction rate, based on Hyperledger's native transactional bandwidth.
- Secure permissioned blockchain network.

What are the technologies that back Hyperledger TURBO?

Hyperledger TURBO uses some of the best innovations in Computer vision, Web and Hyperledger technologies to run it's core platform.

- Hyperledger technology
- Interledger Protocol
- Computer Vision
- Nodejs
- BIGML
- Google's Protocol buffers
- Hyperledger Caliper (For reports generation over hyperledger)
- Hyperledger Composer (on the fly smart contract generation by AI systems)
- SOLIDITY
- HLTURBO DIST (Redundancy logger)
- HLTURBO PAY (Token storage)
- MLX LOGIC (Logic verifier built for the Hyperledger Turbo Platform)

AI + HYPERLEDGER = HYPERLEDGER TURBO

The AI backed system is capable of creating smart contracts on its own, thereby enabling transactions between smart client nodes and the AI based systems connected to the network.

Interledger protocol would allow the system to connect with any ledger based technology or any other AI system to ensure compatibility and any Smart business applications can be built over it.

To give you an example in a real world Near future scenario, Imagine a driverless vehicle that is built on and connected to the HYPERLEDGER TURBO uses the network to learn newer scenarios at identifying more objects, accident patterns, resolution decision etc, and then in turn commits back to the network vital information of any unknown or newer patterns that it encounters, this can help train the other Artificially Intelligent Vehicles connected to the network and prevent or expect the scenario well ahead.

For example, this could be a crucial accident data with inputs from the Onboard diagnostic device and other sensors can push it back for analysis by other AI systems and come up with methods to avert it.

HYPERLEDGER TURBO being a Token based system would generate tokens as a reward for Machines that participate in decision making, contributing to the network and for verifying transactions.

Tokens generated by the AI systems are stored in a crypto wallet built specifically for the platform.

The concept of HyperLedger Turbo was born out of the necessity to bring in an Token based AI Ecosystem across different business sectors, right from manufacturing, supply chain management to Driverless Vehicles.

USE CASES OF HYPERLEDGER TURBO

The concept of HyperLedger Turbo was born out of the necessity of bringing in a Token based AI Ecosystem across different business sectors, right from Driverless Vehicles to manufacturing and supply chain management.

DRIVERLESS VEHICLE RENTAL / Ride sharing platform

A major industry that Hyperledger Turbo would disrupt is the Vehicle rental industry. Driverless Vehicles are getting smarter and can change how people commute or travel.

Still in its early stages, Vehicle rental companies are toying with the idea of deploying driverless vehicles among their fleet as a pilot method to see how they perform.

The driverless vehicle would be capable enough to ferry the users from point A to point B and then collect payments from them, while the fleet owners don't have to worry about collecting the payment in person.

Customers who are using the Rentals / ride sharing platform could choose to pay using the tokens which could be purchased through an Exchange or an issuer.

DRIVERLESS VEHICLE SERVICE & MAINTENANCE INDUSTRY

Vehicle service and maintenance is a perennial industry, any machinery that is in use for over a period of time would need to be checked and maintained from time to time.
A truly autonomous vehicle should be empowered to analyse and diagnose any fault it has and then get it self serviced at compatible service stations.

A smart contract would be created on the fly based on the parameters the system defines and once the service is completed, the conditions on the contract are met the payment is made in the form of the Token.

All the participating service stations would be equipped with terminals to communicate with the Vehicle. The service centres could choose to have robotic assembly chain to carry out the maintenance. In such a case, the service scenarios are also recorded on the network for auto training newer units in the assembly line.

MODERN SUPPLY CHAIN & RETAIL

Hyperledger Turbo backed Modern supply chain & retail channels could enable early stage businesses that rely on finding cheaper and quality products to source from anywhere on the planet.

Artificially Intelligent connected systems could understand the type of product in an inventory, the parameters involved such as the temperature, validity, maximum distance to the ware house etc and chalk out strategies to procure them.

It would also analyse and predict the status of the inventory real world aware accuracy.

Hyperledger Turbo would also level the play field for newer businesses by forming a borderless marketplace by connecting B2B buyers and sellers.

CONCLUSION

Hyperledger Turbo is the Artificially Intelligent Enterprise-grade platform of the future. Modularly designed to accomodate and transact with other real world objects. Hyperledger Turbo was built to add a layer of Artificial Intelligence to every industry that it touches upon.

Key takeaways include:

1. The overarching Hyperledger design philosophy for permissioned blockchain networks follows a modular approach that enables extensibility and flexibility.

2. Within this modular approach, Hyperledger Turbo defines common functional components and the interfaces between them, which allows any component to be modified independently without affecting the rest of the system.

3. The Architecture WG has been and will continue to define the following core components for permissioned blockchain networks: Consensus Layer, Smart Contract Layer, Communication Layer, Data Store Abstraction, Crypto Abstraction, Identity Services, Policy Services, APIs, and Interoperation.

4. The Architecture WG has shared a generalized reference architecture for consensus that can be used by any project based on Hyperledger Turbo

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To the maximum extent permitted by any and all applicable laws, regulations and rules, not TURBO nor any party associated with any of them shall be liable for any indirect, special, incidental, consequential or other losses of any kind, in tort, contract, equity, common law or otherwise (including but not limited to loss of revenue, income or profits, and loss of use or data), arising out of or in connection with any acceptance of or reliance on this whitepaper or any part thereof.
The tokens native to the platform are not structured or sold as securities or any other form of investment product.

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