Clockchain: A Time-Focused Blockchain Network

(www.clockchain.network)

Abstract

In distributed systems, integrity and security depend on maintaining accurate synchronization with real earth times like, NTP, TAI, UTC, and GPS. Contemporary challenges in maintaining such synchronization expose these systems to security vulnerabilities, as evidenced by recent cyber attacks. This paper introduces the Clockchain, a blockchain network designed to offer a secure, immutable, and verifiable time reference, addressing the critical need for accurate timekeeping in digital and legacy systems alike.

Introduction

The precision of time is pivotal in the seamless operation and security of distributed systems across various sectors, including financial transactions, data logging, and system coordination. Traditional time synchronization methods, while functional, fall short in providing a universally verifiable time standard, leading to potential security risks and coordination failures. The Clockchain proposes a novel approach to this problem by leveraging blockchain technology to create a global, decentralized, and secure timekeeping system.

The Problem

Existing time synchronization protocols like, NTP, TAI, UTC, GPS, and timestamp protocols such as, ISO 8601 and RFC 3339, despite their widespread use, are susceptible to manipulation and inaccuracies due to their reliance on centralized sources, the inability to verify the data and a lack of a unified global standard. This discrepancy poses significant risks in sectors where precise timekeeping and time-stamping is essential.

The Clockchain Solution

The Clockchain network, built on Web 3.0 technology, aims to mitigate these risks by offering a blockchain-based solution for accurate and secure timekeeping.

By generating a unique time stamp every second and recording it on a blockchain, the Clockchain network provides a permanent, globally consistent and verifiable time source.

Proof-of-Time Mechanism

Blockchains today use the processing power of their network to build consensus to verify transactions, sequence, identity and functionality. This ensures the validity and accuracy of the primary focus of that particular blockchain network.

The Clockchain network utilizes a consensus mechanism focused on validating time data. Nodes within the network aggregate time data from various global sources, process it through a proprietary algorithm to ensure accuracy and consistency, and then record the verified time onto the blockchain. This process guarantees a secure and immutable record of time, available for verification by any participating system.

Global Time Standardization

The Clockchain enables a universal time standard, creating a single, verifiable instance of time for each second. This standard is crucial for enabling secure and coordinated operations across different digital platforms and legacy systems, fostering trust and reliability in digital transactions and communications.

Clockchain Tech Overview

The D4D Clockchain is built on a custom implementation of the Tendermint blockchain, leveraging a Byzantine Fault Tolerance (BFT) consensus algorithm. This ensures that our network remains resilient even if individual nodes experience issues, meaning the entire system doesn't go down just because one part fails.

$$n \geq 3f + 1$$

Clockchain Network Byzantine Fault Tolerance Algorithm

At the core of our technology is a two-tiered consensus process. When a new node joins the D4D network, it first downloads the ledger's history and then begins participating in a process we call "metronome." This involves the node receiving time requests and

calculating a consensus time value using our custom method, which is derived from the Marzullo algorithm—a technique also used by Network Time Protocol (NTP) systems to synchronize time across different servers.

$$C(t) = \sum_{i=1}^{n} \mathbf{1}(T_i^{\text{start}} \leq t \leq T_i^{\text{end}})$$

Clockchain Network Time Based Marzullo Algorithm

Our system refines this process by utilizing a Median Absolute Deviation (MAD) to account for variances in time reports from different sources. The MAD helps us filter out anomalies and achieve a more accurate, reliable consensus on the time across the network. Once minor consensus is reached by a new node, this time value is passed to the leader node, which then performs the major consensus across multiple nodes using a similar MAD+Marzullo approach.

$$\text{MAD} = \frac{\sum_{i=1}^{n} |x_i - \mu|}{n}$$

Clockchain Network Time Based MAD Algorithm

Additionally, we employ a gossip protocol for communication between nodes, ensuring that data spreads quickly and reliably throughout the network. This protocol, implemented via ScaleCube, enables efficient peer-to-peer communication, which is crucial for maintaining the integrity and speed of our decentralized system.

Clockchain VS Other Blockchains

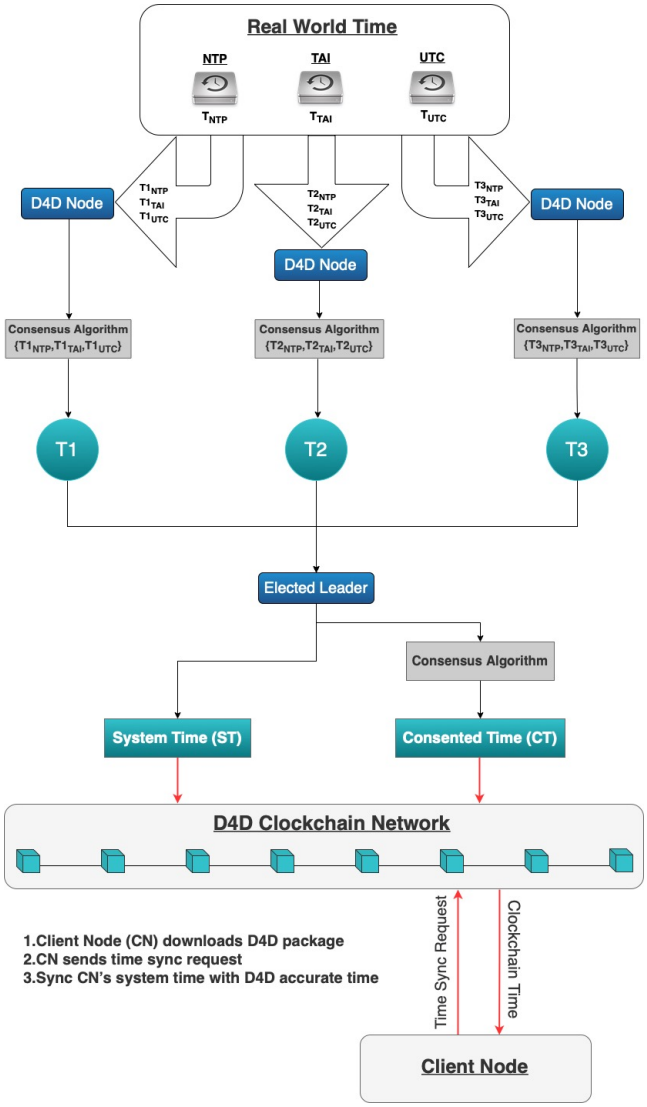
The D4D Clockchain distinguishes itself from other blockchain networks like Bitcoin, Ethereum, and Solana by its innovative approach to time. While traditional blockchains use time merely as a reference, we treat time as a fundamental value within the network. Time in our system is not just a timestamp; it is the main commodity, recorded and refined down to milliseconds.

Unlike existing networks that might rely on a single time source, our blockchain aggregates time data from multiple sources, enhancing accuracy and reliability. By using the MAD (Median Absolute Deviation) for checking the accuracy of time offsets, we

ensure that our network can withstand failures from individual time sources without compromising overall functionality.

Our approach allows for more precise timekeeping, which is essential in applications where exact time tracking is crucial. By refining the concept of time itself within our blockchain, we offer a level of precision and reliability that is unique in the blockchain space, setting us apart from other networks that may not prioritize time accuracy in the same way.

In essence, the D4D Clockchain is more than just another blockchain—it's a network that redefines how time is utilized and valued, providing a foundation for applications that require precise and reliable time synchronization. This focus on time as a commodity rather than just a reference point is what truly sets us apart.



Clockchain Network Flow Diagram

Implementation and Use Cases

The Clockchain has an array of applications, from securing financial transactions to enhancing the integrity of data logs. Its decentralized nature and layer 2 applications enable secure decentralized timestamps, autonomous system management, global event coordination, and the provision of a reliable time source for various digital infrastructures.

Use Case	Examples
Logging Data and Timestamps	• Transactions: law, finance, real estate • Police body camera footage • Votes in elections • Copyrights, trademarks, patents • Event logging, start/end work, key card use • Insurance policies, critical client data
Scheduling and Executing Actions	• Future Smart Contract execution • Supply chain management (ships, planes, trains, packages, people) • Premieres: movies, NFT's, media assets • Term limits: insurance, subscription, contracts • Payroll management, wire transfer, escrow • Remove 3rd parties from inheritance concerns (send a private key to heirs on a given date)
Supply accurate secure "earth time"	• Autonomous system management • Blockchains, exchanges, meta worlds • Verify internal clock systems • Anchor systems to the "real world" • Standardized 3rd Party time source to timestamp transactions between two parties with different internal clocks. • Real world traffic control: planes, cars, trains
Coordinate global events	• Trigger multiple and varied functions across the globe (e.g., watering millions of acres of fields every hour on the hour with Clockchain scheduling and execution) • Large autonomous system coordination (syncing multiple computers or databases across the globe) • Power grid management • Internet traffic relays • Global business management

The Token Economy

The Clockchain network employs its tokens to facilitate various activities within its ecosystem. These tokens are instrumental in compensating nodes for executing essential functions on the blockchain and for participating in Layer 2 activities. They also serve to incentivize the security of the Clockchain, enable the sourcing of accurate time data, and provide users with access to this verified time.

A Token Generation Event is scheduled for the launch of the Clockchain Network in 2024, during which 126,489,600 tokens will be initially minted.

Following this event, the network plans to introduce new tokens annually, amounting to 5% of the total tokens in circulation, as a way to support network operations and growth.

However, the strategy includes a transition towards sustainability, where the increased revenue from processing and service fees will gradually replace the need for these annual token injections. The ultimate objective is to eliminate the necessity for new token emissions, aiming for a zero-emission network.

Nodes

To support its operation and encourage engagement, the Clockchain network has implemented a token-based economy. This system rewards participation, enables event activation, compensates nodes for their contributions, and ensures reliable timekeeping. The network features a structured hierarchy of nodes, differentiated by their roles, from providing time data to validating transactions on the Clockchain.

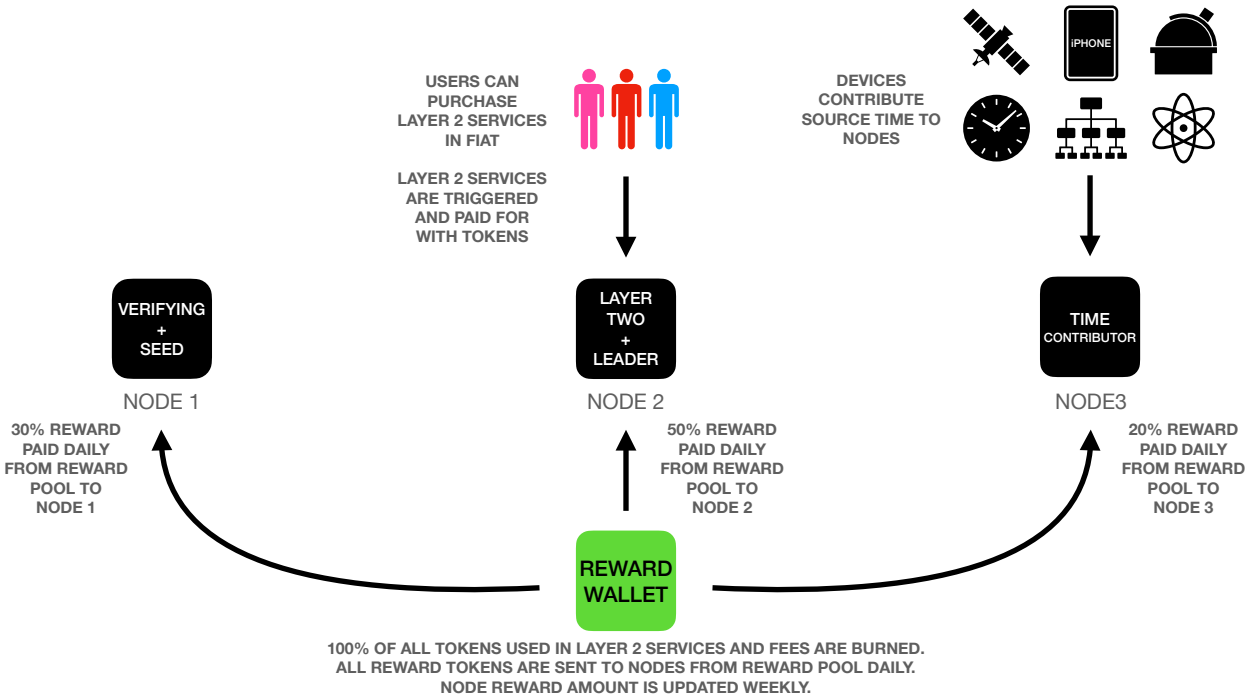
The network designates three types of nodes, each with distinct functions and rewards. Node3s, the most basic, contribute time data to the network and receive tokens based on the accuracy and reliability of their input. These nodes have minimal hardware requirements, making it possible for a wide range of devices, including mobile phones and IoT gadgets, to participate and enrich the network with diverse time sources.

Node2s assume more complex tasks, such as managing Layer 2 operations, which include data logging on the Clockchain and handling smart contracts. They also process time requests through the getTime API. To partake in these activities, Node2s commit a slightly higher amount of Clockchain tokens than Node3s, maintaining an accessible threshold for various participants and preserving the network's openness and inclusivity.

At the top tier, Node1s play a critical role in verifying time data and the integrity of the Clockchain. They are incentivized for performing these essential functions and are required to stake a significantly larger quantity of tokens, demonstrating their dedication to the network's security and functionality. This tiered system ensures a robust, participatory framework for the Clockchain network, fostering a secure, decentralized timekeeping ecosystem.

Responsibilities and Rewards Distribution	Time Contribution Rewards	Layer 2 Execution & getTime API Rewards	Clockchain Validation Rewards
Node1	NO	NO	YES
Node2	YES	YES	NO
Node3	YES	NO	NO

NODE ECONOMY FLOW DIAGRAM



Governance

Governance of the Clockchain network is overseen by a decentralized autonomous organization (DAO), which grants node operators the power to influence protocol modifications and the evolution of the network through voting. This democratic method ensures the network's flexibility, security, and alignment with its participants' shared goals.

Voting rights are exclusive to Node1s and Node2s, with each having an equal vote. These operators have the authority to propose changes to existing systems, introduce new protocols, or suggest developments. Proposals can originate from either Node1s or Node2s.

Once proposals are made, Node1s and Node2s cast their votes on these potential updates. A proposal is accepted and integrated into the network's protocol if it secures approval from at least 66% of the voting nodes, ensuring that changes reflect a strong consensus among participants.

Conclusion

As digital interactions and transactions continue to grow in volume and complexity, the need for a secure, accurate, and globally recognized time standard becomes increasingly apparent. The Clockchain network offers a promising solution to this challenge, leveraging blockchain technology to provide a decentralized, immutable, and verifiable timekeeping system that can support the next generation of digital infrastructure.