NULS Whitepaper V2.1

MAKING IT EASIER TO INNOVATE

A Highly Customizable Blockchain Infrastructure

Abstract

NULS is a blockchain infrastructure that provides customizable services and a global open-source community blockchain project. NULS adopts micro-services to achieve a highly modular underlying architecture, using smart contracts and cross-chain technologies, combined with the ability of ChainBox to quickly build chains, reduce development costs, and accelerate blockchain business application landing.

NULS Whitepaper V2.1

1.   The Future of Blockchain

Since the beginning of human civilization, humans have strived to survive, learn, adapt, and move humanity in a sustainable direction. From the stone age to today's Internet-sharing economy era, every breakthrough technology has solved problems of production, economy, and communication.

With the rapid development of society and the advancement of science and technology, unreliable information and untrustworthy resources have become more severe than ever before. The trust between the government, enterprises, and individuals has become fragile.

Tamper-proof, transparent, and decentralized; those blockchain technology characteristics will revolutionize human society by making complicated relationships between entities straightforward again.

2.   What is NULS

NULS is a blockchain infrastructure that provides customizable services and a global open-source community blockchain project. NULS adopted micro-services to achieve a highly modular underlying architecture. NULS uses smart contracts and cross-chain technologies, combined with the ability of ChainBox to quickly build chains, and reduce development costs, to accelerate blockchain business application development.

The NULS design encourages modular thinking with multi-chain parallel microservice architecture. Using NULS ChainBox, users can flexibly choose core functional modules such as network module, consensus module, storage module, ledger module, and smart contract to create new blockchains in the NULS chain network. They can also define their business logic through smart contracts with little programming work. (NULS provides a wealth of open-source code modules when used with ChainBox providing the user will a personally tailored blockchain.)

With the NULS ChainBox technology, building a brand-new blockchain is as easy as assembling the components of a laptop. Users can flexibly choose consensus, network, ledger, account, and other modules, then assemble them into a blockchain according to their demand, just like assembling a laptop with a CPU, hard drives, RAM, and other components. NULS ChainBox can create blockchains, public chains, alliance chains, or private chains.

3.   The Birth of NULS

With Blockchain's unique qualities of distributed applications, data traceability, and transparency, Blockchain will be the basis for small and large businesses in the future. However, due to one technology barrier, it is challenging to find a solution or project nowadays that is developed with blockchain technology at the core. There are three reasons for the technology barrier.

One, Blockchain is a combination of multiple technologies, which requires high capabilities for developers. Two, blockchain technology is still in the early stages of development, and no mature underlying frameworks are available. Three, there are no technical standards for developers to follow. The above reasons have caused many problems, such as low development efficiency, tremendous workflow, etc. NULS was born to solve these problems and eventually push the enterprise business forward.

4.   The Duty of NULS

Market research and analysis report existing problems in the industry, such as the need for field experts, low-efficiency and time-costing development, and communication between different blockchains seems impossible. On the other hand, more application scenarios need the support of blockchain technology. These conditions cannot be resolved quickly, but NULS can provide a reliable solution for all.

A.   Flexible Customized Blockchain Infrastructure

NULS provides developers and users with a variety of modules. Developers and users do not need to study complicated underlying technology such as cryptography, consensus mechanisms, and storage methods. Instead, they instantly select the required modules from the module warehouse to build a customized blockchain in the most efficient manner possible.

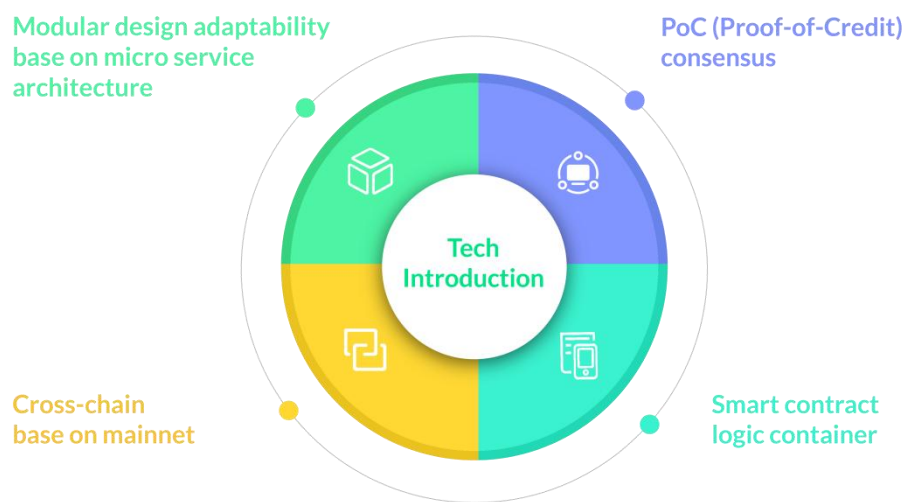### B.   Friendly in Multiple Application Dimensions

Blockchain DApps will gradually become more prevalent in all avenues of life. NULS ChainBox can quickly build a blockchain with specified characteristics (assembled with user-selected modules) and enable data transfer via its cross-chain technology. NULS blockchain supports Java-based and Ethereum Virtual Machines to support all application scenarios.

C. Enable Business-landing for Blockchain Applications

Commercial blockchain applications have extremely high-performance requirements. NULS is committed to solving the performance limitation of existing blockchains. It adopts parallel expansion technology to build multiple independent chains through ChainBox quickly and distribute business modules and DApps to each blockchain. NULS's cross-chain technology connects multiple blockchains, meeting the high TPS requirements of blockchain business.

5. NULS Technical Design

Modular design adaptability base on micro service architecture

PoC (Proof-of-Credit) consensus

Tech Introduction

Cross-chain base on mainnet

Smart contract logic container

NULS Technical Features

A. Micro-Service Infrastructure

In the NULS micro-service architecture, modules are as flexible as programs that can start independently. Users can select different blockchain protocols and design software applications as service suites that can be deployed and scaled independently.

This modular architecture is called NULS 2.0. Modules in this architecture are loosely coupled to each other, and there is no language requirement. This architecture supports distributed deployment, hot module replacement, and transparent scalability. Chain Factory and Cross-Chain Modules are being developed and will coordinate with this architecture.

System design evolution #11: Global interconnected microserver platform - NULS 2.0

Service base lib	Service base lib		Service base lib	Service base lib
Module 1	Module 2	...	Module N	Module N+1

NULS 2.0

Service base lib	Service base lib	Service base lib	Service base lib	Service base lib	Service base lib
Account	Transaction	Block	Consensus	Smart contract	Cross chain

NULS 2.0 common modules

Tier 1

Service base lib	Service base lib	Service base lib	Service base lib	Service base lib
Reporter	Auth	Updater	Grouper	Translator

Tier 2

Service base lib	Service base lib	Service base lib	Service base lib
Manager	Storage	Controller	Connector

Official Applications

Native App base lib	Web App base lib
NULS control center	Explorer
Mobile App base lib	Web App base lib
IOS, Android wallet	Web wallet

Other Applications

| Native App base lib	Web App base lib
Desktop App 1	Web App 1
Mobile App base lib	Web App base lib
Mobile App 1	Web App 2

NULS Micro-Service Frame

Microservices are comprised of different microservice modules. The modules are independent of each other, and the communication between modules is through a defined interface. Microservices do not have code-level coupling, which is the best we can do in modularity. There are no programming language restrictions. Developers can use their preferred language to develop modules, which makes NULS microservices more friendly to developers. NULS microservice architecture has higher scalability than other general modular systems.

B. NULS Modular Architecture

The NULS blockchain is designed to address the assumption that technology will continue to advance rapidly, and static technologies will be left behind. NULS incorporated the modularity of the Linux kernel to give the flexibility of a

dynamic blockchain. Since everything is a module, adding improvements to the blockchain is easy.

NULS modular architecture
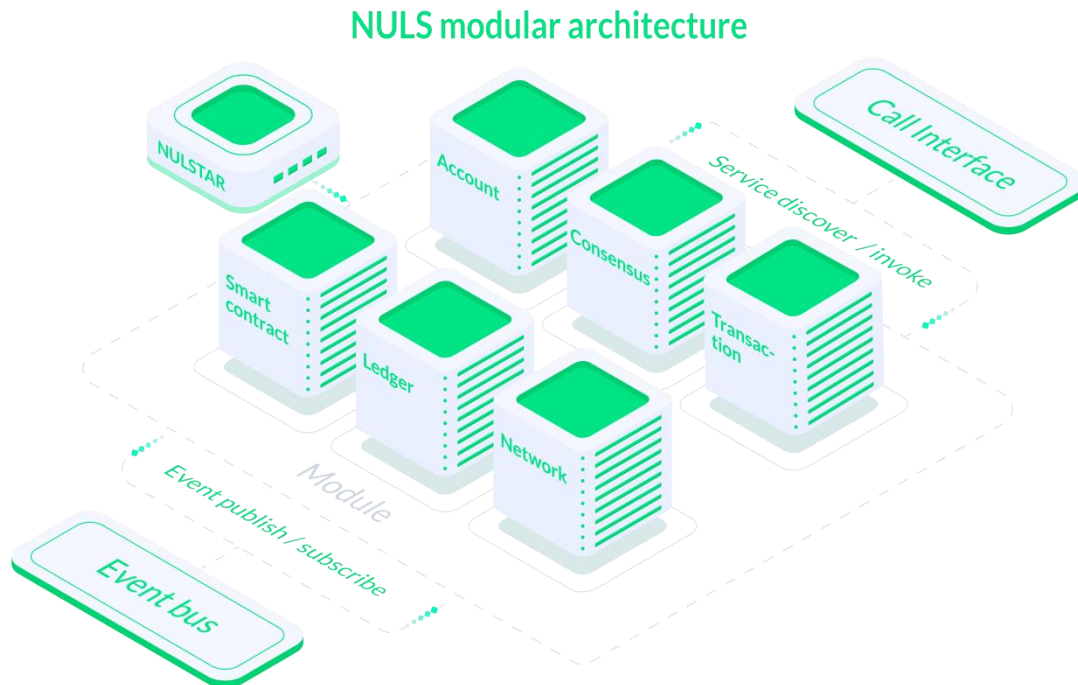
NULS Module Frame

All NULS modules adhere to the definition of the "NULS Module".

NULSTAR manages all modules and defines specifications such as module loading/unloading, service registration, etc. All extension modules that follow the NULS Module definition can be loaded as a NULS node and managed by NULSTAR. When the module is loaded, NULSTAR will register all the module services. The NULS module provides external services, can call the services of other modules, and can trigger events or subscribe to events of other modules. Each NULS module is upgraded according to different technology upgrades and application requirements. From a technical perspective, NULS is a sustainable and adaptable blockchain system.

6.   Introduction of Main Modules

A.   POC Consensus Module

The modular design of NULS supports easy replacement and insertion of all core functional modules, including the consensus module. The NULS mainnet uses the credit consensus mechanism POC (Proof-Of-Credit). To stake in a consensus node, a user must stake a specified minimum amount of NULS. Those

staked NULS remain locked in the user's account. When un-staking from a consensus node, the staked NULS are unlocked.

The NULS POC consensus mechanism uses the credit Index and equity as the incentive standard. It is entirely verifiable, as all actions are recorded on the blockchain.

There are four important independent roles for each node in a POC system. The roles are Block Generator, Agent, Client, and Rewarder. The four roles can exist in different addresses. The Block Generator is the node address that provides blockchain packaging. The Agent is the node address that creates the blocks and accepts the stakers. The Agent can charge a fee from the stakers, which is set at 10% for public consensus nodes. The consensus node needs to have a specified amount of NULS to produce blocks and become an active node in the consensus system. That amount is held by the Client's address. Rewarder is the distributor of the consensus node's staked rewards (earnings). The Rewarder address is generated by the Agent when creating the node.

a.   Consensus Nodes

Anyone can add their node to the NULS consensus nodes and receive consensus rewards, providing the required conditions and rules are met. To become a NULS consensus node, you must stake a certain amount of NULS as a deposit. The required deposit helps make the NULS consensus node system fair and stable. The required deposit amount is 20,000 NULS. The NULS rewards for a consensus node will be calculated according to the proportion of NULS staked in the entire network. A consensus node must have a credit index greater than zero to receive consensus rewards.

Nodes that do not meet the required conditions or cannot provide a stable network service are excluded.

● **Yellow Card Alert**

If a node fails to generate a block due to a network issue or computer crash, the node's credit ratio is downgraded, and a warning is issued.

● **Red Card Alert**

NULS will detect and protect itself from vulnerabilities and exploits such as hostile attacks, double-spend attacks, attempts at forking the system, and attacking the network. Any hostile consensus nodes will have their coins frozen for an extended period, such as 60 days, and their credit ratio will be set to zero, so they can no longer receive consensus rewards.

● Credit Index

In the NULS network, the Credit Index is the consensus node stability coefficient of the node account. The Credit Index has an interval of [-1,1].

The Current Node Credit Index = (the ideal number of blocks that should be generated in the first 100 rounds - The number of yellow cards received in the first 100 rounds)/100.

b. Consensus Incentives

The consensus reward calculation for a node includes four values. The calculation is designed to keep the network well-balanced and fair. The four values are:
- The staking deposit for the consensus node.
- The staking amount for the entire network.
- The credit of the consensus node.
- The credit of all consensus nodes.

The Consensus Incentive Formula：

$$\mathrm{co}inbase = fee + 5000000 * \mathrm{r}nc * \frac{bti}{spy} * \frac{cmc * \max(0, cr)}{\sum_{1}^{rnc} cmc * \max(0, cr)}$$

fee： *Gas fee of the current block*
rnc： *The number of consensus nodes*
bti： *Block time（S）*
spy： *Seconds in a Year period（S）*
cmc： *Amount of entrusted Token*
cr： *Credit Index*

c. General Consensus Module

NULS has an underlying blockchain infrastructure for general use cases. With NULS ChainBox technology, a parallel blockchain with customized operating parameters can be quickly deployed using components from the module warehouse. NULS defined the consensus module's API protocol to handle interfacing with different consensus modules. NULS uses the API protocol of the consensus module so that developers can flexibly customize and develop their consensus mechanism module. There are a variety of consensus mechanisms available in the NULS warehouse using the consensus module API protocol. For example, the POC+BFT consensus mechanism, created for NerveNetwork, is available.

(BFT, Byzantine Fault Tolerance, is an algorithm that will continue to succeed even if some nodes fail or behave maliciously.)

B. Smart Contract Module

NULS has a built-in smart contract virtual machine (NVM) that is structurally between the external service module (e.g., RPC module) and the underlying infrastructure modules (e.g., network module, storage module, account module). The smart contracts are called by the higher-level applications (DApps), interpreted by the interpreter, stored by the storage module, and computed by the NVM module. The NVM will support other high-level programming languages to accommodate developer language preferences and compile the program through the interpreter so that the NVM can understand and read the application.

NVM (NULS Virtual Machine) uses the JAVA language to write smart contracts. JAVA is one of the most widely used programming languages. Developers can easily write the smart contract in JAVA and have the smart contract executed in the NVM.

C. Cross-chain Module

A blockchain created using the NULS ChainBox module warehouse is called a NULS parallel chain. Anyone can create a NULS parallel chain by adding cross-chain modules and registering cross-chain information about the parallel chain in the NULS network. NULS blockchain is the middle network for cross-chain interaction between all NULS parallel chains.

With the cross-chain connections supported by NerveNetwork, NULS interacts with many industrial mainstream blockchains.

The NULS ChainBox cross-chain module can adapt to other public blockchain protocols to create successful cross-chain communication. The NerveNetwork cross-chain module adapts to heterogeneous blockchains such as Ethereum and Bitcoin by NerveNetwork. NerveNetwork supports cross-chain transactions for the NULS network. There are 15 virtual bank nodes that are verified by BFT as validators for NerveNetwork's cross-chain networks.
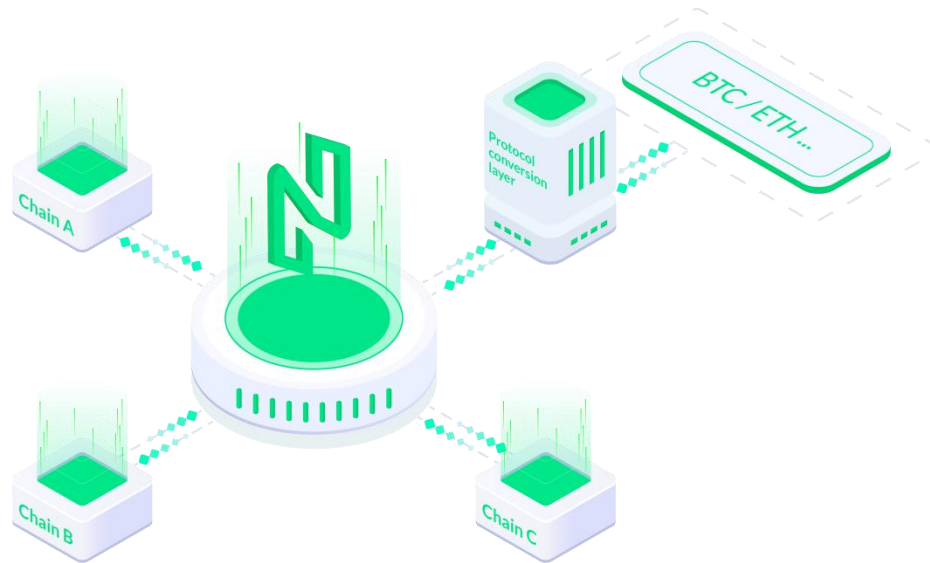
NULS Cross-chain Protocol Structure

Assets on NULS parallel chains and supported heterogeneous chains can be circulated and transferred from one to another. The cross-chain management method provided by the NULS mainnet manages all para-chain assets and information registered on the NULS network. The registered content includes chain information, asset information, cross-chain deposit, etc. Each node on the NULS mainnet is connected to multiple nodes of other supported blockchains. The NULS cross-chain module protocol makes it possible for a single node to connect to multiple nodes on different blockchains at the same time.

7. NULS Economic Mode

NULS is the native fuel asset in the NULS network, which is also the primary fee token of the entire ecosystem. NULS has many use cases, such as community governance, ecosystem development, transaction consumption, consensus incentives, ecosystem fuel fees, handling fees for cross-chain interaction, etc.

The smallest unit of NULS is NA, 1 NULS=100,000,000 NA, and the main unit is (NULS).

A. Token Distribution

The initial supply of NULS was 100,000,000, which was divided into four sections.

a. Airdrop

40% of the tokens were airdropped (40 million) to encourage early supporters, adopters, and community builders.

b.   Development Funding

20% of the total tokens (20 million) went towards continued development. After the mainnet was live, these tokens were unlocked at the rate of 5% (1 million) per month for 20 months.

c.   Community Funding

20% of the tokens (20 million) were allocated for building the community, and no more than 4 million tokens are used per year.

d.   Business Cooperation

20% of the tokens (20 million) were used for business partnerships and to support high-quality NULS-based third-party projects. At most, 4 million tokens will be used per year.

The wallet addresses for Development Funding, Community Funding, and Business Cooperation are available to the community.

NULS distribution mechanism

- ◆ Part of the drop
- ◆ Community fund
- ◆ Development funding
- ◆ Business cooperation
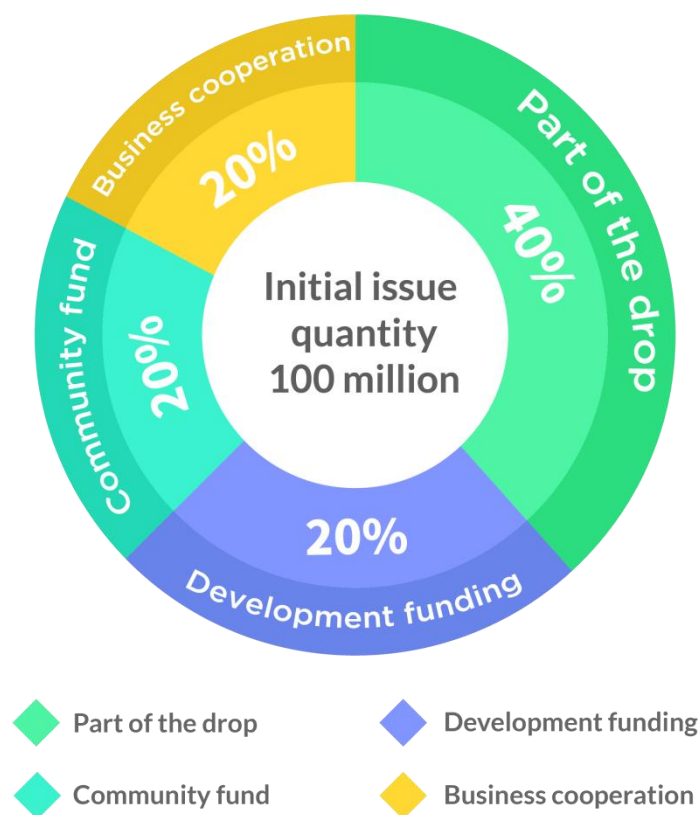
NULS Tokenomics

B. Network Maintenance

Approximately 5,000,000 NULS has been generated annually via node consensus to reward the stakers and node owners of the NULS consensus nodes. NULS calculates the estimated rewards in units of a block. The number of rewards per round for each NULS consensus node and its stakers is determined by the block gas fee, the number of NULS staked, and the node credit value.

Berzeck, Western Community Director, proposed the NULS mainnet incentives be reduced monthly by 0.4% until the total supply reaches 210,000,000 NULS (maximum supply). The reduction was to begin on 2020-07-12 00:00:00 UTC. The proposal was passed.

C. Use Case

a. Consensus Staking

Users can stake anywhere from 2,000 to 500,000 NULS on one or more consensus nodes to earn consensus rewards. (Each consensus node has a staking limit of 500,000 NULS.) The rewards the user receives are directly related to how much they stake.

b. Create a Node

To get more consensus rewards, you can create your own consensus node. In order to create a consensus node, you need to stake 20,000 NULS as a deposit. The number of staked NULS required (excluding the deposit) before the Consensus Node can produce blocks and receive rewards is 200,000 NULS. The maximum NULS staked to a Consensus Node, excluding the deposit, is 500,000 NULS. As the owner of the Consensus Node, you receive commissions for the staked NULS (excluding the deposit). The consensus rewards for the staked NULS are automatically calculated and distributed to the node owner and the other stakers.

The commission ratio is set by the node owner to between 10% and 100% of the NULS rewards. NULS strongly recommends that the Node Owner set the commission to 10%. The NULS Community expects the public NULS Consensus Node commission to be 10%.

c. Transaction Fuel

Fees are charged for actions that take place in the NULS network. Actions include:

- Creating a transaction.
- Creating a node.

- Staking in a consensus node.

- Un-staking from a consensus node.

- Canceling a node.

- Assigning an alias to an account.

Often, the fees are less than one NULS. However, the fee for assigning an alias is one NULS, and the NULS is burnt. The fees for all other actions are given to the Consensus Nodes as part of the consensus rewards.

d.   Smart Contract Consumption

The fees for actions involving a smart contract are called gas. Gas is charged for

- Creating a smart contract.

- Calling a smart contract.

- Executing a smart contract.

- Deleting a smart contract.

The charged gas, also called burned gas, is returned to the NULS consensus node as consensus rewards.

e.   Cross-chain Consumption

A NULS parachains ecosystem can be created using NULS ChainBox. These blockchains can perform cross-chain transactions in this ecosystem through the NULS mainnet. All the chain assets can be transferred to its parachain ecosystem. When assets are transferred across the parachains, NULS fees are collected. These fees will be rewarded to the NULS consensus nodes.

For the parachains to have cross-chain functions, the parachains are required to be registered in the NULS network. A certain amount of NULS must be locked in order to register the cross-chain in the NULS network.

f.   Voting Warrants

Each NULS holder can exercise their voting rights and participate in the NULS community development and growth decision-making process.

The NULS token is used to vote for community proposals.

8. Open-source Community

NULS is an open-source project driven by the blockchain community. Its open-source nature offers transparency and trust for the community and the developers -- both are vital to building a strong community. The community will provide comprehensive development documentation and fully developed tools to assist and support developers.

To fast-track the development of NULS technology, the NULS technical community has established the NTC (NULS Technical Community) organization. NTC is responsible for the ongoing exploration of blockchain technology and the community's growth. Currently, NTC is composed of multiple developers from several different countries.

NULS has set up the Community Foundation with 20 million NULS to support excellent projects and reward contributors in the NULS ecosystem. The NULS Community Foundation is registered in Singapore (NULS FOUNDATION PTE.LTD. 201729333G).

The main goal of NULS is to promote a community-driven development platform that incentivizes innovative projects to be developed and offers the tools to simplify and fast-track the work of developers.

9. Conclusion

The NULS team is aware of the current issues in the Blockchain space. NULS' mission, "Making Blockchain Simpler," reflects its commitment to bridge the gap between businesses and blockchain adoption.

NULS's ChainBox, including its cross-chain technology and smart contracts, enables developers and enterprises to adopt blockchain technology to their business efficiently. With ChainBox, NULS is pushing the commercial implementation of blockchain applications. NULS's goal is to build an ecosystem that benefits developers, companies, and the NULS community.

Last Edited: 01.10.2023
Website: *https://nuls.io*
Twitter：*https://twitter.com/Nuls*
Medium：*https://nuls.medium.com*
Discord：*https://discord.com/invite/aRCwbj47WN*
Telegram：*https://t.me/Nulsio*