Status Report on

WorldLand 2024

WorldLand Foundation

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Abstract

The current geopolitical environment is marked by reduced multilateral cooperation, rising nationalism, and power struggles among major nations. These factors lead to supply chain disruptions, inflated living costs, and greater national debt. Such challenges are exacerbated by demographic changes in developed countries, such as aging populations and decreasing workforces, which are deepening the global wealth divide. In response, advanced nations have implemented broad monetary policies, including quantitative easing, resulting in inflated asset and real estate values. Conversely, developing countries face severe hyperinflation and weakening currencies, compounded by the economic dominance of the US dollar.

In response, the WorldLand project offers a revolutionary solution: a decentralized digital network named 'WorldLand,' which includes a global digital ledger and a universal currency, the WorldLand Coin. This initiative seeks to facilitate direct financial transactions across international borders, promote equality, and counteract the outsized monetary influence of dominant economies. Leveraging the technologies underpinning Bitcoin and Ethereum, WorldLand aims to broaden the reach of decentralized finance with innovative blockchain solutions.

WorldLand envisions a future where digital trade surpasses national boundaries, creating a global marketplace where citizens can routinely trade goods and services within a stable and efficient network. This report details the technical specifications, governance frameworks, and practical uses of WorldLand, presenting a strategy for a scalable, secure, and efficient blockchain future. Initiated by Professor Heung-No Lee and his team, this report highlights a decade of intensive research and development, culminating in the WorldLand mainnet launch on August 8, 2023.

Acknowledgement

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Keywords

De-globalization; multilateral cooperation; monetary policies; ASIC resistance; blockchain; bridge; interoperability; cryptography; decentralization; digital signature; error correction code; proof of work; low density parity check codes; mobile hyperspectral camera; periodic checkpoint; post-quantum cryptography; proof of stake; quantum resistance; sidechain; variable random function; variable coin toss function; zero-knowledge proof protocols.

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Chapter I.

Introduction

1.1. WorldLand

WorldLand™ is a new mainnet whose virtual machine is fully compatible with the Ethereum virtual machine, has quantum-resistant cryptography, novel energy-efficient consensus algorithms, and aims for decentralization. It issues the native WLC currency.

WorldLand is meant to be the next generation blockchain with global reach and scale. This report intends to convey the idea and the realization of it.

1.1.1. Vision

The geopolitical landscape is marked by a lack of multilateral cooperation, rising nationalistic tendencies, and major powers vying for dominance. This has led to supply chain disruptions, increased living costs, and burgeoning national debts.

Demographic shifts, such as aging populations and decreasing workforces in developed countries, contribute to these challenges, alongside the growing wealth gap between the rich and the poor.

Advanced countries have relied on printing money and maintaining low-interest rates to counter economic crises, leading to inflated asset values and real estate prices. Conversely, developing countries face hyperinflation and weakening currencies, exacerbated by the global economic dominance of the US dollar.

The project envisions creating 'WorldLand,' a decentralized digital network that offers a global digital ledger and a universal currency, WorldLand Coin. This system aims to facilitate direct financial transactions across borders, promote equality, and counterbalance the monetary control of major powers.

WorldLand aims to uphold human rights and equality. WorldLand aims to use AI for growth and blockchain for distribution, leading to sustainable social progress. Innovations like Bitcoin and Ethereum have laid the groundwork for decentralized finance, which WorldLand seeks to expand upon with its unique approach.

WorldLand envisions a world where borders fade in the digital trade marketplace. People across the globe will seamlessly exchange goods and services, empowered by a network designed for stability and efficiency.

To these aims, we envision developing a new protocol suite called WorldLand for a global-scale blockchain. The WorldLand network supports a diverse array of applications, nourishing a digital economy woven together by WorldLand's innovation.

The WorldLand suite is quantum safe, energy-efficient, decentralized, secure, and scalable. This network will have a worldwide footprint that includes all five continents, allowing the connection and support of a variety of sidechains, shards, and plasma chains.

1.1.2. LiberVance, the Company

WorldLand is based on technology developed by LiberVance, a university laboratory startup company founded by Professor Heung-No Lee at GIST. Professor Lee has been pioneering the technology needed for the WorldLand project with support from major national research institutes of South Korea, and has secured the intellectual property rights, academic papers, and patents.

1.1.3. WorldLand Foundation & DAO, the Organization

Members of the WorldLand community collaborate within a Decentralized Autonomous Organization (DAO), which is governed by the WorldLand DAO Articles [1]. This structure allows members to actively engage in the management and development of WorldLand.

1.1.4. WorldLand Mainnet Launch

Building on 6 years of continuous innovation by the team of industry pioneers and academic researchers, WorldLand mainnet was launched in August 2023.

Marking its inception, about 41 million WLC coins were minted, honoring the dedication of the founding team and Professor Lee. This allocation, designated as TMG (Total Minted at Genesis), serves as a cornerstone for building a new successful WorldLand ecosystem, ensuring its continued growth and prosperity.

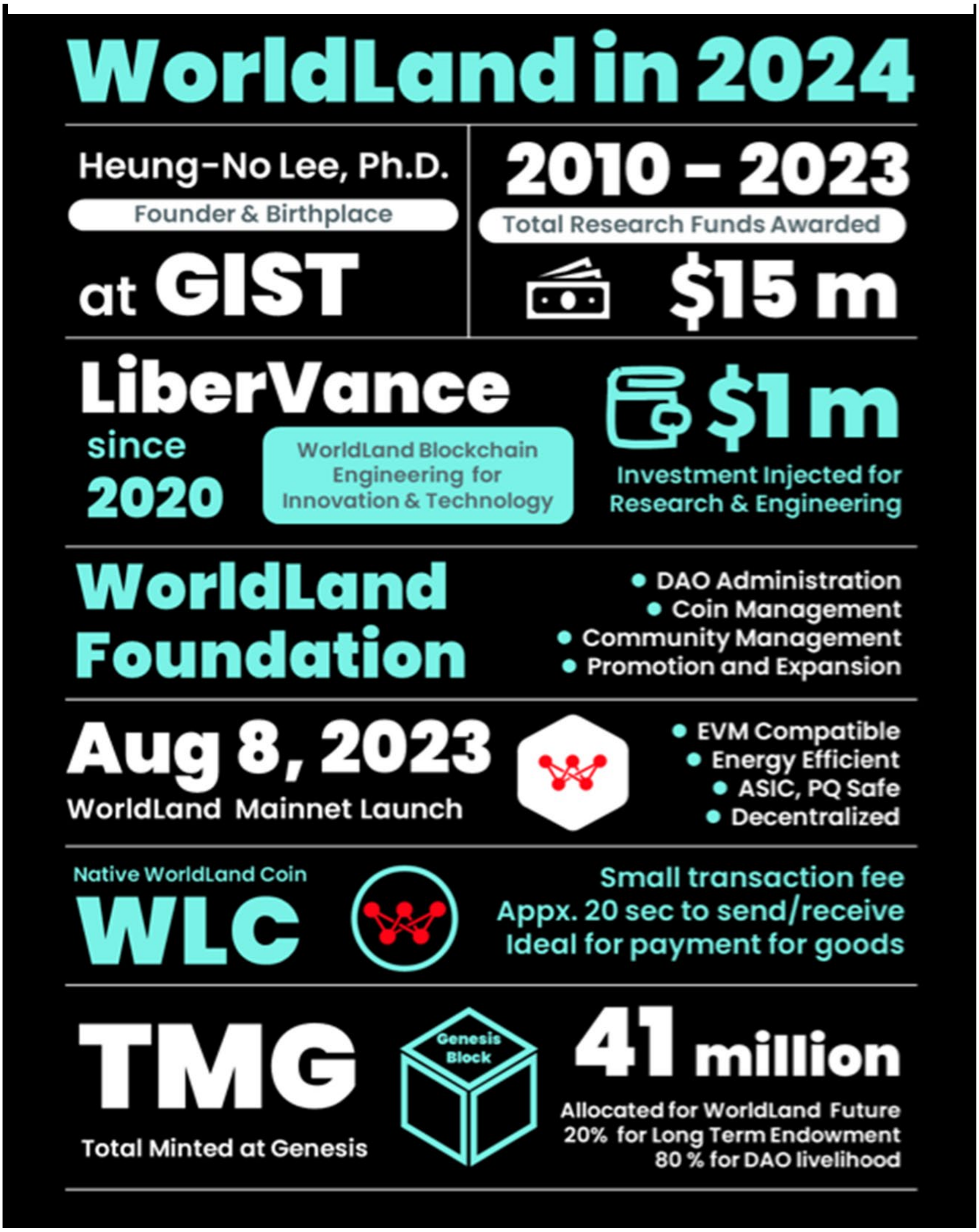
1.1.5. Future of WorldLand

WorldLand is still in the early stages of development, but it is expected to attract attention in the blockchain market in the future due to its various strengths, such as ASIC resistance, an energy efficient consensus mechanism, quantum-resistant cryptography, and decentralization.

1.1.6. WorldLand History in Numbers

Table 1 lists the notable facts and numbers in the WorldLand history.

Table 1 WorldLand history in numbers.



1.2. Layered Structure of WorldLand

From its inception in 2018, the House of WorldLand has steadily taken shape. Though young, its future is bright with the innovative theoretical foundation and sound engineering strides. WorldLand not only offers a comprehensive suite of tools, but also empowers a thriving blockchain ecosystem, letting developers to forge their own dApps and tokens. It is structured in four layers of distinctive characteristics, as depicted in Figure 1.

Figure 1 House of WorldLand, the layered structure.

1.2.1. Layer 1: WorldLand Mainnet

WorldLand is establishing a foundation for a green and decentralized blockchain ecosystem. As the mainnet evolves, it will enhance both security and scalability. Serving as the cornerstone of the WorldLand ecosystem, the mainnet supports the core blockchain network. Here, its distinctive consensus mechanisms are applied, transactions are authenticated, and blocks are generated.

1.2.2. Layer 2: L2 Solutions & Bridges

The cross-chain bridge layer in WorldLand enhances interoperability with other blockchain networks, such as Ethereum and Bitcoin, by enabling smooth transfers of assets and exchange of data across various blockchain systems. These cross-chain bridges are instrumental in increasing liquidity, broadening the range of use cases, and integrating WorldLand into the wider cryptocurrency ecosystem. They provide developers with the convenience to create applications that operate across multiple blockchains. Furthermore, assets like wrapped Ethereum (wETH), wrapped Bitcoin (wBTC), and wrapped USDT (wUSDT) are expected to become accessible through the WorldLand bridges to Ethereum, facilitating a more interconnected blockchain environment.

1.2.3. Layer 3: Virtual Machine & Smart Contracts

The WorldLand Virtual Machine is engineered to align with the Ethereum Virtual Machine (EVM), facilitating developers in crafting smart contracts through Solidity. This compatibility signifies that smart contracts already in operation on Ethereum can be seamlessly deployed on WorldLand without the need for any reprogramming or alterations. Such interoperability is instrumental in fostering the development of the Web3 future society, enabling collaborative efforts among diverse communities.

1.2.4. Layer 4: dApps for Users

The dApp layer in WorldLand acts as the gateway for users to access the platform's functionalities, seamlessly integrating real-world applications along with their favorite apps and tokens. Highlights of this layer include:

- The launch of AI-DEX, an innovative AI-supported decentralized exchange, marking one of the primary services available.

- The creation of AI models within My AI Network™, leveraging the same infrastructure used by WorldLand miners, to deliver custom AI experiences to users.

- The introduction of WLC, WorldLand's proprietary cryptocurrency, which has been issued and allocated to miners and early adopters of the platform since August 2023. This enables users to conduct WLC transactions effortlessly using the MetaMask wallet, which is accessible both within the app and on the web.

A separate full report on AI-DEX and another on My AI Network™ will be available soon. These reports will be devoted to explaining the mainnet WorldLand.

1.3. Addressing the Trilemma of Blockchain

The blockchain trilemma highlights the challenge that refers to the inherent trade-offs between three fundamental properties of blockchain technology: decentralization, security, and scalability.

1.3.1. Decentralization

Decentralization involves spreading out control and decision-making abilities from a single, central authority to various smaller, autonomous groups. In the realm of blockchain communities, this principle is particularly impactful. It allows individuals worldwide to actively engage in the network's governance, moving away from the traditional model of control by a single centralized entity, such as an institution, company, or government. This method fosters a more democratic and fair system for managing and operating the network, ensuring broader participation and representation.

1.3.2. Security

WorldLand implements an innovative Error-Correction Code Proof of Work system [R4][R6] within its blockchain framework. While Proof of Work (PoW) blockchains are highly secure, they are not completely invulnerable to adversarial attacks. A notable risk is the 51% attack, where an adversary gains control of more than half the network's computational power, allowing them to alter the blockchain and manipulate transactions. As such, the security of a blockchain ecosystem can be significantly enhanced by increasing the number of independently operating nodes. A larger and more distributed network of nodes makes it much harder for any single party to acquire the majority control necessary to carry out such attacks, thereby safeguarding the system against compromises.

1.3.3. Scalability

Scalability refers to a network's ability to grow while maintaining transaction speed and output. However, scalability and decentralization often do not go together. Efforts to scale a decentralized network can compromise security, while security measures may hinder changes necessary for scalability. Balancing these two aspects is challenging.

Achieving a balance between decentralization, security, and scalability remains an ongoing challenge in blockchain design.

WorldLand follows the DeSecure approach, a significant contribution in addressing the blockchain challenges of today. In the ever-evolving landscape of blockchain technology, several solutions are being used to address the scalability issue. However, the DeSecure blockchain approach aims to overcome the potential centralization problems that can arise from using such solutions, all while preserving the core principles of decentralization and security. To achieve this, our goal is to replace the SHA-based Proof of Work (PoW) algorithm with a novel Error Correction Code PoW (ECCPoW) algorithm. Since PoW is fundamental to open blockchain systems, it plays a crucial role in the DeSecure blockchain approach [3].

1.4. Four Strong Features of WorldLand

Over several years of committed development, WorldLand has successfully launched a blockchain that not only achieves seamless integration with Ethereum but also places a balanced stance on energy efficiency. It aims to offer protection against potential post-quantum threats and upholds a strong commitment to decentralization. The diagram in Figure 2 comprehensively highlights the innovative features of the WorldLand blockchain, showcasing how it is poised to propel the blockchain economy beyond its current state.

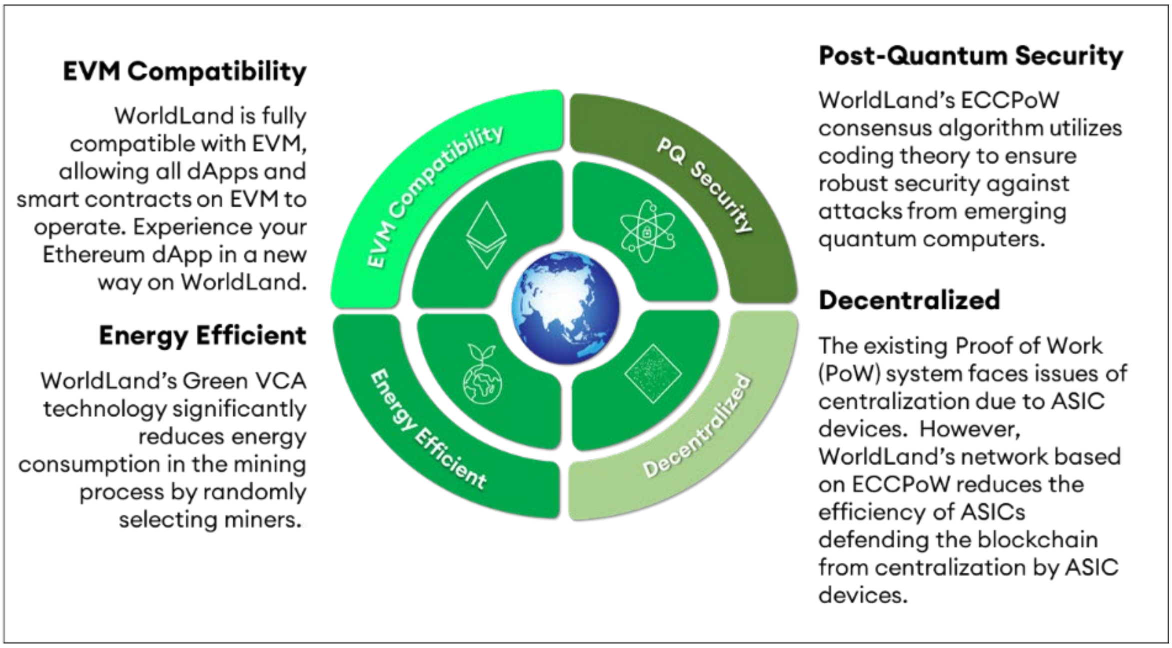


Figure 2 Four features of the WorldLand blockchain

Chapter II.

Strengths

2.1. Additional Challenges beyond the Trilemma

Today, the blockchain landscape faces two significant challenges beyond the well-known trilemma: the substantial carbon footprint associated with minting digital currencies and the issue of blockchain interoperability.

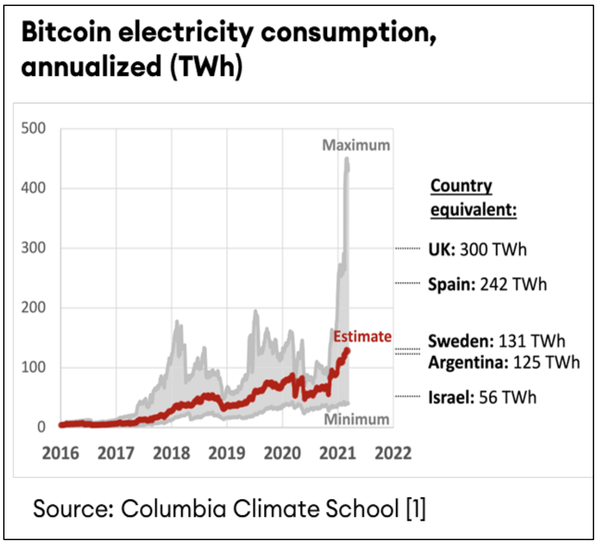


Figure 3 Annual Bitcoin electricity consumption [4].

2.1.1. Greenhouse Gasses

Imagine a digital treasure hunt where the prize is solving complex puzzles using vast amounts of computer power. That is essentially how Bitcoins are "mined," but this hunt comes with a hidden cost: Greenhouse Gasses.

The constant electricity required for these calculations manifests a carbon footprint larger than some countries. It is like leaving the lights on in a giant, never-ending room, adding to the environmental burden.

2.1.2. Interoperability

The proliferation of various blockchains—each with unique features, consensus mechanisms, and use cases—has led to a fragmented ecosystem. These isolated chains operate independently, hindering value transfer and data communication between them. Achieving interoperability requires bridging these silos.

The main goal of this project has been to reach an ideal balance between decentralization, security, scalability, environmental impact, and interoperability of blockchains.

2.2. ECCPoW as Blockchain Game Changer

ECCPoW has been introduced as a novel alternative to the traditional hash-based PoW algorithms used in networks like Bitcoin. ECCPoW merges the efficiency found in error correction codes with the resilience of PoW mechanisms. While PoW is recognized for its superiority over other consensus mechanisms, its benefits have not been universally acknowledged by the global community. PoW enables a vast network of nodes to achieve consensus, as evidenced by the uninterrupted operation of the Bitcoin network. This is attributed to two key reasons:

1. The PoW consensus mechanism's simplicity, where each node independently proposes and verifies each and every new block.

2. The lack of need for nodes to communicate to reach a consensus, as each one focuses on solving the cryptographic puzzle independently.

This simplicity, facilitating millions of nodes to agree on each block without fail, is PoW's most innovative aspect. ECCPoW builds on this strength, presenting an obstacle to the development of ASIC mining equipment, thereby slowing the trend towards centralization. WorldLand is exploring the integration of ECCPoW with other verifiable computational algorithms to enhance decentralization further, including the implementation of a verifiable coin toss function.

2.2.1. What is ECCPoW?

Error Correction Code (ECC) is a sophisticated mathematical method designed for detecting and correcting errors in data during transmission across noisy channels. Among these methods, the Low-Density Parity-Check (LDPC) code stands out as particularly effective, closely approaching the Shannon limit, a theoretical maximum efficiency for data transmission [5].

ECC involves two main components: the encoder and the decoder. The encoder encodes plain data before transmission, while the decoder identifies and corrects errors occurred during transmission at the receiver's end. The effectiveness of the code is proportional to the computational effort required to correct errors; the more errors it aims to correct, the more computationally complex the decoding process becomes. Once errors are corrected, the output data matches the original encoded data.

In the context of a PoW consensus mechanism, the work required by the decoder can serve as a challenging PoW puzzle for each node to solve. Once a node finds a PoW, that node can present the found word as the PoW. Other nodes can verify if the presented word is a codeword or not. This verification can be completed very quickly. ECCPoW integrates this principle as follows:

1. Utilizing the decoder as the PoW mechanism, starting with an erroneous word. A successfully decoded, error-free codeword serves as the PoW, presented by the node.

2. The verification process to determine whether a presented word is a codeword is simple and efficient.

3. Adjusting the puzzle's difficulty can be achieved by modifying the error correction capability, such as altering the codeword's length and the code rate. Longer codewords can correct more errors but require more extensive decoding efforts.

4. By potentially increasing the codeword's length to a very high degree, the development of specialized ASIC hardware for mining becomes prohibitively expensive, if not entirely unfeasible.

5. Introducing variability in the code used for each block adds an additional layer of complexity.

These pioneering strategies are at the heart of ECCPoW's consensus mechanism [6], offering a novel approach that leverages the intricacies of error correction to ensure both the security and integrity of the blockchain network.

2.3. Resolutions of Trilemma & Beyond in WorldLand

2.3.1. Decentralization

Decentralization is a fundamental principle that braces the core strengths of blockchain technology, offering enhanced security, transparency, and open user participation compared to traditional centralized systems. However, achieving true decentralization in practice can be challenging.

a) WorldLand Insists on PoW for Decentralization and Security

WorldLand maintains PoW as its consensus mechanism, which promotes decentralization by allowing widespread participation, securing the network through distributed mining, and incentivizing diverse stakeholders. It remains as the fundamental mechanism for achieving trust and resilience in WorldLand blockchain ecosystem.

b) ECCPoW is ASIC Resistant

ECCPoW impairs ASIC miners by dynamically adjusting the parameters of the LDPC code over time. This time-varying capability makes it challenging for specialized ASIC mining devices to dominate the network and maintains a balanced distribution of power within the network.

Two representative papers by Professor Heung-No Lee and his team on ECCPoW as a PoW algorithm are:

- ECCPoW: Error-Correction Code based Proof-of-Work for ASIC Resistance [2],
- Time-Variant Proof-of-Work Using Error-Correction Codes [6].

2.3.2. Security

WorldLand blockchain runs on the common PoW mechanism and maintains all the characteristics of traditional blockchains. Furthermore, ECCPoW aims to counteract ASIC mining dominance and enhance overall network security.

a) Tamper-Resistant Transactions

ECCPoW guarantees transaction integrity by mandating miners to perform cryptographic computations. Any effort to tamper with a transaction would be computationally expensive and detectable. The use of error correction codes provides an extra layer of protection against unauthorized modifications.

b) Sybil Attack Mitigation

Sybil attacks pose a significant security threat to networks, wherein an attacker generates numerous fake identities or nodes to gain a disproportionate level of influence over the network. ECCPoW combats this risk as a PoW mechanism by requiring significant computational effort from each participating node. Miners must demonstrate their contribution by successfully solving ECCPoW puzzles, a process that demands substantial computational resources. This requirement serves as a deterrent to potential attackers, as mounting a successful Sybil attack becomes impractically challenging without amassing a node collection that exceeds the computational power of the legitimate network. Essentially, ECCPoW leverages the inherent computational complexity and resource demands of its puzzles to maintain the integrity and security of the network against such attacks.

c) Consensus Stability

ECCPoW maintains consensus stability by relying on established cryptographic principles. The use of error correction codes ensures the robustness of the consensus process. A stable consensus prevents forks and ensures the reliability of the network.

d) Quantum-Resistant Approaches of WorldLand

Quantum-resistant algorithms, also known as post-quantum algorithms, are cryptographic methods designed to withstand attacks from powerful quantum computers.

Researchers worldwide are developing quantum-resistant algorithms to safeguard the digital infrastructure. These algorithms rely on mathematical problems considered challenging for quantum computers, such as lattice-based cryptography, code-based cryptography, and multivariate polynomial systems.

ECCPoW, a code-based cryptography, is designed to remain secure even when faced with quantum computers. By leveraging error correction codes, WorldLand enhances its resistance to quantum attacks, as ECCPoW-based signatures remain secure against quantum adversaries.

Overall, WorldLand's ECCPoW not only addresses quantum computing challenges but also provides a solid foundation for secure, efficient, and reliable blockchain operations. As the project evolves, its commitment to security remains at the forefront.

2.3.3. Scalability

WorldLand acknowledges the inherent limitations of single standalone blockchains and proposes an innovative approach to overcome the blockchain scalability challenge by deploying off-chain solutions, and other techniques.

a) Off-Chain Solutions: Layer 2 Solutions

WorldLand leverages Layer 2 solutions to offload certain operations from the main blockchain. These solutions enhance scalability by reducing congestion and improving transaction throughput. Examples of Layer 2 solutions include state channels, Plasma, and Rollups.

These allow users to conduct transactions off-chain while maintaining security and later settling the results on the mainnet.

b) Off-Chain Solutions: Sidechains

WorldLand's integration of sidechains significantly enhances its blockchain infrastructure by enabling parallel transaction processing, despite being a sidechain of the Ethereum mainnet. These sidechains function autonomously but can connect with the larger mainnet as needed. This architecture enables WorldLand to scale effectively, ensuring that an increase in transaction volume does not compromise security. Furthermore, this setup provides a seamless mechanism for users to transfer assets between the mainnet and the sidechains, facilitating a fluid and flexible interaction within the WorldLand ecosystem.

c) Dynamic Block Size

WorldLand dynamically adjusts block sizes based on network demand. This flexibility allows scalability accommodating more transactions per block when needed.

d) Periodic Checkpoint Technique

To bolster the security of sidechains and Layer 2 solutions, which generally operate with less inherent security than the mainchain, layer 2 blockchains may utilize the periodic checkpoint technique [7]. For example, WorldLand can utilize periodic checkpointing on the Ethereum mainnet.

This technique establishes fixed points (checkpoints) within the sidechain, representing states that are irrevocably finalized. By implementing the periodic checkpoint technique, these checkpoints are established at regular intervals and subsequently recorded as transactions on the mainnet. This process effectively inherits the robust security of the mainchain and extends it to the sidechain, enhancing its overall security posture.

2.3.4. Energy Efficiency

Recognizing the problem of explosive energy consumption of PoW blockchain, WorldLand has developed a consensus mechanism that achieves energy efficiency by leveraging the Verifiable Coin Toss Function and ECCPoW.

a) *Verifiable Coin Toss Function*

WorldLand prioritizes both robust security and decentralization inherent to PoW while minimizing energy consumption. To achieve this, it aims to introduce a novel "coin toss" technique that streamlines the consensus process.

Instead of every node burning electricity on computationally intensive puzzle-solving, only a pre-determined percentage (e.g., 10%, 20%, …) are randomly self-selected through a verifiable coin toss mechanism. These self-selected nodes then participate in the energy efficient ECCPoW mining, significantly reducing the overall energy footprint. The success rate of the coin toss can be varied adapted to the changes in the network's available computational resources.

This approach aims to strike a delicate balance between security, decentralization, and environmental responsibility, ensuring a sustainable future for the blockchain ecosystem.

2.3.5. Cross-Chain Interoperability

The challenge of cross-chain interoperability in the blockchain landscape is multifaceted and crucial for the seamless functioning of decentralized networks.

WorldLand has taken significant strides by implementing cross-chain bridges. These bridges serve as vital connectors between different blockchain networks, enabling seamless data transfer and interoperability.

a) *Consensus Heterogeneity, Scalability and Throughput*

Different blockchains employ diverse consensus algorithms (e.g., Proof of Work, Proof of Stake, Delegated Proof of Stake). Integrating them seamlessly while maintaining security and trust is challenging. Cross-chain solutions must handle consensus heterogeneity effectively.

Scalability remains a critical issue. As more transactions occur across interconnected chains, the overall throughput must increase. Ensuring efficient data flow without compromising security is a delicate balance.

b) Inter-Blockchain Communication (IBC)

WorldLand’s cross-chain bridges utilize IBC protocols. These protocols allow secure communication and data exchange between separate blockchains. By establishing IBC channels, WorldLand can interact with other chains, share information, and facilitate cross-chain transactions.

c) Decentralized Validators

WorldLand’s cross-chain bridges rely on a network of decentralized validators. These validators verify and relay transactions across chains. Their consensus ensures the integrity and correctness of cross-chain data.

d) Asset Transfers

WorldLand’s bridges enable the transfer of digital assets between different blockchains. Users can move their assets from one chain to another seamlessly, enhancing liquidity and utility.

e) Smart Contracts and Oracles

WorldLand integrates smart contracts and oracles to facilitate cross-chain interactions. Smart contracts execute predefined logic, while oracles provide external data to trigger cross-chain events.

f) Security Measures

WorldLand ensures the security of cross-chain bridges by implementing cryptographic techniques, threshold signatures, and multi-signature schemes. These measures prevent unauthorized access and maintain the integrity of cross-chain transactions.

WorldLand’s cross-chain bridges play a pivotal role in creating an interconnected blockchain ecosystem, fostering collaboration, and expanding the reach of decentralized applications.

Chapter III.

Technology

3.1. Overview: PoW in VRF

WorldLand protocol aims to build a decentralized, scalable, and secure solution for an immensely large network of nodes, even as the number of participating peer-to-peer nodes reaches a massive scale. A novel and technologically advanced solution is needed.

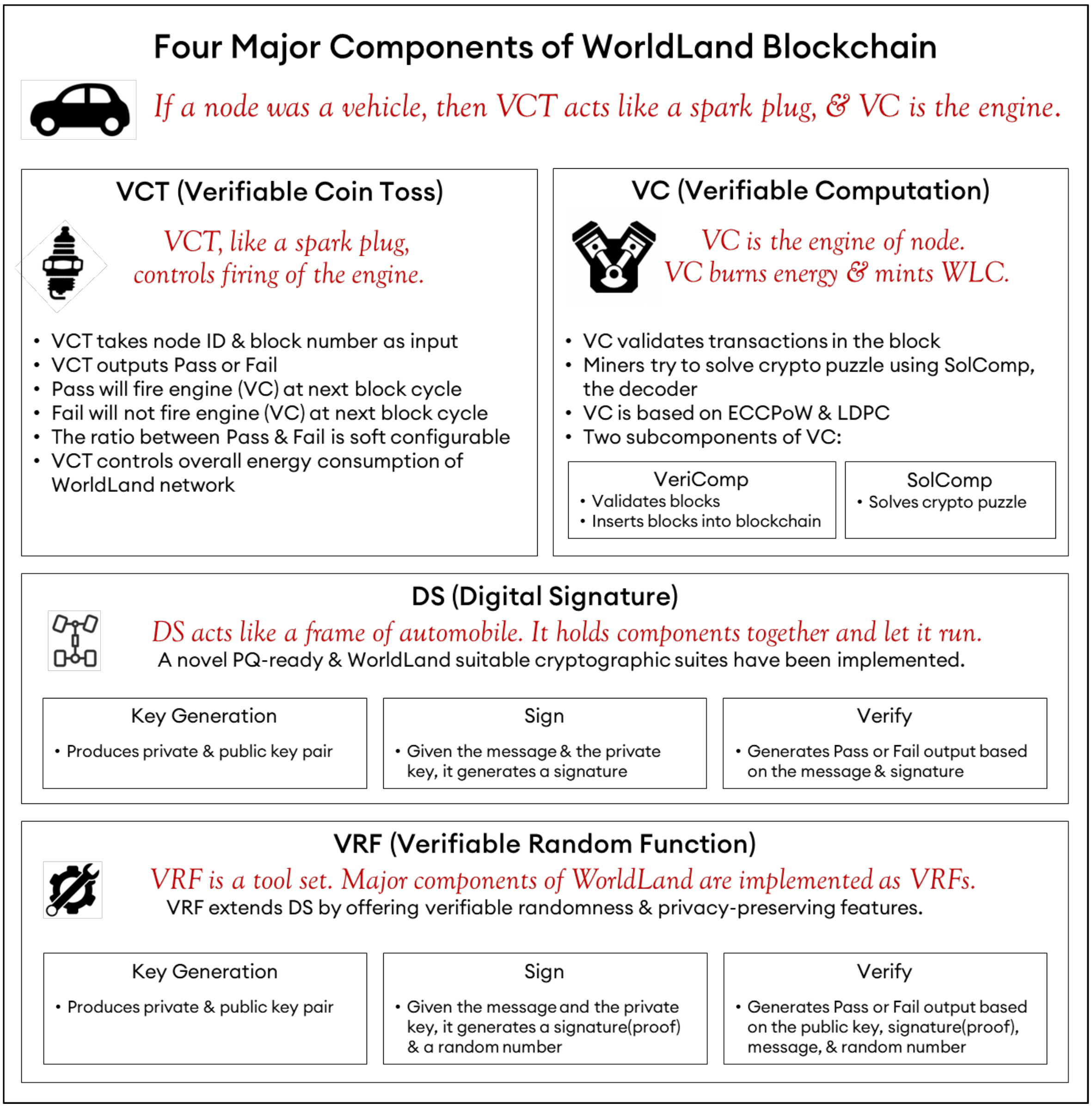
PoW was a significant technological innovation. It enabled the creation of a globally synchronized and immutable database, which was virtually impossible using other methods. It made widespread trust on internet possible without cumbersome intermediaries. But it came with an insatiable energy bill.

Decentralized consensus is achieved while each node simply does its own work of validating transactions, forming a new block, and attaching Proof-of-Computation (PC, a term used here to generalize PoW) to the block. This process is repeated for each new block, resulting in a simple algorithm. Finality is determined by the amount of energy stored in the blockchain. In the case of two blockchains, a node will choose the one with the most energy stored inside and add the new block to it.

Proof of Stake (PoS) has been a long-standing sociopolitical solution. PoW is simple and robust, allowing decentralization. While maintaining the desired properties of PoW, we aim to tackle energy and scalability issues. Similar to the hash PoW, all nodes in the base set collaborate and contribute to generating each new block. There will be no separation of tasks for each node to perform. Each node self-elects itself to do the work by validating transactions, forming a block, and attaching a PC.

At the heart of WorldLand, the PoW consensus mechanism has three major functions, VCT (Verifiable Coin Toss), VC (Verifiable Computation), and DS (Digital Signature). The VCT functions are implemented as post-quantum secure VRFs (Verifiable Random Functions). WorldLand blockchain, the layer 1, is composed of four major components, as illustrated in Table 2.

Table 2 Four major components of WorldLand Blockchain layer 1.



3.1.1. Key Performance Metrics of WorldLand

A set of key performance metrics of WorldLand includes:

- PQ secure cryptography and consensus
- M2. Energy consumption efficiency (ECE)
- M3. Byzantine fault tolerance (1/2)
- M4. The mining schedule
- M5. The block generation time (10 sec average)
- M6. The block size (adaptive)

3.1.2. DS (Digital Signature)

A DS algorithm is composed of three parts:

- KeyGen: Produces a public and a private key pair.
- Sign: Generates a signature given the message and the private key.
- Verify: Generates a binary, either pass or fail, output based on the message and signature.

The DS algorithm in WorldLand is a novel version of code-base cryptography rooted from the Error Correction Codes and the Lattice Codes. It has replaced traditional elliptic-curve DS cryptography in the blockchain space.

3.1.3. VRF (Verifiable Random Function)

A VRF can be defined as a function that generates a random number with a unique signature (proof) attached to it, given a private key and a message. What makes it distinct from an ordinary random number generator is that it also provides a verification procedure.

Thus, any verifier can check whether the random number was properly calculated or not. he generated random number must have high quality; considering the size of the keys, its entropy must be maximized.

A VRF is similar to a DS scheme, but there is a crucial difference: the signature. In a DS method, the signature is non-uniquely stochastic by design, as stochastic signatures enhance security. However, for our blockchain purposes, the signature must be uniquely generated for each fixed input.

We aim to use VRF to conserve energy expenditure in the SolComp stage (See 3.1.5 b). For this purpose, the VRF should be designed to execute just once per block; otherwise, nodes could exploit it by running the VRF multiple times until it produces a favorable output, thus preventing full realization of energy savings.

This enforcement is achieved if the VRF generates a unique signature by design for a specific fixed input message. We can modify the input message to include public information that existed before the VRF was conducted, such as the previous block's header. Consequently, each node is compelled to execute it only once per block.

3.1.4. VCT (Verifiable Coin Toss)

The base set of peer-to-peer nodes comprises all nodes involved in transaction validation and block formation.

The purpose of VCT is to deactivate a specific portion of the base set of nodes; thereby conserving energy. For example, if the proportion is set to 90%, energy-savings would be around 90%, although it may not reach full capacity due to machines continuing to operate at their base level even when not actively mining. VCT functions as a VRF and operates transparently. Therefore, the decision-making process for becoming a WorldLand node is simple.

Each node possesses its own unique (secret key and identification) coin for toss. Prior to the VCT, every node tosses its coin. VCT then produces a single output, either Pass or Fail. It takes two inputs: the unique key of the node and the header of the previous block. As a result, each node is compelled to conduct this VCT once and only once per block.

3.1.5. VC (Verifiable Computation)

ECCPoW is a new VC method developed and published by the team [2],[6],[8]. In its current version, ECCPoW is based on an error correction code known as the low-density parity-check (LDPC) code.

Not all error-correction codes can be readily adapted for efficient use in a PoW setting. The LDPC code, developed in the early days of coding theory in the 1960s by Gallager [5], is a primitive random block code with minimal inherent structure. The project team has utilized this random characteristic of the LDPC codes to create a secure and ASIC resistant PoW solution.

For nodes that have selected themselves to perform computational work, there are two types of computations: VeriComp and SolComp. Every node must execute these computations to mine WLC.

a) VeriComp (Verification Computation)

VeriComp is the process of validating transactions and compiling them into a new block. Upon receiving a new block announcement, each node validates the block and begins process of appending a new block to it.

b) SolComp (Solving Computation)

SolComp refers to the computation required to solve the crypto puzzle. Each round presents a completely new crypto puzzle. The puzzle problem is not predictable in advance but is determined based on the preceding block header.

Each node in the self-elected set then starts the race to solve the crypto puzzle as fast as possible. Once a node obtains the PoS, it inserts the proof into the block header and immediately broadcasts its new block.

3.2. Decentralization

Decentralization is the most fundamental aspect of blockchain technology. WorldLand puts the decentralization requirement at the very forefront.

Additionally, the team has developed a novel consensus algorithm rooted in error correction coding theory. This innovative algorithm effectively addresses the blockchain trilemma.

Several academic papers [2], [6], [8], [9] have been published over the course of several years to document the team's achievements in ECCPoW, with a summary of these endeavors is provided in the following sections.

3.2.1. Why Does Decentralization Matter?

Decentralization is a core principle of blockchain technology, and it offers several key benefits:

- Security: With no central authority, it becomes significantly more difficult for adversaries to manipulate blockchain data. Imagine trying to breach a fortress full of people compared breaking into a single bank vault − that is the contrast between decentralized and centralized systems. Decentralized nodes remain vigilant around the clock, ensuring the integrity of every block.

- Transparency: All transactions on a blockchain are publicly viewable, promoting trust and accountability. It is akin to having a constantly updated public ledger that records all activities.

- Resilience: If one group of nodes on the network goes down, the rest can keep functioning. This redundancy makes blockchains resistant to outages and failures.

- Empowerment: Decentralization puts users in control of their data and assets. There is no need to rely on a third party such as a bank or corporation.

These all add up to a more secure, transparent, and user-driven system, making decentralization a revolutionary concept in blockchain technology.

3.2.2. ECCPoW as Blockchain Consensus Algorithm

ECCPoW is a fascinating concept implemented in WorldLand. It combines two critical components:

- ECC: The error correcting codes (ECC) enhance data reliability by detecting and correcting errors during transmission.
- PoW: The traditional consensus mechanism where miners compete to solve computation-bound puzzles to validate transactions and generate new blocks.

ECCPoW introduces error-correction codes into the PoW framework, creating a novel approach to mining cryptocurrency. It replaces the standard hash PoW used in Bitcoin and other cryptocurrencies. It maintains the symmetry of PoW blockchains while resisting ASIC dominance. By integrating ECC, ECCPoW enhances security, decentralization, and fairness in the mining process.

a) ASIC Resistance

ECCPoW discourages the use of expensive ASIC miners, promoting a more equitable distribution of mining power. More on this topic is discussed later in this chapter.

b) Error Correction Codes (ECC)

ECC is a broad category of techniques used to detect and correct errors in transmitted data. Its primary purpose is to ensure reliable communication over noisy channels.

ECC adds redundancy to the transmitted data, allowing the receiver to recover the original message even if some bits are erroneously flipped. Various ECC schemes exist, including LDPC codes, Reed-Solomon codes, and Hamming codes. ECC mechanisms can detect and correct up to a certain number of errors, improving data integrity.

c) Low-Density Parity Check (LDPC) Codes

LDPC codes are a specific type of ECC. They are linear error-correcting block codes. LDPC codes are particularly suitable for correcting errors in large block sizes transmitted over noisy channels. These codes were developed by Robert G. Gallager in the 1960s [5].

LDPC codes achieve performance close to the theoretical Shannon Limit for symmetric memoryless channels [5]. The key feature of LDPC codes is their sparse Tanner graph structure, which allows efficient decoding algorithms.

Thus, ECCPoW in the WorldLand blockchain represents an innovative fusion of error-correction codes and PoW, aiming to foster a more robust and decentralized ecosystem for blockchain enthusiasts and developers.

d) LDPC Decoder

LDPC codes as an error correction code consist of two main components: the encoder and the decoder. The encoder assigns parity check relations to the plain bit sequences. The decoder receives an error-prone sequence of bits and employs the parity check relationships to correct errors and recover the plain bit sequence. The LDPC decoder iteratively updates the probabilities of bit values based on the received error-prone sequence.

LDPC decoders are crucial for correcting errors introduced in error-prone sequences. For example, consider encoding a plain bit sequence and storing the encoded word in an NAND flash memory storage. Over time, due to wear and tear, the bit sequence can degrade. In such cases, the decoder is employed to recover the original bit sequence. To correct more errors, longer LDPC codes must be used. Consequently, the LDPC decoder has to run more extensive error-correction computations.

3.2.3. ECCPoW is ASIC Resistant Promoting Decentralization

The primary focus of this subsection is to demonstrate that ECCPoW is ASIC resistant and promotes blockchain decentralization. Our objective is to foster decentralization, making ASIC mitigation a pivotal aspect of the discussion.

Bitcoin mining operates through the hash PoW. The higher hash rate increases the likelihood of successful mining, which has led to the emergence of mining pools, often referred to as mining organizations, hinting at recentralization.

Unlike CPUs or GPUs, high-cost ASIC miners have emerged with performance efficiency. The problem is that emergence of ASIC miners eliminates miners with CPUs and GPUs and exposes Bitcoin's mining monopoly. This centralization in mining power increases the risk of censorship and may facilitate double-spending attacks.

We propose a new PoW algorithm, ECCPoW, which utilizes error-correction codes and their decoders [6]. In ECCPoW, puzzles can be intentionally varied from block to block, resulting in a time-variant puzzle generation mechanism. This approach helps prevent the emergence of specialized mining devices, addressing the issues of recentralization and energy consumption.

One of the Team's papers [9] proposes the implementation of ECCPoW, to replace the PoW in Bitcoin. It compares the mining centralization, security, and scalability of ECCPoW with those of Bitcoin's hash PoW. It introduces the ECCPoW implementation method and the process of replacing the SHA 256 hash PoW with ECCPoW in Bitcoin. It suggests the generating of a cryptographic puzzle that changes with every block and shows how to apply the crypto puzzle decoder to the solution. Additionally, the paper presents the implementation of the proposed method by replacing ECCPoW in Bitcoin and measures the distribution of block generation time of the ECCPoW. Finally, it compares ECCPoW and Bitcoin by implementing them in the same environment.

3.2.4. ECC Decoders Implemented in ASICs

ECC decoders are widely used in communication systems, often implemented using ASICs. For instance, cell phones use ASIC decoders to swiftly correct transmission errors with low power consumption. These ASIC decoders are designed with fixed code lengths and fixed parity-check matrices. In the context of LDPC decoders, the structure of the parity-check matrix plays a crucial role in determining the design of ASIC implementations.

Creating an ASIC LDPC decoder that can handle the numerous and constantly changing parity-check matrices, which are set to expand indefinitely as the difficulty level rises, is exceptionally challenging due to the high cost and size constraints associated with chip manufacturing. The decoding puzzle of ECCPoW is changed by the protocol from one block to the other, utilizing an infinite number of randomly chosen parity-check matrices. As a result, ECCPoW inhibits the development of ASICs for ECC decoders. The cryptographic puzzle is randomly generated using both the random generation method by Gallagher [5] and the previous hash value. In other words, ECCPoW randomly generates an LDPC matrix which should be used by the decoder.

It is noteworthy that while ECCPoW offers a method for solving different puzzles in each block to avoid ASICs, existing hash PoW solutions rely on a limited number of fixed hash functions that can be easily implemented into an ASIC solution.

In the WorldLand protocol, we demonstrated how the difficulty control, parity-check matrix generation method, hash vector generation, and code determination methods are all combined to create ECCPoW [6].

3.2.5. PoW vs PoS

PoS alone is not enough as a consensus solution. To make a consensus solution, PoW comes with a Byzantine Agreement (BA) algorithm. But the addition of the BA algorithm does not help much. PoS does not promote decentralization in the end, while ECCPoW does. In this section, we explain why WorldLand took the PoW route.

To address the energy and scalability concerns, Ethereum’s Merge has adopted PoS as an alternative to PoW. PoS aims to address energy concerns and boost transactions per second (TPS). However, PoS comes with its own set of concerns, including centralization and security issues [10], [11]. Unlike PoW, PoS is not considered a technological advancement and relies more on sociopolitical solutions, often criticized for its plutocratic nature.

PoS does not retain any energy on a block, blocks may be readily rewritten; hence, it is insecure. Your stake will be confiscated if you act badly. This is a “fixing a barn after losing a cow” approach. The richest few can make off-chain confidential agreements and take the control of a blockchain. These off-chain conspiring operations leave no on-chain trace, thus no one can even become aware of them. As a result, it is known to be sensitive to bribery or collusion [12]. Now, there is a famous nothing-at-stake problem [13]. There is a risk of grinding attack if the random function for selecting a block creation node is unfair or predictable [14].

The time-energy borne (TEB) wealth property [15] no longer exists with PoS nor with the combination of PoS and the BA algorithm.

3.2.6. PoS Paired with Byzantine Agreement

Today, blockchains are not PQ secure; there are environmental concerns; there are scalability issues. To solve these concerns, several major projects are implementing a PoS paired with a BA algorithm. These algorithms are known to provide Byzantine fault tolerance of less than 1/3. In a typical Byzantine agreement algorithm, at least two-thirds of the total number of nodes must be honest and correctly functioning to achieve consensus. This threshold means that the system can tolerate up to one-third of its nodes being Byzantine (malicious or faulty). It is noteworthy that the Byzantine fault tolerance of PoW is 1/2.

The combination of PoS and BA has its merits; but does not provide the required level of security for a global monetary-grade blockchain network. While the concepts are not new, the BA algorithm (developed in the 1980s [16]) relies on communication across committee nodes to reach consensus, rendering it subject to various attacks, including Distributed Denial of Service (DDoS) and network partition attacks. To ensure scalability with a large number of nodes, the committee size must be kept small, which compromises decentralization.

3.2.7. The WorldLand Approach

We envision to solve the post-quantum (PQ) threats, scalability issues, and environmental concerns while maintaining security, decentralization, and the property of TEB wealth property. Our approach involves the development of new technological solutions designed to tackle these interconnected requirements. These innovative tools enable us to navigate through these complex challenges effectively.

The key principle inherited from the Bitcoin consensus is this: each node performs a simple task individually and autonomously; consequently, each node functions independently; enabling the system to run steadily even with a huge number of participant nodes. Nodes are homogenous in this regard.

This principle is plain simple. Each participating node can easily adhere to the rule. Each node performs the same simple task since no job is divided, no time is divided, and no communications are required for each to participate in the discussion and reach a consensus; each node simply continues to work independently and repeats the same procedure for each block. Consensus is reached when a node announces the next block. The only information each need node needs to stay vigil is the announcement of a new valid block.

This simplicity lowers the barrier of entry and invites more participating nodes promoting decentralization.

3.3. Energy Efficiency

WorldLand consensus is composed of two major parts: a verifiable (self-election) coin toss (VCT) function and a Verifiable Computation (VC) primitive.

Our focus in this subsection is to show how the combination of VCT and ECCPoW addresses the environmental concerns over blockchain energy expenditures.

3.3.1. VCT as Soft Configurable Spark Plug

The purpose of VCT is to have a certain portion of the base set of nodes turned OFF; energy is thus saved. If the proportion is set to 90%, energy-saving is 90%.

We aim to design the VCT function so that the probability of Pass can be closely controlled. The probability of Pass is a critical parameter that the network designer may use to change the amount of energy saved given the size of the base set. For example, when the number of nodes working in the network is small, it shall be set to 100% to maximize security. When the number of nodes is large, it can be set to 10% to save energy.

When a node selects Pass from the VCT phase, it participates in the energy spending VC phase. If it does not pass, it can then be assigned to perform other useful tasks, such as training large language models and servicing trained models. This notion ignites another avenue of topics categorized as “My AI Network™ under WorldLand™”.

For other blockchain networks, this type of controlling mechanism does not exist. Take the Bitcoin network, for example, where energy consumption is staggering since all nodes always operate at any given moment. To date, there is no mechanism known to us that can autonomously but verifiably control its participation in mining in any other PoW-based blockchains.

3.3.2. VCT, Green House Gas Solution

WorldLand’s VCT introduces a self-controlled and verifiable participation mechanism:

- Random Selection: Each node is given a single chance to run the VCT function and self-elect itself as a subset of nodes to participate in mining completion to forge a new block.

- Verifiability: The coin toss process ensures fairness and transparency since VCT is implemented as a VRF.

- Energy Efficiency: Involving fewer nodes at any given moment significantly reduces energy consumption.

- Equitable Participation: Nodes take turns, avoiding constant competition,

- Opportunity Yet Open: The concept of My AI Network provides nodes with a new opportunity for earning WLC rewards by performing useful work when they are not participating in mining competition. Their GPUs can be utilized in training AI models, for example.

WorldLand’s VCT offers a promising solution by optimizing participation, reducing energy consumption, and promoting a greener future.

3.4. Security

WorldLand's ECCPoW, as discussed in previous chapters, is a novel consensus mechanism that combines the principles of error correction codes with the traditional PoW approach. Here are the key points regarding its security.

3.4.1. ECC as Cryptography

ECC, specifically those based on error-correcting codes, can indeed be also used as a foundation for cryptographic algorithms. ECCs are primarily designed to detect and correct errors in transmitted data. They add redundancy to the data, allowing receivers to recover the original message even if some bits are corrupted.

Popular ECC methods include Reed-Solomon codes, Hamming codes, and Low-Density Parity-Check (LDPC) codes.

a) Building Cryptographic Algorithms with ECC

ECCs can be leveraged in various cryptographic contexts:

- Digital Signatures: ECC-based signatures provide authenticity and integrity.
- Encryption: ECC can be used for secure key exchange.
- Randomness Generation: ECC-based random number generators enhance cryptographic protocols.
- Secure Hash Functions: ECC can be part of hash-based constructions.

ECCs offer advantages like compact signatures and efficient verification.

b) Brief History on Early Code-Based Cryptography

McEliece firstly presented the code-based cryptosystems using binary Goppa codes in 1978 [17]. In 1986, Niederreiter proposed a knapsack-type public-key cryptosystem based on error-correcting codes using GRS codes [18]. Later, the Niederreiter method demonstrated to be as secure as the McElice cryptosystem.

Sidel'nikov and Shestakov demonstrated in 1992 that Niederreiter's plan to employ GRS codes was insecure [19].

There are various ideas to minimize the public-key size by employing different codes such as Gabidulin codes [20], [21], algebraic geometry codes [22], [23], and Reed-Muller codes [24].

However, all of these approaches ultimately proved to be unstable [25], [26].

3.4.2. PQ Safe PoW

Today, blockchains are not post-quantum (PQ) secure. Over the last few years, the team has invested a major portion of its resources to equip the WorldLand computational primitives to be PQ secure. The following outlines the progress of this work.

In this project, our aim is to upgrade VRF, VC, and VCT primitives to be PQ safer than plain ECCPoW. A critical component of the virtual machine can also be enhanced; particularly, the elliptic-curve cryptography and other parts built on it can be replaced with a new PQ-safe cryptography.

Quantum computers are known to be capable of breaking well-established cryptographic algorithms such as elliptic-curve cryptography, the digital signature algorithm, and RSA. On the other hand, code-based cryptography issues are known to be quantum safe.

The goal of this stage is to research recent advances in PQ cryptography and select a set of suitable PQ secure algorithms. These can be used to meet our goal of developing a PQ secure signature and a PQ secure VRF for WorldLand.

We conducted preliminary research and found that three initiatives are good candidates for PQ safe signature algorithms: Dilithium [27], Falcon [28], and Durandal [29]. The key metrics used to select them are the size of the keys, the size of the signatures, the time it takes to complete a sign, and the time it takes to verify.

We aim to carefully study these candidate PQ secure algorithms and select the best one that renders results satisfying the key performance metrics of WorldLand. The best PQ secure algorithm will be developed into the WorldLand protocol suite.

The selected signature algorithm will be implemented using the Go language. We will have to replace the elliptic-curve DS cryptography. This work is currently under an active research and development phase, and additional details will be disclosed in the upcoming version of this report.

3.5. Scalability

3.5.1. Block Time

Block generation time, or simply block time, is a critical factor in blockchain scalability. It refers to the time interval between the creation of consecutive blocks in a blockchain network.

- Transaction Throughput: Shorter block times can lead to higher transaction throughput, as more blocks are generated over a given period of time, allowing more transactions to be processed.

- Network Congestion: Longer block times can cause network congestion during periods of high transaction volume, leading to slower confirmation times and higher fees.

- Security vs. Speed: There is a trade-off between security and speed; shorter block times can increase the risk of forks, while longer block times can enhance security but at the cost of speed.

3.5.2. Block Time Set at 10 Seconds for WorldLand

The block time of WorldLand has been set to 10 seconds to strike a balance between efficiency and network security. Shorter block times can lead to quicker transaction confirmations, which improves the user experience and network throughput. However, too short a block time can increase the risk of forks and network instability. The 10-second block time is a strategic decision that aims to optimize transaction processing speed while maintaining the integrity and security of the blockchain.

A block time that is too short can indeed increase the risk of forks in a blockchain network.

- Simultaneous Block Mining: When block times are short, it is more likely that two miners will solve the cryptographic puzzle at nearly the same time, leading to the creation of two valid blocks.

- Network Latency: Short block times do not allow sufficient time for the newly mined block to propagate across the entire network. This can result in different parts of the network working on different blocks, which can lead to a fork.

- Chain Reorganization: The blockchain protocol typically favors the longer or heavier branch, which means that when a fork occurs, the network eventually abandons the shorter or lighter branch. This can lead to transactions that were confirmed in the shorter branch being discarded.

Therefore, while shorter block times can improve transaction throughput, they must be carefully balanced with the risk of increased forks, which can lead to instability and security issues within the network.

3.5.3. Off-Chain Solutions: L2 & Sidechain Solutions

WorldLand acknowledges the inherent limitations of a single blockchain and proposes an innovative approach to overcome the blockchain scalability challenge by deploying off-chain solutions, and other techniques.

a) Off-Chain Solutions: Layer 2 Solutions

WorldLand leverages Layer 2 solutions to offload certain operations from the main blockchain. These solutions enhance scalability by reducing congestion and improving transaction throughput. Examples of Layer 2 solutions include state channels, Plasma, and

Rollups. They allow users to conduct off-chain transactions while maintaining security and later settling the results on the mainnet.

b) Off-Chain Solutions: Sidechains

WorldLand's implementation of sidechains enables parallel processing of transactions. Sidechains operate independently but can interact with the mainnet when necessary. By utilizing sidechains, WorldLand achieves scalability without compromising security. Users can move assets between the mainnet and sidechains seamlessly.

3.5.4. Dynamic Block Size

WorldLand dynamically adjusts block sizes based on network demand. This flexibility allows for accommodating more transactions per block when necessary. The block size is set to be limited to the maximum allowed gas (a target size of 15 Million gas and a limit of 30 Million gas).

3.5.5. Periodic Checkpoint Technique

To bolster the security of sidechains and Layer 2 solutions, which generally operate with less inherent security than the mainchain, WorldLand blockchain aims to utilize the periodic checkpoint technique [7].

This technique establishes fixed points (checkpoints) within the sidechain, signifying states that are irrevocably finalized. By implementing the periodic checkpoint technique, these checkpoints are established at regular intervals and subsequently recorded as transactions on the Ethereum mainchain. This process effectively inherits the robust security of the mainchain and extends it to the sidechain, enhancing its overall security posture.

If a group of network participants controls more than 50% of the total computational power in the network, they can manipulate the blockchain. Therefore, any initial PoW blockchain networks with low computational power are vulnerable to block forgery attacks. Utilizing a smart contract-based checkpoint method can enhance security during the initial phase of blockchain development.

In a checkpoint method, participants periodically record the hash of the block headers in an Ethereum smart contract. The recorded checkpoint block header can be used to validate the blockchain. Participants reject blocks that deviate from the recorded checkpoints. Our method ensures the integrity of blocks up to the height of the most recently generated checkpoint, reducing the risk of double spending.

Checkpoint costs can be optimized by overlapping multiple checkpoint processes in a single transaction. The interval of our checkpoint method increases with the growth of the network, reducing the network's reliance on checkpoints.

We analyze the performance of checkpoints in mitigating attacks and demonstrate that they significantly decrease the success probability of attacks in the network.

3.6. EVM Compatibility

EVM-compatible blockchains refer to blockchains that can integrate with the Ethereum Virtual Machine. These blockchains enable interoperability across various network ecosystems, including Ethereum, Binance Smart Chain, Avalanche, Fantom, Polygon, Arbitrum, and Celo.

The key benefits of EVM-compatible blockchains include:

- Portability and Interoperability: Developers can write and deploy the same smart contracts across multiple EVM-compatible chains without significant code modifications. These smart contracts can interact with other EVM-compatible blockchains through the EVM, allowing the creation of multi-chain dApps.
- Lower Costs: EVM-compatible blockchains provide standardized gas fees and improved transaction speeds.
- They tend to have lower energy consumption per transaction compared to Ethereum.

- EVM-compatible blockchains play a crucial role in addressing scalability and efficiency challenges while advancing the broader blockchain ecosystem.

WorldLand actively embraces these advantages of EVM compatibility, providing an easy migration path for existing dApp ecosystems.

3.7. Brief Introduction of AI-DEX

While a comprehensive introduction is planned for a separate report, we aim to briefly discuss what AI-DEX is here.

Decentralized exchanges (DEXs) offer exciting possibilities for crypto trading by removing the need for trusted intermediaries and enabling peer-to-peer transactions. However, they come with unique challenges, one of which is *impermanent loss*. The difference between the initial value and the final value of the LP's assets constitutes the impermanent loss. Once the LP withdraws tokens, the loss becomes permanent if the prices remain imbalanced.

AI-DEX, a distributed digital asset exchange implemented by the WorldLand team, is of the Automated Market Maker type.

AI-DEX uses smart contracts to generate liquidity pools of paired coins. Traders directly interact with the pool, buying and selling coins at algorithmically determined prices. To determine the trading prices, AI-DEX uses the market price adjusted by our unique AI algorithm to minimize the impermanent loss.

The team has implemented a cross-chain bridge using our unique MAC ZKP to support the coin wrapping process. It currently supports wETH (WorldLand wrapped ETH), DAI, and WLC. wBTC, wUSDT, and wUSDC are planned for future implementation.

3.7.1. Prediction and AMM Smart Contract

Within the WorldLand ecosystem, there is a need for a DEX exchange responsible for digital asset trading. However, existing DEX technologies often exhibit overly simplistic forms due to smart contract computational limitations. Real-time market price utilization is essential for developing the next-generation DEX technology.

3.7.2. AI Model-based DEX

Leveraging an AI model-based prediction system and an efficient Price Oracle model, we predict near future price changes within minutes. We aim to use these predictions and address the limitations of the existing AMM approach. For example, predictions are set to be made every 10 minutes, resulting in reduced cost such as Ethereum gas and Price Oracle transaction fees.

The development of the prediction model and AMM smart contracts has been completed as of the date of this report.

Additional details including the planned date for service launch will be disclosed in the upcoming version of an AI-DEX report.

3.8. Brief Introduction of My AI Network™

While a comprehensive introduction is planned for a separate report, we aim to briefly discuss what My AI Network is here.

Big tech's control of large language models (LLMs) raises risks for sustainable technology development and societal advance. Big tech's dominance in LLMs could tilt the tech battlefield in their favor. The billions-dollar price tag of LLMs creates an exclusive AI club for tech giants.

WorldLand network will in a near future grow to the network of GPU machines, as its ECCPoW deters the advent of ASIC mining. Then, the very same network of the GPU machines (My AI Network) will be made available to train a new layer of AI models. That is the basic idea behind “My AI Network”.

All this is possible due to the WorldLand verifiable computation mechanism, which selects only a small percentage of miners to participate in the computation intensive SolComp phase. The nonparticipating nodes with GPUs can be used in training the AI models, and in doing so, they will be awarded with WLC.

This work is under active design and development, and further details will be documented in the upcoming version of a separate My AI Network™ report.

3.9. Mobile Hyperspectral Camera & ZKP

3.9.1. What is Mobile Hyperspectral Camera?

An RGB camera captures visible light and produces color images by combining the red, green, and blue channels. A spectrometer measures the intensity of light across a wide range of wavelengths from ultraviolet to infrared. It provides detailed spectral information of the incident light, not just as RGB intensity values.

Professor Heung-No Lee and his team have developed an ultra-small snapshot mass-producible spectrometer camera that can fit into mobile phone devices. For example, it can be used for more precise face recognition and digital identification purposes. It took them over a decade of research and development efforts to achieve this feat.

A secure and portable authentication device will be essential for future payment methods. Many applications are adopting face recognition as the primary authentication method for financial and payment applications. However, the traditional face recognition based on RGB cameras is susceptible to presentation attacks (PA). PA attempts to deceive the authentication device by presenting printed images or masked faces.

To tackle this issue, some apps adopt additional sensors, such as near infrared radiation (NIR) cameras or Time-of-Flight (ToF) sensors. However, adopting these sensors, increases the complexity and cost of the hardware configuration for authentication devices.

The team has built a tiny yet effective spectrometer prototype that can be integrated into mobile devices. It uses Multilayer Thin Film (MTF) filters to disperse the light source into many spectra, along with computational spectrometer techniques employing DLL. The team has shown the feasibility of producing snapshot mass-production-enabled MTF spectrometers for mobile applications.

3.9.2. Strategy to Address Face Authentication Issues

Addressing these issues, the team also introduces the computational hyperspectral imaging enhanced with the Zero-Knowledge Proof (ZKP) protocol, as illustrated in Figure 4.

1. The computational hyperspectral camera consists of an MTF and CMOS sensor to achieve a compact size and a low production cost.

2. The computational hyperspectral imager encodes the wavelength information across visible and NIR bands.

3. The deep learning-based face recognition model encodes the spatial information as the key.

4. Authentication is conducted using the encoded information from the computational hyperspectral imager.

5. Encoded information is irreversible, so privacy is contained and enhanced via ZKPs.

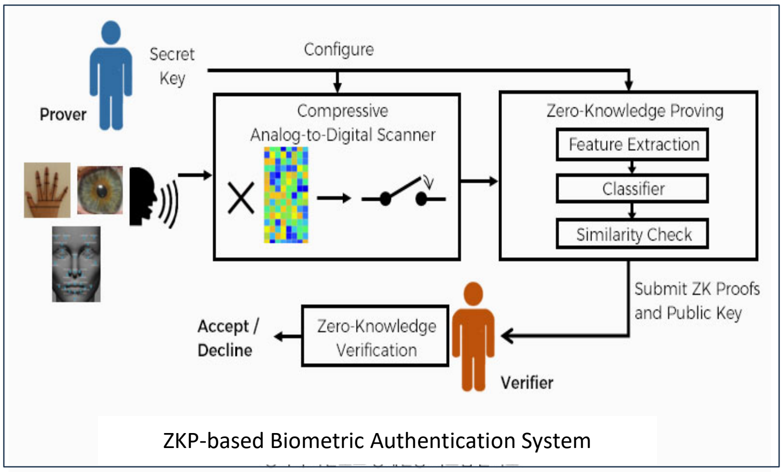


Figure 4 Diagram showing how ZKP works with a digital scanner.

The Spectrometer Camera Module with MTF, CMOS and MLA (Micro-Lens Array) has been implemented by the team, and the study has been published in 2022 [30].

Professor Lee has made significant contributions to the field of MTF-based computational spectrometers.

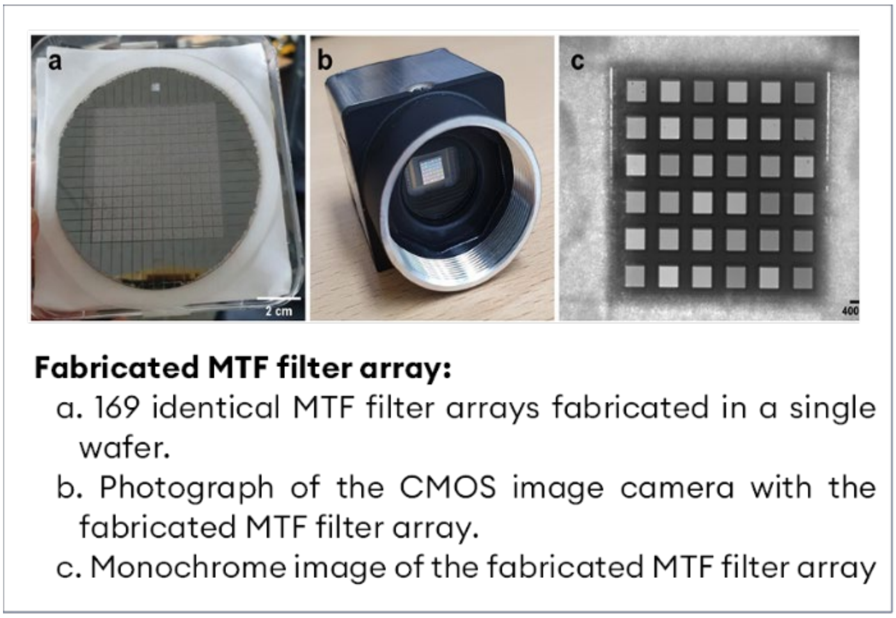


Figure 5 Photos of MTF filter array implemented by the team.

3.9.3. Mass Production-Enabled Spectrometer

The team developed computational spectrometers based on MTF filter arrays. These spectrometers combine thin-film filters with computational techniques to achieve compact size, high resolution, and wide working ranges.

The MTF filter array consists of a 6 × 6 square grid, with 169 identical arrays fabricated on a single wafer. By attaching the MTF filter array and the Muti-Lens Array to a CMOS image sensor, they created a computational spectrometer. With a single exposure, these spectrometers collect 36 unique intensities of incident light. The spectrum of the incident light is then recovered using collected intensities and numerical compression and optimization techniques. These computational spectrometers cover varied light sources in the wavelength range of 500 to 849 nm with a spacing of 1 nm. The reconstructed spectra closely match reference spectra obtained from a grating-based spectrometer. Applications include remote sensing, medical diagnostics, and on-site detection [31].

3.9.4. Deep Learning-Based Snapshot Computational Spectrometer

The team also explored deep learning approaches for computational spectrometers using MTF. They developed a snapshot computational spectrometer that leverages MTF filter arrays. By applying deep learning techniques, the team achieved efficient spectral imaging [29]. The potential of a snapshot computational spectrometer in facial recognition on mobile devices is huge.

Facial recognition systems are vulnerable to spoofing attacks, where an impostor presents fake biometric data (such as photos or videos) to deceive the system.

3.9.5. Potential Use of Computational Spectrometers:

A snapshot computational spectrometer could be employed for anti-spoofing in facial recognition:

- Spectral Information: By capturing detailed spectral information, it can distinguish between real skin and spoofing materials (such as printed photos or masks).

- Unique Signatures: Real skin exhibits specific spectral signatures due to its composition (melanin, blood vessels, etc.).

- Challenges: Efficiently integrating this technology into mobile phones without compromising user experience.

3.9.6. Advantages of Mobile Computational Spectrometer:

Compact Size: Computational spectrometers are smaller than traditional spectrometers, making them suitable for mobile devices.

- Fast Operation: Snapshot acquisition ensures real-time processing.

- High Resolution: Spectral details aid in distinguishing real faces from spoofed ones.

- Wide Working Range: Covers various lighting conditions.

- Privacy: The project proposes deploying ZKP to prevent and to not infringe on user privacy.

- Cost: Ensuring low-cost production is essential for widespread adoption.

- Integration: Seamless integration into existing facial recognition systems is crucial.

While the concept of using computational spectrometers for anti-spoofing is promising, practical implementation and seamless integration with mobile devices remain key challenges.

The Team continues to explore innovative solutions to enhance facial recognition security on mobile devices.

Chapter IV.

Landscape & Coinomics

4.1. WorldLand Landscape 2024

Within WorldLand's ecosystem, every participant plays a vital role, contributing unique value in their own way. The blockchain and its native coin, WLC, act as a secure and streamlined conduit for the exchange of values they generate.

As the network expands and participation grows, the collective value blossoms leading to an appreciation in WLC itself. WorldLand envisions this value radiating outwards, creating a global impact and ensuring equitable and fair distribution among all participants. In this section, we dive deeper into the diverse roles each member plays within the network.

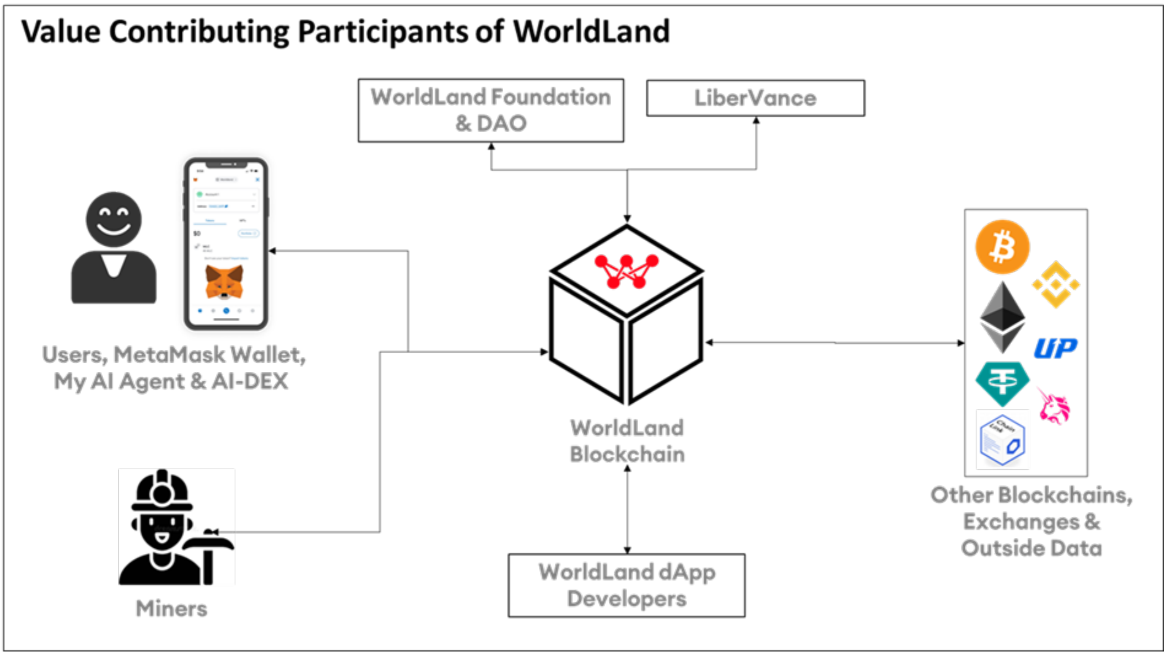


Figure 6 Landscape of WorldLand: value contributing participants of WorldLand.

4.1.1. WorldLand Blockchain: Test and Main Network

WorldLand Seoul is a blockchain mainnet that was successfully launched in South Korea. WorldLand project is a collaborative effort between the GIST Blockchain Intelligence Convergence Center and startup LiberVance. Two versions of WorldLand have been operating, Seoul mainnet and Gwangju testnet.

Since the genesis block in August 2023, 1.6 million blocks have been generated, with 6.4 million WLC's minted, averaging a new block at every 10 seconds at the time of writing this report, February 20, 2024.

The WorldLand networks have been running in a very stable condition without a glitch. This achievement signifies a giant step toward providing next generation blockchain services on a global scale.

4.1.2. WorldLand Users & Subscribers

Users and subscribers will invest in WLC and make use of WorldLand dApps. Their contribution is the livelihood of the network.

a) Value Contribution

Their value reside in directing the network's evolution, stimulating innovation, and securing the network's long-term sustainability. The project aims for the user community to expand to a sustainable size.

b) Wallet.

WLC is the native coin of WorldLand, and users can send and receive WLC via any Web3 wallets, including the MetaMask wallet. MetaMask is the most prevalent and versatile wallet available as both an app and a web extension.

c) My AI Agent

My AI agent is another ambitious app that the project has been planning. It is meant to be a private AI agent for individual users. For example, professionals in fields such as law, medicine, and education can input their professional data and develop their own My AI agents. These agents can be used to train employees. They can also be used to generate revenue by being deployed to serve people worldwide via WorldLand.

The WorldLand team is working with industry and university partners to gain deeper field expertise and a broader spectrum of knowledge.

4.1.3. Miners

a) Value Contribution

Miners invest in hardware, electricity, and time to secure the network. Their computational power ensures transaction validation, block creation, and overall network security. The value they generate lies in maintaining the integrity and reliability of the blockchain.

b) Active Mining Nodes

Since the launch of WorldLand in August 2023, the number of mining nodes has increased steadily. At the time of writing this report, it has reached 780 nodes.

c) Mining Puzzles

The mining puzzle involves solving for a codeword of the LDPC code, whose parity-check matrix randomly varies over time from block to block. This randomness ensures that the puzzle is unpredictable without prior knowledge. The solution must be found through trial and error, making it an ideal puzzle for the block validation PoW. Accelerating the solution of this puzzle is possible because the LDPC decoder involves a huge number of parallel computations. Thus, it is advantageous for a node to use GPUs.

d) Difficulty Level & Block Time

The difficulty level is adjusted to maintain an average solving time of 10 seconds. The winning node will receive 4 WLC during the first halving period from August 2023 to July 2025.

e) *CPU & GPU*

At the time of writing, most mining nodes are running in CPU machines. But as the mining community grows bigger, and the value of WLC appreciates higher, it is expected that GPU nodes will dominate the mining field.

These GPU nodes will later play a critical role in harvesting AI models in what we reference as My AI Network enabling My AI agents.

4.1.4. WorldLand Foundation

a) *Guider and Enforcer of Ecosystem*

WorldLand Foundation serves as a guiding force, provoking collaboration, research, and responsible development within the WorldLand blockchain community. The foundation supports and engages with the WorldLand community. It provides resources, educational materials, and assistance to users, developers, and miners. The WorldLand Foundation participates in governance decisions. It collaborates with stakeholders to shape the network’s future through proposals, voting, and consensus.

4.1.5. LiberVance

a) *Value Contribution*

LiberVance has played a key role in launching the WorldLand mainnet as the engineering arm. The launch of the mainnet, WorldLand Seoul, was a critical milestone for the inception of WorldLand community.

LiberVance actively contributes to the development and maintenance of the WorldLand blockchains. It provides technical expertise, research, and innovation to enhance the ecosystem. LiberVance collaborates with other stakeholders, including developers, miners, and users. It conducts research, explores new technologies, and contributes to the growth of WorldLand.

LiberVance will continue to lead in research and development, pushing the frontier of blockchain and AI convergence. In the near future, My AI Network will operate on WorldLand Seoul, enabling global citizens to run their AI agents and earn income from them.

4.1.6. WorldLand DAO

Anyone can join the WorldLand DAO. Individuals can vote based on their ownership of WLCs. There are several ways to earn WLC, including mining, receiving RnD awards from WorldLand Foundation, and purchasing WLCs. WorldLand DAO welcomes project proposals from the community, which can encompass various areas of interest such as protocol upgrades, ecosystem improvements, or research initiatives [32].

The Articles of WorldLand DAO are periodically updated and enacted through community voting. These articles define the DAO's structure, governance rules, decision-making processes [1], and WLC Coinomics [33].

4.1.7. WorldLand dApp Developers

a) Value Contribution

WorldLand needs many dApp developers. Their contributions are crucial to drive innovation, enhance functionality, and wider adoption. We need to develop real-world daily use cases for end users. The worldwide adoption of WorldLand largely depends on the creativity of dApp developers.

They design and develop new applications by writing smart contracts, decentralized protocols, and user-friendly interfaces, enriching the ecosystem. Building useful dApps, developers attract users and investors, expanding the WorldLand ecosystem and making it more robust and appealing. The dApp developer community adds value by driving innovation, expanding the ecosystem, and enhancing user experiences. Their role is pivotal in shaping WorldLand's success.

WorldLand Foundation welcomes proposals from dApp developers.

4.2. WorldLand Coinomics

4.2.1. Minting and Halving Schedule

WorldLand WLC minting schedule is designed with principle of supporting the sustainable growth and expansion of the ecosystem.

The issuance of WLCs primarily falls under the responsibility of the researchers and engineers who launch and operate the mainnet on behalf of the WorldLand Foundation.

A total of 40,996,800 coins have been minted in the genesis block, which will be used for the growth of the ecosystem. This allocation is referred to as TMG (Total Minted at Genesis).

For miners, at every new block generation with an average 10-second interval, 4 WLC will be minted and distributed to the winning miner based on the WLC halving schedule.

4.2.2. Coin Minting Balance

For the next five years, the network supply of WLC coins to miners will be 40,996,800 coins, matching the number of WLCs issued in the genesis block (TMG). This balance between TMG and the total of mined WLCs is intentional, with the aim of maintaining decentralization of the network between the Foundation and the mining community.

4.2.3. Coin Halving Schedule

To maximize initial network effectiveness, WLC coins will be supplied to the network in four halving cycles, each lasting a 2-year period, over the course of eight years following the genesis block.

After the initial halving of 8 years, the coin supply will be limited to stable and predictable growth at an annual inflation rate of 4%. This inflation is set in the coin schedule to discourage coin HOARDING and encourage spending of WLCs for productive growth.

a) *Coin Burning*

The TMG WLCs can be burned based on decisions made by the DAO.

b) *TMG & Foundation*

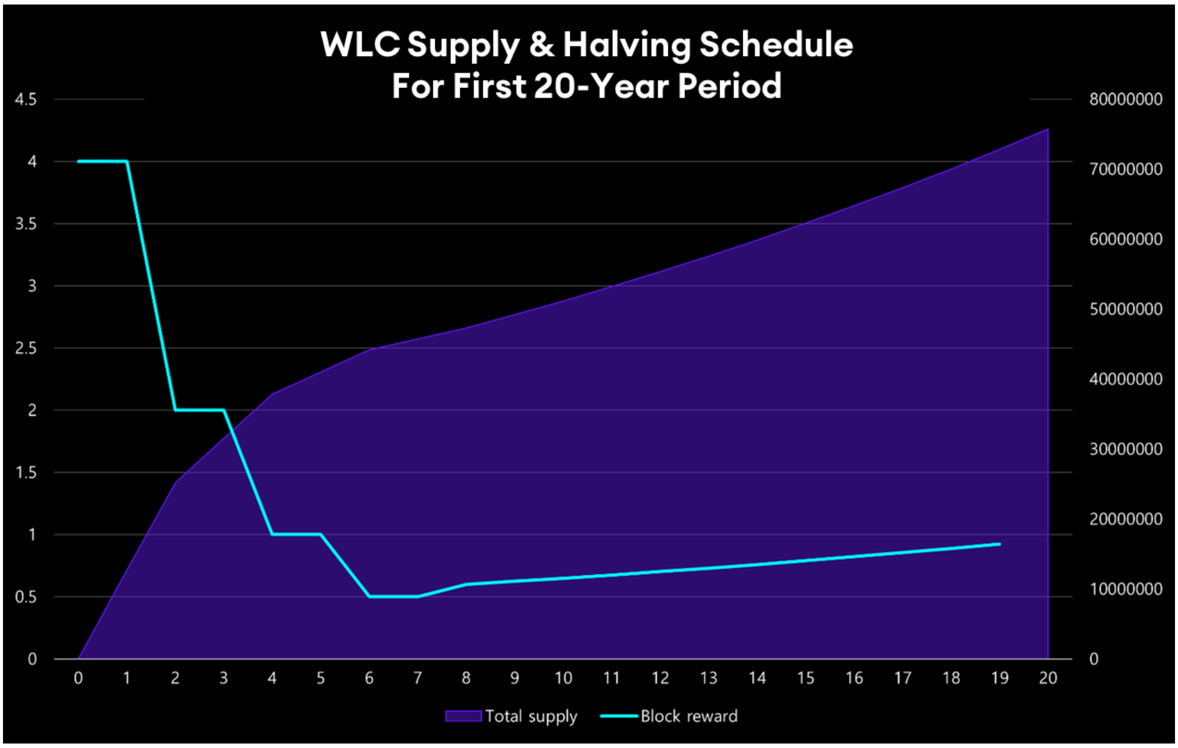


Figure 7 WLC supply & halving schedule for first 20-year period.

The WorldLand Foundation will play a role in the early stages but aims to gradually diversify its stake. The TMG allocation is justifiable due to of years of funding and R&D efforts by Professor Lee's research laboratory at GIST . The Foundation will oversee TMG distribution with voting decisions made by the DAO.

The TMG is initially divided into the long-term endowment (LTE) fund and the ecosystem development (ECO) fund, comprising 20% and 80% respectively of the total.

c) *LTE and ECO Funds Distribution Schedule*

The Foundation's LTE stake in the Genesis Block is 20%. 80% of the shares issued in the Genesis Block are ECO Funds. The ECO Fund will be used to expand the WorldLand ecosystem.

The main projects for ecosystem expansion include Wallets, NFT/Game, Voting/Bridge, My Al Network, Mainnet, Research, Education, and Investment.

The ECO fund will be used in the following proportions: 30%, 30%, 20%, 10%, and 10% per year for 5 years.

d) Decentralization of Foundation `

After five years, the foundation's LTE will be reduced to the 10% level, and this downsizing policy will further support a decentralized, community-driven ecosystem.

By implementing this coinomics, WorldLand aims to encourage new participation, ensure a stable coin supply, and generate a decentralized and sustainable development ecosystem for new dApps and participants on the platform.

Table 3 LTE and ECO fund distribution plan.

Published Plan							
LTE	8,199,360			8/8 - 11/7	11/8 - 2/7	2/8 - 5/7	5/8 - 8/7
ECO	32,797,440			Q1	Q2	Q3	Q4
2023 - 2024	YR 1	30%	9,839,232	2,459,808	2,459,808	2,459,808	2,459,808
2024 - 2025	YR 2	30%	9,839,232	2,459,808	2,459,808	2,459,808	2,459,808
2025 - 2026	YR 3	20%	6,559,488	1,639,872	1,639,872	1,639,872	1,639,872
2026 - 2027	YR 4	10%	3,279,744	819,936	819,936	819,936	819,936
2027 - 2028	YR 5	10%	3,279,744	819,936	819,936	819,936	819,936

TMG will be first broken down into LTE fund and ECO fund, and then ECO fund is further divided into yearly ecosystem development allocations.

4.3. Charter and Governance

The WorldLand Charter is a document that aims to promote fundamental human rights, equality, and peace. It also encourages the use of digital technologies to promote economic and social advancement.

4.3.1. Charter of WorldLand

WE THE PEOPLES OF The WorldLand aim:

- to uphold faith in fundamental human rights, believe in the dignity and worth of the human person, promote equal rights of men and women, of nations large and small,
- to facilitate social progress and better standards of life in larger freedom,
- to live together in peace with one another as good neighbors,
- to unite our strength to maintain international peace and security, and
- to employ digital technologies such as Al and Blockchain for the promotion of the economic and social advancement of all peoples.

HAVE RESOLVED TO ACCOMPLISH THESE AIMS via a global digital network to be known as WorldLand.

4.3.2. WorldLand Governance

WorldLand's governance design principles focus on legal compliance, transparency, decentralization, and scalability. Here are the key principles:

1. Legal Basis: WorldLand aims to follow regulatory procedures and adhere to the laws of sovereign countries with well-established crypto-related systems, ensuring institutional transparency. In the future, it may establish legal entities, such as DAO LLC, in jurisdictions that recognize DAO as an economic entity.

2. Transparency of Asset Execution: WorldLand emphasizes transparency, decentralization, and sustainability in asset execution, ensuring that decisions are made with the consent of various stakeholders.

3. Securing Decentralization through WorldLand DAO: WorldLand utilizes the concept of a decentralized autonomous organization (DAO) to govern the project. Asset execution and major decisions for project development are determined through voting, following the method programmed in the DAO Smart Contract. WorldLand DAO functions as a non- profit organization involved in the project,

attracting, and managing global investment proceeds through a smart contract on the Ethereum platform.

4. Ecosystem Support: The foundation supports developers and provides resources for the continuous improvement of the WorldLand project and ecosystem.

5. Usability: Governance processes are designed to be clear, easily understandable, and accessible to all stakeholders. Mechanisms for active participation and voting are made simple and intuitive to encourage engagement. The governance system aims to be efficient and effective, enabling timely decision-making and implementation.

6. Scalability: The governance framework of WorldLand is designed to scale as the platform grows in scope, complexity, and stakeholder diversity. It can adapt to accommodate an increasing number of participants and evolving requirements.

7. Decentralization: WorldLand's governance ensures the participation of all stakeholders in decision-making processes. The foundation plans to gradually reduce its coin holding rate over time, aiming to decrease it to 17% or less after five years, thus avoiding concentration of power and promoting decentralization.

By adhering to these governance design principles, WorldLand aims to establish a robust, transparent, and inclusive governance structure that promotes community participation, sustainability, and the long-term success of the platform.

Chapter V.

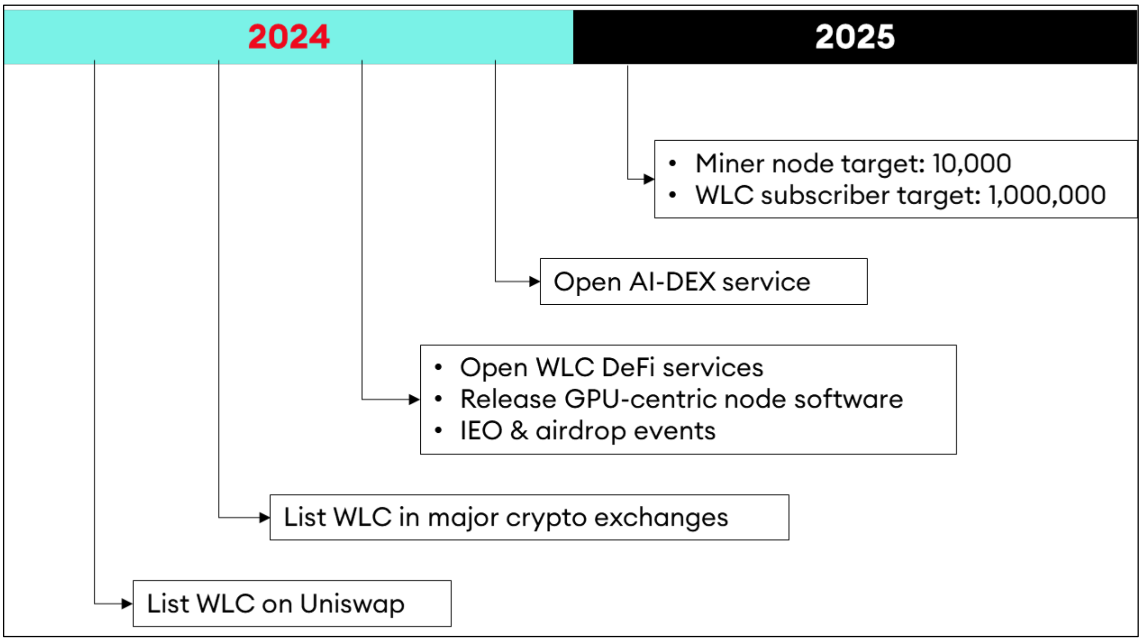
Roadmap

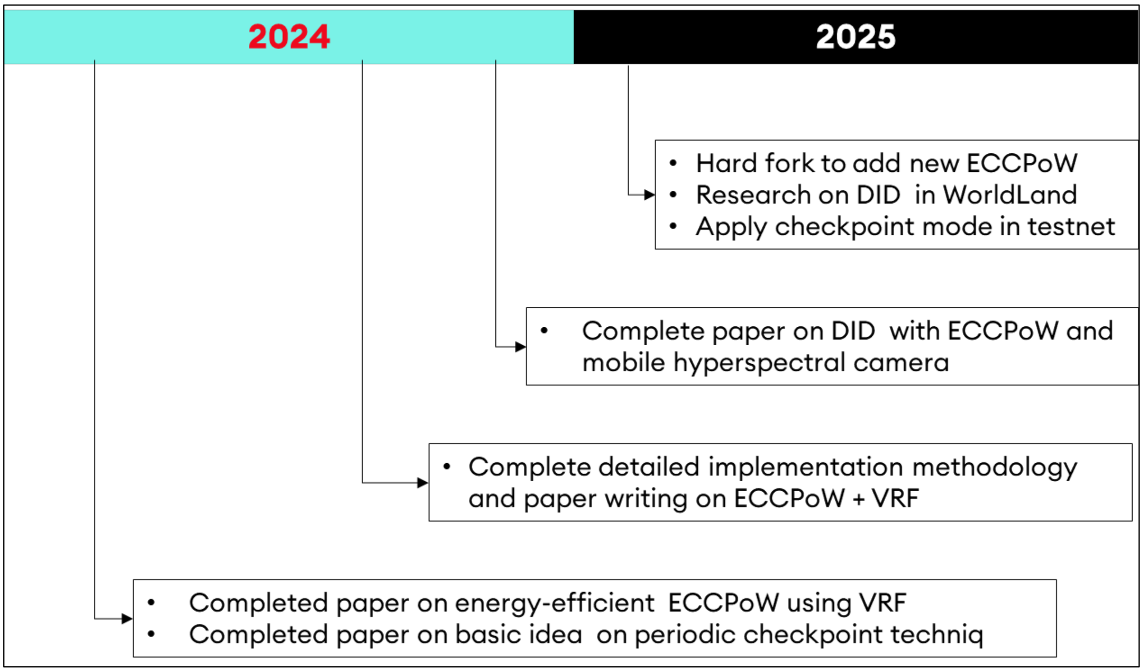
In this chapter, the future plan of WorldLand for the next two-year period is given. We declare that this roadmap depends on funding availability and thus may change without notice. The roadmap is illustrated in five categories:

1. WorldLand Marketing & Business,
2. ECCPoW, Checkpoint & DID,
3. Post-Quantum Cryptography,
4. Spectrometer with ZKP & DID, and
5. AI-DEX & Bridge.

5.1. WorldLand Marketing & Business

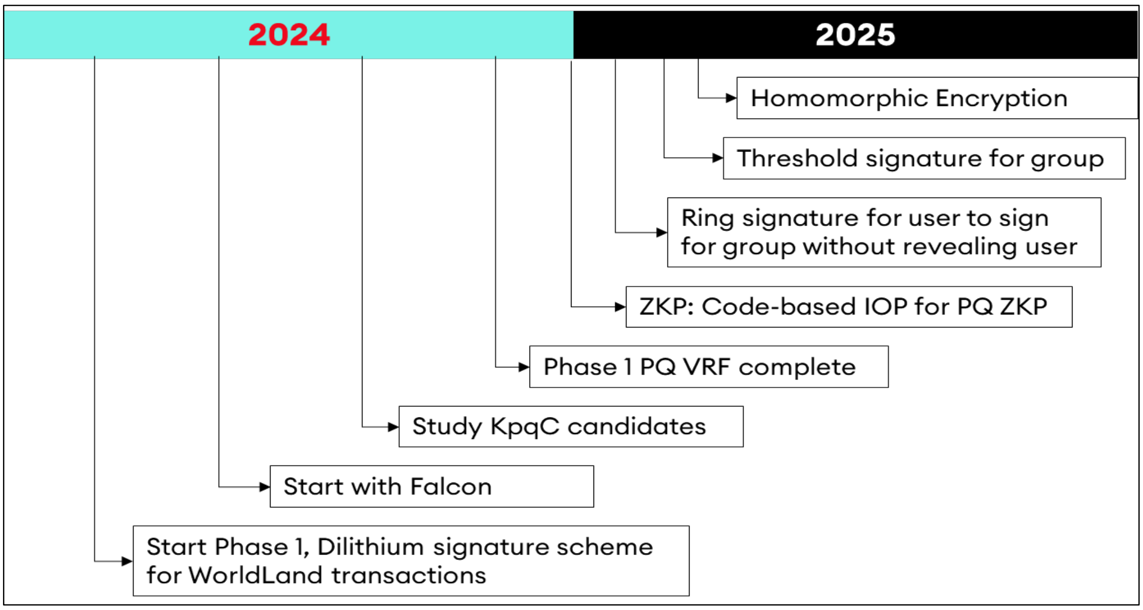
5.2. ECCPoW, Checkpoint & DID

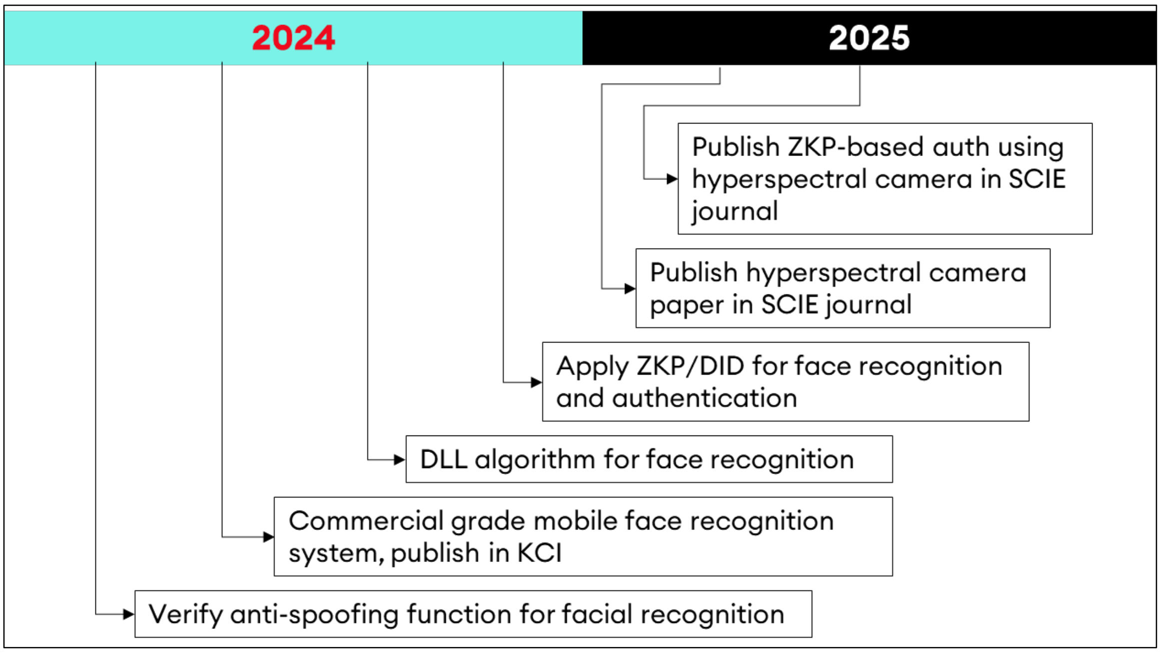




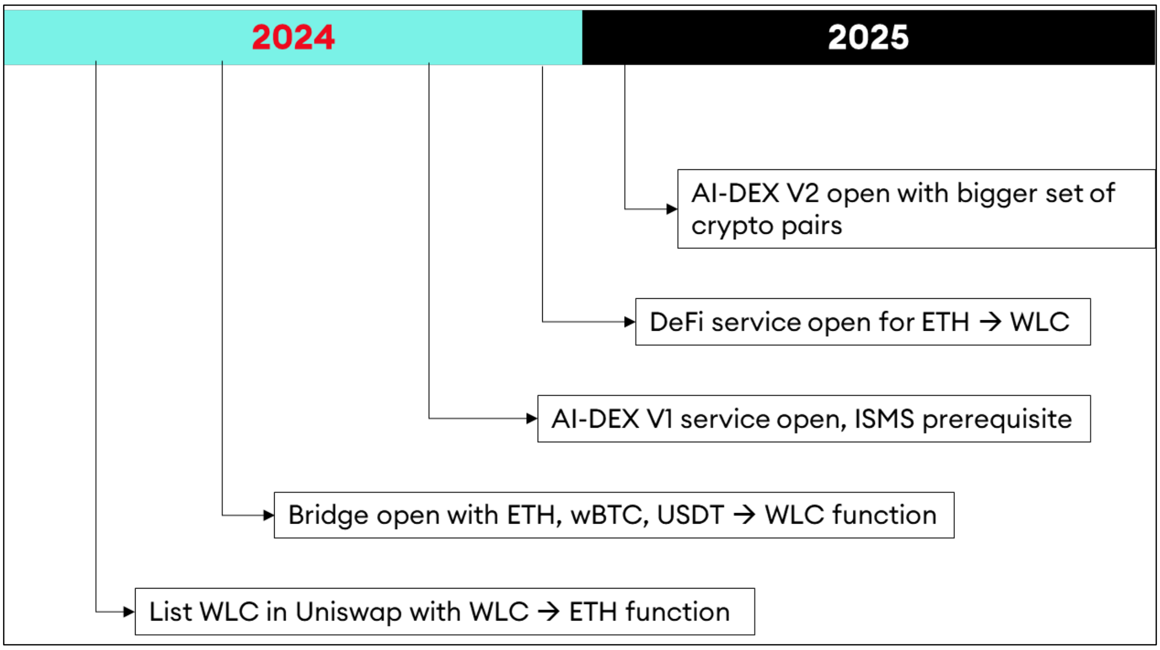
5.3. Post-Quantum Cryptography

5.4. Spectrometer with ZKP & DID





5.5. AI-DEX & Bridge



Chapter VI.

LiberVance Team

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CEO of LiberVance, Co. Ltd.
Director of the ITRC Blockchain Intelligence Convergence Center (Ministry of Science and ICT)
Former Full Professor, the University of Pittsburgh, PA, USA
Former Specialist Committee Member of the Presidential Committee for Policy Planning

Published over 300 domestic and international research papers and hold 60 patents
Associate Editor of IEEE Transactions on Cybernetics (a top 4% SCI Journal) and serves on the editorial boards of several international journals
Recipient of the Haedong Academic Award (2019)
Recipient of the GIST Research Award and Distinguished Technology Award (3 times)
National Research Foundation's Scientist of the Month Award (January 2014)
Recipient of the Prime Minister's Commendation (April 2022)

CTO Young-Sik Kim
Professor at DGIST
Former Professor at Chosun University
Former Senior Researcher at Samsung Electronics:
Ph.D. degree from Seoul National University

Expert in Cryptography, Homomorphic Encryption, and AI Security
IEEE Globcom2022 SAC Cloud, Technical Program Committee Member: Contributing to the technical program committee for IEEE Globecom 2022, specifically in cloud computing.
Published Research on Homomorphic Encryption in EUROCRYPT 2022/2021 and Other Domestic and International Journals: Has authored over 160 research papers related to homomorphic encryption.

Chapter VII

Disclaimer

Carefully read this disclaimer section in its entirety. Before engaging in any activity related to this report, you should consult your own legal, financial, business, investment, tax, or other professional advisors, since nothing in this report constitutes legal, financial, investment, or tax advice.

The WorldLand Foundation (the Foundation), in collaboration with project participants and the blockchain ecosystem, shall not be liable for any direct or indirect damage or loss suffered by you due to of working on the blockchain platform, developing the blockchain platform, distributing or vending tokens, or any service provider associated with the blockchain.

7.1. Considerations Regarding Cryptocurrencies

Numerous jurisdictions have yet to resolve the regulatory regulation of crypto products, which can be extremely hazardous. There might be no regulatory recourse for losses incurred because of WorldLand Coin (WLC) transactions. Any value assigned to WLC is susceptible to rapid change and complete loss. Moreover, the experimental nature of the technologies that comprise the WorldLand Platform, including the WLC, is evident. Predictability regarding the network's operation is not assured.

For additional details, please visit https://worldland.foundation. It is your responsibility to abide by all applicable laws which may prohibit the possession, purchase, or sale of WLC in your jurisdiction.

7.2. Forward-Looking Statements in This Report

This report contains forward-looking estimates and statements regarding the intended actions and objectives of the WorldLand Foundation and the WorldLand Ecosystem, as further described below.

These estimates and statements are largely based on current expectations and projections regarding the outcome of uncertain future events. These factors have the potential to significantly alter the actual results from what is explicitly stated or implied in this report.

It is advised that readers avoid placing excessive trust in these forward-looking estimates and statements. The contents of this report are only current as of the specified date.

7.3. Representations and Considered Warranties

You shall be deemed to represent and warrant the following to the Foundation, the Distributor, their respective affiliates, and the WorldLand Ecosystem by accessing this report or the Website (or any portion thereof):

- in any decision to receive and/or purchase any WLC, you shall not rely on any statement set out in this report or the Website;

- you will and shall at your own expense ensure compliance with all laws, regulatory requirements and restrictions applicable to you (as the case may be); you acknowledge, understand and agree that WLC may have no value, there is no guarantee or representation of value or liquidity for WLC, and WLC is not an investment product including for any speculative investment;

- WLCs may not always be transferable or liquid;

- WLC may not be exchangeable against any goods or services contemplated in this report, especially in case of failure or discontinuation of the project;

- none of the Foundation, the Distributor, their respective affiliates, and/or the WorldLand Ecosystem members shall be responsible for or liable for the value of WLC, the transferability and/or liquidity of WLC and/or the availability of any market for WLC through third parties or otherwise; and

- you acknowledge and understand and agree that you are not eligible to purchase any WLC if you are a citizen, national, resident (tax or otherwise), domiciliary and/or green card holder of a geographic area or country where it is likely that the sale of WLC would be construed as the sale of a security, financial service, or investment product and/or where participation in token sales is prohibited by applicable law, decree, regulation, treaty, or administrative act; and to this effect you agree to provide all such identity verification document when requested for the relevant checks to be carried out.

Regarding any entity or individual, the Foundation disclaims all representations, warranties, or commitments (including, but not limited to, warranties regarding the accuracy, completeness, timeliness, or dependability of the information contained in this report, the Website, or any other materials published by the Foundation or the Distributor).

The Foundation, the Distributor, their respective affiliates, and service providers shall not be liable, to the extent permitted by law, for any indirect, special, incidental, consequential, or other losses of any kind resulting from the use of this report or its distribution, whether in tort, contract, or otherwise (including, without limitation, any liability arising from default or negligence on their part, or any loss of revenue, income, or profits, and loss of use or data).

All risks and uncertainties (including financial and legal risks and uncertainties) associated with the WLC sale, the Foundation, the Distributor, and the WorldLand Ecosystem should be thoroughly considered and evaluated by prospective buyers.

7.4. This Report is Not a Prospectus

You agree and acknowledge that this report does not constitute a prospectus or offer document of any sort and is not intended to constitute an offer of securities in any jurisdiction or a solicitation for investment in securities and you are not bound to enter any contract or binding legal commitment and no cryptocurrency or other form of payment is to be accepted based on this report.

You agree and acknowledge that this report, the undertaking and/or the completion of the WLC sale, or future trading of WLC on any cryptocurrency exchange, shall not be construed, interpreted, or deemed by you as an indication of the merits of the WorldLand Foundation and WLC.

7.5. WLC is Not Security

You agree and acknowledge that in the case where you wish to purchase any WLC, WLC is not to be construed, interpreted, classified, or treated as:

- any kind of currency other than cryptocurrency;
- debentures, stocks or shares issued by any person or any entity;
- rights, options, or derivatives in respect of such debentures, stocks, or shares; or
- any other security or class of securities.

If any of such risks and uncertainties develop into actual events, the business, financial condition, results of operations and prospects of WorldLand Foundation could be materially and adversely affected. In such cases, you may lose all or part of the value of WLC.

Relevant Publication of Team Members

[R1] Heung-No Lee, Young-Sik Kim, Dilbag Singh, and Manjit Kaur, "Green Bitcoin: Global Sound Money," The Journal of Digital Assets," Vol.1, No. 1, pg. 33-47, Oct. 2022, https://doi.org/10.48550/arXiv.2212.13986.

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