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# Accion INNOVATION SUMMIT 2023

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# The Evolution of Smart Contracts
# - Interoperability and Scalability for Decentralized Systems

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## CoE Head - Blockchain and dApps

Software architect with extensive experience in blockchain, decentralized apps, DeFi, and distributed systems.

Passionate about creating innovative and decentralized solutions that provide more autonomy and control to end-users.

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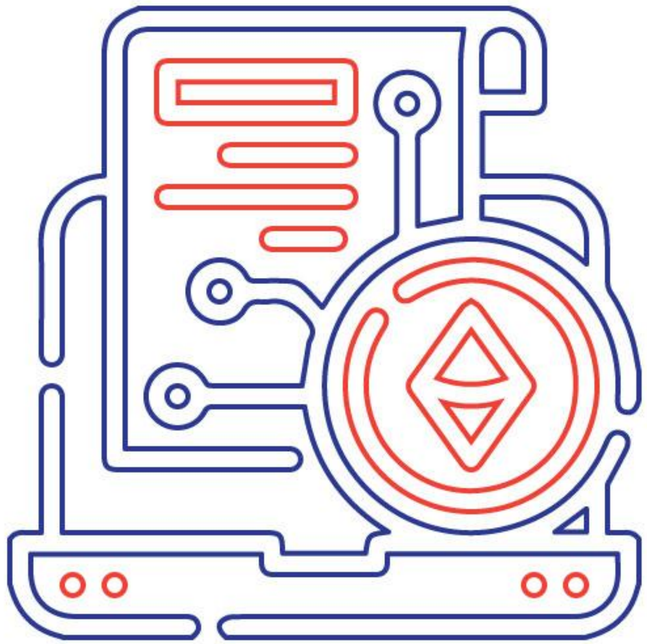
# Introduction



# Smart Contracts

**A self-executing computer program stored and executed in the blockchain.**

# Introduction

- **Smart Contract - A Definition**
  - Smart contract is a computer program stored in the blockchain that is intended to automatically execute, control or document events and actions according to the terms of a contract written in the program.
- **Smart Contracts v/s Cloud Native Applications**
  - Unlike a traditional cloud based software application that requires intermediaries to manage the contract, smart contracts execution is guaranteed by the decentralized consensus algorithm with no third party intervention.
- **Problem Definition for Smart Contracts**
  - The key issues smart contracts can help is to provide transparency, solve third party trust issues, increased efficiency, cost reduction, and automation.
  - Smart contracts can solve a variety of problems in various industries such as finance, supply chain management, and real estate.
- **Ethereum & Solidarity**
  - Ethereum Smart contracts written in Solidity pearce various industries such as supply chain, real estate, and insurance.

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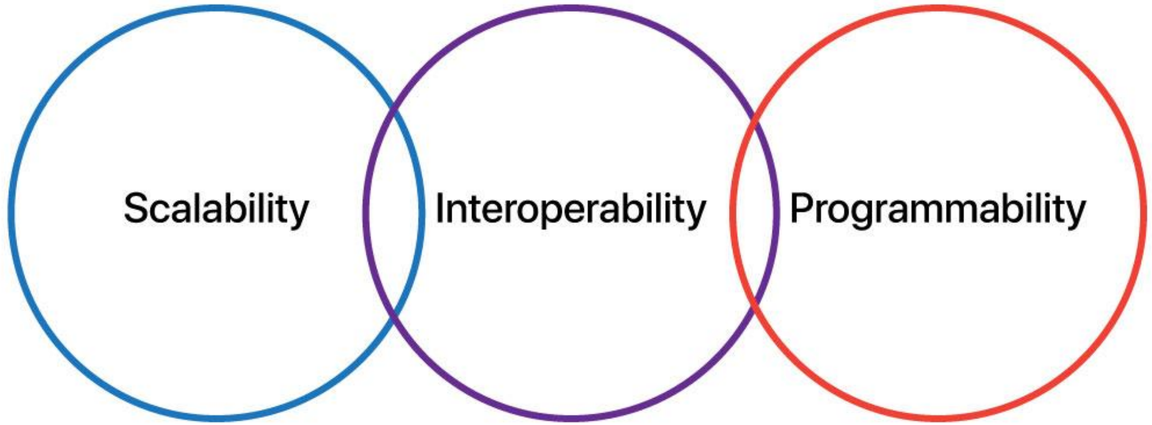
# Problem definition

# Problem Areas in Smart Contract Platforms

- **The Consensus Algorithm**
  - Consensus algorithm such as Proof of work or POW became a bottleneck in the rapidly growing blockchain industry. These consensus algorithms cannot handle the transactions demand resulting in slow transaction and high transaction fees.
- **Peer to Peer Network Growth**
  - Tremendous growth in the peer to peer network resulted in the slower transaction and response time because entire network and chain has be to updated and propagation takes time as every peer differs in the latency, bandwidth and network strength.
- **Lack of Standardization and Data Silos**
  - Each blockchain platform operates in isolation resulting in creating data silos limiting their potential. Blockchain platforms lack standardization and compatibility. Thus, Interoperability between blockchain networks is one of the key problem area.
- **Malicious code detection**
  - Code security is one of the key challenge in the smart contract platform. Smart contracts are self executing code and malicious code results in serious issues such as loss of funds and theft.

# Key Problem Areas

- Scalability, Interoperability, and Programmability remains the key problems in the smart contract platforms.
- Web3 ecosystem increased exponentially in the past and platforms such as Ethereum, EOS, TRON were not able to cope up with this demand.
- Web3 ecosystem is also diverse and scattered across various domains such as finance, gaming, and metaverse.
- Due to this diverse nature of domains, different blockchain platforms are built and optimized for specific domain.
- As there is no single blockchain solution that can provide solutions for all areas, the need for **interoperability** between different blockchain platforms has become essential and is in high demand.
- Platforms should support wide range of programming languages that can be executed in different platforms.



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# Conventional Solutions

# Conventional Solutions

- **Increasing block size**
  - Increasing the size of the block can help to increase the number of transactions processed by the network per second.However, this can lead to larger blocks, which can result in longer validation times and increased storage requirements.
- **Off chain or Sidechains**
  - Sidechains or off-chains enables a large number of transactions to be processed off the main blockchain, reducing the load on the main chain. However, this can lead to reduced security and decentralization.
- **Data Sharding**
  - Sharding the data into smallest unit for performance and security is widely popular and used across various domain. Sharding can be used in the decentralized network to make it more efficient. However, this is complex and requires extreme coordination between shards.
- **Interoperability standards and protocol**
  - Interoperability and communication protocols such as RPC can help in great deal to scale and integrate the network of different standards together and bring a uniformity in the exchange of data.
- **“Write once run anywhere”**
  - Standardization of smart contract programming languages such as JVM can bring in more developers to web3 space increasing the standards and interoperability between chains.

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# Scalability Challenges

# Scalability Challenges in Decentralized System(s)

- **Network Latency**
  - Transactions in decentralized systems require consensus from multiple nodes, which can lead to longer confirmation times and slower transaction processing.
- **Limited Throughput**
  - Decentralized networks have a limited capacity for the number of transactions that can be processed per second, which can result in slow confirmation times during periods of high network usage.
- **Gas Fees**
  - As the network becomes congested, the cost of executing smart contracts (in the form of gas fees) can become prohibitively expensive, making the platform less accessible for small transactions.
- **Resource Intensity**
  - Decentralized systems often require high computational power and storage resources, which can be a barrier to scalability.
- **Scalability Bottlenecks**
  - Some smart contract platforms may be limited by scalability bottlenecks in their underlying infrastructure, such as the number of nodes that can participate in the network.

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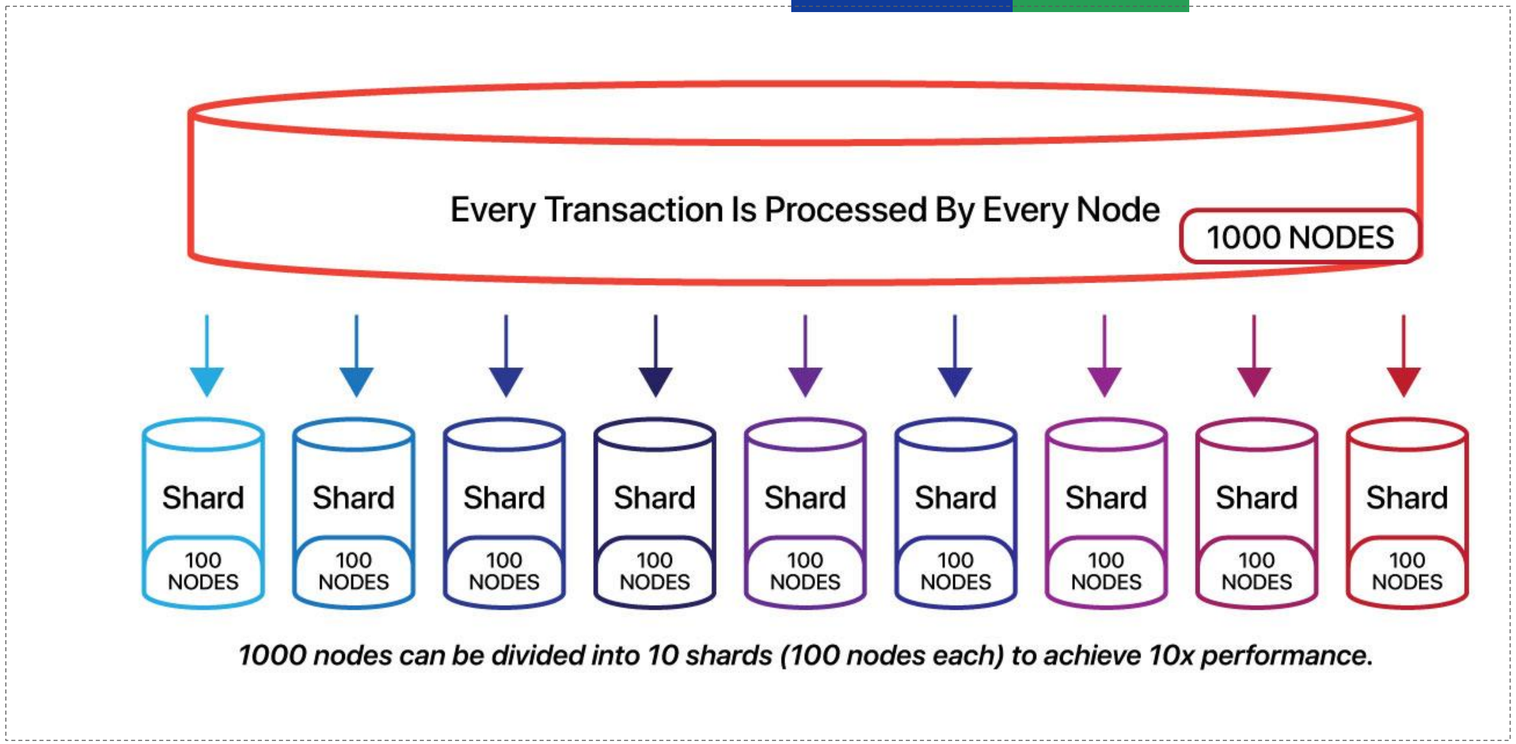
# Innovation Approach

# Scalability Techniques and Approaches

- **Network Sharding**
  - A sharding solution would divide the network into smaller sub-networks, allowing each sub-network to process transactions in parallel, improving overall throughput.
- **Layer 2 Scaling Solutions**
  - This involves adding a layer on top of the main blockchain network to handle a larger volume of transactions, such as state channels and plasma.
- **Lightning Network**
  - Lightning Network is a layer-two payment protocol built on top of the Bitcoin blockchain enabling off-chain payments without broadcasting every transaction to the network.
- **Optimizing Consensus Algorithms**
  - This involves improving the existing consensus algorithms or developing new ones that are more efficient and scalable.
- **Hybrid Systems**
  - Combining centralized and decentralized systems to take advantage of the strengths of both, thereby improving scalability and security, for example cryptocurrency exchange.
- **Interoperability**
  - Developing protocols and standards for decentralized systems to exchange information and assets, enabling them to work together seamlessly.

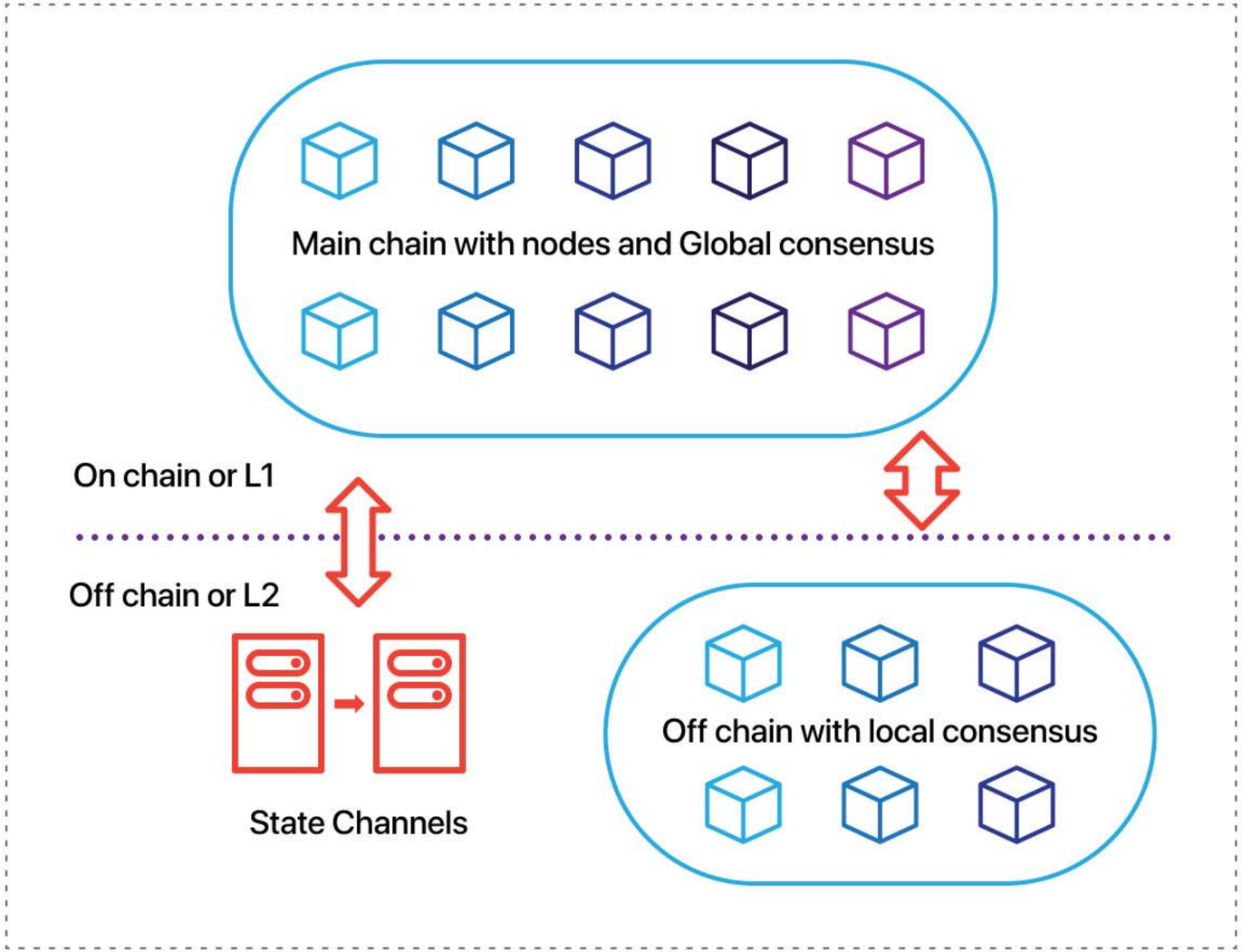
# Network Sharding

- Entire network is divided into smaller groups of nodes called "shards."
- Each shard is responsible for processing a subset of the overall network's transactions.
- This results in higher throughput of transactions per second and reduces the computational load on individual nodes.



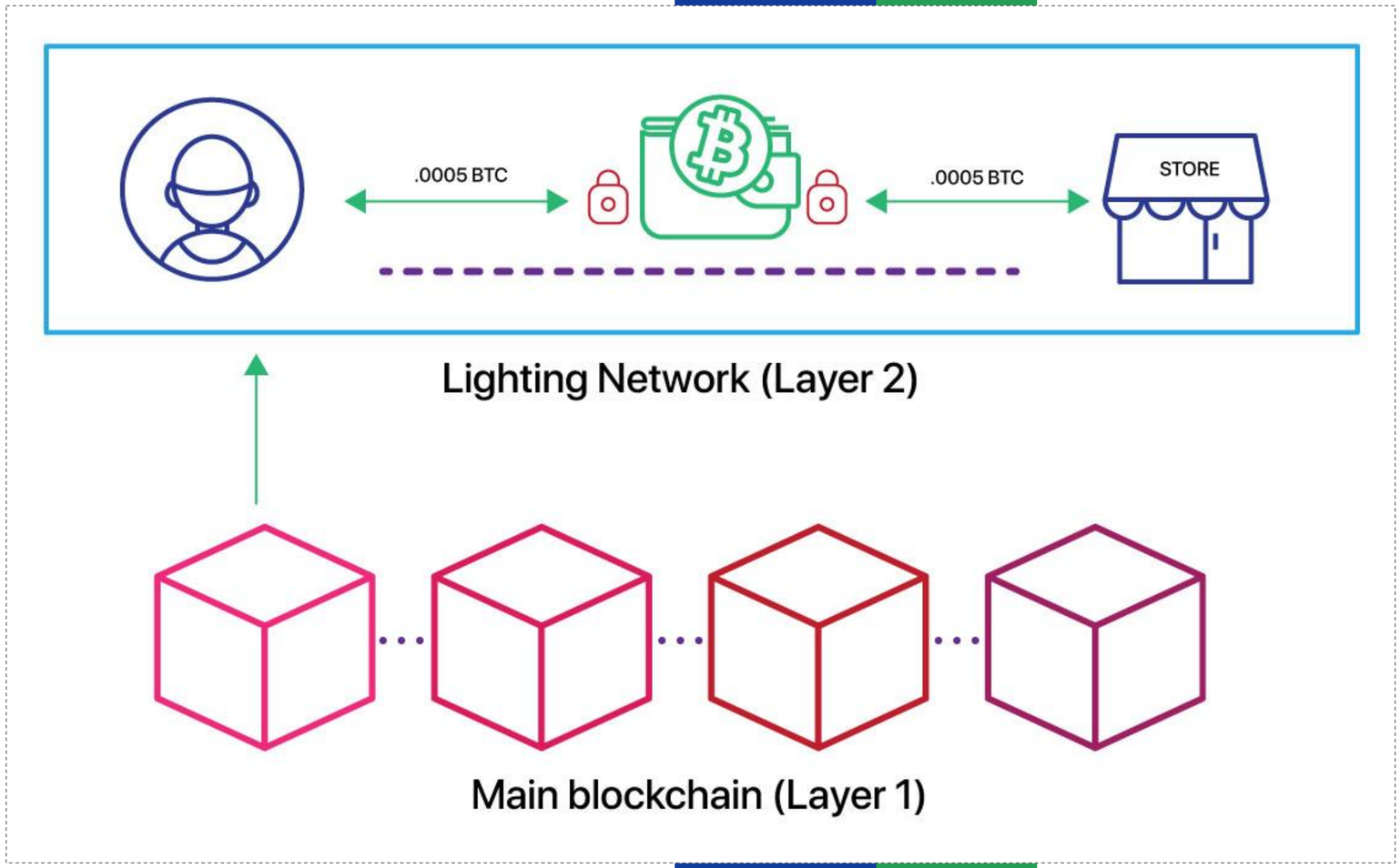
# Layer 2 Solutions

- Layer 2 off chain with local consensus.
- State channels.
- Sidechains.
- Plasma framework.



# Lightning Network

- Layer 2 off chain
- Payment channels between payment entities to perform transactions.
- Reduces network congestion by only recording final balance transactions to prevent double spending.



# Use Cases

- **Payments and Microtransactions**
  - Decentralized payment networks can handle a large number of transactions per second, making them suitable for micropayments and other low-value transactions.
- **Supply Chain Management**
  - Decentralized systems can be used to track the origin, movement, and destination of goods in a supply chain, reducing the time and costs associated with traditional supply chain management.
- **Digital Identity**
  - Decentralized systems can provide secure and scalable digital identity solutions, enabling individuals to control and manage their personal information.
- **Decentralized Finance (DeFi)**
  - Decentralized finance applications such as exchanges, lending platforms, and stablecoins can benefit from scalability to handle the large volume of transactions in the DeFi ecosystem.
- **Gaming**
  - Decentralized gaming platforms can use scalability solutions to handle large numbers of players and transactions, enabling fast and secure gaming experiences.
- **Data Management**
  - Decentralized systems can be used to store and manage large amounts of data, such as medical records, in a secure and scalable manner.
- **Decentralized Autonomous Organizations (DAOs)**
  - Decentralized autonomous organizations can use scalability solutions to handle a large number of members, votes, and transactions in a secure and transparent manner.

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# Interoperability

# Smart Contract Interoperability

- **Interoperability**
  - The key problem to address in order to scale a blockchain and smart contract solution.
- **Data exchange**
  - Smart contract platforms can collaborate and communicate with each other and share data with each other and that helps in building a robust solution.
- **3rd Party Integration**
  - Integration with third party solutions also becomes seamless using interoperability smart contracts.
- **Interoperability can be achieved by the following techniques:**
  - Cross chain atomic swaps without intermediaries
  - Hubs and Relays communication network
- **Robust Systems**
  - Interoperability can also promote greater innovation by enabling developers to build decentralized applications that can connect to multiple blockchain networks, leveraging the strengths of each network to create new solutions.

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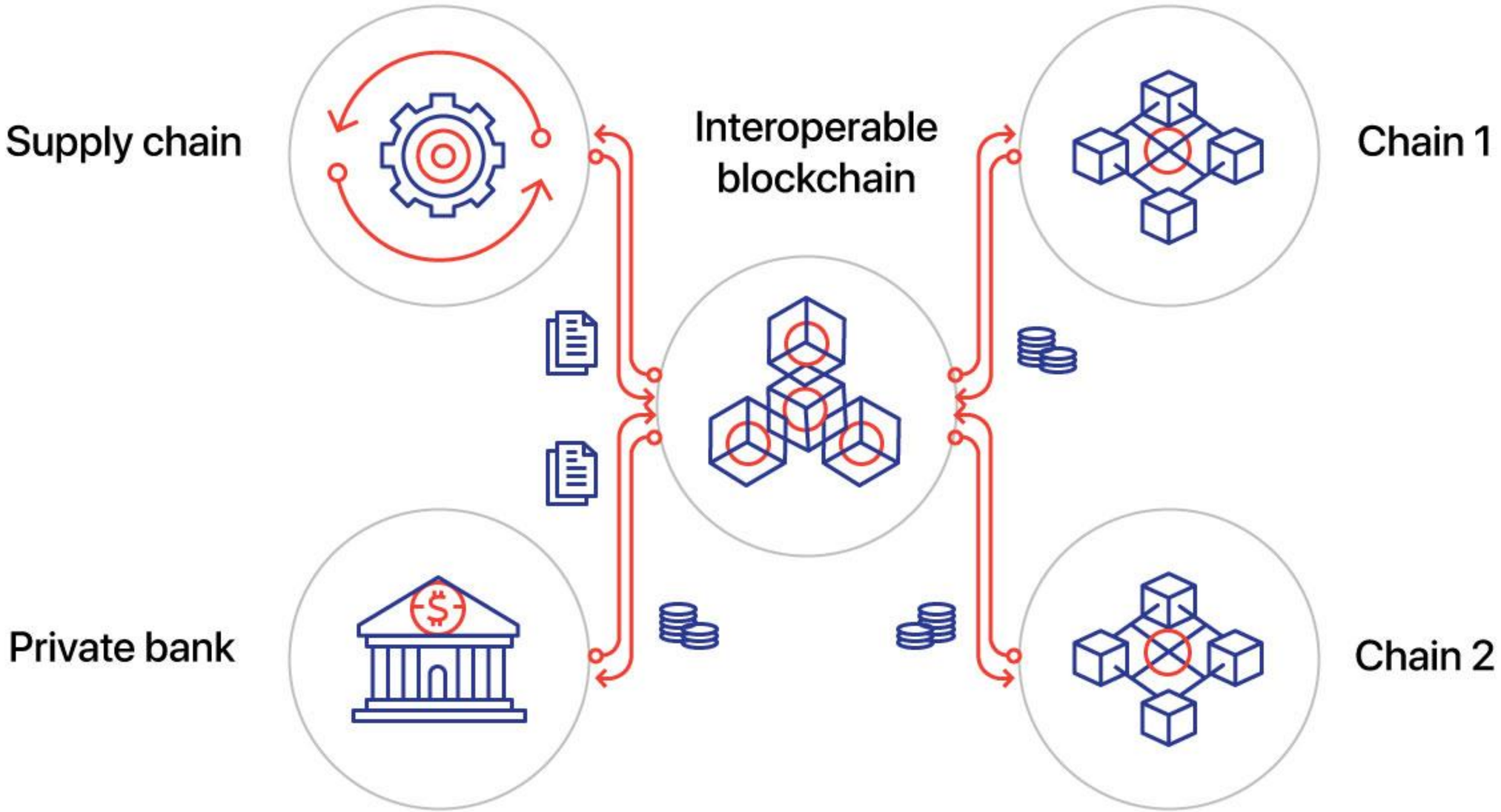
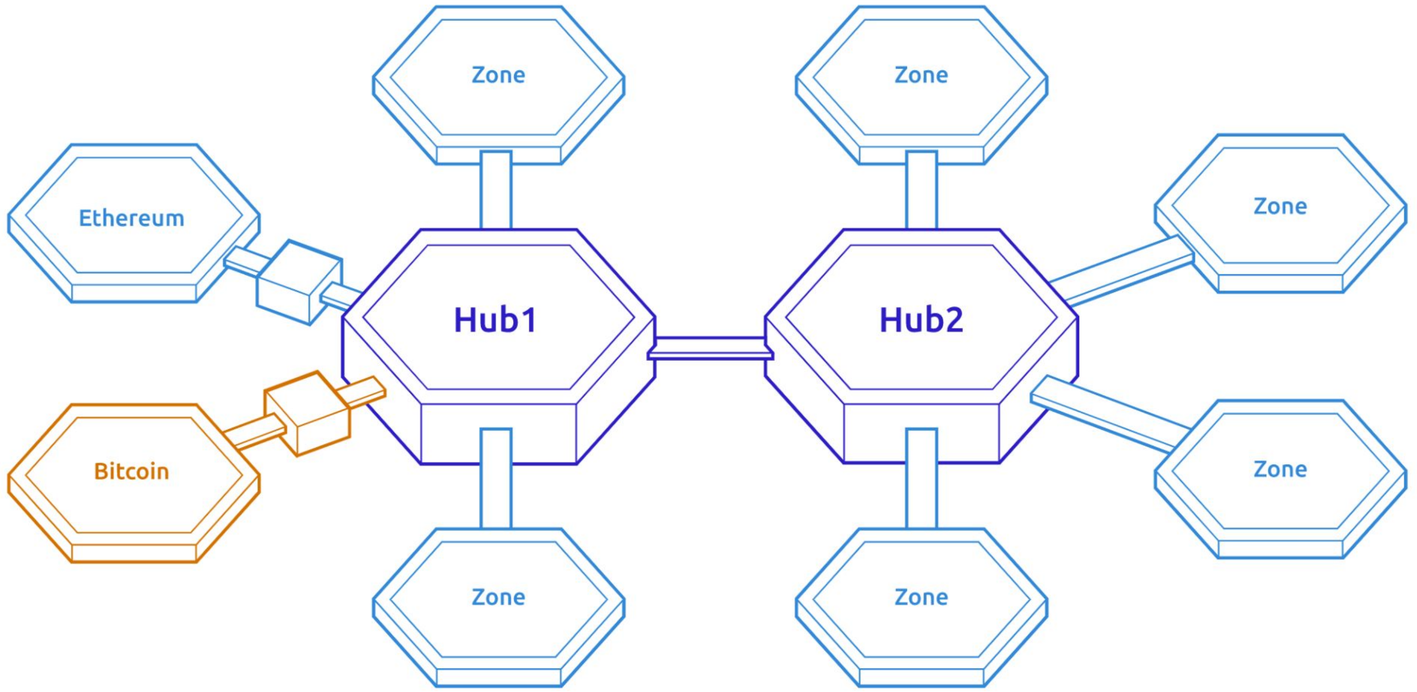

Supply chain
Interoperable blockchain
Chain 1
Private bank
Chain 2

# Cross Chain Atomic Swaps

- **Cross chain Atomic Swaps**
  - Enables smart contract platform to transfer assets between two parties without intermediaries.
- **Atomic transactions**
  - Atomic swaps ensures that the all the parties involved in the trade fulfills all predefined conditions before the trade can be completed.
- **Hashed Timelock Contract**
  - HTLC uses hashed function and timelock to ensure that the both the parties fulfills the transaction in a specified time period.
  - HTLC minimizes the risk of using centralized exchanges for asset transfer and ensure secures and decentralized way of asset transfer between chains.

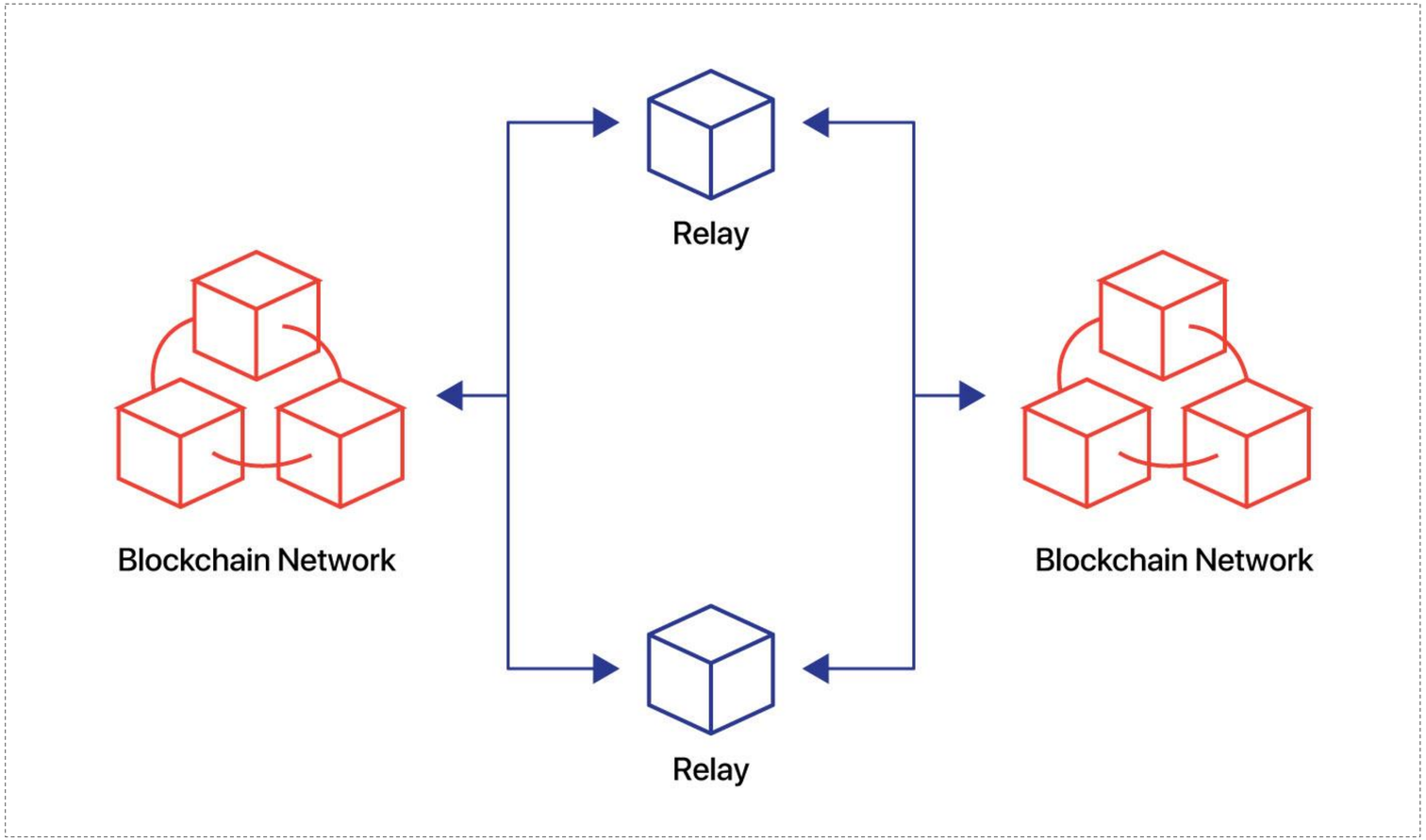
# Hubs

- Hub acts as a central point of communication between blockchain networks.
- Hubs achieve this through the use of smart contracts, which hold the assets on one blockchain while issuing tokens on another blockchain to represent those assets.
- Hub acts as a **central** point of communication between different blockchain network.



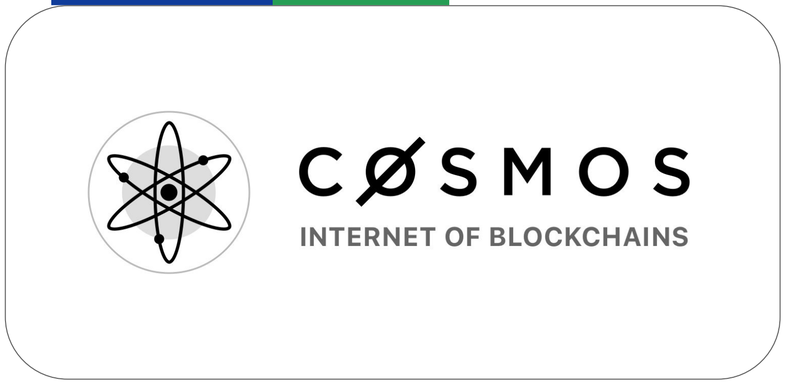
# Relays

- Relay is a bridge that connects two or more blockchain networks.
- Relays is a decentralized node.
- A relay establishes direct connections between blockchain networks and facilitates the transfer of assets and data between them.



# Platforms supporting Interoperability

- Avalanche
- Cosmos
- Polkadot
- Chainlink
- Gno.land (In development)



# Use Cases

| | | |
|---|---|---|
| Cross-chain token transfer | Decentralized finance Ecosystem | Supply chain management |
| Secure data exchange | Decentralized Identity Verification | Connecting Web2.0 System To Decentralized network |

# Programmability

- **Solidity**
  - Solidity is the first turing complete programming language designed for Ethereum smart contract platforms.
  - Blockchain platforms must support EVM in order to enable smart contract functionality.
  - Solidity is limited to the scope of Ethereum blockchain and does not support general purpose programming paradigms.
- **Cross Language Support**
  - This limits the pool of developers to join the Web3 space who are seasoned in general purpose programming languages such as C++, Python, and JavaScript.
  - Smart contract platforms must provide support to these languages to enable cross language developer experience.
  - GoLang is becoming the primary candidate to help execute smart contracts in different platforms with the support of virtual machines similar to JVM.

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## Summary

- Smart contract evolution and the key problem areas
- Conventional approaches to tackle the problems.
- Innovative decentralized approach to solve the problems.
- Use cases and application areas.

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**Thank you!**

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