BINANCE RESEARCH

Interoperability Solutions: Connecting Worlds

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Key Takeaways

- The existence of numerous L1s has contributed to the fragmentation of liquidity and siloed ecosystems. For the multi-chain thesis to play out, interoperability between protocols needs to improve.

- There are generally three different approaches to interoperability - middle chains; light nodes; and ultra light nodes.

- Middle chains act as the intermediary between two chains, facilitating cross-chain messages by providing consensus and validation services. The drawback is the inherent security risk associated with relying on an individual party that has full signing authority to all messages.

- Unlike full nodes that contain the entirety of blockchain data, light nodes store only parts of the ledger's transaction history and facilitate cross-chain communications by participating in the verification of block headers (which contains a summary of contents in the block). We examined the Inter-Blockchain Communication ("IBC") Protocol and Cosmos.

- Similar to light nodes, ultra light nodes perform validation. However, instead of storing all block headers in order, these are streamed on-demand by oracles. Oracles and relayers are relied upon to transfer messages between on-chain endpoints. We used LayerZero and Stargate as case studies in this report.

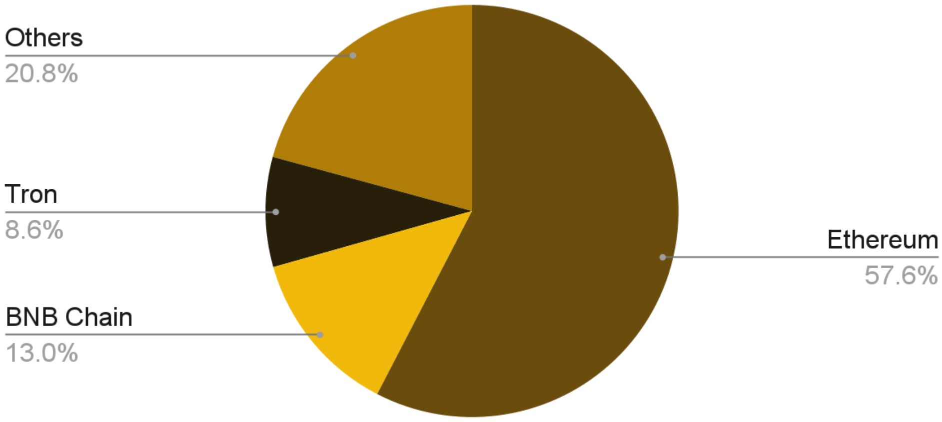
- The development of generic messaging protocols is key to true cross-chain interoperability and is essential for the long-term growth of a multi-chain ecosystem. Considering the nascency of technology and the risks associated with each solution, developers need to be aware of the trade-offs and take deliberate steps to mitigate risks to users.

A Multi-Chain World

The proliferation of alternative layer 1 ("L1") blockchains over the past few years has contributed to opposing thoughts about the future of crypto and specifically, how the L1 landscape will look. On the one hand, some believe that the future is likely to be a "winner takes all" scenario with a single or a small handful of L1s facilitating the bulk of crypto activity. On the other hand, another school of thought is that the future of crypto will be multi-chain - users will utilize a combination of different chains depending on their needs and the utility of different chains.

To put things into perspective, there are currently more than 230 L1 blockchains.[1] However, **despite the vast number of L1s, the crypto market today is largely dominated by a small handful of L1s** when considering metrics like total value locked ("TVL") or market capitalization.

Figure 1: Top 3 blockchains have more than 79% of DeFi TVL



Source: DeFi Llama, Binance Research. Data as of 17 Nov 2022.

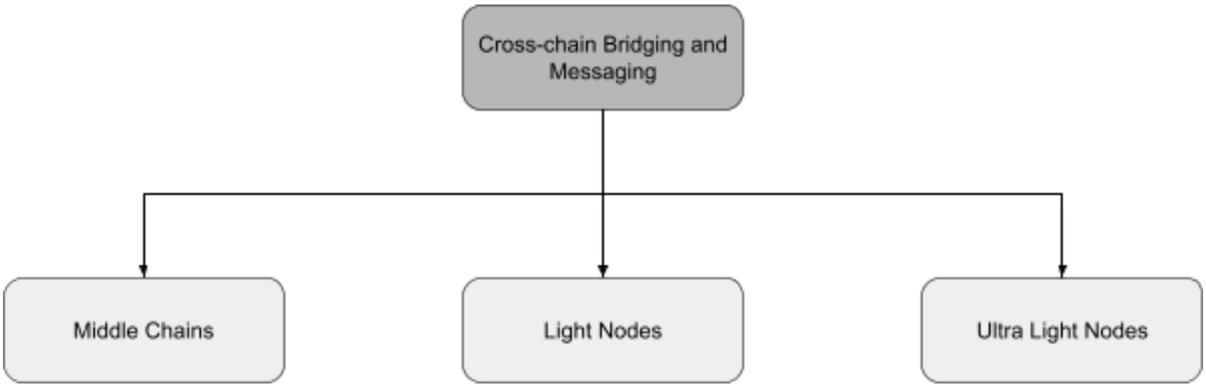
Even if the future does indeed turn out to be multi-chain, the present is far from that. The existence of numerous L1s has contributed to the fragmentation of liquidity and siloed ecosystems. **For the multi-chain thesis to play out, interoperability between protocols needs to improve.** Besides making it easier for users to seamlessly transfer assets and navigate across chains, better interoperability is essential for unified liquidity and for harnessing the synergies of composability.

In this report, we will explore the common interoperability solutions in the market today.

General Approaches to Interoperability

Ideally, all blockchains would have capabilities enabling interoperability between chains as built-in components. However, the reality is that this is not the case and interoperability remains a key issue to be addressed. New technologies are rapidly emerging, seeking to connect blockchains and facilitate the flow of information. Looking at existing solutions based on the underlying technology, they generally fall into one of the following categories.

Figure 2: Overview of Interoperability Solutions



Source: Binance Research

Note that numerous protocols are working on cross-chain technologies and this figure may not encompass all models.

Middle chains

As the name suggests, middle chains act as the intermediary between two chains, facilitating cross-chain messages by providing consensus and validation services. When a transaction is sent from a source chain, the message is transmitted via the middle chain, to the destination chain. **The middle chain is granted signing authority to all messages.**

Light Nodes

Unlike full nodes that contain the entirety of blockchain data, **light nodes store only parts of the ledger's transaction history.** To facilitate cross-chain communications, light nodes validate every block header (which contains a summary of contents in the block) received from the source chain. To do so, the entire sequential history of block headers is stored on both opposing chains, and transaction proofs are verified on-chain against the block headers.

Ultra Light Nodes

This is a term introduced by LayerZero and essentially refers to a system that performs the same validation as an on-chain light node, but **instead of storing all block headers in order, these are streamed on-demand by oracles.** Oracles and relayers are relied upon to transfer messages between on-chain endpoints. An oracle would forward the block header, whereas the relayer would submit the transaction proof to the destination chain.

Figure 3: Overview of pros and cons of interoperability solutions

	Benefits	**Drawbacks**
Middle Chains	❖ Cost-effective: Compared to on-chain light nodes, middle chains do not need to store blockchain information and are less resource intensive.	❖ Low Security: As middle chains are given signing authority over all messages, this represents a single point of failure for blockchains relying on them. ❖ Low Scalability: Chains are connected bidirectionally. If a protocol (e.g. decentralized exchange) wants to support more chains, they would have to implement more middle chains (e.g. different kinds of bridges).
Light Nodes	❖ More secure (vs. middle chains): By receiving and validating every block header on the opposing chain, and checking the block header against transaction proofs, on-chain light nodes provide a heightened level of security compared to middle chains.	❖ Expensive: To keep all the light nodes up and running, the operational costs can be costly.
Ultra Light Nodes	❖ Less costly (vs. light nodes): Ultra light nodes are less resource intensive given that block headers do not have to be stored sequentially, and are streamed on-demand.	❖ Collusion risks: In the worst-case scenario, if an oracle and a relayer collude, there would be security risks borne by applications accepting messages from that specific pair of oracle and relayer.

Source: Binance Research

Middle Chains

Token bridges represent a form of specialized cross-chain bridge with a majority falling under the "middle chains" category. By allowing the transfer of assets between independent blockchains, token bridges improve the liquidity of previously siloed ecosystems and enhance composability. While bridge designs vary, a large majority facilitates transfers by locking assets in the source chain and subsequently minting synthetic tokens on the destination chain. The end result is wrapped tokens on the destination chain that can be deployed in any manner.

A commonly-cited drawback of middle chains is the inherent security risk associated with relying on an individual party that has full signing authority to all messages. This represents a single point of failure as the destination chains rely solely on the middle chain for consensus on the validity of transactions. This means that **if there is an exploit on the middle chain, hackers would have the ability to drain the liquidity on all pair chains.** The larger the amount of liquidity secured, the bigger the target board is for hackers. There can be catastrophic consequences if security assumptions are challenged, and this is especially true for token bridges that secure a large quantity of assets.

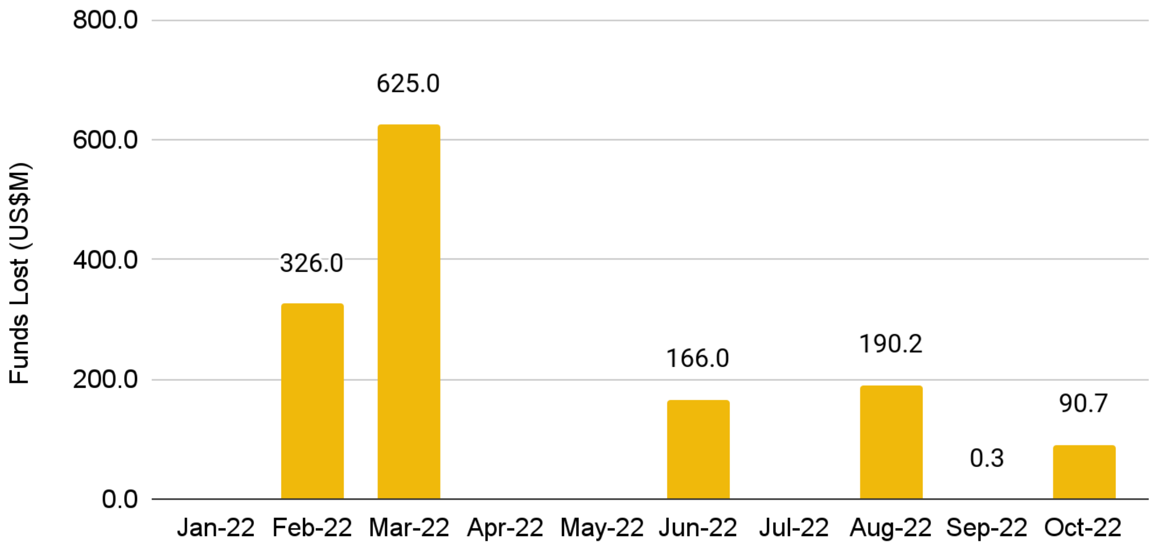
"...if there's 10 million ETH or SOL in the bridge, then the motivation to make an attack becomes much higher... So cross-chain activity has an anti-network effect: while there's not much of it going on, it's pretty safe, but the more of it is happening, the more the risks go up."

- Vitalik Buterin[2]

Wrapped assets are another point of contention. By introducing synthetic tokens, wrapped assets allow non-native assets to be used on any blockchain. However, as custody of non-native assets are taken during the minting process to serve as collateral, the use of wrapped assets introduces trust assumptions. Specifically, users must trust that the wrapped assets can be bridged back to the original underlying assets on a one-to-one basis in the future. **Exploits that successfully drain the underlying assets can leave the wrapped assets undercollateralized, breaking this trust assumption and exposing users to the risk that they would be unable to swap back their assets.**

Given the vast amount of assets secured on bridges and the complexities in securing assets, bridges are a common target for hackers. We have seen nearly US$1.4B hacked from bridges in the first ten months of 2022.

Figure 4: Over US$1.4B has been exploited from bridges in 2022



Source: DEFIYIELD, Binance Research

The path forward

While the dependence on middle chains can expose protocols to a single point of failure, developers and project teams are exploring different ways to increase the security model of such technologies. This includes increasing diversity of validator nodes, enhancing multi-signature processes, or by improving cryptographic guarantees during state validation and relay.

Additionally, while not infallible, project teams should ensure rigorous code audits are conducted by objective, external parties. This may help identify potential security flaws and vulnerabilities before the service is launched on mainnet.

Light Nodes

Light nodes (or light clients) are lightweight versions of nodes that connect to full nodes. **Unlike full nodes that store the complete history of a blockchain, light nodes only store parts of the blockchain that are relevant to a transaction being processed.** Cross-chain communications can be facilitated through the use of light nodes to verify block headers (which contains a summary of block data).

Light nodes have several advantages compared to full nodes in the form of lower resource requirements, reduced storage costs, and higher speed. Using a light node to sync at a faster rate with the blockchain creates opportunities to speed up small requests like quick transactions and account verification tasks. Additionally, low computational power requirements mean that nodes can be accessed on a mobile phone, potentially allowing further decentralization.

Let's take a closer look at how light nodes are used in the Inter-Blockchain Communication Protocol ("IBC") and Cosmos network to facilitate cross-chain communication.

Case Study: IBC and Cosmos

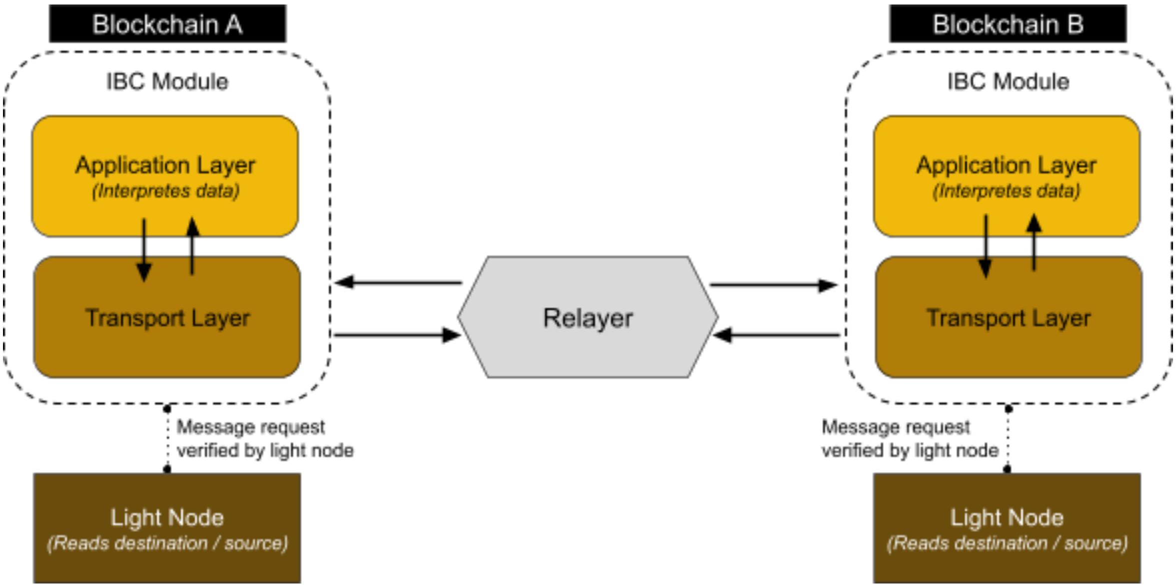
IBC

The Inter-Blockchain Communication Protocol is a cross-chain general purpose messaging protocol that allows messaging and interoperability between different blockchains. In IBC, no third party intermediaries are involved. Any chains that utilize IBC can pass messages between each other and do so by using a shared communication standard to verify state changes. **IBC is not limited to token transfers. It provides the backbone for any form of data to be passed between blockchains.**

There are two main layers to IBC: the transport layer and the application layer.

- The transport layer provides the base foundation to connect and authenticate data packets (messages) between chains.
- The application layer functions on top of the transport layer and helps with the packaging and interpretation of data packets.

Figure 5: Simplified diagram of how IBC works



Source: Binance Research

In the transport layer, messages are sent via data packets. Light nodes are used to verify these data packets and relayers transport them. Referencing the image above, if *Blockchain A* wants to send data packets to *Blockchain B*, the message request will first be verified by the light node on A, before it is being transmitted via the relayer, and verified by the light node on B.

Thereafter, the application layer is responsible for interpreting the data sent across chains. The destination chain (e.g. *Blockchain B)*, the receiver, will be responsible for unloading the message/data packet and interpreting the data on its application layer.

Benefits and Limitations of IBC

Unlike many trusted bridge solutions, **IBC does not depend on a third-party intermediary to verify the validity of cross-chain transactions.** Instead, light clients provide the verification of packet commitment proofs and are used to track and verify the state of the opposing blockchain.

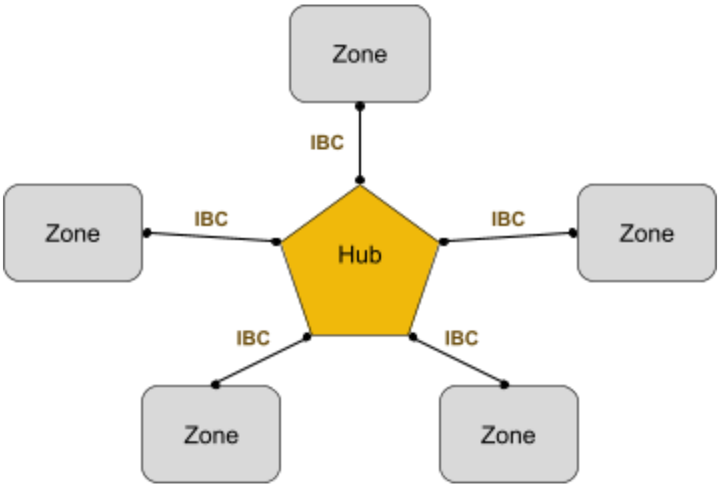
There are drawbacks to IBC though. **IBC requires that chains have a consensus mechanism that offers fast-finality.** This complicates things for chains that do not use fast-finality, like Bitcoin and Ethereum (a workaround is required). **Additionally, token transfers are path-dependent and introduces complications relating to token fungibility.** In other words, the same token on a destination chain that took a different path to get there is not fungible. For example, Token X that was transferred from Chain A > B > C, is not fungible with another Token X that was transferred from Chain A > D > C.

IBC in Action: Cosmos

IBC is the backbone to the Cosmos ecosystem, which aims to serve as the *Internet of Blockchains.* **The Cosmos ecosystem is an interconnected hub of IBC-enabled blockchains and their native apps and services.** Despite being a decentralized network of independent parallel blockchains, interoperability between chains is achieved via IBC, allowing heterogeneous blockchains to communicate.

Cosmos employs a modular architecture consisting of 'Zones' and 'Hubs'.[3] Zones refer to individual heterogeneous blockchains, and Hubs act as connectivity modules to connect Zones. Once a Zone establishes an IBC connection with a Hub, it can access every other Zone connected to the Hub, without having to establish direct, bilateral connections with every other Zone.

Figure 6: Illustration of how Zones, Hubs, and IBC work together



Source: Binance Research

How does IBC facilitate interoperability of the Cosmos ecosystem?

Let's use the Cosmos Hub as an example. It is the first Hub launched on the Cosmos network with a number of Zones that are connected to it. Zones are able to communicate with each other via the Cosmos Hub through the use of IBC. IBC clients are essentially light clients that track the state of each Zone, and participate in verification of proofs to facilitate communication.

Let's illustrate this with an example involving the transfer of Token X from Chain A to Chain B:

- Tracking: Chain A and B receive the headers of each chain on a running basis, allowing each chain to track the state of the other. Each chain runs a light node of the other.
- Bonding: Token X is locked on Chain A once an IBC transfer is initiated.
- Proof Relay: A proof that Token X has been locked on Chain A is relayed to Chain B.
- Validation: The proof is verified on Chain B against Chain A's header. If valid, a representation of Token X is created on Chain B.

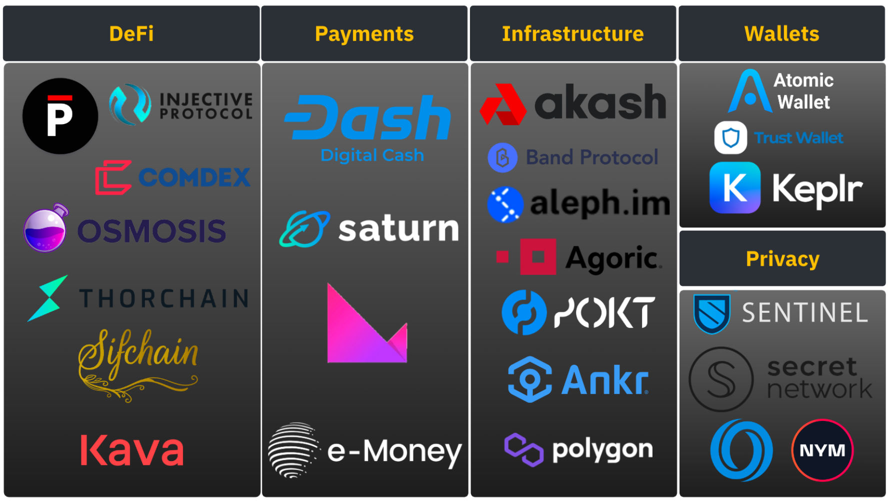
By running light clients of each other, **participating chains can independently verify the block headers of opposing chains, making an attack that involves lying about the state of an opposing blockchain difficult.**

Why does interoperability matter?

Increased interoperability contributes to higher composability, value-add and growth for the ecosystem's apps and services. For comparison purposes, the Cosmos ecosystem can be likened to a version of a global economy with each IBC-enabled blockchain/Zone emulating a nation's economy, the native apps and services emulating businesses/corporations, and the IBC's cross-chain messaging and communication mechanisms emulating international trade.

There are currently 53 active zones in the Cosmos ecosystem and this number continues to grow over time.[4] Additionally, there are upwards of 240 projects across the Cosmos ecosystem, in different phases of production and with varying use cases.[5] **The vibrancy of the ecosystem is enabled by IBC, allowing interoperability between Zones and projects.** The following ecosystem map is just a small portion of the vast Web3 network on Cosmos.

Figure 7: Sample subset of apps in the Cosmos network



Source: Cosmos, Binance Research

The Cosmos hub when it comes down to it is a platform allowing for multiple chains, applications, and users to connect whatever decentralized application they so desire. By laying the foundation for building sovereign and interoperable blockchains, Cosmos offers a potential path towards a more connected, multi-chain future.

Closing thoughts about Light Nodes

The use of light nodes in interoperability solutions represents an innovative approach to mitigate the reliance of trusted intermediaries that is typically seen in middle chains. This is achieved by allowing participating chains to independently verify the block headers of opposing chains, and removes the single point of failure associated with reliance on third party intermediaries.

While less resource intensive as compared to running a full node, light nodes can still be cost-prohibitive given the need to receive and validate every block header for each pairwise chain. This can be cost-prohibitive for blockchains with expensive block space. Ultra Light Nodes aim to solve this (elaborated in the next section).

Ultra Light Nodes

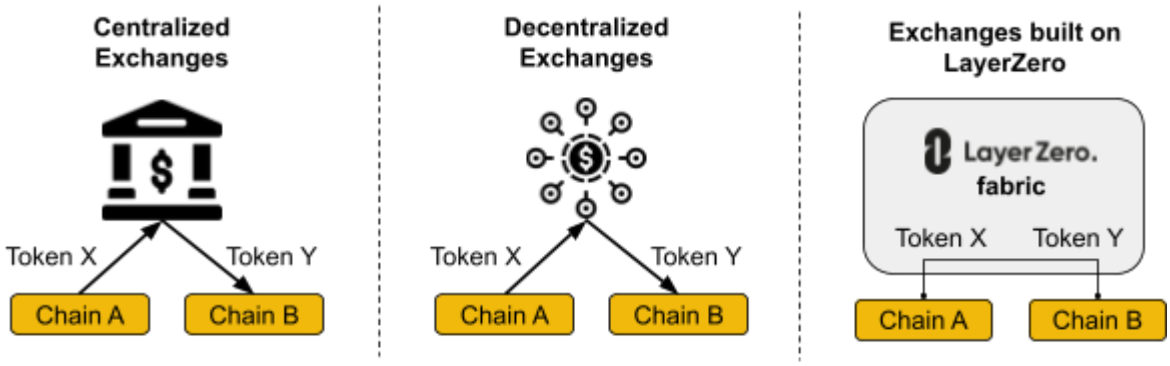
Ultra Light Nodes allows lightweight cross-chain messaging by utilizing oracles and relayers to relay block information and transaction proof across chains. Ultra Light Nodes were introduced by LayerZero and they perform validation services similar to on-chain light nodes. However, instead of storing all block headers in order, these are streamed on-demand by oracles.

Case Study: LayerZero

LayerZero is an omnichain interoperability protocol that is designed to function as a lightweight communication primitive, allowing messages to be transmitted between blockchains.[6] By acting as a general messaging primitive, it provides the infrastructure for decentralized applications ("dApps") to build cross-chain features without relying on a trusted intermediary.

Blockchains can use LayerZero to transmit different kinds of messages, including and not limited to token transfers. To provide a better understanding, let's look at a real use case in the form of token swaps and examine how LayerZero compares with existing solutions in the scenario of cross-chain token swaps.

Figure 8: LayerZero provides an alternative to existing solutions



Source: LayerZero, Binance Research

Generally, if users would like to swap tokens between two different blockchains, they would either go to a centralized exchange ("CEX") or use a cross-chain decentralized exchange ("DEX"). Using a CEX for token swaps involves trust assumptions and relying on the exchange to keep track of deposits/withdrawals off-chain accurately and safely. Alternatively, DEXes overcome the reliance on a centralized party by utilizing smart contracts and conducting transfers on-chain. However, existing cross-chain DEXes generally rely on a protocol-specific token and an intermediate chain (e.g. RUNE on

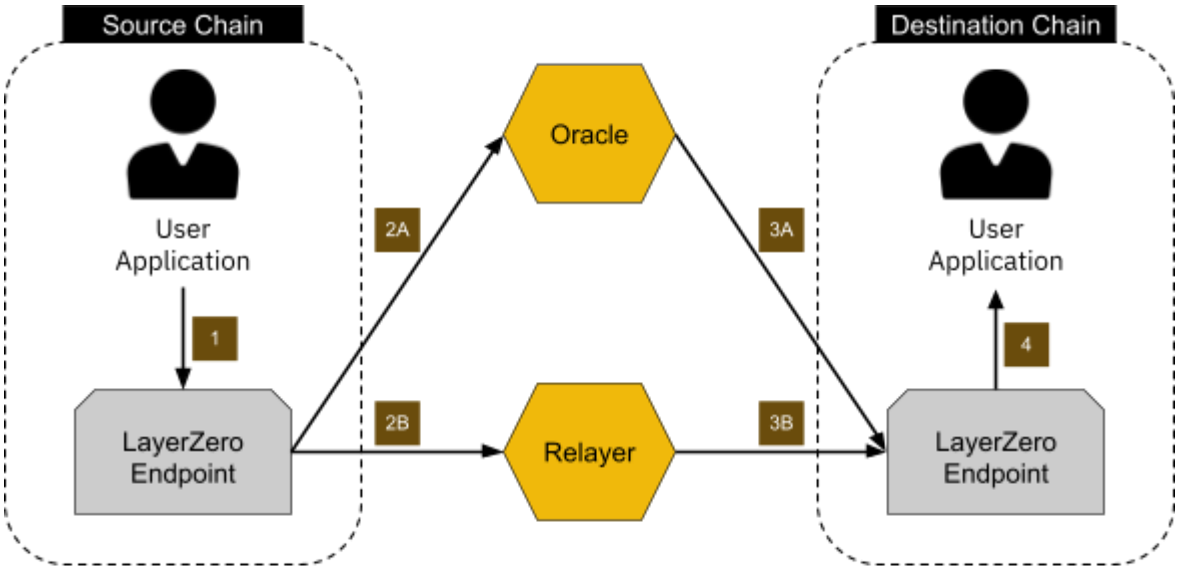
THORChain) to conduct the swap, resulting in an additional intermediary step and additional cost to the swap process.

An exchange that is built on LayerZero would enable single-step, trustless, cross-chain transactions. Through the use of oracles and relayers to deliver messages on both sides of cross-chain transactions, exchanges built on LayerZero can facilitate token swaps without relying on an intermediary or an intermediate token.

How LayerZero works

Key components of LayerZero include an oracle, a relayer, and a pair of on-chain endpoint smart contracts on opposing chains. Any chain with a LayerZero Endpoint can communicate with any other chains with a LayerZero endpoint.

Figure 9: Simplified communication flow of a message through LayerZero



Source: Binance Research

- When an application initiates a message transfer request *(Step 1)*, the LayerZero Endpoint would request the oracle to fetch the block header from the source chain *(Step 2A)* and forward it to the Endpoint on the destination chain *(Step 3A)*.
- Concurrently, the relayer would obtain the transaction proof from the source chain's Endpoint *(Step 2B)* and forward it to the destination chain's Endpoint *(Step 3B)*.
- The destination Endpoint would verify the transaction proof (from the relayer) against the block header (from the oracle) to validate whether the transaction is valid and committed. The message will be submitted on-chain only if the proof and block header match *(Step 4)*.

What does this mean for protocols and users?

By acting as a general messaging primitive, **LayerZero opens up the realm of possibilities with regard to DeFi composability and cross-chain applications.** Technically, this would mean that developers can build cross-chain decentralized exchanges, multi-chain yield aggregators, and cross-chain lending protocols by tapping on LayerZero to provide the messaging infrastructure.

Additionally, unlike IBC which generally cannot accommodate probabilistic-finality chains without workarounds (e.g. Ethereum), **LayerZero can run on any chain, including both fast-finality and probabilistic-finality chains.** This means that protocols can use LayerZero to expand to a wide variety of blockchains and are not limited to fast-finality chains.

Finally, the modular design of **LayerZero allows protocols to add support for new chains with relative ease.** This is achieved through the use of 'Libraries', which are smart contracts that define how communication for a specific chain should be handled. Chains in the LayerZero network have an associated library and communication between chains only requires their respective libraries to be available on both ends.

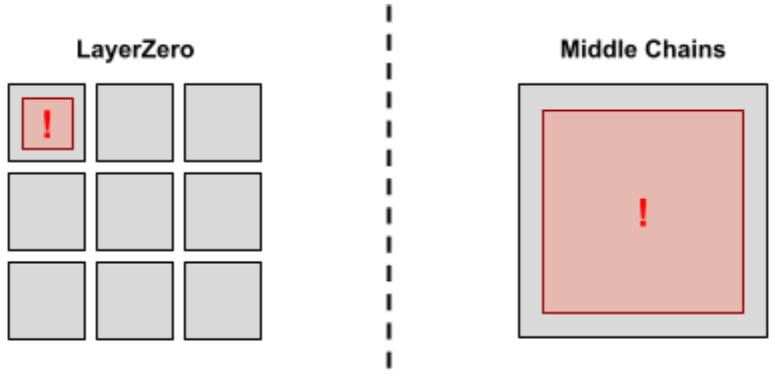
Elephant in the room - collusion risk

There are no perfect solutions in the world. As much as LayerZero offers an interesting alternative to the spectrum of interoperability solutions that exist today, developers need to be aware of the trade-offs.

Specifically, there is a non-zero probability of a collusion between an oracle and a relayer. Recall that LayerZero utilizes oracles and relayers to check the validity of transactions before committing the transaction on the destination chain. As such, **if an oracle and a relayer were to collude, the security of applications that use that specific pair of oracle and relayer would be compromised.**

There are several mitigating factors. Firstly, **in the case that Oracle A and Relayer A collude, only applications accepting messages from this oracle/relayer pair are affected.** This acts as a form of risk compartmentalization where other applications using other oracle and relayer pairs remain unaffected.

Figure 10: Collusion risks are compartmentalized and affects only dApps relying on compromised oracle/relayer pair



Source: LayerZero, Binance Research

Secondly, dApps can choose to run their own relayers. **This essentially eliminates unintentional collusion risks and ensures proper delivery of messages.** Considering the associated operational costs, this may be more suitable for dApps that secure a large amount of value and where security is of the highest priority.

Finally, on a protocol level, what is missing but would be helpful is to provide the option for dApps to implement some form of token incentives to incentivize relayers and prevent collusion. This could be in the form of native token emissions for each successful message transfer (although that does mean additional security costs for the dApps).

LayerZero in Action: Stargate

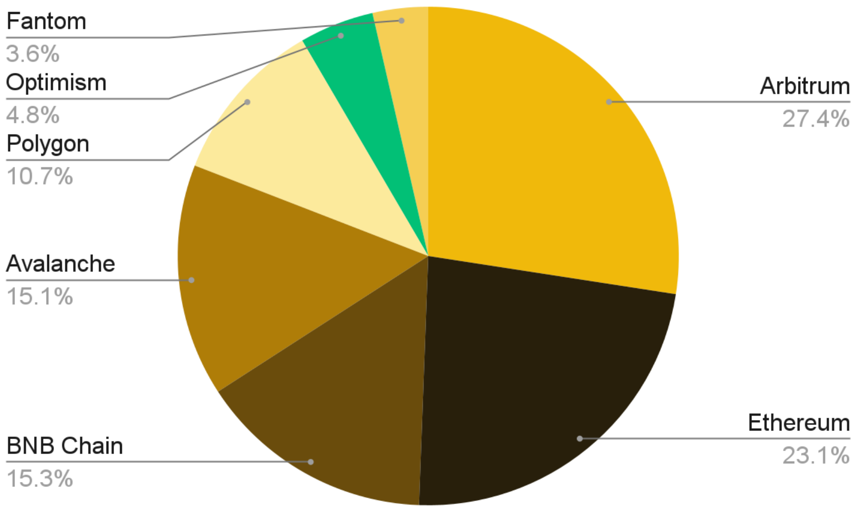
Omnichain communication protocols like LayerZero have enabled the advancements in cross-chain bridges and specifically, made it possible to directly bridge native assets without sacrificing instant guaranteed finality.

Let's examine Stargate, the first decentralized application on LayerZero to see the protocol in action.

Stargate is an omnichain liquidity transport protocol that allows users and dApps to transfer native assets cross-chain while accessing the protocol's unified liquidity pools.[7] In other words, Stargate can be thought of as a combination of a cross-chain bridge and a DEX. Suppose a user would like to swap USDC on Ethereum to BUSD on BNB Chain, this would be possible with Stargate without having to interact with other wallets, wrapped tokens, or exchanges. **Essentially, Stargate allows users to swap native assets cross-chain in a single transaction.**

Stargate is currently deployed across seven chains - Ethereum, Arbitrum, Avalanche, BNB Chain, Optimism, Polygon, and Fantom.

Figure 11: Stargate is deployed across seven chains (TVL share %)



Source: DeFi Llama, Binance Research. Data as of 17 November 2022

How does LayerZero play a part in powering Stargate?

Without diving into details, LayerZero provides the base communication infrastructure, enabling reliable bidirectional inter-chain communication for protocols such as Stargate. Stargate works by having each chain maintain the balance of assets on other chains and credits owed to other chains. It then propagates such information regularly by tapping on the messaging infrastructure provided by LayerZero.

So what? How is Stargate different from other bridges?

Similar to how blockchains face the [blockchain trilemma](), cross-chain bridges need to consider several trade-offs in their architecture design. Stargate used the term "bridging trilemma" in their white paper to describe the few properties that cross-chain bridges generally need to optimize[8]:

- Instant guaranteed finality: The guarantee that any transfer committed on the source chain is also successfully committed on the destination chain.
- Native assets: The ability of users to directly obtain native assets on the destination chain without having to manually swap for them.
- Unified liquidity: All connections deposit and withdraw from a single pool of liquidity rather than in different liquidity pools (as in the case of fragmented liquidity).

Many bridges generally optimize for instant guaranteed finality through the use of lock-and-mint mechanisms (i.e. issuance of wrapped assets). However, the ability to obtain native assets is sacrificed as users have to manually swap the intermediate tokens for native assets in a separate transaction.

Overall, Stargate aims to differentiate itself by overcoming the bridging trilemma and offering a fully composable native asset bridge with unified liquidity and instant guaranteed finality. This means that **users no longer have to conduct several transactions just to obtain native assets, and liquidity providers can achieve high capital efficiency as they no longer have to stake into each connection's liquidity pools separately.** This improves the overall user experience and users can pay the gas fees on both the source and destination chains in one single transaction.

Figure 12: Snapshot of gas fees estimation for transfers between networks

From \ To	Ethereum	BNB	Avalanche	Matic	Arbitrum	Optimism	Fantom
Ethereum	- -	$7.60 0.0062 ETH	$6.94 0.0057 ETH	$6.75 0.0055 ETH	$7.67 0.0063 ETH	$8.11 0.0066 ETH	$6.74 0.0055 ETH
BNB	$9.64 0.0355 BNB	- -	$0.61 0.0022 BNB	$0.43 0.0015 BNB	$1.34 0.0049 BNB	$1.78 0.0065 BNB	$0.42 0.0015 BNB
Avalanche	$9.49 0.7178 AVAX	$0.99 0.0749 AVAX	- -	$0.17 0.0126 AVAX	$1.12 0.0844 AVAX	$1.52 0.1152 AVAX	$0.16 0.0118 AVAX
Matic	$9.07 10.2668 MATIC	$1.05 1.1920 MATIC	$0.21 0.2366 MATIC	- -	$0.92 1.0396 MATIC	$1.33 1.5114 MATIC	$0.02 0.0235 MATIC
Arbitrum	$9.34 0.0077 ETH	$0.96 0.0007 ETH	$0.32 0.0002 ETH	$0.14 0.0001 ETH	- -	$1.47 0.0012 ETH	$0.13 0.0001 ETH
Optimism	$9.23 0.0076 ETH	$1.02 0.0008 ETH	$0.21 0.0001 ETH	$0.02 0.0000 ETH	$0.94 0.0007 ETH	- -	$0.01 0.0000 ETH
Fantom	$9.26 50.8617 FTM	$1.02 5.5957 FTM	$0.22 1.2211 FTM	$0.04 0.2105 FTM	$0.95 5.2400 FTM	$1.38 7.5968 FTM	- -

Source: Stargate. Data as of 17 November 2022

What are some metrics to take note of?

The landscape for cross-chain bridges is still relatively nascent and is rife with competition. TVL for Stargate has fallen nearly 92% from its peak in April, alongside broader market weakness, and currently stands at ~US$312M.

Figure 13: Stargate TVL has been range-bound at around US$300M-US$500M

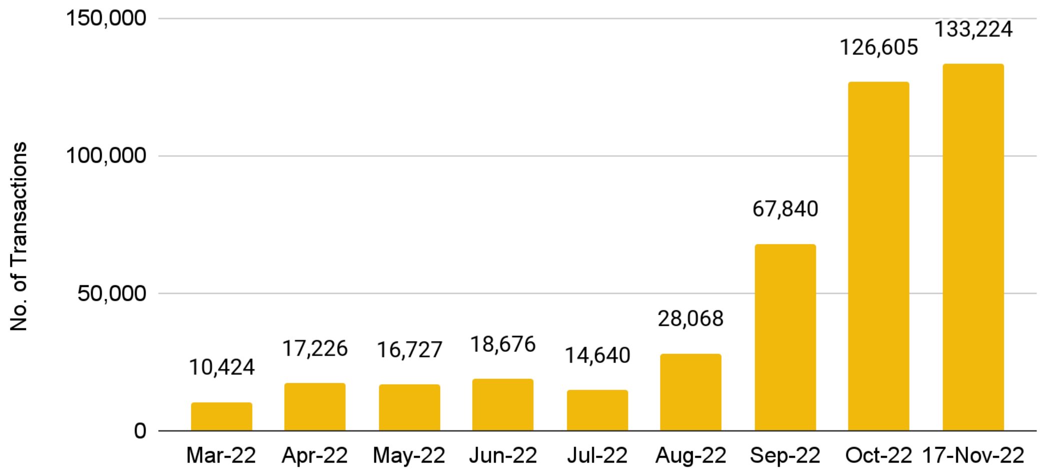
Source: DeFi Llama, Binance Research. Data as of 17 Nov 2022

There are several areas that Stargate can work on to increase its competitiveness.

- Product Suite: Stargate currently only offers cross-chain transfers for stablecoins (USDT, BUSD, USDC, USDD etc.) and ETH. While stablecoins are arguably the lifeblood of the DeFi ecosystem, a wider variety of assets (e.g. BNB on BNB Chain, AVAX on Avalanche, etc.) would be helpful in onboarding more users to the platform.
- Integration with dApps: This is a front that Stargate has been working on. Stargate has integrated with notable dApps such as Sushiswap and PancakeSwap, allowing them to become omnichain and capturing value from bridge activities. More integrations with dApps will be key in driving activity on Stargate.

On a more positive note, **the number of transactions on the platform has increased exponentially in the last 2 months.** The number of transactions in October alone exceeds the cumulative number of transactions in the first 6 months of Stargate's mainnet launch (Mar-Aug). The first 17 days of November logged over 133K transactions, exceeding October's data. This is a positive sign of increasing user activity and is a metric that is worth monitoring and evaluating to understand the underlying demand for Stargate's offerings.

Figure 14: Stargate monthly transactions



Source: Stargate, Binance Research. Data as of 17 November 2022

Overall, while the protocol is still relatively young and is not perfect, Stargate offers a service that is of value to numerous users, especially for those who are looking to obtain native assets on a different blockchain in an efficient manner. For DeFi users looking to farm yield, Stargate also offers another opportunity for users to participate in single-side staking.

Closing thoughts about Ultra Light Nodes

Ultra light nodes provide a viable alternative to existing interoperability solutions, offering a less resource-intensive cross-chain solution. In the case of LayerZero, the information verification process only requires specific transaction details and on-demand block headers, allowing it to run in a lightweight manner. However, given the reliance on oracles and relayers in its set-up and the corresponding non-zero probability of collusion, the trade-off between cost and collusion risk need to be carefully considered.

Outlook and Closing Thoughts

The majority of cross-chain protocols so far have been focused on a specialized form of message transfer - the transfer of tokens between blockchains. This is understandably so given the demand for them. Using cross-chain protocols such as token bridges, users are theoretically not limited to the ecosystem of their native asset holdings and can explore the crypto universe to seek the highest yields on their holdings.

That said, besides conventional cross-chain token bridges, the development of generic messaging protocols is key to true cross-chain interoperability and is essential for the long-term growth of a multi-chain ecosystem. By allowing the transfer of any forms of messages among blockchains with varying trust assumptions, generic messaging protocols offer the prospect of increased interoperability and composability. They provide the infrastructure to spur innovation across asynchronous networks - think of the endless possibilities with regard to cross-chain innovations in different sectors (e.g. DeFi, NFTs, gaming) or areas (e.g. governance).

Considering the nascency of technology and the risks associated with each solution, developers need to be aware of the trade-offs and take deliberate steps to mitigate risks to their users. Yet as the technology develops and matures, users will likely benefit from increased innovation in the space, better risk management, and more use cases.

References

1) https://blockchain-comparison.com/blockchain-protocols/

2) https://old.reddit.com/r/ethereum/comments/rwojtk/ama_we_are_the_efs_research_team_pt_7_07_january/hrngyk8/

3) https://v1.cosmos.network/resources/whitepaper

4) https://mapofzones.com

5) https://v1.cosmos.network/ecosystem/apps#

6) https://layerzero.network/

7) https://stargate.finance/

8) https://stargateprotocol.gitbook.io/stargate/#white-paper

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Binance Research is the research arm of Binance, the world's leading cryptocurrency exchange. The team is committed to delivering objective, independent, and comprehensive analysis and aims to be the thought leader in the crypto space. Our analysts publish insightful thought pieces regularly on topics related but not limited to, the crypto ecosystem, blockchain technologies, and the latest market themes.

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