The Current State of Layer 2 Bridges – 2024 Update

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As previously discussed in our original report on Layer 2 Bridges, we live in a multi-chain world, with billions of USD in asset value locked in 100+ chains. The owners of those blockchain assets behave just like they would with traditional finance assets: they are looking for arbitrage opportunities to make money. However, in contrast to the world of traditional finance where assets in one country can be utilized in arbitrage plays in another country without moving assets by using trusted intermediaries, the same approach did not work for blockchains for a long time for three reasons:

1. blockchains cannot talk to one another,
2. arbitrage plays on a particular blockchain require that all involved assets are present on that blockchain because of the trustless nature of public blockchains,
3. and there was no equivalent to the trusted intermediary as in traditional finance between trustless blockchains.

To solve the problem of capital inefficiency on blockchains, and make money in the process, enterprising individuals created blockchain bridges that addressed those three challenges and started to link the blockchain ecosystem together – yes, you can now trade Bitcoin on Ethereum. Of course, bridges can be used for other types of functionality too; however, the primary function is to improve capital efficiency.

This update to the original report focuses on highlighting which new projects entered the market and what new developments occurred in the Layer 2 Bridge ecosystem.

For an introduction to Layer 2 bridges and different design approaches, please, refer to our original report.

New Types of L2 Bridges

As we discussed in the previous report, L2-to-L2 bridges ideally should satisfy the following criteria:

- Clients must be abstracted away from each L2 protocol they interface with through an abstraction layer – a loose-coupling paradigm.
- Clients must be able to verify that the data returned from the abstraction layer is valid, ideally without changing the trust model beyond the one used by the targeted L2 protocol.
- No structural/protocol changes are required from the interfacing L2 protocol.

- Third parties must be able to independently build an interface to a targeted L2 protocol – ideally a standardized interface.

When looking at the current landscape, one sees most L2 bridges are treating L2s just like another blockchain. Note that fraud proofs used in optimistic rollups, and validity proofs used in zk-rollup solutions, take the place of block headers and Merkle proofs as used in "normal" L1-to-L1 bridges[1]. In addition, the usage of Zero-Knowledge Proofs (zkps) has allowed for a new bridge design:

- **Trustless and Secure:** The correctness of block headers on the source and target blockchains can be proven by zk-SNARKs which are verifiable on EVM-compatible blockchains. Hence, no external trust assumptions are required.
- **Permissionless and Decentralized**: PoS-style or similar validation schemes are not needed due to the usage of zkps as Proof-of-Correct-Execution. Therefore, anyone can join the bridge's relay network.
- **Extensible:** The information from zkp-verified block headers allows for new application-specific verification and functionality.
- **Efficient:** Optimized proof schemes (short proof generation and fast proof verification) significantly shorten processing times.

The current L2 Bridges Landscape

Below we summarize the current and very varied landscape of L2 bridges[2] with a name, brief summary, and bridge design type. Note that we are omitting token bridges for L2s or sidechains where the transfers happen from L1 to the L2/sidechain. We are also omitting bridges focused on L1 - L1 transfers.

Bridge Name	Description	Type of Design
Across	A cross-chain optimistic bridge that uses actors called Relayers to fulfill user transfer requests on the destination chain. Relayers are later reimbursed by providing proof of their action to an Optimistic Oracle on Ethereum. The architecture leverages a single liquidity pool on Ethereum and separate deposit/reimburse pools	Liquidity Network

[1] When sending an asset from L1 A to L1 B, a smart contract on L1 B must be able to validate that a transaction on L1 A immobilized said asset before it can be safely created on L1 B. This is typically done in two steps. First, a group of bridge validators confirms via their signatures that the block header of the block that contains the asset immobilization transaction actually exists on L1 A. Then the smart contract can validate a) that the block header is valid by validating the consensus of the aggregated digital signatures from the bridge validators, and b) use the transaction Merkle tree root from the block header together with the Merkle Proof that the immobilization transaction is part of the transaction Merkle tree of the block to validate the provenance of the asset to be transferred.

[2] Note that some of the projects listed also provide L1 - L2 and L1 - L1 bridging services.

	on destination chains that are rebalanced using canonical bridges.	
Allbridge (NEW)	Enables asset transfers between blockchains by offering cross-chain swaps of native stablecoins using liquidity pools. For its stablecoin liquidity network, it uses either its own AMB, Circle CCTP or Wormhole to pass messages. The token bridge is implemented as a separate contract and core system parameters can be changed by an EOA, risking the loss of all funds stored in the system contracts.	Hybrid (Token Bridge/Liquidity Network)
Ankr (NEW)	Allows transfer of Ankr Liquid Staking tokens between networks while remaining a valid stake and accumulating rewards.	Token Bridge
Beamer (Bridging Paused)	Enables users to move tokens from one rollup to another. The user requests a transfer by providing tokens on the source rollup. Liquidity providers then fill the request and directly send tokens to the user on the target rollup. The core focus of the protocol is to be as easy to use as possible for the end user. This is achieved by separating two different concerns: the service provided to the end user, and the reclaiming of funds by the liquidity provider. The service is provided optimistically as soon as the request arrives. Being refunded on the source roll-up is secured by its own mechanism and decoupled from the actual service.	Liquidity Network
Celer cBridge	A decentralized and non-custodial asset bridge that supports 110+ tokens across 30+ blockchains and layer-2 rollups. It is built on top of the Celer Inter-chain Message Framework which is built on the Celer State Guardian Network (SGN). The SGN is a Proof-of-Stake (PoS) blockchain built on Tendermint that serves as the message router between different blockchains.	Hybrid (Token Bridge/Liquidity Network)
Connext	Connext is a multilayered system that aggregates various native AMBs in a Hub-and-Spoke architecture with Ethereum being the Hub receiving messages from other domains. It implements a liquidity network on top of its Hub-and-Spoke architecture.	Liquidity Network
Chainport (New)	MultiChain bridge supporting 15+ assets. It can operate in multiple bridging modes.	Hybrid (Token Bridge/Liquidity Network) Liquidity Network

Davos (New)	A multi-chain token bridge allows users to transfer DUSD between different blockchains. It burns the original tokens and mints new ones on the destination chain.	Token Bridge
deBridge (New)	deBridge is an interoperability layer that enables messaging between various blockchains. For the typical token transfer, "deToken" is minted on the destination chain. The validation of cross-chain transactions is performed by a network of oracles signing the transaction, which would be later evaluated by the smart contract.	Token Bridge
Elk Finance	Uses ElkNet with features such as ● Cross-chain utility token for value transfer ($ELK) ● Safe and secure transfers compared to traditional bridges ● Cross-chain value transfer via ElkNet in seconds between all the blockchains Elk supports ● Bridging-as-a-Service (BaaS) to provide infrastructure for developers to leverage the ElkNet for custom bridging solutions ● Cross-chain swaps between all connected blockchains ● Impermanent Loss Protection (ILP) for our liquidity providers ● Non-Fungible Tokens (Moose NFTs) with unique abilities and features	Hybrid (Token Bridge/Liquidity Network)
Frax Ferry (New)	The Frax Ferry is a permissioned bridge that can be used to transfer tokens between chains. Users can transfer tokens to the bridge escrow on the origin chain, and the bridge administrator (the Captain) periodically posts hashes of transaction batches on the destination chains. After the challenge period is expired, the batch is considered valid, and another permissioned account (First Officer) executes the transfer of the tokens on the destination chain.	Liquidity Network
Hop Exchange	Rollup-to-rollup general token bridge. It allows users to send tokens from one rollup to another almost immediately without having to wait for the rollup's challenge period. Uses optimistic validation of transactions.	Liquidity Network (using an Automated Market Maker)
Hyphen	Hyphen Bridge is a part of the Biconomy chain and ecosystem. It's a cross-chain bridge that uses liquidity pools to perform token swaps. It is a multi-chain relayer	Liquidity Network

	network utilizing smart contract-based wallets for users to interact with liquidity providers to transfer tokens between different L2 networks.	
LI.FI	A bridge and DEX aggregator that routes any asset on any chain to the desired asset on the desired chain made available on the API/Contract level through an SDK, or as an embeddable widget in a dApp	Liquidity Pool Aggregator
LayerSwap (New)	Bridge for tokens from a centralized exchange account directly to a Layer 2 network (both optimistic and zk-rollups) with low fees.	Liquidity Network (using an Automated Market Maker)
Meson (latest is V2)	An atomic swap application using Hash Time Lock Contracts (HTLC) using secure communications between users combined with a liquidity provider relayer network for the supported tokens. V2 introduces reward tokens.	Liquidity Network
Multichain	Multichain is an externally validated bridge. It uses a network of nodes running SMPC (Secure Multi-Party Computation) protocol. It supports dozens of blockchains and thousands of tokens with both Token Bridge and Liquidity Network.	Hybrid (Token Bridge/Liquidity Network
LayerZero v2 OFTs (New)	The Omnichain Fungible Token (OFT) Standard allows fungible tokens to be transferred across multiple blockchains without asset wrapping or middlechains. This standard works by either debiting (burn/lock) tokens on the source chain, sending a message via LayerZero and delivering a function call to credit (mint / unlock) the same number of tokens on the destination chain. Omnichain is an example of such a bridge. This creates a unified supply across all networks that the OFT supports.	Token Bridge
Optics V2	Optics is a general messaging bridge that uses optimistic verification to validate cross-chain bridging transactions. Version 2 of the bridge was deployed after Celo governance lost control over the Governors MultiSig keys.	Token Bridge
O3 Swap	The O3 cross-chain mechanisms of Swap and Bridge aggregating multiple liquidity pools across chains allow for simple one-time confirmation transactions with a planned Gas Station solving the gas fee demand on each chain.	Liquidity Pool Aggregator

Orbiter	A decentralized cross-rollup bridge for transferring Ethereum-native assets. The system has two roles: Sender and Maker. The 'Maker' is required to deposit excess margin to Orbiter's contract before they can qualify to be a cross-rollup service provider to the 'Sender'. In the usual process, the 'Sender' sends assets to the 'Maker' on the 'Source Network', and the 'Maker' sends them back to the 'Sender' on the 'Destination Network'.	Liquidity Network
Orbit Bridge	Orbit Bridge is part of the Orbit Chain project. It is a cross-chain bridge that allows users to transfer tokens between supported blockchains. Tokens are deposited on the source chain and "representation tokens" are minted on the destination chain. Deposited tokens are not fully locked and can be used in other DeFi protocols by Orbit Farm. Accrued interest is not passed directly to token depositors. Bridge contract implementation and farm contract source code are not verified on Etherscan.	Token Bridge
pNetwork	Token Bridge locks tokens in the escrow contracts on Ethereum and mints “pTokens” on the destination network. The validation of cross-chain transactions is performed by a group of Validators running MPC protocol that control one EOA address on Ethereum. External Validators observe events on the pNetwork bridge and sign transfer requests on the destination chain. On Ethereum, a single EOA address controls such transfers.	Token Bridge
Poly Network	Allows users to transfer assets between different blockchains using a Lock-Mint swap. It uses a PolyNetwork chain to verify and coordinate message passing between Relayers on supported chains. Each chain has a set of Relayers, while the PolyNetwork chain has a set of Keepers that sign cross-chain messages. Chains integrated with Poly Bridge need to support light client verification since validation of cross-chain messages includes verifying block headers and transactions via Merkle proofs. Some of the smart contracts used by the bridge infrastructure are not verified on Etherscan. An example of a bridge using the Poly Network is the Poly Bridge.	Token Bridge
Portal (Wormhole)	Portal Token Bridge is built on top of Wormhole, which is a message-passing protocol that leverages a specialized network of nodes to perform cross-chain communication.	Token Bridge

Satellite (Axelar)	Satellite is a token bridge powered by the Axelar network	Liquidity Network
Socket	Socket is an infrastructure network and SDK with the Socket Liquidity Layer (SLL) as its main component. The SLL aggregates liquidity across multiple bridges and DEXs and also allows for P2P settlements. This is different from a Liquidity Pool network since this single meta-bridge allows dynamical selection and routing of funds via the best bridge as per a user's preferences such as cost, latency, or security. An example of a bridge built using Socket is Bungee.	Liquidity Pool Aggregator
Stargate	Composable native asset bridge, and dApp built on LayerZero. DeFi users can swap native assets cross-chain on Stargate within a single transaction. Applications compose Stargate to create native cross-chain transactions at the application level. These cross-chain swaps are supported by the community-owned Stargate unified liquidity pools.	Hybrid (Token Bridge/Liquidity Network) for V2 Liquidity Network for V1
Synapse Protocol	A token bridge leveraging a validator between chains and liquidity pools to perform cross-chain and same-chain asset swaps.	Hybrid (Token Bridge/Liquidity Network)
Sygma (New)	Sygma currently leverages an MPC relayer network along with threshold signature schemes (TSS) to facilitate cross-chain transfers. From the point of view of Ethereum, transfers are authorized by a single EOA address.	Hybrid
Symbiosis (New)	Symbiosis uses an MPC relayer network to facilitate cross-chain transfers. An AMM on BOBA BNB is used to perform swaps.	Hybrid
Transporter (New)	Transporter is a Token Bridge based on Chainlink's Cross-Chain Interoperability Protocol (CCIP) network. It is a hybrid bridge that can work either as a Token Bridge or a Liquidity Network depending on the requirements of tokens. It uses the Chainlink CCIP standard for cross-chain communication, and it makes use of a secondary network of nodes, called a Risk Management Network, responsible for validating the messages or halting the bridge.	Token Bridge
Umbria Network	Umbria has three major protocols working together: • A Cross-chain Asset Bridge; enabling the transfer of assets between otherwise	Liquidity Network (using an Automated Market Maker)

	incompatible blockchains and cryptocurrency networks (Multichain). ● A Staking Pool, where users can earn interest on their crypto-assets by providing liquidity to the bridge. Liquidity providers of UMBR earn 60% of all fees generated by the bridge. ● A Decentralised Exchange (DEX); and automated liquidity protocol powered by a constant product formula, deployed using smart contracts, governed entirely on-chain. Both protocols work in tandem to provide asset migration between cryptocurrency networks	
Via Protocol	The protocol is an aggregator of chains, DEXs, and bridges to optimize asset transfer routes. This allows asset bridging in three ways: ● Make multiple transactions on different blockchains ● Make one transaction through decentralized bridges that have integrated DEXs ● Make one transaction through semi-centralized bridges, which will trigger a second transaction on the target chain	Hybrid (Token Bridge/Liquidity Network)
Voyager (Router Protocol)	The Router Protocol uses a pathfinder algorithm to find the most optimal route to move assets from the source chain to the destination chain utilizing the Router network which is similar to Cosmos' IBC.	Liquidity Network
zkBridge	zkBridge uses zkSNARKs to enable a prover to efficiently convince the receiver chain that a certain state transition happened on the sender chain. zkBridge consists of a block header relay network and an updater contract. The block header relay network retrieves the block headers from the sender chain, generates proofs of the validity of the block headers, and sends the headers along with the proofs to the updater contract (set up on the receiver chain). The updater contract maintains a light-client state. It automatically adds block headers of the sender chain once the associated proofs are verified, and updates the current main chain of the sender chain.	Token Bridge

The primary source of the table descriptions is the L2Beat project. It maintains an active list of bridges relevant to L2s with the Total-Value-Locked (TVL) in the bridge as well as a description and brief risk assessment, if available.

As one can see, most bridge projects discussed in the last report still exist, and new entrances have significantly extended the list.

Summary of the Update

We can summarize the above discussion and overview of L2 Bridges as follows:

- L2 Bridges have become THE crucial glue of the L2 ecosystem to further L2 interoperability and efficient use of assets and applications across the ecosystem.
- L2 Bridges still have very different trust assumptions between them, e.g., trusted vs. trustless bridges, and very different design choices, e.g., lock-mint-burn vs. liquidity networks. *The ecosystem has not coalesced behind a dominant design paradigm or best practices.*
- The L2 Bridges ecosystem is still nascent and continues to be in a state of flux and growth, although the rate of change has slowed.
- Users, in particular Enterprises, must still do their due diligence to assess which L2 bridges offer the best risk-reward profile for their needs.

While still early in the journey toward a standardized L2 interoperability framework, recent developments show that designs have started to favor Liquidity Networks or (atomistic) Token Bridges, with some projects offering both. It will be interesting to see if the new bridge design paradigm pioneered by zkBridge that only relies on zkps will become the dominant paradigm due to its flexibility and limited trust assumptions, or if its technical complexity will prevent wider adoption. The recent work by the EEA Interoperability Group, EEA Distributed Ledger Technology Interoperability Specification Version 1.0, gives a guide on preferred bridge designs and approaches without taking into account the all-important bridge liquidity question, as this is an economic parameter related to trading and arbitrage, not a technical one. However, it is highly relevant for assessing bridge risk profiles as was discussed in the previous report.

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