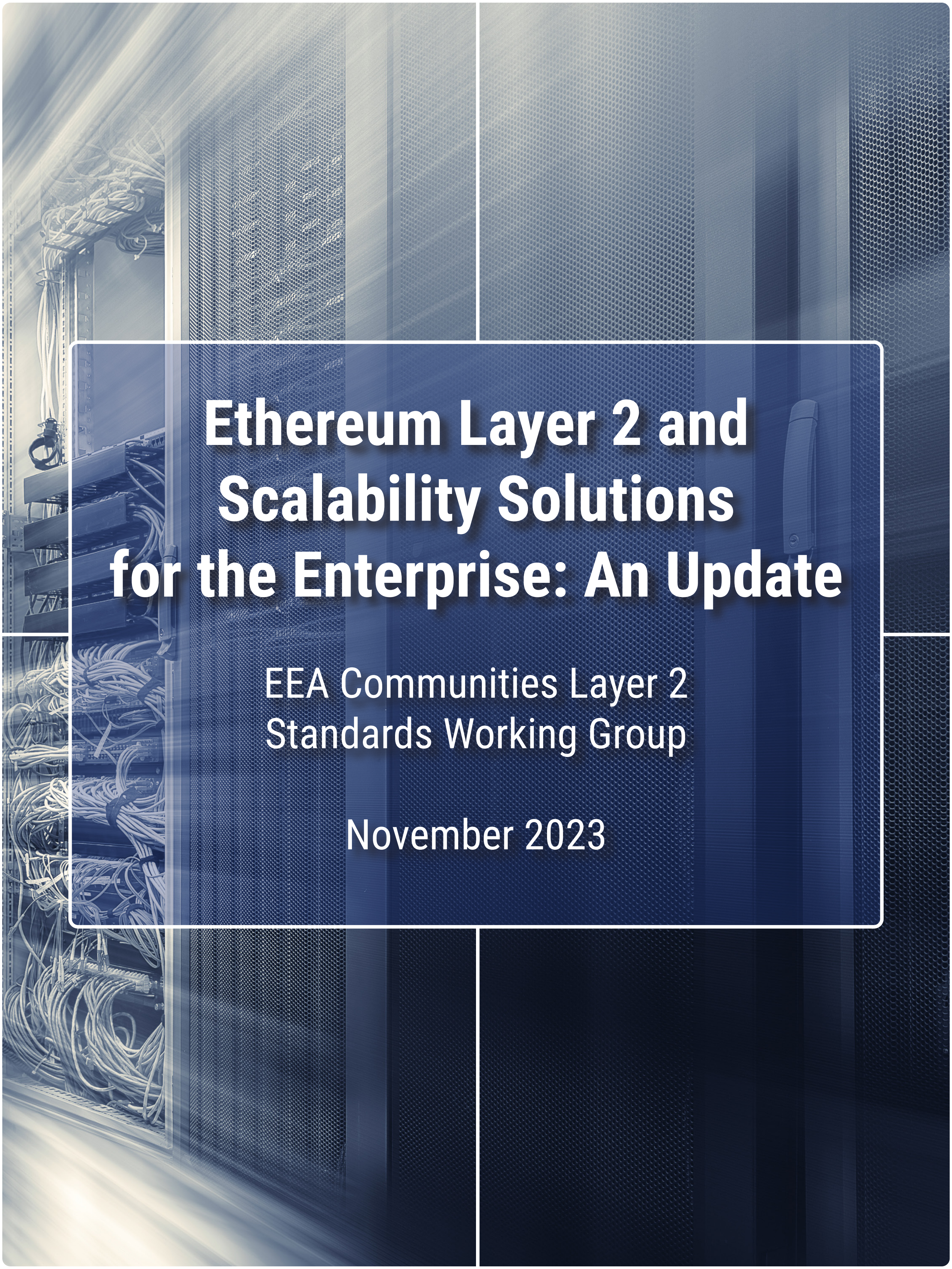

Ethereum Layer 2 and Scalability Solutions for the Enterprise: An Update

EEA Communities Layer 2
Standards Working Group

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Abstract

This summary report is an update to the 2021 EEA Mini Report on Ethereum Layer 2 and other scaling solutions and is designed to be standalone.

This mini-report:
- Provides an update on the current Ethereum Layer 2 and other scalability solution landscape
- It then provides an update on the developments of the main near-term obstacles to enterprise adoption: Education, Lack of Standards, and Interoperability.

Keywords: Ethereum, Layer 2, Scaling

A Brief Introduction to Layer 2 and Other Scalability Solutions

A victim of its success — the Ethereum Mainnet still is a significant bottleneck for the growth of its ecosystem. This is primarily due to high transaction fees and the limited number of transactions allowed per block, even after the network upgrade to Proof-of-Stake consensus with the so-called Merge. While still going strong, this situation endangers long-term the economic viability of Ethereum-based start-ups, even those with sound business models. While additional upgrades such as Danksharding promise a 100x increase in transaction scalability and significantly reduced transaction fees, the rollout of new scalability upgrades is still 12+ months away.

However, over the last 4-5 years several different types of Ethereum scalability solutions have emerged that are reducing transaction costs. What these solutions have in common is that all perform the heavy transaction processing off the Ethereum Mainnet in dedicated computing environments while Ethereum Mainnet is used as the security and data integrity anchor. These solutions are what is colloquially called Layer 2 (L2) because they are solutions sitting above the Ethereum Mainnet, also often referred to as Layer 1.

Below is a brief overview of the major scalability solution categories followed by a brief description of the characteristics of each solution category:

- State Channels
- Sidechains
- Rollups
  - Optimistic Rollups
  - Zero-Knowledge (zk) Rollups
    - EVM Compatible/Equivalent
    - Non-EVM Compatible/Equivalent
- Validium
- Optimium
- Volition
- Plasma

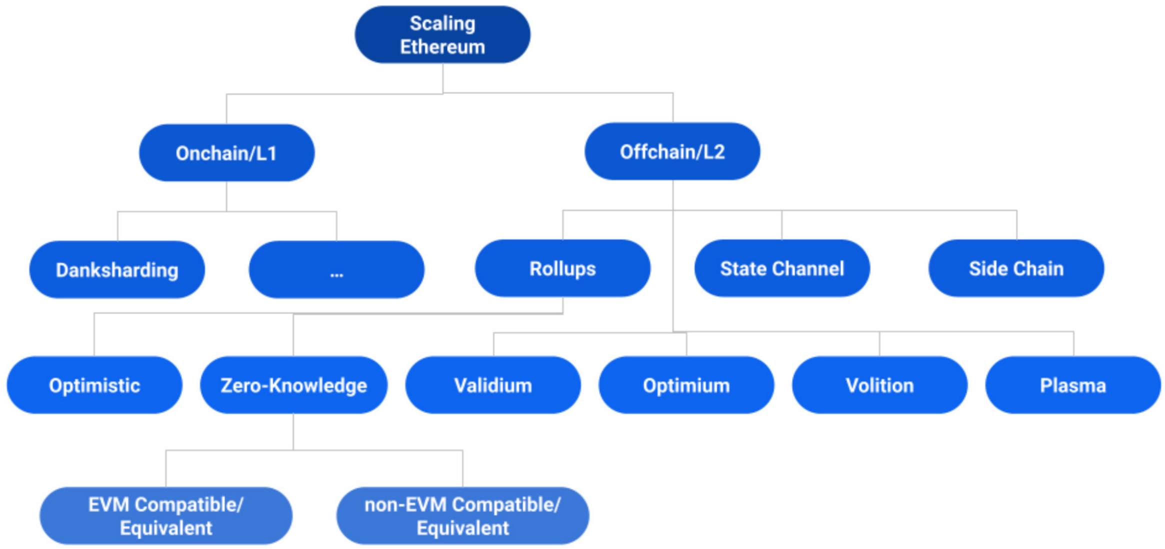

Figure 1: L2 Categorizations

State Channels

State Channels scale the Ethereum Mainnet by performing transactions off-chain. They require a user to deposit a snapshot of the latest Ethereum state the user controls into a multi-signature smart contract; this is analogous to user deposits into payment channels on Bitcoin's Lightning Network. This snapshot will contain important data such as the ETH holdings of an Ethereum address at a given time. State Channels allow for (nearly) free off-chain transactions with instant transaction finality and superior privacy because only the participants in the state channel have visibility into the off-chain transactions besides the state channel operator.

Sidechains

Sidechains are blockchains independent of the Ethereum Mainnet with their own consensus rules. Ethereum transactions can be offloaded to such a chain in a custodial manner, decreasing the burden on the Ethereum Mainnet. Note that many ecosystem participants do not consider sidechains to be true L2 solutions because they do not inherit the security assurances of Ethereum Mainnet due to a lack of onchain transaction data and no ability to arbitrate disputes on the Ethereum Mainnet. Albeit this is starting to change as we will outline below when we survey the scalability landscape. Also, note that sidechains potentially provide preservation of their users' privacy compared to the Ethereum Mainnet.

Rollups

Rollups are similar to advanced, non-custodial sidechains that achieve high transaction throughput while inheriting the security assurances of the Ethereum Mainnet. Rollups typically fall into one of two main categories: Optimistic Rollups and zk-Rollups.

Optimistic Rollups: Optimistic Rollups store sufficient L2 transaction data on the L1 chain, often in a compressed format, such that the L2 state can be reconstructed from the transaction data stored on the L1. Because of the fraud-proof mechanism that is used to guarantee security, users have to wait between 7 and 10 days (challenge period) before their Optimistic Rollup transactions are finalized on the L1 chain. If an L2 state update is contested, the decision of whether a contested state is valid or not is abrogated to the L1 chain, typically using a challenge-response mechanism between a validator (challenger) and the L2 proposer. In addition, Rollup Proposers and Validators are staked/bonded. Thus, if an operator submits a fraudulent transaction to its L1, its stake is slashed on the L1. Optimistic Rollups typically use EVM-compatible or EVM-equivalent transaction execution frameworks such that developers can reuse existing Solidity smart contracts and familiar development and deployment tool chains making onboarding easy.

zk-Rollups: zk-Rollups use zk Validity Proofs to prove that a transaction on the Rollup was executed correctly. These proofs are generated off-chain by either a user or a 3rd-party operator who bundles transactions and submits those batches to an L1 chain. Batches contain minimal, yet sufficient, data to prove transaction validity. Transaction finality occurs once the Validity Proofs are validated on the L1 in a smart contract that performs the validation computation upon proof submission. Note, that in contrast to Optimistic Rollups, a user of zk-Rollups can withdraw their funds immediately with an L1 transaction once a validity proof for an L2 block is verified on the L1.

Domain Specific Languages: The first generation of zk-rollups had limited functionality with preset zk algorithms that computed an asset transfer or swap of an asset with another. More recently zk-rollups came on the scene using zk-optimized domain-specific languages such as Noir from Aztec or Cairo from Starkware. This allows zk-Rollups to execute complex functionality comparable to what a Solidity smart contract can do on Ethereum or an Optimistic Rollup, greatly expanding the use of zk-Rollups.

EVM: Even more recently, EVM-compatible or even EVM-equivalent zk-Rollups have emerged. They are just like a normal zk-Rollup but process normal Solidity Smart Contracts as Ethereum would as its transactions. Therefore, users can send normal Ethereum-type transactions from their preferred wallet to the zk-Rollup rather than having to use zk-Rollup-specific wallets. This means that developers can use their normal Solidity Smart Contract development and deployment toolchains. Consequently, users and developers will have the same experience with a zkEVM rollup as with normal Ethereum, combined with the advantages that a zk-rollup has, including fast finalization and, typically, L2 transaction data availability on the L1 chain. The only drawback is that compared to normal zk-Rollups, users cannot withdraw their funds with only an L1 transaction. The deep technical reason for this is the state entanglement of user assets in a smart contract state that does not allow presenting the required zk Validity Proof of a single, unentangled asset balance to the L1 chain to withdraw the asset.

Rollup-like Solutions
The primary difference between rollups and Validium, Volition, and Plasma solutions is that the L2 state can be reconstructed from the data on the L1 for rollups, but not so for the latter solutions.

Validium: Just as zk-Rollups, Validiums publish zk-proofs (zk-snarks, zk-starks as validity proofs) to verify off-chain transactions on an L1 chain. User funds are controlled by a smart contract on an L1 chain. As with zk-Rollups once a validity proof for a withdrawal request has been verified on the L1, users can withdraw funds by providing Merkle proofs. The Merkle proof validates the inclusion of the user's withdrawal transaction in a verified Validium block, allowing the L1 contract to process the transaction. The big difference from zk-Rollups is that withdrawals can be restricted, if data availability managers which store the actual state data in Merkle trees, withhold off-chain transaction data from users. As a consequence, users cannot compute the Merkle proof required to prove ownership and execute withdrawals on their own. While this may be an unacceptable risk for some applications, such as DeFi, it may be perfectly reasonable for certain enterprise applications where enterprises can participate in ensuring data availability.

Volition: Volition solutions combine zk-Rollups and Validium where the L2 state will be divided into 2 sides: A zk-Rollup, with on-chain data availability, and an off-chain data availability side. The zk-Rollup data will exist on an L1 chain and the Rollup state data in a Data Availability system typically secured by a Proof-of-Stake-like system. The Data Availability providers promise the availability of the state data with an economic stake (value-at-risk) that is locked in a Volition smart contract on the L1 chain. Data Availability providers must keep track of the data to be made available by signing blocks; a data usability failure will cause their stake to be slashed by the protocol. The crypto-economic model is still vulnerable to 2/3-majority-attacks: However, the providers can only censor by not producing blocks but cannot steal the funds since they cannot generate the necessary Validity Proofs. The accounts and the smart contracts on both the zk-Rollup and the Data Availability side can interact with the accounts and contracts on the other side. The only noticeable difference is that on the Data Availability side, a transaction is orders of magnitude cheaper than on the zk-Rollup side.

Note that Rollups commonly do not offer privacy to their users. However, new solutions are emerging, both Optimistic (zk Optimistic) and zk Rollups (zk-zk Rollup), that preserve the privacy of their users. These solutions will be discussed in the next section.
Optimium: Similar to an Optimistic Rollup, the primary difference is that the L2 transaction data is kept in a data availability solution to further reduce transaction costs from posting L2 transaction data on the L1 chain.

Plasma: Although not really in use any longer, we give a brief overview of the concept and methods. Plasma chains are built atop another blockchain (the root/L1 chain). Each "child chain" extends from the L1 chain and is generally managed by a smart contract deployed on the L1 chain. The contract functions, among other things, act as a bridge allowing users to move assets between the L1 chain and a plasma chain, typically using a UTXO model. Transactions are stored off-chain, and finalizing those transactions requires producing blocks posting "state commitments" in the form of Merkle roots on the L1 chain as (interactive) fraud-proofs with challenge periods. This is similar to Optimistic Rollups with the difference being that transaction data is stored off-chain.

The figure below organizes L2 solutions into categories depending on whether they handle data storage on-chain or off-chain, and whether computation is achieved through zero-knowledge validity proofs or user-deposit-slashing fraud proofs. Note, that these L2 solutions have very different trust assumptions. Optimistic and zk Rollups, Plasma as well as Volition, and Optimium in their Rollup mode are trustless; preserving safety/security and liveness. Whereas Validum solutions cannot guarantee liveness due to the possibility of data withholding as mentioned above.

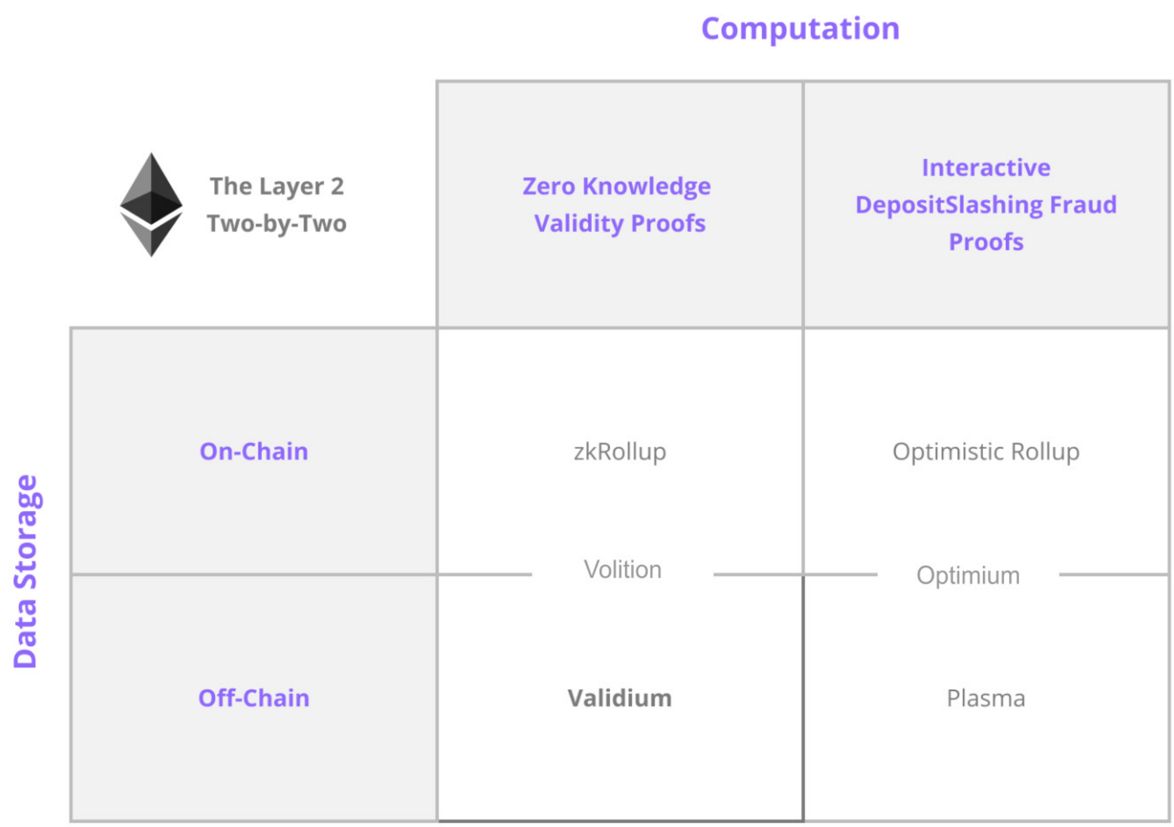

Figure 2: L2 Rollup Categories
Source: buildblockchain.tech; added Volition & Optimium

The above L2 solutions have specific performance, security, economic, and usability characteristics which are summarized in the table below, Note that the new Volition solutions either behave like Validium or a zk-Rollup. Therefore, the characteristics of a transaction are either that of Validium when going down the Validium path or that of a zk-Rollup when going down the zk-Rollup path. Also, note that the new Optimium solutions behave like a Validium solution but without the zk Validity Proofs. Therefore, its characteristics sit between Optimistic Rollups and Validium:

Note that zk-Optimistic Rollups have worse performance characteristics than Optimistic Rollups because each transaction in the rollup block is much larger than in the case of Optimistic Rollups and Ethereum blocks are space-constrained through the block gas limit; a trade-off between privacy and performance. On the other hand, zk-zk Rollups have similar performance characteristics as zk Rollups because of recursive zk proofs which avoids adding more data to a rollup block. Further optimizations in the utilized cryptography avoid an increase in the compute performance requirements compared to zk-Rollups.

Given the rapid changes and optimizations of the employed technologies, the above

	State Channels	Side-chains	Optimistic Rollups	Zk Rollups: UTXO	Zk Rollups: EVM	Validium	Volition	Optimium	Plasma
	Security								
Liveness[2] Assumptions	Yes	Yes	No	No	No	Yes	No/Yes[3]	Yes	Yes
Data Availability[4] Assumptions	No	Yes	No	No	No	Yes	No/Yes	Yes	Yes
A quorum of Validators can freeze funds	No	Yes	No	No	No	Yes	No/Yes	Yes	No
A quorum of Validators can confiscate funds	No	Yes	No	No	No	No	No/Yes	Yes	No
Cryptographic Primitives	Standard	Standard	Standard	New	New	New	New	Standard	Standard
	Usability								
Withdrawal Time	1 confirm[5]	1 confirm.	1 week+	10+ min.	10+ min.	10+ min.	10+ min.	1 week+	1 week+
Time to Finality	Instant	NA	1 confirm.	10+ min.	10+ min.	10+ min.	10+ min.	1 confirm.	1 confirm.
Client-side verification of Finality	Yes	NA	No	Yes	Yes	Yes	Yes	No	No
Instant Transaction Confirmations	Full	Bonded	Bonded	Bonded	Bonded	Bonded	Bonded	Bonded	Bonded
	Other Aspects								
Smart Contracts	Limited	Flexible	Flexible	Flexible	Flexible	Flexible	Flexible	Flexible	Limited
EVM-Compatible/ Equivalent	No	Yes	Yes	No	Yes	No	No	Yes	No
Native Privacy Options	Limited	No	No	Full	No	Full	Full	No	No

Figure 3: L2 Solution Characteristics by L2 and Scalability Solution Category
Source: Matter Labs (2020)

[2]Liveness Definition: All non-faulty participating nodes produce an output indicating the termination, and subsequent restart, of the protocol upon reaching consensus.
[3]Depends on whether the transaction follows the Rollup or Validum processing path.
[4]Data Availability Definition: Every request gets a (non-error) response independent of a node's individual state (might not be the latest state).
[5]1 confirmation represents the best case scenario. In a non-cooperative scenario, the withdrawal time is dependent on the agreement reached before opening the channel between the counterparties, typically a default by the state channel stack.

assessment of the different categories is merely a snapshot in time, and could, and is expected, to change substantially over the next 12 to 24 months. The report will be updated accordingly.

Ethereum Layer 2 and Scalability Solutions Landscape

As already stated, the Ethereum L2 ecosystem is rapidly evolving with new projects coming out of stealth mode every month — from the Plasma Whitepaper in 2017 to Ethereum's largest decentralized exchange, Uniswap, going live on an L2 solution in 2021, and the emergence of a plethora of zkEVM rollups in 2022/2023 such as Era, Linea, Scroll, Kakarot, Zeth, etc. Hence, any overview of the ecosystem will be both incomplete and quickly outdated. However, a current snapshot is still useful to understand the great variety of projects in the space, and their intended use cases.

We will discuss each category, give examples in more detail, and mention additional, notable projects in the same category with links to their websites or Github repositories if they exist. Before we go into further details, it is worth mentioning that the L2Beat Project has produced a risk analysis and maturity framework that allows the categorization of L2 rollup projects, not state channels or sidechains, along the dimensions of security and maturity and features in addition to their market cap as expressed as Total Locked Value and the number of transactions.

L2Beat characterizes risk/security along the following dimensions:

- L2 State Validation: How is the validity of the system state verified?
- Data Availability: Under what security model is the data needed to reconstruct the system state made available?
- Upgradeability: Are the L1 smart contracts upgradeable and are there sufficient safeguards against a malicious L2 operator?
- Proposer Failure: What happens if the Proposer is offline?
- Sequencer Failure: What happens if the Sequencer is offline or censors L2 transactions?

An overview of the risk/security analysis of different L2 projects by L2Beat can be found here. Furthermore, L2Beat grades the maturity and features of L2 projects in stages which are defined as follows:

[6] The Proposer is the entity responsible for sending the state commitments to the L1 including zero-knowledge proofs.
[7] The Sequencer is an entity responsible for constructing L2 blocks and ordering L2 transactions per the protocol.

Stage-0: Full Training Wheels. The rollup is effectively run by the operators. Still, there is source-available software that allows for the reconstruction of the state from the data posted on L1, used to compare state roots with the proposed ones.

Stage-1: Limited Training Wheels. The rollup transitions to being governed by smart contracts. However, a Security Council might remain in place to address potential bugs. This stage is characterized by the implementation of a fully functional proof system, decentralization of fraud-proof submission, and provision for user exits without operator coordination. The Security Council, comprised of a diverse set of participants, provides a safety net, but its power also poses a potential risk.

Stage 2: No Training Wheels. The rollup becomes fully managed by smart contracts. At this point, the fraud-proof system is permissionless, and users are given ample time to exit in the event of unwanted upgrades. The Security Council's role is strictly confined to addressing soundness errors that can be adjudicated on-chain, and users are protected from governance attacks.

The L2Beat maturity and feature assessment of L2 rollups can be found here.

Equipped with this background, we can now go into the description of the current L2 landscape.

State Channels
State Channel: State Channels has developed the Nitro State Channel Network where the network is established through virtual channels. Virtual Channels are generally programmable multi-hop state channels as each state channel can be created with its own "rules."
The previously featured Connext project has evolved into a bridge network for cross-chain dApps with its cross-chain routing hub for Ethereum's many L2 solutions. The project is attempting to address one of the concerns in the L2 ecosystem, that these projects will be too siloed from each other. Connext's new cross-L2 transfer system could prove important to ensure that silos will not be a serious problem going forward.

The Raiden Network mentioned in the last version of this mini-report has stopped operations.

Other notable projects are Scalar and Perun.

Sidechains
xDai Chain: xDai Chain is an EVM-based sidechain designed to stably facilitate larger transaction volumes; currently at about 70 transactions per second (TPS). The project is built around its STAKE token, which consensus providers stake to economically secure the sidechain. Because of its efficiency, xDai Chain has been recently growing in popularity.

POA Network: Similar to xDai Chain at ~ 70 TPS, the POA Network is an EVM-based sidechain that relies on a set of trusted consensus providers to process transactions quickly and cheaply. The solution seems to be usable for almost any use case from blockchain games to community currencies.

Polygon PoS: Polygon (formerly Matic) is a technology framework and protocol that enables developers to deploy and connect through a messaging protocol different types of networks — EVM-based Proof-of-Stake chains, Plasma chains, etc. — with each other and Ethereum. Therefore, the aim is similar to Connext, or non-Ethereum-based frameworks such as Cosmos. The Polygon token is used as a staking token on the different networks that are deployed in the Polygon network of chains to economically secure the consensus providers. The approach and architecture are similar to the substrate and parachain approach of Polkadot.

Other notable sidechains are Skale and the Loom Network.

Optimistic Rollups

Arbitrum (One): Arbitrum, developed by Offchain Labs is an optimistic rollup network with validators economically staked in ETH, processing at about 100x gas reduction. Solidity and Vyper smart contracts can be directly deployed onto Arbitrum without any modifications because the Nitro Virtual Machine, a modified Ethereum Geth client, is the same as the EVM at the bytecode level. Arbitrum One is currently the largest L2 with over 50% of total TVL on L2 according to L2Beat

Notable projects migrated to Arbitrum: Reddit, Uniswap

Optimism: Optimism is an Optimistic Rollup implementation enabling about a 100x reduction in gas utilization that is gaining some early traction among some big DeFi players, such as Synthetix. Optimism has built the OVM, an L2-based EVM such that L1 projects can redeploy their Solidity or Vyper smart contracts on Optimism. Optimism is the second largest L2 in terms of total TVL at around 25% according to L2beat.

Notable projects that migrated to Optimism: Uniswap, Compound, Synthetix.

Other notable Optimistic rollup projects are Base, Boba, Zora, PGN, layer2.finance, Fuel, and Nightfall V3 from Ernst & Young which is a privacy-preserving Optimistic Rollup where the rollup transactions are zk-snark proofs to preserve transaction privacy which leads to reduced TPS due to the size of the proofs.

Plasma

OMGX from the OMG Network mentioned in the last report has been shut down.

Optimium

Mantle: Mantle is an EVM-compatible Optimium that has been designed for use on the Ethereum network, based on the Optimism OVM architecture. It has a modular architecture trying to leverage EigenDA as a Data Availability layer and a Specular Network fraud-proof system for fraud proofs. Note that currently both of these technologies are yet to be fully launched on Ethereum Mainnet. It is currently the largest Optimium solution based on TVL according to L2Beat.

Other Optimium projects are Metis Andromeda and Arbitrum Nova.

zk-Rollups

Traditional zk-Rollups:

zkSync Lite: zkSync Lite is a zk-Rollup L2 solution from Matter Labs that uses zero-knowledge proofs from zk-snarks to realize both high throughputs (~ 300 - 2,000 tps based on the number of transactions in a block) and high security (inheriting Ethereum Mainnet security assurances). Matter Labs is also working on a Validium-type solution called zkPorter.

Loopring: Loopring was the first zk-rollup deployed to Ethereum Mainnet, and has been operating on Ethereum Mainnet for several years. Loopring's zk-Rollup solution is currently focused on scaling decentralized exchanges with Automated Market Makers, Order books, and payments. The Loopring Exchange and Loopring Wallet are based on Loopring's technology. OpenOcean has now also migrated to Loopring.

StarkNet: StarkNet uses StarkEx technology but uses zk-starks instead of zk-snarks, with the main difference being that StarkEx's Validium-based system handles data storage off-chain and posts their zk-stark validity proofs less frequently to Ethereum because of the significantly larger gas costs for both proof verification and storage of zk-starks. This dynamic allows the project to have higher throughput capabilities compared to pure zk Rollup systems.

Notable other zk-Rollups projects using StarkEx: dYdX

A note on Aztec from the previous report: The Aztec technology allows verifying zk proofs of zk-proofs of private transactions, in other words, recursive zk proofs, on the Ethereum Mainnet. Because of the recursive nature of the zk proofs, the same number of transactions as regular zk Rollups can be placed on the Ethereum Mainnet.

This form of zk Rollup seems to be the most promising approach for many enterprise use cases given their strong privacy requirements.

However, both Aztec and Aztec Connect are being sunsetted this and next year to be replaced with a significantly more modular zk-zk-rollup Aztec is currently building based on its DSL Noir.

Other notable zk Rollups are ZKSpace, and DeGate (V1 & V2).

zkEVM Rollups
zkSync Era: zkSync Era is a general-purpose zk-rollup platform from Matter Labs implementing nearly full EVM compatibility in its zk-friendly custom virtual machine, a Type 4 zkEVM. It implements standard Web3 API and it preserves key EVM features such as smart contract composability while introducing some new concepts e.g. native account abstraction.

Linea: Linea is an EVM-equivalent zk-rollup, with a Type 2 zkEVM (fully EVM equivalent) as its execution engine.
Polygon zkEVM: The Polygon zkEVM goal is to become a decentralized Ethereum Layer 2 scalability solution. It uses cryptographic zero-knowledge proofs to offer validity and finality to its Layer 2 transactions. The Polygon zkEVM is intended to become equivalent to the EVM. Currently, it is EVM compatible and can be characterized as a Type 3 zkEVM.

Other zkEVM rollups are Scroll, Kakarot, and most recently Zeth from Risc0.

Validium
Immutable X: Immutable X claims to be the first L2 solution for NFTs on Ethereum. It promises zero gas fees, instant trades, and scalability for games, applications, and marketplaces without compromise. It is powered by the StarkEx technology which is based on zk-STARK proofs, rather than zk–SNARKs as most other zk-Rollup-type solutions.

Canvas Connect: Canvas Connect is a Layer 2 solution based on StarkEx technology, specifically designed to provide centralized investment and trading services to financial institutions.

Other Validium projects are ApeX, Sorare, rhino.fi, and Brine.

Plasma
OMG: The OMG Plasma Network, is similar to OMGX but is built on the Plasma architecture, instead of an Optimistic Rollup. The project has been sunsetted.

Polygon: Polygon has also released a version of its Polygon sidechain discussed above as a Plasma chain that can exchange messages with other sidechains and rollups as discussed for the Polygon Proof-of-Stake sidechain. This network is used as the bridge between Polygon PoS and Ethereum Mainnet.

There are currently no other Plasma projects in operation.

Latest developments of the main near-term obstacles to enterprise adoption:

Education, Lack of Standards, and Interoperability

In our last report in 2021, three primary obstacles were identified to enterprise adoption of Layer 2 solutions: a lack of standards, a lack of interoperability, and "untrusted crypto". The same report suggested a two-pronged approach to tackle those problems; education and standards development. Two years later we can now report on the advances that have been made so far.

Education Efforts

There are enormous efforts in the L2 ecosystem underway to advance the state of zero-knowledge technology as evidenced by the numerous new zk-Rollup projects discussed in this report. However, there is a significant developer shortage for both these new zk-Rollup projects and enterprises to utilize them. Therefore, a proposal for an Open Source Zero-Knowledge Technology Education Series has been made to accelerate the closing of this global gap. Such a series could be utilized by any individual or enterprise to informally skill up to either improve their market value or the skill level of their developers and by any educational organization either accredited or unaccredited to be packaged into different certificate courses.

L2 Standards Efforts

To address the lack of standards in the L2 ecosystem, a Layer 2 standards working group was created within the EEA Community Projects umbrella in early 2022 with the following goals:

- Develop standards and methods for Layer 2 Blockchain protocols that minimize harm to EVM-compatible public Blockchains. For example, support Zero Maximal Extractable Value (MEV) or do not reduce economic security assurances,
- Develop standards and methods for Layer 2 Blockchain protocols that optimize value along multiple value dimensions. For example, Total-Value-Locked (TVL), MEV, security, accessibility, asset diversity, etc.,
- Develop standards and methods for Layer 2 Blockchain protocols that further ecosystem diversity e.g. making EVM-compatible public Blockchains attractive for enterprises, increasing the number of monthly users (MUs);
- Develop standards and methods for Layer 2 Blockchain protocols that reduce adoption friction for enterprises, tooling, and mainstream software developers
- Develop standards and methods for Layer 2 Blockchain protocols that can further equitable access and usage of EVM-compatible public Blockchains. For example, low L2 transaction fees, transaction diversity in blocks, etc.
- Develop standards and methods that facilitate interoperability between applications and different Layer 2 Blockchain protocols, and among different Layer 2 Blockchain protocols and EVM compatible Layer 1s.

- Gather and document information about existing L2 EVM-compatible public blockchains to understand existing implementations and how they would meet and relate to the standards that are being developed.

Some initial good progress has been made since then:

- The Canonical Token List standard is an official EEA Communities Draft with one active implementation by the Linea project. One more implementation is needed to complete for the Draft to become a full standard.
- The Canonical Token List standard is also an Ethereum Improvement Proposal (EIP) in draft status.
- The EVM-based Address Aliasing standard is an official EEA Communities Draft.
- The EVM-based Address Aliasing standard is also an EIP in draft status.
- The working group also started its journey towards L2 interoperability standards by creating a first draft of definitions of L2 transaction fees; a common language is key for L2 interoperability in the long run.
- Currently, the working group is focused on creating an L2 transaction data fee standard.
- Two thought leadership pieces on L2s and Digital Assets with Residual Payments and on the current state of L2 bridges were also published by the working group.
- Furthermore, active collaborations were started with the EEA CrossChain Interoperability Working Group and with L2BEAT.

Interoperability

The EEA Community Project's Layer 2 Standards group created a detailed report on the current state of development in the Layer 2 Bridges ecosystem which is solving the interoperability challenges in very different ways. The efforts have not converged and it will likely take more time until truly robust and secure solutions have solidified.