

The Rollups-as-a-Service Primer

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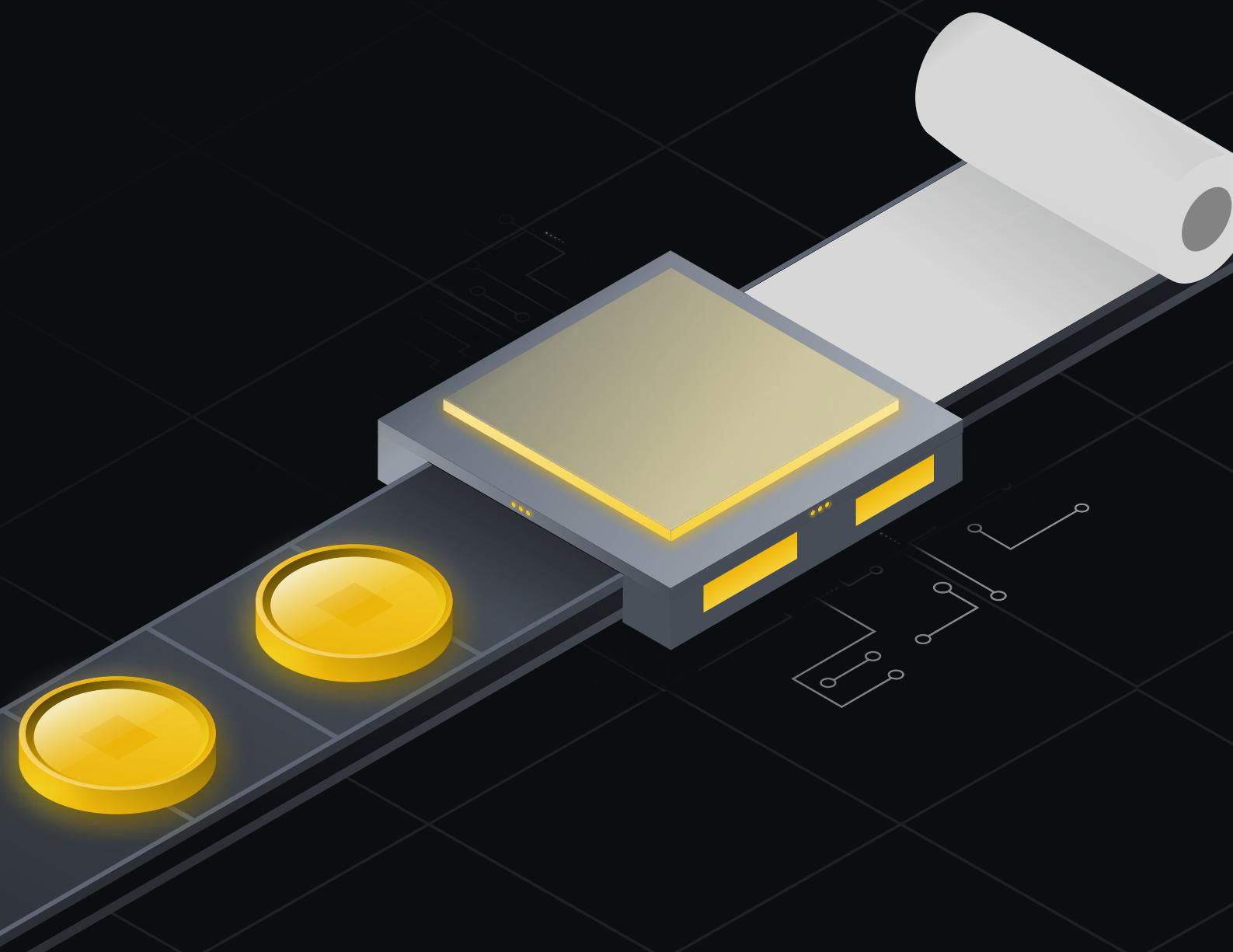


Table of Contents

Key Takeaways	2
Introduction	3
Why So Many Rollups?	4
Options for Developers	5
1. Deploying on an Existing L1	5
2. Deploying on an L2	6
3. Deploying as an Application-Specific Blockchain (“Appchain”)	7
4. Deploying on Your Own Rollup	8
The Growing RaaS Ecosystem	9
Notable Projects	11
Conduit	11
AltLayer	15
Caldera	17
Gelato	20
Lumoz	23
Outlook and Closing Thoughts	25
References	27
Latest Binance Research Reports	28
About Binance Research	29
Resources	30

Key Takeaways

- ❖ Rollups are the most popular types of Ethereum Layer-2 (“L2”) scaling solutions and are the primary venue for activity occurring outside the Layer-1 (“L1”). There are two types of rollup solutions: optimistic and zero-knowledge (“zk”).
- ❖ A number of major rollups have recently launched solutions that make it possible for developers to launch new rollups based on their technology. Examples include Arbitrum’s Orbit chains, Optimism’s OP Stack chains, and zkSync’s Hyperchains.
- ❖ Rollup-as-a-service (“RaaS”) providers are the next step within the ecosystem. RaaS providers help users deploy and maintain their own rollups. To facilitate this, they provide a range of solutions and services, from rollup management to no-code deployment.
- ❖ In general, developers can choose to deploy their dApp on an existing L1, deploy on a L2, create their own appchain, or launch a rollup. There are various advantages and considerations for each option. However, launching a rollup might provide the ideal balance between customization, performance, and effort, especially when considering the level of ease that RaaS solutions provide.
- ❖ Conduit has been a notable early participant in the RaaS space, initially focusing on launching OP Stack rollups and recently announcing support for Arbitrum Orbit. Conduit has helped launch rollups such as Zora Network, Mode, Public Goods Network, and Ancient8 Chain.
- ❖ Caldera is another major player focused on helping launch optimistic rollups. We also look at AltLayer and their innovative Flash Layers, which are disposable app-specific rollups that can be temporarily spun up to meet excess user demand.
- ❖ Gelato, an existing Web3 infrastructure provider who recently announced their RaaS offering covering both zero-knowledge and optimistic rollups, is another noteworthy player. We also cover Lumoz, which focuses exclusively on zero-knowledge rollups and brings an interesting hybrid consensus mechanism to the table.

Introduction

Rollups are the most popular types of Layer-2 (“L2”) scaling solutions and have come to dominate the Ethereum scaling universe. While other [solutions](#) like validiums, plasma, and sidechains exist, rollups continue to be the primary venue for activity occurring outside the Ethereum Layer-1 (“L1”) other than Polygon PoS (a sidechain).

As a reminder, **rollups execute transactions away from the L1 and then post their transaction data to it.** This allows Ethereum rollups, such as Arbitrum One and OP Mainnet, to be secured by Ethereum’s security. **There are two types of rollup solutions: optimistic and zero-knowledge (“zk”).** At a high level, the primary difference between the two is how they prove the validity of their transactions. Optimistic rollups assume transactions are valid and use fraud proofs to prove validity in the case of a challenge. Zk-rollups, on the other hand, use validity proofs to prove the validity of each transaction. This means that, while optimistic rollups have to post all transaction data (which is expensive and time-consuming) to the L1, zk-rollups only have to provide validity proofs. In practice, this means that zk-rollups are typically cheaper and faster to use compared to optimistic rollups.

To learn more about rollups, please check out the Layer-2 section in our [2023 Half-Year Report](#).

Figure 1: Eight out of ten of the top Ethereum scaling solutions are rollups

Logo	Name	Type of Solution	TVL (US\$B)	Market Share
	Arbitrum One	Optimistic Rollup	6.6	55.6%
	OP Mainnet	Optimistic Rollup	2.9	24.7%
	Base	Optimistic Rollup	0.6	4.7%
	zkSync Era	Zero-Knowledge Rollup	0.4	3.6%
	dYdX	Zero-Knowledge Rollup	0.4	3.2%

	Mantle	Optimum	0.1	1.2%
	Starknet	Zero-Knowledge Rollup	0.1	1.1%
	Immutable X	Validium	0.1	0.9%
	Loopring	Zero-Knowledge Rollup	0.1	0.8%
	Linea	Zero-Knowledge Rollup	0.08	0.7%

Source: l2beat.com, Binance Research, as of November 3, 2023

A number of major industry players have recently launched solutions that make it possible for developers to launch new rollups based on their technology. **Examples include Arbitrum's Orbit chains, Optimism's OP Stack chains, and zkSync's Hyperchains.** We cover a number of these solutions in our recent report, [The Layer-2 Evolution: Superchains, L3s, and More.](#)

Rollup-as-a-service (“RaaS”) providers are the next step within the ecosystem. **RaaS providers help users deploy and maintain their own rollups.** To facilitate this, they provide a range of solutions and services, from rollup management to no-code deployment. While some solutions have primarily focused on one rollup technology, e.g., Conduit and OP Stack, others, such as AltLayer, have cast a wider net. **A number of recently launched or announced rollups have partnered with RaaS solutions to help their deployment**, with providers steadily increasing the number of services they can offer.

In this report, we will explore the growing RaaS landscape, taking a close look at the leading projects in the space and what types of services they offer to developers. We also explore upcoming innovations and expected developments in the rollup market.

3

Why So Many Rollups?

RaaS providers are in the business of helping users deploy and maintain their own rollups. This can encompass a number of services, ranging from rollup management to no-code deployment. Before we dive deeper into this ecosystem, let's answer the question of **why there is a need for so many rollups in the first place.**

Options for Developers

Developers working on decentralized applications (“dApps”) of all kinds essentially have four options when deciding where to deploy.

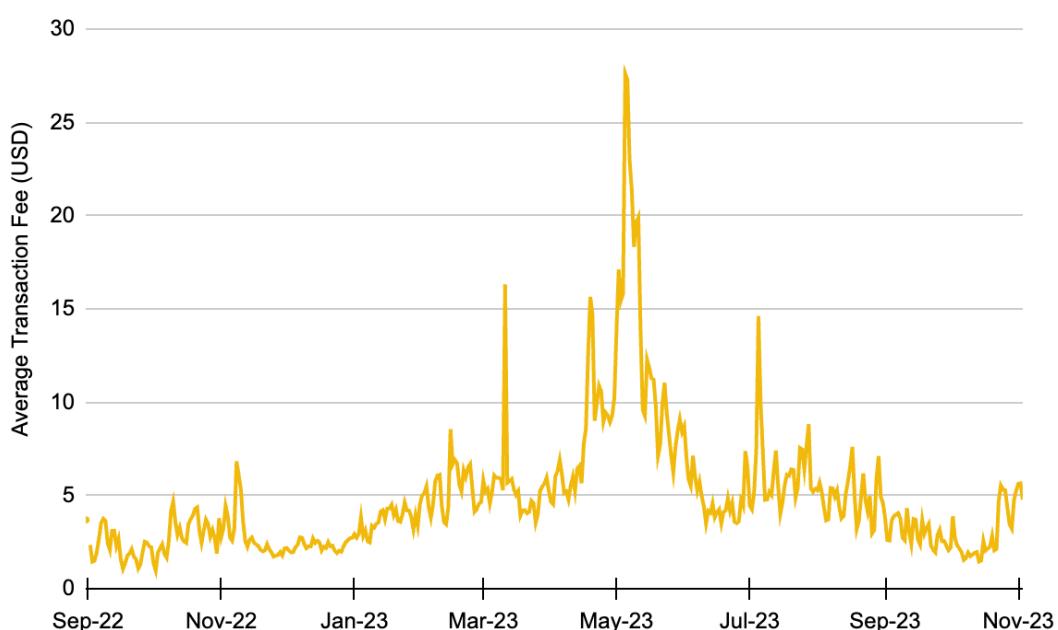
1. Deploying on an Existing L1

Some of the most successful crypto dApps on the market have used this classic method to deploy. Examples include the likes of Uniswap, Aave, and MakerDAO, who all started out by deploying on Ethereum as their first home before expanding to other chains.

The key **benefits** of deploying on an existing L1 include being **crypto-economically secured by the L1, along with the benefits of sharing an ecosystem with other native dApps**. This is particularly meaningful when deploying on a major L1 like Ethereum or BNB Chain, where there are significant network effects that dApps could benefit from.

On the other hand, the fact that each dApp shares blockspace with many others leads to inevitable **scalability and performance issues**. All of the applications on the L1 are **competing for limited blockspace. Given that blockspace is auctioned off in a market, higher competition leads to higher transaction costs** and a degraded and expensive user experience. This is an instance of the “**noisy neighbor problem**”⁽¹⁾ and is the reason why a hot NFT mint or a new memecoin on Ethereum might spike gas costs for all other participants of the chain, who might be using completely different applications.

Figure 2: Ethereum transaction fees can often demonstrate short-term spikes, affecting all users of the chain, regardless of which dApp they are using



Source: etherscan.io, Binance Research, as of November 4, 2023

2. Deploying on an L2

L2s were developed as a solution to the scalability problems of transacting on an L1 and have led to significant improvements in average transaction fees.

Figure 3: L2 rollups are significantly cheaper to transact with than the Ethereum L1

Logo	Name	Rollup type	Cost to send ETH (US\$)	Cost to swap tokens (US\$)
	Loopring	Zero-Knowledge	0.03	0.45
	Polygon zkEVM	Zero-Knowledge	0.03	0.49
	OP Mainnet	Optimistic	0.05	0.11
	zkSync Lite	Zero-Knowledge	0.05	0.12
	Arbitrum One	Optimistic	0.07	0.19
	Ethereum	Base Layer	0.75	3.75

Source: l2fees.info, as of November 3, 2023

Nonetheless, as **L2s gain popularity, they start to suffer from the same issues as L1s, namely, scalability constraints**. As each dApp is forced to compete with others for the same shared blockspace, fees can start to rise. Even if they do not spike to the same level as Ethereum, the fluctuations can be enough for many users to start getting priced out, especially for **transaction-heavy use cases such as gaming or SocialFi**.

Additionally, **deploying on a shared network (whether that be an L1 or L2) means that developers have limited scope for customization**. General-purpose L1s and L2s are designed to serve a wide variety of use cases, whereas some dApp developers might be looking for more optimized solutions. For example, consider a Web3 game that prefers quicker settlement and is willing to make a trade-off with a centralized sequencer. The developer cannot modify the specifications of a general-purpose L1 or L2 to fit this use case. However, they might be able to deploy a custom rollup with their particular needs taken into account.

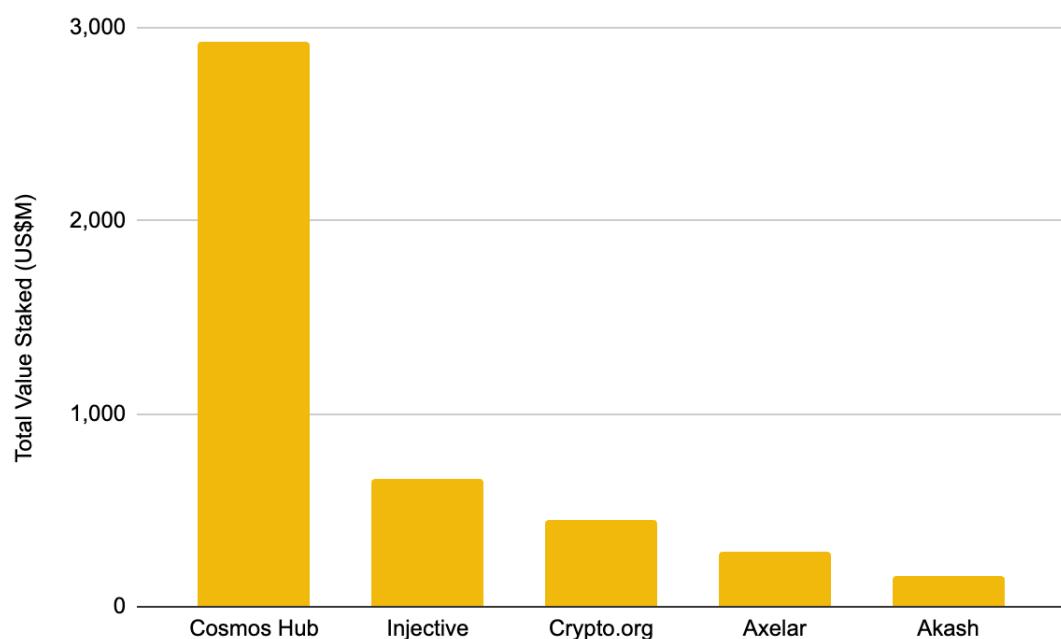
3. Deploying as an Application-Specific Blockchain (“Appchain”)

The appchain solution sits somewhere between deploying on an existing L1 / L2 and deploying on your own rollup. **Cosmos** is widely known as one of the biggest proponents of this solution and currently has **over 60 different “Zones”**⁽²⁾ (i.e., appchains that are connected to the Cosmos Hub and use Inter-Blockchain Communication (“IBC”)). You can learn more about Cosmos and its ecosystem in our recent report, [Modular Blockchains: The Race to Become the Top Security Provider](#).

While **appchains can provide developers with flexibility and allow for customizability** in their dApp design, there is still a **significant issue with security**. Cosmos appchains face the **expensive and time-consuming responsibility of bootstrapping a sufficiently staked and decentralized validator set**. This requires all Cosmos appchains to issue their own tokens, which has been met with varying degrees of success. Overall, for new appchains with a low token price and limited staking, this can be a difficult bottleneck to surpass and can make them attractive attack targets.

Although the advent of Replicated Security, which is essentially a method of rehypothecating security from a larger Cosmos appchain to a newer appchain, is a potential solution, this is still a relatively new concept and yet to gain major traction. We discuss this in more detail in the previously linked report above.

Figure 4: Outside the Cosmos Hub, crypto-economic security has been difficult to secure for other Cosmos appchains



Source: mapofzones.com, Binance Research, as of November 7, 2023

4. Deploying on Your Own Rollup

While the three solutions described above have been popular to varying degrees of success, there are clear trade-offs, and it should be evident that certain dApps will require a different solution.

Deploying on your own rollup means that **developers have a significant amount of flexibility when it comes to the design and specifications of how their dApp works**. They are not completely bound by the rules of Ethereum, Arbitrum, etc. In addition, **rollups inherit security from their settlement layer and do not have to concern themselves with the time-consuming and expensive process of bootstrapping a new validator set**. Perhaps most importantly, **deploying a dApp on its own rollup means that there is no competition for limited blockspace like there would be if you were to deploy on a shared L1 or L2**. This provides the dApp with its own **isolated fee market**, which then creates a better user experience as users do not have to battle spiking transaction prices resulting from completely unrelated dApps.

Another point we should mention is **sustainability**. In general, users pay transaction fees for rollups to sequence and submit their transactions to the settlement layer, i.e., the L1. The rollup pays some of these fees to the L1 as a settlement fee and keeps the rest as profit. In this way, if a **builder chooses to launch a rollup, they can capture this profit and therefore create an economic model for themselves**. This would not be possible if the builder chose to launch their product as a dApp on an existing L1 or L2. Launching their own rollup, with the caveat that it is successful and generates user fees, allows them to create an additional source of revenue and thus create a more sustainable business model for themselves as compared to the other options available.

One **possible consideration is liquidity**. Naturally, **general-purpose public chains like Ethereum will hold the most liquidity as a result of the significant network effects they have been able to accrue**. Transferring this liquidity into these custom rollups will require **safe and efficient bridging channels or their own fiat on-ramps**. This means that deploying your own rollup might not be entirely suitable for all types of dApps, some of which might be better served by joining the larger liquidity pool of an existing L1 or L2. However, for many others, efficient bridging and cross-chain solutions can render liquidity a non-issue. Additionally, they can take advantage of the other benefits that come from deploying their own rollup. It is perhaps a combination of these reasons that explain why we are seeing increased excitement and interest around launching your own rollup and more projects deciding to take this route. This is where RaaS solutions come in.

The Growing RaaS Ecosystem

As described above, RaaS providers help developers deploy and maintain their own rollups. While this is a growing sub-sector within crypto, there are a small number of key projects that have been spearheading the movement. In this section, we will take a closer look at some of the most notable projects on that list and cover some of the upcoming players.

Figure 5: Key metrics for our covered RaaS providers

Logo	Name	Stage of Development	Type of Rollup(s)	Rollup Ecosystems	Notable Chains Launched
	Conduit	Mainnet	Optimistic	OP Stack, Arbitrum Orbit	Zora Network, Public Goods Network, Ancient8 Chain, Mode
	AltLayer	Testnet	Optimistic and Zero-Knowledge	OP Stack, Arbitrum Orbit, Polygon CDK, StarkNet	Various testnet chains
	Caldera	Mainnet	Optimistic	OP Stack, Arbitrum Orbit	Curio, Loot Chain, Manta Pacific
	Gelato	Mainnet	Optimistic and Zero-Knowledge	Polygon CDK, OP Stack	Astar zkEVM (testnet)
	Lumoz	Testnet	Zero-Knowledge	Polygon CDK, zkSync, Scroll, StarkNet	Only a few early testnet chains currently deployed

Source: Company documentation, as of November 3, 2023

Value capture for RaaS providers can come from a variety of places. There are **fees** associated with helping a team simply launch their rollup, as well as a number of

infrastructure services that can be provided, e.g., data storage, transaction monitoring, full node operation, hosting the sequencer, etc. Some teams provide a **white-glove service** to help rollup teams make decisions and undergo technical upgrades. RaaS providers can also **charge some percentage of the total sequencer fees generated by the rollup**. As a reminder of the general business model of a rollup, users pay transaction fees to L2 rollups to sequence and submit their transactions to the L1. The L2 pays some portion of these fees to the L1 for submission and captures the rest as profit. If an RaaS provider can capture some of this profit, it could be a great way to capture additional upside.

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For companies that may not have dedicated teams that will have an opportunity to run and manage the rollup in production, **RaaS providers can provide a very useful service and help reduce the burden and increase the range of products that might be built in a rollup**. There are a lot of talented teams in Web3 that do not have protocol developers, system engineers, operations staff, etc. Thus, a lot of teams have good ideas but not the personnel to launch and manage a chain. This is where RaaS providers can truly add value.

Notable Projects

Conduit

Conduit is an RaaS platform that allows developers to easily launch their own **optimistic rollups**. While Conduit initially focused exclusively on the OP Stack, they also recently added support for [Arbitrum Orbit](#). The **Conduit team operates and maintains the rollups** so that developers can focus on building products rather than dealing with infrastructure.

Since launching their **mainnet** in March 2023, a number of different OP Stack chains, including **Zora Network, Public Goods Network, Ancient8 Chain, and Mode, have chosen to partner with Conduit** in launching their rollups. Conduit also recently collaborated with the Uniswap Foundation⁽³⁾ to announce an OP Stack rollup to serve as a Uniswap v4 sandbox for developers to experiment with. Given that they only recently announced support for Arbitrum Orbit, we are yet to see any rollup launches with the Arbitrum suite.

❖ What Services Does Conduit Provide?

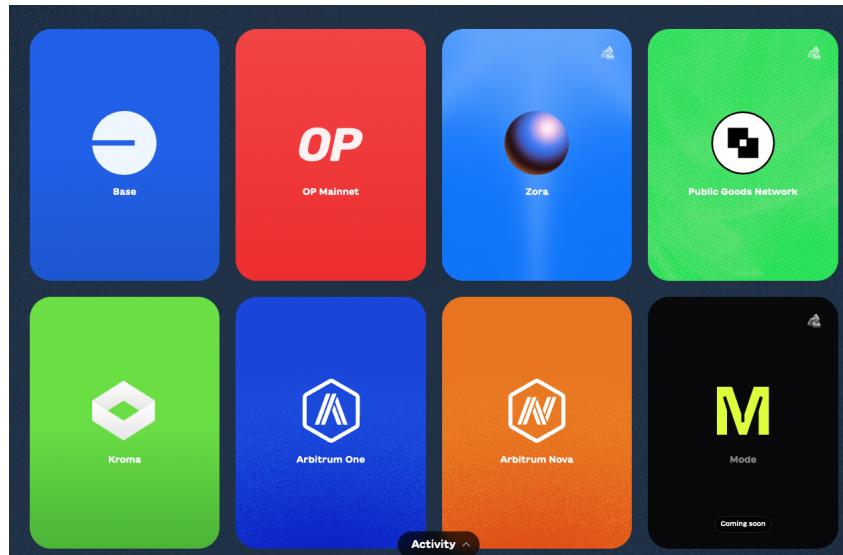
- Conduit helps with all aspects of launching and maintaining an L2 rollup. While launching your own application-specific rollup can take weeks to months of development and engineering effort, Conduit's solutions allow developers to spin up an L2 in minutes.
- Conduit's deployments come with a **block explorer, transaction tracer, autoscalable RPCs (which are crucial to build dApps), logs, chain monitoring**, and more.
- The Conduit team will also ensure that each of their partner L2s is **automatically updated with the latest OP Stack code base and integrated into the Optimism Superchain** (when available).
- Rollup teams that launch with Conduit are also eligible to **earn a share of the sequencer fees and MEV from their rollups**⁽⁴⁾. Part of the fees will also be committed to the Optimism Collective for public goods funding.

❖ Conduit Integrations

- [Integrations](#) are part of Conduit's rollup management service and allow their rollup partners to **connect with other helpful infrastructure projects**. Examples include Token Terminal, The Graph, Axelar, Snapshot, etc.
- This further adds to Conduit's all-in-one infrastructure and makes it easier for rollups to grow their user base after launching.
- A notable recent example was **Conduit's first native integration with Superbridge**, a bridging protocol that allows users to bridge from Ethereum

to various OP Stack-based chains. Superbridge also recently added support for bridging to Arbitrum One and Arbitrum Nova, with additional support for Arbitrum Orbit chains⁽⁵⁾. This integration makes it **very simple for Conduit's OP Stack and Arbitrum Orbit rollups to quickly launch a bridging interface**, an important feature given the integral importance of being able to efficiently bridge funds from L1 to L2 in the rollup model.

Figure 6: The Superbridge user interface

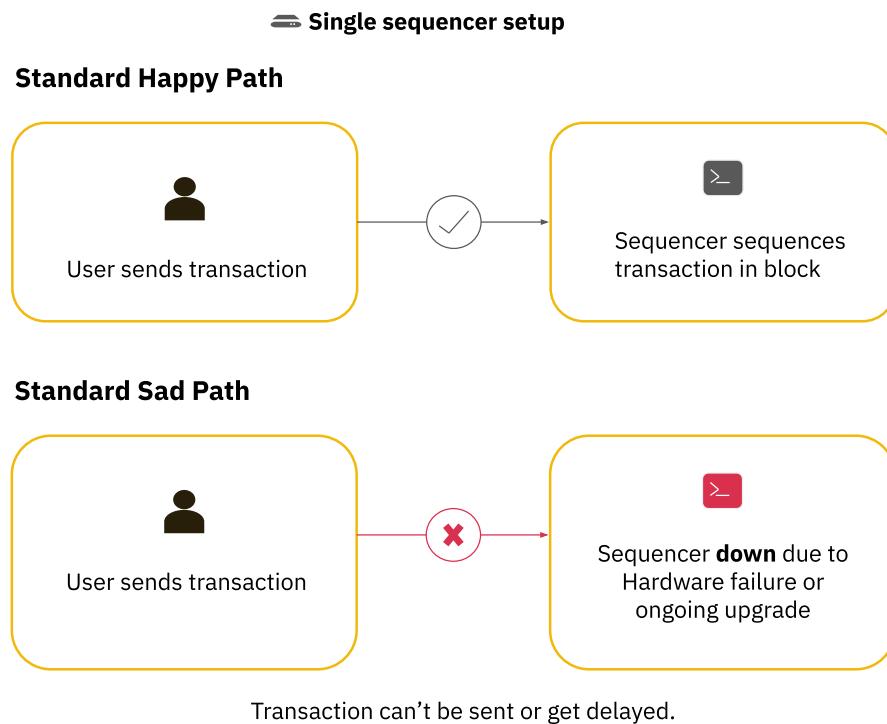


Source: superbridge.app

❖ **Conduit Elector**

- Elector is a consensus layer that helps **reduce sequencer downtime** for OP Stack-based chains. Specifically, Conduit states that Elector will reduce downtime by over 50%⁽⁶⁾.
- The **standard OP Stack configuration comes with only one sequencer**. If there is an update to the software required or if there is any sort of hardware failure, the **sequencer can go down**, preventing the rollup from producing any blocks. This means that **transactions get delayed and users cannot interact with the rollup, affecting revenue and performance**.

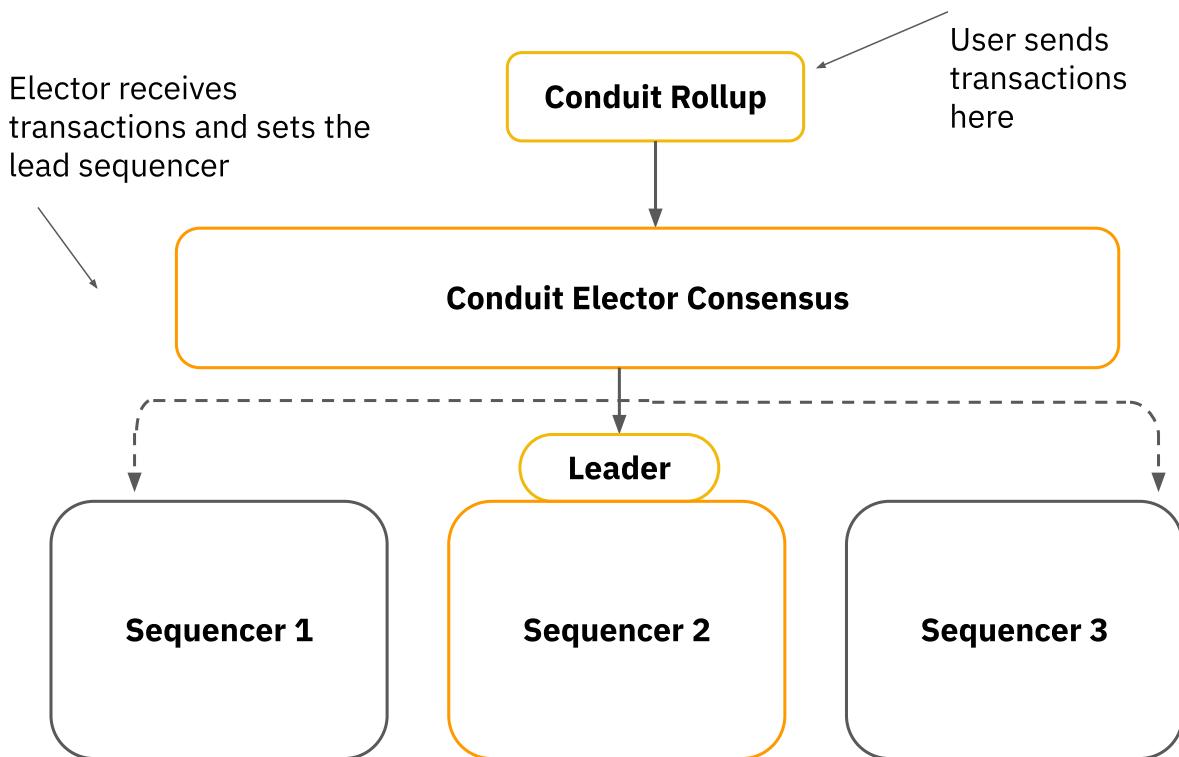
Figure 7: The standard single sequencer setup can affect rollup performance in case of an outage



Source: Conduit documentation, Binance Research

- Conduit Elector solves this issue by functioning as an automated election protocol running on top of the OP Stack. **Elector includes three sequencers, who can all be elected to be the leader** in case the others are down. Conduit claims that through this solution, they can offer **“99.95%+” uptime guarantees** for every Conduit OP Chain.
- Elector also **allows Conduit to update software and infrastructure with zero downtime**. All existing Conduit OP Chains have been upgraded to use Elector, while new chains will use it from genesis. Founder Andrew Huang also stated that “in the future, variations of this technology can be used for shared sequencing,”⁽⁷⁾ which could be an interesting future story to follow.
- To learn more about shared sequencers and the potential issues with running a single-sequencer setup, please check out our recent report, [Ethereum’s Rollups are Centralized. A Look Into Decentralized Sequencers](#).

Figure 8: An illustration of how Conduit Elector works



If the leader is unavailable or down, Elector will automatically choose another sequencer

Source: Conduit documentation, Binance Research

❖ **Funding**

- Conduit has also raised a **US\$7M seed round⁽⁸⁾** (led by Paradigm).

AltLayer

AltLayer is also an **RaaS** protocol that allows developers to launch both optimistic and zk-rollups. AltLayer's platform is designed for a **multi-chain and multi-VM** world and thus **supports EVM as well as WASM** (used by Cosmos, Polkadot, etc.). AltLayer also has plans to support the Solana VM (Sealevel) and the Move VM⁽⁹⁾.

AltLayer supports Arbitrum Orbit, Polygon CDK, and others alongside the OP Stack.

AltLayer is **currently in testnet**.

❖ What Do They Offer?

- AltLayer's product offering consists of **three core components**:
 - i. **No-Code Dashboard**: This allows developers or even users with limited coding experience to **spin up a customized L2 rollup within minutes**. Customization includes network-level (e.g., number of sequencers) and chain-level (e.g., block gas limit) parameters, alongside middleware such as bridges and RPCs.
 - ii. **Rollup SDK**: An alternative to the no-code dashboard for developers who would like to integrate the rollup service directly into their own offering.
 - iii. **Shared Sequencer Set**: AltLayer uses a common network of nodes called the Beacon Layer (more detail below), which can serve as a shared sequencer set for L2 rollups deploying with AltLayer. This also makes **cross-chain atomic transactions and messaging** possible with other L2s that launch with AltLayer.
- Other than supporting various rollup SDKs, AltLayer also supports a number of different data availability solutions, sequencer sets, and interoperability platforms.
- An interesting recent innovation has been AltLayer's partnership announcement with RISC Zero to bring "on-demand" zk-proofs to optimistic rollups. More details can be found in their blog post [here](#).

❖ The Beacon Layer

- AltLayer offers a core network called the Beacon Layer. **The Beacon Layer is an intermediate layer between the execution layer of the L2 and its data availability layer**.
- The Beacon Layer facilitates a number of services, including providing a shared sequencing layer, a verification layer, a staking/slashing layer, an

interoperability layer, and more. Each rollup can be verified by the nodes of the Beacon Layer and will also have a trust-minimized bridge to it.

- Given that every AltLayer rollup will have a bridge to the Beacon Layer, it will act as a bridging hub to allow asset transfers and messaging between rollups, thereby increasing interoperability.

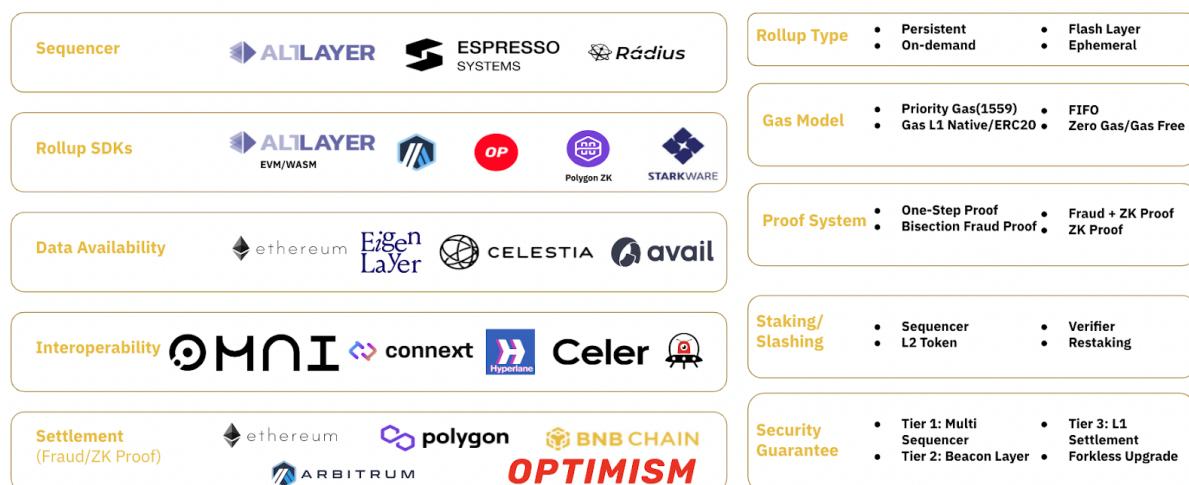
❖ Flash Layer Rollups

- Flash Layers (also called **ephemeral rollups**) are **disposable application-specific rollups**. With Flash Layers, a developer expecting an increase in traffic for their application can quickly spin up a disposable, temporary rollup and then dispose of it when demand tapers off.
- Flash Layers can be **extremely useful in high-traffic events⁽¹⁰⁾ such as NFT mints**, mini-games, event ticketing, etc. These events, particularly hot NFT mints, often cause a large spike in traffic for a short period of time and can cause significant fluctuations in gas fees on L1 networks. Being able to use Flash Layers to prevent the clogging up of the L1 can be very helpful for events like this. Interestingly, AltLayer has announced a collaboration with EigenLayer to secure Flash Layers through restaking⁽¹¹⁾.
- AltLayer also offers **standard optimistic rollups** as part of their platform. Dubbed “**Persistent Rollups**,” these are more ideal for longer-term applications, e.g., GameFi, SocialFi, etc.

❖ Funding

- AltLayer raised a US\$7.2M seed round⁽¹²⁾ in 2022 (led by Polychain Capital).

Figure 9: AltLayer’s versatile rollup stack supports a variety of protocols



Source: AltLayer documentation, Binance Research

Caldera

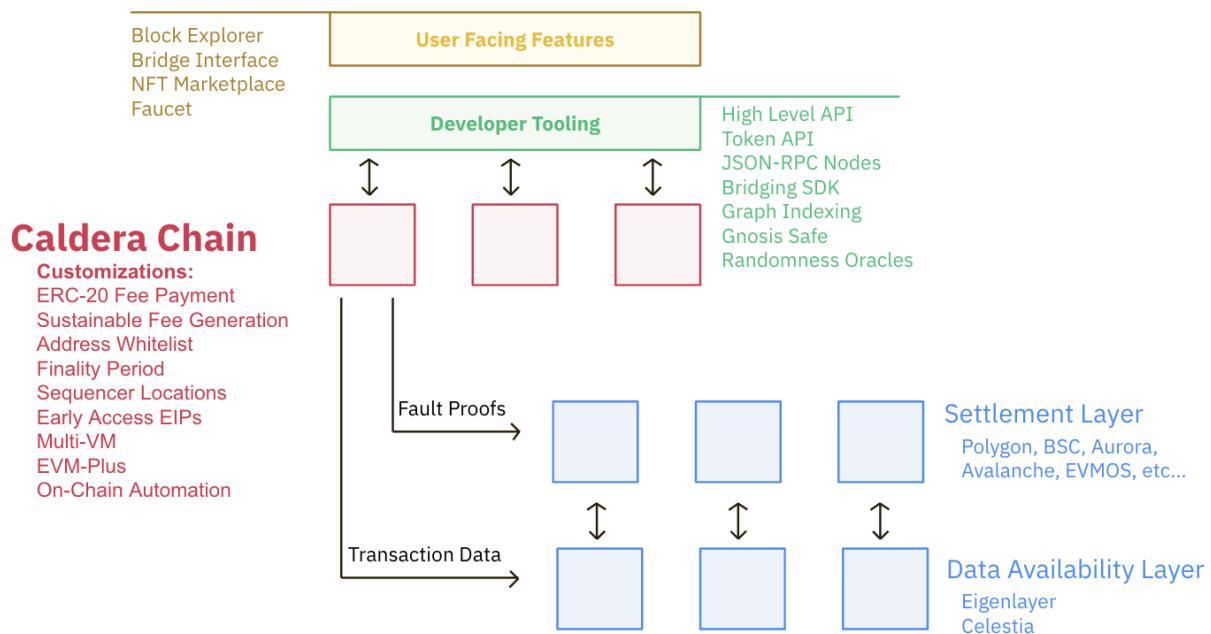
Caldera allows users to create **Caldera Chains**, which are L2 optimistic rollup chains that utilize either the OP Stack or Arbitrum Orbit frameworks. Caldera bills itself as a one-stop shop to deploy rollups, providing developers with all the tooling and resources they need to effectively launch their own optimistic rollups.

In addition to providing all sorts of developer tools such as block explorers, faucets, bridges, etc., Caldera also allows for **gas token customization**. This will allow developers to set their native project token as the gas token or even completely remove gas fees, which could be very useful for certain use cases, e.g., Web3 gaming.

❖ Architecture

- Caldera allows Caldera Chains to **settle on all EVM-compatible chains**, ranging from the likes of Ethereum and BNB Chain to Polygon and Avalanche. Additionally, they also employ **fault proofs** (also known as [fraud proofs](#)) to increase the security of their platform.
- Caldera takes a modular approach to their platform and allows their chains **flexibility in choosing a data availability partner⁽¹³⁾**. This can either be the EVM settlement layer or a dedicated data availability layer such as Celestia or EigenDA.

Figure 10: An illustration of the various levels of customization available to Caldera Chains



Source: Caldera documentation, Binance Research

❖ Chain Customization

- Caldera allows developers a wide range of customization options so that they can tailor their Caldera Chain to their specific use cases. You can see a list of possible customizations in Figure 10.
- Developers can choose to use any ERC-20 token for fees, have the ability to whitelist addresses that can interact with their chain, and can also **set their own finality periods**, allowing for different levels of finality and security for different use cases. Caldera is also building features that will allow their chains **early access to Ethereum Improvement Proposals (“EIPs”)**, i.e., developers can use new capabilities before they are implemented on the Ethereum mainnet.
- Support for **multiple virtual machines** (“VMs”), such as the Solana VM or the Move VM, as well as **on-chain automation**, are also features worth mentioning. More details can be found in their [official documentation](#).

❖ Developer Tooling

- Caldera Chains provide in-built support for a number of useful tools to create a developer-friendly environment. Notable examples include **account abstraction tools using Biconomy and support for Gnosis Safe** for asset custody and management.
- Caldera features **over 30 integrations** with a number of major industry players to equip their developers with the best tools for their Caldera Chain.
- Another interesting service that Caldera is able to provide their rollups is **“Whitelabel Docs”⁽¹⁴⁾**. Caldera can work with rollup teams to create their own set of documentation, which includes frequently asked questions, developer queries, etc. Services like this can help empower developers building with Caldera and educate their wider ecosystem.

❖ User Features

- Other than the usual block explorers, token faucets, etc., Caldera also boasts a partnership with **Hyperlane to provide permissionless interoperability** between both Caldera Chains and with other EVM-compatible chains.
- Caldera Chains also provide built-in features for creating, using, and trading NFTs. It will be interesting to see if Caldera is able to attract an outsized amount of NFT-related rollups to their platform using these features.

❖ Espresso Systems Partnership

- In July, Caldera announced a partnership with the decentralized sequencing protocol, Espresso Systems. The platforms **worked together to deploy an OP Stack rollup built with Caldera and integrated with Espresso's decentralized shared sequencing solution**. The rollup is called **Vienna** and was recently deployed to testnet⁽¹⁵⁾.
- Vienna was built with and has developer tools provided by Caldera, while using Espresso for sequencing and data availability. It is a **good test case for developers who are building with Caldera** and want to decentralize their sequencing using Espresso. To learn more about Espresso and decentralized, shared sequencing, please check out our recent report, [Ethereum's Rollups are Centralized. A Look Into Decentralized Sequencers](#).

❖ Notable Chains

- Caldera has been [working](#) with on-chain gaming studio Curio to create custom rollups to help develop fully on-chain Web3 games.
- Caldera has also worked with the Loot ecosystem to launch its Loot Chain⁽¹⁶⁾, as well as Manta Network on their Manta Pacific chain⁽¹⁷⁾.
- Caldera also has a further list of partners that they are working with to launch Arbitrum Orbit chains⁽¹⁸⁾. These partners include Syndr, Sanko GameCorp, and Volatilis Technology.

❖ Funding

- Caldera has raised US\$9M across two funding rounds, as announced earlier this year⁽¹⁹⁾.

Gelato

Gelato is an infrastructure and tooling provider that recently announced the latest offering in its product suite: a **zero-knowledge (“zk”）RaaS solution**. Gelato’s zkRaaS lets users **create zk-rollups that use the Polygon Chain Development Kit (“CDK”)**. Gelato recently announced the launch of the testnet of their first client, the Astar zkEVM⁽²⁰⁾. In addition to their zkRaaS, Gelato also has plans to add support for the OP Stack, i.e., optimistic rollups.

❖ Background

- Prior to introducing their zkRaaS, Gelato was involved in providing a range of backend infrastructure services to **EVM-compatible chains**, including Ethereum, BNB Chain, Polygon, Avalanche, and others. Gelato has been heavily involved in smart contract automation services, which address volatility and liquidity issues and help simplify crypto for end users.
- Outside their zkRaaS, Gelato currently offers **four main services**⁽²¹⁾:
 - i. **Web3 Functions**: Allows developers to connect their on-chain smart contracts to off-chain data by running decentralized cloud services.
 - ii. **Automation**: Automates smart contracts and executes transactions automatically in a developer-friendly and decentralized manner.
 - iii. **Relay**: Gelato can handle translation validation in a quick and efficient manner. This improves UX and enables features such as gasless transactions. Gelato Relay’s [integration](#) with Gnosis Pay was a notable recent highlight.
 - iv. **Gasless Wallet SDK**: Gelato has partnered with Safe to develop a powerful account abstraction software development kit (“SDK”) to enable builders to provide a smooth UX for wallets.

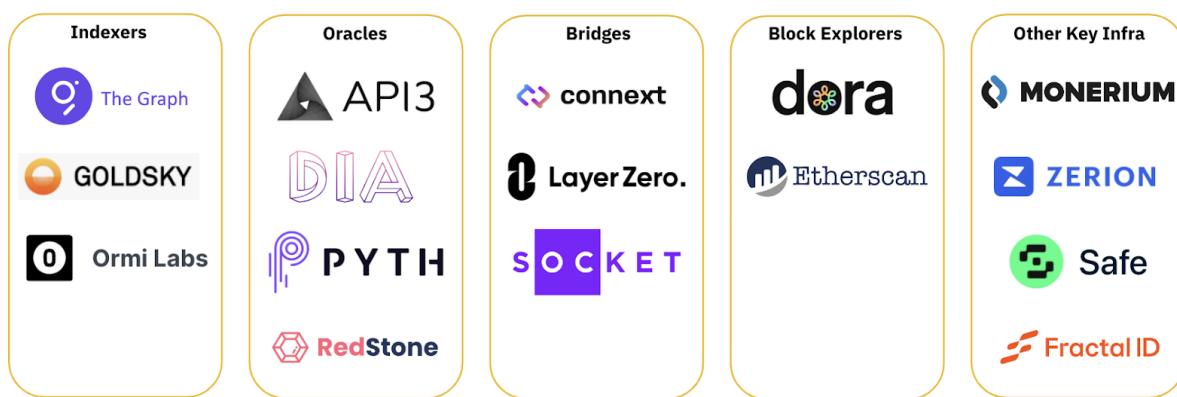
❖ zkRaaS

- In early September, Gelato announced⁽²²⁾ its zkRaaS solution. Working with the [Polygon CDK](#), Gelato’s zkRaaS helps developers launch zk-rollups “in a single click”⁽²³⁾. Their core features include **hosting, monitoring, and operating the rollups** for the developer team. Rollups will also benefit from essential tools such as block explorers, indexers, faucets, and more.
- Rollups that launch with Gelato will also have **access to their other infrastructure solutions, including native account abstraction, smart contract automation, Web3 functions**, etc. This could give Gelato’s solution an advantage over some of its newer competitors, given that Gelato is an existing infrastructure provider and thus has an existing suite of products and middleware services that can complement their zkRaaS.

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- Gelato zkRaaS has launched with a list of **over 15 infrastructure partners** to help provide their rollups with a number of different middleware services from the start. Partners include the likes of LayerZero, Pyth, The Graph, and more.

Figure 11: Gelato’s zkRaaS features partnerships with the following service providers from launch



Source: Gelato Twitter, Binance Research

- Polygon’s CDK is an **open-source, modular codebase that developers can use to launch their own zk-powered rollups**. This also includes the tools to launch **your own zkEVM**, a notable feat given the intense discussion surrounding zkEVMs over the last year or so. The CDK offers all sorts of choices for developers, including choosing between rollup or validium mode, various data availability solutions and execution environments, sequencer choice, etc. Gelato can help developers make the right choices for their use case and walk them through the customization process.

To learn more about zkEVMs, check out our recent report, [The zkEVM World: An Overview of zkSync](#).

❖ **Astar zkEVM Testnet**

- Astar Network’s zkEVM testnet (dubbed the zKatana testnet) represents the **first zkRaaS client of Gelato that has launched a testnet**. Astar offers customizable blockchain solutions to accelerate Web3 adoption and has an established presence in their home market of Japan.

- The **Astar zkEVM is the latest addition to its tech stack** and provides developers with more choice and optionality when creating applications in the Astar ecosystem. This solution fits in alongside their existing Astar Substrate solution, built on top of Polkadot.

- ❖ **Support for OP Stack**

- Gelato has also announced plans to add support for OP Stack chains, meaning that they **will be able to help developers deploy both zk and optimistic rollups**. Given that they are one of the only solutions that provide support for zk rollups, the functionality to also work with optimistic rollups will be a welcome addition to its product suite. Add to this its existing suite of infrastructure services, and we can see how Gelato is well positioned in the budding RaaS market.

- ❖ **Funding**

- Gelato's most recent round of funding came in 2021, when they raised a US\$11M Series A round⁽²⁴⁾.

Lumoz

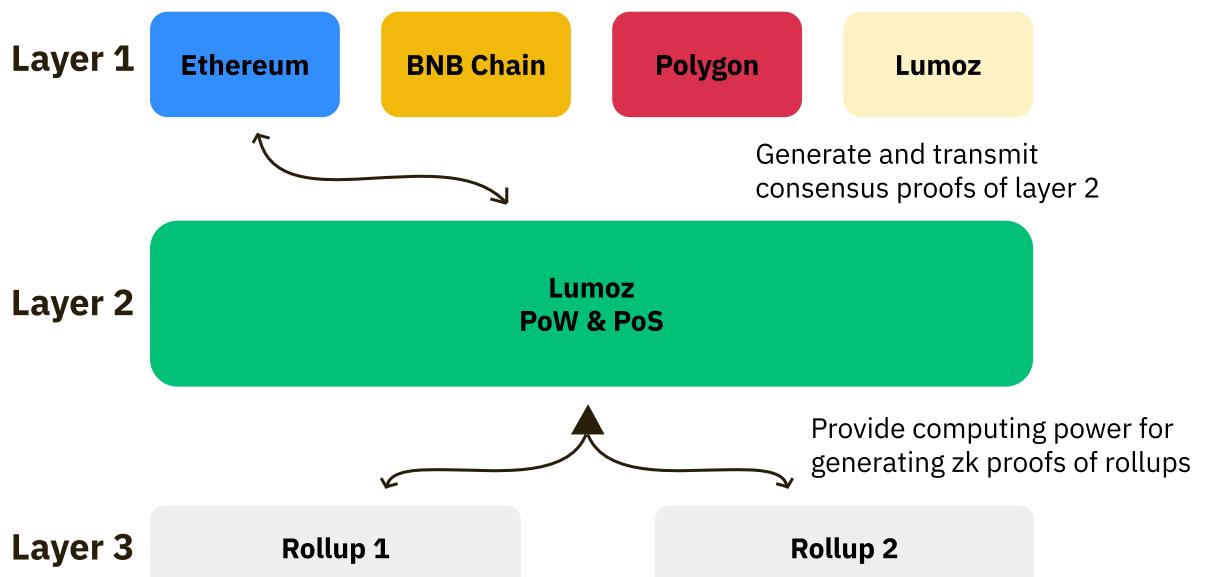
Lumoz is a **zkRaaS** platform that utilizes an innovative hybrid consensus mechanism including proof-of-stake (“PoS”) and proof-of-work (“PoW”). Lumoz supports multiple chains to function as base settlement layers, as well as multiple types of zkEVM solutions and data availability layers.

Lumoz recently rebranded from its previous name, Opside. They have been in testnet since May, with a mainnet launch expected in early 2024.

❖ **Architecture**

- Lumoz offers developers a zk-rollup “[LaunchBase](#)” that lets them deploy different types of zk-rollups with a choice of multiple settlement layers. At present, **developers can choose to settle on Ethereum, BNB Chain, Polygon, or Lumoz** itself.
- Developers can then choose the type of zkEVM they would like to launch. Currently, they **can be built using Polygon zkEVM, zkSync, Scroll, or StarkNet**. They can also choose to use \$ETH or customize their gas token.
- Lumoz also offers a number of **different choices for data availability**, including Ethereum, Celestia, EigenDA, and more. Finally, developers can choose to use Lumoz’s PoS sequencer or integrate with Espresso’s shared sequencing solution.

Figure 12: Lumoz’s architecture



Source: Lumoz documentation, Binance Research

❖ Hybrid Consensus

- Lumoz operates a **three-layer system**, with the base settlement chain at the top, an EVM-compatible and rollup-friendly L2, followed by multiple zk-rollup chains in the Layer-3.
- The **PoS** part of the consensus is fairly standard. Validators can stake Lumoz's native token and are **responsible for verifying the validity of blocks** that are sent from the various rollups to the Lumoz L2 before they are sent for settlement. If a validator behaves dishonestly, their stake can be slashed.
- In order to support the extensive hardware resources required by numerous L3 zk-rollups, **Lumoz utilizes the services of miners to generate zk-proofs on behalf of these rollups**. This constitutes **Lumoz's PoW mechanism**. As we described in the [introduction](#), zk-rollups require the computation of proofs to prove the validity of each transaction. It is these proofs that the miners generate. More details can be found in their documentation [here](#).

❖ Offering

- After a developer spins up their zk-rollup, they can integrate various additional features into it, including block explorers, oracles, wallets, DEXes, etc.
- Lumoz also provides developers with an account abstraction toolkit and the ability to create a decentralized identity system for their rollup (in partnership with Space.ID and others).

❖ Testnet Chains

- There are currently 16 Lumoz chains in testnet with over 4.5M transactions across more than 150K addresses⁽²⁵⁾.

❖ Funding

- Lumoz has raised a US\$4M seed round⁽²⁶⁾.

Outlook and Closing Thoughts

It seems that almost every week we hear of a new dApp choosing to launch their own rollup rather than competing for the limited blockspace and thus higher transaction fees of existing L1s. With the increasing popularity of RaaS solutions, we expect to continue seeing this proliferation of rollups in the coming weeks and months.

An interesting set of developments to **closely monitor is how the costs of sending your data, i.e., settling, on the Ethereum L1 will trend over time**. The biggest cost for any rollup is the fee to settle its data on the L1, and in order to pay for this, they have to generate a sufficient amount of user fees. This serves as a limit to the types of rollups that are possible because products that might generate lower amounts of user fees might not be suitable for their own rollup, as the developers cannot generate enough fees to settle on Ethereum. To bring in more of these types of dApps, there needs to be a reduction in the cost of settlement. Developments like [EIP-4844 \(Proto-Danksharding\)](#) will be crucial here, promising to “bring rollup fees down by orders of magnitude”⁽²⁷⁾. You can learn more about EIP-4844 and other upcoming Ethereum developments in our recent report, [Ethereum: Beyond The Merge](#).

Other important innovations that will impact these costs and thus make it cheaper to run rollups will be the **continued development and deployment of lower-cost data availability layers**. The most relevant example here is **Celestia**, which launched its mainnet last week. It will be interesting to see how Celestia progresses and which market players decide to use its data availability software rather than the more expensive native Ethereum option. Other **upcoming options also include EigenDA and Avail**. The combination of developments such as EIP-4844 and increasing innovation in the data availability market are likely tailwinds for rollups and RaaS providers.

The **struggle of power between RaaS providers and rollup frameworks like the OP Stack and Arbitrum Orbit is also worth considering carefully**. Rollup frameworks are observing the business model of RaaS providers and understanding the potential for value capture they can achieve, whether that be through directly taking a portion of sequencing fees, or through providing ancillary infrastructure services. **Naturally, any rollup framework might wonder whether they can enter this market themselves, particularly as they have the internal expertise behind the rollup software itself**. It is for this reason that it would not be surprising to see existing rollup frameworks create their own RaaS solution to help people deploy their rollup e.g., the OP Stack can bundle their rollup software with their in-house RaaS solution. An alternative option might be for a rollup framework to acquire an existing RaaS provider and essentially have it function as the business development arm for their rollup software, e.g., the OP Stack acquires Conduit.

Another angle that will be interesting to follow is **whether other existing Web3 infrastructure players will follow Gelato's lead and also enter the RaaS market**. While it is still relatively early days for RaaS, it is clear that Gelato has an advantage over some of the newer RaaS providers because they already have an existing suite of middleware products and services. This has undoubtedly made their pivot into RaaS more straightforward and **gives them an opportunity to leverage their existing product line and expertise**. Many other existing infrastructure players, including the likes of Alchemy or Infura, might see this and consider how their existing blockchain infrastructure expertise can help them enter and gain a good position in the RaaS market. If more providers decide to pivot or enter the RaaS space, we might see more rollups or higher-quality RaaS services, among other things.

RaaS providers are an interesting new sub-sector of the crypto market landscape and one that is innovating and growing fast. We look forward to seeing how things develop.

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