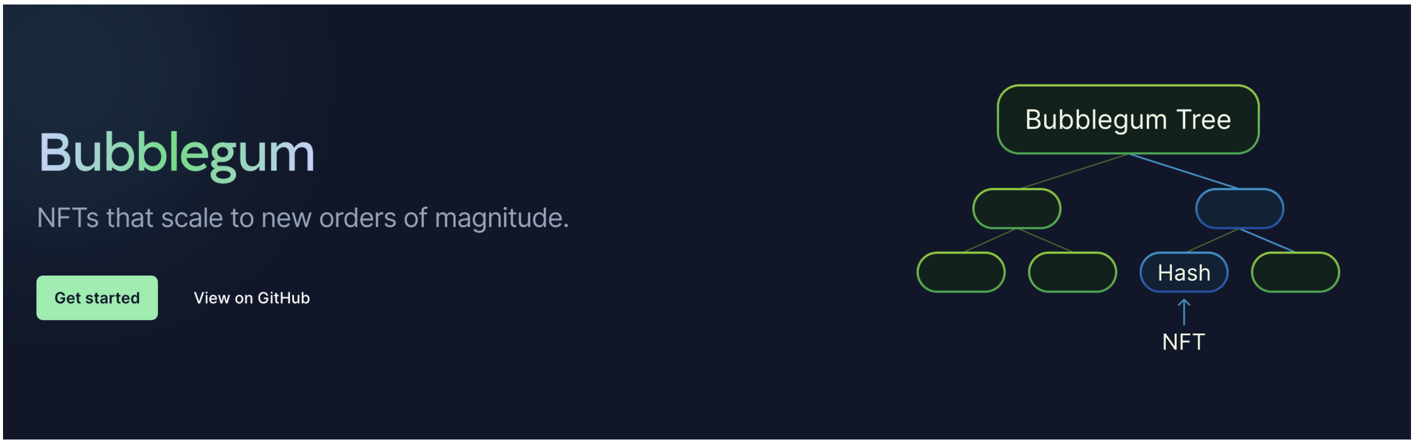
Lesson 16

> ## Compressed NFTs
>
> See Docs
> We have seen that NFTs with their metadata is stored on chain.
> This can be very expensive if you need to mint large numbers of NFTs
> Compressed NFTs were introduced to reduced this cost, they do so by storing the metadata off chain.
> They use state compression and merkle trees to store data off chain in a special ledger, but it is still made available for consensus.
>
> Metaplex have created the Bubblegum project to handle compressed NFTs
>
> 
>
>
> Compressed NFTs store all of their metadata in the ledger, instead of in traditional accounts like

uncompressed NFTs, so indexing services are needed to retrieve the metadata.
This indexing service is available from RPC providers such as

- Helius
- Triton
- SimpleHash

Creating a compressed NFT

- create an NFT collection (or use an existing one)
- create a concurrent merkle tree (using the `@solana/spl-account-compression` SDK)
- mint compressed NFTs into your tree (to any owner's address you want)

Transfering the NFT

1. get the NFT "asset" information (from the indexer)
2. get the NFT's "proof" (from the indexer)
3. get the Merkle tree account (from the Solana blockchain)
4. prepare the asset proof (by parsing and formatting it)
5. build and send the transfer instruction

For a walkthrough of this process see Docs

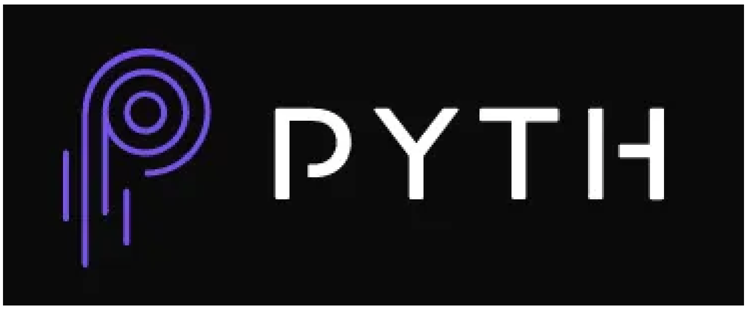
> Using compressed NFTs can reduce the cost of minting by up to 99%

Debugging Solana Programs

> For a guide to debugging Solana programs see [Cookbook]()

Pyth Oracle Network

See site



Pyth Network is an oracle project built on Solana. It focuses on bringing high fidelity market data from trust worthy data provider in a high speed manner.

Market data, as well as a confidence level of that market price are submitted by data provider to be aggregated on Solana chain.
It also has cross chain compatibility using Wormhole as a bridge between ERC20 and SPL tokens.

Example data feed

Integrating a data feed

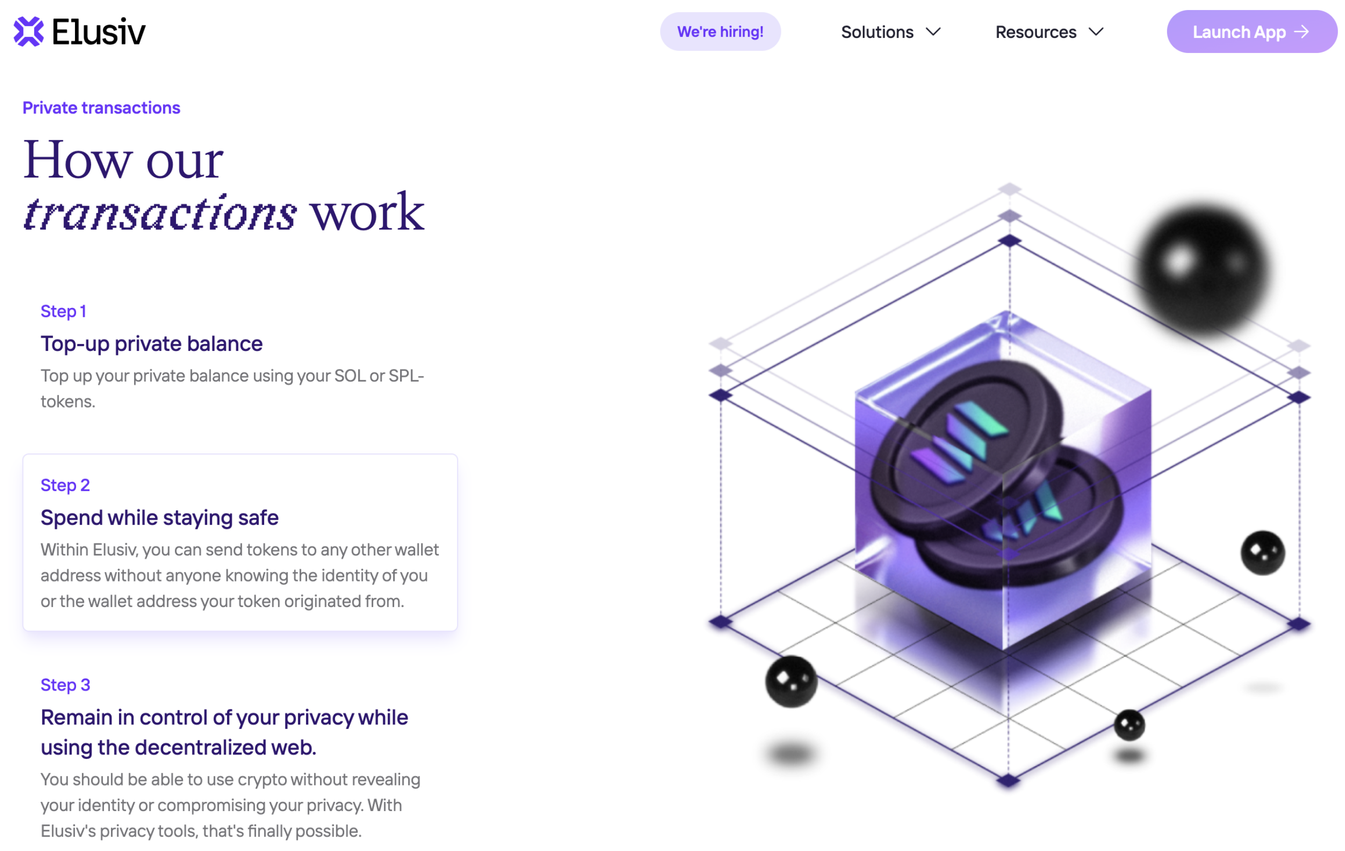
See Docs
Pyth on Solana Docs

Developers should integrate Pyth into both their on-chain and off-chain code:

> 1. On-chain programs should read prices from the Pyth program deployed on the same chain
> 2. Off-chain frontends and jobs should include Pyth price updates alongside (or within) their application-specific transactions.
> 3. Pyth provides ecosystem-specific SDKs to assist with both the on- and off-chain pieces of the integration. The easiest way to use Pyth price feeds is to integrate the appropriate SDKs into your application.
>
> ## Pyth on Solana
>
> Example Anchor code and lib.rs

Zero Knowledge Proofs / Privacy on Solana

Elusiv payment layer



Private transactions

How our *transactions* work

Step 1

Top-up private balance

Top up your private balance using your SOL or SPL-tokens.

Step 2

Spend while staying safe

Within Elusiv, you can send tokens to any other wallet address without anyone knowing the identity of you or the wallet address your token originated from.

Step 3

Remain in control of your privacy while using the decentralized web.

You should be able to use crypto without revealing your identity or compromising your privacy. With Elusiv's privacy tools, that's finally possible.

From their blog

"Elusiv is a compliance-in-mind Zero-Knowledge protocol for privately sending and receiving SOL or SPL tokens on the Solana blockchain.
Furthermore, we propose Elusiv VMs, an extension of Elusiv, to enable more rapid development of solutions leveraging more general ZK circuits. "

Solana Circom Verifier

See Repo

Still a work in progress

Solana Circom Verifier allows you to verify Circom circuits in Solana programs.

This project makes it possible to verify Circom circuits in, and thus build ZKP-based programs on Solana.

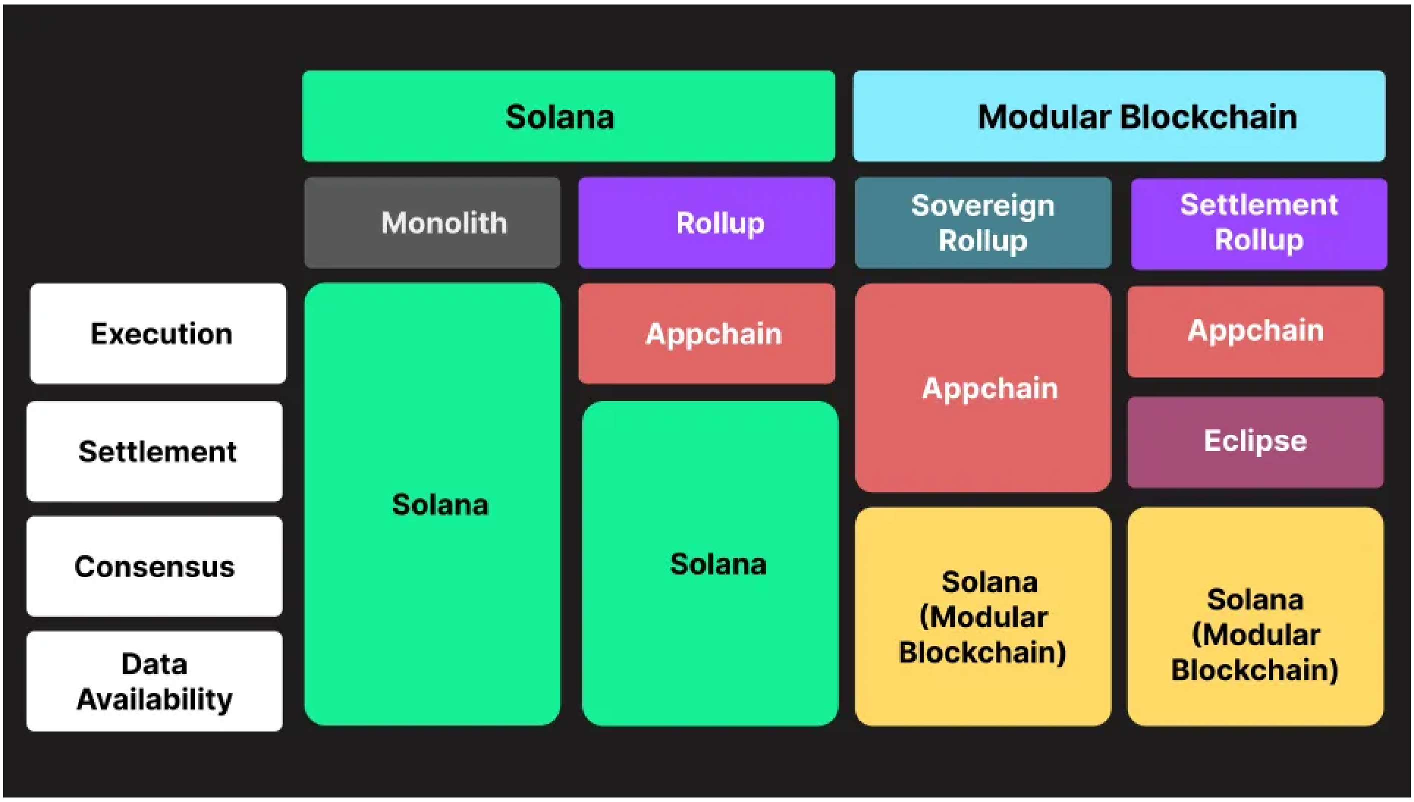
> # Incognito <> Solana Bridge
>
> See Repo
> Attempt to bring shielded assets to Solana
>
> Article from HOPR mixnet about privacy concerns on Solana.

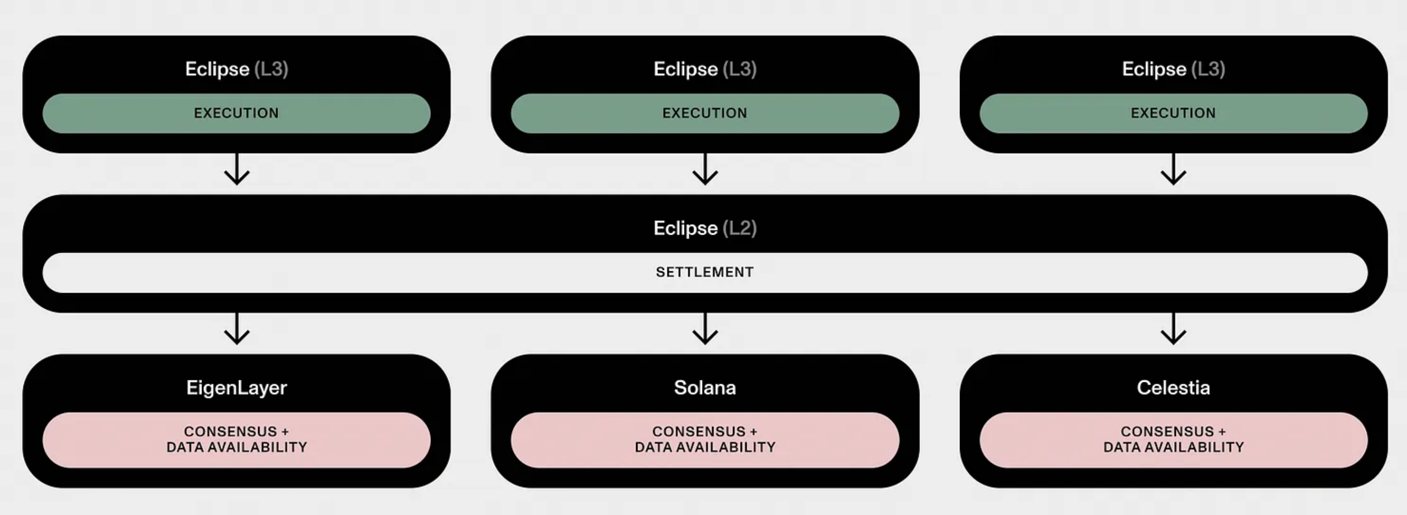
Eclipse and App specific rollups

See Eclipse Docs

See Article

See Bankless Podcast





Eclipse is a rollup as a service, as an IBC-enabled rollup on Celestia, which is the data availability layer.

> Eclipse allows you to spin up your own rollup with the Sealevel VM with a base layer provided by CelestiaOrg , Polygon Avail , or Eigen Layer.
> There are also options to run an EVM or the Move VM.
>
> ## Advantages to using Eclipse
>
> 1. **Maximum customisability:** Any dApp can adjust its block times, subsidise gas, or restrict who can use your blockchain.
> 2. **Shared security:** dApps don't have to worry about managing infrastructure or bootstrapping validators, because it borrows security from the underlying Layer 1.
> 3. **Scale horizontally:** This means that dApps can always spin up another execution layer, giving the power of Solana all to themselves.
> 4. **Cheaper running costs:** The data availability layer doesn't need to support execution, and therefore the cost of running a node is cheaper promoting decentralisation.
>
> The Eclipse mainnet should be available in Q4 2023

PDA in Anchor

See Anchor book explanation

CPI in Anchor

See Anchor book explanation

Further Anchor examples

Election program with Anchor

Example program in Anchor to run an election

See Article

Staking NFT

See article

Solana Resources

Solana CLI Guide

See CLI Guide

The Solana Cookbook

See Cookbook

Solana Blog

See Blog

Solana Podcast

See Validated

Course Review

Lesson 1

Decentralisation / Blockchain theory / Cryptography

Lesson 2

Solana Community / Solana Architecture / Rust

Lesson 3

Solana Command Line / Rust

Lesson 4

Solana Command Line / Rust

Lesson 5

Rust - Errors / Traits

Lesson 6

Solana Concepts / Intro to Development
Solana Accounts

Lesson 7

Intro to DeFi / Token Program

Lesson 8

Solana programs / PDAs

Lesson 9

PDAs and account design / Upgrading

Lesson 10

Cross Program Invocation / Anchor Introduction

Lesson 11

Web3 introduction

Lesson 12

Anchor / Solana Program Library

Lesson 13

Anchor / NFTs / DeFi

Lesson 14

DeFi / Security / Confidential tokens / Token-2022

Lesson 15

Solidity / Anchor Examples

Lesson 16

Compressed NFTs
Rollups

> Anchor examples
>
> ZK on Solana
>
> Review

Solana Community

See resources page

This details their telegram / discord channels etc.

There are many meetup groups available worldwide

Hacker House

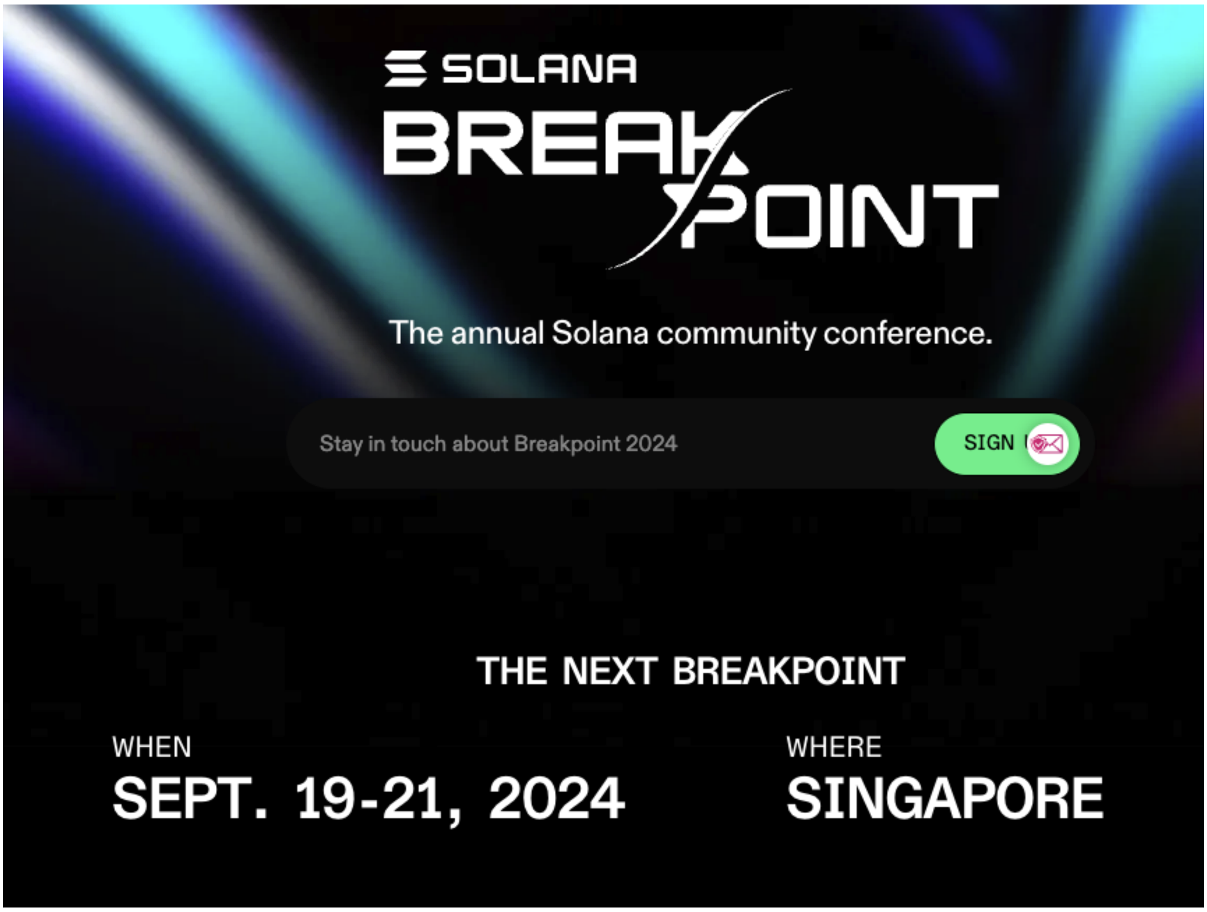
In 2022 there were hackathons hosted in many cities

Solana / Encode Hackathon

Superteam

Global Events

Solana Breakpoint - Sept 2024



The annual Solana community conference.

Stay in touch about Breakpoint 2024

THE NEXT BREAKPOINT

WHEN
SEPT. 19-21, 2024

WHERE
SINGAPORE

Solana Collective

See Docs
This is a program to help Solana supporters contribute to the ecosystem and work with core teams.

Solana Grants

Anyone can apply for a grant from the Solana Foundation.
That includes individuals, independent teams, governments, nonprofits, companies, universities, and academics.

Here is the list of initiatives Solana are currently looking to fund.
and categories they are interested in

- Censorship Resistance
- DAO Tooling
- Developer Tooling
- Education
- Payments / Solana Pay
- Financial Inclusion
- Climate Change
- Academic Research

> # Where to go from here
>
> ## Encode Events and Bootcamps
>
> See Events
>
> Solana / Encode Hackathon
>
> ## Extropy Resources
>
> > ### Discord Server
> >
> > Invite
>
> > ### Medium
> >
> > Wormhole exploit post mortem