



A toolbox for monitoring the health of the Ethereum P2P Network

Devcon SEA, 2024-11-13



Yiannis Psaras & Dennis Trautwein

Probelab @ Shipyard

Why we exist

Things do not always work the way you think they do.

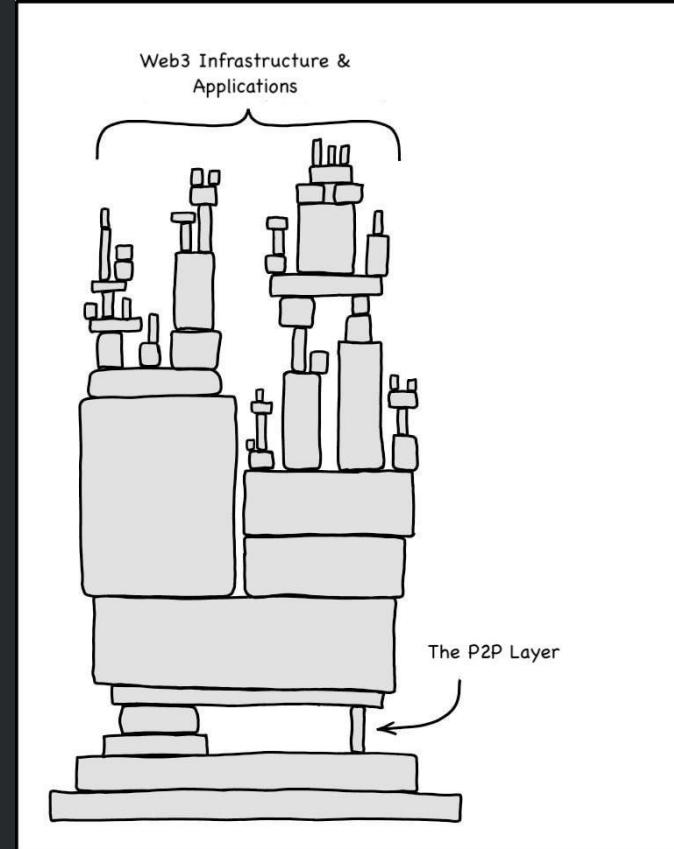


Why look deeper

A ton of on-chain metrics and dashboards.

Nearly everything that happens on a blockchain relies on a decentralized peer-to-peer (P2P) network.

Yet, the P2P layer of the Web3 stack has been significantly overlooked.



Obligatory XKCD: <https://xkcd.com/2347>

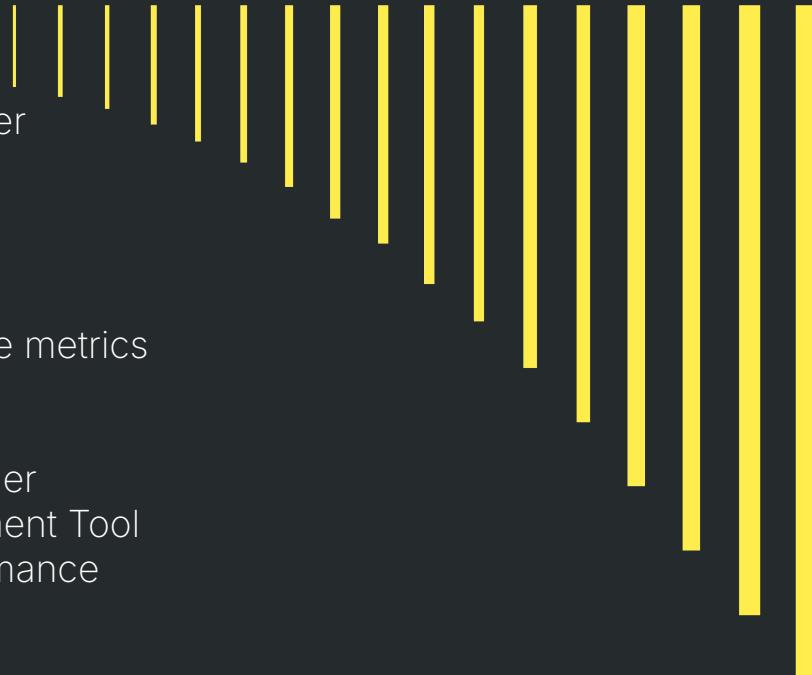
ProbeLab's Mission

We carry out rigorous P2P protocol measurements
and benchmarking in order to
make P2P networks faster, safer and more resilient.

ProbeLab's Measurement Toolbox

Network Topology

- **Nebula:** A network Agnostic DHT Crawler
- **Ants:** A DHT Client Monitor



Infra & Platform Monitoring

- **Boomo:** A Bootstrapper Monitor
- **Tiros:** IPFS-hosted Website performance metrics

Protocol Performance

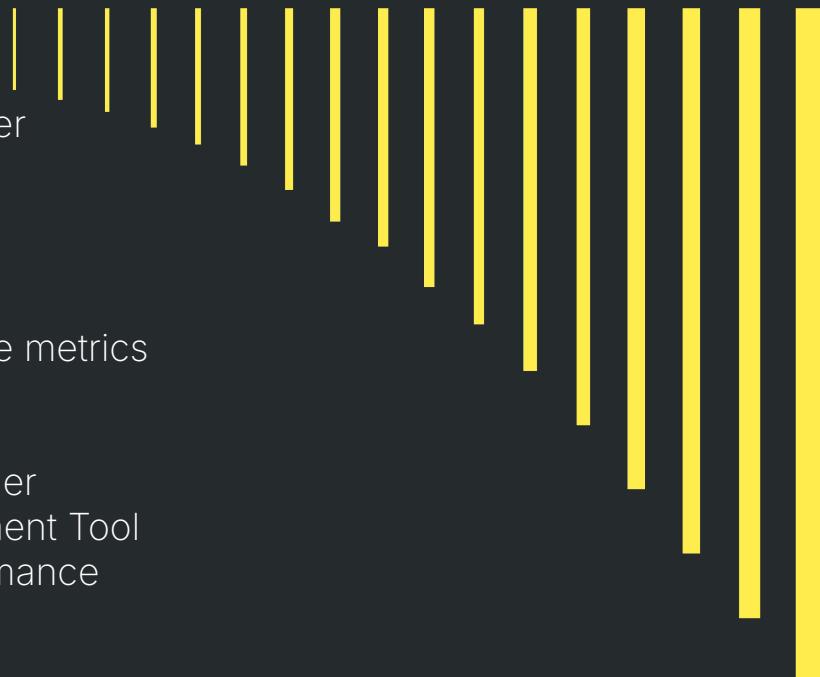
- **Hermes:** A GossipSub Tracer and Listener
- **Ookla:** A Network Bandwidth Measurement Tool
- **Parsec:** DHT Lookup Monitoring Performance

Data Availability

- **Akai:** A libp2p-generic DA Sampler
- **Hoarder:** A CID Availability Monitor



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Network Topology

Network Topology

Nebula - A Network Agnostic DHT Crawler



NEBULA

Methodology

- Recursive enumeration of DHT Server Peers
- Liveliness Monitoring



Supported Networks

- IPFS
- Ethereum (Consensus, Execution) Layer
- Filecoin
- Polkadot (Mainnet, Kusama, Rococo, Westend)
- Celestia (Mainnet, Arabica, Mocha)
- Avail (Mainnet, Hex, Turing, Goldberg)
- Pactus
- *Coming Soon:* Cardano, Bitcoin, BitTorrent

<https://github.com/dennis-tra/nebula>

Quiz

**Which Ethereum
CL client is least
dependent on
centralised cloud
infrastructure?**



Quiz

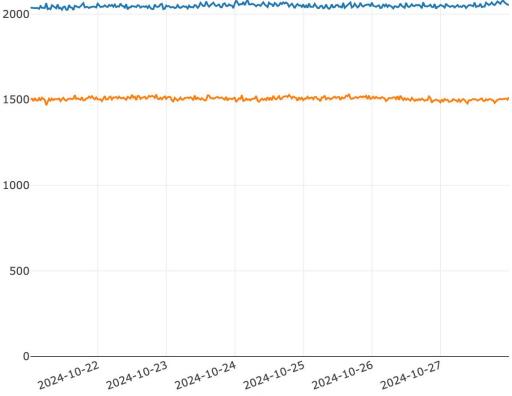
**Which Ethereum
CL client is least
dependent on
centralised cloud
infrastructure?**

Nimbus

lighthouse Cloud Rate

Total Mean: 3,554

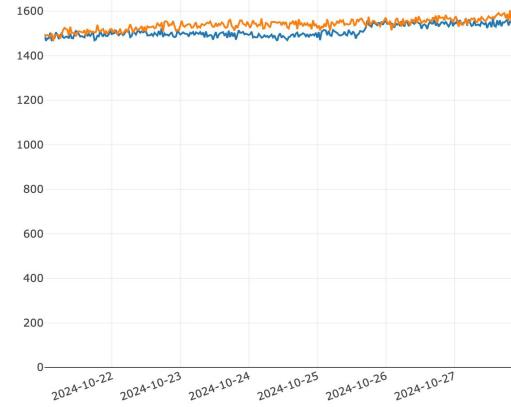
lighthouse ▾



prysm Cloud Rate

Total Mean: 3,050

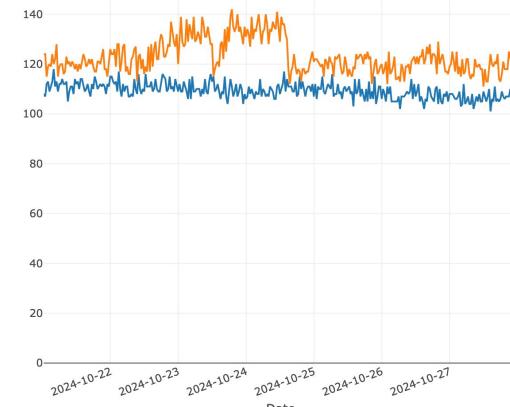
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lodestar Cloud Rate

Total Mean: 232

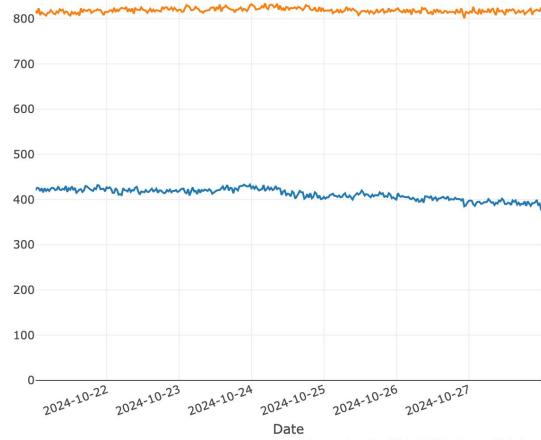
lodestar ▾



teku Cloud Rate

Total Mean: 1,230

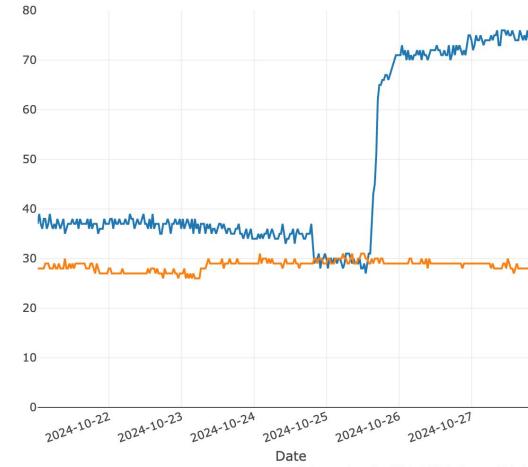
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rust-libp2p Cloud Rate

Total Mean: 76

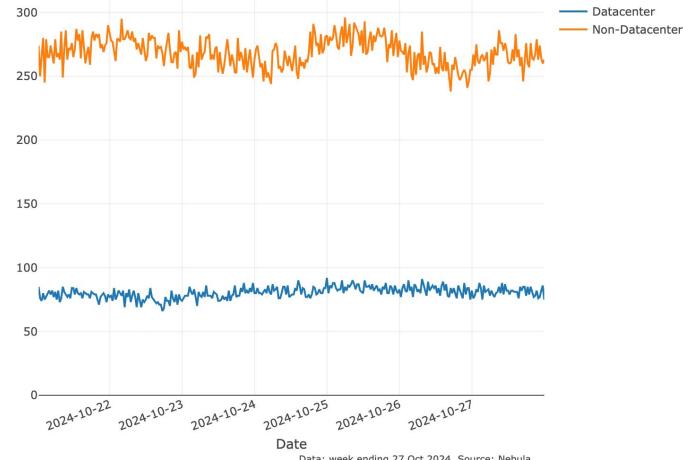
rust-libp2p ▾



nimbus Cloud Rate

Total Mean: 349

nimbus ▾

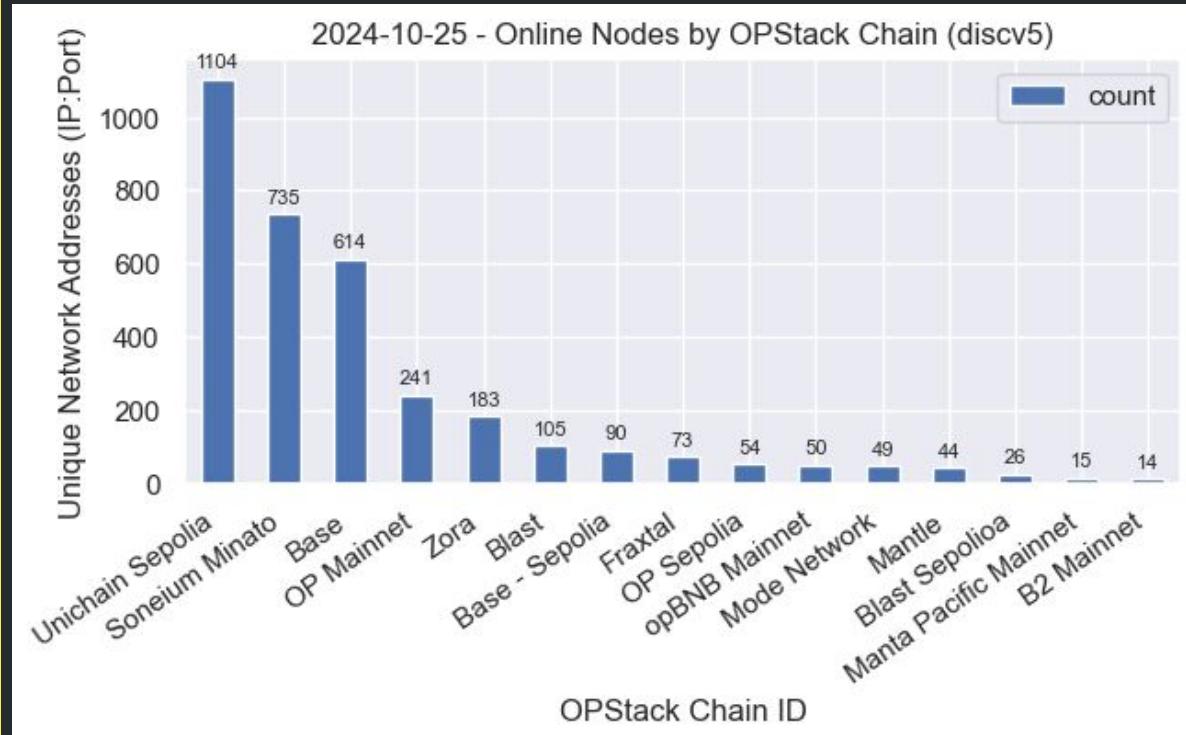


Data: week ending 27 Oct 2024. Source: Nebula

Data: week ending 27 Oct 2024. Source: Nebula

What's the most popular chain on OP?

What's the most popular chain on OP?



Network Topology

Ants - A DHT Client Monitor

Methodology

- Comprehensive keyspace coverage through carefully deployed DHT servers
- Automatic adjustment to network size
- Monitoring of incoming requests for data and routing table updates

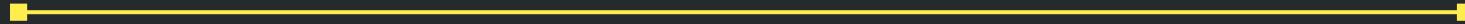


Supported Networks

- Celestia
- *More soon*

Ants

Methodology



Ants

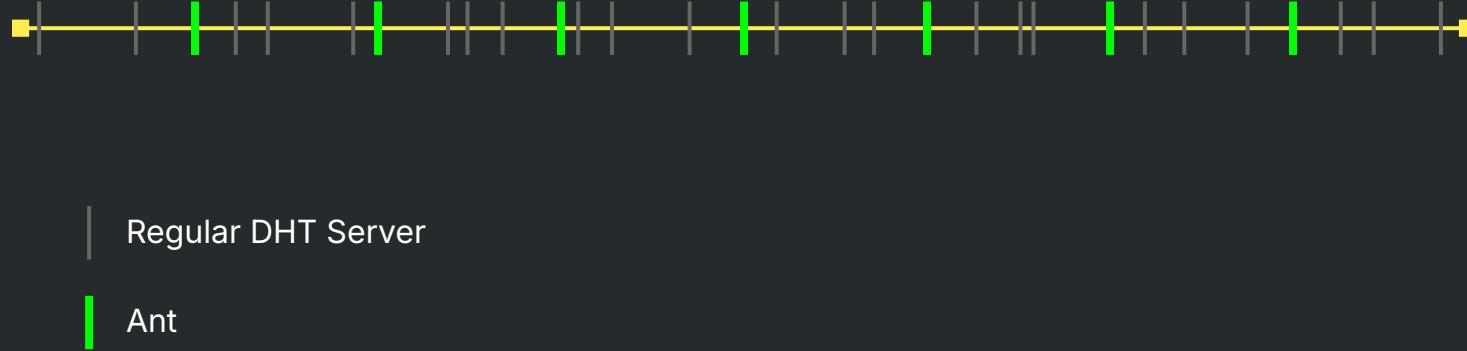
Methodology



| Regular DHT Server

Ants

Methodology



Ants

Methodology



Ants

Methodology





Protocol Performance



Protocol Performance

Hermes - A GossipSub Listener & Tracer

Measurement Goals

- Message propagation latency
- Number of received duplicate messages
- Validator Node Bandwidth Consumption

Methodology

- Avoid running an Ethereum full node
- Lightweight libp2p host
- Implements all relevant protocols
- Trace **all** GossipSub events



Protocol Performance

Hermes - A GossipSub Listener & Tracer

Libp2p Host Events

- Connections & Disconnections
- Sent & Received RPCs

GossipSub Trace Events

- GRAFTs & PRUNEs
- Subscriptions
- IHAVEs & IWANTS
- Peer scores
- Message arrivals

Req/Resp Events

- Pings
- Beacon Status
- Beacon Metadata
- Blocks by root/range
- Blobs by root/range

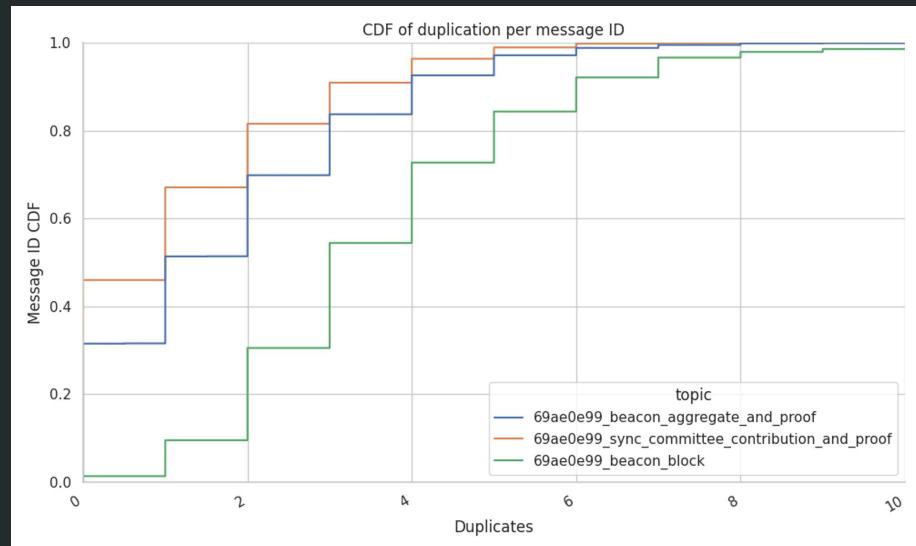


Protocol Performance

Hermes - A GossipSub Listener & Tracer

GossipSub Duplicate Messages

- **High ratio** of duplicates per message
- Bigger messages are more prone to be duplicated
- Time to the first duplicate opens a window for improvements





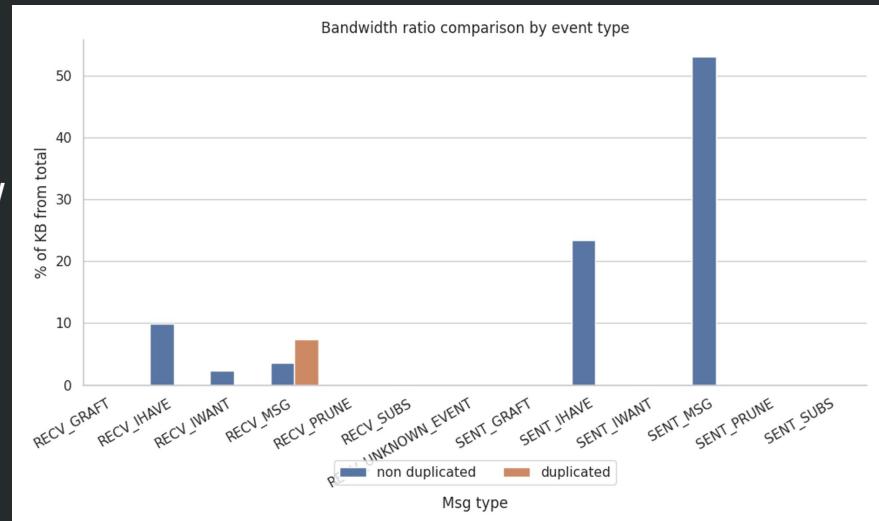
Protocol Performance

Hermes - A GossipSub Listener & Tracer



GossipSub Bandwidth

- **IHAVEs represent 33% of total BW**
- **Messages represent 64% of total BW**
- **7.5% Incoming duplicates**
- No numbers of sent duplicates
(estimations $\frac{2}{3} = \sim 36\%$)



Protocol Performance

Hermes @ ethresear.ch

Mesh Stability

GRAFTs & PRUNEs



**GossipSub
BANDWIDTH**



GossipSub Effectiveness

IHAVEs & IWANTs



**CL Block
ARRIVAL TIMES**



MessageMetrics

DUPPLICATES



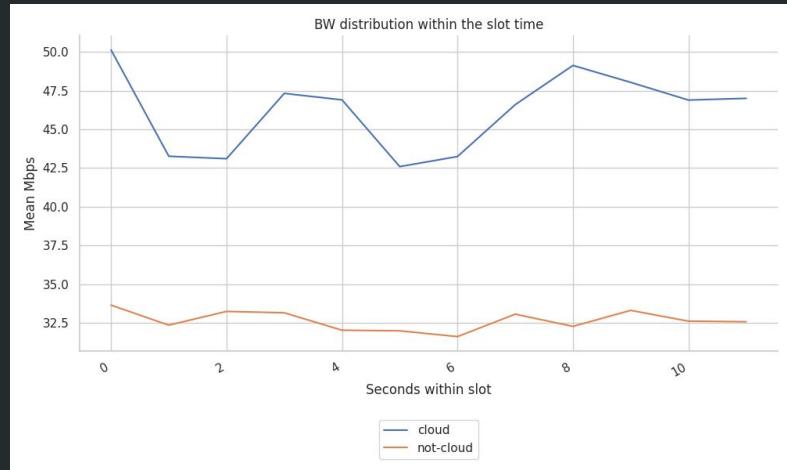


Protocol Performance

Ookla - A Network Bandwidth Monitor

Methodology

- Query all online peers seen from **Nebula** crawling
- Spawn **Hermes** to interact with the network
- Download a carefully chosen volume of data from these peers
- Measure available bandwidth
- Repeat from multiple geo locations



Recap



ProbeLab

ProbeLab's Measurement Toolbox

Recap

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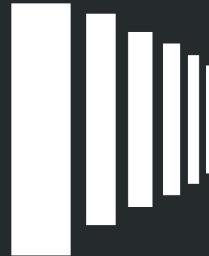
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Looking Ahead

- API Development
- Integrate additional Networks
- NAT Traversal Performance
- Focus on DAS



ProbeLab

- Head to <https://probelab.io> for more results
- Head to <https://probelab.network> for info about our team

Thank you!

Get in touch

Email: yiannis@probelab.io

TG: @yiannisbotx



Demo Time!

ProbeLab

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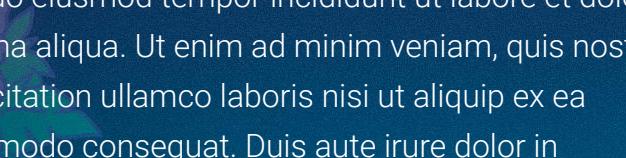
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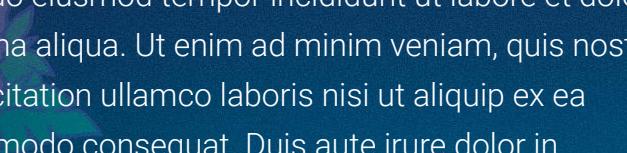
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Here's the timeline.

Event 1



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Event 2



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Event 3



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“Number rules the universe.”
— Pythagoras

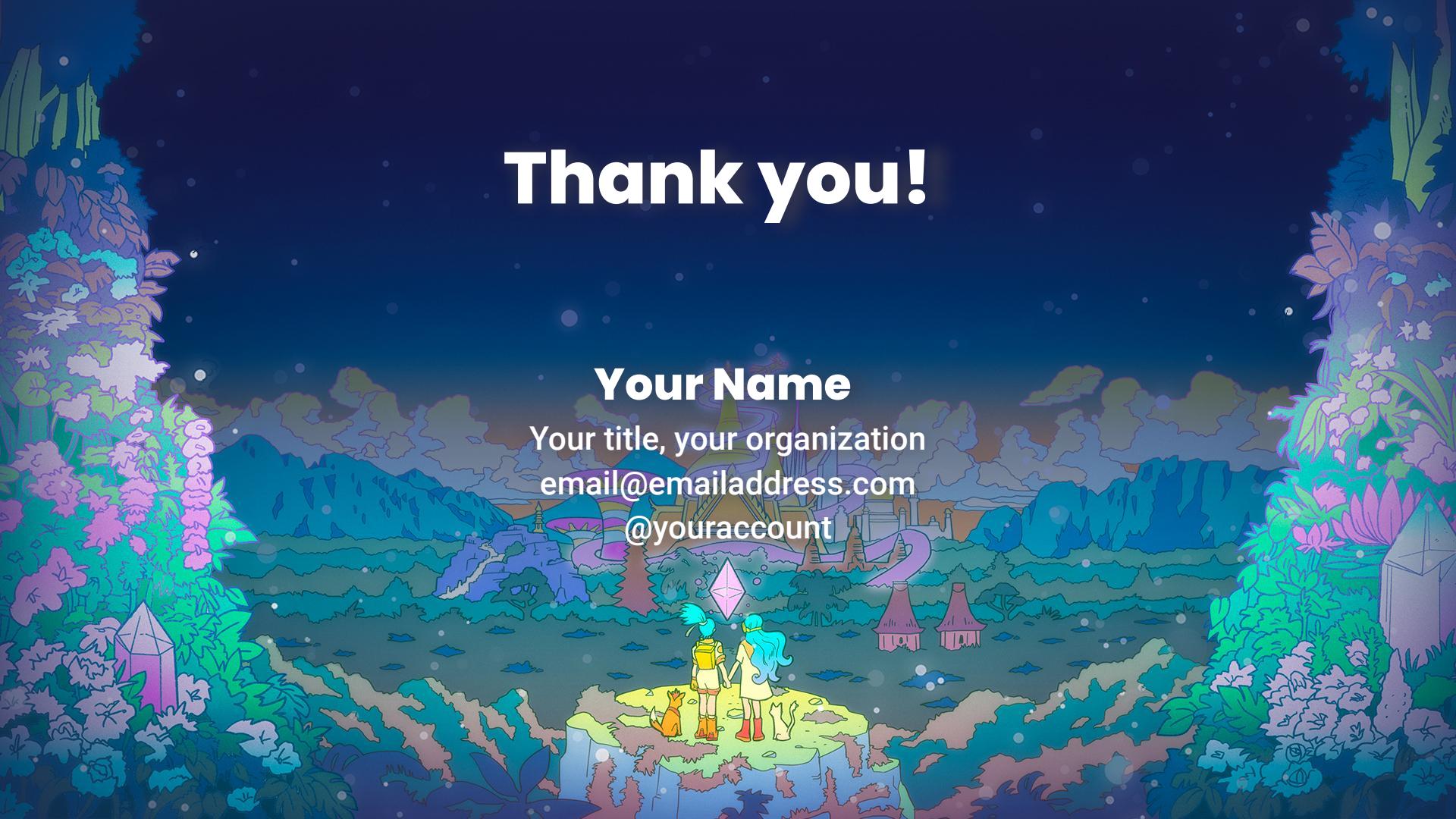
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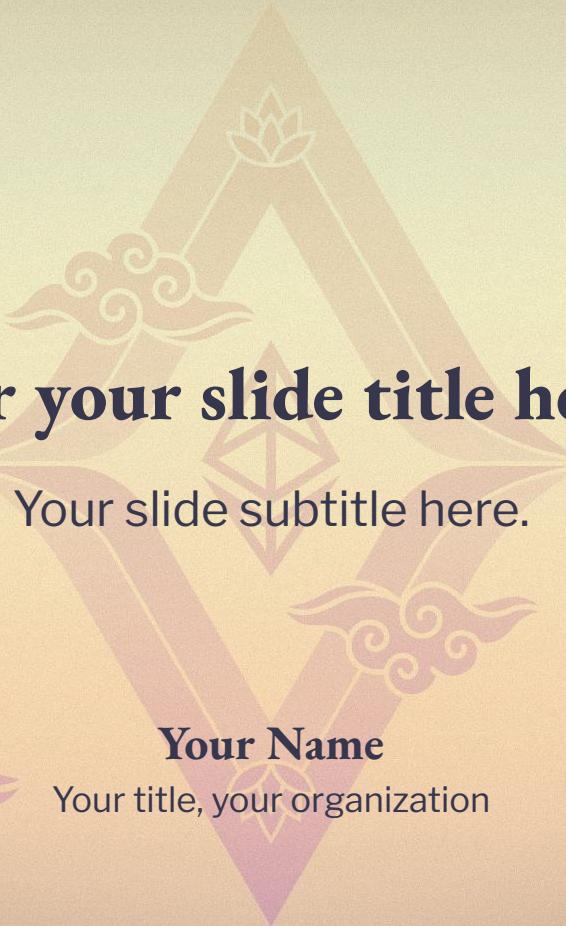
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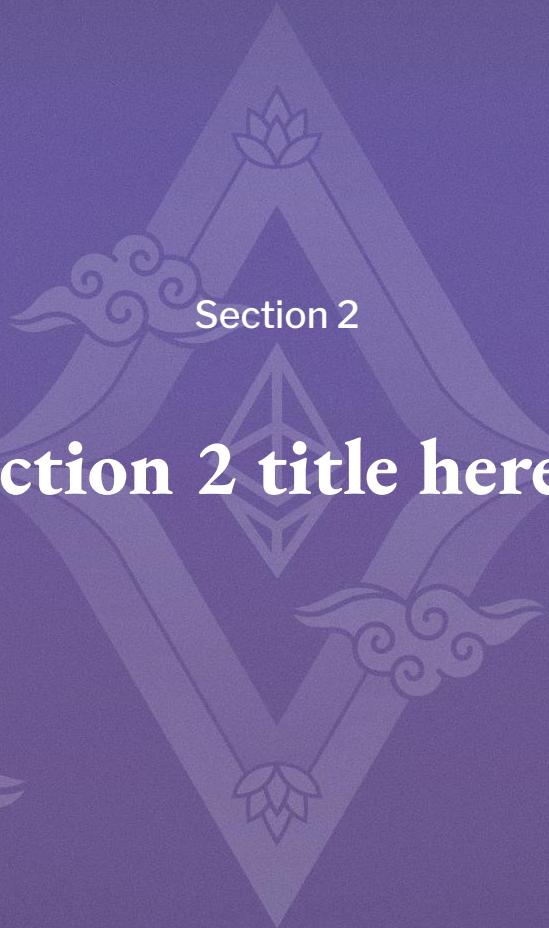
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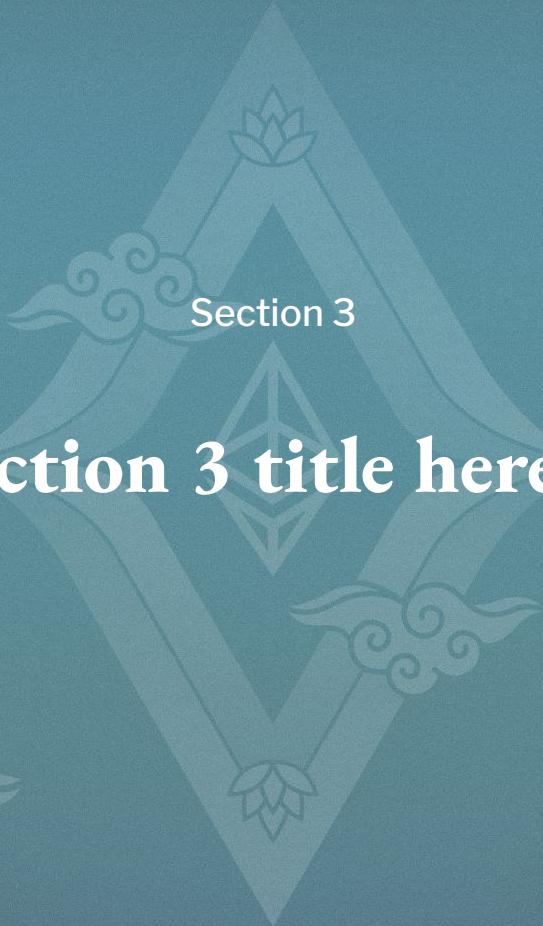




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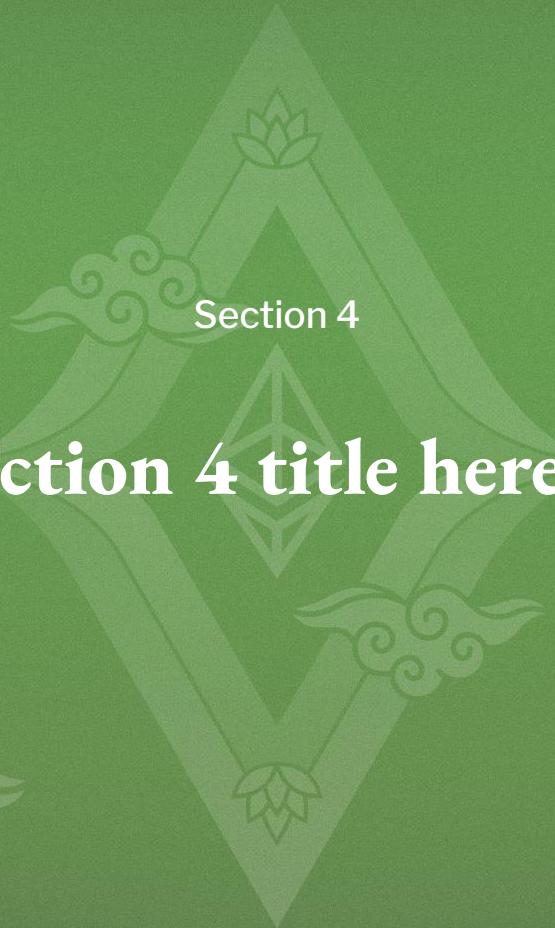
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Event 2



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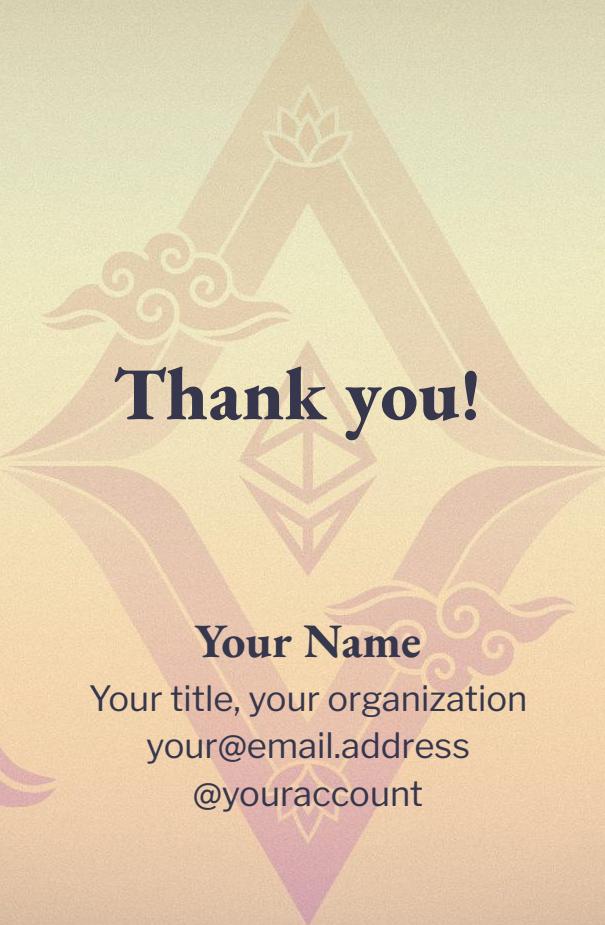


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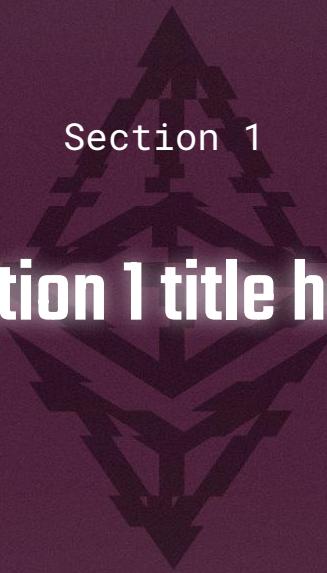


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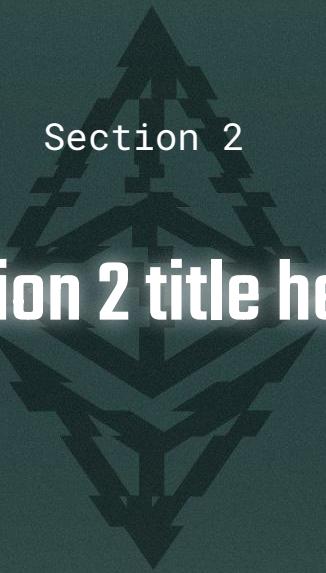
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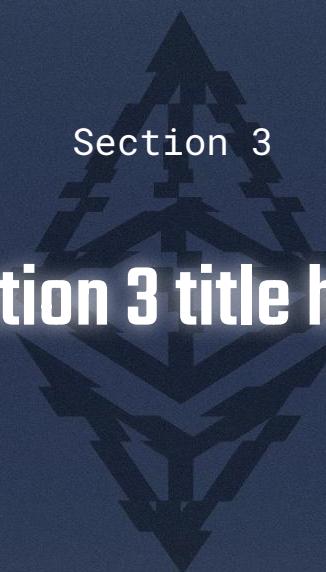
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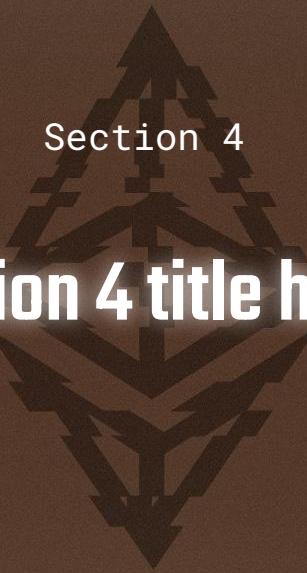
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Here's the timeline.

Event 1



A horizontal timeline is shown with three circular markers on a thin horizontal line. From left to right, the markers are colored purple, blue, and brown. Above the purple marker is the text "Event 1". Below the purple marker is a block of placeholder text. Between the purple and blue markers is the text "Event 2". Between the blue and brown markers is the text "Event 3".

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Event 2

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Event 3

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“Number rules the universe.”
– Pythagoras



Your Name

Your title, your organization
your@email.address
@youraccount