

A Web3-native geospatial vision

Towards a regenerative financial system

23 May 2022

J R Hoopes, Astral Protocol, Toucan Protocol
ESA Living Planet Symposium
E1.01.1: Where Fintech Meets Nature

🔑 How we got here

The Internet

A convergence of crises

Web3: the user-controlled Internet

Web3?

A movement to build a safer, fairer Internet with human dignity embedded at every level.

- Consensus networks, blockchains, smart contracts
- Cryptocurrencies, NFTs and other digital assets
- DAOs and digital governance processes
- Data storage and access systems
- Decentralized identifiers and verifiable credentials

Who am I?

Name:	J R Hoopes / John X / johnx25bd
Day job:	Co-founder at Toucan Protocol
Main side project:	Co-founder at Astral Protocol
Past:	Ordnance Survey, KERNEL, startups, international conflict research
Education:	UCL — MSc Spatial Data Science and Visualisation (Distinction)



What to expect

Web3 values (an opinionated perspective)

A short history on Web3 spatial

The road ahead

Web3 values

Opt in:

Anyone can choose to join, but no one is forced to join

User-centric:

Built to serve their users in a dignified way on a fundamental level

Locked open

Open access

Open interfaces

Open source

Self-improving

To reliably support humanity's critical functions, our systems need to respond constructively to their own flaws

🌐 Why Web3 x spatial?

Safer, fairer location-based applications

A powerful new palette for experimentation in
regenerative finance — ReFi

A short history

Pioneers:

- IBISA: parametric insurance for farmers
- FOAM: decentralized positioning — peer-to-peer GPS
- Regen Network: a framework for ecocredits
- Arbol Network: parametric insurance for weather risk
- Grassroots Economics: Community inclusion currencies

The road ahead

The next generation:

- Cadastres
- Regenerative finance
- Transport + mobility
- Supply chain management
- Gaming
- ... ?



Tying Web3 spatial together

- Public basemaps with geospatial logic
- Verifiable Location Claims
- Web3-native GIS — data storage and compute systems

Regenerative Finance

Leverages the best of the Web3 and spatial data domains

- **Web3:** a innovative, open, global financial environment
- **Spatial:** accurate, high resolutions measurements of things, people and ecosystems

Celo & the Climate Collective

- Celo:** Building a financial system that creates the conditions for prosperity — for everyone
- Climate Collective:** Technical, strategic and financial resources for Web3 projects working to coordinate a climate response

Celo & the Climate Collective

Celo:

- Natural-capital backed currencies
- Negative interest economics
- Local / complementary currencies

Climate Collective:

- Toucan Protocol
- Astral Protocol
- Curve Labs
- Regen Network
- Kolektivo
- Byterocket
- Loam



Toucan

Unlocking climate action at scale:
Web3-native carbon markets

A credible path forward

Need + creativity = innovation

Spatial data: situational awareness

Web3: an Internet-native incentive layer

What will we build?

Questions?

23 May 2022
@johnx25bd

Astral Protocol

 Verifiable spatial data registries

 Verifiable location credentials

 Web3-native geospatial data storage systems

Verifiable Spatial Data Registries

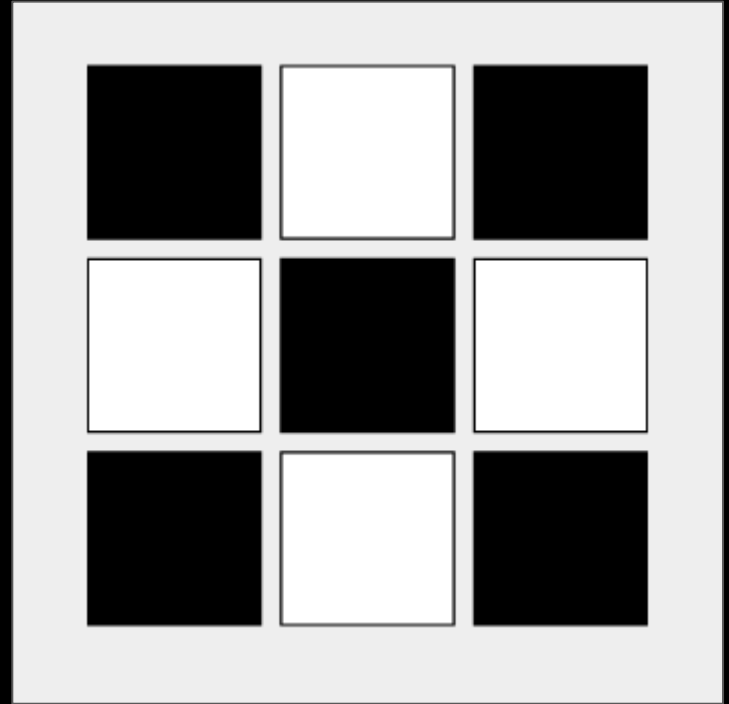
Smart contract-based registries that include a spatial dimension to each entry:

id	name	geometry
1	Berlin	[52.52, 13.405]
2	Copenhagen	[55.676, 12.568]
3	London	[51.507, -0.127]

Verifiable Spatial Data Registries

Smart contract-based registries that include a spatial dimension to each entry:

- Regular grid cells: squares or hexagons



Verifiable Spatial Data Registries

Smart contract-based registries that include a spatial dimension to each entry:

- Regular grid cells: squares or hexagons
- Vector features like irregular polygons, lines, or points stored on-chain

id	name	geometry
1	Berlin	[52.52, 13.405]
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On-Chain Registries

- Spatial data stored on chain, therefore simple to access within the EVM
- More storage intensive: currently not possible for large / high resolution datasets
- Computationally intensive (and gas intensive) to perform computational geometry in the EVM
- (Assumptions need to be validated / explored by Saquib's team)

Off-Chain Registries

- Spatial data stored off chain, likely referenced using decentralized identifiers (Ceramic?) or IPFS / Arweave
- Complex to access from within the EVM — via an oracle or otherwise
- Does the off-chain data store need to be mutable? i.e. time series data. If so, DID. If not, perhaps IPFS CID

Control of Entries

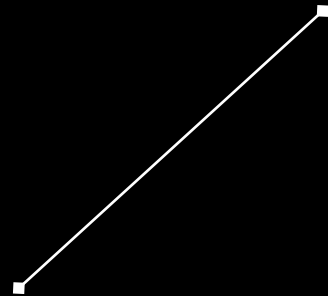
How are registry entries controlled?

- Designed for maximal compatibility with commonly-used standards like ERC721, ERC1155 and ERC998
 - Individual registry entries are represented as non-fungible tokens (NFTs)
 - “GeoNFTs”
 - Composable with NFT protocol landscape

→ We value composability and interoperability, so we will aim to build compatible technologies.

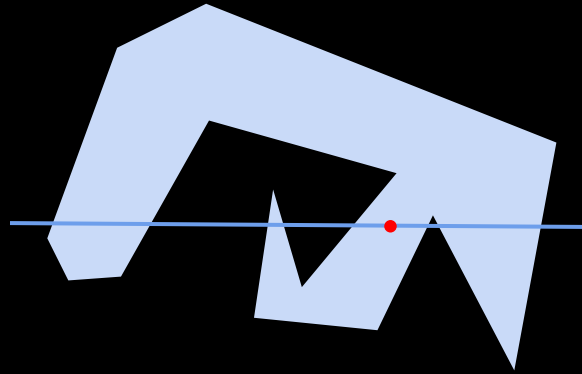
Key Geometric Functionalities

- Distance, bearing between points



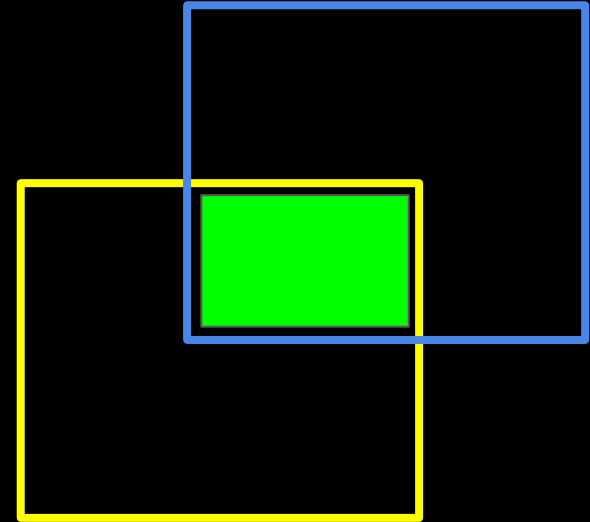
Key Geometric Functionalities

- Distance, bearing between points
- Point-in-polygon



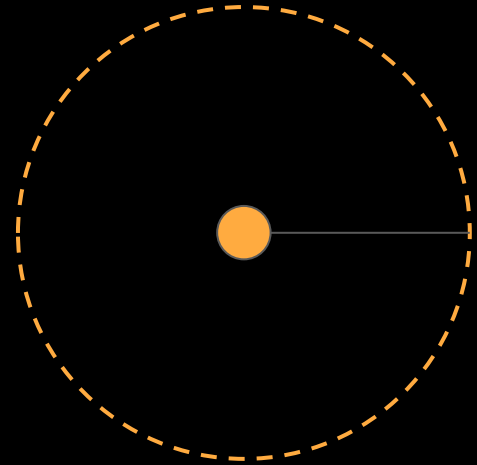
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Key Geometric Functionalities

- Distance, bearing between points
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- Polygon overlap or intersection
- Buffer
- Coordinate conversions?

`convert([52.52, 13.405])`

→ 52°31'12"N 13°24'18"E

Key Geometric Functionalities

- Distance, bearing between points
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- Coordinate conversions?

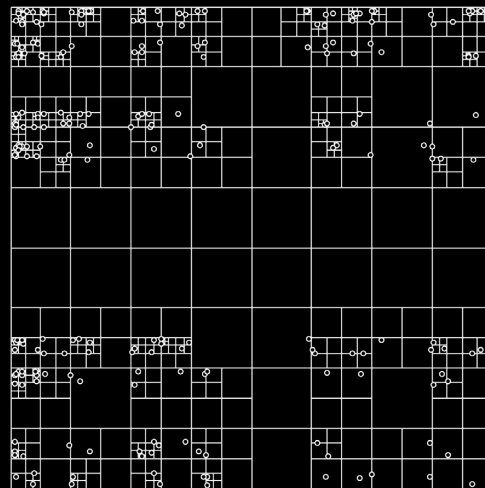
→ **Why?**

To empower builders.

Registry Lookup

hierarchical structure with support for
irregular polygons

- Fast lookup of registries with quadtree or kd tree
- Specify accuracy during search



🔑 Verifiable Location Credentials

A verifiable credential representing the *position* of some *thing* at some *time* (typically).

- Core specification: a standard data model
- Extensions: add evidence to build trust
- Application developers decide minimum trust threshold
- Generated and signed on a mobile device: user-controlled
- Interoperable with any Astral-compatible dapp or on-chain registry


→ A “universal location

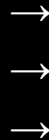
check-in”


Web3-native spatial data storage

- User-controlled
- Cryptographically verifiable
- Uncensorable, permanent
- Private by design?
- Investigating decentralized Identifiers
- Spatial datatokens

- Advanced spatial querying?
- Internet-wide indexing + search?
- Web3-native map tile servers

 Verifiable spatial data registries

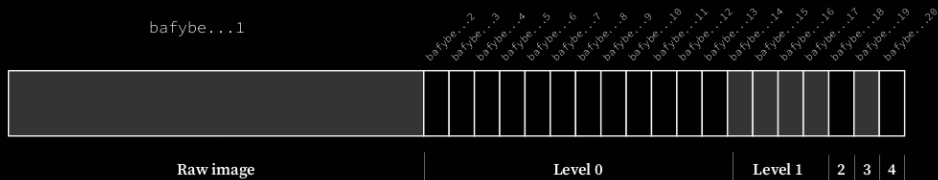
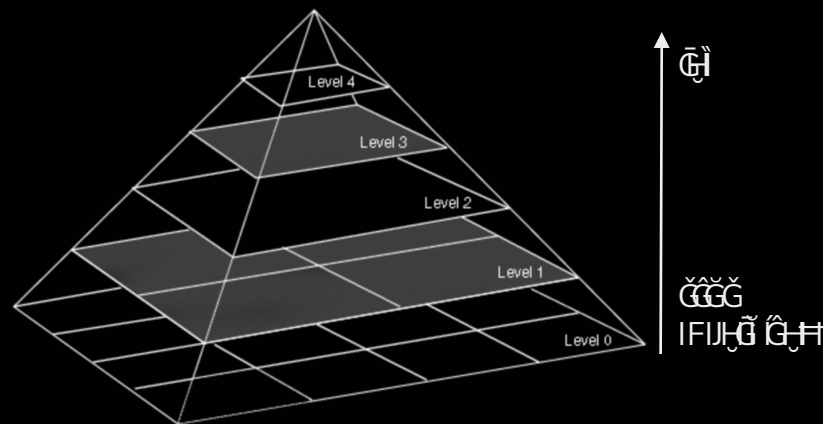


 Verifiable location credentials



IPLD-encoded GeoTIFFs + Vector Tiles

- ✓ Remotely sensed imagery
- ✓ Minimize data duplication
- ✓ Streaming data with vector tiles
- ✓ IPLD Selectors



<https://docs.astral.global/develop/ipld-and-geotiffs>

<https://ipld.io/#what-is-ipld>