

XWORLDS'26

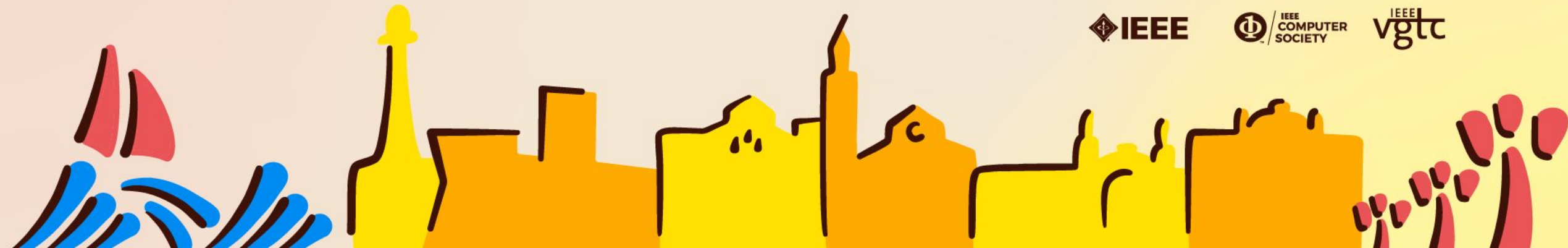


*The 1st International Workshop on Advancing Interoperability
in Virtual Worlds*

ISMAR 2026

October 5 – 9, Bari, Italy

The 25th International
Symposium on Mixed
and Augmented Reality





The Web of Worlds – Towards a Referential Architecture for Open Spatial Worlds

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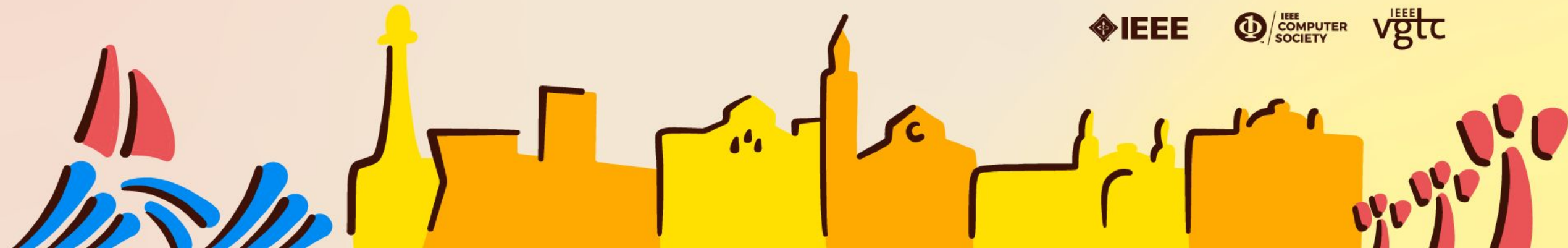
Nicholas Polys, Virginia Tech

Johannes Behr, Threeddy

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Foundation

- 2025: 3D Web Interoperability WG
 - 2025-Q2, Initial Blog Posts
 - [Building The World Wide Webiverse](#)
 - [Linked Spatial Experiences: The Web of Worlds](#)
- 2026: Web of Worlds SG and Initiative
 - 2026-Q1, **MSF White-paper**
 - [Github home](#)
 - 2026-Q1, **First Service API**
 - [Github home](#)
 - 2026-Q2, **MSF Spatial Computing WG**
 - [MSF Home](#)
 - New Spatial Computing Subgroup
 - [Web of worlds subgroup](#)
 - **2026-Q3, first Implementation previews :**
 - 3: simpleWorlds, instant3Dhub, open-spatial-lab

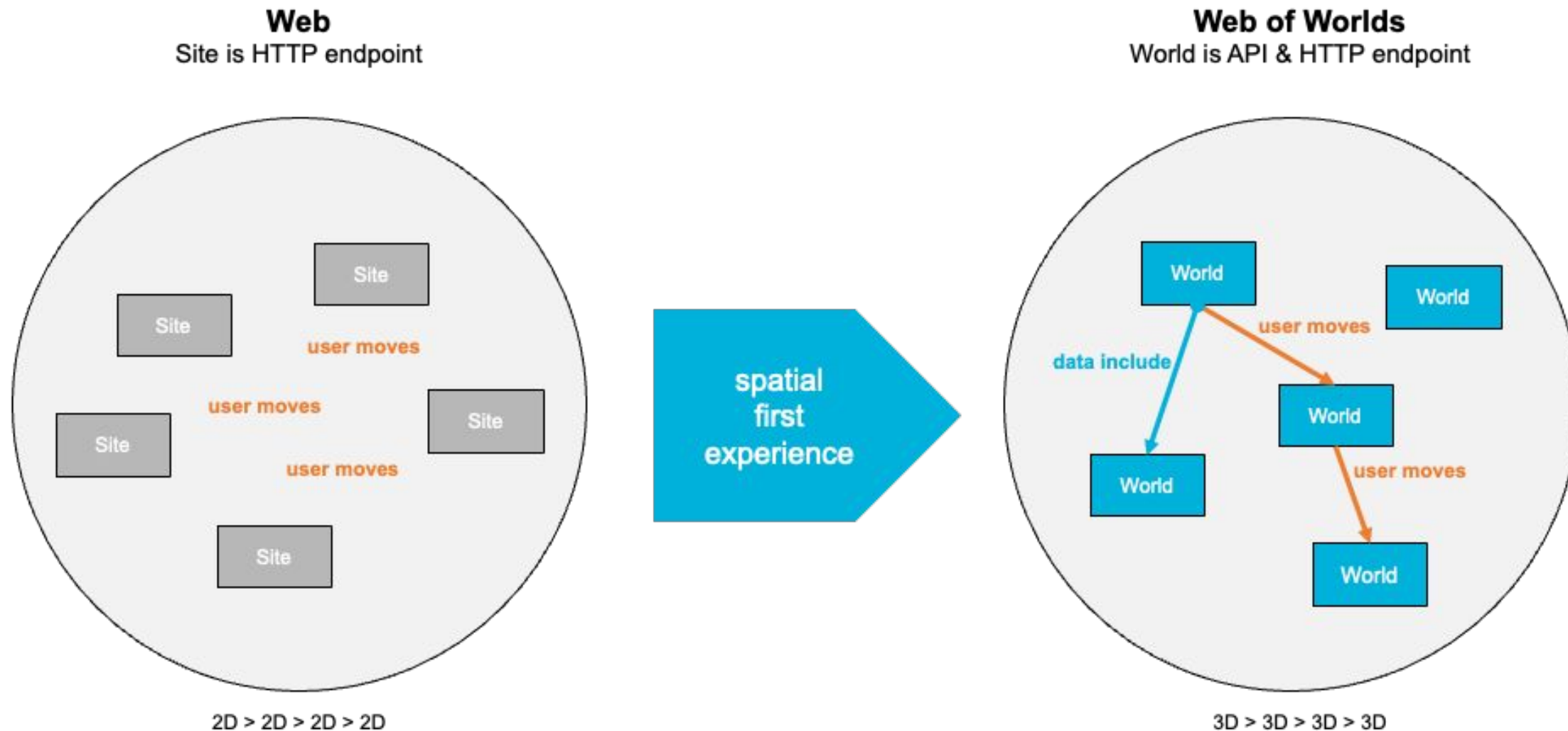


New Core Result: The White-paper and architecture

- The **3D Web Interoperability Group** in the Metaverse Standards Forum has worked through the Usability Engineering process, developing the open-source, royalty-free, **Web of Worlds** Whitepaper and API proposal:
 - Use Cases
 - Requirements
 - Gap Analysis
 - Whitepaper, github, and website
- The result is a clean **API service architecture and service stack that leverages existing W3C, Web3D, Khronos, IANA, and OGC standards.**



"Mechanisms to link virtual worlds and parts thereof"





The Web of Worlds

A Metaverse Standards Forum Initiative:

[Announcing the Web of Worlds Whitepaper:
A Concrete Path to the Open Metaverse](#)

To reduce complexity and encourage adoption, WoW leverages a harmonized "glue layer" of existing standards.



The Web of Worlds (WoW) Architecture and API

The architecture is built on three core pillars:

1. **Open Spatial World API**: Treats virtual worlds as persistent **API and HTTP endpoints**, allowing users to join, view, and preview worlds using a single URI.
2. **Open User Manifest API (The "Digital YOU")**: Powers a **portable, user-controlled identity** layer. Utilizing **JSON-LD, Decentralized Identifiers (DIDs)**, and Verifiable Credentials, users can carry their avatars, preferences, and assets across different virtual worlds.
3. **Open Spatial Asset API**: Facilitates modular, reusable 3D components by leveraging existing standards such as **glTF, X3D, USD**, and others, which are already registered with IANA.

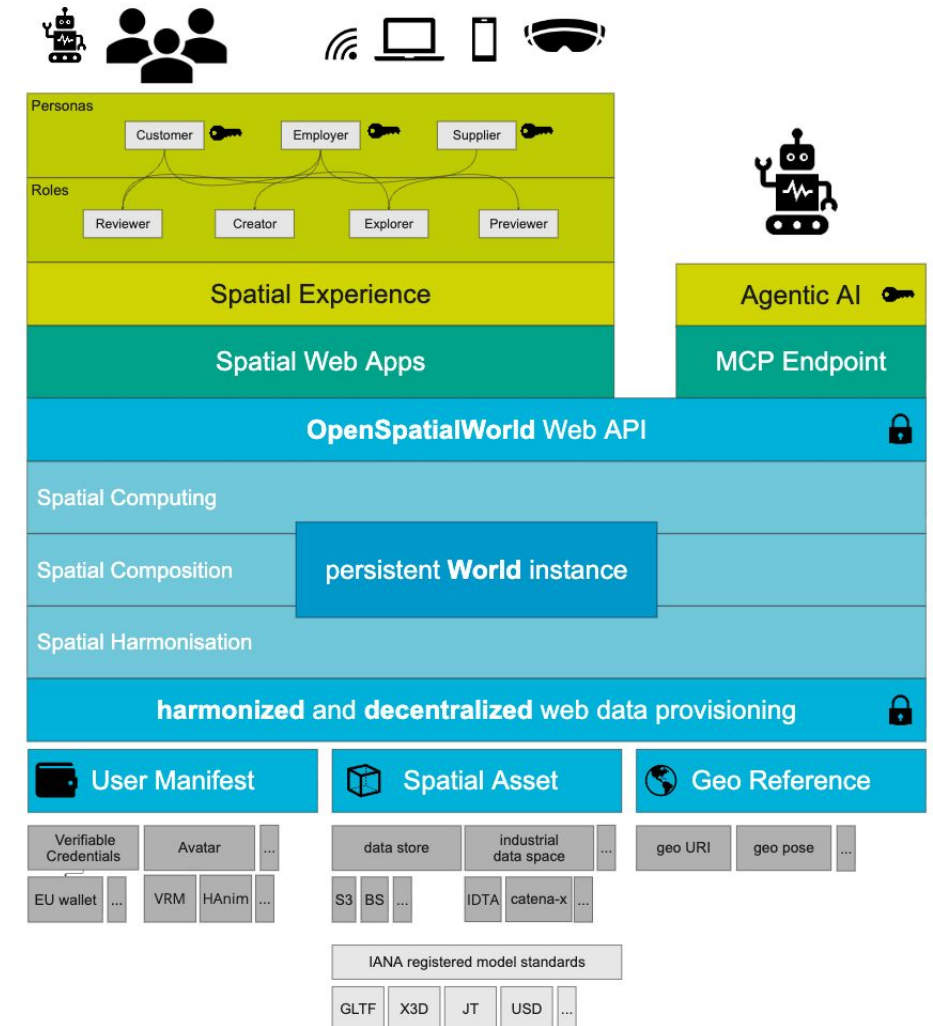




Refined architecture updates

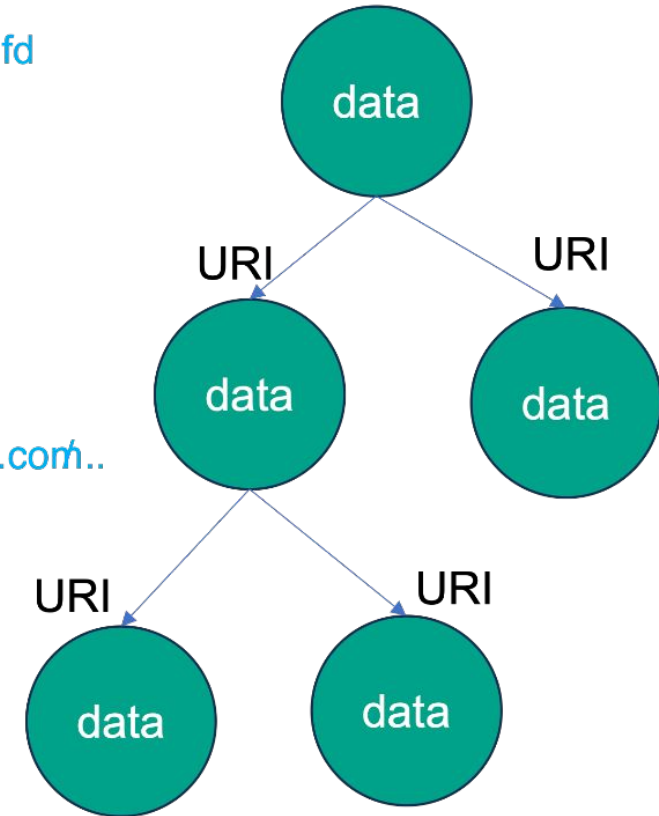
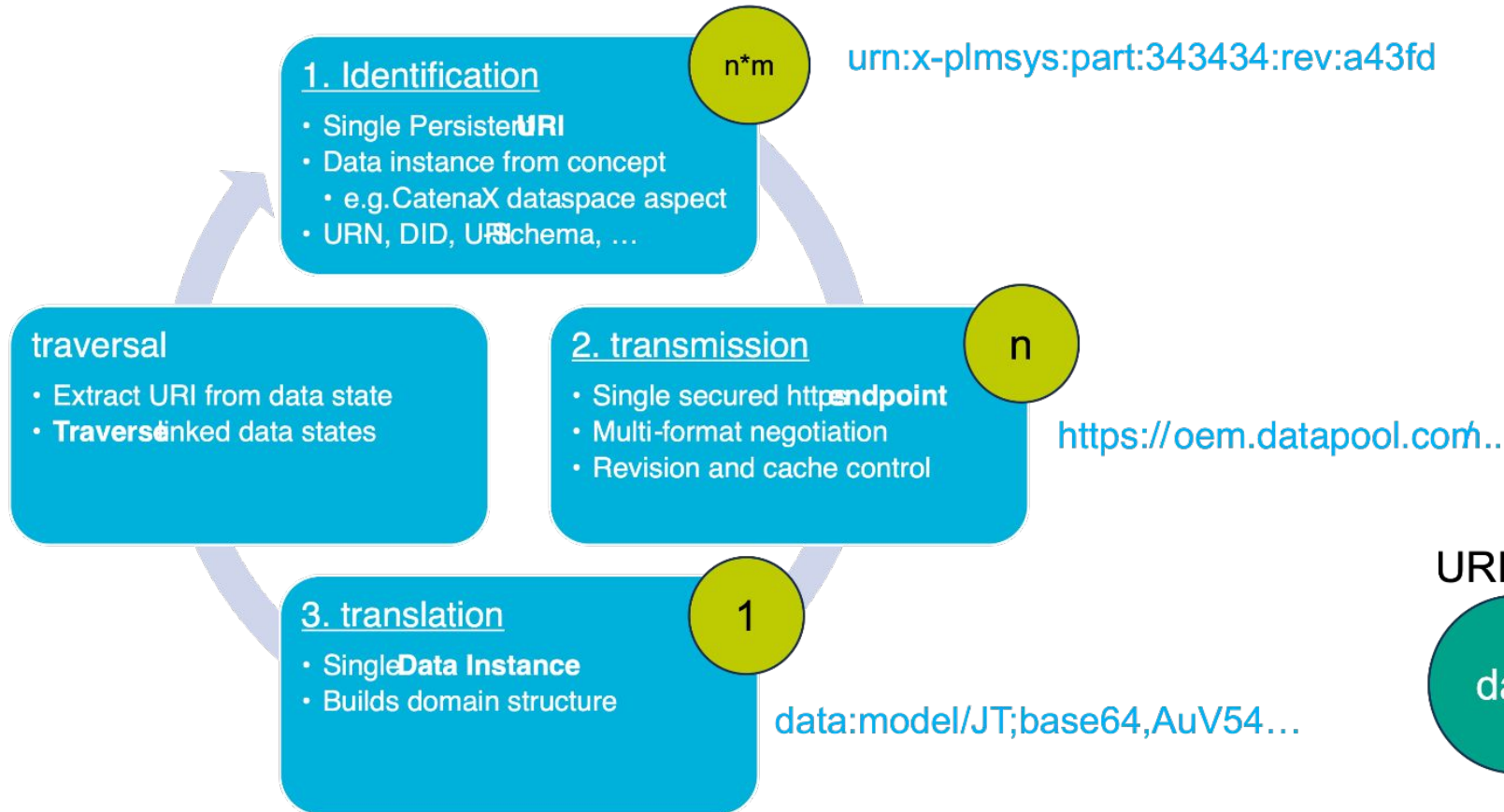
Web Service APIs for persistent Worlds

1. **Open Spatial World API**
 - a. Spatial experience delivery
 - b. Spatial data management
 - c. Harmonized web data access
2. **Open User Manifest API**
 - a. Digital You
3. **Open Spatial Asset API**
 - a. 3D Models with links



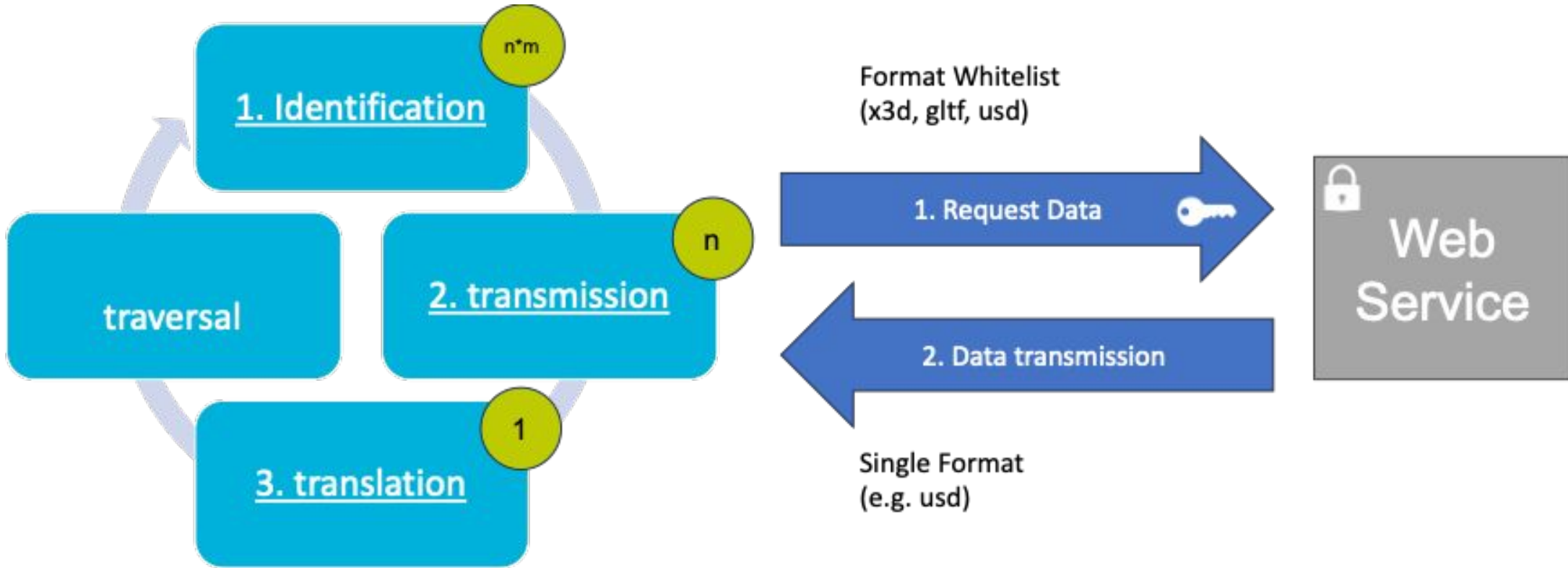
Harmonized and decentralized web data provisioning

URI (e.g. DID:, URN:, HTTP:) **data instance** => **Secured HTTP transfer** => **Data State translation**



Harmonized and decentralized asset data provisioning

This pattern mirrors the new `<model src="3d-assets/car"></model>` behaviour [w3c spec](#)



Generalized asset fragments addressing

- URI Fragment standards allow to address sub-data
E.g.: [RFC7111](#) for "text/csv":
["example.com/data.csv#row=3-5"](#)
- [W3C Media Fragment URI](#)
Spatially-, temporally- and structure-based addressing schema

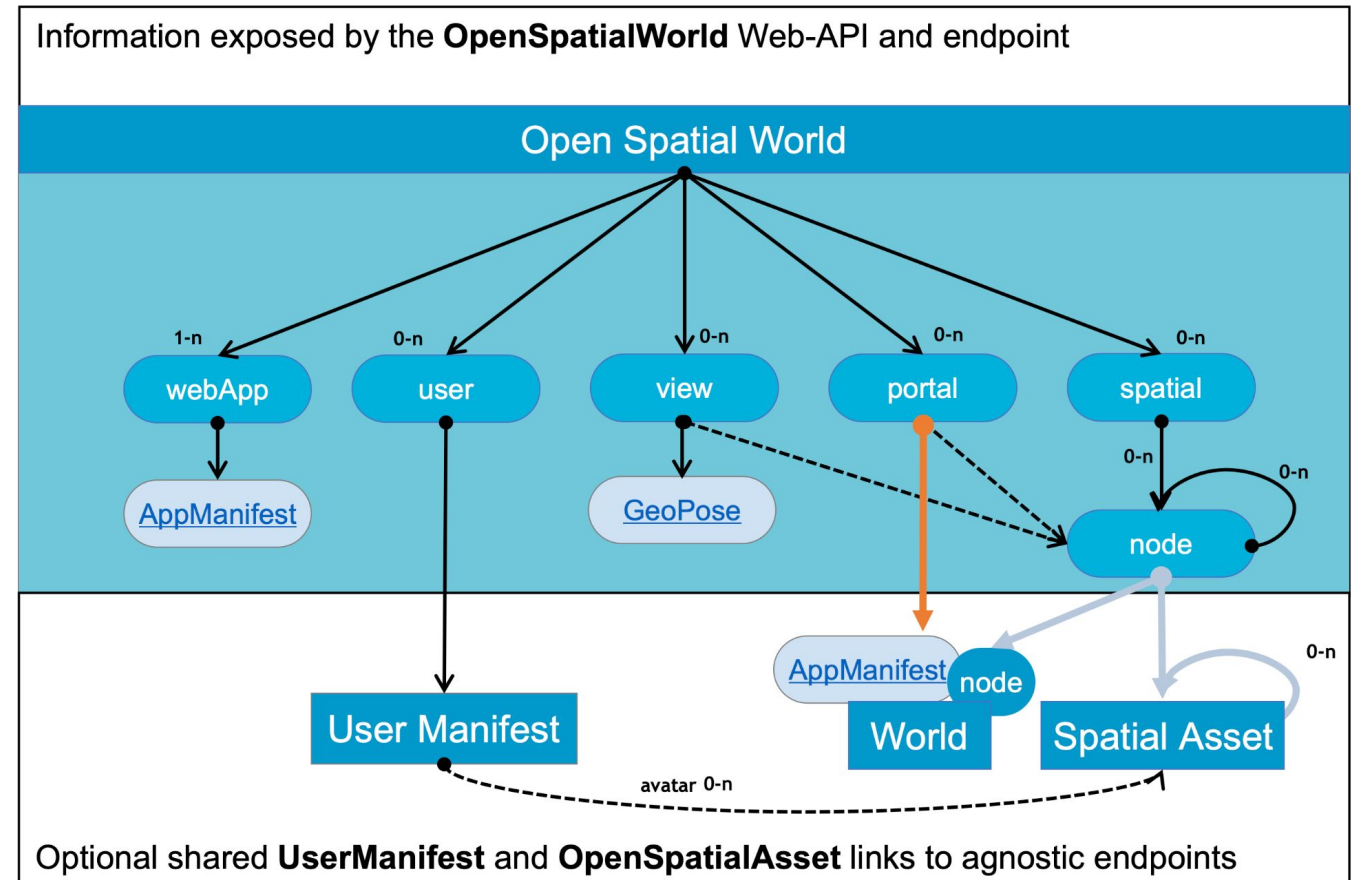
[example.com/media/movie.mpg#xywh=100,100,10,10&t=10,20](#)
[example.com/media/movie.mpg#id=cap](#)
- ***Open Opportunity: Missing "Model Fragment URI"***
Spatially-, temporally- and structure-based addressing

[example.com/model/434/#xyzwhz=100,100,100,20,20,20&t=10,20](#)
[example.com/model/434/#objects="/tire"](#)



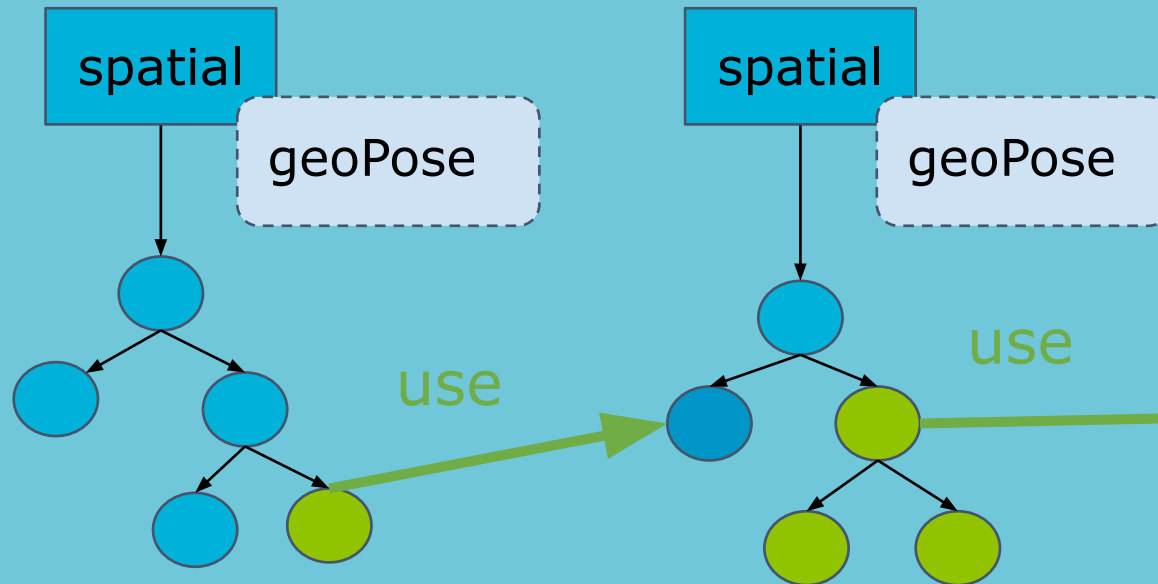
World Aspect Schema

- World Aspects
 - webApp JSON Schema
 - User JSON Schema
 - View JSON Schema
 - Portal JSON Schema
 - Node JSON Schema

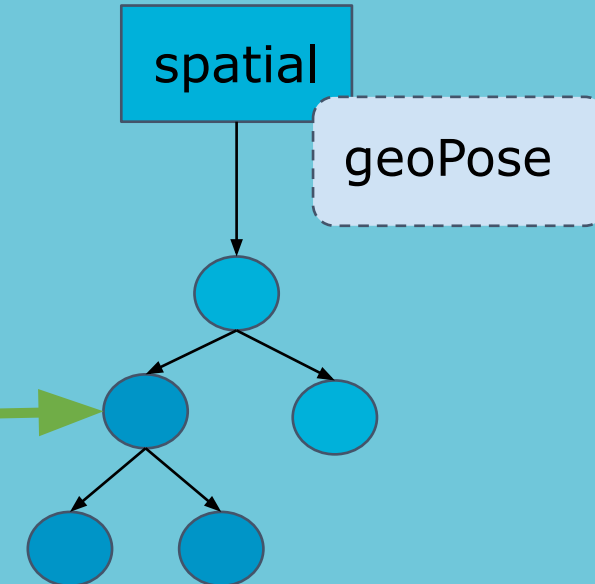


Spatial data interoperability between Worlds

Service and World A



Service and World B



Use Cases:

Catena-X Digital Twin
Virtual shop in real street
POI from OpenARCloud

Spatial Data Management on Worlds

	<u>Create</u> +Assets Links	<u>Create</u> +Asset Copy	<u>read</u>	<u>update</u> +Assets Links	<u>update</u> +asset copy	<u>delete</u>
REST WOW	/node/ POST => JSON-Tree <= JSON-Tree with new nodeID	/node/ POST => model/* asset	/node/ GET =>fields-whiteli st + depth <= JSON-Tree	/node/ Update => JSON-Tree + depth	/node/ Update	/node/ Delete => NodeID
MCP	Tools createNodes => JSON-Tree	? binary data in Tools	resource	Tool updateNodes => Json-Tree	? binary Data in tools	Tool deleteNodes => NodeID group

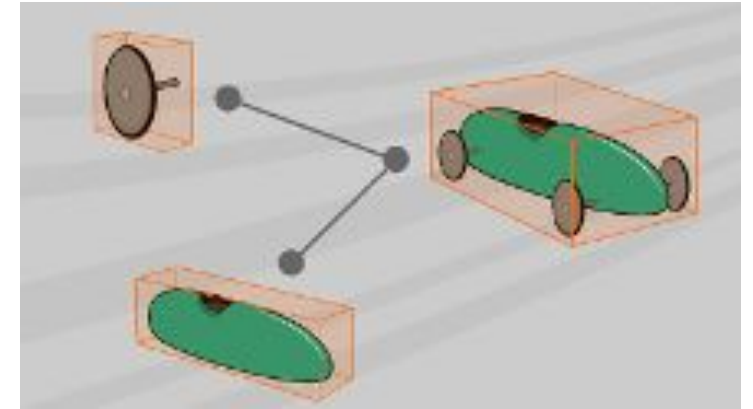


Example: create spatial nodes with linked assets

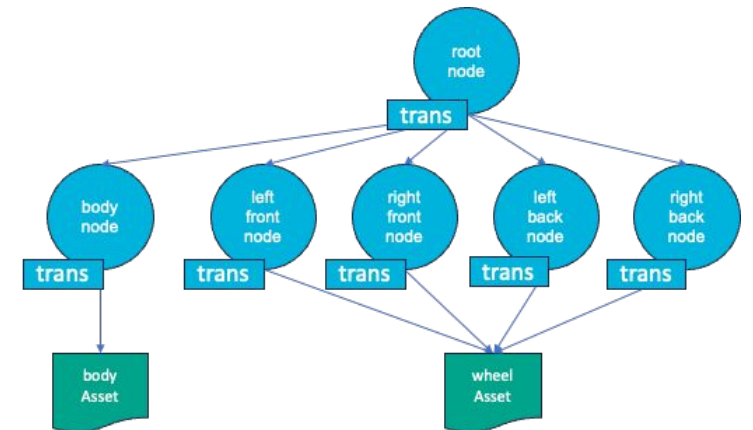
<http://example.com/world/604djg942/wow/spatial/3858/node/35643>

POST

```
{
  "name": "body",
  "assetURI": "http://example.com/data/carbody056834",
  "children": [
    {
      "name": "leftFront"
      "localTransform": [ ... ]
      "assetURI": "did:example:123?service=wheelAssembly35"
    },
    {
      "name": "rightFront"
      "localTransform": [ ... ]
      "assetURI": "did:example:123?service=wheelAssembly35"
    },
    {
      "name": "leftBack"
      "localTransform": [ ... ]
      "assetURI": "did:example:123?service=wheelAssembly35"
    },
    {
      "name": "rightBack"
      "localTransform": [ ... ]
      "assetURI": "did:example:123?service=wheelAssembly35"
    }
  ]
}
```

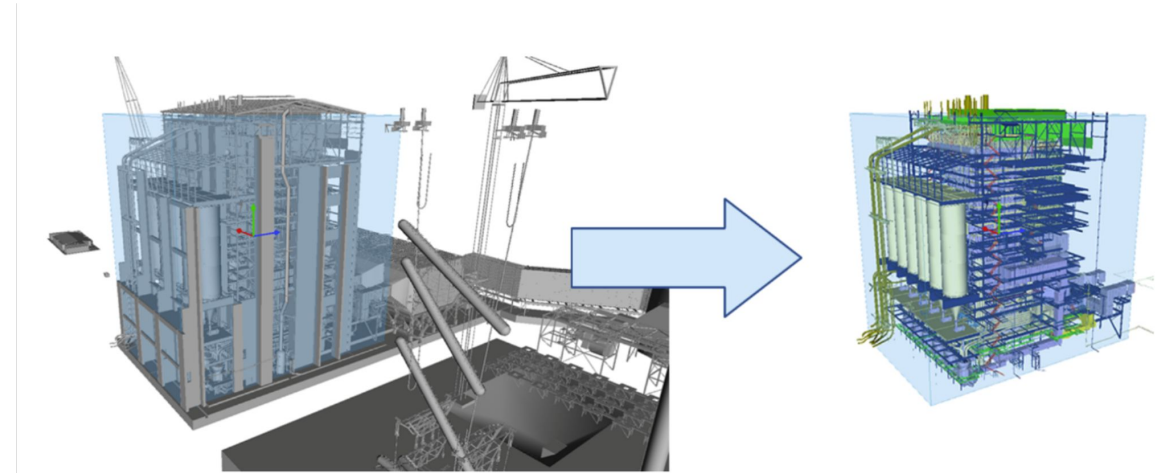


2 Assets/URI with 5 data instances



Spatial computation function on Worlds

- **Compute Bounding Volume**
 - < bounds
- **Compute Volume Selection**
 - < bounding volume
 - > node selection
- **Compute Minimal Distance**
 - < nodeGroupA, nodeGroupB
 - > minimal Distance
- **Compute Clashes / Collision**
 - < nodeGroupA, nodeGroupB
 - > clasList
- **Compute Preview**
 - < user, view or portal
 - > model/image binary





Implementations updates and previews

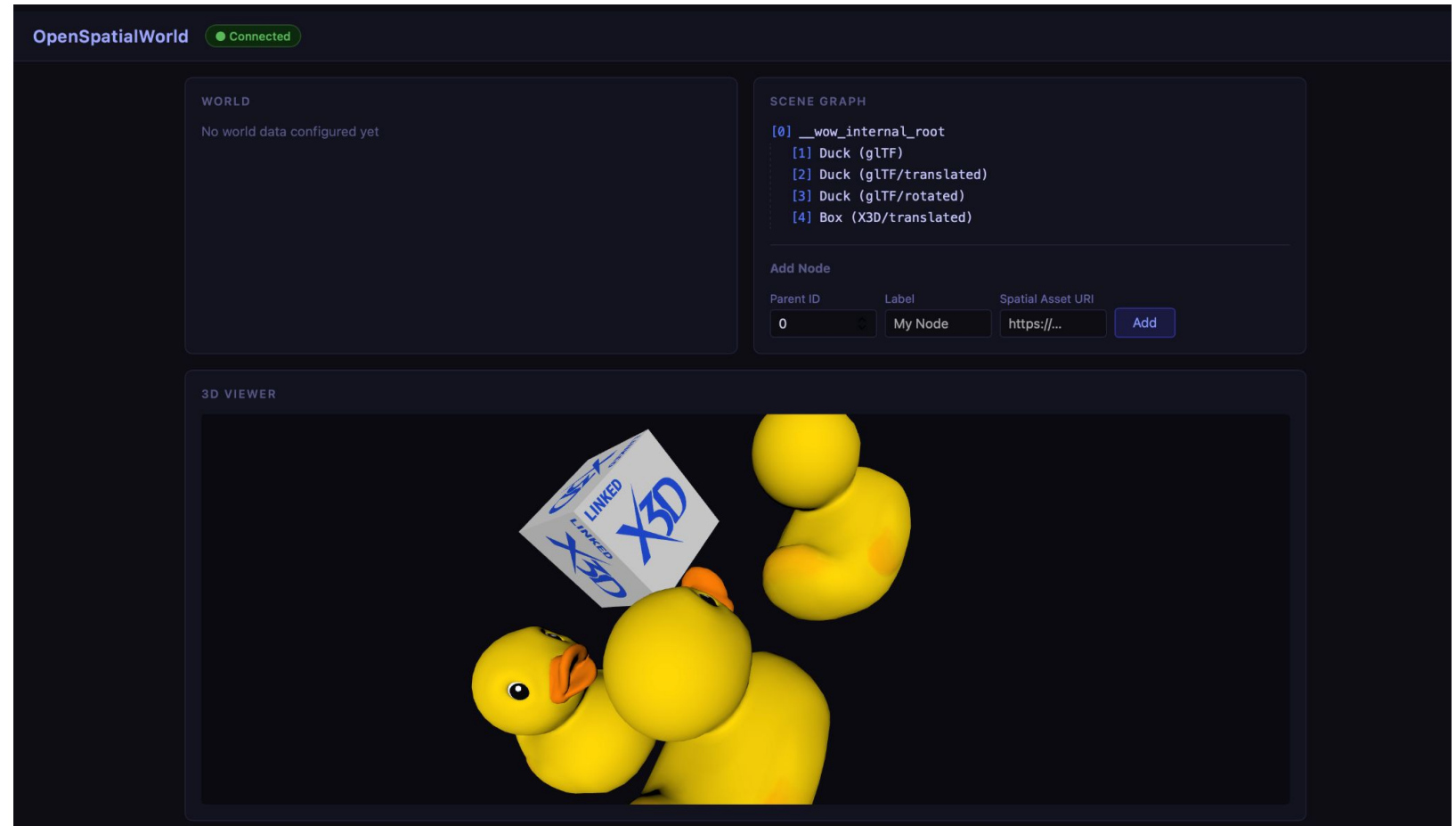
Implementation

	License	Service Technology	Webapp - Client Technology	Asset Links
simpleWorlds	Apache 2.0	node.js + world state	X3DOM + asset downloads	gltf-binary, gltf+json, X3d+xml vnd.usda, vnd.usdz+zip ?
Threedy.io	Commercial	instant3Dhub	webvis + 3D Streaming	e57, gltf-binary, gltf+json, JT, step, vnd.usda, vnd.usdz+zip, x3d-vrml, x3d+fastinfoset, x3d+xml, las ...
Open-Spatial-Lab	Apache 2.0	node.js + world state	three.js + asset downloads	gltf-binary



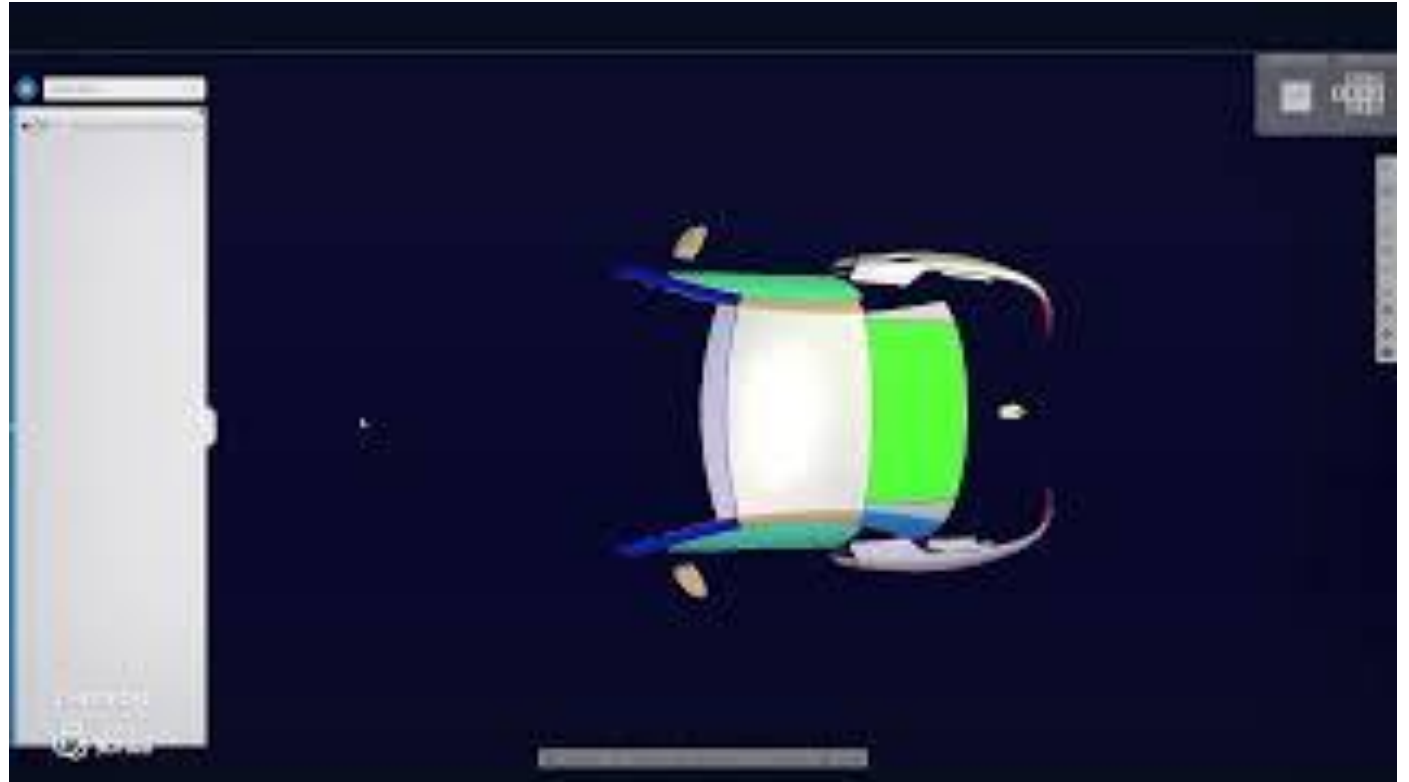
Implementation updates : simpleWorlds

- <https://github.com/WebOfWorlds/simpleWorlds>
- Node.js server
 - Persistent graph
 - Multi user
 - No 3D data store
- web apps
 - Debug app
- Asset Formats
 - X3D-XML
 - All GLTF
 - USD ?



Implementation updates : instant3Dhub

- <https://www.threedy.io/product/instant3dhub>
- Modern Kubernetes cluster
 - No GPU Server
 - Persistent graph
 - Multi user
 - Hidden spatial cache
- web apps
 - webVis
- Asset Formats
 - JT, Step, CAD-Native
 - All X3D
 - All GLTF
 - All USD



Implementation updates : Open Spatial Lab

- <https://github.com/grigb/open-spatial-lab>
- Node.js server
 - Persistent graph
 - Multi user
 - No 3D data store
- web apps
 - Join,
 - View
 - Preview
- Asset Formats
 - Gltf-binary





Conclusion and Outlook

WoW Roadmap

In the first iteration, we only included use cases from the “3D Web Interoperability” WG, and the joint vision is presented in this white paper.

In the next iteration, we will continue to improve three aspects in parallel:

1. API Spec Completion
2. First implementation for testing and evaluation
 - 3 Initial preview in Q3 => Siggraph
3. Consider requirements from new use cases
 - Use Case backlog
 - OMA3, Alfred Tom
 - OpenARCloud, Spatial Computing WG





Upcoming

Metaverse Standards Forum

- Web of Worlds Initiative

SDOs

- Web3D Consortium
- W3C Immersive
- ISO
- Khronos
- Open Geospatial Consortium



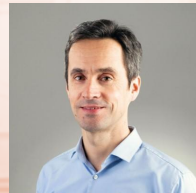


Thanks!

*The Very Long Title of Your Paper With Poppins Typeface,
Regular Weight, Italic Style, and 9 pt. Left Alignment, Vertical
Centering and no Justification*



Holger Graf



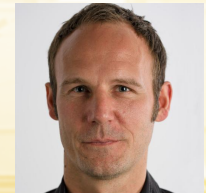
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Tracey Swales



Nicholas Polys



Johannes Behr

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