

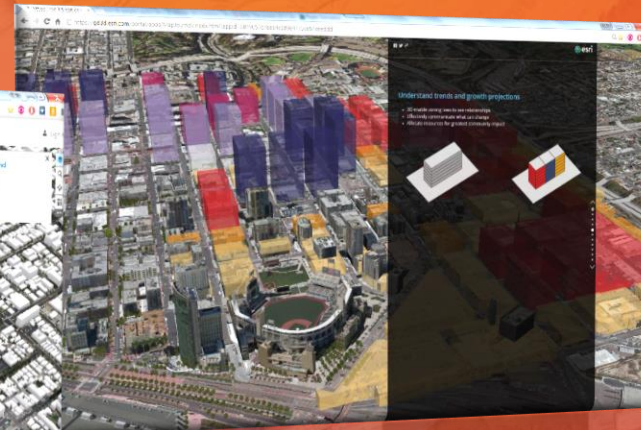
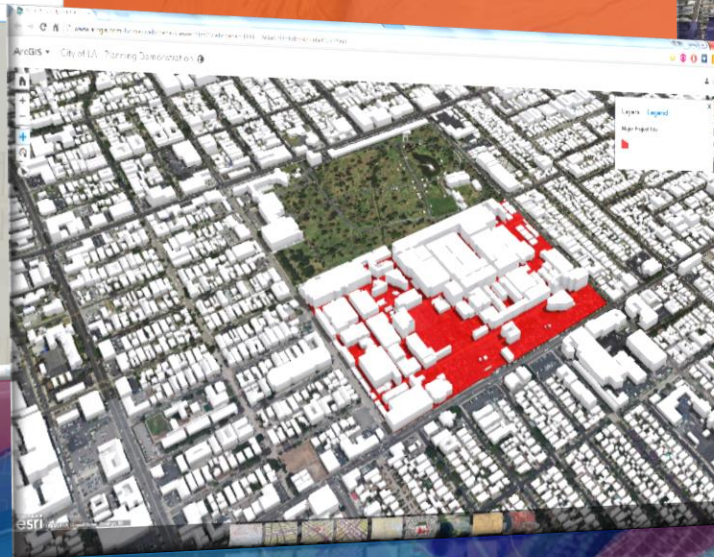
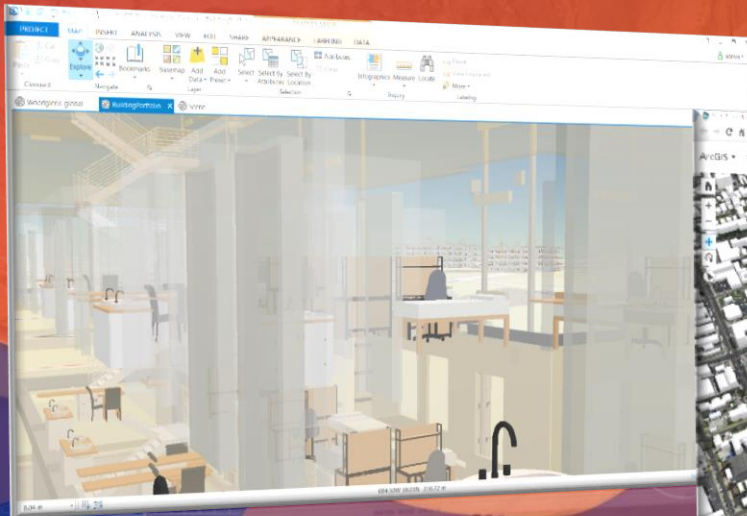
Sharing 3D Content

Don Kuehne, Tamrat Belayneh, Sean William Morrish

Agenda

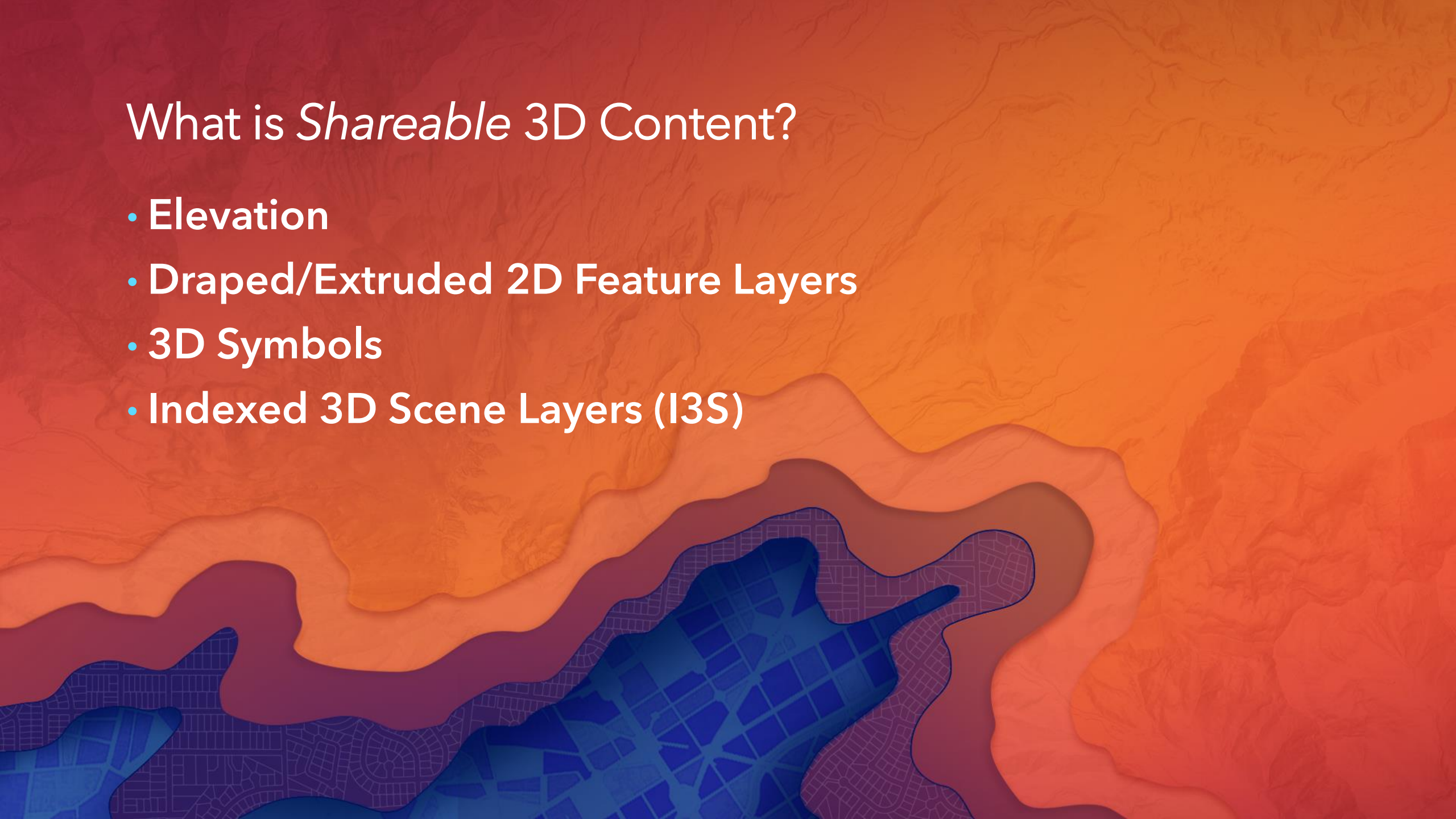
3D Scenes Layers Across the Platform

Sharing Scenes Best Practices



What is *Shareable* 3D Content?

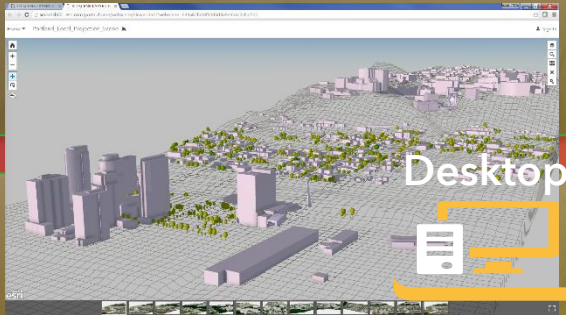
- Elevation
- Draped/Extruded 2D Feature Layers
- 3D Symbols
- Indexed 3D Scene Layers (I3S)



Building a 3D Scene to Share

Feature Service Layers

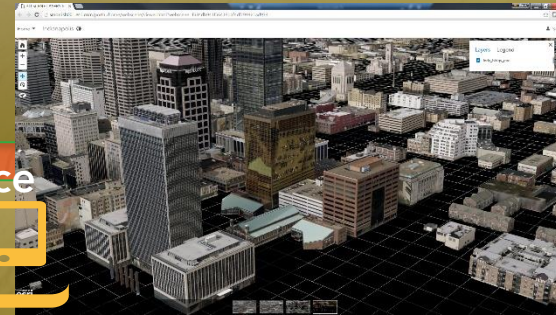
Scene Layers
(I3S)



2D Layers
Draped or *Absolute**

Web
2D Layers
(Absolute Z')

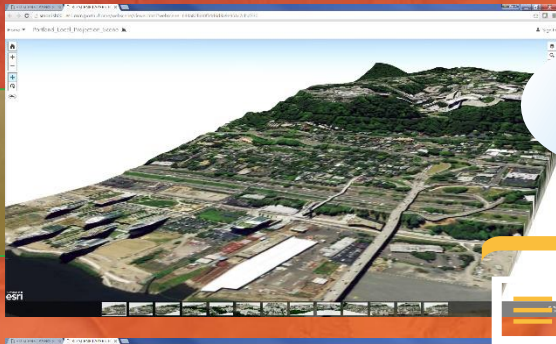
Device



Feature Service Layers

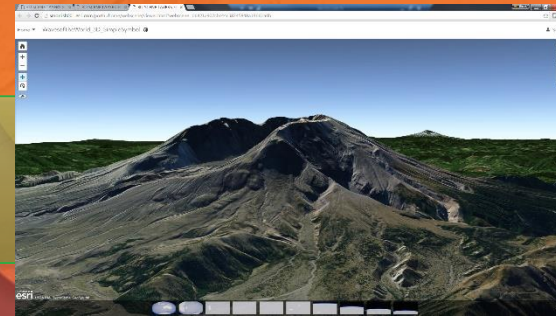
Scene Layers
(I3S)

Your Local Imagery

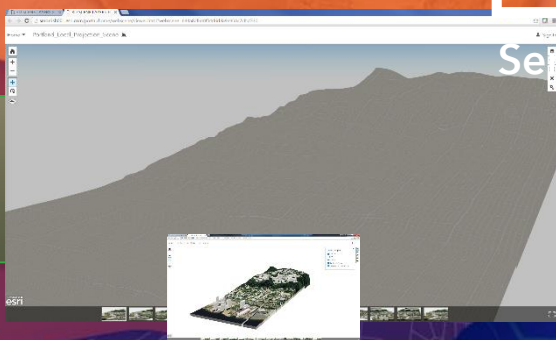


Draped Imagery

ArcGIS Online



Your Local Terrain

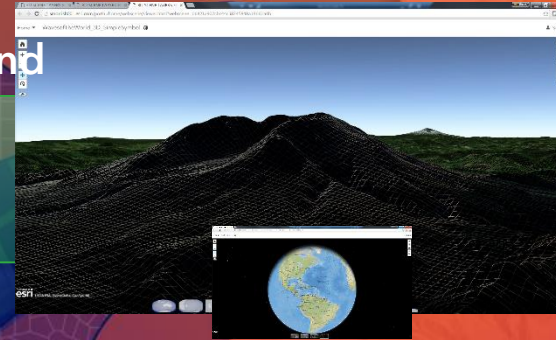


Server

Online Content and
Services

Terrain

ArcGIS Online



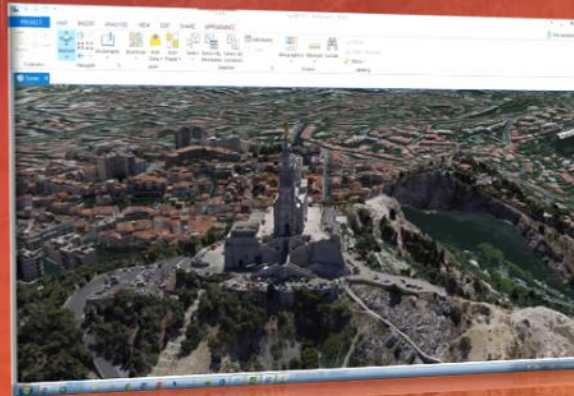
Local Scene

Global Scene

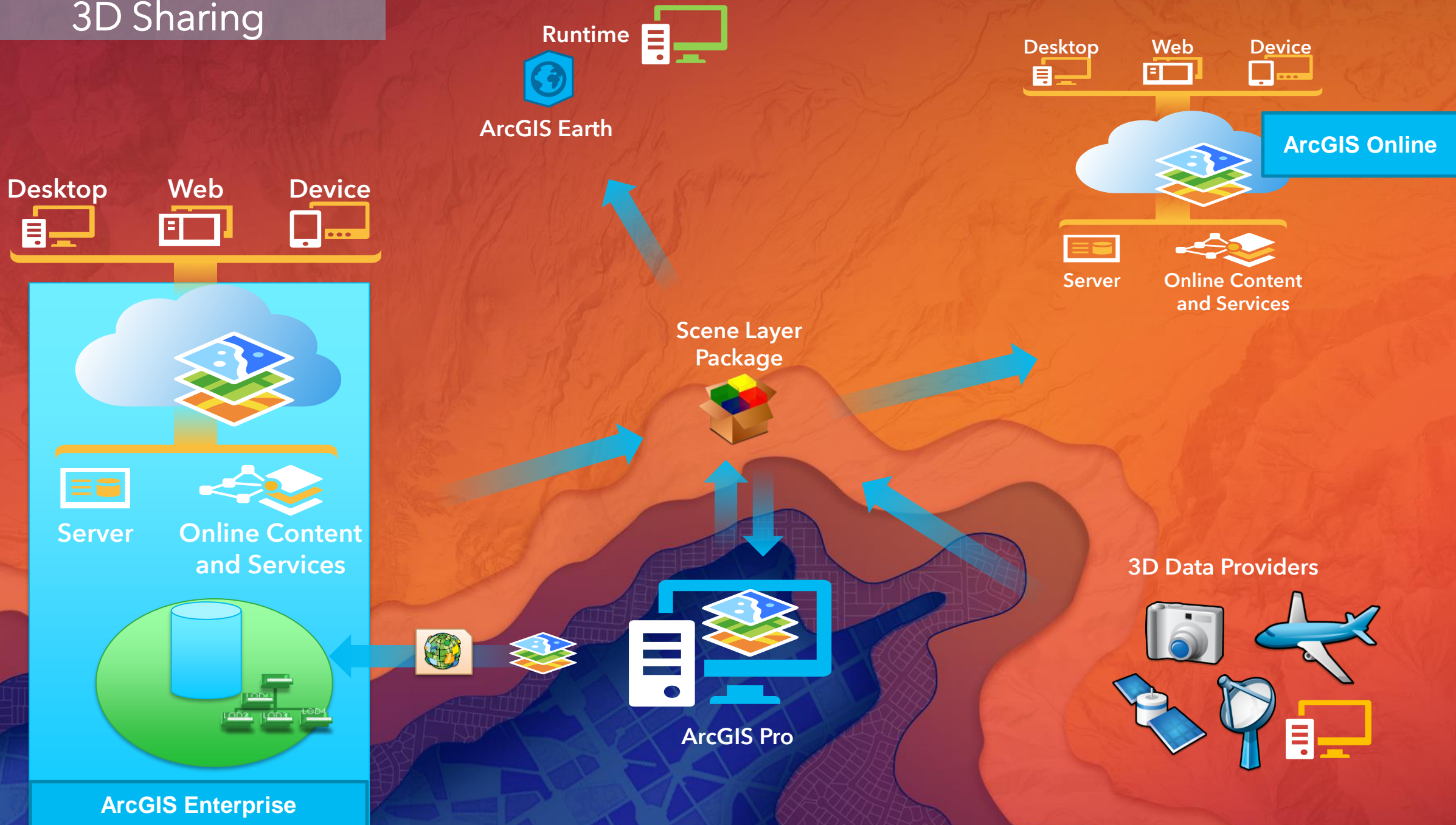
Indexed 3D Scene Layers

ArcGIS Scene Layers

- 3D Object Scene Layer
- 3D Point Scene Layer
 - Preset Point Symbols (Trees...etc)
 - User Defined 3D Symbols
- 3D Integrated Mesh Layer
- 3D Point Cloud Scene Layer



3D Sharing



Indexed 3D Scene Layers are supported across the ArcGIS platform

Publishing/Sharing

Consuming

ArcGIS
Enterprise

ArcGIS
Online

Drone2Map
for ArcGIS

Esri
CityEngine

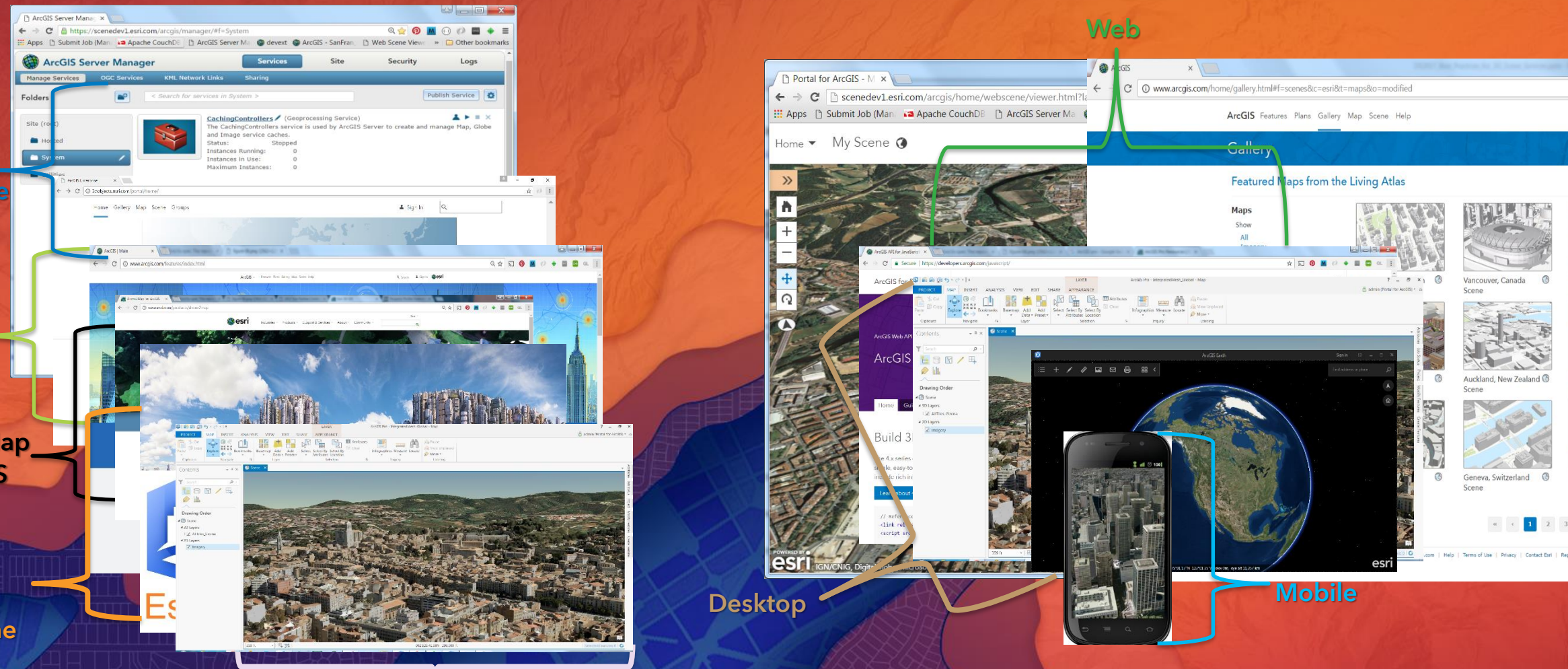
ArcGIS Pro

Desktop

Mobile

Web

Gallery



Indexed 3D Scene Layers (I3S) – What is it ?

- Open standard for storage and transmission of large, heterogeneous 3D geospatial data sets
- Cloud, Web and Mobile friendly based on JSON, REST and modern web standards
- Support 3D geospatial content, various coordinate systems along with a rich set of layer types
- An I3S data set, referred to as a *Scene Layer* is:
 - a container for *arbitrarily large* amounts of *heterogeneously* distributed 3D geographic data

Indexed 3D Scene Layers (I3S) – What is it ?

- I3S is currently under adoption vote to become an OGC community standard
- The standard includes specification for Scene Layer Package (SLPK):
 - A single file that packages the complete node tree and its resources into an archive that supports direct access to the individual nodes and resources within it
- I3S can serve as a common tool to package and disseminate, a variety of GIS content
- Both I3S and SLPK are licensed under Creative Commons
- Available @ <https://github.com/Esri/i3s-spec>

Indexed 3D Scene Layers (I3S) – What is it ?

I3S Design Principals for a 3D GIS visualization format

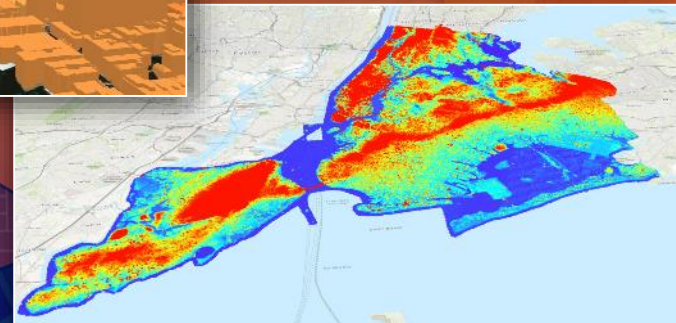
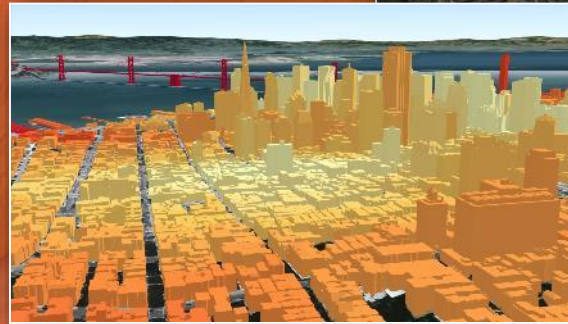
1. **Web friendly:** JSON + Typed Arrays
2. **Mobile friendly:** Works good with varying bandwidth
3. **Extensible:** Support different types of content
4. **Declarative:** Reduce required implicit knowledge
5. **Efficient:** Use spatial indexing for quick delivery
6. **Scalable:** Provide Level of Detail Support
7. **Protected:** Ensure that content is protected
8. **Open:** Full Specification publicly accessible

<https://github.com/Esri/i3s-spec>

Scene Layer types and profiles

Support different geometry types

- 3D Objects
- Points
- Integrated Meshes
- Point Clouds



Indexed 3D Scene Layers (I3S)

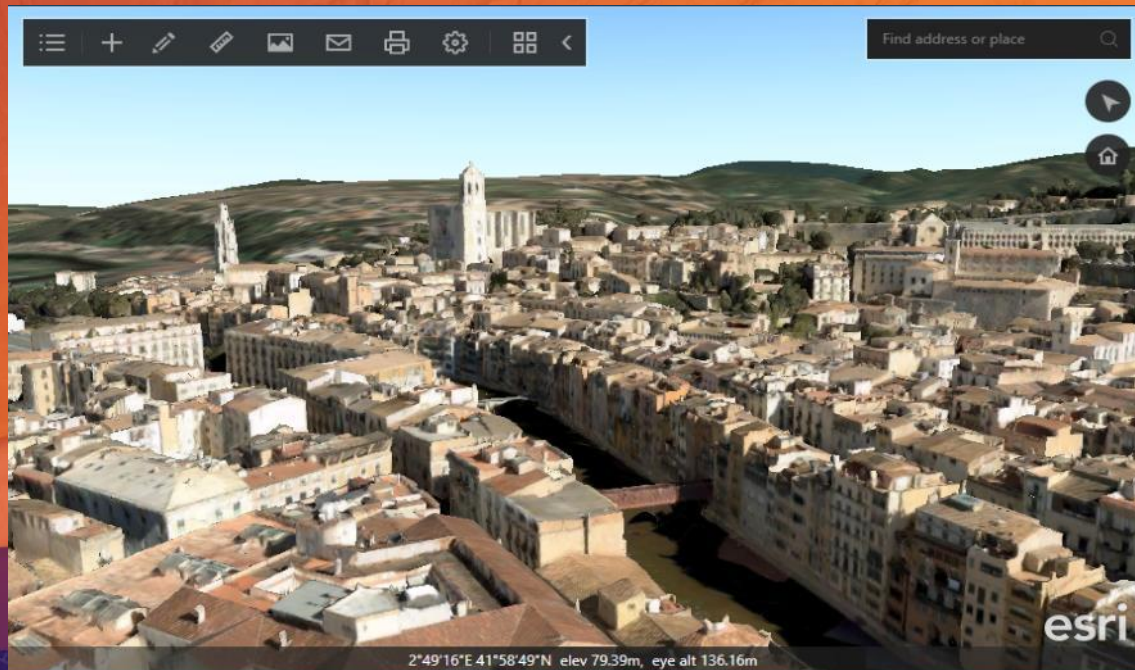
- 3D Objects
 - Example: Building Exteriors
 - Sources: Derived from GIS Data, as well as 3D models in various formats



Indexed 3D Scene Layers (I3S)

- Integrated Meshes

- Examples: Mesh surface representing the skin of the Earth, including vegetation, buildings and roads
- Sources: Derived from satellite, aerial or drone imagery via dense matching photogrammetry, or calculated



Indexed 3D Scene Layers (I3S)

- Points

- Examples: Hospitals, schools, trees, cars
- Sources: Feature locations combined with Instanced 3D models generated by hand



Indexed 3D Scene Layers (I3S)

- Point Clouds
 - Example: LiDAR data sets
 - Sources: Typically sensor-collected or Photogrammetrically derived

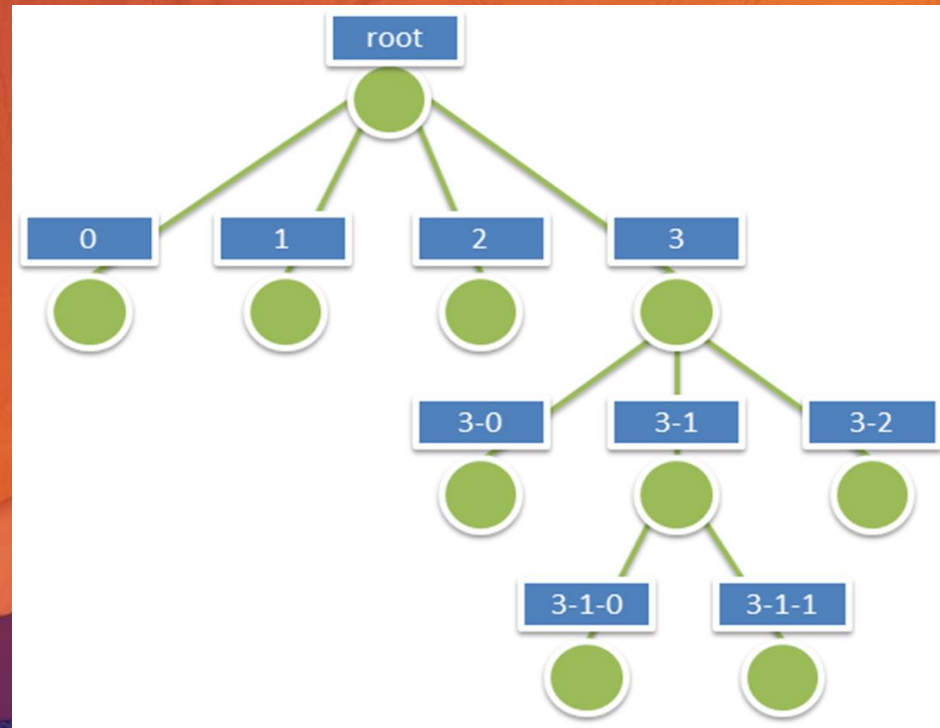


Viewing and Consuming Scene Layers

In Browser, ArcGIS Pro, Earth, App or mobile

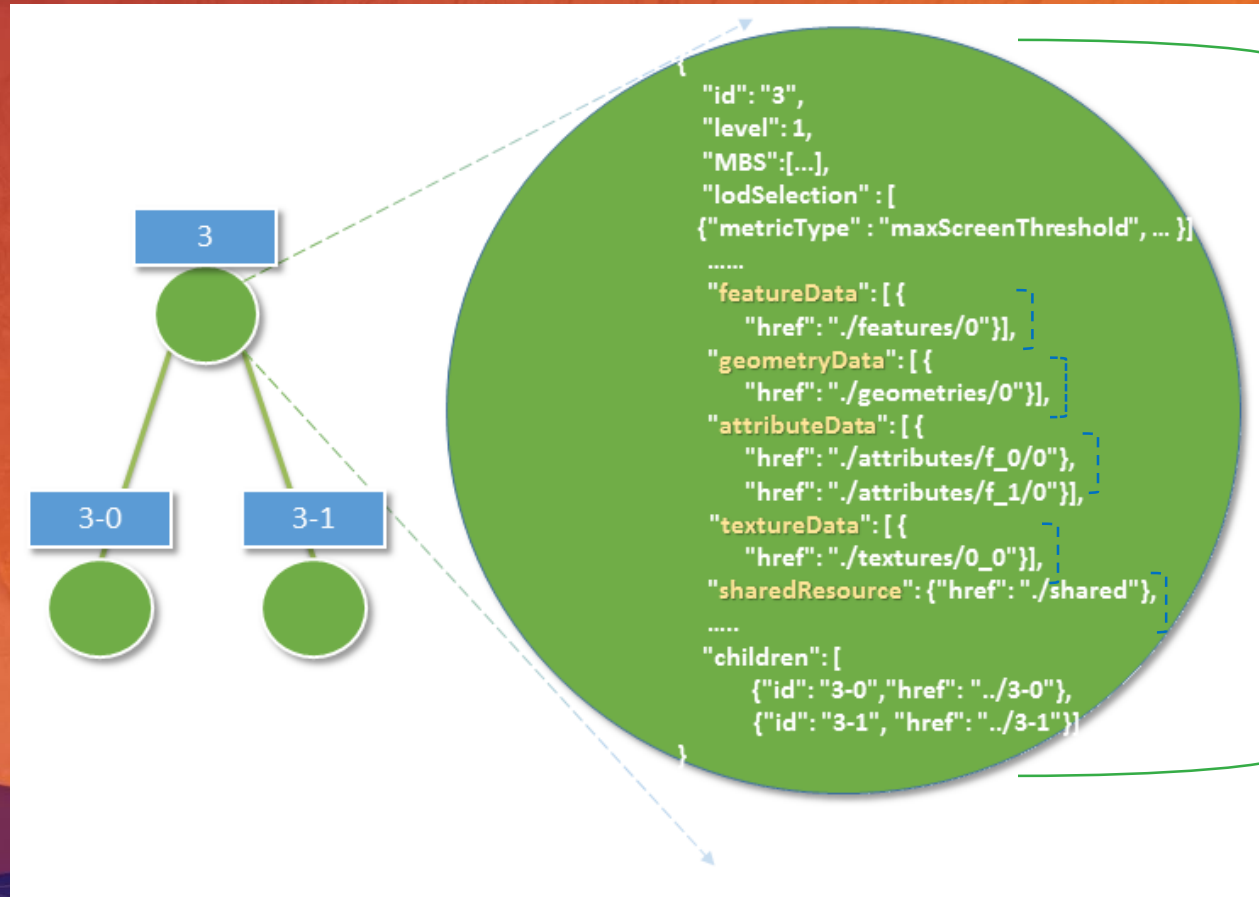
I3S: Organization and structure

- Organizes geospatial data using a hierarchical, node-based spatial index structure



I3S: Organization and structure

The physical organization of information within node:



I3S: LoD Models, Selection Metrics

- I3S promotes the concept of discrete levels of details with multiple discrete representations of features and nodes
- An example lod selection metric is *the maximum screen size* that the node may occupy before it must be replaced with data from more detailed nodes.
- This model of discrete LOD rendering is referred to in I3S as *node switching*.



I3S: Consumption

- *As a service (via a REST API) or locally as a file system (SLPK)*
 - As RESTful interfaces/services:
 - Via a RESTful interface that exposes the scene layer, its nodes and their associated resources (geometries, attributes, textures) as web addressable resources.
 - I3S resources are designed for direct access (via a unique key) from key value based cloud blob stores such as Windows Azure Blob Storage or Amazon Simple Storage (S3) using built in REST APIs of such infrastructures
 - As a single large Scene Layer Package (SLPK):
 - A single file that packages the complete node tree and its resources into an archive that supports direct access to the individual nodes and resources within it.

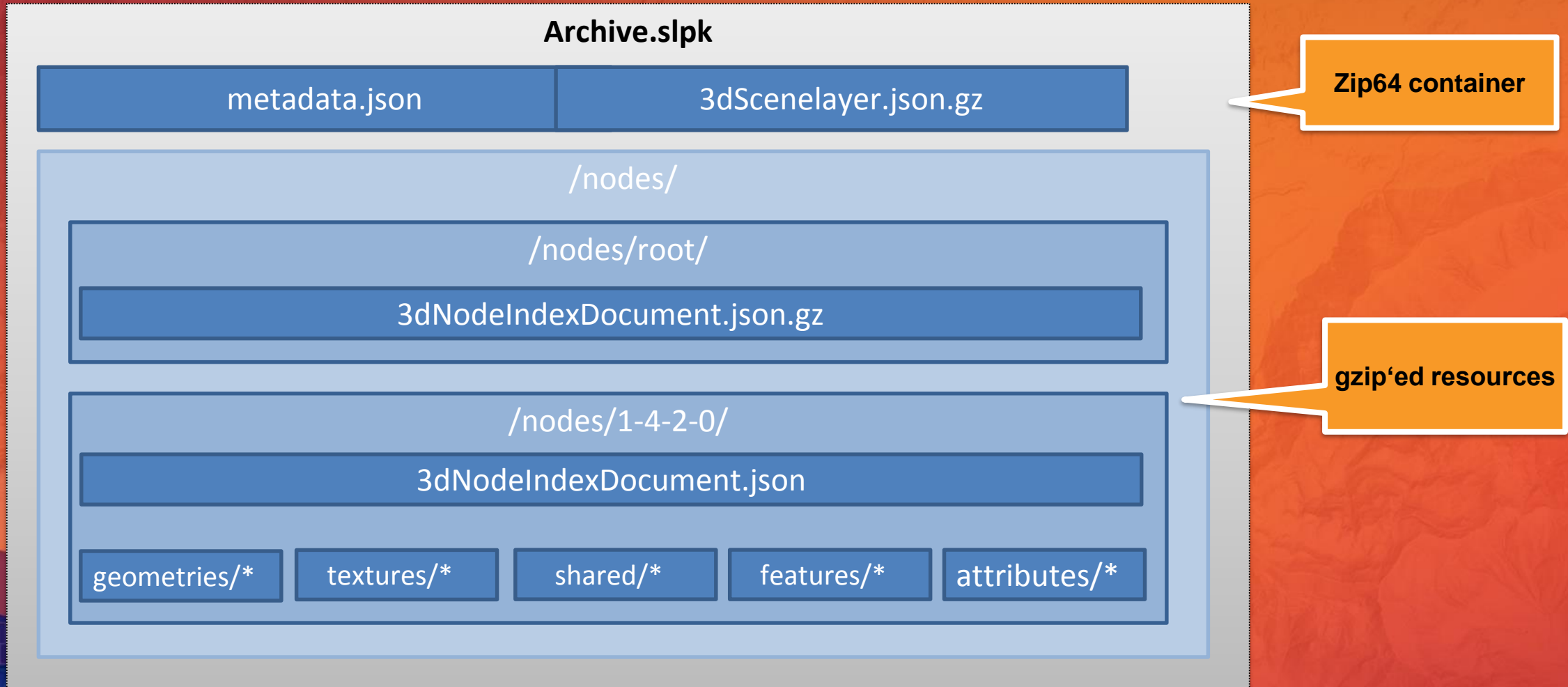
I3S: Flexibility

- Examples of I3S flexibility:
 - Minimum Bounding Volume (MBV):
 - Minimum Bounding Sphere (MBS)
 - Oriented Bounding Box (OBB)
 - The node structure may be
 - 'expanded' - with complete meta-information about node's position and BVH topology
 - 'fixed-size' - in support of 'paged' access pattern

I3S: Flexibility (cont'd)

- Nodes may have “embedded” vs “binary” geometry/attribute content format
 - Embedded geometry: as JSON in-lined with additional metadata
 - Binary format: as typed array buffer views
- LOD Selection based on different metricTypes:
 - *maxScreenThreshold* - LOD switching based on screen ‘size’ of the node’s MBV
 - *screenSpaceRelative* - LOD switching based on screen ‘scale’ of the node’s MBV
 - *distanceRangeFromDefaultCamera* - LOD switching based on normalized distance of the node’s MBV from the camera
 - *effectiveDensity* - estimation of the point density covered by the node

Scene Layer Package (SLPK) and Scene Service REST API



Best Practices when working with I3S content

An Open Specification for the Community

- Use Sharing tool in ArcGIS Pro to upload large Packages (2GB +)
- Try to organize content via layers (don't mix large scale with small scale data in the same layer)
- Use hardware compressed textures whenever possible
- Pre-cache attribute driven symbolization
- Scene Layer Package tool is handy to create I3S content offline and upload the content to your portal or online

•

Road Ahead

- Adoption of I3S as OGC community standard
- Provide I3S utility tools including (validation (Available with ArcGIS Pro 2.0), re-projection, optimization)
- Support additional compressed texture formats (optimized for mobile)
- Caching Performance Improvement
- Detailed specification of point cloud layer type
- Areas of active R&D:
 - Enhanced support for BIM data types
 - Partial Updates of Scene Layers
 - Support paged node index access for all layer types
 - Support more use case for Integrated Mesh layer types (attribution, use as surface etc...)
 - Mesh Compression
 -

Publishing Web Scenes

To Enterprise and ArcGIS Online



esri

THE
SCIENCE
OF
WHERE