Sharing 3D Content

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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)
- Your Local Imagery
- Your Local Terrain
- ArcGIS Online
- Online Content and Services
- Server
- Desktop
- Web
- Device
- Local Scene
- Global Scene
- Drape or Absolute*
- 2D Layers
- 3D Layers (Absolute Z')
- Terrain
- Scene Layers (I3S)
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
Indexed 3D Scene Layers are supported across the ArcGIS platform.
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](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:

```
{
    "id": "3",
    "level": 3,
    "MBS" : [ ... ],
    "iodSelection": [
        { "metricType": "maxScreenThreshold", ... }]
    ...
    
    "featureData": [ {
        "href": "./features/0"}],
    "geometryData": [ {
        "href": "./geometries/0"}],
    "attributeData": [ {
        "href": "./attributes/f_0/0"},
        { "href": "./attributes/f_1/0"}]
    "textureData": [ {
        "href": "./textures/0_0"}],
    "sharedResource": { "href": "/shared"},
    ...
    "children": [ {
        "id": "3-0", "href": "../3-0"},
        { "id": "3-1", "href": "../3-1"}]
}
```
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
• 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
  - distancRangeFromDefaultCamera – 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

<table>
<thead>
<tr>
<th>Archive.slpk</th>
</tr>
</thead>
<tbody>
<tr>
<td>metadata.json</td>
</tr>
</tbody>
</table>

/nodes/

/nodes/root/

3dNodeIndexDocument.json.gz

/nodes/1-4-2-0/

3dNodeIndexDocument.json

geometries/* textures/* shared/* features/* attributes/*

Zip64 container

gzip’ed resources
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