Designing and Using Cached Map Services

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What we will cover

• Session Topics
  - Map cache basics
  - Map cache workflows
  - Cache as a raster dataset
  - Caching imagery

We will answer questions at the end of the session
Why should I care about map caches?

- Performance, performance, performance
- Scalability: Industry standard
- Cartographic quality

- ArcGIS Explorer Online
Map cache basics
What is a map cache?

Cache tile

1:16000
1:8000
1:4000
1:2000
1:32000
1:16000
1:8000
1:4000
1:2000

Landbase
Hydrography
Transportation
How does a map cache work?

Client → ArcGIS Server → Dynamic map → Cached Map

- Render
- Label
- Project
Users expect map cache speed & quality

10 years ago
- Dynamic drawing
- Slow to render
- Compromised cartography

Today
- Cached maps
- Fast response
- Enhanced cartography
What should you cache?

- Base maps (always)

- Operational layers that satisfy one of the following:
  - High volumes of traffic
  - Don’t change often
  - Cover small scales only
What about optimized map services?

- Optimized drawing format
  - Based on MSD file
  - Enhanced map drawing engine
  - Use to generated map tiles faster

- Does NOT replace cache map service
  - Requires dynamic rendering
  - Web services are optimized for cached tiles
Map cache workflow
Building a map cache

1. Choose coordinate system and scales
2. Author and publish the map
3. Setup cache properties
4. Create tiles
Choosing coordinate system and scales

1. ArcGIS Online & Google Maps & Bing Maps
   - WGS 1984 Web Mercator (Auxiliary Sphere) coordinate system

2. Create your own
Overlaying with ArcGIS Online

• Project your map to WGS 1984 Web Mercator (Auxiliary Sphere)
  - Recommended choice
  - Works in all clients

• Project your map to WGS 1984 Web Mercator
  - Datum transformations more difficult this way
  - Won’t work in some clients (.NET ADF)
Creating your own scales

• Build just the scales you need
  - Determine closest scale (Raster resolution)
  - Divide scale by 2 for each subsequent scale
  - Adjust smallest scale to full extent

• Consider ArcGIS Online scales

Sample 10 level cache

<table>
<thead>
<tr>
<th>Level</th>
<th>Scale</th>
<th>Tiles</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1:16,000,000</td>
<td>1</td>
<td>0.000%</td>
</tr>
<tr>
<td>2</td>
<td>1:8,000,000</td>
<td>4</td>
<td>0.001%</td>
</tr>
<tr>
<td>3</td>
<td>1:4,000,000</td>
<td>16</td>
<td>0.005%</td>
</tr>
<tr>
<td>4</td>
<td>1:2,000,000</td>
<td>64</td>
<td>0.018%</td>
</tr>
<tr>
<td>5</td>
<td>1:1,000,000</td>
<td>256</td>
<td>0.073%</td>
</tr>
<tr>
<td>6</td>
<td>1:500,000</td>
<td>1,024</td>
<td>0.293%</td>
</tr>
<tr>
<td>7</td>
<td>1:250,000</td>
<td>4,096</td>
<td>1.172%</td>
</tr>
<tr>
<td>8</td>
<td>1:125,000</td>
<td>16,384</td>
<td>4.688%</td>
</tr>
<tr>
<td>9</td>
<td>1:62,500</td>
<td>65,536</td>
<td>18.750%</td>
</tr>
<tr>
<td>10</td>
<td>1:31,250</td>
<td>262,144</td>
<td>75.000%</td>
</tr>
</tbody>
</table>

Final level is ~75% of the total
2 Author the map

- Design map for cache scales
  - Add tiling scheme scales ArcMap
    - ArcGIS Online / Bing Maps / Google Maps available
    - Only display these scales when zooming
- Group layers by scale level
  - Only have to set the scale range at the group layer level
  - Copy layers between groups
- ArcGIS Resource Center
Authoring labels for the map

- Individual tiles are cut from large area (supertile)
  - 4096 x 4096
  - 2048 x 2048 if using antialiasing
- Supertile necessary to
  - Reduce duplicate labeling
  - Reduce requests to map service when caching
- Labeling rules can repeat across super tile boundaries
  - Maplex places better labels
  - Annotation

Supertile
No antialiasing
4096x4096

Supertile antialiasing
2048x2048

512x512 tile size
256x256 tile size
ArcGIS Online / Bing / Google
3 Setup cache properties

- Time to build map cache
- Antialiasing
- Map quality
- Tile size
- Map service performance
- Image format
- Storage
- Size on disk
Tile size

- Pixel dimensions of each image
  - 256x256 is the web standard
    - 512 X 512 : legacy ArcGIS Online
  - Larger dimensions are faster to build, but tiles take longer to download
Choosing an image format

- Image format effects
  - Tile storage space requirements
  - Web application performance (speed and supported browsers)
  - Tile image quality and transparency
- JPEG
  - Great compression for many colors but not transparency
- PNG
  - Best compression for less colors
- Mixed

- JPEG
- PNG
## Comparing image formats

<table>
<thead>
<tr>
<th>Output format</th>
<th>Transparency</th>
<th>Compression</th>
</tr>
</thead>
<tbody>
<tr>
<td>JPEG</td>
<td>No</td>
<td>Lossy (groups similar cell values)</td>
</tr>
<tr>
<td>Mixed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PNG-32</td>
<td>Yes</td>
<td>Lossless (groups same cell values)</td>
</tr>
</tbody>
</table>
Mixed mode image format

- Generates JPEG tiles unless transparent pixels detected
- If transparent pixels detected, creates PNG32
- Mashup basemaps with ArcGIS Online
- **Mixed Mode Caches**

Two overlapping map services
Mixed mode cache on top of a JPEG cache
Operational layers: Image format guidelines

- **PNG 8**
  - Small size on disk + transparency support
  - Not for imagery
  - Use MSD-based service + heavy testing if over 256 colors
- **PNG 32**
  - Over 256 colors
  - Good for vector overlays with antialiasing
  - Caution: Large tile sizes
- **(PNG 24)**
  - Avoid in Web apps (poor IE 6 support)
- **Solar Boston**
Example: Tiles are too large

Aerial photo and vector blend using PNG 32
When should I use antialiasing

- High quality line and label appearance on vector maps
- Web standard (Google, Bing, AGOL)
- Optimized map services preferred for antialiasing (speed and appearance)
Choose storage format

- **Compact**
  - Stores tiles in compact, continuous file streams ("bundles")
    - Maximum ~16,000 tiles per bundle
  - Faster copying
  - Smaller size on disk
- **Exploded**
  - Tiles stored as individual images on disk
    - Can access with other tools
  - Marginally faster than compact
    - 5%-8% in most cases
  - Much larger on disk / difficult to manage
Generate Tiles

- Manage Map Server Cache Tiles geoprocessing tool
  - Almost always use this in a model

- Allows spatial and scale constraints

- Can run multiple times to “target” creation of tiles
  - All tiles at small scales
  - Most important tiles at large scales
Cache as a raster dataset in ArcGIS

- ArcGIS Desktop
- Disconnected field work (compact format recommended)
- ArcGIS Mobile (use cache in mobile project)
Cache export tool

- Export tiles
  - Based on extent or polygon features
  - Convert storage format
  - Use for cache import or as a disconnected cache

Exported using Nevada and Utah state boundary features.
Cache import tool

- Import tiles
  - Based on extent or polygon features
  - Must have same storage format

Import from a previously exported map cache.
Collaborative caching

- Use export and import tools
  - Import the “best available” cache content
  - Esri Community Base Maps program
  - Session: Thursday, July 14 3:15 - 4:30 PM
    - Building the Community Map: Technical Tips and Best Practices

Pasadena City College Contribution
Caching imagery
When should you cache imagery?

Cached map service
- Base map display
- Optimal performance
- Maximum scalability

Dynamic image service
- On the fly processing
- Exact extent returned
- Always up-to-date

Server Blog: Should I use a map cache or image service?
Cached imagery workflow

- Prepare imagery
  - Build raster pyramids
  - Create mosaic dataset with overviews
- Author map document
  - Add imagery to map
  - Save as MSD
- Publish as a map service
- Create and manage the map cache
  - Configure cache definition
  - Generate cache tiles
  - Update cached tiles
Image resolution and cache scales

- Largest scale = raster resolution
  - Zoom to raster resolution
  - Factors of 2 to full extent

- Scale based on 96 DPI
  - Scale (ft) = ( x/12 ) * 96
  - Scale (m) = ( x/0.0254 ) * 96

| Cell size (m|ft) | Scale 1:X |
|--------------|-----------|
| 0.15         | 0.50      | 567       |
| 0.50         | 1.64      | 1,890     |
| 1.00         | 3.28      | 3,780     |
| 10.00        | 32.80     | 37,795    |
| 30.00        | 98.42     | 113,386   |
| 90.00        | 295.27    | 340,157   |
| 1,000.00     | 3,280.83  | 3,779,527 |
Choosing the best image format

- Large number of continuous colors
  - JPEG ( start with quality = 55 )
  - Mixed ( if transparency required )

Which one looks better?

JPEG 90 – 2$KB
JPEG 90 – 30$KB
Using mixed mode for image overlay

JPEG = 3.06 MB

PNG-32 = 19.3 MB

Mixed = 6.07 MB

Disk space usage

Transparency

Best of both
Cache import for imagery

- Merge high resolution imagery into a base cache
- Seamless integration import feature boundary
Questions?

Please fill out a session survey...