Esri International User Conference | San Diego, CA
Technical Workshops | Thursday, July 07, 2011

Designing and Using Cached Map Services

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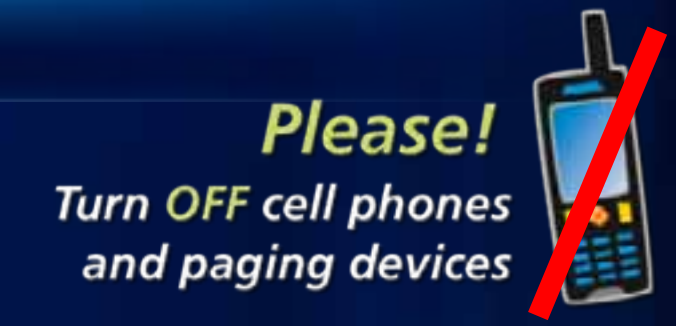
What we will cover



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

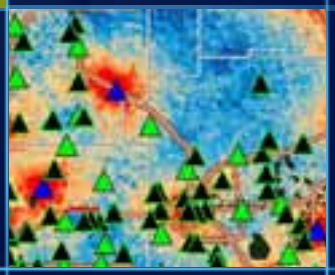
We will answer questions at the end of the session

Why should I care about map caches?

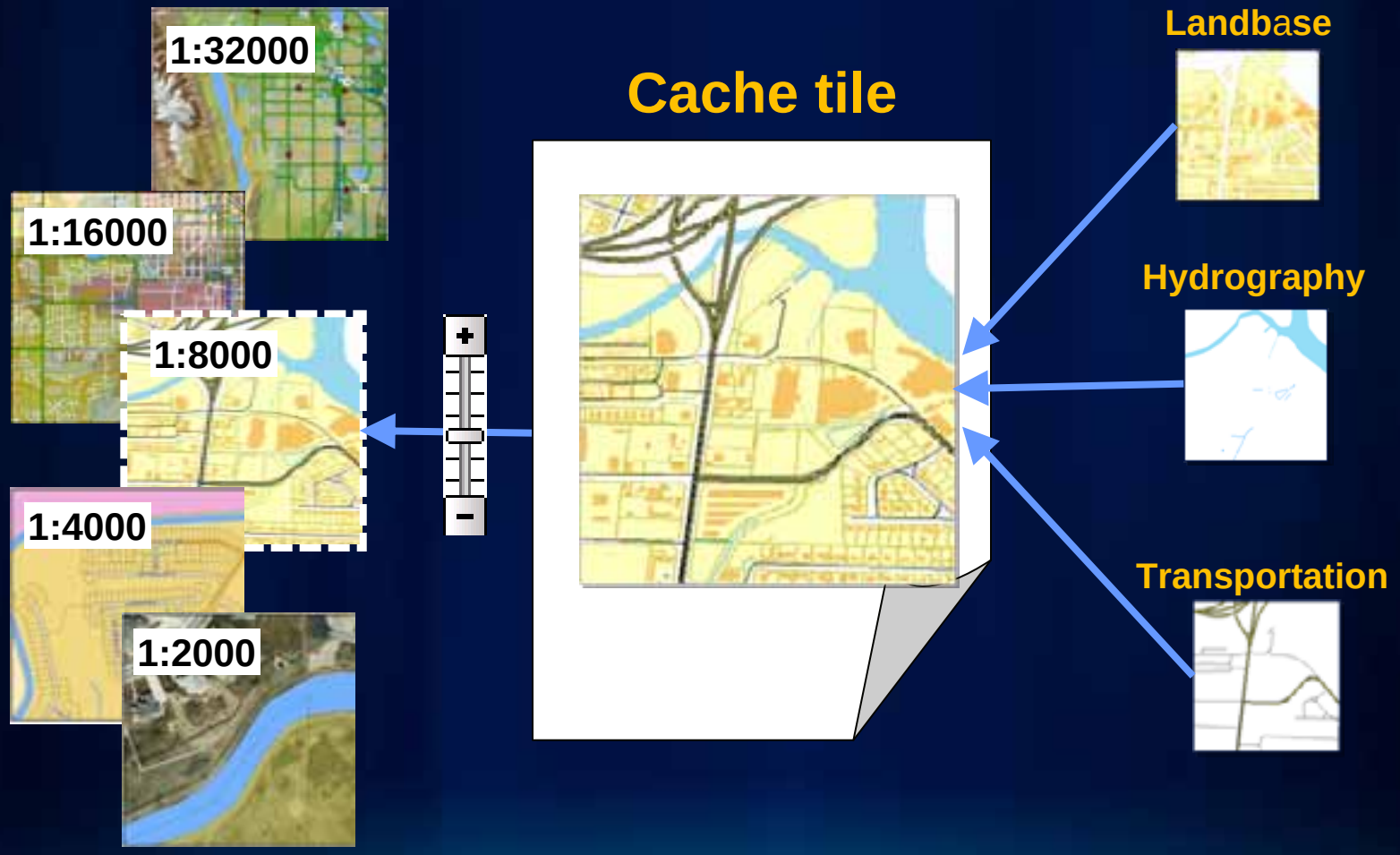
- **Performance, performance, performance**
- **Scalability: Industry standard**
- **Cartographic quality**

- ArcGIS Explorer Online

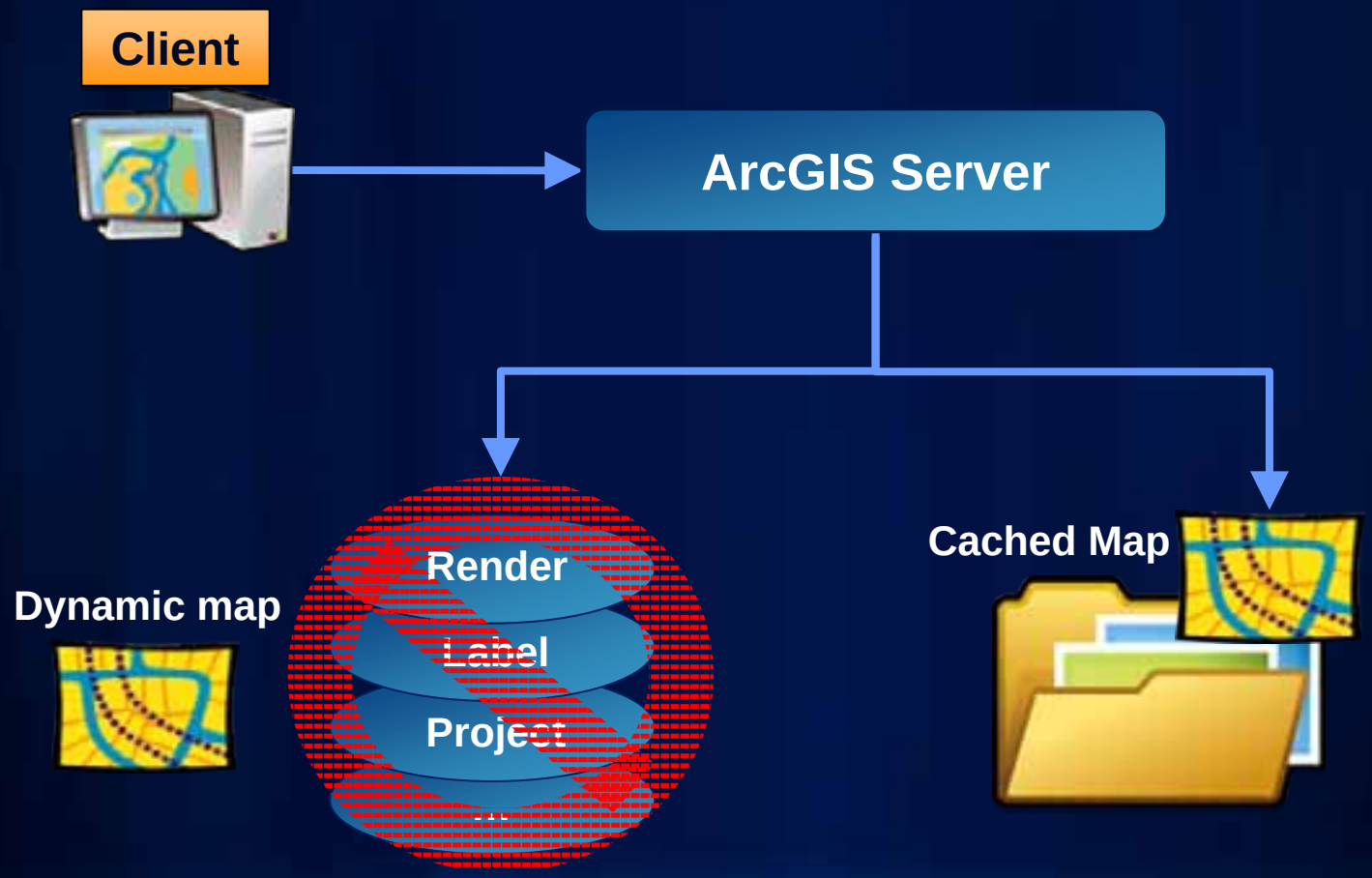
Map cache basics



What is a map cache?



How does a map cache work?



Users expect map cache speed & quality

10 years ago

- Dynamic drawing
- Slow to render
- Compromised cartography

Today

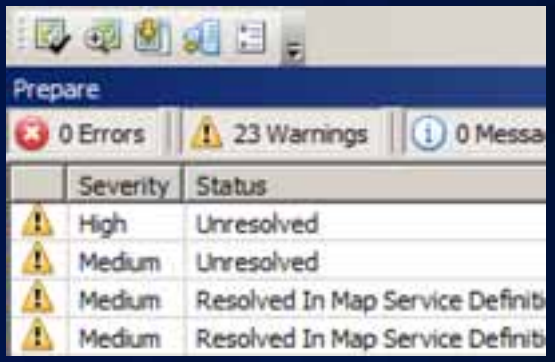
- Cached maps
- Fast response
- Enhanced cartography

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

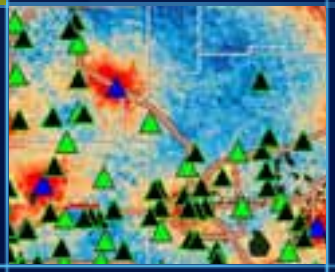
What about optimized map services?

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

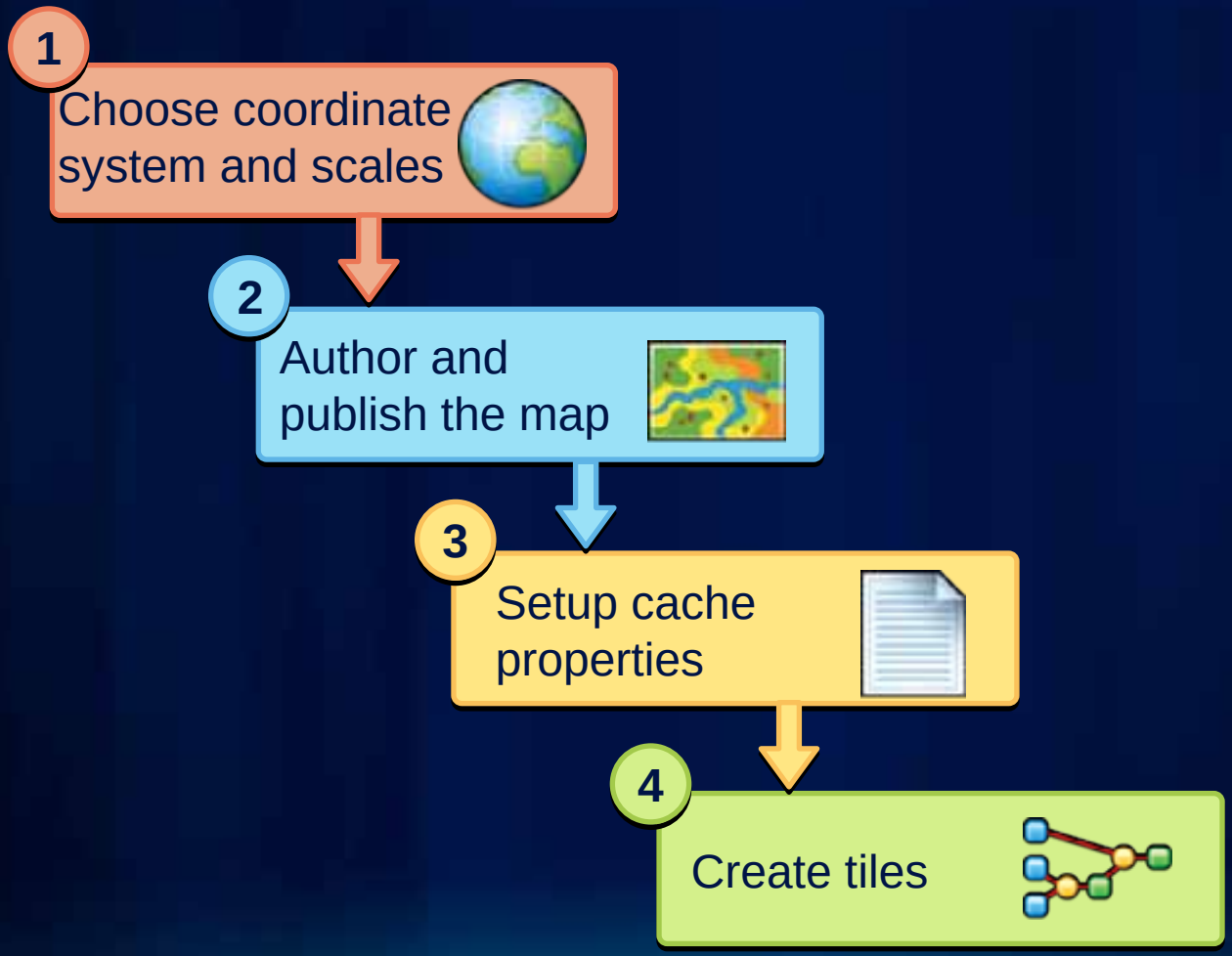


- Does NOT replace cache map service
  - Requires dynamic rendering
  - Web services are optimized for cached tiles

Map cache workflow



Building a map cache



1 Choosing coordinate system and scales

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

- **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

Sample 10 level cache

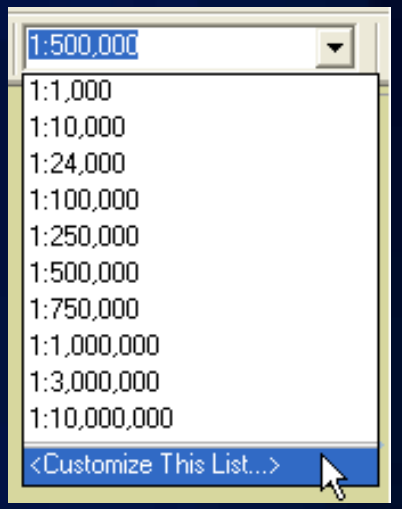
Level	Scale	Tiles	% of total
1	1:16,000,000	1	0.000%
2	1:8,000,000	4	0.001%
3	1:4,000,000	16	0.005%
4	1:2,000,000	64	0.018%
5	1:1,000,000	256	0.073%
6	1:500,000	1,024	0.293%
7	1:250,000	4,096	1.172%
8	1:125,000	16,384	4.688%
9	1:62,500	65,536	18.750%
10	1:31,250	262,144	75.000%

Final level is ~75% of the total

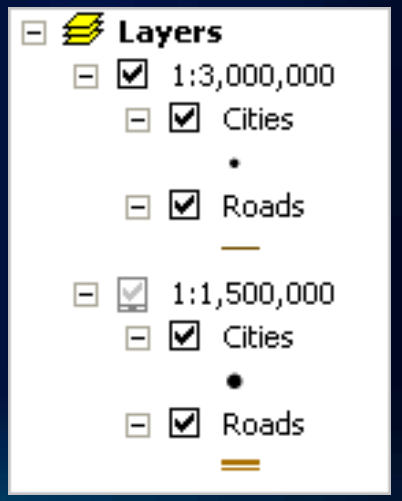
- **Consider ArcGIS Online scales**

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**

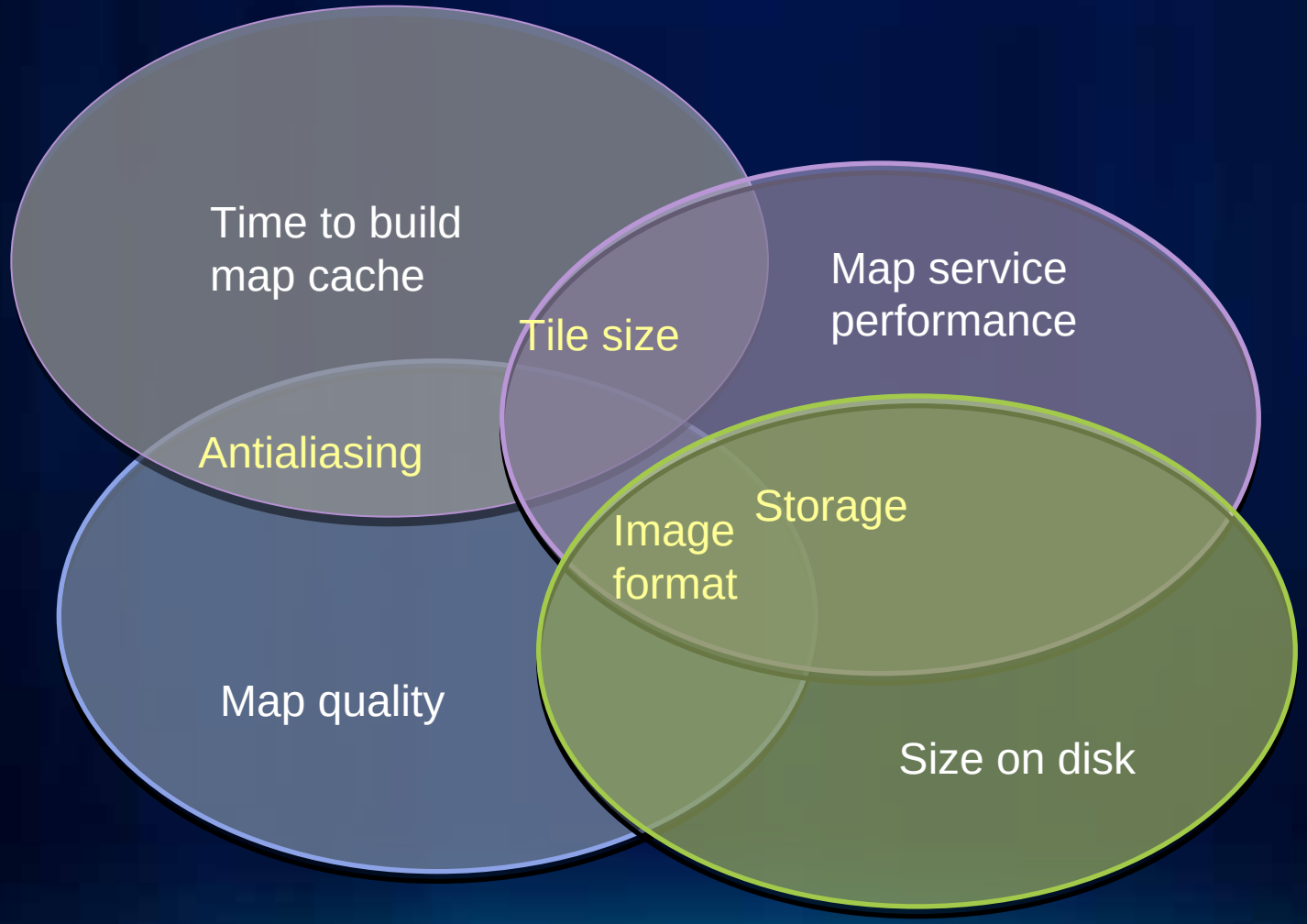
Authoring labels for the map

- **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**

512x512 tile size

256x256 tile size
ArcGIS Online / Bing / Google

3 Setup cache properties



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

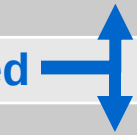
Choosing an image format

- **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**

.JPG

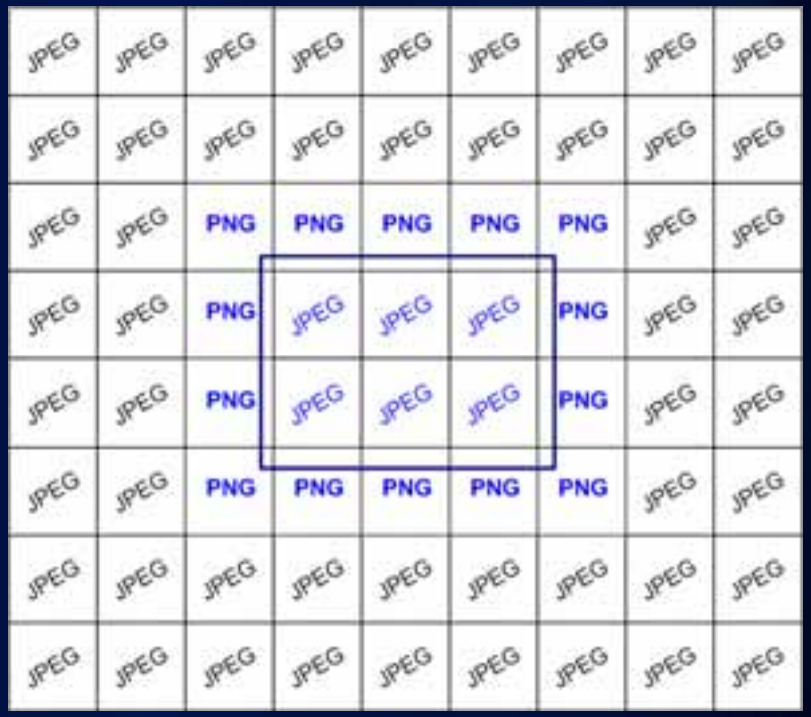
.PNG

Comparing image formats

Output format	Transparency	Compression
JPEG	**No**	**Lossy** (groups similar cell values)
Mixed 		
PNG-32	**Yes**	**Lossless** (groups same cell values)

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

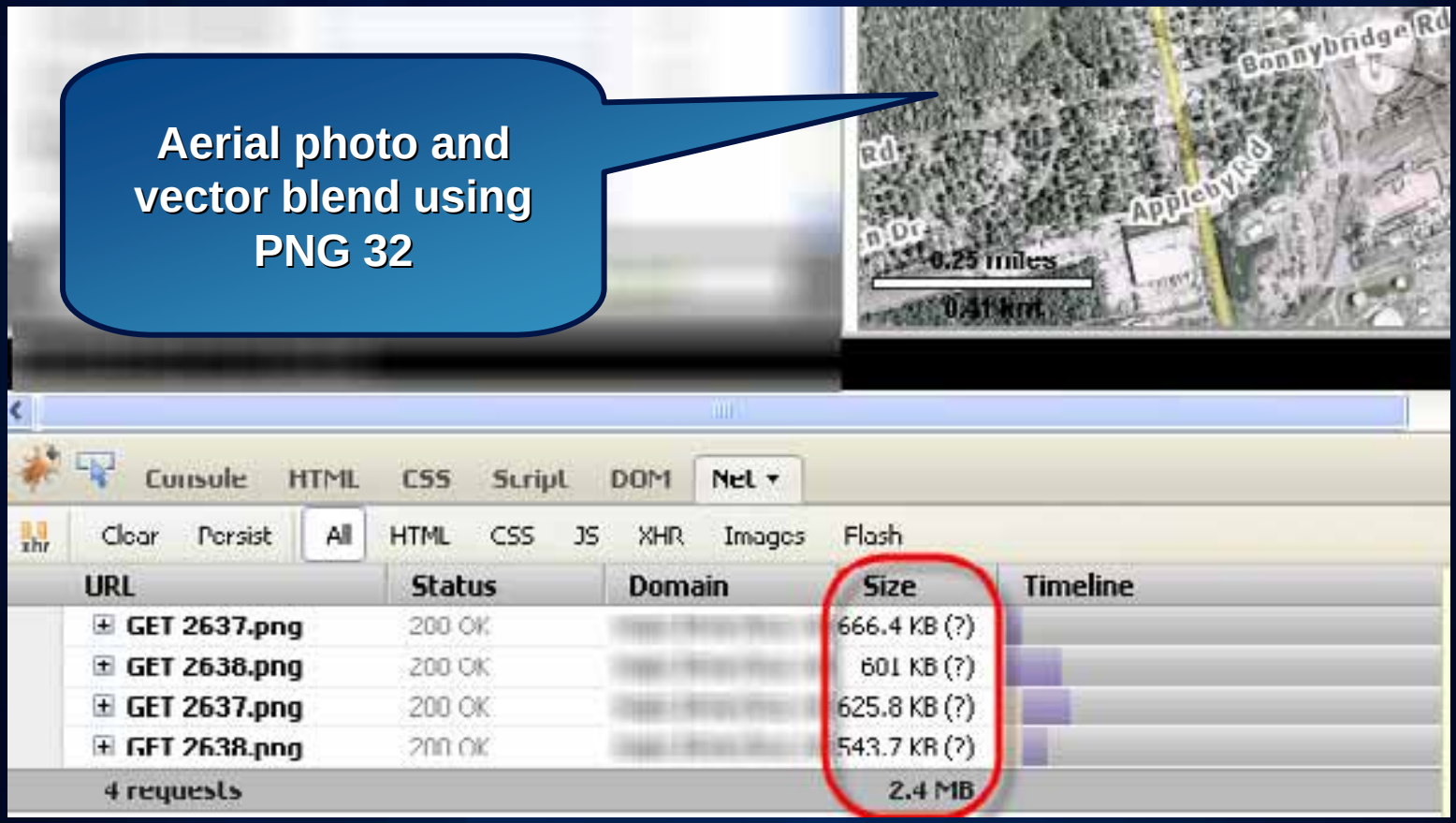


Two overlapping map services
Mixed mode cache on top of a JPEG cache

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



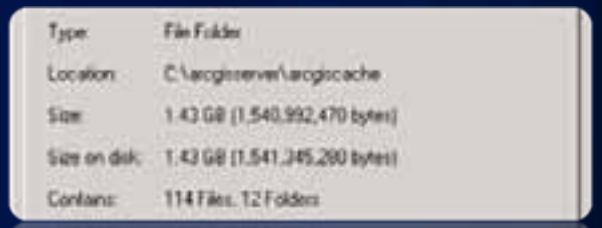
When should I use antialiasing

- 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

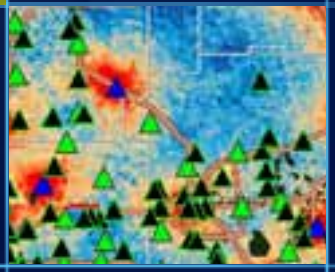


- **Exploded**
  - Tiles stored as individual images on disk
    - Can access with other tools
  - Marginally faster than compact
    - 5%-8% in most cases
  - Much larger on disk / difficult to manage

4 Generate Tiles

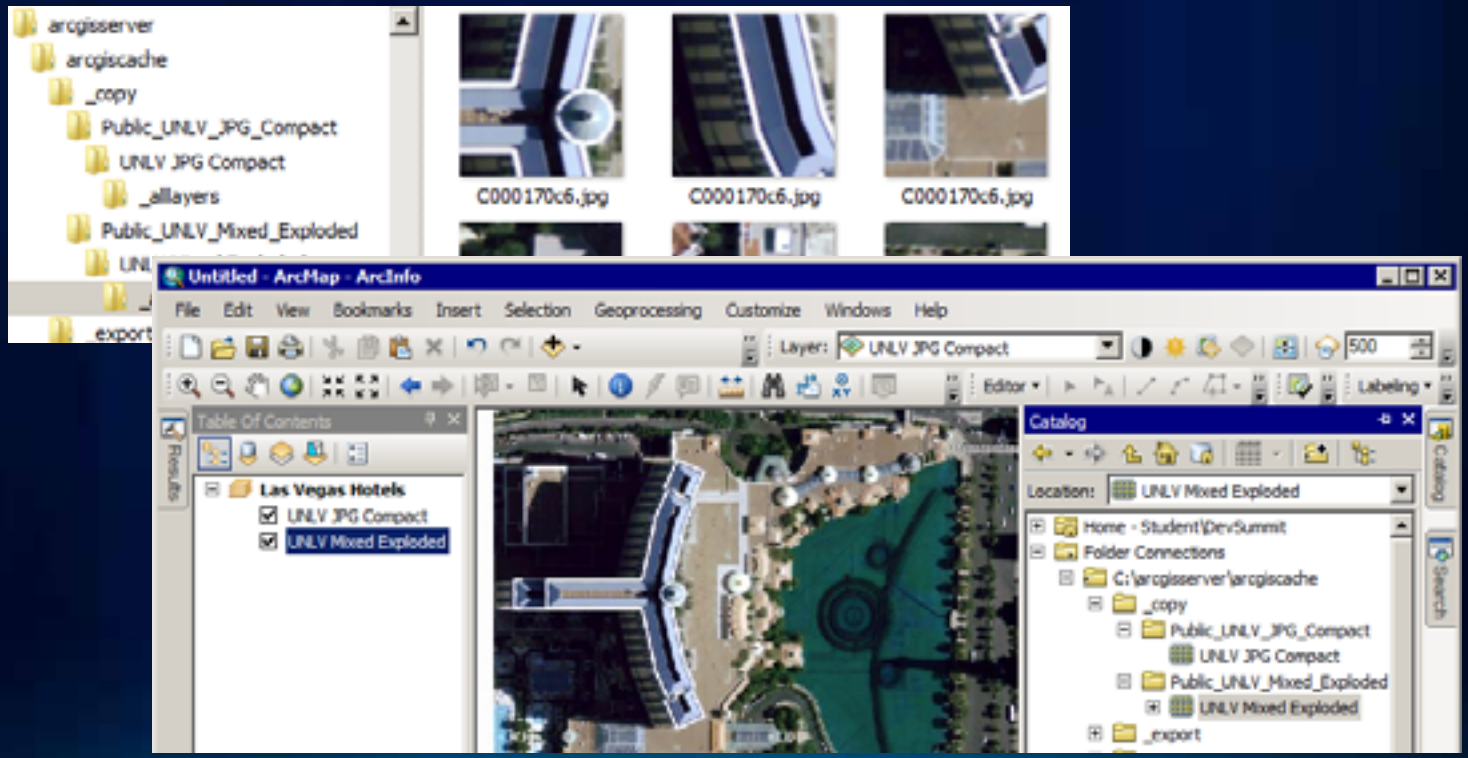
- Manage Map Server Cache Tiles geoprocessing tool
  - Almost always use this in a model
- Allows spatial and scale constraints
- Can run multiple times to “target” creation of tiles
  - All tiles at small scales
  - Most important tiles at large scales

Cache as a raster dataset



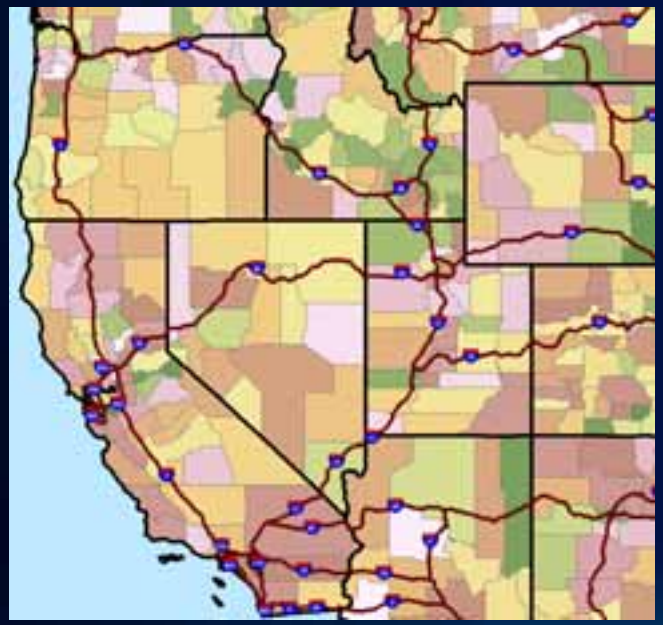
Cache as a raster dataset in ArcGIS

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

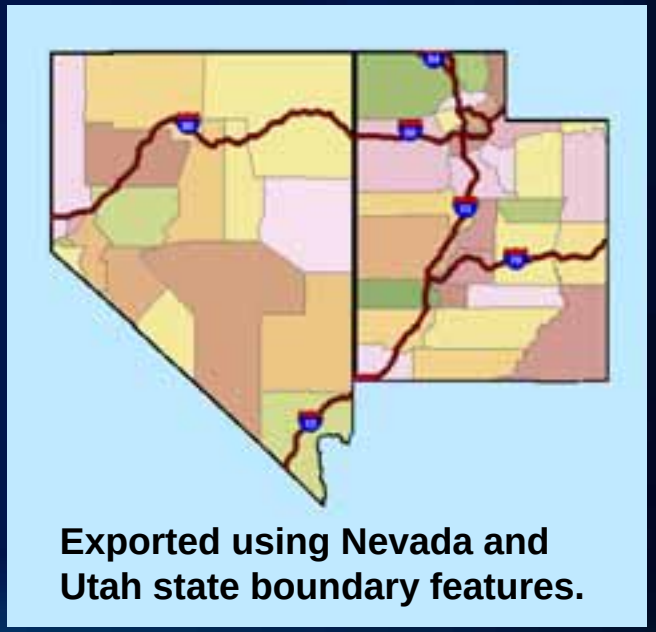


Cache export tool

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



Export



Exported using Nevada and Utah state boundary features.

Cache import tool

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

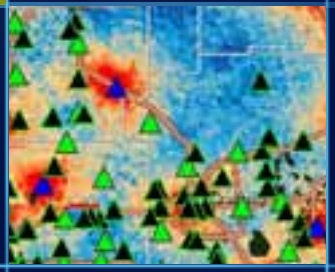
Import from a previously exported map cache.

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 – 25KB

JPEG 90 – 30KB

Using mixed mode for image overlay

JPEG = 3.06 MB

Disk space usage

PNG-32 = 19.3 MB

Transparency

Mixed = 6.07 MB

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…

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