



# Creating 2D Map Caches with ArcGIS Server 9.2

*Presented by:*

*The multi-threaded, over-clocked, dual core “Diplo – Matt Still”*

**AND**

*the fast, the furious, the fully cached, “Jonathan Fisk”*

# What is a map cache?

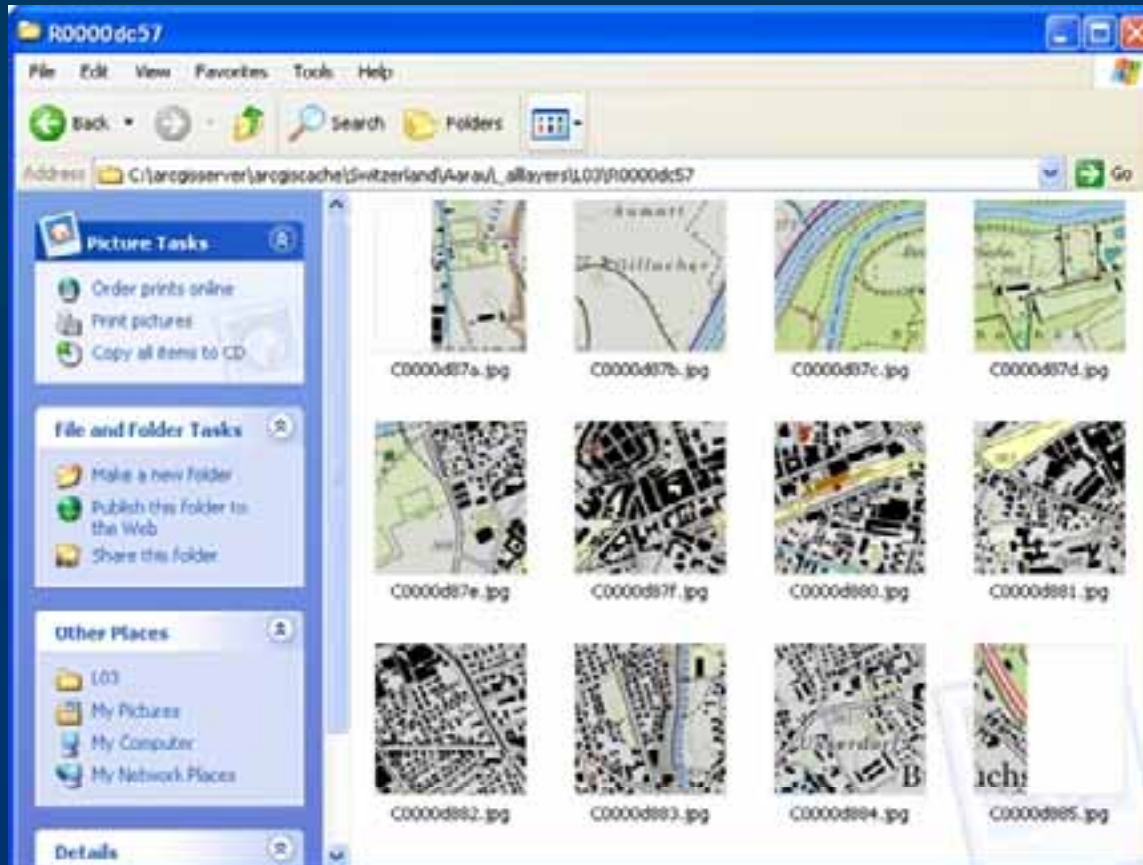
- A map cache is a set of map images that have been pre-rendered for rapid display.



- You create map caches at pre-determined scale levels.



# The cached images are stored on disk (Server Side Cache)



Example of a cached map service

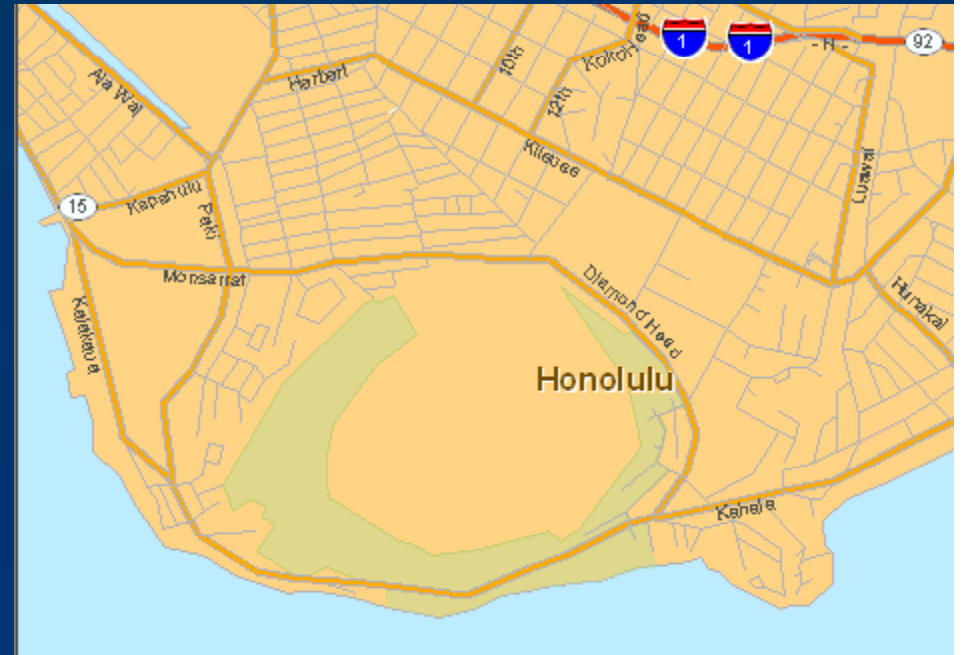


# Can I still access the underlying data?

- **The GIS server still has access to the data for operations such as:**
  - **Query**
  - **Identify**
  - **Selection**



# Keep Cartographic Quality and Map Performance with ArcGIS Server cached map services



- Shaded Relief
- Transparent Layers
- Maplex Labeling
- Cache can be higher quality than original data layers!

- Low-res relief
- Solid colors
- Annotation



# Why Bother to Create a Map Cache?

- Which is faster?
  - Let the server draw the map OR
  - Get the map image from a cache
- By caching, you only have to render the map once: When you create the cache.
- Caching is an *investment*.





**Tell me why I should cache again?**

# Industry Standard

- Google Maps and Google Earth
  - Microsoft Virtual Earth
  - Yahoo! Maps
  - ArcGIS Online
  - others...
- 
- You want **performance, scalability, and high quality!**





# Maps on the web in today's world

- High demand map services to be used by the general public **MUST BE CACHED.**
- Dynamic map services will not be as fast as cached map services.

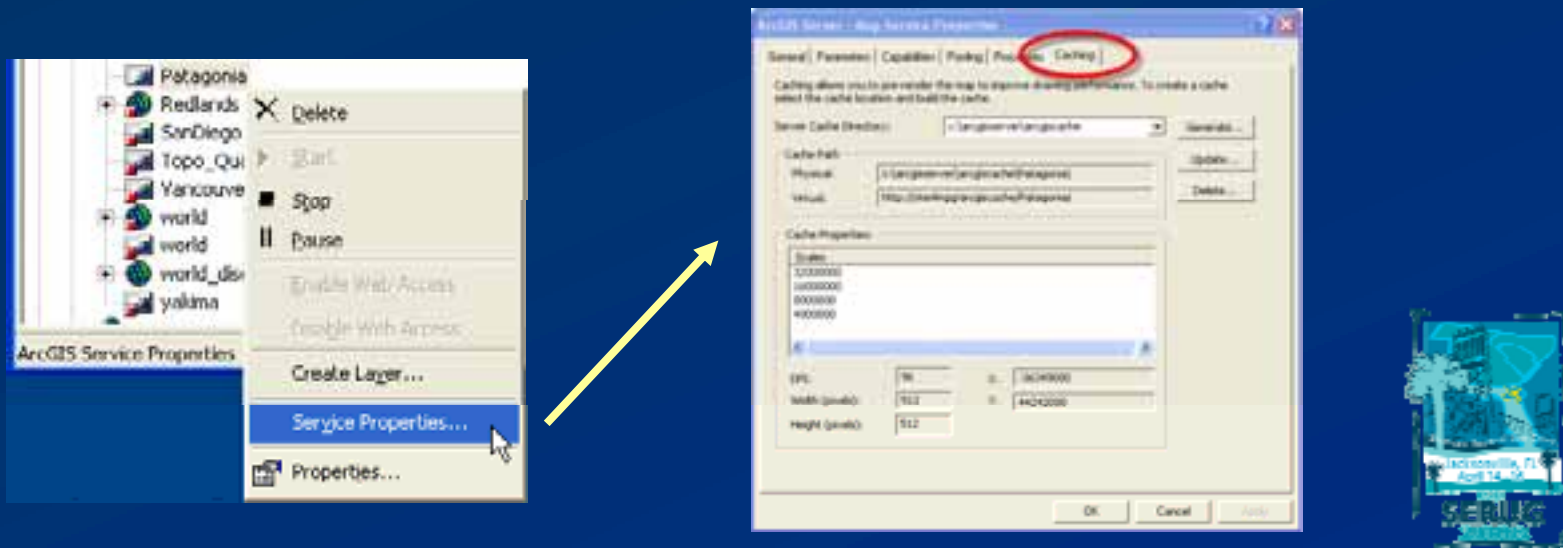




**How do I create a cache of my map service?**

# So you want to create a map cache?

- You can create the cache in ArcCatalog
- You must have an existing map service running
- Use the Caching tab of the Service Properties



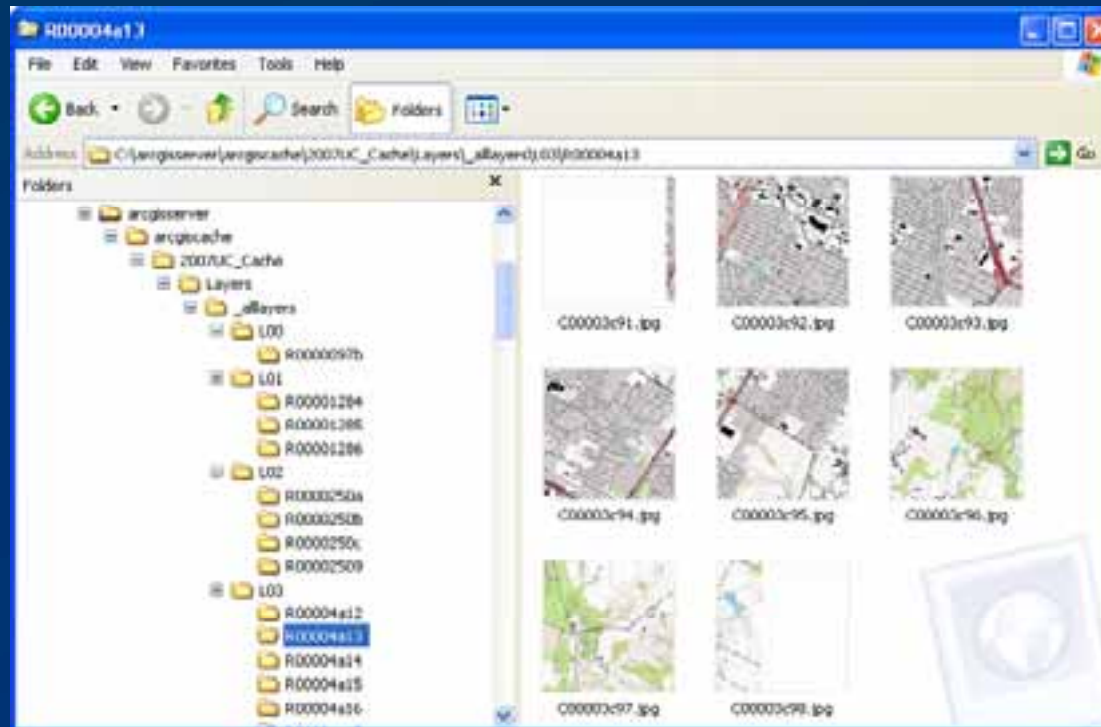
# What you need to create a cache . . .

- **Quality Base Map / Map Service (Get it right the first time)**
- **Disk Space (could occupy more than the original data)**
- **Caching Configuration Options (Get it right the first time)**
- **Some time (could require days of processing)**

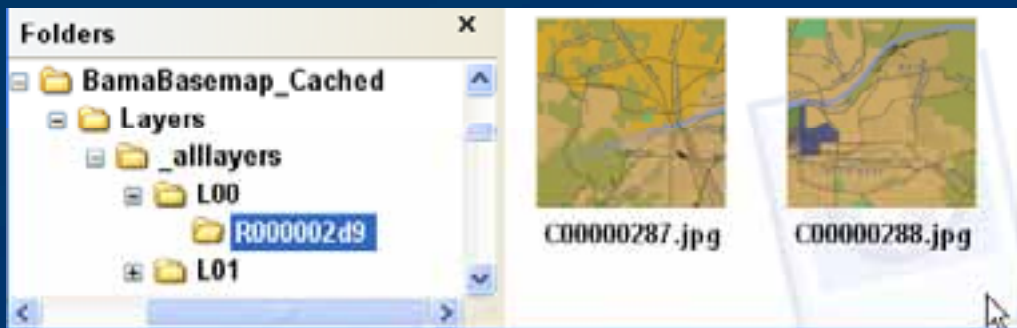


# What happens during caching?

- The server draws the map at all of the scale levels you specified
- Cached tiles are stored in a folder hierarchy in your server cache directory



Tiles are cached in “Levels”  
from left to right, Top to  
Bottom



# What happens during caching?

ArcGIS SERVER HELP

ESRI.com | ESRI Support Center

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sync tool

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### Map Service Cache Directory Hierarchy for Single Fused Cache

Cache Description: The cache configuration file

A complete description of the cache, including its organization and a mapping between the spatial reference of the source map document and the tiling grid, is provided in a **cache tiling scheme** file called "conf.xml" located at the top of the directory hierarchy. The tiling grid uses a level-of-detail (scale-level), row, column referencing scheme. For example, a tile named C00000000.png in the R00000000 row directory of the L00 level of detail directory corresponds to a tile in the upper-left-most corner of the tiling grid at the smallest scale level. This upper-left-most corner is mapped to a tile origin specified in map units of the source mxd. The tiling scheme file also defines the scale levels (levels of detail) at which the cache has tiles, the size of the tiles in pixels and the screen resolution (DPI) for which the tiles are intended to be most commonly displayed.

### The web server

Done

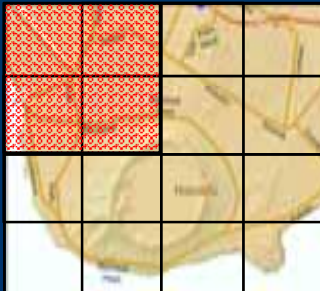
Local intranet

# Tile and file count quadruple each time a scale is divided by 1/2.

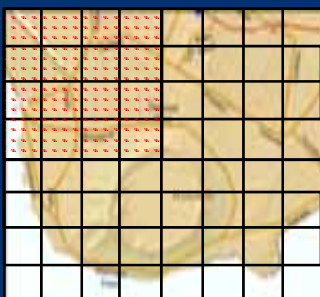
1: 250,000 Extent



**1 Tile**  
1: 125,000



**4 Tiles**  
1: 64,000



**16 Tiles**  
1: 32,000

Tile count is also a good predictor of final cache size & processing time.







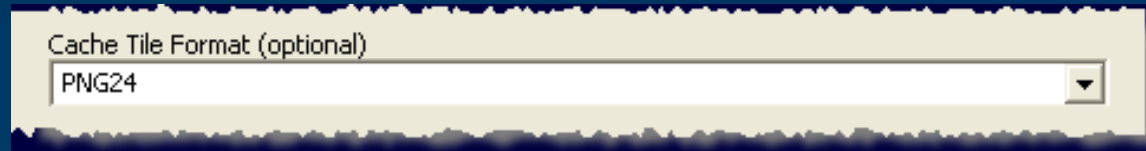
# Caching Options & Best Practices

# Best Practices – Cache Options

- **Some of the Caching Options we will discuss**
  - Fused vs Multilayer cache
  - JPG vs PNG image type
  - Anti-aliasing vs not
  - Dimension of Tiles (512x512 or 256 x 256 or etc.)



# Best Practices – Cache Tile Format



- **PNG8** Transparency is stored in the color index palette, excellent browser support
- **PNG24** Transparency value is stored in the image header. Versions of Internet Explorer less than version 7 do not support this type of transparency
- **PNG32** —Supports large color variations (16 million colors) and transparency.
- **JPEG** —Supports large color variations (16 million colors) but does not support transparency



# Best Practices – Cache Tile Format

- Use JPEG for raster-based base maps such as imagery
- Use JPEG or PNG for vector-based base maps such as street maps
- Use PNG8 for overlay services that need to be supported in all browsers



# Best Practices – Background Color

- The background color is used to define the transparent part of the image
- Explicitly define the background color
  - If the background color is not defined then the transparent color will be set to 253,253,253
- Use a color not used in the symbology



# Best Practices – Spatial Reference

- All map caches must have a defined spatial reference
- Derived automatically from the data frame being cached



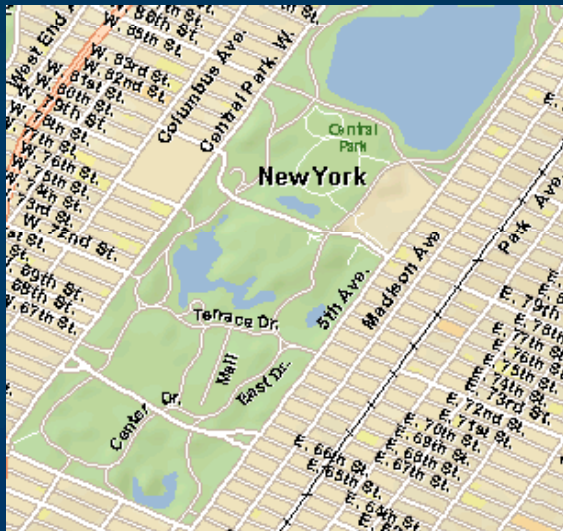
# Best Practices – Tiling Origin

- Specified in map units
- Can be located inside or outside of your data frame extent
  - Tiles will not be created outside the tile origin.

Tiling origin in map units (optional)	
X Coordinate	Y Coordinate
<input type="text" value="-118489100"/>	<input type="text" value="142221800"/>



# Best Practices – Anti-aliasing



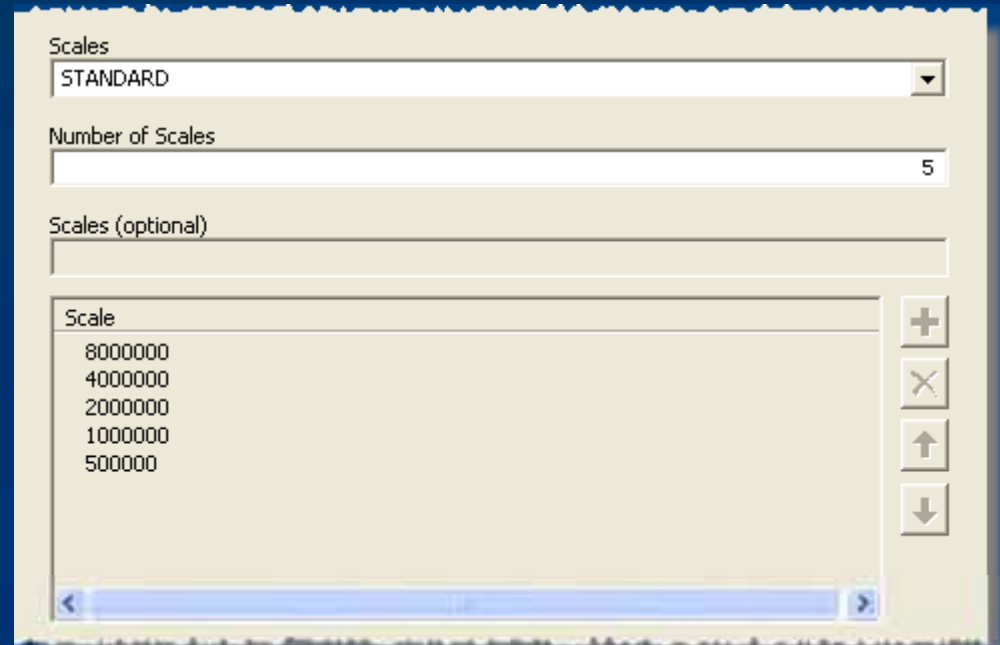
- Smooths the edges of labels and lines by blending them with the background.
- The resulting screen display quality can be better than standard rendering in ArcMap.
- Tiles are rendered at finer resolution by down sampling (takes twice as long to cache an area when using anti-aliasing)
- <http://serverx.esri.com/antialiasingexamples/>





# Best Practices – Scales (Levels of Detail)

- Each cache has a set of user-defined scale levels
- Choose scale levels carefully!
  - They determine cache creation time and storage size on disk
  - Users will be limited to these scales
- Scales appear as LODInfos in conf.xml (LOD = “Levels of detail”)



The screenshot shows a dialog box titled "Scales" with the following fields and controls:

- Scales:** A dropdown menu currently set to "STANDARD".
- Number of Scales:** A text input field containing the number "5".
- Scales (optional):** A list box containing the following scale values:
  - 8000000
  - 4000000
  - 2000000
  - 1000000
  - 500000
- Controls:** On the right side of the list box, there are four buttons: a plus sign (+) for adding a scale, a minus sign (-) for removing a scale, an up arrow (↑) for moving a scale up, and a down arrow (↓) for moving a scale down.



# Best Practices – Scales (Levels of Detail)

- How big will my cache be?
  - The more detail, the bigger disk space required
  - Code available from EDN:  
<http://arcscripts.esri.com/details.asp?dbid=15045>



# Tips for large scope caching jobs

- **When caching very large geographic areas break up caching job to distinct areas**
  - Use UpdateMapServerCache at specific user defined extents in a script environment (Service Pack 2)
- **Areas that don't need to be cached should be built using custom extents**
  - Alaska, Hawaii, Continental US, but not all scale levels of the Pacific Ocean
  - You can cache the same map service using different full extents as long as your cache tiling schema doesn't change



# Generating the map cache – 9.2 tools

Note: You must manually add Server Tools to ArcToolbox

- **GenerateMapServerTilingScheme**
  - Generates a tiling scheme that can be used to create caches for multiple services
- **GenerateMapServerCache**
  - Generates the cache for a map service
  - Works with either a pre-defined or a newly defined tiling scheme
  - Creates the cache and populates it
- **UpdateMapServerCache**
  - Updates the cache for a map service within a specified extent
  - Creates only missing and empty tiles OR
  - Recreates all tiles
- **DeleteMapServerCache**
  - Deletes the cache for a map service



# Factors that influence cache creation time

- **Geographic extent**
- **Number and choice of scale levels**
- **Complexity of the map**
  - **If it takes a long time to draw in ArcMap, it will take a long time to cache.**
- **Anti-aliasing**
  - **Generally twice as long to generate**
- **Server resources**
  - **For example, SOC machines and available service instances**
- **Network bandwidth between SOC machine and cache directory**



# Factors that influence cache creation time

- **Tile size also affects cache creation time**
  - **Larger size produces fewer tiles**
    - Less disk space (block size)
    - Faster creation
    - Easier to manage
  - **Smaller size**
    - Allows partial update of the display
  - **Takes approximately 5X as long and takes up 1Gb more of space when creating a cache at 128x128 tile size versus 512x512 tile size with the same data (Hawaii)**
  - **In most cases, it's best to keep the default of 512x512**



# CACHE DEMO

- **Cached using JPG with Anti Aliasing (17 min, 137MB)**
- **Cached using JPG NO anti Aliasing(10 min, 156 MB)**
- **Cached using PNG, 8Bit (21 min, 230MB)**



## Best Practices 9.2 – Dynamic Data

- Can you schedule updates to your cache? (GP)
- Is the point to see it near real time?
- Example: **Crimson Tide Football Games 2007**
  - Campus Security combined points from their dispatch system with their campus base map for a game day Common operational picture. **SHOW SLIDE!**





Active Calls - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address: <http://joudman.lardst.us.edu/activecalls/SF2/>

Google

### Active Calls

ESRI | ESRI Support Center | Help

Results > 33

Map Contents > 22

- ActiveCalls\_GPSUSH
- Assets
- ActiveCalls
- GPS Tracking
- GPSUSH
- HyperlinkPhotos
- TRD\_Maint\_Offenses

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Overview > 33

The map displays a residential area with several streets including PINE IDENTICAL CIR, 4TH ST, STADIUM CIR, COLONIAL DR W, SORORITY CIR, MAWOLA DR, VAPSTONE DR, ELM DR, MARGARET, DEVOTHE DR, SMITHWOOD CIR, UNIVERSITY BLVD, HACKBERRY LN, 3TH AV, 4TH AV, and 9TH ST. A red polygon outlines a specific area. Several call information popups are visible:

- ASSET (ARRVD-R3-T1)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T2)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T3)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T4)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T5)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T6)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T7)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T8)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T9)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T10)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T11)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T12)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T13)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T14)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T15)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T16)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T17)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T18)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T19)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T20)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T21)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T22)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T23)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T24)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T25)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T26)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T27)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T28)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T29)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T30)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T31)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T32)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T33)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T34)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T35)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T36)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T37)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T38)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T39)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T40)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T41)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T42)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T43)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T44)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T45)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T46)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T47)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T48)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T49)**: Current as 2:14:02 PM
- ASSET (ARRVD-R3-T50)**: Current as 2:14:02 PM

Done

start

My Pictures

3 Microsoft Office D...

5 Internet Explorer

Command Prompt - Itz

LSU\_COP.Amp - Paint

Internet

ArcGIS Server Technology Transfer

33

2:14 PM

# LSU Beats Alabama 41-34 at Tuscaloosa Saturday, Nov. 3, 2007



# Options for Dynamic Data

1. All content is dynamic (Basemap + events)
2. Base map is cached, Events are dynamic.
  - Combine separate map services in WebADF client
  - Combine basemap and events in ArcMap & republish. (work around for 9.2.)



# Coming in 9.3

- Improved performance for dynamic data.
- Build map cache by area of interest feature class
- Improved Workflow for defining, building, & maintaining a cache
- Out of the box cache tiling schemes
- Monitoring caching progress
- Add or remove scales from a cache
- Cache can be populated on demand
- Client side caching control



# Problem: “My data is too dynamic”

<http://www.weather.com>

Local Weather Maps

Interactive Weather Map | [Classic Local Maps](#) | [Business Travel](#) | [Lawn & Garden](#) | [Pets](#) | [Golf](#)

Interactive Weather Map **BETA**

[Recenter on starting location](#) [ English | [Metric](#) ] [What's This?](#) | [Map Help](#)

Updated Dec 6 5:45 pm GMT / 12:45 pm ET

Points of Interest Weather Layers Transparency 40% In Motion

View What Matters Most  
Slide the transparency bar to change layer appearance.

In/Near the U.S.  
 Radar  
 Clouds  
 Clouds & Radar

International  
 Clouds



# Problem... “Radar imagery can’t be cached!”

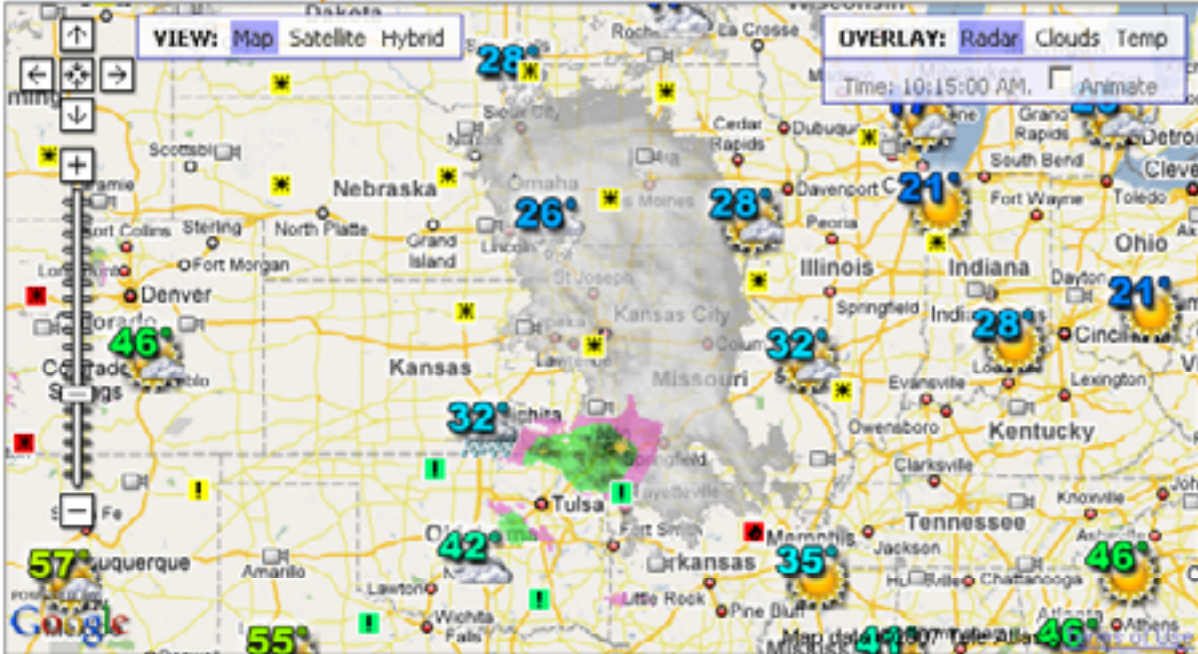
<http://www.weatherbonk.com>

Live Conditions Thu 10:28 AM [permalink/refresh]

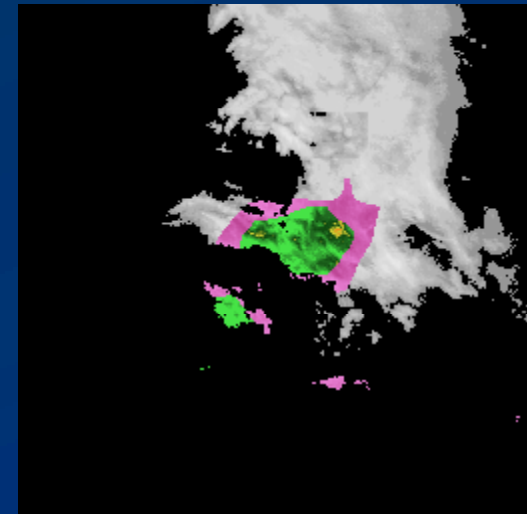
**Alert: Flash Flood Watch for your area. Click alerts below for more info.**

VIEW: Map Satellite Hybrid OVERLAY: Radar Clouds Temp

Time: 10:15:00 AM,  Animate



Drag green arrow or double click anywhere on map to change location. [Enlarge map](#) with Power Map.  
[Make this my default view.](#)



<http://gima.weather.com/TileServer/imgs/radar/u1196982900000/02311.png>



## 9.3 Solution

- **Use scripting tools to programmatically build/update a cache**
  - For data like radar images, build a process that caches only areas of interest down to a certain regional scale.
  - If you had 9.2 scripts, migrate them to use new tool names
  - See help topic: Automating cache creation and updates with geoprocessing
- **Use cache by feature class to efficiently update the area of interest**



## Cache by feature class

- Cache only within boundary of features you supply
  - In 9.2 cache was based on a rectangular extent; If you cached based on the extent of California you would get Nevada for “free”!
  - You can supply a feature class with just one feature
  - Avoid numerous features or geographically small features
- Saves time and disk space
- Set the feature class in the Manage Map Files tool or through scripting
- California example:



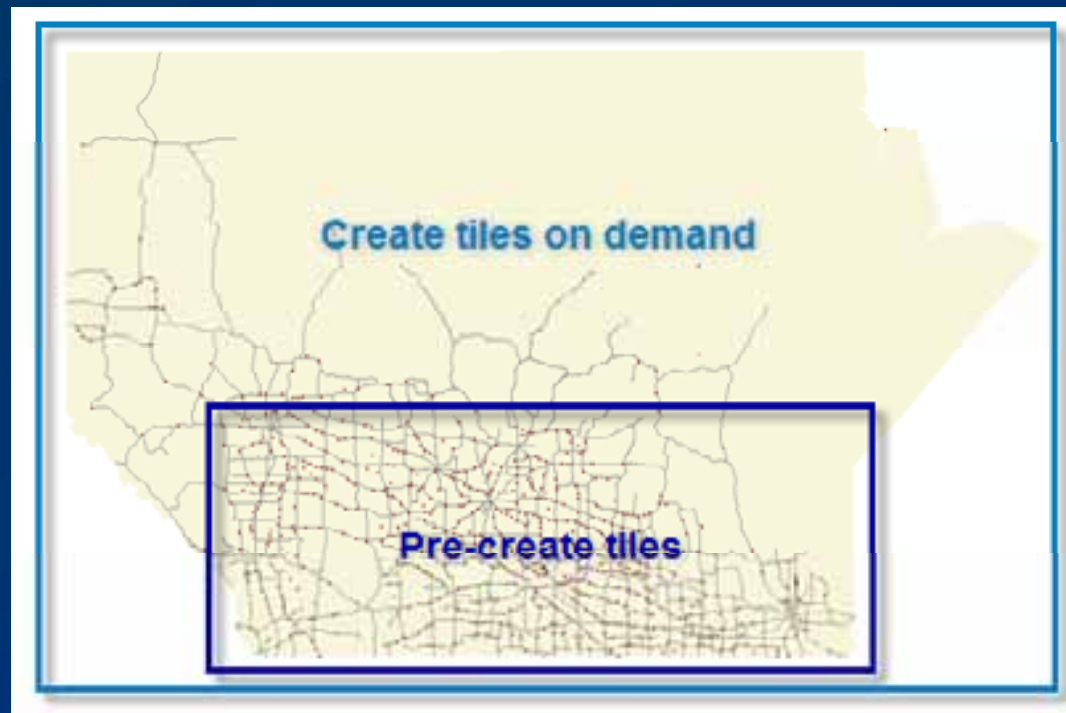
files tool





# Performance tips for on-demand caching

- Use with ArcGIS Server Internet connections
- **Tip:** Pre-create tiles for areas that you anticipate will be most popular, then create the rest on demand



## 9.3 Solution: Why cache on demand?

### How We Watch the City: Popularity and Online Maps

Danyel Fisher  
Microsoft Research  
1 Microsoft Way, Redmond, WA  
danyelf@microsoft.com

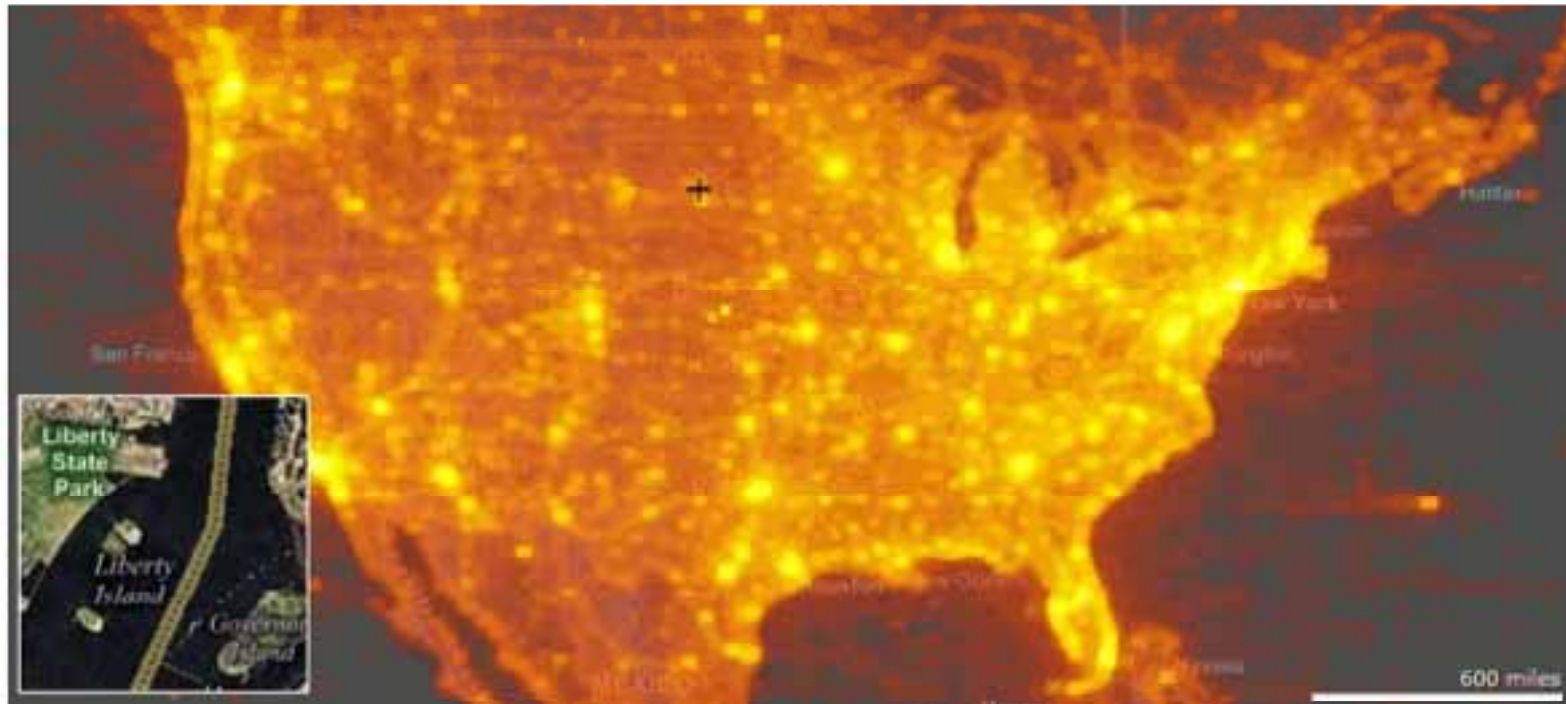


Figure 1: A heat map of popularity of tiles over the US at level 12 (approximately 40 meters per pixel scale). The brightest points have on the order of half a million hits, while the dimmest visible points show closer to a thousand hits. Note that usage patterns at this scale seem to follow population. Inset: mapping imagery at the level (but not size) represented by one pixel.

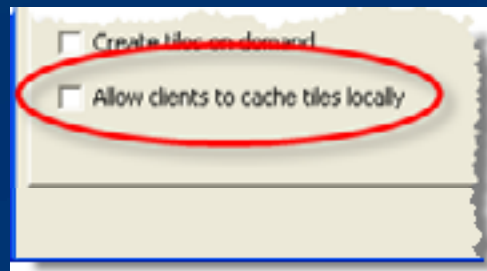
**Problem: “I as a server administrator have no control of the client side cache mechanisms for ArcGIS Desktop and Explorer products”**

- **ArcMap, ArcGlobe, & ArcGIS Explorer keep a local cache on the client computer for performance and scalability reasons.**
- **It is up to the user to clear this local cache**
- **Clients can now opt out of caching data locally**
- **All clients have a way to manually clear local cache**



## 9.3 Solution: Disabling local caching by clients

- Server admin can disable local caching by all clients if the cache will be updated frequently
- This is set in the Caching tab of the Service Properties



# Online Resources

- [ArcGIS Server Blog - Map Caching](#)
- [Online Help](#)

