Caching Best Practices | Goals for Today

- Differences between Raster Tiles and Vector Tiles
- Picking a format
- Best ways to cook each
- How to share them
- How to consume them
# Creating, Using, and Maintaining Tile Services

<table>
<thead>
<tr>
<th>WORKSHOP</th>
<th>LOCATION</th>
<th>TIME FRAME</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tuesday, 10 July</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• ArcGIS Pro: Creating Vector Tiles</td>
<td>• SDCC – 17B</td>
<td>• 10:00 am – 11:00 am</td>
</tr>
<tr>
<td>• Caching Maps and Vector Tile Layers: Best Practices</td>
<td>• SDCC – 10</td>
<td>• 2:30 pm – 3:30 pm</td>
</tr>
<tr>
<td>• Working With OGC WMS and WMTS</td>
<td>• SDCC – Esri Showcase: Interoperability and Standards Spotlight Theater</td>
<td>• 4:30 pm – 4:50 pm</td>
</tr>
<tr>
<td><strong>Wednesday, 11 July</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• ArcGIS for Python: Managing Your Content</td>
<td>• SDCC – Demo Theater 01</td>
<td>• 11:15 am – 12:00 pm</td>
</tr>
<tr>
<td>• ArcGIS Online: Three-and-a-Half Ways to Create Tile Services</td>
<td>• SDCC – Demo Theater 06</td>
<td>• 1:15 pm – 2:00 pm</td>
</tr>
<tr>
<td>• Understanding and Styling Vector Basemaps</td>
<td>• SDCC – 15B</td>
<td>• 2:30 pm – 3:30 pm</td>
</tr>
<tr>
<td>• Working With OGC WMS and WMTS</td>
<td>• SDCC – Esri Showcase: Interoperability and Standards Spotlight Theater</td>
<td>• 4:30 pm – 4:50 pm</td>
</tr>
<tr>
<td><strong>Thursday, 12 July</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• ArcGIS Enterprise: Best Practices for Layers and Service Types</td>
<td>• SDCC – 16B</td>
<td>• 10:00 am – 11:00 am</td>
</tr>
<tr>
<td>• ArcGIS Pro: Creating Vector Tiles</td>
<td>• SDCC – 17B</td>
<td>• 10:00 am – 11:00 am</td>
</tr>
<tr>
<td>• Web Mapping: Making Large Datasets Work in the Browser</td>
<td>• SDCC – 16B</td>
<td>• 1:00 pm – 2:00 pm</td>
</tr>
<tr>
<td>• Caching Maps and Vector Tile Layers: Best Practices</td>
<td>• SDCC – 04</td>
<td>• 4:00 pm – 5:00 pm</td>
</tr>
<tr>
<td>• Understanding and Styling Vector Basemaps</td>
<td>• SDCC – 10</td>
<td>• 4:00 pm – 5:00 pm</td>
</tr>
</tbody>
</table>
Caching Best Practices | Roadmap

1. Overview
2. Compare and contrast
3. Use cases
4. What’s new in ArcGIS Pro
5. Optimizing raster tile generation
6. Optimizing vector tile generation
7. Share and Publish
8. Restyling multiple maps from one tileset
Raster and Vector Tiles

...an overview
Overview | Raster Tiles

- What are Raster Tiles?
  - Pre-rendered snapshots of your map
  - JPEG’s and PNG’s

- Tiling Scheme:
  - Origin
  - Tile Dimension and Format
  - Extent
  - CRS
  - LOD’s

- Generate Cache
  - Cooking
Overview | Vector Tiles

• What are Vector Tiles?
  - Tiled containers of your data
  - Separate style provides rendering instructions for how to draw your map

• Client device / browser is responsible for drawing the map

• Tileset components:
  - Tiles
  - Styles
  - Sprites
  - Fonts
  - Index
Overview | Vector Tiles in ArcGIS

- Leverages several Open Source projects
  - Tiles use the Mapbox vector tile spec
  - Based on Google protocol buffers
  - Styling conforms to the Mapbox GL style spec

- More aggressive overzoom
  - Indexed tiling scheme
  - Support for traditional tiling also exists

- Any supported Coordinate System
Overview | Advantages of Vector Tiles

• Display quality
  - Best possible resolution for HD displays

• Dynamic labeling
  - Clearer, more readable text
  - On the fly labeling for heads up display

• Map Styling
  - Many styles from one tileset
  - Restyling
Compare and Contrast
Raster Tiles and Vector Tiles
## Compare / Contrast | Authoring Clients / Tools

### Raster Tiles
- MXD’s, Map Projects, and MosaicDatasets
- ArcGIS Desktop
  - Manage Tile Cache
  - Create Map Tile Package
  - Integrated sharing in ArcGIS Pro 1.4
- ArcGIS Server / Enterprise / Online
  - Server tools / caching toolset

### Vector Tiles
- Map Projects
- ArcGIS Pro v1.2+
  - Create Vector Tile Package
- ArcGIS Pro v1.4*
  - Integrated sharing workflow
Compare / Contrast | Tileset Structure

• Raster Tiles:
  - .bundle
    - JPEG, PNG8, PNG24, PNG32, LERC
    - Smart Tiles: PNG, MIXED

• Vector Tiles:
  - .bundle
    - Tiled data encoded as Protocol Buffers (.PBF)
    - Fonts
      - Glyphs as .PBF
    - Sprites
      - Sprite.png / Sprite@2x.png
    - Style
      - .JSON
Compare / Contrast | Tile creation process - Esri World Basemap

• Raster Tiles for entire world
  - ~ many weeks on a server cluster per map style
  - Tiles ~ 20 TB

• Compared to vector tiles
  - ~ 12 hrs on a desktop machine
  - Tiles ~ 26 GB
  - Multiple styles can use the same tileset
Compare / Contrast | Supporting Architecture

ArcGIS Server

Raster Tiles

Federated Server

ArcGIS Pro

Vector Tiles

ArcGIS Online

Hosting Server

Cached Map Image Layers

Cloud store

Hosted Tile Layers
## Summary | Compare and Contrast

<table>
<thead>
<tr>
<th></th>
<th>Raster Tiles</th>
<th>Vector Tiles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imagery</td>
<td>√</td>
<td>X</td>
</tr>
<tr>
<td>Projection</td>
<td>All Supported CRS</td>
<td>All Supported CRS</td>
</tr>
<tr>
<td>Updating AOI</td>
<td>√</td>
<td>Future Release</td>
</tr>
<tr>
<td>Changing styles</td>
<td>X</td>
<td>√</td>
</tr>
<tr>
<td>Tile format</td>
<td>JPEG, PNG, LERC</td>
<td>PBF</td>
</tr>
<tr>
<td>Tile consumption</td>
<td>ArcGIS Pro, ArcGIS Desktop</td>
<td>ArcGIS Pro 1.3+</td>
</tr>
<tr>
<td></td>
<td>Runtime</td>
<td>Modern Browsers with WebGL support*</td>
</tr>
<tr>
<td></td>
<td>JSAPI</td>
<td>Runtime 100.0+</td>
</tr>
<tr>
<td></td>
<td>ArcGIS Earth</td>
<td>JSAPI 3.15+</td>
</tr>
<tr>
<td>Authoring Clients</td>
<td>ArcGIS Pro, ArcGIS Desktop</td>
<td>ArcGIS Pro 1.2+</td>
</tr>
<tr>
<td>Hosting Components</td>
<td>ArcGIS Online, ArcGIS Enterprise</td>
<td>ArcGIS Online</td>
</tr>
<tr>
<td></td>
<td>ArcGIS for Server</td>
<td>ArcGIS Enterprise 10.4+</td>
</tr>
<tr>
<td>Export Packages</td>
<td>√</td>
<td>ArcGIS Enterprise 10.6.1 and ArcGIS Online</td>
</tr>
<tr>
<td>Printing</td>
<td>√</td>
<td>ArcGIS Enterprise 10.6 and ArcGIS Online</td>
</tr>
</tbody>
</table>

*Current Display Driver*
Use Cases
Raster Tiles and Vector Tiles
Use Cases | Common Basemaps

Raster Tiles:
- Imagery Basemap
- CADRG / ECRG (Scanned Maps)
- Hillshade / Shaded Relief
- 3D Terrain
- StreetMap
- Canvas Maps
- Boundaries and Places
- Transportation

Vector Tiles:
Use Cases | Mapping & Visualization Comparison

- Vector:
  - Map Service (Tiled)
  - Vector Tile Service
  - Map Service (Dynamic)
  - Feature Service

- Raster:
  - Image Service (Tiled)
  - Image Service (Dynamic)
What’s new?
Quite a bit actually…
Authoring | What’s new in ArcGIS Pro?

• New at Pro 2.2
  - Popups for vector tile layers!
  - Visual variables / attribute driven styling
    - Single symbol / unique value
  - Color picker directly from symbol
  - Font fallback

• New at Pro 2.1
  - Visual variables / attribute driven styling
    - Graduated / Proportional symbols
  - Text rotation
  - Unclassed symbol support in vector tiles

- Pause drawing!
- Improved rendering of vector tiles
- Convert representations to unique values
- Batch geoprocessing
- Create directories and FGDB’s
- Improved polygon labeling / placement
- Improved vector tile layer display in Pro
Caching | What’s new in ArcGIS Enterprise and Online?

• **ArcGIS Enterprise 10.6.1**
  - Level 1 users are free 10.6
  - Replace vector tile layer
  - Offline / Export tile layers
  - Caching in cloud store directories
    - Amazon S3
    - Azure Blob Store
    - Alibaba OSS
    - Huawei OBS

• **ArcGIS Online**
  - Replace vector tile layer
  - Auto update Hosted Tile Layers based on Hosted Feature services
Optimizing Raster Tile Generation

Raster Tiles
Raster Tiles | Are they still relevant?
<table>
<thead>
<tr>
<th>Product</th>
<th>Raster Basemaps</th>
<th>Vector Basemaps</th>
</tr>
</thead>
<tbody>
<tr>
<td>ArcGIS Pro Map Type</td>
<td>Imagery, Scanned Maps/Charts, Elevation</td>
<td>3D Terrain</td>
</tr>
<tr>
<td>Publish as</td>
<td>Map</td>
<td>Scene</td>
</tr>
<tr>
<td>Tile Format</td>
<td>JPEG or MIXED</td>
<td>LERC</td>
</tr>
<tr>
<td>Compression / Quality</td>
<td>65 - 75</td>
<td>0.1</td>
</tr>
<tr>
<td>Mosaic Dataset Overviews</td>
<td>Optional</td>
<td>YES</td>
</tr>
<tr>
<td>Data location</td>
<td>Source rasters - network share / NAS / SAN</td>
<td>Local FGDB</td>
</tr>
<tr>
<td>Cache Extents</td>
<td>Mosaic Datasets - local FGDB</td>
<td></td>
</tr>
<tr>
<td>Special Considerations</td>
<td>Increase mosaic max rasters and row/columns</td>
<td>Optionally compress the FGDB</td>
</tr>
<tr>
<td>Maplex</td>
<td></td>
<td>When needed</td>
</tr>
<tr>
<td>Data Conditioning</td>
<td></td>
<td>Check spatial indices and attribute indices</td>
</tr>
<tr>
<td>FGDB Health</td>
<td></td>
<td>Compact FGDB’s after data updates / edits</td>
</tr>
<tr>
<td>Analyzers</td>
<td></td>
<td>Utilize mosaic dataset and map analyzers to identify common issues</td>
</tr>
</tbody>
</table>
Pop Quiz
Raster Tile Selection
Raster Tiles | Imagery

- **Service Type:**
  - Map or Image Service
  - Web Map Image Layer
  - Web Image Layer

- **Tile format:**
  - MIXED
  - JPEG-65

- **Cache Extents:**
  - Mosaic Dataset footprints
Raster Tiles | 3D Terrain

- **Service Type:**
  - Image Service
  - Web Elevation Layer

- **Tile format:**
  - LERC-0.1

- **Cache Extents:**
  - Mosaic Dataset footprints
Raster Tiles | Topographic Map with Hillshade

- Service Type:
  - Map Service
  - Web Map Image Layer

- Tile format:
  - JPEG-90

- Cache Extents:
  - Custom

Cache smarter…not harder
Raster Tiles | Navigation StreetMap

- Service Type:
  - Map Service
  - Web Map Image Layer

- Tile format:
  - JPEG-90
  - PNG?

- Cache Extents:
  - Custom
• Don’t use Fine, Verbose, or Debug logging.

• Size your Caching Tools Instances:
  - $N = \# \text{ of cores per machine}$
  - Min and Max = $N$
  - 2 - 4GB of RAM x $N$
    - Decrease $N$ if necessary

Cache smarter…not harder
• Only cache what is necessary

• Use AOI’s with decreasing coverage as you increase LOD’s

• Break your basemap project into multiple cache jobs by bracketing LOD’s
  - Each job can / should have a unique AOI

• Only update what has changed
  - You don’t need to re-cache everything if you have partial updates to your data

Cache smarter…not harder
Summary | Optimizing Raster Tile Generation

• Optimize your data:
  - spatial index, compact FGDB, copy data local

• Optimize MXD / APRX and Imagery Projects:
  - analyzer results, scale dependencies, Maplex when needed, Mosaic Dataset tuning

• Configure ArcGIS Server Caching instances

• Optimize cache jobs:
  - Multiple jobs, AOI per LOD’s per job, only cache what is necessary

• ArcGIS Server will scale and leverage system resources

Cache smarter…not harder
Optimizing Vector Tile Generation
Vector Tiles
Vector Tiles | Data

- Use a local FGDB copy / extract of your data

- Clean your data
  - Eliminate duplicates
  - Check/fix geometry errors

- How dense is your data?
  - Set reasonable scale dependencies
  - Generalize
Vector Tiles | Cartography

- Set your scales according to the tiling scheme you select

- Remember scale logic in Pro is different from ArcMap

- Convert representations to unique value symbols

- Limit...
  - number of layers
  - duplication of content
  - inclusion of additional fields / data in the tileset
• Avoid…
  - group layers
  - complex symbols and unsupported symbol effects: hatched / gradient fills
  - unsupported layer types: annotations, basemaps

• Be mindful of users that want to re-style your maps
Vector Tiles | Cooking Tips

- Create and use index polygons
- Set max scale appropriately
- Choose a local directory for the .VTPK
Summary | Optimizing Vector Tile Generation

- Uncheck the box - “Draw up to and including maximum scale in scale ranges.”
- Pick a tiling scheme and set scale properties to match
- Copy your data to a FGDB
- Get your data healthy
- Make a valid map
- Make an efficient map
Make an Efficient Map
#KnowBeforeYouPro
Sharing, Cooking, and Updating

...is caring
Sharing
Cached Image Layers
Share Web Elevation Layers
Sharing Web Elevation Layers
Sharing Web Elevation Layers
Sharing and Cooking

Vector Tile Layers

1. Draw a line in the map.
2. Select the line and press enter.
3. Right-click the line and select Share as Web Layer.
4. Name the layer "Migrate Final Vector".
5. Check the box for Vector Tile.
6. Click Publish.
7. Share with "Admin (root)".
New Zealand Production

Overview

Map of New Zealand, streetMap Content, Production2

Tile Layer (hosted) by sharing1

Created: Jul 6, 2018   Updated: Jul 6, 2018   View Count: 0

Description

This is a street basemap of New Zealand, production2

Layers

New Zealand Production

Terms of Use

Open in Map Viewer

Open in Scene Viewer

View style

Share

Replace Layer

Item Information

Low

High

Details

Source: Vector Tile Service

Created from: New Zealand Production, Vector Tile Package
Restyling multiple maps from one tileset
ArcGIS Vector Tile Style Editor

Design your own custom styles for Esri Vector Basemaps.

Get Started
Summary
Raster Tiles and Vector Tiles…choose wisely
Caching Best Practices | Summary

Raster Tiles:
- Rasters and elevation datasets
- Any client
- Big Footprint
  - TB’s of cache data
- Generation can consumes lots of resources
  - Days and Weeks

Vector Tiles
- All vector datasets
- Modern browsers with WebGL
- ArcGIS Pro 1.3+
- Small footprint
  - ~26 GB for whole world
- Generation consumes less resources
  - Minutes and Hours

https://esri.box.com/v/CachingReadAhead
References

ArcGIS Pro
- Cartography MOOC (5 September - 17 October): https://www.esri.com/training/catalog/596e584bb826875993ba4ebf/cartography/

Vector Tiles
- Esri Vector Tile Style Editor (VTSE): https://developers.arcgis.com/vector-tile-style-editor/
- UC 2017 - Creating Vector Tiles: https://www.youtube.com/watch?v=dqKsEos1iSw
- Replace vector tile workflow: https://developers.arcgis.com/rest/users-groups-and-items/replace-service.htm

ArcGIS Online
- Esri Vector Basemap Group: https://www.arcgis.com/home/group.html?id=30de8da907d240a0bccd5ad3ff25ef4a#overview
- Blogs Human Geography Basemaps:

JSAPI Sample Apps
- Flights:
  - Code: https://github.com/gbochenek/vector-tile-demo-js
  - Live Demo: https://gbochenek.github.io/vector-tile-demo-js
- Browse Styles:
  - Code: https://github.com/tfauvell/vt-styles-js
  - Live Demo: https://tfauvell.github.io/vt-styles-js
<table>
<thead>
<tr>
<th>WORKSHOP</th>
<th>LOCATION</th>
<th>TIME FRAME</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tuesday, 10 July</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• ArcGIS Pro: Creating Vector Tiles</td>
<td>• SDCC – 17B</td>
<td>• 10:00 am – 11:00 am</td>
</tr>
<tr>
<td>• Caching Maps and Vector Tile Layers: Best Practices</td>
<td>• SDCC – 10</td>
<td>• 2:30 pm – 3:30 pm</td>
</tr>
<tr>
<td>• Working With OGC WMS and WMTS</td>
<td>• SDCC – Esri Showcase: Interoperability and Standards Spotlight Theater</td>
<td>• 4:30 pm – 4:50 pm</td>
</tr>
<tr>
<td><strong>Wednesday, 11 July</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• ArcGIS for Python: Managing Your Content</td>
<td>• SDCC – Demo Theater 01</td>
<td>• 11:15 am – 12:00 pm</td>
</tr>
<tr>
<td>• ArcGIS Online: Three-and-a-Half Ways to Create Tile Services</td>
<td>• SDCC – Demo Theater 06</td>
<td>• 1:15 pm – 2:00 pm</td>
</tr>
<tr>
<td>• Understanding and Styling Vector Basemaps</td>
<td>• SDCC – 15B</td>
<td>• 2:30 pm – 3:30 pm</td>
</tr>
<tr>
<td>• Working With OGC WMS and WMTS</td>
<td>• SDCC – Esri Showcase: Interoperability and Standards Spotlight Theater</td>
<td>• 4:30 pm – 4:50 pm</td>
</tr>
<tr>
<td><strong>Thursday, 12 July</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• ArcGIS Enterprise: Best Practices for Layers and Service Types</td>
<td>• SDCC – 16B</td>
<td>• 10:00 am – 11:00 am</td>
</tr>
<tr>
<td>• ArcGIS Pro: Creating Vector Tiles</td>
<td>• SDCC – 17B</td>
<td>• 10:00 am – 11:00 am</td>
</tr>
<tr>
<td>• Web Mapping: Making Large Datasets Work in the Browser</td>
<td>• SDCC – 16B</td>
<td>• 1:00 pm – 2:00 pm</td>
</tr>
<tr>
<td>• Caching Maps and Vector Tile Layers: Best Practices</td>
<td>• SDCC – 04</td>
<td>• 4:00 pm – 5:00 pm</td>
</tr>
<tr>
<td>• Understanding and Styling Vector Basemaps</td>
<td>• SDCC – 10</td>
<td>• 4:00 pm – 5:00 pm</td>
</tr>
</tbody>
</table>
Download the Esri Events app and find your event

Select the session you attended

Scroll down to find the feedback section

Complete answers and select “Submit”