ArcGIS Pro: Create Raster and Vector Tiled Basemaps

Matthias Schenker

Gerhard Trichtl

ESRI EUROPEAN DEVELOPER SUMMIT

esri

What are Basemaps for

- Basemaps provide a optimal background and orientation for displaying your data on top

- Should be
  - Fast
  - Nice cartography

Areas where you use Basemap

- ArcGIS Desktop
- ArcGIS Pro
- ArcGIS Runtime
- JavaScript API
- ArcGIS Maps for Office
- WebMaps
- :
- ➔ Everywhere

Types of Basemaps

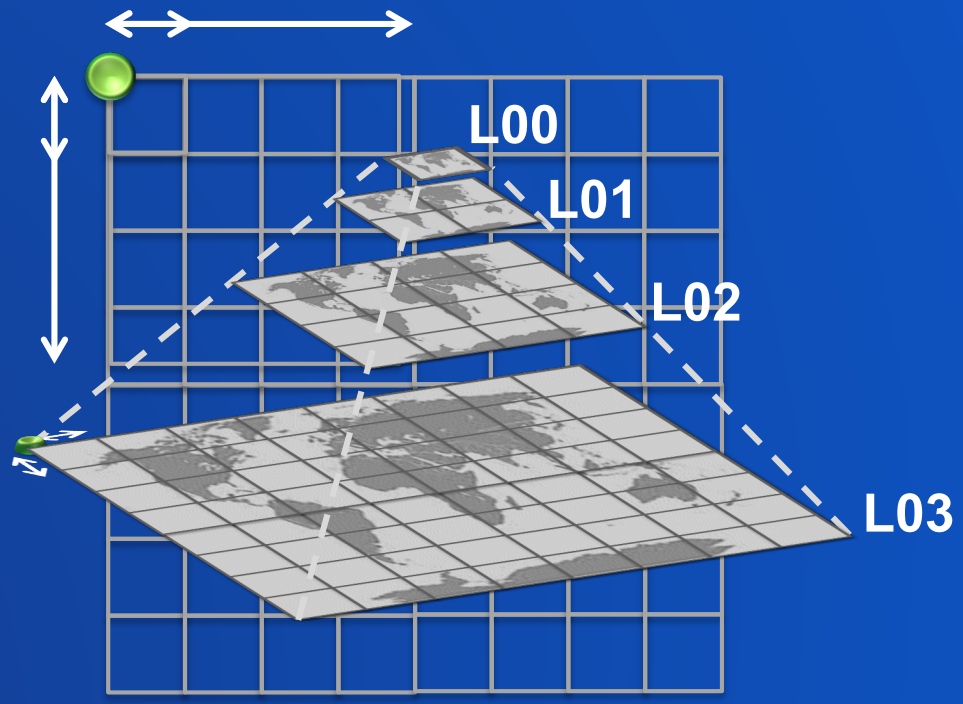
- Raster based/Map Caches
  - Cached MapServices (Server, Online/Portal)
  - Tilepackages

- Vector based
  - TileService (Online/Portal)
  - VectorTilePackages

Basemaps: Raster Tiles/Map Caches

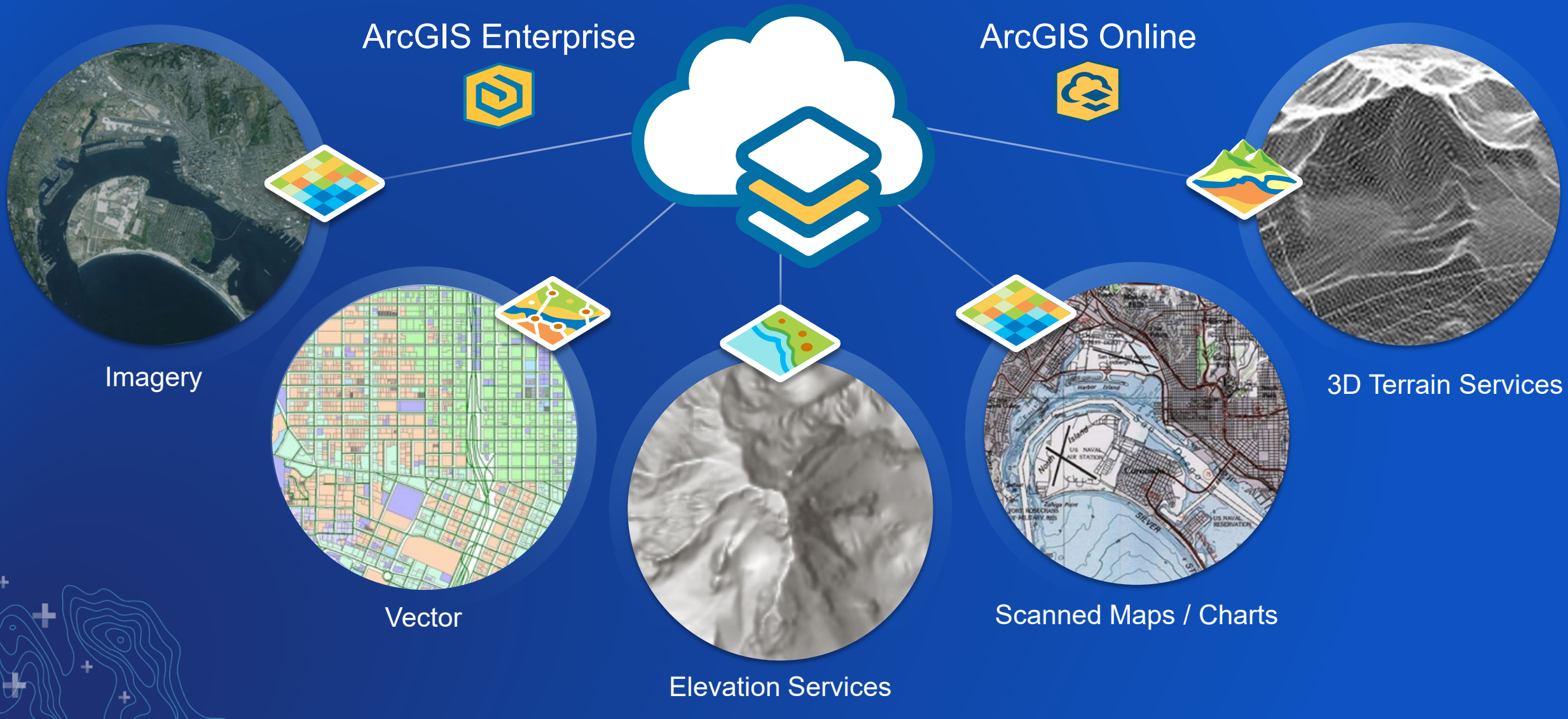
Overview | Raster **Tiles**

- **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**



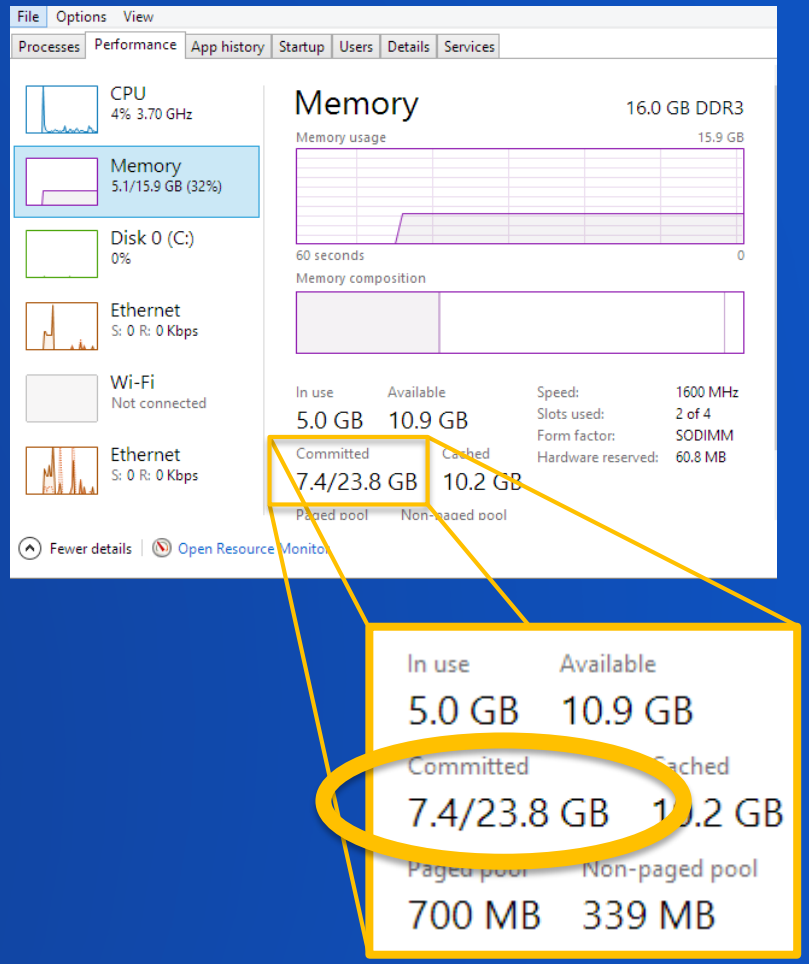
Cache

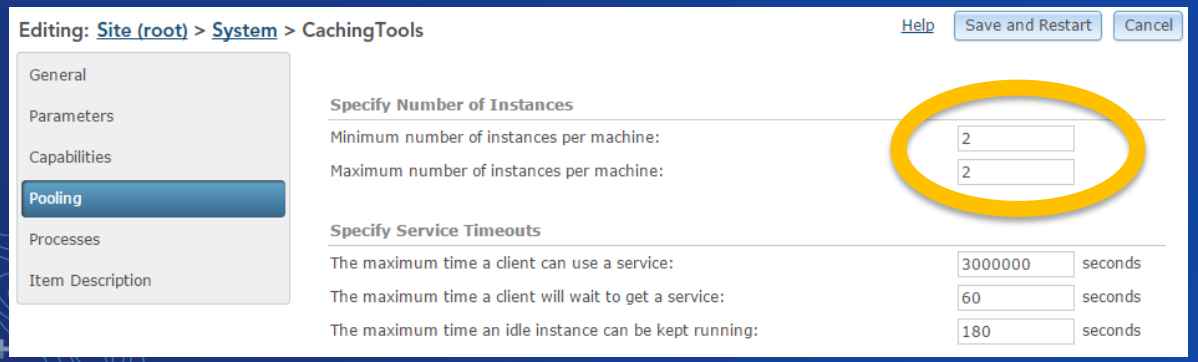
Raster Tiles | Are they still relevant?



Raster Tiles | ArcGIS Server Configuration

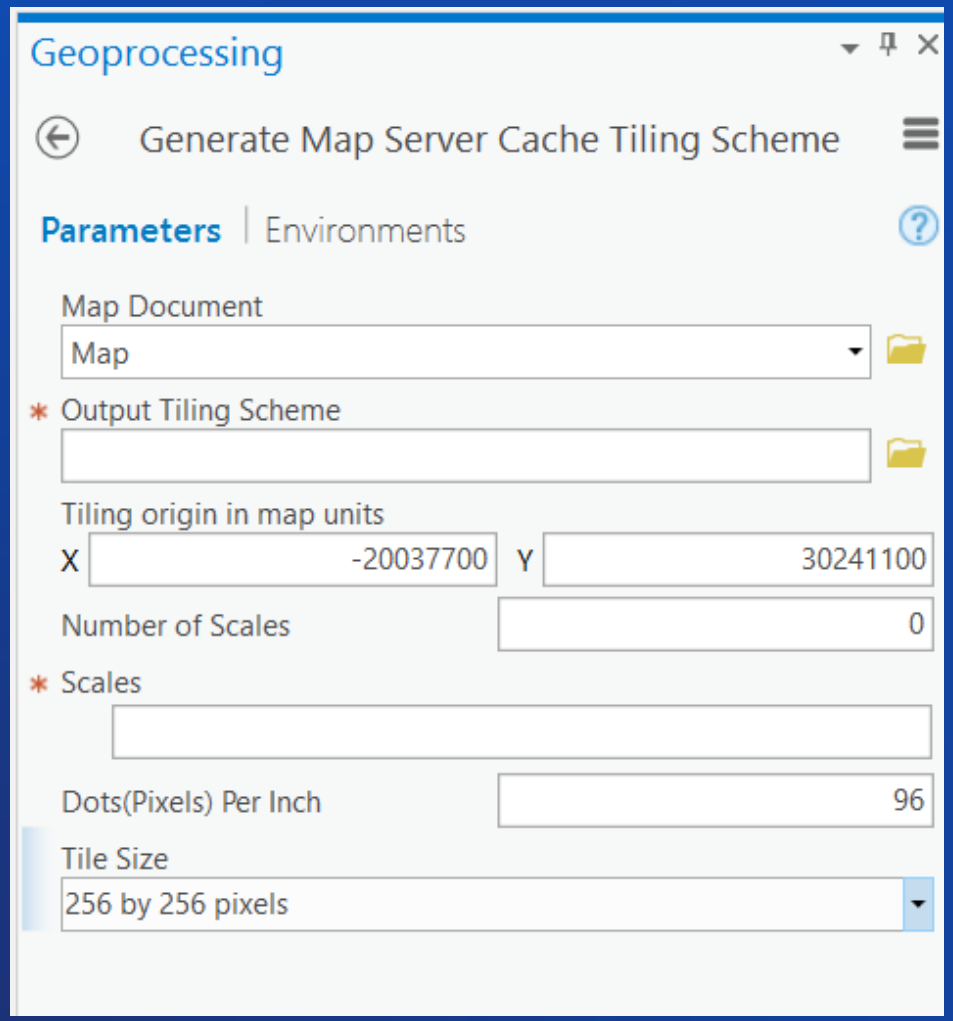
- **Don’t use Fine, Verbose, or Debug logging.**
- **Size your Caching Tools Instances:**
  - **N = # of cores per machine**
  - **Min and Max = N**
  - **2 – 4GB of RAM x N**
    - **Decrease N if necessary**



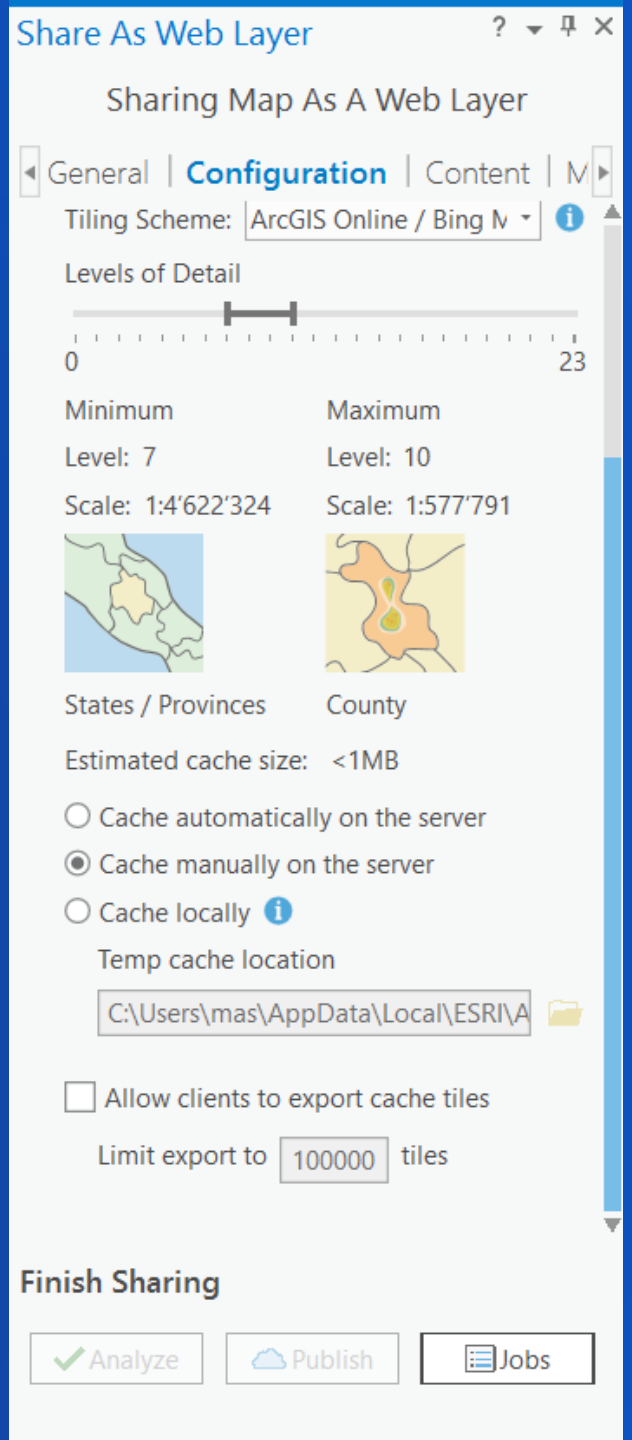


Cache smarter…not harder

Settings for Map Cache

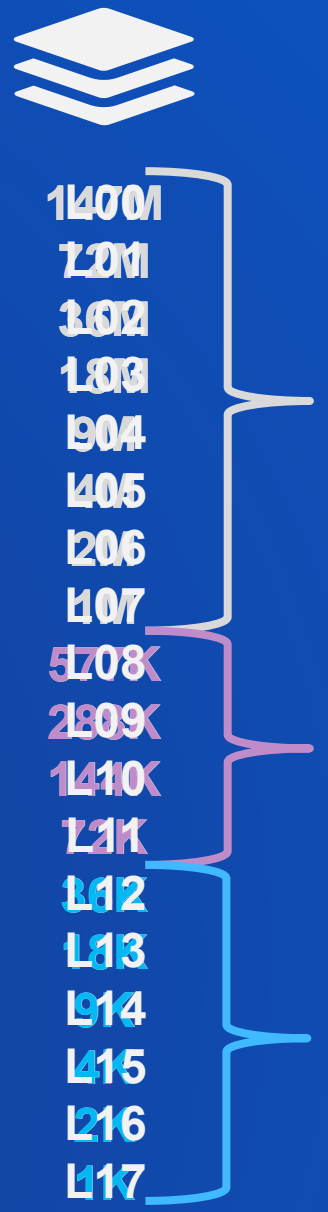


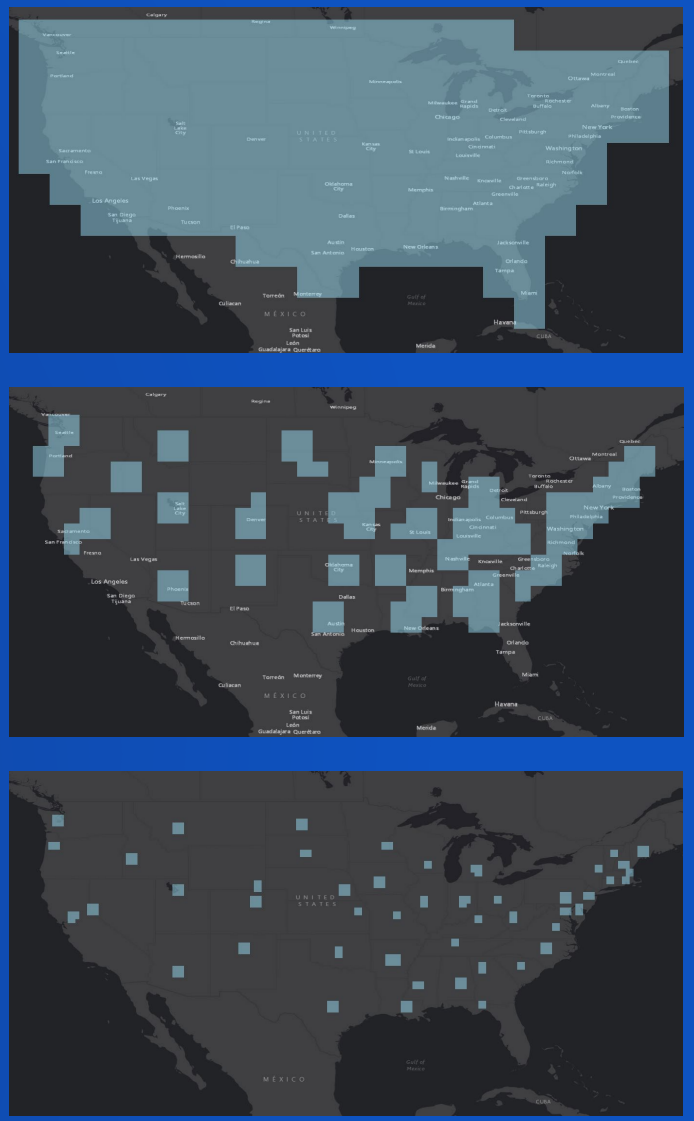
C:\Program Files\ArcGIS\Pro\Resources\TilingSchemes



Raster Tiles | Cache Jobs

- Only cache what is necessary
- Use AOI's with decreasing coverage as you <u>increase</u> 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

Raster Basemaps entering Mature Support

- **Already in mature support**
  - ESRI Elevation World; USGS Elevation US; World Physical Map; World Shaded Relief; World Terrain Base
  - USA Topo Maps; World Boundaries and Places Alternate; World Navigation Charts; World Reference Overlay
- **June 2020**
  - Arctic Ocean Reference; DeLorme World Base Map; World Ocean Reference
- **June 2021**
  - World Dark Gray Base, World Dark Gray Reference, World Light Gray Base, World Light Gray Reference
  - India Dark Gray Base, India Dark Gray Reference, India Light Gray Base, India Light Gray Reference
  - World Boundaries and Places; World Hybrid Overlay; World Transportation
  - NatGeo World Map; World Street Map; World Topo Map
- **No changing in Support**
  - Antarctic Imagery; Arctic Imagery
  - Arctic Ocean Base; World Ocean Base
  - World Hillshade; World Dark Hillshade
  - World Imagery (including Clarity, Firefly, GCS, and Wayback)

See also Blogpost:
https://www.esri.com/arcgis-blog/products/arcgis-online/announcements/lifecycle-for-esris-hosted-raster-basemap-services/

Basemaps: VectorTiles

Web and mobile mapping over the last 10+ years

- Typically vector content (points, lines, polygons)
- Displayed on top of basemaps
- Since ~2005, basemaps have usually been raster tiles

- Dynamic updates of the map consist of two things:
  - Updating overlay content as drawn in client
  - Changing the basemap

- Paradigm is changing

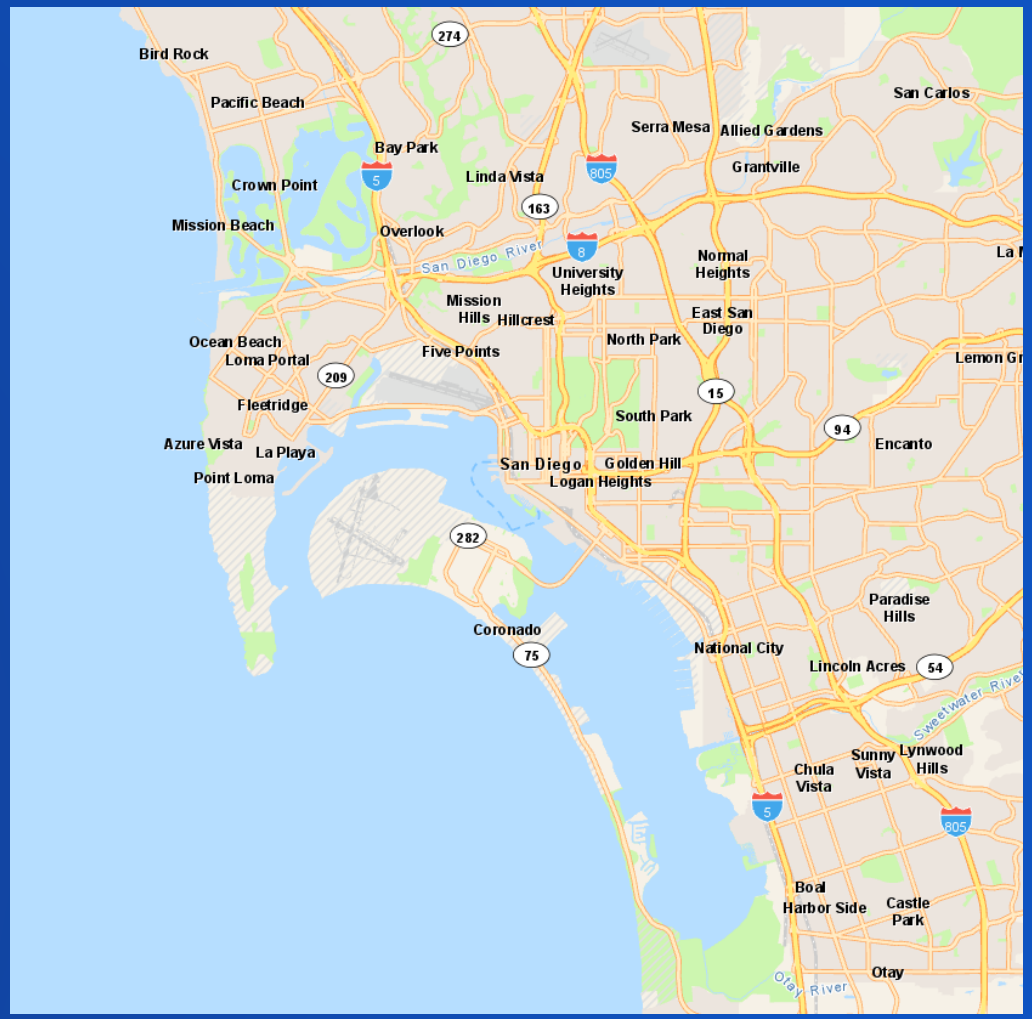
Why Vector Tiles?

Raster is Faster, but Vector is Corrector

– Joseph Berry

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

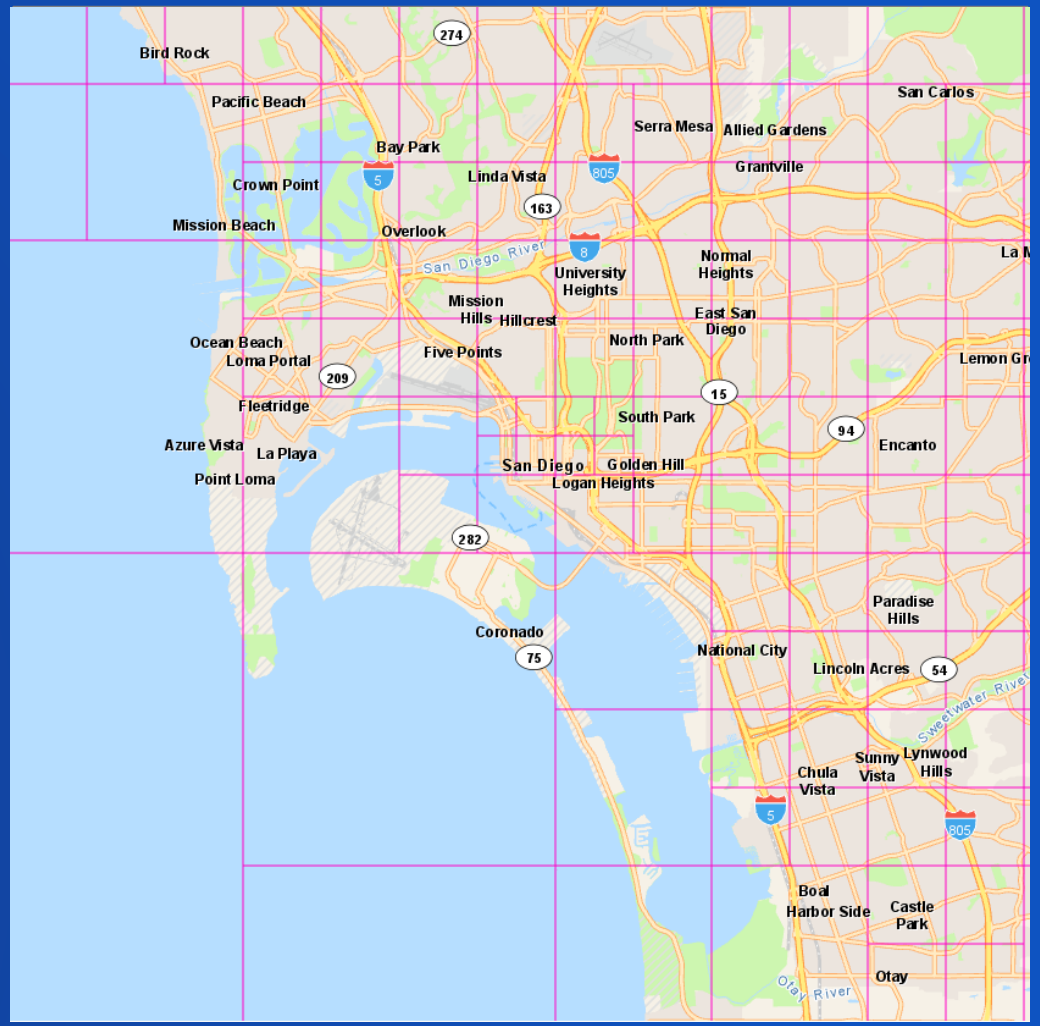


Overview | Vector Tiles in ArcGIS

- 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 / Contrast | Authoring Clients / Tools

Raster Tiles

- MXD's, Map Projects, and Mosaic Datasets

- 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

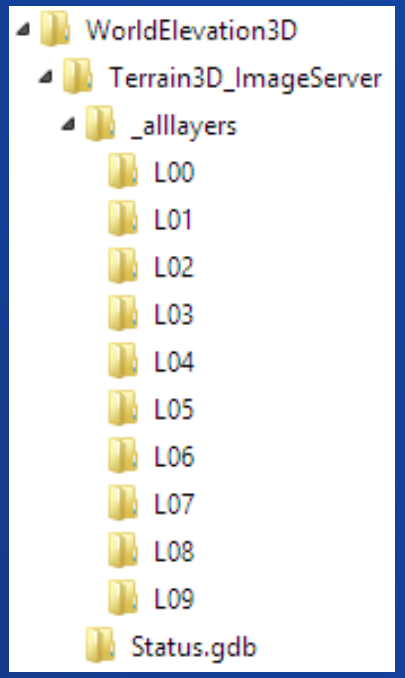
- Map Projects

- ArcGIS Pro v1.2+
  - Create Vector Tile Package

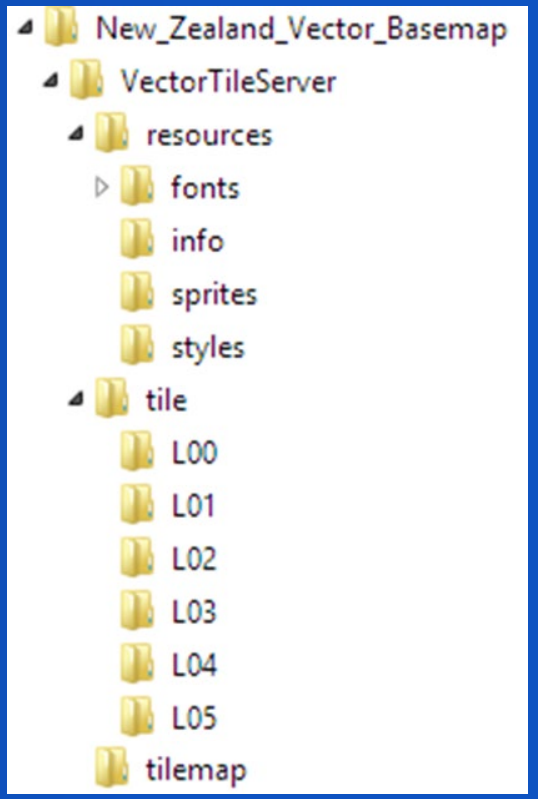
- ArcGIS Pro v1.4*
  - Integrated sharing workflow

Compare / Contrast | Tileset Structure

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



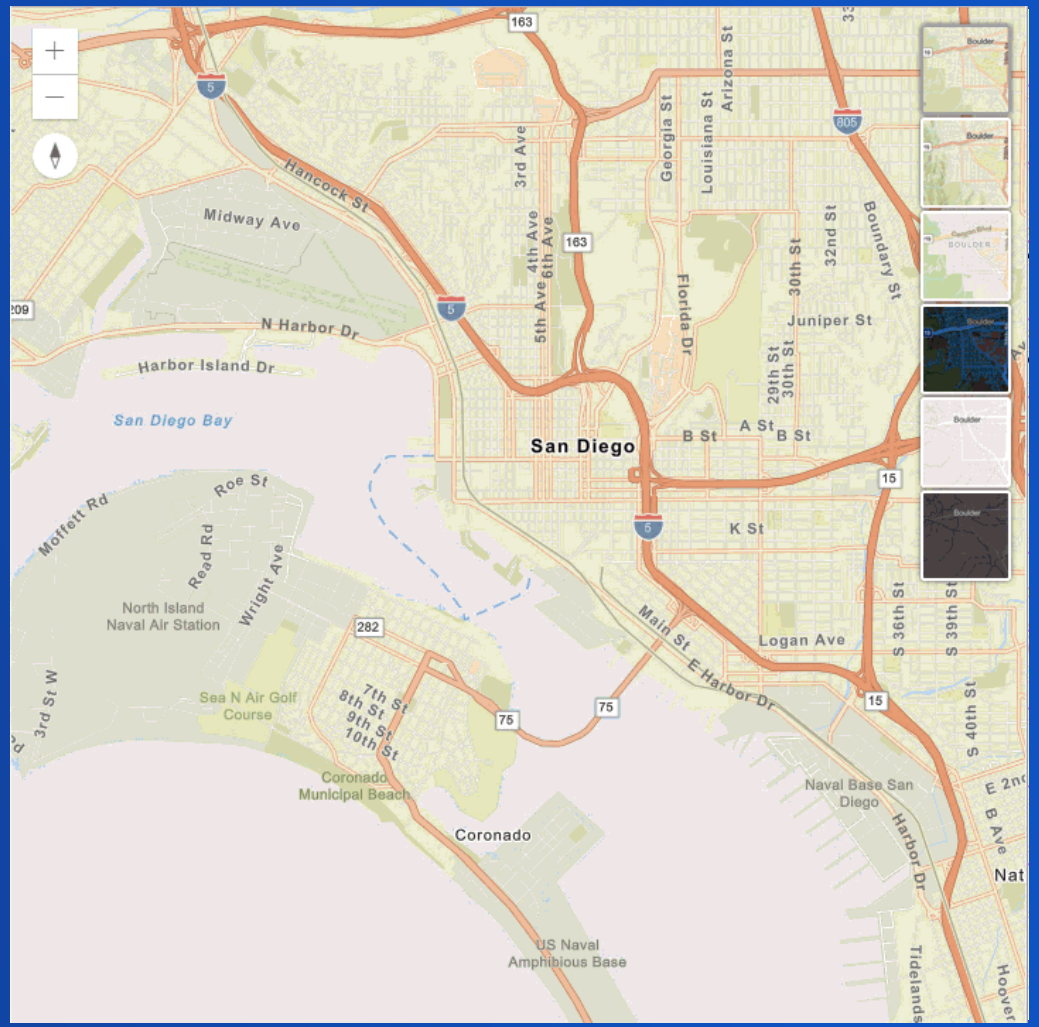
- **Vector Tiles:**
  - **.bundle**
    - **Tiled data encoded as Protocol Buffers (.PBF)**
  - **Fonts**
    - **Glyphs as .PBF**
  - **Sprites**
    - **Sprite.png / Sprite@2x.png**
  - **Style**
    - **.JSON**



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**



Summary | Compare and Contrast

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

*** Current Display Driver**

Tile Creation Process

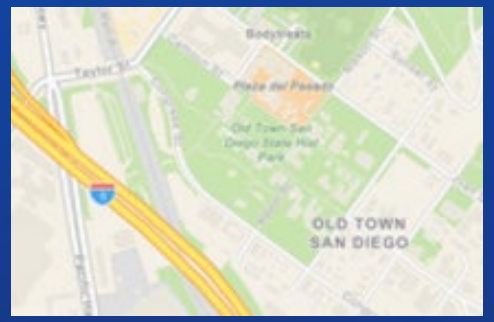
Esri Streetmap	Raster Tiles	Vector Tiles
Area	Earth	Earth
Volume	~ 20 TB	~26 GB
Duration	Weeks	~ 12 hours
Processing	Serverfarm with X Cores	Desktop machine

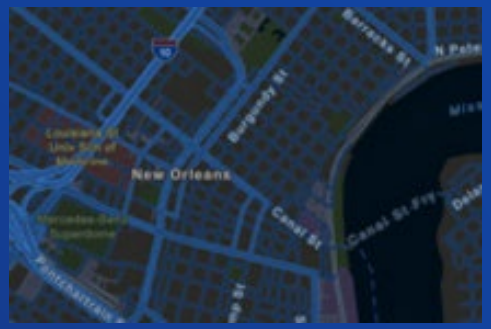
BasemapAT	Raster Tiles	Vector Tiles
Area	City of Vienna (~ 400 km²)	City of Vienna (~ 400 km²)
Volume	325 MB	84 MB (*)
Duration	12 minutes	3 minutes (*)
Processing on same hardware	6 Cores	1 Core

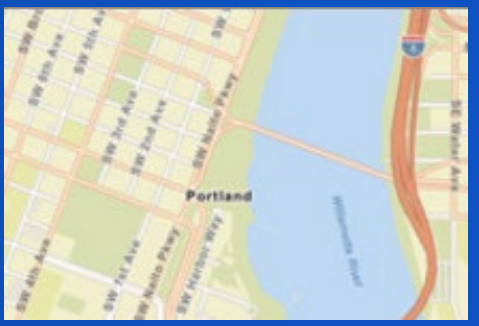
(*) Visualization not yet optimized for Vector Tiles

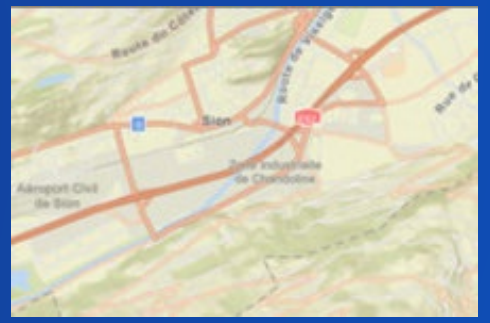
Vector tile basemaps

- Available on ArcGIS.com since November 2015 – since Dec. 2016 in Production
- Street (with and w/o relief), Topo, Night, Navigation, Dark Canvas, Light Canvas, Hybrid









Vector basemap blogs

ArcGIS Resources

ArcGIS Online Sign In

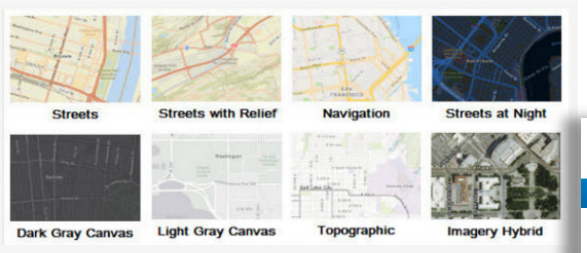
Home Communities Help Blog Forums Videos Search the ArcGIS Blog

Introducing Esri Vector Basemaps (Beta)

by Deane Kensok on November 18, 2015

Share 135 Tweet 448 Share 1013

Earlier this year, Esri announced plans for bringing vector tiles to the ArcGIS platform and shared a preview of vector basemaps being developed. With the November update of ArcGIS Online, we are introducing initial support for vector tiles as a layer in the web map. As part of this, Esri is providing access to an updated set of vector basemaps (now in beta release) that can be accessed within ArcGIS Online and used to build maps and apps.



are rendered client-side based on a style file that is delivered with the vector tiles. Esri has generated these vector tiles with early versions of ArcGIS Pro 1.2. With the release of ArcGIS Pro 1.2 in early 2016, users will be able to generate vector tiles from their own data and serve these out as vector tile layers using either ArcGIS 10.4 for Server or ArcGIS Online. The vector basemaps can be displayed in most current, desktop web browsers and, in the near future, various desktop and mobile apps. Users are able to customize the look and feel of the vector basemaps by creating custom styles that are used to render the vector tiles.

Available Vector Basemaps

The initial set of Esri vector basemaps includes eight different map styles built using a

This Blog

Sign in

Subscribe to the RSS Feed

Comments RSS

Technical Communities

3D GIS (184)

Analysis & Geoprocessing (313)

ArcGIS Resources

ArcGIS Online Sign In

ArcGIS Resource Center Help Blog Forums Videos Search the ArcGIS Blog

Understanding Esri Vector Basemap File Structure

by ArcGIS Content Team on December 2, 2015

Share 18 Tweet 184 Share 220

The ArcGIS Content development team has (and still does!) put a lot of work into creating a comprehensive set of basemaps to help you as an ArcGIS user to show off your work, but, much as we would like to, we can't cover everyone's unique requirements. Until now, this effort was put into creating cached raster tile maps, but we are now expanding that by *re*-creating these maps in the new vector tile environment. One of the great features of vector tile mapping is that you now have the opportunity to customize the maps yourself. The extent to which you wish to do this is up to you, from 'tweaking' a few significant colors to creating a completely new look.

Three previous posts on the topic of Esri Vector Basemaps were recently published to the ArcGIS Blog: Introducing Esri Vector Basemaps (Beta), How to Customize Esri

i Vector Basemap Boundaries and Labels. Each

tting started to use and customiz

ese and explores three more to

explains some basic controls yo

own vector basemaps. There is

cludes lists of the map features

d the list of disputed boundary c

tyle. For vector tile layers you ow

and update the item through Arc

structure will benefit you as you

basic Esri Vector Basemap JSON

res included in the maps (Backgr

dle section details the type of fea

/or stroke symbol while the gree

e lines of JSON code starts with

these background features first

This Blog

Sign in

Subscribe to the RSS Feed

Comments RSS

Technical Communities

3D GIS (184)

Analysis & Geoprocessing (313)

ArcGIS Resources

ArcGIS Online Sign In

Home Communities Help Blog Forums Videos Search the ArcGIS Blog

How to Customize Esri Vector Basemaps

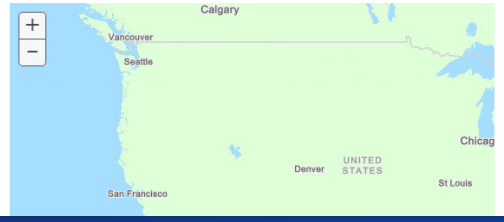
by Deane Kensok on November 19, 2015

Share 6 Tweet 248 Share 342

As described in this earlier post, Esri has introduced a new set of vector basemaps (now in beta release). These vector basemaps offer several benefits (e.g. fast to download, look great on high-res displays, smaller and easier to update, etc), but perhaps the greatest benefit is that users can customize the look and feel of the basemaps.

Custom Map Style Example

Below is an example of a custom map that has been created from one of the available Esri vector basemap tile layers.



This Blog

Sign in

Subscribe to the RSS Feed

Comments RSS

Technical Communities

3D GIS (184)

Analysis & Geoprocessing (313)

ArcGIS Online (1081)

Developer (530)

Editing (160)

Geodata (212)

Imagery (355)

ArcGIS Resources

ArcGIS Online Sign In

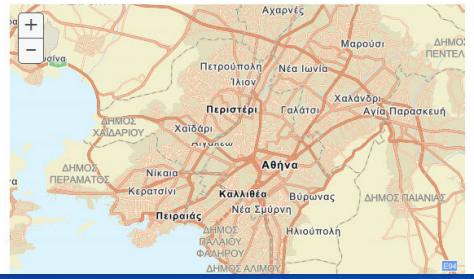
Home Communities Help Blog Forums Videos Search the ArcGIS Blog

Customize Esri Vector Basemap Boundaries and Labels

by Deane Kensok on November 23, 2015

Share 51 Tweet 45 Share 170

In an earlier post, we described how you can customize the Esri vector basemaps (now in beta release). In that post, we provided an example of changing the colors for an existing map style to create a different look for the map, which will probably be the most common way in which the vector basemaps are customized. We also shared the step-by-step instructions for how you can create a custom map.



This Blog

Sign in

Subscribe to the RSS Feed

Comments RSS

Technical Communities

3D GIS (184)

Analysis & Geoprocessing (313)

ArcGIS Online (1081)

Developer (530)

Editing (160)

Geodata (212)

Imagery (355)

Authoring Vector Tiles

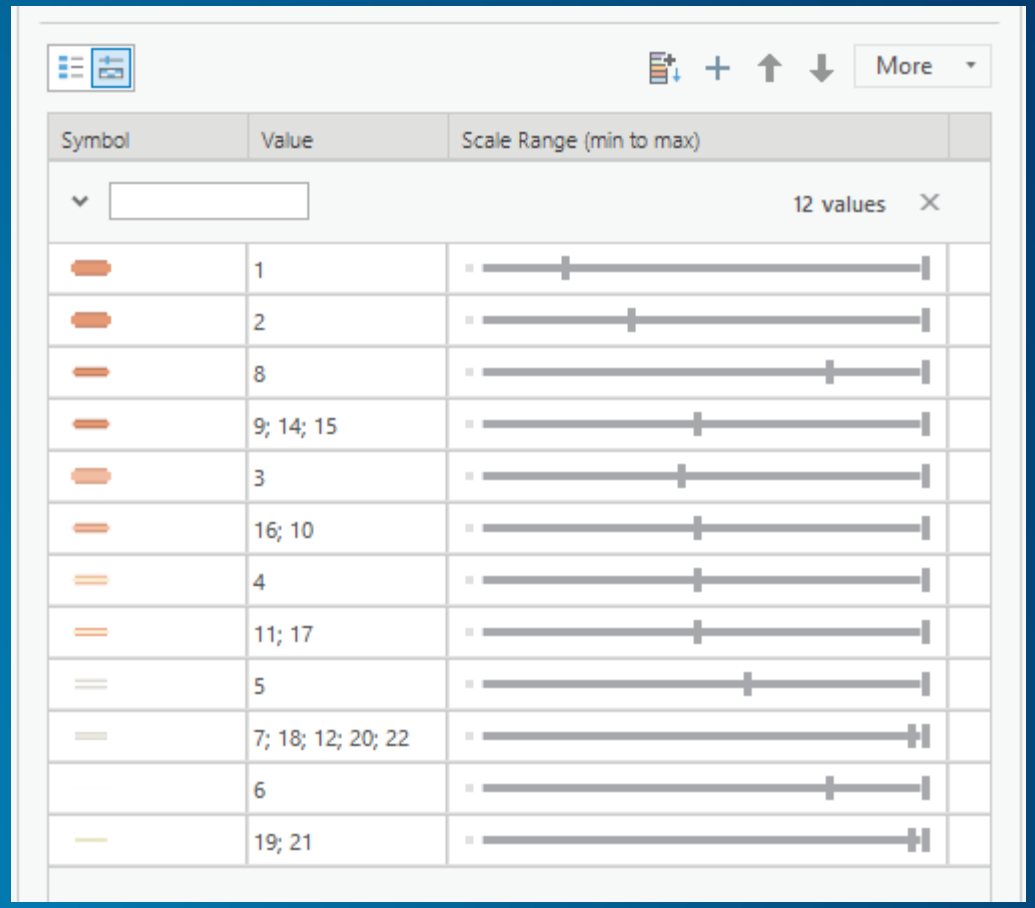
Authoring maps

- Only feature layers with simple, unique value, graduated, or class breaks symbology supported
- Maps should be re-authored for vector tiles
  - Limit number of layers
  - Limit duplication of content
- Several improvements have been made in ArcGIS Pro to assist with this
  - Scale dependent capabilities added to symbology
  - Alternate symbols added to symbology
  - Scale based sizing added to symbology
  - Improvement to scale logic

Scale dependent symbology

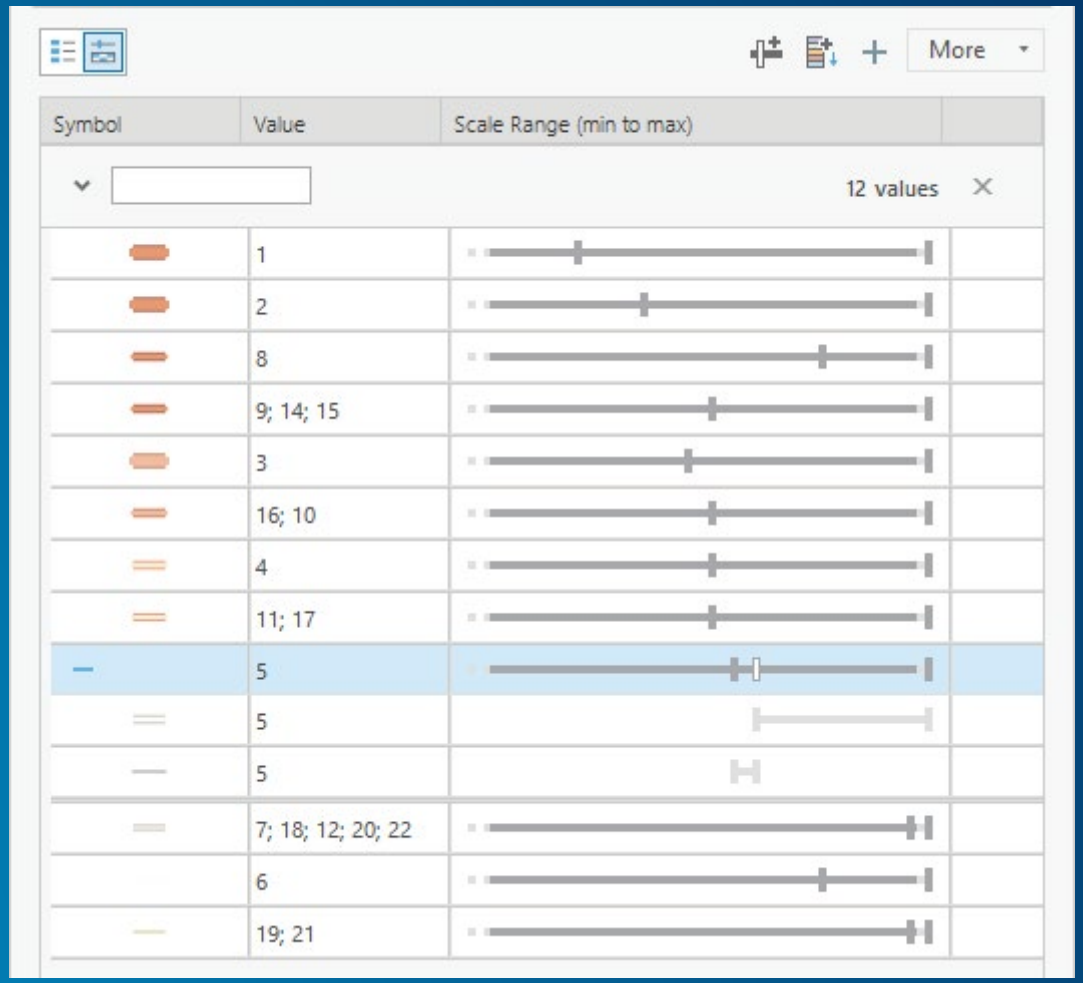
- Each symbol class can be assigned a scale range
  - Unique value
  - Class breaks

- Allows a multiscale map to be authored without duplicating content



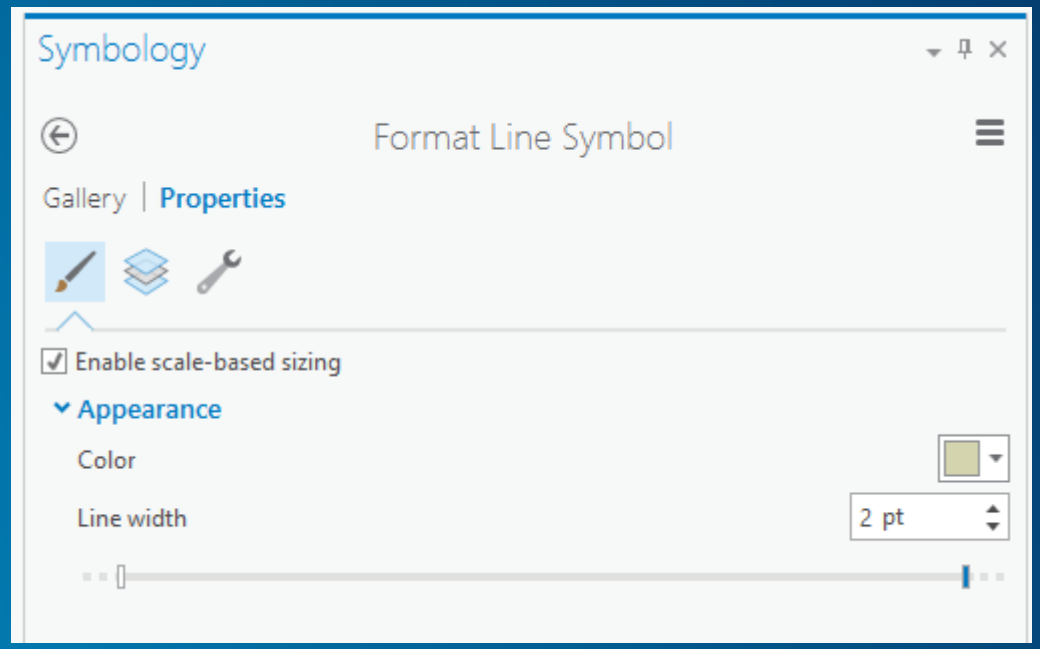
Alternate symbols for symbology

- Symbol classes can switch symbols at scales
  - Unique value
- Allows you to change the appearance of a symbol without duplicating layer



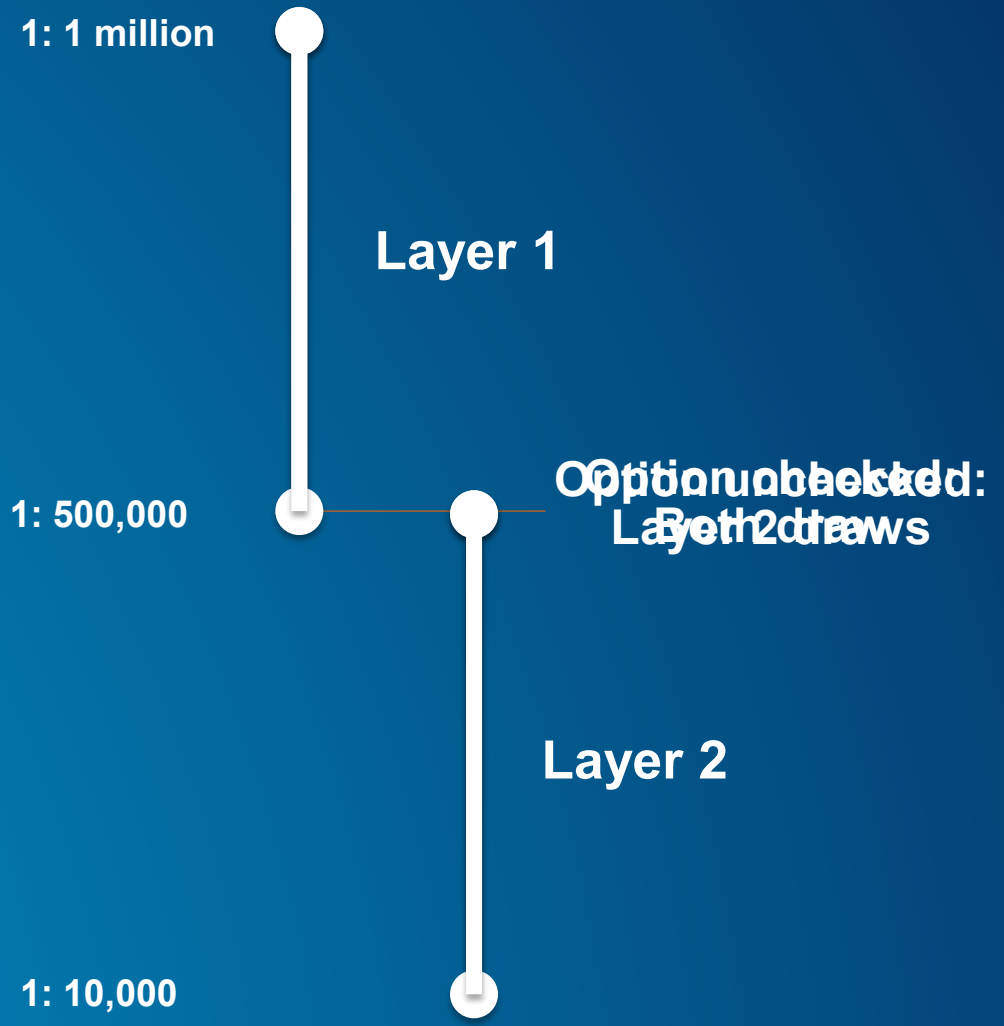
Scale based symbol sizing

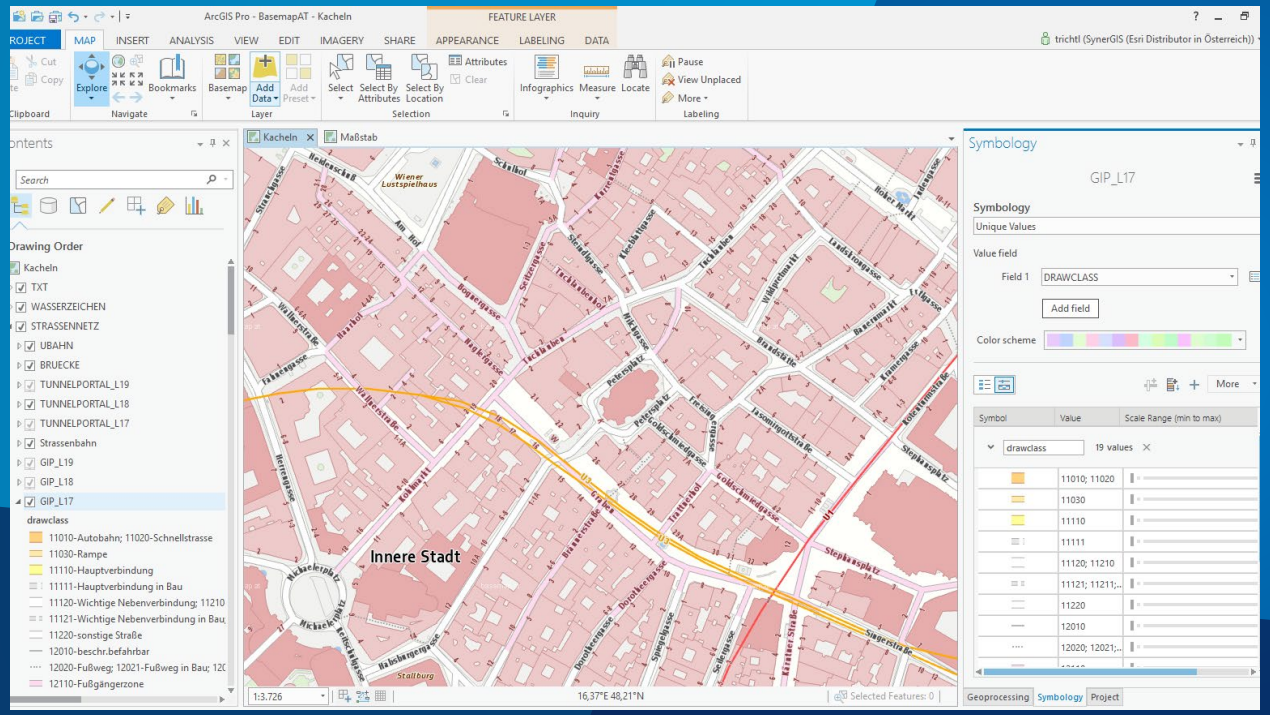
- Each symbol can have scale based sizing configured
  - Single symbol
  - Unique value
  - Class breaks
- Allows for small changes to symbol size across scales



Scale logic changes

- ArcMap and ArcGIS Pro 1.1
  - Layers will draw AT and BETWEEN minimum and maximum scales
- ArcGIS Pro 1.2+, layers don't draw at max scale by default
  - -Check "Draw up to and including the maximum scale in scale ranges" to revert to old behavior
    - This is checked for old Pro projects or imported ArcMap maps





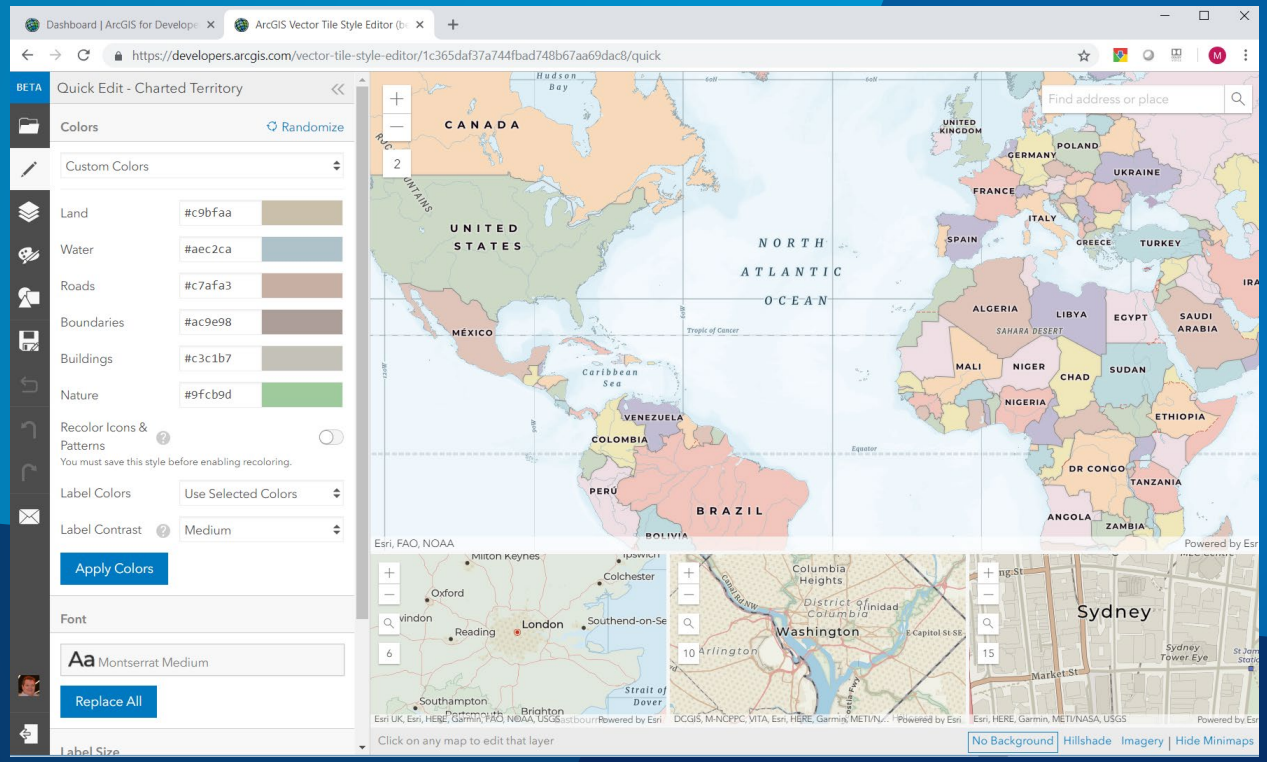
Authoring and creating vector tiles in ArcGIS Pro

Demo

Using and styling vector tiles

Styling vector tiles

- Simple Style Copy
  - Save tile layer to your Portal or Online account
- Hand editing JSON
  - Update map item
- Vector Styling Apps simplify this:
  - Vector Style Editor on developers.arcgis.com
  - Vector Style JSON Editor - GitHub
  - Mapstyler by Esri UK- GitHub



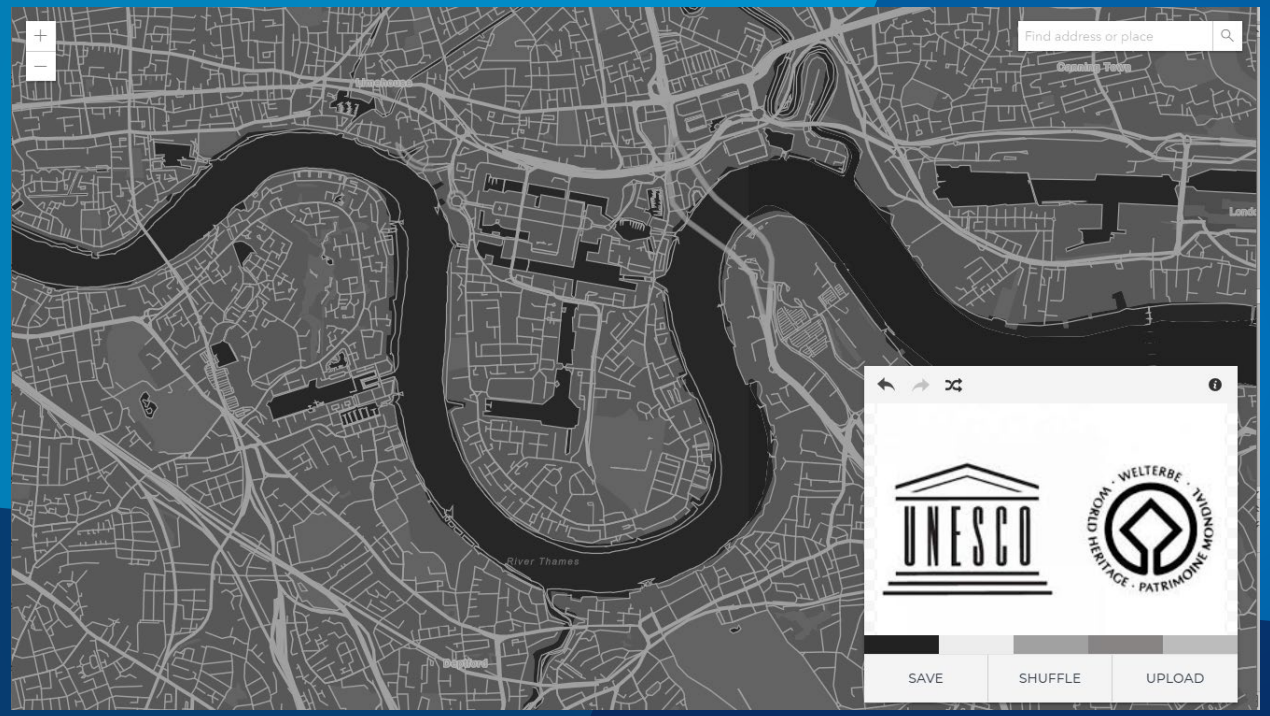
Styling vector tiles

Demo

[Vector Basemap Style Editor]

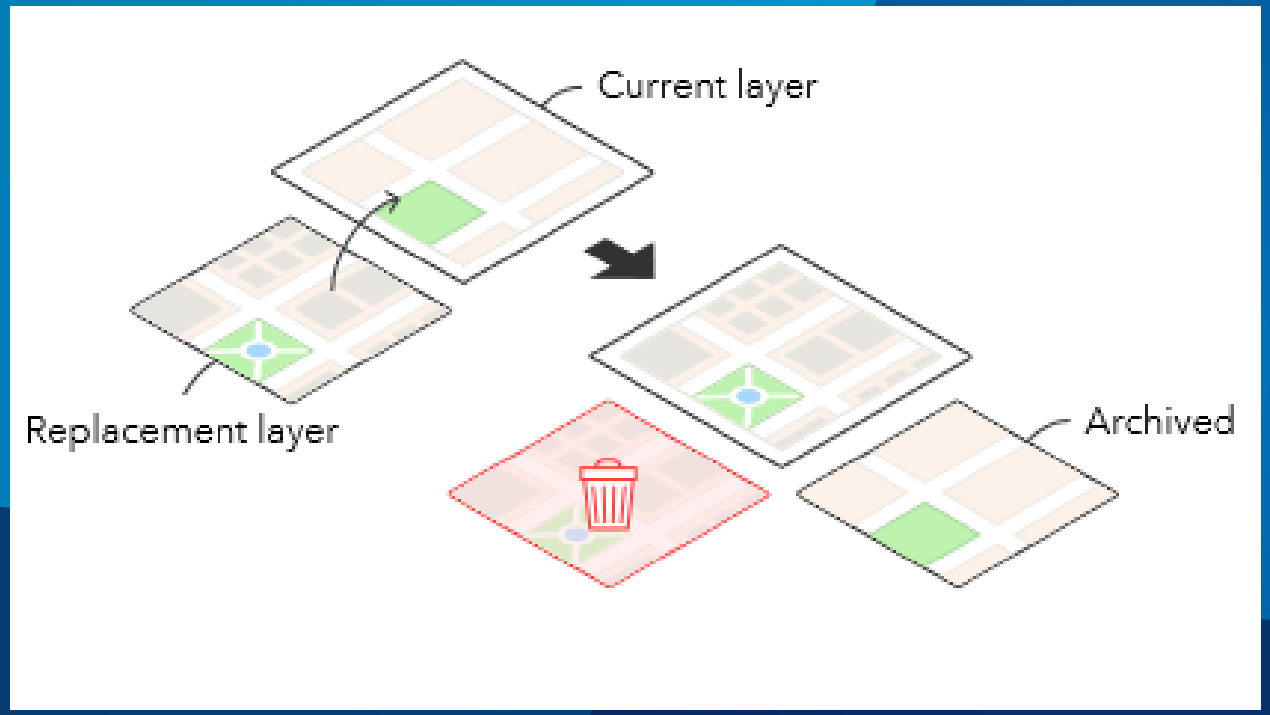
Using VectorTile Styles

Demo



Mapstyler

Demo



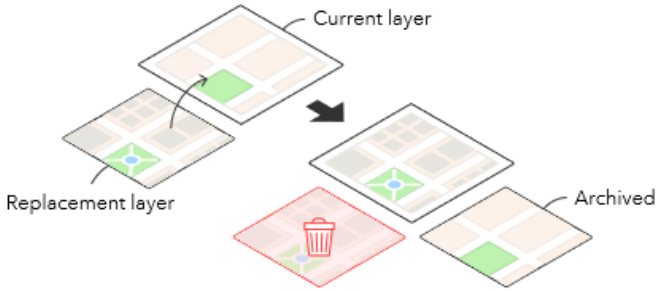
ReplaceLayer VectorTiles

Replace Vector Tiles Layer (10.8*)

Archive the current layer as Austria_2019_11_02_14_43

The content of the current layer is archived. A new layer is created to archive the current layer. The replacement layer is deleted afterwards.

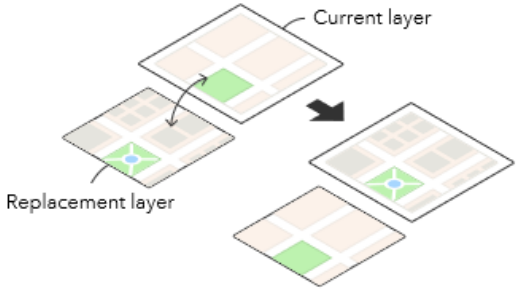
- The item id and URL of the current layer is retained so that apps and styles referencing the layer continue to work.
- The content of the current layer is archived as a new layer.
- The replacement layer is deleted after the current layer is replaced.
- Ideal for creating designated layers for archives.



Use the replacement layer as the archive

The content of the current layer is swapped with the content of the replacement layer.

- No new layers are created. The item id and URL of both the current layer and replacement layer are retained so that apps and styles referencing the layers continue to work.
- Ideal for environments that do not want to create a designated layer for archiving.



What‘s New

What‘s New?

- Multiple-source vector Tiles (ArcGIS Pro 2.4+, ArcGIS API for JavaScript 4.11+)
  - Include data from multiple hosted vector tile layerfiles in a single style
- Improvments to label conversion at tile creation (ArcGIS Pro 2.3+)
  - Multiple label classes
  - Translation style abbrevation
  - Forced Stacking
  - Label repetition
  - Never remove labels
- Offline vector Tiles (ArcGIS Pro 2.4) – Download vector tiles locally
- Modify style with ArcGIS API VectorTileLayer (ArcGIS Pro 2.4)
  - Create add-ins for ARcGIS Pro to update appearance/filtering

Common Questions

Q: Why would I need to create raster tiles anymore?

A: Consider consuming clients and map requirements before committing to vector tiles. At this time, it’s not an answer for everything. Vector tiles will never be a solution for most raster datasets.

Q: Can my data be extracted from vector tiles?

A: Think of vector tiles as generalized graphic derivations of your data. In many cases features are cut at tile boundaries, overlapped at tile boundaries, or are dissolved for optimal draw. Only a minimum number of attributes needed for feature draw are stored. It’s not raw data.

Q: Can I show popups for vector tiles?

A: Popups can be configured in ArcGIS Pro 2.2 – there are two options:

- Associate a feature service (recommended approach)
- Popup against the tile directly (the tiles need to be created in ArcGIS Pro 2.2 with the OBJECTID configured as highlighted

We have this on the roadmap for the other client implementations of vector tiles (JavaScript API, ArcGIS Runtime)

Q: Can I create vector tiles for any map projection?

A: Yes.

Originally, only Web Mercator (Auxiliary Sphere) was supported for the initial releases (ArcGIS Pro 1.2 and 1.3). ***From ArcGIS Pro 1.4+ vector tiles can be created in any projection and used with the JavaScript API version 3.18+, ArcGIS Runtime 100+, and ArcGIS Pro 1.4+***

Q: Should I re-author my maps for vector tiles?

A: Yes, start by reading the help topic titled Author a map for vector tile creation

Q: Will ArcMap support vector tiles?

A: It is unlikely that ArcMap will ever support viewing vector tiles. Creation of vector tiles will not be implemented in ArcMap.

Q: How do I do vector tiles updates ?

A: We recommend using the Replace layer workflow to perform updates. This can be scripted for regular automated updates including server-base3d automated scripts written in ArcGIS Pro an shared ArcGIS Enterprise.

ArcGIS Enterprise 10.8+ would support this Workflow directly.

Partial updates are in the roadmap for future work

Q: Vector tiles don’t draw correctly in my browser, is this a bug?

A: You’re likely experiencing a problem with WebGL support in your browser. Ensure you have the latest driver for your video card from the driver manufacturer.

Do not rely on Windows Update on Windows machines for video drivers.

(although Windows 10 is better with this –

consider also Windows 7 support in Jan.2020)

Q: Can I use any font for vector tiles?

A: From a technical standpoint any TrueType or OpenType font can be processed into the vector tile font format. However, font licenses vary widely and you should ensure you’re licensed for such use.

Q: Can Esri clients view non-Esri tiles conforming to the spec?

A: This is our goal. There are examples of this in the JavaScript API.

Example: Mapillary

Q: Does the print service support vector tiles?

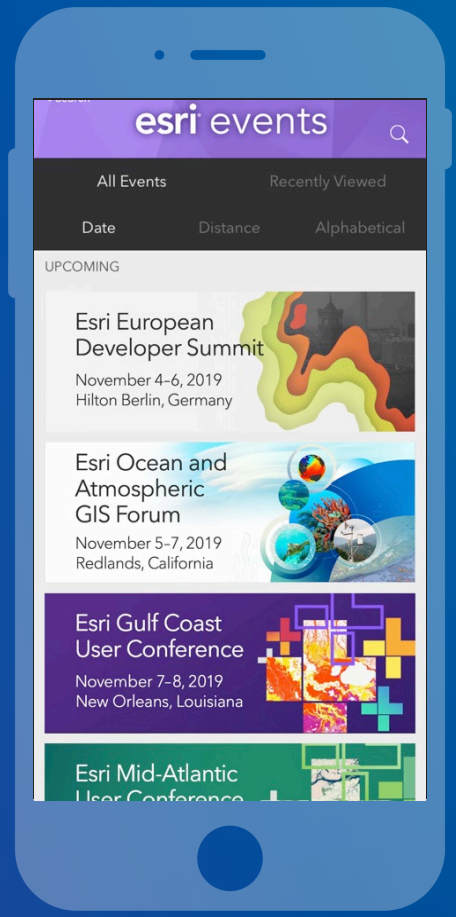
A: Vector tiles can be printed in ArcGIS Pro. The Print-Service in ArcGIS Enterprise 10.6+ supports vector tiles. You need ArcGIS API for Javascript 4.6 or 3.24 or layer to fully leverage this capability.

If the ArcGIS API for Javascript detects an older print service, it send a raster rendering of vector tiles through to the print service.

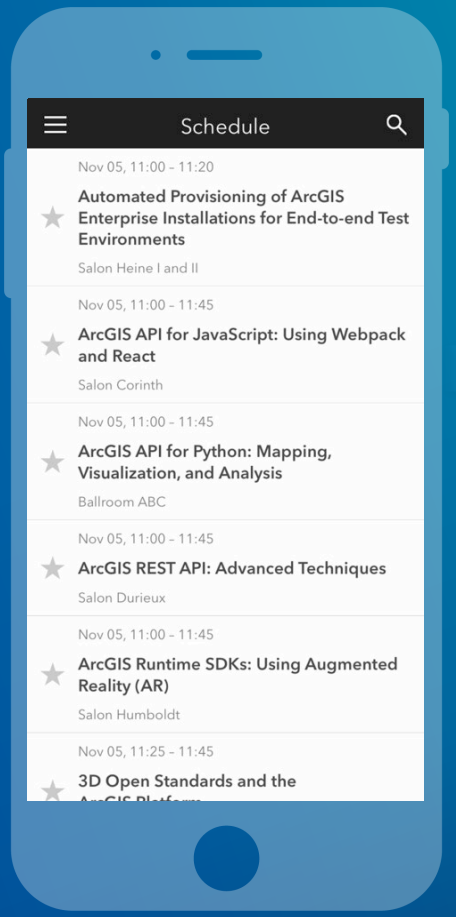
Questions ?

Please Take Our Survey on the App

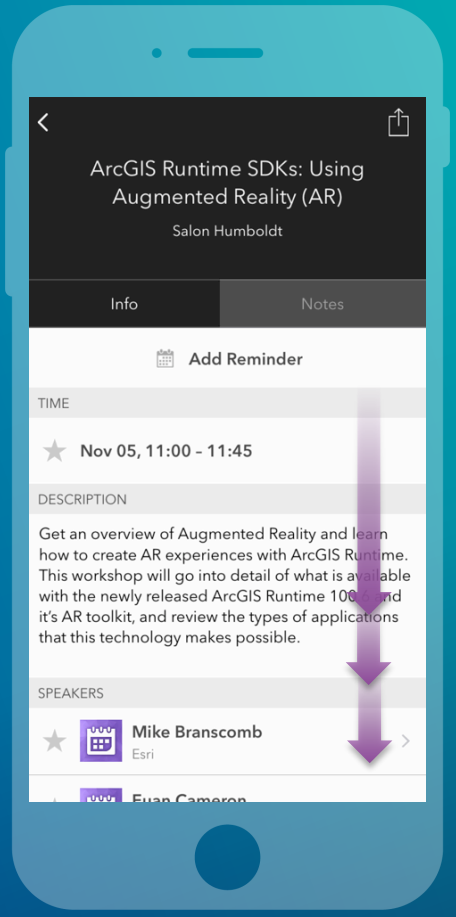
Download the Esri Events app and find your event



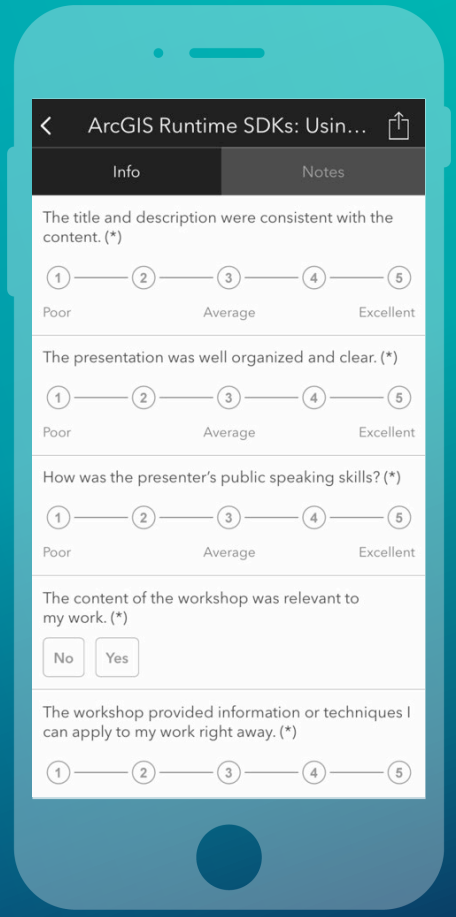
Select the session you attended



Scroll down to find the feedback section



Complete answers and select "Submit"



esri
THE
SCIENCE
OF
WHERE