Building Basemaps: MapCaches and VectorTiles

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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**

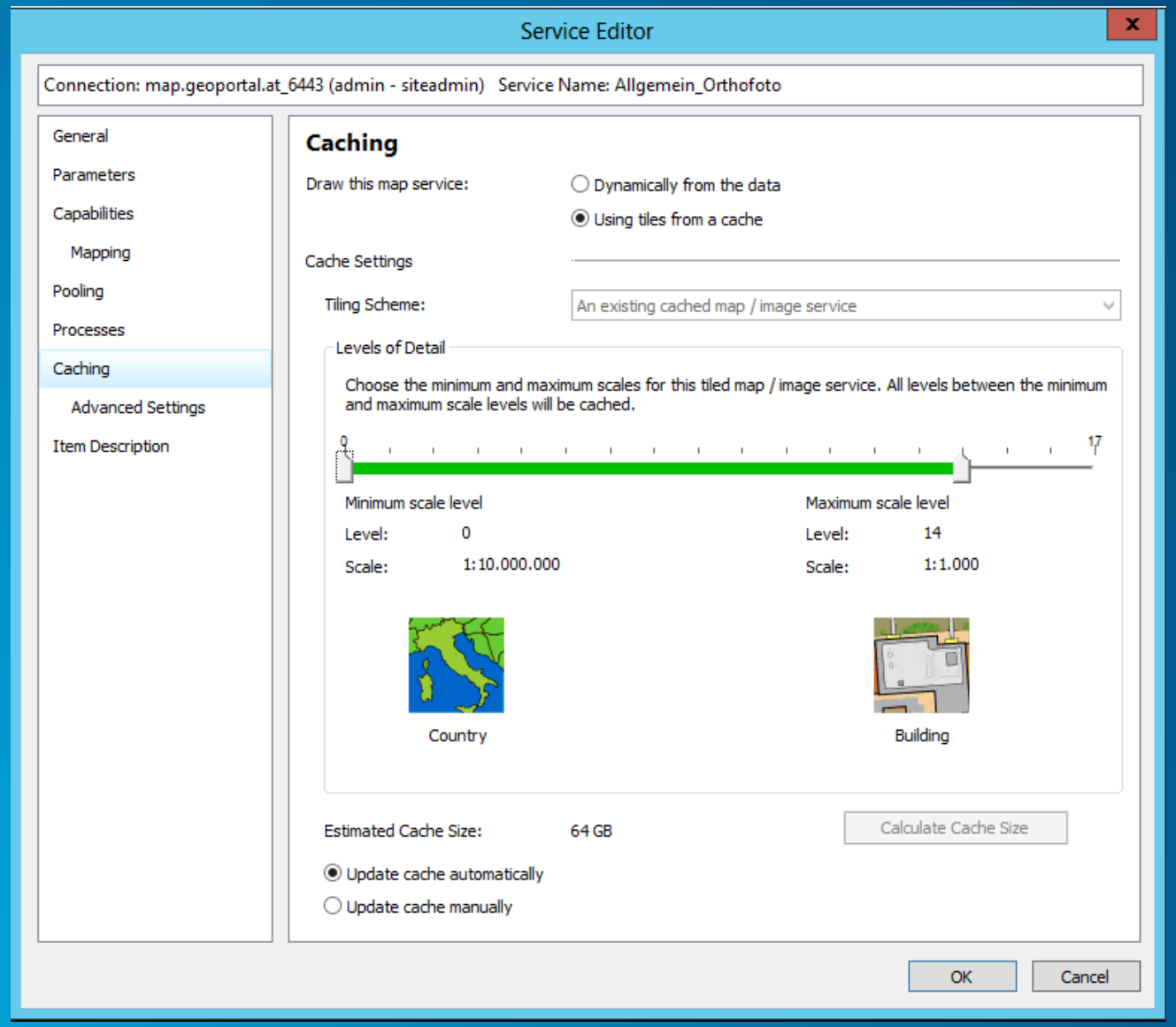
- **Vector based**
  - **TileService (Online/Portal)**
  - **VectorTilePackages**

Basemaps: Raster Tiles/Map Caches

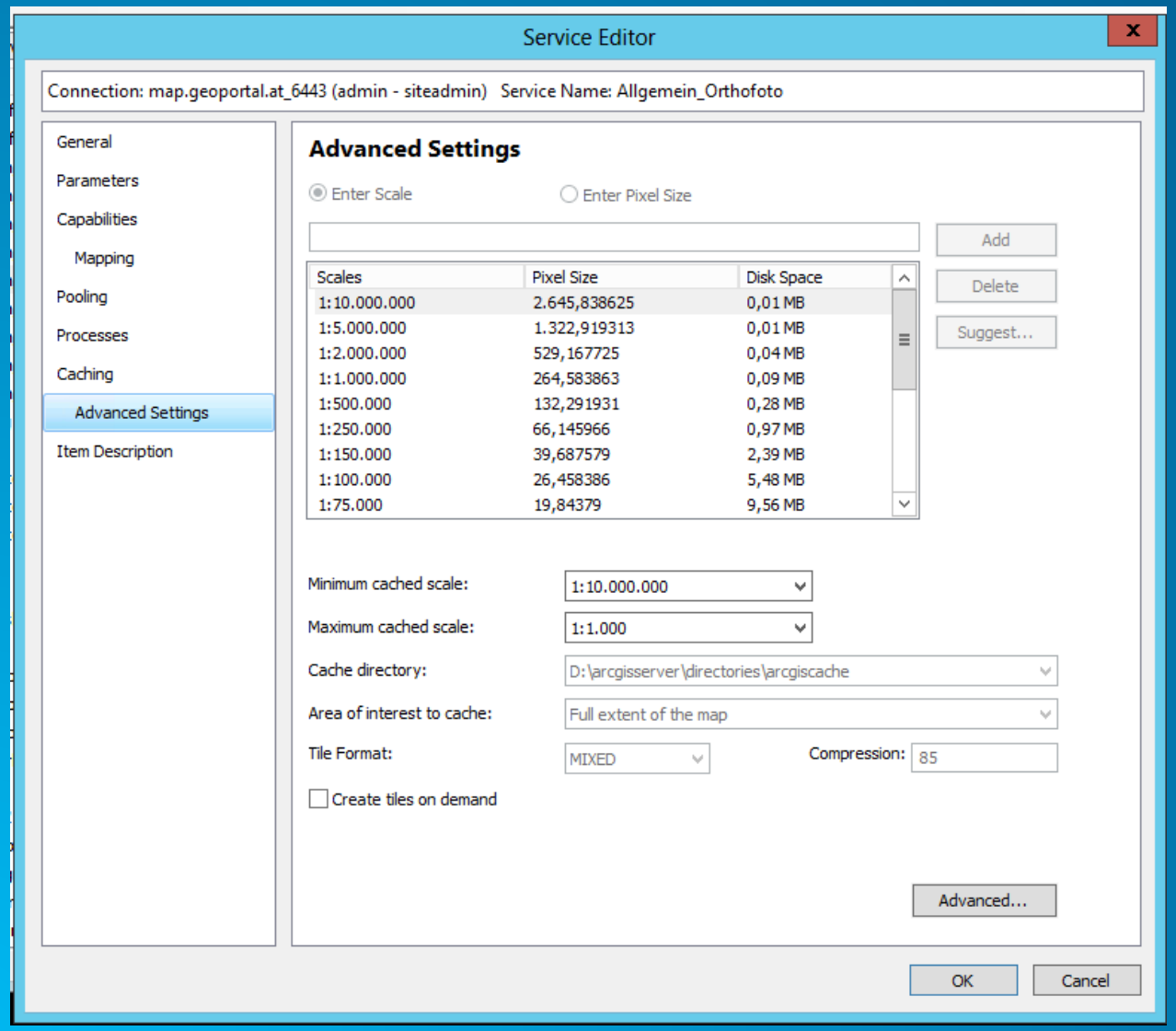
Raster Tile Basemaps

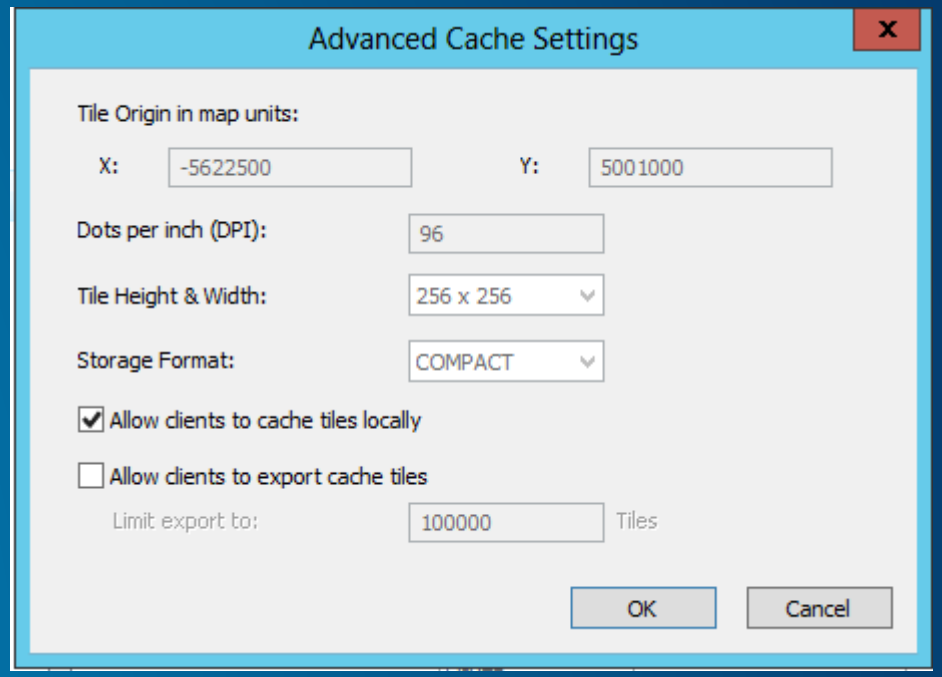
- Created for years with ArcGIS Desktop and ArcGIS Server
- Hosted Services on ArcGIS Online and Portal for ArcGIS
- Option to choose StorageFormat of Rastertiles
  - PNG
  - JPEG
  - MIXED
- And Storage on Disk
  - Exploded
  - Compact

Settings for Map Cache



Advanced Settings for Map Cache





Basemaps: Vector Tiles

Vector Tiles - Overview

- Why vector tiles?
- Vector tiles in ArcGIS
- ArcGIS vector tile basemaps
- Overview of creating vector tiles
- Authoring a map for vector tiles
- Consuming and styling vector tiles
- Common questions

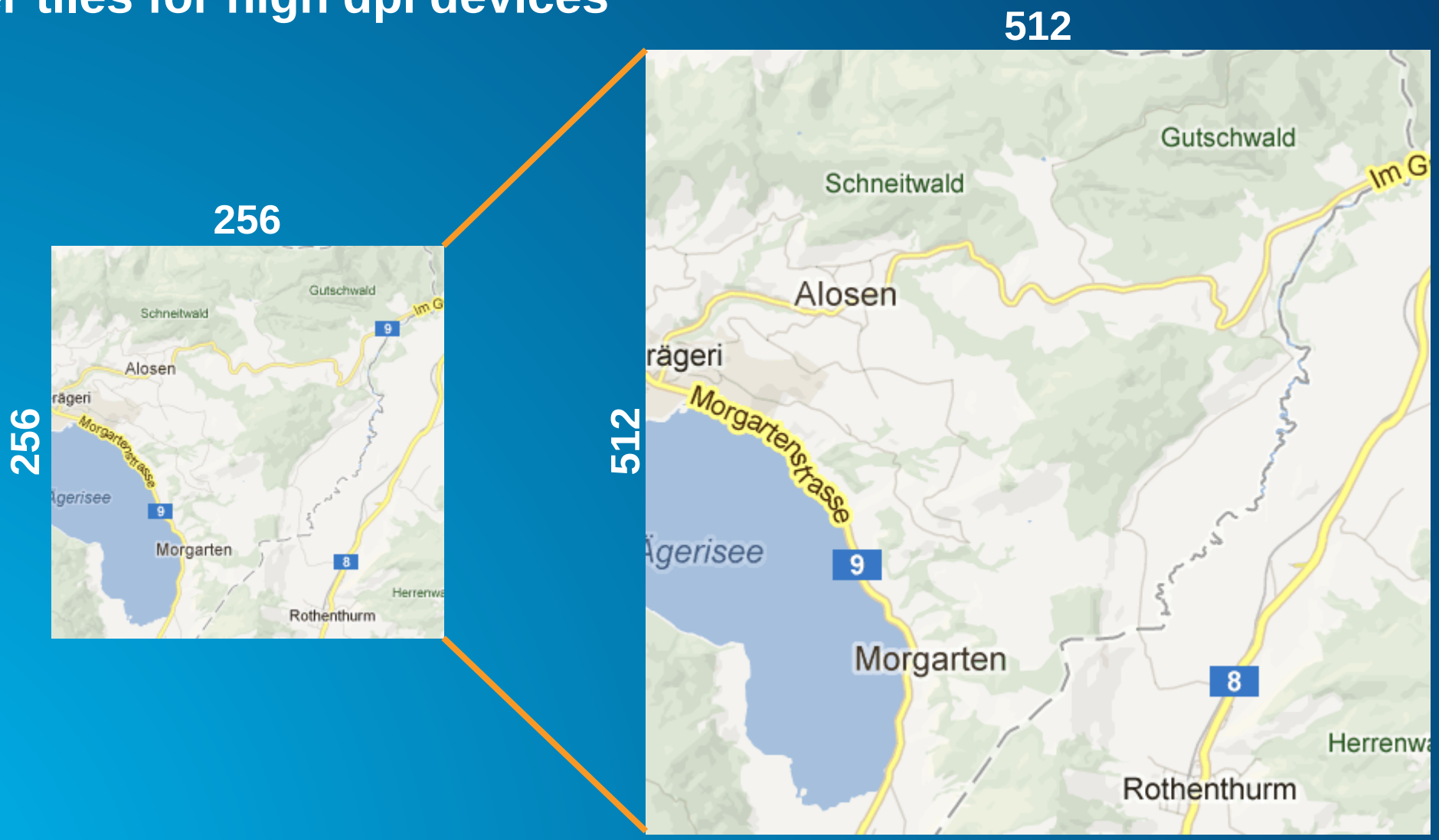
Web and mobile mapping over the last 10+ years

- 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

Raster tiles for high dpi devices



Example from Google Maps

Why vector tiles?

Raster is ~~Faster~~, but Vector is Corrector

– Joseph Berry

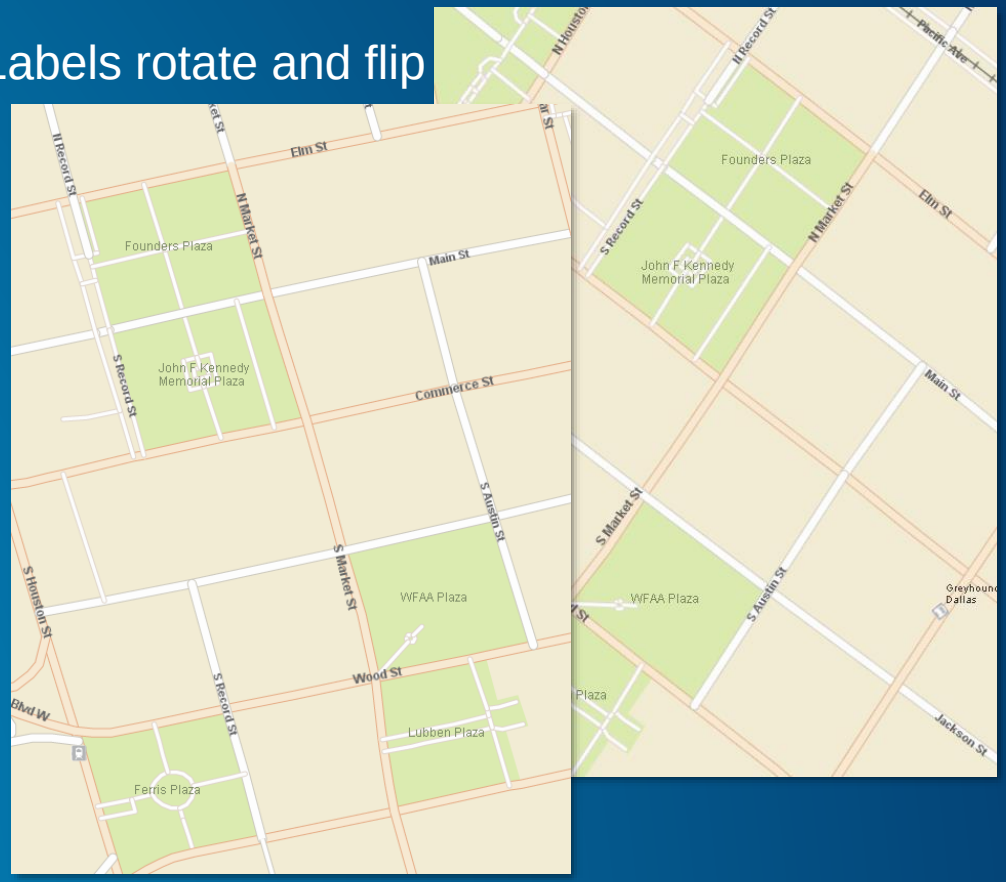
Why vector tiles?

- GPUs have changed the landscape
  - On your devices (OpenGL ES)
  - In your browser (WebGL)
  - On your desktop (DirectX, OpenGL)
  - Even in virtualized systems (vGPU)
- Vector data can remain vector, draw at native resolution
- Raster data still best served as raster in most circumstances

Advantages of vector tiles

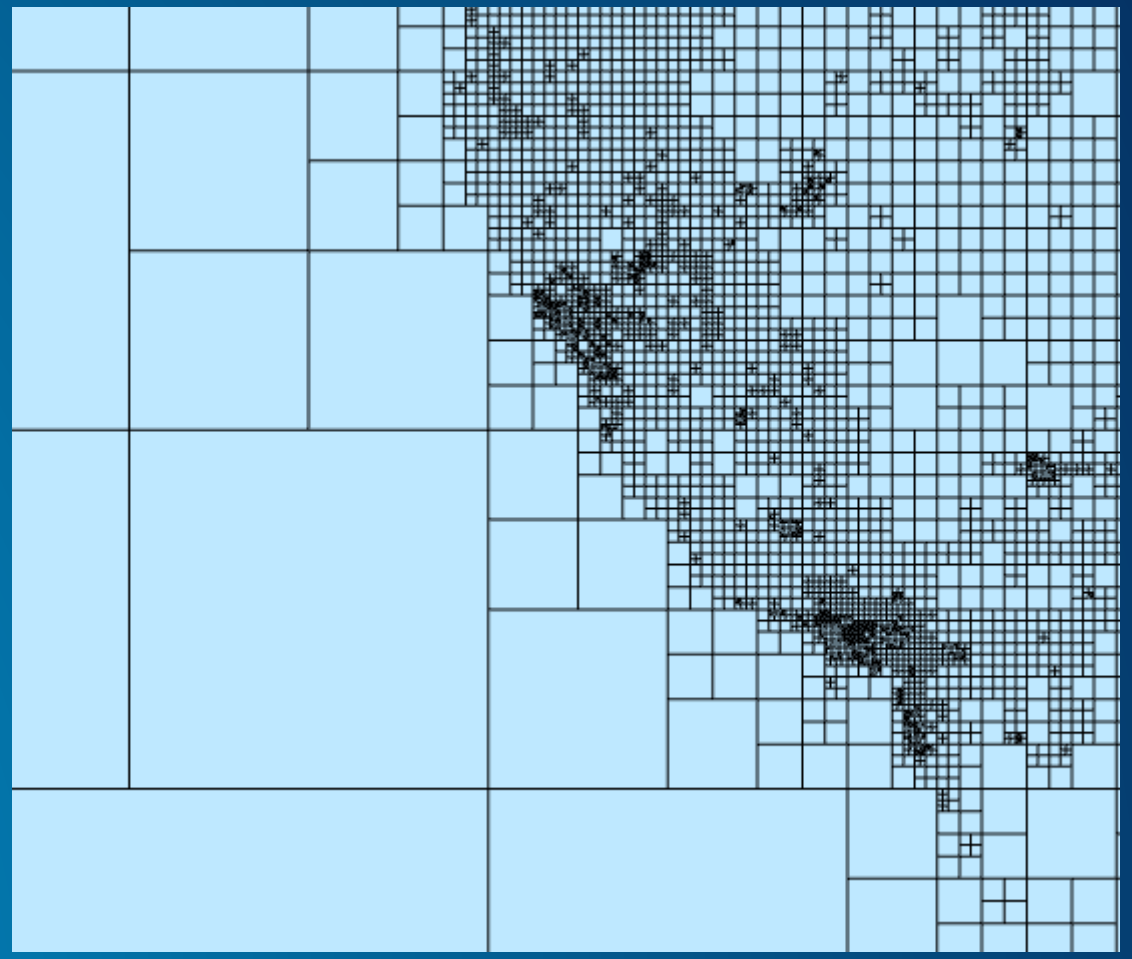
- **Display quality**
  - Best possible resolution for Retina displays
  - Small efficient format
- **Dynamic labeling**
  - Clearer, more readable text
  - On the fly labeling for heads up display
- **Map Styling**
  - Streets, Topo, Canvas from one tileset
  - Day and Night mode
  - Restyling

Labels rotate and flip



Vector tiles in ArcGIS

- Tiles produced in ArcGIS Pro 1.2+
  - Use the Mapbox vector tile spec
    - Which uses Google protocol buffers
  - Styling converted to Mapbox gl style spec
- Tiles produced in ArcGIS Pro 1.4+
  - Extended Spec with support of any CRS
- More aggressive overzoom
  - Builds on generalization work done in past ArcGIS releases
  - Support for traditional tiling also exists



Vector tile format

- Vector tiles are stored using protocol buffers
  - Compact binary format for transferring data
  - Data is organized into layers of geometry with key/value pairs of attributes

- A style file defines
  - The layer order
  - Definition query for each symbol layer
  - Symbol information for each symbol layer
  - Pro maps are converted to this model
    - Is a downgrade in some cases

Tile Creation Process

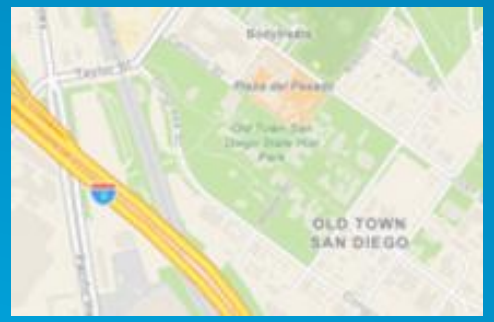
Esri Streetmap	Raster Tiles	Vector Tiles
Area	Earth	Earth
Volume	~ 20 TB	~13 GB
Duration	Weeks	~ 8 hours
Processing	Serverfarm with X Cores	Desktop machine

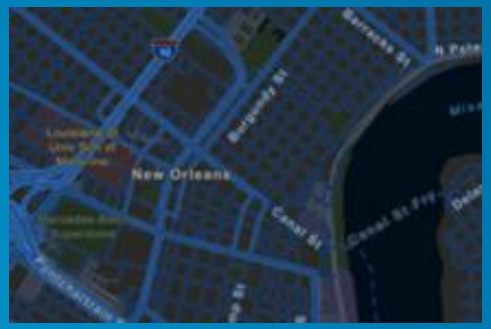
BasemapAT	Raster Tiles	Vector Tiles
Area	City of Vienna (~ 400 km²)	City of Vienna (~ 400 km²)
Volume	325 MB	84 MB (*)
Duration	12 minutes	3 minutes (*)
Processing on same hardware	6 Cores	1 Core

(*) 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

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Introducing Esri Vector Basemaps (Beta)

by Deane Kensok on November 18, 2015

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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

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Understanding Esri Vector Basemap File Structure

by ArcGIS Content Team on December 2, 2015

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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 Vector Basemap Boundaries and Labels. Each

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How to Customize Esri Vector Basemaps

by Deane Kensok on November 19, 2015

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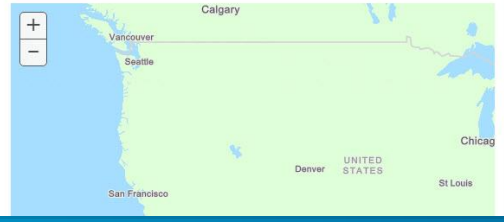
As described in this earlier post, Esri has introduced a new set of vector basemaps (now in beta release). These vector basemaps offer several benefits (e.g. fast to download, look great on high-res displays, smaller and easier to update, etc), but perhaps the greatest benefit is that users can customize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



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Customize Esri Vector Basemap Boundaries and Labels

by Deane Kensok on November 23, 2015

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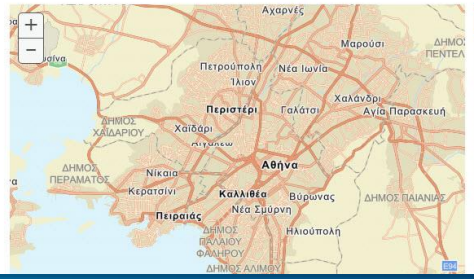
In an earlier post, we described how you can customize the Esri vector basemaps (now in beta release). In that post, we provided an example of changing the colors for an existing map style to create a different look for the map, which will probably be the most common way in which the vector basemaps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



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ArcGIS vector tiles – consumption

- Tile consumption
  - ArcGIS JavaScript 3.15-3.17 and 4.0/4.1 APIs
    - Uses the mapbox-gl-js library
    - Need a WebGL capable browser (e.g. IE11+, Chrome, Firefox)
  - ArcGIS JavaScript 3.18+ and 4.2+
    - Own implemented library to support other Tiling Schemas and Coordinate Systems
    - WebGL capable browser needed (e.g. IE11+, Chrome, Firefox)
  - ArcGIS Runtime 100.0+
    - Ground up implementation - OpenGL ES2 and DirectX (depends on platform)
  - ArcGIS Pro 1.3+
    - Will share Runtime implementation
  - ArcGIS Pro 2.0+
    - Printing/Export of Map with vector tiles implemented

Using vector tiles in your applications

- Multiple ways to use vector tiles:
  - A) Use Esri provided vector tiles / styles
  - B) Style Esri vector tiles for your own use
    - Change colors
    - Drop layers
    - Match the needs of your application
  - C) Create your own vector tiles from your own data

Authoring vector tiles

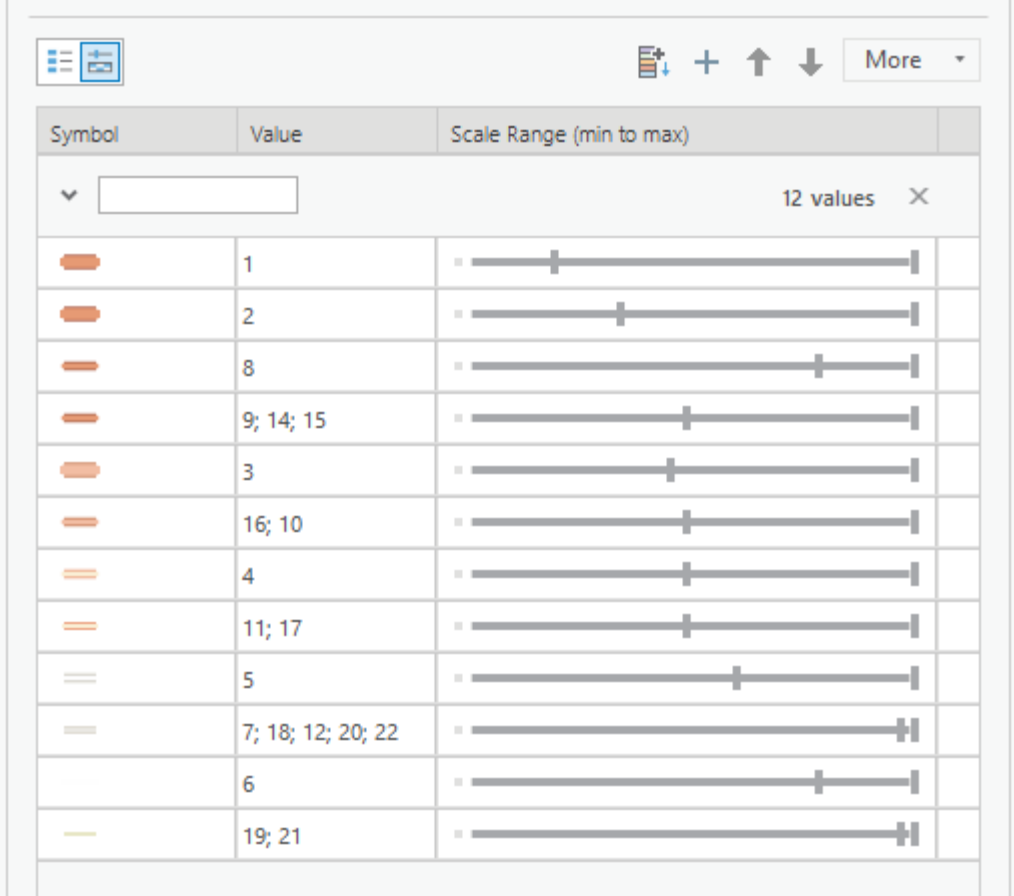
Authoring maps

- 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

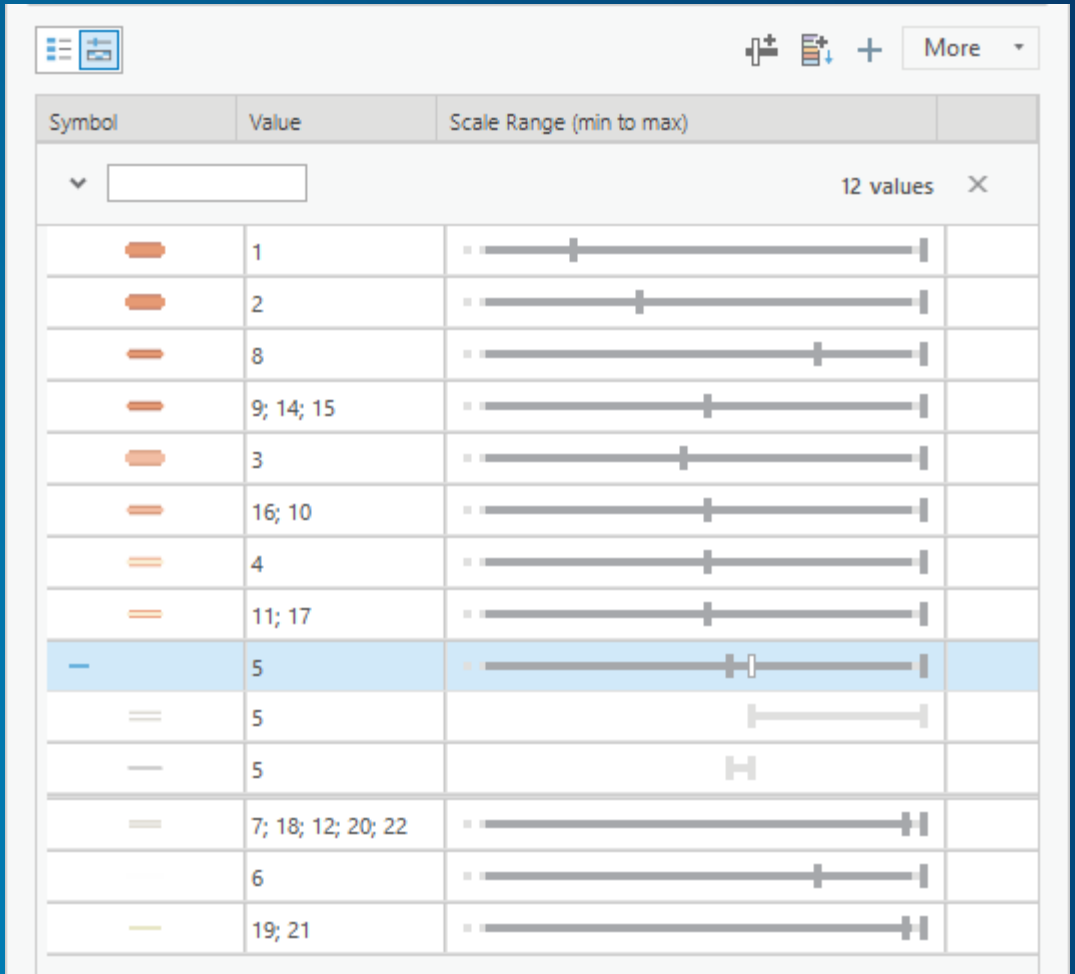
- Allows a multiscale map to be authored without duplicating content



Alternate symbols for symbology

- Symbol classes can switch symbols at scales
  - Unique value

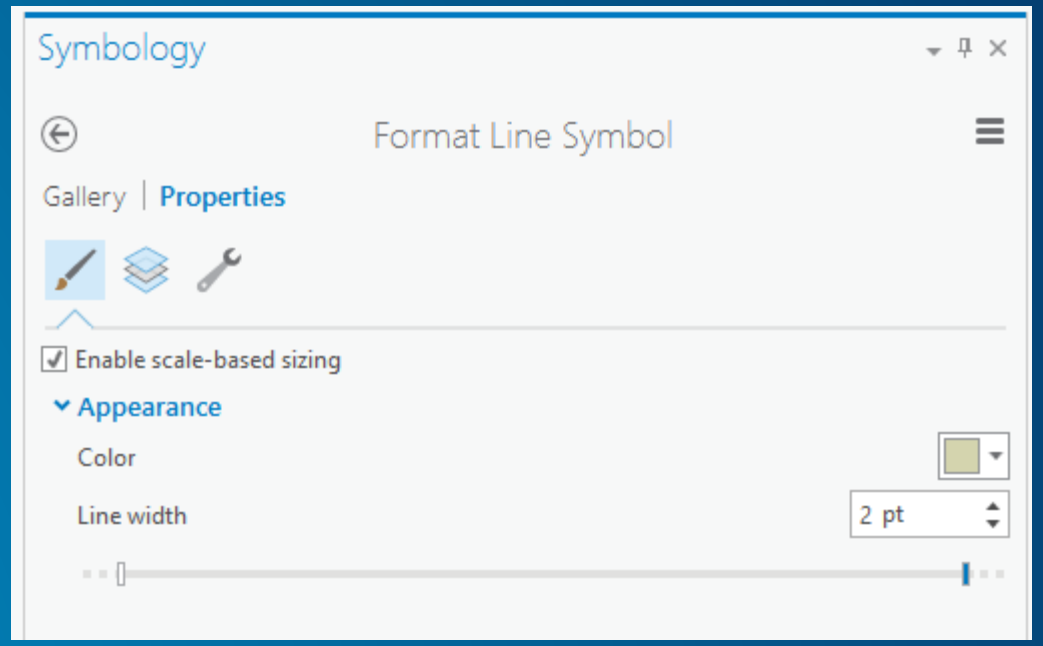
- Allows you to change the appearance of a symbol without duplicating layer



Scale based symbol sizing

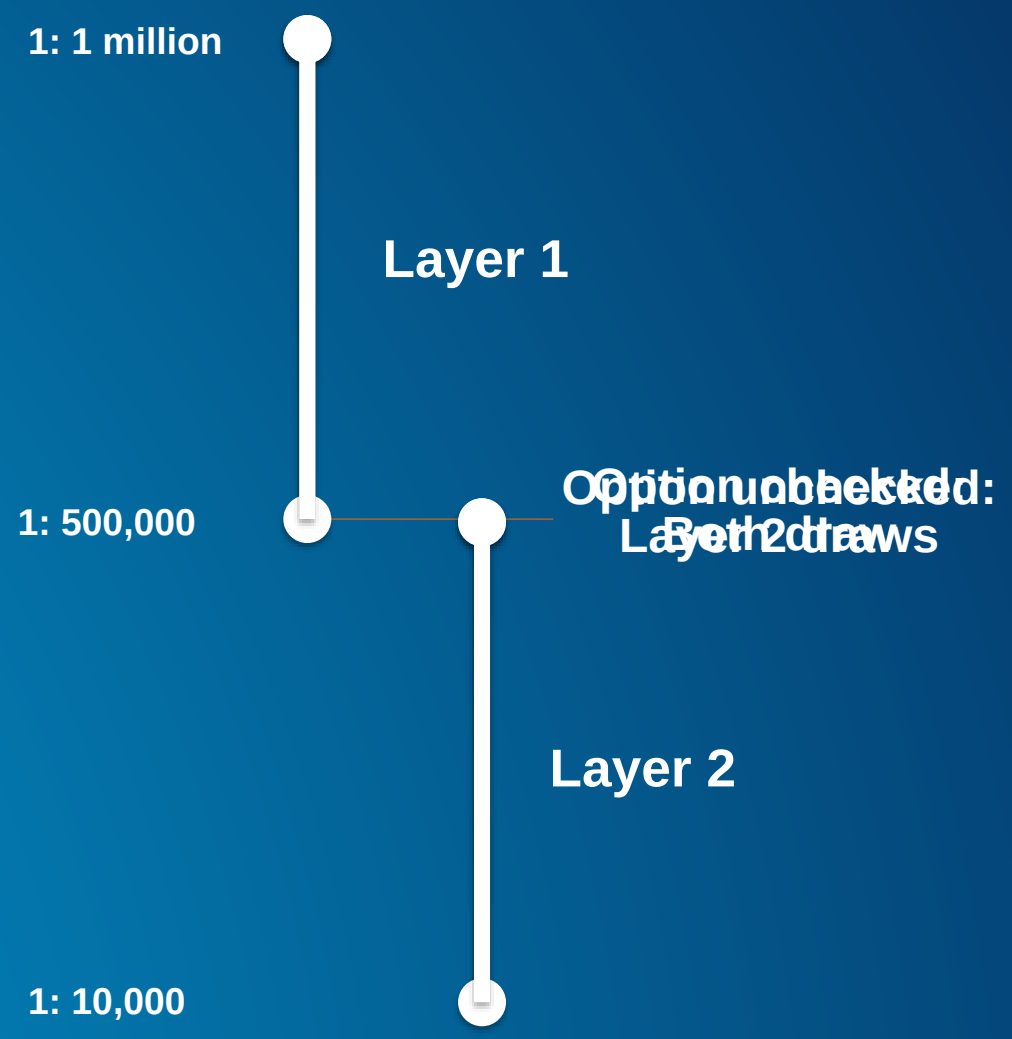
- Each symbol can have scale based sizing configured
  - Single symbol
  - Unique value
  - Class breaks

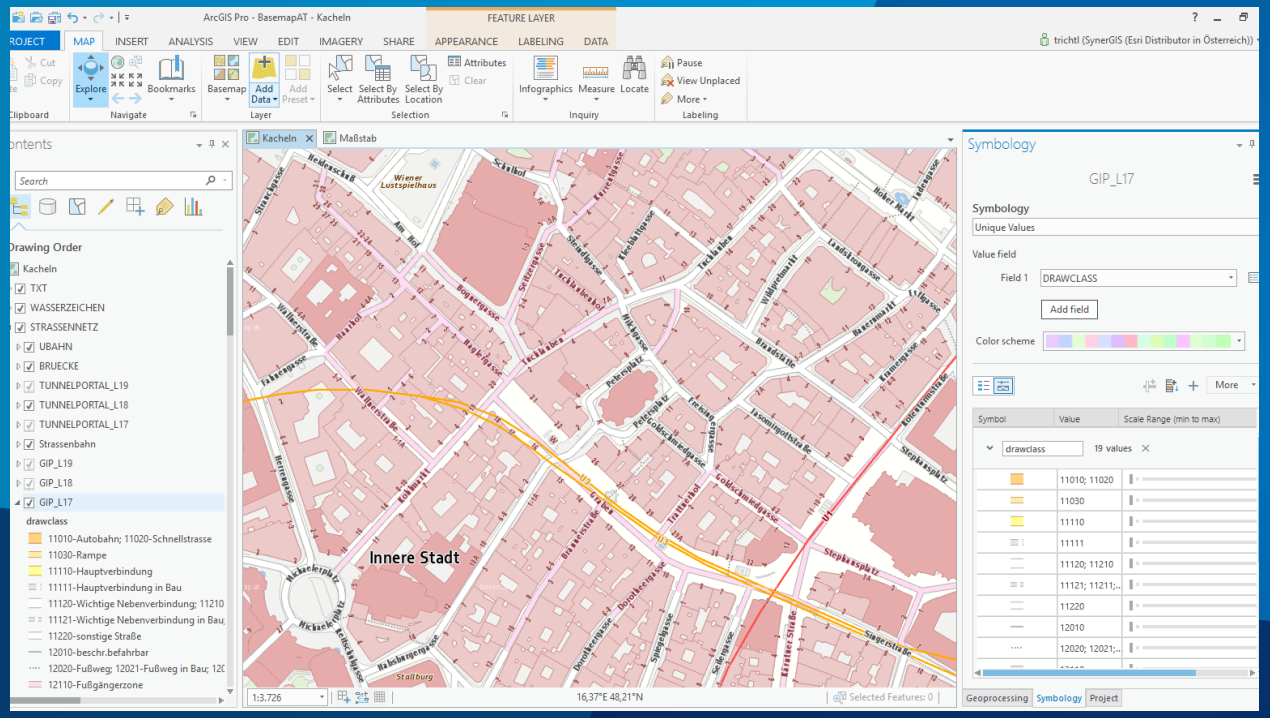
- Allows for small changes to symbol size across scales



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





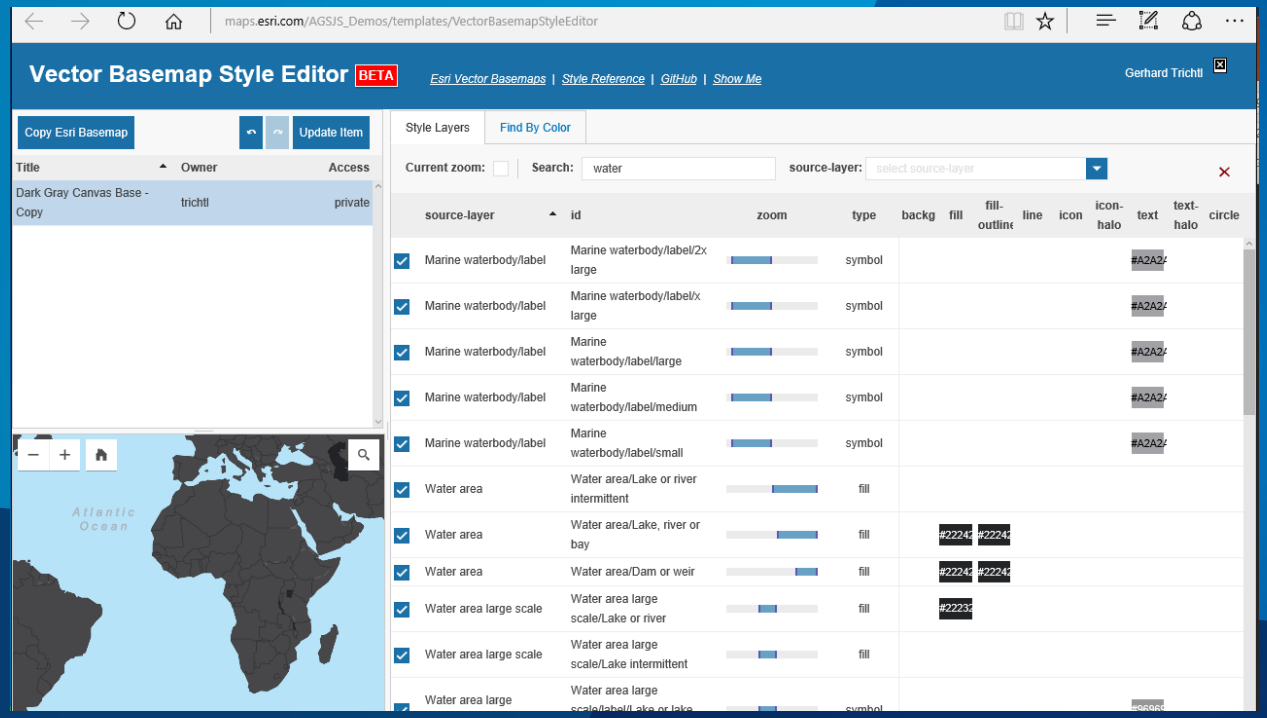
Authoring and creating vector tiles in ArcGIS Pro

Demo

Using and styling vector tiles

Styling vector tiles

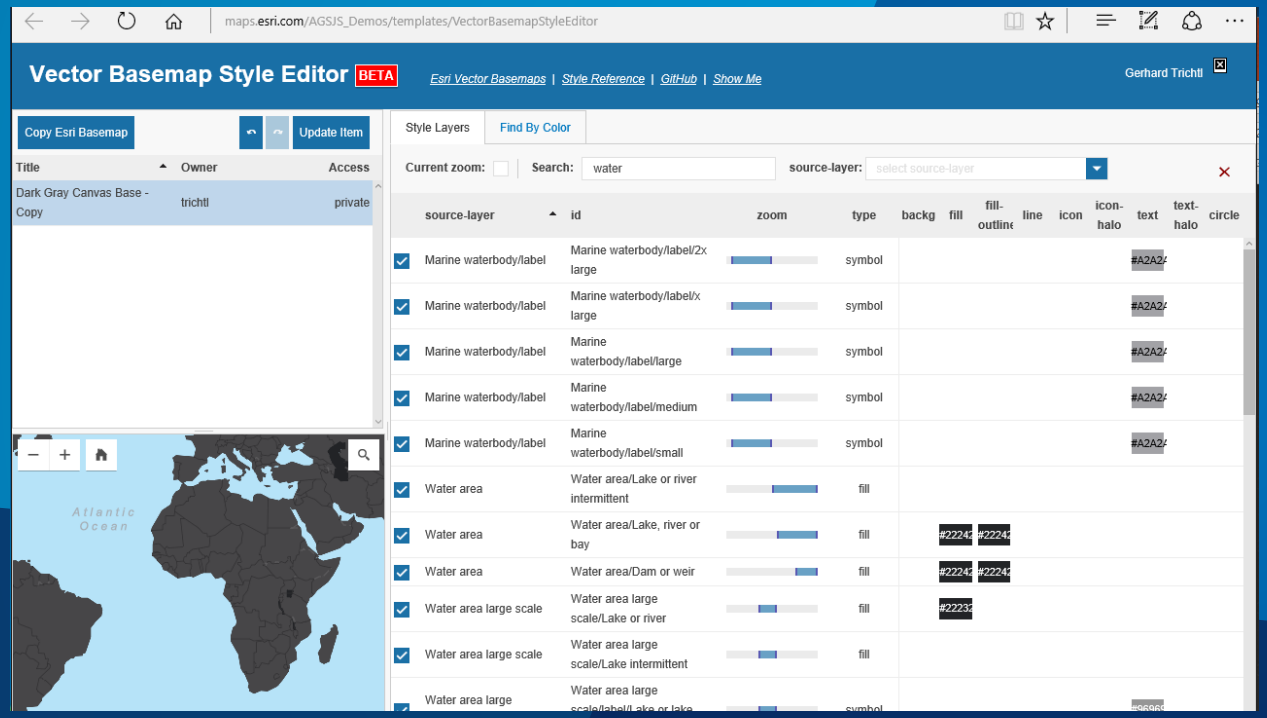
- **Simple Style Copy**
  - **Save tile layer to your Portal or Online account**
- **Hand editing JSON**
  - **Update map item**
- **Two additional sample Vector Styling Apps simplify this:**
  - **Vector Style JSON Editor - GitHub**
  - **Vector Basemap Style Editor - GitHub**



Styling vector tiles

Demo

[Vector Basemap Style Editor]



Accesing VectorTile Styles

Demo

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: Not at this time, we have this on the roadmap for our client implementations of vector tiles (JavaScript API, ArcGIS Runtime, ArcGIS Pro)

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

A: Only Web Mercator (Auxiliary Sphere) 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: Can I project vector tiles on the fly?

A: ArcGIS Pro supports this with a much improved implementation at version 1.4. We do not expect to add this to other clients.

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: Can I do server side vector tile creation?

A: Not at this time, we have this on our roadmap for Portal / ArcGIS Online including support for incremental updates.

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.

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 does not support vector tiles at this time. We have development plans to support vector tiles in the print service at a future release. Newer releases of the JavaScript API send a raster rendering of vector tiles through to the print service until print service support is added.

Questions?

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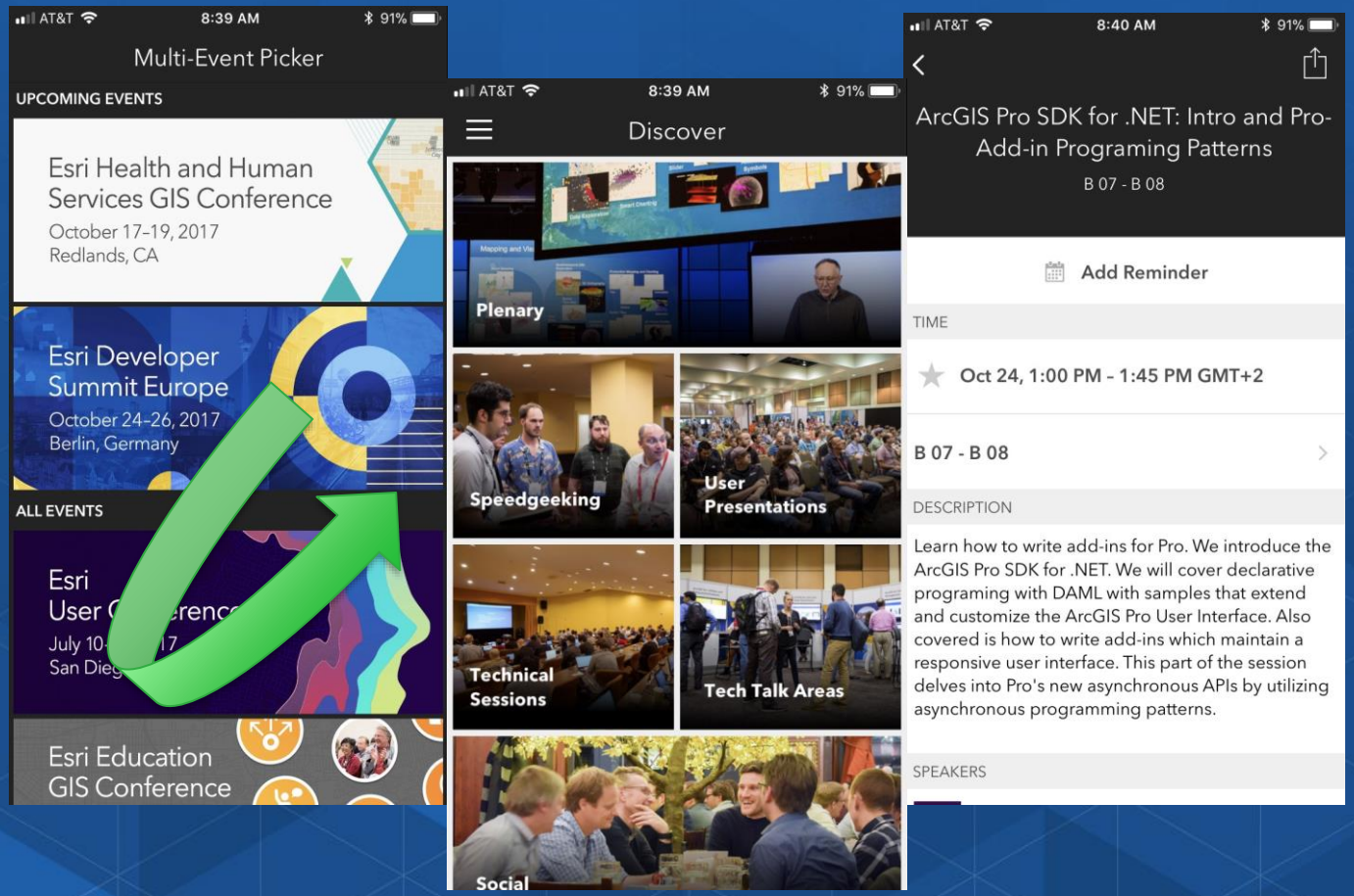
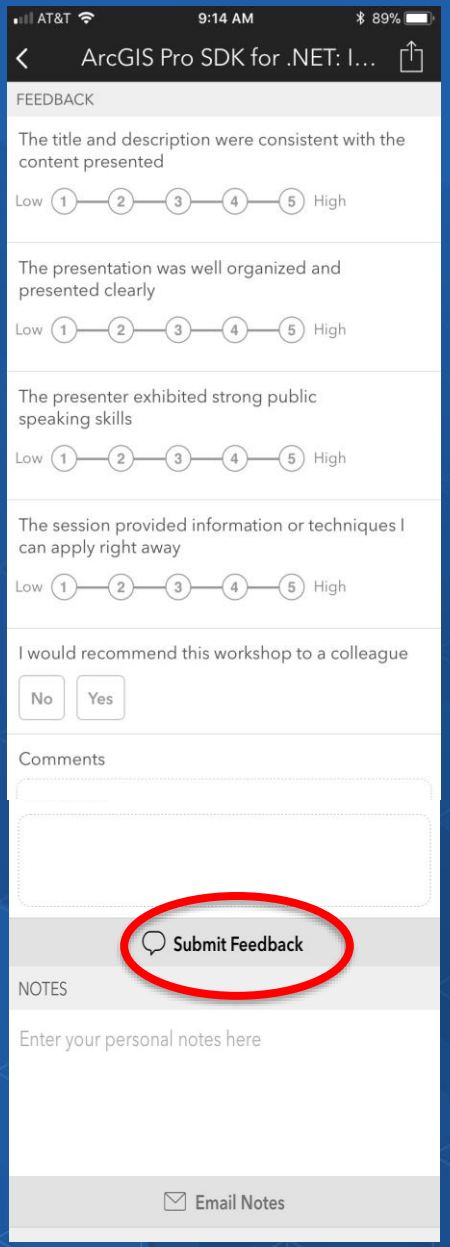
Download the Esri Events app and go to DevSummit

Select the session you attended

Scroll down to the "Feedback" section

Complete Answers, add a Comment, and Select "Submit"





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