ArcGIS Pro: Creating Vector Tiles

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GIS INSPIRING WHAT'S NEXT

Overview

- Why vector tiles?
- Vector tiles in ArcGIS
- ArcGIS vector tile basemaps
- Consuming and styling vector tiles
- Overview of creating vector tiles
- Authoring a map for vector tiles
- What’s new?
- 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

- We're now moving to vector tiles

- Paradigm is changing due to technology
  - High DPI screens
  - Device capabilities

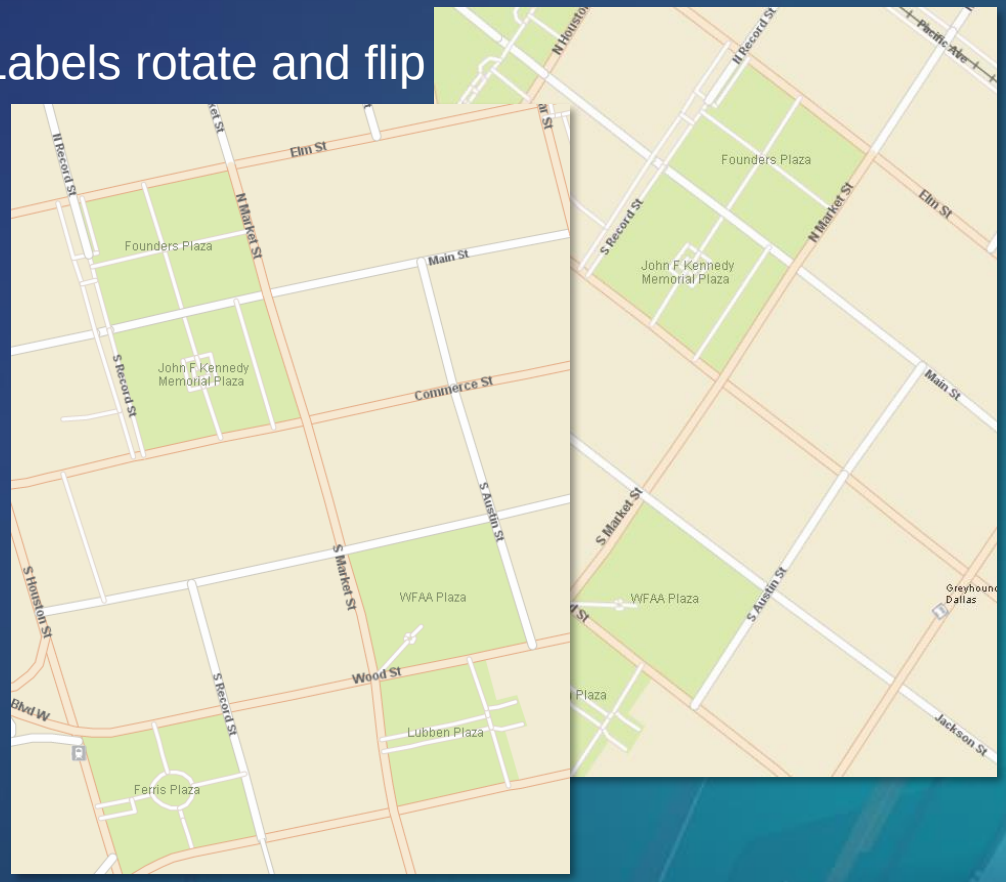
Why vector tiles?

- GPUs have changed the landscape
  - On your devices (OpenGL ES2+, Metal)
  - In your browser (WebGL+)
  - On your desktop (DirectX, OpenGL, Metal)
  - 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

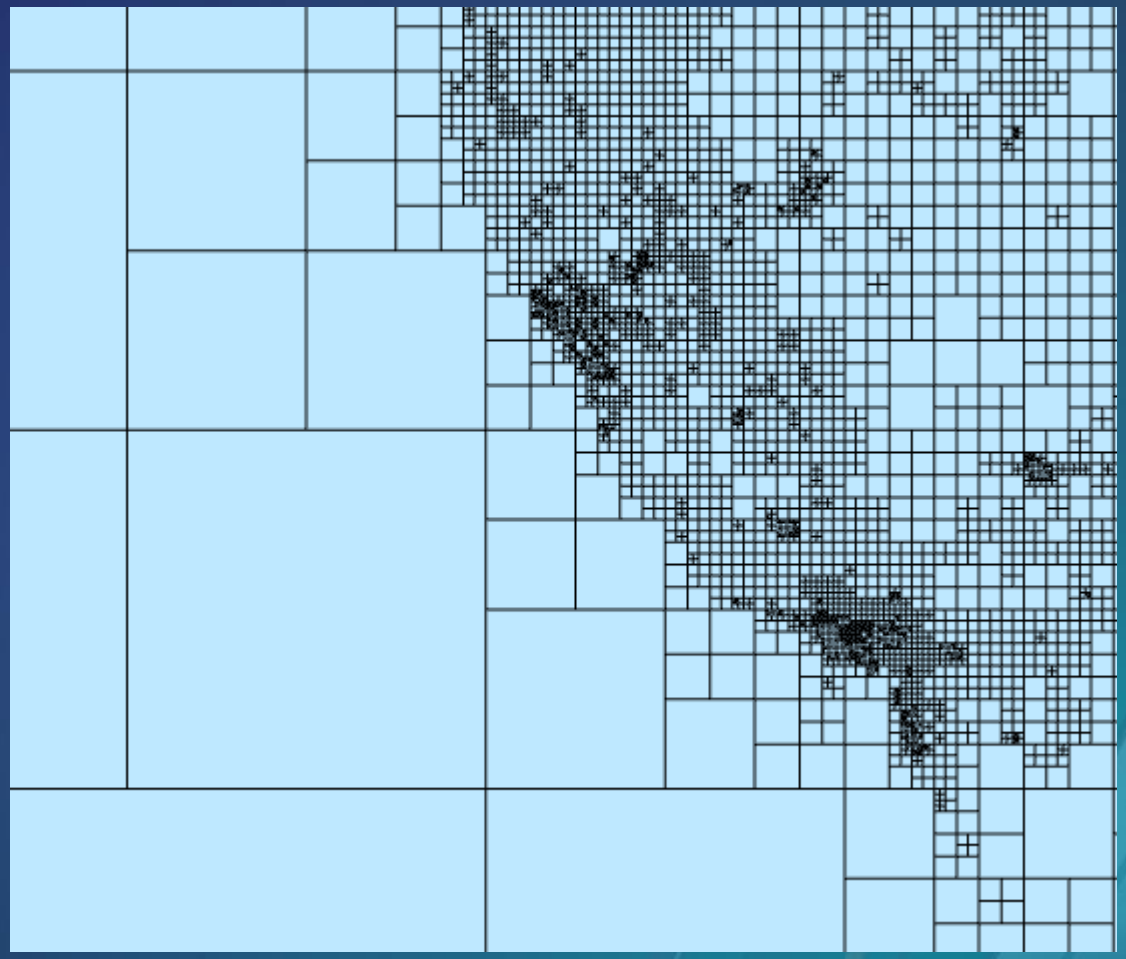
- **Display quality**
  - Best possible resolution for Retina displays
  - Small efficient format
- **Dynamic labeling**
  - Clearer, more readable text
  - On the fly labeling for heads up display
- **Map Styling**
  - Streets, Topo, Canvas from one set of tiles
  - Day and Night mode
  - Restyling

Labels rotate and flip



Vector tiles in ArcGIS

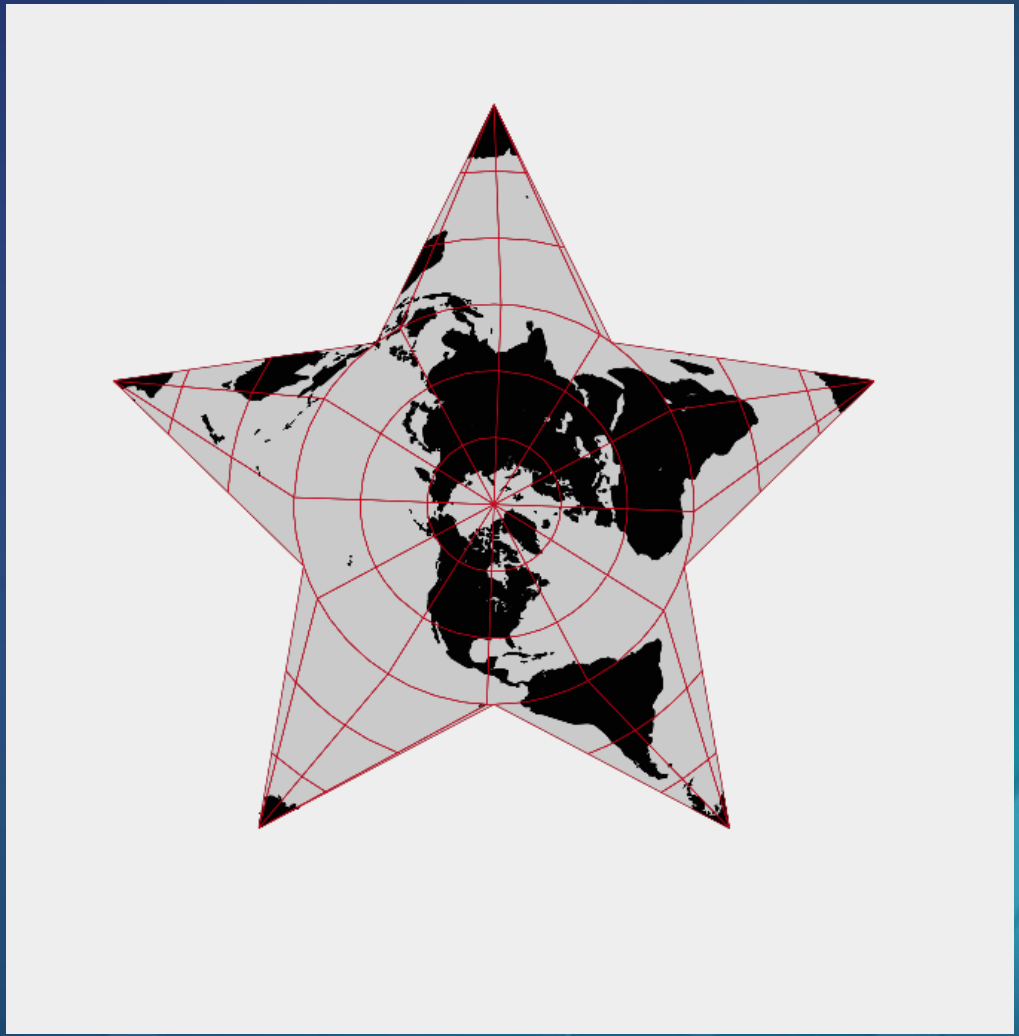
- Tiles produced in ArcGIS Pro
  - Use the Mapbox vector tile spec
    - Which uses Google protocol buffers
  - Styling converted to Mapbox gl style spec
- More aggressive overzoom
  - Builds on generalization work done in past ArcGIS releases
  - Support for traditional tiling also exists
    - For tile use in other APIs



Vector tiles in ArcGIS (con’t)

- Vector tiles can be produced in any coordinate system
  - All Esri clients support drawing tiles from any coordinate system

- Recent work
  - More support for data driven workflows
    - Visual variables and overrides
    - ArcGIS Pro 2.1 and JavaScript (4.6/3.23) and Runtime 100.2 releases
  - Support for vector tiles in the print service (10.6)



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
  - Filter for each symbol layer
  - Symbol information for each symbol layer
  - Pro maps are converted to this model
    - *Is a downgrade in some cases*

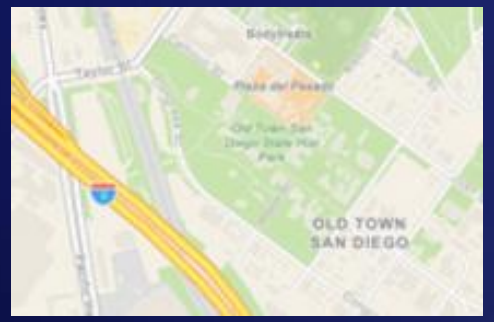
Tile creation process: Esri basemaps

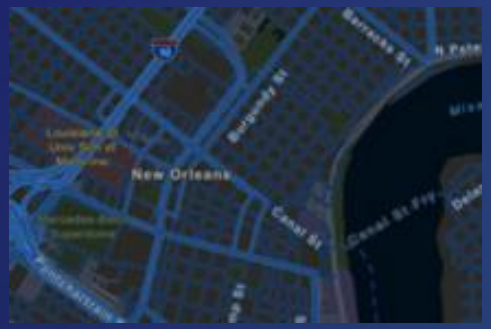
- Entire world
  - ~ 8hrs on a desktop machine
  - Tiles ~ 13 GB
  - Multiple styles can use the same tiles

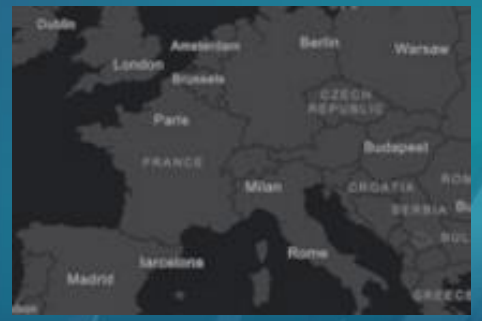
- Compared to raster for the entire world
  - ~ many weeks on a server cluster per map style
  - Tiles ~ 20 TB

Vector tile basemaps

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



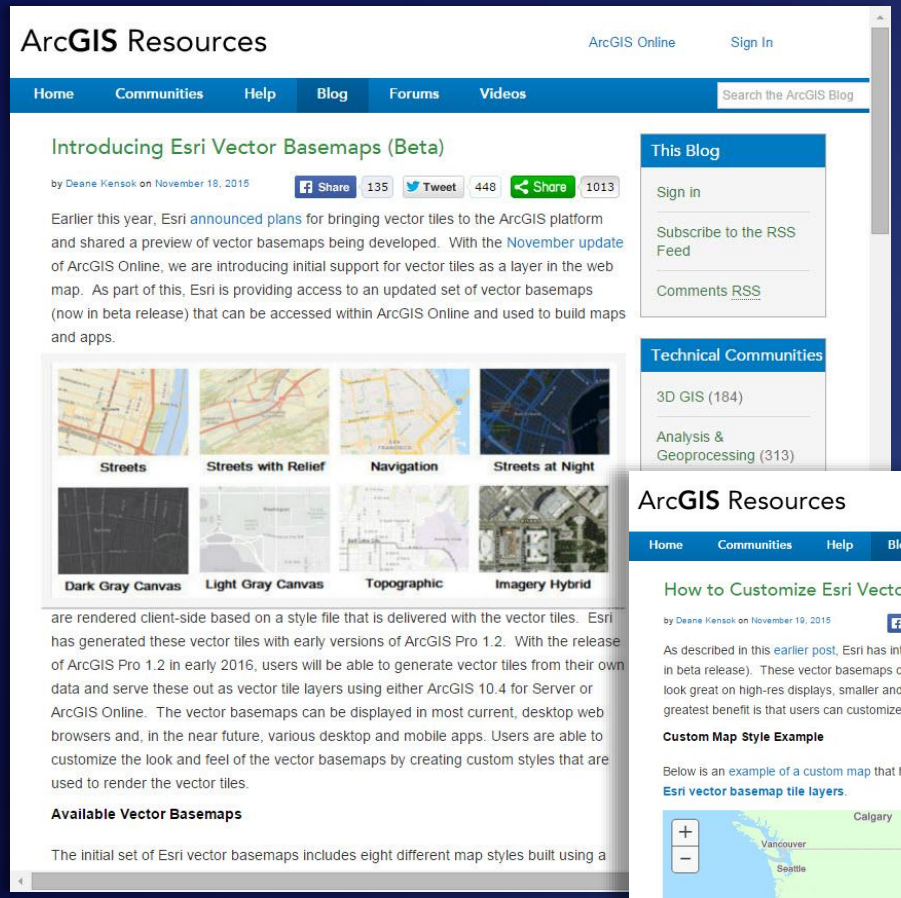


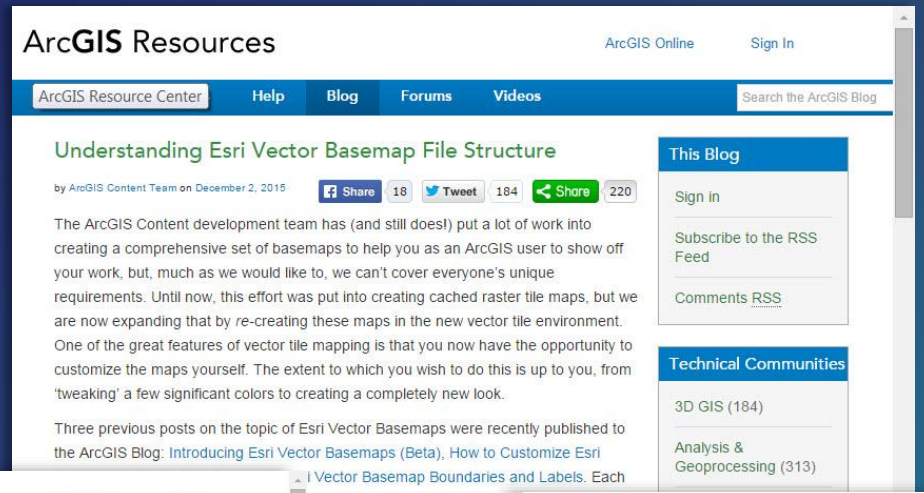


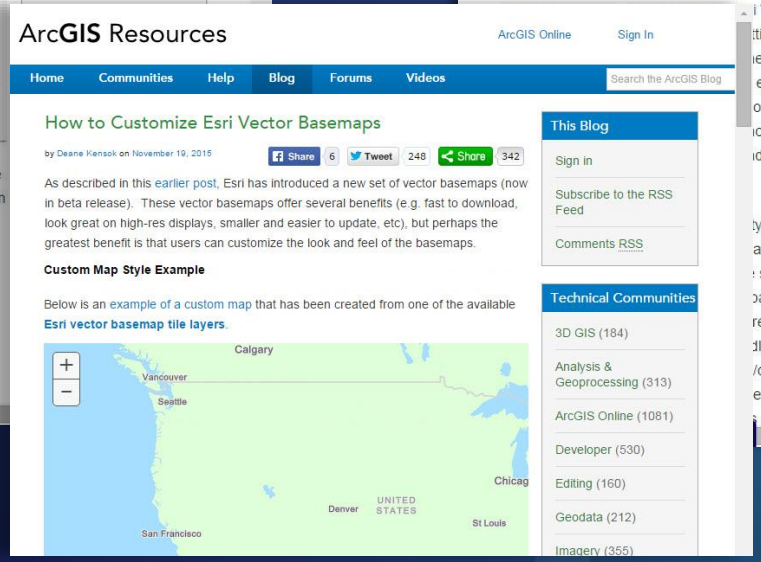
Case Study

ArcGIS Basemaps

Vector basemap blogs







ArcGIS vector tiles – consumption

- Tile consumption
  - ArcGIS JavaScript 3.15+ and 4.0 APIs
    - Need a WebGL capable browser
    - 3.18+ use a new implementation
  - ArcGIS Runtime 100.0+
    - OpenGL ES2 and DirectX (depends on platform)
  - ArcGIS Pro 1.3+
    - Shares ArcGIS Runtime implementation

Using and styling vector tiles

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

Styling vector tiles

- Simple Style Copy
  - Save tile layer to Enterprise or Online account
- ArcGIS Vector Tile Style Editor now in beta
- Two additional sample Vector Styling Apps simplify this:
  - Vector Style JSON Editor - GitHub
  - Vector Basemap Style Editor – GitHub
  - Hand editing JSON and uploading is also an option

Demo

Styling vector tiles

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Creating vector tiles

Creating vector tiles

- Tile creation in ArcGIS Pro
- Publish tile layers in ArcGIS Online and ArcGIS Enterprise 10.4+

- Sharing experience
  - Share as Web Layer experience supports vector tiles
  - Create, upload, and publish in one step
  - Also scriptable with Geoprocessing tools

- Accessory tools:
  - Share Package updated to support vector tiles
  - Extract Package updated to support vector tiles

ArcGIS vector tiles service

```
http://<catalog-url>/<folder>/<serviceName>/VectorTileServer
|--root.json
|--tilemap/
|--tile
|--resources
    |--fonts/
    |--styles/
    |--sprites/
    |--info/
```

Service example

Authoring vector tiles

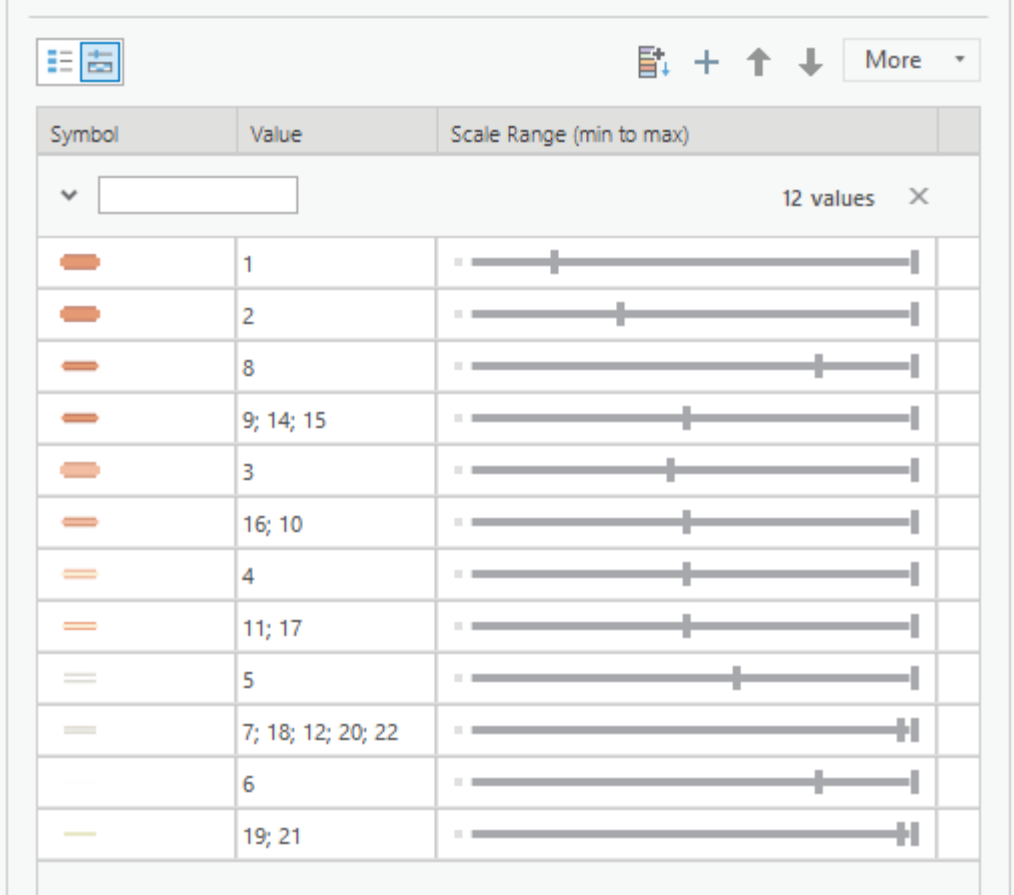
Authoring maps

- Only feature layers with simple, unique value, graduated, class breaks, and unclassed 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
  - Display filtering based on attributes
  - Improvement to scale logic

Scale dependent symbology

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

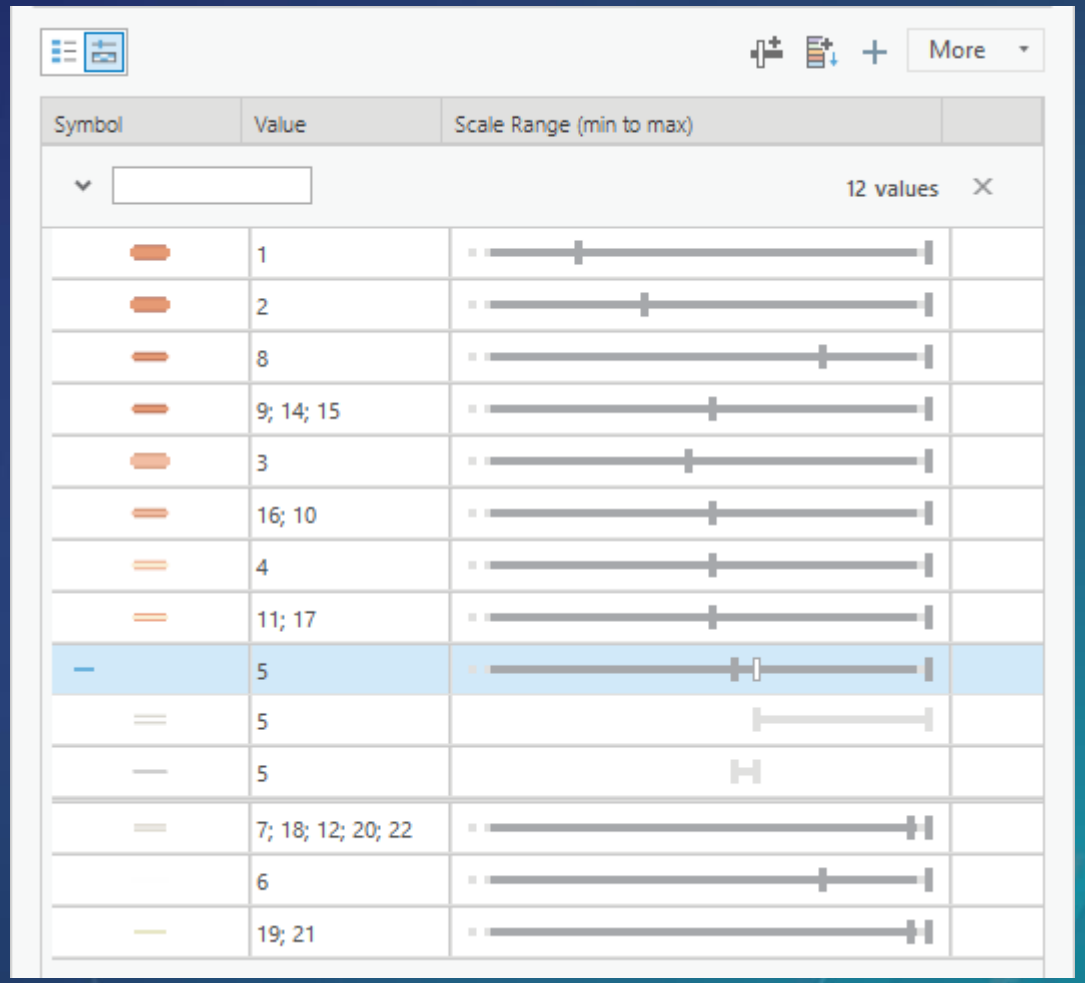
- Allows a multiscale map to be authored without duplicating content



Alternate symbols for symbology

- Symbol classes can switch symbols at scales
  - Unique value

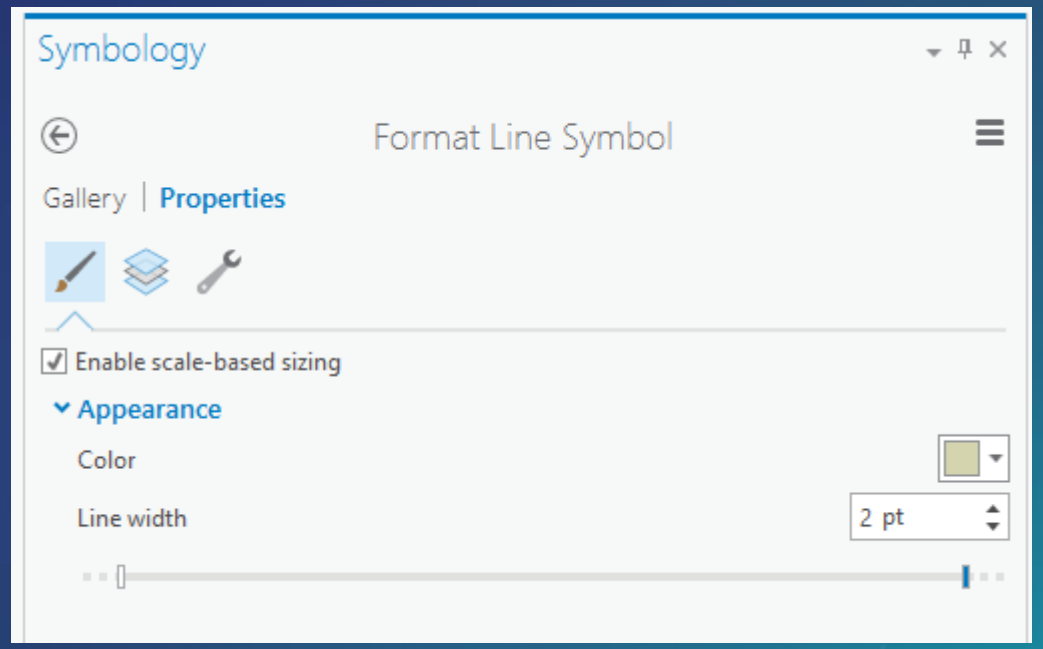
- Allows you to change the appearance of a symbol without duplicating layer



Scale based symbol sizing

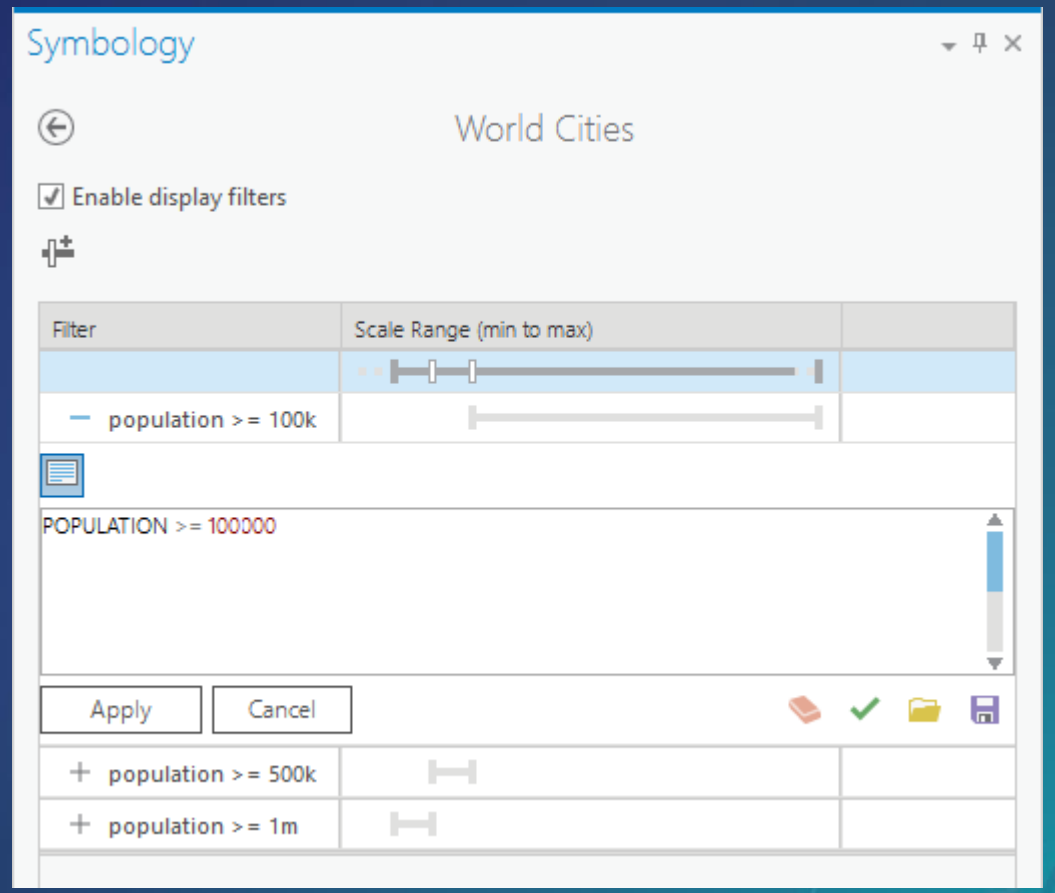
- Each symbol can have scale based sizing configured
  - Single symbol
  - Unique value
  - Class breaks

- Allows for small changes to symbol size across scales



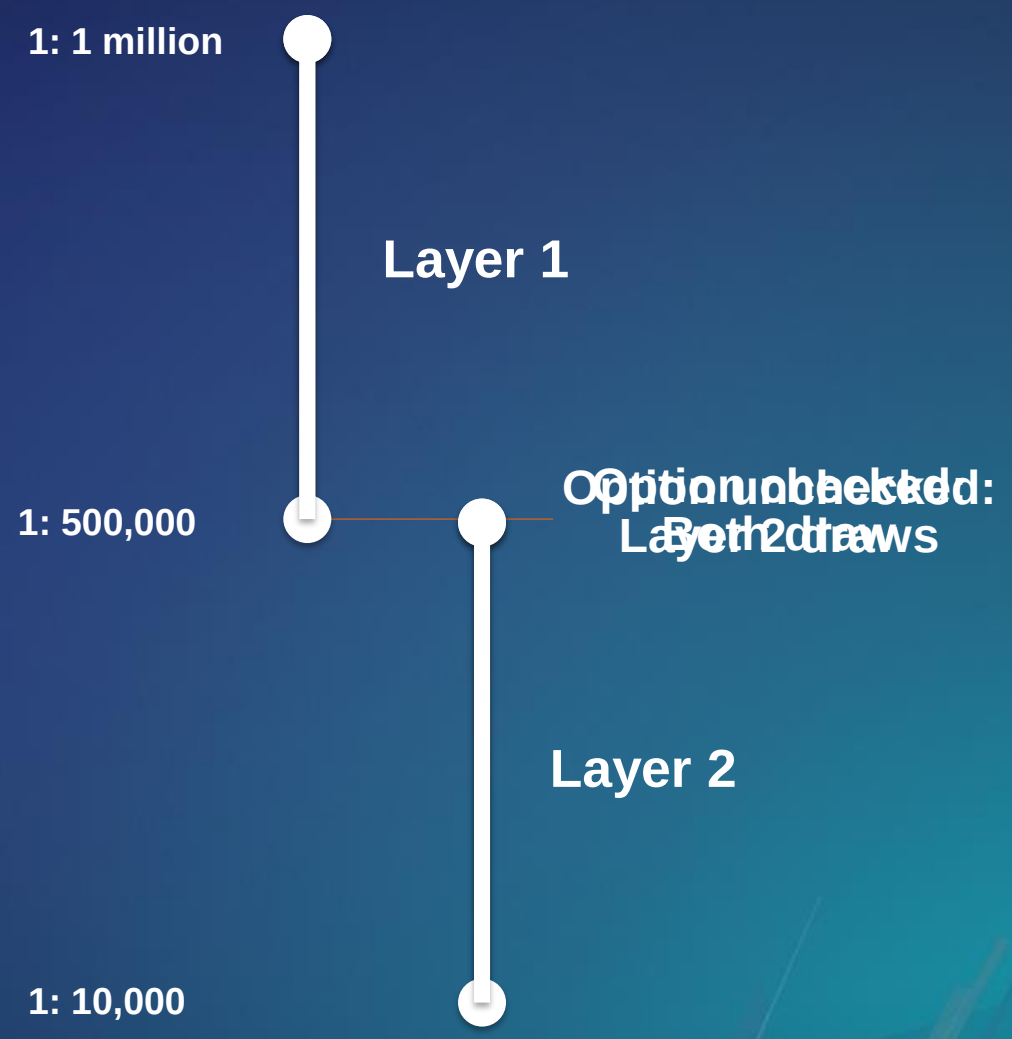
Display filters

- Filter features via attributes other than what you're symbolizing on
- Allows for scale dependent feature filtering
  - Lighten payload in your tiles



Scale logic changes

- ArcMap
  - Layers will draw AT and BETWEEN minimum and maximum scales
- ArcGIS Pro, 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 very old Pro projects or imported ArcMap maps



Demo

Authoring and creating vector tiles in ArcGIS Pro

What's new?

- Replace layer (ArcGIS Enterprise 10.6.1)
  - Replace one vector tile service for a new one
    - Useful for data updates
    - Maintains IDs
    - Use with caution – could break layer items referencing service if service is significantly different
    - Original service is archived
    - No UI for Replace in ArcGIS Online, but it's available in the API
    - http://esriurl.com/PythonAPIContentManager
- Pro 2.2, Runtime 100.3, JavaScript APIs (4.7/3.24)
  - Improved tilemap capabilities
  - Tilemap can be requested on demand when available from AGOL / Enterprise 10.6.1
  - Support for the circle layer
    - Note, we don't create circle layers in tile creation workflows yet
- If not signed into an organization at Pro 2.2, the basemap gallery will have vector tiles by default now

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 Pro 2.2 or higher with the OBJECTID field highlighted

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

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: How do I do vector tile updates?

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

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)

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 the 4.6 and 3.24 JavaScript API or later to fully leverage this capability.

If the JavaScript API detects an older print service, it sends a raster rendering of vector tiles through to the print service.

Q: Is a sample ArcGIS Pro project available?

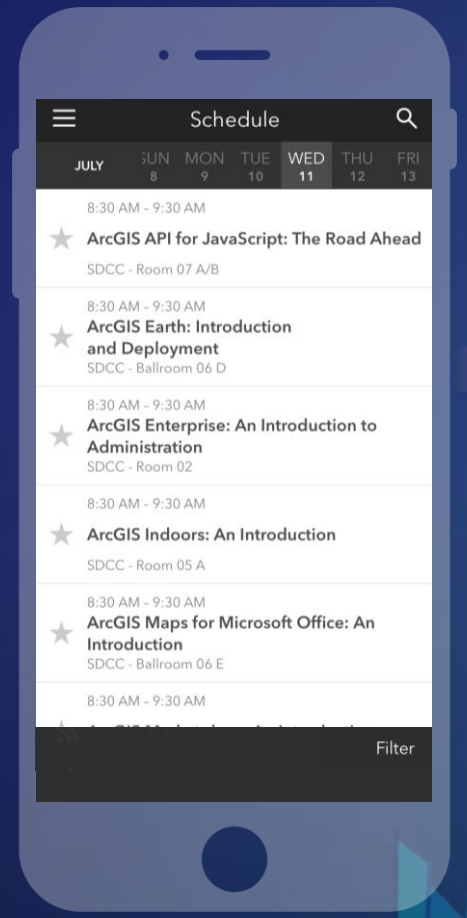
YES!

http://esriurl.com/VTSampleProject

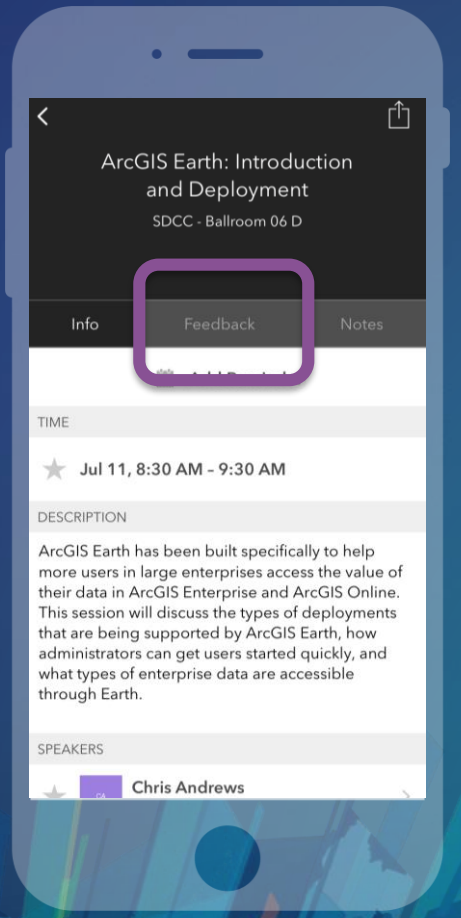
Please Take Our Survey on the App

Download the Esri Events app and find your event

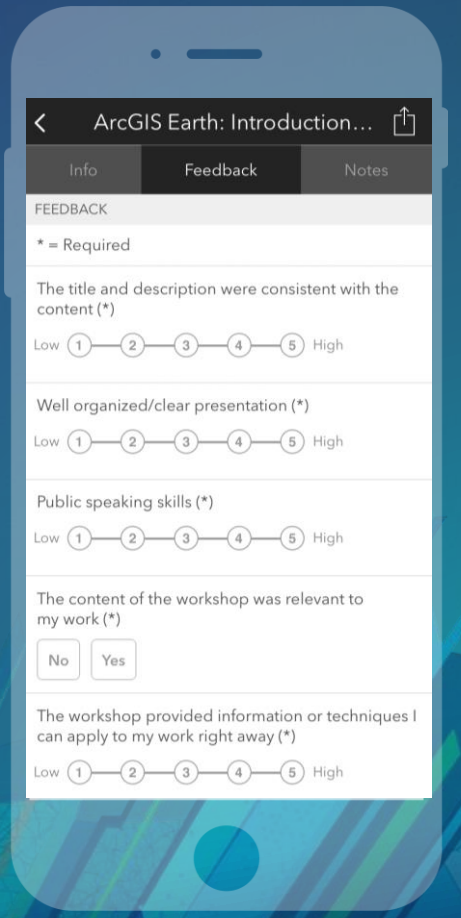
Select the session you attended



Scroll down to find the feedback section



Complete answers and select “Submit”



See Us Here

WORKSHOP	LOCATION	TIME FRAME
ArcGIS Pro: The Road Ahead	Ballroom 06 B	Tuesday: 8:30 am - 9:30 am
ArcGIS Pro: Mapping and Visualization	Ballroom 06 E	Tuesday: 2:30 pm - 3:30 pm
ArcGIS Pro: The Road Ahead	Ballroom 06 B	Tuesday 4:00 pm - 5:00 pm
ArcGIS Pro: Mapping and Visualization	Room 01 A/B	Wednesday 4:00 pm - 5:00 pm
ArcGIS Pro: Q&A with the Development Team	Ballroom 20 D	Thursday 8:30 am - 9:30 am
ArcGIS Pro: The Road Ahead	Room 01 A/B	Friday 9:00 am - 10:00 am

Or come see us at the Mapping and Visualization area in the Expo

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