ArcGIS Enterprise: An Introduction for Developers

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2021 ESRI DEVELOPER SUMMIT

Agenda

- What is ArcGIS Enterprise
  - End-user
  - Administrator
  - Developer
- REST APIs
- Enterprise SDK
  - SOEs/SOIs
  - Webhooks
- Higher-level APIs
  - ArcGIS API for JavaScript
  - ArcGIS Runtime SDKs
  - Non-Esri and open-source APIs

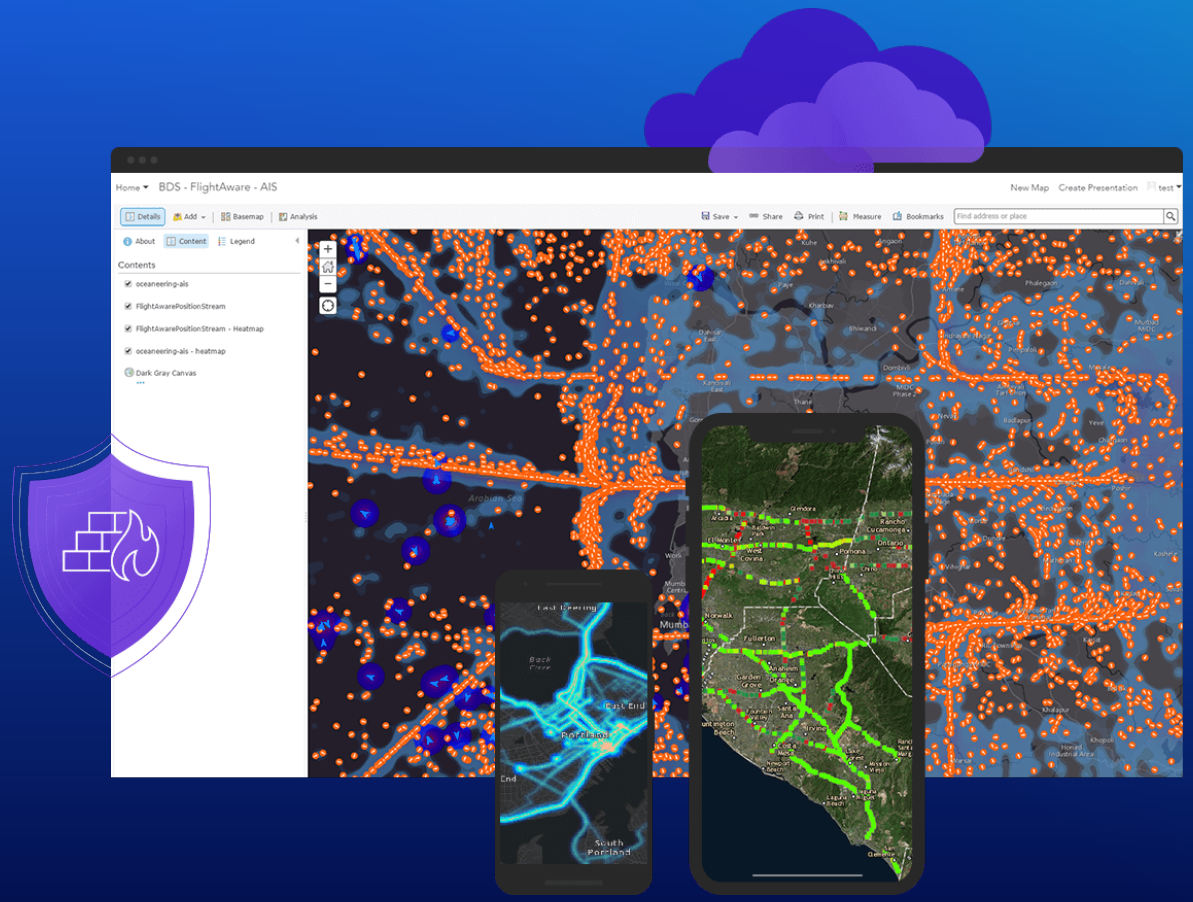
What is ArcGIS Enterprise

What exactly is this software we're here to talk about?

ArcGIS Enterprise is the foundational system for mapping and visualization, data management, spatial analysis, and application building.

It is the backbone for your GIS workflows. It is designed to integrate with ArcGIS Pro, ArcGIS Online, and Esri’s suite of applications.

ArcGIS Enterprise is installed on infrastructure you control, whether in the cloud or on-premises, and is scalable to meet your needs.



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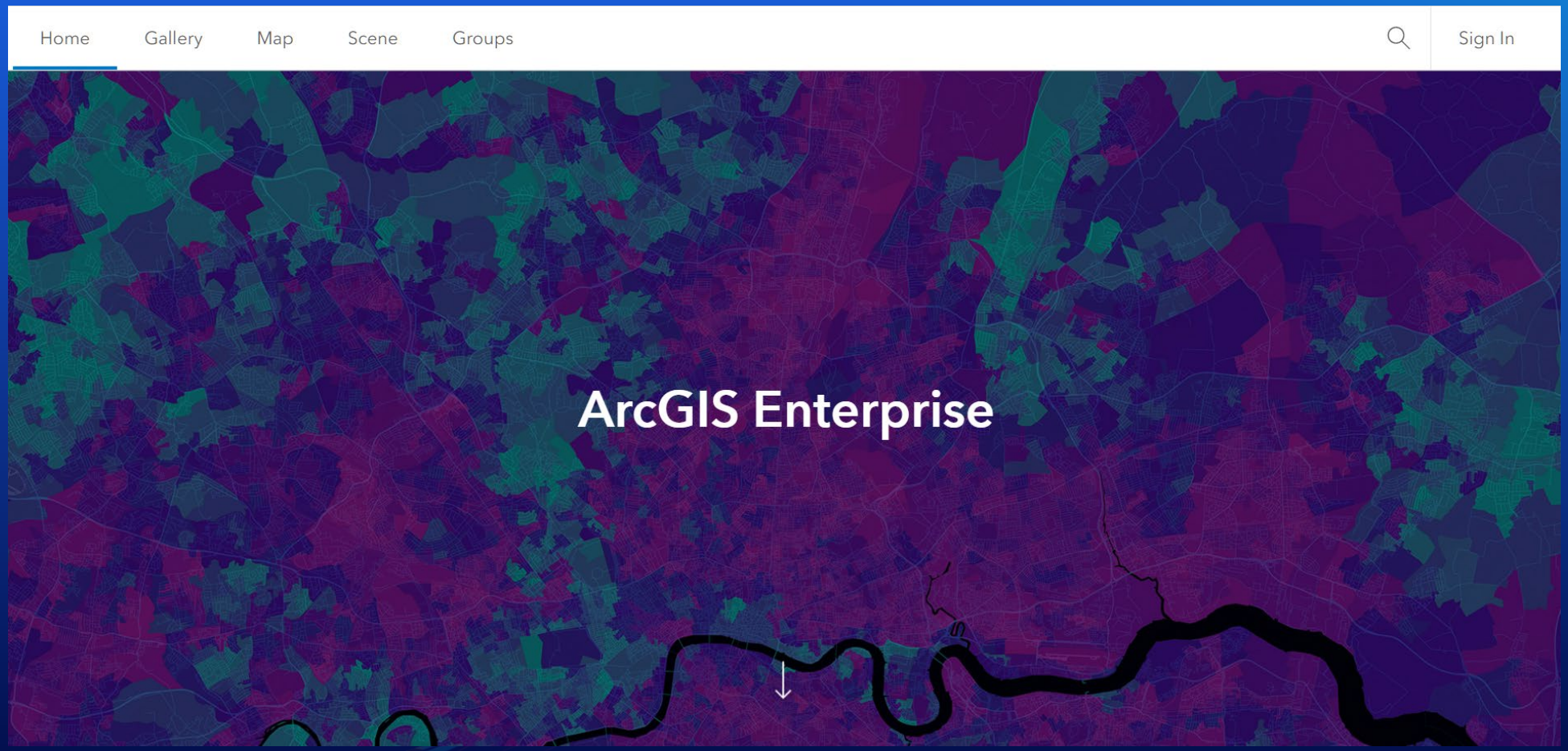
End users

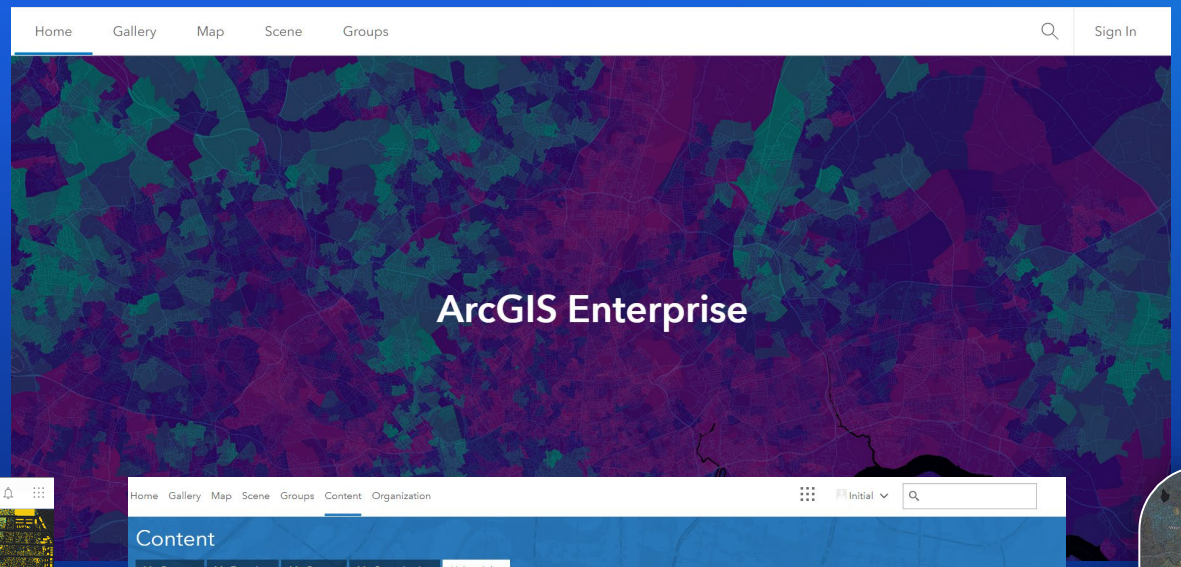
IT administrators

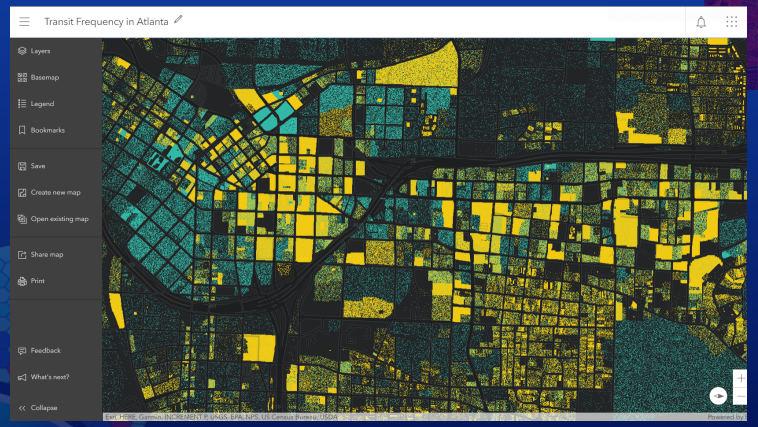
Developers

ArcGIS Enterprise for end users

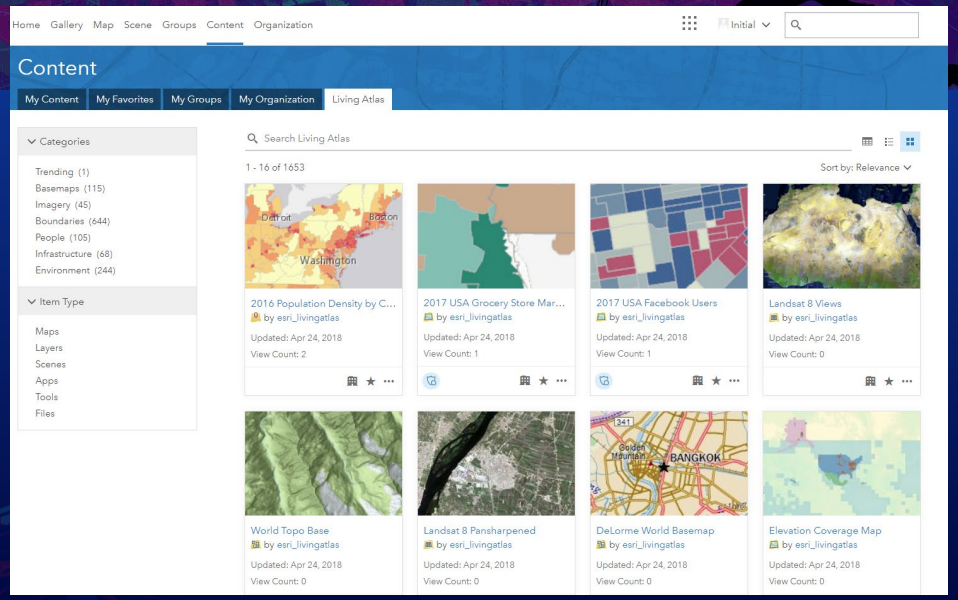


ArcGIS Enterprise for end users



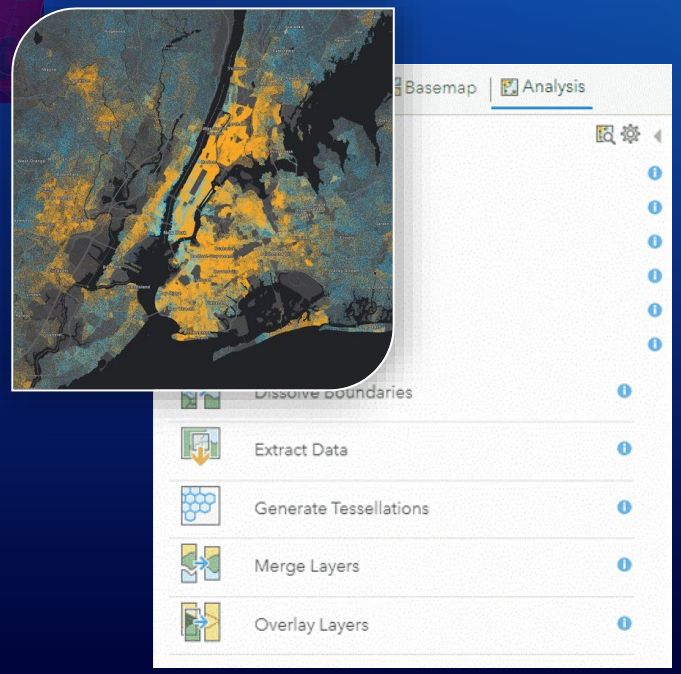


Map Viewer



Access to organization's content

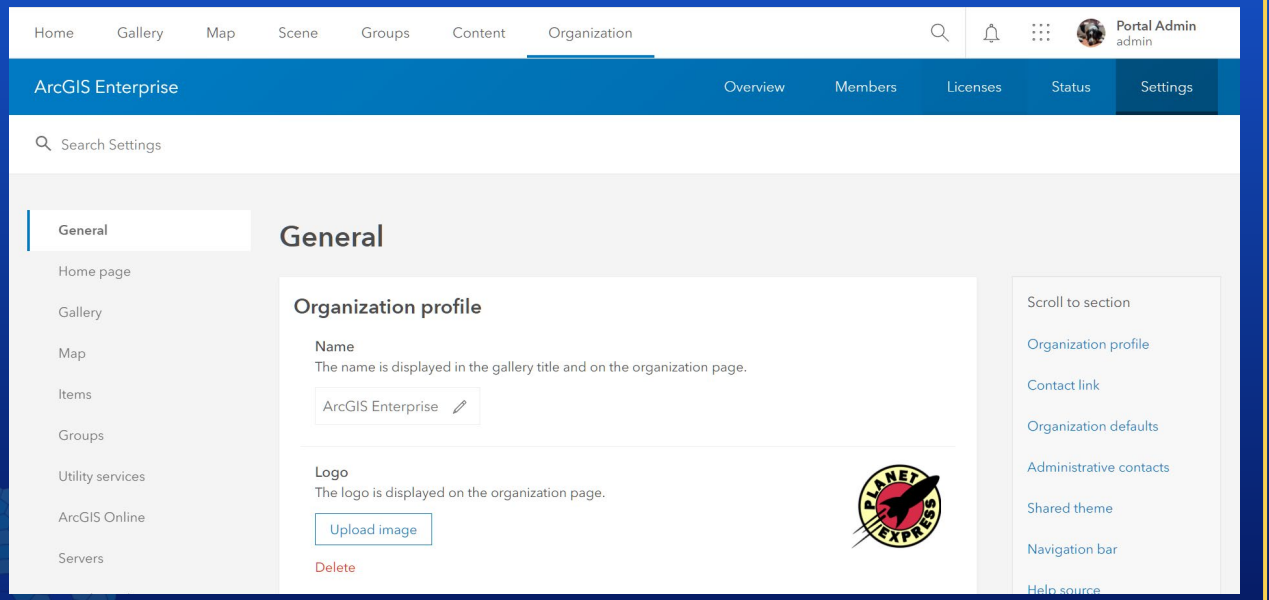
and more



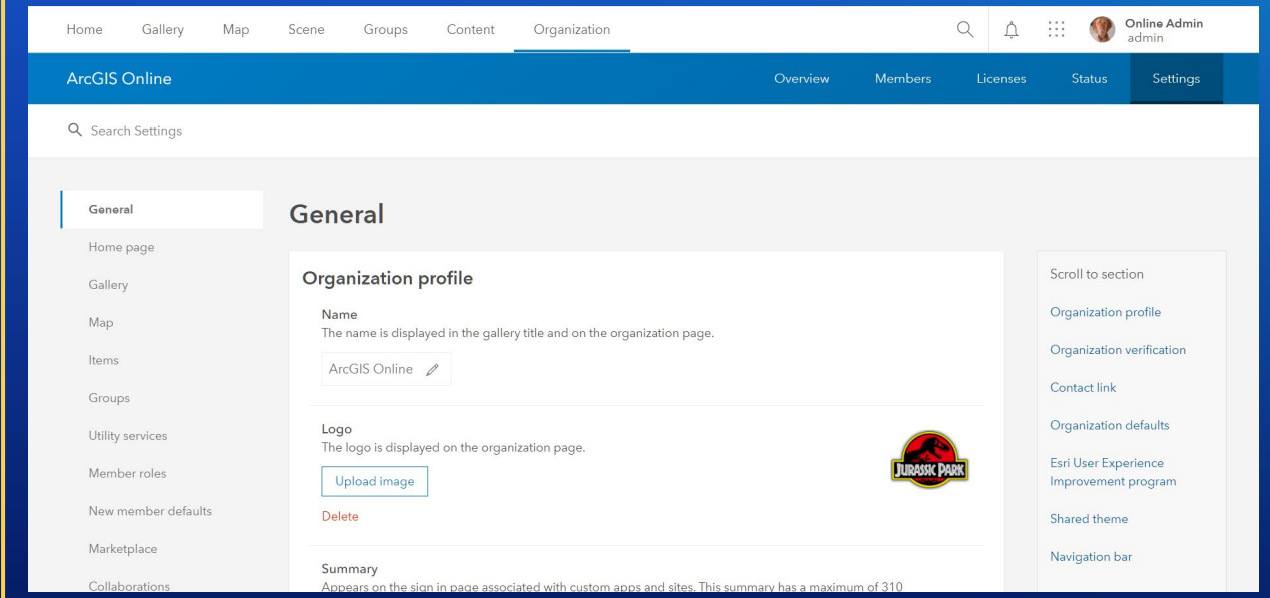
Analysis

ArcGIS Enterprise for end users

ArcGIS Enterprise



ArcGIS Online

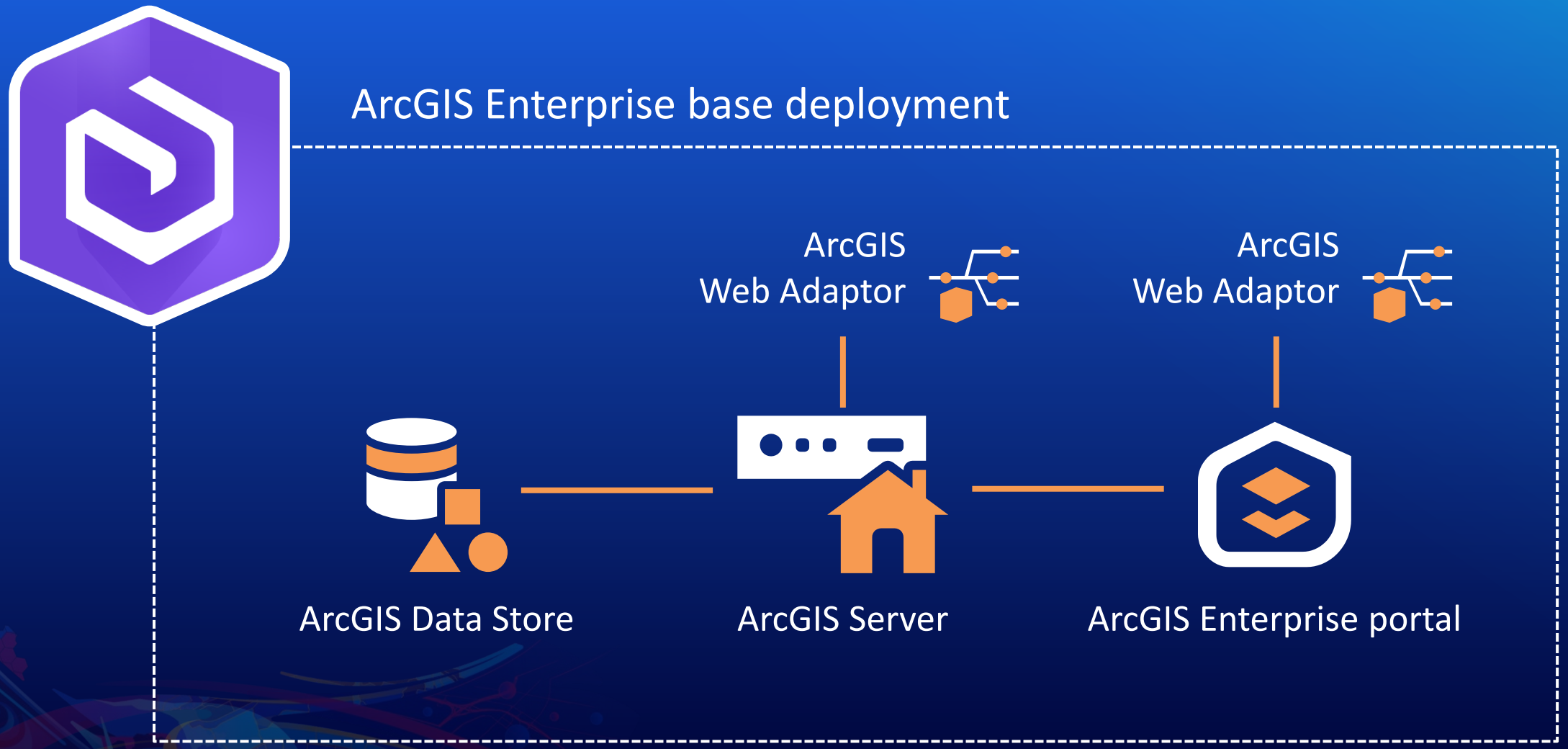


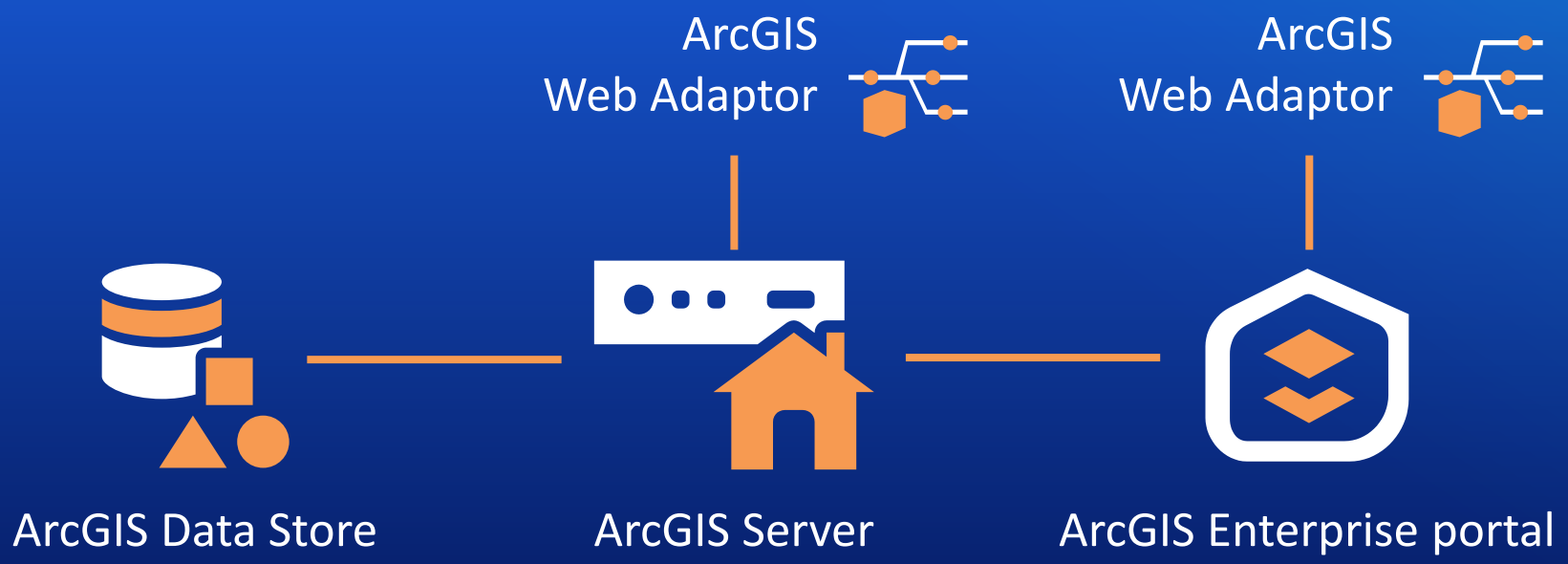
ArcGIS Enterprise for IT administrators

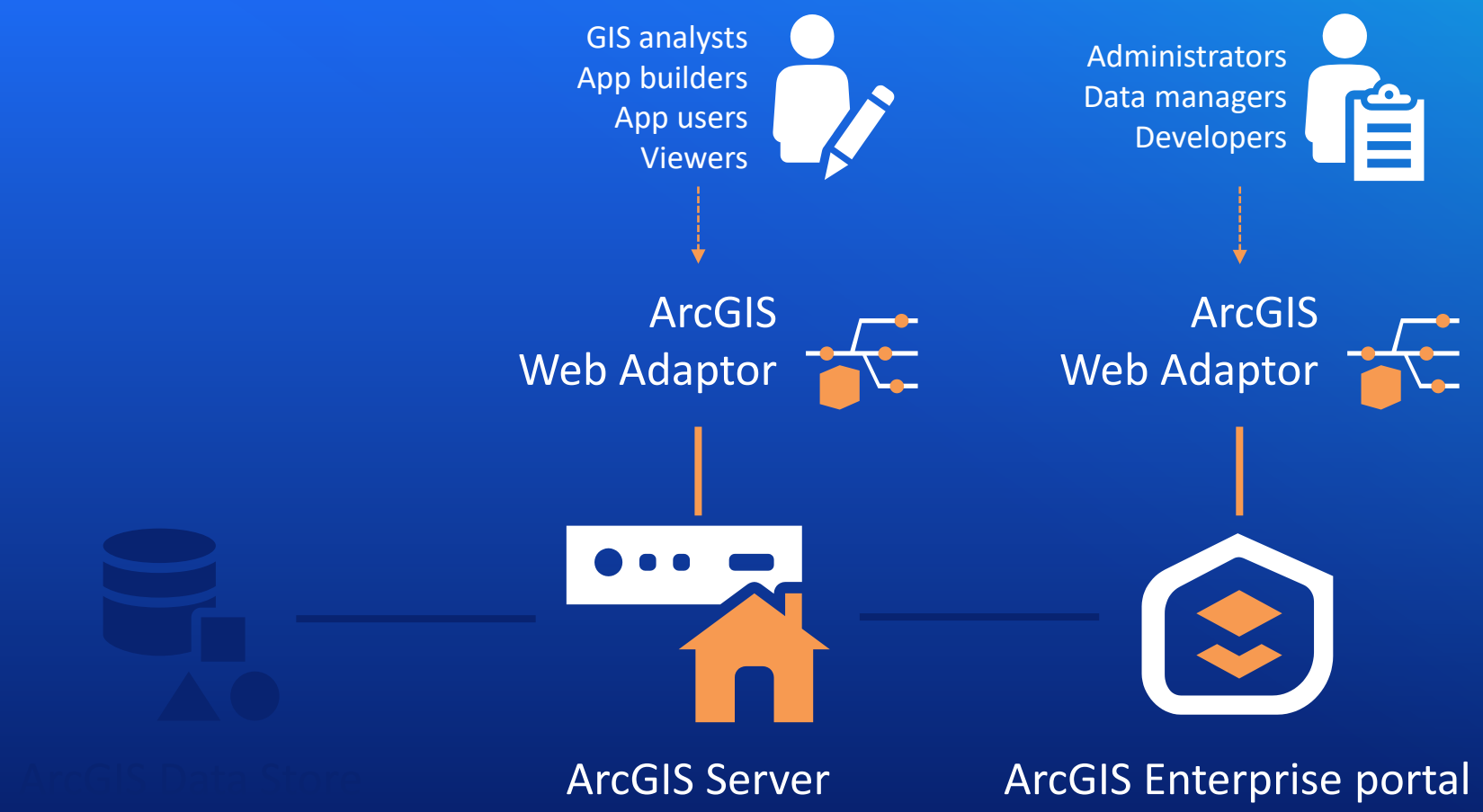
Unlike ArcGIS Online, which is a SaaS, ArcGIS Enterprise is software that you control.

- Installed on Windows, Linux, or (soon) Kubernetes
- On-premises, virtual machine, or private cloud
- Accessible inside or outside your firewall
- Connected or disconnected environments
- Can set up for high availability
- Scalable – one machine, four machines, or more!

ArcGIS Enterprise for IT administrators




ArcGIS
Web Adaptor
ArcGIS
Web Adaptor
ArcGIS Data Store
ArcGIS Server
ArcGIS Enterprise portal


GIS analysts
App builders
App users
Viewers
Administrators
Data managers
Developers
ArcGIS
Web Adaptor
ArcGIS
Web Adaptor
ArcGIS Server
ArcGIS Enterprise portal

Share content from desktop GIS

View and work with content in a map viewer

Bring in GIS items from web

Produce outputs (maps, analysis, apps)

Similar to ArcGIS Online

ArcGIS Server

Run GIS services that power your items

Handle all requests
(zoom on a map, find a location, analysis, and more)

Scale processes based on traffic

Connect to user managed data
Hosting server

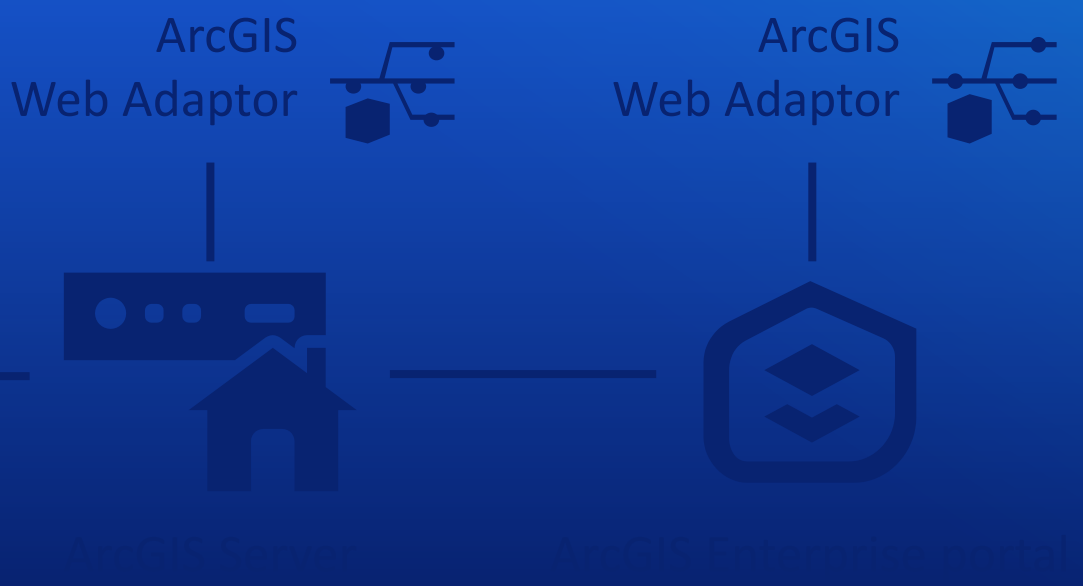
ArcGIS Data Store

ArcGIS managed data source

Hosts the data referenced by your items

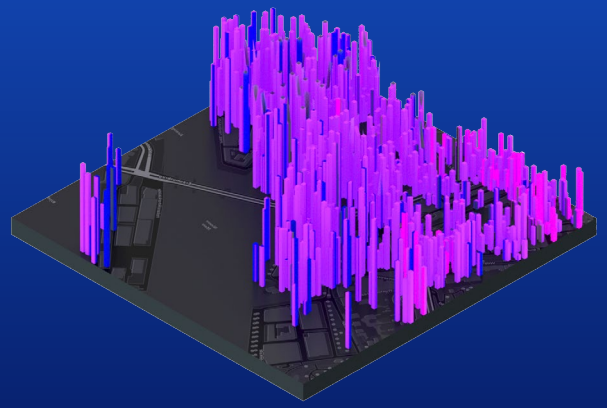
Facilitate instant data retrieval

Allows data editing from the Enterprise portal

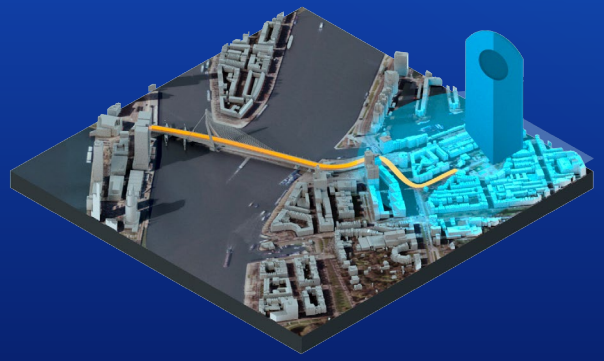


ArcGIS Enterprise for IT administrators

ArcGIS Server can also be licensed
for additional server roles,
each with its own respective capabilities.



GeoAnalytics Server



GeoEvent Server

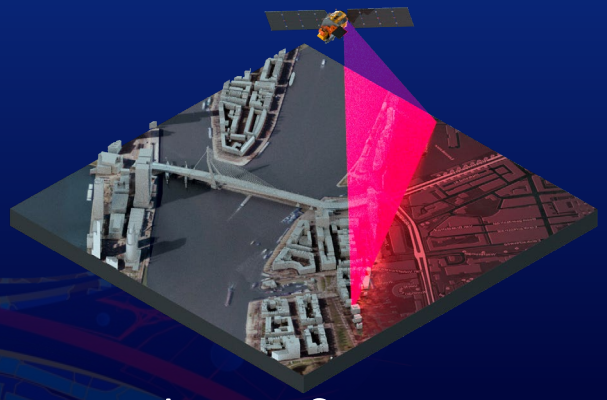
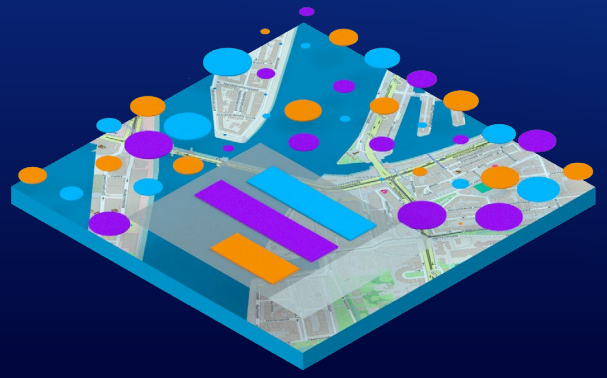


Image Server



Notebook Server

ArcGIS Enterprise for developers

On top of the considerations for end users and IT administrators, developers also have access to…

REST APIs

Sharing API // Services API // Admin APIs

Extending ArcGIS Enterprise

ArcGIS Enterprise SDK // Webhooks

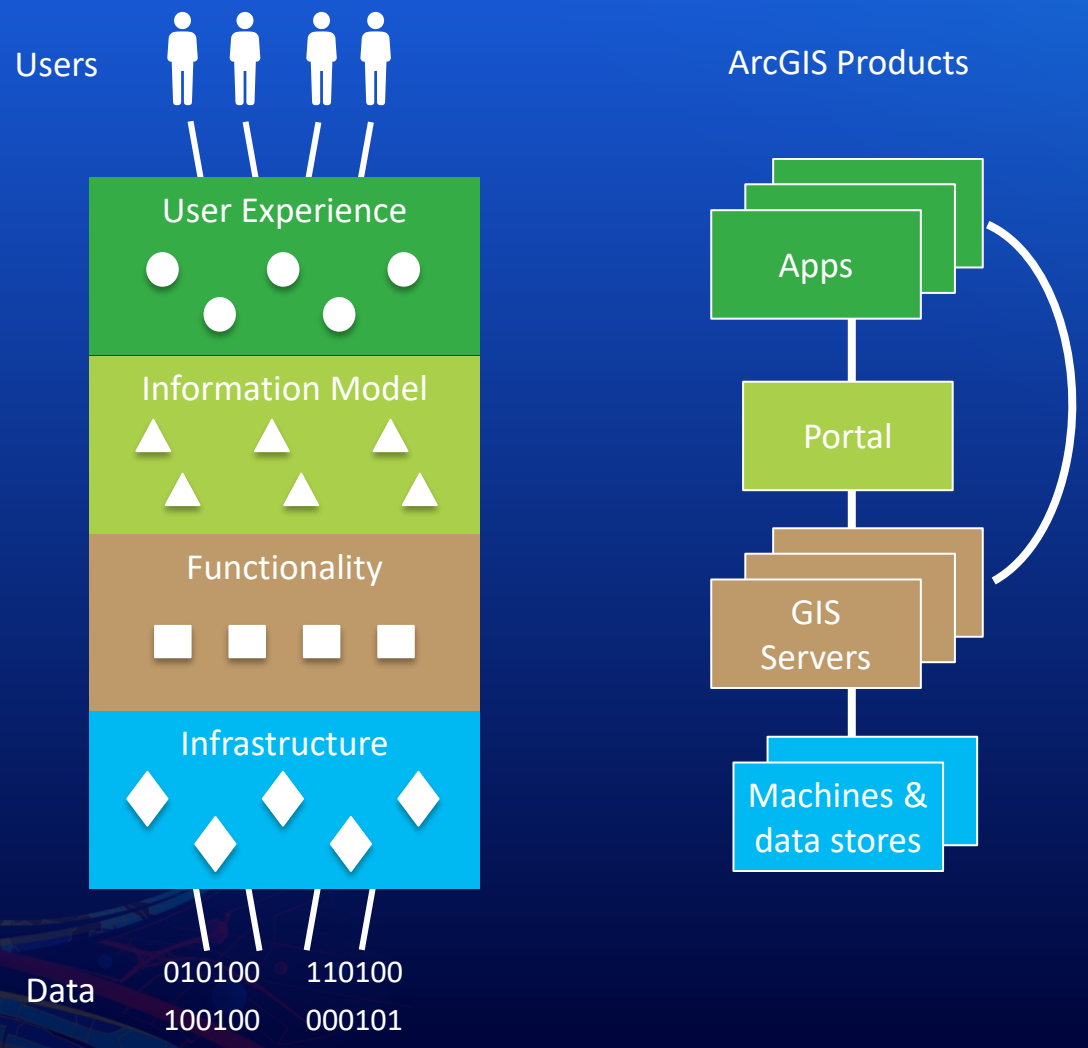
Higher-level APIs

ArcGIS API for JavaScript // ArcGIS Runtime SDKs // ArcGIS API for Python

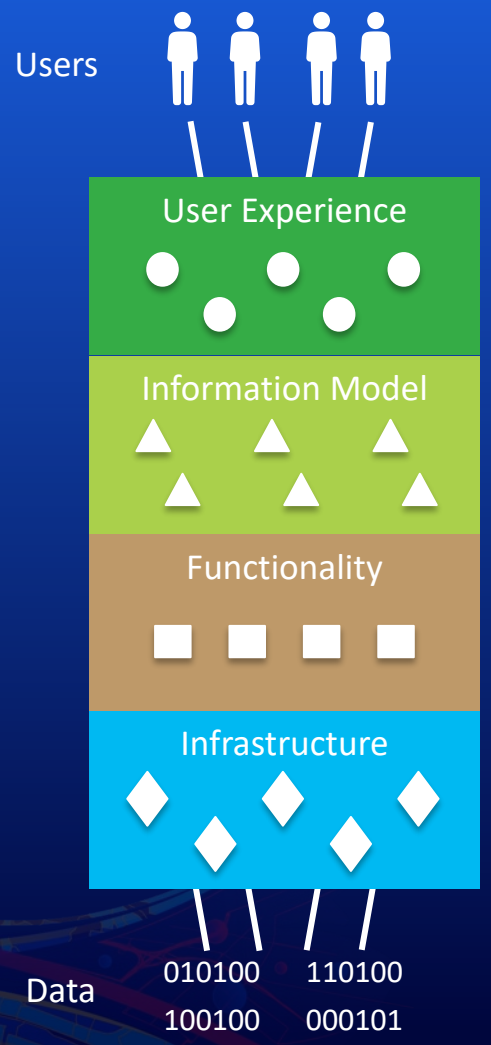
ArcGIS REST APIs

The fundamental underpinnings

Conceptual components



REST API structure

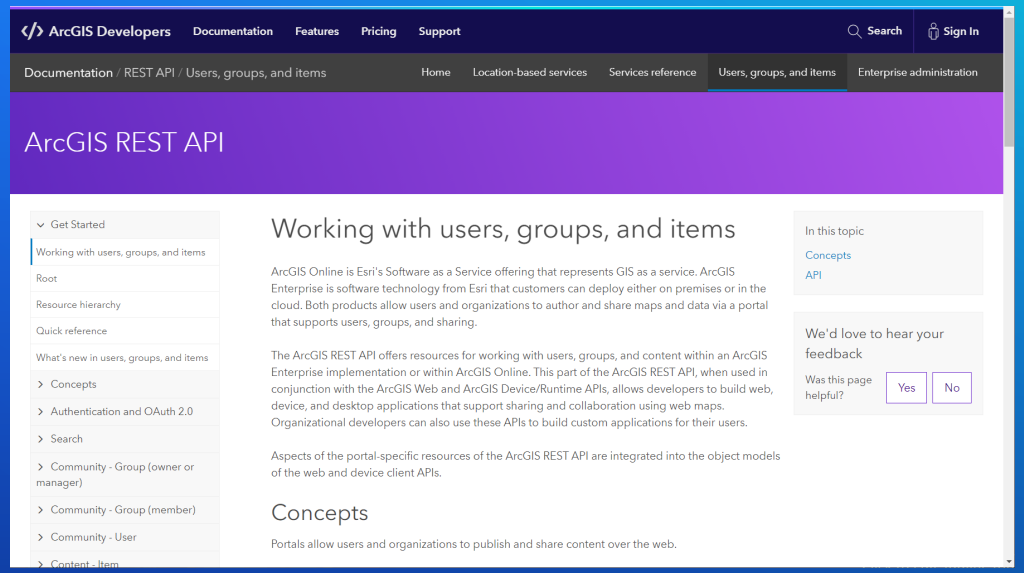


REST APIs for working with users, groups, and items
- **Informally known as the *Sharing API***
- **Found at /sharing on the Enterprise portal**

REST APIs for working with services
- **Found at /rest/services on ArcGIS Server sites**

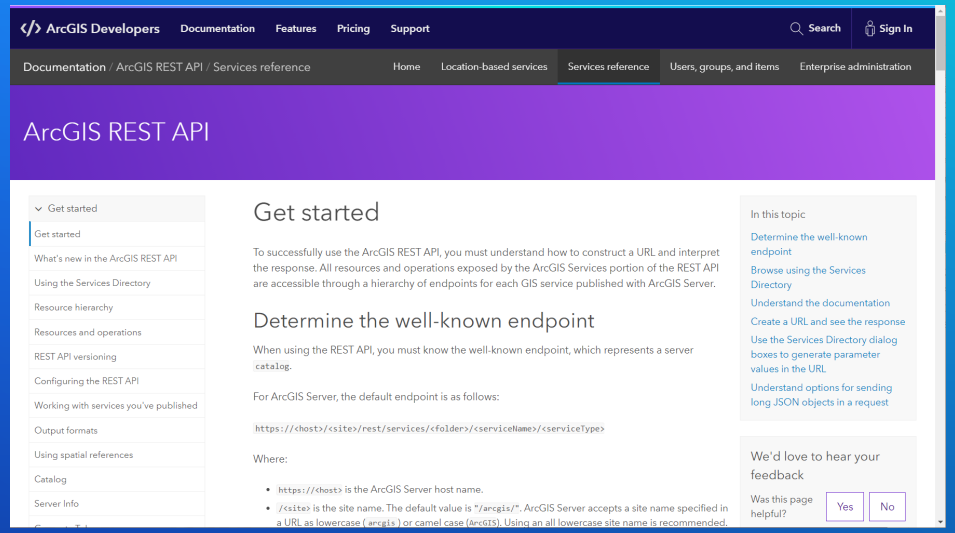
REST APIs for administering ArcGIS Enterprise components
- **Found at /portaladmin on the ArcGIS Enterprise portal**
- **Found at /admin on ArcGIS Server sites**

REST API concepts- Sharing API

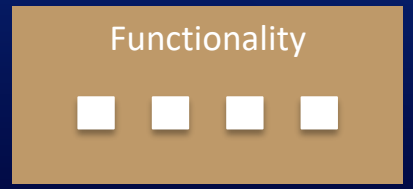


- Working in ArcGIS Enterprise (and ArcGIS Online) involves interacting with *users, groups, and items*.
  - *Users* and *groups* form the foundation of the security model: authenticating who is making a request (the user) and whether they have permission to access the requested content (the content has been shared with the user via a group)
  - *Items* represent pieces of information that define behavior- think of them as configuration files for everything from individual web services to application configuration.
    - Various higher-level Esri APIs and applications know how to read and interpret different item types. E.g. all Esri mapping APIs know how to read a *web map* item.

REST API concepts- services APIs



- All geospatial functionality is exposed as REST-based web services
  - Map services: ability to draw 2D maps and query underlying data
  - Feature services: ability to edit spatial and tabular data, sync data for taking offline
  - Geocoding services: ability to turn an address into coordinates (and vice-versa: reverse geocode by turning coordinates into an address)
  - Network services: ability to route on a street network
  - Geoprocessing services: ability to invoke long-running analysis jobs based on Python and ModelBuilder
  - And so on.. ArcGIS Enterprise supports many, many types of geospatial services.



REST API concepts- services APIs

- Map service example

ArcGIS REST Services Directory

Login

Home > services > SampleWorldCities (MapServer)

Help | API Reference

JSON | SOAP | WMS

SampleWorldCities (MapServer)

View In: ArcGIS JavaScript ArcGIS Online Map Viewer ArcGIS Earth ArcMap ArcGIS Pro

View Footprint In: ArcGIS Online Map Viewer

Service Description: The SampleWorldCities service is provided so you can quickly and easily preview the functionality of the GIS server. Click the thumbnail image to open in a web application. This sample service is optional and can be deleted.

Map Name: World Cities Population

Legend

All Layers and Tables

Dynamic Legend

Dynamic All Layers

Layers:

- Cities (0)
- Continent (1)
- World (2)

Description: The SampleWorldCities map service displays world cities symbolized based on population.

Supported Query Formats: JSON, geoJSON, PBF

Supports Query Data Elements: true

Min Scale: 0

Max Scale: 0

Supports Datum Transformation: true

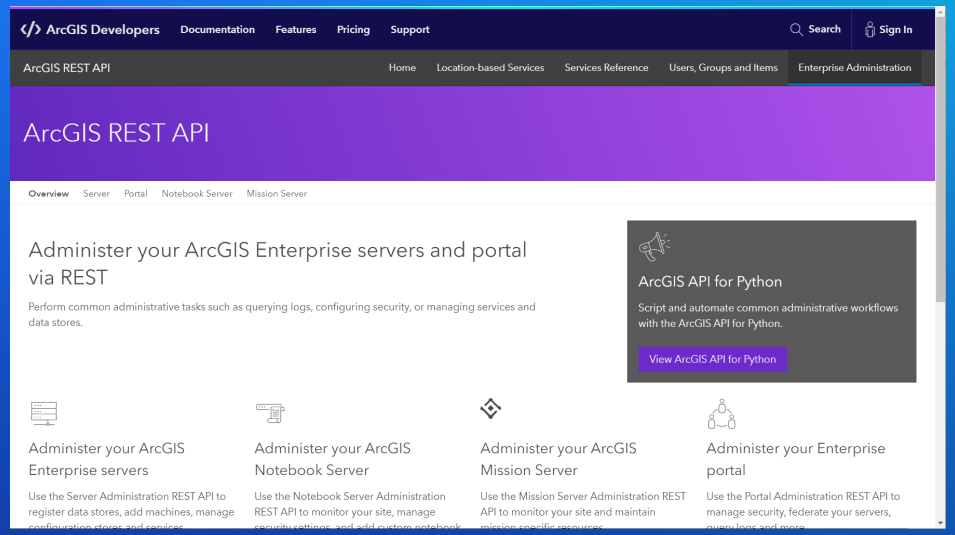
Child Resources: Info Dynamic Layer

Supported Operations: Export Map Identify QueryDomains QueryLegends Find Return Updates Generate KML

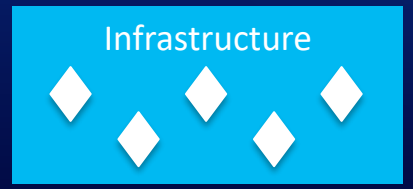
- /rest/services/SampleWorldCities/MapServer/export
- /rest/services/SampleWorldCities/MapServer/identify
- etc.

Functionality

REST API concepts- admin APIs



- ArcGIS Enterprise consists of multiple components with separate administrative APIs
  - Portal for ArcGIS: /portaladmin
  - ArcGIS Server: /admin
  - Additional optional components have similar administrative APIs.
- Administrative APIs are for *configuring* the system as well as *troubleshooting* (access to logs) and *monitoring* (usage metrics and reporting).
- Note: the new ArcGIS Enterprise on Kubernetes option has a separate unified administrative API!



ArcGIS Enterprise SDK

Making the backend do more things or do them differently

ArcGIS Enterprise SDK

Allows for developers to extend the functionality of map and image services published via ArcGIS Pro.

There are two types of extensions:
SOEs and SOIs

Can be written in .NET or Java.

Deployed and enabled through
ArcGIS Server Manager.

While similar to ArcObjects SDK,
ArcGIS Enterprise SDK has its own distinct API.

Server object extensions (SOEs)

Allow developers to expose new operations in ArcGIS Server.

These operations are exposed through the ArcGIS Server REST API.

SOEs introduce new APIs so they only work with custom applications.

Only for map services.

SOE example | Election night

State officials wants their users to click on any county in their mapping application to return vote percentages for each candidate.

A standard query through the REST API

County	Candidate A (# of votes)	Candidate B (# of votes)	Candidate A (% of votes)	Candidate B (% of votes)
Sacramento	10	30	?	?
Yolo	30	10	?	?

The map service only contains data for the number of votes in the county, nothing regarding the percentage.

Field calculations could be performed through the client to get the percentages.

A custom query with a SOE

County	Candidate A (# of votes)	Candidate B (# of votes)	Candidate A (% of votes)	Candidate B (% of votes)
Sacramento	10	30	25	75
Yolo	30	10	75	25

Though the map service only contains data for the number of votes in the county, a SOE can be created to query the data and calculate the percentages before returning the results.

Server object interceptors (SOIs)

- Allow developers to modify the behavior of existing operations in ArcGIS Server through pre or post-processing of requests.
- Can be invoked through any client application, out-of-the-box or custom.
- Can log messages in the ArcGIS Server logs.
- For map and image services.

SOI example | Custom watermark

A utility company wants to superimpose a custom watermark on map images exported by map services to ensure proper branding when their map services are displayed or printed by end users.

Map images are exported through the export operation at the REST endpoint.

- The export request will be sent by the client and received by ArcGIS Server
- Image will be exported
- SOI will add the watermark
- Image response sent back to the client

This ensures that the watermark will be on all map images exported, regardless of the client making the request.

Webhooks

An action occurs.

- Something is published
- A user creates a new account
- An item is deleted

The webhook is triggered.

- Delivers JSON description of the event
- Relevant info fields


```
{
  "info": {
    "webhookName": "Group monitoring",
    "webhookId": "72fed926aeb74c9ca8a22aacddc6725a",
    "portalURL": "https://machineURL/portal/",
    "when": 1543192196521
  },
  "events": [{
    "username": "administrator",
    "userId": "173dd04b69134bdf99c5000aad0b6298",
    "when": 1543192196521,
    "operation": "update",
    "source": "group",
    "id": "173dd04b69134bdf99c5000aad0b6298",
    "properties": {}
  }]
}
```


Your platform of choice kicks in.

- IFTTT
- Integromat
- Microsoft Power Automate

It performs an action.

- Emails you
- Posts in Slack
- Alexa announces it at the dinner table (maybe not)

!

When to use webhooks

- /groups: When someone shares an item to a collaboration group, notify group members through Slack.
- /items: If the sharing settings are changed for a layer that contains confidential information, email administrators.
- /users: Once a user is deleted, notify your admin via text.
- And more!

- /roles/add
- /roles/update
- /roles/delete

- /users/updateUserRole
- /users/updateUserLicenseType

Higher-level APIs

Or: how not to reinvent the wheel. JavaScript, .NET, Qt, Python, oh my!

Wealth of APIs

- Most developers should not be using the REST API directly at all. The few that use the REST API directly should do so sparingly.

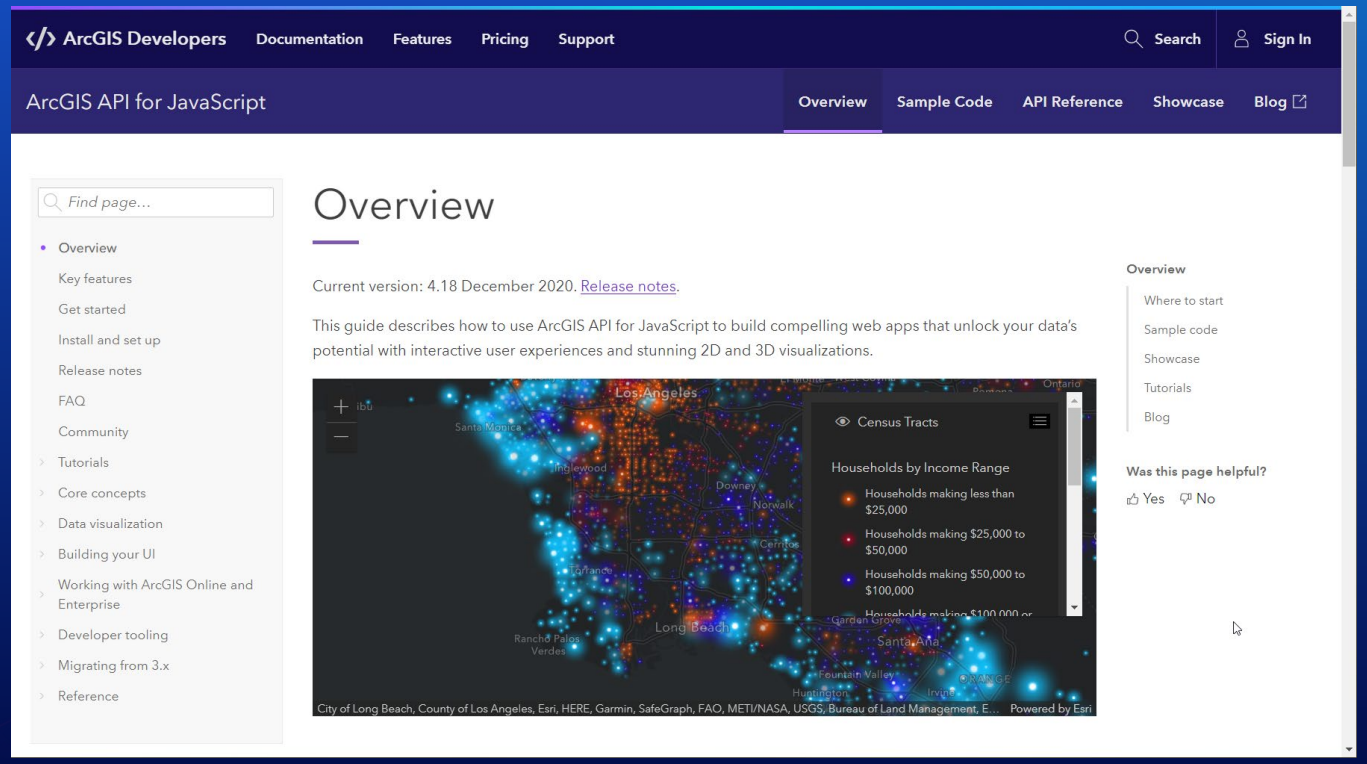
- For creating web apps that consume geospatial content and services:
  - Esri's premier API is the ArcGIS API for JavaScript
  - Multiple non-Esri and open-source options as well
    - Leaflet w. Esri Leaflet plugins
    - OpenLayers
    - Mapbox GL JS

- Higher-level APIs
  - Deeper dive on JS API + Runtime: using sharing + services APIs
  - Deeper dive on Python: using/consuming content + administrative workflows

ArcGIS API for JavaScript

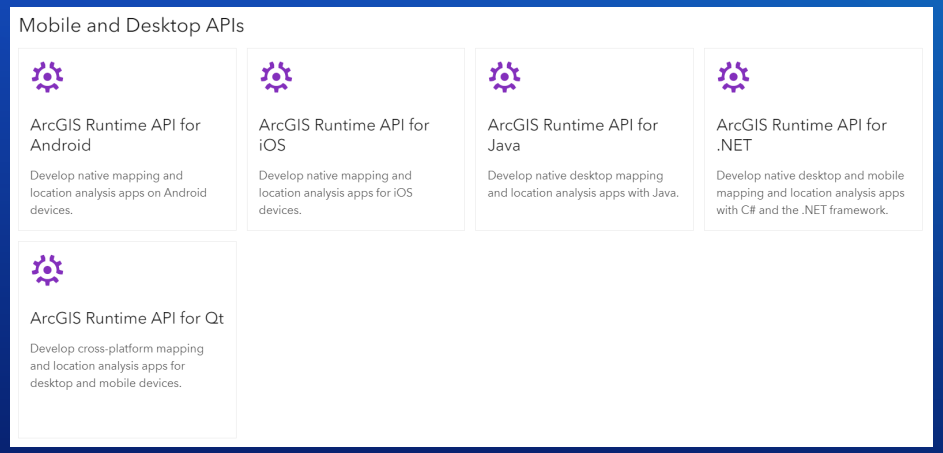
- **Full-featured, modern JS API that exposes full set of ArcGIS capabilities from ArcGIS Enterprise and ArcGIS Online.**

- **The API that is used to build all of Esri's own web apps**
  - **ArcGIS Dashboards**
  - **ArcGIS StoryMaps**
  - **ArcGIS Workforce**
  - **Etc.**



Native applications

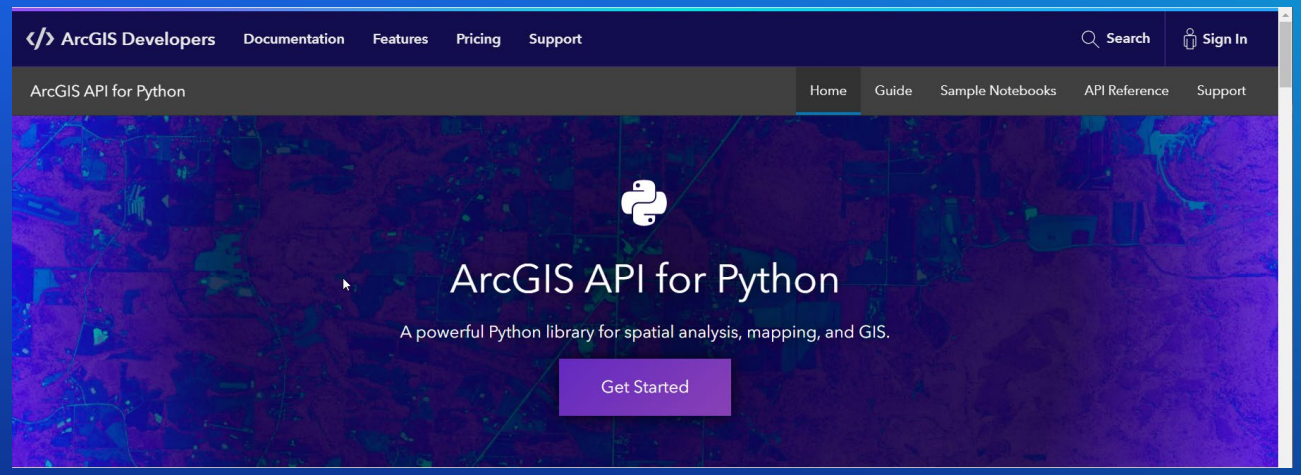
- ArcGIS Runtime SDK is the premier Esri technology for building native mobile and desktop applications
- ArcGIS Runtime SDK comes in *many* flavors for every type of device imaginable
  - Android (API level 23+)
  - iOS (iOS 12+)
  - Java (Java 11)
  - .NET (.NET Framework 4.6+, .NET Core 3.1, .NET 5.0)
  - Qt



- While ArcGIS Runtime apps can function completely independently using local data, they are often powered by or interact with ArcGIS Enterprise and ArcGIS Online.

Scripting options: data management and administrative workflows

- ArcGIS API for Python provides a powerful pythonic wrapper for performing administrative and data management workflows in addition to being able to drive lots of analytics as well.



Resources

- ArcGIS Developers: https://developers.arcgis.com/
  - REST API: https://developers.arcgis.com/rest
  - ArcGIS API for JavaScript: https://developers.arcgis.com/javascript
  - ArcGIS Runtime: https://developers.arcgis.com/documentation/#arcgis-runtime

Additional sessions and presentations

- ArcGIS API for JavaScript: Getting Started with Web Development
  - web developers
    https://www.youtube.com/watch?v=zQTkkFUhzLI
- ArcGIS Enterprise: Architecting Your Deployment
  - IT architects and system administrators
    https://www.youtube.com/watch?v=EoWhScTvQ10
- ArcGIS Enterprise: Best Practices for Layers and Service Types
  - Developers and GIS analysts publishing services
    https://www.youtube.com/watch?v=BzSjtN_hSms
- ArcGIS Runtime: An Introduction to the API and Architecture
  - Native app developers creating apps for mobile devices and laptop + desktop computers
    https://www.youtube.com/watch?v=iqaC79GsOoc
- ArcGIS API for Python: A Tour of Different Modules
  - DevOps and anybody interested in automation
    https://www.youtube.com/watch?v=FO6BzG-IxJM

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