Introduction to ArcGIS Server 10.1

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Module Outline

- What is ArcGIS Server?
- GIS Resources and Services
- ArcGIS Server Components
- ArcGIS Server Editions and Levels
WHAT IS ARCGIS SERVER?
What is ArcGIS Server?

• ArcGIS Server helps you share geographic information with others
What is ArcGIS Server?

- Platform for sharing GIS resources
- Shareable Resources
  - Maps, globes, address locators, geodatabases, tools
- Can be shared within your organization or externally
  - Intranet web mapping applications
  - Through ArcGIS Desktop
  - Mobile applications
- Out-of-the-box applications and services
- Rich developer opportunities
Why Use ArcGIS Server?

- Data is centrally managed
- Multi-user support
- Data always up to date
- Out of the box client tools for consuming services
- Web development platform for custom applications
What Can You Do with ArcGIS Server?

• Share GIS data through web and desktop applications
• Publish map documents as dynamic web mapping applications
• Create custom web and mobile mapping applications for specific purposes
• Publish geoprocessing services
• Deliver GIS resources to mobile workers
• Centrally manage GIS data
What Clients Access ArcGIS Server?

- ArcMap
- ArcGIS Explorer
- ArcGlobe
- Custom Apps
  - Flex
  - Silverlight
  - JavaScript
Case Studies

• ArcGIS Server Showcase
  http://www.esri.com/software/arcgis/arcgisserver/showcase
Technical Requirements

- Requires a server running 64 bit operating system
- OS can be Windows or Linux
- Can be deployed on virtual machines or cloud platforms such as Amazon EC2
- Minimum 4GB of RAM for development environment; production environment will vary
- All system requirements
Amazon EC2 Deployment

- ArcGIS Server available through Amazon as an Amazon Machine Image (AMI)
- Deploy AGIS in the Amazon Elastic Computer Cloud (EC2)
- No installation or post-installation necessary
- Pay only for the hardware you need
- Resize deployment in response to demand
GIS RESOURCES AND SERVICES
You are going to hear these terms used a lot with ArcGIS Server. What are they?

**GIS Resources**
- Maps, geodatabases, address locators, geoprocessing tools, raster datasets, and other tools you need for storing and using geographic data
- Originate in ArcGIS Desktop

**GIS Services**
- Representation of a GIS resources that ArcGIS Server makes available to other computers through a network
  - Network can be local or the Internet
Authoring Resources

- Resources are authored in ArcGIS Desktop
  - ArcMap or ArcCatalog

- Example: Map resource created as map document file (.mxd) in ArcMap
  - Once authored this map document resource will be published as a service
Publishing Resources As Services

- Resources can be published to ArcGIS Server through
  - ArcGIS Server Manager
  - ArcCatalog
ArcGIS Server Workflow

Author
- Create Resources
- ArcGIS Desktop

Publish
- Uses Resource
- Creates service

Consume
- Use service
- Web or desktop
• Central concept to ArcGIS Server

• ArcGIS Server provides GIS services
  – Many types of GIS services
    • Map, Geoprocessing, Locator, Globe, Image
    • Each performs a specific task

• GIS Services consumed by clients
  – Web
  – Desktop
  – Mobile
Clients consume GIS services

Types of Services:
- Map
- Image
- Globe
- Geodatabase
- Geocoding
- Geoprocessing
- Geometry

ArcGIS Server
ARCGIS SERVER COMPONENTS
ArcGIS Server Components

- Several components
  - Clients
    - Traditional web applications, desktop applications, mobile applications
  - Web Server and optional Web Adapter
    - Hosts web applications
    - Use Web Adapter if you need to use an existing web server in your organization (IIS, WebSphere, WebLogic, and others)
  - GIS Server
    - Fills GIS requests (draws maps, executes queries, runs tools, etc)
    - Can be one machine or distributed
  - Data Server
    - Can be a centralized data repository (ArcSDE or file geodatabase)
    - Or can be placed on each individual server
ArcGIS Server Components

Image provided by ESRI
• Optional setup

• Used when you want to use ArcGIS Server with your own web server

• Used when
  – You want to customize the URL to services
  – Configure security policies at the web tier
Data Storage for ArcGIS Server

- ArcGIS Server will need access and permissions to the data used to create services
- Need to consider how and where your data will be stored
- ArcSDE or File Geodatabase?
  - ArcSDE usually best choice
    - Works with RDBMS (SQL Server, Oracle, etc)
    - High availability support, backup and recovery, concurrency, scalability
    - Do need a database administrator (DBA) to support the geodatabase
  - File geodatabase works well in some situations
    - Relatively static datasets
    - No RDBMS and/or DBA
    - Very good performance
File Geodatabase

- Place identical copy of file geodatabase on each machine or centralized copy
  - Only necessary when you have a distributed deployment
  - Should not access the same file geodatabase over the network
  - Minimizes network communication traffic
- Work well in read-only applications
- Not so well in editing applications
  - Lock acquired during editing
- Work well for map caching
ArcSDE

- Used with Enterprise Level Geodatabases
- Integrated into ArcGIS Server
- Gateway between ESRI clients and RDBMS
- Works with Oracle, SQL Server, PostgreSQL PostGIS, DB2, Informix
- Middleware software
- Critical for multi-user editing environments, distributed editing, replication across RDBMS architectures, managing historical archives
ArcSDE

ArcGIS Desktop  Web Clients

ArcGIS Server

ArcSDE

RDBMS

- SQL Server
- Oracle
- IBMS DB2
- IBM Informix
- PostgreSQL
WHAT’S INCLUDED WITH ARCGIS SERVER
What’s Included with ArcGIS Server

• Web service publishing
• Preconfigured services
• ArcGIS Server Manager
• ArcGIS Web Adapter
• ArcGIS Server Services Directory
• ArcGIS Server Administrator API
• Configurable Web Applications
• Web APIs
• ArcGIS for SharePoint
• Mobile APIs
• Extensions
• Primary capability of ArcGIS Server
• Publish resources to services
  – Services then consumed by clients
  – Maps, imagery, geoprocessing models
• Services consumed by a wide variety of clients
  – Web, desktop, mobile
Pre-configured Services

• ArcGIS Server provides several out-of-the-box services for common tasks
  – Caching Tools
  – Publishing Tools
  – Reporting Tools
  – Printing Tools
  – Geometry Service
  – Search Service
  – SampleWorldCities Service
Pre-configured Services – Caching Tools

• Caching is resource intensive
  – Hardware and software

• Geoprocessing service
  – Called CachingTools
  – Pre-configured in System folder
  – Can be confined to run on a cluster of machines
  – Started by default and can’t be deleted
Pre-configured Services – Reporting Tools

- Generates reports on the status of a map or image service caching job
- Pre-configured in System folder and started by default
Pre-configured Services – Publishing Tools

- Services can be published from ArcGIS Server Manager or ArcGIS Desktop
- New geoprocessing service: PublishingTools
  - Used to
    1. Upload the service definition file
    2. Unpack on the server
    3. Deploy as a service
- Pre-configured in System folder and started by default
Pre-configured Services – Printing Tools

- Geoprocessing service for printing web maps
- Returns a printable image from a map service
- Pre-configured in the Utilities folder and stopped by default
Preconfigured Services - Geometry Service

- Performs geometric calculations
  - Buffer, simplify, calculate area/length, projection
- Used in web editing
- Pre-configured in Utilities folder and stopped by default
Preconfigured Services - Search Service

- Creates a searchable index of your GIS content
- Used on a local network
- Pre-configured in Utilities folder and stopped by default
Preconfigured Services – SampleWorldCities Map Service

- Sample map service for viewing functionality of ArcGIS Server
- Pre-configured in root folder and started by default
ArcGIS Server Manager

• Web application for managing services
  – Add and remove service
  – Tune and secure service
  – Organize services in folders
  – Configure machines and directories
ArcGIS Web Adaptor

- Optional setup

- Used when you want to use ArcGIS Server with your own web server

- Used when
  - You want to customize the URL to services
  - Configure security policies at the web tier
ArcGIS Server Services Directory

- Contains metadata about the services provided by your ArcGIS Server instance
- Helpful for web developers

Demographics/ESRI_Census_USA (MapServer)

**View In:** ArcMap, ArcGIS Explorer, ArcGIS JavaScript, Google Earth, ArcGIS.com Map

**View Footprint In:** Google Earth

**Service Description:** This service presents various population statistics from Census 2000, including total population, population density, racial counts, and more. The map service presents statistics at the state, county, block group, and block point levels. This is a sample service hosted by ESRI, powered by ArcGIS. ESRI has provided this example so that you may practice using ArcGIS APIs for JavaScript, Flex, and Silverlight. ESRI reserves the right to change or remove service at any time and without notice.

**Map Name:** Layers

**Legend**

**All Layers and Tables**

**Layers:**

- **Census Block Points** (0)
- **Census Block Group** (1)
- **Counties** (2)
  - **Coarse Counties** (3)
  - **Detailed Counties** (4)
- **states** (5)

**Tables:**

**Description:** This service presents various population statistics from Census 2000, including total population, population density, racial counts, and more. The map service presents statistics at the state, county, block group, and block point levels.
ArcGIS Server Administrator API

- New REST Administrative API
- Script common administrative actions
  - Publish a service
  - Start and stop a service
- Can use with any programming language that can make HTTP requests
  - Python, Perl
Configurable Web Applications

- Free viewers that you can use to build web applications without programming
  - Flex API
  - Silverlight API
Web and Mobile APIs

• Used to build custom web and mobile applications
  – ArcGIS Server API for JavaScript
    • Uses HTML/CSS/JavaScript to build applications
  – ArcGIS Server API for Flex
  – ArcGIS Server API for Silverlight

• Mobile APIs
  – iOS, Android, Windows Phone
ArcGIS for SharePoint

• Leverages Microsoft SharePoint to provide configurable mapping components

• Can use:
  – ArcGIS Server
  – ArcGIS Spatial Data Server
  – ArcGIS Online
  – Microsoft document libraries
• Optional extensions provide additional functionality

• 3D Analyst

• Data Interoperability

• Data Reviewer

• Geostatistical Analyst

• Image

• Network Analyst

• Schematics

• Spatial Analyst

• Workflow Manager
Deployment Scenarios

• ArcGIS Server provides a scalable architecture

• Numerous deployment options
  – May choose to install everything on one machine
    • Works fine for small deployments or development and testing
  – Large deployments may require multiple machines
    • Large community of users with heavy access
ARCGIS SERVER EDITIONS
• Provided via three editions
  – Basic
  – Standard
  – Advanced
• Geodatabase management (ArcSDE)
• Publish feature services for map visualization and query
• Geometry service
• Publish geodata services
ArcGIS Server Standard Edition

- Everything included with Basic Edition
- All web service types for maps, imagery, 3D globes, etc
- Web based editing with feature services
- Publish geoprocessing services from ArcGIS Desktop Standard tools
- Schematics extension
ArcGIS Server Advanced Edition

• Everything in Basic and Standard Editions
• Publish geoprocessing tools from any ArcGIS Desktop Advanced tools
ArcGIS Server for Workgroup

- Workgroup level
- Lower price point
- Small deployments with file-based geodatabases or SQL Server Express
- Available at Basic, Standard, and Advanced Editions
WHAT’S NEW IN ARCGIS SERVER 10.1
What’s New in ArcGIS Server 10.1

- 64-bit application
  - Enhances performance of hardware
- Setups distinguished by Windows or Linux
  - Previously .NET and Java Platform
- Simplified installation
  - Just one account for accessing resources, data and running a service
    - Previously there were several accounts
    - No post-installation
- ArcGIS Server site replaces SOM-SOC model
- ArcGIS Web Adaptor
What’s New in ArcGIS Server 10.1

- New look ArcGIS Server Manager
- Create scripts for administration
- ArcGIS Server clusters
- Server object extensions deployable from Manager
- Set of pre-configured services
- Data can be copied to the server on publication
- No distinction between mxd and msd services
Publishing ArcGIS Server Services

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Module Outline

- Publishing Basics
- Service Types
- Preparing Data Resources for Publication as Services
- How to Publish Services
PUBLISHING BASICS
# How to Publish a Resource

<table>
<thead>
<tr>
<th>Maps, Globes</th>
<th>Geoprocessing Model or Tool</th>
<th>Geodatabase, Address Locator, Others</th>
</tr>
</thead>
</table>
| • Use ArcMap or ArcGlobe  
  • File → Share As → Service | • Results window in ArcMap  
  • Right click → Share As → Geoprocessing Service | • ArcCatalog  
  • Right click → Share As Service |
Publication Choices

• Publish a service

• Save service definition file
  – Service definition file used when publishing will occur later or on a separate machine
  – Cloud environments, secure environments, server not immediately available

• Overwrite existing service
  – Used when you want to update a GIS service with new resource data
SERVICE TYPES
## Types of Services

<table>
<thead>
<tr>
<th>Feature</th>
<th>Geocode</th>
<th>Geodata</th>
<th>Geometry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geoprocessing</td>
<td>Globe</td>
<td>Image</td>
<td>KML</td>
</tr>
<tr>
<td>Map</td>
<td>Mobile</td>
<td>Network Analysis</td>
<td>OGC</td>
</tr>
<tr>
<td>Schematics</td>
<td>Search</td>
<td>Workflow</td>
<td></td>
</tr>
</tbody>
</table>
• Serve features over the web and provided symbology for displaying features
• Often used for editing
• Data resides in ArcSDE
• Can use templates for editing
Geocode Services

- Used to display addresses on a map
- Can be used to generate driving directions
- Create address locator in ArcGIS Desktop (ArcCatalog)
- Can also perform reverse geocoding
  - Find address nearest a point
Geodata Service

- Allows access to a geodatabase through the web
- Replication, extract data, execute queries
- Can be file or ArcSDE geodatabase
- Published from ArcCatalog
Geometry Service

- Performs geometric calculations
  - Buffer, simplify, calculate area/length, projection
- Used with web editing applications
- Automatically created in Utilities folder
- Not started by default
  - Started with ArcGIS Desktop or Manager
- Only one geometry service per ArcGIS Server instance
Geoprocessing Services

- Geoprocessing allows you to automate and chain together GIS operations
- Create custom tools and models with ArcGIS Desktop
  - Chain tools and models in a logical fashion
  - Accomplish some sort of GIS task
  - Example: Buffer a stream layer and then clip vegetation layer to the buffer
- These models can be run on a centralized server and accessed through web applications
Geoprocessing Services

Model built in ArcGIS Desktop

Published to ArcGIS Server as Geoprocessing Task

AGIS

GP

Geoprocessor Object

API for JavaScript

Web Application
• Share 3D content
• Content originates in ArcGlobe
• Clients that can consume ArcGlobe services
  – ArcGlobe, ArcGIS Explorer Desktop, ArcReader, custom ArcGIS Engine applications
• ArcGIS Server works with 3D Analyst Extension
Image Services

- Raster and image data shared as image services
- Source data
  - Geodatabase
  - Layer file referencing a raster dataset or mosaic dataset
- Need Image Extension to share a mosaic dataset or a raster layer containing a mosaic function
- Location of image data
  - Data should be on a shared drive registered with the server
  - Data can also be duplicated on the server
KML Services

- Can share your GIS data with KML clients
  - KML is a type of XML
- Map and image services expose a KML network link through REST
- Result of queries, geoprocessing, and geocoding returned as KML
- KML is dynamically generated
- KML services are generated by default with map and image services
Map Services

- Maps made available through ArcGIS Server
- Authored in ArcMap
- Map services make maps, features, and attribute data available inside many different types of clients
Mobile Data Service

- Provides access to source data of a map document to ArcGIS Mobile applications
- Created in ArcMap as a map document file (mxd)
- Share map as a service with Mobile Data Access capability enabled
OGC Services

- Open Geospatial Consortium (OGC) services provide a way that you can make maps and data available in an open format over the web
- OGC defines specifications for making maps and data available on the web
- Several types of services can be published with ArcGIS Server
  - Web Map Service (WMS) – serving collections of layers as map images
  - Web Map Tile Service (WMTS) – serving map layers as cached map tiles
  - Web Features Service (WFS) – serving data as vector features
  - Web Coverage Service (WCS) – Serving data as raster coverages
  - Web Processing Service (WPS) – Serving geospatial processing
Schematics Services

- Service for accessing schematic diagrams
- Uses Schematics Extension to access, create, update, and edit schematic diagrams
- Use ArcMap to create a map document that contains schematic layers
Search Services

- Creates a searchable index of your organization’s GIS content
- Useful for organizations with large data holdings across multiple databases and file shares
Making Data Accessible to ArcGIS Server

- ArcGIS Server needs access to data to expose it to clients
- 3 things you need to do to make data accessible to ArcGIS Server
  1. Store data where ArcGIS Server can see it
  2. Grant ArcGIS Server account permissions to the data
  3. Register data with the server
• Important!

• Should use ArcSDE or Universal Naming Convention (UNC) paths for storing data
  – Should not use local data sources (c:\gisdata\projects) in most cases.
    • ArcGIS Server won’t have the same local reference unless you have the same folder structure on the server.

• ArcGIS Server must also have access and permissions to the map document (mxd)
Data Permissions on Geodatabase

- Data stored in geodatabase
  - ArcGIS Server should have appropriate permissions to access geodatabase
    - ArcGIS Server account should be granted permissions to data. This is the operating system account used to install ArcGIS Server.
  - ArcSDE
    - Permissions depend upon authentication
      - Can be database or operating system authentication
  - File or Personal Geodatabase
    - Use operating system to give ArcGIS Server account read permissions to folder containing geodatabase
Data Permissions on File Based Data Sources

• Working with shapefiles and coverages?
  – ArcGIS Server must have at least read access to the data
  • Need write access if doing editing
  – Work with the operating system to grant access to ArcGIS Server
Automatically Copying Data to ArcGIS Server

- When you publish a service you can automatically copy data to ArcGIS Server
- Ensures ArcGIS Server has access and permissions to the data
- Doesn’t give you control over how server and services will access data
- Useful in some situations
  - Publishing to a server you don’t have permissions to access
  - Help keep internally edited datasets separate from those placed on the server
Scenarios for Automatic Data Copy

• Scenario: Data to be copied does not require enterprise geodatabase
  – Ignore the warning: ‘data source is not registered with the server and data will be copied to the server’ in the Prepare window
  – Data is automatically copied
  – No further action on your part
Scenarios for Automatic Data Copy

• Scenario: Running ArcGIS Server in a Cloud Environment
  – More efficient to use automatic copying in this scenario
    • Don’t have to login and transfer data to the cloud
  – Can cause replication of data if many services use same data
Scenarios for Automatic Data Copy

- Scenario: On Premise Server
  - Don’t have login rights to ArcGIS Server
  - Publish a snapshot of your data
Scenarios for Automatic Data Copy

- Scenario: Service Type Requires Enterprise Geodatabase
  - Used with feature services or WFS services
  - Also used with Cloud services
  - Must first create the database on the server and register it as ArcGIS Server’s Managed Database
  - Data is then copied to the enterprise database
Registering Data with ArcGIS Server

• Can register your data folders and geodatabases with ArcGIS Server
• Gives ArcGIS Server a list of locations the server administrator has verified that can be accessed
• Registration does not grant ArcGIS Server permissions to access data
  – Must do this separately
• Need to ensure the 64 bit version of the database’s client software is installed on each GIS server in your site
  – [Setup for SQL Server](#)
  – [Setup for Oracle](#)
  – [Setup for PostgreSQL](#)
Benefits of Registering Data with ArcGIS Server

• Validates that the data being used in a service is in a known and approved location
• Automatic remapping of paths to data when you publish
Scenarios for Registering Data

- Scenario: Publisher’s machine and server have same database
  - Import the publisher’s database connection
  - Set the server’s database connection to ‘Same as publisher’s connection’ when registering your data
Scenarios for Registering Data

- Scenario: Publisher’s machine and server working out of the same folder
  - File or personal geodatabases, shapefiles (data stored in a folder)
  - Specify the publisher’s folder path and set the server’s folder path to ‘Same as publisher’s path’ when registering data
**Scenarios for Registering Data**

- **Scenario:** Publisher’s machine and the server are working with different databases
  - May be working with different databases
  - Import both the connection to the publisher’s database and the connection to the server’s database
  - Maintains a copy of the data
Scenarios for Registering Data

• Scenario: Publisher’s machine and server are working out of different folders
  – Enter the path to both the publisher’s folder and the server’s folder
  – Maintains a copy of the data
Using ArcGIS Desktop to Register Data

- Can use ArcCatalog to register folder and geodatabases
- ESRI provided demonstration showing how to register a database
- ESRI provided demonstration showing how to register a folder
PUBLICATION OF SERVICES
Creating Map Services

• Using ArcMap
  – Open a map document file
  – File → Share As → Service

• Using ArcCatalog
  – Right click map document file → Share as Service

• Using ArcGIS Server Manager
Process for Creating a Service (Map Service)

1. Open map document file (mxd) in ArcMap
2. Select File → Share As → Service from ArcMap
3. Select Publish a service
4. Connect to ArcGIS Server
5. Define an optional name for your service (defaults to name of resource)
6. Select folder for the service (default is root)
7. Set service properties
8. Analyze the resource for problems
9. Fix errors
10. Optionally click Preview
11. Publish the service
Exercise

• Please complete the following exercise:
  Creating a Map Service from a Map Document File
PREPARING DATA RESOURCES FOR PUBLICATION AS SERVICES
Preparing Resources for Publication

• ArcGIS Server must have access to
  – GIS resource
    • Example: Map document file you create for a map service must be accessible by ArcGIS Server
  – Data contained in the resource
    • Example: All data in the map document file must be accessible
• Resource and data should be stored on a server with a shared directory and/or geodatabase
  – **DO NOT** store resource and data locally (i.e. C:\Data)
Analyzing a Map Document File

• The Analyze button help you identify
  – Errors
  – Warnings
  – Informational messages

• Errors must be fixed before a map document can be published as a service
Creating a Service Definition File

- Contains all the service properties including capabilities and type in a single file
- Used to transfer to an ArcGIS Server instance at a later date
  - Cloud environments, secure environments, server not immediately available
- Watch a demonstration
ArcGIS Server Caching

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Module Outline

- Introduction to Map Caching
- Map Caching Process
- Cache Properties and Generation
- Caching Strategies
- Map Cache Usage by Clients
INTRODUCTION TO MAP CACHING
What is Map Caching?

- Process of generating tiles of a map at various scales
  - Map image tiles are stored on the server and distributed to the client as necessary
- Speeds up your applications by drawing data faster
Reasons for Creating Map Caches

- **Performance**
  - Maps delivered quickly to users

- **Quality**
  - Performance not affected by map detail

- **Industry Standard**
  - Google Maps, Bing Maps, OpenLayers all use this approach
What Data to Cache?

- Caching is a snapshot in time
- Used for maps that **DO NOT** change often
  - Base Maps
    - Streets, imagery, terrain
  - Layers with infrequent changes
MAP CACHING PROCESS
Map Caching Process

- **Design and Publish Map**
  - ArcMap
  - ArcGIS Server

- **Set Cache Properties**
  - ArcCatalog
  - Tiling Scheme
  - Scales

- **ArcGIS Server**
  - Images stored as files

- **Cache Created**

- **Images Served**
  - Client Apps
Planning the Map Cache

- Need to consider various factors before building map cache
  - What layers and symbology will be used?
  - Do the layers and symbology change as the scale changes?
  - What scales should be used:
    - How often does the data in these layers change?
  - What type of tiling scheme would be most appropriate?
  - What resources (hardware) are needed to build the cache?
Map Design for Caching

- Must ensure that your map is readable at multiple scales
- Start with a template
  - ESRI Map Templates Resource Center
    - Downloadable examples of multi-scale maps
- Choose scales and scale dependencies
  - Apply scale dependencies to labels and features
    - More detailed datasets when zoomed in
      - Less detailed datasets turn off
    - Labels and feature type changes convey information
- Carefully choose coordinate system for data frame
Planning Layer Visibility

• By default, ArcGIS Server creates a fused cache
  – Fused cache means all layers cached in one image
  – Can’t turn layers on/off
  – Used because they are fast

• Multilayer cache also available
  – Groups of layers in a map fused together
  – Client applications must wait for AGIS to retrieve multiple images, overlay them, and draw labels on top
  – Not much performance benefit

• How do we get fast performance and still be able to turn layers on/off?
Planning Layer Visibility

- Clients can overlay \( n \) fused caches faster than \( n \) layers in a multilayer cache

- Solution:
  - Group related sets of layers in separate map document files
  - Publish a map service and create a fused cache from each map document

```
MXD  Service  Cache  Application
     ↘     ↘     ↘
     ↘     ↘     ↘
     ↘     ↘     ↘
```
Cache Creation Time

- Map images created for full extent at each scale
- Multi-layer caches repeat process for each layer
- Scale levels factor in
- Server resources available
- Density of map information
- Cache Type
Choice of Cache Type

- Cache generation quicker with fused cache type
  - All layers cached into one image.
  - One image per tile across full extent for each scale
- Multilayer cache type
  - Images for each layer across full extent for each scale
  - Can take much longer if many layers
Choice of Scale Levels

• Caching takes longer when:
  – Have more scale levels
  – You zoom in on the map

• Example on next slide
<table>
<thead>
<tr>
<th>Level</th>
<th>Scale</th>
<th>Tiles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st level</td>
<td>1:32,000,000</td>
<td>1 tile</td>
</tr>
<tr>
<td>2nd level</td>
<td>1:16,000,000</td>
<td>4 tiles</td>
</tr>
<tr>
<td>3rd level</td>
<td>1:8,000,000</td>
<td>16 tiles</td>
</tr>
<tr>
<td>4th level</td>
<td>1:4,000,000</td>
<td>64 tiles</td>
</tr>
<tr>
<td>5th level</td>
<td>1:2,000,000</td>
<td>256 tiles</td>
</tr>
<tr>
<td>6th level</td>
<td>1:1,000,000</td>
<td>1,024 tiles</td>
</tr>
<tr>
<td>7th level</td>
<td>1:500,000</td>
<td>4,096 tiles</td>
</tr>
<tr>
<td>8th level</td>
<td>1:250,000</td>
<td>16,384 tiles</td>
</tr>
<tr>
<td>9th level</td>
<td>1:125,000</td>
<td>65,536 tiles</td>
</tr>
<tr>
<td>10th level</td>
<td>1:62,500</td>
<td>262,144 tiles</td>
</tr>
<tr>
<td>11th level</td>
<td>1:31,250</td>
<td>1,048,576 tiles</td>
</tr>
</tbody>
</table>

Provided by ESRI
More Service Instances = Faster Cache Generation
Map Density

- Cache size and generation time affected by density of map information
- Many changing colors and patterns
- High resolution images
- Many layers
Monitoring Progress of Cache Generation

- Manage Map Server Cache Tiles tool contains progress bar
  - Gives percentage complete
- Can also view creation in Windows Explorer
CACHE PROPERTIES & GENERATION
Cache Generation

Set Properties

Generate Tiles
Available Cache Properties

- Accessed through Caching tab

### Basic
- Tiling Scheme
- Levels of Detail

### Advanced
- Scales
- Minimum cached scale
- Maximum cached scale
- Cache directory
- Area of interest to cache
- Tile format
- Compression
How to Access Cache Properties

• Open ArcCatalog
  – Expand GIS Servers node
• Establish a connection to ArcGIS Server
  – As a publisher or administrator connection
• Right click the service of interest and select Service Properties
  – Displays Service Editor dialog
• Click Caching tab
• Adjust cache properties
Cache Properties: Tiling Scheme

- **Includes**
  - Scale levels
  - Tile dimensions
  - Tile origin

- **Options**
  - ArcGIS Online/Bing Maps/Google Maps
  - Tiling Scheme File
  - Existing Cached Map/Image Service
  - Suggest
### Cache Properties: Tiling Scheme Choices

<table>
<thead>
<tr>
<th>Google/Bing/ESRI</th>
<th>Existing Map Service</th>
<th>Tiling Scheme File</th>
<th>Suggest</th>
</tr>
</thead>
<tbody>
<tr>
<td>ArcGIS Online</td>
<td>Your organization has defined a tiling scheme</td>
<td>Conf.xml in cache directory</td>
<td>ArcGIS suggests scales</td>
</tr>
<tr>
<td>Bing Maps</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Google Maps</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ArcGIS Online, Bing Maps, Google Maps Tiling Schemes

- Do you intend to use ArcGIS Online, Bing Maps or Google Maps as a base layer?
  - Use one of these tiling schemes
    - Data frame in your source MXD file must use WGS 1984 Web Mercator projection
- Use one of these tiling schemes if your data will overlay base layers from these providers
- May contain scales zoomed in too far for your data
  - Creating caches at large scales can take a lot of time and disk space so plan accordingly
Tiling Scheme from Existing Map Service

- Many organizations choose to define a common tiling scheme for their data
- In this case you can simply select an existing map service created from this tiling scheme
- Ensures that tile will overlay correctly in web applications
- Use same coordinate system
Tiling Scheme File

- Use **Generate Map Server Cache Tiling Scheme** tool in ArcToolbox
- Generates an XML file (conf.xml)
- ArcGIS Server cache directory contains a **conf.xml** file.
- Used to hold tiling scheme
- Often obtained through email or file sharing
Cache Properties: Levels of Detail

• Tiling schemes contain many scales
  – May want to forego some large and small scales
  – ArcGIS will attempt to suggest a min and max scale
  – Can adjust the scales using the slider seen below

• Limit to 20 or few scales

Levels of Detail
Choose the minimum and maximum scales for this tiled map/image service. All levels between the minimum and maximum scale levels will be cached.

Minimum scale level
Level: 9
Scale: 1:1,155,581.108577

Maximum scale level
Level: 17
Scale: 1:4,513.988705

1: 250,000
1: 125,000
1: 64,000
1: 32,000
1: 16,000
1: 8,000
Cache Properties: Scales

• Accessed through Caching → Advanced Settings on Service Editor

• Ideally you should select the scales yourself

• Simple way to pick scales
  – Determine closest scale user will view map
  – Continue to double scale denominator
  – Stop when you reach a scale that will visualize area of interest in one or two tiles
  – Example: Closest scale is 1: 2,000
  – Values would be 2,000, 4,000, 8,000, 16,000, 32,000, etc until you reach a point where one or two tiles covers the area of interest
Cache Properties: Storage Settings

• Compact
  – Each file contains a bundle of tiles.
  – Bundles are 128 x 128 tiles
  – Copy much faster than exploded and take less disk space

• Exploded
  – Each tile stored as a file on disk
  – Larger caches
Cache Properties: Cache Directory

- Folder where cache tiles are stored
- Can have more than one directory for storage
- Also contains several files
  - Tiling scheme file (config.xml)
  - Default extent information (conf.cdi)
  - Geodatabase for cache status reports
Cache Properties: Tiling Scheme Origin

- Upper left corner of tiling scheme grid
- Origin not necessarily the point at which tiles begin to be created
  - Map tile generation begin when the full extent of the map is reached
- Keep the default value
Cache Properties: Tile Width and Height

- Default is 256 x 256 pixels
- Can choose any value that is power of 2
- Recommended that you use 256, or 512
- Use the same values if you are building a cache to overlay another cache
Cache Properties: Tile Format

- PNG
- PNG8
- PNG24
- PNG32
- JPEG
- Mixed
Cache Properties: Area of Interest to Cache

- Determines which area of the map will have tiles created
- Used when you use ArcGIS to build cache when service is published
- Options
  - Full extent of map (Default)
  - Current extent of map (Initial extent of map)
  - Import from a feature class (uses a template feature class)
    - Used for large caches or area of interest not rectangular
Several ways to calculate

1. Estimate Cache Size estimate on Caching tab of Service Editor
   - Rough estimate
2. Also a Manage Map Server Cache Tiles tool
3. Calculate Cache Size utility
   - Most accurate
Creating Map Cache Tiles

• Can create cache tiles in several ways
  – Use ArcGIS Desktop to create cache when service is initially created
  – Access the Service Editor on a service after creation
  – Build tiles on demand when user first visits an area
  – Generate Map Server Cache Tiling Scheme tool
    • Creates a tiling scheme file in XML format
  – Manage Map Server Cache Tiles tool
    • Create, update, or delete tiles in a cache
Creating a Cache from a Feature in a Feature Class

- Constrains tile creation to the boundaries in a feature class
- In Service Editor go to Caching → Advanced Settings and set the Area of interest to cache to ‘Import from a feature class’
- Can also use Manage Map Server Cache tool.
  - Set the Area of Interest parameter
- Must use polygon feature class
  - Only cache by feature class at large scales
  - Generalize feature boundaries
    - Improves performance of cache creation
On Demand Map Caching

- Tiles created when first visited by a user
  - Short wait time for first user
- No wait for subsequent users
- Useful for areas of low interest to your audience
  - Example: Non-populated area of an application that focuses on high population areas
- Saves time and disk space
  - Can cause performance problems when used improperly
- Ways to reduce performance costs
  - Properly determine areas that will be on-demand
  - Testing and optimizing the map
• Right click a service in ArcCatalog and click View Cache Status
Recommendations for improving performance of cache creation:

- Use local file geodatabase
- Avoid projection on the fly
- Choose antialiasing levels with care
- Fully utilize CPU
- Create only the tiles you need
Exporting and Importing a Map Cache

• Two tools (Server Tools toolbox)
  – Export Map Server Cache
  – Import Map Server Cache

Server 1 → Map Cache → Server 2
Exporting and Importing a Tile Cache

- Workflow
  - Export a tile set from an ArcGIS Server instance (Export Map Server Cache tool)
  - Import the tile set to a new ArcGIS Server instance
    OR
  - Import as a disconnected raster dataset

- Export Tile Set
  - Optionally use as disconnected raster dataset
  - Optionally import tiles into cache
Exporting a Map Tile Cache

• Use Export Map Server Cache tool
  – Can define an area of interest to export (use a feature class as area of interest)

• Export destination
  – Shared folder on the network
  – Web enabled folder
  – Occasionally disconnected laptop
  – External hard drive

• In addition to tiles, export contains
  – Tiling scheme file (config.xml)
  – Cache dimension information (conf.cdi)
Using an Exported Tile Cache as Disconnected Raster Dataset

• Tile cache can be used directly from disk
• ArcMap accesses as raster dataset
• Can be useful in disconnected laptop settings
Importing the Tile Cache

- Use Import Map Server Cache tool
  - Imports to an existing cache
- Tiling schemes must match
- Image format of caches must match
  - Where possible use PNG or MIXED when exporting/importing
- Optionally define area of interest to import
MAP CACHE STRATEGIES
Map Cache Strategies

• Two primary strategies

1. Pre-create tiles so they are available to users
   - Advantage is increased performance for entire study areas
   - Disadvantage is the storage capacity needed and time to create the cache

2. Create tiles on-demand
   - Tiles created when an area is first viewed
   - First visitor will have a wait time
     • Subsequent visitors take advantage of newly created tiled
Map Cache Strategies

- Effective caching strategy
  - Pre-create tiles for heavily visit areas
  - On demand creation for rarely visited areas

Image source: ESRI
Pre-Creating Tiles Based on Feature Extent

- Designation of pre-cached areas done through feature class
- Caching tools allow you to select a feature class
- Use ‘Update specific areas using a feature class’ option
  - Manage Map Server Cache Tiles tool
Map cache is a snapshot of your data

As data changes you need to update cache to reflect changes

2 things need to happen

1. **Update the cache**
   - Involves re-creating some or all tiles
   - Use Manage Map Server Cache Tile tool

2. **Clear local cache on client**
MAP CACHE USAGE BY CLIENTS
How Applications Use the Cache

- Map service is automatically restarted when cache creation is complete
- Service then begins using the cache
- Client usage of the cache differs depending upon the type of application
  - Web Applications
  - ArcMap
  - ArcGlobe and ArcExplorer
Web Application Cache Usage

- REST APIs (JavaScript, Flex, Silverlight) use a specific class to connect to cache map service
  - Example: Flex API uses ArcGISTiledMapServiceLayer class
  - Tiles retrieved from the cache by REST calls
ArcMap Usage of Cache

• Cached map services added to ArcMap using Add Data button
  – Same as with any other map service

• 2 ways to view cache in ArcMap
  1. Access cache through map service
     • Browse to GIS server and map service used to create the cache
     • ArcMap connects to determine if there is a cache
     • Tiles retrieved from the cache directory if a cache is present
  2. Access cache as raster dataset
     • Browse to directory containing the cache tiles
     • Choose add dataset to ArcMap

• ArcMap can handle viewing multilayer caches
ArcGlobe and ArcExplorer Cache Usage

- Both can read 2D caches and drape them over the surface of the globe
- Best results if cache was built with ArcGIS Online, Google Maps, Bing Maps tiling scheme
- Can use 3D globe caches instead of 2D caches
  - 3D globe caches not covered in this course
Local Caching of Layers on the Client

- ArcMap, ArcExplorer, ArcGlobe maintain local caches of tiles that have been visited
- Local cache used when visited areas re-visited
- Improves performance as not round trip to server is necessary
- Can choose to save tiles to the local caches for future sessions or use local cache only for current session
- Can also choose not to store tiles locally
- See next slide for visual depiction of this process
Local Caching of Layers on the Client

ArcMap

View Area

Tiles available locally

Tiles not available locally

ArcGIS Server
Tips and Best Practices for Map Caching

- ESRI provides a list of best practices and tips for map caching
Build Web Applications without Programming
ArcGIS Viewer for Flex

E-Learning for the GIS Professional – Any Time, Any Place!
geospatialtraining.com
Module Outline

- What is the ArcGIS Viewer for Flex?
- Using Application Builder to Construct Applications without Programming
  - Downloading the Application Builder and Getting Started
  - Adding Basemaps and Operational Layers
  - Adding Widgets
  - Application Layout
  - Application Design
  - Preview
  - Publication
WHAT IS THE ARCGIS VIEWER FOR FLEX?
What is the ArcGIS Viewer for Flex?

- Configurable application built with Flex and the ArcGIS Server API for Flex
- No programming required
- Can add basemaps and operational layers
- Add widgets
- Structure the layout of your application
- Design the layout
• No programming, just configure and deploy your web application

• What do you need?
  – Web browser
  – Web server (IIS, Apache, others)
  – Application Builder (must have write access to web server directory where your application will be created)

• Limitations?
  – Must create custom widgets to add functionality not included with pre-defined widgets
  – Mobile limitations
Application Builder

- **Download**
  

- **Installation guide**
  
  http://resources.arcgis.com/en/help/flex-viewer/concepts/index.html#/01m30000002w000000

- **Apache Web Server**
  
  - Download from the Exercise Materials folder if needed
USING APPLICATION BUILDER TO CREATE A GIS WEB APPLICATION
Application Builder

- **Download**
  

- **Installation guide**
  
  http://resources.arcgis.com/en/help/flex-viewer/concepts/index.html#//01m30000002w000000

- **Apache Web Server**
  
  - Download from the Exercise Materials folder if needed
Introduction to Application Builder

- WYSIWYG editor for building or editing web GIS applications
- No programming
- Workflow for building an application

Application Builder Workflow:

1. Data Content
2. Functionality
3. Appearance

Begin building your first application
Files Associated with Application Builder

- First time Application Builder starts will require two parameters to be set
  - Web Server Base Folder
    - Default physical location where web applications will be created
    - Example: C:\Apache\htdocs\flexviewers
  - Web Server Base Folder URL
    - URL base address for your viewer applications
    - Creates a flexviewers folder by default
    - Example: http://localhost/flexviewers
      - This would point to a physical location of c:\Apache\htdocs\flexviewers
Creating a New Application

- **Application Builder**
  - Displays existing projects
  - Provides a button for creating new applications

- **Create new application**
Adding Maps

• Can add web maps or basemaps and operational layers to your application
  
  – Web Maps
    • Provided through ArcGIS.com
  
  – Basemaps and Operational Layers
    • ESRI basemaps and layers you define

<table>
<thead>
<tr>
<th>Maps</th>
<th>Widgets</th>
<th>Layout</th>
<th>Design</th>
<th>Preview</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Web Maps" /></td>
<td><img src="image2.png" alt="Basemaps and Operational Layers" /></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Adding Web Maps

- Featured maps
  - From ArcGIS.com
- Content associated with your login
  - Portal login
Adding Basemaps

- Add basemaps
  - ArcGIS Online
  - ArcGIS Server
  - Web

- Select a layer from the list provided → Click Include to move to Selected Basemaps
Adding Operational Layers

- Custom, organization specific business datasets
- Uses and ArcGIS Server instance
  - Can also use ArcGIS.com
- Select an operational layer and click Include
• Need to periodically click the Save button

• Saves your additions and edits for the application
Defining the Initial Map Extent

- Use the Map Extent tab
- Use Navigation tools to zoom in or out
- Can also use ‘Zoom to operational layers extent’
- Set of widgets that can be added
- Add functionality to application
- Click a widget from the catalog and select Include button
- Can change display order
- Have properties
• Widgets have properties you can set
• Set various layout aspects
  – Splash screen
  – Header
  – Navigation
  – Map switcher
  – Overview map
  – Attribution
  – Static image
  – Scale Bar
  – Coordinates
  – Attribute Table
• Design tab
  – Include an organization logo (png, jpg, or gif format)
  – Title and Fonts
  – Color Scheme
• Gives you an interactive preview of the application

![Relationship of unemployment to population change](image-url)
• Settings dialog used to set
  – Web Server base and URL folders
  – Locale
  – Bing Maps Key
  – HTTP Proxy URL
  – Geometry Service URL
  – Portal for ArcGIS
  – Getting Started Pop-ups
  – Manage custom widgets
Custom Widgets

• May need to include functionality not provided in current set of widgets provided by Application Builder

• Can add custom widgets
  – Widgets developed with Flex and the ArcGIS Server API for Flex
  – Programming
  – Can be third party or widgets you’ve developed

• Add through Settings dialog
Exercise

- Please complete the following exercise:
  Using Application Builder to Create a GIS Web Application