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# What's New in ArcGIS 9.4?

September 21, 2009

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## General

- Resource Centers and Support Website merged into a single Website and user experience.
- Product documentation re-organization and improvements, including reduced install size, addition of videos to the Web Help, and the addition of workflows and tutorials. In addition, over 75% has been re-written and updated for 9.4.

## Data Management

### The geodatabase

#### Data types

- **ArcSDE 9.4 geodatabases support three new data types:** ST\_Raster, VarbinaryMax() in SQL Server, and native DBMS XML types in IBM DB2, Oracle, PostgreSQL, and Microsoft SQL Server.
- New functionality at 9.4 related to data types includes the ability to migrate raster data from binary to ST\_Raster and improved management of spatial references on SQL Server geometry tables registered with ArcSDE.
- **New SQL data type for raster data:** A new raster storage type, ST\_Raster, is available in ArcSDE geodatabases. This type allows you to alter and obtain information about raster data using SQL, including doing such things as return or set the pixel value of a raster; set the color map, mosaic, or build statistics or pyramids on a raster; crop or export a raster; and get the version, compression type, interleave type, or pyramid level of a raster. You can migrate existing raster data to the ST\_Raster type using the Migrate Storage geoprocessing tool or the sderaster administration command.
- **Support for native XML columns:** At 9.4, ArcSDE supports the use of native XML columns in geodatabases in DB2, Oracle, PostgreSQL, and SQL Server databases. New DBTUNE parameters have been introduced to specify whether a native XML or ArcSDE XML column is created and to control the storage of native XML columns.
- **Support for varbinarymax() columns in SQL Server:** Microsoft has deprecated the Image type in SQL Server. When creating new datasets in an ArcSDE geodatabase for SQL Server, columns that would have been created as an Image type in previous releases will now be created as VarbinaryMax() columns. Examples of columns that will use VarbinaryMax() instead of Image columns include binary geometry and raster columns.
- **Improved internal management of spatial references for SQL Server geometry data types in a geodatabase:** The way the geodatabase manages spatial references when you register SQL Server tables that contain geometry data type columns has also been improved.

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## Create layers based on SQL queries

- A new utility, Query Layers, is available in ArcMap that allows you to create new layers or stand alone tables that are defined by SQL queries. The queries you define are executed each time you use or render the data; therefore, the query returns the data in its current state.
- After a Query Layer has been created it can be saved as a layer file (.lyr) or used to create a layer package (.lpx). This makes it easy to share Query Layers with other applications, map documents, and with other users.
- Map documents can be saved and published to ArcGIS server, making Query Layer information available to many of the ArcGIS Server APIs.
- Query layers can also be created on spatial data in databases that do not contain a geodatabase.

## Replication

- **Improvements to geodatabase replication;** The geodatabase replication model has been improved at 9.4 to include one way replication using archiving and one way child to parent replication.
- **One-way replication using archiving:** Newly implemented at 9.4 is the ability to use archiving instead of versioning to keep track of replica changes. This option is only available for one way replication, and only if the source replica is the DEFAULT version.
- **One-way child to parent replication:** One-way replication allows data changes to be sent multiple times from the parent replica to the child replica and, starting at 9.4, from the child replica to the parent replica.

## Geodatabase management

- **Upgrade all types of geodatabases using the Upgrade Geodatabase geoprocessing tool or Python script:** You must use the Upgrade Geodatabase geoprocessing tool or Python script to upgrade personal and file geodatabases as well as ArcSDE geodatabases licensed under ArcGIS Desktop or ArcGIS Engine, ArcGIS Server at the Workgroup level, or ArcGIS Server at the Enterprise level.
- **Control the storage of geometry and BLOB columns in file geodatabases:** When you create a feature class or feature dataset in a file geodatabase, you can specify the configuration keyword. This keyword instructs the geodatabase to store the geometry or BLOB columns in that dataset out-of-line. That means the column itself stores a pointer to a different location in the geodatabase where the data itself is stored.
- **Create a geodatabase in the sde user's schema in SQL Server by specifying a new option:** At 9.4, all new geodatabases must be created by a dbo user. Therefore, you must be able to specify whether you want the geodatabase to be owned by a user named sde or the dbo user.

- **Administer geocoding rules and locators in ArcGIS Server and ArcGIS Desktop:** The creation and administration of geocoding rules and locators has been removed from ArcSDE geodatabases and moved into ArcGIS Server and ArcGIS Desktop. Therefore, the `sdegcd` and `sdelocator` ArcSDE administration commands have been removed along with associated functionality and API functions.
- **Remove and block direct connections to an ArcSDE geodatabase:** You can use the `sdemon` command with the `kill` operation to drop direct connections to an ArcSDE geodatabase. You can also use the `sdemon` command to prevent connections, both ArcSDE service and direct connections, from being made to a geodatabase. Use the `pause` operation to do this.
- **Backward-compatible, ArcSDE direct-connect drivers included with ArcGIS Desktop setup:** At 9.4, you do not have to install backward-compatible direct-connect drivers in ArcGIS Desktop to access 9.2 or 9.3 geodatabases from an ArcGIS 9.4 Desktop client; the necessary drivers are present by default.
- **Changes to the geodatabase system tables:** The geodatabase schema has been restructured for the 9.4 release, consolidating the information previously stored in the geodatabase system tables into 6 tables. This is done partly by using XML columns to store information related to the data in the geodatabase. All new and upgraded file, personal, and ArcSDE geodatabases will have the new geodatabase schema.
- **New network functionality:** At 9.4, both geometric networks and network datasets support 3-dimensional (vertical) networks.
- **Vertical networks:** Geometric networks and network datasets at 9.4 include the ability to create and edit 3-dimensional networks.

### Application programming interfaces (API)

- **Locator management and geocoding ArcSDE API deprecated:** Since locator and geocoding management have been moved into ArcGIS Server and ArcGIS Desktop, the C and Java functions previously used for this have been deprecated. If you have custom applications that use these API, you must rewrite them using ArcObjects methods.
- **New ArcSDE functions to work with native XML types:** New API have been introduced to work with XML columns and schemas within each DBMS that supports them. These are as follows:
 

○ SE_xmlcolumninfo_get_document_option	○ SE_xmlschema_create
○ SE_xmlcolumninfo_set_document_option	○ SE_xmlschema_delete
○ SE_xmlcolumninfo_get_schema	○ SE_xmlschemainfo_add_schema
○ SE_xmlcolumninfo_set_schema	○ SE_xmlschemainfo_create
○ SE_xmlcolumninfo_get_storage_type	○ SE_xmlschemainfo_get_name
○ SE_xmlcolumninfo_set_storage_type	○ SE_xmlschemainfo_set_name
- **New ArcSDE functions to allow impersonation on login:** Most databases allow an application to log in to the database as one user, and then perform specific tasks under a second login. The second login usually has elevated permissions granted to it, which allow the login to perform the task. The functions implemented to allow for impersonation are `SE_connection_switch_to_proxy_session` and `SE_connection_restore_primary_session`.

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## Editing

- Enhanced and simpler editing experience, including a redesigned Editor toolbar
- Easier to add new features through the use of feature templates, which define all the information needed to create a feature. The Editor toolbar and new Create Features window provides centralized access to feature templates and tools used to construct features.
- New pop-up toolbars provide quick access to editing tools when you are creating and editing features
- Redesigned snapping environment, which is simpler and easier to manage
- Easier to select features and edit the vertices and segments of existing features
- Redesigned Attributes and Edit Sketch Properties windows

## Parcel editing

- **New Parcel Editor introduced with ArcGIS 9.4:** At version 9.4, the Survey Analyst-Cadastral Editor product has been replaced by the Parcel Editor Toolbar available with an ArcEditor license. The previous Cadastral Fabric dataset has also been replaced by the new Parcel Fabric.
- **Parcel Fabric** – The new Parcel Fabric has many new features that make editing and maintaining parcel databases more efficient and streamlined. The new Parcel Fabric can be created in ArcCatalog inside any feature dataset. Existing 9.2 and 9.3 Cadastral Fabrics can be upgraded to a Parcel Fabric through a utility in ArcCatalog.
- The Survey Analyst – Cadastral Editor Extension product has been replaced by a single toolbar called the **Parcel Editor**.
- **Parcel Editor Toolbar:** Includes a new dropdown menu that integrates the Editing commands and has some new items, including the Plan directory and Fabric Options.
- The Parcel Construction Toolbar, available with the Cadastral Editor in previous releases, has been integrated into the **Parcel Details** window at version 9.4. It includes new features, such as Save and Join, Build Parcel and Join, Line String, Intersection, and Parcel Editing Context Menu that includes Bearing, Distance, Delta X,Y, Bearing/Distance, Tangent Curve, Parallel to Line, Perpendicular to Line, and Deflection off Line.
- **Feature Templates** – Feature templates are new at 9.4 to make editing very efficient, to accommodate feature templates the Parcel Details has a new column on the lines tab. This column allows you to specify different templates for individual lines during a New Parcel or Construction.
- **Parcel Division** – This tool allows you to split existing parcels inside a Parcel Fabric into new parcels using certain rules.
- **Parcel Remainder** – This tool allows you to cut a new parcel into an existing parcel in the Parcel Fabric. This handles legal descriptions that “except” only a portion of a larger parcel.
  - **Merge** – At 9.4, the Parcel Editor has a much improved Merge mechanism that allows users to utilize existing attributes from other parcels for a transfer and specify certain line types for the “Merged” line.

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## Raster data

### ArcGIS Desktop

- **GDAL library:** Starting in ArcGIS 9.4, all raster formats are using the GDAL library. The GDAL support enables ArcGIS to read and write out more raster formats. As well there are more TIFF compressions available when creating a TIFF file.
- All new pyramids created in ArcGIS 9.4 will be saved as an OVR file (with the exception of the ERDAS IMAGINE® format). The new OVR files are more flexible since they work with all file formats that allow for pyramids. As well, the OVR files can be compressed so that they do not take up as much disk space.
- Raster Storage Environment Settings have been added to ArcGIS 9.4.
- **New mosaic dataset data model:** A mosaic dataset is a new geodatabase raster data model. The mosaic dataset is supported in all types of geodatabases (personal, file, and ArcSDE). To serve a mosaic dataset using ArcGIS Server requires the Image Extension License.
- **Geoprocessing:** There are new geoprocessing tools available for raster data, including the Split Raster tool and the Recursive Pyramids and Statistics tool, and two new Environment Settings available for the Raster Storage Options: pyramid compression type, and more TIFF compression types.
- **Create a custom CLR file:** ArcGIS 9.4 allows you to create a custom color scheme, within the Unique Values renderer dialog, and then save it to a CLR file. Once you have a CLR file created, you can use it with the Add Colormap geoprocessing tool to add the color scheme to your raster dataset.
- **Advanced labeling with the stretched renderer:** The stretched renderer now has the option to perform advanced labeling. This will allow you to specify values on the color ramp that you would like to display. In addition, you can set up an advanced color ramp between each of the specified values.
- **Functions:** Functions allow you to perform on-the-fly processing to your mosaic datasets and on raster dataset layers (in some cases). Functions can be chained together allowing you to add multiple processes to your mosaic dataset or raster dataset layer. They are applied from the bottom up.
- **Raster Options:** There are four tabs in the Raster Options dialog box: Raster Dataset, Raster Catalog, Raster Layer, and Mosaic Dataset.
- **Image Analysis window:** The Image Analysis window is a new dockable window that can be used to quickly perform many display and processing raster tasks. It can be added to ArcMap via the Image Analysis item, on the Window menu. Many of the display options that exist in ArcMap, but are buried in various dialogs, and options can quickly be accessed in this window: contrast, brightness, transparency, gamma stretch, dynamic range adjustment, ignore background value, Nadir top-up, contrast stretch, display re-sampling method, zoom to raster resolution, swipe layer, and flicker layer.

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- **Color Correction tab:** The Color Correction tab provides additional color correction options for your raster catalogs. Some of the new parameters available to you include, pre-stretching, more color balancing methods, the ability to specify a color balancing target surface type, and the ability to specify a color balancing reference target image.
  - **Mosaic Color Correction window:** When you have a mosaic dataset that needs color correction, the Mosaic Color Correction window can be used to perform the color correction task. This window gives you many options to color balance your mosaic dataset. The Exclude Areas option can be especially helpful for areas that are difficult to color balance, such as water or clouds. The Mosaic Color Correction window button can be added to any toolbar in the Customize Mode.

## ArcGIS Server

- **Serve mosaic datasets:** Mosaic datasets are optimized to serve raster data. ArcGIS Server allows you to serve the newly created mosaic datasets allowing you to share and serve your large image mosaics to your users.
- **JPIP (JPEG 2000 Interactive Protocol) Streaming:** JPIP streaming allows you to stream your JPEG 2000 data (JP2 and JPX) to your clients. This type of streaming is especially helpful when only a small bandwidth is available. Only the requested areas are downloaded, thus saving the amount of data that needs to be transmitted.
- **Enhanced Image Service parameters:** The image service properties page now allows you to control a greater number of default service parameters. This will give you more control over the amount of data a user can request, the type of information that can be requested, and the allowable mosaic and compression methods. The new service parameters are:
  - Maximum image size per request
  - Maximum number of rasters per mosaic
  - Default resampling method
  - Allowed compressions
  - Allowed mosaic methods
  - Maximum number of records returned per request
  - Metadata level
  - Allowed fields
  - Maximum number of downloads per request

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## CAD

- **Context menus in ArcMap:** Context menus now enable right-click conversion of CAD feature layers to a GDB, and automatically add them to your map.
- **Bulk-loading CAD data from a Catalog window:** This is now possible with the new tool **CAD to Geodatabase**. This tool automates a series of conversion procedures that include importing CAD annotation and merging of identical feature class names, types, and attribution. The feature classes will automatically be added to the map when running the tool from a Catalog window in ArcMap.
- **Simplified CAD-field display in ArcMap feature class attribute tables:** Non-essential fields are now turned-off by default.
- **SPLINE geometry** is now supported.
- **ArcGIS 9.4 deprecates the following CAD Geoprocessing tools** but will continue to support them in existing models and scripts: **Import from CAD, Set CAD Alias, and CreateCAD Xdata**.
- **Simplified CAD-data browsing:** The CAD drawing dataset (white icon) has been removed from displaying in a Catalog window.

## Map projections and coordinate systems

- Added new coordinate systems and transformations
- Incorporated definitions from the EPSG Geodetic Parameter Dataset versions 6.15 through 7.1 including 181 geographic (datum) transformations and over 280 coordinate systems.
- Added the Berghaus Star projection. The projection used in the American Association of Geographers (AAG) logo.

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# Mapping & Visualization

## General

- **Application Interface:** ArcGIS 9.4 has improved the organization of menu's and toolbars, and updated most icons.
- **Catalog window:** You can manage and organize your maps data through the Catalog window in the desktop applications (ArcMap, ArcGlobe, and ArcScene).
- **The map's default geodatabase:** When you work with the desktop applications you can add data from a geodatabase, edit geodatabase data, and save data into a geodatabase. The default geodatabase is the geodatabase that the application will use by default when you perform these operations.
- **Search:** You can search for maps, data, and tools in the search window in the desktop applications (ArcMap, ArcGlobe, ArcScene and ArcCatalog). Data and tools from a search result can be used with your active map or model.
- **Map and Layer packaging:** A map or layer package is a single, convenient, ready-to-use file containing a map layer and the data it uses. You can package maps, layers, and a layers schema, and optionally include or reference Server data (Enterprise Geodatabases). When creating the map or layer package, it is saved to your file system or directly uploaded to ArcGIS Online.
- **Table of Contents:** The table of contents has 4 views for working with your map layers. They are List by drawing order, List by data source, List by visibility, and List by selection.
- **Fields:** You have more control over the presentation of field values in the desktop applications through Field order, Highlighting, and the ability to set fields as 'read-only'.
- **Item Description:** You can author item descriptions for maps and data, which can then be used to refine queries in the search window. This used by the new Search capabilities in ArcGIS 9.4.
- **Selection tools:** You can now choose to create selections by rectangle, polygon, lasso, circle and line.
- **Report writer:** The new reporting tools include the equivalent functionality of the 9.3 "simple reports", and offer a number of enhancements for authoring and running reports.
- **Tables:** The table's container offers a better way for you to manage the tables you have open. You can use the table window to organize tables by stacking, docking, or viewing them side by side. The table's toolbar offers you access to tables commands previously in the Options button for managing relationships and selections.

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- **Join Validation:** You can now validate a join, before it is created, by validating the join field names and values, and determining the count of successfully joined records.
  - **Identify Window:** The Identify window is now dockable.
  - **Measure snapping:** ArcGIS now has a preconfigured snapping environment that is used by the editor and measure tools. You can snap to points and edits, intersection, midpoint, or sketches.
  - **Display expression:** You can create display expressions using description text and more than one field. Display expressions are used in the Attributes window, Identify, and map tips.
  - **Hyperlinks:** You can use VBScript for advanced logic with fields used for hyperlinks.
  - **Geoprocessing menu:** You can access common analysis tools, search for tools, and setup the Geoprocessing environment from the main menu of the Desktop applications. Additionally, you can add tools to the main menu by dragging them from the customize dialog onto menus or onto toolbars.
  - **Application framework:** The application framework has been improved for better control of toolbar placement by managing the placement of dockable windows, the use of shy dockable windows, and Tool Pallets.

## Symbols and styles

- Finding appropriate symbols to apply to your features and graphics is easy in ArcGIS 9.4 because you can search for symbols without knowing in which style files they are stored. You can search from within all the styles that are installed with ArcGIS 9.4, or you can limit search results by referencing just the styles you'd like to work with.
- Each symbol now has searchable tags that describe its graphic characteristics, such as its color or type. These tags can be modified in the Style Manager. Tags contain ASCII characters and can be up to 255 characters long.
- You can arrange the way that symbols are organized in the symbol selector. You can group symbols by the style file in which they are contained, or by their category. You can emphasize the appearance or the title of a symbol by choosing Icon view or List view respectively. Hovering over a symbol with the mouse cursor in the Symbol Selector window opens a popup that lists relevant information for each symbol. You can resize the Symbol Selector window to see more symbols at once.
- You can add or modify symbol tags from the Report view of the Style Manager.
- The Style Manager dialog is now accessible directly from the Customize window and is resizable.
- The Report view has an additional column when a symbol (marker, line, fill, or text) table is selected, allowing you to view the tags of each symbol and modify them if the style is not read-only.

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## Map Display and Navigation

- Basemap Layers allow navigation of the map without having to stop and wait for redraw. For more information on working with Basemap Layers, see “Working with Basemap Layers” in desktop help.
- QuickPan mode allows continuous panning in any direction, even while digitizing features.
- Scale Settings dialog now allows limiting map display to certain scale levels.
- Scale Settings presets for common web map schemas such as ArcGIS Online.

## Display Cache

- One tab in application Options dialog manages the display cache for cached map services, Basemap Layers and ArcGlobe’s GlobeCache.

## Improved map display performance

- Basemap Layers make it easy to navigate around a map by providing continuous display updates during pan and zoom. With Basemap Layers, map navigation is responsive and interactive - no need to stop and wait for the map to redraw.

## Representations

- **UI enhancements:** The representation renderer will now display a value for the number of features assigned a rule in the representation class. This appears in the dialog as “Show Feature Count” and is specific to individual representation classes. This setting will remain in place until the dialog is closed.
  - The Move tool’s context menu provides additional options for specifying a distance to move selected feature(s). The Distance parameters are available to control a movement which is not strictly horizontal or vertical.
  - The Set Size context menu in Marker Editor provides further options to refine the change in the size of a selected element(s).
- **Position property:** New for Dashes geometric effect and the Along Line, Randomly Along Line, Along Outline and Randomly Along Outline marker placement styles. Currently all repeating patterns start at unit zero and the position property gives the user a mechanism to indicate where a pattern should be begin to be displayed for a feature. This is especially important for synchronizing the placement of markers in relation to dashed lines.
- **Improved warning messages for customization:** Missing components in a 9.4 geodatabase will provide a full name of the component to the user. These components include custom geometric effects and marker placement styles.
- **Improved experience with feature layers using representations:** When a feature class with representations is added to the TOC, the layer will automatically be symbolized with the representation renderer. The first representation of the feature class will be used by default when there are multiple representation classes available.

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## Geocoding

- The geocoding toolbar in ArcMap includes the new Manage Address Locator dropdown box and Address Input box for single line address matching.
- The geocoding engine is redesigned. The following features are supported:
  - Single-line address input
  - The number of address styles is reduced. It is no longer needed to select an address style with zones or without zones as in ArcGIS 9.3. The additional zone files are optional and the address locator will distinguish if the zone fields are required or not based on the inputs you specify when creating the address locator.
  - The search logics for finding address candidates are more flexible and hence more matches can be found.
  - Customized address styles for Unicode characters can be created for international geocoding.
- New address locators and composite address locators can be created to make use of the new indexes and functions introduced with the new geocoding engine.
- Two new geocoding tools are added to the Geocoding Toolbox: Create Composite Address Locator and Reverse Geocode.

## Time in ArcGIS

- ArcGIS 9.4 will have a new experience for working with time. Layers will have a new property page for setting the location and description of temporal information from the source dataset.
- ArcGIS Desktop and ArcGIS Server will be time aware and contain new time slider user interface controls to visualize temporal data.
- Layers authored with time information can be published using ArcGIS Server and consumed by client applications (SOAP/REST APIs).

## Animations

- Ability to export animations as sequential images (series of animation "stills"). The supported output image formats you can export your animations to are Windows Bitmap (\*.bmp) and JPEG (\*.jpg).

## Graphs

- Graphs are available in 3D applications – The ability to create graphs in ArcGlobe and ArcScene, further enhances your experience of visualizing and exploring geographic data.
- Three new graph types will be supported – Bubble graph, Bar Min and Max graph, and Polar graph.
- New geoprocessing tools to create and save graphs – Make Graph and Save Graph.

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## Find Route

- You can now connect to ArcGIS Server and ArcGIS Online routing services in the Find Route dialog for street routing in ArcMap.
- The free ArcGIS Online routing and geocoding services are available for use by default in the Find Route dialog, which enables users to get driving directions in ArcMap without needing their own street data.
- Geodatabase, shapefile, and SDC network datasets are now supported.

## Metadata

- New dialog box, accessed from the Item Description page, to view and edit metadata.
- New ArcGIS metadata format. All metadata created before 9.4 must be upgraded before it can be edited or updated.
- Tasks for managing metadata are accomplished using new geoprocessing tools: Importing Metadata and Exporting Metadata.
- Choose the metadata standard or profile you want to follow by choosing a metadata style from the Options dialog box. The metadata style determines how metadata will be edited, exported and validated. Only metadata standards based on ISO 19139 are supported.
- Validating metadata based on a metadata standard's XML Schema is supported.

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# Geoprocessing and analysis

## General

- **Background processing:** Geoprocessing tools now execute in the background, letting you continue working with ArcMap while the tool executes.
- **Search and Catalog window replace ArcToolbox:** In version 9.4, ArcToolbox functionality has been replaced by the Search window, the Catalog window, and the Results window. The ArcToolbox window is still available in 9.4, but is no longer considered your primary method for finding and using tools.
- **Geoprocessing menu:** A new Geoprocessing menu has been introduced to the standard toolbar. This menu contains all the options for configuring geoprocessing as well as six tools.
- **Tools can be added to menus:** You can now add tools to any menu or toolbar.

## Python and ArcPy

- **Python window replaces the Command Line window:** The Python window is where you can execute tools in command line style, as you did in the previous Command Line window. You can do much more with the Python window than you could with the Command Line window. You can execute any Python code within the Python window, not just geoprocessing tools.
- ArcGIS installs Python version 2.6
- **ArcPy:** All geoprocessing tools, as well as a wide variety of useful functions for interrogating GIS data, are available in the ArcPy site-package. A site-package is Python's term for a library that adds additional functions to Python, and the ArcPy site-package is how GIS functions are added to Python. The ArcPy site-package is installed with ArcGIS. You can think of ArcPy as replacing arcgisscripting in your Python code.
- ArcPy contains two important modules, the mapping module for interacting with ArcMap and creating map books, and the spatial analyst module for performing map algebra. A third module, Geostatistical analyst, contains classes for setting up complex neighborhood searches.

## Tools

- **New Model Only geoprocessing tools:** 7 Model Only tools have been added. These tools only work in ModelBuilder. They are: Calculate Value, Collect Values, Get Field Value, Merge Branch, Parse Path, Select Data, and Stop.
- **New geoprocessing tools:** More than 50 core geoprocessing tools have been added to ArcGIS 9.4.

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- **Password protection for model and script tools:** With ArcGIS 9.4 you can protect your models and scripts- with a password. This prevents the recipients to edit your model and script tool while allowing them to run it and subsequently delete it. A password-protected model cannot be viewed. When copying it, the password-protection stays intact.
  - You can import your \*.py file into the tool (in fact, you must do this in order to password protect a script tool). This means you don't have to deliver a separate \*.py file for your script tool to work. Once the \*.py file is imported, you can export it again (as long as you know the password, if any).

## ModelBuilder

- **ModelBuilder:** Many enhancements have been made to ModelBuilder, including toolbar and menu updates, undo/redo are now supported, model elements now have tooltips, and the default spacing between elements has changed from 30 to 15.

## Iterators

- Iterators replace the series option in Model Properties.
- 12 new Iterators have been added to be used for iteration or for repetitive tasks in a model. Ten of these iterators are implemented as geoprocessing tools.
- Using an Iterator in a model disables the 9.3 Iteration options in Model Properties and sets a default value of -1, which simply means that the model will run for unlimited times or based on the number of inputs in an Iterator, and not on a set number.
- If a model containing an iterator is exported to a Python script, the script will not include the iteration logic.

# Desktop app development

## ArcGIS .NET SDKs

- **Add-ins:** ArcGIS 9.4 introduces several new and innovative features which make it easier for developers to customize and extend ArcGIS applications. The new Desktop Add-In Model provides developers with a declaratively based framework for creating custom functionality. These Add-In files can then be easily shared between users without relying on installation programs or COM registration; Add-In files can be *installed* by simply copying them to a well known folder, and *uninstalled* by deleting them from this folder. Add-ins offer a subset of the most common customizations: buttons, tools, combo boxes, toolbars/menus, dockable windows, and extensions for the application and editor.

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# Mobile GIS

## Improving the usability of the handheld application

- Enhanced for touch screen access with larger, more readable text and menu options, lists that scroll using gestures, and improved workflows that are more intuitive and flexible.
- The View Map task has been enhanced with new functionality for measuring lines, areas and features, and support for new types of connected and disconnected base maps.
- The Collect Features task workflow has been enhanced and streamlined. GPS data collection has a simplified user experience that provides a simple push button start and stop for averaging GPS positions while providing the flexibility for you to view the map or GPS status while in the process of collecting positions. There is a new GPS Streaming method for constructing polylines and polygons that can filter positions by distance or time interval and place the shape at a lateral offset from the actual captured location.
- Using the Search task, you can now save your search criteria and it will be stored with your project so that the next time you open the project you can simply execute your saved search.
- The Synchronize task now has options for automatically posting edits to the server. You can post changes whenever features are collected or updated, at a set time interval or when the device is cradled.
- A new task called View Field Crew enables field collaboration between field workers. Using the Field Crew task, you can see where other field workers are on the map to contact them by email, SMS or by calling them directly.

## Expand the application platform support to include touch-screen Windows devices

- Supported on Windows devices and has been optimized for ruggedized touch screen devices that are often mounted in a vehicle.
- Features unique to the Windows application include an integrated touch-screen keyboard, day and night-time skins, and the ability to adjust the brightness of the application itself.
- You can dim base map layers so that operational map layer content stands out from base map content providing visual contrast between layers.

## Open the field applications for developers to provide custom workflows

- Using .NET and using the applications as a framework, you can create new tasks that are specific to your business workflows for field data management, alter existing ESRI tasks to provide additional capabilities or extend the application as a whole.

## Simplify project management using a new application called the Mobile Project Center

- The Mobile Project Center is a new application for the 9.4 release that focuses on creating and managing field projects. You can create field projects that are managed within catalogs on a Project Server.
- The Mobile Project Center lets you define the contents of your field map which can contain multiple operational layers or mobile services provided that their spatial references match.
- Tasks and extensions that you create using the application framework are exposed to field projects using the Mobile Project Center.

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# Putting GIS on the Web

## General

- **Increased monitoring of SOC processes:** A new process, ArcSOCMon.exe, runs on each server object container (SOC) machine, monitoring the state of the SOC processes. This increased monitoring results in faster recovery when the SOM comes back online after unplanned downtime.
- **Logging offloaded to SOCs:** Log files are now kept on each SOC machine by the ArcSOCMon process. Offloading the logging to the individual SOCs is a more scalable approach than was used in previous versions, in which the SOM kept one log file for all messages. You can use Manager or the Server API to generate a chronological list of log messages compiled from all SOC machines.
- **Improved Help search:** The Search tab of the Help now uses ranking logic to list the most relevant topics at the top of the results.

## Services

- **Feature service added:** ArcGIS Server 9.4 introduces feature services, which expose access to vector feature geometries and attributes. A great benefit of feature services is the ability to expose feature editing through JavaScript, Flex, and Silverlight applications. Feature services are published from map documents, and the source datasets are required to reside in a single ArcSDE geodatabase.
- **Search service added:** Search services allow you to index GIS content and folders throughout your enterprise and make them easily findable by users. Your intranet clients can then use the updated search interface in ArcGIS Desktop to connect to your search service and find useful content. They can then drag and drop the results into their maps.
- **Mobile data services are no longer required to be created from map services:** The mobile data service is now a core service type at 9.4, meaning that you can publish a mobile data service directly from a map document (MXD). Previously, you were required to publish a mobile data service as a capability of a map service, burdening the mobile data service with a dependency on the map service. You can still associate a mobile data service with a map service if you want by checking the Mobile Data Access capability when you publish a map service.
- **Map services support time-aware layers:** ArcGIS offers time-aware layers that store information about the state of a dataset over periods of time. You can make many of your layers time-aware using ArcMap. When you publish your map to ArcGIS Server, the time-aware information is preserved and is accessible through the map service. You can use this information to change the display of your maps or perform temporal queries.

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- **Layers in a WMS service can be referenced using name strings:** Previously, layers in ArcGIS Server-published WMS services were referenced using zero-based integers representing the layer's position in the Table of contents. You now have the option to expose layer names as strings, which use the name in the Table of contents.
  - **Maximum record count property exposed in ArcCatalog and Manager:** By default ArcGIS limits the number of records returned by a query to 500. Previously, the only way to change this number was to manually edit the service configuration file. Now, this property is exposed in the Service Properties in ArcCatalog and Manager.

## Map caching

- **Compact cache storage:** You can now choose to use a compact cache format that groups tiles into large "bundle" files instead of storing each tile as a separate file. Compact caches consist of a smaller number of overall files and use less space on disk than traditional "exploded" caches. Compact caches can be moved much more quickly from one machine to another, which is helpful when copying caches between staging and production environments.
- **Mixed mode caches:** A mixed mode cache allows you to use tiles of different image formats in the same cache. This is helpful when displaying a raster cache on top of another raster cache. You can use JPEG for the tiles in the middle of the cache to keep your relative file size low, while using PNG32 on the periphery of the cache where part of the tile needs to be transparent.
- **Caches as a raster dataset:** Caches can be added directly to ArcMap or ArcGlobe as a raster dataset using the Add Data button. Just browse to the location of your cache directory on disk and add the cache like any other dataset. This option removes the dependency of the cache on a parent map service.
- **Collaborative cache building:** New tools have been added for importing and exporting cache tiles to and from the cache directory. This makes it easier to collaboratively build a cache among a network of organizations and departments that are using the same tiling scheme.
- **Direct drawing of map caches by ArcGIS Explorer and ArcGlobe:** When you build a 2D cache with the ArcGIS Online / Google Maps / Bing Maps tiling scheme, the cache can be drawn directly in 3D by ArcGIS Explorer and ArcGlobe at a speed faster than you would see if you were to use a globe cache. This allows you to expose your service to ArcGIS Explorer users in 2D and 3D mode while only maintaining one cache.

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## Web ADFs

- **Support for Subtypes and Domains:** Developers and users utilizing the Java and .NET Web ADF will now be able to more effectively enforce data integrity during management, display, and editing operations by leveraging new support for subtypes and domains. Subtypes and domains offer a way to organize your data so that certain operations, such as editing, become more efficient while the integrity of the attributes are maintained. For instance, if you are performing a web editing session on a county zoning infrastructure database, the Web ADF will allow you to select the desired subtype, such as "City", and then choose from the appropriate domain, such as "Residential", "Commercial", or "Industrial". Most importantly, is that the domain description "Residential" will display instead of the coded value "R".
- **Support for Relates and Standalone Tables:** The Java and .NET Web ADF introduces enhanced user inquiry results by supporting relates and standalone tables. Relates simply define a relationship between two tables without appending the associated data in each table. In many cases, the relates point toward standalone tables, which lack geometry but often contain valuable attribute information. For example, if you published an .MSD that contained relates between city parcels and a standalone table of parcel owners, you could utilize the search, query, and identify tasks in the Web ADF to return the owners and location of the parcel in the results window.
- **Print Task preserves either scale or extent:** New options have been added to the .NET Web ADF Print Task to allow the person printing the page to choose whether to preserve the scale of the map or the extent of the map. The Print Task requests a higher resolution version of the map for printing so it's not always possible to preserve both scale and extent.
- **Set Magnifier map resource in Manager:** When creating a .NET Web application in Manager, you can now choose which layer will be shown through the Magnifier tool. Prior to ArcGIS Server 9.4, you could only change this property in Visual Studio.
- **Set zoom factor when zooming to point results:** The tasks that you add to your .NET Web applications in Manager allow you to zoom to the results. When the result contains polygons, lines, or multiple points it's easy to calculate how much zooming should occur. Automatically determining a proper zoom factor for a single point result can be more of a challenge and Manager now gives you control over the amount of zooming that will occur if a result is a single point.
- **Web Mapping Application has new tools for zooming:** The out-of-the-box .NET Web Mapping Application that you create with Manager contains two new tools for zooming. One of the tools zooms to a specific scale, the other tool zooms to an X, Y coordinate that you supply.

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# ArcGIS Extensions

## 3D Analyst

### Display performance

- Faster rendering of 2D Map Caches in ArcGlobe, reducing the need to create both 2D and 3D caches for sharing content.
- Improved display performance of 3D text through built-in conflict detection to ensure overlapping text is not displayed.
- Improved display performance of textured multipatches through automatic texture management
- Improved display performance of 3D vectors, using OpenGL stencil buffers for surface-hugging vectors.
- Memory allocation settings are stored within the ArcGlobe document. This changes the persistency of the 3dd file and allows users to configure each 3D map differently, so it will consume the right amount of memory for the layers within it.

### Creating and managing 3D data within the standard editing environment

- Start editing, stop editing, save edits, use Undo and Redo functions, and do other standard edit management tasks in 3D. The classic Snapping environment is also supported as are precision-creation options (such as parallel, perpendicular, deflection, absolute XYZ),
- Create and delete individual features. This includes the creation and storage of vertical lines in the geodatabase.
- Move, rotate, scale and replace feature geometry (higher level geometry edits to features). This includes the ability to place 3D models (e.g.: COLLADA files) directly into the 3D view as new multipatch features, and then move/scale/rotate them on the landscape.

### Analysis of 3D vector features

- 3D Boolean operators such as Intersect 3D, Union 3D and Inside 3D to be used with closed multipatches
- Geoprocessing tools that expose 3D vector analysis specifically for virtual city workflows, such as Skyline and Skyline Barrier
- Enhancement of existing GP tools to work better with 3D – ‘Select by Location’ dialog uses 3D distances, multipatch objects can participate in the Line of Sight tool
- Network Datasets with full 3D connectivity
- Ability to interactively measure in 3D: distance along a surface, height of 3D object, distance between 2 points in 3D, distance from observer (i.e. how far away is an object?).

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## Other enhancements

- Continued expansion of Terrain datasets:
    - Tighter integration with LIDAR sources
    - Tools for finding data errors
    - The ability to run analytical operators directly against Terrains
    - Import layer symbology for terrain
    - Terrain contour and point renderers
    - Terrain point profile graph
    - Reset elevation range classes based on current display extent
    - Support for anchor points
    - Terrain overview optimization
  - Expansion of TIN datasets
    - Support for: constrained Delaunay, ArcGIS spatial reference, edge tag persistence, node source persistence
    - Import layer symbology for TIN
    - TIN contour renderer
    - Reset elevation range classes based on current display extent
  - Video layers – georeferenced, full motion, and video can be draped on the surface of ArcGlobe.
  - Point feature symbology – for size and full 3D-rotation - can be driven directly by feature attributes.
  - Styles – 3D styles have been updated to have better names and better description tags, which leads to significantly improved results when using ‘Search’ from the Symbol Selection dialog.
  - Improved user experience for setting the two most common 3D properties – Base Heights and Extrusion. It is now easier to complete these settings with built-in graphics that demonstrate the effect of the property change being made.
  - Revamped navigation model, which makes navigating around the 3D view simpler than ever.
  - Ability to export large images (larger than the desktop) from ArcGlobe and ArcScene
  - Ability to create graphs in ArcGlobe and ArcScene
  - 26 new geoprocessing tools:
    - Add Z Information
    - Construct Sight Lines
    - Feature To 3D By Attribute
    - Inside 3D
    - Intersect 3D
    - Intersect 3D Line With Multipatch
    - Is Closed 3D
    - Near 3D
    - Skyline
    - Skyline Barrier
    - Skyline Graph
    - Union 3D
    - LandXML to TIN
    - Raster to Multipoint
    - Terrain to Points
    - Add Surface Information
    - Locate Outliers
    - Surface Aspect
    - Surface Contour
    - Surface Difference
    - Surface Slope
    - Change Terrain Resolution Bounds
    - Append Terrain Points
    - Delete Terrain Points
    - Replace Terrain Points
    - Copy TIN
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# Geostatistical Analyst

## 11 New Geoprocessing Tools

- Diffusion Interpolation With Barriers
- Kernel Interpolation With Barriers
- Create Spatially Balanced Points
- Density Sampling Network
- Global Polynomial Interpolation
- IDW
- Local Polynomial Interpolation
- Radial Basis Function
- Extract Values To Table
- Cross Validation
- Subset Features

## Improvements to the Wizard including

- Resizable windows, new dialog layout and functionality, visualization of the semivariogram, ability to turn on/off the dataset and surface preview, addition of interpolation methods and enhanced local polynomial interpolation to include surface of condition numbers, surface of prediction errors, and an optimized model.

## Further Enhancements

- A new Conditioning measurement error field is added to the Gaussian Geostatistical Simulations tool.
- Large dataset handling: Local Polynomial Interpolation and IDW can now manage very large input datasets. IDW with roughly 2 billion input points (contained in more than 400,000 multipoints) produced an output raster of 250 by 250 columns and rows in 20 hours.
- All raster formats are supported.

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# Maplex

## General

- “Read only” support for documents that use Maplex. “Read-only” map documents will retain all the rich Maplex label properties without reverting back to the ESRI standard label engine.
- Maplex labeling support in an optimized map service. Maps using Maplex can now benefit from the increased performance from the drawing engine used by optimized map services.

## Label Placement options

- The Repeat label parameter has been expanded to allow you to repeat a label within the same polygon.
- An option has been added to the Boundary Placement style to support labeling polygons along the side of a boundary that does not have a polygon directly opposite.
- An additional polygon placement option has been added to support labeling polygons that contain holes.
- Improvements to the overall label placement quality for both contour placement and river placement.

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## Network Analyst:

- **Three-dimensional network datasets:** Network datasets are now 3D-enabled, which allow you to model and perform network analyses on interior pathways of buildings.
- **Historical traffic:** Using historical traffic helps route and vehicle routing problem analyses produce more accurate travel and arrival times; additionally, it helps find the best routes based on a specific time of day and day of week.
- **Time-dependent restrictions:** Similar to how historical traffic models drive-time costs that vary with time, time-dependent restrictions permit and prohibit certain network elements based on time of day. Thus, it is possible to model streets that become one-way during peak travel times to accommodate the major traffic-flow direction, or model turns that are prohibited at certain times of the day.
- **Incremental rebuilds:** When you create, edit, or delete any feature that participates in a network dataset, the network needs to be rebuilt to capture the changes. Previously, the entire network dataset would be rebuilt regardless of how small the changes were. Now the rebuild process only rebuilds the network in "dirty areas", which are areas immediately surrounding the edited features. This drastically reduces the time it takes to rebuild large networks.
- **Modifying network dataset properties in ArcMap:** Using the new Catalog window in ArcMap, now you can use the network dataset and modify its properties from within ArcMap. It's not necessary to open and close ArcGIS applications to modify the network anymore.
- **New geoprocessing tools:** Upgrade Network and Dissolve Network.
- **Location-allocation solver:** Location-allocation helps you choose facilities based on their potential interaction with demand points.
- **Point, line, and polygon barriers:** In ArcGIS 9.4, you can create point, line, and polygon barriers. You can also restrict travel through barriers or use them to temporarily change the cost of the underlying network elements.
- **No U-turns at network locations:** Network locations (such as a stop on a route or an order on a vehicle routing problem), have a property for curb approach, which specifies the direction a vehicle may arrive at and depart from the network location. A new option, No U-turn, was added. When chosen, a vehicle can approach the network location from either direction, but when it departs, the vehicle must continue in the same direction it arrived in. This is especially useful when routing large vehicles that can approach the stop from either direction but can't turn around there.
- **Exclude restricted portions of the network when loading locations:** By checking this option, which is a new property of network analysis layers, you can make sure that network locations are only placed on traversable portions of the network. This prevents placing network locations on elements that you can't reach due to restrictions or barriers.

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- **Multiple breaks:** The vehicle routing problem lets you add multiple breaks to each route. So instead of only modeling a driver's lunch break, you can include a morning and afternoon break as well.
  - **Starting and ending at orders:** You don't need to set a start and end depot for routes in a vehicle routing problem anymore. If a route's Start Depot property is null when a solution is generated, the route will start from the first assigned order. Similarly, if the end depot is null, the route will end at the last assigned order. In ArcGIS 9.4, routes can both start and end at orders.
  - **Vehicle Routing Problem, Location-Allocation, and Origin-Destination Cost Matrix support:** There are now server parameter co-classes and server results co-classes, available in SOAP and the GISServer API, to work with the VRP, Location-Allocation, and OD Cost Matrix.
  - **Closest Facility and Service Area Support in REST:** There are now REST endpoints for Closest Facility and Service Area.
  - **Save Layer on Server:** You can save the results of an analysis on the server and reuse the layer in subsequent requests to build on existing solutions.
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## Spatial Analyst:

- With all of the benefits provided by Geoprocessing, the limited selection of functionality available in the previous Spatial Analyst toolbar is removed at 9.4. The interactive tools (Contour, Histogram) on the toolbar remain as before.
- The new Python Map Algebra in 9.4 provides a rich and integrated way for performing Map Algebra, and replaces the Raster Calculator. The syntax remains basically the same and offers you the following benefits:
  - Can be accessed from the integrated Python Interactive Window or through your own favorite Python scripting IDE (Interactive Development Environment).
  - Full Intellisense capabilities.
  - All Spatial Analyst tools are available in the Map Algebra syntax.
  - Supports a comprehensive set of mathematical and logical Operators, that can be strung together to create single or complex statements.
  - Local ("per-cell") expressions have been optimized to increase performance.
  - Python Classes are available for certain parameter collections, enabling easier reuse as well as easier programmatic access to individual parameters. Following is a general list of these classes:
    - Neighborhoods, Remap tables, Weighted Overlay and Weighted Sum tables, Vertical and Horizontal Factors, Topo to Raster input, and Fuzzy membership.

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- Provide native read / write capability to the Spatial Analyst engine, allowing for faster and more robust processing of your data. The reduction in processing time and disk space consumption is made possible by avoiding the creation and internal management of temporary scratch files. Other benefits include:
    - Any fieldname and path length limitations imposed by the ESRI Grid format are overcome.
    - The 2.1GB shapefile size limit is avoided.
    - If supported by the specified input and output formats:
      - Time values in the date fields are preserved
      - Nulls are treated as such and no longer being converted to zero's
    - Two new interfaces, *IRasterAnalysisGlobalEnvironment* and *IRasterOpBase*, are introduced with ArcGIS 9.4 to allow for the processing of raster data in Spatial Analyst using ArcObjects without the need to convert to ESRI grid format
    - The default setting of False for *IRasterAnalysisGlobalEnvironment::AvoidDataConversion* ensures that the execution path is the same as in versions of ArcGIS prior to 9.4.
    - Setting *IRasterAnalysisGlobalEnvironment::AvoidDataConversion* to True will ensure that all processing will be performed natively on raster and feature data.
    - The *IRasterOpBase* interface provides a mechanism to specify the name of the output data, and also its workspace, before the operation is performed which results in the output being directly written permanently to the required format.
    - New Geoprocessing tools: *Extract Multi Values To Points*, *Iso Cluster Unsupervised Classification*, *Fuzzy Membership*, *Fuzzy Overlay*, and *Zonal Histogram*.
    - The Focal Statistics tool has a new algorithm that significantly improves its performance, particularly when using large neighborhoods such as rectangular neighborhoods of 12x12 or larger, and circular neighborhoods with radius 5 or greater
    - A new toolbar Image Classification is introduced in 9.4. The functionalities include:
      - Interactive creation and editing of training samples.
      - A Manager dialog to manage classes and training samples.
      - Three new displays for training sample evaluation are the histograms evaluation window, scatterplots evaluation window, and statistics window
      - Existing Spatial Analyst Multivariate tools are accessible through the Image Classification toolbar.
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## Tracking Analyst

- New email alert service action allows you to automatically send a customizable email message to selected recipients when the trigger conditions are met.
  - New data modification service action allows you to modify data values in an incoming data message using custom functions when the trigger conditions of the action are met.
  - New data summary service action allows you to automatically generate data summary reports for your real-time tracking data a configurable time interval.
  - Arriving Trigger allows you to execute an action when a tracked object arrives at a location represented by a polygon.
  - Departing Trigger allows you to execute an action when a tracked object departs from a location represented by a polygon.
  - Track Crosses Trigger allows you to execute an action when a tracked object arrives at or departs from or appears to cross a location represented by a polygon.
  - New Display Modes for tracking layers in 9.4 have been added. The new display modes allow for tracking layers to be non-cached or only partially cached.
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