



Performance Tips and Tricks for ArcGIS™ Desktop 8.1

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An ESRI Technical Paper

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Performance Tips and Tricks for ArcGIS Desktop 8.1

Introduction This document provides a variety of recommendations and suggestions intended to help you leverage ArcGIS™ effectively. The focus of the document is to suggest ways that you can optimize performance while performing various tasks using ArcGIS. This information reflects the results of analysis conducted in response to working with many of our users on specific user scenarios and other information that was not available when the user documentation was printed.

Other Suggested Resources

Database Tuning Guides available with ArcSDE™
Online Help System

Suggested Hardware Configuration for ArcGIS Desktop 8.1

For best performance, use an appropriately configured PC.

- Processor: Pentium® 450 MHz (minimum) or higher is recommended.
- Memory: 128 MB RAM minimum (256 MB recommended).
- Hard drive: Disk drives that deliver fast data access (e.g., SCSI, Ultra ATA, and so on) are highly recommended due to the nature of GIS data.
- Windows® NT 4.0 SP 6a or Windows 2000.
- Typically, you will want to set your paging file on your machine to be twice the amount of physical memory on your system.
- If Windows Terminal Server is used, then a larger total amount of memory should be allocated. This is especially dependent on the number of clients running off that server.
- For display, a true color monitor and video card are recommended. We recommend at least 16 MB of memory for the video card.
- If you are using ArcGIS 3D Analyst™, you should invest in a good OpenGL™ video card with a minimum of 16 MB of memory. Depending on what data you plan on using in the ArcScene™ application, you may also need at least 256 MB of physical memory on the machine and a video card supporting a large amount of texture memory.

- It has been reported that some antivirus software can significantly impact performance if it has been configured to scan all types of files on access. You should consult your antivirus software manual for more information.
- If the Microsoft® “Find Fast” process is running on your PC, we recommend turning it off. This process periodically searches your file system and indexes the files for faster searching. However, this may cause your system to appear to hang if you are using ArcGIS when the index process begins.

Computers that plan on serving ArcSDE should be sized according to the database vendor’s specifications.

ArcMap

General Drawing Speed

- Shapefile data sources will draw significantly faster if you use only a single symbol for display and have the map in the same projection as the data.
- Shapefiles and coverages should have spatial indexes built for best performance. (This is done from the ArcCatalog™ property page of the dataset.)
- Many users find that turning off the option to make newly added layers visible by default helps save time when initially composing a map. To turn this option off, uncheck the box for this on the Options dialog box on the Application tab.
- The mask functionality when symbolizing using Dot Density can be very slow on complex mask polygons. You may want to consider only using this for the final hardcopy maps.
- Using on-the-fly projection will increase the initial load time of a map document. Performance will always be better if you project all of your data into the same projection prior to displaying it in ArcMap™.

Graphics and Text

- Halos on a large amount of text are slow to display; therefore, halos should be used sparingly. Use a scale range on your label classification so not too many labels are displayed at once. For many applications, text shadows provide the text background you need without the performance impact of using halos.
- Dashed lines and patterned lines draw more slowly than solid lines. You may want to consider only using these patterns for the final hardcopy maps.
- The Advanced drawing options on the data frame will cause multiple redraws, increasing display time. Use the advanced drawing only when printing or when zooming in to a small area.

Printing When printing with transparency or with rasters in the map, your plot file can be quite large. From the Page Setup dialog box, you can control the output image quality and *significantly* reduce the plot file size. Often, this will not have any significant impact on the resulting printed map's overall quality, but it will reduce the time required to print the map as well as the size of the file that gets printed. This is especially important when printing MrSID® images, as these images are uncompressed to the appropriate resolution prior to printing.

Saving Maps If you are creating a complex map, you may want to turn off the “Create Thumbnail” option—found in the Map Properties dialog box. Creating a thumbnail of your map (for viewing in ArcCatalog) will increase the time it takes to save the map document. If it is taking a long time to save the document, and you have the thumbnail option on, simply press the Escape key; this will immediately terminate the thumbnail creation process but will not terminate the save process.

Tables Use attribute indexes on fields. Attribute queries use attribute indexes if the indexes are available; this will improve performance for such queries..

Tables, On-the-Fly Joins

- Data from appended fields can be used to symbolize and label features and perform queries and many other operations. Accessing the joined data will be slower than accessing data from the base table because of the additional work needed to maintain the join. The following tips can be used when working with joined data to improve performance.
 - ◆ Create attribute indexes on the join fields. Performance will be improved especially when editing, and in most cases, overall performance will improve. If your joins involve only shapefiles, dBASE® files, coverages, or INFO™ files, indexing will not improve performance when drawing or working with the table window.
 - ◆ When joining data from the same ArcSDE server or from the same personal geodatabase, you should click the Advanced button and choose “Keep only matching records”. In some cases, this option will produce different results than you may want but allows the join to be processed by the database. You will find that this is normally faster for operations that require accessing the data in the joined columns (i.e., symbolizing or labeling). The default “Keep All Records” option always performs processing on the client. Performance is normally good for operations that don’t require accessing joined data (i.e., drawing with default symbolization). An operation may become much slower if accessing joined data is needed.
 - ◆ Cross database joins, where the target table and the join table are from different data sources, may have poorer performance. This is especially the case where the join table is from an ArcSDE server, personal geodatabase, or an OLE DB connection. Performance is much better when the join table is from a file-based data source (i.e., shapefiles, dBASE files, and coverages) and the target table has an ObjectID column (most data sources).

- ◆ Joining multiple tables or layers to a single layer can be costly in terms of performance. If all of the data is from the same ArcSDE server and you chose “Keep only matching records” when joining, performance should not be greatly affected. If “Keep All Records” is chosen, then the client, rather than the server, has to perform considerably more work, and performance will be impacted as a result.

Dynamic Segmentation

Indexes make dynamic segmentation display faster (especially geodatabases). We recommend an attribute index for the route key field in both the route feature class and the event table. We also recommend a spatial index for the route feature class.

Utility Network Tools

If you plan on doing traces from the Utility Network toolbar, it is recommended that you perform a “find connected trace” task first to cache the contents of the logical network in memory. This will cut the time of future trace tasks in half.

ArcCatalog

Add Data Browser and ArcCatalog Tree

- By default, the “Use a special icon for folders containing geographic data” option is turned off. If you choose to turn this option on, it can significantly increase the startup and navigation time for ArcCatalog and the data browsers in ArcMap and ArcToolbox™.
- Turning off data types you do not normally use can speed up ArcCatalog and the data browser. To do this, choose “Options” from the Tools menu, and from the General tab, turn off the data types you don’t need to see.
- By default, ArcCatalog only shows rasters based on file extensions. ArcCatalog can discover rasters with other extensions if the option is turned on. This option can have a negative impact on ArcCatalog and the data browser performance. This option can be found in the Options dialog box from the Tools menu under the Raster tab.
- To improve the navigation times for ArcCatalog and the data browser, you should uncheck the “Examine all extensions” option for DGN files in the Tools>Options dialog box under the CAD tab.
- To improve the navigation times for ArcCatalog and the data browser, you should minimize the number of network folder connections. Connect them only when you are using those network drives. Also, do not connect to network folders at the root level. Connect them directly to your desired network folder.
- You can drag and drop a folder in ArcCatalog onto a catalog node in the treeview to make a quick folder connection.
- To improve the navigation times for ArcCatalog and the data browser, you should avoid using extended column properties in Details view (such as file size, date, and metadata properties).

- When ArcCatalog opens, it returns to the last used location; this can be slow for network connections and locations containing a lot of data. You can turn off the “Return to last location when ArcCatalog start up” option under the General tab in the Options dialog box.
- When you are creating a layer file from a very large feature class, turn off the “Create Thumbnail” option. If it is taking a very long time to create the layer file, simply press the Escape key. This will immediately terminate the thumbnail creation process and will successfully create the layer file.

Geometric Networks When creating a geometric network from existing feature classes, be sure to select the option to snap features if your features are not precisely located or have not previously participated in a network. If a network was previously built from the features classes that have already been snapped, you should not have to specify snapping again.

Raster Display Performance

Creation of Pyramids The best way to improve the display speed of a large image is to build pyramids for it. Pyramids are multiscale resampled versions of the image that ArcGIS can create and manage. Pyramids are useful when the raster dataset is larger in rows and columns than the screen canvas you are trying to “paint”. Without pyramids, the entire dataset must be read from disk and resampled to a smaller size. This is called display resampling and occurs on refresh of the ArcCatalog Preview pane or the ArcMap display canvas. Pyramids decrease the amount of time spent reading from disk and processing. Taking the one-time cost to create pyramids will save time in the end. You can build pyramids from the raster context menu in ArcCatalog. The pyramid will be a file named `imagename.rrd` and will be 8 percent of the original uncompressed file size.

Raster Compression Compression can improve performance by reducing the amount of time spent reading from disk. However, since compressed data must be uncompressed to draw to the screen, it can be slower than uncompressed data. The amount of time spent on decompression is often related to the compression ratio. The more highly compressed the raster, the longer it will take to decompress.

Calculation of Statistics When a raster without previously stored statistics is first introduced into ArcMap, and statistics are needed to render the raster correctly, ArcMap will create default statistics and place these into an associated auxiliary file (AUX). If this occurs, then time is needed for the default statistics calculation. Creating statistics for rasters in ArcCatalog prior to use in ArcMap is recommended.

Display Resampling By default, ArcMap uses the fastest display resampling technique for all rasters, which is Nearest Neighbor resampling. For continuous rasters, Bilinear Interpolation makes for a smoother-looking raster but takes a little more time. This can be changed on the Display tab of the raster layer Property sheet.

**ArcSDE Raster for
Multiuser Access**

When many users are accessing the same raster files simultaneously, you will get better performance from a properly tuned relational database than from a file-based system. ArcGIS 8.1 supports the storing of raster data in a relational database using ArcSDE. After loading the data into ArcSDE, you should analyze the table for optimum performance.

**ArcGIS
Geostatistical
Analyst**

ArcGIS Geostatistical Analyst is optimized for small sampled datasets. To process the data, the extension loads all the data and processes it in memory.

To minimize the amount of data loaded, you should select a subset of points to use in your analysis.

**ArcGIS Spatial
Analyst**

Make sure your analysis extent is set appropriately so you do not perform analysis on the whole dataset without fully intending to do so. Use the extent properties in the Spatial Analyst Options dialog box to set the extent.

ArcGIS 3D Analyst

- Turn off Saving a thumbnail with the scene document; this slows down the save process. To do this, uncheck the option under File>Document Properties.
- Using on-the-fly projection will increase the initial load time of a scene document. Performance will always be better if you take the time to project all of your data into the same projection prior to displaying in ArcScene (or ArcMap).
- As with ArcMap, many users find that turning off the option to make newly added layers visible, by default, helps with initially composing a map or scene. To turn off this option, uncheck the box for this on the Options dialog box on the Application tab.
- When displaying images, you can boost the performance by draping them on a TIN rather than a raster.
- 3D Analyst has to load all data sources into memory to render them in 3D. This can use a lot of memory and affect the speed of opening a scene document. To minimize the amount of data loaded, you can set a fixed extent of the scene that will only load data within the extent. (Use the Extent tab on the Scene Properties dialog box to set this.)
- For 3D navigation, consider using lower resolution data to display only while navigating, and then show the detailed data once navigation has stopped. This can be set on the Rendering tab on the layer properties dialog box.
- Raster data will be resampled while displayed in 3D. You can set the raster resolution in the layer on the Base Heights tab of the layer properties. ArcScene does a good job of dynamically setting these properties, but you may need to change the settings. Very large images will always need some resampling unless you have very high-end video cards.
- OpenGL cards with a large amount of texture memory (32 MB+) improve quality and performance when working with images.

ArcGIS StreetMap USA

- Many times display problems are corrected by downloading the latest video drivers from the video card manufacturers.
- Although you can use ArcGIS StreetMap™ USA data directly from the CD-ROM, for drawing and geocoding performance, it is recommended that you store the data on a hard disk. To do this, create a new folder (e.g., d:\streetmap) and copy all the data from the CD-ROM to this directory. It requires approximately 650 MB of disk space.
- If you prefer not to copy all the data from the CD-ROM to the hard disk, you can copy only the files you need to use. On the ESRI Data & Maps for StreetMap CD, you will find the compressed street data in the \data\streets folder. The files are named in the format of <state abbreviation>.edg—for example, “ca.edg” for California streets. If you know the addresses you are going to geocode are in the same state, you may copy the <state abbreviation>.edg to your hard disk. Then you can create a new geocoding service for this .edg file. Your geocoding performance will be improved.
- To improve the drawing performance for streets in a particular state, you can copy the <state abbreviation>.edg and the StreetMap USA map document or layer file from the CD-ROM to the hard disk. Then you can modify the layers data source property by resetting the data source to different locations, either on the hard disk or on the CD-ROM.

Geodatabase

The geodatabase contains many new concepts such as feature datasets, geometric networks, relationship classes, and so on. How your data model is designed with respect to some of these will be critical to how well your geodatabase performs. A poorly designed data model will affect the performance of the applications using it.

Designing a Geodatabase

- Group only the necessary feature classes into a single feature dataset (e.g., those that have topological relationships with each other).
- When building a geometric network, choose only the necessary feature classes to participate in such a relationship.
- When using relationships, be sure to maintain the indexes. The performance is maximized when indexes are maintained for the primary and foreign keys for the relationship class. ArcInfo™ and ArcEditor™ will automatically create these indexes for you, but be aware of their importance. Indexes are very important for all relationship classes.
- Load all the data you can before building your geometric network and before versioning your data.
- Generate/Load all of your annotation before versioning your database.
- In general, do as much data loading as possible before building networks and applying your UML model.

Working with a Geodatabase

- If you do need to do a large amount of data loading or annotation creation after you have versioned your database, run Compress to get those new features from the “adds” tables to the base tables.
- Always use the edit cache when editing geodatabase data.
- Annotation performance is based on the actual number of annotation features that are displayed rather than the number of classes they persist in. Make sure to apply scale suppression with annotation so you only see it when it is meaningful.
- All related classes should be in the map when navigating relationships and editing composite objects.
- When using a geodatabase, creating thumbnails for your large feature classes sometimes results in quicker browsing of the database in ArcCatalog.
- Keep in mind that the shared edge editing tool works on all feature classes in a feature dataset regardless of whether they are layers in your map or not. If you are using the shared editing tool, include all the classes from the feature dataset you are working with on your map.