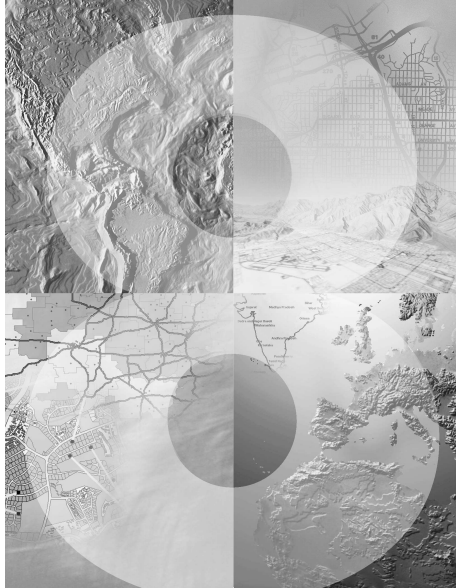


An ESRI White Paper



ArcInfo 8: A New GIS for the New Millennium

January 2000



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ArcInfo 8: A New GIS for the New Millennium

ArcInfo™ 8 software is a significant new release of ESRI® professional geographic information system (GIS) software. ArcInfo 8 has been redesigned and reengineered to be easier and faster to use and to take advantage of the most modern concepts of software engineering and GIS theory. The key feature of the release is that it makes sophisticated GIS usable by nearly anyone familiar with desktop computing. This is a major change from ArcInfo software's historic reputation. While the depth of functionality in ArcInfo is extraordinary, new user interfaces and wizards make it easy by presenting users with what they need when they need it.

New User Interface

The most striking feature of ArcInfo 8 is its new user environment. ArcInfo 8 is accessed through three new applications that represent the fundamental methods of how people interact with a GIS—maps, data, and tools.

Users will typically interact with the system by having two or all three of these applications open.

- **ArcMap™** is the map-centric application for editing, displaying, querying, and analyzing map data. In addition, ArcMap contains a sophisticated scientific charting and graphic system, an object-oriented editor, and a full report writer. ArcMap is the environment for working with map data and creating production-quality cartographic output.
- **ArcCatalog™** is the data-centric application that locates, browses, and manages spatial data. With ArcCatalog you can create and manage spatial databases. ArcCatalog is where users lay out their data schema in the database and specify and use metadata.
- **ArcToolbox™** is a complete environment for performing the hundreds of rich geoprocessing operations provided by ArcInfo such as data conversion, overlay processing, buffer creation, and map transformation.

Data Models

ArcInfo 8 supports two primary geographic data models—the georelational model (i.e., coverages and shapes with attributes) and a new object-oriented model called a geodatabase. The new applications of ArcInfo 8 support both of these models.

At ArcInfo 8, the georelational data model is extended into an object-oriented model that allows users to add behavior, properties, rules, and relationships to their data. The geodatabase model allows definition of features that more closely resemble the real

world. This object-oriented model is extensible for users with more specialized requirements, allowing for user-definable features.

This new data model is implemented as an extension to standard relational database technology. The new geodatabase model supports topologically integrated feature classes, similar to the current coverage model. However, it extends the coverage model with support for complex networks, relationships among feature classes, and other object-oriented features. The new ArcInfo 8 applications (ArcMap, ArcCatalog, and ArcToolbox) also work with geodatabases as well as with coverages.

The geodatabase model defines a generic model for geographic information. This generic model can be used to define and work with a wide variety of different user- or application-specific models (i.e., water networks, electrical features, and other domain-specific data). By defining and implementing the behavior of a generic geographic data model, ArcInfo 8 provides a robust platform for creating and working with different user data models. ArcInfo 8 allows easy creation of custom data models using visual tools such as computer-aided software engineering (CASE) and standard unified modeling language (UML) notation.

Data Management

The ArcInfo geodatabase model is implemented on standard relational databases with the ArcSDE™ application server. ArcSDE defines an open interface to database systems for our users. It allows ArcInfo to manage geographic information on a variety of different database platforms including Oracle, SQL Server, and others. If the underlying database technology supports spatial types (for example, Oracle Spatial), ArcSDE can use the native spatial type implementation. In addition to providing the bridge between ArcInfo and spatial database implementations, the ArcSDE application server defines an open C application programming interface (API). This API defines a relational (simple feature) view of the geodatabase.

You can implement personal geodatabases or multiuser geodatabases. The ability to create and manage personal geodatabases is included with ArcInfo 8. Personal geodatabases, designed for personal or small workgroup use, are stored in the Microsoft Jet Database Engine (the database engine used in Access). As the size of the data set grows or the number of viewers and editors expands, you can implement a multiuser geodatabase. Available as an ArcInfo 8 extension, ArcSDE manages multiuser geodatabases on a variety of database platforms including Oracle, Microsoft SQL Server, and others.

Unlimited Customization Options

ArcInfo 8 addresses the needs of most end users by providing a series of out-of-the-box GIS applications. It also provides more advanced users and developers with a comprehensive customization capability. Programmers and nonprogrammers can easily customize ArcInfo 8 using the drag-and-drop and menu-driven tools. Industry-standard Microsoft Visual Basic for Applications (VBA) is in the box for all scripting and application customization jobs. Advanced programmers and commercial application developers will also be satisfied with the completely extensible object-component data model and tools and the open data management API. Any component object model (COM)-compliant programming language can be used to customize and extend ArcInfo 8.

Other Enhancements

ArcInfo 8 updates and enhances many basic technologies employed in previous versions of ArcInfo. Enhancements include improved versions of the ARC, ARCEDIT™, and ARCPLOT™ applications; the ARC Macro Language (AML™) and Open Development Environment (ODE) customization capabilities; and extensions such as ArcScan™, ARC GRID™, ARC COGO™, and ARC NETWORK™. New features of the basic product include a complete Java development environment that allows users to program complete applications in Java on any supported platform (i.e., a Java ODE API). Also supported are new cartographic generalization tools, updated and new data converters, and much more.

ArcMap: Mapping and Editing Made Easy

In ArcInfo 8, display, query, and analysis of your map data are supported by the new map-centric ArcMap application. ArcMap expands on concepts and interfaces first introduced in ESRI's popular ArcView® GIS software. ArcMap provides the ease of use of ArcView GIS with the full functionality of ArcInfo.

ArcMap extends even further ESRI's popular direct data read capability, which allows data sets to be used on the fly without translation or use of an intermediate format. ArcMap supports ArcInfo coverages, ESRI shapefiles, Spatial Database Engine™ (SDE®) layers, map libraries, ArcStorm™ layers, DXF and DWG, DGN, many image types, Global Resource Information Databases (GRIDs), and much more. In addition, ArcMap supports on-the-fly projection and the individual layer level.

Many users will see ArcMap as the central application where they will spend most of their time. It is an easy-to-use, fully menu-driven application for working with any type of map data. Existing ArcInfo users will think of it as the power and flexibility of ARCEDIT and ARCPLOT in one modern application and more. It is a completely integrated application for creating and editing spatial databases, displaying and querying geographic data, performing complex analysis, generating quality reports and charts, and making high-quality maps. ArcMap introduces high-quality maps and reports in the desktop environment.

ArcMap

- Integrated map display, editing, and production environment
- Easy, modern user interface
- Better visualization for superior data interpretation/analysis
- Out-of-the-box usability
- Easy-to-create charts and reports
- Advanced mapping capabilities
- Computer-aided design (CAD) editing on intelligent GIS databases (ArcSDE databases, coverages, and shapefiles)
- Drag and drop customization

The New ArcMap Object Editor

ArcMap includes a fully integrated Object Editor capable of multiuser geographic and attribute entry and update. The Object Editor is easy to learn and is implemented in such a way as to ensure a simple, quick, and natural transition from viewing geography to editing geography. The Object Editor can work with coverages, shapefiles, and geodatabases stored in a database management system (DBMS) using ArcSDE.

The new Object Editor supports

- Creation and updating of shapefiles, coverages, and geodatabases
- Editing of features according to rules/behavior (i.e., network connectivity, attribute consistency, etc.)
- Very fast display of raster and vector data
- Snapping to any vector data (including CAD files)
- Versioning and conflict resolution across work groups
- Advanced CAD/sketching function directly on the GIS database
- Complete WYSIWYG editing
- Editing within magnify windows
- Integrated tracing
- Easy customization for user-defined tasks/tools

The Object Editor includes many of the graphic editing functions popular within the latest CAD editing packages (creating and editing of parametric geometry). Powerful and intuitive ergonomic features let users easily edit features using rule-based tools for creating and maintaining spatial databases. The new Object Editor also enables users to directly edit data in a DBMS via ArcSDE.

ArcCatalog: The Spatial Data Explorer and Manager

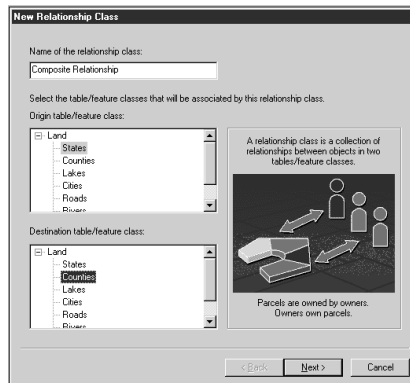
ArcCatalog is a new ArcInfo application for locating, browsing, and managing spatial data. It resembles the Windows Explorer but can see down into databases and quickly view geographic data and metadata. It also hosts all data management tasks with easy-to-use interfaces and wizards. It provides the data-centric perspective to ArcInfo.

ArcCatalog helps GIS database administrators maintain spatial and tabular GIS data for use by others in their organization. With ArcCatalog, GIS professionals performing spatial analysis can more easily fulfill their responsibility for metadata maintenance tasks following actual analysis and data conversion. And application users and entry-level analysts can employ ArcCatalog to discover the content and properties of core and derived GIS data.

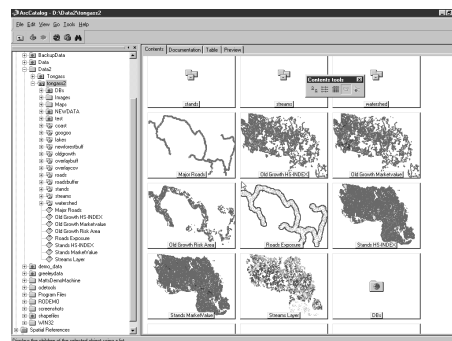
Since it eases the complexity of geographic data management, the use of ArcCatalog results in a significant increase in user productivity. Users can select data sets with

ArcCatalog and then drag and drop them into ArcMap for query and analysis. The Windows Explorer style of ArcCatalog makes it more intuitive than ever before to begin using ArcInfo software's powerful tools for data creation and manipulation.

Data handled by ArcCatalog includes ArcInfo coverages, ESRI shapefiles, geodatabases, SDE layers, ArcStorm layers, INFO tables, images, GRIDs, triangulated irregular networks (TINs), ArcSDE, CAD files, address tables, dynamic segmentation events, and other ESRI data types and files.



Create "smart" data using ArcCatalog. Establish relationships between objects in two table/feature classes. For example, parcels are owned by owners, and owners own parcels.



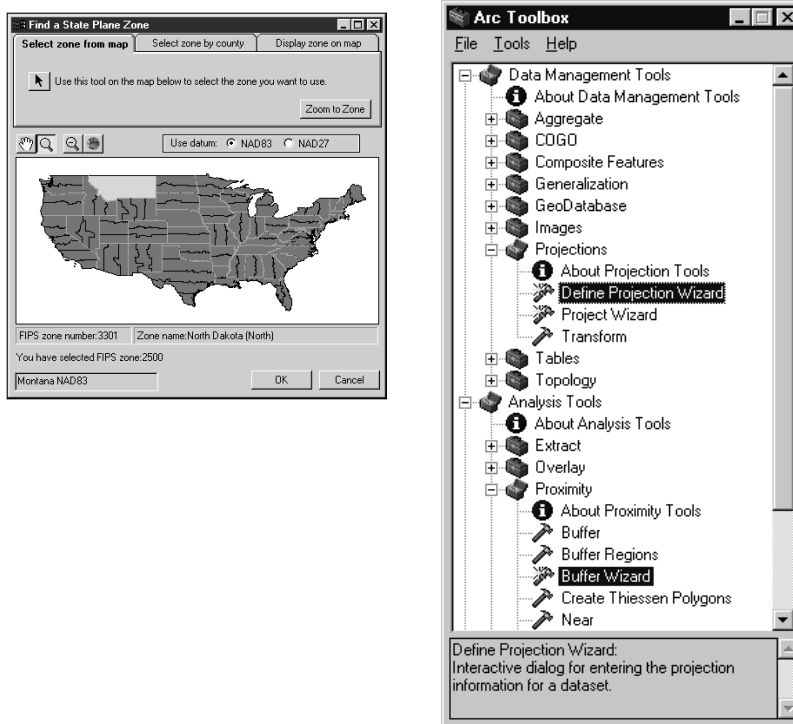
ArcCatalog is a data organizer and manager. The left-hand "tree" is a hierarchical view of the data on a user's machine and network. The right-hand pane is a preview of the data layers and maps in a particular folder (directory).

ArcToolbox: The Geoprocessing Power Tool

ArcToolbox is a new application for performing geoprocessing operations such as conversion, overlay processing, buffering, and map transformation. More than 120 tools are organized in a tree view for easy access. Each tool has a menu-driven interface with wizards or dialogs. If you can never remember whether it is the Identity, Union, or Intersect overlay operator you want—no problem. The Overlay wizard offers easy-to-interpret pictures.

ArcCatalog is fully interoperable with other applications; you can drag and drop your GIS data from ArcCatalog into ArcToolbox to take advantage of an intuitive interface to your most common geoprocessing tools. No other system offers this wealth of geoprocessing functionality, and no one else makes advanced spatial analysis so simple.

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ArcToolbox: Geoprocessing made accessible. The right-hand window shows the hierarchy of ArcToolbox tools. The left-hand window is a single panel from the Projection wizard.

Geoprocessing Server

In addition to running these geoprocessing tools on a single machine, users of ArcInfo 8 can also take advantage of the new Geoprocessing Server. At ArcInfo 8, the network becomes your GIS platform. You can compose geoprocessing jobs on a client desktop and submit them for execution on a different hardware device (i.e., server). The Geoprocessing Server allows users to run ArcInfo applications, schedule geoprocessing for peak performance times, and run AML and other scripts directly from ArcToolbox. Users can compose massive geoprocessing jobs on their desktop, submit them for execution on a server, and keep working.

ArcToolbox can be considered a new interface to the thousands of geoprocessing functions of ArcInfo. ArcToolbox makes advanced geoprocessing easier to comprehend and use. ArcToolbox brings high-level geoprocessing within the grasp of everyone.

Object-Oriented Data Model: An Introduction

Prior to this release, ArcInfo was solely based on the highly successful georelational data model. This geometry-centered model focuses on point, line, and polygon geometry types, storing geometry and topology in binary files and associated attributes in a DBMS. ArcInfo 8 continues to support the full georelational data model.

In addition, ArcInfo 8 also introduces a new object-oriented data model for the creation of intelligent geodatabases that combine the properties of objects with their behavior. ArcInfo implements objects in a modern and standard way. Each object is defined as a separate component or building block. This allows users to create their own object-oriented models that extend the base model. Object-oriented data models closely resemble the user's own view and classification of the things they study. These data

models are therefore intuitive and simple to use—the software will deal with user-oriented concepts like land parcels and easements, transformers and fuses, not system-oriented concepts like points, lines, and polygons.

One of the implications of the geodatabases is that GIS will be more extendable by users and third party developers. New components can be easily plugged into the system and anyone proficient in modern programming techniques will be able to create first-class objects. Standards mean better use of well established tools such as programming languages, CASE tools, and databases; they also mean openness and interoperability. The new ArcInfo 8 applications have been designed specifically to work with this object-oriented data model.

The ArcInfo 8 object-oriented data model facilitates important tasks including

- Editing a heterogeneous set of features such as points and lines
- Modeling complex network features such as devices on a network that have internal circuitry represented by discrete features
- Representing a feature's geometry with parametric curves such as circular arcs and Bezier curves
- Representing features in multiple ways in the core software (e.g., the generic draw methods of city objects could represent them as red points at 1:500,000 scale, and orange polygons at 1:50,000)
- Managing a versioned database that supports work order management and many simultaneous edits

Object and Relational Views of the Geodatabase

The geodatabase model supports an object-oriented vector data model. In this model, entities are represented as object with properties, behavior, and relationships. Support for a variety of different geographic object types is built into the system. These object types include simple objects, geographic features (objects with location), network features (objects with geometric integration with other features), annotation features, and other more specialized feature types. The model allows you to define relationships between objects, together with rules for maintaining the referential integrity between objects.

ArcInfo 8 supports two views of this data model: the object view and the relational view. The object view of the database is used by the new ArcInfo applications to define and work with the database as an integrated network of geographic objects. The relational view provides a simpler, nonobject view of the data model. The relational model corresponds to the "simple feature" model used in ArcView GIS, MapObjects®, Oracle Spatial, and other systems and standards (such as OGIS simple features and SQL 3 spatial). This means that software and applications that understand georelational data (i.e., ArcView GIS 3.x, ARCPLOT, MapObjects, etc.) can view and make use of geodatabases.

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ArcObjects: Unprecedented Flexibility for GIS Developers

ArcInfo 8 provides customization capabilities that go far beyond any other GIS software. The entire environment—from data objects to menus—is completely customizable at three levels:

- Menu-driven, drag and drop (for simple customization without programming)
- VBA (for most application programming needs)
- Object-Component programming (for advanced development)

Menu-Driven Customization

Menu-driven customization is the simplest option and requires no programming experience. Using the standard out-of-the-box ArcInfo graphic user interface (GUI), menu controls (e.g., buttons and toolbars) can be turned on or off and moved around. Menus can be added to the user interface by simply checking a box.

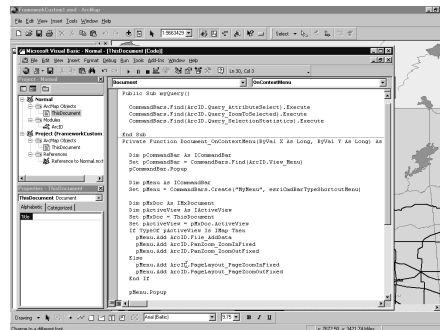
Visual Basic for Applications

With built-in VBA scripting capability, frequently performed ArcInfo tasks can be automated, and new forms and controls can easily be added to both ArcMap and ArcCatalog. VBA is the premier development technology for rapidly customizing packaged applications and integrating them with existing data and systems. VBA offers a sophisticated set of programming tools based on Microsoft Visual Basic that developers can use to harness the power of packaged applications.

Because of VBA, companies can buy software like ArcInfo and easily customize the user interfaces of its toolbar-driven applications or design custom solutions to meet their specific requirements, rather than building from scratch. This saves time and money, reduces risks, leverages programmer skills, and delivers precisely what users need.

Object-Component Programming

A new feature to GIS software is the ability to work with and extend ArcInfo at the lowest level. ArcMap, ArcCatalog, and ArcToolbox can be customized with any COM-compliant programming language (e.g., Visual Basic, Visual C++, and Visual J++). Users and developers will find all the components of ArcInfo available to embed within non-GIS applications. What is especially innovative is the very fine granularity of the COM implementation; this is not a COM wrapper around legacy code. With more than 1,200 components, hundreds of well-documented interfaces, and thousands of methods, this is a developer's paradise.



3.5 million developers worldwide are familiar with Microsoft VBA. Take advantage of plentiful programming resources and flexibility with this powerful and easy-to-use customization language.

Metadata in ArcInfo 8

ArcInfo 8 has been engineered to support data set properties and documentation across all supported data types. More specifically, ArcCatalog supports editing and viewing of metadata. Metadata includes useful information about your spatial data such as when the data was gathered, data attributes, the scale of the original source information, the accuracy of locations, and the map projection used. ArcInfo 8 has been designed to create metadata for any data set supported/created by ArcInfo as well as any other data set identified and cataloged by the user (e.g., text, CAD files, scripts). Supported data sets include

- Geodatabases (personal and ArcSDE)
- ArcInfo coverages
- ESRI shapefiles
- CAD drawings
- Images
- GRIDs
- TINs
- PC ARC/INFO® coverages
- Workspaces
- Folders
- Maps
- Layers
- INFO tables
- dBASE tables
- DBMS tables
- Projections
- And much more

ArcCatalog comes with support for several popular metadata standards. There are editors to enter metadata, a storage schema, and property sheets to view the data. The implementation is completely customizable so any metadata format can be implemented. The metadata is actually stored in XML (extended markup language) format. It is stored with the data, and all data management tools honor it (copy, kill, rename, etc.).

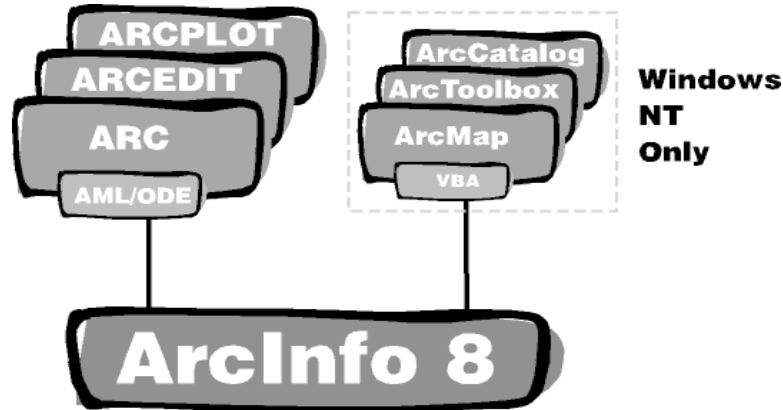
Implementing your own custom metadata documentation editor is easy and requires the following components:

- Schema
- ActiveX control (editor)
- Document type definition (optional—for validation)
- Style sheets (for viewing)

Out-of-the-box metadata documentation editors are provided with ArcInfo 8 by ESRI. In addition, ESRI anticipates both third party developers and end users will develop a significant number of custom metadata documentation editors.

Just as it supports multiple metadata documentation editors, ArcCatalog can also support multiple style sheets to give you different ways to look at the underlying XML. These style sheets basically convert XML to a more easily readable HTML.

In future releases of ArcInfo 8 technology, ArcCatalog will include a number of enhancements for even more robust metadata support including additional out-of-the-box metadata editors, as well as a rule base for lineage of metadata through geoprocessing.



ArcInfo 8: Platform Support

Existing users currently use ArcInfo across a range of UNIX and Windows NT platforms. ESRI will continue to support and extend ArcInfo on both of these platforms taking advantage of their inherent strengths. We envision that UNIX systems will form the backbone of future GIS systems for many users in the same manner as it does today.

Conversely, the new ArcInfo applications (ArcMap, ArcCatalog, ArcToolbox) that are graphic, highly interactive, and user-interface oriented will take advantage of the Windows environment and all that it offers.

ArcInfo 8 is a system of integrated components. The components can be deployed on a single workstation or can be distributed over a heterogeneous network of workstations and servers.

At ArcInfo 8, users will start to think of their computer networks as "the platform." Our vision is that users will continue to leverage their investments in UNIX hardware, and they will also begin to add Windows NT seats on their networks for appropriate tasks. ArcInfo 8 is designed to facilitate this.

ArcMap, ArcCatalog, and ArcToolbox are designed for use solely on Windows NT (and in the very near future, Windows 95, 98, and 2000). Yet they are also designed to integrate and work directly with the ArcInfo UNIX environments. Alternatively, all of ArcInfo can operate on a single Windows platform in a client/server mode.

Users will be able to implement an integrated UNIX/Windows network to perform many tasks. A single license manager process on a network can be used for both UNIX and Windows NT seats. ArcInfo on Windows can work with data stored and maintained on UNIX systems. Furthermore, the ArcToolbox application can execute its geoprocessing functions on remote UNIX/Windows servers. In this way, users can compose and execute very large geoprocessing jobs in a Windows environment and run them on UNIX hardware anywhere on the network.

**Distributed GIS
Vision**

The ArcInfo 8 architecture allows users to begin considering their investment in ESRI software as part of an overall system of components that can be distributed across a network.

**Frequently Asked
Questions About
ArcInfo 8**

**Who Will Get the
New Parts of ArcInfo
(dependent on
Windows NT)—Only
Windows NT Users?**

No. All ArcInfo users, regardless of their current platform, will receive both ArcInfo for their specific platform (e.g., Sun Solaris) and a complete copy of ArcInfo for the Windows environment. A single license manager will regulate use of the integrated system.

**Will I Have to Do
Anything Different to
Run ArcInfo 8?**

No. You can install and use ArcInfo 8 as you have all past releases.

**Has ESRI Stopped
Development on
UNIX ArcInfo?**

No! Many enhancements have been added to ArcInfo and are available for the same platforms that ESRI supports at ArcInfo (Sun, HP, IBM, Silicon Graphics, Digital UNIX, and Intel and Alpha versions of Windows NT). Highlights include

- New data converters (SDTS, TIGER, DIGEST).
- More than twenty major new functions and tools in ARC COGO.
- Industry line and marker symbolsets for many users. These same symbolsets are provided with ArcView GIS 3.2.
- Java support for ODE, allowing users to develop standard interfaces that work across all supported platforms.
- New generalization tools such as automated street centerline generation from simple road casings and tools for simplifying building shapes.
- ArcSDE 8 support including many performance enhancements and advanced search tools.
- Shapefile 2 support integrated with ArcSDE 8.
- Advanced layer-on-layer selection in ARCCEDIT and ARCPLOT.
- Support for three-dimensional coordinates and measures in shapefiles and ArcSDE.
- Improved map projection of grid data sets.
- Integrated license management.
- New Geoprocessing Server for remote geoprocessing.
- Bug fixes and performance enhancements.

I Have Invested a Lot in My UNIX Network and Hardware. What Should I Do with My UNIX Investments Now?

The majority of ArcInfo 8 will run on supported UNIX platforms. This means you can continue to use your UNIX investments. You should consider adding at least one Windows NT platform to your network to start to exploit the new ArcInfo applications. ArcInfo 8 is designed to run the new applications on Windows while being networked into a UNIX platform (server), which is envisioned for analysis and data services.

Your UNIX platforms should be used for server-based tasks, as well as for intensive computing activities. For example, when high availability for a specific task is critical, UNIX may be a very important and wise choice. These are exceptional cases. In most cases, we recommend that you start to think about using PCs for many advanced desktops in your organization. But plan wisely.

Once you have started to use and understand ArcInfo 8, you will probably want to add additional Windows desktops on your network for appropriate work. You will probably perform highly interactive tasks on Windows and major heavyweight computing and data management on UNIX via your desktops.

This "new" strategy may not be much of a change from your existing system configuration; many users today have similar configurations with PCs running X-emulation software on their UNIX networks.

What About My Investments in AML and ODE?

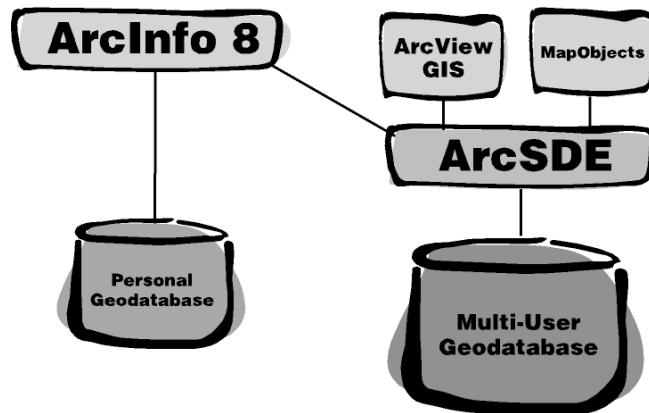
All AML and ODE applications will continue to work. All existing procedures that have been built with them will also continue to work. Nothing needs to change about your ArcInfo system and day-to-day work. AML applications written in version 6 of ArcInfo work perfectly with ArcInfo 8. Data sets created in previous versions also continue to work.

I Hear There is a New Spatial Database Format at ArcInfo 8 That Is All-Relational. Am I Required to Purchase a DBMS or Convert My Existing Data to Use ArcInfo 8?

No. ArcInfo 8 will work on all existing data including ArcInfo coverages, ESRI shapefiles, SDE layers, GRIDs, TINs, images, CAD drawings, and INFO tables. For example, ArcMap is an excellent editor for ArcInfo coverages and ESRI shapefiles. Moving data to SDE is optional.

What About INFO as a Tabular Database Tool for ArcInfo? Does It Continue to Work? Do I Have to Move All My Attribute Data into Another Database?

INFO is a supported software module within ArcInfo 8 and continues to be maintained by ESRI.



ArcSDE 8: Data Management for ArcInfo

One of the keys to enterprise GIS success is providing strong data management. ArcInfo 8 was designed from the outset to be a multiuser system. ArcInfo 8 uses SDE technology for organizing and managing its data. With ArcInfo 8, SDE (ArcSDE) becomes a standard part of the ArcInfo GIS system and will be made available to all users. This provides powerful data management capabilities to the ArcInfo environment.

With ArcSDE you can manage vast data sets distributed across multiple platforms and DBMSs. ArcSDE provides the open access necessary to integrate GIS data into a corporate or enterprise information system. ArcSDE also provides a standard, published API to all ArcInfo-managed GIS data.

ArcSDE ArcSDE stores information in a DBMS and offers multiuser access to a secure, reliable, scalable spatial database. It operates in a very efficient client/server network mode.



For more than 30 years ESRI has been helping people manage and analyze geographic information. ESRI offers a framework for implementing GIS in any organization with a seamless link from personal GIS on the desktop to enterprisewide GIS client/server and data management systems. ESRI GIS solutions are flexible and can be customized to meet the needs of our users. ESRI is a full-service GIS company, ready to help you begin, grow, and build success with GIS.

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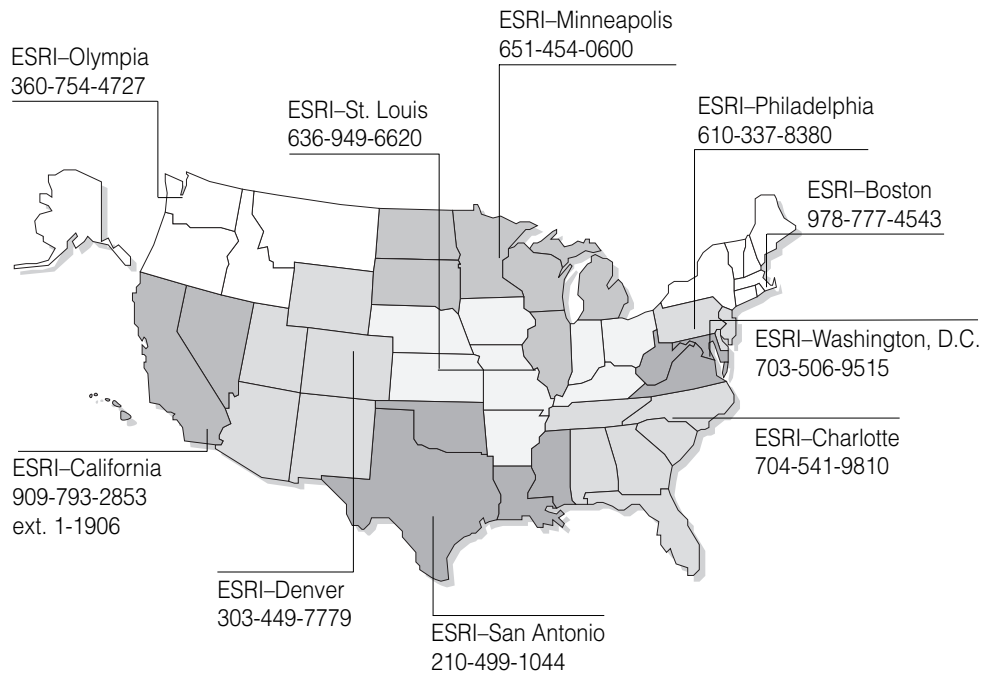
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