



Comparative Analysis

**Technical Comparison: Autodesk MapGuide 6  
and ESRI's ArcIMS 4**

**This analysis was performed and written by a third party and GIS web developer, Alex Fordyce.**

## Table of Contents

<b>Introduction</b> .....	3
<b>GIS on the Web</b> .....	3
Autodesk MapGuide Product Architecture .....	4
ESRI ArcIMS Product Architecture.....	5
<b>Component Comparison</b> .....	5
Autodesk MapGuide Components.....	5
ESRI ArcIMS Components.....	6
<b>Maps, Data, and Viewers</b> .....	6
Advantages of SDF over SHP for Web Delivery .....	7
Viewer Types.....	8
Viewers Without Plug-In Requirements.....	8
Plug-in Viewers .....	9
<b>Authoring Maps and Publishing on the Web</b> .....	11
Ease of Use of Autodesk MapGuide Authoring.....	12
Publishing to the Web.....	13
ArcIMS Designer.....	14
<b>Servers</b> .....	17
<b>Application Development</b> .....	20
<b>Conclusion</b> .....	21
<b>About the Author</b> .....	21
<b>Appendix 1: Questions and Answers</b> .....	22
<b>Appendix 2: Functionality Quick Reference</b> .....	25

## Introduction

This white paper provides a technical comparison of Autodesk MapGuide® 6 and ESRI® ArcIMS® 4 (Internet Map Server) software programs. Autodesk MapGuide is the leading solution for web-based GIS and distributing maps online because of its ease of use with map authoring, highly scalable server built for network environments, and customizable viewer application programming interface (API).

Autodesk was the first major software company to bring dynamic, vector-based, and interactive online maps to the consumer market and has been developing web-based GIS software since the mid-1990s. From the beginning, the Autodesk MapGuide architecture was designed expressly for Internet and intranet applications. Autodesk MapGuide is a full-featured Internet GIS authoring and viewing environment, complete with an API for application-specific customization. In addition, because of Autodesk's focus on data integration in their GIS product line, Autodesk MapGuide can handle data from a variety of existing formats (including SHP, MIF/MID, DGN, DWG, and ESRI coverages), which can be brought into Autodesk MapGuide from different servers and then published to the Web.

In comparison, ESRI ArcIMS technology allows desktop-based Shapefiles to be viewed with a standard web browser using a proprietary programming language (ArcXML). Although enabling users to view GIS data over the Web was an important step, ESRI's IMS software was first engineered using desktop-based technology, not web-based. ArcView IMS was released in the mid to late 1990s. It used the desktop software ArcView as its engine and was prone to crash. The Internet component was essentially an extension to the desktop software, and so ESRI's first venture into Internet mapping was really just an attempt to web-enable their desktop GIS software, a system never designed with the network in mind. ESRI also released MapObjects IMS, a more effective tool but one with a difficult development environment. Version 2 of MapObjects IMS was released in 1998, and ESRI invested its next effort into a different code stream. Despite its version number, ArcIMS 4 is a second release of that code stream. ESRI numbered the premier release of ArcIMS as version 3 since it followed release 2.1 of MapObjects IMS, but these code streams are completely separate. As a result, ArcIMS is a relatively new technology compared to Autodesk MapGuide and has the performance and reliability problems one might expect from a new software line. Although the latest release of ArcIMS, version 4, addresses some of these issues, the problematic legacy remains.

Although both are powerful tools, the differences between Autodesk MapGuide and ArcIMS parallel the differences in their origins—between technology developed for the desktop and technology developed for the Web. Autodesk believes that the mature legacy of Autodesk MapGuide and their historic focus on ease of customization provide a more effective solution.

## GIS on the Web

Distributing GIS data over a web-based network is a powerful method for effective communication. One strength of web-based GIS is that users can view GIS data using an inexpensive, standard Internet browser. With desktop GIS a user typically must purchase, install, and learn how to use a general GIS software tool to load, manipulate, query, and analyze the data. Conversely, a common difficulty associated with web-based GIS is the variable and sometimes limited bandwidth for data flow between the data server and user. As a result, web-based GIS must be highly scalable—successful applications take advantage of networks with high bandwidth while working efficiently to avoid problems with slow

## Technical Comparison: Autodesk MapGuide 6 and ArcIMS 4

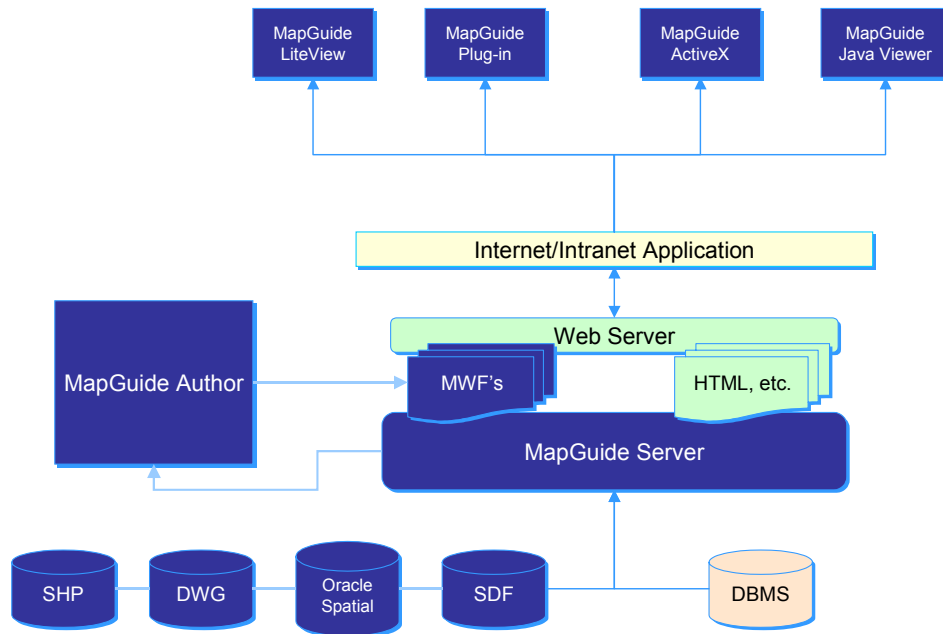
networks and low bandwidth. *Therefore, when choosing a web-based GIS, scalability is essential.*

The demands placed on GIS solutions today show a great need for high performance and scalable solutions designed and built specifically for Internet applications. Autodesk MapGuide was designed and built from the ground up for networked, web-based GIS. In fact, it wasn't until the widespread release of ArcIMS 3 in 2001 (a new code stream despite the release number) that ESRI offered anything other than a raster snapshot image of SHP files across the Web with constant requests and data traffic moving to and from the user and server, slowing performance.

In general, viewing GIS data on the Web involves a three-tiered architecture:

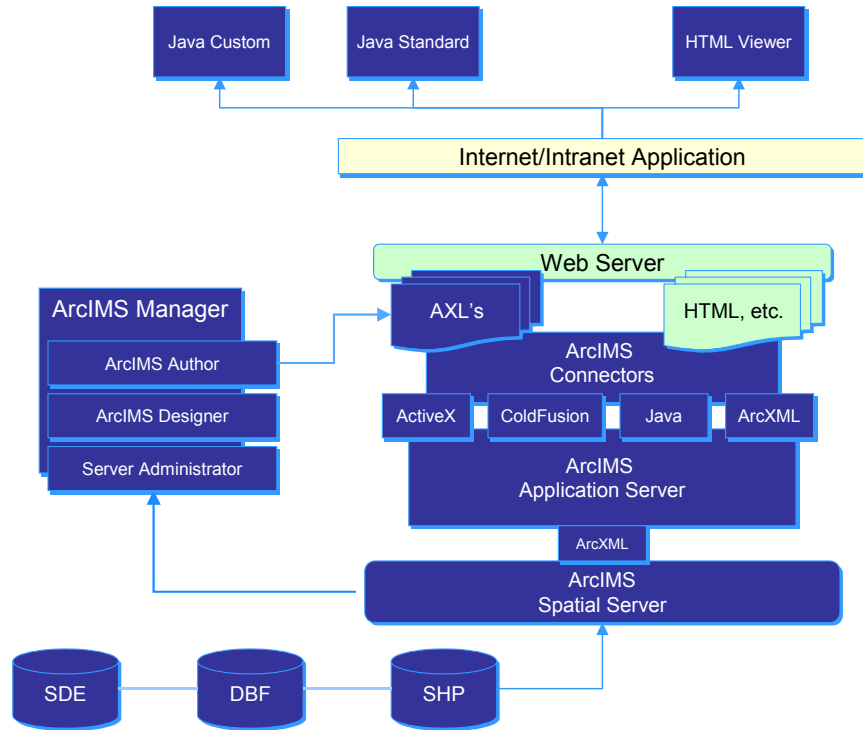
1. A spatial server that can efficiently communicate with a web server and is capable of sending and receiving requests for different types of data from a browser environment.
2. A mapping file format that can be embedded into a web page.
3. A web-based application in which maps can be viewed and queried by an end user/client via web browsers.

### Autodesk MapGuide Product Architecture



*Autodesk MapGuide software's simple and efficient architecture.*

## ESRI ArcIMS Product Architecture



*The more complex architecture of ArcIMS technology.*

## Component Comparison

This section describes the individual components of each web mapping system.

### Autodesk MapGuide Components

Autodesk MapGuide consists of three major components that were developed for distributed network environments. These three components work together with a web server to serve dynamic maps to a web browser. A few other components are also available for additional functionality and customization.

1. **Autodesk MapGuide Server:** Handles requests from a viewer and delivers the appropriate data.
2. **Autodesk MapGuide Author:** Creates the map (saved as an MWF file), which is then embedded into a web page. All of the map's properties (color, line style, layers accessible at different map scales, and more) and viewer functionality are defined and created in the Autodesk MapGuide Author. (Alternatively, users can author maps with Autodesk® Envision, a separate companion desktop product for Autodesk® Land Desktop, Autodesk Map™ and Autodesk MapGuide.)

## Technical Comparison: Autodesk MapGuide 6 and ArcIMS 4

3. **Autodesk MapGuide Viewers:** The following four viewers are available for Autodesk MapGuide:
  - a. Plug-in for Netscape®
  - b. ActiveX® Control for Microsoft Internet Explorer
  - c. Java™ Viewer for Sun® and Macintosh® operating systems
  - d. Autodesk MapGuide LiteView—no plug-in required.

Other components include SDF Loader, SDF COM Toolkit, Dynamic Authoring Toolkit, Data Provider for SHP (allows for direct Autodesk MapGuide reading of SHP files), Data Provider for Oracle® Spatial (allows Autodesk MapGuide to read directly from an Oracle Spatial or Oracle Locator database), Raster Workshop, and Symbol Manager.

### ESRI ArcIMS Components

ArcIMS consists of five major components that interact with each other to enable users to view and query GIS data with an Internet browser. Additional components provide different features for customization.

1. **ArcIMS Spatial Server:** Processes requests for maps and attribute information.
2. **ArcIMS Application Server:** Written in Java, this component tracks client requests for information and distributes them to the appropriate ArcIMS Spatial Server.
3. **ArcIMS Application Server Connectors:** Connects the web server to the ArcIMS application server. Any of the four connectors can be used to translate client requests into ArcXML. (ArcIMS Servlet Connector uses ArcXML, ColdFusion Connector translates Macromedia® ColdFusion® into ArcXML, ActiveX Connector translates ASP or VB into ArcXML, and ArcIMS Java Connector uses JSP).
4. **ArcIMS Manager:** A web wrapper that combines three separate ArcIMS applications (ArcIMS Author, ArcIMS Designer, ArcIMS Administrator) into one user interface. Because of its web framework, the ArcIMS Manager can be used remotely. The three individual applications can also be used separately on a local machine.
5. **ArcIMS Viewers:** There are three viewers available for ArcIMS—the HTML Viewer, the Java Standard Viewer, and the Java Custom Viewer.

Other components include ArcSDE™, ArcMap™, and Route Server.

### Maps, Data, and Viewers

The Autodesk MapGuide Author pulls vector data and raster images from the Autodesk MapGuide Server as layers to create an MWF file. The MWF file is the map file that gets embedded in a web page (or otherwise published to the Web). A big advantage of Autodesk MapGuide is that once the MWF file is authored there is no special publishing or formatting necessary, whereas with ArcIMS, application developers must first create an Image or Feature Service. An Autodesk MapGuide LiteView application and an application developed for the Autodesk MapGuide ActiveX Control can both point to the same MWF. In this way, Autodesk MapGuide makes it easier to deliver maps on the web to different client viewers since all viewers—raster or vector—can point to a single source file.



## Technical Comparison: Autodesk MapGuide 6 and ArcIMS 4

Another benefit of SDF over Shapefiles is the ability to quickly compile a large number of similar Shapefiles into a single SDF. An example of this powerful feature is seen in assessor books. Assessors typically keep each parcel book as a separate set of Shapefiles (that is, bk041, bk072, bk105). Combining these Shapefiles into a single SDF file gives the user a single, seamless base map instead of several hundred files that must be managed separately.

The Autodesk MapGuide SDF file works differently. The MGKey\_ID, an attribute within the SDF file, can be defined when creating an SDF file. The MGKey\_ID can be the unique key field of a remote database(s) and linked to records accordingly. The relevant attribute data is retrieved only when the application calls for it. The remote database could be any ODBC-compliant database: a DBF file, Microsoft SQL Server, Microsoft® Access, or an Oracle database. Establishing the link between SDF files and databases is straightforward, well documented, and easy with Autodesk MapGuide. Only the necessary information from an Autodesk MapGuide SDF file is sent across the network for a particular query, making processing more efficient. Further, only the spatial data defined by the coordinate extents of the client map are processed on the Autodesk MapGuide Server.

When building a query using the ArcIMS HTML client, the user receives all the fields of the associated DBF file. All the Shapefile's attribute information is associated directly with the spatial data. This type of data design—explicit association to attribute data—can equate to high processing and slow performance. In contrast, Autodesk MapGuide offers a linked, indirect relationship that results in less processing and faster performance.

When comparing speed of native formats, users will find that this intuitive data design makes Autodesk MapGuide SDF files superior to ESRI SHP files for delivery and distribution of spatial data over the Internet or an intranet. In fact, because Autodesk MapGuide uses this enhanced approach to indexing spatial data, many developers claim that Autodesk MapGuide serves ESRI's own Shapefiles over the Web as fast or even faster than either ArcView during a local desktop session or ArcIMS over the Web.

### Viewer Types

Both Autodesk MapGuide and ArcIMS provide client technologies with or without a required plug-in download. As with most client technologies, whether an application requires a plug-in depends on the end-user functionality needed. There are differences in functionality, potential functionality, and performance between applications that are based on plug-ins and those that are not. For example, if the user needs only to view data and query attribute data related to spatial data, then perhaps a developer will build a simple raster image-based application that does not serve live vector data and thus does not require a plug-in.

### Viewers Without Plug-In Requirements

Autodesk MapGuide LiteView enables the Autodesk MapGuide Server to display maps in a browser without a plug-in. LiteView is a Java program that runs as a servlet and converts Autodesk MapGuide MWF files into a PNG file.

The ArcIMS HTML Viewer is the only non-Java based viewer option available for ArcIMS. The ArcIMS HTML Viewer sends an ArcXML request another proprietary language from Servitor the ArcIMS Server and receives an ArcXML response. The ArcIMS HTML Viewer has more built-in functionality than Autodesk MapGuide LiteView, such as buffering, spatial selections(select by rectangle or circle), and measuring distances, but much of the same functionality can be added to Autodesk MapGuide LiteView through customization.

## Technical Comparison: Autodesk MapGuide 6 and ArcIMS 4

### *Functionality*

This chart compares the functionality of web mapping systems that require no plug-in download and installation.

	<b>Autodesk MapGuide LiteView</b>	<b>Autodesk MapGuide LiteView Customized</b>	<b>ArcIMS HTML Viewer</b>
Download required			
Output image	PNG	PNG	JPEG, GIF, PNG
Zoom In, Zoom Out, Zoom Full, Pan	✓	✓	✓
Create Buffer		✓	✓
Select within Buffer			✓
Identify—select geographic object and view data	✓	✓	✓
Measure Distance		✓	✓

### **Plug-in Viewers**

ArcIMS has two versions of the Java Viewer—Java Standard Viewer and Java Custom Viewer—both of which require a plug-in.

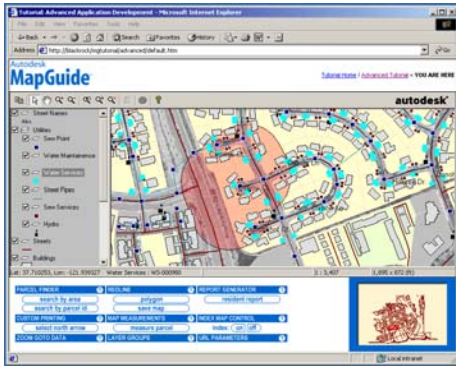
ArcIMS offers out-of-the-box direct data editing. Autodesk MapGuide does not. However, the SDF COM Toolkit allows Autodesk MapGuide developers to add this functionality to applications and offers many examples to help them get started. The ArcIMS Java Viewer using Feature Services has two functions called MapNotes and EditNotes (EditNotes is available only for the Java Standard Viewer). The MapNotes function enables the user to add text or graphics to the map (on the MapNotes layer). These edits are then sent to the MapNotes folder on the ArcIMS Server. The EditNotes function enables the user to edit features on the displayed map. Similar to MapNotes, once the user is finished editing, the changes are submitted to the EditNotes folder on the ArcIMS Server for the server administrator to review. For true data creation, EditNotes must be converted to SHP files or XML. With the SDF COM Toolkit, developers can extend the Autodesk MapGuide Viewer to enable users to create, edit, or delete actual SDF files—no conversion necessary.

Although the data-editing capabilities in ArcIMS may seem important, most web developers use their applications to communicate to a larger audience and don't want that audience editing their GIS data directly. Instead, they prefer to have users make notations that the GIS professional can review and consider for incorporation. Direct data-editing by users is rarely cited as a requirement for these applications.

Autodesk MapGuide provides the ability to create complex buffers from disparate feature types (points, lines, and polygons) that are close together or far apart and creates a single buffer that can be either joined together (when close) or separate, but act as a single entity (when far apart). ArcIMS does not offer this powerful feature.

## Technical Comparison: Autodesk MapGuide 6 and ArcIMS 4

Autodesk MapGuide does not provide redlining functionality out of the box; however, redline functionality is accessible through the MGRedLineSetup object in the Autodesk MapGuide Viewer API. The Autodesk MapGuide API allows access to redlining attribute properties like polygon edge style and color, polygon fill style and color, symbol rotation, and many others. Further, the SDF COM Toolkit enables developers to add, edit (change styles and properties), and delete SDF files directly. It is a powerful tool and highly customizable. The Autodesk MapGuide API also enables the user to add a point directly to the map and appropriate database. For detailed examples that show how to create these functions using JavaScript and ColdFusion or ASP see the *Autodesk MapGuide Developer's Guide*.



Select within a buffer with Autodesk MapGuide Viewer.

Another powerful Autodesk MapGuide feature is the ability to select or deselect map features or objects using SHIFT-pick. This capability is especially powerful after a buffer has been created because the user can add or remove parcels, roads, or other objects from the selection set using the standard Windows method of SHIFT-pick. ArcIMS does not provide this capability. In addition, the selection of objects in ArcIMS viewers is restricted to only the active layer. This means users can select either Parcels or Buildings but not both.

ArcIMS uses the standard web printing feature of Microsoft Internet Explorer. Another feature in the ArcIMS Java Viewers enables users to add Shapefiles and ArcSDE layers from local machines and map services from other ArcIMS websites. It is interesting to note that the ArcIMS Author does not allow users to access data from other ArcIMS websites. Autodesk MapGuide puts this functionality in the Author rather than the viewer.



Redline polygon, circle, and text with Autodesk MapGuide Viewer.

### Functionality

This chart compares functionality of viewer technology that requires a software download and installation.

	Autodesk MapGuide Viewers	ArcIMS Java Viewer
Download required	✓	✓
Support for Netscape	✓	*
Select objects by rectangle	✓	✓
Select objects by radius	✓	
Select multiple objects on different layers	✓	

## Technical Comparison: Autodesk MapGuide 6 and ArcIMS 4

	<b>Autodesk MapGuide Viewers</b>	<b>ArcIMS Java Viewer</b>
Select objects with SHIFT-Pick	✓	
<b>Buffering</b>		
Create buffer	✓	✓
Buffer creates new layer	✓	
Select within buffer	✓	✓
Complex buffer creation	✓	
<b>Querying</b>		
Identify—select geographic object and view data	✓	✓
Set map units	✓	✓
Set selection mode (centroid or intersection)	✓	
Set mouse position display units (Lat/Lon or Mapping Coordinate System)	✓	
<b>Presentation</b>		
MapTips/Map Tooltips	✓	Feature Service only
Customized printing	✓	
Online help files	✓	

*\*The Java Standard Viewer supports only Netscape versions 4.75 and 6.0. The Java Custom Viewer does not support Netscape at all.*

## Authoring Maps and Publishing on the Web

The Autodesk MapGuide Author enables users to add spatial and attribute data to an MWF file as layers and edit properties of these layers. The MWF file can also be saved as an MWX file for use with Autodesk MapGuide LiteView and XML. Further, the MWX can be edited with a text or XML editor and then reopened within the Autodesk MapGuide Author with the new changes.

The ArcIMS Author also enables the user to bring in data as layers and edit layer properties, but saves the map as an AXL file—ESRI’s version of the MWF/MWX file. Connections to remote databases (IBM DB2, IBM Informix, Microsoft SQL Server, and Oracle only) must be made through ESRI’s SDE software. If the user decides to make changes to the AXL file with a text or XML editor, the changes will be lost when the file is brought back into the ArcIMS Author. This makes customization of the AXL file challenging.

Autodesk MapGuide provides more tools for map authoring and a more helpful approach to web-based GIS development. Generally, ArcIMS provides many tools for authoring maps, but most of the more powerful functions reside on the client side. Why are the ArcIMS Viewers more powerful than the ArcIMS authoring tools? One would think that the author should have at least the same amount of functionality as the end user. After all, it is the map author that is creating the map and subsequent access to its data via functionality. If the author is going to provide the end user with buffering functionality, then the author had better know how the buffer function might work with the map before publishing it to the web. Autodesk MapGuide provides a superior map-authoring program that contains all the functionality of its viewer and much more. The Autodesk MapGuide authoring and viewing products are consistent, while ArcIMS allows the ArcIMS Author to perform only a subset of the functionality of its Java viewers.

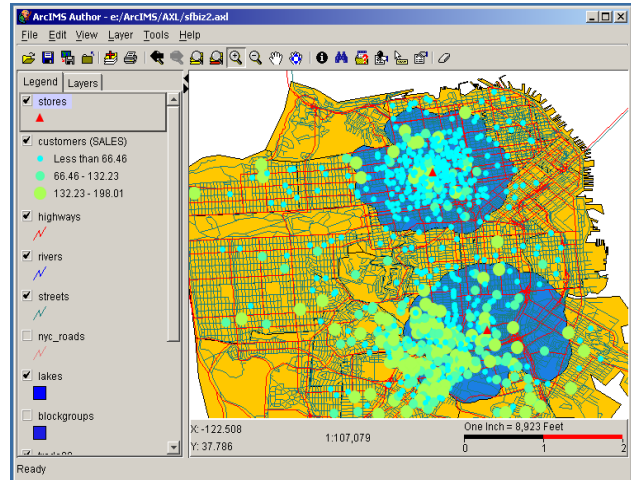
### Ease of Use of Autodesk MapGuide Authoring

Autodesk MapGuide users can right-click to access all the tools available in the menu— ArcIMS users cannot. In fact, there are many ways to access different layer properties and global map properties in Autodesk MapGuide, making the interface more user friendly.

Both technologies have set scale features for bringing in data layers, and different view properties can be scale dependent. However, some of the functions in the ArcIMS Manager are inconsistent; for example, clicking a layer and changing the width of the legend produces erratic results.

Both the SQL Expression/Query Builder and the Find/Select functions in ArcIMS Author are useful, and the Zoom-To and Pan-To features are in the same dialog box after searching for map features. However, there are some serious limitations.

ArcIMS Author cannot edit the properties of multiple layers at the same time, nor can it create layer groups (layers within layers), which allow for better data organization. Nor can users change the data source of a layer defined in the ArcIMS Author.



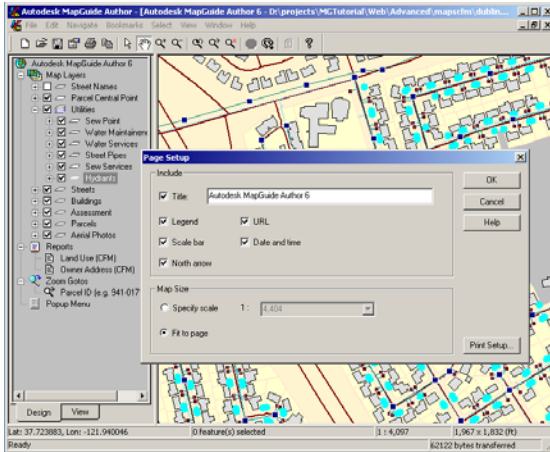
*ArcIMS Author, less functionality than ArcIMS Viewers.*

Autodesk MapGuide treats layer properties (such as line width and color) and layer data sources similarly in that they are defined at the property level. In fact, a layer's data source is one of its properties. This illustrates the ease of use and intuitive design of Autodesk MapGuide. With ArcIMS Author, changing the data source of a layer requires that users delete the layer (with all its associated properties) and then add the layer from another data source and redefine its properties. For a technology built for network environments, this is poor design.

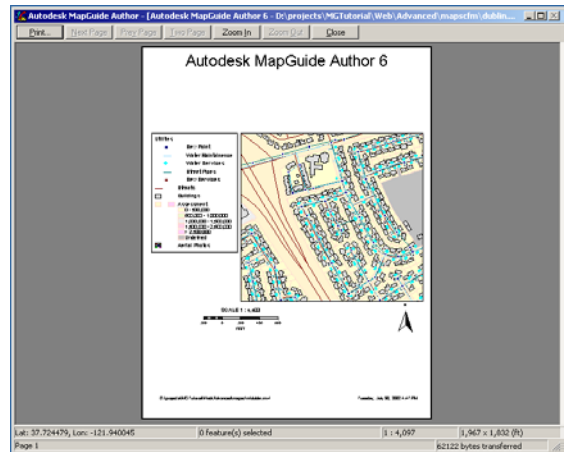
Although ArcIMS Author's Apply button in the Layer Properties dialog box is useful when making multiple, consecutive changes to a layer at once, it only works after clicking it several times. This bug makes this tool very unreliable.

ArcIMS Author lacks printing functionality and uses the Windows® default print feature. In contrast, Autodesk MapGuide offers its own printing function (with Windows printing) and enables the user to set many properties, including scale bar, north arrow, title, time and date, and URL. It also provides a print preview. Further, all printing properties can be customized and are available to the Autodesk MapGuide Viewer through the API.

## Technical Comparison: Autodesk MapGuide 6 and ArcIMS 4

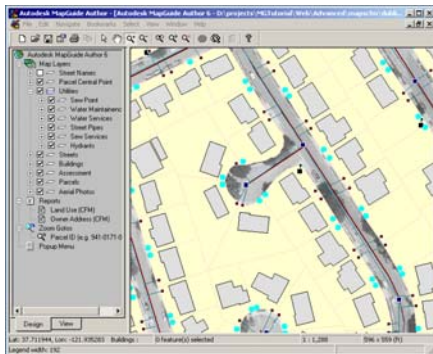


*Autodesk MapGuide software's Page Setup dialog box enables the user to choose which map information to print.*

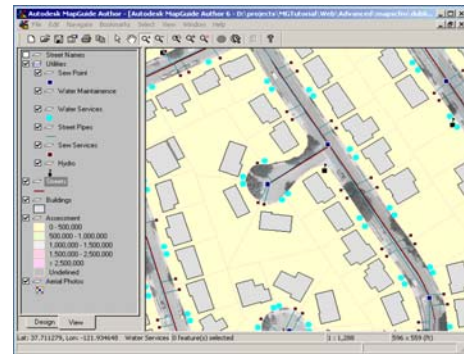


*Autodesk MapGuide software's print preview feature enables the user see the final draft before printing.*

The map explorer and print preview are two examples of Autodesk MapGuide Author's ease of use. The authoring tool in Autodesk MapGuide has the same look and feel as the Autodesk MapGuide viewer, making development easier and enabling the developer to be more creative and productive by requiring less time spent on QA.



*The Autodesk MapGuide Author Design tab displays the tools for design that will be hidden once the application is launched.*



*The Autodesk MapGuide Author View tab displays how the client displays the map and legend for the end user.*

Autodesk MapGuide enables the user to change individual layer properties but requires that the user click OK to apply these changes, which closes the Layer Properties dialog box. However, when the user reopens the Layer Properties dialog box, Autodesk MapGuide Author returns the user to where they left off.

### Publishing to the Web

The output of maps created with the Autodesk MapGuide Author is an MWF file, and the ArcIMS Author creates an AXL file. ArcIMS authors then use the ArcIMS Designer to publish the AXL file to the Web. This component of ArcIMS enables the GIS map user with little knowledge of web development to design a website and view an authored map in a web page. However, knowing that with Autodesk MapGuide Author, what you see during

## Technical Comparison: Autodesk MapGuide 6 and ArcIMS 4

development is what you will see on the Web far outweighs the ease of use of the ArcIMS Author and Designer, where what you see is not necessarily what you get. The trade-off is that ArcIMS users spend more time authoring and Autodesk MapGuide users spend a little more time getting it on the Web.



```
1 <!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.0 Transitional//EN">
2 <html>
3 <head>
4 <title>Autodesk MapGuide</title>
5 </head>
6 <body>
7
8 <object width="100%" height="100%" id="map" classid="CLSID:62789780-B744-11D0-986B-00609731A21D"
9 codebase="ftp://adeskftp.autodesk.com/webpub/mapguide/ver6/viewer/en/mgaxctrl.cab#Version=6,0,2,4">
10 <param name="URL" value="http://www.mapguide.com/maps/sanraf.mwf">
11 <param name="MapUnits" value="FT">
12 <param name="Lat" value="38.003535">
13 <param name="Lon" value="-122.524747">
14 <param name="MapWidth" value="2180">
15 <param name="LayersViewWidth" value="150">
16 <param name="ReportTarget" value="reports">
17 <param name="ObjectLinkTarget" value="FloatReport">
18 <param name="AutoLinkLayers" value="Incidents">
19 <param name="AutoLinkTarget" value="InWindow">
20 <param name="AutoLinkDelay" value="0">
21 </object>
22
23 </body>
24 </html>
```

*Simple HTML code used to embed an MWF into a web page. The page can then be accessed by a web browser and the map viewed by the Autodesk MapGuide Viewer plug-in.*

## ArcIMS Designer

ArcIMS Designer provides an easy-to-use wizard to set up a simple web application in about eight steps. This is a powerful demo that Autodesk MapGuide sales staff should be aware of. In fact, the Autodesk MapGuide development team might also consider a wizard approach to application development. The applications the wizard creates are simple, and many users will want to customize their interface and integrate web databases. Then they will discover why ArcIMS has a poor reputation as a development platform and why it is so difficult to customize their applications.

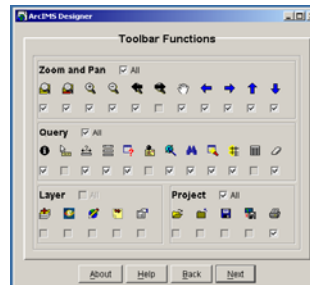
The ArcIMS Designer guides the user through a process of choosing many map properties that in Autodesk MapGuide are defined through the Autodesk MapGuide Author. This wizard approach to web development creates a local directory for the web files, and links that directory to the map service (Image or Feature) created in the ArcIMS Server Administrator. With Autodesk MapGuide this would be the equivalent to writing a web page that points to an MWF file in the <object> tag. ArcIMS Designer also enables the user to choose a legend, a scale bar, and an overview map as well as which layers are turned on or off. For Autodesk MapGuide users this is achieved through the Autodesk MapGuide Author.

Although the ArcIMS Designer may appeal to the needs of some potential users, functionality is inconsistent throughout the product. For example, choosing the Java Standard Viewer option gives the user all the viewer functions possible, but by choosing the Java Standard Viewer users cannot customize the application. Choosing the Java Custom Viewer allows for application customization with HTML and JavaScript but does not let the user access the MapTips or EditNotes function.

## Technical Comparison: Autodesk MapGuide 6 and ArcIMS 4



*Choosing the Viewer Type with ArcIMS Designer.*

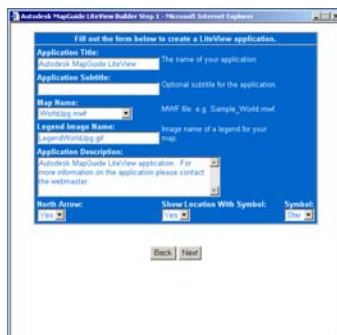


*Choosing the viewer functionality with ArcIMS Designer.*

With Autodesk MapGuide the developer must be familiar with HTML and web design. As with most wizard approaches to application development, there are pros and cons to the ArcIMS Designer: it may save time in the short run, but automated code generation and access to only a predefined set of functionality mean that extending and customizing such applications may take longer.

Although Autodesk MapGuide does not provide a wizard component in the box, this type of publish-to-web functionality can be developed with the Dynamic Authoring Toolkit. This powerful component enables access to all the properties of an MWF file via XML. In fact, one of the examples provided with the Dynamic Authoring Toolkit (DAT) launches a web page that allows the user to choose the coordinate system of an MWF, the layers that should be added, and what viewer functions to show in the Autodesk MapGuide Viewer's popup menu. This essentially serves the same function as the ArcIMS Designer. This DAT sample application could be expanded to include more properties, and ColdFusion or ASP code could be added to design a web template around it.

There is an excellent example of this use of technology in the Sample Applications on the Autodesk MapGuide website. The sample is called "Build your own LiteView Application," and the source code is available. This sample is similar to the ArcIMS Designer.



*Selecting map and website properties with the "Build your own LiteView Application" sample using the DAT from Autodesk.*

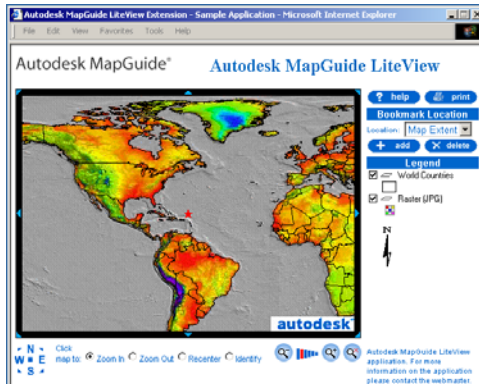


*Application properties summary before creating the website using the DAT from Autodesk.*

For beginning users, an easy Setup wizard in Autodesk MapGuide would be useful. Easy setup approaches are useful for certain applications and to get a new user up and running quickly but can be a hindrance for other reasons. Developers may feel bound to certain functionality or application flow because of the way the program produces code. Generally,

## Technical Comparison: Autodesk MapGuide 6 and ArcIMS 4

this will not be an issue if Autodesk MapGuide does adopt a wizard tool for application development because the product supports open development standards and provides good documentation and a robust API.



*Resulting customized application using the DAT from Autodesk.*

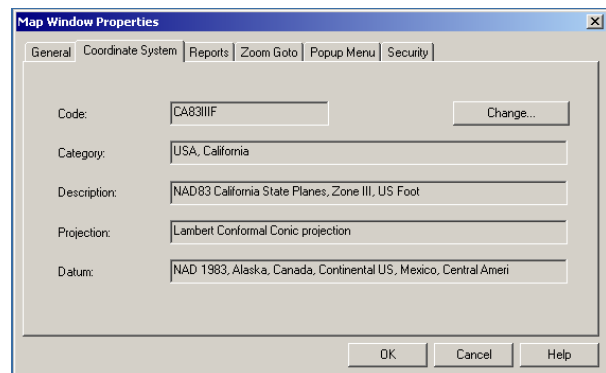
Certain changes made to the map in the ArcIMS Author are not applied until the map is republished through the ArcIMS Designer. There is no global setting for map extents except through the Designer so the author does not know how map will look until it is published. With Autodesk MapGuide the user can set the extents of the viewable map area: the user can work on areas at the city level and save the changes while retaining the integrity of the map extents. This is a major drawback with ArcIMS for time to application.

This approach to map publishing is like a CAD engineer working on a city street map, zooming in to an intersection, and editing the attributes of a waterline, but when the map is saved everything outside the view is cropped and disappears.

With ArcIMS, cosmetic changes made to the map in the ArcIMS Author can be saved, but the map service then needs to be refreshed and the viewer must reload the map.

However, to add a new layer of data, the map must be republished using the Designer. In other words, the entire working web directory must be overwritten. Then the service needs to be refreshed through the Server Administrator.

Changes made to the map are reflected in the viewer when the map is republished through the ArcIMS Designer. For example, when the user adds a new layer, zooms to that area, saves the map, and then refreshes the map service, the viewer shows the extents of the previous map in the main map window and the new map extents saved in the ArcIMS Author in the index map window. To apply all the changes, the map must be republished through the ArcIMS Designer. Depending on the changes (and this is not explained in the documentation), the user may have to republish the site through the Designer.



*Autodesk MapGuide Author enables the user to set many global map properties, including coordinate system, map extents, server location, and security.*

Both the Autodesk MapGuide Author and the ArcIMS Author enable the user to create thematic maps by setting theme values for different layers. However, with ArcIMS the theme field must be added from a Shapefile. With Autodesk MapGuide the theme field can come from the SDF file or an OLE DB data source, resulting in more sophisticated and easier GIS analysis over the Web.

## Technical Comparison: Autodesk MapGuide 6 and ArcIMS 4

### *Author Functionality*

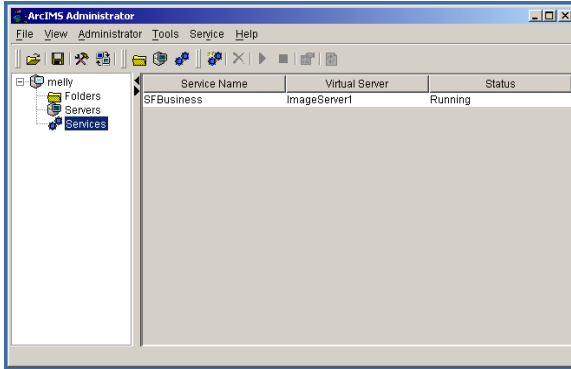
	<b>Autodesk MapGuide 6</b>	<b>ESRI ArcIMS 4</b>
Save as...	.mwf, .mwx	.axl
Save individual layer	✓	
Copy map as...	.emf, URL	.jpeg
Open file from HTTP location	✓	
<b>Navigation</b>		
Zoom width	✓	
Zoom scale	✓	
Zoom selected object	✓	✓
Zoom goto address—address matching	✓	✓
<b>Selection</b>		
Select objects by rectangle	✓	
Select objects by radius	✓	
Select objects by map feature	✓	✓
Select objects by polygon	✓	
Select multiple objects on different layers	✓	
Select objects with SHIFT-Pick	✓	
<b>Buffering</b>		
Create buffer	✓	
Buffer creates new layer	✓	
Select within buffer	✓	
Create complex buffer	✓	
<b>Authoring</b>		
Link map features to URL	✓	
Measure distance	✓	
MapTips	✓	One layer only
Add scale bar		✓
Labeling	✓	✓
Map preview	✓	
Change coordinate system	✓	
Create queries/stored queries	✓	✓
Thematic mapping based on OLE DB data source	✓	
Graduated symbols		✓
<b>Security</b>		
Map password protected setting	✓	
Track map usage	✓	

## Servers

Installing ArcIMS for multiple servers is much more complicated than with Autodesk MapGuide software. In short, the user needs to share a directory on the "host" ArcIMS machine, edit the *arcimsdefaults.properties* file, change the web server service Startup parameters to "This Account" (system account will not work), share a data directory (each

## Technical Comparison: Autodesk MapGuide 6 and ArcIMS 4

ArcIMS Spatial Server must be able to access *all* data displayed in *all* ArcIMS services), and finally edit another map configuration file. There are many steps, requirements, and limitations that make the process time consuming and error prone compared with other web services, not just Autodesk MapGuide. In contrast, Autodesk MapGuide enables the developer to simply point to additional servers or type in the URL, username, and password through a graphical interface.



*ArcIMS Server Administrator.*

The ArcIMS Administrator enables the user to add a new map service to the server. Maps can be added or published as an Image Service (available for HTML and Java viewers), which provides a “snapshot” of the map to the user, or a Feature Service, which streams the map features to the user. However, the Feature Service option is available for the Java Plug-in viewer only.

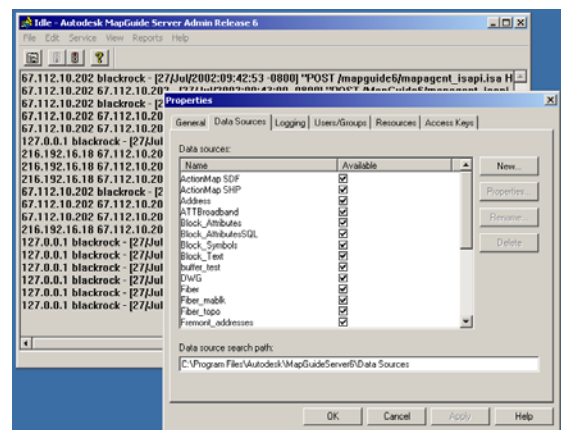
For database access, scalability, and access to ESRI coverages, ESRI recommends ArcSDE. The Autodesk MapGuide Server has greater scalability and more features, and is designed to connect with any ODBC/OLE DB-compliant

database like SQL Server and Oracle, including Oracle Spatial or Oracle Locator. With Autodesk MapGuide the process to connect to an Oracle database is similar to connecting to Microsoft Access or a DBF file. Further, the Autodesk MapGuide Server can have a direct connection with Oracle Spatial, ESRI SHP, and AutoCAD® DWG, making conversion to Autodesk MapGuide software’s SDF format unnecessary.

The Autodesk MapGuide Server Administrator also enables the user to easily make direct connections to any ODBC/OLE DB data source. *The ArcIMS Administrator does not support direct connections to ODBC/OLE DB data sources. This means the ArcIMS cannot theme a data layer directly to an ODBC/OLE DB data source.* A database connection with must be made through ArcSDE. Further, Autodesk MapGuide can create point layers directly from an ODBC/OLE DB data source with the same simplicity as adding a SDF layer. This feature is ideal for visualizing databases that are frequently updated, such as GPS and fleet tracking applications. ArcIMS needs ArcSDE to do this; ArcSDE, by itself, is high-maintenance middleware that requires a high level of technical expertise.

ESRI states in its ArcIMS documentation that access to Shapefiles is “much faster if the Shapefiles reside on the same computer as the ArcIMS Spatial Server.” With the Autodesk MapGuide Server, access to SHP is fast regardless of location.

With Autodesk MapGuide, map authors can easily use multiple servers or have map layers point to different Autodesk MapGuide Servers. In addition, Autodesk MapGuide can process multiple requests simultaneously to the same server or to multiple servers, taking full advantage of multiprocessing and load



*Autodesk MapGuide Server Administrator*

## Technical Comparison: Autodesk MapGuide 6 and ArcIMS 4

balancing. Authors can create maps to best take advantage of this technology by dividing the layers between servers. For example, with access to two Autodesk MapGuide Servers, authors could set up raster layers to use one server and all other layers to use the second server. Additionally, if Autodesk MapGuide Servers are set up with identical configurations and duplicate data, Autodesk MapGuide can detect which server currently has the least traffic and will retrieve data from that server to take advantage of load balancing. ArcIMS does not have this level of scalability.

Autodesk MapGuide security is far more flexible than ArcIMS security. Using the Autodesk MapGuide Server Administrator, users with access to resources such as Autodesk MapGuide Author or the Viewer API can be added. Further, authors can restrict access to a particular resource: spatial data sources, database sources, raster image files, or Zoom Goto.

### *Server Functionality*

<b>Server</b>	<b>Autodesk MapGuide 6</b>	<b>ESRI ArcIMS 4</b>
Security—restrict access to resources	✓	
Open data sources from remote web server	✓	
Load balancing	✓	✓
Direct connection to OLE DB/ODBC	✓	
<b>Native Database Connectivity</b>		
Oracle	✓	
SQL Server	✓	
Sybase	✓	
<b>Spatial Data Support—Vector</b>		
ESRI SHP	✓	✓
DWG	✓	**
ESRI ARC/INFO® coverages	*	***
MapInfo MID/MIF	*	**
Intergraph DGN	*	**
Atlas BNA	*	**
ASCII comma-delimited CSV	*	
<b>Spatial Data Support—Raster</b>		
BMP	✓	✓
CALS	✓	
ECW	✓	
MrSID®	✓	✓
PNG	✓	✓
TGA	✓	
TIFF	✓	✓
<b>Spatial Data Support—World Files/Georeference</b>		
ESRI world files	✓	✓
MapInfo tab files	✓	
Geo TIFF files	✓	✓

\* *Converted with SDF Loader.*

\*\* *Needs to be converted to Shapefile with ArcView™ or ArcGIS™.*

\*\*\* *Connection made through ArcSDE.*

## Application Development

[Author's note: *The analysis I performed was based on the HTML viewer option because the ArcIMS Java Viewers were crashing MSIE. This problem has also prevented me from using the ArcIMS Manager. I can use the Author, Design, and Server Administrator individually but most of the documentation refers to the ArcIMS Manager. Once in a while, I've had difficulty developing with MapGuide, but working with ArcIMS has been a far more difficult experience. I put a call into ESRI's technical support, and they responded after four days and left a message. I called back and no one was available to help me. I corresponded with ESRI support, but they were still unable to resolve my issues. I also installed the ColdFusion and ActiveX Connectors.*]

Both products require development skills to implement anything but the most basic application. Although the ArcIMS Designer suits nondeveloper users, the standard template and functionality provided will not meet the needs of an organization. A developer must be available to customize the reports, interface, and functionality. *Autodesk provides the best development environment and technology for developing web-based GIS applications.* To build an application with strong GIS functionality running on ArcIMS (and ESRI does provide the tools to do this), companies must be willing to spend a lot of money on development.

ArcIMS provides four customizable clients: HTML, Java, ActiveX, and ColdFusion. When the user chooses the HTML Viewer option in the ArcIMS Designer, HTML and JavaScript are created and formatted to build an application. This output defines the look, feel, and functionality of the application as well as how the HTML Viewer communicates with the ArcIMS Servlet Connector. The HTML Viewer is customized by modifying the existing code (mostly JavaScript) created by the ArcIMS Designer.

ArcIMS Application Server Connectors connect the web server to the ArcIMS Application Server and allow for customization through various programming languages. The ArcIMS Servlet Connector is the standard connector. Alternative connectors are the Java Connector, ColdFusion Connector, and ActiveX Connector. ArcXML is the protocol for communicating with the ArcIMS Spatial Server. In short, setting up and configuring Autodesk MapGuide for customized development environments is much easier because the protocols it follows are open and standard, the API and other tools are robust, it is compatible with many other systems and databases, the documentation is clear and easy to navigate, and above all it is stable and not prone to crash.

Application development and customization of ArcIMS is done through ArcXML or by translating from another language to ArcXML. The different ArcIMS Application Server Connectors translate the language a developer wants to use. The connectors come with ArcIMS but require a custom installation. Autodesk MapGuide does not need this type of middleware.

The ArcIMS HTML Viewer API is a set of JavaScript functions, called the HTML Viewer JavaScript Library, which developers can use to modify the display of attribute information and change the web application's look and feel. Similar to the API model of the HTML Viewer, the Java Viewer API is a collection JSP tags. Although offering different connectors allows for a diverse customization environment, each connector has different restrictions on what the developer can do. Also, there is inconsistency between the four connectors. Autodesk MapGuide has a much greater openness and consistency across its Viewer APIs, making application development faster.

## Technical Comparison: Autodesk MapGuide 6 and ArcIMS 4

Generally, ESRI recommends that a developer customize an application after it has been created with the ArcIMS Designer. This strategy helps beginning users get up and running, but it also creates some challenges for the developer. The developer needs to learn not only the object model but also someone else's application flow and coding style. Developers with their own development style and "box of tools" will not view this as an advantage.

Many of the JavaScript functions needed for ArcIMS HTML Viewer customization are actually map properties that in Autodesk MapGuide would be changed in the Autodesk MapGuide Author, which is far easier than developing through coding or from scratch. Once an Autodesk MapGuide website or mapping application is designed, it is much easier to make changes to the map. Simply make changes with the Autodesk MapGuide Author and save the MWF file. The changes are reflected in the viewer once the MWF file is reloaded.

The ArcIMS ColdFusion Connector provides a custom toolbar and CFX object that integrate with CF studio. Autodesk MapGuide should provide this. However, Autodesk MapGuide provides two powerful development tools: the Dynamic Authoring Toolkit and the SDF COM Toolkit. Using these two components, developers can build much more powerful applications in less time than they can with ArcIMS. The Dynamic Authoring Toolkit provides access to all the properties of the MWF file, so a developer can create an application that would give a user functionality similar to that of the Autodesk MapGuide Author, or ESRI's ArcView, on the web. The SDF COM Toolkit enables the end user to edit spatial data directly in SDF files and see the changes in real time. This is a more mature version of ArcIMS's MapNotes and EditNotes functions. Direct access to SDF files through the SDF COM Toolkit also enables developers to create other server-side applications like routing and SDF data conversion.

## Conclusion

Most GIS users would like to simply view and query data over the web, and both Autodesk and ESRI provide technologies to help them do that. However, as demand for more sophisticated analysis increases, Autodesk MapGuide is in a better position to meet those needs. ArcIMS is still in an early phase of development, demonstrated by inconsistencies in features and functions and by processes that do not work as expected. Its central strength is that it works with ESRI products (showing images of SHP files on the web). Because Autodesk MapGuide also works with ESRI products, its powerful capabilities and scalability make it a better choice for implementing a web-based system.

## About the Author

Alex Fordyce is an independent GIS consultant specializing in desktop and web application development using ESRI and Autodesk software. He has worked in the GIS industry since receiving his degree in environmental studies from Boston University in 1995. Contact him at [afordyce@ix.netcom.com](mailto:afordyce@ix.netcom.com)

## Appendix 1: Questions and Answers

Armed with answers to the following tough questions, you may want to raise these issues with prospective customers yourself.

### **1. What does Autodesk MapGuide have that is similar to ArcIMS MapNotes and EditNotes?**

Autodesk MapGuide uses the SDF COM Toolkit, which is much more powerful and flexible than ArcIMS MapNotes and EditNotes.

### **2. What does Autodesk MapGuide have that is similar to ArcIMS SQL Query Builder?**

With Autodesk MapGuide, you can develop applications and queries with ColdFusion or ASP and link your data to ODBC-compliant databases. You are not limited to DBF files, as you are with ArcIMS.

### **3. What does Autodesk MapGuide have that is similar to the ArcIMS Designer?**

Autodesk MapGuide software's Dynamic Authoring Toolkit can provide functionality similar to that of ArcIMS Designer. For an example, see "Build your own LiteView Application" on the Autodesk MapGuide product center, at [www.autodesk.com/mapguide](http://www.autodesk.com/mapguide).

Also, the ArcIMS Designer has some real limitations and poses challenges for developers who want to customize the application later.

### **4. Doesn't Autodesk MapGuide require a copy of the data in SDF?**

No. SDF is one of four vector data formats that Autodesk MapGuide reads natively. The others are SHP, Oracle Spatial/Locator, and DWG. Autodesk suggests that other native data format support will be added in future releases.

SDF offers many advantages. Unlike other data formats, SDF is designed to deliver geographic data efficiently across a network. So, the question is whether you want a slow, raster-based or nonindexed solution with native data files, or fast, interactive SDF data designed specifically for this purpose?

Other advantages include points and text that come directly from a database, and raster imagery that is served in its native format. You don't have to use middleware technology like SDE. Data can be converted quickly and automatically. And GIS data files converted to SDF are usually significantly smaller than the original data.

### **5. I need to download the Autodesk MapGuide Viewer. Isn't this a problem?**

No, downloading the viewer is not a problem for a number of reasons:

- With Autodesk MapGuide LiteView, no plug-in is needed.
- Downloading and installing the Autodesk MapGuide Viewer ActiveX Control and Java Edition are transparent to the user.
- Only the Netscape plug-in requires that the user restart the system after installation. ESRI's Java viewers often require an additional Java software download that slows

## Technical Comparison: Autodesk MapGuide 6 and ArcIMS 4

installation, and file size is significantly larger than that of Autodesk MapGuide Viewer.

- Downloading a powerful viewer, reduces future network traffic.
- The viewer offers more functionality and performance than a non plug-in system.
- The installation of plug-ins and other devices has not hampered the acceptance of other popular applications like Real Audio, Quick Time, and Macromedia Flash.
- Installing a viewer on intranet sites is not generally a problem.

### **6. Autodesk MapGuide uses vector data. Can a user just download and copy our data?**

No. Autodesk MapGuide vector data is transferred as a byte stream, not as a file. Autodesk MapGuide complies fully with industry specifications for Secure Socket Layer (SSL) technology. No data is copied onto the user's hard drive, only the temporary cache memory of the Autodesk MapGuide Viewer. In addition, some customers have successfully implemented Autodesk MapGuide to distribute confidential and proprietary databases across the Internet.

### **7. Does Autodesk support Open GIS Consortium (OGC) standards? What action is Autodesk taking to fulfill those requirements?**

#### *Open Web Services (OWS) 1.2*

OWS is a long-term OGC project that aims to advance interoperable geospatial and imagery web services technology, support development of a multivendor portable demonstration, and feed requirements and recommendations into OGC's OpenGIS Specification process. OWS 1.2 will focus on developing new OGC interface specifications in the areas of image handling, sensor web enablement, service chaining, and feature handling, as well as extending existing OGC interface specifications and drafting engineering specifications developed in OWS 1.1 and other OGC interoperability initiatives. Autodesk is participating in OWS 1.2 along with 30 OGC members. The Autodesk GIS engineering group is performing R&D related to this.

#### *Relationship with Galdos Systems*

Acclaimed by the industry for its contribution to the Geographic Markup Language (GML), Galdos Systems is a recognized expert in the GML field. For example, Ron Lake, president of Galdos Systems, received the highest OGC award this year. Autodesk and Galdos have joined forces for OWS 1.2 by leveraging Galdos expertise on GML- and OGC-compatible server technology with Autodesk technology. Autodesk has also sponsored the first GML developer conference organized by Galdos.

### **8. Questions for the Competition**

- Was your base solution (ArcView GIS, GeoMedia, MapInfo, and so forth) designed from the start for the Web or a network?
- Does your application (ArcIMS) natively connect directly to enterprise-level RDBMSs such as Oracle, Oracle Spatial, SQL Server, Informix, and Sybase *without* middleware like SDE?
- Can you provide a demonstration today using my data? (Chances are, the answer is no.) A qualified Autodesk Sales Application Engineer can get an Autodesk MapGuide application using a clean customer data set running within a short time.

**9. Do Autodesk MapGuide and ArcIMS comply with the U.S. government's requirements for technology accessibility standards (Section 508)?**

The US federal government has requirements for technology to comply with certain guidelines mostly designed "for people with vision impairments". Autodesk has published a white paper on Autodesk MapGuide compliance. This Section 508 compliance white paper is posted at [www.autodesk.com/mapguide-whitepapers](http://www.autodesk.com/mapguide-whitepapers)

**10. What is the single most difficult question to ask an ESRI sales person?**

"Can you build a custom application in a matter of hours, days or weeks?" Autodesk has won many accounts by showing that it takes much less time to develop a custom MapGuide application than a custom ArcIMS application. Autodesk's resellers have encountered devoted, longtime ESRI customers who struggled for months or even a year or more to build their application. When they try building the same application with MapGuide, the time is usually measured in weeks. Get a clean set of your customer's data and build a quick MapGuide application. Show it to the customer and ask them to request the same from ESRI. You'll be pleased with the results.

## Appendix 2: Functionality Quick Reference

### *Viewer Functionality*

	<b>Autodesk MapGuide 6</b>	<b>ESRI ArcIMS 4</b>
Download required	✓	✓
Support for Netscape	✓	**
<b>Navigation</b>		
Zoom In, Zoom Out, Pan, Extents	✓	✓
Zoom to map feature	✓	✓
<b>Selection</b>		
Select objects by rectangle	✓	✓
Select objects by radius	✓	
Select objects by map feature	✓	✓
Select objects by polygon	✓	✓
Select multiple objects on different layers	✓	
Select objects with SHIFT-Pick	✓	
<b>Buffering</b>		
Create buffer	✓	✓
Buffer creates new layer	✓	
Select within buffer	✓	✓
Complex buffer creation	✓	
<b>Querying</b>		
Identify—select geographic object and view data	Simple report	✓
Find map objects by feature	✓	✓
Integrate predefined queries and reports	✓	✓
Query Builder	ColdFusion or ASP	✓
Measure Distance (Euclidean or Great Circle)	✓	
Set map Units	✓	✓
Set selection mode (centroid or intersection)	✓	
Set mouse position display units (Lat/Lon or Mapping Coordinate System)	✓	
Locate Address	✓	✓
<b>Presentation</b>		
MapTips	✓	*
Customized printing	✓	
Help files	✓	

\* Available in Java Viewer using Feature Service only.

\*\* Netscape is not supported except for Netscape versions 4.75 and 6.0 with the Java Standard Viewer. Netscape is not supported at all with the Java Custom Viewer.

## Technical Comparison: Autodesk MapGuide 6 and ArcIMS 4

### *Author Functionality*

	<b>Autodesk MapGuide 6</b>	<b>ESRI ArcIMS 4</b>
Open map file...	.mwf, .mwx	(.xml, .axl) (.mxd, .pmf)
Save map as...	.mwf, .mwx	.axl
Save individual layer	✓	
Copy map	.emf, URL	.jpeg
Open file from HTTP location	✓	
<b>Navigation</b>		
Zoom in, zoom out, pan	✓	✓
Zoom extents	✓	✓
Zoom width	✓	
Zoom scale	✓	
Zoom selected object	✓	✓
Zoom goto address—address matching	✓	✓
Zoom goto location	✓	✓
<b>Selection</b>		
Select objects by rectangle	✓	
Select objects by radius	✓	
Select objects by map feature	✓	✓
Select objects by polygon	✓	
Select multiple objects on different layers	✓	
Select objects with SHIFT-Pick	✓	
<b>Buffering</b>		
Create buffer	✓	
Buffer creates new layer	✓	
Select within buffer	✓	
Create complex buffer	✓	
<b>Authoring</b>		
Link map features to URL	✓	Customize in viewer
Open multiple maps at once	✓	
Measure distance	✓	
MapTips	✓	One layer only
Add scale bar		✓
Labeling	✓	✓
Map preview	✓	
Change coordinate system	✓	
Create queries/stored queries	✓	✓
Thematic mapping based on OLE DB data source	✓	
Graduated symbols		✓
<b>Security</b>		
Map password-protected setting	✓	
Track map usage	✓	

## Technical Comparison: Autodesk MapGuide 6 and ArcIMS 4

### *Server Functionality*

	<b>Autodesk MapGuide 6</b>	<b>ESRI ArcIMS 4</b>
Security—restrict access to resources	✓	
Load balancing	✓	✓
Open data sources from remote web server	✓	
Direct connection to ODBC/OLE DB	✓	
<b>Native Database Connectivity</b>		
Oracle	✓	***
SQL Server	✓	***
Sybase	✓	
Informix	✓	***
DB2	✓	***
Access	✓	
MySQL	✓	
<b>Spatial Data Support—Vector</b>		
ESRI SHP	✓	✓
DWG	✓	**
ESRI ARC/INFO coverages	*	***
MapInfo MID/MIF	*	**
Intergraph DGN	*	**
Atlas BNA	*	**
ASCII comma-delimited CSV	*	
<b>Spatial Data Support—Raster</b>		
BMP	✓	✓
CALS	✓	
ECW	✓	
GeoSPOT	✓	✓
JPEG	✓	✓
MrSID	✓	✓
PNG	✓	✓
TGA	✓	
TIFF	✓	✓
<b>Spatial Data Support—World Files/Georeference</b>		
ESRI world files	✓	✓
MapInfo tab files	✓	
GeoTIFF files	✓	✓
GeoSPOT BIL Header Files	✓	✓

\* Converted with SDF Loader. \*\* Needs to be converted to Shapefile with ArcView. \*\*\* Connection made through ArcSDE.

**autodesk**<sup>®</sup>

Autodesk, Inc.  
111 McInnis Parkway  
San Rafael, CA 94903  
USA

Autodesk, AutoCAD, Autodesk MapGuide, Autodesk Map are either registered trademarks or trademarks of Autodesk, Inc., in the USA and other countries. All other brand names, product names, or trademarks belong to their respective holders.

© Copyright 2002 Autodesk, Inc. All rights reserved.