



ArcPad™: Mobile Mapping and GIS

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Contents	Page
Introduction	1
ArcPad: Mobile Mapping and GIS	1
Many Potential Applications	2
Key Features.....	2
Supported Data Formats.....	2
ArcIMS Connectivity	4
Display and Query.....	5
Editing and Data Capture	6
GPS Support.....	6
User Interface	7
ArcPad Tools for ArcGIS Desktop	8
ArcPad Tools for ArcView 3.x	8
System Requirements.....	8
Customization: ArcPad Application Builder.....	9
More Information	9

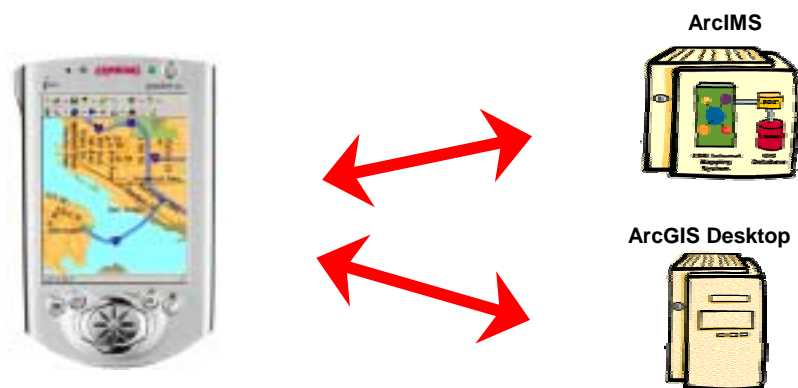
ArcPad: Mobile Mapping and GIS

Introduction

ESRI® ArcPad™ software is a mobile mapping and geographic information system (GIS) technology. Mobile computing is creating fundamental changes in the way we utilize geography with the ability to bring your work with you and interact directly with the world around you. Mobile GIS comprises the integration of four technologies: GIS, lightweight hardware, the global positioning system (GPS), and wireless communication.

ArcPad: Mobile Mapping and GIS

ArcPad provides database access, mapping, GIS, and GPS integration to users out in the field via handheld and mobile devices. Data collection with ArcPad is fast and easy and significantly improved with immediate data validation and availability. ArcPad is part of the enterprise GIS solution and is integrated with ArcGIS™.



ArcPad leverages existing mapping and GIS software systems and databases. ArcPad supports vector map and raster image display, which includes ESRI's shapefiles and LizardTech's MrSID® imaging language formats. Data obtained in the field can easily be uploaded into the master database in the office. Data can also be provided by the Internet via wireless communication. In addition, ArcPad offers integration with an optional GPS or differential global positioning system for real-time data capture. Data is now immediately available and validated in the context of an actual map.

The addition of a mobile GIS solution to ESRI's comprehensive family of GIS software programs gives users a new way to leverage their geographic databases—in the field.



ArcPad supports numerous handheld, Windows CE devices.

Many Potential Applications

ArcPad is a GIS and mapping system everyone can use. ArcPad enables specialized mapping and data collection in a wide range of industries and applications including

- Street sign inventory
- Power pole maintenance
- Meter reading
- Road pavement management
- Military fieldwork
- Mineral exploration
- Habitat studies
- Toxic inventory
- Crop management
- Property damage assessment
- Field surveying
- Incident reporting and inspection

Key Features

The key features of ArcPad include support for industry-standard data formats; ArcIMS® connectivity; display and query functionality; editing and data capture; optional GPS plug-in capability; a simple and modern user interface; ArcPad tools for ArcGIS Desktop or ArcView® 3.x, which is used to prepare data for ArcPad; and the ArcPad Application Builder, a development framework for creating custom solutions for mobile systems.

Supported Data Formats

A key feature of ArcPad is the ability to use data directly from an individual's desktop or an organization's enterprise GIS system without the need to convert to unique portable formats. ArcPad uses vector data in industry-standard shapefile format (as used by ArcInfo™, ArcEditor™, ArcView, ArcIMS, and other ESRI software programs). In addition, ArcPad directly supports the use of the following raster image formats (world file required): JPEG, MrSID (compressed images), and Windows® bit map (BMP).

ArcPad supports vector and raster data in a multilayered environment. Users can combine vector and raster data with the only limitations being the speed and memory capacity of the hardware in use. The map engine that supports the vector and raster data was built and tuned in accordance with the Windows CE platform, and great care has been taken to maximize performance.



ArcPad allows users to create new shapefiles and view raster and vector data in a multilayer environment.

Spatial Index of Features

ArcPad supports the shapefile spatial index of features. A spatial index results in significantly improved draw and search times. The spatial index is stored in two files (shapefile.SBN and shapefile.SBX) in the same directory as the associated shapefile. Spatial indexes are created in ArcView 3.x or ArcGIS Desktop.

Donut Polygons

ArcPad includes support for island or donut polygons contained in shapefiles. ArcPad supports the following tools for donut polygons:

- Draw
- Symbolization
- Identify
- Find
- Measure
- Editing of attributes

ArcPad does not support the ability to create new donut polygons, add or delete parts, or modify the geometry.

Projections

ArcPad supports the following projections:

- Geodetic or geographic coordinates (latitude–longitude)
- Albers Equal Area Conic
- Cylindrical Equal Area
- Double Stereographic
- Transverse Mercator (also called Gauss-Krüger)
- Lambert Conformal Conic
- New Zealand National Grid
- Stereographic

The above projections cover all Universal Transverse Mercator (UTM) projections (for example, Australian Map Grid [AMG], Map Grid of Australia [MGA], and many national grids). State Plane is covered by Transverse Mercator and Lambert Conformal Conic. The only State Plane zone not supported is Alaska Zone 1, which is an Oblique

Mercator projection. ArcPad supports display of coordinates on the screen or incoming GPS coordinates in the Military Grid Reference System (MGRS).

Datums ArcPad supports on-the-fly datum conversion from the geographic GPS input datum to the projection and datum of the current map. A database of 250 world datums is supported and can be expanded by users if required. This greatly simplifies the problem of datum matching between maps and the GPS hardware.

ArcPad supports any datum that meets the following criteria:

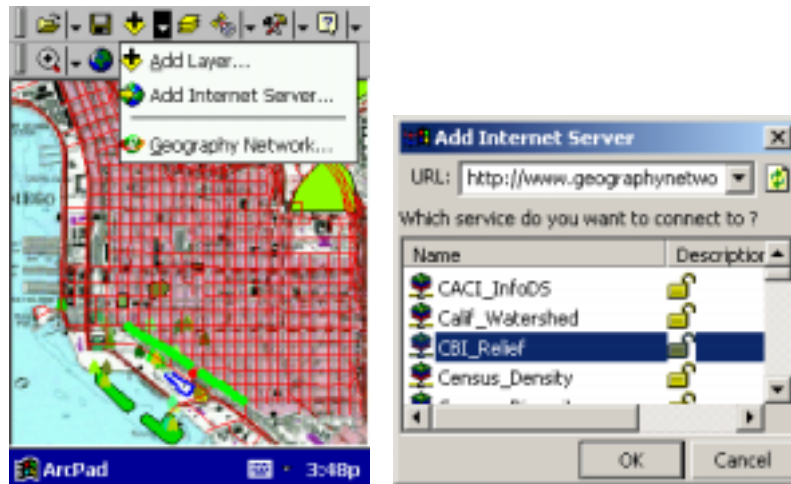
- The transformation parameters for going to WGS84 are known.
- The transformation uses one of the following equation-based methods: Bursa-Wolf (which is treated the same as Coordinate Frame), Coordinate Frame, Geocentric Translation, or Position Vector.
- Datums that require grid-based transformations to go to WGS84 are not supported.

ArcIMS Connectivity ArcPad also includes wireless data acquisition. ArcPad can act as a client to ArcIMS, ESRI's Internet mapping and GIS software, or to the Geography NetworkSM (www.geographynetwork.com). Data is downloaded to ArcPad using a TCP/IP connection such as a wireless local area network, cellular phone, or a wireless modem. Features can be readily identified on the image layer.

ArcPad includes an ArcIMS client for image services only. To use ArcPad as a client to ArcIMS, the following steps need to be followed:

1. Establish a TCP/IP connection outside of ArcPad.
2. Use the Add Internet Server tool (located in the Add Layers drop-down menu) to browse ArcIMS hosts for compatible map services. Enter the URL of the ArcIMS host and refresh the list of map services on that host. Choose a service. Click OK, and ArcPad will create a Geography Network Definition (GND) file, which stores the reference to the ArcIMS host URL and the chosen map service.
3. The GND file may be added to the ArcPad view via the normal Add Layers dialog. ArcPad will automatically establish a connection to the server and retrieve data for the current view (providing an active TCP/IP connection exists).
4. The ArcIMS data is downloaded and stored locally as a JPEG image.
5. ArcPad also supports the Information tool on ArcIMS layers, if a layer comprises any attributed vector data at the host server.

The layer properties for the GND file have an option to automatically or manually refresh the ArcIMS layer when the map extent changes. The downloaded JPEG image will be used for display if Automatic Refresh is disabled. A Refresh button is included on the Browse toolbar.



Wireless data acquisition with ArcPad

Display and Query

ArcPad includes a comprehensive set of map navigation, query, and display tools.

Map Navigation

ArcPad has a number of map navigation tools including variable zoom and pan, fixed zoom, zoom to a specified layer or spatial bookmark, and center on the current GPS position. Users can also zoom to the extent of all visible layers or pan to features selected by an attribute search.

Query

ArcPad also enables users to identify features and display their associated attributes; display layers with scale dependencies; create a hyperlink to external files including photographs, documents, and video or sound recordings; measure distance, radius, and area on-screen with the touch of the map; and calculate geographic statistics for selected features such as area and length.

Display

Users can control on-screen presentation of map data on a layer-by-layer basis in ArcPad. Users can set layer styles such as color, style, thickness, and fill patterns; text labels; and symbols as required. ArcPad supports simple labeling for points, lines, and polygons and angled label text. Symbols must be defined using ArcView 3.x or ArcGIS Desktop. Users can also choose to display an optional scale bar.



ArcPad allows users to query data, locate features, and navigate maps in the field.

Editing and Data Capture

ArcPad allows the user to create, delete, and move point, line, and polygon features in shapefiles. In addition, users can add, delete, and move vertices for lines and polygons and append vertices to existing features. Users can edit the coordinates for these features with the option to use current GPS coordinates. Shapefiles can be created in ArcPad using input from pen, cursor, or GPS. ArcPad also supports capturing GPS points while in the process of capturing a line or polygon with the GPS (nested points).

Attributes can be manipulated through the built-in editing interface or through a user-designed form created using the ArcPad Application Builder. Users create custom forms using the ArcPad Application Builder for use in ArcPad. Forms can consist of multiple pages and can include required fields, read-only fields, and horizontal and vertical scroll bars for multiline edit fields.



ArcPad forms support multiple pages and multiple fields for ease of use.

GPS Support

ArcPad also offers integration with an optional GPS or differential global positioning system (DGPS). With an optional GPS attached, ArcPad displays an individual's current position on the map in real time. Position coordinates are instantly available at the touch of a pen on the photo or map.

Supported GPS Receivers

GPS support for basic navigation and GPS data capture is available worldwide to all receivers that support any of the following GPS protocols:

- NMEA 0183 (National Maritime Electronics Association)
- TSIP (Trimble Standard Interface Protocol)
- DeLorme Earthmate binary protocol

ArcPad can display the following GPS information: receiver model and version, GPS mode (two-dimensional, three-dimensional, DGPS), Speed Over Ground (SOG), Course Over Ground (COG), constellation, signal quality, position, altitude, compass, and differential (on/off). ArcPad includes a debug window for displaying messages received from the GPS and a message option to send messages to the GPS.

GPS Data Capture

All GPS data can be recorded as a "track log" that is stored as a point shapefile, stored as a point location (waypoint), or used to capture polygons and polylines in a shapefile. The GPS information is stored as attributes within the shapefile.

ArcPad supports the following data capture options with a GPS receiver:

- Support for point mode digitizing (i.e., the ability to capture explicit points as opposed to stream mode digitizing)
- Support for position averaging when capturing a point feature and a vertex for a polyline or polygon feature
- Ability to pause the capturing of GPS line or polygon features and resume capturing at a later stage
- Option to set the maximum thresholds for error messages such as position dilution of precision (PDOP) and estimated position error (EPE)
- Option to activate an alarm when the GPS mode changes (two-dimensional, three-dimensional, and differential GPS) and automatically stop GPS data capture
- Ability to specify minimum time intervals between GPS positions used for data capture of vertices

User Interface

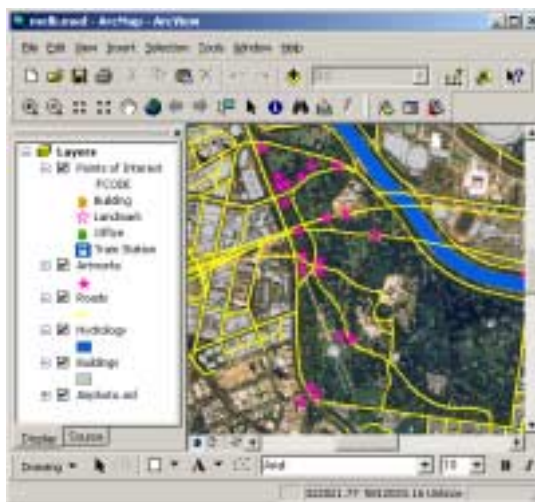
The ArcPad user interface provides a simple and modern approach to the underlying functionality. Users can perform a wide range of functions through controllable toolbars. This has been a significant design criterion as screen space is limited, especially on smaller palm-sized PC Windows CE devices.

ArcPad includes three toolbars that can be displayed or hidden depending on the functionality being performed. The Standard toolbar allows the user to activate the other toolbars, add data, access the online Help system, and save projects. The Browse toolbar activates the display tools including zoom, pan, and find. The Edit/Drawing toolbar activates the editing tools. Using the ArcPad Application Builder, users can customize the appearance of the ArcPad user interface by creating new toolbars that contain built-in and custom tools.

ArcPad Tools for ArcGIS Desktop

The ArcPad tools for ArcGIS Desktop allow you to extract, convert, and project your data using ArcGIS Desktop 8.1 or higher products (ArcView, ArcEditor, and ArcInfo). The custom toolbar in ArcGIS includes ArcPad tools for

- Preparing data for use in ArcPad
- Exporting ArcGIS Desktop layer symbology into ArcPad layer files (APL)
- Creating ArcPad map files (APM)
- Packing shapefiles



Use data maintained in ArcView 8.x in the field with ArcPad.

ArcPad Tools for ArcView 3.x

Included with ArcPad is ArcPad tools for ArcView 3.x, which allow ArcView 3.x users to extract, convert, and project data for ArcPad. With ArcPad tools for ArcView 3.x, users can

- Prepare data for use in ArcPad.
- Export ArcView 3.x symbology into ArcPad layer files (APL).
- Create ArcPad map files (APM).
- Pack shapefiles.
- View summary tool.

System Requirements

ArcPad has been designed specifically for the Windows CE (Pocket PC) environment. ArcPad supports Windows CE 2.11, 2.12, and 3.0 (Pocket PC and Pocket PC 2002) and the following CPU chips:

- StrongARM
- MIPS
- x86
- Hitachi SH3 and SH4

These four chips account for the majority of Windows CE devices currently available including the Pocket PC, palm-size, handheld, notebook, and pen computer varieties. ArcPad is also supported on Windows NT®, 95/98, Me, 2000, and XP.

ArcPad has a low minimal hardware requirement and will operate on a 32 MB memory (64 MB recommended), 133 MHz processor, with approximately 10 MB of free disk space. A typical Windows CE system would have 64 MB memory, 266 MHz processor, a color display, and a memory card for extra map data. ArcPad imposes very few hardware requirements; equipment specifications are typically based on the user's needs and the type and volume of map data to be used.

Customization: ArcPad Application Builder

Creating a personalized and customized field solution for data collection and updates is essential to ensure the integrity and value of your GIS data. ArcPad users are able to personalize and customize ArcPad using the ArcPad Application Builder, a separate product available from ESRI.

The ArcPad Application Builder bundles the following:

- A desktop customization application called ArcPad Studio
- A license of ArcPad
- Detailed documentation and sample code
- First year's maintenance (includes support and upgrades for both ArcPad Studio and ArcPad)

All customization for ArcPad is performed on the desktop primarily using ArcPad Studio and deployed with ArcPad on the mobile device. The ArcPad Application Builder gives users the tools to customize ArcPad, but is not required to utilize a customized version of ArcPad. The ArcPad Application Builder enables users to

- Create new toolbars that contain built-in and custom tools.
- Design custom forms to streamline data collection in the field.
- Build applets that focus on unique goals.
- Write scripts that interact with ArcPad software's internal objects.
- Develop extensions to support new file formats and positioning services.

More Information

Visit www.esri.com/arcpad for the latest information on ArcPad and the ArcPad Application Builder.