Production Line Tool Sets and Component Tools

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Introduction   Production Line Tool Sets (PLTSs) by ESRI are a collection of software applications for building and maintaining digital databases and for cartographic map production. These tools have been developed to produce standard National Imagery and Mapping Agency (NIMA) products, including digital data in Vector Product Format (VPF) and hardcopy products such as Topographic Line Maps (TLMs) and Harbor Approach and Coastal (HAC) nautical charts that meet NIMA specifications. The tool sets, currently in use at NIMA, ESRI, and many commercial contractors around the world, have been successfully employed in high-volume production environments. They have also been successfully installed and adapted to support other government agencies in producing and maintaining a broader range of products.

The PLTS software has been developed within the ESRI Database Services Department on actual production projects. The tools have evolved into simple, easy-to-use, menu-driven components that form a highly integrated system for producing digital databases and cartographic products. These tool sets operate on top of standard ESRI® base software for both the Windows NT and UNIX environments.

PLTS is oriented toward producing one or two standard database or hardcopy products of NIMA. These are

- Production Line Tool Set for Digital Nautical Chart (DNC) database and for Harbor Approach and Coastal hardcopy charts.

- Production Line Tool Set for Foundation Feature Data (FFD) database.

- Production Line Tool Sets for Vector Map (VMap) database and hardcopy products from cartographic and/or imagery source available in two separate products.

  - Production Line Tool Set for Vector Map Level 1 (VMap 1) and Joint Operations Graphic-Air (JOG-A) hardcopy maps
  - Production Line Tool Set for Vector Map Level 2 (VMap 2) and Topographic Line Map hardcopy maps

- Production Line Tool Set for Urban Vector Map (UVMap) database.

The following two PLTS components are included with each PLTS and are also offered separately.

■ GIS Data ReViewer extension for database quality control

■ Map Production System (MPS) cartographic map finishing tools for hardcopy design and editing

While these production lines are currently structured to produce specific NIMA products, they are generically designed and can be customized or adapted by ESRI for other agencies interested in producing topographic maps and geographic information system (GIS) database products.

Production Line Tool Sets

Database production, VPF finishing, and hardcopy finishing are complex tasks that require many processes to successfully complete. PLTSs are designed to streamline both database production and product finishing. While each PLTS is designed to produce NIMA-compliant products, the production environment and processes are similar. PLTS takes full advantage of graphical user interfaces (GUIs), which make all production and finishing tasks more efficient and easier to understand. By designing the PLTS GUI environment similarly with and across PLTS products, the PLTS system is easy to learn while giving you the ability to quickly produce NIMA-compliant products.

The following is a general description of the main components of all applicable Production Line Tool Sets followed by product-specific details.

Database Production

A standard ArcInfo™ database must exist to successfully produce a digital or hardcopy product. This requires an ArcInfo database design and features coded within the database coverages. The PLTS database production tools simplify the data capture, coding, and quality control.

Config (Configuration Files)

Each NIMA product is defined by a product specification. By interpreting a product specification a set of control files has been built that control the ArcInfo database design. This includes coverage and table definitions as well as acceptable values within the fields of the tables. A set of control files has been built for each PLTS. By selecting a product the PLTS environment is automatically set to point to the necessary control files for successful production of that product.

Production Setup

High-quality geographic information relies on accurate data referenced to a real-world coordinate system. The first step in database production is to establish project and database control. The PLTS builds project and database control by prompting you for specific metadata about the project and database. This drives the creation of the general production directory structure and required control coverages and projection files.

DBEdit—Extraction and Coding

DBEdit is a data editing tool built on ARCEDIT™ software to improve the efficiency with which ArcInfo vector data is produced and edited. Many frequently used commands, which would ordinarily be typed at the command line, are replaced with buttons on a menu to simplify their use. Attribute entry is streamlined using valid value files for each data set in the PLTS.

Valid Value Files

Valid value files are control files that contain valid attribute combinations for features contained in a product specification. With the use of imagery as a backdrop, DBEdit can

be used for editing existing feature geometry, extracting new fully attributed features, and attributing existing features. Image sources may include flown imagery, scanner output, CADRG, or any other image source supported by ArcInfo.

General Capabilities

DBEdit is used to add, delete, move, intersect, merge, reshape, and code features. A suite of submenus is also provided that allows users to easily manage edit- and backcoverages, select images, manage the draw and back environment, and manage the snap environment. Some image enhancement capabilities are also available within DBEdit.

QCView—Database Quality Control

QCView is a software application incorporating existing ESRI technology into a custom application for performing automated quality assurance/quality control for new or existing ArcInfo databases. QCView validates that the ArcInfo data structure, coverage format, and topologic structure are correct. An ArcView® GIS front end provides a simple user interface to the software that allows for easy operation. QCView uses a set of ASCII control files that store database specifications for table formats, editing tolerances, and the list of tests to be applied to the coverages. QCView has three standard output error files that contain information specific to errors and situations warranting attention in the data. The three main error files are the log, error, and report files. The log file is a summary of tests that failed and contains a qualitative statement about each test. The report file is simply a free-floating graphic format output that contains detailed information for each record-based check. The error file is a standard comma-delimited file that contains the unique identifying "tag" for each failure contained in the report file along with a NOERROR entry for all tests that passed.

The tests and parameters requirements for each product are based on the product specification and database design. Therefore, not all products use the same tests within QCView. Refer to the PLTS documentation for specific information on which tests are utilized for each PLTS.

Plotting—Database Quality Control

Often the best way to quality control data is to make a hardcopy plot. This will allow you to see the data, in most cases, at product scale. PLTS incorporates tools for selecting and plotting coverages either as simple line and point features for geometry verification or as coded features for attribute verification.

Edgematching

Frequently data automation from various nonoverlapping sources causes edgematching issues. With these sources coverages may be produced that contain the same types of data and are adjacent to each other. In many cases features that should be continuous do not line up coordinately. The edgematching tools within the PLTS assist with matching features from different sources so that within the final database they are continuous across source boundaries.

Projecting

Typically there are only a limited number of projections required for a project. The PLTS has tools for generating and using projection files that are specific to a project. This makes projecting between the standard projections of a project much easier and more controlled. Because not all possible projection parameter combinations are produced, a general tool for projecting is also included.

Clipping

Features are collected so they extend outside the project area of interest. By doing this a clean edge can be produced by clipping back the features to a template. Processes for

clipping the data to a template area of interest are included in the PLTS. The area of interest template is established as part of the project setup processes.

Mapjoining/ Appending

In many cases the source of the data only covers part of the project area of interest. In these cases there may be several sources of data that must be joined to cover the entire project area of interest. Utilities for selecting and joining coverages are provided within each product.

VPF Conversion

The conversion of ArcInfo vector data to NIMA's VPF format can be a very time-consuming endeavor. The amount of time needed to ensure data integrity prior to conversion, coupled with the amount of data manipulation and tailoring required to comply with a VPF product specification, makes this process a very expensive and resource-intensive task. ESRI, in conjunction with NIMA, developed the VPF standard for the Digital Chart of the World (DCW) contract. Since then, ESRI has made it a goal to make VPF conversion easier for the production user. ESRI's VPFKit is the result of many years of experience converting and working with VPF databases. This fully menu-driven process includes, but is not limited to, data tiling, the ability to meet the 1993 or 1996 VPF standard, merging metadata with spatial data, conversion to VPF, and finally, the tailoring process needed to meet the required product specification. The VPFKit currently supports all five PLTS products for exporting and can be expanded to include more if needed. VPF to ArcInfo importing capabilities are available for four product specifications: DNC, FFD, VMap 1, and VMap 2. The menu-driven interface and the layer tracking functionality make it almost impossible to create VPF data outside of the process flow. Additional tools allow you to edit the VPF metadata tables and make minor modifications in your VPF data with ease.

GIS Data ReViewer Tool

The GIS Data ReViewer is an ESRI software application based on ArcView GIS. ReViewer was developed by ESRI in order to help ESRI, NIMA, and NIMA's outsourcing contractors conduct visual quality review of data in support of database production. Use of this tool has streamlined the data review/acceptance process for VMap, UVMap, DNC, and FFD. The GIS Data ReViewer is a customized ArcView GIS extension that contains a series of buttons and Avenue™ scripts supporting review of data in ArcInfo coverage format, ArcInfo LIBRARIAN™ format, and Vector Product Format. The features of each data set are symbolized in a consistent and easily interpreted manner. A variety of tools are provided to aid in the identification of data capture and attribution errors. The application allows the user to identify where corrections and additions must be made to spatial data and to attributes of spatial data easily and accurately. This information is recorded in a standardized, tabular error report and saved in dBASE format. The GIS Data ReViewer automates and applies a database process to what was formerly a paper trail of quality control error calls and correction processes.

Correct Errors

Visiting and Correcting

The Correct Errors tool uses the table generated from the GIS Data ReViewer to locate the potential errors (flagged features) in the ArcInfo database. An operator visits each flagged feature in the table and reviews the change request. If the operator agrees with the call, the coverage is updated to reflect the change request. After each flagged feature is visited, a correction status is added to the table identifying what action was taken with the feature.

Revisiting and Tracking

The table can then be loaded back into GIS Data ReViewer for the quality control analyst to verify that the corrections were completed properly and review any rejected calls. This creates a tracking cycle that is 100 percent verifiable.

Map Production System Tool

The Map Production System is a menu-driven application specifically designed to facilitate the cartographic production of topographic and hydrographic maps. The system includes a full set of WYSIWYG cartographic editing tools and generation tools for creating a variety of map elements such as north arrows, scale bars, adjoining sheet diagrams, and elevation guides. Also included are a number of data manipulation tools to project, symbolize, and annotate data and features prior to basemap generation. The supplied symbol sets and generation tools combine to form topographic map products that meet NIMA's current specifications. PostScript files generated directly from the system can be used to create film separates. Presently, the system supports the production of 1:50,000 and 1:100,000 TLMs, JOG-A series maps, and HAC charts but can be fully customized to create unique map products. ESRI has produced other map series with MPS, such as Operational Navigation Charts (ONCs) and Tactical Pilotage Charts (TPCs), and welcomes the opportunity to customize these tools for customer-specific needs.

Product-Specific Information

Each PLTS product has been developed to ease the database automation and finishing processes. While all the product environments look similar they each have different guidance for database capture and product specification. The PLTS tools were developed to provide general database automation while adhering to product-specific guidance. Some of the product-specific processes have been outlined to give a better understanding of the PLTS software.

DNC Product

The Digital Nautical Chart Production Line Tool Set is used to produce NIMA VPF standard DNC databases from existing NIMA HAC and General charts or National Oceanic and Atmospheric Administration (NOAA) charts. This production line has been used extensively by a number of organizations for the production of NIMA DNC databases. The production line includes tools for the capture of cartographic source information, generation of a complete DNC-specific ArcInfo database, quality control of the database, conversion to a NIMA standard VPF DNC product, and cartographic chart generation.

Database Production

Maintenance Tools

These tools allow users to take imported VPF DNC data back into the DNC production environment. Each chart in the imported library will be clipped into its own chart

workspace where updates can be made. Once updates have been finalized, the host of DNC tools will be available to the user for full automation and conversion back to VPF.

DXF Files

PLTS enables the user to create a line work ArcInfo coverage by automatically converting from DXF format. The DXF files may be generated through scanning and vectorization or as part of conversion from other data formats. Most often the DXF files are generated by scanning and vectorizing existing cartographic sources such as Mylar separates. Once an ArcInfo coverage is produced tools are available for adding geographic control to the coverages.

Bottom Characteristic Decoder

This tool will take any HYDPOINT or BCPOINT coverage and determine the LABEL value for any combination of attributes describing the sea floor bottom characteristic. This will expedite the time required to review imported VPF DNC bottom characteristic data, which has no LABEL information.

Hydrographic Area Attribution

This will attribute the HYDNET coverage by using the surrounding depth curve values and associated sounding information to determine the high (CVH) and low (CVL) values of each hydrographic area.

Limnet Attribution and Editing

One DNC layer (LIMNET) uses ArcInfo routes and regions to manage topology and coding of overlapping/coincident features. This tool completely automates the process of adding scale-specific subclasses and attribute fields. It also provides a GUI for creating route and region features from lines and polygons and for coding features using a menu tailored to the selected feature. It also greatly simplifies the task of performing such topological edits as append, merge, split, or remove by placing tools in the GUI to perform these tasks. There are also display and query tools that allow the user to symbolize their data for more accurate review, as well as to select features and examine their codes.

Notice to Mariners

A suite of tools that allow for Notice to Mariners updates. These tools allow for sector lights, line features, area features, and point features to be added, selected, relocated, and deleted from a selected coverage.

Unit Conversion

There are two types of unit conversion tools. The first will convert all elevation values given in feet to meters. The second will convert all depth values given in fathoms and feet, fathoms and fractions, and feet into meters.

MPS for HAC Production

HAC charts are hardcopy navigational tools used to ensure safe passage of waterborne commerce. They show aids-to-navigation, cultural landmarks, earth cover, environment, hydrography, inland waterways, land cover, limits, obstructions, port facilities, relief, and data quality. The charts are produced at a wide variety of scales, and their corresponding specification can be quite varied. For this reason, a high degree of flexibility has been built into the HAC production tools. The geographic portion of the chart is created by applying feature symbology based on internal attribution within the DNC database. As a significant time-saving option, all feature annotation, including soundings, can be automatically formatted and cartographically positioned using Maplex, which is sold separately. Maplex is not a system requirement, and in its absence, annotation can be formatted and positioned in a semiautomated fashion using the tools provided. The

surrounding portion of the chart is generated by a series of component tools, most of which create standard templates that are easily modified to meet differing specification requirements. These include tidal charts, compass roses, source diagrams, scale bars, and complex borders, to name a few. The cartographer then has complete control to make cartographic enhancements to the basemap using a menu-driven graphical Data Editor. All components are compiled into a single map sheet, and the Map Editor can be used in the final stages of production to enhance the page layout of individual map sheets.

FFD Product

The FFD production line is used to produce NIMA VPF standard FFD databases from features and elevation data extracted primarily from stereo imagery. The tool set provides a menu-driven interface to all of the functionality needed for FFD database production; minimal command line ArcInfo is required. Included with the tool set is documentation detailing how to produce an FFD-specific ArcInfo database that can be converted to the final VPF product. The production line includes tools for the following: converting feature and terrain data extracted by the BAE Systems (formerly Marconi Integrated Systems) product, SOCET SET, to ArcInfo; converting feature and terrain data extracted in MicroStation Interactive Graphic Design Software (IGDS) format to ArcInfo; creating triangulated irregular network (TIN) data structures for modeling the three-dimensional aspect of the database; capturing cartographic source information from existing maps; generation of a complete FFD-specific ArcInfo database; and conversion of the database to a VPF standard FFD product. All necessary quality control tools are included with this production line. The Digital Terrain Elevation Data (DTED) quality control tools support review of existing DTED and TIN data structures.

Database Production

SOCET SET Input Data

Included is a series of tools that converts SOCET SET ASCII files to ArcInfo F_CODE coverages. This is a fully automated, menu-driven process that prompts the user for the files to convert. From the ASCII file name, F_CODE and SOCET SET captured feature types (point, line, or area) are determined. These determine feature-specific processing and output ArcInfo feature classes (point, line, and region). Region features for a set of ASCII files are output into a specific region subclass. Valid region subclasses are defined by standardized specification description variables. Also, each output F_CODE coverage is standardized to the appropriate database schema. Integrity checking is performed during conversion, and an output coverage description report is generated for error and status checking.

IGDS Input Data

A series of tools has been developed that converts IGDS files (*.dgn) output from SoftPlotter or MicroStation environments into ArcInfo coverages. Attributes stored in any ArcInfo supported external database, such as Oracle, are joined to the features. The tools allow for the extraction of some or all of the thematic layers and feature primitive types from the IGDS files depending on user needs. Automated tools are provided to standardize feature attribute tables and coverages to the ArcInfo database design required for conversion to VPF, and a suite of quality control (QC) tools are available to ensure the highest data quality after conversion to ArcInfo coverages.

Thematic Integration   The tools have been developed to fully automate the thematic layer integration process through a menu-driven interface. All layers are processed with the same ArcInfo functions using existing F_CODE coverages projected into a Universal Transverse Mercator coordinate system to output final network and point coverages. The necessity to minimize loss and reconstruction of information in the integration process where overlapping features exist has motivated the development of feature-specific processing. During integration, routes are created for all F_CODE line features. Additional functions of the integration process include creation of route subclasses from F_CODE line features, standardization in accordance with the database schema, automated and input and output coverage integrity checking for coverage feature class content, projection, and INFO table definition.

TIN Generation   These tools provide functionality that creates TINs used to model the three-dimensional aspect of the features and terrain in the database during conversion to VPF. The tools provided allow for fully automated, menu-driven TIN creation using either the z-values collected during feature extraction in the SOCET SET environment or the z-values collected from existing DTED posts. Elevation posts from existing DTED can also be used to enhance areas of the TINs where few or no feature z-values are present. Also included are tools that allow for visual and quantitative QC of the TIN surfaces.

VPF Conversion   The PLTS for FFD production allows for fully automated VPF conversion of three-dimensional VPF data. TIN structures generated during the database production stage are used during the VPF conversion process to provide z-value coordinates to feature primitives upon export to the VPF data structure. The VPF conversion process handles creation and conversion of all supplemental VPF tables required by the FFD product specification such as related attribute tables and documentation tables. A new functionality is the ability to import existing FFD databases into the PLTS ArcInfo database design.

VMap 1 JOG-A Product   VMap 1 includes tools for scanning, converting, attributing, and the quality control of data captured from cartographic map sources such as color lithographic maps, map film separates, and digital source information, which can then be converted into VMap-specific ArcInfo databases.

The VMap 1 PLTS also includes feature conversion and terrain data extraction functionality for SOCET SET, the BAE Systems (formerly Marconi Integrated Systems) product for stereo extraction, or Autometrics SoftPlotter stereo extraction system into VMap-specific ArcInfo databases. Included are tools for capturing ancillary source information to the VMap-specific ArcInfo databases. Tools for monoscopic image extraction and update are also provided within the DBEdit component.

Database Production

DXF Files   PLTS enables the user to create a line work ArcInfo coverage by automatically converting from DXF format. The DXF files may be generated through scanning and vectorization or as part of conversion from other data formats. Most often the DXF files are generated by scanning and vectorizing existing cartographic sources such as Mylar

separates. Once an ArcInfo coverage is produced, tools are available for adding geographic control to the coverages.

Image Source Data PLTS supports data extracted from imagery. If the imagery is an orthophoto the data can be extracted using DBEdit and the valid value tables. However, when using stereo image pairs, the data must be collected using stereo image extraction software such as SOCET SET or SoftPlotter. Both SOCET SET exported data and IGDS files can be used as input. PLTS tools can convert these formats (provided the data was extracted with the appropriate specifications) directly to ArcInfo coverages.

AAFIF The NIMA standard Automated Air Facilities Information File (AAFIF) can be used by the PLTS to produce both airport and runway features. These features can then be incorporated into the transportation coverage.

DVOF The NIMA standard Digital Vertical Obstruction File (DVOF) can be used by the PLTS to produce vertical obstruction features. These features can then be incorporated into their respective theme coverages.

Aeronautical Features While the VPF product does not require airspace boundary features the JOG-A product does. The aero theme has been defined to contain airspace boundaries and aids to navigation. These features are typically collected from an existing cartographic source such as an existing JOG-A by digitizing the features. The features can be captured and coded simultaneously within DBEdit using the valid value tables.

MPS for JOG-A Production JOG-A charts are the aeronautical part of a family of three JOG products at a 1:250,000 scale that also includes ground and radar charts. These maps share a common base graphic in order to facilitate operations involving air, ground, and naval forces. These five-color maps include a bleed edge on the north and east edges to allow adjacent sheets to be spliced together and are symbolized to highlight airfield information, changes in elevation, and obstructions to air transportation. These and other unique features on JOG-A charts are handled by custom generation routines resident within MPS including routines to create a location diagram, a GEOREF guide, a conversion graph, and scale bars. The complete JOG-A neatline and grid are reproduced automatically using the scale, projection, and location as inputs. Templates have been provided for notes, legends, the meter reference guide, and the glossary. Each of these can be easily customized to individual map sheets using the provided editors. As with the HAC products, all components are compiled into a single map sheet, and the Map Editor can be used in the final stages of production to enhance the page layout of individual map sheets.

DTED The data collected for VMap 1 and JOG-A production can be used to produce DTED level 1 files. The PLTS DTED production tools utilize the hydrography and elevation vector data to create a digital elevation model (DEM) as an ArcInfo grid. Once a grid is created, it can be converted to a specification-compliant DTED file.

VMap 2 TLM Product VMap 2 includes tools for scanning, converting, attributing, and the quality control of data captured from cartographic map sources such as color lithographic maps, map film separates, and digital source information, which can then be converted into VMap-specific ArcInfo databases.

PLTS for VMap 2 also includes feature conversion and terrain data extraction functionality for SOCET SET, the BAE Systems (formerly Marconi Integrated Systems) product for stereo extraction, or Autometrics SoftPlotter stereo extraction system into VMap-specific ArcInfo databases. Included are tools for capturing ancillary source information to the VMap-specific ArcInfo databases. Tools for monoscopic image extraction and update are also provided within the DBEdit component.

Database Production

DXF Files PLTS enables the user to create a line work ArcInfo coverage by automatically converting from DXF format. The DXF files may be generated through scanning and vectorization or as part of conversion from other data formats. Most often the DXF files are generated by scanning and vectorizing existing cartographic sources such as Mylar separates. Once an ArcInfo coverage is produced tools are available for adding geographic control to the coverages.

Image Source Data PLTS supports data extracted from imagery. If the imagery is an orthophoto the data can be extracted using DBEdit and the valid value tables. However, when using stereo image pairs, the data must be collected using stereo image extraction software such as SOCET SET or SoftPlotter. Both SOCET SET exported data and IGDS files can be used as input. PLTS tools can convert these formats (provided the data was extracted with the appropriate specifications) directly to ArcInfo coverages.

DVOF The NIMA standard Digital Vertical Obstruction File can be used by the PLTS to produce vertical obstruction features. These features can then be incorporated into their respective theme coverages.

MPS for TLM Production TLMs (1:50,000 and 1:100,000) are used primarily for ground troop movement. They are symbolized to accentuate vegetated zones, transportation routes, and vertical obstructions. The five-color maps include a variety of surround elements to aid the map reader's interpretation of the landscape including elevation, location and slope diagrams, a conversion graph, a glossary, and a boundary guide.

In order to replicate these maps digitally, MPS was customized to automatically generate each of these components based on specific parameters present in the data. The complete TLM neatline and grid is reproduced automatically using the scale, projection, and location as inputs. In each case, the output from the generation tools can be edited to meet the needs of individual map sheets using the supplied Map Editor. A series of routines is initiated to automatically symbolize the modified FACC data and compile it to a basemap that meets NIMA's TLM specifications. As with the HAC and JOG production tools, the cartographic technician has access to graphical editors to adjust the spatial data and to refine the layout of the sheet.

DTED   The data collected for VMap 2 and TLM production can be used to produce DTED level 1 or DTED level 2 files. The PLTS DTED production tools utilize the hydrography and elevation vector data to create a DEM as an ArcInfo grid. Once a grid is created, it can be converted to a specification-compliant DTED file.

UVMap Product   This PLTS has been used extensively for the production of NIMA UVMap databases derived from existing city graphic maps. The PLTS includes tools for capturing cartographic source information, feature attribution, quality control, generation of a complete UVMap-specific ArcInfo database, and conversion of the database to a NIMA standard UVMap VPF product.

The production tools for UVMap have not been bound to a standard GUI environment as the other PLTS products have. However, the procedures and tools for successfully producing a NIMA-compliant UVMap have been completed and are available at command line. Some of the specific tools and processes essential to UVMap production have been outlined.

Database Production

DXF Files   PLTS enables the user to create a line work ArcInfo coverage by automatically converting from DXF format. The DXF files may be generated through scanning and vectorization or as part of conversion from other data formats. Most often the DXF files are generated by scanning and vectorizing existing cartographic sources such as Mylar separates. Once an ArcInfo coverage is produced, tools are available for adding geographic control to the coverages.

Coverage Editor   PLTS contains tools and menus that allow the user to clean up initial line work using the most common editing tools and to fix any topological errors so the coverage can be built properly. The user can add arcs, points, circles, or any other feature that is necessary. Tools allow features to be selected, added, snapped, moved, deleted, and so forth. Arcs representing buildings will be squared off at ninety-degree angles automatically, or the arcs can be squared off manually if additional cleanup work is needed.

Master Coverage and Coder   Since UVMap databases rely so much on coincidence between layers, all of the features are captured together in a master coverage. The master coder is a menu interface that allows the user to code the master coverage arcs and points with specific code attributes and IDs in preparation for splitting the arcs and points out to their respective coverages. Each arc will contain eight items (BND, POP, VEG, HYDRO, IND, PHYS, UTIL, and VEG) representing each coverage. An item that is coded with a 1 indicates to which coverage the arc belongs, a 0 means the arc will not go into that particular coverage. For example, if the arc belongs in the BNDNET coverage, then the BND attribute will be coded with a 1. The other seven coverage attributes will be coded with a 0. Arcs that are coincident and belong in two different coverages will have more than one coverage attribute coded with a 1. For example, if the arc belongs in both HYDRONET and PHYSNET, then the HYDRO and PHYS attributes will be coded with a 1. The remaining coverage attributes for that arc will be coded with a 0.

Extraction of Layers PLTS contains tools that will automatically split the arcs and points out of their respective master coverages and put them into their proper coverages. The extractor knows which coverage an arc belongs to based on which coverage attributes are coded with a 1. The points are split out based on the coding of their IDs. The coverages are then built for topology and a report is generated letting the user know which coverages, if any, do not contain features.

Production Line Environment PLTS operates directly (and dependently) with ESRI's base ArcInfo and ArcView GIS software. The applications are programmed primarily using either ARC Macro Language (AML™) or Avenue scripts. In some cases, the C and Perl programming languages are also used.

The ESRI supported hardware operating environments are as follows:

Hardware Platform	Operating System
Sun	Solaris 2.5 or greater
SGI	IRIX 6.5 or greater
Intel Pentium	Microsoft Windows NT 4.0

The hardware configuration requirements for the Production Line Tool Sets are the same as those for the core ESRI software packages. The Windows NT version of the production line will operate across any Intel hardware platform operating with the Windows NT 4.0 operating system. The UNIX version of the production system is operating on Sun Solaris 2.5 and SGI IRIX 6.5 workstations. PLTS is fully tested on all of these platforms.

The production lines can be made available on other UNIX platforms; however, ESRI time and materials services may be required to perform the porting and testing. The production lines currently utilize Scangraphics scanners and HP inkjet plotters. ESRI time and materials services are available to support clients wishing to adapt to other input and output devices.

The following ESRI and third party software are required or recommended to support the operations of the Production Line Tool Sets and component tools. Minimum version requirements for ESRI core software are ARC/INFO® 7.2.1 and ArcView GIS 3.1.

Production Line	ArcInfo and Extensions					Maplex	ArcView GIS and Extensions		
	ArcInfo	ARC GRID™	ARC TIN™	ArcScan™	ArcPress™		ArcView GIS	ArcView Spatial Analyst	ArcView 3D Analyst™
Tool Sets									
Digital Nautical Chart (DNC)	X	X		X*	X*	X*	X	X	
Foundation Feature Data (FFD)	X	X	X	X*			X	X	X
Vector Map Level 1 (VMap 1) and Joint Operations Graphic (JOG)	X	X		X*	X*		X	X	X
Vector Map Level 2 (VMap 2) and Topographic Line Map (TLM)	X	X		X*	X*		X	X	X
Urban Vector Map (UVMap)	X			X*			X		
Component Tools									
GIS Data ReViewer							X		
Map Production System (MPS)	X	X			X	X*			

*ArcScan, ArcPress, and Maplex are not required, only recommended on these tool sets.

NOTES: Bitstream fonts are required for the production of JOG-A, TLM, and HAC hardcopy maps.
          Perl programming language is required for all of the Production Line Tool Sets and is provided with all PLTS.
          ARC/INFO 7.2.1 is required for VPF conversion to the VPF 96 standard.

Production Line Tool Set Training

In addition to support, ESRI offers training for each of the Production Line Tool Sets and component tools. We highly recommend that training be given to key staff who will be using these tool sets. The training, which varies in length from five to twenty days, can be conducted either at the ESRI headquarters training facility in Redlands, California, or any appropriately equipped client site.

Production Line Tool Set Support

ESRI offers annual support for each Production Line Tool Set and component tool. As with other ESRI software packages, the first year of support is provided with the purchase of the initial license. Support may be purchased on an annual basis after the first year. Telephone hot line, fax, and e-mail support; bug fixes to existing AMLs, Avenue scripts, and data files; as well as application updates are included in the support package. Clients may utilize e-mail, voice mail, or fax communications twenty-four hours a day, seven days a week. ESRI staff will respond to client support requests five days a week, twelve hours a day, 6:00 a.m. to 6:00 p.m. Pacific time. Since the Production Line Tool Sets and component tools are also in use at ESRI, users will benefit from our own process improvement as the applications continue to be enhanced in a full production environment. Custom support packages can also be quoted on a time and materials basis to meet any specific need.

What the Future Has in Store for PLTS

Future releases of the Production Line Tool Sets will utilize the new ArcInfo software. ESRI is currently developing production procedures and processes in next generation ArcInfo software (8.x technology, ArcMap™, ArcCatalog™) for the production of NIMA products. This includes the use of geodatabase models for each of the PLTS product databases, custom object behaviors, and enhanced editing tools. PLTS users can expect to see future releases of PLTS running in the next generation software.

Contact Information　　For further information and pricing, please contact

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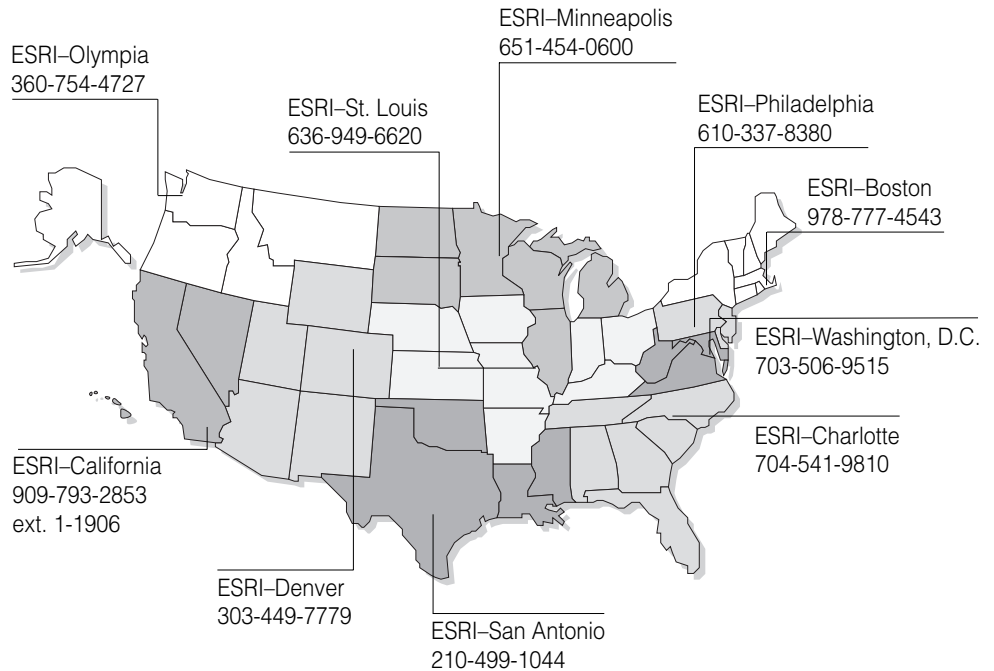For more information call
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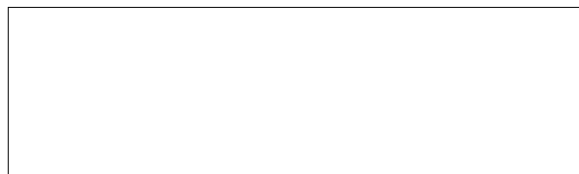
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