BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

In re: Application for limited proceeding for recovery of incremental storm restoration costs related to Hurricanes Irma and Nate by Duke Energy Florida, LLC	Docket No. 20170272-EI Dated: June 28, 2018

DUKE ENERGY FLORIDA, LLC'S FIRST SUPPLEMENTAL RESPONSE TO CITIZENS' SECOND REQUEST TO PRODUCE DOCUMENTS (NOS. 11-15)

Duke Energy Florida, LLC ("DEF"), responds to the Citizens of the State of Florida, through the Office of the Public Counsel's ("Citizens" or "OPC") Second Request to Produce Documents (Nos. 11-15) as follows:

PRODUCTION OF DOCUMENTS

11. Please provide all correspondence, including but not limited to, emails, between DEF or any affiliate, agent, or representative of DEF and the vendor of the Outage Management System ("OMS") (including any agent or representative of the vendor) related to problems, failures, defects and patches related to the OMS' performance or operation during Hurricane Irma and afterwards.

Response: Please see response previously provided on June 27, 2018.

12. Please provide all internal correspondence, including but not limited to, emails, between and among DEF employees or the employees of any affiliate, agent, or representative of DEF (including among and between employees of any service company (including DEBS) and affiliates and consultants or agents) related to problems, failures, defects and patches related to the OMS' performance or operation during Hurricane Irma and afterwards.

Response: Please see response previously provided on June 27, 2018.

13. Please provide the approval documentation (including supporting documentation) for purchase and installation and implementation of the OMS within DEF (or a larger set of affiliated companies).

Response: Please see attached documents bearing bates numbers 20170272-DEF-OPC-POD 2-13-000001 through 20170272-DEF-OPC-POD 2-13-000293.

14. Please provide all documents identified in your response to OPC Interrogatory No. 59.

Response: Please see response previously provided on June 27, 2018.

15. Please provide all documents identified in your response to OPC Interrogatory No. 60.

Response: See DEF's objection filed contemporaneous with this response.

Respectfully submitted,

/s/ Matthew R. Bernier

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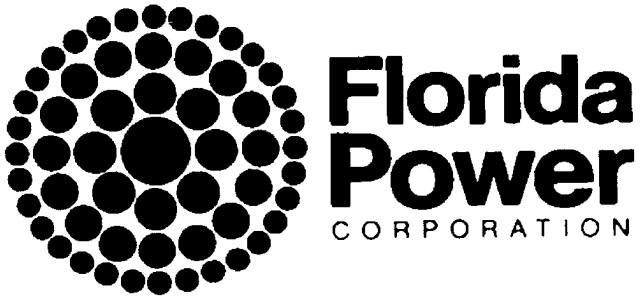
INTERGRAPH
PUBLIC SAFETY

SOLUTION DOCUMENT

INTERGRAPH PUBLIC SAFETY (IPS)
Solution for the
Florida Power Corporation Outage Management System



INTRODUCTION

Intergraph Public Safety (IPS) welcomes the opportunity to propose a state-of-the-art hardware platform and software solution for a Computer-Aided Dispatch (CAD) System and Outage Management System (OMS) that meets the requirements of Florida Power Corporation.

During the past eight years, IPS has implemented the IPS/Computer-Aided Dispatch (I/CAD) System for public safety and roadside assistance agencies around the world. We are sensitive to the mission-critical nature of these industries and believe that the combination of our hardware design, operating system, and software configuration offers the most reliable platform and robust CAD system available in today's marketplace.

In addition to Computer-Aided Dispatch, Florida Power requires a state-of-the-art Outage Management System. Such a system would combine, in a single workflow, Computer-Aided Dispatch, Trouble Analysis, and interfaces to a variety of existing Florida Power systems. The system could also include Mobile Data Terminals (MDTs) with GPS in service vehicles to aid in the communication of repair activities and to provide information to field vehicles.

IPS has been actively searching for a partner to help us combine our expertise in CAD and Systems Integration and Intergraph's expertise and presence in the Utilities Facilities Management market to produce an operational Outage Management System. Through this proposal we hope to establish such a partnership with Florida Power Corporation. For the past three months we have worked with Florida Power personnel to produce a functional design document. This proposal addresses the requirements identified in that document.

This document presents the IPS solution in the following format:

1.0 Proposed Hardware Configurations

Section 1.0 provides hardware configuration diagrams, server specifications, optional workstation specifications, and peripheral specifications. In addition, this section lists hardware requirements that must be satisfied in order to integrate with existing systems.

This section also provides customers who have background knowledge in client/server topology and hardware specifications with a quick overview of the proposed hardware configurations.

2.0 Proposed Software Configurations

Section 2.0 provides a textual description of the I/CAD System software for the proposed system servers and workstations. All servers and workstations are presented individually with software configuration.

3.0 Outage Management System

Section 3.0 contains an overview of functional requirements developed jointly by Florida Power and IPS personnel that defines the software development specific to the Outage Management System.

4.0 Proposed Cost Schedules

IPS realizes that Florida Power may change the configuration, requirements, or provide additional information before making a final decision, and IPS agrees to adjust the pricing accordingly.

5.0 The System Architecture

Section 5.0 provides a rationale for the architecture proposed for the CAD and OMS and covers the strategies used to ensure system operability, performance, maintainability, scalability, flexibility, and fault tolerance.

In addition, Section 5.0 introduces the operating system used to support I/CAD System software and covers the advantages of client/server topology. Section 5.0 also covers open systems, the Windows NT operating system design, the Microsoft graphical user interface (GUI), and system and security administration as provided by the Windows NT platform and I/CAD software.

6.0 Networking Hardware Prerequisites

Section 6.0 describes the networking system and environment required to efficiently operate the I/CAD System.

7.0 Software Capabilities

Section 7.0 provides an overview of I/CAD software capabilities and the integrated CAD functionality.

8.0 Project Management

Section 8.0 presents the 5-phase process used by IPS to move the system from contract award to production operation.

9.0 System Implementation

Section 9.0 provides detail on two on-site workshops conducted by IPS. The I/CAD Implementation and Configuration Workshop is intended to ensure a quick, well-founded startup. The I/CAD Data Modeling Workshop functions as a vehicle for gathering information critical to generating the base I/CAD map and customizing the system to meet Florida Power's requirements.

10.0 Training

Section 10.0 introduces some cost-effective training options for Florida Power. In designing a Training Plan, IPS offers a number of courses that are comprehensive, yet can be tailored to meet the specific needs of Florida Power.

11.0 Warranty and Maintenance

Section 11.0 provides an overview of warranty, as well as the programs available for ongoing maintenance of the system.

Appendix A: Mobile Workstations

Appendix A provides an overview of the proposed Mobile workstations and the products and services required for their installation in Florida Power vehicles.

Appendix B: Functional Requirements

Appendix B is the functional requirements document produced jointly by Florida Power and IPS.

Appendix C: Detailed Pricing

Appendix C provides detailed pricing of the complete configuration.

Appendix D: Project Schedule

Appendix D provides a complete project schedule for the Outage Management System.

Appendix E: I/CAD System Overview

Appendix E is IPS' standard I/CAD overview. While this document is written using Public Safety terminology, we hope that it will provide a detailed overview of the I/CAD suite of standard products.

1.0 PROPOSED HARDWARE CONFIGURATIONS

The CAD/OMS for Florida Power requires installation of two complete and independent dispatch centers. Two centers provide a level of redundancy such that, if one center is destroyed or must be evacuated, the other center is capable of continuing operations. These two dispatch centers are identified as East and West. Outage Management operations at the East center are for the eastern portion of Florida Power's coverage area, and operations at the West center are for the west. These two centers communicate with each other and with existing systems (such as CSS and SCADA) via Florida Power's Wide Area Network (WAN).

The configuration at each center consists of dual redundant database servers, one interface/communications server, and one optional tertiary backup server. Proposed workstations are also included in the configuration diagram.

The tertiary backup server supports the scenario where, when one center is destroyed or evacuated, the other center is capable of continuing operations. Each tertiary server contains a replicated copy of the database from the other center. In this scenario, the surviving center dedicates certain workstations to the replicated database of the other center and continues operations. The servers supporting this mode of operation are optional because the replicated database could reside on the I/CAD secondary server. For operational and performance reasons, IPS recommends a separate server for this purpose. If the tertiary server is omitted, then the I/Backup product must be moved to the secondary server.

Server specifications and descriptions, as well as information covering the workstations follow the diagram in Sections 1.1.1 and 1.1.2, respectively. Section 1.1.3 lists the hardware requirements necessary to successfully operate the I/CAD base software, and, therefore, integrate existing, or second-source workstations into the proposed I/CAD System. Specifications for the peripheral hardware used to support archival and backup services are provided in Section 1.1.4.

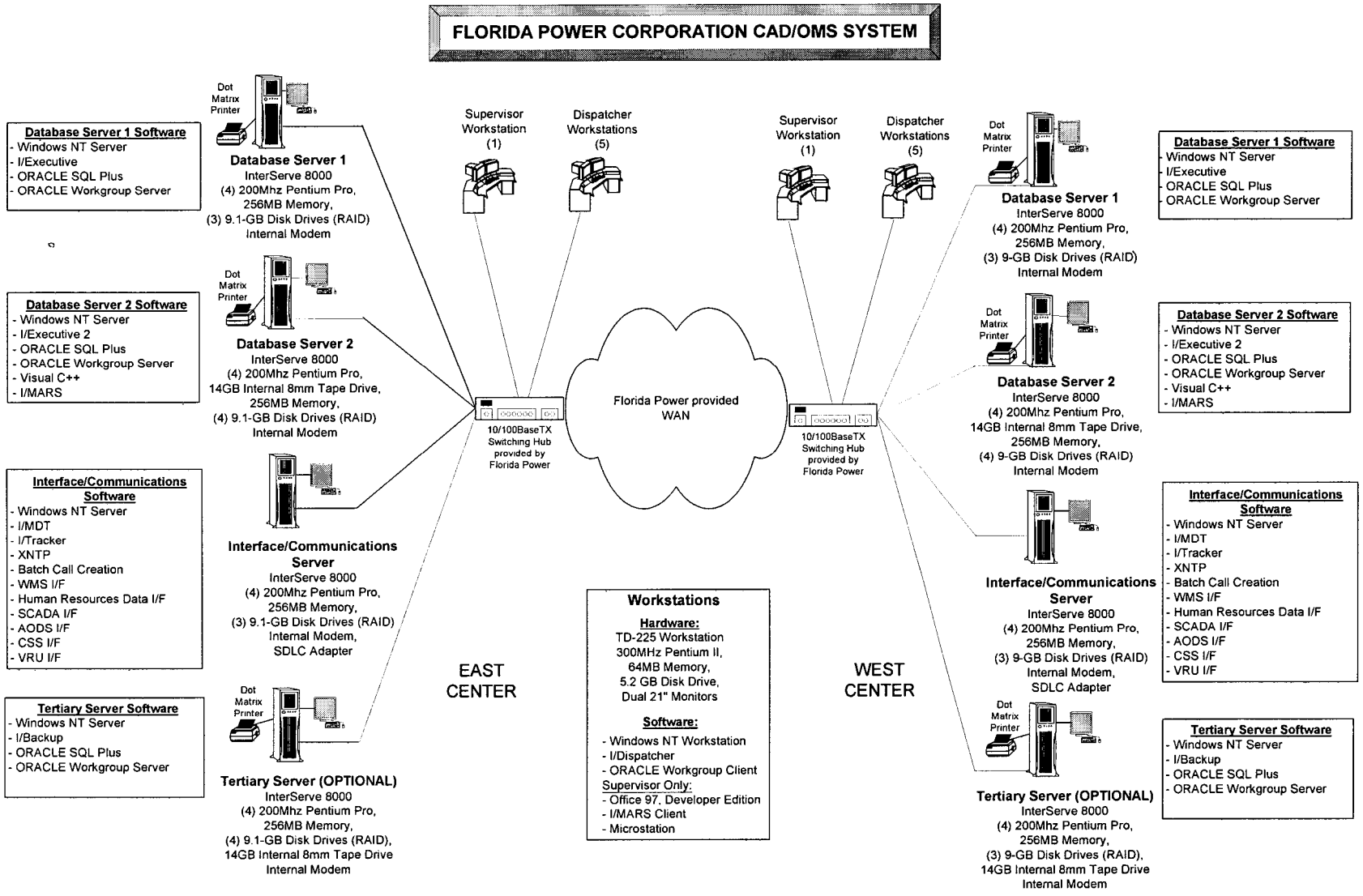


Figure 1. Proposed CAD Configuration

1.1 Hardware Specifications

The proposed Intergraph Intel-based systems are designed to deliver performance, reliability, and scalability for mission-critical dispatch environments based on Windows NT. Built for maximum availability, InterServe Servers offer reliability, with hot-swappable dual power supplies, RAID striping, and a variety of fault-tolerant features for backup of mission-critical data. With a variety of configurations and expandability options, InterServe Servers enable users to scale their networks to accommodate any-sized operation, from a single application to an enterprise serving many users.

The Intergraph TD Personal Workstations are rich -- both in features and performance, while providing quality and return on investment. These high-performance graphics workstations bear the excellence of Intergraph's graphics-tuned architecture and the attention to quality and expandability. Intergraph systems effectively capitalize on the best characteristics of PCs to provide a single, highly productive package, with high-level performance, graphics, and integrated networking in a truly open, industry-standard architecture.

1.1.1 Database and Interface/Communications Servers Descriptions and Specifications

For Florida Power, IPS proposes two Database Servers, one Interface/Communications Server, and one backup server at each center.

Each proposed server is an InterServe-8000 equipped with 256 megabytes of RAM and four 200-megahertz Pentium Pro processors. Database Server 2 is configured with 36 gigabytes of storage, while Database Server 1 and the Interface/Communications Server both provide 27 gigabytes of storage. These servers are sized to provide quick response times, as well as to allow for significant growth.

The Interface/Communications Server is configured to support the proposed interfaces and communications software, taking into consideration the following:

- The number of interfaces required by Florida Power and the anticipated frequency of communication for each interface

- The estimated amount of data associated with each transaction
- The software used to support each interface

The actual interfaces are discussed in Section 2.1.

With the exception of Database Server 2 and the optional Tertiary Server, which is equipped with an extra 9-gigabyte disk drive and an internal 14-gigabyte, 8-mm tape drive, server specifications are standard. Each server is configured with:

- Four, 200-megahertz Intel Pentium Pro processors
  - 512-kilobyte synchronous internal cache for each processor, 4-way set associative, write-back
- 256 megabytes of random access memory (RAM), expandable to 4 gigabyte
  - Industry-standard single in-line memory management (SIMM) technology (5-volt, 60-nanosecond, fast page mode, single- or double-sided)
  - 288-bit error correction code (ECC) architecture
  - One-, 2-, or 4-way interleave
- Internal modem
- Three PCI buses
- UltraWide Small Computer Systems Interconnect (SCSI) interface controller
- PCI-based RAID interface controller
  - On-board Intel i960 processor with 8 megabytes of 2-way interleaved dynamic random access memory (DRAM)
  - Three Fast/Wide SCSI channels
  - Additional RAID controllers supported for maximum external expansion
  - Dynamic resizing
  - Array management console
- Three (4 on Database Server 2) 9-gigabyte, 3.5-inch system disk drives providing
  - Hot-swappable, form factor disk drives
  - 6.0- to 9.5-megabyte per second internal data transfer rate
  - 9.0-millisecond average seek time
  - 13.2-millisecond average access time
  - 7,200 revolutions per minute
- 3.5-inch floppy disk drive
  - 1.44-megabyte/720-kilobyte capacity (formatted)

- Network Interface
  - PCI 10/100BaseT (uses one slot) supports full duplex operation, RJ45 style connector
- InterSite server monitoring system
  - Includes an ISA-based monitoring card with built-in PCMCIA modem and 4-hour battery backup
  - Provides local and remote monitoring with easy-to-view status and graphs
  - Monitors power; temperature; and more than 250 system variables, including memory, disk, CPU; and network performance
  - Offers SNMP event reporting, as well as remote event reporting using the PCMCIA modem with pager capabilities
- Remote system administration, including diagnostics, remote system reboots, and remote power on/off
- PCI/ISA slots
  - Nine PCI slots
  - Three ISA slots
- Miscellaneous I/O ports
  - One DB-25 enhanced parallel port/extended capabilities port (EPP/ECP)
  - Two DB-9 buffered serial ports
  - One external SCSI port
  - PS/2 mouse and keyboard ports
- Two type I/II or one type III PCMCIA slot
- Three-button, PS/2 mouse
- 101-key, AT-compatible keyboard
- PCI-based G95 graphics accelerator
  - Matrox Millennium chip with 2 megabytes of Windows random access memory (WRAM)
  - Standard SVGA monitor support
- Network Cabling
  - 10/100Base-T Ready
  - UTP CAT5 Patch Cord Cable

The 15-inch, multi-sync color monitors proposed for all servers offer a maximum resolution of 1,280 by 1,024 pixels at a refresh rate of 60 hertz. Lower resolutions support a higher refresh rate. Specifications for the proposed 15-inch monitor are as follows:

- 14-inch viewable image

- 0.27-millimeter dot pitch
- Horizontal scan rate of 30 to 67 kilohertz; vertical scan rate of 50 to 120 hertz
- Energy Star-compliant, conforming to VESA DPMS protocol

The following specifications relate to the 14-gigabyte, 8-mm tape drive internal to Database Server 2 only. This tape drive uses removable, rewritable 8-mm tape cartridges. Features include:

- An integrated, single-ended SCSI controller
- Advance helical scan technology that can store
  - 14 gigabytes of data on a 160-meter XL tape at a 2:1 compression ratio, or 7 gigabytes of data on a 160-meter XL tape in native mode
  - 10 gigabytes of data on a 112-meter tape at a 2:1 compression ratio, or 5 gigabytes on the same tape length in native mode

1.1.2 136-Column, 9-Pin Dot Matrix Printers

Two dot matrix printers, one connected to each Database Server via an RS-232-C serial interface, print a sequential hardcopy log of server transactions. In the event of a server failure, hardcopy logs can be used to troubleshoot the server. In the unlikely event of system failure, these logs provide a bridge between the most recent backup of the database and transactions completed since the last backup. Printer features include:

- Print speed
  - Draft mode: 300 characters per second (cps)
  - Utility mode: 250 cps
  - Near letter quality mode: 63 cps
- Print pitch
  - 10 characters per inch (cpi)
  - 12 cpi
  - 17.1 cpi
  - 20 cpi
- Print paper
  - Accepts cut sheet paper in widths of 7.2 to 14.3 inches
  - Accepts tractor feed paper in widths of 3 to 16 inches

1.1.3 Workstation Specifications

If the Intergraph hardware platform is based on standard Intel technology and the proposed system is non-proprietary, what sets Intergraph workstations apart from other PCs available in the marketplace? There are two answers–the industrial engineering and performance of the system and utilization of first quality components.

Within the PC market, there are many platforms available from many different vendors; however, the engineering applied in constructing these systems varies. PCs built from standardly available components that meet customer requirements constitute one end of the engineering spectrum. Computers that have been specifically engineered and tested to meet the performance criteria demanded in a 24 hour per day, 7 day per week operating environment constitute the other end of the spectrum.

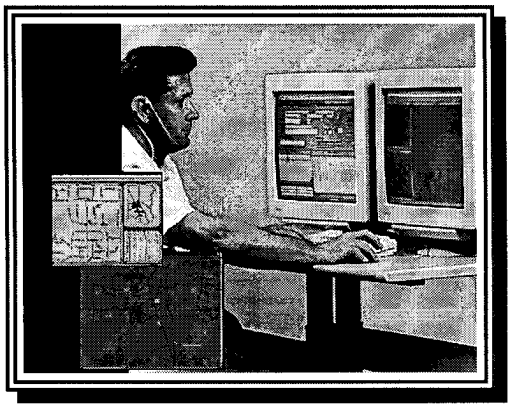
The proposed Intergraph workstations undergo an unusually high degree of testing. They are also tested by the National Software Testing Laboratories (NSTL), ensuring adherence to a variety of hardware and software standards and performance criteria. The IPS proposed system has been engineered to run day and night, in mission-critical environments, 365 days per year. Heat buildup in the base has been carefully studied, and the component layout has been specifically designed for maximum uptime. Only components that meet the highest specifications and quality standards are used. Even the keyboards are produced to withstand day and night, continuous operation, every day of the year.

It is possible to select any computer that meets the appropriate hardware prerequisites and has the ability to run the Windows NT operating system. However, we believe there is significant merit in evaluating the engineering and construction of proposed IPS workstations. Furthermore, should there ever be any operational problems, because IPS is responsible for both system software and hardware, there will be no doubt who owns the problem and who will provide the solution–IPS.

All proposed workstation positions are high-performance Intergraph TD-225 personal computers (PCs) based on 300-megahertz Pentium II processors. These workstations have been priced with 21-inch monitors; however, monitor sizes are also available in 15-, 17-, 19-, 24-, and 28-inches.

The workstation configuration proposes dual-screen workstations for dispatcher and supervisor positions. A single, easy-to-use mouse and keyboard controls either configuration.

Intergraph's TD-225, which features one 300-megahertz processor, 64 megabytes of RAM, and 2.1 gigabytes of disk storage, has dedicated graphics accelerators and drivers optimized for high resolution. Each PC is equipped with a 32-bit, PCI-based Ethernet controller, a 3.5-inch disk drive, and is network ready.



Since dispatcher monitors display a large amount of information in a relatively small space, high-quality monitors are required to prevent unnecessary eye fatigue. In addition, map displays require clear, large monitors to present detail in a usable format. When selecting a workstation monitor, performance, readability, reliability, ergonomics, and flexibility should be considered—Intergraph monitors are designed to accommodate these demands. Our proposed monitors feature anti-glare coating, line-surge and brown-out protection, and automatic sizing, centering, and geometry.

Each proposed PC is configured with:

- 300-megahertz Intel Pentium II processor
- 64 megabytes of EDO random access memory, upgradeable to 256 megabytes
- System I/O Bus – Dual EIDE channels supporting 4 devices
- System Disk Drive
  - 5.2 gigabytes EIDE
- Floppy Drive
  - 3.5-inch, 1.44-megabyte (formatted)
- Matrox Millinium II graphics accelerator
  - 4 megabytes of dual-ported WRAM

- Miscellaneous I/O Ports
  - Two DB9 serial ports
  - One DB25 enhanced parallel port/extended capabilities port (EPP/ECP)
- 104-key, Windows 95-compatible keyboard; three-button, PS/2 mouse
- Peripheral slots and bays
  - Motherboard card slots; 7 total card slots (3 PCI; 3 ISA; 1 Shared)
  - Peripheral bays: 6 total (3 internal 3.5-inch; 1 external 3.5-inch; 2 external 5.25-inch)
  - Card and peripheral options: networking, Fast SCSI-2 controller and drives, plug-in PCMCIA assembly supporting two Type I or II PC cards or one Type III card
- Microsoft Intellimouse (PS/2)
- 32-bit Ethernet controller with standard 10Base-T support

Intergraph's 21-inch monitor is a superb choice for users who would like the generous real estate of a big-screen monitor at a very affordable price. With an improved electron gun design for enhanced focus, the image quality of the monitor displays brighter, richer color, and better contrast at the same time. The monitor provides flat, square screen technology; the monitor minimizes distortion for a very accurate display, even at screen edges and corners.

1.1.4 Base Hardware Requirements for Existing or Third-Party Workstations

In order to provide the requisite processing speed and memory necessary to support the required I/CAD System software, existing or third-party workstations must satisfy the following minimum configuration:

- 200-megahertz Pentium processor
- 64 megabytes of RAM
- 2-gigabyte hard drive
- Must be capable of running the Windows NT operating system
- Must be network enabled/ready

2.0 PROPOSED SOFTWARE CONFIGURATIONS

The following tables list the software for each proposed server and workstation, by type. An additional software configuration is included for MDTs. Although a brief description is provided for each application, refer to the *I/CAD System Overview* (Appendix E) for more detailed information on the purpose and functionality of the I/CAD application modules or third-party software packages.

Inherent to the I/CAD System standardization is an open systems software architecture that offers complete modularity, providing system expandability without disruption to the base configuration. It does not matter whether future expansion takes the form of adding new servers, new workstations, or new software modules, nor does it matter whether expansion is the result of additional responsibilities in the dispatch center or is forced by the demands of community growth.

Florida Power has also requested that all workstations and servers have access to Network File System (NFS) data throughout the corporate network. To support this access, a 25-user license of DiskAccess, NFS Client for Windows NT has been proposed. Using DiskAccess, Windows NT users are able to mount and access files on UNIX and other systems acting as NFS servers. DiskAccess is designed to be an integral part of a Windows NT system, allowing users to browse for NFS systems through Explorer, Network Neighborhood, and File Manager. It includes the following features:

- Network File System (NFS) version 3 client support
- Authentication by connection; pcnfsd authentication/printing
- Windowed ftp and telnet applications
- showmount, rpcinfo, and DNS query utilities
- 32-bit (WIN32) multithreaded, kernel-mode application
- Microsoft's native TCP/IP protocol stack
- IBM 5250 and Graphics 3270 Terminal Emulations
- NTP (Network Time Protocol) server and client tools
- RSHD (remote shell server) and RCP (remote copy)
- DOS to UNIX text conversion utility

2.1 Server Software Configurations

Database Server 1 Software	
Windows NT Server	Windows NT Server provides the operating system for Database Server 1 and enables this server to act as the Primary Domain Controller (PDC), centralizing security for the domain.
I/Executive	I/Executive coordinates all IPS software modules and passes information between the I/MDT and I/Informer interfaces and the various client workstations. In addition, I/Executive includes map and database maintenance utilities and prints standard reports of dispatch center activity. The I/Executive security toolkit is used to fine-tune access and control privileges to dispatch databases.
ORACLE Workgroup Server	ORACLE Workgroup Server provides the relational database management (RDBMS) system used by the I/CAD System to store incident histories and resource information. A copy of ORACLE Workgroup Server resides on both database servers. Copies of ORACLE Workgroup Client, resident on each client workstation, communicate with the server databases via standard ORACLE transactions, thereby continuously updating the databases to retain currency.
ORACLE SQL*Plus	ORACLE SQL*Plus provides a user-friendly environment for querying, defining, and controlling the database. ORACLE SQL*Plus delivers full implementation of ORACLE SQL and PL/SQL query languages, along with a rich set of extensions.

Database Server 2 Software	
Windows NT Server	Windows NT Server provides the operating system for Database Server 2 and enables the server to function as backup domain controller and to authenticate log-on requests. In the event that Database Server 1 fails, Database Server 2 assumes the role of Primary Domain Controller (PDC), re-centralizing security for the system.
I/Executive 2	I/Executive 2 provides the utilities to support dual redundant database operations. In the unlikely event of server failure, I/Executive 2 automatically redirects network traffic to the functioning database and alerts designated users of the failure. Following recovery, I/Executive resynchronizes the failed database, then re-enables dual server operation.
ORACLE Workgroup Server	Refer to the ORACLE Workgroup Server description provided in the software table for Database Server 1.
ORACLE SQL*Plus	Refer to the ORACLE SQL*Plus description provided in the software table for Database Server 1.
Visual C++	On site, Visual C++ is used to tailor the GUI to the individual requirements of each agency. In addition, Visual C++ also provides a system for managing third-party OLE controls, as well as features that allow developers to store classes, resources, and header files as C++ components that can be re-used.
I/Management Analysis and Reporting System (I/MARS) Server	I/MARS is a map-based incident analyses system that allows users to query records and to display those records in graphic form using the CAD map used at calltaking and dispatching consoles. Results of incident selection processes are also available as graphs, bar charts, pie charts, histograms, and printed lists.

Tertiary Server Software	
Windows NT Server	Windows NT Server provides the operating system for Database Server 2 and enables the server to function as backup domain controller and to authenticate log-on requests. In the event that Database Server 1 fails, Database Server 2 assumes the role of Primary Domain Controller (PDC), re-centralizing security for the system.
I/Backup	I/Backup provides support for an off-site, near real-time backup of an I/CAD database server over a medium- to low-speed communication link. This support is normally used in the following situations: 1. Off-site Server The database server site must be evacuated or is disabled or destroyed and there is a need to resume operations with as little disruption as possible. A supervisor may declare the backup database as live and the calltakers/dispatchers may log into the backup database. This presumes that the calltakers/dispatcher are also offsite and have remote communication with the backup server. 2. Multi-Center Dispatching There is a requirement for multiple, regional dispatch centers which operate autonomously but must provide backup for each other in case of the failure of one center. In this scenario, each center has a backup of the other center's database. If one center must shut down, the supervisor declares the backup database at the other center to be the live one and dispatchers/calltakers from the surviving center may log into the backup database. I/Backup also provides support when both centers are operational. Events and resources can be transferred from one center to another. Inquiries may be performed on the backup database so that centers may coordinate activities. I/Backup is a compliment to the database redundancy that is part of the I/Exec2 product. Either or both products may be used to

	ensure continued operation in the face of system failure. I/Exec2 is used for seamless failover for servers in the same Local Area Network. I/Backup is used for near real-time failover for servers separated in a wide area network. I/Backup makes use of database replication technology to back up a command center over a medium- to low-speed communication link. Provisions are made to switch control to the backup center on a failure of the main or primary center. When operation at the primary center is restored, the databases are automatically synchronized and normal operation is resumed.
ORACLE Workgroup Server	Refer to the ORACLE Workgroup Server description provided in the software table for Database Server 1.
ORACLE SQL*Plus	Refer to the ORACLE SQL*Plus description provided in the software table for Database Server 1.

Interface/Communications Server Software	
Windows NT Server (operating system)	Windows NT Server provides the operating system for the Interface/Communications Server and enables the server to function as a backup domain controller and to authenticate log-on requests.
I/Mobile Data Terminal (I/MDT)	I/MDT provides the server side functions required for a complete implementation of mobile data terminals. This application will, via CDPD, establish communication between the dispatch environment and vehicle-based MDTs with I/Mobile software. This connection enables MDTs to review and update incident, unit, personnel, and equipment information maintained in the dispatch environment.
I/Tracker	I/Tracker accepts, via I/MDT, incoming vehicle location data received from a GPS receiver in the mobile computer. This product functions as an extension to the dispatcher functionality. I/Tracker periodically sends the latest updated location information to the dispatch environment for map update of vehicle locations.
XNTP	XNTP is third-party software used to permit time synchronization of the entire dispatch environment.
Trouble Analysis	The Trouble Analysis component analyzes call data to determine, from the pattern of calls within the outage area, a probable outage device. The server process will then create an outage event based on this analysis.
Batch Call Creation	The Batch Call Creation component is a new standard IPS product that provides a standard mechanism for external processes to create events in the I/CAD System. The external process would replace or supplement the standard I/Calltaker product as a mechanism for entering events into the I/CAD System. The Batch Call Creation component is a gateway to the I/CAD database and network protocols. The database fields that make up an event record are configurable to some degree in the I/CAD System. Certain fields must be present, but others may be added to meet the needs of specific customers. The component must support this configurability.
Interface to WMS	The Workorder Management System (WMS) is provided by Severn Trent Systems as part of another proposal. I/Dispatcher will send work order requests to the WMS. These work requests will be in the form of records written to the appropriate table in

	the WMS Oracle database. (WMS periodically checks this table for additions.) I/Calltaker and I/Dispatcher will not interface directly to WMS for lineup information, but once WMS is online shift lineups may be imported into the I/CAD Oracle database from the WMS Oracle database using a transfer process written for that purpose.
Interface to Human Resources Data	I/Dispatcher will not have a direct interface to the customer's Human Resources system, but it will be possible to transfer personnel identification and skill information to the I/CAD Oracle database via an external utility program. The default interface will be via an ASCII file. The customer will be responsible for exporting the data from the HR system in a format to be specified. I/CAD will provide a utility to update the Oracle database from the ASCII file. This process may be displaced by the Interface to WMS.
Interface to SCADA	The OMS will have a server-based program that monitors and manipulates Supervisory Control and Data Acquisition (SCADA) status. This server process will accept requests from the Dispatcher workstations and forward SCADA status information to the workstation displays.
Interface to AODS	The OMS will have a server-based program that monitors and manipulates Automated Outage Detection System (AODS) status. This server process will accept requests from the Dispatcher workstations and forward AODS status information to the workstation displays.
Interface to CSS	The OMS will have a server-based program that accepts new call information from the Customer Service System (CSS) and creates I/CAD jobs via the batch call creation interface. There are other components of the Interface to CSS that operate on the client workstation.
Interface to VRU	The OMS will have a server-based program that creates callout requests on a voice response unit (VRU). These requests can provide a list of customers that should be called to determine if power is restored at their home. These requests can also provide a list of field personnel that can be called up to perform outage work.

2.2 Workstation Software Configurations

Dispatcher Workstations	
Windows NT Workstation	Windows NT Workstation provides an independent operating system for client workstations, allowing clients to participate in the network and to load and run software applications locally.
ORACLE Workgroup Client	ORACLE Workgroup Client is the relational database management (RDBMS) system used by client workstations to communicate with the server databases, thereby allowing continuous updating of the databases.
I/Dispatcher	I/Dispatcher incorporates all the functionality of I/Calltaker plus dispatching and emergency vehicle monitoring and control capabilities that include recommendation of emergency vehicles for dispatch; access to agency deployment plans; the ability to transfer incidents between emergency vehicles; the ability to log emergency vehicles on and off; the ability to transfer emergency vehicles between stations; and the ability to generate automatic route recommendations.

Supervisory Workstation	
Windows NT Workstation	Windows NT Workstation provides an independent operating system for client workstations, allowing clients to participate in the network and to load and run software applications locally.
ORACLE Workgroup Client	ORACLE Workgroup Client is the relational database management (RDBMS) system used by client workstations to communicate with the server databases, thereby allowing continuous updating of the databases.
I/Dispatcher	I/Dispatcher incorporates all the functionality of I/Calltaker plus dispatching and emergency vehicle monitoring and control capabilities that include recommendation of emergency vehicles for dispatch; access to agency deployment plans; the ability to transfer incidents between emergency vehicles; the ability to log emergency vehicles on and off; the ability to transfer emergency vehicles between stations; and the ability to generate automatic route recommendations. Using supervisory log-on privileges, I/Dispatcher commands are available that only supervisors should use, such as the ability to monitor any I/CAD incident transparently to both dispatchers and calltakers.
Microsoft Office 97, Developer Edition	The Office 97 software is used in the I/CAD System to produce, integrate, and distribute management report documents that encompass information output in Microsoft Access, Word, Excel, and PowerPoint. Microsoft Access allows managers or supervisors to design and generate customized reports and to distribute the reports to other users. While Microsoft Office 97, Developer Edition provides the traditional Office Professional suite of software, capabilities have been upgraded to enhance integration and usability of the individual Office modules and to add Microsoft Forms, more than 500 programmable objects, and Visual Basic, Applications Edition (VBA). In addition, development tools are packaged with this suite, including a royalty-free run-time license, Microsoft Access/Microsoft Visual SafeSource, Replication Manager, Setup Wizard, and expanded ActiveX controls.

Mobile Computer	
Windows 95	Windows NT Server provides the operating system for Database Server 1 and enables this server to act as the Primary Domain Controller (PDC), centralizing security for the domain.
I/Mobile	I/Mobile is the software that resides in each MDT. I/Mobile provides the mobile user interface to the I/CAD System and to other mobile MDTs. The MDT also interfaces with automatic vehicle location hardware. I/Mobile communicates with I/CAD through the Server-based I/MDT product. Messages are sent and received asynchronously. I/Mobile allows units to access a subset of I/CAD commands and provides an interface to external databases for queries like vehicle license checks.

3.0 OUTAGE MANAGEMENT SYSTEM

The I/CAD System has been developed over the years to meet a variety of needs for public safety service providers. These providers include police, fire, ambulance, and roadside assistance (auto club) customers, and multi-agency customers that provide multiple types of service.

The core products in I/CAD are I/Calltaker and I/Dispatcher. The function of I/Calltaker is to support the person taking telephone calls from the public (or club members) and creating events (requests for service). The function of I/Dispatcher is to support the person communicating with the units in the field (for example, fire trucks and patrolmen) and managing the assignment of events to units. Both products use a GUI and a digital map, and provide real-time status displays, database inquiry, and message facilities.

Generally a calltaker takes calls from anywhere in the service area, and the resulting event is automatically sent to the appropriate dispatcher workstation based on the event type and location. All entered data is entered into a central Oracle database, and a subset of the data is broadcast on the local area network to update the real-time status displays of other workstations. The GUI and the database schema are highly configurable so that the system may be tailored for the terminology, workflow, and data processing requirements of a wide range of customers. Both I/Calltaker and I/Dispatcher use a high-speed map display to display geographic and situational information.

There is a large degree of overlap between the requirements of public safety customers and those of utility customers. However, the following differences have been identified:

- In public safety, the general rule is that one telephone calls leads to one dispatchable event. There are cases when the same occurrence is reported multiple times (like traffic accidents), and the I/CAD System detects nearby events and recommends to the calltaker that they may be collapsed into a single event. In a utility distribution system, the general rule is that multiple calls reporting a service outage need to be aggregated to a single dispatch to repair the failed piece of equipment upstream from the callers. This aggregation should be based not on geographic proximity, but rather on information about the distribution network and current knowledge about the equipment and the other outstanding outage reports. The aggregation may need to change as more information is obtained about equipment status and outages. Therefore, the I/CAD System will need a new *Trouble Analysis* function to perform the analysis to predict the equipment that needs repair and to maintain the association between outage calls and repairs
- In public safety, the two primary pieces of information in taking a call are the event location and the event type. From those, the agency response, dispatch

group, and unit recommendations are computed. The event location may be entered as a street address, intersection, commonplace name, alarm identifier, or geographic coordinate. The location entry is converted to a map point and a response zone by the process of *location verification,* using the map and the geographic database. While some locations may have specific information or response plans stored for them, most do not. In a utility distribution system, the key is to identify a customer premise. The input may be a customer name, address, or account number. Each customer can be found in a customer database with important additional information needed to process the call, such as the identification of the service transformer and whether service has been cut off for nonpayment. Since this customer database is used for many other business purposes, it will remain external to the I/CAD System. Therefore, the I/CAD System will need a new *Customer Data Interface* function to supplement or replace the existing location verification function. This interface can also support other functions, such as recording outage repair times, inquiry of supplemental premise information, and the generation of a list of customers affected by an outage

- In public safety, the displayed base map is primarily a street map with a dynamic overlay of unit and event location symbols. The street graphics are linked to database tables used for address verification, optimal routing, and road closures. Optional static overlays include building outlines, political and administrative boundaries, utilities, and more. These optional graphic levels may also be linked to database tables and interactively queried, but are not otherwise used in direct processing. In a utility distribution system, the distribution network is a core component of the base map, and the street network has less importance. The distribution network graphics should be linked to a network model that is either stored within the I/CAD System, or external in an AM/FM GIS. In addition, the map should show an additional dynamic overlay for the status of the network based on SCADA information or other sources.

IPS has worked with Florida Power to identify the functional requirements for an initial implementation of Outage Management. The result of this activity is a functional requirements document that is attached to this proposal as Appendix B.

This functional requirements document identifies two phases for the implementation of the OMS. The two phases were defined to separate those activities that were required for a minimal operational capability of the OMS from those activities that were not required or were dependent on other projects such as the AM/FM/WMS project. The proposed schedule for this project does not differentiate between these phases. IPS would prefer to address these activities as outlined in the proposed project schedule. In this way, design decisions can be made early and development can proceed in advance of the required

systems integration. This will serve to minimize the impact of software change in the operational OMS. If, during detailed project analysis, it is determined that a second phase is required, IPS will work with Florida Power to develop a viable schedule.

The success of this implementation depends on data and interfaces from a variety of sources. The tables below identify IPS' understanding of the sources and its responsibilities with respect to the data and interfaces.

Data Dependencies	
GIS Map Base	Prior to the implementation of the AM/FM/WMS project, the I/CAD GIS Map Base will be provided by Florida Power based on data acquired for another project with the Lightstone Group. Details of our assumptions and dependencies are outlined in Section 7.4 of this document. After the implementation of the AM/FM/WMS project, the GIS Map Base will come from data developed and maintained through that project. We assume that this data will meet, at a minimum, the same requirements as listed above. We also assume that, by this time, Florida Power personnel will be trained and experienced with upgrading CAD maps and will be able to roll this information into the system. We have not, as part of this proposal, bid the services required to make this transition. However, if required, we would be glad to bid these services as the need arises.
Facilities Data (FRAMME)	Prior to the implementation of the AM/FM/WMS project, the facilities data required to support Trouble Analysis will be provided by Florida Power in the form of a FRAMME Database. This data, like the pilot project data, will be translated from the existing DIFIS data. IPS has a copy of the Pilot Project database translated from DIFIS with which to do software development. We assume that Florida Power will want to provide fresh data prior to system testing and training as well as just prior to going into live operation with the OMS. After the implementation of the AM/FM/WMS project, the facilities data will come from data developed by that project. We assume that this data will be in the form of a FRAMME Database that is compatible with the previous database for the information on which OMS is dependent. It is our understanding that the connectivity data (critical to

	Trouble Analysis) for a FRAMME project is consistent from project to project and should therefore require no change to software. We have not, as part of this proposal, bid any software development effort required to make this transition. However, if required, we would be glad to bid this effort as the need arises.

Interface Software Dependencies	
I/Mobile Data Terminal (I/MDT)	I/MDT provides the server side functions required for a complete implementation of mobile data terminals. This application will, via CDPD, establish communication between the dispatch environment and vehicle-based MDTs with I/Mobile software. This proposal bids a mobile computer with CDPD modems and GPS. We assume that Florida Power is responsible for procuring CDPD bandwidth from GTE. If necessary for pricing, IPS can provide details on the required data bandwidth.
I/Tracker	I/Tracker accepts, via I/MDT, incoming vehicle location data received from a GPS receiver in the mobile computer. This product functions as an extension to the dispatcher functionality. I/Tracker periodically sends the latest updated location information to the dispatch environment for map update of vehicle locations. This proposal bids a mobile computer with CDPD modems and GPS. We assume that Florida Power does not require Differential Correction to the GPS coordinates.
Interface to WMS	The Workorder Management System (WMS) is provided by Severn Trent Systems as part of another proposal. I/Dispatcher will send work order requests to the WMS. These work requests will be in the form of records written to the appropriate table in the WMS Oracle database. (WMS periodically checks this table for additions.)
Interface to Human Resources Data	I/Dispatcher will not have a direct interface to the customer's Human Resources system, but it will be possible to transfer personnel identification and skill information to the I/CAD Oracle database via an external utility program. The default interface will be via an ASCII file. The customer will be responsible for exporting the data from the HR system in a format to be specified. I/CAD will provide a utility to update the

	Oracle database from the ASCII file. This process may be displaced by the Interface to WMS.

Interface to SCADA	The OMS will have a server-based program that monitors and manipulates SCADA status. This server process will accept requests from the Dispatcher workstations and forward SCADA status information to the workstation displays. We assume that this interface will be performed using TCP/IP protocol over the Florida Power WAN communicating with a program provided by Florida Power. This interface will receive packets describing the state of the SCADA system and send packets to affect change.
Interface to AODS	The OMS will have a server-based program that monitors and manipulates AODS status. This server process will accept requests from the Dispatcher workstations and forward AODS status information to the workstation displays. We assume that this interface will be performed using TCP/IP protocol over the Florida Power WAN communicating with a program provided by Florida Power.
Interface to CSS	The OMS will have a server-based program that accepts new call information from the CSS and creates I/CAD jobs via the batch call creation interface. There are other components of the Interface to CSS that operate on the client workstation We assume that this interface will be performed using TCP/IP protocol over the Florida Power WAN communicating with a program provided by Florida Power.
Interface to VRU	The OMS will have a server-based program that creates callout requests on a VRU. These requests can provide a list of customers that should be called to determine if power is restored at their home. These requests can also provide a list of field personnel that can be called up to perform outage work. IPS has discussed this interface with Laird Smay of Baker Audio/Telecom. Mr. Smay agrees that the appropriate interface can be provided. We assume that Florida Power is responsible for providing this interface. We would be glad to work with Baker Audio during the design of this interface.

4.0 PROPOSED COST SCHEDULES

IPS has provided pricing for the complete configuration as requested by Florida Power. Based on the fact that this project is a partnership between the two companies, we have included significant discounts to our normal list prices. The details of that discounting are included in Appendix C. IPS realizes that Florida Power may change the configuration, requirements, or provide additional information before making a final decision, and IPS agrees to adjust the pricing accordingly. Please refer to Appendix C for detailed Pricing.

5.0 THE SYSTEM ARCHITECTURE

To sustain the system operability requisite in any dispatch environment, an open systems architecture that incorporates configuration flexibility, redundancy, and fault tolerant technologies, is essential. IPS believes that our proposed architecture furnishes these elements in a truly open, non-proprietary environment.

The IPS goal in selecting each hardware and software component was to produce a system that combines the best technological solutions available in today's marketplace while preserving the system's ability to be upgradeable to the next generations of technology. To ensure the continuing viability of Florida Power's CAD system, the IPS system architecture is based to the use of industry-standard technology and software, such as Intel processors, the Microsoft Windows NT operating system, and the ORACLE Relational Database Management System (RDBMS). Code is written in C++, and the Microsoft GUI is leveraged to provide a familiar user interface that reduces training requirements.

The following subsections describe the proposed IPS system architecture and provide a high-level rationale for the selections we have made to maximize Florida Power's investment.

5.1 Client/Server Topology

The maintaining of system operability while allowing for future growth makes the selection of a client/sever architecture a natural fit.

Within the client/server topology, each workstation (client) is equipped to perform most of its tasks, creating what might be called a heavy client. To accomplish this independence, workstations are configured with the hardware components and software applications necessary to perform tasks locally. By increasing processing speed and adding random access memory (RAM) and hard drive disk space to each client workstation, most of the system processing is distributed to the client, meaning that applications software can be installed and run locally and applications processing can be accomplished locally. This modular architecture eliminates much of the network traffic associated with mainframe computing, and this combination of distributed processing and client autonomy sustains system operability by schematically isolating the impact of a client malfunction. In addition, the flexibility of the architecture allows new workstations to be added without disrupting operations within the dispatch center.

However, while the majority of processing is distributed to client workstations, the results of that processing must be collectively accessible to all clients. Consequently, there must be a centralized machine capable of the following:

- Continuously updating the information database constructed to initiate operations
- Maintaining ongoing communication with the individual clients

These tasks become the business of the server. In establishing communications between itself and each client, the server provides a communications network used by the system to pass information from one client to another. And, by continuously updating the database with new information accumulated by clients, the server centralizes database information and maintains the currency of that information. By maintaining a current database, the server can pass the most up-to-date information to clients so that they, in turn, can use the best available information to perform their processes.

It's a simple, elegant solution. The same design that sustains system operability supplies the flexibility necessary to add clients to the network or to take clients off-line for routine maintenance or to install upgrades. To further enhance this flexibility, if activity on one server becomes too great, new servers can be added and new processes or existing processes can be redirected. As an example, each interface application residing on the Interface/Communications Server could be redistributed and run on a separate server.

But what if a Database Server fails?

5.2 Providing Redundant Database Servers

Since access to information in the database and communication between clients is cardinal to sustaining Florida Power's operability, the proposed system architecture includes two, fully redundant database servers to prevent disruption of operations in the unlikely event of a server failure. From the perspective of system operations, each server has a mirrored copy of the database; neither is primary, and the database on each server is maintained by the system in real-time.

In providing database redundancy, if a client workstation detects a problem with one of the database servers, all client nodes are discreetly notified, all database operations are diverted to the functional database server, designated personnel, such as the system administrator, receive notification of failover, and database operations are terminated against the failed server. Software on the functional server marks the point of failover in the database so that, once brought back on-line, the failed server's database can be reconstructed. All of these activities occur automatically, without operator intervention and without impacting calltaker or dispatcher operations.

After repairing the failed server, the administrator initiates a recovery process, and the failed server begins updating its copy of the database from the point of failure. The amount of time it takes to fully update the database depends on the amount of time the server was down. This process will continue until both server databases are synchronized. As with failover, recovery does not impact calltaker or dispatcher operations.

Following recovery, all nodes are discreetly notified that both servers are back on-line, and the servers are returned to mirrored dual operation. Again, return to dual server operation takes place without disruption to operator procedures.

Using a similar sequence of events, a server can be taken off-line for routine maintenance without interfering with normal operations.

Reliability analyses of I/CAD Systems around the world confirm that an availability rate greater than 99 percent is expected and achievable with the proposed configuration. The aim of the configuration is to provide continuous operation for the Communications Department 24 hours a day, 365 days a year.

5.3 Interface/Communications Server

The proposed Interface/Communications Server ties the external systems necessary to complete Florida Power's configuration requirements into the network.

During the last eight years, IPS has developed and established an extensive suite of interface products for the dispatch industry and is committed to creating new products to add to this suite as dispatch interface requirements emerge. We also actively update our existing suite of products to provide improved performance or to incorporate new features.

The open systems, client/server architecture proposed by IPS is ideal for adding new interface devices and interface software without disturbing mainline functionality.

While the Interface/Communications Server provides significant communication services within the system, continued operation of this server component is not mission-critical. In the unlikely event that the Interface/Communications Server should fail, operability within the system would continue; however, functionality would be limited. For this reason, IPS has not proposed a backup Interface/Communications Server. However, if Florida Power would like to configure a system that includes redundancy of the Interface/Communications Server, IPS can provide this configuration.

5.4 Fault Tolerance

In addition to providing database redundancy, the IPS proposed system architecture is designed to provide fault tolerance, meaning that the system is designed to continue functioning even after failure of a system component.

IPS uses Redundant Array of Independent Disks (RAID) technology on all servers to enhance reliability within the system and to minimize loss of data, should a disk fail.

When a server disk fails, designated personnel are notified of the failure and simply remove the disk and replace it with a new one. Each disk is "hot-swappable," which means that it can be removed and replaced without taking the server off-line and that during the period of time between failure and disk replacement, the system automatically writes data to the functioning disks. In the meantime, operations within the Communications Department continue normally.

Hot swappable power supplies also contribute to the fault tolerant design. Once again, should an internal power supply fail, designated personnel are notified and the failed power supply is swapped for a new component without taking the server off-line and without disrupting normal operations.

5.5 Windows NT–The Operating System

Think about Microsoft Corporation's Windows NT, and security, stability, and reliability quickly come to mind. Ask people who use it on a daily basis, and they will tell you Microsoft Windows NT systems that crash are about as common as 286-based machines running Windows 1.0 are today. The Windows NT operating system design replicates the paradigm of the client/server environment: isolate and modularize processes to produce stability.

Microsoft pushed tasking to operating system sublevels, allowing the Windows NT base operating system to perform only those processes that could not be reasonably performed elsewhere. The result is a base operating system that is as small and tight as possible. Functionality removed from the base operating system is distributed to a set of "protected subsystems."

The result is a very stable, modularized platform. While a subsystem may fail, the core operating system and remaining subsystems can continue to function. Enhancements occur at the protected subsystem level, which enables the system to be upgraded without rebuilding the entire operating system. In fact, new protected subsystems can be added to the operating system, or subsystems can be upgraded, without requiring modification to either the base operating system or to existing subsystems.

In addition to decentralizing as much of the core operating system as possible, the Windows NT modular design provides an open systems platform that allows users to engineer system functionality by selecting industry-standard software from a variety of vendors.

Embedded in the definition of "industry standard" are two categories: *de jure* and *de facto*. *De jure* standards are those that have been created by standards bodies such as the American National Standards Institute (ANSI) or the International Standards Organization (ISO). An example of a de jure standard is the ANSI American Standard Code for Information Interchange (ASCII) character encoding standard. De facto standards are those that have been widely adopted by industry but not originally endorsed by any of the standards bodies. An example of a de facto standard is the Transmission Control Protocol/Internet Protocol (TCP/IP) network communications protocol. De facto standards have arisen either to fill gaps left by implementation specifications of the de jure standards or because no standard had yet been defined for the particular area.

It is safe to say that open systems based solely on de jure standards have yet to be fully realized, and it is doubtful that they ever will be. At the heart of the problem are the very different natures of the computer industry and the academic standards process. The speed with which the technology is changing is staggering, and the formal standards process is inherently unable to keep pace with it. So, the utopian "de jure"-centric world of open systems has largely given way to the newer, reality-based recognition that real-world open systems cannot live by de jure standards alone. In today's open systems, both de facto and de jure standards are combined to create inter-operable systems. It is this strategic combining of both types of standards, this middle-of-the-road approach, that enables open systems to keep pace with the rapidly changing nature of technology.

The beauty of this architecture is that it allows for the plug-and-play of modules, meaning that a new module implementing a de facto standard can later be supplemented or replaced with one that implements a de jure standard. In effect, you end up with the best of both worlds: open systems and industry standards.

5.6 A GUI Standardized across Applications

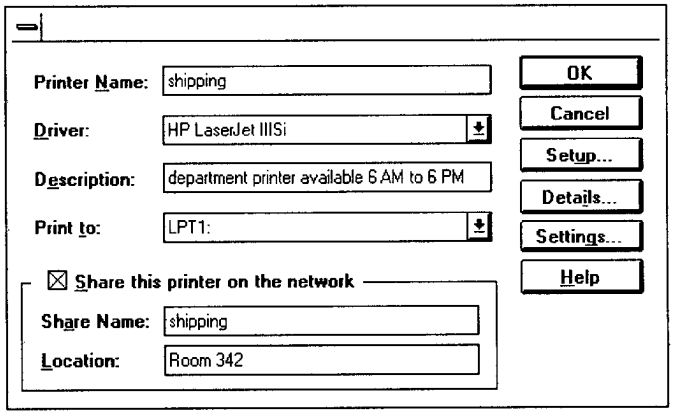
Since its introduction in the initial release of Windows in 1985, the Windows GUI has steadily eroded older-generation, command line user interfaces (CLUIs). In an astonishingly short period, Windows operating systems have become the platform used on 87 percent of computer systems worldwide, virtually removing command line-only interfaces from the marketplace.

Why the success? It has more to do with ease of learning and the convenience of using icons, buttons, and dialog boxes to communicate with the operating system; it has to do with consistency. During the past 12 years, Microsoft and third-party applications have leveraged what users already know about how to control their operating system to provide a structure for learning new software. With millions of Windows users, Microsoft guidelines for GUI development have effectively become ubiquitous, and there are currently more then 11,000 shrink-wrapped, commercial, off-the-shelf (COTS) applications that can be run on Windows NT, all of which share the Microsoft GUI.

Each I/CAD module proposed for Florida Power's system offers complete implementation of the Microsoft GUI, allowing commands to be entered from the CAD map, through the use of forms or dialog boxes, or by using the command line or shortcut keys. And, while developing new or updated products and technology on a biannual basis is an integral part of IPS corporate operations, user familiarity with the GUI will continue to be supported to reduce training requirements.

5.7 Systems Administration of the Operating System

From an administrator's standpoint, the most improved aspect of the Windows NT operating system may have taken place in the systems administration arena. From installation and configuration of the operating system itself, to configuration of peripheral devices, to installation and configuration of application software, Windows NT uses its GUI-based setup programs to step administrators through building their systems, relieving them of the burden of editing numerous configuration files. Dialog boxes are used to solicit configuration information, such as which file system to use or which print drivers to download, and the system automatically writes this information to the Windows NT Registry database.



The use of dialog boxes for various installation procedures reduces the chances of a configuration error. However, if an error does occur, Windows NT provides a descriptive message, directing the administrator to the problem.

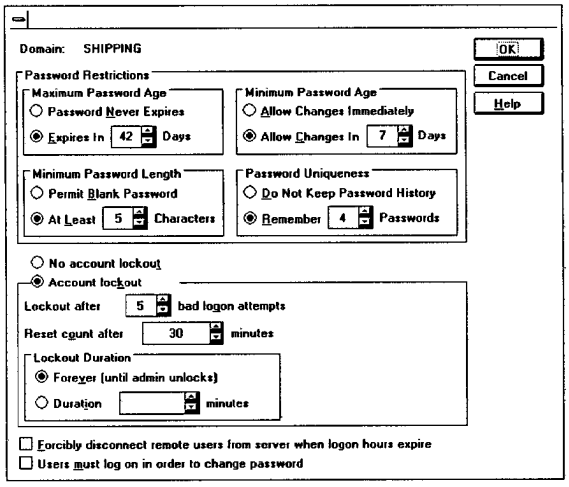
5.8 Windows NT Security Administration

Windows NT automatically supports multiple file systems; however, the file system of choice for a dispatch environment that needs to protect both internal and external database access is the Windows NT File System (NTFS), which provides the highest level of security; the ability to institute fault-tolerant disk strategies; and which supports large files and disk sizes.

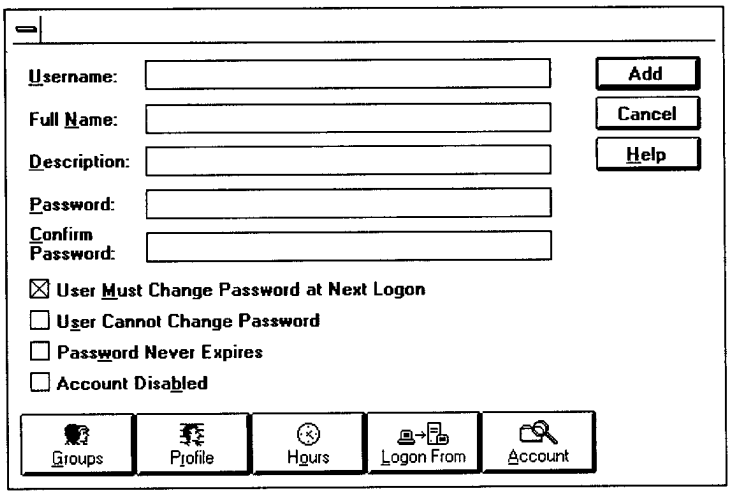
As with the setup programs used to load new software or to update existing software, security administration is GUI-driven. However, rather than stepping the administrator through rigid, system-defined security policies, Windows NT uses combinations of options presented on dialog boxes or in user windows to establish a system security setup that circumscribes the customer's requirements.

These utilities set:

- Domain account policies and restrictions, that determine
  - Maximum and minimum password ages
  - Minimum password length
  - Number of passwords that must be used before a previously used password can be recycled (password uniqueness)
  - Number of bad log-on attempts prior to enacting account lockout
  - The amount of time the account lockout remains in effect
  - Forcible disconnection of users when a set number of hours expire
  - Forcible user log on prior to changing a password. This option prevents users whose passwords have expired from logging into the system

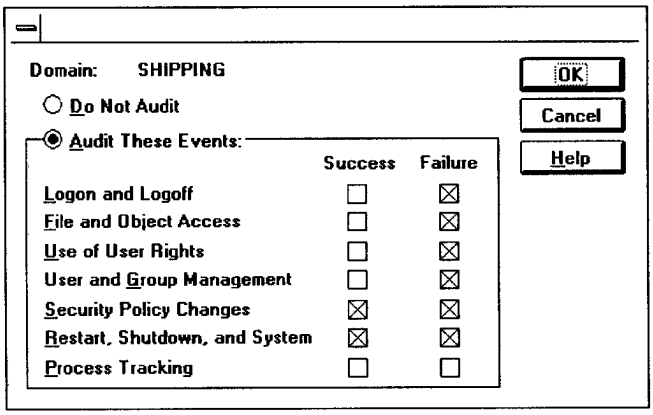


- User account policies, such as
  - Whether or not users can independently change passwords or whether password modification requires system administration assistance
  - Whether a user account is enabled or disabled. An account may be disabled if an operator is on vacation, for example. If the user no longer works for Florida Power, however, the user account should be removed
  - Groups the user belongs to
  - Time of day users are entitled to access the system
  - Specific workstation a user is entitled to log on to



- Group and user account parameters and privileges, that determine
  - Which user accounts have access to system management privileges, such as
    - Administrator privileges
    - Server operator privileges
    - Account operator privileges
    - Print operator privileges
  - Which folders and files a user group may access
  - Who can log on to the server
  - Who has the right to kick off backups of the system. Potentially, operators granted this privilege can carry information off-site
  - Who can set up auditing and security logs
  - Who can take ownership of files or other objects

- System audit policies and administrator account privileges, such as
  - Whether or not to audit failed log-on attempts, file and object access, security policy changes, workstation startup and shutdown, and process use
  - Whether or not administrative procedures must be performed from a designated workstation
  - Removal or retention of the Domain Administrator's Group for each workstation



- File and directory permissions and shares privileges and auditing options such as
  - Whether or not accessing files or folders will be audited
  - Which groups or users have access to certain files and folders

5.9 Customization versus Custom Design

The IPS solution integrates several widely used, standard applications available from IPS, as well as from third-party vendors. I/CAD software modules are COTS products and are designed to be available to the marketplace as a whole. All I/CAD customers run standard software with each system tailored to customer needs by adding the appropriate I/CAD applications, then setting extensive user-definable parameters. If customers purchase an active full maintenance contract, all product enhancements are received at no cost. In this way, as technology advances and new software standards become available, the IPS customer keeps pace.

The alternative to providing a COTS-based system is to develop custom software created for each specific user agency. To upgrade custom software, each customer must bear the *full cost of the upgrade*, and a good deal of time and effort is required to move the customer forward.

The reliability of the proposed I/CAD COTS software is demonstrated by the fact that as I/CAD has evolved over the last 8 years, the base product has repeatedly proved itself, currently functioning at more than 60 sites (customers) around the world.

6.0 NETWORKING HARDWARE PREREQUISITES

IPS understands that Florida Power will supply the network hardware and software for the CAD system. The following subsection describes the IPS networking environment.

6.1 Networking Environment

The I/CAD System is a network-based, distributed computing environment with each client workstation running its own application software and Windows NT operating system. These workstations communicate with and through the database server(s) over a local area network (LAN) or a wide area network (WAN). This distributed approach avoids interdependence and leads to a simple and elegant solution.

IPS' network is a 10 and/or 100Base-T Ethernet design using the TCP/IP transport protocol. TCP/IP is a long-tested, preferred protocol, particularly for local and wide area networking. Its routability, scalable architecture, reliable delivery, and global use have made TCP/IP a necessity for any customer wishing to build wide area networks or to access worldwide information networks, such as the Internet.

All of our workstations and servers include an IEEE 802.3 Ethernet communication interface to provide optimal throughput. Intergraph uses a 10/100Base-T PCI card for high bandwidth communication with each server and workstation. This backbone takes advantage of existing industry-standard network technology and provides an excellent migration path to future network products.

The physical network consists of 100Base-T for the servers and 10Base-T for the workstations. IPS uses the standard hub design because it delivers proven, industry-standard connectivity for demanding network environments, such as a dispatching environment. Hubs provide a low-cost, high-performance solution that prevents network bottlenecks and provides high response times—the design is also expandable to accommodate large networks.

Windows NT is a complete operating system with fully integrated networking, including built-in support for both peer-to-peer and client/server networking. It provides interoperability with remote dial-in access to existing networks, support for distributed applications, file and print sharing, and the capability to easily add networking software and hardware. The following transport protocols are supported: TCP/IP; NBF, derived from NetBEUI; NWLink, an NDIS-compliant version of Novell Internetwork Packet Exchange (IPX/SPX); Microsoft Data Link Control (DCL); and AppleTalk. The use of Windows Sockets provides true transport protocol independence and extends Windows NT's support to additional protocols and technologies, including DECnet, OSI, ATM, wireless, and telephony.

7.0 SOFTWARE CAPABILITIES

The I/CAD software capability integrates calltaking, dispatching, and supervisory functionality with an interactive map display. This functionality requires no special interface and places any geographic information that has been entered into the I/CAD System at the fingertips of dispatchers and calltakers.

7.1 I/Calltaker

At Florida Power, calltaking is normally done through the CSS system and transferred to I/CAD via that interface. We have not bid calltaker seats for this proposal but this application is available. Essentially a subset of the I/Dispatcher software, I/Calltaker retains the functionality necessary to answer calls, verify locations and enter incident information, and to forward calls to dispatchers. For details, reference Appendix A, the *I/CAD System Overview*.

7.2 I/Dispatcher

In addition to providing all the functionality of I/Calltaker, I/Dispatcher allows users to dispatch emergency service vehicles and monitor vehicle and incident status and type. Using the digital map, I/Dispatcher also provides automatic dispatch recommendations based on incident and vehicle location, type, availability, and other pertinent factors. For details, reference Appendix A, the *I/CAD System Overview*.

7.2.1 Supervisory Functionality within I/Dispatcher

Many I/CAD commands can be restricted to the Supervisor. The Supervisor may also be configured to be a part of the approval process, and to that of security and administration.

Using I/Dispatcher, supervisors can monitor any I/CAD incident from any workstation, and the monitoring of an incident is transparent to both dispatchers and calltakers.

The ORACLE RDBMS enables the I/CAD System to store any number of records for an agency's use, such as personnel records and building floor plans, and supervisors can access this database information to produce 17 standard I/Dispatcher reports. Additional, specialized reports may be written on-site using system-provided tools.

7.3 I/CAD Software Highlights

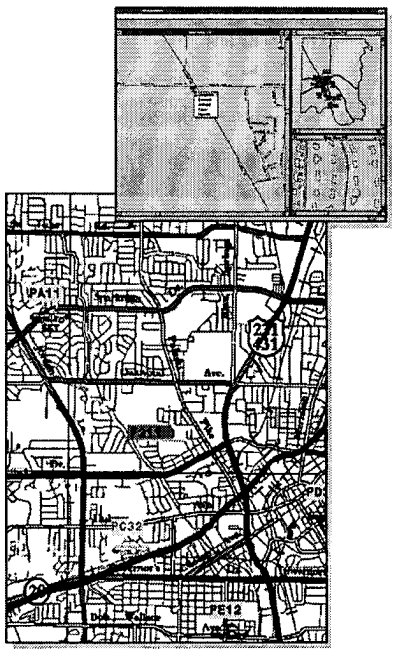
I/CAD combines sophisticated dispatching functionality and mapping by using one interface, one operating system, one database, and one hardware platform for the entire I/CAD System. In public safety terminology, I/CAD is a multi-agency system (for example, Police, Fire and Ambulance). While Utilities in general and Florida Power in

particular don't have "agencies", they may have groups of field resources with individual responsibilities. I/CAD may be used to coordinate the activities of these independent groups.

Other I/CAD features include:

- Screen forms and incident types that can be customized by agency and jurisdiction, and monitor displays that allow individual operators to personalize status, pending incident, and map display
- Multiple deployment (coverage area) strategies that can be mapped to shortcut commands
- Multiple roster and lineup information
- Incident copying for transfer of information to multiple agencies
- Location histories, hazard information, notes, and other data that are maintained and can be recalled, including building floor plans that can be retrieved and displayed
- Road closures that appear on the graphic display and that the system recognizes so that units are automatically routed around them
- Fire hydrants and utility poles, as well as gas, water, and sewer lines and locations that can be displayed as symbols on the map
- Database links to information relevant to any map symbol that can be accessed by simply clicking on the symbol
- Sophisticated address verification algorithms
- Call scheduling that can be applied to specific units, at appointed times, or both
- Unit and incident transfer between dispatchers, including transfer of ongoing TDD calls
- Unit recommendations that factor in current location, call type, specialized equipment or training requirements using a true street network, not an "as the crow flies" algorithm
- Extensive customer customization

7.4 Integrated Mapping



IPS understands that Florida Power Corporation has an ongoing project with the Lightstone Group that includes data that could possibly be used for the CAD Map. We also understand that the original source of this information was GDT. Maps generated using GDT data have been used for IPS CAD before, and are efficiently translated and loaded onto the I/CAD System and displayed on the dispatcher's screen to determine the location of an outage, event, or other reference location. The system can also determine the location and status of repair units.

For the sake of this proposal we will assume that the customer will provide a CAD-compatible map to IPS, and IPS will provide the services necessary to integrate that map with CAD. IPS has experience with this approach and believes that it provides the best solution with the least amount of redundant map maintenance effort. We are committed to providing the training services to the utility and system administration personnel to identify the special requirements necessary to make the map compatible with the I/CAD System. This training has been included in the cost of the proposed system. The I/CAD System maintains an integrity check on the use of the GIS data. All invalidated locations entered into the system are recorded in the database and a report of all inconsistent or new addresses is easily generated.

When the geofile and database are generated from the GDT data, the graphics and database information for the coverage area will be correct both in form (linework, intersections, area features, and symbols created and connected properly according to CAD requirements) and information (street names, address ranges, zip codes, and more). IPS will provide a document, if needed, that identifies the structure needed to be successful in a CAD map. This file will be the resultant street network file I/CAD will use for its "address verification" and "routing" utilities. It is the most important graphics and tabular layer to the dispatching system. It needs to be as complete and updated as possible, but will function as long as network and database structure is correct. Maintenance will continue on an on-going basis, and updates can be provided to the map using either the customer's or I/CAD's graphics and database editing tools.

The information in the table below is valid information that meets the minimum requirements of the I/CAD System, so there will be very little data content work that is necessary. It should be stressed that the following be true; however,

1. The CAD system will only verify addresses and locations and even streets that are contained within the graphics files and the database information tables. For example, if an outage call came in for "213 Topsail Court" and the address range on that road was only from "201-211 Topsail Court", the system would have no way of finding that address.

2. IPS has not provided cost for any time or services for updating and/or correcting the content of the data from which the CAD map will be derived. IPS has used the commercial GDT data in the past for accounts, and it is generally geometrically excellent, but database content and information is sometimes inconsistent. IPS fully assumes that Florida Power will be responsible for all map data provided for the system, and the attribution accuracy contained therein. IPS assumes that update work will be necessary on this data.

3. IPS also assumes that any other map data that may be needed or desired for reference (such as waterways and lakes, cartographic labels and text at all scales, and man-made landmarks and reference points) will be provided by the customer.

4. There are three services that IPS will provide as part of this proposal: an educational workshop to describe the information needed to run the CAD Map system, implementation time and services to verify and install the map in the CAD system, and training services to show the customer and/or map provider how to maintain this map data.

5. IPS makes an open offer to help the customer create, update, and/or maintain the map at anytime, particularly due to time constraints or data problems. IPS would price this amount of work at a later date.

The required columns are:

Feature Name	Column Width	Verbal Description	Column Type
FDPRE	2	Road Prefix	C
FNAME	30	Road Name	C
FTYPE	4	Road Type	C
FDSUF	2	Road Suffix	C
LEFTADD1	11	Low Left addr	C
LEFTADD2	11	High Left addr	C

ZIPCOLEF	5	Zip Code Left	I
RGTADD1	11	Low Right Addr	C
RGTADD2	11	High Right Add	C
ZIPCORGT	5	Zip Code Right	I

The attributed street network is the most valuable and necessary layer in the CAD map. There are many choices to be made about what attribution and graphics can be included above and beyond that information mentioned above. All data, such as railroads and hydrology to hydrants and building footprints, will make for a very complete, informative, and aesthetically pleasing map image as well. These additional layers will serve as feature references, that can be intelligent if they have the attribution, or purely visual reference for the operators if not. Informative (cartographic) text is another layer not to be overlooked. From the street level text to title or greater scale overview text, the operators will need a frame of reference from which to make geographic. (Any areas of parks, bodies of water, or other real obstacles to crew and equipment are also useful.) The customer will provide all of this information unless otherwise priced and discussed.

The Map Advantage

With systems that do not provide a map, calltakers and dispatchers often depend on personal knowledge of an area and memory to locate landmarks, street intersections, construction, and street closures.

I/CAD has the distinction of offering the first CAD system to integrate mapping to assist public safety calltakers, dispatchers, and supervisors in providing the most efficient and effective response to calls. Since its introduction in 1989, numerous CAD vendors have included an "interface" to a map as part of their dispatch system. However, IPS has gone far beyond providing a map that represents a graphic picture of an area; we provide an integrated and intelligent map that functions as part of the system and the user interface. Changing a unit's location or adding an incident, for example, automatically updates all map displays to reflect the change. Commands can be issued from the command line, the menu, or the map, and response lists that apply to multiple units can be mapped to single commands. The map also provides a source for additional, situation-dependent information.

There is no technical limit on the amount of information that can be displayed on the fully interactive, intelligent map. In addition to streets and highways, the map is capable of displaying building footprints, HazMat flags, power lines, rivers, lakes, railroad lines, and much more. Multiple windows can be opened and manipulated so that different areas and information sets can be viewed simultaneously. These intelligent maps are not just pictures on a screen—they are "smart" maps, encompassing features that include

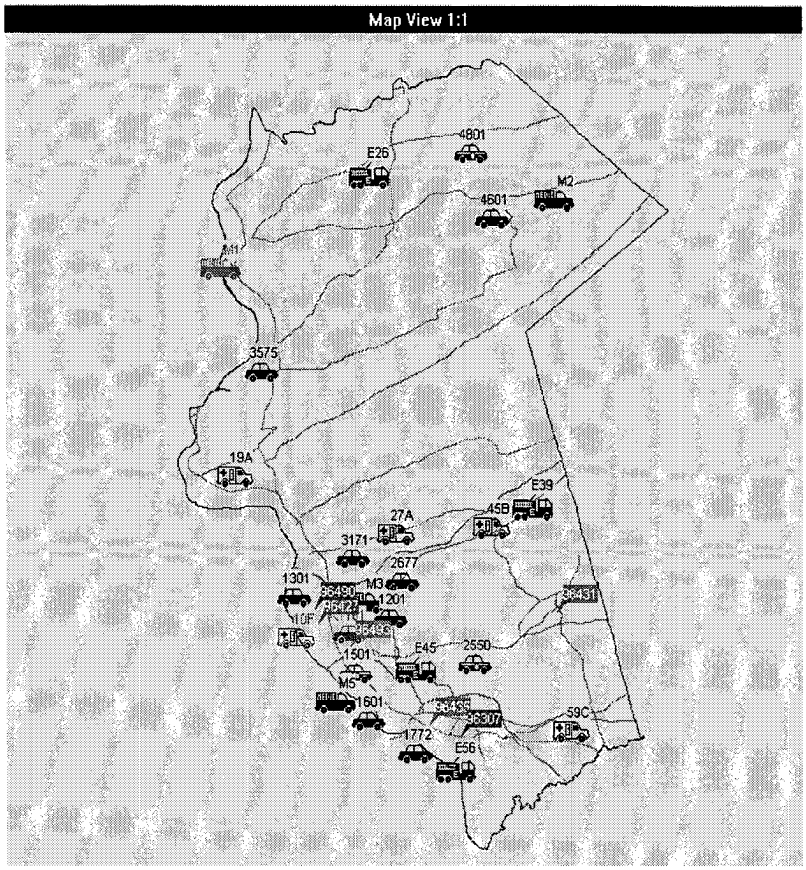
extensive database records that can be accessed for immediate data recall. Operators can scale map displays to any size and access information by simply pointing and clicking on map symbols. Using the street network, the system enables operators to route units to locations by the shortest time, shortest distance, fewest turns or intersections, and minimum risk involved while taking into account daily traffic fluctuations and the type of vehicle being dispatched. When a dispatcher closes a street, all map displays within the system update to reflect the closure, and units are automatically re-routed.

Individual operators control their map displays by zooming in or out and by turning levels of information on and off.

IPS has many customers who integrate mapping data from a GIS into the I/CAD System. While MGE, ARC/INFO, and MapInfo represent the most common data formats used by previous customers, other GIS vendor data has been successfully integrated into the I/CAD System.

It is understood that Florida Power will provide the required map data for the system, and that IPS is to use this information to generate the base map. Any unique information provided, such as special addresses, commonplace names, and unique identifiers for streets, will also be imported to the I/CAD System. IPS will support the initial map data translation/implementation and offer training for designated personnel on the workflow for future maintenance.

The following figure illustrates a typical Window containing a CAD map. Note that incidents and units are colored-coded to signify current status.


Map View 1:1
E26
4801
M2
4601
M11
3575
19A
E39
45B
27A
3171
2677
1301
M3
1201
M1
E45
2550
1501
M5
1601
1772
E56
59C

The map data structure is organized so that similar graphic elements can be placed on separate layers/levels and different types of graphic features can be separated into different files. For example, all transportation elements and related text may be in one file, but interstates may be on level one, primary roads on level two, secondary roads on level three, and alleys on level four. Related textual names may be placed on separate levels. Boundary graphics may be in a totally different graphic file, with municipal boundaries on level one, emergency service zones (ESZs) on level two, and response beats on level three, with their text separated as well. Reference data, such as drainage, fire hydrants, or vegetation, can be similarly separated. In this manner, file sizes and data response times are negligible compared to the capability of the software to display them.

Any graphic entity on the map can have an attribute record attached to it, and that record can be queried and reviewed. The database stores any information that the customer determines to be of value about each graphic entity on the map. In addition, the customer defines graphic symbols and default color schemes.

7.5 Map and Database Creation and Maintenance

IPS supports the following options for maintaining and updating the I/CAD System base map:

- Local GIS maintenance
- CAD department maintenance
- IPS service maintenance

For this proposal, we assume that Florida Power or its contractors will assume the responsibility for maintaining the data (that is, CAD department maintenance).

Local GIS Maintenance

If the initial map data comes from a local GIS department, then that department may continue to provide the Utility with regular updates. After the Utility's workflow is determined, IPS can offer guidance on selecting the necessary tools and developing the necessary skills to maintain data.

CAD Department Maintenance

IPS has many customers that update the CAD base map using the following tools embedded in the I/Executive software:

CADTools

The CADTools utility provides database geofile maintenance and support functions that assist the administrator in maintaining the graphic map and the database records associated with elements that comprise the map. This tool is specifically designed to work and interact with the I/CAD System as part of a complete package. With CADTools, the GIS administrator can define emergency service zones (ESZs), jurisdictional boundaries, beats, or even assign multiple names to a highway. The utility interfaces with the database and updates the database records as map-related commands are provided to support the following edits:

- Street segment
- Street intersection
- Address
- ESZ
- Geographic area
- Beat
- Traffic data
- Street names
- Feature symbols
- Special addresses

In addition to editing capabilities, CADTools provides a database verification component that helps to determine the location of potential problems in the map and its associated database tables. The following automated verification processes are provided:

- Street segments with no corresponding edges
- Street segments with no street names
- Street segments with invalid street names
- Street segments with undefined address ranges
- Street segments with no assigned municipalities
- Street segments with no assigned ESZ

Map and database updates are usually performed on a separate database, allowing normal dispatch operation to continue uninterrupted during map changes. Once updates have been completed and verified, the changes can be merged with the live system without disruption to service.

CAD Database Manager (CADDBM)

The CADDBM utility provides a GUI that allows a database administrator to manipulate I/CAD database records. Using CADDBM, the administrator can create new records in

the database and revise existing records. CADDBM also provides the mechanism for maintaining system security and administrator privileges. The following list summarizes the database maintenance functions supported by the CADDBM utility:

- Agency Definitions–such as police, fire, and EMS
- Deployment Plans–creates new beats or allows administrators to edit existing beats
- Disposition Types–defines the disposition codes used by the I/CAD System when dispatchers clear a unit
- Estimated Time of Arrival Table–enables the system to estimate times of arrival based on agency, dispatch group, hour of the day, and day of the week
- Lineup Definition–creates and maintains database tables that catalog available units and the personnel assigned to those units for each agency serviced by the system
- Number Table–defines the numbering schema used by the system to automatically assign case, incident, arrest, and accident numbers
- Out of Service Type–catalogs the non-active duty status types and associated overdue alert timers for each agency in the database
- Personnel–creates and maintains personnel records for employees of the various agencies serviced by the system
- Personnel (Limited Access)–allows personnel with lower security levels to update non-sensitive personnel records in the database
- Response List–creates the information used by the I/CAD Recommend Unit command and the Select and Recommend command to determine which units and how many units to recommend for a particular type of incident
- Roster Definition–creates and maintains duty rosters for various agencies
- Rotational Service Definition–assigns an identification number to a company and catalogs all of the equipment available at that company and, for each piece of equipment, lists the hours of availability by day of week
- Special Address Definition–cross-references and maintains database records of address locations that can be identified by a common place name
- Special Situation Definition–catalogs locations or areas of special interest
- Task Force Definition–groups several units into a single task force that can be dispatched using a single command
- Unit Definition–creates and maintains the database records for units belonging to each agency. A vehicle and employees are assigned to a unit. Thus a unit may be defined as a 4-person ladder truck, a 2-person patrol car, etc.
- Vehicle Definition–catalogs information for each vehicle assigned to an agency

IPS Service Maintenance

IPS maintains several customer databases and base maps to ensure that current information is in place. IPS will price this option at Florida Power's request.

7.6 I/CAD Security Administration

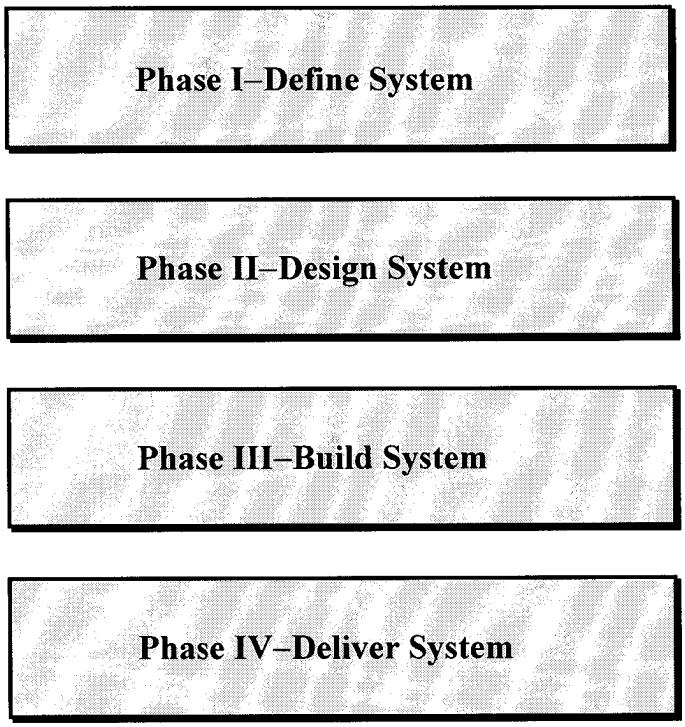
Within the I/CAD environment, security measures beyond those provided by the operating system can be instituted to restrict access to applications and commands by job function. For example, by requiring I/CAD user names and passwords, the security administrator can fine-tune I/CAD user privileges according to user types, such as a calltaker or a dispatcher. Dispatchers can further be divided into dispatch groups that provide access to resources and personnel assigned to that group but prohibit access to resources and personnel assigned to another dispatch group. Classifying users in this manner determines the commands and functionality available to the user.

8.0 PROJECT MANAGEMENT

Since 1989, IPS has installed more than 60 dispatch systems in the United States, Canada, England, France, Australia, New Zealand, Germany, and Thailand. IPS customers include the world's largest fire fighting authority, the world's largest naval base, and the world's busiest airport, as well as a shuttle space center, a military base, and two automobile clubs.

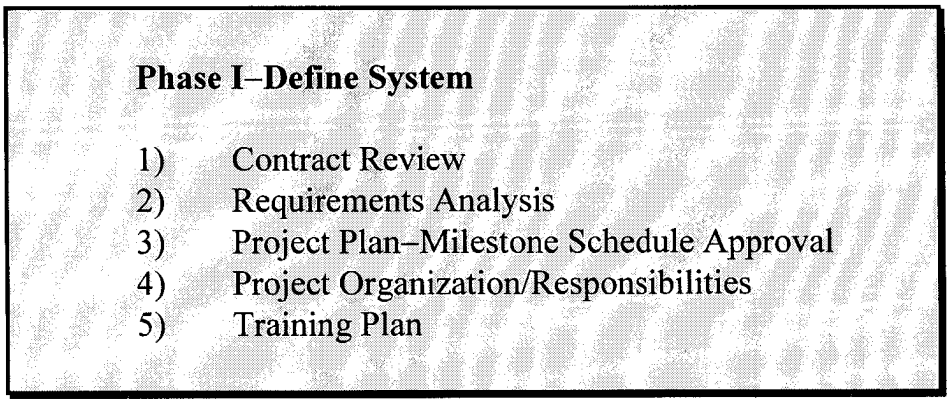
An Assessment Phase usually precedes any large project, and IPS considers this phase completed upon contract award. During the process leading up to award, the customer and IPS will have examined requirements, solutions, goals, objectives, feasibility considerations, risks and risk analyses, costs, and benefits. The negotiated contract will be the primary input into the initial project management plan.

IPS follows a 5-phased project management methodology, outlined in the following figure, to ensure that each dispatch system satisfies its mission requirements–on schedule and within budget. The five phases of the IPS project management methodology are incorporated into an Implementation Plan that includes the following general elements.



Phase I–Define System

The process of defining the system ensures that the operational intent and the proposal and contract, as written, are consistent. Key components of this phase may include, but are not limited to, the following.



1) Contract Review

The contract:

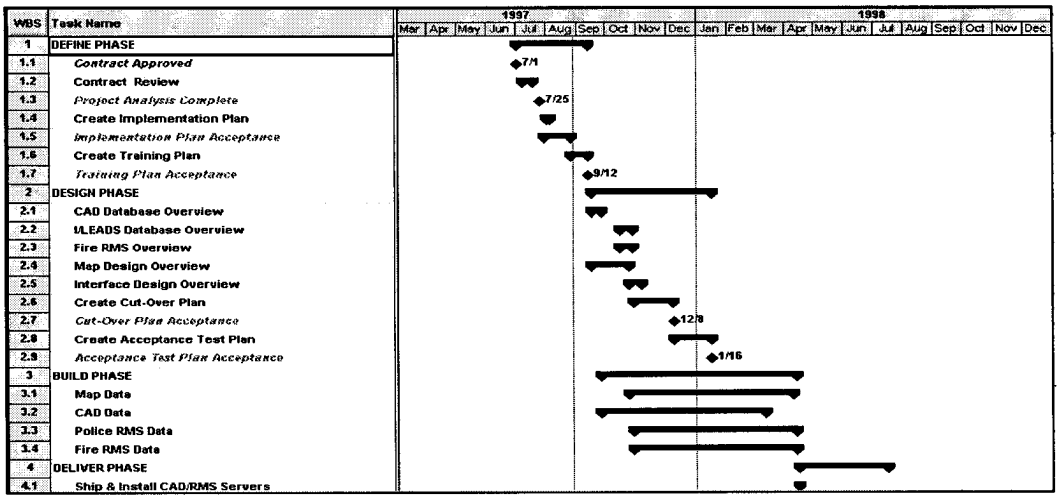
- Functions as the original statement of work reflected in the initial proposal and proposal addenda
- Documents specifically the work to be performed
- Establishes the conditions of work
- Sets the expectations for the system
- Is reviewed by the customer and IPS to ensure that the joint project team understands the requirements

2) Requirements Analysis

A system can be responsive to a given problem only if that problem is properly understood. Experience has demonstrated that most errors result from a misunderstanding of how the system should perform. The Requirements Analysis allows the project team to analyze functional, operational, performance, application, data, and interface requirements.

3) Project Plan–Milestone Schedule Approval

The project plan and milestone schedule is created/updated and expanded in accordance with decisions made during this phase. This document defines the baseline project description against which project direction and status are maintained. This deliverable is formatted in a GANTT chart similar to the one below.



4) Project Organization/Responsibilities

The following organizational charts define members of the project teams for each organization and show how the members of the customer team will relate to the IPS team.

IPS Project Team

a. Project Manager (interacts with b)
f. CAD Development Lead
g. Map Construction Lead (interacts with d)
h. Interface Development Lead
i. Implementation Support Lead (interacts with c)
j. Training Support Lead
k. Field Service Lead
l. Sales Support Representative

Customer Project Team

b. Project Manager (interacts with a)
c. System Administrator (interacts with i)
d. Map Lead (interacts with g)
e. Data Lead

The responsibilities of the team members are as follows:

a) IPS Project Manager:

- Directs the project as the primary contractor contact and is responsible for project performance from initiation to closure, which includes planning, organizing, managing, and controlling all aspects of the project to ensure that project tasks are performed according to schedule
- Reviews the final contract internally and with Florida Power's Project Manager

At project initiation, the IPS Project Manager:

- Coordinates the project kickoff between Florida Power and IPS
- Reviews the estimated project schedule
- Conducts an initial post-contract site visit/evaluation
- Identifies any known local scheduled events or seasonal celebrations that may impact the availability of customer resources during the project lifecycle
- Reviews any CAD custom development requirements
- Reviews CAD interface requirements
- Reviews non-CAD and subcontractor commitments
- Resolves any discrepancies or conflicts
- Reviews initial IPS work authorization reports and proposed parts lists to ensure compliance with final contracted project configuration
- Initiates project reporting and filing systems
- Conducts initial project implementation team meeting and project kickoff
- Establishes and maintains a network configuration diagram
- Establishes Florida Power's resources for IPS project management, such as work space, telephone, office and copying services, site access, and other communications, such as e-mail
- Establishes project change order procedures, which are controlled by the IPS Project Manager

- Conducts on-site evaluation to verify site preparation
- Resolves such training logistics considerations as schedules and classroom resources

On an as-needed basis, the IPS Project Manager:

- Responds to Florida Power's inquiries
- Obtains written customer clarification or change requests for interfaces and other custom development before establishing a development schedule
- Monitors critical schedules such as hardware delivery and custom development
- Processes requests for quotes
- Initiates contract change orders
- Monitors subcontractor commitments
- Conducts design review sessions between subcontractors and IPS personnel
- Monitors IPS commitments, such as map development
- Monitors Florida Power's trouble reports
- Coordinates IPS logistics for all on-site activities
- Researches alternatives and sources for any contract changes
- Visits the site with the customer to review and evaluate project progress

On a weekly basis, the IPS Project Manager:

- Updates IPS upper management
- Provides a general wrap-up of project activity to the implementation team members
- Monitors milestone payments/invoices and recommends that billing be initiated

On a monthly basis, the IPS Project Manager:

- Submits a monthly progress report to the customer
- Updates and submits any agreed-upon changes to the implementation schedule to Florida Power for approval

At project completion, the IPS Project Manager:

- Establishes a "punch list" of any incomplete requirements or unresolved issues
- Coordinates field service personnel to initiate ongoing maintenance contracts and agreements
- Closes out and resolves any customer concerns or problems

b) Florida Power's Project Manager:

- Acts as Florida Power's single point of contact for working with IPS

- Has sufficient authority and responsibility to make decisions on a day-to-day basis about the project
- Coordinates the activities of Florida Power's personnel
- Provides sufficient resources to implement the operational use of the system

c) Florida Power's System Administrator:

- Collaborates with the IPS Implementation Lead for system-specific training and implementation of backup, recovery, and archiving activities
- Monitors and configures the servers, workstations, and other interface systems
- Troubleshoots and files trouble reports as required
- Installs software upgrades
- Serves as a liaison for IPS field service personnel

d) Florida Power's Map Lead builds the graphics CAD map according to contract requirements.

e) Florida Power's Data Lead works with the IPS Map Lead and collects and verifies all agency-specific data (such as personnel, unit, and call-for-service data) for the system in conformance with information and direction provided by IPS.

f) The CAD Development Lead is responsible for all Florida Power-specific software development tasks related to the IPS CAD base product as defined in the contract.

g) The Map Construction Lead is responsible for the successful construction of the map data used by the I/CAD System. Specifically, this lead provides assistance in recommending procedures and providing tools necessary to construct the maps needed for the project in accordance with the level of effort proposed.

h) The Interface Development Lead is responsible for all software development activities related to system interfaces, including testing, installation, and support.

i) The Implementation Support Lead is responsible for providing the necessary technical expertise to implement the IPS project. This includes overseeing all system configuration activities, providing system administration training, supporting cutover activities, and installing the IPS system and related software.

j) The Training Support Lead provides the necessary instruction for the successful operation of the IPS system. The on-site standard system training courses taught prior to the I/CAD courses are provided by IPS trainers or

instructors or non-IPS trainers who depend on client-specific training requirements.

k) **The Field Service Lead** installs the hardware in the communications center and is responsible for the continued hardware maintenance and support services throughout the system's life, as long as the system is under a current maintenance contract.

l) **The IPS Sales Support Representative** ensures a smooth transition from pre-contract to project start-up.

5) Training Plan

This deliverable ensures that all of the purchased classes and modules are provided during the project. The training classes and modules are scheduled according to their appropriate phase of the project. For example, the classes for building CAD tables must be scheduled before Florida Power begins building the tables, and operator training must be scheduled to ensure a smooth transition to live operations. The training plan also restates and reviews the training methods (such as Train-the-Trainer) that have been selected. Additional considerations for the training plan include classroom resources and personnel scheduling.

Phase II–Design System

During the Design System Phase, the project team defines the system construction and configuration, which becomes the blueprint for the project. Key components of this phase may include, but are not limited to, the following.

Phase II–Design System

1) Acceptance Test Plan
2) Cutover Plan

1) Acceptance Test Plan

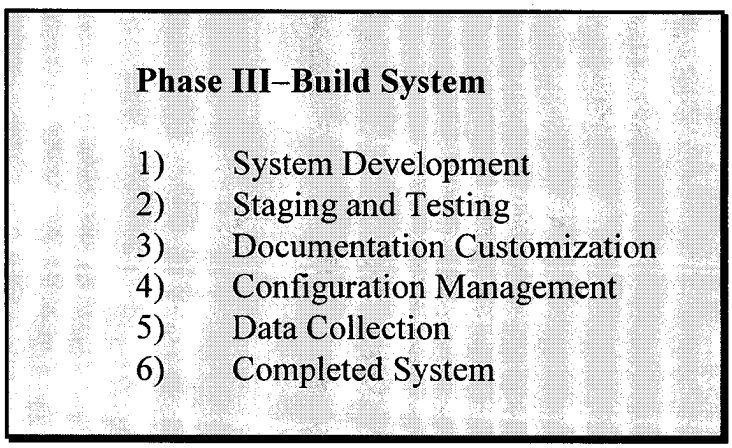
IPS supplies an initial draft of the Acceptance Test Plan, which is revised for the customer, then baselined. This plan defines the functional testing methodology for the project. It is important that a robust test plan be developed and exercised, and that the documented results of the test be accepted by Florida Power after a successful test. The test plan must originate with the development of requirements and culminate with the completion of the design. The tests exercised in the Build System and Deliver System Phases are as defined in the test plan, which ensures that everyone involved is measuring the system by the same ruler.

2) Cutover Plan

This deliverable explains how to place the system into live operation with minimal impact to any existing operations.

Phase III–Build System

During the Build System Phase, the project team gathers input and performs system configuration activities to support Florida Power's unique operational workflow. The database is populated and the map is constructed during this phase. Key components of this phase are as follows.



1) System Development

During System Development, IPS translates the requirements into usable hardware components, adaptable interfaces, and appropriate code. As noted earlier, the IPS breadth of off-the-shelf software makes this effort much easier and cost effective than a ground-up development effort.

2) Staging and Testing

Integration consists of staging the system, preparing the test platform, and testing the system. Together with development, these activities produce the required system.

3) Documentation Customization

Windows hypertext Help files are provided for all of the IPS CAD products, and these files become the baseline documentation.

4) Configuration Management

IPS builds the system in accordance with the configuration that has been defined. Configuration management includes not only maintaining baselined documentation, system configuration details, and baselined software, it also includes managing change. The IPS Project Manager is responsible for processing and maintaining change orders throughout the life of the project, and is also responsible for updating the initial configuration diagram provided with the proposal. By instituting an active configuration management process, IPS ensures

that the system development effort will move ahead, that critical baseline information is rigorously maintained, and that change requests are properly evaluated and effectively implemented when appropriate.

5) Data Collection

IPS works closely with customers to ensure that the data collection meets the system's requirements.

6) Completed System (Deliverable)

The Build System Phase culminates in the creation of the system.

Phase IV–Deliver System

During the Deliver System Phase, the system is tested and placed into live operations. The Acceptance Test Plan serves as a foundation for the system to be rigorously tested for correct operation prior to its actual use. Key components of this phase are as follows.

Phase IV–Deliver System

1) Operating Environment Creation
2) Training
3) Operation
4) Acceptance
5) Production System
6) System Acceptance Form
7) Cutover to Operations/Support

1) Operating Environment Creation

To create the system operating environment, IPS and the customer will:

1. Install the system
2. Establish the baseline operating environment
3. Set up the system with all product-related data, such as product administration accounts and product schema definitions
4. Initialize the system and bring it on-line according to the startup instructions

5. Load converted data and connect to any other external systems as required
6. Create, configure, and customize, as appropriate, the required user accounts

The system is now ready for customer acceptance testing.

2) Training

Although training will probably have started in the Build System Phase, completion of most of the required training will occur during this phase.

3) Operation

Although not necessarily in production, the system is now operational, and the next activity is acceptance testing.

4) Acceptance

The System Acceptance Test establishes that the system is ready to go into production. It is performed as documented in the previously developed Acceptance Test Plan. After it is complete, the customer can choose the timing for taking the system into full production use.

5) Production System (Deliverable)

This phase's deliverable is the installed, functional, tested, and signed-off system ready to go into production.

6) System Acceptance Form (Exit Criterion)

The exit criterion from this phase is a System Acceptance Test form that has been reviewed and approved by the customer and IPS.

7) Cutover to Operations/Support

After site acceptance, the development project is complete. The next step in the project management methodology is a transition to operations and support mode. This process normally begins after the System Acceptance Test or during the defined warranty period of the system.

Phase V– Maintain System

Maintenance is a vital part of any product and production system. Maintaining the developed system and providing a mechanism for expansion are both fundamental to maximizing the system's productive life. Key components of this phase are as follows.

Phase V–Maintain System

1) Project Wrap-up
2) Maintenance

1) Project Wrap-up

After customer acceptance, the procedures specified for project wrap-up complete this phase. Project wrap-up activities involve tasks that take place after System Acceptance but before the beginning of the Maintenance phase. Typical activities include:

- Resolving any system issues identified in a punch list at the conclusion of Acceptance Testing
- Verifying and documenting the final hardware and software configurations prior to initiating the Maintenance phase
- Resolving any outstanding invoices or credits associated with the project implementation
- Handing over the project to the Warranty/Maintenance organization

2) Maintenance

The IPS Project Manager begins this phase by reviewing the subsequent maintenance procedures with the customer. Maintenance personnel are available to address all questions about problems with the system. Calls for maintenance support go to the IPS Help Desk and are immediately handled by the support staff. The support staff analyzes the problem, and, if the problem is with the project-developed custom system, corrects the problem.

Regardless of the type of problem, there is a single organization, IPS, that is responsible for ensuring prompt resolution.

8.1 Project Management Conclusion

From initiation to completion of each project, IPS project managers employ:

- Project management procedures that form an IPS-customer partnership. This partnership ensures a mutual understanding and agreement of the tasks to be completed and the schedule to be observed. These procedures also require that the correct organizational structure for the project be established, that the proper resources for the project be identified and committed, and that the proper authority and accountability for the project be established
- Project planning methods that document the customer's expectations so that there are no false starts or wasted effort. The Project Plan-Schedule is maintained throughout the project, and it provides the baseline description against which project direction and status can be judged. The plan is also an outline for future work and can be used to minimize the impact of future changes
- Project control methods that synchronize the project with the contract. Good management control, deliverable product control, and technical acceptance reviews are the keys to successful project control. The IPS Project Manager will hold management reviews to help ensure that the project is properly focused on meeting the requirements and delivering a quality system. Deliverable product controls include internal reviews and configuration management and change control
- Project monitoring reviews, reports, and records. A complete record of the project's history will be maintained
- Project quality assurance (QA) techniques that orient the project team to produce a quality system during each phase, activity, and task of the project. The QA steps in the five phases provide formal opportunities for users to confirm the quality of the deliverables

9.0 SYSTEM IMPLEMENTATION WORKSHOPS

Upon contract award, the IPS Project Management Team immediately initiates implementation activities to ensure project success. Most of these activities are thoroughly covered in Section 8.0, Project Management.

However, during our years of experience in implementing the I/CAD System worldwide, IPS has designed two workshops critical to achieving smooth project implementation. Both workshops are conducted on-site and require the participation of Florida Power's Project Management Team members. The following subparagraphs delineate the purpose and member participation necessary to make these workshops a success.

9.1 The I/CAD Implementation and Configuration Workshop

The I/CAD Implementation and Configuration Workshop provides guidance to Florida Power's implementation team, serves as a starting point for the database and map creation phase, and is designed for leaders and decision makers who have day-to-day responsibility for making the communications center function properly. The main objective of the workshop is to define a functional plan for gathering data and implementing an operational (as opposed to technical) system. The plan will define participant responsibilities and tasks as well as designate milestones and significant dates. This workshop should be held early in the project–as soon after contract award as possible.

9.2 The I/CAD Data Model Workshop

The I/CAD Map Data Model Workshop, which is designed for Florida Power's CAD Implementation Team, focuses on effectively and efficiently building the I/CAD map and identifying the participation and relationship of IPS and Florida Power personnel in this activity. During this workshop, which should be held as soon after the I/CAD Implementation and Configuration Workshop as possible, IPS will define our understanding of Florida Power's CAD map requirements and responsibility breakdown as well as detail our understanding of IPS responsibility for translating the data to I/CAD format.

Other objectives of the workshop include:

- Outlining the technical map requirements for producing Florida Power's I/CAD map and communicating a basic understanding of their relationship to the functional I/CAD System
- Reviewing personnel, resource, and scheduling requirements impacted by the mapping effort

- Providing an overview of the workflow necessary to complete the map translation
- Reviewing the I/CAD database design and setup
- Describing existing map validation routines and process flows
- Discussing possible future enhancements

10.0 TRAINING

IPS proposes that initial CAD training be conducted by installing the hardware and software with a training dataset prior to cutover.

IPS offers complete training tailored to the customer's needs, which includes:

- Trainer or operator courses from IPS instructors
- Intergraph product and Microsoft product training from IPS instructors or Intergraph Corporate Training Services
- IPS-taught Microsoft Official Curriculum training for the Microsoft Windows NT platform and related dispatch server configurations. The IPS training staff maintains Microsoft Certified Trainer (MCT) and Microsoft Certified Professional (MCP) status; this ensures that IPS offers the best instruction available for the Windows NT operating system while orienting classes towards the dispatch environment
- ORACLE training provided from either Intergraph or third-party providers, such as local community colleges. In this case, IPS recommends that the customer select the ORACLE training program that best suits the needs and budget of Florida Power

The IPS course structure is modular, and the design of each course module is evaluated by the customer and IPS to ensure that the Training Plan objectives are met. In the past, IPS instructors, who customize their courses to meet different needs, have been required to develop flexible schedules, to provide specialized training in foreign languages, and to rely on their operational experience in emergency services to design training programs.

To meet the contract demands, IPS will establish an initial customer-driven Training Plan, then:

1. Train the designated Florida Power trainers, or
2. Train Florida Power operators, then
3. Create a Training Plan to be implemented at the center to fulfill ongoing requirements

10.1 Training Florida Power's Trainers

To establish in-house resources that can provide an ongoing training program, IPS recommends training designated primary Florida Power trainers. Following IPS-provided

training, Florida Power primary trainers can continue to offer the expertise, motivation, site knowledge, and resources to implement a higher quality of sustained training.

Specifically, in-house primary trainers enable Florida Power to:

- Train new personnel on an ongoing basis
- Implement and maintain a training dataset
- Develop site-specific Help files, training materials, and aids
- Implement refresher courses as required
- Implement new features or upgrade versions
- Diagnose and identify software problems
- Report software problems or issues related to application functions
- Evaluate and describe new feature requests
- Interact with the Intergraph Public Safety Customer User's Group

10.2 Training Florida Power Operators

The major challenge of providing an operator training approach is in conducting training sessions at the optimal time before cutover; the more operators to be trained, the more complex the logistical considerations that must be considered. A typical train-the-operator training session requires one instructor and takes one week to train 12 students (maximum number per session).

10.3 Creating a Training Plan

Training requirements vary widely, but the following courses are usually included in a plan.

10.3.1 Operator Training

Operator training courses include Introduction to Microsoft Windows NT, I/CAD I/Calltaker, I/CAD I/Dispatcher, and I/CAD Supervisor. The following subparagraphs provide general descriptions of these courses.

- **Introduction to Microsoft Windows NT**

  This course familiarizes users with the basics of the Microsoft Windows NT environment. Details of working with the GUI are covered, including the Desktop, Windows Explorer, and use of the mouse. Laboratory exercises are included to provide students with hands-on experience.

  - *Primary Learning Objective:* To become comfortable with Microsoft Windows NT terminology and the GUI
  - *Prerequisites:* Must be employed by a dispatch or governmental agency associated with the CAD system
  - *Who:* All operator levels, system administrators, mapping support personnel, database support personnel, and managers; class size limited to 12
  - *When:* All operator training should be completed two weeks before parallel operation or cutover. This course or its equivalent should be completed before attending the I/CAD I/Calltaker class.
  - *Duration:* 8 hours
  - *How:* On-site, hands-on workshop

- **I/CAD I/Calltaker**

  The I/CAD I/Calltaker course familiarizes personnel with the basic features of IPS workstations, terminology, forms, navigation, and event creation. Also covered are map use, utilities, and inquiries. Laboratory exercises are included with each module to provide additional experience in workstation operation.

  - *Primary Learning Objective:* To enter service requests into the I/CAD System and competently manage those calls
  - *Prerequisites:* Students must
    (a) be employed by a dispatch or governmental agency associated with the CAD system,
    (b) have knowledge of basic dispatch terminology, and
    (c) have knowledge or training in Windows NT
  - *Who:* All operator levels, system administrators, mapping support personnel, database support personnel, and managers; class size limited to 12
  - *When:* All operator training should be completed two weeks prior to parallel operation or cutover
  - *Duration:* 8 hours
  - *How:* On-site, hands-on workshop

- **I/CAD I/Dispatcher**

  This class expands upon the call taker course, emphasizing handling field units and personnel. Advanced map use, routing, utilities, and inquiries are also covered.

  - *Primary Learning Objective:* To dispatch service requests entered in I/CAD and to manage the calls and available resources
  - *Prerequisites:* Students must
    (a) be employed by a dispatch or governmental agency associated with the CAD system,
    (b) have knowledge of basic dispatch terminology,
    (c) have completed the calltaker course, and
    (d) have a working knowledge of, or training in, Windows NT
  - *Who:* Dispatchers and supervisors, system administrators, mapping support personnel, database support personnel, and managers; class size limited to 12
  - *When:* All operator training should be completed two weeks before parallel operation or cutover
  - *Duration:* 16 hours
  - *How:* On-site, hands-on workshop

- **I/CAD Supervisor**

  This course familiarizes participants with high-level CAD commands and report-writing utilities required to effectively supervise the daily activities of Florida Power's Outage Management operators.

  - *Primary Learning Objective:* To understand I/CAD system functionality and how it can best be used as a management tool
  - *Prerequisites:* Students must
    (a) be employed by a dispatch or governmental agency associated with the CAD system,
    (b) have knowledge of basic dispatch terminology,
    (c) have completed the call taker and dispatcher courses, and
    (d) have a working knowledge of, or training in, Windows NT
  - *Who:* Supervisors, system administrators, mapping support personnel, database support personnel, and managers; class size limited to 12
  - *When:* This training is offered on a request-only basis two weeks prior to parallel operation or cutover
  - *Duration:* 8 hours
  - *How:* On-site, hands-on workshop

10.3.2 Interface Training

Depending on the interface, this training includes courses on I/MDT, I/Mobile, and courses related to Florida Power specific interfaces. If offered with operator training, the interface must be installed prior to training time.

10.3.3 Unique Training Requirements

Unique training includes Administration of Microsoft Windows NT 4.0, Supporting Microsoft Windows NT 4.0–Core Technologies, and the I/CAD System Administrator course. We understand the Florida Power has a department with the necessary skills for Windows NT system administration but courses in I/CAD administration will be necessary. The information provided below describes these courses.

- **Administration of Microsoft Windows NT 4.0 (MS803)**

  This Microsoft Official Curriculum course is taught by a Microsoft Certified Trainer, and is intended for Florida Power personnel responsible for administering Windows NT Server and Windows NT Workstation. Course instruction includes management of accounts, account policies, disk resources, printers, servers, backups, configurations, and troubleshooting. This course provides students with the knowledge and skills necessary to perform post-installation and day-to-day administration tasks in either a single- or multiple-domain Windows NT-based network. This course can also help to prepare the student for certification in the Microsoft Certified Professional program.

  - *Primary Learning Objective:* To perform post-installation and day-to-day administrative tasks for a single- or multiple-domain Windows NT-based network
  - *Prerequisites:* Students must
    (a) be employed by a dispatch or governmental agency associated with the CAD system,
    (b) have completed the Intergraph Corporate Database and Mapping Classes,
    (c) have completed the Introduction to Windows NT course, or have equivalent knowledge of the Windows NT graphical user interface, and basic computer terminology
  - *Who:* System administrators, mapping support personnel, database support personnel, and trainers; class size limited to 5
  - *When:* This training should begin prior to operator classes, should be given in conjunction with the map building and data loading phase soon after hardware is delivered on-site; this course is taught on a request-only basis

- *Duration:* 24 hours
- *How:* On-site, hands-on workshop

- **Supporting Microsoft Windows NT 4.0–Core Technologies (MS922)**

  This Microsoft Official Curriculum course is taught by a Microsoft Certified Trainer and is intended for support professionals who install, customize, configure, and support Windows NT Workstation and Windows NT Server, version 4.0. This course provides the core foundation necessary to support the Microsoft Windows NT, version 4.0 operating system. In addition to the regular Microsoft curriculum content, this course is tailored to include configuration and support issues specific to the I/CAD System. This course can also help to prepare students for certification in the Microsoft Certified Professional program.

  - *Primary Learning Objective:* To install, configure, customize, optimize, network, integrate, and troubleshoot Windows NT 4.0
  - *Prerequisites:* Students must
    (a) be employed by a dispatch or governmental agency associated with the CAD system, and
    (b) have completed the Administration of Microsoft Windows NT 4.0 (MS803) course
  - *Who:* System administrators; class size limited to 5
  - *When:* This training should begin prior to operator classes, should be given in conjunction with the map building and data loading phase soon after hardware is delivered on-site; this course is taught on a request-only basis
  - *Duration:* 40 hours
  - *How:* On-site, hands-on workshop

- **I/CAD System Administrator**

  This intensive course is designed for those who are responsible for the administration, management, or support of an I/CAD System.

  - *Primary Learning Objective:* To perform the basic functions associated with the day-to-day operation and support of a dispatch system
  - *Prerequisites:* Students must
    (a) be employed by a dispatch or governmental agency associated with the CAD system,
    (b) have completed the Intergraph Corporate Systems, Database, and Mapping Classes
  - *Who:* System administrators, mapping support personnel, database support personnel, and trainers; class size limited to 5

- *When:* This training should begin after the above prerequisite courses, prior to operator classes, and should be given in conjunction with the map building and data loading phase; this course is taught on a request-only basis.
- *Duration:* 40 hours
- *How:* On-site, hands-on workshop

10.3.4 Facility and Resource Logistics

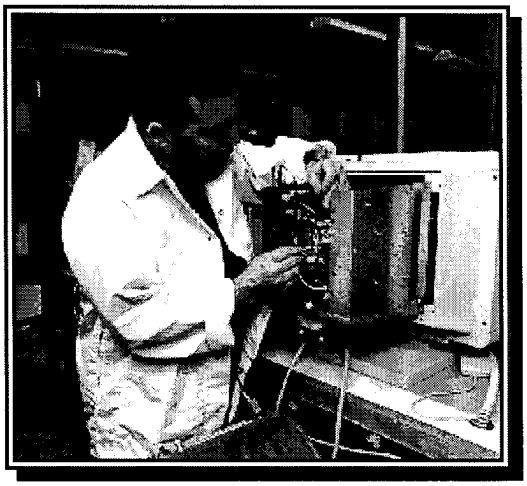
Based on detailed discussions with the client, the Training Plan will specify:

- The information to be included in lesson plans, course handouts, and laboratory sessions
- Training locations
- The equipment required for training, specifically: the data shell, overhead projectors, whiteboards, and workstations
- Trainers' access to Florida Power's training facilities before and after classroom hours
- How to minimize or avoid classroom interruptions

10.3.5 Tentative Schedule

The IPS Project Manager will include tentative scheduling options in the Training Plan, as well as in the Implementation Plan. These options can include multi-shift and flexible training sessions of 4, 6, and 8 hours at a time. IPS schedules courses so that the participants are primed for their actual duties. For example, operator training is conducted just prior to implementing parallel or cutover operations.

11.0 WARRANTY AND MAINTENANCE



IPS understands that warranty, maintenance and support for Dispatch systems must necessarily be different from that provided by the general computer hardware and software industries. Response to a problem must be timely. IPS has structured a warranty and maintenance program to provide a corresponding increase in level of service, beginning when it is needed operationally, and continuing indefinitely under a maintenance program.

Ongoing support from IPS is meaningful, when continuous operations are essential. We provide total support from a single vendor on every issue—a single source to address all problems. And, when such a service is obtained, it is clear who is responsible for problem resolution—IPS. IPS provides warranty, maintenance, and support for all products purchased from IPS.

For products not purchased from IPS, but that are included as part of the system, IPS will work together with the customer and the other vendor to resolve any issues, with each party having warranty, maintenance, availability, and response time responsibility for that part of the solution provided.

Approach

The IPS approach is to provide a non-mission-critical industry level of service up to the point of cutover to live operations. Prior to cutover, timely responses and resolution are required but not at the command-and-control mission-critical level. When the system is in productive operation, an increased level of support compatible with both the needs and budget of the customer is appropriate and required.

The components of this service are hardware, IPS software, third-party products, and total system support. These components must be addressed under the warranty and as ongoing maintenance that begins at the end of the warranty period. All these components must be addressed relative to cutover to live operation. The following table addresses them in this manner.

	Start Date	End Date	Includes	Response
Warranty				
Hardware	At installation	Year 1	Parts and Labor	Next Business Day
		Year 2	Parts and Labor	Return to factory
		Year 3	Parts and Labor	Return to factory
IPS Software	Begins at cutover	90 days after cutover	Fixes and Features Releases	Covered by system support
Third-Party Products	Pass through from the manufacturer	Pass through from the manufacturer	Pass through from the manufacturer	Covered by system support
System Support	At contract	90 days after cutover	Help Desk – single point of call	Critical - 7X24
				Other - Next day
Maintenance				
Hardware	Cutover	Continuous by annual contract	Parts and Labor (Labor is per call after hours)	7X24 with 8-hour response availability
IPS Software	90 days after cutover	Continuous by annual contract	Fixes and Features Releases	Covered by system support
Third-Party Products			Upgrades provided by customer	Covered by system support
System Support	90 days after cutover	Continuous by annual contract	Help Desk – single point of call	Critical - 7X24
				Other - Next day

When required, a longer warranty may be purchased, as part of the initial contract, in the form of additional maintenance. The maintenance program is designed to provide the equivalent service. The extended warranty may be purchased in increments of three (3) months with the same level of service as defined for Maintenance, above. IPS has many customers that prefer to purchase coverage through the first year after acceptance, as part of the initial contract.

System Support

To meet the requirements of mission-critical dispatch operations, IPS system support provides 24-hour-a-day/7-day-per-week software support for critical problems to all IPS customers. System support begins at contract signing and continues through the warranty period and then into the maintenance period if a maintenance contract is obtained. IPS provides the central point-of-contact and the first level of direct support for all products purchased from IPS as part of the contract. This includes IPS software, the operating system, database management system, development tools, report writers, productivity tools, networking software, and external interface software.

The pricing of system support is not a separate line item. System support is included in the pricing for the software component.

IPS Software Updates and Upgrades Included

IPS software maintenance coverage is excellent. IPS provides scheduled Fixes Releases and Features Releases, including the documentation, which is often an additional cost from other vendors.

- A Features Release is a major release of software that contains significant product enhancements and improvements designed to improve system operations. IPS encourages all customers to stay current with Features Releases. While doing so takes customer resources and effort, across time the IPS customer will stay up-to-date technologically and functionally and delay, if not completely avoid, the need to repeat the procurement cycle to get up-to-date

- A Fixes Release is a minor release of software that contains, primarily, error corrections. A Fixes Release may also contain limited improvements that do not affect the overall structure of the software. Fixes Releases of software are generally provided at 6-month intervals, and all customers are encouraged to stay current with Fixes Releases

When an IPS customer purchases software maintenance at the end of the warranty period, the customer continues to receive IPS product upgrades (with the appropriate license) to those products at no additional cost. Upgrades are not included for mass-market (commodity) products, including Oracle, Windows NT, Microsoft Office, ODBC Drivers, Microsoft Visual C++, and Microsoft Exchange. Purchasing commodity upgrades is the customer's responsibility, but IPS will continue to support the products through the maintenance agreement.

The IPS software releases are tested and certified before being released. These releases are the same as those that will be delivered to new customers.

An upgrade consists of delivery media, license, and documentation. Customers may implement these releases without assistance from IPS, or they may purchase implementation services to assist in the installation of the new release. Implementation services are priced when requested by the customer. The customer may also elect, at anytime, to purchase existing or future products not included in this proposal.

The product version for the upgraded IPS products is not time-critical and does not normally require product upgrades to coincide with third-party releases of the operating system, database, and other products. Third-party products continue to run on the next version of the operating system and with existing applications. In many cases, vendors do

not make new versions of products available at the same time the operating system is released. As a matter of policy, IPS waits to assess the stability of new products before committing to them for mission critical systems.

IPS provides compatibility in new versions of IPS software with existing versions of mass-market products, and plans to provide compatibility and new features consistent with new versions of the mass-market products and the operating system.

Software Problem Reporting and IPS Response

Support is the process by which the customer reports errors and IPS responds. Before reporting any problem, IPS requests that the System Administrator conduct a preliminary error review to verify a problem's existence and attempt to determine if the problem is with the hardware or software; then, the circumstances under which the problem occurred should be documented. The System Administrator should also attempt to duplicate the problem and attempt to determine the priority level of the problem before contacting IPS.

There are four levels of priority for reported problems:

Priority One: Critical *Reflects a problem that causes loss of data, data corruption, or prohibits productive execution of the I/CAD System, and for which no workaround is available*
Priority Two: No Release *Reflects a problem causing the primary purpose or productive execution of the I/CAD System to be significantly impacted, but not prohibited, and for which a workaround is generally not available. Priority Two problems include aborts, but not loss of data or data corruption*
Priority Three: Normal *Reflects a problem causing the I/CAD System to produce incomplete results. Priority Three problems do not include aborts, do not impact productive execution of the system, and workarounds are generally available*
Priority Four: Minor *Reflects a problem related to a function that is not a major requirement for I/CAD System execution and for which a workaround is generally available*

Any problems reported to IPS between 8:00 a.m. and 5:00 p.m. CST are responded to immediately by qualified personnel who staff a HelpDesk, ensuring that any customer problems are addressed immediately. The IPS HelpDesk personnel are able to perform the following functions remotely:

- Software diagnostics
- Database diagnostics
- CPU monitoring and diagnostics

- Memory usage and performance monitoring
- Operating system parameters analysis and diagnostics
- Remote downloading of software (fixes and features releases)
- Immediate response to calls

The I/CAD System includes a telephone modem, allowing IPS personnel to access system to perform remote diagnosis, verification, and correction of system problems. Access to the system via modem is completely under the security controls imposed by the customer. IPS agrees to work within the security framework for all access to the system.

After normal working hours and on weekends and holidays, response is provided by trained personnel who are available via digital pager. These support personnel have dial-in modem access to the system and can usually quickly isolate the problem. If, in working a problem, IPS deems that on-site software support is necessary, IPS will provide this.

Each error priority level, described in the table above, defines the actions that will be taken by IPS for Response Time, Resolution Time, and Resolution Procedure. The customer shall assign an initial priority level for each error reported, either verbally or in writing, based on the conditions described in the table above. IPS shall notify the customer of any upgrading or reducing of a particular error to a different priority level, if after examining the problem there is reason to do so.

Priority One and Two problems, which have no discernible workaround, are escalated to IPS upper management for resolution guidance. Skilled personnel will be assigned to aggressively address the problem until a resolution is found. Responses and resolutions for other problems are shown in the table below.

PRIORITY	RESPONSE TIME	RESOLUTION TIME	RESOLUTION
ONE: CRITICAL	Immediately during weekday hours of 8:00 a.m. and 5:00 p.m. CST. Within 30 minutes of notification after 5:00 p.m. CST	Within 12 hours of the notification	Program code correction or a procedure to work around the error condition
TWO: NO RELEASE	Immediately during weekday hours of 8:00 a.m. and 5:00 p.m. CST. Within one hour of notification after 5:00 p.m. CST	Within 48 hours of notification	Program code correction or a procedure to work around the error condition
THREE: NORMAL	Immediately during weekday hours of 8:00 a.m. and 5:00 p.m. CST. Within eight hours of notification after 5:00 p.m. CST	Resolution in a future Fixes Release	Program code correction
FOUR: MINOR	Immediately during weekday hours of 8:00 a.m. and 5:00 p.m. CST. Within two days of notification	Resolution in a future Fixes Release	Correct software or document as a permanent system limitation or restriction

Maintenance Plan Information

The proposal is for the level of service proposed in Plan 2 below. This is a plan that shares responsibility between the customer and IPS. Plan 1 can be provided, instead of Plan 2, for those customers that have access to existing hardware maintenance resources or maintenance contracts. Customers that desire IPS to train them to do their own hardware maintenance can also use it. The plan is oriented toward customers who want to supply more service themselves, and provides ongoing maintenance at a reduced cost.

Plan 3 below moves toward IPS providing more service through a plan that includes a resident engineer to assume more responsibility.

The following paragraphs present the three maintenance plans available from IPS. Plan 2 is priced and proposed. Pricing for Plan 1 or Plan 3 will be provided, if either is more attractive.

Plan 1: Customer Provided Hardware Maintenance

For equipment that is out of warranty, a per-call maintenance plan is available. Because of the system's reliability, open architecture, and modularity, many customers choose this plan in combination with a self-maintenance program. Under this plan, IPS will structure a self-maintenance agreement customized to the customer's requirements and will provide, on request, a training plan and prices for training personnel to maintain the equipment.

The proposed system architecture uses industry-standard, PC-based technology and is supportable by most third-party maintenance suppliers. The system architecture also allows any hardware component to fail without affecting the total system's capability to continue to provide dispatching service. If a server fails, the redundant server continues

to provide full functionality and the failed server is taken off-line. If a workstation fails, the other workstations can continue to provide service. This architecture allows remedial maintenance to be performed during the standard workday schedule without the expense of 24-hour-per-day/7-day-per-week personnel. The most expensive component of any maintenance program, particularly a 24-hour-per-day/7-day-per-week program, is the cost to provide continuously available personnel.

Plan 2: Full Service Maintenance Contract

IPS has proposed and priced a Full Service Maintenance Contract for a guaranteed response 24 hours per day, 7 days per week. This covers all replacement parts and labor charges within normal business hours for as long as the maintenance contract is in force. On-site response to calls for service outside of normal business hours will incur an additional charge at the current per-call rate. The maintenance costs associated with this level of support primarily reflect the cost of the personnel required to be on standby and backup to provide an immediate response to system hardware problems 24 hours per day, 7 days per week.

The plan provides for remedial on-site maintenance, including:

- Guaranteed call-back response times for major system malfunctions
- Guaranteed call-back response times for minor system malfunctions
- Mandatory Engineering Change Order (ECO) implementation
- Preventative maintenance
- Unlimited telephone calls to the IPS HelpDesk
- Help Desk point-of-call support

The nearest Intergraph hardware support office is located at Suite 100, 5405 Cypress Center Drive, Tampa, Florida.

The pricing for Plan 2 may be adjusted based on the requirements and budget of the customer. The Pricing Section has the pricing for Plan 2 with 7X24 response. IPS can provide a quote for a different level of service on request.

Plan 3: Resident System Maintenance

With the Resident System Maintenance Plan, the costs for a resident can be cost-effective when combined with normal maintenance costs. IPS passes any IPS reduction in the cost to provide maintenance by providing a resident at less than the normal cost of a person.

The Resident System Maintenance Plan represents the highest level of support available from IPS. In addition to providing hardware maintenance, it also provides for system software support and application system support. Additionally, rapid response to any

hardware, software, or system problem is available 24 hours per day, 7 days per week. Regardless of the nature of the problem, the Resident System Engineer will provide an initial response within 30 minutes and arrive on-site within one hour to correct any major problem that may cause an interruption of service.

Although the configured, industry-standard, Intel Pentium-based workstations and database servers are designed to provide uninterrupted operation, the failure of a system component can cause undue operational problems. These problems can be prevented or quickly remedied by the Resident System Engineer. Furthermore, the Resident System Maintenance Plan is an extremely cost-effective plan that is designed to provide round-the-clock maintenance, system availability, and an unparalleled depth of complimentary corporate support and expertise. Over its 29-year history, Intergraph has earned a distinguished reputation for customer support and maintenance that has become the industry benchmark.

Maintenance Plan 3 focuses on operational support and maintenance. The proposed system is based on a highly interactive, client/server architecture. The system relies on a local area TCP/IP network, is communications-intensive, and employs a sophisticated Oracle distributed database management model. With the Resident System Maintenance plan, a highly trained Resident System Engineer will be provided, ensuring continuous operational support of the system. The System Engineer will be skilled in all facets of hardware maintenance, system software management, database administration, application engineering, and network management. The System Engineer will also be responsible for providing operational support, system administration, and management of the I/CAD System 24 hours per day, 365 days per year. IPS resources will continually support the System Engineer in solving complex problems or providing remote support. Any extended absences will be filled by a qualified temporary replacement. Additional responsibilities of the on-site System Engineer include performing first line hardware maintenance by replacing a failed component with an on-site spare component. IPS believes that the described dedicated support can be prudent for continuous mission-critical operations, whether IPS or the customer provides it. The Resident System Engineer can:

- Provide a single point-of-contact for all hardware, software, communications, interfaces, configuration, and general support issues
- Manage, administer, and maintain the I/CAD System, ensuring continuous calltaking and dispatching operations
- Develop and implement a disaster recovery plan, ensuring continuity of calltaking and dispatching operations in the event of individual component failure
- Perform periodic testing of the I/CAD System's contingency and back-up plans and procedures

- Manage the security and access to the I/CAD System
- Develop and maintain the I/CAD System's support operating procedures
- Perform routine, daily operational tasks for remedial and preventative hardware maintenance
- Perform the first level of hardware maintenance, including using diagnostic tools to isolate problems and replace defective components to minimize downtime
- Provide the interface with the IPS second-level hardware maintenance engineer to expedite on-site support and to effectively manage all "return-to-factory" component repairs
- Perform routine, daily operational tasks applicable to software maintenance, such as purging system log files
- Perform the scheduling and administration of the backup and recovery of data and configuration files
- Monitor system loading and provide advice on efficient use of hardware and software
- Monitor system performance, tune the system for peak performance, and generate system performance reports
- Perform I/CAD System capacity planning studies
- Install and administer Windows NT software and utilities
- Administer user accounts and passwords
- Manage the network, including assigning TCP/IP addresses and monitoring network activity
- Perform Windows NT and application software upgrades, including training for the I/CAD System Administration staff
- Maintain I/CAD System documentation
- Administer the I/CAD database, including database recoveries, regular data integrity and consistency checks, and database upgrades
- Document any I/CAD System anomalies for inclusion into periodic site reports
- Manage any system problem reports using the Intergraph Fault Tracking System database
- Provide the interface to the IPS product development process to promote future software features to enhance operations
- Manage the interface with a map maintenance organization or supplier
- Provide map maintenance address verification failure reports

- Install and verify proper installation of map upgrades
- Provide custom management information reports, as needed, on events, calls for service, unit assignments, and operator workload

The System Engineer will work for and take day-to-day direction from the customers management and will maintain an on-site office.

The price for a resident will include negotiated spare parts, which avoids delays waiting for parts. As an example, a spare workstation will allow any component of a workstation to fail. The engineer can just swap machines, and allow the customer to continue operation, while the failed machine is being repaired. Depending on the location of the customer, spares could be an attractive option. This should be a valid consideration even without a resident.

APPENDIX A
MOBILE WORKSTATIONS

Intergraph Public Safety (IPS) has chosen L&E Mobile Computer Mounts, Inc. (L&E) as the supplier of mobile computers, modems, mounts, and installation for the Outage Management System proposal. In surveying suppliers for this equipment, we received direct recommendation of this supplier from Panasonic and their distributor MicroAge.

IPS will assume the complete responsibility to Florida Power for the implementation of the mobile computing environment. IPS will configure the mobile computers with all required software, test the computers, and work with L&E to install the computers in the vehicles. IPS will be the first line of support for all issues for the mobile computers. IPS will also be the point of contact for maintenance for the mobile computers. This proposal includes 10 additional mobile computers for use as a maintenance pool. IPS will assume full maintenance responsibilities.

Company Background

L&E is pleased to offer Florida Power a turn-key solution to mobilizing your communication systems. Our catalog highlights the best in mounting equipment for voice and data communication that is made of 3/16-inch electrostatically powercoated steel. For safety, all edges are milled and corners rounded. The design allows installation in minutes without drilling or modifying the vehicle. Our radio brackets are universal and simple to install and adjust. The system is air bag friendly when properly installed. The simplicity and strength of our design provide a margin of safety unsurpassed in the industry and ease of installation that saves you time and money.

From Consultation to completed installation, L&E can offer the value-based capabilities necessary for mounting your computer and other communication systems in your vehicles. L&E Emergency Equipment & Supply, Inc. started as a company dedicated to the emergency service field. L&E Emergency specializes in the lights, sirens, and most other equipment necessary for the conversions of emergency service vehicles in police, fire, ambulance, and towing fields. As part of this company, the manufacturing and supplying of equipment mounting systems was necessary.

As a result of the increased market for mobile computer mounts and the vast experience that L&E Emergency had acquired in the industry, L&E Mobile Computer Mounts, Inc. was formed. Taking with it the experience of the parent company, L&E Mobile is dedicated to the "integration" of turn-key solutions of

mounting communication systems and computers into vehicles. We are suppliers of vehicle computers, software, docking stations, mount systems, communication equipment, antennas, cable, power distribution centers, and our newest product "Voltage Armor" units nationwide.

Our latest product is ***the Complete Locking-Docking Station designed for the PANASONIC CF-25 Computer***. It includes a Built-In Port Replicator, Locking-Docking Tray, Tilt & Swivel Mechanism, and 12 Volt DC Power Supply. It comes completely assembled.

What makes L&E unique is that, not only are we suppliers of state-of-the art in computers to hardware, but our reputation for being ***"The Best Technical Installers"*** is supremely established. L&E maintains an installation facility outside of Philadelphia, with secured storage space for 200 vehicles. Also, with our unique mobility staff, we can travel anywhere in the United States and do first class work for you.

L&E is a young, aggressive company, with old fashion "work ethics", that make your communications mobilization as simple a process as it should be. We look forward to having the opportunity to further discuss what L&E can do for your company.

L&E will travel from Philadelphia, Pennsylvania with a Project Manager/Technician and professional Installers to the specified Utility Location. Pricing is configured at a minimum of 300 vehicles. L&E will install customer-supplied Panasonic CF-25 Computer, Docking Station, CDPD Modem with GPS, Antenna and Mounting Equipment in various specified International Harvester Small 3-Ton Vehicles with Buckets. L&E will pre-build wiring harnesses/mounts in Philadelphia and will travel to do installations of an estimated 10+ vehicles per day scheduled consecutively to minimize time vehicle taken out of service. Price is figured on a per vehicle basis, which includes all travel and living expenses of L&E Technicians.

L&E will provide the following equipment to this project:

1. **L&E** will supply a ***Panasonic CF-25, Mark III Laptop Computer, #CF-25LJF8EAM***, with Pentium 166MMX, 32MG, 2.2GB, 12.1" TFT Color Screen with Anti-Glare Option, 10x CDROM Module, 3-year warranty.

   Or Available*: Panasonic CF-25, Mark II Laptop Computer, #CF-25EGC4DAM/CF-VCD252,* with Pentium 133, 32MB, 1.35GB, 10.4"TFT Color Screen with Anti-Glare Option, 10x CDROM Module, 3-year warranty.

2. **L&E** will supply a **Utility Mount, LE-B-LIL**, with Powdercoated Steel Flat Floor/High Seat Mount Base with an extended Top Plate.

3. L&E will supply the ***Complete Panasonic DV-25 Locking-Docking Station*** with built-in Panasonic Port Replicator, 12 volt DC-to-DC Power Supply, CF-25 Locking-Docking Tray and Tilt/Swivel Device, 3-year warranty. (This docking station will mate to any type of mounting equipment you will select.)

4. **L&E** will supply the ***Voltage Armor Units*** with programmable On/Off Device from 15 minutes to 15 hours. These units give added protection to low- and high-voltage spiking, and reverse polarity protection.

5. **L&E** will supply the **Sierra Wireless *CDPD Modem with "GPS", Slide Tray* Mount *Kit, Serial Cable and Hard Mount Antenna.***

6. **L&E** will supply the a **Wiring Harness** for each vehicle for installation project, which includes all cable, wiring, fuses, connectors, etc.

L&E will also provide the services to install this equipment including:

- All power wire to supply the Panasonic CF-25 Computer Unit (20 AMP Service)
- All Power connectors
- Fusible Link (20 AMP)
- Standard Length Computer Cables (shelf items)
- Mount and Wire Panasonic DV-25 Docking Station
- Mount and Wire Voltage Armor Unit
- Mount and Wire Antenna
- Mount and Wire CDPD Modem, GPS antenna, and Slide Mount Tray
- Run all connecting wires to Antenna, Modem, and Voltage Armor Unit
- Mount all Vehicle Mounting Equipment
- Test Equipment/Function (Power To Unit, Modem To Transmit)

L&E's Project Manager will work with the IPS Project Manager and the Florida Power site supervisors to devise a mutually workable schedule for installations. They will work out a complete schedule for day-to-day installations with your staff. They can offer extended work hours if you desire, in an attempt to get the installations done in a shorter amount of time. Once we are out of town on a job, they are quite flexible with regard to working hours.

Following each week's installations, IPS will provide Florida Power a report giving the specific vehicle, and services provided including:

- Vehicle ID, Model, Year, and Serial #
- RF Modem Tag, Serial No. & IP Address
- Results of Modem Test: Signal Check, Registered, Approval Code#
- Installation Set: Visual and Functional Checks for Computer, Docking Station, Voltage Armor, Filter, Wiring, Antenna, Connectors
- Report of any problems, resolutions, and comments

*Please note: all vehicles scheduled for installation will be clean of ALL utility property, driver property, and trash prior to installation. The cleaning should be concerned only where the Installation Team will be working in the vehicle. If not, a $25.00 Fee will be added for that vehicle.

L&E requires that:

1. L&E requests all mounting hardware to be at L&E Mobile Computer Mounts, Inc. three (3) weeks prior to Installation Date (including mounting equipment, docking station, voltage armor, CDPD modems) for advance mounting preparation & wiring on Installation. ***(The advance preparation done in our Philadelphia Facility, then requires your vehicle to be out of service for only a short period of time, for the final install stage when organized as L&E prefers to do a job.)***

2. L&E will receive written notification schedule of vehicle type and quantity at least two (2) weeks prior to Installation, should vehicle type change.

3. All vehicles scheduled for Installation be in "Running Condition".

4. Each vehicle will be cleaned so that the Installation Team can have free access to required areas necessary to complete Installation.

5. L&E be provided with a Garage Facility area able to hold a minimum of two (2) vehicles or more, so that Installation can be completed in a timely manner.

6. The provided Garage Facility be heated and have electrical outlets to supply 110 volts and 20 amps. of service.

WORKING HOURS SCHEDULED PRICING:

L&E will be working on an eight (8) hour work schedule that conforms to all State and Federal Employment Laws. This "PRICE QUOTE" reflects a workday of

eight (8) hours starting between the hours of 8:00 a.m. and 11:00 a.m., Monday through Friday. If more convenient, L&E will be available for extended working hours.

WARRANTY

L&E Mobile Computer Mounts, Inc. warrants their installation work for a period of ninety (90) days from the date of installation. Any failures, problems, or deficiencies in the wiring or mechanical installation of the Panasonic CF-25 Computer System (Panasonic Docking Station, Voltage Armor, CDPD Radio Modem, and Pedestal Mount) not due to accident or abuse will be repaired or replaced at no cost.

Failures in the CDPD modem or in the vehicle electrical system not related to the Panasonic CF-25 Computer Vehicle system Installation are not the responsibility of L&E. Should Florida Power suspect a failure of the vehicle system, basic diagnostics and a description of the problem should be attempted before contacting the IPS Project Manager. The appropriate Florida Power manager will request that service personnel be dispatched as soon as possible to address the problem.

REFERENCES:

Bob Carr, Vice President, Panasonic	(201) 271-3179
Clint Nye, XL Computing, Inc. (PC Mobile)	(407) 589-7344
Don Paisley, President, Walkabout Computers, Inc.	(614) 882-0015
Ron Oklewicz, President, TelePad Corporation	(800) 736-7235
Steve Gower, North East Regional Rep., Panasonic	(508) 744-2331
Nick Zemlachenko, Director, Bell Atlantic NYNEX Mobile	(215) 638-5582
Jason Coenouver, Sierra Wireless	(604) 231-1100
Chief Thomas Stone, Norristown, PA Police Dept.	(610) 272-0977
Sgt. Russ James, Fleet Mgr., Bristol, CT Police Dept.	(860) 584-4865
Lt. James Sorrentino, New Haven, CT Police Dept.	(203) 946-7294
Lt. Ed Borrow, Mobile, AL Police Dept.	(334) 434-1994
Sgt. Godfrey Sohler, Bridgewater, NF Police Dept.	(908) 725-4044
Chief Thomas Daley, Plymouth Community Ambulance	(610) 368-6768
Lt. John Bennett, Fleet Mgr., Marple Twp. PA Police Dept.	(610) 356-1500

Philadelphia Police Dept., Mobile Data Computer Project
Harry Martin, Bell Atlantic, Project Manager (215) 575-8236
Chief Inspector, Charles Brennan (215) 686-3138
Installation Technical Support & Equipment
650 Police Vehicle Project

Dave Rand and Mike Pirylis, PSE&G – New Jersey
Public Service Electric & Gas Company (201) 912-3293
800+ Utility Vehicle Project
Installations, Technical Support and Equipment

Bay State Gas Company, Westborough, MA
Fred MacLennan, Project Manager (508) 836-7205
248 Vehicle Design, Equipment, Installations

Mike Martin, Ford, Factory Rep., Mt. Laurel, New Jersey (609) 727-3627
Ford Factory "Police/Computer Mount Package" Car
Conversions – 1995, 1996, 1997, 1998 "Factory" Show Cars

Details of the VOLTAGE ARMOR Automatic On/Off Timer Switch

The *Voltage Armor* automatic timer switch extends vehicle battery life by automatically switching your 2-way radio on and off. It can also be used with other vehicle electrical devices.

EASY TO INSTALL

No ignition switch connection.

- Complete – nothing else to buy
- Programmable: 15 min. to 15 hr.
- Can be located anywhere in the vehicle
- Protects the battery and radio equipment
- One-year limited warranty
- Made in USA

The *Voltage Armor* unit's built-in sensors automatically turn on a vehicle mobile radio when the engine is started. When the motor is turned off, the radio will stay on up to 15 hours – depending on how you program the *Voltage Armor* unit. Programming simply involves selecting the combination of DIP switch settings for the length of delay required – from 15 minutes to 15 hours.

The *Voltage Armor* unit mounts quickly and easily anywhere in the vehicle – provided it is wired directly to the battery.

Built in safeguards include:

LOW VOLTAGE PROTECTION

Low voltage disconnect (10V) takes priority over the delay timer and turns the unit off – regardless of the remaining delay before normal dropout. It automatically removes the *Voltage Armor* unit from the circuit for ultimate battery protection.

HIGH VOLTAGE PROTECTION

High voltage disconnect (17V) protects the radio equipment from erratic vehicle voltage regulators by disconnecting your electronic equipment *before* catastrophic failure occurs.

REVERSE POLARITY PROTECTION

Voltage Armor unit is electronically prevented from operating in reverse polarity.

Available in 12-Volt and 24-Volt Models.

SPECIFICATIONS: 12V/24V

Operating Voltage	13.6/27.2V
Low Voltage disconnect	10/20V
High Voltage disconnect	17/34V
Stand-by Current	7/14 MA
Operating Current	80/55 MA
Load Current Rating	30 Amp.
Minimum Time Delay	15 Min.
Emergency Bypass Time	15 Min.
Selectable Time Delay	1.15 Hr.
Weight	6 oz
Size	5 ¼ x 2 ¼ x 1 ¼
Operating Temp. Range	-50 deg. - +200 deg. F

Intergraph Public Safety, Inc. 2/22/98

Electric Utility Dispatch

Functional Design

Original Date: February 2, 1998

Revision Date:February 17, 1998

Author: Allen Acree
Title: Electric Utility Dispatch
Status: Proposed
Reference Number: FDD_Elec_Utility
Customer Name: Florida Power Corporation

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1. Introduction

1.1. Purpose of Document

The purpose of a I/EUD Functional Design (FD) is to define the high-level development implementation for the inclusion of a functional requirement(s) described in the corresponding I/EUD Requirements Document in affected products. An FD has three basic objectives: (1) to communicate to the requirement's author and all affected parties the intended implementation to ensure complete understanding of the requirement; (2) to identify user interface changes which will enable product documentation and literature to be updated; and (3) to more completely define the magnitude of the product change on users to enable organizations providing support to more accurately assess the change's impact on their resources.

This FDD describes the requirements for a dispatch system for the electric distribution utilities market, and the modifications and additions required for Intergraph Public Safety products to meet these requirements. The proposed system will be installed in two phases. Phase 1 is an initial operating capability, which will be implemented before other overall system components (FRAMME and WMS) are brought on line. Phase 1 will be based on a preliminary version of the FRAMME database, and will not include certain interfaces and functions. Phase 2 will be the final implementation, including all components. Functions and interfaces described in this document are proposed for Phase 1 except where explicitly noted.

1.2. References

The following documents, although not a part of this document, serve to amplify or clarify its contents.

Table 1 Document References

	Title of document	Version	Document number	Issue date
1.	Functional Specifications for an Outage Management System			**22-Dec-97**

2. General Description

The Intergraph Public Safety Computer Aided Dispatch (I/CAD) system has been developed over the years to meet a variety of needs for public safety service providers. These providers include police, fire, ambulance, and roadside assistance (auto club) customers, and multi-agency customers that provide multiple types of service. The core products in I/CAD are I/Calltaker and I/Dispatcher. The function of I/Calltaker is to support the person taking telephone calls from the public (or club members) and creating events (requests for service). The function if I/Dispatcher is to support the person communicating with the units in the field (fire trucks, patrolmen, etc.) and managing the assignment of events to units. Both products use a Graphical User Interface (GUI) and a digital map, and provide real-time status displays, database inquiry, and message facilities. Generally a calltaker takes calls from anywhere in the service area, and the resulting event is automatically sent to the appropriate dispatcher workstation based on the event type and location. All entered data is entered into a central Oracle database, and a subset of the data is broadcast on the local area network to update the real-time status displays of other workstations. The GUI and the database schema are highly configurable so that the system may be tailored for the terminology, workflow, and data processing requirements of a wide range of customers. Both I/Calltaker and I/Dispatcher use a high-speed map display to display geographic and situational information.

There is a large degree of overlap between the requirements of public safety customers and those of utility customers. The following differences have been identified:

- In public safety, the general rule is that one telephone calls leads to one dispatchable event. There are cases when the same occurrence is reported multiple times (like traffic accidents), and the I/CAD system detects nearby events and recommends to the calltaker that they may be collapsed into a single event. In a utility distribution system, the general rule is that multiple calls reporting a service outage need to be aggregated to a single dispatch to repair the failed piece of equipment upstream from the callers. This aggregation should be based not on geographic proximity, but rather on information about the distribution network and current knowledge about the equipment and the other outstanding outage reports. The aggregation may need to change as more information is obtained about equipment status and outages. Thus a new *Trouble Analysis* function will be needed for the I/CAD system, to perform the analysis to predict the equipment that needs repair, and to maintain the association between outage calls and repairs.
- In public safety, the two primary pieces of information in taking a call are the event location and the event type. From those, the agency response, dispatch group, and unit recommendations are computed. The event location may be entered as a street address, intersection, commonplace name, alarm identifier, or geographic coordinate. The location entry is converted to a map point and a response zone by the process of *location verification,* using the map and the geographic database. While some locations may have specific information or response plans stored for them, most do not. In a utility distribution system, the key is to identify a customer premise. The input may be a customer name, address, or account number. Each customer can be found in a customer database, with important additional information needed to process the call, such as the identification of the service transformer, and whether service has been cut off for nonpayment. Since this customer database is used for many other business purposes, it will remain external to the I/CAD system. Thus a new *Customer Data Interface* function will be needed for the I/CAD system, to supplement or replace the existing location verification function. This interface may also support other functions, such as recording outage repair times, inquiry of supplemental premise information, and the generation of a list of customers affected by an outage.
- In public safety, the displayed base map is primarily a street map with a dynamic overlay of unit and event location symbols. The street graphics are linked to database tables used for address verification, optimal routing, and road closures. Optional static overlays include building outlines, political and administrative boundaries, utilities, etc. These optional graphic levels may also be linked to database tables and interactively queried, but are not otherwise used in direct processing. In a utility distribution system, the distribution network is a core component of the base map, and the street network has less importance. The distribution network graphics should be linked to a network model that is either stored within the I/CAD system, or external in an AM/FM GIS. In addition, the map

should show an additional dynamic overlay for the status of the network based on SCADA information or other sources.

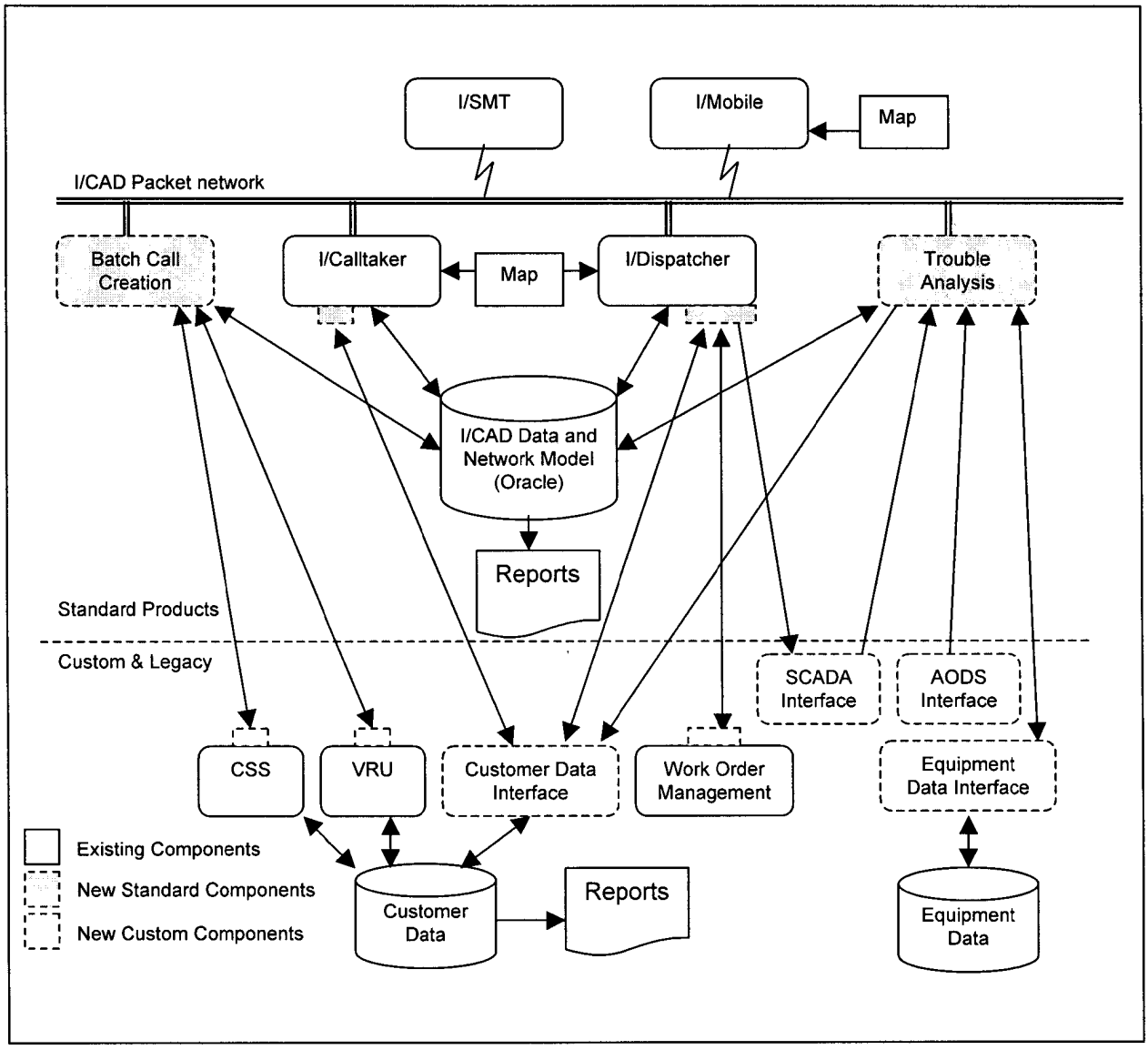


Figure 1. System Interface Diagram

3. Glossary

AODS	Automated Outage Detection System – An information system based on devices at customer locations that monitor power status and automatically make telephone calls to report changes.
CMI/C	The ratio of the number of Customer Minutes of Interruption divided by the total number of customers. This statistic is usually quoted for a year of service, and may exclude planned construction outages and outages due to hurricanes. It may be quoted for an entire system or a smaller service area.
CSS	Customer Service System
ERT	Estimated Response Time
FPC	Florida Power Corporation
GIS	Geographic Information System
IPS	Intergraph Public Safety
OMS	Outage Management System
POD	Probable Outage Device
SCADA	Supervisory Control and Data Acquisition
VRU	Voice Response Unit – allows customers to enter outage information via an automated telephone system ("press 1 for ...").
WMS	Work Order Management System

4. Components

4.1. Batch Call Creation

The Batch Call Creation component is a new standard IPS product. Its purpose is to provide a standard mechanism for external processes to create events in the I/CAD system. The external process would replace or supplement the standard I/Calltaker product as a mechanism for entering events into the I/CAD system. The Batch Call Creation component is a gateway to the I/CAD database and network protocols. The database fields that make up an event record are configurable to some degree in the I/CAD system. Certain fields must be present, but others may be added to meet the needs of specific customers. The component must support this configurability. This component will be useful in a variety of applications, so it may include capabilities that are not specifically required for the utility distribution industry.

4.1.1. User Interface

The Batch Call Creation component has no user interface.

4.1.2. Functions

4.1.2.1. Create Event

The Create Event function is used to add a new event to the I/CAD system. It performs the required insertions into the I/CAD database and sends the network packets notifying Dispatcher positions and other processes of the new event.

The Create Event function will have three parameters.

- A character string of the form "*fieldname1=value1; fieldname2=value2; ...*". Fields which allow NULL values in the database may be omitted from the string. . In order to simplify implementations, there will be a configurable translation between the field names in the parameter string and the actual database field names.
- A returned string containing the list of agency event identifiers separated by commas. (In the I/CAD system, a single event may generate subevents for multiple agencies. The master event has an integer identifier, and the agency events have alphanumeric string identifiers.)
- A returned string containing an error message, if the function fails.

The return value of the Create Event function will be a positive integer for the identifier of the created event, or zero if the function fails.

4.1.2.2. Query Event

The Query Event function is used to retrieve current information about an event. This may include information that was added to the event after it was created, such as estimated response times, additional remarks, and dispatch status.

The Query Event function will have three parameters.

- A character string containing the agency event identifier.
- A character string containing the list if field names to be returned, separated by commas, or "*" for all.
- A returned character string containing the data, in the form "*fieldname1=value1; fieldname2=value2; ...*".

The field names will be translated using the same configuration as Create Event.
The return value of the Query Event function will be one for success, or zero for failure.

4.1.2.3. Add Event Comments

The Add Event Comments function will have three parameters.

- A character string containing the agency event identifier.

- A character string containing the event comment(s) to be added.
- A scope parameter, indicating whether the comments are to be applied to all agency events for the same master event, or to just the one named.

The return value of the Add Event Comments function will be one for success, or zero for failure.

4.1.2.4. Update Event

The Update Event function will have three parameters.
- A character string containing the agency event identifier.
- A character string of the form "*fieldname1=value1; fieldname2=value2; ...*", listing the values to be modified.
- A returned string containing an error message, if the function fails.

The field names will be translated using the same configuration as Create Event.
The return value of the Update Event function will be one for success, or zero for failure.

4.1.2.5. Cancel Event

In I/CAD the Calltaker position usually cannot actually cancel an event, because a Dispatcher may already be working on the event. Instead, the Calltaker posts a cancellation request for the event. The Dispatcher is notified of the request, and may complete the cancellation. The mode selection parameter allows the Cancel Event function to work either way.

The Cancel Event function will have three parameters.
- A character string containing the agency event identifier.
- A mode selection, indicating whether to cancel the event immediately, or just request cancellation by a Dispatcher.
- A returned string containing an error message, if the function fails.

The return value of the Cancel Event function will be one for success, or zero for failure.

4.1.2.6. Verify Location

The I/CAD system has the capability to verify addresses and generate map coordinates. This function will allow an external process to use this capability. The process may need the coordinates to perform a nearby event test, prior to creating and event.

The Verify Location function will have five parameters.
- A character string containing the address.
- A returned string containing the parsed address, in field format. Missing components may be filled in which may be uniquely inferred from the input string.
- The returned X coordinate of the verified address.
- The returned Y coordinate of the verified address.
- A returned string containing an error message, if the function fails to match a unique address.

The return value of the Verify Location function will be one for success, or zero for failure.

4.1.2.7. Nearby Events

An external application may want to test if there are already events in the vicinity of a new report, prior to creating a new event, just as I/Calltaker does.

The Nearby Events function will have five parameters.
- The X coordinate to be tested.
- The Y coordinate to be tested.
- The range to search for nearby events (in map coordinate units), or zero for default I/CAD range testing.
- A returned string containing the list of agency event identifiers within range of the test point.

The return value of the Nearby Events function will be the number of nearby events found, or zero if none.

4.1.3. Interfaces

4.1.3.1. Network Interfaces

The Batch Call Creation component will generate standard I/CAD network packets for each event creation, update, and cancellation operation.

4.1.3.2. Database Interfaces

The Batch Call Creation component will insert, update, and query the I/CAD database tables holding event information. It will also query the geographic information tables for the Verify Location function.

4.1.3.3. External Interfaces

Each of the functions listed above will be available to external processes via a mechanism to be determined. Options at this time are:

- A Common Object Model (COM) server process interface.
- A Remote Procedure Call (RPC) server process interface.
- A low-level TCP/IP network packet protocol.

4.2. Trouble Analysis

The purpose of the new Trouble Analysis component is to analyze outage reports, and predict the likely equipment malfunction causing the outages. Based on this prediction, the component will create I/CAD events representing repair work orders. The component will function automatically, reacting to new outage call events in the system, and to Dispatcher requests and overrides. The trouble Analysis component will maintain a connectivity model of the distribution network to be used to trace circuits.

4.2.1. User Interface

The Trouble Analysis component has no direct user interface. Any user inputs are handled by the I/Dispatcher product, which will trigger Trouble Analysis processing via network packets.

4.2.2. Functions

4.2.2.1. Maintain Connectivity Model

The Trouble Analysis component will maintain and use a connectivity model containing all distribution lines, transformers, fuses, breakers, switches, and AODS and SCADA monitoring points. The data in the model will include customer counts, phase, normal load, design load limits, the normal operating state of the switches, and the current operating state of devices. The connectivity model will be stored in the I/CAD database where it will be available to I/Dispatcher.

The static part of the data will be loaded from the Engineering Data interface. The dynamic data (current operating state) will come from the SCADA interface, I/Dispatcher, and the AODS interface. AODS will be added in Phase 2.

4.2.2.2. New Outage

This function performs the analysis for a new outage call. It is initiated by a new event packet from I/Calltaker, I/Dispatcher, or the Batch Call Creation component. On the first call from an area, a new repair event (trouble ticket) will be created with no predicted equipment failure identified, only a list of upstream devices. An estimated time to repair will be added based on the assumption that the failing device is the last one on the line. When additional calls are received, the software will determine the Probable Outage Device (POD) and update the repair event (See 4.2.2.4).

4.2.2.3. Automatic New Outage

The Trouble Analysis component will automatically generate a new outage call when a power failure is reported by AODS. There will be a configurable time delay for this function to avoid creating outage calls for momentary interruptions. Once created, the automatic outage call will be processed just like any other. This function will be available in Phase 2.

4.2.2.4. Determine Probable Outage Device (POD)

When two or more outages are entered in an area, the software will trace the distribution network model to identify a probable outage device (POD). The algorithm to determine the POD will consider:

- The power phase utilized by the reporting customer
- The percentage of all customers downstream from the device which are reporting an outage
- The times of the outage reports
- Any available SCADA measurements of upstream demand changes
- The *a priori* reliability of the device type

The repair event will be updated with

- the new POD
- a corresponding estimated time to repair
- the number of customers downstream from the POD
- the normal load associated with the POD

4.2.2.5. Determine Estimated Time to Repair

The Trouble Analysis component will calculate an estimated time to repair based on a table look-up based outage type, outage area, time of day, day of week, holiday status, storm status. The outage area will be determined by a point-in-polygon lookup using the POD location and a set of polygon definitions maintained just for this purpose.

4.2.2.6. Updated Outage

If an outage call event is modified, the Trouble Analysis component will receive the network packet identifying the change. The software will determine if the modification could affect the POD, and if so, initiate a reanalysis of open outage calls and repair events.

4.2.2.7. Completed Repair

When the dispatcher closes a repair event, the Trouble Analysis component will receive the network packet identifying the change. The component will then automatically close all associated outage call events. It will also calculate the Customer Minutes of Interruption (CMI) for the outage, and add that data to the repair event. If the dispatcher has not manually set the outage start time from field reports, it will be calculated from the earliest associated outage call event, or the creation time of the repair event if there are no associated outage call events. If the dispatcher has not manually set the outage end time from field reports, it will be set to the time of closure of the repair event. The customer count for the CMI will already be in the repair event record. (See 4.2.2.4.)

4.2.2.8. Set Equipment Status

This function performs the new analysis of the "No Lockout" function. It is initiated by a network packet from I/Dispatcher requesting Override Equipment Status

4.2.2.9. Query SCADA Status

During outage analysis, The Trouble Analysis component will automatically query the external SCADA interface for the status of SCADA-equipped devices, if no recent updates have been received.

4.2.2.10. Set SCADA Mode

The Trouble Analysis component may be configured dynamically to automatically query the status of SCADA-equipped devices, or not.

4.2.2.11. Generate Switching Orders

The Trouble Analysis component will automatically generate recommended switching orders to isolate a section of equipment for repair, and to restore power after repair. This recommendation will be in response to a request for I/Dispatcher, and based on a configurable set of rules. These rules will consider the design limits and normal load for the circuits being switched. The recommended steps will be stored in the I/CAD database, and the copy of I/Dispatcher requesting the orders will be notified via a network packet of their availability.

4.2.3. Interfaces

4.2.3.1. Trouble Analysis to Engineering Data

The Trouble Analysis component will load its initial connectivity model from the customer's Engineering Data interface (FRAMME or equivalent). This information may be reloaded periodically, but there will be no real-time link to copy engineering changes as they happen.

4.2.3.2. Trouble Analysis to I/Dispatcher

The interface between Trouble Analysis and I/Dispatcher will be in the form of I/CAD network packets. Some of these will be existing packet protocols (like new event), and others will be new.

Each copy of I/Dispatcher can request SCADA updates for a geographic area. When the Trouble Analysis component receives updates from the SCADA system, those updates will be forwarded from Trouble Analysis to those copies of I/Dispatcher which are monitoring an area including the update.

I/Dispatcher can request recommended switching orders to isolate or restore power to a section of equipment. I/Dispatcher will be notified when the recommended switching orders are available in the database.

4.2.3.3. Trouble Analysis to SCADA

The Trouble Analysis component will accept real-time data from the SCADA system to track device operations and dynamic loads. Because of the large data volume, the SCADA system should not forward individual telemetry items to Trouble Analysis. It should bundle items into packets based on change thresholds and a configurable time interval.

The Trouble Analysis component will query data from the SCADA system as needed to determine the state of devices, if no recent updates have been automatically received.

Information from SCADA will be stored in the database in the connectivity model.

4.2.3.4. Trouble Analysis to AODS

The Trouble Analysis component will accept real-time notification from the AODS system. Each will contain customer identification, a time stamp, and a power status. This interface will be implemented in Phase 2.

4.3. Additions to I/Dispatcher and I/Calltaker

The I/Calltaker product is essentially a subset of the I/Dispatcher product, built without the functions dealing with the control of units. Both products have the capability to load custom software modules that add functions to the standard product. These custom modules have access to the data and functions in the standard product, so that new capabilities can be added

with a minimum of new code and a maximum reuse of proven product. The following changes will be needed to the base product to support the new add-on functions:

- In the map display, the ability to specify a TrueType® font name to be used for each font number in the original DGN files, to support symbol fonts.
- In the map display, the ability to register callback functions to be called before and after display updates, to support application-specific backdrops and overlays.
- In the network packet interface, the ability to register callback functions to handle specified new packet types, to support the addition of application-specific packets.

4.3.1. User Interface

The changes to the user interface for I/Dispatcher and I/Calltaker include changes to the map display, and addition of dialog-based commands.

4.3.1.1. Map Display

The map display in I/Dispatcher and I/Calltaker will include the graphics for the distribution network (FRAMME graphics), as well as a standard street network. The current map display uses only one font for text. The display of FRAMME data will require the ability to use a symbol font for the engineering symbols for distribution equipment such as transformers, breakers, and fuses.

A new capability will be added to the map display to allow the user to specify which events to display, based on event type, priority, and customer count.

4.3.1.2. SCADA Display

One of the map views will be required to display a dynamic overlay of real-time SCADA status. This information is received from the Trouble Analysis component, and will be immediately reflected in the map display when received. This overlay will contain:

- Status and quality indications for SCADA-equipped devices.
- Load measurements.
- Special symbology for lines that are not energized due to device operations.
- Active tags (Red, Yellow, Blue, White) from the network model.

4.3.1.3. Status Monitors

The tabular displays for pending events and unit status are implemented in I/Calltaker and I/Dispatcher as separate DLLs, to facilitate application-specific functions. The standard versions of these displays include most of the data required for this implementation, but a new version will be required to add the following fields:

- The number of customers affected.
- High priority customers affected.
- Time remaining to end of shift for logged-on unit.

The unit status monitor will indicate an alarm state when a unit is still logged on beyond the scheduled end of shift. This will be indicated by an initial audible alert (beep), and a hilighted button or text message on the status monitor dialog.

A new capability will be added to the pending event monitor to allow the user to specify which events to display, based on event type, priority, and customer count. (An analogous capability already exists for the unit status monitor – "Define Custom Display".)

4.3.1.4. New Dialog-based Commands

New dialogs will be added for each of the functions listed in section 4.3.2.

4.3.2. Functions

4.3.2.1. Verify Customer Information

As an alternative to the standard I/CAD address verification, the calltaker or dispatcher may verify a location through CSS by specifying a customer name, premise address, telephone number, account number, or meter number.

4.3.2.2. Create Event for Device

The calltaker or dispatcher will be able to create a new event at a location determined by selecting a device from the map display. The default event type in this will be configurable, typically to a type indicating that the device has failed and needs repair. The operator may override the event type.

4.3.2.3. Create Event for Customer Premise

The calltaker or dispatcher will be able to create a new event of any type at a premise location verified as in section 4.3.2.1.. The default event type in this will be configurable, typically to a type indicating a service outage. The operator may override the event type.

4.3.2.4. Display Customer Premise History

The calltaker or dispatcher will be able to query the CSS for customer premise history, and display the results. The customer my be identified by selecting an outage call event, or from a customer list (see 4.3.2.10), or by directly identifying the customer as in paragraph 4.3.2.1.

4.3.2.5. Override Equipment Status

This is the user interface to the "No Lockout" function. Send a message to the Trouble Analysis component to request a reanalysis assuming a specified piece of equipment has a particular status. This function is available only on I/Dispatcher.

4.3.2.6. Outage Restored

This function will close the Repair event (Trouble Ticket) and all of the cross-referenced Outage Call Events. The dispatcher may enter the actual time the outage was restored and any final information about the cause or conditions. This command is a convenient user interface to the existing Clear Event command, and is used to close multiple repair and outage events with one request. The outage start and end time and cause code will be passed to CSS along with a list of affected transformers, to be recorded for each affected customer. This function is available only on I/Dispatcher.

4.3.2.7. Outage Partially Restored

This function will may close all outages on a specified feeder circuit that are cross-referenced to a selected repair event, without closing the entire repair event. The dispatcher may enter the actual time the outage was restored and any final information about the cause or conditions. This command is a convenient user interface to the existing Clear Event command, and is used to close multiple outage events with one request. The outage start and end time and cause code will be passed to CSS along with a list of affected transformers, to be recorded for each affected customer. This function is available only on I/Dispatcher.

4.3.2.8. Display Outage Call List

Display a tabular report of Outage Call events cross-referenced to a selected Repair event. This function is available on I/Dispatcher and I/Calltaker.

4.3.2.9. Display Single Outage Call List

Display a tabular report of Outage Call events that have not been grouped with other outage calls by the Trouble Analysis module. These may represent transient circuit breaker operation rather than true outages, and may require just a telephone callback.

4.3.2.10. Display Customer List

Display a tabular report of customers downstream of a selected piece of equipment. The piece of equipment may be selected from the map, or may be the POD of a selected repair event. To generate the list, I/Dispatcher will query the connectivity model to determine the transformers downstream from the POD, and then query CSS for each transformer to get the list of customers served by that transformer.

4.3.2.11. Display Priority Customer List

Display a tabular report of high priority customers downstream of a selected piece of equipment. This function will work like Display Customer List, but will only display the customers marked as priority in the data returned from CSS.

4.3.2.12. Set SCADA Mode

Modify the SCADA mode of the Trouble Analysis component for a selected device, set of devices, or region. Normally, the Trouble Analysis component will automatically query SCADA-equipped devices for lockout status. If this function is turned off, the component will instead send a no lockout question to the responsible dispatcher. This function is available only on I/Dispatcher.

4.3.2.13. No Lockout Question

When the Trouble Analysis component determines that it needs to know the status of a device which is not configured for an automatic SCADA query, it will post a coded form of the question to the database, and send a message to the dispatch group responsible for the device. When the dispatcher receives the message, he should invoke the No Lockout Question command. This command will present a list of pending questions for the covered dispatch groups. The dispatcher may answer the questions, using a dialog. Each response will be stored in the database, and a network packet will be sent to the Trouble Analysis component indicating a new response. This function is available only on I/Dispatcher.

4.3.2.14. No Lockout Run

The new No Lockout Run command will allow the Dispatcher to initiate a new analysis of outage calls with an updated lockout state of specific devices. This function operates by sending a network packet to the Trouble Analysis component indicating the change. This function is available only on I/Dispatcher.

4.3.2.15. Edit Estimated Repair Time Table

A new dialog-based command in I/Dispatcher will allow an authorized operator to edit the values in the Estimated Repair Time table. (See 4.2.2.5.) This command will be implemented either as an external Visual Basic program or as a DLL-based add-in.

4.3.2.16. Populate Estimated Repair Time Table from History

A separate utility program will be developed to extract repair time history from the I/CAD database, and generate statistical estimates that will be used to automatically populate the Estimated Repair Time table. This utility will be implemented in Phase 2, so the table should be populated by manual editing for Phase 1.

4.3.2.17. Query Load for Line

The dispatcher will be able to query the design load on a line segment by selecting it from the map display.

4.3.2.18. Generate Callback List

The dispatcher will be able to request a list of a random selection of the customers affected by a POD. To do so, it will query the connectivity model to determine the transforms downstream from the POD, and then query CSS for each transformer to get the list of customers served by that transformer. It will then select a random fraction of the customers, based on the percentage

selected by the dispatcher. The list may be viewed online or printed. In Phase 2, an interface to an automatic calling system will be implemented for automatic callbacks.

4.3.2.19. Display Customer Outage Statistics

The dispatcher will be able to request a calculation of the outage count and the Customer Minutes of Interruption per Customer (CMI/C) for a device, feeder, or polygonal area, and a specified time period. The request may include a restriction of the cause codes to be included. I/Dispatcher will compute the list of service transformers for the query, and then retrieve the outage history from the database and compute the count and CMI/C.

4.3.2.20. Create Work Request

The dispatcher will be able to generate a work request for the Work Order Management System (WMS). This is a dialog-based command, with data content yet to be determined. A configurable set of fields may automatically be copied to the request from an open or closed I/CAD event. This function is available only on I/Dispatcher, and will be implemented in Phase 2.

4.3.2.21. Request Switching Orders

The dispatcher will be able to request recommended switching orders by specifying one or more pieces of equipment to be isolated or restored to power.

4.3.2.22. Review and Update Switching Orders

The dispatcher will be able to review the switching orders recommended by the Trouble Analysis component, and modify them as needed. The dispatcher will also be able to generate switching orders manually. The dispatcher will be ultimately responsible for the accuracy and safety of the switching orders.

4.3.2.23. Log Switching Orders

I/Dispatcher will allow the dispatcher to check off each step of the switching orders, and record the identity of the person receiving the orders. I/Dispatcher will record the times that the dispatcher indicates that each step was issued to the field, verified by the recipient, and completed. The dispatcher will be able to select the recipient be selecting either from a list of logged-on units, or a list of logged-on personnel. The log will be available for on-line review, and may be printed at the end of each shift for signature and archiving.

4.3.2.24. Initiate SCADA Control Actions

I/Dispatcher will allow the dispatcher to initiate control actions to be passed back to the SCADA system.

4.3.2.25. Manage Tags

The dispatcher will be able to create, query, edit, and remove tags from the network model. The dispatcher can select the tag to manipulate by picking it from the graphic SCADA display. These color-coded tags (red, yellow, blue, and white) represent physical tags that are placed in the field to communicate information about the equipment. For example, a lineman places a red tag on a switch when he de-energizes a line to work on it. No one else is allowed to close the switch while the red tag is there, and only the original lineman is authorized to remove the tag.

4.3.3. Interfaces

4.3.3.1. I/Dispatcher to Trouble Analysis

I/Dispatcher will send a network packet to the Trouble Analysis component when the SCADA view is changed, to specify a new request area for SCADA updates.

I/Dispatcher will accept SCADA update packets from the Trouble Analysis component, containing device status, and inferred power status of downstream lines.

4.3.3.2. I/Dispatcher to Customer Data Interface

I/Dispatcher will retrieve a list of customers served by a transformer from the Customer Data Interface.

I/Calltaker and I/Dispatcher will retrieve customer and premise information from the Customer Data Interface by name, address, phone, account number, or meter number.

I/Calltaker and I/Dispatcher will retrieve premise history information from the Customer Data Interface by address or meter number.

I/Dispatcher will send the outage start and end times and cause codes, with a list of affected service transformers, to the Customer Data Interface.

4.3.3.3. I/Dispatcher to VRU

During Phase 2, I/Dispatcher will be interfaced to a new Voice Response Unit (VRU) for automatic customer callback and crew callout. This VRU will be a separate system (with separate telephone lines) from the VRU used for customer outage reports.

For customer callbacks, the VRU should ask customers if their power has been restored. If any customers respond that their power is still off, the VRU should create new outage call events via the Batch Call Creation component.

For the crew callout function, the VRU should record whether each person called was available, not reached, or turned down the call-out. The results should be sent back to I/Dispatcher as an ASCII file.

4.3.3.4. I/Dispatcher to Human Resources System

I/Dispatcher will not have a direct interface to the customer's Human Resources system, but it will be possible to transfer personnel identification and skill information to the I/CAD Oracle database via an external utility program. The default interface will be via an ASCII file. The customer will be responsible for exporting the data from the HR system in a format to be specified. I/CAD will provide a utility to update the Oracle database from the ASCII file. During Phase 2 implementation, a direct database-to-database transfer may be possible.

4.3.3.5. I/Dispatcher to WMS

In Phase 2, I/Dispatcher will send work order requests to the WMS. These work requests will be in the form of records written to the appropriate table in the WMS Oracle database. (WMS periodically checks this table for additions.)

I/Calltaker and I/Dispatcher will not interface directly to WMS for lineup information, but in Phase 2 shift lineups may be imported into the I/CAD Oracle database from the WMS Oracle database using a transfer process written for that purpose.

4.3.3.6. I/Dispatcher to SCADA

I/Dispatcher will send control actions to the SCADA system for execution.

4.4. Additions to I/Mobile

I/Mobile currently supports updating only the information related to the unit associated with the mobile computer. Enhancements will be required to allow a field supervisor with a mobile computer to manage the information for other units and personnel under his control

4.4.1. Functions

4.4.1.1. Log On and Off Units

I/Mobile will be enhanced to allow a supervisor to log on and off units and personnel in other units. This will be a Phase 2 implementation.

4.4.1.2. Update Unit Information

I/Mobile will be enhanced to allow a supervisor to update information about other units. This will allow the supervisor to extend shifts. This will be a Phase 2 implementation.

4.5. Customer Data Interface

We assume that the customer database will be external to the I/CAD system, and will contain at a minimum the identification of the last piece of equipment (terminal device) in the primary distribution network leading to the customer.

4.5.1. Functions

4.5.1.1. Get Customers for Device

Retrieve a list of customers served by a specified terminal device (service transformer).

4.5.1.2. Get Customer Information

Retrieve information about a specified customer, specified by name, address, telephone number, account number, or meter number. The retrieved information will contain all of the above, plus customer priority and account status.

4.5.1.3. Set Connection Information

Record the fact that a customer service has been connected or disconnected for account reasons.

4.5.1.4. Add Outage History

Record the cause code and the times an outage began and service was restored for a customer, or for all customers served by a specified terminal device.

4.6. Equipment Data Interface

4.6.1. Interfaces

The Trouble Analysis component will load its initial connectivity model from the customer's Engineering Data interface (FRAMME or equivalent). This information may be reloaded periodically, but there will be no real-time link to copy engineering changes as they happen. The Equipment Data Interface must make the following data available for transfer: all distribution lines, transformers, fuses, breakers, switches, and AODS and SCADA monitoring points. The data will include map coordinates, customer counts, phase, normal load, design load limits, and the normal operating state of the switches.

4.7. Additions to CSS

4.7.1. User Interface

The requirements in this document do not directly require any user interface changes to CSS.

4.7.2. Interfaces

4.7.2.1. CSS to Batch Call Creation

CSS must send new outage call information to the Batch Call Creation component to be entered into the system.

4.7.2.2. CSS to Trouble Analysis

CSS must be modified to accept the Estimated Time to Repair (ERT) as an asynchronous input value at some time after the outage call is created. Typically this will available a few seconds after the call is send to Batch Call Creation.

4.8. Additions to VRU

4.8.1. User Interface

The requirements in this document do not directly require any user interface changes to VRU.

4.8.2. Interfaces

4.8.2.1. VRU to Batch Call Creation

VRU must send new outage call information to the Batch Call Creation component to be entered into the system.

5. Functional Specification Cross Reference

Table 2 contains the mapping of the requirements from the Functional Specifications for an Outage Management System to the requirements in this document. Requirements that are to be partially implemented or deferred to future versions are in **bold** type.

Table 2 Functional Specification Cross Reference

	OMS Requirement	Paragraph
1.1	The OMS will receive its connectivity model and landbase information from the GIS and perform circuit *tracing* to identify a probable outage device (POD).	4.2.3.1, 4.2.2.4
1.2	The OMS will determine the number of customers affected by a POD.	4.2.2.4
1.3	The OMS will determine the demand (load) affected by a POD. The demand may be modeled as a single number or a load profile, or it will be allocated from SCADA analog readings (Gemini ?).	4.2.2.4
1.3.1	The OMS will calculate the load on a line segment(s) or area defined by a polygon using the cumulative load stored in FRAMME.	4.3.2.16
1.4	The OMS will calculate an estimated restoration time (ERT) based on a table look-up which accounts for current outage level, time of day, day of week, holiday status, storm status. A table will be associated with any operating area defined by a polygon.	4.2.2.5
1.4.1	The OMS will allow user input of ERT information into the look-up table.	4.3.2.15
1.4.2	The OMS will allow dispatchers and mobile supervisors to override ERTs for individual outages.	Standard I/CAD function – Update Event
1.4.3	The ERT table information will be calculated for an area defined by a polygon.	4.2.2.5
1.4.4	The OMS will provide a mechanism for providing ERT historical information to populate the look-up tables.	4.3.2.16 **(Phase 2. Use manual entry for initial population.)**
1.5	The OMS will infer PODs utilizing *fuzzy* logic, by:	4.2.2.4
1.5.1	Comparing the POD's demand to SCADA demand changes.	4.2.2.4
1.5.2	Comparing the number of customers reporting an outage as a percentage of the total number of customers on a device. The percentage will be configurable by device.	4.2.2.4
1.5.3	Comparing the phase of all customers reporting outages.	4.2.2.4
1.5.4	Comparing the time when outages are reported.	4.2.2.4
2.1	The OMS will automatically generate an incident and incident number for each POD.	4.2.2.2
2.1.1	The OMS must support different incident types.	Standard I/CAD function
2.1.2	The incident must be routed to the appropriate dispatch group which can be assigned to any workstation based on location and incident type.	Standard I/CAD function
2.2	The OMS will recommend assignment of an incident to a mobile unit based on incident type, location, skill set, vehicle type, equipment, priority, and availability.	Standard I/CAD function

2.2.1	Incident types will include outage calls, device outages, PODs, pre-arranged outages, streetlight outages, line down, dig-ins, structural problems, nearby events by proximity, address, intersection (a.k.a. immediate outage ticket), and fire calls.	Standard I/CAD function – all incident types and subtypes are configurable.
2.3	The OMS will automatically assign incidents to a mobile unit based on incident type, location, skill set, vehicle type, equipment, priority, and availability.	**Optional implementation of the Autodispatch product.**
2.4	The OMS will randomly & automatically call customers back (VRU) to help eliminate embedded outages.	4.3.2.18 for call list creation. 4.3.3.3 **for Phase 2 VRU interface.**
2.5	OMS will have the capability of automatically calling personnel from a call-out list & record their response code (available, not reached, turned down). When required personnel have responded as available, the OMS will automatically assign the incident.	4.3.3.3 **for Phase 2 VRU interface. IPS currently offers a one-way automatic paging interface.**
2.6	The OMS will track log-in and log-off times and allow for a supervisor with a mobile computing terminal to log-in and log-out other equipment and personnel.	Tracking times is a standard I/CAD function, when the operation is performed by I/Dispatcher or I/Mobile. For new I/Mobile requirements, see 4.4.1.1
2.6.1	The OMS will allow a dispatcher or mobile supervisor to extend a work shift.	dispatcher – standard I/CAD function. Mobile: 4.4.1.2
2.6.2	The OMS will alarm when personnel are working into extended work hours.	4.3.1.3
2.6.3	Non-extended or regular work shifts will be configurable.	standard I/CAD function
2.7	The OMS will provide the mechanism for creating work requests which will be automatically routed to the WMS.	4.3.2.20 (**Phase 2**)
3.1	The OMS will dynamically calculate CMI/C by device, feeder, or geographic area defined by a polygon. The OMS will have the capability of reporting this information with user-definable filters for cause codes, including pre-arranged outage effects.	4.3.2.19
3.2	The OMS will log outage starting time, ending time, and CMI at the closure of each outage event.	4.2.2.7
3.3	Logging of starting and ending times will involve the comparison and reconciliation of customer calls, AODS records, and field reports.	4.2.2.7 **(AODS in Phase 2)**
3.4	The OMS will dynamically calculate number of interruptions by device, feeder, or geographic area defined by a polygon. The OMS will have the capability of reporting this information with user-definable filters for cause codes including pre-arranged outage	4.3.2.19
3.5	Momentary interruptions.	**need clarification of requirement**
3.6	Real time event and unit summaries & *ad hoc* reports.	The real-time summaries are standard I/CAD functions. *ad hoc* reports may be generated from the Oracle database using standard commercial tools.
3.7	The OMS will print a switching log at the end of each shift for signatures and archiving.	4.3.2.23
4.1	The OMS will display SCADA information on the facilities graphics display. SCADA information will include:	4.3.1.2
4.1.1	Real-time device status (tripped, closed, tagged)	4.3.1.2

4.1.2	Real-time analog data (watts, VARS, voltage).	4.3.1.2
4.1.3	Calculated values from analog data (power factor, % MVA).	4.3.1.2
4.1.4	Quality codes (scan disabled, communication failed, maintenance mode).	4.3.1.2
4.2	PODs will be highlighted and the downstream-connected network will change color to indicate status (energized or not).	4.3.1.2
4.3	Incidents will be displayed geographically.	Standard I/CAD function
4.3.1	Different incident types will use different & configurable symbols.	**This is planned as a future I/CAD enhancement, but will not be available for initial installation.**
4.3.2	The OMS will support the ability to dynamically select the incidents displayed geographically by incident type, level, priority, etc.	4.3.1.1, 4.3.1.3
4.4	Incidents will also be displayed tabularly.	Standard I/CAD function (status monitors)
4.4.1	Information displayed tabularly will include incident number, incident type, address or premise or customer name or customer revenues (user selectable), status, truck(s) assigned, priority, incident level, incident duration, number of customers affected.	4.3.1.3
4.4.2	The information displayed tabularly will be sorted hierarchically, on demand, by any field or number of fields (i.e. priority, incident duration, incident type, level, number of customers.	Standard I/CAD function
4.4.3	Tabular displays will be color coded by status (dispatched, unassigned, etc.).	Standard I/CAD function
4.4.4	Tabular incident displays will be differentiated by blinking, colors, fonts, or font size. This will be configurable by the fields reported in 4.4.1.	**I/CAD uses Colors only, with no blinking or font support. Different subsets may be displayed on different tabbed pages of the lists.**
4.5	Incidents can be created in the OMS.	Standard I/CAD function
4.5.1	Incidents can be entered by pointing to a device or premise.	4.3.2.2, 4.3.2.3
4.5.2	Incidents can be entered by entering grid or coordinate, or by pointing to a geographical location.	Standard I/CAD function
4.6	The OMS will allow for the creation and removal of tags (Red, Yellow, Blue, and White) anywhere on the connectivity model. Selecting the tag will display pertinent information regarding its placement.	4.3.2.24
4.7	The OMS will provide a training mode that does not affect the operational model and real time database. Outages may be entered by someone at another workstation in training mode.	Standard I/CAD function
4.8	The OMS will provide an interactive simulator that does not affect the operational model and real time database.	**Simple automated outage creation may be implemented in Visual Basic. IPS may offer a more comprehensive simulator as part of a future version.**
4.9	The OMS will allow for entry of information to close-out an incident (i.e. cause codes, phase, device) by both a dispatcher position and a mobile computing terminal.	Standard I/Dispatcher and I/Mobile functions.
4.10	The OMS will recommend switching orders to restore power and not violate equipment ratings and voltage profiles based on:	4.2.2.11

4.10.1	A single demand per node	4.2.2.11
4.10.2	Loadflow modeling	**This may be offered as a future enhancement. The initial system will use only a single demand per node.**
4.11	The OMS will allow for the entry, logging, storing, & retrieval of switching orders.	4.3.2.21, 4.3.2.22, 4.3.2.23
4.11.1	The current dispatcher and time will be captured automatically.	Standard I/CAD function
4.11.2	The field contact will be selectable through a pull-down menu which is populated with personnel for the current shift.	4.3.2.23
4.11.3	An on-line form will contain three fill-in areas for switching equipment out, issuing clearances, and restoring to normal.	4.3.2.23
5.1	Operational data will be captured in a standard, commercial, relational database (preferably Oracle).	Standard I/CAD function
5.2	OMS server and client software will remain current with RDBMS revisions.	Standard IPS practice. Details to be worked out contractually.
5.3	The OMS will support Windows NT 4.0 servers.	Standard I/CAD function
5.4	OMS server and client software will remain current with operating system revisions.	Standard IPS practice. Details to be worked out contractually.
5.5	The OMS will use NFS & TCP/IP for file sharing and networking.	I/CAD uses TCP/IP for network operations. File sharing is configurable.
5.6	The OMS must be certified Year 2000 compliant.	Standard I/CAD function
6.1	Device status will be polled or accepted unsolicited from SCADA for outage analysis and ticket grouping.	4.2.3.3
6.2	The OMS will accept a manually entered device status.	4.3.2.1
6.3	Device status and quality code data will be obtained and displayed from the SCADA system.	4.3.1.2
6.4	Analog and quality code data will be obtained and displayed from the SCADA system.	4.3.1.2
6.5	Control actions will be passed back to SCADA for execution.	4.3.2.24
6.6	The OMS will accept outage, momentary, restoration, and voltage anomalies from automated outage detection devices (AODS) and process this information for analysis or reporting purposes.	4.2.2.3, 4.2.3.4 **(Phase 2)**
6.7	The OMS will be interfaced into the Customer Service System (CSS) for accepting trouble calls and supplying estimated restoration times in real-time.	4.1.2.1, 4.2.2.5, 4.7.2.2
6.8	The OMS will be interfaced into the Customer Service System (CSS) to query customer information (search and validate name, address, premise, meter number).	4.3.2.1, 4.3.3.2, 4.5.1.2
6.9	The OMS will be interfaced into CSS to supply it with outage information (start, end, cause code, # of customers involved?) by station. This information will be used to calculate the number of interruptions experienced by a customer or customers.	4.3.2.6, 4.3.2.7
6.10	The OMS will be interfaced into a Voice Response Unit (VRU) for accepting trouble calls in real-time. This may be useful for large industrial customers or at such time when Energy Delivery responds to customers without aggregator intervention.	4.8.2.1
6.11	The OMS will be interfaced with the WMS to accept shift line-up information and to supply the WMS with start and stop	4.3.3.5 **(Phase 2)**

	times for employee shifts.	
6.12	The OMS will be interfaced with the WMS to supply it with work requests entered in the OMS.	4.3.3.5 **(Phase 2)**
6.13	The OMS will be interfaced with the HR system (PeopleSoft) for skills.	4.3.3.4 **(Phase 2)**
6.14	The OMS must accept proposed and as-built engineering changes from the GIS, while not overriding operational changes. Proposed facilities will have to be easily distinguishable from facilities that are in service.	**The connectivity model will be loaded from only the as-build data – see 4.2.3.1. The map display will show both proposed and as-built graphics, with different symbologies.**
6.15	The OMS will provide current outage, restoration, and vehicle information to a web server for internal and external viewing.	**The required information is accessible in the Oracle database. IPS may offer a standard web display product as part of a future version.**
6.16	The OMS will be able to query CSS for premise history information	4.3.2.4
6.17	The OMS will be able to interface with a Windows based radio & telephone console. Vehicle ID will be passed to the radio/telephone console through an API.	**Optional implementation of the I/Radio product.**
7.1	Technical and user support will be available from the supplier via a maintenance fee structure.	Standard IPS practice. Details to be worked out contractually.

Detailed Pricing

Intergraph Public Safety (IPS) is pleased to provide a detailed pricing specification for the Florida Power Corporation Outage Management System. Based on the fact that this project is a partnership between the two companies, we have included significant discounts to our normal list prices. A description of the discounts applied is listed below.

- A 50% discount on all IPS Commercial-Off-The-Shelf (COTS) software.
- A 20% discount on Utility Outage Software Development.
- A 0% discount on software interfaces that are specific to the Florida Power OMS project.
- IPS will waive software maintenance fees for Utility Outage Software developed for this project as long as IPS remains in the Utility Outage Software Business. This includes upgrades of functionality in future releases of the product.
- A 20% discount on Intergraph Hardware.

While this proposal defines a system with two complete sites that are capable of operating independently as well as providing backup for each other, this configuration requires significant duplication of server hardware and additional licenses of interface software to support independent operation. We have therefore provided pricing on three configurations that provide various levels of backup and redundancy. These configurations are described below.

The Baseline System

The baseline system includes 2 redundant database servers and a communication server at the western site. It also includes six dispatcher workstations at each site (east and west) where one workstation at each site is configured as a supervisor station.

In this configuration, the workstations at the eastern site operate remotely to the servers through Florida Power's wide area network (WAN). If there were a failure of the WAN, then the workstations at the eastern site would be unavailable for further OMS/Dispatch operations until the WAN is restored. The I/CAD system always stores live operation data on the dual redundant database servers. Operators at the western site could resume operations for the eastern coverage area by loading the eastern data from the database server. While the workload at the western site would be doubled, operations could continue.

The proposed system includes dual redundant database servers so that, if one server fails, operations resume on the other server. However, if the western site were destroyed or if it needed to be evacuated, both servers would be unavailable and OMS/Dispatch operations could not continue.

The performance of remote workstations is dependent upon the characteristics of the wide area network. Florida Power has an FDDI network supplying significant bandwidth between the CSS, eastern and western sites. While the raw bandwidth of the Florida Power WAN is more than sufficient to support the 6 remote workstations at the eastern site, the latencies introduced by this shared resource might interfere with the productive use of those workstations. IPS normally recommends 64kBps dedicated bandwidth to each remote workstation. This bandwidth gives an acceptable level of performance although it is noticeably slower than the operation of workstations at the server site for commands that require significant data transfers (i.e. queries returning large result sets). If Florida Power chooses the baseline configuration, then these issues must be resolved during detailed system design.

Option A

Option A adds a tertiary server and a backup communication server to the eastern site. These servers would be used when the western site is destroyed or must be evacuated. The tertiary server would contain a replicated copy of the database at the western site. The dispatchers at the eastern site would resume operations using the data on the tertiary server and using the backup communications server. They would cover both the eastern and western coverage areas. When the western site is restored, the operational data must be copied back to the western servers and operations would resume using the restored servers.

Option B

Option B adds a tertiary server to the western site and a primary and secondary database server to the eastern site in addition to those servers proposed in Option A. This is the complete configuration as described in the proposal. Each center is complete and independent. If either center is destroyed or must be evacuated, operations can continue for both coverage areas using the replicated data on the surviving side. If there is a failure of the WAN between the sites, both sites operate independently until the WAN is restored. The replication to the tertiary server on each side would continue undisturbed when the WAN was restored.

This configuration has the advantage that all workstations are local to their server. There are no latency issues introduced by remote workstations operating in the

WAN. Additionally, workstation could logon to the other site's database remotely to support the other site when the workload is greater at the remote site.

Optioned Pricing

The following schedules outline the pricing of each option. This includes details of the discounting described above. After those schedules, we include a detailed, item by item price (undiscounted) for the entire configuration.

West Site

Baseline System		LIST	DISCOUNTED
	CAD1, CAD2, Comms at West		
Software			
	IPS Product	$ 176,000	$ 88,000
	Other s/w	$ 17,278	$ 17,278
	Utility Outage	$ 474,375	$ 379,500
	FP Specific	$ 92,000	$ 92,000
	Subtotal	$ 759,653	$ 576,778
Services			
	Project Management	$ 75,000	$ 75,000
	Implementation	$ 60,000	$ 60,000
	Map	$ 17,250	$ 17,250
	Data Conversion	$ 12,500	$ 12,500
	Training	$ 52,750	$ 52,750
	Subtotal	$ 217,500	$ 217,500
Hardware			
	Servers	$ 77,615	$ 62,092
	Workstations	$ 36,882	$ 29,506
	Subtotal	$ 114,497	$ 91,598
Baseline System Total			
	Software	$ 759,653	$ 576,778
	Services	$ 217,500	$ 217,500
	Subtotal	$ 977,153	$ 794,278
	Hardware	$ 114,497	$ 91,598
	TOTAL	**$ 1,091,650**	**$ 885,876**

East Site

Baseline System		LIST	DISCOUNTED
Software			
	IPS Product	$ 91,000	$ 45,500
	Other s/w	$ 4,616	$ 4,616
	Utility Outage		$ -
	FP Specific		$ -
	Subtotal	$ 95,616	$ 50,116
Services			
	Project Management	$ 12,500	$ 12,500
	Implementation	$ 10,000	$ 10,000
	Map		
	Data Conversion		
	Subtotal	$ 22,500	$ 22,500
Hardware			
	Servers		$ -
	Workstations	$ 36,882	$ 29,506
	Subtotal	$ 36,882	$ 29,506
Baseline System Total			
	Software	$ 95,616	$ 50,116
	Services	$ 22,500	$ 22,500
	Subtotal	$ 118,116	$ 72,616
	Hardware	$ 36,882	$ 29,506
	TOTAL	**$ 154,998**	**$ 102,122**

Option A: Add Tertiary Server and backup Comms server at East

Software					Software			
	IPS Product		$ -			IPS Product	$ 25,000	$ 12,500
	Other s/w		$ -			Other s/w	$ 1,970	$ 1,970
	Utility Outage	$ -	$ -			Utility Outage		$ -
	FP Specific	$ -	$ -			FP Specific		$ -
	Subtotal	$ -	$ -			Subtotal	$ 26,970	$ 14,470
Services					Services			
	Project Management					Project Management	$ 12,500	$ 12,500
	Implementation					Implementation	$ 10,000	$ 10,000
	Map					Map		
	Data Conversion					Data Conversion		
	Training							
	Subtotal	$ -	$ -			Subtotal	$ 22,500	$ 22,500
Hardware					Hardware			
	Servers					Servers	$ 53,603	$ 42,882
	Workstations					Workstations	$ -	$ -
	Subtotal	$ -	$ -			Subtotal	$ 53,603	$ 42,882
Option A Total					Option A Total			
	Software	$ -	$ -			Software	$ 26,970	$ 14,470
	Services	$ -	$ -			Services	$ 22,500	$ 22,500
	Subtotal	$ -	$ -			Subtotal	$ 49,470	$ 36,970
	Hardware	$ -	$ -			Hardware	$ 53,603	$ 42,882
	TOTAL	**$ -**	**$ -**			**TOTAL**	**$ 103,073**	**$ 79,852**

Option B: Add Tertiary Server to West and CAD1 and CAD2 servers at East

Software					
	IPS Product	$	25,000	$	12,500
	Other s/w	$	1,970	$	1,970
	Utility Outage			$	-
	FP Specific			$	-
	Subtotal	$	26,970	$	14,470
Services					
	Project Management	$	12,500	$	12,500
	Implementation	$	10,000	$	10,000
	Map				
	Data Conversion				
	Training				
	Subtotal	$	22,500	$	22,500
Hardware					
	Servers	$	28,901	$	23,121
	Workstations			$	-
	Subtotal	$	28,901	$	23,121
Option B Total					
	Software	$	26,970	$	14,470
	Services	$	22,500	$	22,500
	Subtotal	$	49,470	$	36,970
	Hardware	$	28,901	$	23,121
	TOTAL	**$**	**78,371**	**$**	**60,091**

Software					
	IPS Product	$	85,000	$	42,500
	Other s/w	$	7,381	$	7,381
	Utility Outage			$	-
	FP Specific			$	-
	Subtotal	$	92,381	$	49,881
Services					
	Project Management	$	12,500	$	12,500
	Implementation	$	10,000	$	10,000
	Map				
	Data Conversion				
	Subtotal	$	22,500	$	22,500
Hardware					
	Servers	$	52,913	$	42,330
	Workstations			$	-
	Subtotal	$	52,913	$	42,330
Option B Total					
	Software	$	92,381	$	49,881
	Services	$	22,500	$	22,500
	Subtotal	$	114,881	$	72,381
	Hardware	$	52,913	$	42,330
	TOTAL	**$**	**167,794**	**$**	**114,711**

TOTALS

Baseline	$	1,091,650	$	885,876
Option A	$	-	$	-
Subtotal	$	1,091,650	$	885,876
Option B	$	78,371	$	60,091
Total	**$**	**1,170,021**	**$**	**945,966**

Baseline	$	154,998	$	102,122
Option A	$	103,073	$	79,852
Subtotal	$	258,071	$	181,974
Option B	$	167,794	$	114,711
Total	**$**	**425,865**	**$**	**296,685**

GRAND TOTAL BOTH SITES

Baseline	$	1,246,648	$	987,997
Option A	$	103,073	$	79,852
Subtotal	$	1,349,721	$	1,067,850
Option B	$	246,165	$	174,802
Total	**$**	**1,595,886**	**$**	**1,242,652**

ADDITIONAL S/W AND SERVICES FOR AVL/MDT

IPS s/w	*$*	*114,650*	*$*	*92,150*
TOTAL TOTAL	*$*	*1,825,186*	*$*	*1,426,952*

IPS s/w	*$*	*114,650*	*$*	*92,150*

Base Pricing **Florida Power Corporation Outage Management System**

Item Description	Purpose	Required or Optional	Qty	Unit Cost	Total Cost
Interserve 8000 2 (200Mhz) Pentium Pro Processor 512KB Cache 128 MB RAM, ECC 3 - 9.1 Gigabyte Drives RAID CD ROM Drive 100 Base-T Ready Keyboard and Mouse Microsoft Windows NT Server InterSite Server Monitor InterSite DiskKeeper Network Cable 15 Inch Monitor Modem for Support 136 Column Logging Printer	Primary Database Server (East and West)	R	2	$ 24,702	$ 49,404
Oracle SQL-Plus	Database Administration Tool	R	2	$ 495	$ 990
Oracle Workgroup Server Licenses	CAD Database Access	R	24	$ 295	$ 7,080
I/Executive	I/CAD Database Server Software	R	2	$ 35,000	$ 70,000
DiskAccess NFS Client (25 User License)	NFS Client Access	O	1	$ 5,281	$ 5,281
Interserve 8000 2 (200Mhz) Pentium Pro Processor 512 Cache 128 MB RAM, ECC 3 - 9.1 Gigabyte Drives RAID CD ROM Drive 100 Base-T Ready Keyboard and Mouse Microsoft Windows NT Server InterSite Server Monitor InterSite DiskKeeper Network Cable 9.1GB Backup Disk Drive 15 Inch Monitor 136 Column Logging Printer 14GB 8mmXL Internal Cartridge Tape	Secondary Database Server (East and West)	R	2	$ 28,211	$ 56,422
Oracle SQL-Plus	Administrative Tool	R	2	$ 495	$ 990
Oracle Workgroup Server Licenses	CAD Redundant Database	R	10	$ 295	$ 2,950
I/Executive2	I/CAD Database Server Software	R	2	$ 25,000	$ 50,000
Visual C++	Configuration Tool	R	2	$ 476	$ 952
Microsoft Office Developer edition	Administrative Tool	R	2	$ 900	$ 1,800
I/MARS Server	Analytical Reporting	R	2	$ 25,000	$ 50,000

Item Description	Purpose	Required or Optional	Qty	Unit Cost	Total Cost
Interserve 8000 2 (200Mhz) Pentium Pro Processor 512 Cache 128 MB RAM, ECC 3 - 9.1 Gigabyte Drives RAID CD ROM 100 Base-T Ready Keyboard and Mouse Windows NT Server InterSite Server Monitor InterSite DiskKeeper Network Cable 136 Column Printer 15 Inch Monitor	Server for Interface Communications	R	2	$ 24,702	$ 49,404
I/MDT	Server Side Mobile Data Product	R	2	$ 57,700	$ 115,400
I/Tracker	Server Side GPS Product	R	2	$ 56,950	$ 113,900
Interserve 8000 4 (200 Mhz) Pentium Pro Processor 512 Cache 256 MB RAM, ECC 3 - 9.1 Gigabyte Drives RAID CD ROM 100 Base-T Ready Keyboard and IntelliMouse Windows NT Server InterSite Server Monitor InterSite DiskKeeper Network Cable 136 Column Printer 14GB 8mmXL Int. Cartridge Tape 15 Inch Monitor	Terterary Database Server (Site Backup)	O	2	$ 28,901	$ 57,802
I/Backup	Offsite Backup/Replication	R	2	$ 25,000	$ 50,000
Oracle SQL-Plus	Database Administration Tool	R	2	$ 495	$ 990
Oracle Workgroup Server Licenses	Interface Database Access	R	10	$ 295	$ 2,950
NT Client Access Licenses	NT Client Access Licenses (Additional)	R	0	$ 40	$ -

Item Description	Purpose	Required or Optional	Qty	Unit Cost	Total Cost
TD-225B Workstation	Dispatch Workstations	R	10	$ 6,147	$ 61,470
300 MHz Pentium II					
64MB RAM					
Millennium II graphics					
5.2 Gigabyte Disk					
Network Ready					
Microsoft NT Workstation					
Microsoft Office '97 - Small Business Edition					
Keyboard and IntelliMouse					
Single to Dual Monitor Adapter					
Dual 21-Inch Multi-Sync Monitors					
50 Foot UTP Cat 5 Network Cable					
I/Dispatcher	IPS CAD Software	R	10	$ 15,000	$ 150,000

Item Description	Purpose	Required or Optional	Qty	Unit Cost	Total Cost
TD-225B Workstation 300 MHz Pentium II 64MB RAM Millennium II graphics 5.2 Gigabyte Disk Network Ready Microsoft NT Workstation Microsoft Office '97 - Small Business Edition Keyboard and IntelliMouse Single to Dual Monitor Adapter Dual 21-Inch Multi-Sync Monitors 50 Foot UTP Cat 5 Network Cable	Supervisor Workstations	R	2	$ 6,147	$ 12,294
I/Dispatcher	IPS CAD Software	R	2	$ 15,000	$ 30,000
I/MARS Client	Management Analysis and Reporting	R	2	$ 1,000	$ 2,000
MS Office Professional	Reporting Tool	R	2	$ 621	$ 1,242
Microstation	CAD Map Editing Tool	R	2	$ 3,995	$ 7,990
Panasonic CF-25 166 MHz Pentium w/MMX 32MB RAM 10X CD-ROM 1.35 Gigabyte Disk 10.4in TFT Screen Sierra Wireless CDPD Modem w/GPS Microsoft Windows 95 In-Vehicle Mounting Hardware Antennas Voltage Armour (Power Cond. and Auto Cutoff) In-Vehicle Mounting Services	Mobile Computer	R	310	$ 8,064	$ 2,499,871
I/Mobile	IPS Mobile Data Client Software	R	300	$ 2,067	$ 620,000
Outage Management Software	Software which can be Productized	R	1	$ 474,375	$ 474,375
Outage Management Software	Project Specific Software	R	1	$ 92,000	$ 92,000

Item Description	Purpose	Required or Optional	Qty	Unit Cost	Total Cost
Services:					
Project Management		R	1	$ 125,000	$ 125,000
CAD Implementation		R	1	$ 100,000	$ 100,000
CAD Map Implementation		R	1	$ 17,250	$ 17,250
Data Conversion Consultation		R	1	$ 12,500	$ 12,500
Training:					
I/CAD Train-the-Trainer		R	1	$ 12,500	$ 12,500
I/CAD Configuration & Imple. Training		R	1	$ 6,750	$ 6,750
I/CAD System Administrator Training		R	1	$ 6,750	$ 6,750
I/CAD CADDBM Training		R	1	$ 4,450	$ 4,450
I/CAD CADTools Training		R	1	$ 4,450	$ 4,450
CAD Map Fundamentals Workshop		R	1	$ 4,450	$ 4,450
CAD Map Maintenance		R	1	$ 5,500	$ 5,500
I/MARS Administrator Training		R	1	$ 5,100	$ 5,100
I/MARS User Training		R	1	$ 2,800	$ 2,800
Other:					
			1	$ -	$ -
Shipping and Insurance		R	1	$ 500	$ 500
Installation		R	1	$ 3,600	$ 3,600

TOTAL SYSTEM BASE PRICE:					
Tax (Prices are exclusive of tax)	Tax Exemption assumed				$ -
Sub-Total Exclusive of Options					**$ 4,949,157**
Base System Discount					$ -
Total Exclusive of Options					**$ 4,949,157**

System Maintenance for Florida Power Corporation Outage Management System

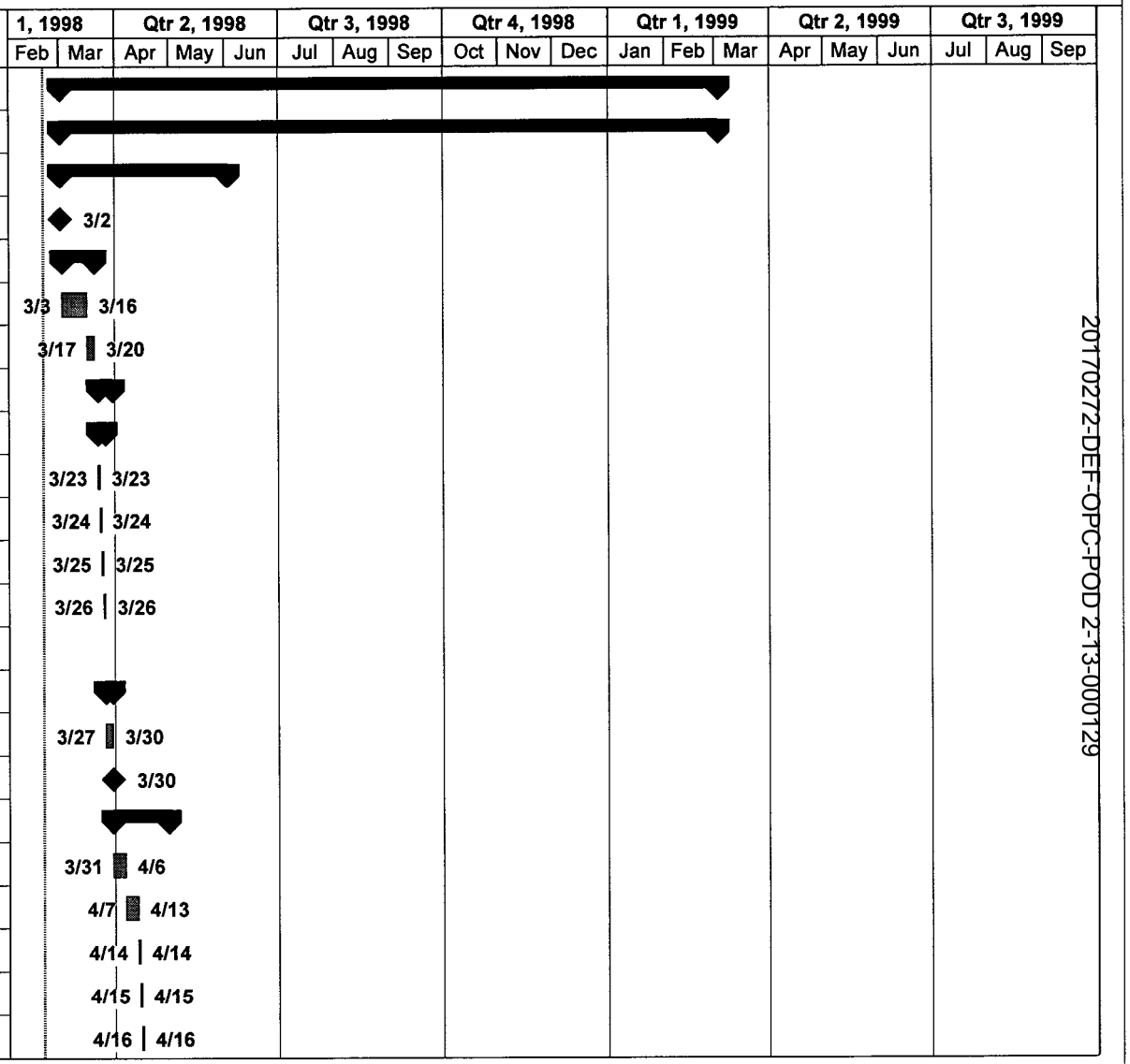
Plan 1 – Per Call Hardware Maintenance Rates (portal to portal):			
During PPM	per hour (minimum 2 hours) plus travel expenses	$	150
Outside PPM	per hour (minimum 2 hours) plus travel expenses	$	180

Plan 2 – Annual Full Service Plan (8 hour response)	
Base Configuration (1 set of servers)	
Intergraph Hardware	$22,348
IPS Software	$66,184
Base Configuration Plus Option A	
Intergraph Hardware	$29,670
IPS Software	$69,934
Base Configuration Plus Option A and B	
Intergraph Hardware	$40,590
IPS Software	$93,184
Mobile Computer System	
Intergraph I/Mobile Software	$93,000
Mobile Computer Hardware	$40,000

Plan 3 – Resident Engineer		
Resident Engineer	$	105,000

Florida Power Corporation OMS Implementation Schedule

ID	Task Name
1	**Florida Power Outage Management System Project**
2	**PHASE I BASE SYSTEMS**
3	**DEFINE PHASE**
4	***Contract Approved***
5	**Contract/Statement of Work Review**
6	Contract/Statement of Work Review (Internal)
7	Project Team Defined
8	**Project Requirements Review with Client**
9	**Requirements Review with Client**
10	Project Kickoff Meeting with Customer
11	Analysis of Schedule Requirements
12	Analysis of Deliverables Requirements
13	Establish Project Organizational Structure
14	Analysis of Training Requirements
15	**W.A. Review**
16	Confirm Materials and Services Match Contract
17	***Project Analysis Complete***
18	**Create Implementation Plan**
19	Draft for Internal Review
20	Internal Review
21	Resolution of Differences
22	Create Final Draft
23	Obtain Internal Approvals



20170272-DEF-OPC-POD 2-13-000129

Florida Power Corporation OMS
Date: 2/20/98

Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone ◇
Rolled Up Progress

Florida Power Corporation OMS Implementation Schedule

ID	Task Name	1, 1998		Qtr 2, 1998			Qtr 3, 1998			Qtr 4, 1998			Qtr 1, 1999			Qtr 2, 1999			Qtr 3, 1999		
		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
24	Submit to Client																				
25	Client Approval Process			4/17		4/30															
26	***Implementation Plan Acceptance***					4/30															
27	**Create Training Plan**																				
28	Draft for Internal Review			5/1		5/7															
29	Internal Review			5/8		5/14															
30	Resolution of Differences			5/15		5/18															
31	Create Final Draft			5/19		5/19															
32	Obtain Internal Approvals																				
33	Submit to Client																				
34	Client Approval Process			5/20		6/2															
35	***Training Plan Acceptance***					6/2															
36	**DESIGN PHASE**																				
37	**System Configuration Management**																				
38	Develop/Modify Configuration Drawing			4/14		4/20															
39	Internal Review by Project Team			4/21		4/27															
40	Revise Configuration Drawing			4/28		4/28															
41	Order Hardware (for CAD imp training)			5/1		6/4															
42	**Facility Design**																				
43	Verify Hardware Placement			5/1		5/8															
44	**Map Design Overview**																				
45	MAP Data Collection/Configuration Workshop			5/1		5/5															
46	**I/CAD Overview**																				

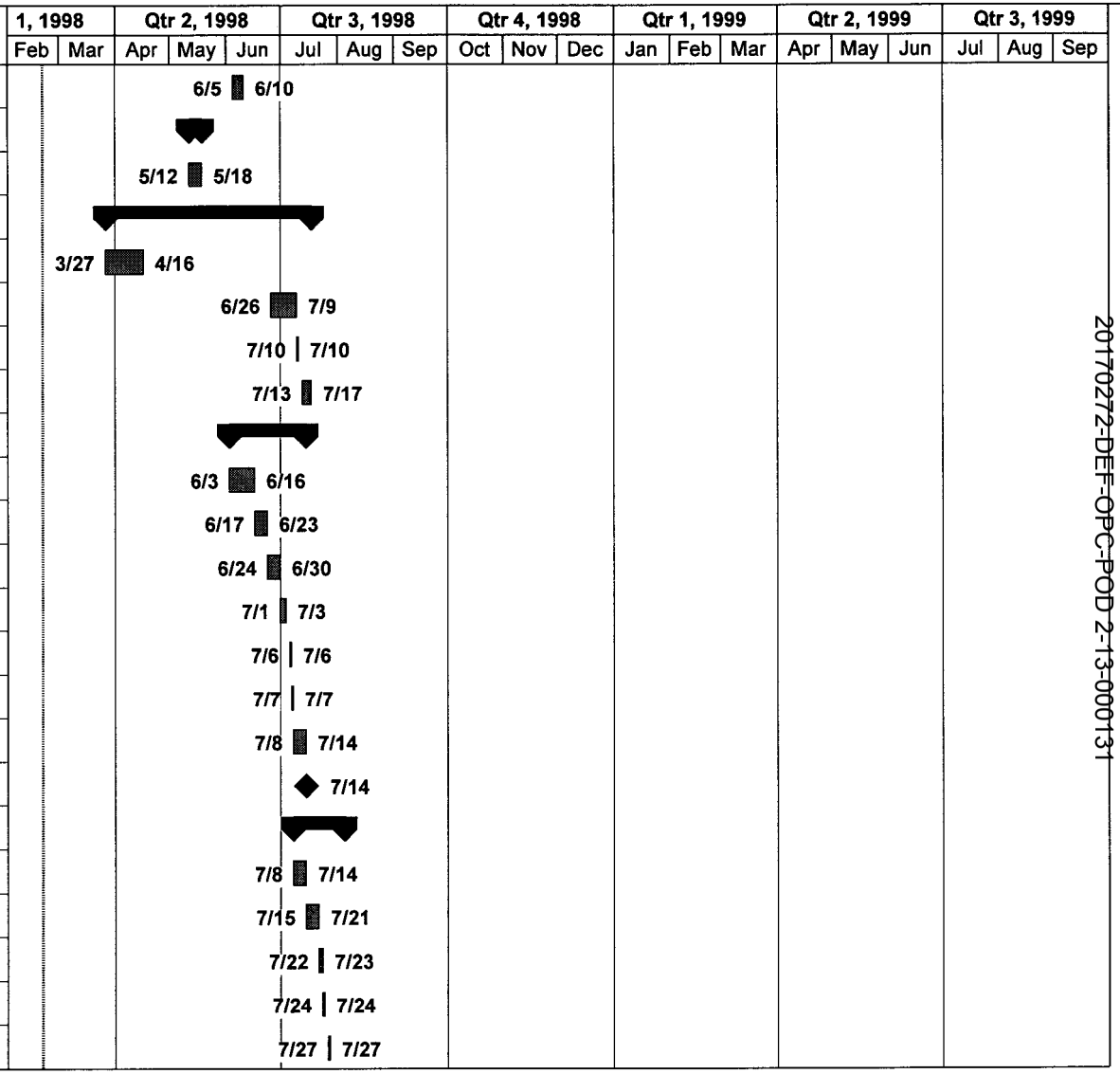
20170272-DEF-OPC-POD 2-13-000130

Florida Power Corporation OMS
Date: 2/20/98

Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone ◇
Rolled Up Progress

Florida Power Corporation OMS Implementation Schedule

ID	Task Name	
47	Configuration/Implementation Workshop	6/5 6/10
48	**OMS Design Overview**	
49	Conduct Final OMS Design Overview	5/12 5/18
50	**Data Conversion analysis**	
51	Review Existing Data	3/27 4/16
52	Prepare Data Conversion Plan	6/26 7/9
53	Submit Data Conversion Plan	7/10 7/10
54	Data Conversion Plan Approval	7/13 7/17
55	**Create Cut-Over Plan**	
56	Draft for Internal Review	6/3 6/16
57	Internal Review	6/17 6/23
58	Resolution of Differences	6/24 6/30
59	Create Final Draft	7/1 7/3
60	Obtain Internal Approvals	7/6 7/6
61	Submit to Client	7/7 7/7
62	Client Approval Process	7/8 7/14
63	***Cut-Over Plan Acceptance***	7/14
64	**Create Acceptance Test Plan**	
65	Draft Acceptance Test Plan	7/8 7/14
66	Internal Review	7/15 7/21
67	Resolution of Differences	7/22 7/23
68	Create Final Draft	7/24 7/24
69	Obtain Internal Approvals	7/27 7/27



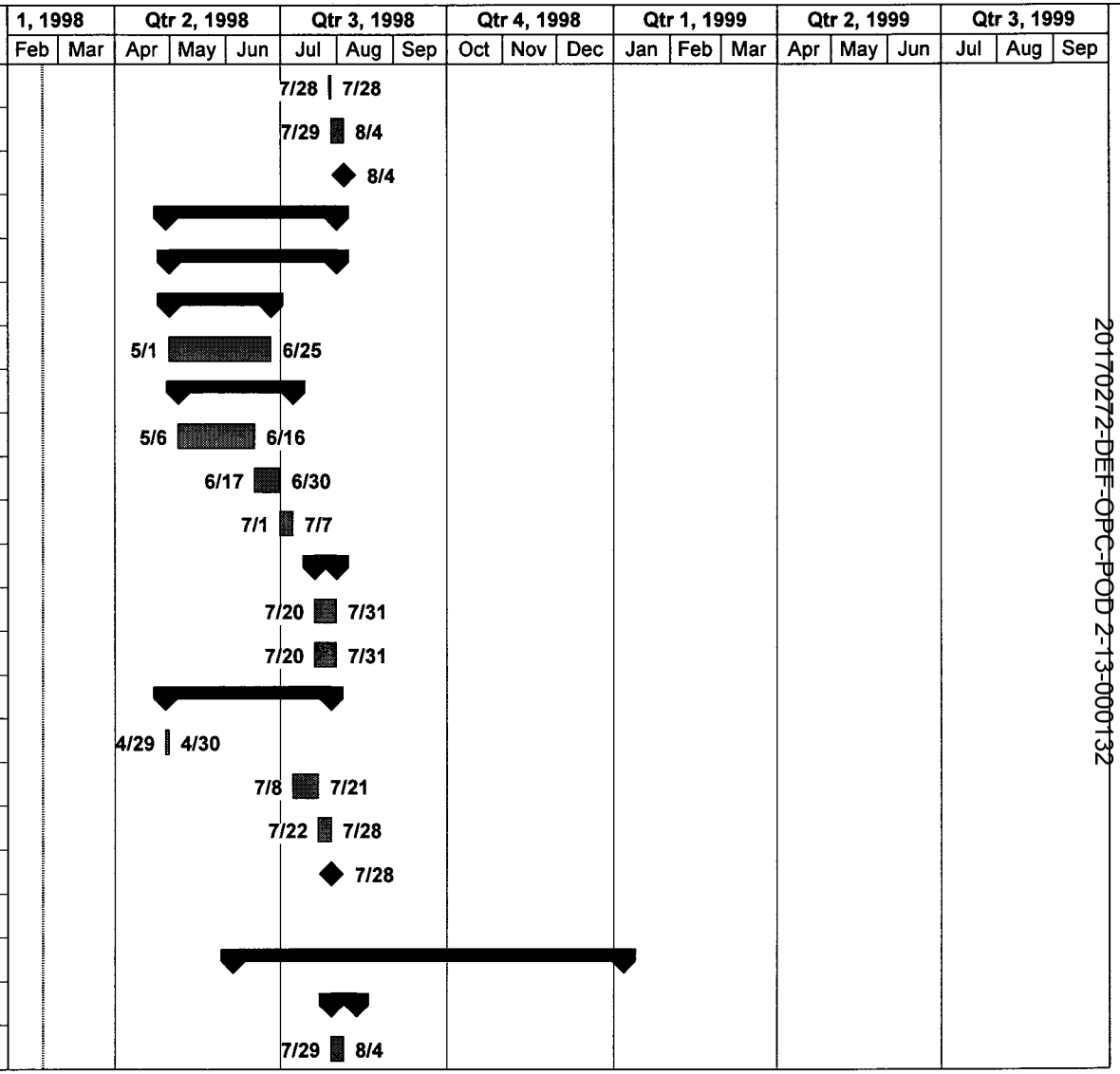
20170272-DEF-OPC-POD 2-13-000131

Florida Power Corporation OMS
Date: 2/20/98

Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress

Florida Power Corporation OMS Implementation Schedule

ID	Task Name
70	*Submit to Client*
71	*Client Approval Process*
72	*Acceptance Test Plan Acceptance*
73	**BUILD PHASE**
74	**System Build and Development**
75	**I/CAD Development**
76	Prepare I/CAD Database
77	**I/CAD Map Development**
78	Prepare I/CAD Map
79	Review of Production Ready I/CAD Map
80	Load Production Ready Map in I/CAD
81	**Data Conversion Development/Implementation**
82	CAD
83	Frame/OMS
84	**Stage H/W & S/W**
85	Verify Configuration
86	Configure System
87	Verify Proper I/CAD Execution
88	**Staging Activities Complete**
89	
90	**DELIVER PHASE**
91	**Ship & Install H/W**
92	Hardware Shipment



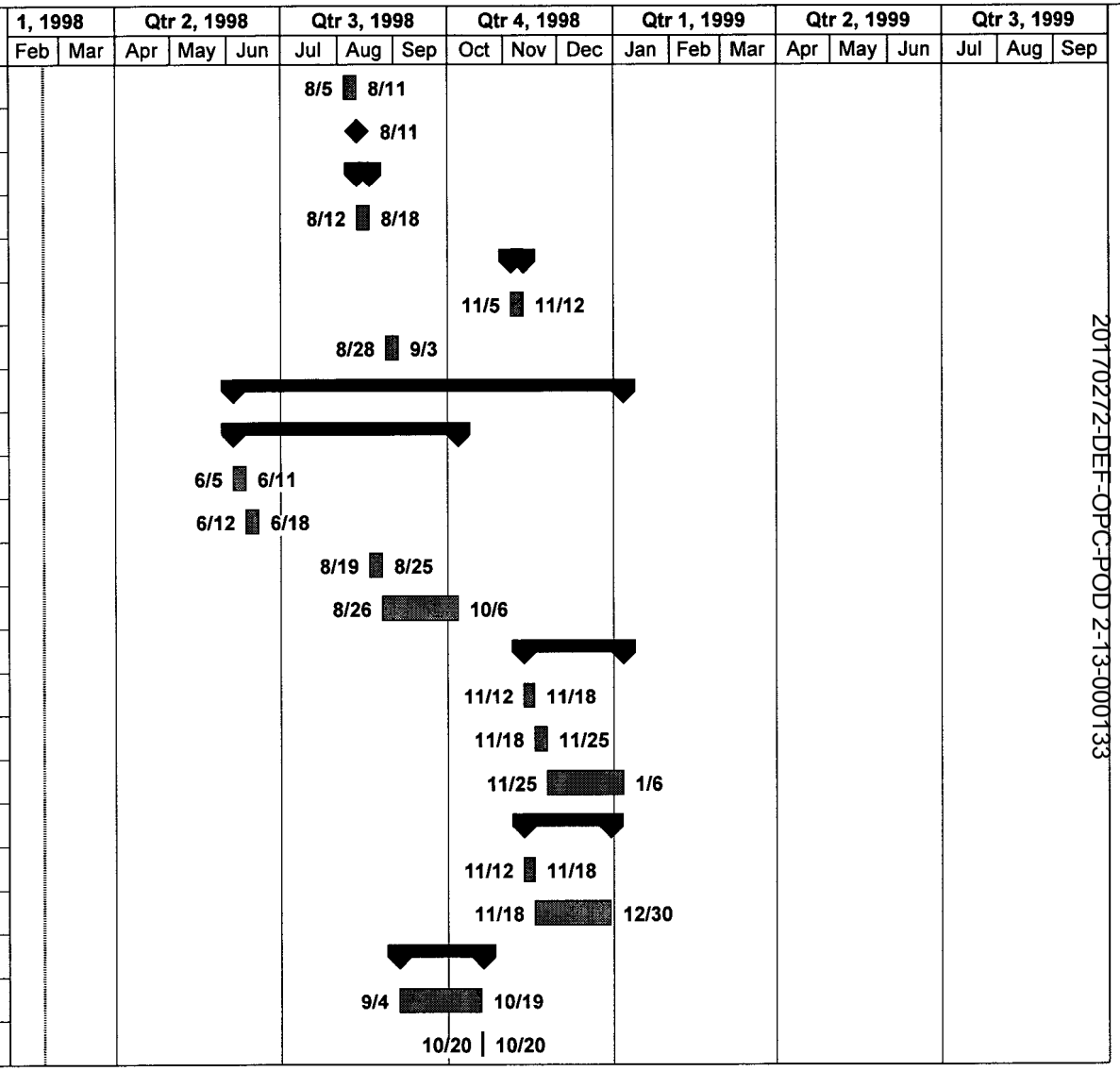
20170272-DEF-OPC-POD 2-13-000132

Florida Power Corporation OMS
Date: 2/20/98

Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone ◇
Rolled Up Progress

Florida Power Corporation OMS Implementation Schedule

ID	Task Name
93	Installation at Site
94	**Hardware Acceptance**
95	**Ship and Install I/CAD S/W**
96	***Install and Verify I/CAD S/W***
97	**Ship and Install OMS Software**
98	Install and Verify OMS Software
99	**Install and Verify I/MARS S/W**
100	**Execute Training Plan**
101	***I/CAD Training***
102	CADDBM/CADTOOLS
103	System Administrator
104	Train the Trainer
105	In-House Customer Training
106	**OMS Training**
107	System Administrator
108	Train the Trainer
109	In-House Customer Training
110	**I/Mobile Training**
111	Train the Trainer
112	In-House Customer Training
113	**I/MARS Training**
114	I/MARS Admin
115	I/MARS User

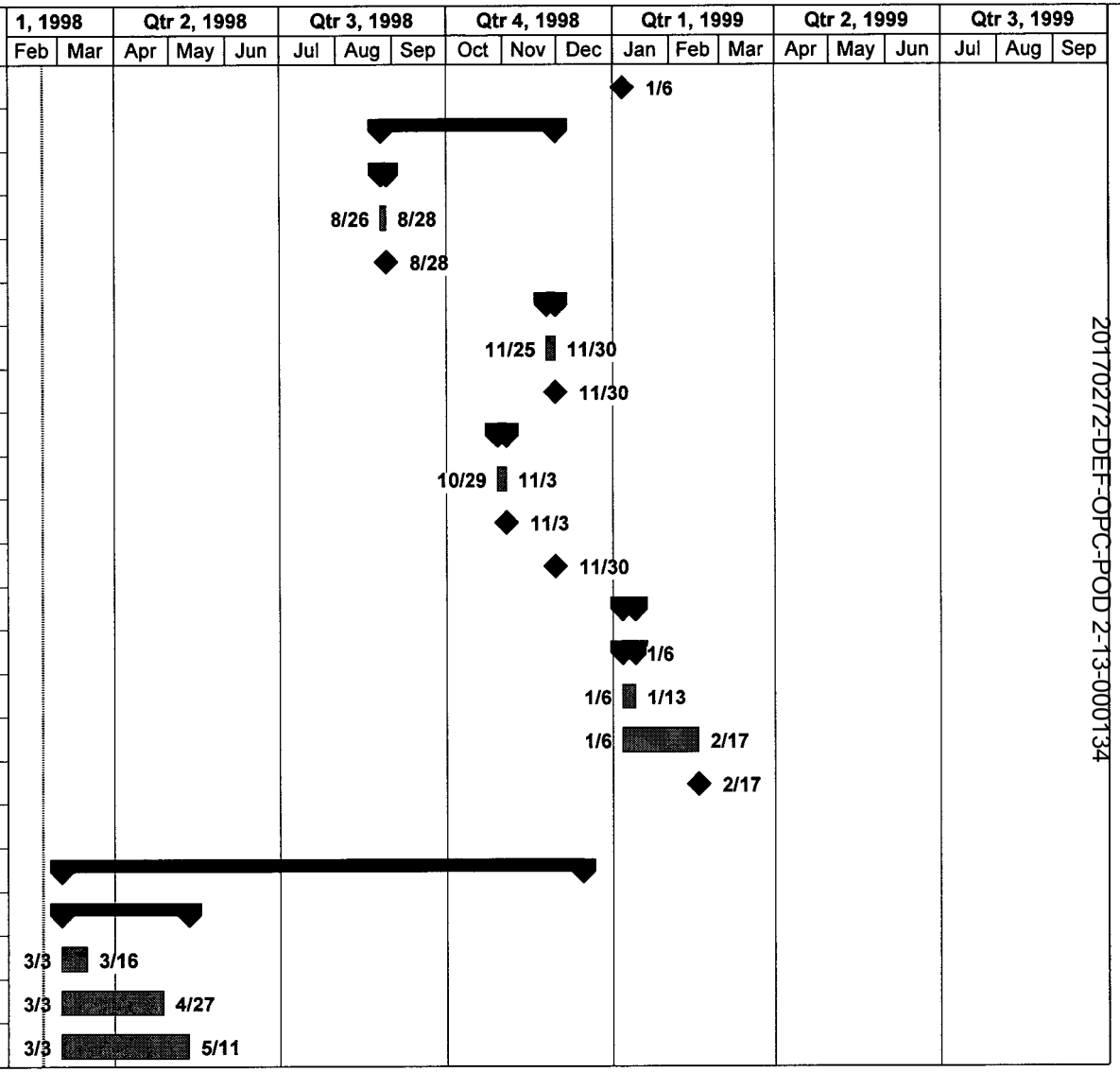


Florida Power Corporation OMS
Date: 2/20/98

Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress

Florida Power Corporation OMS Implementation Schedule

ID	Task Name
116	*Training Complete*
117	**Execute Acceptance Test Plan**
118	**Execute I/CAD System Acceptance Test Plan**
119	I/CAD Functional Testing
120	*I/CAD Functional /System Test Acceptance*
121	**Execute OMS System Acceptance Test Plan**
122	OMS Functional Testing
123	*OMS Functional/System Test Acceptance*
124	**Execute I/Mobile Acceptance Test Plan**
125	I/Mobile Functional Testing
126	*I/Mobile Functional/System Test Acceptance*
127	**System Acceptance Test Complete**
128	**Ready for Live Operations**
129	**Ready for Live Operations**
130	Commence Cutover
131	**Acceptance Period**
132	**Base System Acceptance**
133	
134	**Outage Management Software Development**
135	**Design OMS Software**
136	Batch Call Creation
137	Trouble Analysis
138	Additions to I/Dispatcher

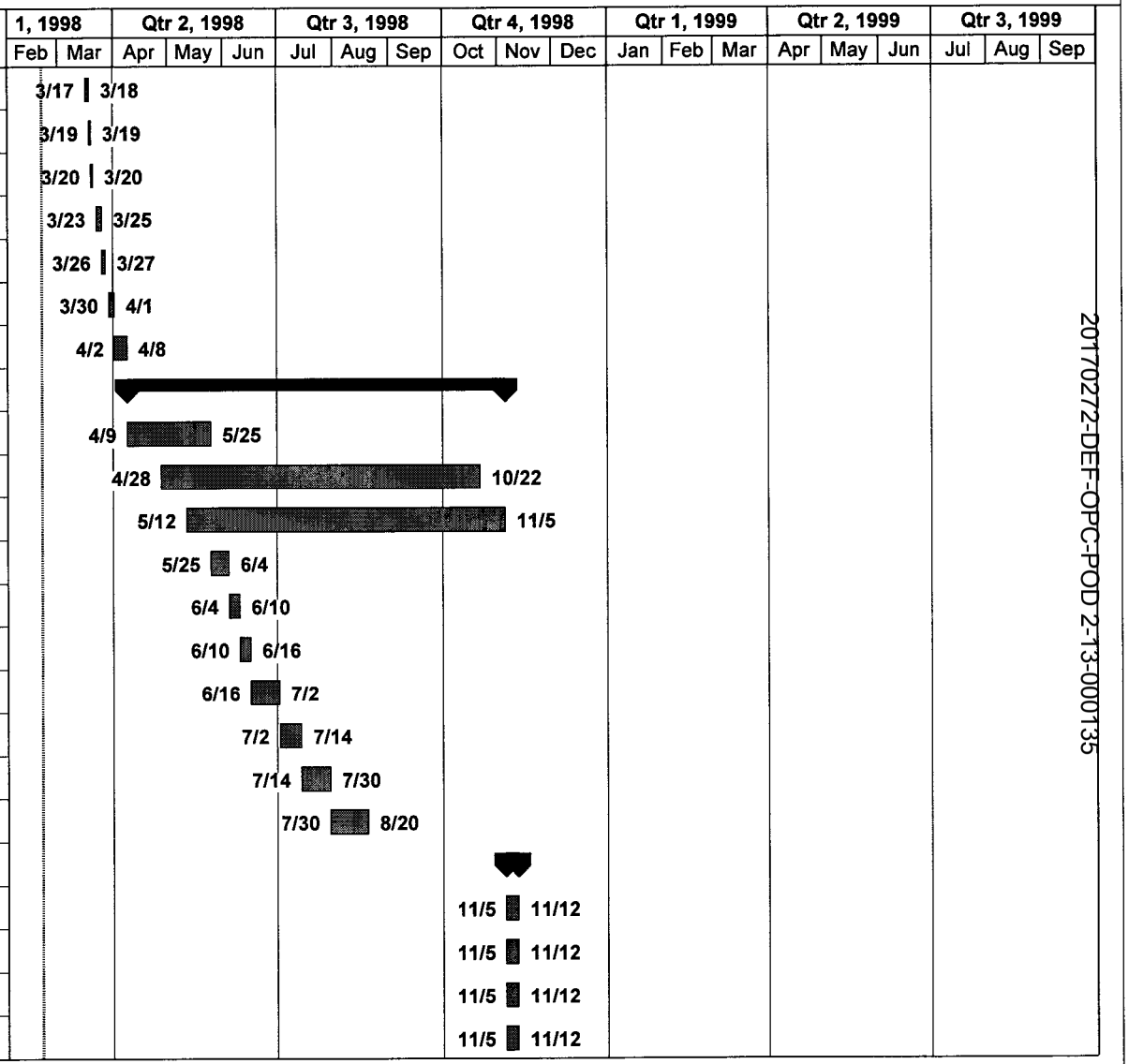


Florida Power Corporation OMS
Date: 2/20/98

Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress

Florida Power Corporation OMS Implementation Schedule

ID	Task Name	Start	Finish
139	Interface to WMS	3/17	3/18
140	Interface to Human Resources Data	3/19	3/19
141	Interface to SCADA System	3/20	3/20
142	Interface to AODS System	3/23	3/25
143	Interface to CSS System	3/26	3/27
144	Interface to VRU System	3/30	4/1
145	Additions to I/Mobile and I/MDT	4/2	4/8
146	**Develop OMS Software**		
147	Batch Call Creation	4/9	5/25
148	Trouble Analysis	4/28	10/22
149	Additions to I/Dispatcher	5/12	11/5
150	Interface to WMS	5/25	6/4
151	Interface to Human Resources Data	6/4	6/10
152	Interface to SCADA System	6/10	6/16
153	Interface to AODS System	6/16	7/2
154	Interface to CSS System	7/2	7/14
155	Interface to VRU System	7/14	7/30
156	Additions to I/Mobile and I/MDT	7/30	8/20
157	**Deliver OMS Software**		
158	Batch Call Creation	11/5	11/12
159	Trouble Analysis	11/5	11/12
160	Additions to I/Dispatcher	11/5	11/12
161	Interface to WMS	11/5	11/12



20170272-DEF-OPC-POD 2-13-000135

Florida Power Corporation OMS
Date: 2/20/98

Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress

Florida Power Corporation OMS Implementation Schedule

ID	Task Name	1, 1998 Feb	Mar	Qtr 2, 1998 Apr	May	Jun	Qtr 3, 1998 Jul	Aug	Sep	Qtr 4, 1998 Oct	Nov	Dec	Qtr 1, 1999 Jan	Feb	Mar	Qtr 2, 1999 Apr	May	Jun	Qtr 3, 1999 Jul	Aug	Sep
162	Interface to Human Resources Data									11/5		11/12									
163	Interface to SCADA System									11/5		11/12									
164	Interface to AODS System									11/5		11/12									
165	Interface to CSS System									11/5		11/12									
166	Interface to VRU System									11/5		11/12									
167	Additions to I/Mobile and I/MDT									11/5		11/12									
168	**I/MDT, I/Tracker and I/Mobile Project Implementation**																				
169	Design Software Implementation						8/20		9/1												
170	Develop Software Implementation							9/1			10/15										
171	Install Software								10/15			10/29									
172	Install Mobile Computers									11/3			12/15								
173	**Reconcile/Close Project Files**													2/17	3/3						

20170272-DEF-OPC-POD 2-13-000136

Florida Power Corporation OMS
Date: 2/20/98

Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress

APPENDIX E

I/CAD SYSTEM OVERVIEW

1.0 INTRODUCTION

This overview contains supplemental information about the IPS/Computer-Aided Dispatch (I/CAD) System hardware configuration and software components. It is intended to provide integral information in order to enhance understanding of the Windows NT operating system, I/CAD and third-party software applications, and to provide a rationale for the system architecture.

In developing the I/CAD System, IPS selected both equipment and software that adhere to current industry standards and that provide on-going commercial viability. The long-term performance, reliability, future expandability, and system maintenance of the system depends upon the use of industry standard hardware and software and the commercial strength of each product component.

The IPS software solution for public safety is a proven performer. Each component is a standard application; no application product within the I/CAD System requires custom software designed for a single user, installed at a site-specific location. As standard software, I/CAD applications are updated regularly, and features are added to introduce new and improved procedures and processes, to take advantage of new standards and new radio and telephone technologies, to resolve problems addressed by the customer base, and to satisfy new government regulations. Every customer with a full maintenance agreement receives I/CAD software upgrades for no additional cost.

The I/CAD System hardware configuration is a network-based, distributed computing environment with each workstation running its own application software and having sufficient processor and disk capacity to run its tasks in isolation. These workstations communicate with, and through, the Database Server(s) and the Interface/Communications Server over a local area network (LAN) or a wide area network (WAN). This distributed approach avoids interdependence and leads to a simple and elegant solution.

The easiest way to explain the overall system architecture is to present it in layers or levels, which separately address the system hardware and software configurations. Section 2.0 of this document, System Architecture, provides a high level overview of the hardware environment and the system software. Section 3.0 provides a detailed discussion of the various software modules used to build the I/CAD software and operating environment; Section 4.0 addresses system security; Section 5.0 delineates the IPS hardware used to configure the system; and Section 6.0 provides a rationale for both

the selection of Windows NT as the IPS operating system and the for hardware architecture.

To ensure a mutual understanding of the features and characteristics of the I/CAD System, this addendum first defines specific terminology used throughout the document to discuss both the public safety environment and the I/CAD System.

1.1 Definitions

I/CAD and I/CAD System

I/CAD is an encompassing term, describing the suite of software products that constitute the complete Computer Aided Dispatch System from IPS. I/CAD does not refer to a specific software product, but to the software architecture that includes both IPS and third-party applications. An example of another software suite is Microsoft Office, which provides a set of products that creates a specific documentation environment.

I/CAD System refers to the complete hardware and software product from IPS, including the system architecture.

Event and Event Type

An I/CAD event is defined as an incident requiring action by Police, Fire, or Emergency Medical Services (EMS), such as a burglary, a home fire, or a medical emergency.

Event types are used to categorize calls by a user agency. Event types are entered during the call taking process and are validated against predefined event types in the I/CAD database. Each agency can specify the following event type parameters:

- Literal names of event types
- Event type codes (such as 10-codes)
- Approved abbreviations
- Yes/no responses indicating whether an agency should respond to an event type
- Event type priority assignments
- Appropriate unit assignments
- Event type timer alarms
- Pre-defined special instructions associated with an event type

- Whether or not a "location of interest" should be automatically performed for the event type

Unit

A unit represents a piece of apparatus used to respond to events, such as, a policeman's patrol car, a fire truck, or a specialized medical services vehicle.

For every unit entered into the system, a list of attributes exists. Attribute information that can be modified includes:

- Unit ID (usually unit IDs are assigned by radio call sign)
- Unit type (squad car, pumper, or Advanced or Basic Life Support ambulance, for example)
- Page group assignment
- Agency ID
- Station ID
- Dispatch group assignment
- Area/beat assignment
- Permanent deployment location (station or precinct)
- X-coordinate of a unit's location
- Y-coordinate of a unit's location
- Availability
  - via radio
  - at quarters or permanent deployment location
- Graphic map display symbol

In addition to the unit attributes, vehicle attributes can be added to the database. Vehicle attributes allow customers to specify:

- Vehicle ID
- Agency ID
- MDT address
- Availability
  - Voice
  - MDT
- Page code assignment

- Automatic paging
- Unit equipment list (up to eight)
- Vehicle maximums
  - Height
  - Width
  - Weight

Specifying unit and vehicle attributes allows the IPS software to effectively log units on and off, recommend the proper units for event handling, and locate units with special characteristics, such as skills or equipment.

Call for Service

An I/CAD Call for Service is a request for assistance.

Resources

Customers can organize physical and human resources into groups that relate to daily activity, including:

- Personnel rosters that include all available personnel resources
- Personnel lineups that are specific to personnel shift resources
- Deployment plans or variable response allocations
- Dispatch groups or related resources under the control of one dispatcher or of a group of dispatchers

The organization of data into I/CAD tables provides the application software with base information regarding available units and personnel and allows assignment of dispatch responsibilities and recommendations.

Agency

An I/CAD agency is an organizational entity that provides a service response in the public safety environment. Each participating agency is defined in the I/CAD database. This process specifies the following:

- Name, address, and type of each agency
- Point-of-contact name and number
- Area/beat and line-up plans for resources
- Agency-unique event and case number sequencing

Police, Fire, and Ambulance are obvious high-level examples of agencies. However, the agency definition can be extended to include

other special needs, such as a SWAT team, a special investigation team, or a drug task force squad. In fact, *an agency can be any physical or abstract entity that has resources and that has defined deployment plans, types of events, and priorities*. Agencies are automatically involved in the dispatching operation when an incident results in an event type that requires a response from that agency. For example, "burglary-in-progress" might be a code that requires a Police agency response. Event types are initially assigned during the call taking process but may be updated as more information becomes available.

The agency is a point of planning, with each having its own resource deployment plans stored in the I/CAD database. The deployment plan contains beat, backup beats, and dispatch group by Emergency Service Zone (ESZ). As shifts change or as special events occur, different deployment plans can be invoked by the operator. Larger agencies are normally broken into districts and dispatching occurs at that level.

Using the deployment plan for an agency at the ESZ level provides a great deal of flexibility. Special deployment plans can be created, moving assigned territories as shifts change or to meet special situations. For example, a customer could establish a special deployment plan for use during a major automobile racing event. This type of planning takes place at the agency level.

Dispatch Groups

When a dispatcher logs onto I/CAD, that dispatcher becomes a member of a dispatch group. Specific dispatch group assignments are made based on I/CAD username, password, and access privileges. The information used to make this determination is part of the system configuration, which also specifies the workstation(s) the operator can use.

Being made a member of a specific dispatch group results in the dispatcher being assigned to an agency and an area (district). The area is usually one that the dispatcher knows well. Incumbent within the agency assignment are resources, such as units, unit personnel and equipment, a resource deployment plan, and coding for types of incidents and priorities. Units can then be logged on and logged off as shifts change, and equipment can be added or removed from service as the dispatcher manages the assigned area and resources.

When a service call is received and the address verified, the I/CAD System immediately designates an area. The call taker need only specify the nature of the call (event type) to determine which agency or agencies should respond. Based on the area/agency determination, the call is assigned to a dispatch group, and, after the event is created by the call taker, is automatically sent by the I/CAD System to a dispatcher responsible for that dispatch group.

Dispatchers receive calls to dispatch, evaluate the resource(s) needed and the resources available for that area, and use the I/CAD System to dispatch accordingly. Dispatchers are literally in control of a geographic area using the resources that have been assigned. I/CAD assists dispatchers by displaying up-to-date information about the area on the map, in the Pending Events window, and in the Unit/Event Status window. Database information relevant to any map symbol, such as building footprints or utilities systems, can be accessed by simply clicking on the symbol, and the positions of units equipped with Automatic Vehicle Location (AVL) devices are updated on the map in near real-time. The event status is often shown on both the map and in a dialog box. In addition, I/CAD can assist dispatchers by making resource and routing recommendations. For example, the system can recommend the nearest unit to handle an accident and be intelligent as it does so, making sure that special skills of the personnel or special equipment needs are considered.

The use of dispatch groups seems obvious when one considers the task of dispatching, and, during system customization, the concept, can be extended. For example, if it were necessary for dispatchers at a designated secondary center to take over the dispatching responsibility for a primary center, the transfer of operations can be accomplished using dispatch groups. In this situation, special usernames, passwords, and dispatch groups would be set up at the secondary center, and operators would use them to log on. At log on, operators would then become members of a dispatch group designated to receive calls normally sent to the primary center.

This empowers the operators at the secondary dispatch center to perform the dispatching functions and to command the resources, as needed, to satisfy requests.

In a computer science sense, the practical concept of a "dispatch group" is a virtual capability and can be applied in many ways.

Response Lists

Response lists are used to generate specific levels of response for particular event types. Response lists determine the following, based on event type and priority:

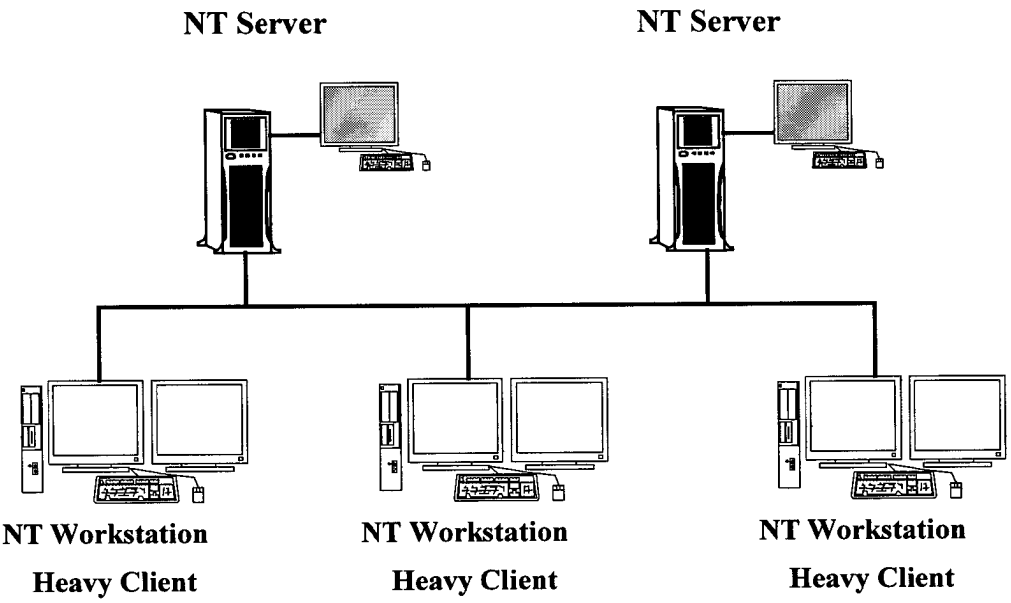
- Number of units to dispatch
- Types of units to dispatch, including specific attributes, skills, and equipment
- Alternate choices of unit types
- Other agency responses, if a multi-agency center

Because response lists specify unit types rather than specific units, the same list can be used for several different event types and by several different agencies. For example, in a Police Response List, the system administrator might create a list designated "A-1," which calls for two regular patrol cars and one detective to respond to a particular event type. Response list "A-1," therefore, could be associated with any agency or any police event requiring two patrol cars and one detective assignment. Also, agencies may have the same event types defined in I/CAD that result in the creation of multi-agency responses from a single call for service. For example, an "accident with injury and a fuel spill" can automatically create an event for Police, Fire, and Ambulance response.

2.0 SYSTEM ARCHITECTURE

2.1 Client/Server

The high-level overview of the I/CAD System architecture is a simple client/server topology using a LAN, as illustrated below.



High-Level Overview of the I/CAD System

This configuration consists of two types of machines: servers and clients. Each machine functions as a complete and powerful system with its own disk, memory, CPU, and other components. The software functionality within the configuration is located, as needed, to maximize the distribution of processing and availability. I/CAD System clients are not "thin clients" that have minimum functionality with most of the processing being done on the server. The IPS system does not resemble a mainframe with terminals. In the I/CAD System environment, each client workstation supports a large amount of the processing, hence the term "heavy client." The system allocates functionality where it is most needed. As an example, one or more servers provide the functionality of the Database Server, which centralizes and maintains the I/CAD database, guarantees the integrity of the data, and allows proper data sharing. An Interface/Communications Server is used to support peripheral processes.

I/Dispatcher is an example of client software; it is resident on each dispatch workstation and provides all dispatcher functionality locally. All hardware is more efficiently used because of this distributed processing system. In addition, the system is easy to expand by adding workstations as the need for more dispatcher positions grows. If activity on

one of the servers becomes too great, new servers can be added and processes moved accordingly.

The client/server topology maximizes functionality where it is needed, allows for system growth, and provides continuous processing in the event of a hardware failure. User functionality can be enhanced, frequently by adding client software at the workstation level and, often, by adding a server to the network.

2.2 Commercial-off-the-Shelf (COTS)

The I/CAD System is built from widely-used, standard products that are available from IPS, as well as from external sources. Most of the non-IPS products are commodity products. IPS software products are referred to as commercial-off-the-shelf (COTS) products and are designed to be available to the marketplace as a whole. All I/CAD System customers run standard COTS products, with each software system customized to meet specific needs by setting extensive user-definable parameters. If customers have an active full maintenance contract, all I/CAD enhancements are received at no cost. In this way, as technology advances and new software standards become available, the IPS customer keeps pace.

The reliability of the proposed I/CAD COTS software is demonstrated by the fact that as the product has evolved, the base product has repeatedly proven itself, with over seven years of testing at more than 50 sites (customers) around the world.

As opposed to COTS software, custom software creates a specific system for every customer, and each system is different. To upgrade custom software, each customer must bear the *full cost of the upgrade*, and a good deal of time and effort is required to move the customer forward. Such is not the case with the IPS I/CAD COTS software products.

2.3 Commodity-Based Open Systems

Another significant characteristic of the I/CAD System is that it is based on the most widely used set of products and the most advanced technology in the world. The operating system is Windows NT; the database is the Relational Database Management System (RDBMS) from ORACLE; and specialized reports are created using Microsoft Access. I/CAD does not require a proprietary report generator, backup, or administration tool. A report can be generated using Access and included in a Word document, along with embedded Excel spreadsheets and the I/CAD map.

IPS offers a complete implementation of the Microsoft Windows graphical user interface (GUI). Because Microsoft Windows runs on more desktop computers than any other interface in the industry, applications that fully employ the Windows GUI tend to be easier to learn and use. While developing new or updated products and technology on a

biannual basis is an integral part of IPS corporate operations, user familiarity with the Windows operating system and products will continue to be leveraged to reduce training requirements.

3.0 I/CAD ENVIRONMENT

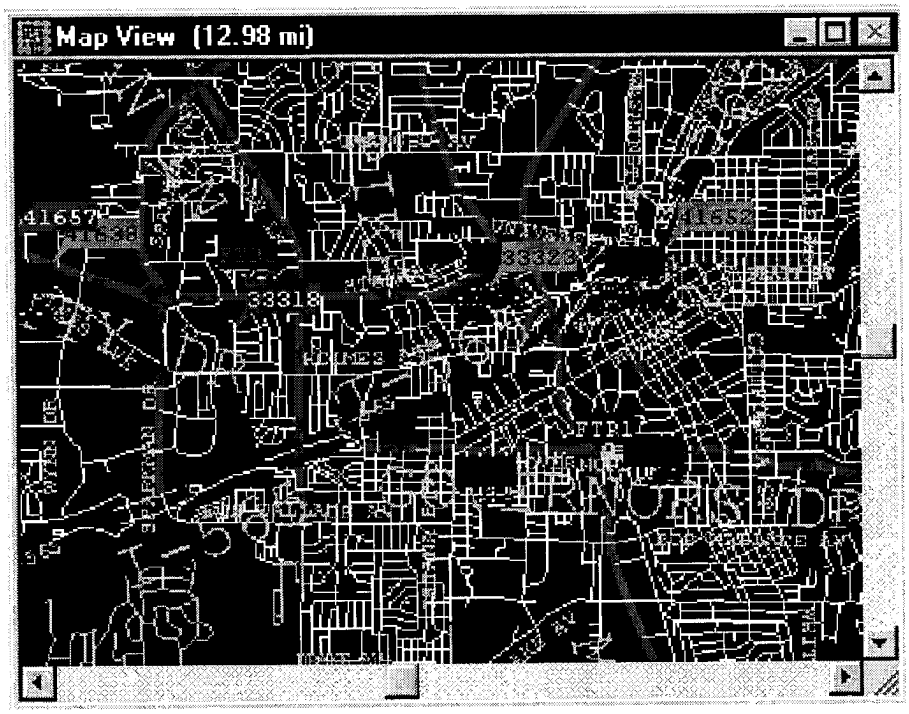
When dispatchers are responsible for handling both call taking and dispatching operations, the I/Dispatcher product is used; when the separation of call taking and dispatching duties is required, the I/Calltaker software module is proposed. I/Calltaker is essentially a subset of the I/Dispatcher software but retains only the commands needed to support call entry and event creation and the routing of calls to a dispatcher. It provides a low-cost product for customers desiring to separate the call taking and dispatching functions and can be supported using either a single- or dual-monitor workstation configuration. In either configuration, windows are used to display both data entry forms and the integrated graphical map.

In the typical dispatch setting, a dual-monitor workstation is recommended, with one screen often displaying the graphical map and the other displaying dialog boxes, forms, or windows supporting the dispatching operation. The following picture illustrates the dual-monitor dispatching environment.

A single mouse and keyboard are used to communicate with both monitors. Windows and icons can be moved as operator needs dictate. Windows, including the map window, may also be dismissed, resized, and minimized. To activate a window, the operator simply clicks anywhere on the window and the title bar changes color to visually indicate that the window is active. The operator can also easily switch to another window by using the ALT/TAB keys to cycle through open applications.

The spatial relationship of emergency vehicles to incident locations is displayed on the map, complete with roadways and jurisdictional boundaries. Dispatchers can quickly identify the most appropriate response personnel and judge the fastest and safest route to the event. The I/CAD System uses both graphic and non-graphic information to determine real-time vehicle position, provide automatic dispatch recommendations, and assist in optimal path planning.

The I/CAD map is very robust. There is no practical limit to the amount of information that can be displayed on the fully interactive, intelligent map. In addition to streets and highways, the map can display building footprints, HazMat (hazardous information) flags, fire hydrants, power lines, rivers, lakes, and railroad lines. These intelligent maps are not just pictures on a screen—they are "smart" maps. All information regarding map features that has been stored in database records is available for immediate data recall. The operator can query the system by simply pointing and clicking on symbols on the map. Using the street network, the system can route units to locations by the shortest time, shortest distance, fewest turns or intersections, and minimum risk involved. When a dispatcher has closed a street, the system can route units around the closure.



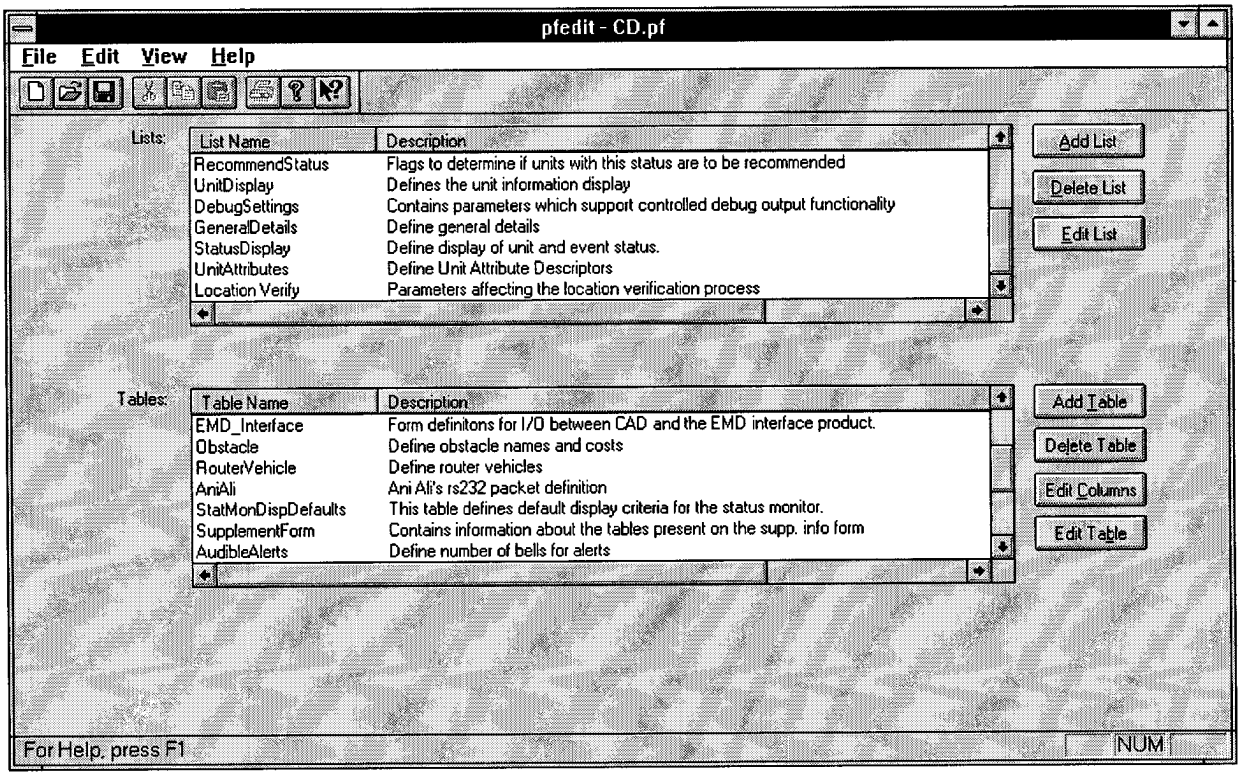
Dispatchers can easily understand the real-time, color display of streets, units, status, event markers, and stations on the map screen. Building floor plans can be retrieved and displayed; road closures are mapped and units routed around them; and locations of fire hydrants and utility poles, as well as gas, water, and sewer lines can be displayed.

Dispatchers can zoom in on views, window certain areas, attach related graphic files to expand their informational base, turn on and off different map layers to control the amount of data shown, display multiple views, and query the database about map symbols.

To an observer, the power of the map resembles a GIS. The mapping component of the system is not linked to a GIS, although the information required to produce the map may be taken from an existing GIS of the area. Instead, the capability, speed, intelligence, and integration of the map is purposefully designed to function as an integral part of I/CAD.

3.1 Configurability

Many vendor products require customers to change their standard operating procedures in order to accommodate the system. The I/CAD System minimizes the operational impact of implementing a new system by customizing the system to reflect the current operating procedures of the customer. To accomplish this, I/CAD makes extensive use of parameter files and tables designed to provide a flexible environment. Each workstation has parameter files and tables used to configure it to the user's needs. A sample form for setting parameters is shown in the following figure:



Sample Parameters Form

More than 600 I/CAD parameters allow the system to be customized without making software code changes. Depending on user requirements, the system can be extensively customized, or customization can be kept to a minimum. Items to be customized are user-determined. The I/CAD System comes complete with the utilities needed to perform customizations. Once customization items have been identified, they are implemented in a test environment and verified for proper operation prior to implementing the changes in the live system. A log of each implemented change is maintained by I/CAD for future reference in the event questions arise.

I/CAD customized software parameters are stored in tables and parameter files, which are used in the course of processing event information. During software upgrades or updates, these customized tables and parameters can be saved and applied to the newly installed version, thereby, eliminating the need to spend time redefining customizations.

The I/CAD System provides the capability to change customized parameters while the system remains operational. Once the desired changes are defined, an I/CAD command is executed to refresh the parameter settings, and the new settings become operational. In addition, exports of I/CAD database information are performed at system administrator-defined intervals, while the system remains operational. If a new software executable is needed, the new program can be moved to the proper directory on a workstation, and the operator need only exit and re-enter I/CAD to make use of the new executable.

Configuration files are local to each workstation. Therefore, changes can be made that apply only to certain machines, or configuration files can be shipped to other sites for use. It is recommended that system supervisors make and control configuration changes and distribution.

I/CAD provides for controlled access to all user-configurable parameters, and since the parameters are local to each workstation, the distribution of changes is simplified.

File maintenance programs provided with I/CAD utilize intuitive, user-friendly screens, but the appropriate authorization privileges are required before they can be used. All activities such as data archiving and report generation require proper operator access privileges.

3.2 I/CAD Database Redundancy

To ensure system reliability, the I/CAD System recommendation uses redundant database servers. Both servers maintain a copy of the database so that, in the unlikely event that one server fails, operations can continue without interruption. Each server maintains a mirrored copy of the database in real-time. When a workstation detects a problem with one of the database servers, all systems are discretely notified, all database operations are

diverted to the functional server, the system administrator is notified that failover has occurred, and database operations are terminated against the failed server. The operational server marks the point of failover for subsequent updating of the database on the failed server. This occurs automatically without operator intervention and without impacting production of call takers or dispatchers.

After the failed server is repaired, the administrator initiates the recovery process, and the failed server begins updating its database from the point of failure. The amount of time the update takes depends upon how long the server has been down. The process will continue until the databases of both servers are synchronized. There is no impact to call takers or dispatchers during recovery.

After recovery, the process continues by discretely notifying all I/CAD Systems that both servers are back on-line. All systems then return to the mirrored dual operation. And, again, this happens without impact to call takers or dispatchers. The failure of a server and the return to dual operation may, in fact, never be known to call takers and dispatchers.

The system is designed to provide continuous operation with a high level of availability. Additionally, the client/server architecture used by the I/CAD System allows for maintenance to be performed at individual positions with no effect on system operation.

Reliability analysis of I/CAD Systems around the world confirm that an availability rate greater than 99-percent is expected and achievable with the proposed configuration. The aim of the configuration and architecture is to provide continuous operation for the control center.

Redundant Array of Independent Disks (RAID) technology is also used, meaning that a disk failure can occur and be corrected without causing failover. A disk may, in fact, be replaced with no impact on that server if hot swappable drives are used.

For fault isolation, each CPU in the system has its own memory, system clock, and a copy of its own operating system. The system comprises duplicate subsystems, ensuring that critical functions are maintained at all times because there is no single point of component failure.

Fault-tolerant hardware; symmetrical multiprocessors (SMP); RAID technology; dual power supplies; local graphics processing at each terminal; and conditioned power, form a robust hardware environment that is currently employed by IPS in safety-critical sites throughout the world. The hardware redundant configuration is an essential foundation of an overall fail-safe strategy.

IPS expends considerable effort in configuring the redundant capability of the I/CAD System to suit the operational and financial imperatives of its customers.

3.3 I/CAD Software Products

Having introduced a high-level understanding of the I/CAD System and the client/server architecture, the following section covers the software products that support the public safety environment. The software tables in Item 24, paragraph 3.22.2 of this response lists the proposed server and client software and provides a brief description of each product. This section provides additional discussion of available I/CAD software. Some of the following applications may be beyond the scope of an initial implementation, but the information contained will promote further understanding of the potential capabilities and expandability of the dispatching and call taking environment within I/CAD.

For ease of reference, the IPS-developed products are presented in alphabetical order, followed by third-party software. The products that were not proposed are marked optional for future consideration.

3.3.1 I/Alarm (Optional)

I/Alarm provides connectivity between the dispatch environment and third-party alarm system controllers, and allows alarms to be automatically generated and inserted into the dispatch environment without an operator manually creating an incident. This software includes utilities for defining location, event type, and contact information regarding the alarm so that the externally generated incidents appear in the dispatch environment as either new or advised (closed) incidents. As with internally created incidents, alarms are logged into the database.

3.3.2 I/Backup (Optional)

The I/Backup product uses database replication technology to provide support for an off-site, near real time backup of the I/CAD database server over a medium to low speed communication link. This support is normally used in the following situations:

Offsite Server

The primary database server site is evacuated, disabled, or destroyed and there is a need to resume operations with as little disruption as possible.

Multi-Center Dispatching

There is a requirement for multiple regional dispatch centers that operate autonomously but that must provide backup for each other in the case of failure of one center.

Switching from the primary dispatch center to the backup site requires manual failover, and prior provisions must be made to establish special usernames and passwords that enable dispatchers to shift control of resources from the primary center to the secondary site. When access to the primary center is restored, tools are provided to facilitate database synchronization prior to resuming normal operations at the primary center.

3.3.3 I/Calltaker

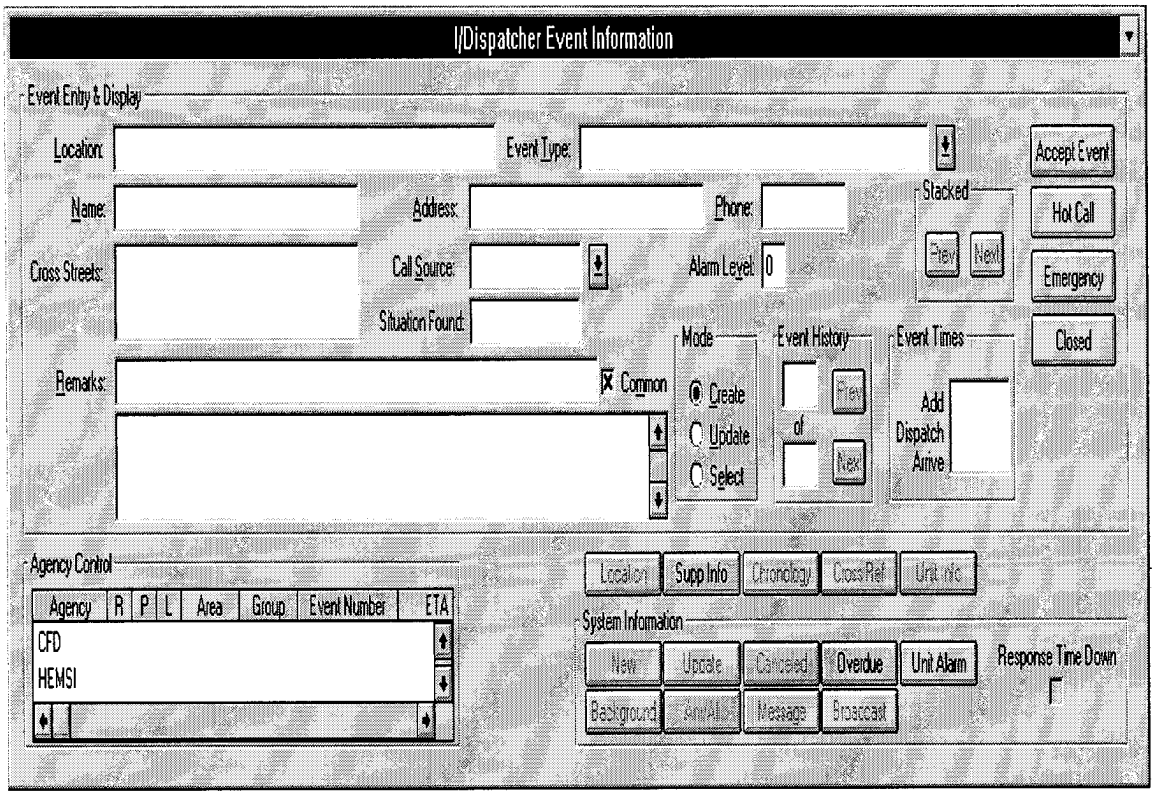
I/Dispatcher combines the functionality of call taker and dispatcher positions, accommodating a CAD environment that merges call taker/dispatcher responsibilities. I/Calltaker is offered as a low-cost solution intended to serve call takers given a dispatch environment that separates call taker and dispatcher positions. I/Calltaker basically consists of a subset of I/Dispatcher features.

Call taking features provide the capabilities required to enter and validate information received from an emergency call. The call taking functionality of the software is intended for operators responsible for interfacing with the public over the telephone, accumulating information, and forwarding the call to an appropriate dispatcher.

Throughout I/CAD, the following interchangeable methods can be used for invoking commands:

- Selecting a command from the pulldown menu
- Selecting a command button
- Typing information into the command line
- Pressing a programmed function key or shortcut keys

Upon answering a call, call takers use the "Create Event" command to open the Event Information dialog box and enter base information about the reported event. This main form is used by all agencies, and each text field, text box, button, and option on the dialog box is labeled. The Event Information dialog box initially appears in review-only mode. To begin entering information, the operator must select the create or update mode. The following figure provides an illustration of the Event Information dialog box. The data fields and controls available for call entry and dispatching are described following this figure. Any operator may create and accept events for any dispatch group.



Event Information Dialog Box

I/CAD forms and dialog boxes may be customized to accommodate local methods of gathering and recording information. These easy-to-use forms lead operators through the process of recording information, dramatically reducing human error and increasing productivity.

3.3.3.1 Event Information Dialog Box Fields and Controls

The following table lists the fields on the Event Information dialog box and describes their use. Both call takers and dispatchers use the Event Information dialog box to gather event information; however, Location and Event Type field information is the minimum information necessary to create an event and is generally entered by a call taker.

Event Information Dialog Box Fields	
Location	When calls for service are received, location is the primary information necessary for the call taker to gather in order to initiate a service response. During I/CAD development, extensive research was conducted into the most common methods by which a caller provides location information to a call taker. The purpose of this research was to enable the system to automatically convert the caller-provided, "real-world" location to a system location that can be used by dispatchers. Many methods are included as standard functionality in I/CAD. When an address is entered in I/CAD, a single command searches the database to validate the address by street name, jurisdiction, prefix or suffix, direction, and range. If the event location, as entered, is insufficient for positive identification, a list of likely choices is displayed. If the location is verified, the map zooms in on the location, to within a range configured by the system administrator, and a temporary pointer is placed at the location. This gives immediate feedback on current activity in the area. The "Verify Location" command provides call takers with information on station or beat, proposed dispatcher assignment, jurisdiction, and subdivision. If the event is accepted, the map pointer becomes a labeled event flag pointing to the location, and an x and y coordinate, in relation to the map, is recorded in the database for the event. Six methods for entering locations include: ANI/ALI; keyed-in specific addresses; street intersections; commonplace names; catalogued alarms; or graphic location entry. These methods are the same for Police, Fire, and EMS events.

Location (continued)	The ANI/ALI interface receives telephone company information via an RS-232 port, and both lights an indicator button and emits an audible signal to notify the operator that an E9-1-1 call has been received. When the operator selects the indicator button, I/CAD automatically loads all available telephone company information into the Event Information dialog box, and the Location field and the Address field both display the same address. If the location is different than the caller address, the call taker can override the incorrect address by typing in the correct one. Or, by configuration, I/CAD allows automatic population of the Location field to be turned off, forcing manual entry of location information. Whether automatic population of the Location field is toggled to on or off, if the operator is processing a call and another call is queued to that workstation, the system prompts the user for a decision to stack or to abandon the current event. If an event is created, all raw data from E9-1-1 is logged to the database, and all event and logged information is associated. The system records the date and time the E9-1-1 call was received in the event record. E9-1-1 calls are recorded in the I/CAD database by call source. This information may be recalled with a command that returns all available telephone company information. Because of the differences in telephone company database structures, the precise contents of the recall form are determined by the individual customer. Street addresses are extensively used and, in order to accommodate ambiguous or unclear caller details, can include "Soundex" searches, "wild-card" substitutions, and aliasing, providing quick or extended matches for a caller-supplied location. Addresses may be stored in the database as ranges relating to a road segment or as specifically known, or "geocoded," locations, such as property point locations. When a location is entered into the I/CAD, the "Verify Location" command attempts to verify the complete address string as entered. If unsuccessful, I/CAD then attempts to minimally match the

Location (continued)	input. A street name minimally matches input when each street component entered matches the corresponding street name component. "Bishop," therefore, minimally matches "Bishop Cir," "Bishop St," and "Bishop Ave." Wild cards can be used as input so that "Bis% A%" minimally matches only "Bishop Ave." If the system finds only one match, the unspecified data is entered, and the location is verified. If two or more possible locations are returned, the user is prompted to choose the correct data, after which the specified location is verified. If no location matches are returned, the street name is Soundexed, and a resulting list of locations is presented from which the user may choose or the operator may modify the location via the Verify Location dialog box. If no matches are returned, an error message appears. If the street address is found to be an alias of another street, a substitution is automatically performed, and the correct primary street name is displayed as the verified location. If the user entered only a street name as a location, it is possible that the address will be verified without accessing the Verify Location dialog box. If the street is in only one ESZ, the user need not enter a address number to provide the system with minimum routing information (area and dispatch group). If there is a commonplace name associated with one location on the street, the system loads that precise location into the Event Information dialog box Location field, however the user may delete it if incorrect. In the case of a single ESZ for the street, the first segment located in the geofile is used to indicate the event location on the map, because the street may comprise many street segments. If the street name matches using the Soundex algorithm, a dialog box is returned and selections may be made. Address ranges appear in the text boxes of the dialog box, and an approximate location may be given for routing purposes. When the street is comprised of more than one ESZ, the dialog box is returned, and the user selects an approximate location. Once the user accepts the dialog box, the corresponding ESZ, area, and dispatch group are retrieved and entered in the appropriate fields in the Event Information dialog box. The operator can always override any system-generated information and type information directly into the Event Information dialog box.

Location (continued)	When an address has been verified without an address number, an event flag is placed on the map to indicate the start of the appropriate street segment. If the street name entered has been verified, but no address number has been provided, the appropriate street segment is highlighted and the map zooms in to display the highlighted area. The user is then prompted to select a subsegment and street side. Cross-street locations or intersections are commonly used to verify locations in the system and undergo similar Soundex, alias, and wild-card searches to match normal street addresses and accommodate ambiguous or unclear details. An intersection is represented by using "/" in between the two intersecting streets. If the full address string cannot be verified, intersection verification uses the same minimal match concept as does street address verification. I/CAD creates a list of minimally matching streets for street 1 and street 2, then presents a list of all intersections between the streets on this list that occur in the optionally specified area and municipality. If one intersection is found, this becomes the verified location. If two or more intersections are found, the list is displayed in the Verify Intersection dialog box, and the user selects one. If no intersections are found, the lists for street 1 and street 2 are constructed using the Soundex algorithm and the intersections of the streets in these two lists are shown in the Verify Location dialog box for the user to select. Verification also supports aliases for intersection street names, and if one or both streets are aliases, the primary street names are substituted for the verified intersection. Commonplace names are another regularly used method of caller-provided location identification. The extent of the list of commonplace names may be agency-specific. A commonplace name used as an address is designated by placing a "@" before the name in the Location field. If the input is enough to identify the commonplace name uniquely, that name becomes the commonplace name to be verified. It is possible to have more than one location for the same commonplace name, for example, a Domino's or McDonald's. If only one location is in the database for the commonplace name, that location is chosen. Otherwise, the Commonplace Location dialog box prompts users to select the correct location.

Location (continued)	Catalogued alarms can be used for automatic alarms by using a coded alarm number in the Location field. This is represented by placing a "#" before the alarm number. Once the code is verified, I/CAD displays the location of the alarm, the type of alarm, the contact person name and phone number, and additional information based on the alarm. The system can also be configured to use an alphanumeric street directory or rural road directory reference number, such as 68 C5, to assist dispatchers or call takers in locating the event. Finally, the operator can geographically identify an event location using any map geographic detail as a point of reference, assuming the inclusion of natural or man-made features in the geographic data and that the proximity or distance to an event can be measured.
Event Type	Event types vary by jurisdiction and agency, allowing each agency to customize the event types it uses. Experienced call takers may type in codes; less experienced call takers can bring up an associated list from which to make a selection. Entering an event type supplies call takers with information on priority and response (police, fire, medical, or a combination of agencies) and provides valuable information for use by the dispatcher. Call takers always have the option of overriding the priority, agency response, or dispatcher responsible, based on the call. Event type is a mandatory field, and, as with all mandatory fields, the field name appears in bold to visually distinguish it from a non-mandatory field. Event types that require a response from more than one agency automatically route the information to all designated agencies. In addition, the call taker can route events to an agency that usually does not receive that type of event by marking the Agency column in the Agency Control panel of the Event Information dialog box. If an agency not initially assigned to the call is requested by responding units, event information can be copied to the requested agency without retyping. Each agency event is assigned its own agency event number, which is linked by a system number and shown in the records as cross-referenced to the other agency events.

Caller Name, Address, Phone Number	The caller's address may, or may not, be the same as the event location. The caller name, address, and phone number are automatically downloaded to the Event Information dialog box when an E9-1-1 call is received, and the fields can be configured using any format.
Cross Streets	If cross streets exist for the location, the nearest intersection automatically populates the Cross Street field once location of the event has been verified.
Call Source	The Call Source field contains a list of valid call sources that indicate how a call originated. I/CAD provides a standard list of call sources, which can be expanded during customization, or operators can ignore the list and type a call source into this field.
Remarks	Unlimited comments concerning an event can be added in the Remarks field. Each line is automatically date and time stamped, and the operator's personnel ID and terminal ID also appears. Once the operator presses the Enter key, remarks are loaded into the non-editable text box below the Remarks field. Once entered, remarks cannot be deleted or changed.
Agency Control	The system automatically populates the Agency Control panel columns once the event location is successfully verified. To view the Agency Control panel extents, arrows and a scroll bar are provided. Information relevant the Agency Control panel is displayed or used by the system as follows: • The Area column displays the jurisdiction (beat, zone, or district) for the event location. If the location cannot be verified through I/CAD due to a non-existent address in the geofile (for example, a new subdivision), the call taker may manually enter the area of the call. When the area is added, the Group column automatically populates.

Agency Control (continued)	• The Group column defines the dispatch position to which the event will be routed. If the location of the event is verified, the dispatch group is automatically defined. If the location cannot be verified, the call taker can manually enter the dispatch group. The assigned Area and Group determine which dispatcher will receive the new event for processing. • When an Event Type is selected, the system populates the R[esponse] and P[riority] columns. R[esponse] determines which agency will respond to the event, and P[riority] references the priority of the new event. **Note:** The operator may override any of the information in the editable columns (R[esponse], P[riority], L[ocation], Area and Group). After the event is accepted, the software completes the remaining columns of the Agency Control panel.
Mode	Before information can be manually entered in the Event Information dialog box, the operator must set the mode to the Create or Update option.
Situation Found	The Situation Found field is used to record instances in which the originally reported event varies markedly from the actual situation encountered by the field unit, but it is not appropriate to change the event type. Using this field, the system maintains an audit trail showing that, as an example, the originally reported event type was a high-priority event, but the actual event was not an emergency. The original information is retained, but database records are established to indicate the changes made, who made the changes, and the time the changes were made.

Mandatory information needed by a call taker to create an event in I/CAD is location and event type. Once the location is verified and the event type is determined, the event can be accepted. Or, upon completion of event entry, the call taker can determine the type of acceptance for the event. The following table describes the Event Entry & Display panel acceptance buttons provided on the Event Information dialog box. Selection of any of these buttons forwards the event information to the appropriate dispatcher.

Event Information Dialog Box Acceptance Buttons	
Accept Event	This command creates the event and assigns a priority.
Hot Call	By selecting the Hot Call button, an operator simultaneously creates an event and assigns a hot call priority to that event. If the normal event type priority assignment would determine a lower priority, selecting the Hot Call button automatically upgrades the priority level. In addition, the Hot Call button allows call takers to accept an event after having location and event type information only, so that the dispatcher immediately receives the minimum information. Even though the event has already been created, the call entry fields remain in edit mode so that the call taker can gather additional information, then transfer that information to the dispatcher.
Emergency	The Emergency button automatically assigns an event an emergency priority. Once the event has been accepted and routed, every dispatch position receives notification of the emergency event, and any dispatcher can immediately review that event.
Closed	The Closed button is used to enter event information collected after an event has been closed. Selecting the Closed button opens the Closed Event dialog box, which enables the operator to append any information required.

The following table briefly explains the function of the Event Information dialog box indicator buttons used by both call takers and dispatchers during call processing. As pertinent information becomes available, each indicator button turns red. This visual indicator informs the operator of additional information that may require attention.

Event Information Dialog Box Indicator Buttons	
Location	When a call taker enters a new event, by default, the software automatically initiates a Location of Interest (LOI) search. If LOI information is available, the Location button activates (turns red). An LOI search looks for, and returns, specific location information, such as hazardous materials, medical histories, or past events at that address.
Supp Info	The Supplemental Event Information (Supp Info) button is always active so that the operator can add supplemental event information at any time. When supplemental information already exists for an event, the button turns red. Selecting the Supp Info button opens the Supplemental Information dialog box used to organize additional event information by vehicle, person, tow, contact, or property. While information can also be added in the Remarks field of the Event Information dialog box, using the Supplemental Information dialog box makes information available for later searches. Fields in the Supplemental Information dialog box are highly configurable and can be changed to accommodate agency-specific data capture, such as parking violations, animal control, or patient information.
Chronology	The Chronology button activates as soon as an event is accepted. Selecting the Chronology button displays a full, chronological audit trail from event creation through to the last update of the event history.
Cross Ref	The Cross Reference Event (Cross Ref) button is always available. Selecting this button enables the operator to view events related to a selected event.
Unit Info	Selecting the Unit Information (Unit Info) button displays a history of all units assigned to the event and all unit status. This button turns red once a unit has been dispatched.

New	An active (red) New button notifies the operator that an event has been added to the Pending Events window. Selecting the New button accesses the pending event information.
Update	A red Update button indicates that the operator has an event to update.
Canceled	An active Canceled button indicates that the operator has received a request to cancel an event and should review the request to determine whether or not to do so.
Overdue	If a event has been pending for longer than a predefined time, the Overdue button activates.
Unit Alarm	An active Unit Alarm button indicates a unit emergency.
Background	If the Background button activates, background information about the current event is available and can be accessed by selecting the button.
Ani/Ali	A active ANI/ALI button indicates that ANI/ALI information is available.
Message	An active Message button notifies the operator of a message.
Broadcast	An active Broadcast button indicates that broadcast information is present and has not been read.
Response Time Down	This is a checkbox. The system automatically places an "X" in the checkbox if the response time for a unit to reach an event may not be able to be met.

3.3.3.2 Time Stamping

Performing any of the following call taking activities causes all information to be date and time stamped, as well as appending the terminal ID to the event history log:

- Receiving E9-1-1 calls
- Creating events
- Adding remarks
- Accepting events

- Stacking calls
- Updating events
- Reading LOI information
- Canceling events

3.3.3.3 Duplicate Call Search

I/CAD notifies the call taker (or dispatcher) of events within a defined range, such as 0.5-mile radius, which is specified in the system's parameter file. If other events occur within the defined range, the Nearby Events dialog box appears listing the event number, location, event type, priority, and current status.

In this way, the operator can review the details of any nearby event to determine whether the current call is a duplicate. If it is duplicate, I/CAD appends all of the information from the current call onto the original event, preventing the call taker from having to re-enter the call information.

3.3.3.4 Hazard/Flag Alerts

The LOI function in I/CAD provides specific location information, such as hazardous materials or patient histories, as well as recent events for that location.

By default, I/CAD automatically initiates an LOI search once a location has been verified and an event is accepted. This process runs in the background, searching both premises and recent incidents information, and returns results if a historical record is found for the event location *or surrounding area*. I/CAD-based LOI searches entail more than looking up and down the same block or the adjacent block, as with most CAD systems. Using powerful graphics-based location processing, I/CAD actually searches the neighborhood.

After LOI is completed, any operator looking at an event can access this information by selecting the red LOI button on the Event Information dialog box. HazMat records, known health problems, active warrants, and major call records become available at the touch of a button. The I/CAD storage and retrieval information system functions whether data was entered manually or captured automatically by the system.

In addition, I/CAD presents a form listing summary information for all searches pertinent to a location, including whether the notation is for a recent event or for a special situation. Selecting an entry from this list displays the full details of the entry. Special situations can be defined in I/CAD and can include dangerous or hazardous situations for any agency. These circumstances are generally temporary, but can be designated as permanent in the database maintenance program.

The database maintenance program can also be used to enter and associate remarks to special addresses or locations. Using this feature, when an incident occurs at that location, the verification process appends these remarks, such as field unit warnings, to the Event Information dialog box Remarks field.

When an LOI search has been completed, a line of comments is added to the Remarks field. After the operator reads the returned LOI information, another line is added to Remarks field with the date, time, operator personnel ID, and terminal ID.

LOI searches may also be configured to require manual initiation.

3.3.3.5 Suspect/Vehicle Description Information

Suspect and vehicle information are recorded in the Supplemental Information dialog box. By entering specific person and vehicle information into this form, this data becomes available during searches of past events involving that person or vehicle.

3.3.3.6 Placing/Resuming Calls on Hold

I/CAD provides the flexibility to take partial information on a low-priority call, set the call aside, and answer a higher priority call. Once a call is "stacked" or put on hold, the call taker can complete the higher priority call. Stacked calls have a predefined time limit and are monitored by I/CAD. If a call is on hold beyond this time limit, the operator is alerted. Call takers can stack more than one call and recall any calls in any order. All information previously taken on the call is saved, unless the call is abandoned, in which case no information is to be recorded. Each stacked call is date and time stamped for future reference and analysis.

3.3.4 I/Dispatcher

In addition to retaining all call taking functionality, I/Dispatcher provides full dispatching capabilities using a color, dual-screen workstation, and interactive mapping that provides both dispatching and monitoring functions. The map display is fully integrated with information forms and dialog boxes so that all information entered is accessible and visible to dispatchers, assisting the decision-making process. From the dispatch position, operators can dispatch services effectively, monitor units and events, and control the operations of all emergency service vehicles. Because visual information is so readily assimilated, dispatchers can make decisions in routine and emergency situations quickly, accurately, and with confidence, knowing that they have the best information available.

In the typical setup, one screen is used to display the map, while the other screen displays the Event Information Dialog Box, a Pending Events window, a Unit/Event Status window, as well as temporary forms and dialog boxes used to display or collect

information. The Pending Events and Unit/Event Status windows are color-coded, allowing dispatchers to monitor the status of units and events in their control at a glance. The same color coding applied to the map is also applied to I/CAD forms.

Timers, set by the system administrator, notify dispatchers, both visually and audibly, before problems develop. For example, a timed alarm sounds if a unit is out of communication longer than expected or if a low-priority incident, which had been stacked for later dispatch, needs attention.

In the typical I/Dispatcher configuration, one of the two workstation monitors is primarily used for displaying the street map. Some of command buttons on this monitor can be used to issue the same dispatching commands available on the forms screen, but others control the appearance of the map display. Using these buttons, dispatchers can zoom-in, window certain areas, attach related graphic files to expand their informational base, turn on and off different map layers to control the amount of data shown, and query the database about map symbols.

The data in both the forms windows and the map windows remain current and synchronized. Regardless of the source of the data, as new information is entered into I/CAD, it becomes available to the user.

The following sections cover operations for tracking pending and assigned events and for monitoring unit status. These procedures are the same for Police, Fire, and EMS events.

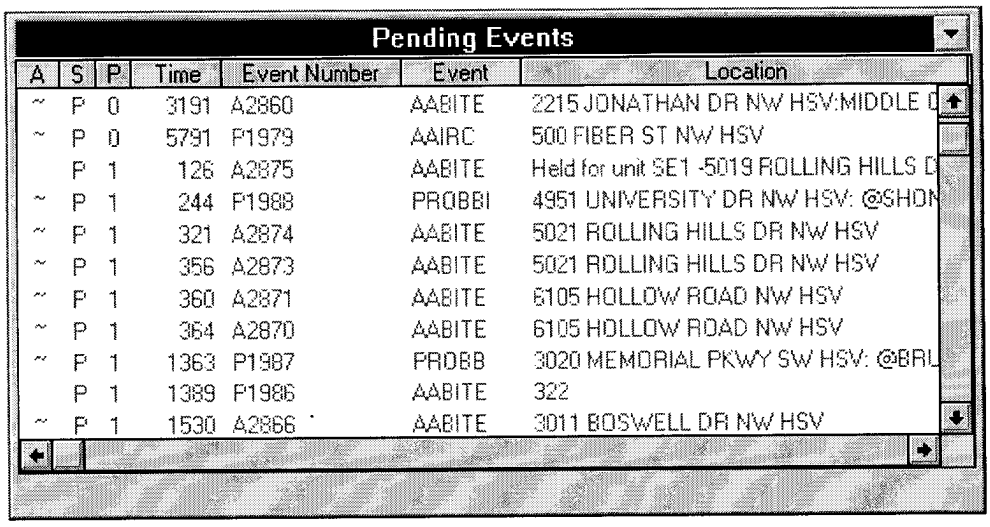
3.3.4.1 Pending Events

By default, the Pending Events window continuously displays the unassigned events relevant to each dispatcher position. However, the window can also be configured to display all unassigned agency events. The status of each event, whether new, pending, held, or station alerted, is distinguished by color.

Pending Events window information is automatically updated without operator request, appears in a tabular format, and displays information in the following columns:

- Event alarm timer (A)
- Event status (S)
- Event priority (P)
- Time in pending (Time)
- Event number

- Event type (Event)
- Event location (Location)



As new calls for service arrive, dispatchers receive meaningful summaries, plus an easy-to-view graphic representation of event area activity. The New indicator button on the Event Information dialog box activates to denote new event information, and the touch of a button displays the new event.

Scroll bars, located on the side of the Pending Events window, serve to indicate the relative number of events hidden from view, and dragging the scroll bar enables the user to page to specific information. The window size can also be temporarily maximized to view more events at one time.

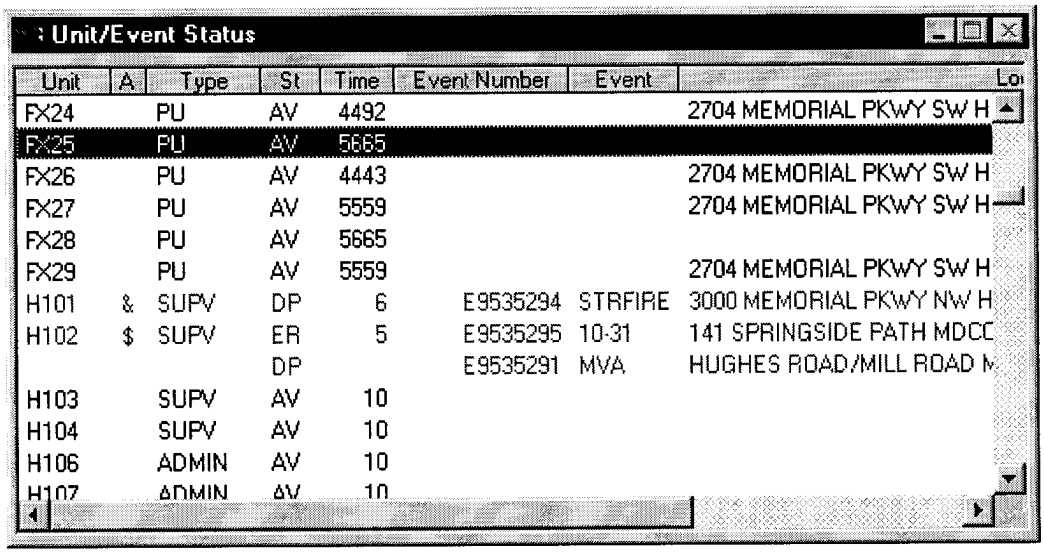
The Pending Events window can be sorted to appear in any order preferred by the dispatcher, with the standard display showing the "oldest" event of the highest priority at the top of the list. Operators can sort the window as often as desired, in any manner desired. A default sort style is originally defined in the database for all workstations, but the default sort can be changed on-line for each workstation.

These windows are user-configurable and provide options for style, color, size, and display location.

3.3.4.2 Unit/Event Status

As calls come into the system and are accepted, they move to the Pending Events window for the appropriate dispatch group. When a call is dispatched, the event moves into the Unit/Event Status window. This window contains all of the units for that dispatch group, as well as the events that have a unit assigned and being worked. Both the map and the Unit/Event Status window show the events and the units that are active, and how they relate to each other.

The Pending Events form and the Unit/Event Status form are the two forms that frame events. All events are in one of these forms, but never both.



Unit	A	Type	St	Time	Event Number	Event	Lo
FX24		PU	AV	4492			2704 MEMORIAL PKWY SW H
FX25		PU	AV	5665			
FX26		PU	AV	4443			2704 MEMORIAL PKWY SW H
FX27		PU	AV	5559			2704 MEMORIAL PKWY SW H
FX28		PU	AV	5665			
FX29		PU	AV	5559			2704 MEMORIAL PKWY SW H
H101	&	SUPV	DP	6	E9535294	STRFIRE	3000 MEMORIAL PKWY NW H
H102	$	SUPV	ER	5	E9535295	10-31	141 SPRINGSIDE PATH MDCC
			DP		E9535291	MVA	HUGHES ROAD/MILL ROAD M
H103		SUPV	AV	10			
H104		SUPV	AV	10			
H106		ADMIN	AV	10			
H107		ADMIN	AV	10			

3.3.4.3 Unit Assignment

I/CAD allows dispatchers to select units for assignment in a number of different ways. For example, the dispatcher can manually assign a unit to an event by issuing the "Dispatch Unit" command, then use the graphical interface, the command line, or hot keys to designate the unit. Each of these methods speeds the process of dispatching units, once the event is selected. In addition, a unit can be dispatched by selecting the unit ID from the Unit/Event Status window or by entering the unit ID. Multiple units can be assigned to a single event by dispatching each unit separately or by invoking a separate "Assist" command.

Multiple events can also be assigned to the same unit, and the system can be configured to show all of the assignments for that unit in the Unit/Event Status window, or it can be configured to return all but the first incident to the Pending Events window. If returned to

the Pending Events window, the events are coded as assigned to a unit, and the unit ID number is listed with the event.

3.3.4.4 Unit Reassignment

Units can also be exchanged, switching unit status, as well as assignments; or units can be pre-empted from one assignment and given another. A change of original assignment can be performed in several ways, such as returning the event to the Pending Events window and holding it for the original unit, returning the event to the window and reassigning it to the next available unit, or immediately reassigning the event to another unit.

3.3.4.5 Unit Recommendation

A unit can be assigned to an event by unit recommendation, which considers several factors, such as the geographical area as well as information contained in various database tables, to determine which unit(s) a dispatcher should use.

The Event Type table determines which agency or agencies should respond to a given event type code, and each event type code is tied to an associated response list record in the Response List table. I/CAD uses the response lists to determine unit response based on the event type code.

In addition to the information retrieved from the Event Type and the Response List tables, I/CAD retrieves information from the Deployment Plan table concerning the proper station order or specific unit order associated with a given geographical area. The Deployment Plan table maintains records that indicate when a given event type for a specific geographical area should use a response list recommendation different from the normal response list. This feature accommodates the requirements of special recommendations, such as nursing homes, hospitals, schools, and churches.

All system-configured conditions are taken into account when units are automatically recommended for response. The proper recommendation, based on conditions, is displayed in the Recommend Units form, which further lists the units in the recommended order of response. The list highlights one, or a number of units, as system recommendations, and can be accepted by selecting a single button, which automatically dispatches all highlighted units. If a unit is currently assigned to an event with a lower priority, yet fits the recommendation parameters, it appears as unhighlighted on the list. To dispatch an unavailable unit, the dispatcher must highlight the unit prior to accepting the Recommend Units form. Of course, regardless of the recommendation, dispatchers can always send a specifically chosen unit.

In addition to a list of units, the Recommend Unit dialog box provides Task Force assignment, special instructions, information about the area or the location, and procedures to follow for the particular event type.

I/Dispatcher provides several methods by which dispatchers can recommend units, but beat and station order are the standards for most responses. When required, however, I/Dispatcher can also make recommendations by the closest unit (real travel distance, not "as the crow flies") or by special equipment needs.

3.3.4.6 Time Stamping in Dispatching

Any unit assigned through manual dispatch, unit recommendation, or through a unit status change is date and time stamped, with the terminal ID appended. All unit status changes are recorded in the unit history record, and a full audit trail can be given on the activities of a unit while on duty.

3.3.4.7 Queue Timers

By default, calls for service are sorted in the Pending Events window by priority and each event is monitored by the queue timer. In this way, if three priority-one calls exist simultaneously, they will be listed together in the Pending Events window, with the "oldest" call listed first.

Based on the event type, call priority, and a predefined time limit, notification timers may be established and loaded into the system. When an event remains in pending status longer than the time allowed for that event type and priority, a notation appears in the alarm column, an alarm sounds, and an indicator button lights. In this manner, operators are reminded to assign a call or to transfer a call to another dispatch group, preventing any call from being neglected without the operator being aware of it. Timer notifications are also displayed to supervisors monitoring the dispatch group.

When an event times out, the time-out information is recorded and can be derived in a management report.

There is also set of queue timers that work the same way for the Unit/Event Status form, so that alarms may be established for active events and the units assigned to them.

3.3.4.8 Complaint Disposition

When the first unit clears an event, a disposition can be assigned. Based on the event type, the disposition may be required or optional. If a disposition is required, I/CAD prompts the operator to enter a code. Valid disposition codes are predefined in the database and are displayed to dispatchers.

3.3.4.9 Complaints/Events Generated from the Street

The "Field Event" command creates events initiated by field units; the operator is then prompted to enter the event type, unit, location, and remarks. After accepting this information, the unit is automatically assigned to the event with the status of arrived. The unit history record shows a one-second time-stamp delay between the dispatch, enroute, and arrived status codes to preserve the proper order of unit history records if they are subsequently retrieved from the database.

Four other options can be used with the "Field Event" command: Traffic Stop, Traffic Pursuit, Subject Stop, and Subject Pursuit. When an operator selects any of these options, the event type field is populated based on the predefined code for each option. Selecting any of these options automatically assigns the relevant unit to the event and places the unit in the arrived status.

3.3.4.10 Vehicle Stops

Vehicle stops are handled using the Traffic Stop option of the "Field Event" command, allowing the operator to specify the unit that stopped the vehicle and enter the vehicle's location, license number, state, license year, and license type. Additional remarks can also be added. The vehicle information is automatically entered into the vehicle supplemental information table. By accepting this information, the unit is immediately assigned to the traffic stop and marked as arrived at the location. Once the traffic stop event is created, I/CAD has the capability to perform a Vehicle of Interest search based on the license number. If previous events are found based on that same license number, the dispatcher is notified and allowed to review the historical information.

3.3.4.11 I/Dispatcher Supervisory and Reporting Capabilities

By assigning supervisory privileges to special log on names and passwords, supervisors can monitor ongoing event activity from any workstation that runs the I/Dispatcher software module, and the fact that an event is being monitored is transparent to dispatchers and call takers.

In addition, supervisory privileges can be granted that allow managers to analyze center activity over time by accessing records stored in the system's ORACLE database. This I/Dispatcher reporting functionality prints 17 standard reports covering dispatch center activity. Other reports may be written on-site using system-provided tools. The following subparagraphs briefly describe the standard reports delivered with I/Dispatcher:

Event Snapshot

The Event Snapshot report provides a snapshot of pending events, unit status, and a chronology of events, comments, and unit activity over a specified timeframe.

Events by Type

This report calculates the number and type of events, per agency, that have been processed within a user-specified timeframe. The data is ordered by event type code within the agency.

Events by Source and Priority

The Events by Source and Priority report provides the number of incidents by agency, priority, and call source that have occurred within a user-specified timeframe.

Events by Source, Day of Week, and Hour of Day

This report compiles a listing of events by the day of the week and the hour of day in which the events occurred, according to the agency and call source. The reporting timeframe can be user-defined.

Event Handling Time

The Event Handling Time report lists the number and type of events, per agency, computing the average and maximum times used to address the events. The reporting timeframe can be user-defined.

Event Register

The Event Register report catalogs detailed information, by agency, including providing the event type, location, event receipt time, beat, emergency service zone (ESZ), and the dispatch group that addressed the event. Unit information is also delineated, including the units assigned to each event, unit dispatch time, unit arrival time, time the unit became available, and the personnel staffing the units.

Calls per Agency

The Calls per Agency report lists, by agency, the number of calls for service during a user-specified timeframe.

Calls for Service

The Calls for Service report lists the number of calls for service by day of week for a user-specified timeframe.

Calls per Hour of Day

This report provides, by agency, an hourly breakout of the number of calls for service received over a user-specified timeframe.

Average Response Time per Hour of Day

This report computes, by agency and hour of day, a summary of the number of calls received and the average length of time that was required to respond. The reporting timeframe can be user-defined.

Logged On Duty Time

The Logged On Duty Time report calculates the amount of time operators have been logged onto the I/CAD System. The information is reported by agency, operator name, and day of the week within a user-specified timeframe.

Logged On Duty Position

This report provides information on operator position assignments over a user-specified period of time. The information is reported by operator, terminal identification (ID), and day of week of the assignments.

Unit Workload

The Unit Workload report lists, by agency, each unit and the number of events that unit has responded to over a user-specified timeframe.

Units' Time In Service

This report chronicles, by agency, the logged on time, time spent on assignment, and the time spent out of service for each unit. The reporting timeframe can be user-defined.

Operator/Officer History

The Operator/Officer History report provides a historical listing of the events that specific operators or officers have addressed within a user-specified period of time. The information is listed by operator/officer ID and contains event data, such as the event number, date and time of event, and any remarks associated with the event.

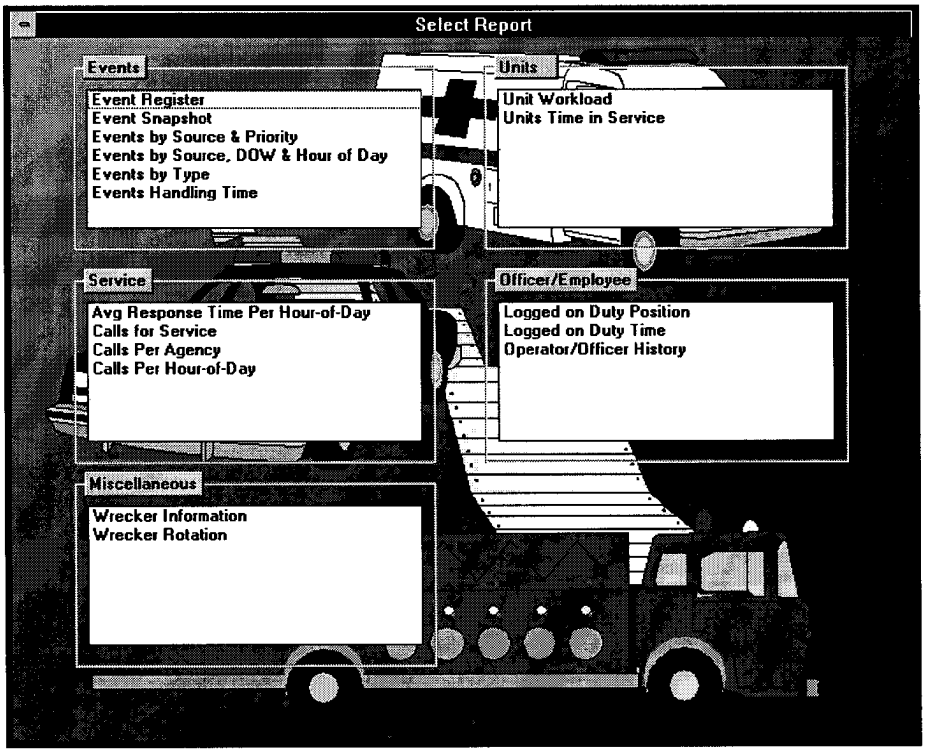
Wrecker Rotation

The Wrecker Rotation report provides an index of wrecker companies that are available for service calls. The report lists the companies in the order in which they should be called by placing the wrecker company with the oldest date at the top of the list.

Wrecker Information

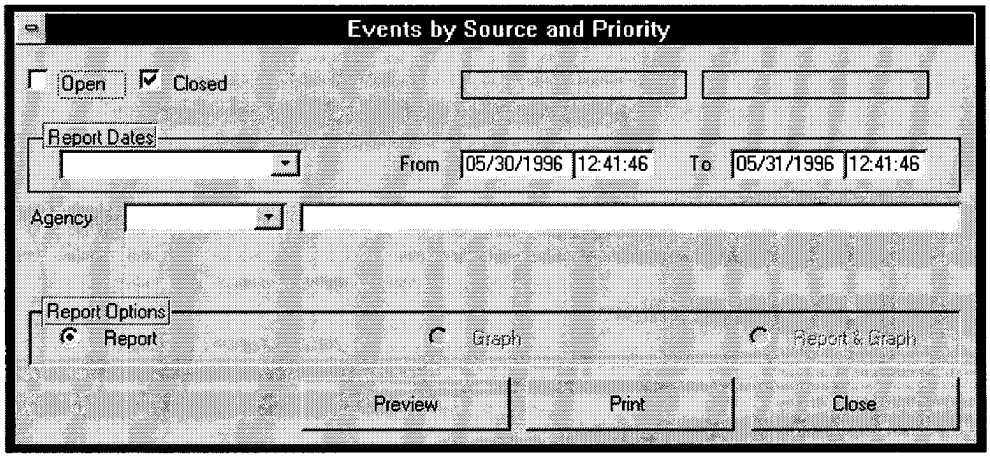
The Wrecker Information report itemizes wrecker company services. Information provided includes company name, equipment, phone number, date last used, and availability.

The main menu used for the reporting applet is illustrated below:



Select Report Menu

After selecting the desired report, an associated form appears for the operator to use in supplying additional information that specifically defines the report. The following dialog box illustrates the information requested for the "Events by Source and Priority" report.



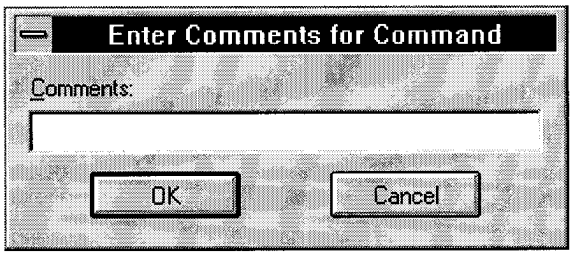
Events by Source and Priority

In addition to the standard reporting utility provided with I/Dispatcher, IPS recommends the Intergraph Public Safety/Management Analysis and Reporting System (I/MARS) to enhance reporting and provide trend and statistical analyses capabilities. I/MARS is discussed in detail later in this overview.

3.3.4.12 Additional I/Dispatcher Commands

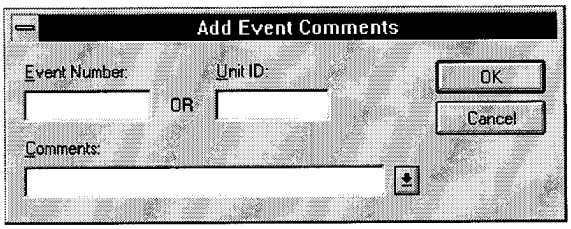
In addition to the commands covered during the previous discussions of I/Dispatcher, the following section briefly describes auxiliary I/Dispatcher commands.

Accept Advised Event Records an event that does not need a unit response, but does require entry into the database, for example, a call to the wrong jurisdiction or an information-only report.



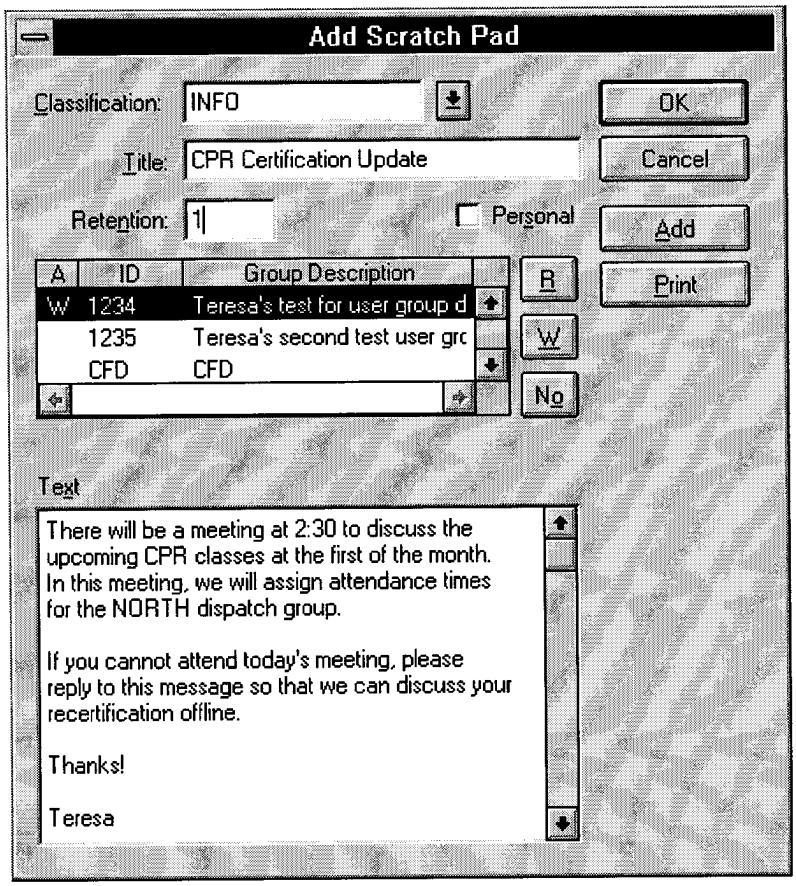
Add Event Comments

Used when one event is active and comments need to be added to another. Using this command allows the operator to append comments to an inactive event without deactivating the active event.



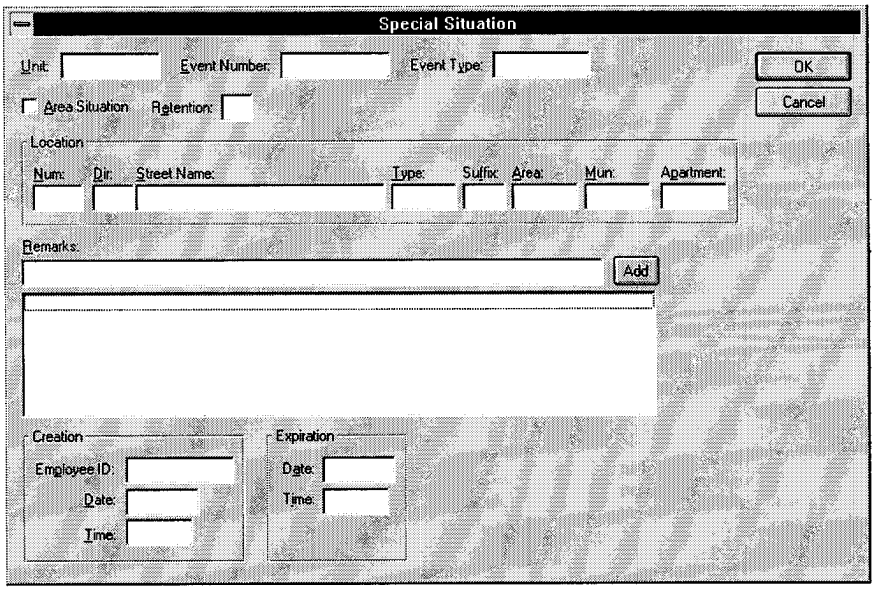
Add Scratch Pad

Used to enter information which is primarily of interest in the communications center. The system stores this information in a notes format maintained by category or subject—the operator may recall the information when needed. Because such information may be sensitive, this command has security restrictions.



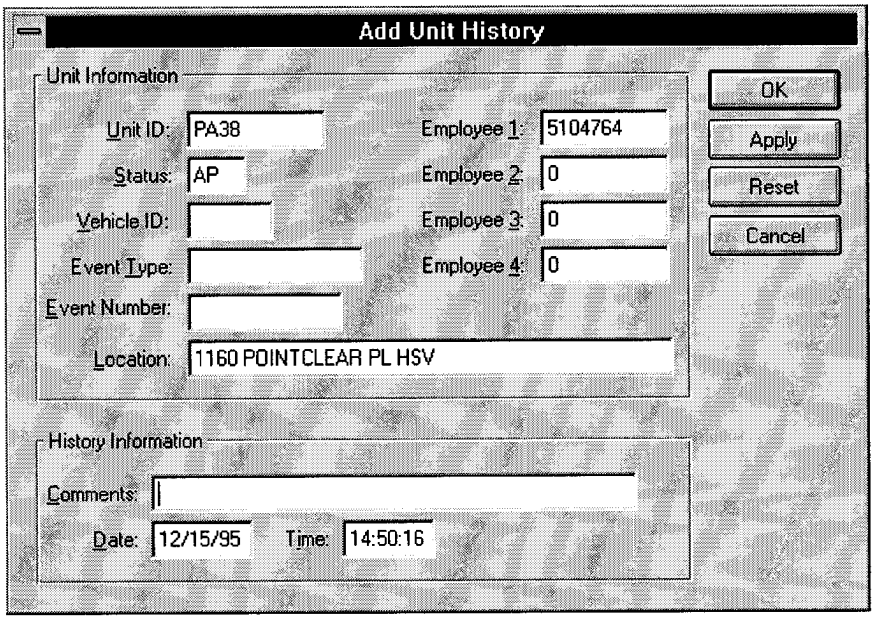
Add Special Situation

When information is received about a location of special interest, but is probably temporary, this command can used to add the information to the database. If it is later determined that the special information is permanent, the systems administrator can change the temporary status.



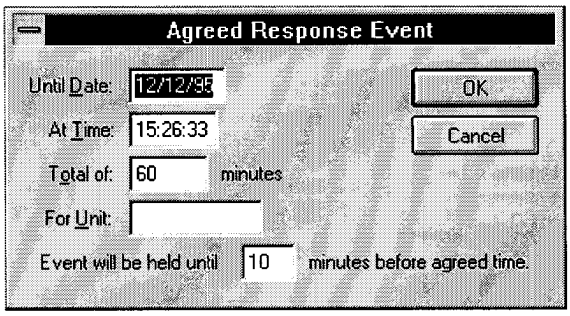
Add Unit History

Writes information, such as personnel or vehicle changes, to a unit history record.



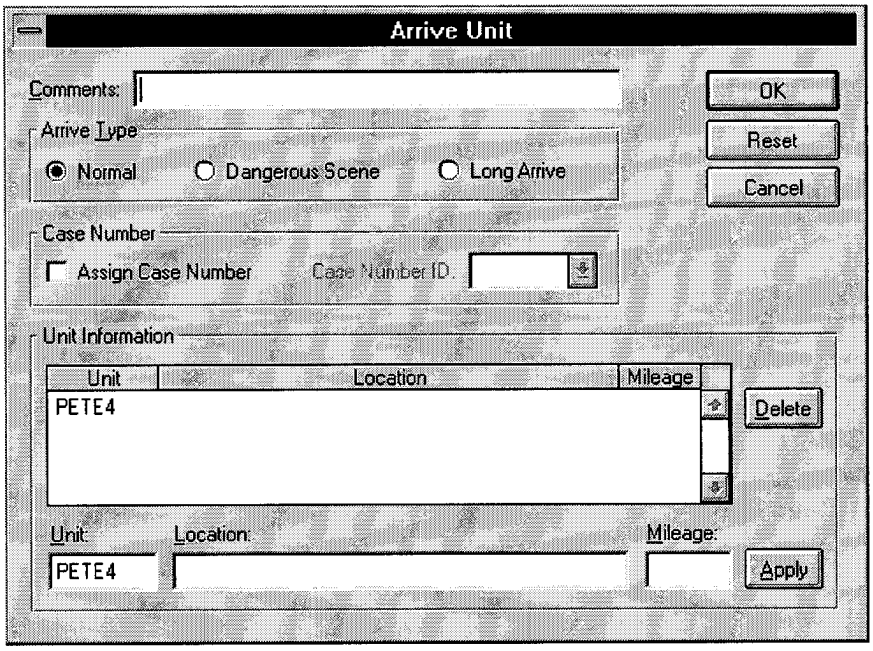
Agreed Response

Used for any new event that does not require immediate response and for which the complainant agrees to meet the responding unit at an agreed-upon time.



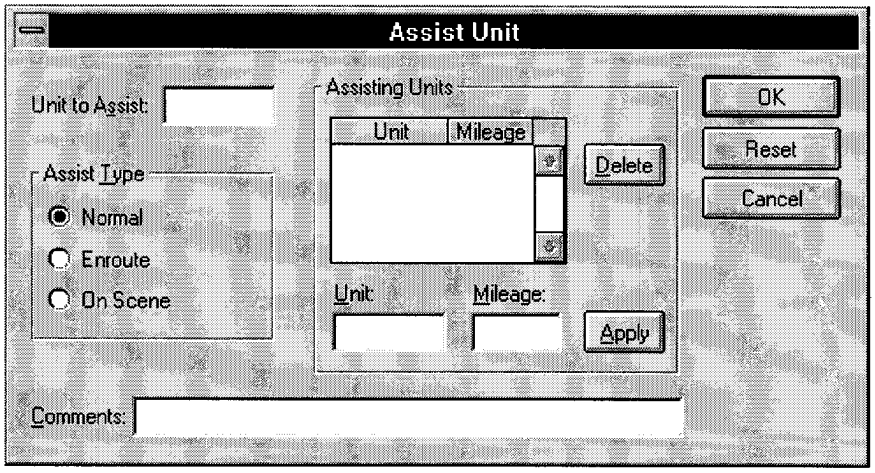
Arrive Dangerous Scene

Units that have arrived at an incident can be marked with the status of "arrive dangerous scene." This status records the arrival time of the unit and indicates that the unit will wait for back-up or an escort before proceeding or will wait until it is safe to proceed.



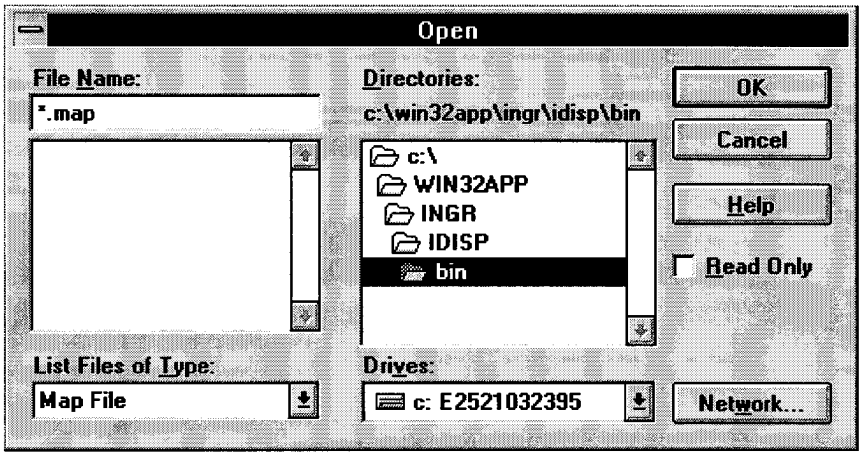
Assist Unit

Used to send back-up or additional units to a dispatched event, even if the dispatched unit is not yet on the scene.



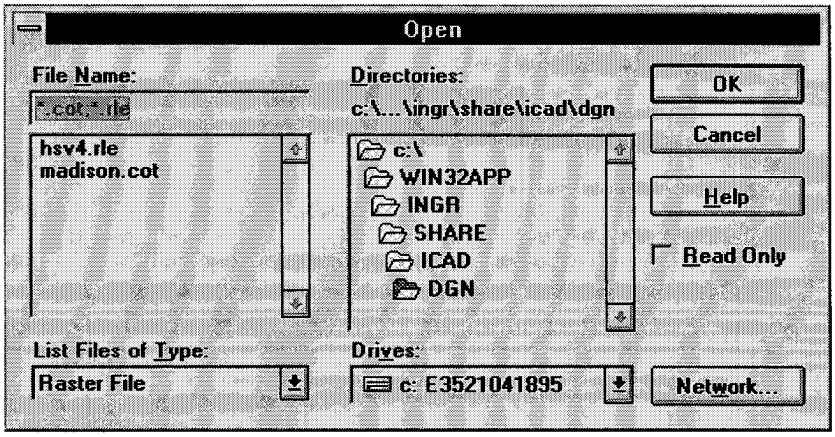
Attach Reference File

Attaches one or more map files to the current map file. When a reference file is attached, the file is drawn on the map monitor, overlaying the active design file. The reference file can be manipulated in the same way the active file is manipulated (for example, the user can zoom in or out). The attached file remains attached until the "Detach Reference File" command is selected.



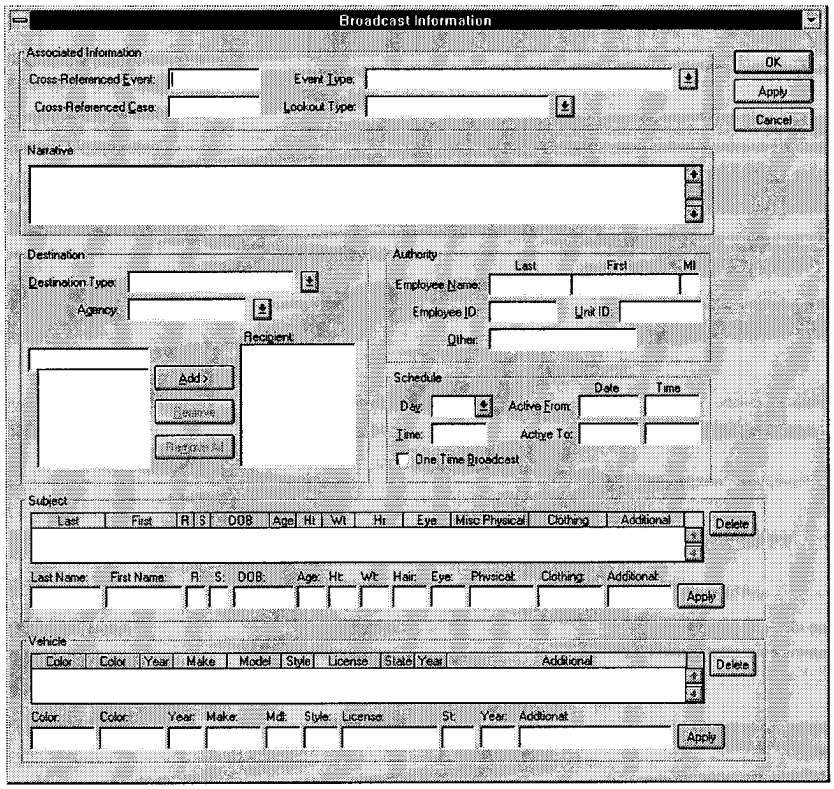
Attach Raster File

Attaches one or more raster files as a backdrop to the map. The attached raster file can be manipulated in the same way that the active file is manipulated (for example, the user can zoom in or out). The attached raster file remains attached until the "Detach Raster File" command is selected.



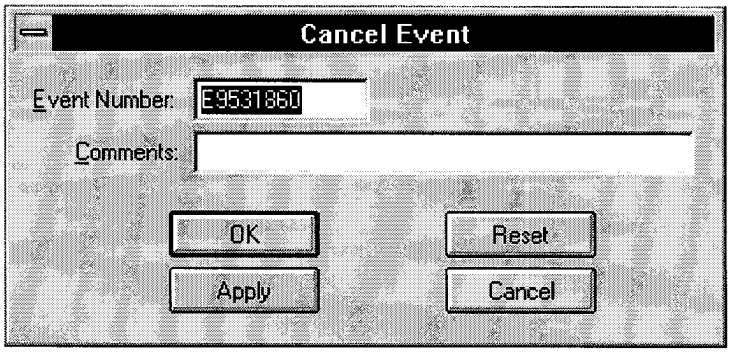
Broadcast Information

Issues bulletins and other agency-wide information, regardless of priority or event relationship.



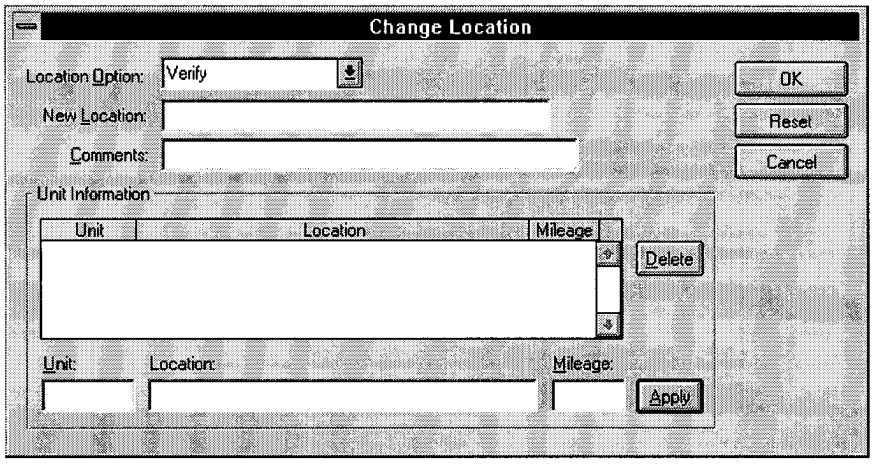
Cancel Event

Used to cancel an active, unassigned event.



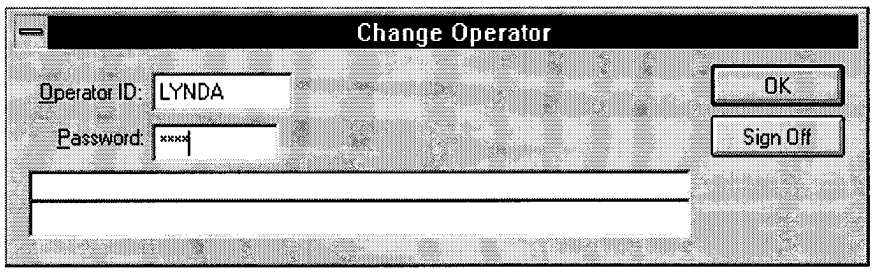
Change Location

Tracks the changes when a unit moves to a secondary location while still assigned to an event. For example, a police unit moves from an event location to another address for further investigation. The "Change Location" command can also be used for unassigned units. Map symbols of units can also be dragged and dropped to a new location on the map display, and the database will automatically reflect the updated location.



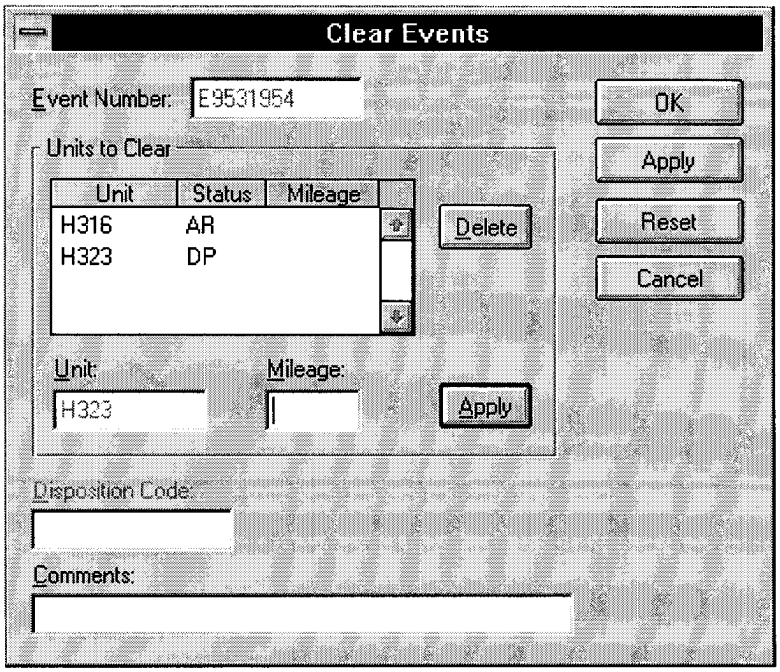
Change Operator

Allows operators to change positions without signing off of the system. Typically, this is performed when one operator relieves another.



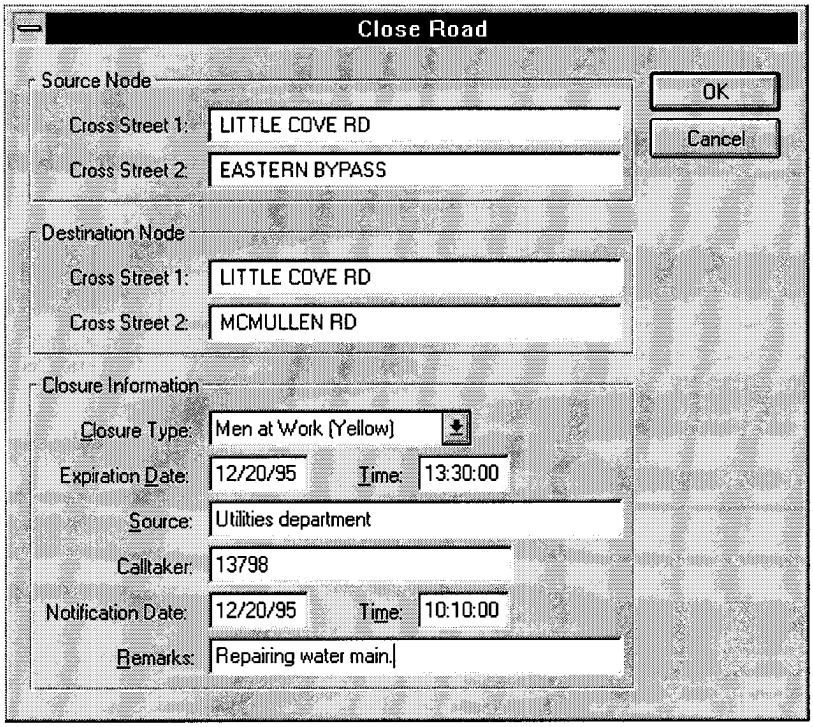
Clear Event

Clears all units and/or agencies assigned to an event.



Close Road

Allows an operator to close a road. The map displays the closed roads, and the database captures the information for queries and processing. The road remains closed on the map until it is re-opened.

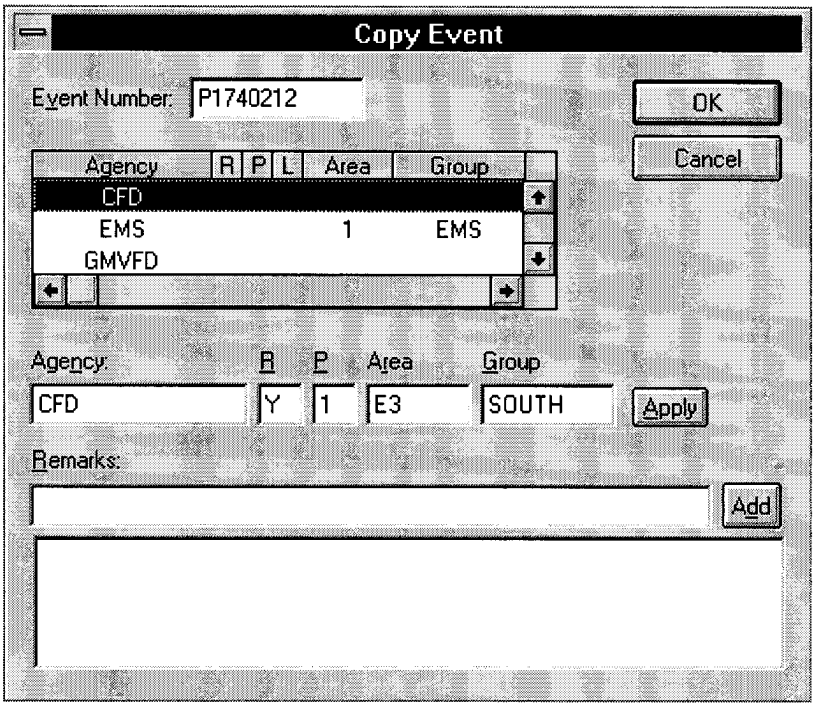


Copy Event

Allows information to be copied to another agency, to multiple agencies, or to another dispatch group in the same agency. This is especially useful when an active event requires a response from more than one agency or from more than one dispatch group within an agency.

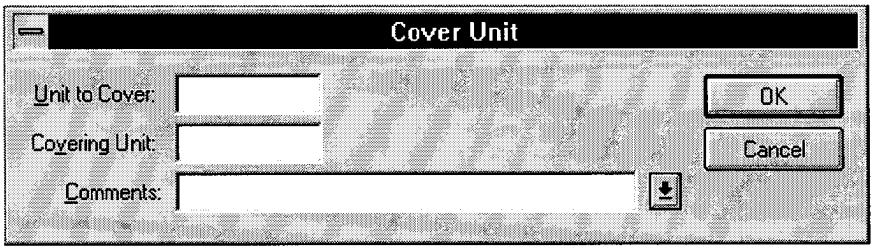
For example, a traffic accident is automatically a police event. If the accident involves injuries, it is also an EMS event. If the accident involves spilled fuel, it is a fire event as well. The "Copy Event" command allows the user to copy the police event to the fire department and EMS agencies and avoid re-entering the information.

Note: The "Create Associated Event" command can also be used to copy events to dispatch groups in the same agency, as well as to other agencies.



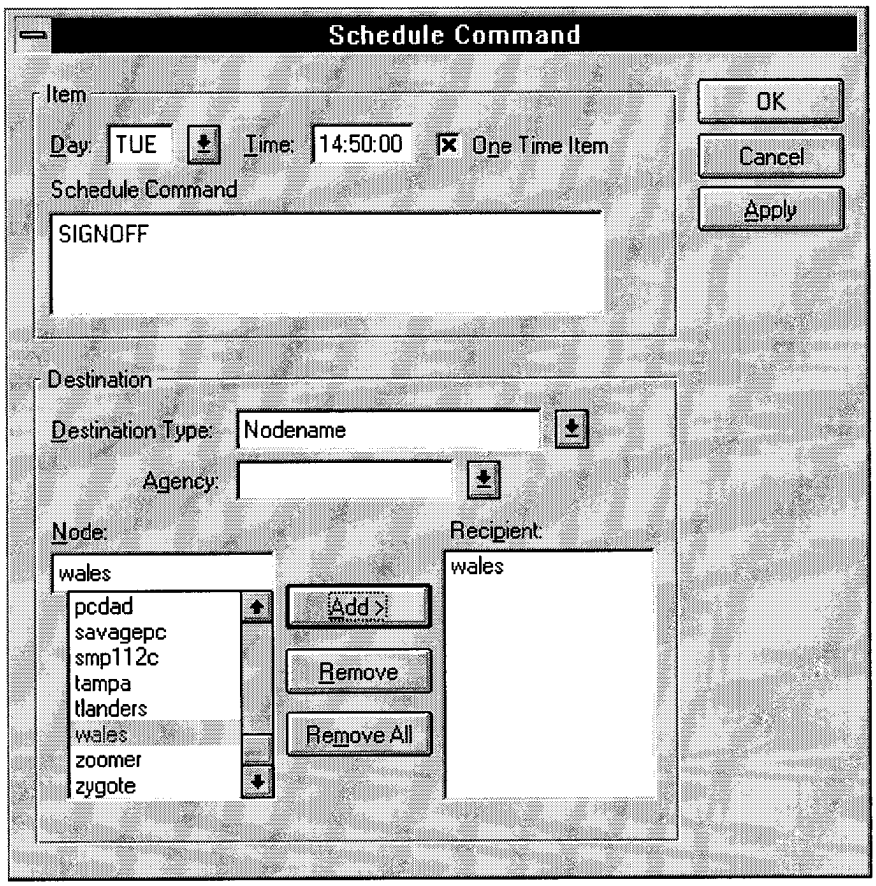
Cover Unit

Used when a unit temporarily assumes the responsibility of another unit.



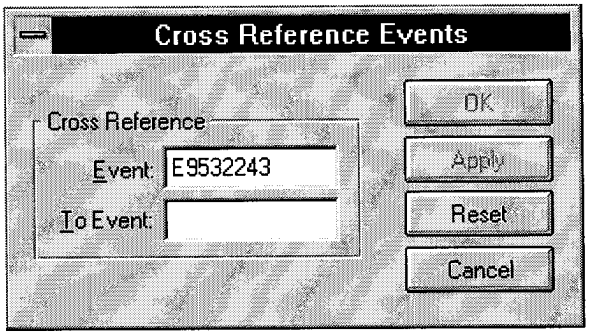
Create Scheduled Event

Used to schedule a non-emergency run, usually for an EMS agency. For example, it can be used to schedule a run for a dialysis patient each Monday, Wednesday, and Friday at 1030 hours. In this example, an ambulance must be scheduled to pick up the patient in time to make the appointment, and the same, or another ambulance, must be scheduled to return the patient after treatment.



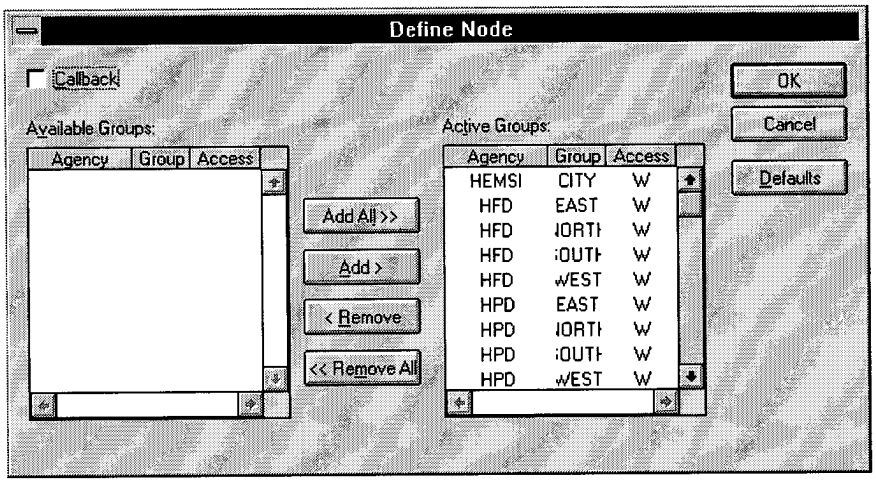
Cross Reference Event

Cross references two or more events that appear to be related, creating entries in the history records of each event.



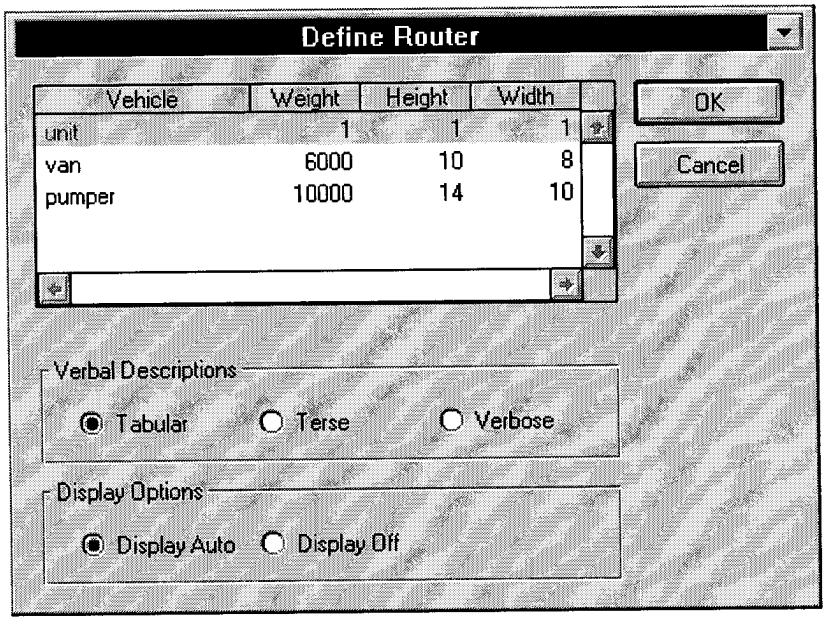
Define Node

Defines the agency/dispatch groups to be loaded or changed on an operator's workstation; also used to make the workstation a call-back station.



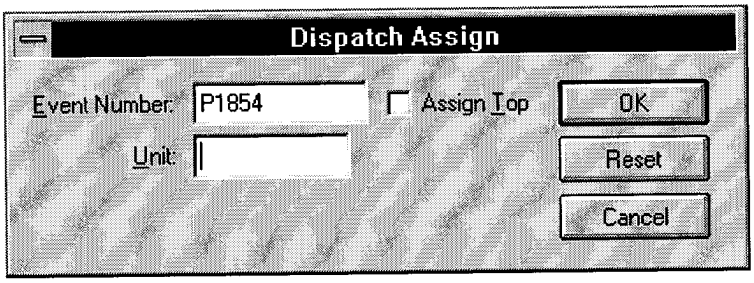
Define Router

Notifies I/CAD how routes are to be drawn. At configuration, the system has a default definition, or description, which the operator may want to change. By defining the router, the operator can specify vehicle types, how to format the verbal directions, whether the route is to be drawn fast or slow, and whether the route should display in the foreground or the background.



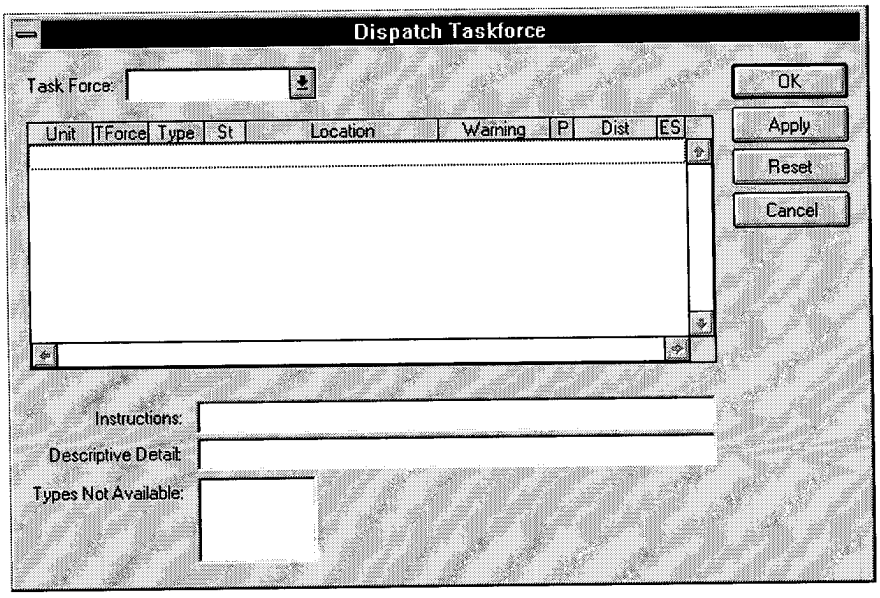
Dispatched Assigned

Stacks an event to a unit, allowing the operator to assign multiple events to one unit.



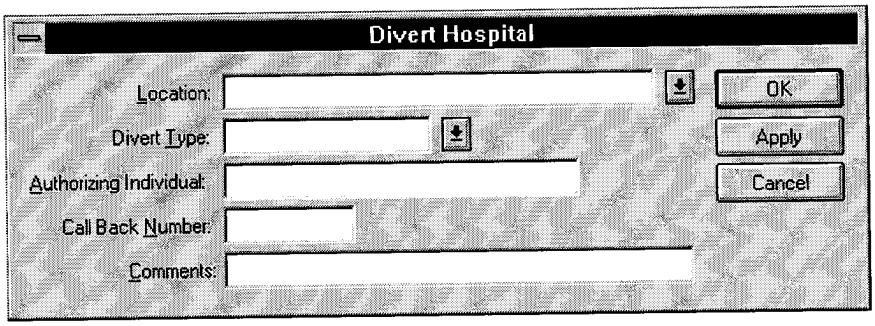
Dispatch Task Force

Allows the user to dispatch a task force, which is a group of units that can be dispatched as a single entity.



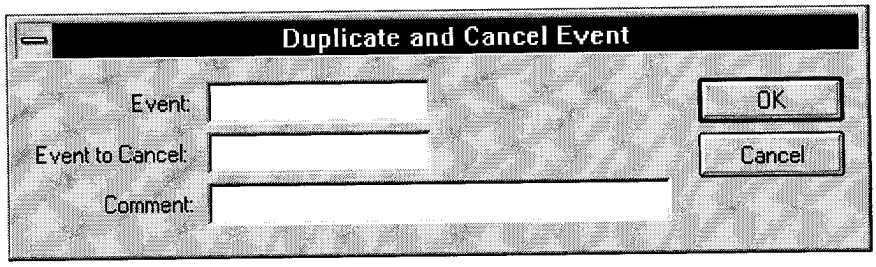
Divert Hospital

Hospitals sometimes notify EMS agencies of existing conditions that restrict their ability to accept more patients. The hospital may be full or it may have restrictions in one area that would exclude certain types of patients (for example, cardiac patients). The "Divert Hospital" command maintains the status of each hospital. An operator will receive a warning if a unit starts to transport to a hospital on diverted status.



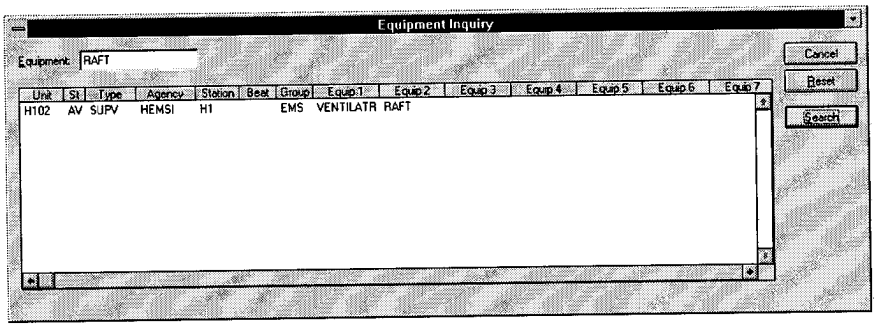
Duplicate and Cancel

When it is recognized that two events are actually the same event reported by two different parties, the "Duplicate and Cancel" command is used to record and cross-reference the incidents and cancel one of them.



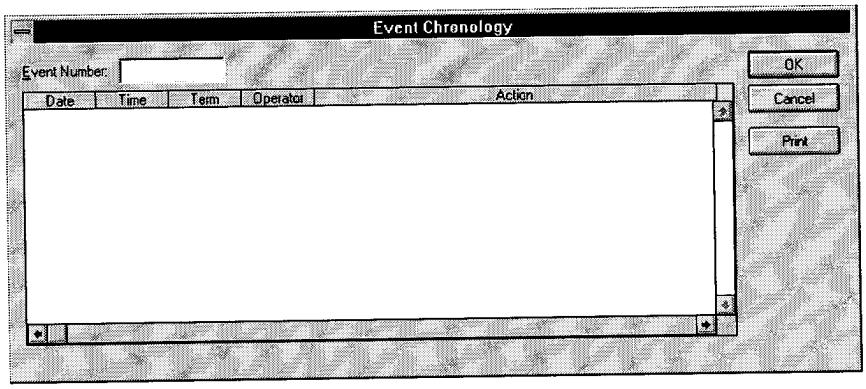
Equipment Inquiry

Allows the operator to locate units that have special equipment such as the "Jaws of Life" or "Life-Pak."



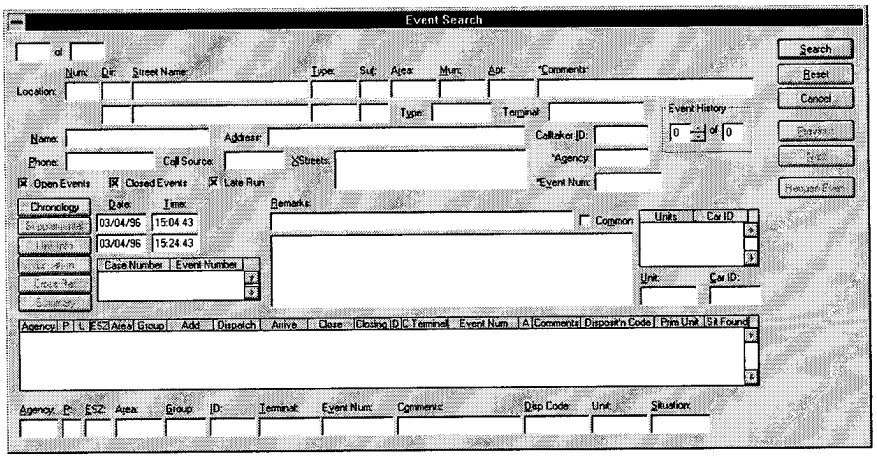
Event Chronology

Displays an event lifecycle summary that is arranged chronologically.



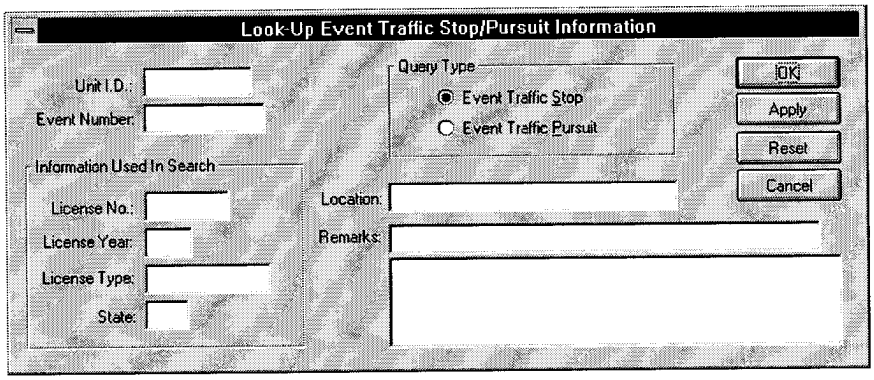
Event Search

Allows the operator to search for an event when the event number is not known. Because "Event Search" is a background command, any other I/CAD command can be executed while waiting for the search to be completed. There are several fields available to set the search criteria.



Event Traffic Pursuit

Records and maintains traffic pursuits as specific types of events. An Event Traffic Pursuit must be related to an event; in other words, it must occur in conjunction with a previously assigned event. The system appends the information from this command to the original assigned event rather than creating a new event.

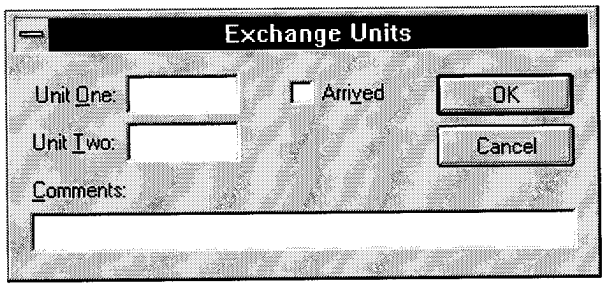


Event Traffic Stop

Records and maintains traffic stops as specific types of events. An Event Traffic Stop must be related to an event; in other words, it must occur in conjunction with a previously assigned event. The system appends the information from this command to the original assigned event rather than creating a new event. This command uses the same form as the "Event Traffic Pursuit" command.

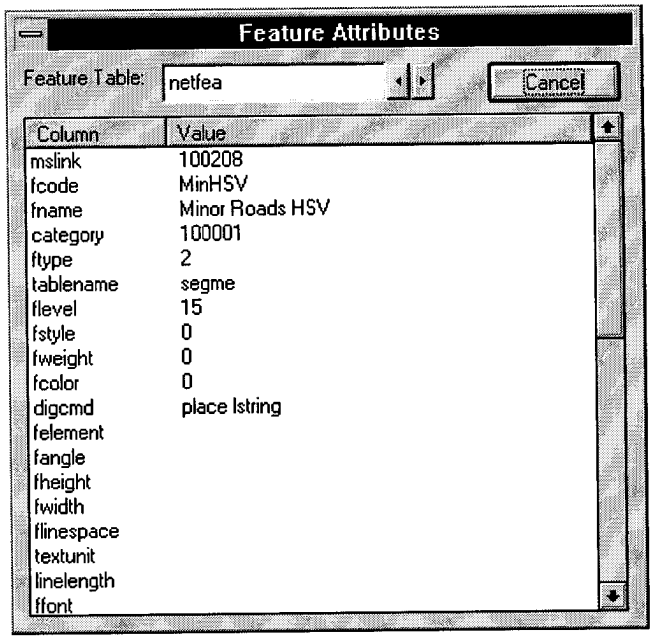
Exchange Unit

Allows two units to be identified and their assignments and status's swapped.



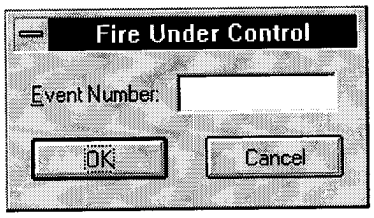
Feature Attributes

Reviews attributes of a particular graphic entity on the map. An attribute is a quality or characteristic of a feature; for example, an attribute of a particular street might be the street name or the zip code of the identified block.



Fire Under Control

Allows the operator to record the date and time in the database when units advise that a fire event has reached the "under control" stage.

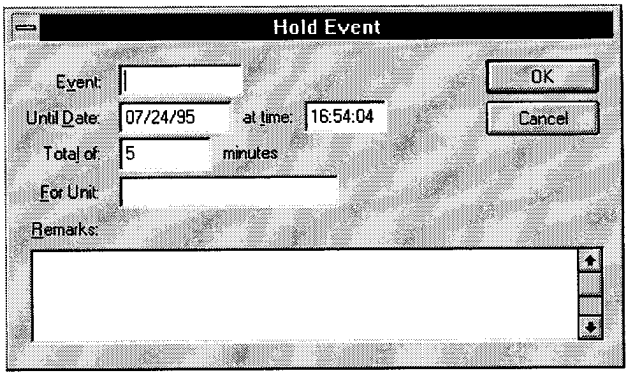


Greater Alarm

Raises the alarm level of an active event. Each time the "Greater Alarm" command is selected, the alarm level is increased by one. Using the "Unit Recommend" command will recommend units needed for that alarm level.

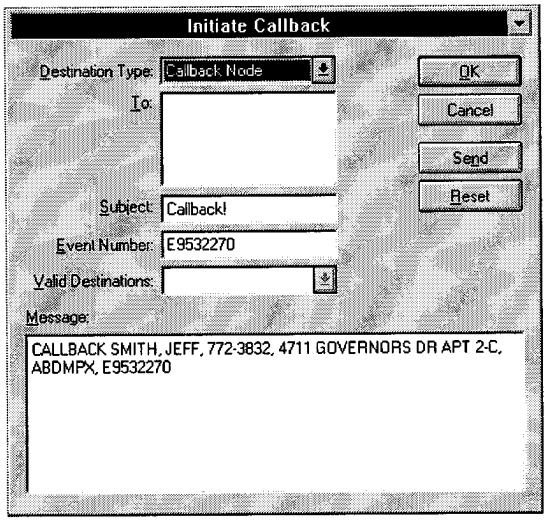
Hold Event

Used to place a non-critical event on hold. An event can be held for a certain time, date, or specified unit, or any combination of the three. If more than one condition is specified, all of the conditions must be met. In other words, if an event is held for a certain time and a specific unit, both the time and unit constraints must be met before the event goes off hold.



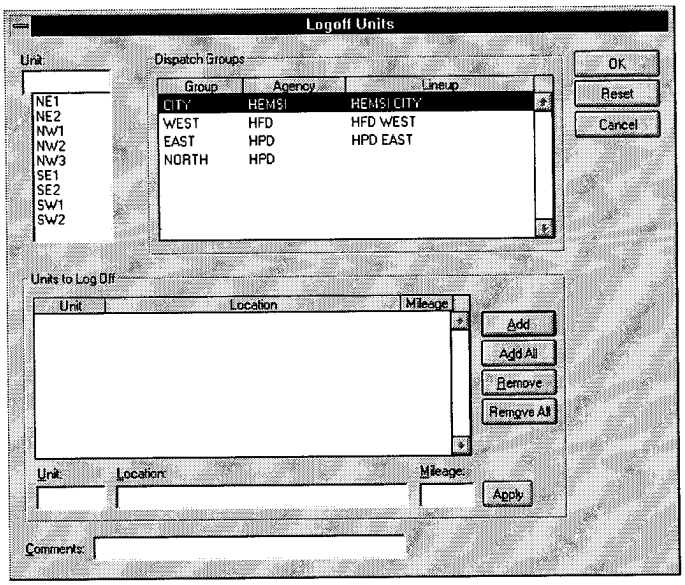
Initiate Callback

Sends a message to the originating workstation (if it is designated as a callback workstation) to recontact the reporting party of an event. This command displays a dialog box loaded with the existing complainant information.



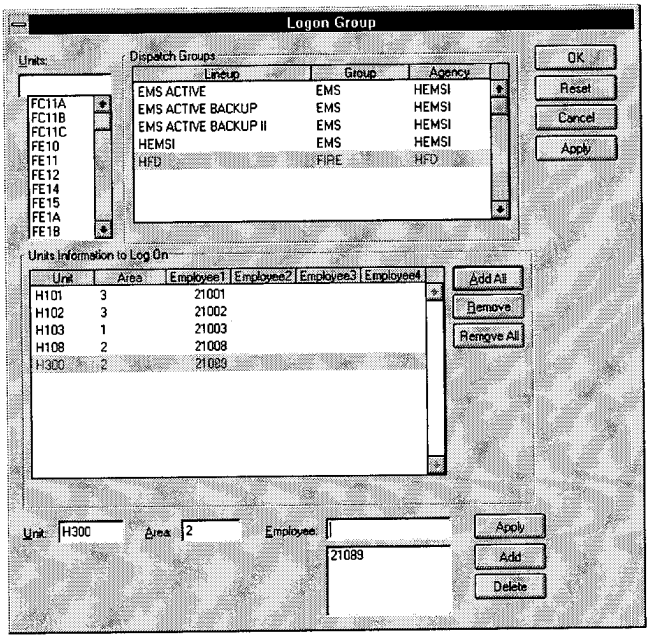
Logoff Unit

Used to log off units either individually or as a group. When units that have dispatch-assigned events log off, the dispatch-assigned events are returned to the Pending Events dialog box. Units working one event, but with other dispatch-assigned events, are marked as "awaiting logoff," and the dispatch-assigned events are returned to the Pending Events dialog box.



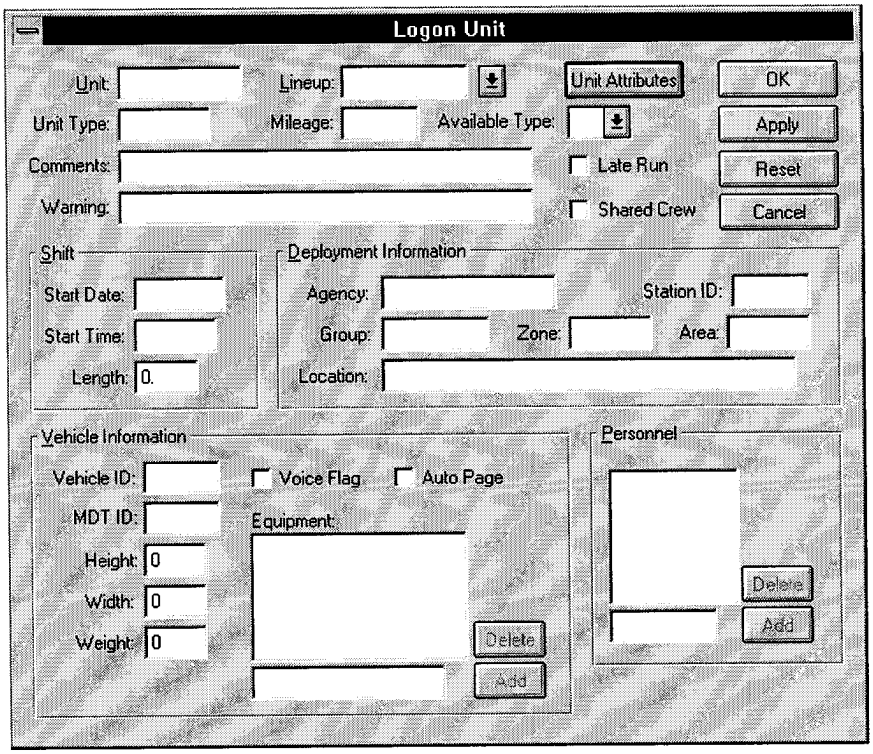
Logon Group

Logs on an entire dispatch group simultaneously. It is usually used in agencies where a supervisor informs communications that an entire group of units may be logged on.



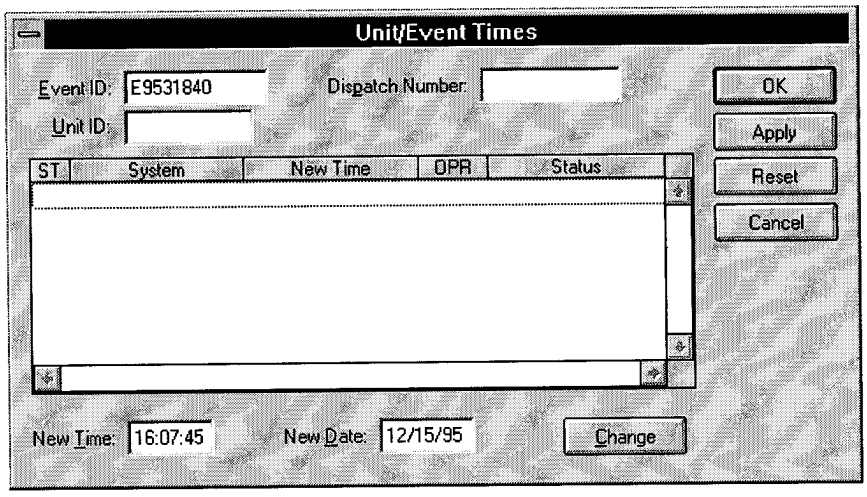
Logon Unit

Allows the operator to log on individual units.



Manual Times

Used to enter unit and event times manually. This typically occurs when there is heavy radio traffic or the unit is not able to communicate its times immediately.



Minimum Distance

Draws a route between two specified points on the map that passes over the shortest distance, taking one-way streets, closures, and possible turns into account.

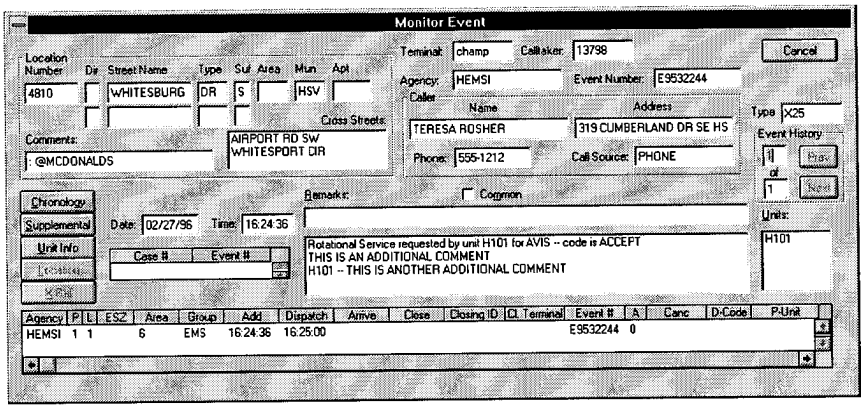
Minimum Intersections Draws a route between two specified points on the map that passes through the fewest intersections, taking into account intersections, closures, and one-way streets.

Minimum Risk Draws a route between two specified points on the map that has the lowest risk for the unit, taking into account risks associated with the street segment, speed limits for the street segments, stop signs and signals, closures, one-way streets, and intersections.

Minimum Time Draws a route between two specified points on the map that takes the shortest time possible, taking into account speed limits for the street segments, stop signs and signals, closures, and intersections.

Minimum Turns Draws a route between two specified points on the map that contains the fewest turns, taking into account the number of turns, closures, one-way streets, and intersections.

Monitor Event Allows an operator to watch the processes of another event as they occur in real-time.

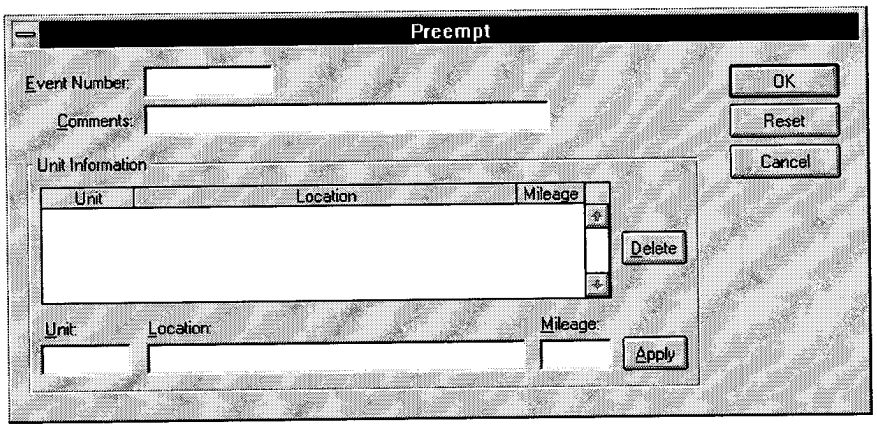


Open Road Re-opens a road listed in the database as closed.

Preempt Unit

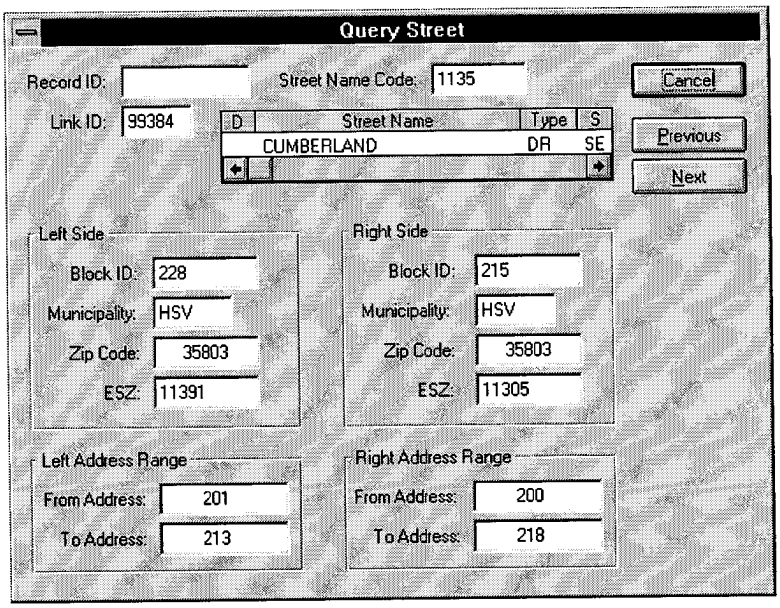
Pre-empts a unit from an event. When a unit is pre-empted, that unit is separated from the event to which it is assigned. When a unit is pre-empted that is not the only unit on the event, the unit is released from the event and is available for dispatch again. When it is pre-empted and is the only unit on the event, the Pre-empt Warning dialog box appears and presents the following options:

- Return the event to the Pending Events dialog box
- Hold the event for the unit (same as selecting the "Hold Event" command), which returns the event to the Pending Events dialog box as an event held for that unit
- Dispatch assign the event to the unit (same as selecting the "Dispatch Assigned" command)
- Place the dispatch assigned event at the top of the list (same as selecting the "Move Assigned Top" command)



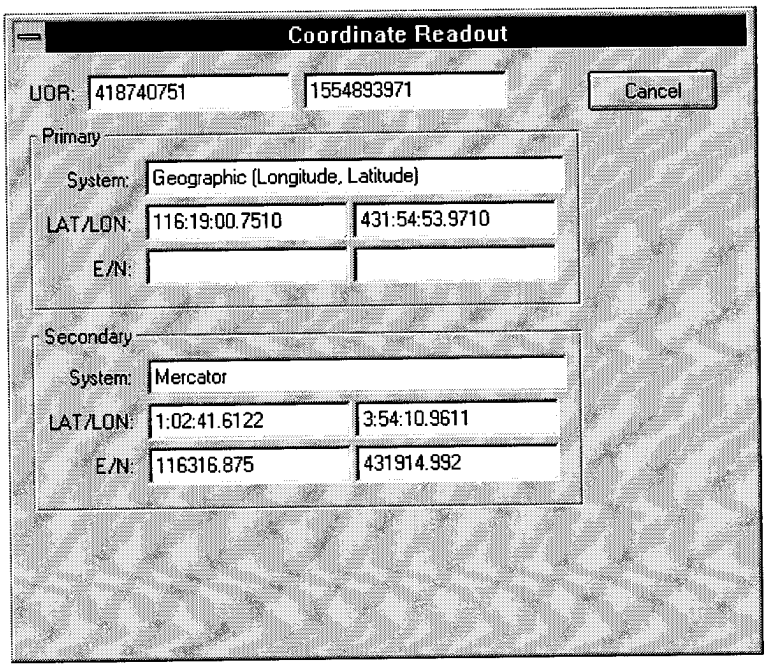
Query Street

Retrieves information about streets and street segments.



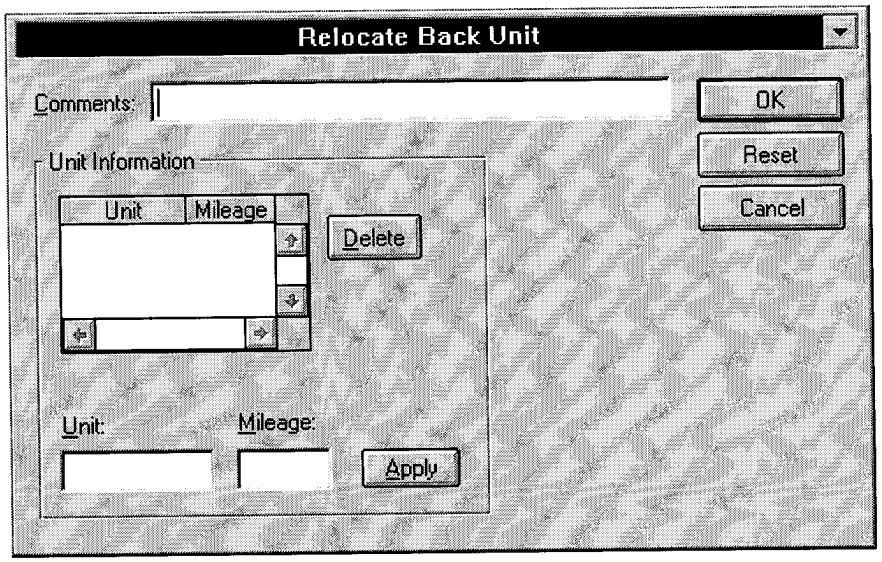
Readout

Allows the operator to display the coordinates of a specified point on the map. The Coordinate Readout dialog box provides spaces to display the major coordinate systems (for example, Mercator or Longitude/Latitude), and the presence or absence of data depends upon the coordinate systems that have been established for the I/CAD database.



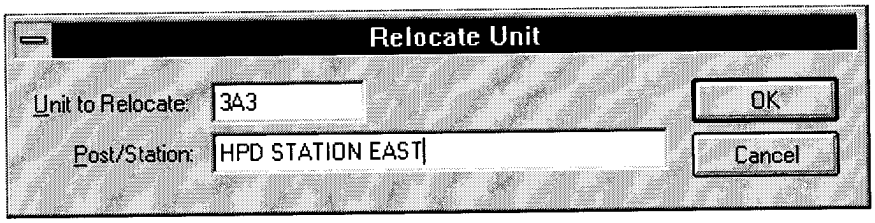
Relocate Back

Returns a unit to its home quarters.



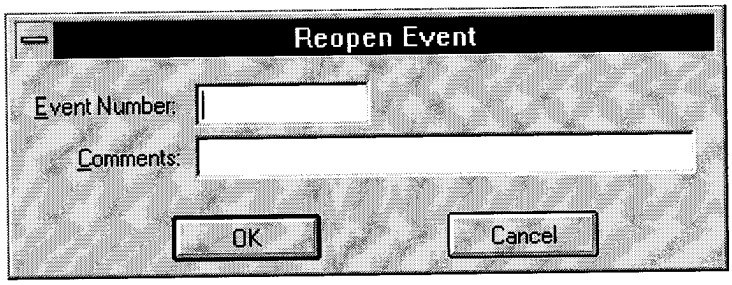
Relocate Unit

Temporarily moves a unit from its home quarters or station to another station.



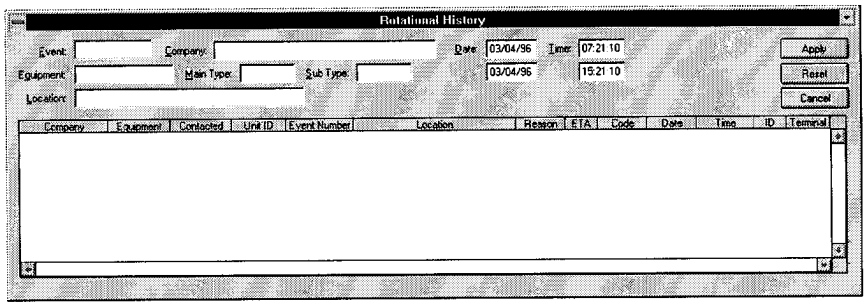
Reopen Event

Used to re-open a closed event rather than having to create a new event that is cross-referenced to the closed event.



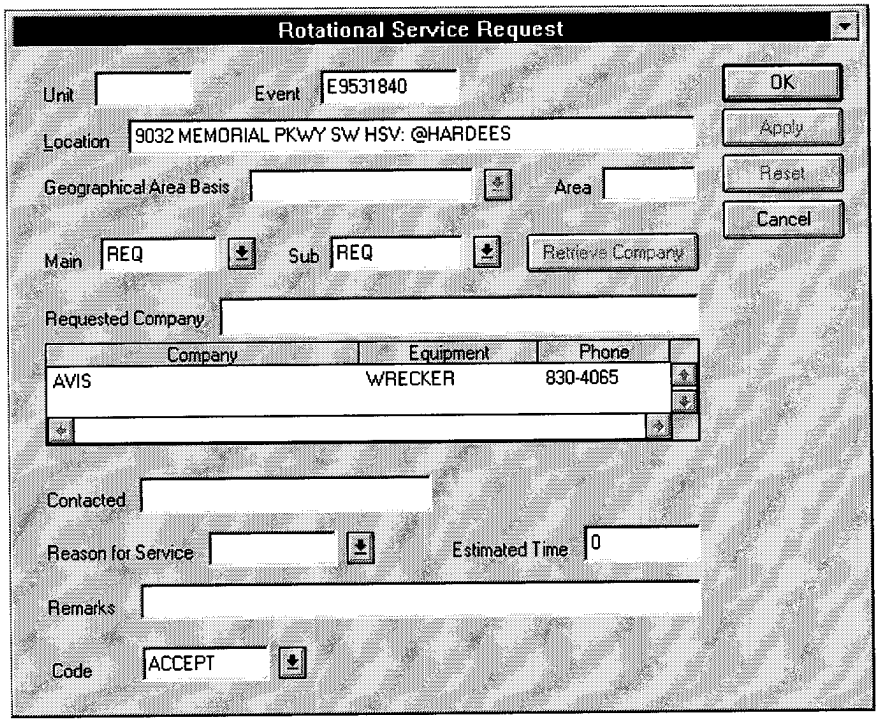
Rotational History

Allows the operator to inquire about contacts made to commercial contractors, such as tow services and private ambulances, called upon through a rotational policy.



Rotational Service Request

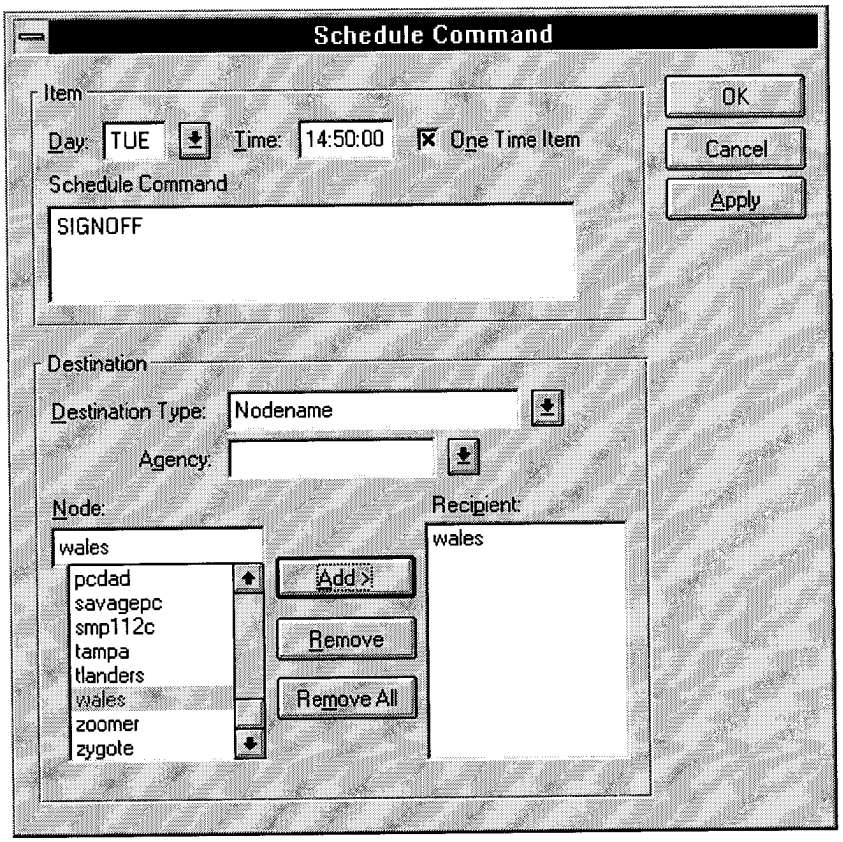
Used to select a commercial contractor that provides a specific service. A Rotational Service Request in I/CAD is a request to call a commercial contractor, such as a tow service—I/CAD maintains a rotating list of these contractors.



Schedule Command

Schedules any valid command for automatic execution on a particular day and at a particular time, or every day at a specified time. Commands most commonly scheduled are:

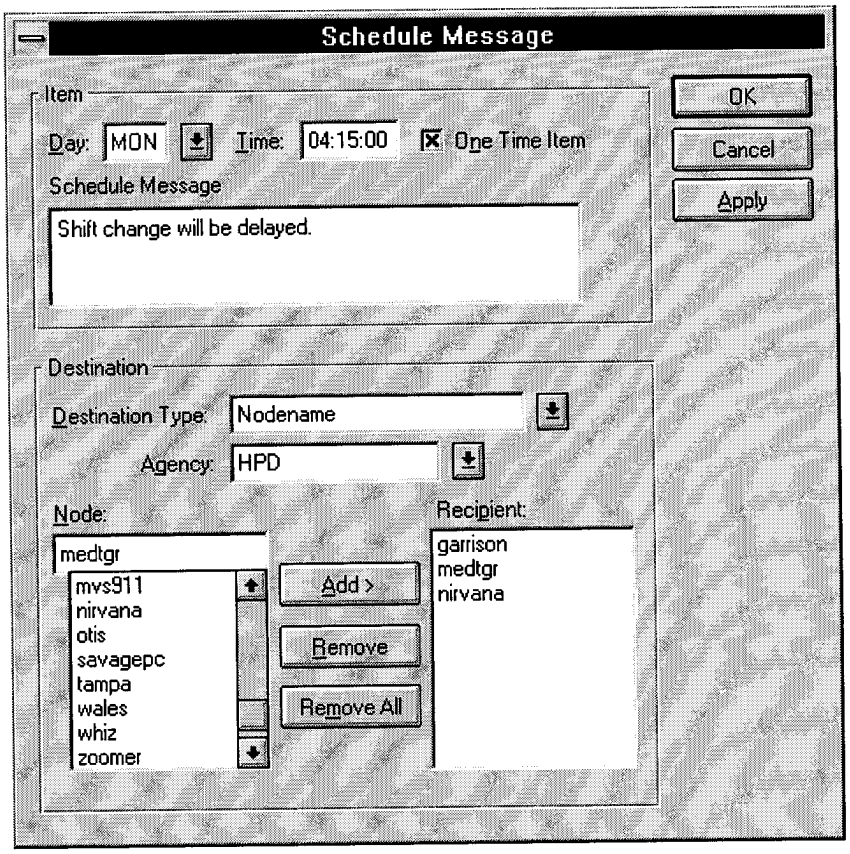
- Automatic deployment plan changes
- Unit logons
- Unit logoffs



Schedule Message

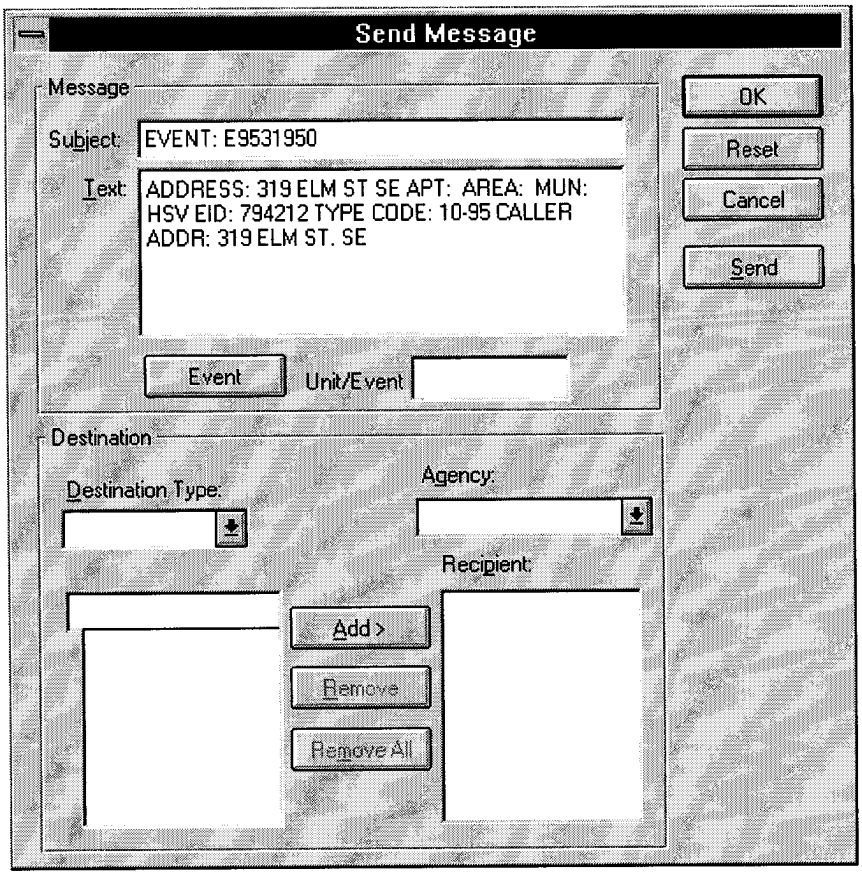
Allows a message to be automatically displayed on a specified day and at a specified time or every day at a specified time. A list of recipients can be preselected. Commonly scheduled messages include the following:

- Broadcast bulletins
- Administrative announcements
- Training announcements
- New procedures
- Schedules (vacation, meals, and holidays)



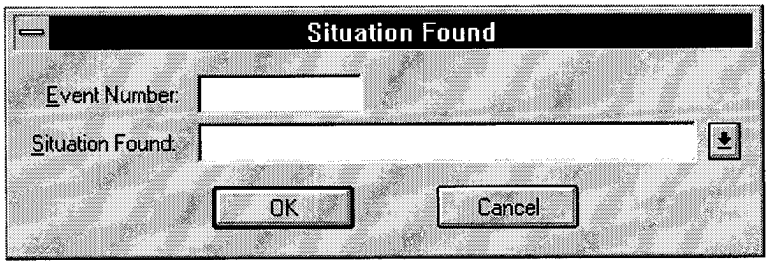
Send Message

Used to send information, primarily between workstations in the communications center, informing personnel of information such as meetings and policy changes. It can also send information from the center to MDT-equipped units—in those instances, event-related information is sent.



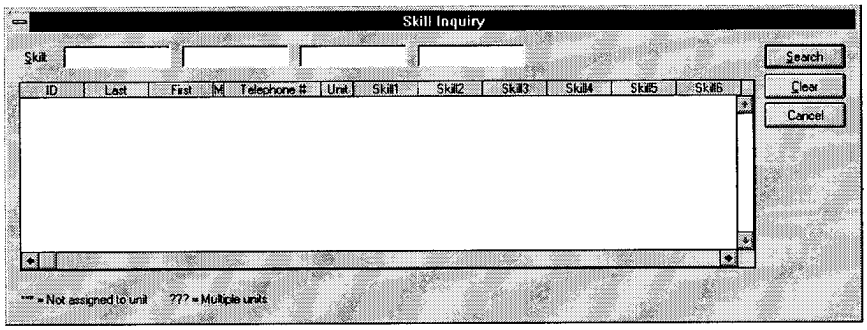
Situation Found

Used to record instances in which the originally reported incident varies markedly from the actual situation found by the field unit, but it is not appropriate to change the event type. With this command, the system maintains an audit trail showing that, as an example, the originally reported event type was a high-priority event, but the actual event was not an emergency. The "Situation Found" command retains the original information, but with database records established to show the changes made, by whom, and the time of the changes.



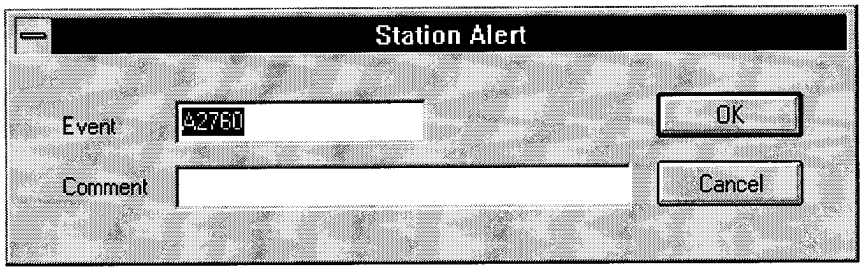
Skill Inquiry

Locates personnel with special skills, such as foreign language skills, CPR, or sign language.



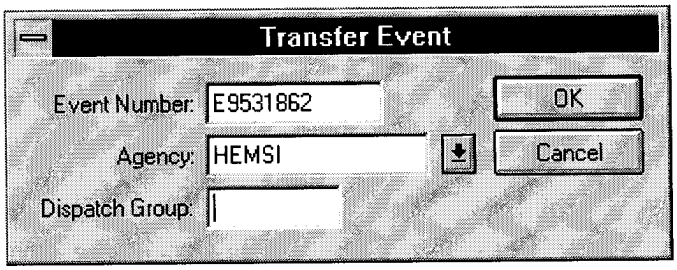
Station Alert

Creates a system time stamp and marks that the station was notified of a new event. Typically, Station Alert is used in jurisdictions served by volunteer fire departments.



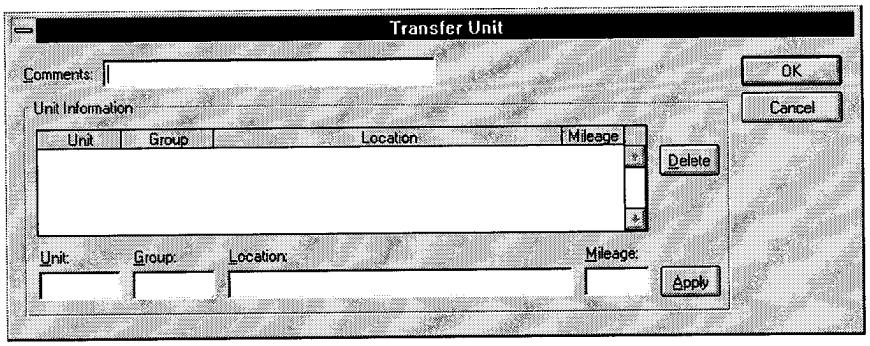
Transfer Event

Transfers an event and all of its associated assigned units to another dispatch group, regardless of status.



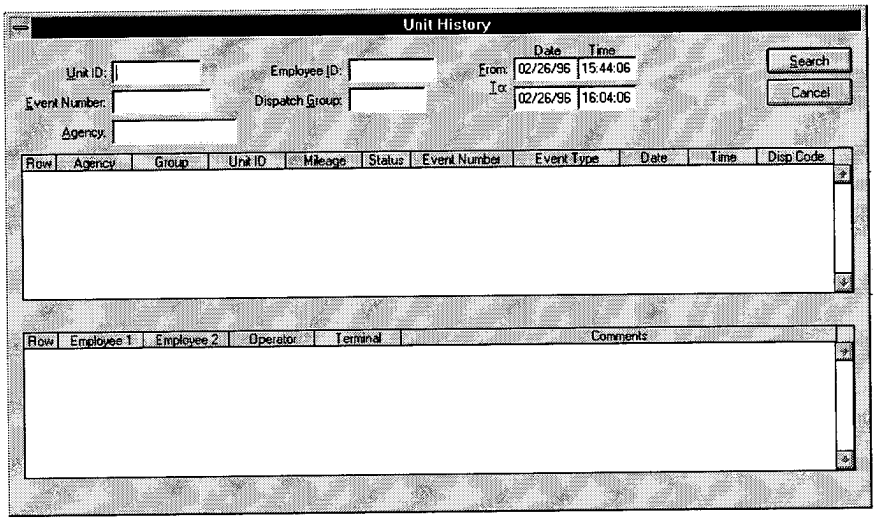
Transfer Unit

Allows an operator to lend a unit to another dispatch group.



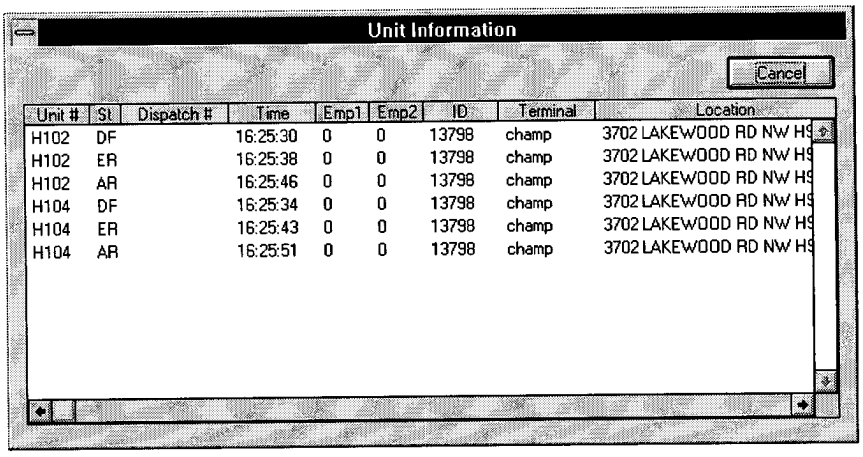
Unit History

Allows the operator to review a historical display of all unit activities based on the defined search criteria.



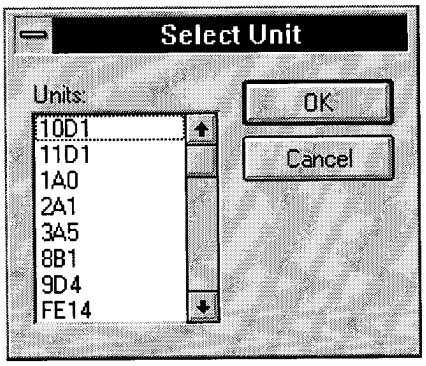
Unit Information

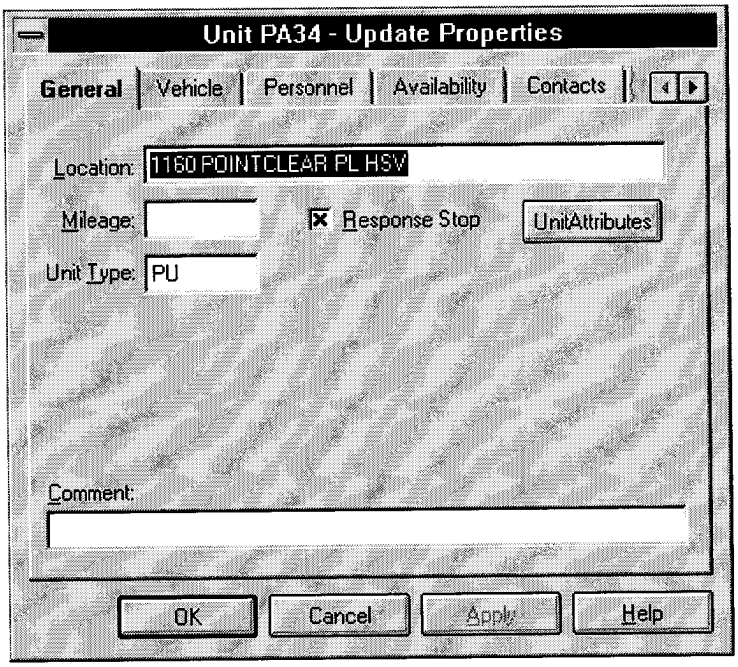
Allows an operator to review a list of the current unit history record for each unit assigned to a selected event.



Unit Properties

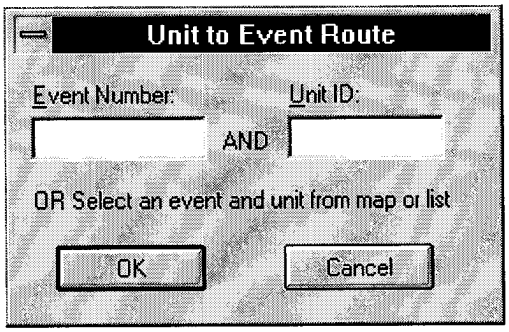
Allows the operator to make changes to unit information. The rosters and lineups contain information about the characteristics of a unit at logon. If that information changes, it may be updated on-line, without creating a new record or logging the unit off and back on.





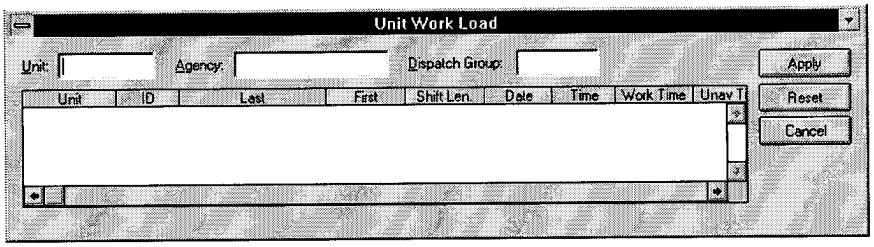
Unit to Event

Starts the "Minimum Distance" command and draws a route between a unit symbol and an event flag identified on the map.



Unit Work Load

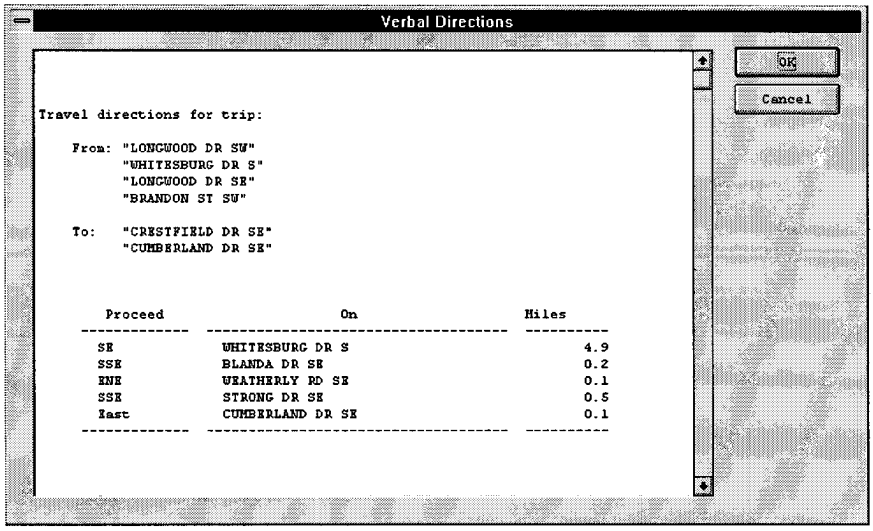
Some agencies have units working shifts of different lengths, commonly 8-, 10-, 12-, or 24-hour shifts. Because different units may be working different shifts at any one time, a user may need to know the length of a shift for each unit and what its workload has been during its present shift. It may be expected that a unit working an 8-hour shift be assigned to calls during most of that 8-hour period (80-percent utilization), whereas a unit working a 24-hour shift is expected to have some time for rest. The assignment expectation for a 24-hour unit is, therefore, about 25-percent of its shift. The "Unit Work Load" command is used to review these figures for units before they are dispatched. If a crew has changed unit ID numbers during the shift, the workload data for the crew carries to the new unit ID number.



Verbal Directions

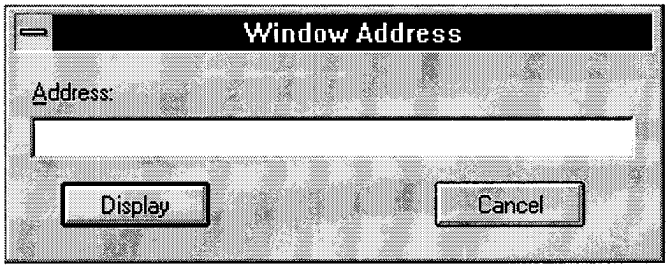
Creates verbal instructions for a route. The following formats are available for verbal instructions:

- Tabular
- Terse
- Verbose



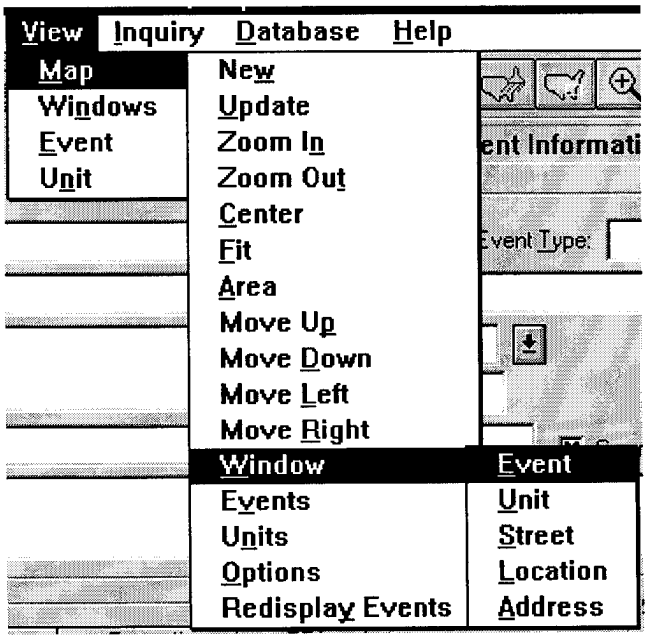
Window Address

Used to isolate and zoom in on a particular address or intersection.



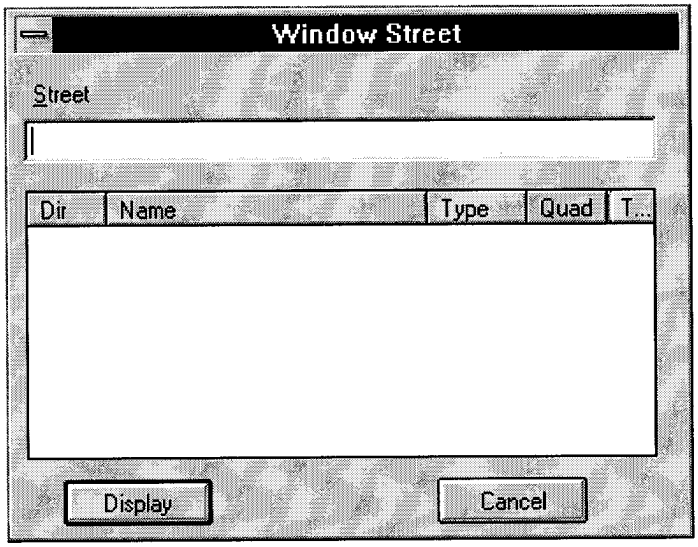
Window Event

After an event is identified, the map zooms in on that event to a predefined range.



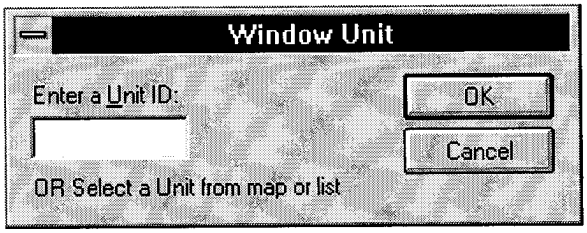
Window Street

Allows the operator to view street segments with the same name in a magnified portion of the map.



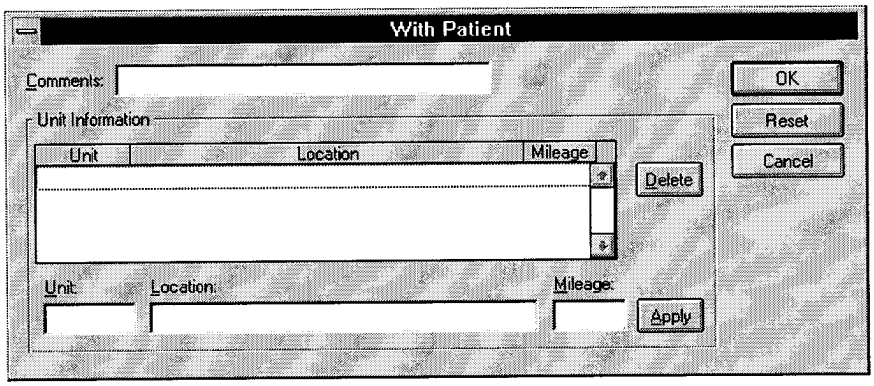
Window Unit

Allows the operator to identify a unit, and have the map zoom in on that unit's location to a predefined range.



With Patient

Tracks a unit's status while it is with a patient on the scene of an event. This command usually follows the "Arrive Dangerous Scene" command, which indicates that the unit is on the scene and the ambulance crew is waiting to leave the vehicle until an escort arrives or until the situation no longer requires an escort. The "With Patient" command indicates that they have entered the building and located the patient.



3.3.5 I/Executive and I/Executive 2

I/Executive and Executive 2 both provide the same functionality; however, I/Executive 2 is offered at a discount to encourage communications centers to incorporate redundant database servers in their system architecture.

The I/Executive software coordinates all IPS software modules and passes information between the I/MDT and I/Informer interfaces and the various client workstations, ensuring the correct transfer of data. In addition, I/Executive and I/Executive 2 includes map maintenance utilities.

In the event of a database server failure, I/Executive discreetly notifies all nodes of failover, automatically redirects network traffic to the functioning database, and alerts designated users of server failure. Following recovery, I/Executive resynchronizes the failed database, then notifies all nodes that dual server operation has resumed.

The I/Executive security tool kit is used to fine-tune access and control privileges to external public safety databases, such as the NCIC.

3.3.6 I/Major Incident (Optional)

A Major Incident is any emergency that requires implementing special arrangements by one or all of the emergency services for the following:

- The rescue and transport of large numbers of casualties
- The involvement, either directly or indirectly, of large numbers of people
- The handling of a large number of inquiries most likely to be generated from the public and news media
- The mobilization of large-scale, combined forces of the main emergency services
- The mobilization and organization of the emergency services and supporting organizations to respond to the threat of death, serious injury, or homelessness to a large number of people

I/Major Incident provides a facility for storing major incident plans that meet any of the above criteria and for linking the plans to specific event types. Major Incident plans are made up of relevant Action Lists plus any other information needed to facilitate the handling of a major incident and are designed to aid call takers and dispatchers in completing the tasks in an orderly manner. Plans may also be entered for event types that have the potential of escalating to Major Incident status. Operators are able to access these plans, quickly and easily, and to carry out the tasks outlined in the plans, checking off action items as they are completed.

3.3.7 I/Management Information and Reporting System (I/MARS) (Optional)

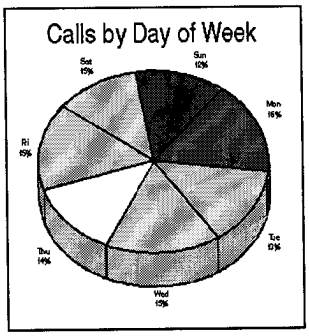
I/MARS–Server

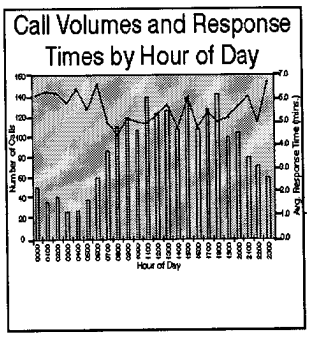
I/MARS is a generalized management tool that facilitates the generation of performance reports and provides crime and incident analyses from a geographic perspective. Capabilities include analyzing the geographic distribution and requests for service by time of day and by response time.

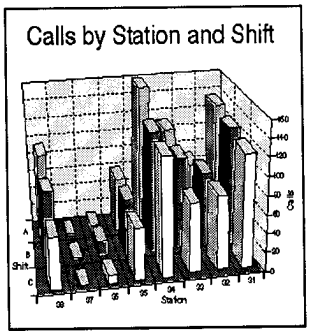
I/MARS also provides tools for creating deployment plans that consider the number of available resources by time of day or by the day of the week.

Query results can be returned as printed lists, in spreadsheet format, displayed on the same map seen by call takers or dispatchers, or can be output as graphs, bar charts, or

histograms. Selected datasets can be manipulated by many functions, including: filter, sort, trend analyses, univariate or multivariate analyses, and dynamic analyses.







Example I/MARS Query Results

I/MARS-S incorporates the Analysis and Administrator utilities that, respectively, define output options/selection criteria and fine-tune security restrictions for I/MARS users.

Default I/MARS reports are divided into two categories: Center Performance, which assists decision makers in the management of resources, and Resource Utilization, which assists management in the utilization and deployment of field resources.

The default reports within the area of Center Performance are as follows.

Time to Enter Events

This report measures the performances of call takers by calculating the time required by an operator to enter data associated with an event. Time to Enter Events is defined as the amount of time elapsing between the time the event is accepted and the time the event is created.

Calltaker Accuracy

The Calltaker Accuracy report computes the number of modifications to event data entered by the call taker. Counts of the number of event type code changes and the number of address re-entries are provided.

Calltaker Workload

This report calculates the number of events handled by call takers from a designated logged on time.

Time to Dispatch

The Time to Dispatch reports measure the performances of dispatchers by calculating the amount of time required to send the first unit to an event after receiving a notification of the call from the call taker.

Total Time to Dispatch

This report measures the overall performance of center personnel by calculating the time required to dispatch the first unit to an event after the initial call is received.

Dispatcher Workload

Dispatcher Workload reports the number of events handled by a dispatcher from a designated logged on time.

Event Statistics List

This report groups a designated number of events by any combination of the defined selection criteria.

Event List

This report provides a textual display of detailed information related to an event.

Event Chronology

This report displays key occurrences in the progression of an event from creation to closure.

The default reports within the Resource Utilization area are as follows.

Unit Workload

The following Unit Workload reports may be generated:

- Available by Agency
- Available Time by Dispatch Group
- Available Time by Unit
- Events Dispatched by Day of the Week
- Events Dispatched by the Hour of the Day
- Transports by Day of the Week
- Unit Response by Day of the Week

Demand Analysis

The Demand Analysis report measures unit demand during each hour of the day. This report also displays the average event completion time during each hour of the day.

Planned Coverage
The Planned Coverage report correlates planned unit load to actual unit load for each hour of a specified day.

Event Handling Time
This report provides an indication of the efficiency of unit personnel by computing the time elapsed between unit arrival at an event site and the time the event is cleared.

Response to Emergency Events
This report calculates the time elapsed between a dispatcher's assignment of a unit to an event and the time the unit actually leaves enroute to the event.

First Responding Unit Time
The First Responding Unit Time report calculates the time elapsed between the dispatch of units to the event site and the time the first unit arrives on site.

Arrival to Transport Time
This report calculates the amount of time elapsed between the arrival time of a unit and the time transport begins.

Transport to Clear Time
The Transport to Clear report computes the amount of time elapsed between the beginning of a unit's transport of a patient to a hospital and the unit's arrival at the hospital.

Create to Transport Arrive
This report computes that amount of time elapsed between initial receipt of a call and delivery of a patient to the hospital.

Hospital Diversion
The Hospital Diversion report displays the times in which units were diverted from primary hospitals to secondary hospitals.

Event Statistics List
This report displays the number of events that meet defined selection criteria.

Event List
The Event List report details event information.

Event Chronology
The Event Chronology report provides a historical synopsis of event progression.

I/MARS–Client

I/MARS-C provides the client workstation with a GUI interface to the I/MARS-S software located on the Interface/Communications Server. I/MARS-C enables performance reporting and provides crime and incident analyses from a geographic perspective.

I/MARS also provides tools for creating deployment plans that consider the number of available resources by time of day or by the day of the week.

Query results can be returned as printed lists, in spreadsheet format, displayed on the same map seen by call takers or dispatchers, or can be output as graphs, bar charts, or histograms. Selected datasets can be manipulated by many functions, including: filter, sort, trend analyses, univariate or multivariate analyses, and dynamic analyses.

3.3.8 I/Mobile

The I/Mobile software resides on each MDT, connecting the mobile user to the I/CAD System and to other mobile MDTs. The MDT software also interfaces with automatic vehicle location hardware.

I/Mobile communicates with the I/CAD System through the Interface/Communications Server based I/MDT product. Messages are sent and received asynchronously. I/Mobile allows units to access a subset of I/Dispatcher commands and provides an interface to external databases for queries like vehicle license checks.

Although certain operations are handled locally by the unit, ultimate event and unit management is handled at the dispatch center. In this way, I/Mobile mainly facilitates and supports the overall I/CAD System. Without communications back to the center, the usefulness of the MDT is severely limited, but not totally lacking. Some local database queries can still be useful and, as a general-purpose personal computer, additional software can be used. By and large, however, I/Mobile serves as a mobile user interface to the I/CAD System, empowering remote personnel with the ability to deal with units, events, people, and locations.

I/Mobile runs on a Window/95 or Windows/NT operating system and can, therefore, run concurrently with other software, such as an editor for report capture. I/Mobile does not preclude additional software from running on the operating system so long as it does not interfere with I/Mobile operation. I/Mobile provides a mechanism to allow:

- The dispatch center operator to provide information to the unit
- The dispatch center operator to make inquiries about the I/Mobile unit

- Field personnel to feed information to the I/CAD System
- Automatic vehicle location
- Field personnel to query the I/CAD database
- Field personnel to query external databases, such as the NCIC
- Field personnel to communicate with other units

3.3.9 I/Mobile Data Terminal (I/MDT)

I/MDT runs on the Interface/Communications Server and provides the communication services between the dispatch environment and the vehicle-based mobile data terminals (MDTs). By way of this connection, MDTs are capable of reviewing and updating event data; as well as unit, personnel, and equipment information maintained in the dispatch centers database.

3.3.10 I/Page Message

I/Page Message enables the dispatch environment to connect to third-party paging terminals. This product extends dispatcher functionality by allowing transmission of alphanumeric messages to be sent from the dispatch center to destination paging terminals. I/Page Message must be customized to adapt to the third-party paging terminals available.

3.3.11 I/Page Tone (Optional)

I/Page Tone interfaces with third-party paging encoders to allow the dispatcher to work with personnel names and mobile vehicle identifiers and to send an alerting tone to request further voice communication. I/Page Tone converts the dispatcher's symbolic destination to the proper coded sequence, allowing the paging encoder to route the transmission to the proper pager.

3.3.12 I/Push to Talk (I/PTT) (Optional)

I/PTT interfaces to a radio controller, identifying the field unit transmitting to the dispatch environment by displaying a banner on the workstation monitor. I/PTT also supports a Unit Emergency signal from a PTT radio.

The following configurations can be used to customize the display of incoming message notification:

- banners that scroll vertically down the workstation monitor
- banners that scroll horizontally across the workstation monitor
- all I/PTT transmissions display to all workstation monitors
- banners appear only on agency and dispatch group monitors

3.3.13 I/Question and Answer (I/QA) (Optional)

The I/QA software provides a utility designed to assist users in developing scripted series of questions and answers that support call takers and dispatchers in the process of collecting information. By scripting question and answer trees, the I/QA product allows call takers or dispatchers to enhance their ability to quickly assist a caller or to make decisions regarding the disposition of a call. Predefined lines of questions can be manipulated (inserted, changed, or deleted) and answers have an associated action, such as setting the event type or raising the priority of the selected incident. I/QA provides a robust GUI using built-in icons, buttons, and comment boxes to assist the operator.

Using I/QA, dispatchers follow a hierarchical set of questions that, when responded to, rapidly records pertinent information concerning an incident. Each response entered determines the next question to be asked. For example, a "Yes" response to Question 4 cues the system to ask Question 5, but a "No" response cues the system to skip to Question 9. This treed or conditional branching logic is useful for calls where, for example, a burglary is in progress and the operator is immediately prompted to pursue a line of questions specifically designed to determine from the caller if the suspect is armed. This vital information can then be relayed to a dispatched police unit.

As the questions are asked and answered, I/QA automatically date and time stamps each entry to the I/CAD database. Later, the user can query a report that lists each question in the order asked, with the corresponding "Yes" or "No" answer and any comments recorded.

I/QA interfaces with the database in real-time and updates the records as information is entered. In addition, I/QA's flexibility ensures that it can be tailored to any specific requirement. I/QA can be configured to automatically run with each call or can be started at a call taker or dispatcher's discretion. Questions that are responded to with a "Yes" may require that a comment be added—if configured differently, a comment may be entered as an option.

I/QA consists of a server component, called I/QA Builder, and a client component that integrates the question and answer session into the dispatch environment. I/QA Builder uses the Microsoft Access database management system through an ODBC driver. A license for both Microsoft Access and ODBC are required for each workstation that builds I/QA question and answer scripts. An I/QA client license is required for each workstation that makes use of the question and answer databases.

3.3.14 I/Radio (Optional)

I/Radio provides automatic management of talk groups, such as units, incidents, dispatch groups, and all active units and dispatchers. A unit talk group encompasses all radios for that unit, including hand-held radios. An incident talk group includes all units currently assigned to an incident, as well as the dispatchers responsible for the incident. A dispatch talk group represents all units and dispatchers of a given agency responsible for incidents of a particular type in a given geographic area. An active units and dispatchers talk group includes all personnel currently signed on. These talk groups are managed dynamically as personnel sign on and off the system and as units are dispatched.

Dispatchers can also manually create new talk groups by combining individual radios and the automatic talk groups defined above. For speaking, a dispatcher can identify a Unit, Incident, Dispatch group, or manually created talk group and with a single keystroke, select that group.

Dispatchers can also monitor multiple talk groups. When simultaneous communication by multiple talk groups occurs, a priority scheme is maintained. By default, automatically created dispatch groups are arranged by incidents in priority order, however, dispatchers can manually rearrange the priority.

3.3.15 I/Roster (Optional)

I/Roster provides an advanced tool for generating rosters based on specified criteria entered by the user; however, rosters generated using this module can be manually edited and changed at any time prior to the roster start date. Using the fundamental unit of a "shift" as the basis for generating rosters, shifts are organized into sequences called "cycles," which can be replicated as far into the future as required.

The specified criteria used to generate rosters are called "constraints," and constraints are expressed by users as "rules" that are simplified to hide the complexity of the process. Example rules are:

Only allow these particular ranks to staff a particular shift.
The total hours worked in 14 days must be between 60 and 100 hours.

Once all rules are defined for a specified period and assuming 24-hour coverage, I/Roster then generates a sequence of shifts that satisfy the input criteria. If it is not possible to satisfy the criteria with the available staff, I/Roster will notify the user.

If used in conjunction with I/Skill, I/Roster can include additional skills criteria in staffing profiles.

Once I/Roster has generated the roster and the user accepts the output, the software automatically populates the I/CAD database with the appropriate resources at the beginning of each shift. This function eliminates the need for dispatchers to manually log on staff allocated to each unit at the start of shifts.

3.3.16 I/Satellite (Optional)

I/Satellite–Server

I/Satellite–Server provides an interface to the I/CAD system for all I/Satellite clients. The Interface/Communications server performs the insert, query, and notifications of events data to the clients.

I/Satellite–Client

I/Satellite–Client provides limited I/CAD functionality for occasional users running a Microsoft Windows NT or Windows 95 operating system. This product is offered as a low-cost alternative to complete I/CAD functionality and is intended for use by remote personnel. Functionality included in I/Satellite includes the ability to create events, monitor active events, display event details, monitor units, and support I/CAD messaging. I/Satellite does not support a map.

3.3.17 I/Skill (Optional)

I/Skill allows organizations to efficiently plan for and track training requirements by consolidating the following related systems:

- Course and schedule administration
- Automatic setting and management of training budgets
- Automatic forward planning of courses and resources
- Venue planning
- Monitoring an organization's personnel skill base

Specific advantages accrued through the use of I/Skill include:

- Managerial ability to easily monitor the skill level of staff members. Information for future operational planning and management of growth and projected needs is readily available. Managers can interrogate skills levels and training needs based on event trends and operational requirements. Standards are maintained with responsibility arenas, whether centralized or local.
- Individual personnel have access to an ongoing training plan, and staff can maintain a clear picture of group progress. While providing an overall assessment of group progress, I/Skill supports the career aspirations and prospects of individuals.
- Training departments maintain a constant picture of current and future course schedules, including costs. I/Skill generates budgets and tracks year-to-date costs, considering both operational needs and competency requirements.

Courses can be scheduled for specific locations or can include self-paced study. Training resources and materials are allocated to courses, and the system tracks usage and cost, including costs associated with non-material resources, such as the students, assessors, and instructors.

3.3.18 I/Status Message Terminal (I/SMT) (Optional)

The I/SMT runs on the Interface/Communications Server and supports the exchange of unit status information between the dispatch environment and mobile resources equipped with status message terminals. I/SMT also allows the dispatch center to transmit messages to status message terminals. However, transmitted information is limited to the display available on a single workstation screen.

3.3.19 I/System Status Monitor (I/SSM) (Optional)

I/SSM is a server process that monitors activity and resources and notifies dispatchers and supervisors when available resources fall below a pre-defined level. Using the CADDBM utility provided in I/Executive, a baseline resource level that delineates the number of units necessary to conduct business is established. This baseline includes plans that identify station locations of additional resources if needed. Using these plans, when the number of resources falls below the established level, dispatchers and supervisors are notified and may request that additional units be "moved up," which involves moving units from one location to another to sustain baseline resources. I/SSM assists dispatchers and supervisors by calculating and recommending the optimum units to be moved up.

3.3.20 I/Telephone (Optional)

I/Telephone is a Computer Telephony Integration (CTI) product that provides the link between the phone system and the I/Dispatcher product. It is an extension to the I/Dispatcher product that is being proposed to provide this functionality. The product consists of a server component that resides on the External Interface Communications Server and a client component that resides on the operator's workstation. I/Telephone uses the Microsoft Telephony API (TAPI) – to communicate with the phone system PBX. A service provider may control the PBX and reside on a server, or it may control an individual phone board and handset residing on a workstation.

Using the same GUI seen in the I/Calltaker and I/Dispatcher software, I/Telephone moves telephone operations to the computer screen, minimizing the number of operator actions necessary for dispatchers and call takers to control their telephones. When a call is received at the workstation the Active Call dialog box displays the call, and answering the call requires a single operator action performed at the workstation screen. The Call Control dialog box allows the operator access to all call operations including placing calls, answering calls, and controlling operations such as call hold, call transfer, and call conference. Calls can be placed by keying in the numbers using the Call Control dialog box, by selecting a call for call back from the Call History display, or by selecting a speed dial key or a number from an on-line directory.

I/Telephone can co-exist with a traditional automatic call distribution (ACD) or can replace the traditional ACD and provide additional capability such as mapping calls to call groups based on the geographic location of the call.

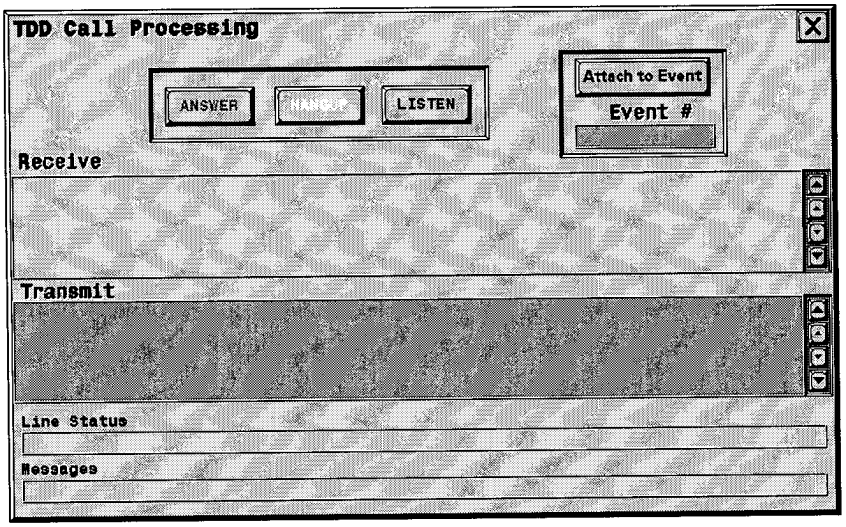
I/Telephone interfaces with the I/TDD product to support communication with hearing or speech impaired callers.

If a local caller database is present, calls arriving without ALI information trigger an automatic search of the local address database to determine the address and translate it to a geographic location for reference on the map enabling the call to be assigned to the correct geographic call group.

3.3.21 I/Telephone Device for the Deaf (I/TDD) (Optional)

The IPS I/TDD software provides an interface to a Zetron Model 3030 device through an RS-232 port.

This software detects a TDD call from a hearing- or speech-impaired person via Baudot tone and allows the operator to converse with the caller using the TDD form displayed below.



Upon initial detection of Baudot tones, the I/TDD signals the call taker with an audible alert, then automatically opens the TDD Call Processing window. This I/TDD conversational window displays both sides of a TDD conversation. A single button option appends the complete conversation to the incident record, ensuring transfer of the conversation to the dispatcher position.

Call takers and dispatchers can move seamlessly between TDD operation and incident data entry by selecting the window/field in which to enter data or by using the <ALT><TAB> key combination to toggle between windows.

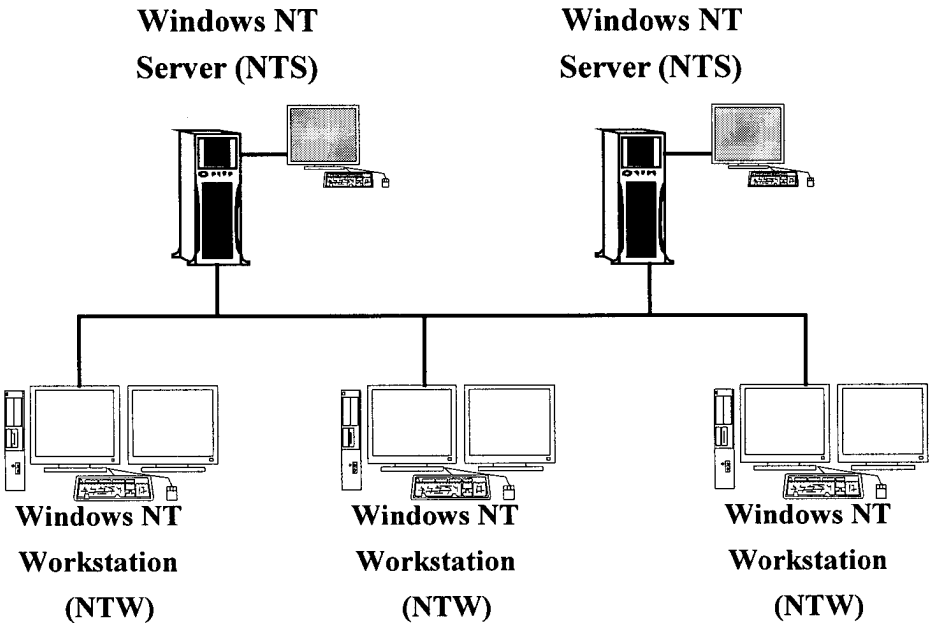
3.3.22 I/Tracker (Optional)

I/Tracker accepts incoming vehicle location data received from an Automatic Vehicle Location (AVL) controller and/or from I/MDT when global positioning system (GPS) data is sent by an in-vehicle MDT. This product enables unit location information to be periodically updated on the map displays in the dispatch center.

When AVL systems accept commands to control the frequency of locations updates from an external system, I/Tracker interfaces with the external system to set the frequency of location reporting based on a unit's type and status and the incident type.

3.4 I/CAD System Third-Party/Commodity Software Products

3.4.1 Windows NT



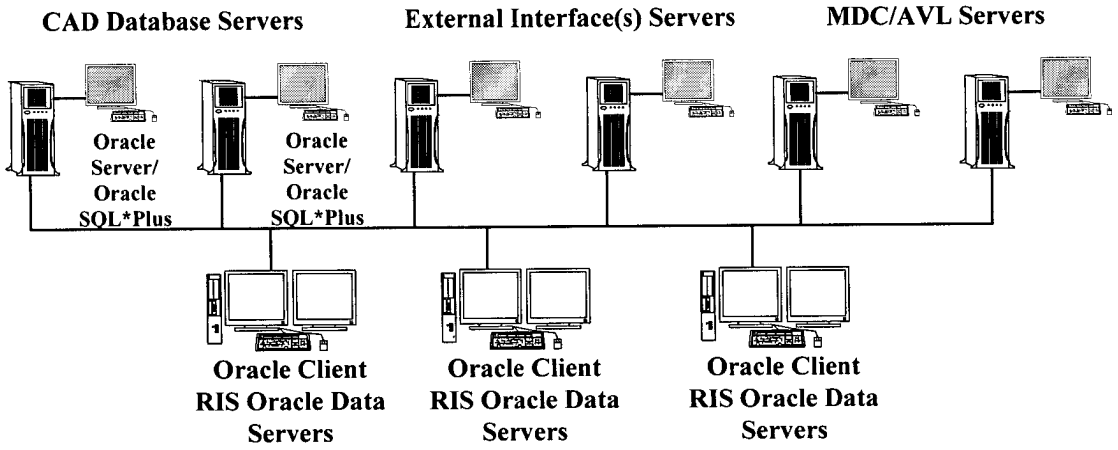
Distribution of Windows NT Operating System Software

The I/CAD System operates under the Windows NT operating system. The servers use Windows NT Server (NTS) and the workstations use Windows NT Workstation (NTW).

Section 6.0 compares the Windows NT operating system design to UNIX and provides additional information to assist in a more complete understanding of the Windows NT operating system environment, including coverage of Window NT security features.

3.4.2 ORACLE Relational Database Management System (RDBMS)

Having presented the basic client/server topology and redundant database strategy used to provide the reliability imperative in a public safety environment, some discussion should be focused on ORACLE and how this industry-standard Relational Database Management System (RDBMS) is used in the I/CAD System. Basically, a client portion of ORACLE resides on each client workstation, and the server (or main) portion of the RDBMS resides on each of the redundant database servers.



I/CAD ORACLE Software Architecture

The I/CAD functionality that resides on the clients uses the ORACLE RDBMS to create standard ORACLE transactions for both database servers. If one of the servers fails, failover occurs and transactions are issued to the functional server until there is a return to dual operation.

All transactions for ORACLE are standard. Either every update within a single transaction is recorded, or none of the updates are recorded.

While referential integrity exists in the I/CAD System, the primary logic for it is in the applications, rather than in using features of the database itself. Such features as embedding logic in the database, are avoided in order to maintain some degree of independence should there ever be a need to use a different RDBMS.

The structure of the database includes event and resource histories, which are maintained by the Database Servers as changes take place. Each change is date and time stamped and shows the operator involved. It is possible to take these histories and reconstruct what happened and when by moving forward or backward; thus, one can track, step-by-step, what happened during a particular emergency. Information can also be used to analyze activity during a specified time period, such as measuring responses or the performance of specific units.

The ORACLE RDBMS is a structured query language database management system based on the relational database model for storing corporate data. It is built on an adaptable, self-tuning, multi-threaded architecture, achieving high performance through the elimination of a central processing unit (CPU), input/output (I/O), memory, and operating system bottlenecks. Database processes dynamically adjust to the workload, ensuring quick response time for all users, with minimum utilization of system resources.

With support for stored procedures, declarative referential integrity, and full cursor support, ORACLE handles the demanding client/server I/CAD environment.

Features of the ORACLE environment include the following:

- Multi-threaded server architecture
- Scaleable SMP performance
- SQL Optimizer
- Unrestricted row-level locking concurrency control
- On-line backup by file, table space, or database
- On-line recovery
- Parallel recovery
- Parallel backup/restore utility
- Checksums on database and redo log file blocks
- Dynamic resizing of database files
- 100-percent ANSI/ISO SQL 92 entry level compliance
- ANSI/ISO standard pre-compiler API
- Robust SQL extensions
- Choice of internal or Windows NT user authentication
- Encrypted passwords
- Fine-grained database privileges
- Hierarchical role-based security for group-level access control
- ANSI/ISO SQL3 security standard via role-based security hierarchy
- Site-customized DBA roles
- US TCSEC C2 and European ITSEC E3 evaluations
- Automatic auditing on per-session or per-object basis
- Easy-to-use Service Manager GUI, menu-driven utility for Windows NT
- Secure remote database administration
- User-account administration

3.4.3 ORACLE SQL*Plus

ORACLE SQL*Plus is included to provide an easy-to-use environment for querying, defining, and controlling data. ORACLE SQL*Plus delivers full implementation of ORACLE SQL and PL/SQL, along with a rich set of extensions. ORACLE SQL*Plus features allow users to:

- Perform database activities easily
- Create ad hoc queries
- Retrieve and format data

3.4.4 Microsoft Visual C++

The use of C++ at the customer site is normally not for customization or for coding new features, but to configure the system to meet specific needs.

Visual C++ 4.0 also provides features that promote code reuse, allowing developers to write code once and easily reuse it many times in several projects. Various tools promise code reuse, but Visual C++ is the first C++ product to deliver several concrete features that make code reuse a reality.

The Component Gallery, an intelligent storage and management system for OLE Controls and C++ components, allows developers to easily store C++ classes, resources, and header files as C++ components for reuse or for sharing with other developers. It also provides an ideal system for managing third-party OLE Controls. Visual C++ 4.0 includes a variety of ready-to-use C++ components and OLE Controls.

Visual C++ 4.0 includes MFC 4.0, an industry-standard application framework for Windows-based application development. New features include support for all Win32 API common controls, including rich-text edit controls and enhanced support for multi-threaded applications.

Adherence to language standards is a must for serious C++ developers. The Visual C++ 4.0 compiler supports significant new C++ language features from the current working papers of the ANSI/ISO X3J16 committee on C++, including namespaces and run-time type information (RTTI).

3.4.5 Microsoft Access

Microsoft Access provides the tools to create, package, and distribute Access applications. Features include the following:

- Set-up Wizard to package Access applications for distribution
- Access runtime license for distributing applications to multiple desktops
- Replication manager

Within I/CAD, Access is used to customize reports, to create new reports and to distribute those reports to other machines, and to customize the question/answer logic trees used by the I/QA software.

3.4.6 Microsoft Office Small Business Edition

The Microsoft Office Small Business Edition software suite includes Word, Excel, Publisher, and Outlook; these full-featured programs work together and work alike. Users can manage key contacts in Microsoft Outlook and drop their addresses into Microsoft Word with the click of a button. Customers can use a Wizard to turn reports into PowerPoint presentations, convert a list in Microsoft Excel into a relational database in Microsoft Access, or create a report with Access and include the report in a Word document, along with an Excel spreadsheet and the I/CAD map. These are just four examples of the ease of use and integration between these products.

3.4.7 InterSite (Included with Intergraph hardware only)

InterSite is a suite of hardware and software tools used for server and site management. InterSite includes tools to automate a variety of tasks including the following:

- System monitoring to alert system managers to a variety of events, such as power supply, disk, or memory failure and excessive temperatures. In addition, hundreds of user-selectable events, such as memory usage, failed log-in attempts, and file usage, can be monitored, allowing designated personnel to be alerted. The server can alert personnel by dialing a pager or by dialing a remote system.
- System management, such as software distribution, remote help, remote diagnostics, asset control, and remote system reboot
- Router management

The modularity of InterSite tools makes it easy to choose the management tools needed at initial installation. Appropriate tools can be added later as needs change.

3.4.8 Server Remote Access Service (RAS)

As networks become prevalent, dial in access becomes increasingly important. The Windows NT Server Remote Access Service (RAS) application allows Windows NT users to extend the network to phone lines. RAS provides both mobile and remote users with seamless access to the I/CAD network and is a cost-effective and easy-to-use. Using RAS, the Windows NT user works via a standards-based, dial-up server that enables client/server computing for remote terminals. RAS is compatible with different protocols, and most computers already include software that supports RAS for end-users.

RAS supports all of the mainstream networking clients, including the following:

- Windows for Workgroups-based clients
- LAN Manager-based clients
- Windows 95-based clients
- Windows NT Workstation-based clients
- Windows NT Server-based clients
- UNIX-based clients
- Macintosh-based clients
- NetWare clients
- OS/2-based clients

With RAS, remote users can access files and printers, run applications across distances, and expand client/server computing to a wide area network (WAN).

RAS is based on Point-to-Point Protocol (PPP), the industry standard for dial-up access services and also supports industry standards for authentication and encryption. Users may dial up across phone lines, ISDN, or X.25 and access TCP/IP-, IPX-, or NetBEUI-based LANs.

RAS is the most scaleable dial-up access server in the industry today. Organizations can use a single Windows NT Server-based system to provide dial-up facilities for up to 256 concurrent users.

3.4.9 Optivity For Hewlett-Packard's (HP) OpenView For Windows

Optivity for Hewlett-Packard's (HP's) OpenView for Windows provides a powerful solution for managing mixed Ethernet, frame switched, and Token-Ring internetworks comprised of high-speed backbones, geographically-dispersed domains, and a variety of

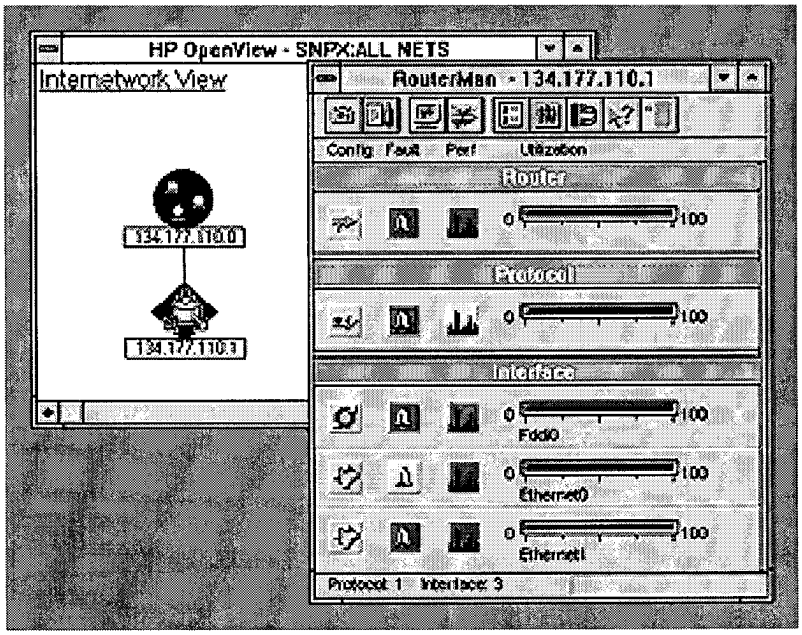
cabling media—all from a single workstation. Compatible with the Simple Network Management Protocol (SNMP), this application delivers complete configuration management, performance monitoring, fault analyses, and troubleshooting capabilities for the enterprise network.

3.4.9.1 System-Level Focus

Optivity delivers a complete set of tools for managing the network fabric—the LAN's flexible, underlying physical infrastructure—as a single, cohesive system, instead of as a collection of unrelated devices. By managing the relationship between hubs, switches, routers, bridges, and end-stations, Optivity delivers a global overview of the enterprise for complete system-level control.

Seamlessly integrated with the OpenView for Windows platform, Optivity allows managers to monitor, control, configure, and troubleshoot a network comprised of switched and shared-media solutions. Integrated router management and RMON support allows users to gather detailed fault, performance, and diagnostic data anywhere in the network, while a unique dynamic mapping feature offers unprecedented visibility into the system for precise, port-level control.

The application supports Bay Networks' full line of product solutions, including the System 800, System 2000, System 3000, Distributed 5000, and System 5000 hub families. It also supports Access Node (AN), Access Node Hub (ANH), Access Stack Node (ASN), Backbone Node (BN) routers and LattisSwitch System 28000 Fast Ethernet switching hubs.



Optivity's router management application, running on top of the host platform, provides complete monitor and control capabilities for all Bay Networks, Cisco, and other MIB II devices.

3.4.9.2 Dynamic Network Discovery

Optivity's systems approach begins with the patented Autotopology dynamic mapping feature. Autotopology extends OpenView's global Internet view by automatically discovering the network's primary building blocks (hubs, switches, routers, bridges, and end-stations) and their physical relationship throughout the system. These discovered devices are seamlessly integrated with the OpenView platform view, providing a series of increasingly detailed maps that offer unprecedented visibility into the network infrastructure.

Network managers can navigate through the network views to collect and store performance data, such as MAC-layer (Media Access Control) diagnostics, errors, and utilization levels throughout the system. Configuration changes are automatically reflected in these displays, ensuring that the manager always has an accurate network blueprint.

- Flat Network View displays Ethernet or Token-Ring segments or rings connected by bridges or switches and bounded by routers, showing the physical relationship between bridged or switched segments. Color-coded displays quickly guide managers to lower-level problems.
- Segment View shows the physical relationship between hubs in an Ethernet or Token-Ring segment bounded by bridges or switches. Hierarchical (Ethernet) or logical ring (Token-Ring) displays report how devices are physically linked, with connections identified by slot location and media type, assisting in troubleshooting and network reconfiguration operations.

3.4.9.3 Software-Based Configuration

Optivity includes the LANarchitect application, which revolutionizes the network configuration process. Working with the System 5000, Distributed 5000, and LattisSwitch System 28000 product families, LANarchitect allows managers to assign individual ports, slots, or clusters to specific workgroups (such as segments and rings), regardless of their physical location. The result is a highly-flexible, software-based "logical" configuration that makes the most of available resources.

LANarchitect, launched from a Model 5000, Distributed 5000, or LattisSwitch System 28000 switching hub icon on the network map, employs a unique file-folder model to display all LAN workgroups in the hub. Opening a folder reveals all ports and clusters contained in the workgroup and, through an intuitive drag-and-drop operation, managers can easily add new ports or clusters, move ports between LANs, or create entirely new workgroups. Connections are established and maintained through the embedded

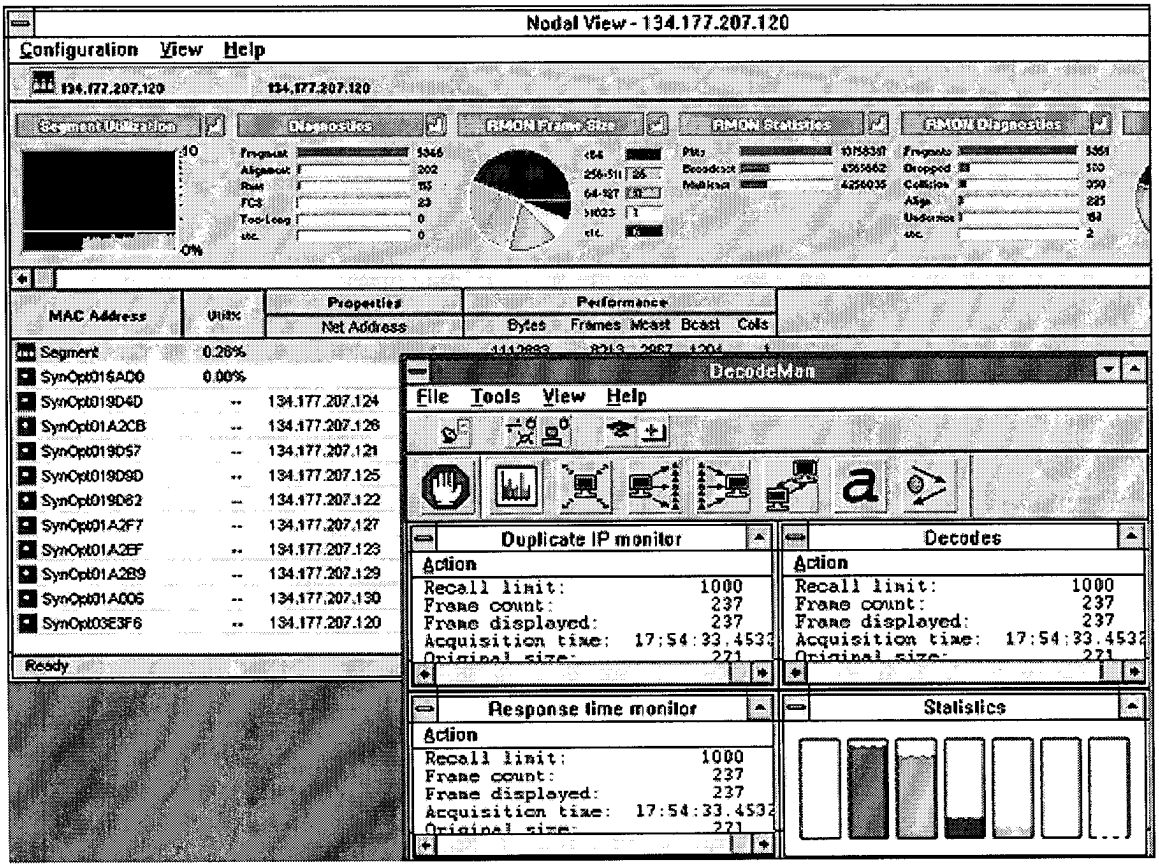
management software, eliminating the need to physically reconfigure the network every time a change is made.

Through LANarchitect, network managers can also assign Data Collection Engines (DCEs) on Model 5000 and Distributed 5000 network management modules to specific segments or rings to perform detailed packet analyses and processing. This "roving" capability, combined with a structured network design, provides the manager with additional flexibility for selectively analyzing segments or rings anywhere in the network.

3.4.9.4 Integrated Router Management

Optivity includes an integrated router management application, allowing users to monitor and control all Bay Networks (Wellfleet® and SynOptics®), Cisco, and other MIB II routers from a central console.

The router management application gathers detailed fault, performance, and configuration data from routers throughout the network and displays it as part of a simple, color-coded interface, simplifying SNMP and MIB management operations. All protocols and interfaces supported by the router are automatically displayed, enabling managers to easily determine device, protocol, or interface status at a glance. Alarms and alerts provide early problem notification, improving network reliability through rapid fault identification and resolution. In addition, a configuration management feature provides an audit trail of network changes, allowing managers to review previous configurations to identify the optimum network design.



Optivity applications such as Nodal View and DecodeMan provide detailed RMON-based fault detection, performance, and troubleshooting tools.

3.4.9.5 RMON-Based Analyses and Performance Management

Optivity offers advanced industry-standard RMON applications that provide detailed fault detection, performance, and troubleshooting tools for Ethernet and Token-Ring networks.

DecodeMan, a powerful RMON-based troubleshooting tool developed for Bay Networks by Network General, allows managers to decode and analyze network traffic on remote LANs. Based on Network General's Foundation Manager, DecodeMan provides full 7-layer decodes for all major protocols, including IP, IPX, AppleTalk, DECnet, Vines, OSI, SNA, and NetBios, enabling problems on remote segments to be resolved quickly and easily from a central location.

- The DecodeMan application leverages the "probe in a hub" capabilities provided by the Bay Networks Advanced Analyzer agent to obtain detailed diagnostic data throughout the network. In a Model 5000 or Distributed 5000 environment, network managers can use the LANarchitect application to rove DCEs with

Advanced Analyzer agents anywhere in the network, targeting DecodeMan at specific segments for detailed packet capture operations.

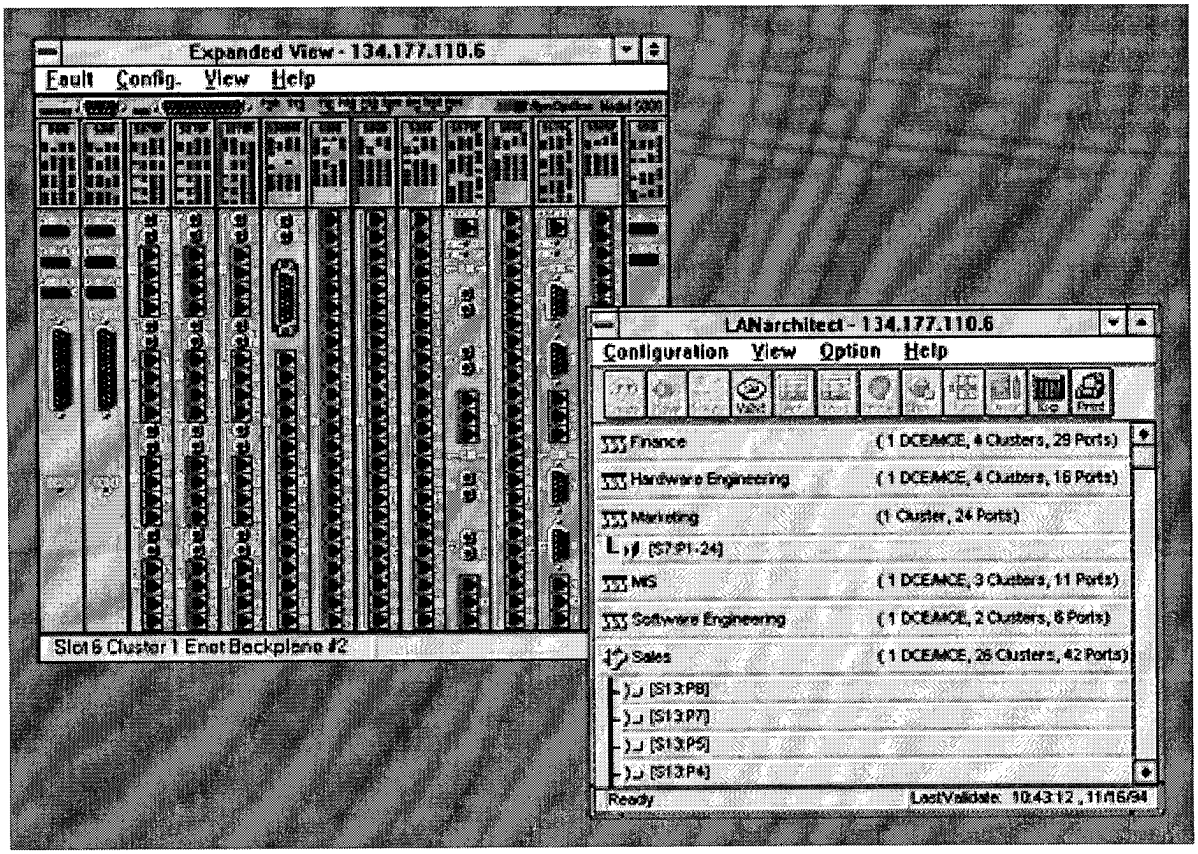
- Nodal View offers a powerful tool for collecting detailed RMON-based fault and performance statistics, such as utilization, errors, or protocol distribution from all stations on an Ethernet or Token-Ring segment or ring. End-stations appear within a concise, color-coded window, allowing managers to quickly determine their status and to identify potential trouble spots. Display options are user-definable and can be listed by username, network address, or network location, enabling managers to quickly and easily identify network resources.

A Sort feature also allows the manager to display data based on traffic levels, errors, IP addresses, and other criteria, allowing users to quickly identify top talkers, error-prone stations, gaps in the addressing scheme and other network conditions. Performance information for the segment or individual nodes can also be flexibly displayed as graphs, pie charts, or strip charts, providing a graphic interpretation of the data.

3.4.9.6 Proactive Fault Analyses and Troubleshooting

Optivity also supports proactive management capabilities to detect problems before they actually occur and adversely affect network performance.

Thresholds allow the network manager to establish and enforce specific error, performance, and activity levels for Ethernet and Token-Ring networks. If a threshold is crossed, the system automatically generates an event report to notify the manager. These RMON events, or alarms, can also trigger user-defined responses, such as partitioning a port, sounding an alarm, sending an e-mail message, or dialing a beeper.



The LANarchitect application supports Optivity's revolutionary configuration switching capabilities, while Expanded View offers a real-time image of any selected hub.

3.4.9.7 Real-Time Device Management

To complement the system-level tools, Optivity also offers industry-leading, real-time device management capabilities for monitoring and controlling hubs at the port level.

The patented Expanded View GUI provides an accurate, real-time display of any selected hub, complete with installed modules and active LEDs. Managers may obtain a variety of information via Fault, Performance, or Configuration menus to monitor activity and review status down to the port level. Connections can also be enabled, disabled, or temporarily partitioned for precise network control.

3.4.9.8 Powerful Management Tools and Utilities

Optivity offers several additional tools that assist managers in quickly and easily identifying and locating network problems, finding users, and controlling access to the network.

- The Find Nodes feature assists managers in rapidly locating network users and isolating elusive problems. Using only summary data such as MAC addresses or alias names, Find Nodes immediately identifies subjects by their hub, slot, and port location. Managers can also launch Segment, Nodal, or Expanded views within Find Nodes, allowing them to "zoom in" on the problem at any network level.
- Agent Manager automates the process of distributing or downloading new and upgraded software agents across the enterprise. The application also automatically inventories all hub-based agents running on the system, providing the manager with a complete list, including network management module type, agent version, and firmware version. Additional Agent Manager tools are available for creating, modifying, and customizing agent configuration templates.
- Allowed Nodes security enables managers to determine who may access the network. If an unauthorized station attempts to enter the network, the system can be programmed to either send a warning or to automatically wrap/partition the port.
- The Show Nodes tool compiles a protocol-independent list of all nodes attached to a hub, identified by network, MAC address, or username, assisting managers in identifying resources for baselining, fault recovery, and network planning.

3.4.10 XNTP

XNTP is used to update the servers' system clocks and to permit time synchronization throughout the dispatch environment.

3.4.11 Microsoft SNA

Together, the Microsoft SNA Server and Client licenses provide connectivity to IBM mainframes and AS/400 applications and data for the purpose of accessing external databases that use these structures.

4.0 SYSTEM SECURITY

4.1 Database Security

The database is a standard ORACLE RDBMS using standard ORACLE permissions. The security for the database is user-defined, in accordance with the customer's needs, as part of initial system configuration.

4.2 Application Security

The IPS suite of CAD products builds on the Windows NT foundation, which is covered in Section 6.6. Using Windows NT as the operating system, any operator must necessarily pass through the Windows log-on security to access a CAD application. Some users may enter the system at this level only and perform administrative tasks without physically entering the I/CAD applications. In this case, the protections defined for system and database security are in effect, resources are protected, and permissions are based on those set by the security administrator. For call taking and dispatching, the operator is required to enter a second username and password to access the I/CAD applications. Permissions established by the administrator will determine application access.

I/CAD usernames and passwords go a step further in enhancing security within the CAD environment. At this level, the username and password is used to classify the type of user. As an example, the I/CAD user log on classifies the user as a call taker or as a dispatcher, and if a dispatcher, the user will be assigned to a particular dispatch group. The particulars of a classification and the permissions granted is part of configuring the system for each specific customer. Classifying users in this manner determines the commands and functionality available for that particular user. Security within the CAD environment is defined by job function. And since a dispatcher becomes a member of a dispatch group, privileges are based on the resources for that geographic area.

5.0 HARDWARE

5.1 Servers

All of the proposed servers in the configuration are based on symmetric multiprocessing (SMP) computers featuring four 200-megahertz Intel Pentium Pro processors that are easily upgradeable. The client/server architecture also allows new servers to be added and applications easily moved across servers.

5.1.1 InterServe-8000

A third-generation Pentium® Pro server, the InterServe 8000 sets a new standard in scalability for departmental servers based on the Windows NT® platform. Offering up to four 200 MHz processors, the InterServe 8000 integrates industry-standard components to deliver outstanding performance at an affordable price.

Essentially, the InterServe 8000 is based on the same technology as our award-winning IS660, a previous rackmount-only, enterprise-designed server. By leveraging those robust features, the InterServe 8000 offers the most expansion in its class at much lower price points. The design also offers customers the flexibility in getting the exact feature set required while maintaining investment protection due to numerous in-the-field upgrade options. In addition to the InterSite™ hardware monitoring card and redundant network interface controller options, you can choose from one to four CPUs, select single or dual power supplies, go with RAID or non-RAID disk subsystems, and decide on deskside or rackmount configurations.

Intergraph backs the InterServe 8000 with a complete array of hardware and software solutions, including 3D graphics PCs and workstations, InterSTOR™ mass storage and network backup offerings, as well as the InterCon-X™ family of LAN and WAN network products. In addition, Intergraph ensures comprehensive, world-class service and support.

Standard Features

Supported software

- Microsoft Windows NT Server 4.0 (standard)
- Microsoft Windows NT Server 4.0 Enterprise Edition (option)
- Citrix Winframe 1.7 (available from authorized Citrix dealers)

Chassis style
Deskside tower, can also be rackmounted. In a rack environment two systems can be mounted side by side in a 17u rack

Racks options
40u rack holds up to 4 systems with space for additional options; 17u rack holds 2 systems

CPU
1 - 4 Pentium Pro, 200 MHz; 512 KB or 1 MB synchronous four-way associative, write-back, L2 cache for each processor

Chipset
Intel 82450GX

Memory
Industry-standard SIMM technology (5V, 60ns, fast page mode, single- or double-sided); 288-bit ECC architecture; 2- or 4-way interleaved; min./max. config. 128 MB - 4 GB

I/O bus
Three PCI buses with a combined bandwidth of 264 MB/s

Disk Controller

CD-ROM and tape
Onboard Ultra SCSI controller supports synchronous transfers up to 20 MB/s. Used for tape and CD-ROM devices only.

Non-RAID
Dual-channel Ultra-Wide SCSI-3 controller, peak bandwidth 80 MB/s, uses one PCI slot.

RAID
PCI-based with two Ultra-Wide SCSI-3 channels, peak bandwidth 80 MB/s; on-board Intel processor with 8 MB cache; supports RAID levels 0, 1, 3, 5, 0+1, 0+3 and 0+5. Four additional RAID controllers supported for maximum external expansion.

Drive bays
Eight 1.6-inch high drive bays. Five bays free in all configurations. All drive bays support UltraWide SCSI-3 drives.

Additional drive bays
Three 5.25-inch half height bays, one used for CD-ROM. All bays are front accessible.

Disk Drives

4 GB: 9.0 ms seek; 13.2 ms access; 7,200 rpm; 6.0 to 9.5 MB/s internal transfer rate
9 GB: 9.0 ms seek; 13.2 ms access; 7,200 rpm; 7.0 to 11.0 MB/s internal transfer rate

All drives are UltraWide SCSI-3 and SMART compatible.

Floppy drive
3.5-inch form factor; supports dual density, 1.44 MB/720 KB (formatted) capacity media

CD-ROM
24X SCSI; Integrated controller; 115 ms random seek time; 120 ms random access time; 1.8 MB/s sustained transfer rate

Network interface
PCI 10/100BaseT (uses one slot), supports full duplex operation, RJ45 style connector. Optional second 10/100BaseT NIC provides a redundant network interface.

Cards slots
13 total: 9 PCI, 3 ISA, 1 shared

External I/O Ports
Two DB9 buffered serial ports; Single DB25 enhanced parallel port/extended capabilities port (EPP/ECP); PS/2 keyboard and mouse ports; Ultra SCSI (50 pin) connector for external tape and optical devices

Keyboard
101-key rack-mount keyboard or 104-key Windows 95-compatible keyboard; both available in five languages

IntelliMouse™
Three-button and traditional two-button mouse support

Graphics Adapter
Matrox Millennium with 2 MB of WRAM; onboard PCI device; supports standard SVGA monitors

Power supply

- Dual hot swappable or single fixed supply
- 550 W for each hot swappable supply
- 540 W for the fixed supply
- 100-120 VAC/220-240 VAC Autosensing
- 50/60 Hz Autosensing
- 1.2 K Va UPS recommended

5.2 Workstations

The proposed workstations are high-performance Intergraph TD-225 personnel computers based on 300-megahertz Pentium II processors. To complement the high-performance workstations and enhance the robust I/CAD work environment, the 17-inch monitor is recommended. However, other monitor sizes are available.

5.2.1 TD-225 Desktop Workstation

The TD-225 PCs integrate industry-standard components with a custom-designed motherboard. By doing so, Intergraph has created a distinctive high-bandwidth architecture for the TD-225 that sustains interactive on-screen response for production computer-aided design and publishing applications running under the Windows NT operating system. Intergraph eliminates bottlenecks that prevail in contending graphics systems, complementing the TD-225's Pentium II processor with advanced subsystem design and integration. In addition, Intergraph bundles only upscale, high-performance peripherals with the TD-225.

These PCs undergo an unusually high degree of testing. They are also tested by the National Software Testing Laboratories (NSTL), ensuring adherence to a variety of hardware and software standards and performance criteria. The IPS proposed system has been engineered to run day and night, in mission-critical environments, 365 days per year. Heat buildup in the base has been carefully studied, and the component layout has been specifically designed for maximum uptime. Only components that meet the highest specifications and quality standards are used. Even the keyboards are produced to withstand day and night, continuous operation, every day of the year.

TD-225 Specifications:

- 300-megahertz Intel Pentium II processor
  - 8-kilobyte, two-way set associative instruction and data caches
  - 256-kilobyte pipelined burst
  - Level 2 cache

- 64 megabytes of EDO random access memory, upgradeable to 256 megabytes
  - Two 32-megabyte SIMM modules
- System I/O Bus
  - PCI, 120 megabytes per second bandwidth
  - Plug-and-play compatibility
- System Disk Drive
  - 1.7 gigabytes EIDE
  - 3.5-inch form factor
  - Mode 4-enhanced
- Floppy Drive
  - 3.5-inch, dual-density floppy disk drive with a 1.44-megabyte/720-kilobyte formatted capacity
- Audio
  - Creative Labs Vibra 16C; motherboard-integrated FM synthesize; midi/joystick interface; standard line-in/line-out and mic-in connections
  - Portable speakers and microphone optionally available
- Miscellaneous I/O Ports
  - Two DB9 serial ports
  - One DB25 enhanced parallel port/extended capabilities port (EPP/ECP)
- 104-key, Windows 95-compatible keyboard; three-button, PS/2 mouse
- Peripheral slots and bays
  - Motherboard card slots; 7 total card slots (3 PCI; 3 ISA; 1 Shared)
  - Peripheral bays: 6 total (3 internal 3.5-inch; 1 external 3.5-inch; 2 external 5.25-inch)
  - Card and peripheral options: networking, Fast SCSI-2 controller and drives, plug-in PCMCIA assembly supporting two Type I or II PC cards or one Type III card
- Three-button Intellimouse PS/2 mouse
- Onboard 32-bit Ethernet controller with standard 10Base-T

5.2.1.1 Color Monitor

Intergraph has 17-, 19-, 21-, 24-, and 28-inch monitors available. All monitors provide a crisp, brilliant display. A non-interlaced resolution of up to 1,280 by 1,024 pixels, edge-to-edge display, and a dot pitch of 0.27 mm provide a clear, detailed view. Text is easy to read at small point sizes, and thin vectors are readily distinguishable. A 75-hertz refresh rate assures that the screen will not flicker, even at maximum resolution. At lower resolutions, the refresh rate can run as high as 160 hertz.

5.3 Peripherals

5.3.1 14-Gigabyte, 8-Millimeter, Internal, Extended Length Cartridge Tape Drive

The 14-gigabyte, 8-millimeter, internal, extended length (XL) cartridge tape drive, with an integrated, single-ended, Small Computer Systems Interconnect (SCSI) controller, is a cost-effective choice for data exchange and hard disk backup. It uses a removable and rewritable 8-millimeter tape cartridge. Advanced helical scan technology ensures high recording density and data storage capacity in compressed and uncompressed modes. With a 2:1 compression ratio and 160-meter XL tape, the drive can store up to 14 gigabytes of data; while in native mode, 7 gigabytes may be stored on each tape. Using standard 112-meter tape, the drive can store up to 10 gigabytes with 2:1 compression or 5 gigabytes in native mode. The actual compression ratio varies depending upon the type of data; 2:1 compression is typical.

5.3.2 Dot Matrix Printer

The dot matrix printer is a 136-column, 9-pin printer with an RS-232-C serial interface. The printer offers speeds of 300 characters per second (cps) in draft mode, 250 cps in utility mode, and 63 cps near letter-quality mode. Print can be accomplished at 10, 12, 17.1, or 20 characters per inch (cpi). The printer accepts cut-sheet paper in widths of 7.2 to 14.3 inches and tractor feed paper in widths of 3 to 16 inches.

5.4 Networking

5.4.1 BayStack 10Base-T Hub

The BayStack 10Base-T Hub offers a simple, scaleable solution to support small and growing Ethernet networks. Delivering industry-standard IEEE 802.3i 10Base-T connectivity to support 10-megabit-per-second (Mbps) Ethernet over unshielded twisted pair (UTP) cabling, the hub provides a robust, expandable foundation for networks anticipating future growth. The hub includes two option slots, one for a media adapter to support additional end users or backbone connections to centralized hubs, switches, or routers and an option slot for network management. It includes 12 RJ-45 ports.

As more users join the workgroup, additional BayStack 10Base-T hubs can be added. Up to 10 hubs can be stacked to support a total of 260 nodes. The hub stack can be divided into three distinct network segments. Individual hubs can be selectively assigned to any of the three segments to improve network performance by eliminating bandwidth congestion.

5.4.2 BayStack 10Base-T Standard SNMP Network Management Module

The BayStack 10Base-T Standard SNMP Network Management Module (NMM) can be installed on any BayStack 10Base-T Hub's rear-panel expansions to add full management capabilities. The NMM enables the Optivity Network Management for HP OpenView application to manage the hub by providing full SNMP-based management.

The NMM provides high-speed core statistics gathering and reporting for all segments in a stack, including isolated hubs. Using the hub's stack management bus, the NMM supports SNMP over both IP and IPX and collects detailed fault, configuration, and performance data throughout the network. The Standard NMM also supports, via a GUI, a detailed real-time image of the hub or stack on the Optivity console for precise port-level management.

A single NMM manages all hubs by providing complete monitoring and control for all 260 ports in the hub stack. Management functionality can also be extended to remote hubs in a managed stack through standard unshielded twisted-pair (UTP) patch cables that are connected to management extension ports on the hub's back panel.

Features:

- Comprehensive performance, configuration, and fault management of the BayStack products
- Powerful drag-and-drop operations for simple, intuitive configuration
- Windows support
- In-band management of remote sites

Benefits:

- Easy additions, moves, and changes
- End-to-end management of switched Ethernet networks

6.0 COMPARISON OF MICROSOFT WINDOWS NT AND UNIX OPERATING SYSTEMS

Section 6.0 contains excerpts from a White Paper published by the Microsoft Corporation. This document delineates the advantages of the Windows NT operating system and client/server environment by comparing it to a traditional UNIX host-based terminal environment.

6.1 A Tale of Two Operating Systems

It was the best of operating systems, it was the worst of operating systems, it was the age of wisdom, it was the age of foolishness, it was the epoch of belief, it was the epoch of incredulity, it was the season of light, it was the season of darkness, it was the spring of hope, it was the winter of despair, we had everything before us, we had nothing before us, in short, we had UNIX.

Life with UNIX has been/is a love-hate relationship, with most people or organizations falling strongly on one side or the other. This section discusses Windows NT, which has roots that stretch back almost as far as those of UNIX. It is an operating system that, like most, owes much to UNIX. But it also differs markedly from UNIX in both design and philosophy.

Windows NT and UNIX address the same world, but from very different points of view. It is a mistake to assume that Windows NT provides a direct, feature-for-feature replacement for UNIX. It does not. It represents a different perspective, a paradigm shift, and, as such, offers fresh solutions to some very old, chronic problems.

6.2 Operating System Basics

6.2.1 Overview and Philosophy

Windows NT was designed for client/server computing; UNIX was designed for host-based terminal computing. Each operating system represents a different computing paradigm. Windows NT is not a multi-user operating system in the usual sense of the word (although it can be with additional third-party products). Users do not work from limited-function dumb terminals, dumb terminal emulators, or X-terminals connecting to a Windows NT-based host. Instead, users work on single-user, general-purpose workstations (clients) that connect to multi-user, general-purpose servers, and the processing load is shared between both. The distinction between the two environments is subtle, but understanding it is key to understanding Windows NT.

6.2.2 UNIX, X, and Server/Client

Windows NT follows what has become the industry-standard terminology (paradigm) for the client/server relationship, with the client residing on the user's desktop and the server being in the back office. Unfortunately, there is a portion of the UNIX world in which this relationship is reversed; the client is the server, and the server is the client.

The most common graphical user interface on UNIX is X, which was developed at the Massachusetts Institute of Technology (MIT) as part of Project Athena. In X, client software resides on the computer that performs the processing, and the server software resides on the computer that displays the output. This effectively makes the desktop the server, not the client.

6.2.3 Kernel Mode vs. User Mode

In modern operating systems, applications are kept separate from the operating system. This setup enables the operating system code to run in a privileged processor mode, known as kernel-mode, and provides access to system data and hardware. Applications run in a non-privileged processor mode, known as user-mode, and have limited access to system data and hardware through a set of tightly controlled application programming interfaces (APIs).

Windows NT is a micro-kernel-based operating system, which shares similarities to Mach, a micro-kernel-based operating system developed at Carnegie Mellon University. One of the primary design goals of Windows NT was to keep the base operating system as small and as tight as possible. This goal was accomplished by allowing only those functions that could not reasonably be performed elsewhere to remain in the base operating system. The functionality that was pushed out of the kernel ended up in a set of non-privileged servers known as the protected subsystems. The protected subsystems provide the traditional operating system support to applications through a feature-rich set of APIs.

This design results in a very stable base operating system. Enhancements occur at the protected subsystem level. In fact, new protected subsystems can be added without modification to either the base operating system or to other existing protected subsystems. Contrast this with traditional UNIX systems where the kernel has become the dumping ground for any and all functionality.

In addition to the micro-kernel design, a number of other theoretical models influenced the design of Windows NT. Three of the most important ones were: the client/server model; the object-oriented model; and the symmetric multiprocessing model. These models provide a framework for understanding the inner workings of Windows NT.

6.2.4 Client/Server

Windows NT is a natural fit for the world of client/server computing. Not only does it live in this world, but its internal design is based on client/server principles. For example, the applications that an user runs are clients that request services from the protected subsystems, which are servers. The idea is to divide the operating system into several discrete processes, each of which implements a set of cohesive services such as process creation or memory allocation. These processes communicate with their clients, with each other, and with the kernel by passing well-defined messages back and forth.

The client/server approach results in a modular operating system. The servers are small and self-contained. Because each runs in its own protected, user-mode subsystem, a server can fail without taking down the rest of the operating system. The self-contained nature of the operating system components also makes it possible to distribute subsystems across multiple processors on a single computer (symmetric multiprocessing) or even multiple computers on a network (distributed computing).

6.2.5 Object-Based

Windows NT is not an object-oriented system in the strictest sense of the term, but it does use objects to represent internal system resources. Software objects are a combination of computer instructions and data that model the behavior of things, real or imagined, in the world. Objects are composed of three entities:

1) attributes, in the form of program variables that collectively define the object's state;
2) behavior, in the form of code modules or methods that can modify attributes; and
3) an identity that distinguishes one object from all others.

Objects interact with each other by passing messages back and forth. The sending object is known as the client and the receiving object is known as the server. The client requests and the server responds, and often times in the course of conversation the client and server roles alternate between objects.

One of the hidden powers behind UNIX is the file metaphor. In UNIX, devices such as printers, tape drives, keyboards, and terminal screens all appear as ordinary files to both programmers and users. This simplifies many routine tasks and is a key component in the extensibility of the system. Windows NT capitalizes on this metaphor and expands it. Windows NT uses an object metaphor that is pervasive throughout the architecture of the system. Not only are all of the items in the UNIX file metaphor viewed as objects by Windows NT, but so are commodities such as processes and threads, shared memory segments, and access rights.

6.2.6 Symmetric Multiprocessing

Multitasking and multiprocessing are two terms that are closely related and easily confused. Multitasking is an operating system technique that shares a single processor among multiple threads of execution. Multiprocessing, on the other hand, refers to computers with more than one processor. A multiprocessing computer is one that is able to execute multiple threads simultaneously, one for each processor in the computer. A multitasking operating system *appears* to execute multiple threads at the same time; a multiprocessing operating system actually does it, executing one thread on each of the computer's processors.

Multiprocessing operating systems can be either asymmetric or symmetric. The main difference is in how the processors are used. In asymmetric multiprocessing (ASMP), the operating system typically sets aside one or more processors for its exclusive use. The remainder of the processors run user applications. In symmetric multiprocessing (SMP), any processor can run any type of thread. The processors communicate with each other through shared memory.

SMP systems provide better load-balancing and fault-tolerance. Since the operating system threads can run on any and all processors, the chance of hitting a CPU bottleneck is reduced over the ASMP model. A processor failure in the SMP model will only reduce the computing capacity of the system. In the ASMP model, it can easily take down the whole computer if it happens to be one of the operating system processors that fails.

SMP systems, such as Windows NT and many flavors of UNIX, are inherently more complex than ASMP systems. A tremendous amount of coordination must take place within the operating system to keep everything synchronized. For this reason, SMP systems are usually designed and written from the ground up. Their ASMP counterparts typically are not.

6.2.7 Open Systems

Finally, before delving into the inner workings of Windows NT, we need to touch on the subject of Open Systems and Industry Standards. Unfortunately, the concept of an open system means many different things to many different people. However, the goal of open systems is the same regardless of the definition. Its primary aim is to give the customer cost-effective choices in a multi-vendor world that is in a constant state of change.

The subject of industry standards is every bit as perilous as the subject of open systems. There are two categories of standards: de jure and de facto. De jure standards are those that have been created by standards bodies such as the American National Standards Institute (ANSI), the Institute of Electrical and Electronic Engineers (IEEE), and the

International Standards Organization (ISO). Examples of de jure standards are the ANSI American Standard Code for Information Interchange (ASCII) character encoding standard, the IEEE Portable Operating System Interface for UNIX (POSIX) standard, and the ISO Open System Interconnection (OSI) reference model for computer networks. De facto standards are those that have been widely adopted by industry, but not originally endorsed by any of the standards bodies. An example of a de facto standard is the Transmission Control Protocol/Internet Protocol (TCP/IP) network communications protocol. De facto standards have arisen either to fill gaps left by the implementation specifications of the de jure standards or because no standard had yet been defined for the particular area.

It is safe to say that open systems based solely on de jure industry standards have yet to be fully realized, and it is doubtful that they ever will be. At the heart of the problem is the very different natures of the computer industry and the academic standards process. The speed with which the technology is changing is staggering, and the formal standards process is inherently unable to keep pace with it. It is similar to what happens when an all-powerful force meets an immovable object, one or the other has to give way. In this case the all-powerful force is the market, which always has its way. So, is there no hope for open systems?

The utopian "de jure"-centric world of open systems has largely given way to the newer, reality-based recognition that real-world open systems cannot live on de jure standards alone. In today's open systems, both de facto and de jure standards are combined to create inter-operable systems. It is the strategic combining of both types of standards, this middle-of-the-road approach, that enables open systems to keep pace with the rapidly changing nature of technology.

One key element of this approach is the use of strategically-placed layers of software that allow the upper and lower adjoining software layers within the operating system to be loosely coupled. These tightly controlled software layers provide a standardized and well-publicized set of APIs to both the software above and below. A good example is the Network Device Interface Specification (NDIS) that was developed jointly by Microsoft and 3Com in 1989. Another is the Desktop Management Interface (DMI) created by the Desktop Management Task Force (DMTF), an industry organization with more than 300 vendor members including Microsoft, Intel, IBM, and Novell.

The beauty of this architecture is that it allows for plug-and-play of modules above and below the isolation layer, and that means you can start out with a module that implements a de facto standard and later supplement or replace it with one that implements a de jure standard. In effect, you end up with the best of both worlds; open systems and industry standards.

6.2.8 Executive

The Windows NT executive is the kernel-mode portion of Windows NT and, except for a user interface, is a complete operating system unto itself. It differs dramatically in architecture from the UNIX kernel, and unlike the UNIX kernel, the Windows NT executive is never modified and recompiled by the system administrator.

The Windows NT executive is actually a family of software components that provide basic operating system services to the protected subsystems and to each other. The executive components are completely independent of one another and communicate through carefully controlled interfaces. This modular design allows existing executive components to be removed and replaced with ones that implement new technologies or features. As long as the integrity of the existing interface is maintained, the operating system runs as before.

6.2.8.1 Object Manager

The Object Manager creates, manages, and deletes Windows NT executive objects. Executive objects are abstract data types used to represent operating system resources such as shared memory segments, files and directories, and processes and threads. The Object Manager manages the global namespace for Windows NT, which is modeled after the hierarchical file system where directory names in a path are separated by a backslash (\). As with other Windows NT components, the Object Manager is extensible and modular so that new object types can be defined as technology advances.

6.2.8.2 Process Manager

A program is a static sequence of computer instructions. A process is the dynamic invocation of a program along with the system resources needed for the program to run. A Windows NT-based process differs from a UNIX-based process in that it is not an executable entity. A Windows NT-based process contains one or more executable entities known as threads, and it is these threads and not the process that the Windows NT kernel schedules for execution. Remember that Windows NT supports symmetric multiprocessing. In order for an SMP system to work, processes must be dividable into multiple threads of execution.

The process model for Windows NT works in conjunction with the security model and the Virtual Memory Manager to provide inter-process protection. The Process Manager is the Windows NT-based component that manages the creation and deletion of processes. It provides a standard set of services for creating and using threads and processes in the context of a particular protected-subsystem environment. Beyond that, the Process Manager does little to dictate rules about threads and processes. It does not

impose any hierarchy or grouping rules for processes, nor does it enforce any parent/child relationships. Instead, these design decisions are left for the protected subsystems to implement. For example, the parent/child relationship that exists between UNIX processes is implemented in the POSIX protected-subsystem of Windows NT.

6.2.8.3 Virtual Memory Manager

Both Windows NT and UNIX implement 32-bit linear memory addressing and demand-paged virtual memory management. Under Windows NT, each process is allocated a four gigabyte (2^{32} bytes) virtual address space, with half of it reserved for program storage and half of it reserved for system storage. The Virtual Memory Manager maps virtual addresses in the process' address space to physical pages in the computer's memory. In doing so, it hides the physical organization of memory from the process's threads. This ensures that the thread can access its process' memory as needed, but not the memory of other processes.

An ordinary machine today typically has much less than four gigabytes of physical memory. When physical memory becomes full, the Virtual Memory Manager transfers, or pages, some of the memory contents to disk. Windows NT and many UNIX systems share a common page size of 4K. The process that the Virtual Memory Manager uses to determine which pages to move to disk is referred to as the paging policy.

The primary goal of any paging policy is to allow as many processes or threads as possible to use the machine's memory without adversely impacting the overall performance of the system. It is a very fine balancing act. On one side you have wasted machine resources, on the other you have a situation in which the memory manager uses up most of the CPU cycles by swapping things back and forth from memory to disk, a condition known as thrashing.

The Windows NT Virtual Memory Manager uses a paging policy known as local first in, first out (FIFO) replacement. With local FIFO replacement, the Virtual Memory Manager must keep track of the pages currently in memory for each process. This set of pages is referred to as the process's working set.

One of the most important features of this paging policy is that it enables Windows NT to do some unattended performance tuning. When physical memory runs low, the Virtual Memory Manager uses a technique called automatic working-set trimming to increase the amount of free memory in the system. Roughly speaking, this is a process whereby the Virtual Memory Manager attempts to equitably allocate memory to all of the processes currently on the machine. As it cuts the amount of memory to each process it also monitors their page-fault rates and works to strike a balance between the two.

6.2.8.4 Local Procedure Call Facility

Applications and the protected subsystems have a client/server relationship. That is, the application (client) makes calls to the protected subsystem (server) to satisfy a request for some type of system service. In general, clients and servers communicate with each other through a series of well-defined messages. When the client and server are both on the same machine, the Windows NT executive uses a message-passing mechanism known as the Local Procedure Call (LPC) facility. LPC is an optimized version of the industry-standard Remote Procedure Call (RPC) facility used by clients and servers communicating across networks.

6.2.8.5 Input/Output (I/O) Manager

The Input/Output (I/O) Manager is the part of the Windows NT executive that manages all input and output for the operating system. It is made up of a series of sub-components such as the file systems, the network re-director and server, the system device drivers, and the cache manager. A large part of the I/O Manager's role is to manage the communications between drivers. To simplify the task, it implements a well-defined, formal interface that allows it to communicate with all drivers in the same way, without any knowledge of how the underlying devices actually work. In fact, the I/O model for Windows NT is built on a layered architecture that allows separate drivers to implement each logically distinct layer of I/O processing. The I/O Manager is the Windows NT executive component that makes the most use of the software isolation layers mentioned above in the open systems discussion.

In addition to the uniform driver model, the I/O Manager works with other Windows NT executive components, most notably the Virtual Memory Manager, to provide asynchronous I/O, mapped file I/O, and file caching.

File caching bears special mention. It is controlled by a sub-component of the I/O Manager called the Cache Manager. While most caching systems allocate a fixed number of bytes for caching files in memory, the Windows NT cache dynamically changes size depending on how much memory is available. This load-balancing feature is provided by the Cache Manager and is another example of automatic self-tuning within Windows NT.

6.2.8.6 Security Reference Monitor

The Security Reference Monitor, in conjunction with the Log-on Process protected-subsystem and the Security protected-subsystem, forms the security model for Windows NT. In a multitasking operating system, applications share a variety of system resources including physical memory, I/O devices, files and directories, as well as the system processor(s). Applications must have proper authorization before being allowed to access any of these system resources, and the components of the security model for Windows NT enforce this policy.

With UNIX, security of this nature usually comes in the form of an expensive add-on such as Kerberos™. Kerberos, which gets its name from the three-headed dog that guards the entrance to Hades in Greek mythology, was developed at MIT as part of Project Athena. It has become a de facto standard for network security and is expected to be incorporated into a future version of Windows NT.

In the meantime, the Security Reference Monitor acts as the watchdog, enforcing the access-validation and audit-generation policy defined by the local Security protected-subsystem. It provides run-time services to both kernel-mode and user-mode components for validating access to objects, checking for user privileges, and generating audit messages. As with other components in the Windows NT executive, the Security Reference runs exclusively in kernel-mode.

6.2.8.7 Kernel

The Kernel is at the core of the layered architecture for Windows NT and manages only the most basic of the operating system functions. The micro-kernel design enables this component to be small and efficient. The Kernel is responsible for thread dispatching, multiprocessor synchronization, and hardware exception handling.

6.2.8.8 Hardware Abstraction Layer (HAL)

The Hardware Abstraction Layer (HAL) is an isolation layer of software provided by the hardware manufacturer that hides, or abstracts, hardware differences from higher layers of the operating system. Because of the HAL, the different types of hardware all look alike to the operating system, removing the need to specifically tailor the operating system to the hardware with which it communicates. The goal for the HAL was to provide routines that allow a single device driver to support the same device on all platforms.

HAL routines are called from both the base operating system (including the Kernel) and from the device drivers. The HAL enables device drivers to support a wide variety of I/O architectures without having to be extensively modified. The HAL is also responsible for hiding the details of symmetric multiprocessing (SMP) hardware from the rest of the operating system.

6.2.9 Protected (Environment) Subsystem

The protected subsystems are user-mode servers started when Windows NT is booted. There are two types of protected subsystems: integral and environment. An integral subsystem is a server that performs an important operating system function, such as security. An environment subsystem is a server that provides support to applications native to different operating system environments. Windows NT currently ships with three environment subsystems: the Win32® subsystem, the POSIX subsystem, and the OS/2® subsystem. The Win32 subsystem is the "native-mode" subsystem of Windows NT. It provides the most capabilities and efficiencies to its applications and, for that reason, is the subsystem of choice for new software development. The POSIX and OS/2 subsystems provide "compatibility-mode" environments for their respective applications and, by definition, are not as feature-rich as the Win32 subsystem.

6.2.9.1 Win32

The Win32 subsystem is the most critical of the Windows NT environment subsystems. It provides the graphical user interface and controls all user input and application output. It is the server for Win32-based applications and implements the Win32 API. Not all applications are Win32-based, and the Win32 subsystem does not control the execution of non-Win32-based applications. It does, however, get involved. When the user runs an application that is foreign to the Win32 subsystem, it determines the application-type and either calls another subsystem to run the application or creates an environment for MS-DOS® or 16-bit Windows in which to run the application.

The subsystems for MS-DOS and 16-bit Windows run in user-mode in the same way the other environment subsystems do. However, unlike the Win32, POSIX, and OS/2 subsystems, they are not server processes, per se. MS-DOS-based applications run within the context of a process called a Virtual DOS Machine (VDM). A VDM is a Win32-based application that establishes a complete virtual computer running MS-DOS. The 16-bit Windows environment is a hybrid application, one that runs within the context of a VDM process, but calls the Win32 API to do most of its work. This feature of running 16-bit Windows within Win32 is known as WOW, which is short for Windows On Win32.

Creating environments for MS-DOS and 16-bit Windows as user-mode subsystems affords them the same protection that the other subsystems have. They cannot interfere with the operation of each other, the other protected-subsystems, or the Windows NT executive.

6.2.9.2 POSIX

POSIX, which stands for Portable Operating System Interface for UNIX, began as an effort by the IEEE community to promote the portability of applications across UNIX environments by developing a clear, consistent, and unambiguous set of standards. POSIX is not limited to the UNIX environment and has been implemented on non-UNIX operating systems, such as Windows NT, VMS, MPE™/iX, and CTOS.

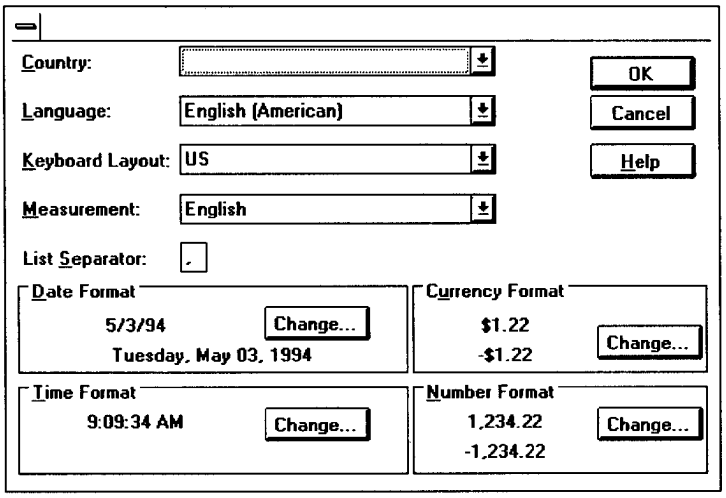
POSIX actually consists of a set of standards that range from IEEE 1003.0 to 1003.22 (also known as POSIX.0 to POSIX.22). However, most of these standards are still in the proposed state. The POSIX subsystem on Windows NT supports 1003.1, which is also known as the international ISO/IEC IS 9945-1:1990 standard. This standard defines a C-language, source-code-level API to the operating system environment. All POSIX standards are based on specifications for which there is no binary reference implementation.

6.2.9.3 OS/2

The OS/2 subsystem supports 16-bit graphical and character based applications. It provides these applications with an execution environment that looks and acts like a native OS/2 system. Internally, the OS/2 subsystem calls the Windows NT executive to do most of the work, as the Windows NT executive services provide general-purpose mechanisms for doing most operating system tasks. However, the OS/2 subsystem implements those features that are unique to its operating environment.

6.2.10 Internationalization

Microsoft builds products that are *world-ready*; Windows NT is no exception. There are currently 15 international versions of Windows NT: Brazilian, Chinese, Danish, Dutch, Finnish, French, German, Italian, Japanese, Korean, Norwegian, Portuguese, Russian, Spanish, and Swedish. A process called localization is used to create these different versions.



Specifying International Settings

When installing Windows NT, the user selects a language to use and is assigned a default locale. The default locale gives the culturally-correct defaults for keyboard layout, sorting order, currency, and date and time formatting. Of course, these defaults can be overridden by the user.

At its most basic level, a locale consists of a language, a country, and the binary codes used to represent the characters of a particular language. The latter is referred to as the code set. The United States has traditionally adopted the ASCII standard for representing data. However, ASCII is woefully inadequate for other countries because it lacks many symbols and punctuation. For example, the British pound sign and the diacritical marks used in French, German, Dutch, and Spanish are missing.

To address these shortcomings, Windows NT employs the new Unicode™ standard for data representation. Unicode is a de jure standard for encoding international character sets. The Unicode standard was developed by the Unicode Consortium, a consortium of vendors including Microsoft, IBM, Borland, and Lotus. Unicode separates the "essence" of a character from the font and formatting information used to display it. It employs a 16-bit character coding scheme, which means that it can represent 65,536 (2^{16}) individual characters. This is enough to include all languages in computer commerce today, several archaic or arcane languages with limited applications (such as Sanskrit, and, eventually, Egyptian hieroglyphics), all punctuation marks, mathematical symbols, and other graphical characters. With all of this, there is still plenty of room for future growth.

Unicode is the native code set of Windows NT, but the Win32 subsystem provides both ASCII and Unicode support. Character strings in the system, including object names, path names, and file and directory names, are represented with 16-bit Unicode characters.

The Win32 subsystem converts any ASCII characters it receives into Unicode strings before manipulating them. It then converts them back to ASCII, if necessary, for output.

Localization is only one part of the effort that goes into ensuring that an operating system can be used effectively in a world-wide environment. A *world-ready* operating system must also provide services to support the use of international applications and to support the global market by making the application developer's job easier. For example, some of the language issues that international users and application developers face are:

From the user's perspective–
Some users need to include more than one language in a document. For example, they might be translating from English into Russian, or they might be writing a product instruction manual in many different languages. When using more than one language, users must deal with a series of obstacles. For example, they must repeatedly switch to another keyboard layout on-the-fly. When using a database, users face the problem of sorting the information in the correct order for a given language.

From the developer's perspective–
When localizing a product, developers are faced with several questions, such as:

- What is the correct sorting order for French?
- How is a date represented in Germany?
- If a document contains text in more than one language, is there some way for the software to distinguish the different languages?
- Can information in a multilingual document be cut and pasted into another application?

Many developers try to address these issues in their applications and fall short, creating problems for the users, their support organization, and their own development team.

Microsoft is incorporating international language support at the operating system and API level. Built-in, international language support adds functionality that provides solutions for developing and using software and for exchanging documents around the world.

6.3 Networking/Communication

6.3.1 Overview

Windows NT is a complete operating system with fully integrated networking, including built-in support for multiple network protocols. These capabilities differentiate it from other operating systems such as MS-DOS and most versions of UNIX. With other

operating systems, network capabilities are either installed separately from the core operating system as an add-on or the range of supported network protocols is restricted. With some operating systems, both limitations exist.

Windows NT offers built-in support for both peer-to-peer and client/server networking. It provides inter-operability with, and remote dial-in access to, existing networks; support for distributed applications; file and print sharing; and the ability to add networking software and hardware.

6.3.1.1 ISO OSI Model

The International Standards Organization (ISO) developed a seven-layer, theoretical model called the Open Systems Interconnection (OSI) reference model. It is used to describe the flow of data between the physical connection to the network and the user application. This model is the best known and most widely used model to describe networking environments, and we will use it as the framework to discuss the networking components for Windows NT.

In the OSI model, the purpose of each of the seven layers is to provide services to the next higher layer, shielding the higher layer from the details of how the services are actually implemented. The layers are abstracted in such a way that each layer believes it is communicating with the same layer on the other computer. In reality, each layer communicates only with adjacent layers on the same machine.

Layer 0, which is not officially a layer in the OSI model, is commonly used to define the underlying transmission media, such as cables or fiber, that interconnect each of the computers on the network. Layer 0 is known as the Media Layer.

6.3.1.2 Network Adapter/Network Interface Card (NIC)

The Network Adapter or Network Interface Card (NIC) connects the internal communication bus of the computer with the external network. It acts as a bridge between the Media Layer (Layer 0) and the Physical Layer (Layer 1) in the OSI model. Windows NT views the NIC as a peripheral device and controls it through a device driver.

6.3.1.3 Network Device Interface Specification (NDIS)

The IEEE 802 project further defined sub-layers of the Data Link Layer (Layer 2) in the OSI model. The two sub-layers are the Media Access Control (MAC) and the Logical Link Control (LLC). The MAC sub-layer communicates directly with the NIC and is responsible for delivering error-free data between two computers on the network.

In 1989, Microsoft and 3Com jointly developed a specification defining an interface for communication between the MAC sub-layer and protocol drivers higher in the OSI model. This standard is known as the Network Device Interface Specification (NDIS), and is a key isolation layer of software. NDIS isolates the details of the NIC from the transport protocols and vice versa.

6.3.1.4 Transport Protocols

The transport protocols reside primarily in the Network Layer (Layer 3) and the Transport Layer (Layer 4) of the OSI model and communicate with the NIC(s) through an NDIS-compliant device driver. Windows NT ships with the following transport protocols: TCP/IP; NBF, derived from NetBEUI; NWLink, an NDIS-compliant version of Novell® Internetwork Packet Exchange (IPX/SPX); Microsoft Data Link Control (DLC); and Appletalk®.

6.3.1.5 STREAMS

STREAMS was originally developed by AT&T for UNIX System V, Release 3.2. It is an isolation layer of software that wraps around STREAMS-based transport protocols. Calls to the transport protocol driver must first go through the upper layer of the STREAMS device driver to the protocol, then back through the lower layer of STREAMS to the NDIS device driver. The STREAMS environment allows the many STREAMS-based transport protocol drivers that already exist to be plugged into Windows NT with little or no modification. New transport protocol drivers, however, should be written to the newer, more versatile Transport Driver Interface.

6.3.1.6 Transport Driver Interface (TDI)

The Transport Driver Interface (TDI) is another isolation layer of software that falls at another strategic breakpoint in the OSI model, namely between the Transport Layer (Layer 4) and the Session Layer (Layer 5). The TDI is not a single piece of software but rather a protocol specification to which the upper bounds of the transport protocol device drivers are written. It enables a single version of a session-layer component, such as a network re-director or server, to use any available transport mechanism loaded on the machine, for example TCP/IP or IPX/SPX.

6.3.1.7 Windows Sockets (WinSock)

In network programming, a socket provides an endpoint to a connection; two sockets form a complete path. A socket works as a bi-directional pipe for incoming and outgoing data between networked computers.

Windows Sockets (WinSock), a session-layer interface, is a de facto standard for Windows-based network programming. Version 1.1 of Windows Sockets was developed by a group of 30 vendors, including Microsoft, and released in January 1993. This original version is compatible with the UC Berkeley (BSD) Sockets APIs, which are a de facto standard for UNIX network programming. Version 1.1 provided independence from the underlying TCP/IP protocol stack. As long as the TCP/IP stack was WinSock-compliant, an application written to the WinSock APIs would run on it.

Version 2.0 of Windows Sockets provides true transport protocol independence by extending support to additional protocols, including IPX/SPX, DECnet™, and OSI. It has also been extended to support additional network technologies, such as ATM, wireless, and telephony.

6.3.1.8 NetBIOS

The Network Basic Input/Output System (NetBIOS) is a session-layer interface similar in function to Windows Sockets. It is used by applications to communicate with NetBIOS-compliant transports such as NetBEUI Frame (NBF). The NetBIOS interface is responsible for establishing logical names on the network, establishing a connection between any two of those names, and supporting reliable data transfer between computers once the connection has been established. The network re-director is an example of a NetBIOS application.

6.3.1.9 Re-Director/Server

The re-director and server are integral subsystems that are key components of the network architecture for Windows NT. The re-director is the network component responsible for sending, or redirecting, I/O requests across the network when the file or device to be accessed is not on the local machine. The server is the network component on the remote machine that entertains connection requests from the client-side re-directors and provides them with access to the desired resources. Under Windows NT, multiple re-director/server pairs can concurrently execute, enabling transparent, multi-server access.

Both of these components reside above the TDI and are implemented as file system drivers. This has several benefits. Applications can call a single API to access both local and remote files, and, from the I/O Manager's perspective, there is no difference between accessing files stored on a remote networked computer and accessing those stored on a local hard disk. This transparent resource access is, in many ways, similar to the functionality provided by remote file systems under UNIX, such as the Network File System (NFS) and the Andrew File System (AFS).

6.3.1.10 Provider

For each re-director in the Session Layer (Layer 5) there is a corresponding component known as a *provider* in the Application Layer (Layer 7) of the OSI model. A provider establishes Windows NT as a client of a remote network server. When an application issues a request, a software component known as the Multiple Provider Router (MPR) determines the appropriate provider and routes the request to it. The provider then passes the request on to the corresponding re-director for transmission across the network. Typical operations performed by a provider are establishing and releasing network connections, transferring data across the connection, and printing remotely. The Windows NT File Manager is an example of an application that uses the services provided by the provider(s).

While Windows NT includes integrated networking, its open design provides for transparent access to other networks. Windows NT supplies provider/re-director pairs for its own network as well as others. For example, it includes the Client Service for NetWare® with Windows NT Workstation and the Gateway Service for NetWare with Windows NT Server, with which a computer running Windows NT can connect as a client to a NetWare network. You can also install third-party provider/re-director pairs to expand the connectivity of Windows NT beyond what is already supported "out of the box."

6.3.1.11 Named Pipes

Though not compatible with UNIX Named Pipes, Windows NT Named Pipes are conceptually similar. Named pipes provide a high-level interface for passing data between two processes, regardless of network location. Named pipes, like files, are implemented as file objects in Windows NT and operate under the same constraints and security mechanisms as other NT executive objects. The named pipe file system driver is a pseudo-file system that stores pipe data in memory and retrieves it on-demand. When processing local or remote named pipe requests, it functions like an ordinary file system.

6.3.1.12 Remote Procedure Call (RPC)

The Remote Procedure Call (RPC) facility is the backbone of true distributed computing and is rapidly becoming the Inter-Process Communication (IPC) method of choice for software developers. Much of the original design work for an RPC facility was started by Sun Microsystems. It has continued with the Open Software Foundation (OSF) as a core part of their Distributed Computing Environment (DCE) standard.

The Microsoft RPC is compatible with the OSF® DCE® RPC. Being compatible is not the same as being compliant. Compliance, in this case, means starting with the OSF

source code and building upon it. The key element here is not compliance; it is inter-operability. If the software is inter-operable, it does not need to be compliant, and the Microsoft RPC facility is completely inter-operable with other DCE-based RPC systems, such as those from Hewlett-Packard and IBM.

The RPC facility is unique because it relies on other IPC mechanisms to transfer functions and data between the client and the server. In the case of Windows NT, RPC can use named pipes, NetBIOS, or Windows Sockets to communicate with remote systems and the LPC facility to communicate with systems on the local machine. This IPC-independence makes RPC the most flexible and portable of the IPC mechanisms for Windows NT.

6.4 File Systems

6.4.1 Overview

Windows NT automatically supports multiple file systems. The two most commonly used are:

Windows NT File System (NTFS)–
The Windows NT File System (NTFS) is a new, advanced file system that supports file recovery, extremely large storage media, and long file names. NTFS provides the highest level of security and is the file system of choice on Windows NT.

File Allocation Table (FAT)–
The File Allocation Table (FAT) is the file system used by the MS-DOS and Windows operating systems. FAT does not provide security

A computer running Windows NT can use one or more of these file system on its disks and partitions. This is referred to as multiple active file systems.

6.4.1.1 NTFS

Journaling file systems are based on the transaction processing concepts found in database theory. NTFS is a journaling file system with fast file recovery. Internally, it resembles a relational database more than a traditional file system. It is comparable in function to the Veritas file system found on some UNIX implementations, and the really good news is you do not have to deal with **fsck** or **lost+found**.

NTFS was designed to provide recoverability, security, and fault tolerance through data redundancy. In addition, support was built into NTFS for large files and disks, Unicode-based names, bad-cluster re-mapping, multiple data streams, general indexing of file attributes, and POSIX. All of these contribute to making NTFS an extremely robust file system.

6.4.1.2 Fault Tolerance

Fault tolerance is the ability of a system to continue functioning when part of the system fails. The expression *fault tolerance* is typically used to describe disk subsystems, but it can also apply to other parts of the system or the entire system.

6.4.1.3 Redundant Arrays of Independent Disks (RAID)

Fault-tolerant disk systems are standardized and categorized in seven levels known as Redundant Arrays of Independent Disks (RAID) level 0 through level 6. The RAID levels are somewhat loosely defined, and details on performance or disk use vary from one configuration to the next. Depending on the implementation, definitions may overlap or be combined. Each level offers various mixes of performance, reliability, and cost. Windows NT supports RAID levels 0 through 5.

The major difference between RAID and earlier, more expensive large-disk technologies (also called Single Large Expensive Disks, or SLED) is that RAID combines multiple disks with lower individual reliability ratings to reduce the total cost of storage. The lower reliability of each disk is offset by the redundancy.

RAID Level 0–
This strategy is commonly known as disk striping without parity and uses a disk file system called a stripe set. Data is divided into blocks and spread in fixed order among all of the disks in the array. RAID Level 0 may enhance disk performance, but it does not provide redundancy. For that reason, it is not considered to be a true RAID level, nor does it qualify as fault tolerant.

RAID Level 1–
This strategy is commonly known as disk mirroring, disk duplexing, or disk shadowing. It provides an identical twin for a selected disk; all data written to the primary disk is also written to the twin, or mirrored, disk. This strategy provides the best performance when a member fails, but it is also the most expensive to implement due to the two-for-one disk space requirements.

RAID Level 2–
This strategy is commonly known as disk striping with error correcting code (ECC). This method achieves redundancy with ECC. It employs a disk striping strategy that breaks a file into bytes and spreads it across multiple disks. At the same time, the ECC data is spread across multiple check disks. In the event of data loss, the ECC information can be used to reconstruct the lost data.

RAID Level 3–
This strategy is the first in the series of levels that provides disk striping with parity. It employs the same striping method used in Level 2 but replaces the ECC method with a parity-checking scheme that requires only one disk on which to store the parity information.

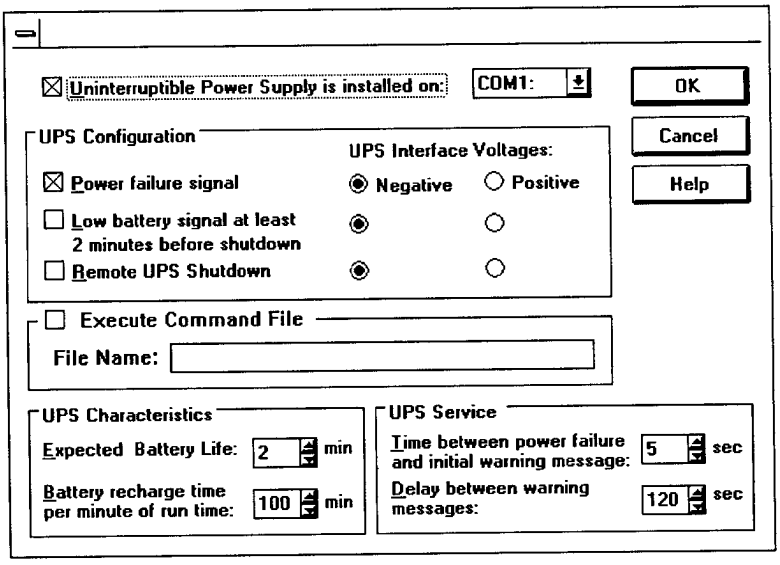
RAID Level 4–
This strategy is similar to Level 3 in that it stores the parity information on a separate check disk. Where it differs is in the striping. This method stripes data in much larger chunks.

RAID Level 5–
This has become the most popular strategy for recent fault-tolerant designs. Like Level 4, it stripes data in big chunks. Unlike Level 4, it does not use a separate check disk for parity information. Rather it stripes the parity across the disks as well. The data and parity information are arranged on the disk array so that the two are always on different disks.

RAID Level 6–
This is essentially Level 5 with the addition of redundant hardware such as disk controllers and power supplies.

6.4.1.4 Uninterruptible Power Supplies

An uninterruptible power supply (UPS) provides power when the local power fails. It is usually rated to provide a specific amount of power for a specific period of time. This power comes from batteries that are kept charged while main power is available. The main power is converted from AC voltage to the DC voltage used to charge the battery. When needed, the DC power is converted to an AC voltage compatible with the computer power supply. Usually, all that is needed from a UPS is time to shut down the system in an orderly fashion by terminating processes and closing sessions.



Configuring UPS Under Windows NT

Many UPS devices offer the ability to interface with operating systems, enabling the operating system to notify users automatically of the pending shutdown process or to provide notification that the power has been restored and a shutdown is no longer necessary. Windows NT provides an interface for these types of UPS devices through a serial port connection. Communication is handled in much the same way as hardware handshaking is handled on a normal RS-232C connection. Hardware signals are translated into power-state messages that are then interpreted by Windows NT software.

For example, during a power failure, the UPS service for Windows NT immediately pauses server access for Windows NT to prevent any new connections and sends a message to notify users of the power failure. The UPS service then waits a specified interval of time before notifying users to terminate their sessions. If power is restored during that interval, another message is sent to inform users that power has been restored and normal operations have resumed.

6.5 Distributed Computing–Directory Services

6.5.1 Overview

The goal is distributed computing. Directory Services is one key piece of that goal, but it is only a means to an end, not the end in itself. Distributed computing can be thought of as a seamless extension of the desktop where information is readily available at your fingertips. It goes far beyond the file and print sharing services common today.

A complete distributed computing infrastructure will be constructed from a variety of technologies and components. One essential component is a micro-kernel-based operating system as the foundation. A micro-kernel-based operating system

accommodates the heterogeneous nature of today's networks and provides the flexibility and the building block for tomorrow's networks. Another essential component is directory services. However, to make distributed computing truly seamless, directory services will need to be built on, and tightly integrated with, the micro-kernel-based operating system. It needs to be something more than adding X.500 on top of UNIX. Both the micro-kernel-based operating system and the directory services will also need to support a widely accepted and well integrated set of APIs for application development. In the case of directory services, strategic isolation layers of software will also need to be defined and accepted.

Because directory services are an important component of a distributed computing infrastructure, it is important to understand the continuing evolution of directory services. Fully functional directory services are an important element of the larger distributed computing picture, and their arrival will be the harbinger of a fundamental change in the network computing model as we know it. Along with distributed and object-oriented file systems, security services, and object-oriented development frameworks, directory services will ultimately enable a distributed computing environment that changes the way people use networks.

While the directory services provided by today's network operating systems have increased in functionality over the last several years, they are still primarily used in single-purpose administrative roles, such as electronic mail, multi-user accounting applications, and work-group applications. From a functional point of view, these directory services are designed to make the network operating system environment more manageable.

It is important to realize, however, that the vision of distributed computing cannot be fulfilled with directory services that have such limited scope. For example, next-generation directory services will not be deployed as subsets of other applications and services; they will be implemented as an integral part of the operating systems that serve as the foundation for distributed computing. Instead of being exposed as a separate database, as current-generation directories are, next-generation directories will be integrated with the network file system. The operating system, the network file system, and the directory services will be one single, unified package rather than disparate pieces loosely glued to each other.

Next-generation directories will contain all of the information on the network—in the form of *objects*—and not just the user profiles, access control lists, and other administrative information found in today's directories. As a result, users will be able to use the query capabilities of the directory to search for more than the name of a given server or printer. They will be able to search for any and all types of information on the

network and, hence, also contained in the directory. The information will be much more accessible, so that users can focus on their work, rather than on how the network works.

Next-generation directories must also provide significant levels of inter-operability with the existing administrative directories deployed as part of other applications and operating systems. This seamless inter-operability will allow system administrators to unify the implementation, access, and management of all network resources, including current-generation directory services, within the next-generation directory itself.

6.5.1.1 Domains and Trust Relationships

The Windows NT Domain should not be confused with a UNIX Domain. In UNIX, a domain refers to how a particular computer is named on a TCP/IP Internetwork. In Windows NT, a domain is a group of servers running Windows NT Server that share common security policy and user account databases. Therefore, the Windows NT Domain is the basic unit of security and centralized administration for Windows NT, and the servers in the domain, in some ways, can be viewed as a single system.

One computer running Windows NT Server acts as the Primary Domain Controller (PDC), which maintains the centralized security databases for the domain. Other computers running Windows NT Server in the domain function as backup domain controllers and can authenticate log-on requests. Users of a Windows NT Domain are authenticated by the PDC or by a backup domain controller. Domains can also contain computers running Windows NT Server that are not domain controllers, server computers that are not running Windows NT Server, and client computers such as those running Windows NT Workstation, Windows® for Workgroups, and MS-DOS.

The other key concept in Windows NT Domains is the trust relationship. A trust relationship is a link between two domains that enables a user with an account in one domain to have access to resources in another domain. When you establish a trust relationship between domains, one domain (the trusting domain) trusts the other domain (the trusted domain). Trust relationships are unidirectional. Bi-directional trusts are created with two unidirectional ones. In addition, trust relationships are not transitive. For example, if Domain A trusts Domain B, and Domain B trusts Domain C, Domain A will not trust Domain C by default. If Domain A needs to trust Domain C, a separate trust relationship must be set up between the two domains.

Domains and trust relationships are the key components in the Windows NT Directory Services. By combining domains and trusts, you are able to strike a balance between access, control, and administration for your particular network requirements. There are four common ways of combining domains and trust relationships into what are known as

domain models. They are: Single Domain, Master Domain, Multiple Master Domain, and Multiple Trust.

Single Domain–
In the single domain model, there is only one domain. Because there are no other domains, there are no trust relationships to administer. This model is best for organizations with fewer than 40,000 users in which establishing trust relationships among departments is not an issue. In an organization with multiple departments where there is no need to share information among them, the best configuration is often multiple single domains.

Master Domain–
In an organization with fewer than 40,000 users in which establishing trust relationships among departments is an issue, the master domain model is a suitable option. In this model, one domain, the master domain, is trusted by all non-master sub-domains, but does not trust any of them. The master domain contains the user accounts database and provides authentication services to the trusting sub-domains. This model offers the benefits of both central administration and multiple domains.

Multiple Master Domain–
In this model, there is more than one master domain. All of the master domains trust each other, and all are trusted by the non-master sub-domains, but none of the master domains trusts any of the sub-domains. This model works best when computer resources are grouped in some logical fashion, such as by department or by location. Each master domain can support as many as 40,000 users, so this model works well in large organizations. And because all the master domains trust each other, user accounts need only exist in one of them.

Multiple Trust–
In the multiple trust model, all domains trust each other. There are no master domains. This model is sometimes referred to as the complete trust model and is the simplest to understand. As with the multiple master domain model, the multiple trust model is scaleable as the organization grows, and because each domain has full control over its own user accounts, it can work well for a company without a centralized information services (IS) department.

6.5.1.2 Name Resolution

A computer on a network usually has both a name and an address. Take TCP/IP, for example. It requires an IP address and computer name, which are unique identifiers for the specific computer on the network. Computers use the IP addresses to identify each other, but people usually find it easier to work with the computer names. Therefore, a

mechanism must be available to convert computer names into their corresponding IP addresses. This mechanism is known as name resolution.

A computer running Windows NT can use one or more of the following methods to ensure accurate name resolution in TCP/IP internetworks:

- **Windows Internet Name Service (WINS)** is a NetBIOS over TCP/IP (NBT) mode of operation as defined in RFC 1001/1002 as p-node.
- **Broadcast Name Resolution** is a NetBIOS over TCP/IP (NBT) mode of operation as defined in RFC 1001/1002 as b-node.
- **Domain Name System (DNS)** is defined in RFCs 1034 and 1035.
- A **HOSTS file** is a flat file used to specify the DNS computer name and IP address mapping.
- An **LMHOSTS file** is a flat file used to specify the NetBIOS computer name and IP address mapping.

6.5.1.3 Dynamic Host Configuration Protocol (DHCP)

To fully understand the power of WINS, it is necessary to first know something about the Dynamic Host Configuration Protocol (DHCP). DHCP relieves the administrative burden associated with assigning and maintaining IP addresses. It offers dynamic configuration of IP addresses for computers. DHCP provides safe, reliable, and simple TCP/IP network configuration, ensures that address conflicts do not occur, and helps conserve the use of IP addresses through centralized management of address allocation. DHCP services for Windows NT are implemented under RFCs 1533, 1534, 1541, and 1542.

DHCP uses a client/server model and is based on leases for IP addresses. The system administrator controls how IP addresses are assigned by specifying address allocation ranges and lease durations. It is also possible to have static IP addresses, which are addresses with leases that do not expire. During system startup, a DHCP client computer sends a "discover" message that is broadcast to the local network and might be relayed to all DHCP servers on the private internetwork. Each DHCP server that receives the discover message responds with an offer message containing an IP address and valid configuration information for the client that sent the request.

The DHCP client collects the configuration offerings from the servers, chooses one of the configurations, and sends a request message to the DHCP server for the selected configuration. The selected DHCP server sends an acknowledgment message to the client. The DHCP acknowledgment message contains the IP address originally sent with the offer message, a valid lease for that address, and the appropriate TCP/IP configuration

parameters for use by the client. After the client receives the acknowledgment, it enters a bound state and can now participate on the TCP/IP network and complete its system startup.

Client computers save the received address for use during subsequent system startups. By default, the client attempts to renew its lease with the DHCP server when 50% of the lease time has expired. If the current IP address lease cannot be renewed, a new IP address is assigned.

As an example of how maintenance tasks are made easy with DHCP, consider the case in which a computer is moved from one sub-net to another. The IP address is released automatically for the DHCP client computer when it is removed from the first sub-net, and a new address is automatically assigned to it when it is attached to the new sub-net. Neither the user nor the system administrator needs to intervene to update the configuration information.

6.5.1.4 Windows Internet Name Service (WINS)

The Windows Internet Name Service (WINS) provides a dynamic database for registering and querying name-to-IP address mappings in a routed network environment. When a DHCP client moves from one sub-net to another, the IP address change is automatically updated in the WINS database. As with DHCP, no intervention is required of either the user or the system administrator to update the configuration information.

WINS consists of two components: the WINS server, which handles name queries and registrations; and the client software, which queries for computer name resolution. WINS servers support multiple replication partners in order to provide increased service availability, better fault tolerance, and load balancing. Each WINS server must be configured with at least one other WINS server as its replication partner. These partners can be configured to be either pull partners or push partners depending on how replications are to be propagated. WINS can also provide name resolution service to certain non-WINS computers through proxies, which are WINS-enabled computers that act as intermediaries between the WINS server and the non-WINS clients.

6.5.1.5 Domain Name System (DNS)

The Domain Name System (DNS) is a distributed database that provides a hierarchical naming system for identifying hosts on the Internet. A UNIX Domain is synonymous with a DNS Domain. DNS was developed to solve the problems that arose when the number of hosts on the Internet grew dramatically in the early 1980s. Although DNS might seem similar to WINS, there is a major difference: DNS requires static

configuration for computer name-to-IP address mapping, while WINS is dynamic and requires far less administration.

The DNS database is a tree structure called the domain name space, where each domain (node in the tree structure) is named and can contain sub-domains. The domain name identifies the domain's position relative to its parent domain in the database. A period (.) separates each part of the name. For example, tsunami.microsoft.com could be the name of a computer owned by Microsoft. The root of the DNS database is managed by the Internet Network Information Center. The top-level domains were assigned organizationally and by country. These domain names follow the ISO 3166 standard.

DNS uses a client/server model, where the DNS servers contain information about a portion of the DNS database and make this information available to clients, called resolvers, that query the name server across the network. DNS name servers are programs that store information about parts of the domain name space called zones. The domain administrator sets up name servers that contain database files with all the resource records describing all hosts in their zones. DNS resolvers are clients that are trying to use name servers to gain information about the domain name space. Windows NT includes all the resolver functionality necessary for using DNS on the Internet.

6.6 Security

6.6.1 Overview

The security model for Windows NT is designed to meet both national and international security criteria. In the United States it is the C2-level criteria as defined by the US Department of Defense *Trusted Computer System Evaluation Criteria* document (DOD 5200.28-STD, December 1985). This document is commonly referred to as the *Orange Book*. The C2-level security rating requires what is known as Discretionary Access Control and is one in a range of seven levels of security specified by the DOD. Some of the most important requirements for C2 are:

- **Identification and Authentication.** Each user must identify herself or himself by typing a unique log-on name and password before being allowed access to the system. The system must be able to use this unique identification to track the user's activities.
- **Discretionary Access Control.** The owner of a resource (such as a file) must be able to control access to the resource.
- **Object Reuse.** The operating system must protect objects so that they are not randomly reused by other processes. For example, the system protects memory so

that its contents cannot be read after it is freed by a process. In addition, when a file is deleted, users must not be able to access the file's data.

- **Audit.** System administrators must be able to audit security-related events. Access to this audit data must be limited to authorized administrators.
- **System Architecture.** The system must protect itself from external interference or tampering, such as modifications to the running system or system files stored on disk.

In the European community, the rough equivalent of the *Trusted Computer System Evaluation Criteria (TCSEC)* document is the *Information Technology Security Evaluation Criteria (ITSEC)* document. ITSEC is the product of the Common Criteria Editorial Board, an international standards body made up of representatives from various countries including France, Germany, the Netherlands, the United Kingdom, and the US. Because of the differences in criteria, there is no direct, one-to-one rating between the TCSEC document and the ITSEC document. A TCSEC rating of C2 translates roughly into an ITSEC rating of F-C2, E2. The higher TCSEC rating of B1 translates roughly into an ITSEC rating of F-B1, E3. Windows NT is currently being evaluated for an ITSEC rating of F-C2, E3, which is a mixture of the TCSEC B1 and C2 ratings.

The security model for Windows NT is made up of the following components:

- **Log-on Processes**, which accept log-on requests from users. These include the initial interactive log-on, which displays the log-on dialog box to the user and remote log-on processes, which allow access to server processes within Windows NT by remote users.
- **Local Security Authority**, which ensures that the user has permission to access the system. This component is the center of the security subsystem. It generates access tokens, manages the local security policy, and provides interactive user authentication services. The Local Security Authority also controls audit policy and logs the audit messages generated by the Security Reference Monitor.
- **Security Account Manager (SAM)**, which maintains the user accounts database. This database contains information for all user and group accounts. SAM provides user validation services, which are used by the Local Security Authority.
- **Security Reference Monitor,** which checks to see if the user has permission to access an object and perform whatever action the user is attempting. This component enforces the access validation and audit generation policy defined by the Local Security Authority. It provides services to both kernel and user mode to ensure that the users and processes attempting access to an object have the

necessary permissions. This component also generates audit messages when appropriate.

Together, these components are known as the security subsystem. This protected subsystem is an integral subsystem rather than an environmental subsystem because it affects the entire Windows NT operating system.

6.6.1.2 Users and Groups

Under Windows NT, any person who needs access to resources on the network must have a valid user account on a domain that allows or is allowed that access. The Windows NT user account contains the following information:

- **Username.** The unique name the user types when logging on.
- **Password.** The user's secret password.
- **Full Name.** The user's full name.
- **Log-on Hours.** The hours during which the user is allowed to gain access to the resources on the network.
- **Log-on Workstations.** The computer names of the workstations from which the user is allowed to work.
- **Expiration Date.** A future date when the account automatically becomes disabled.
- **Home Directory.** A directory on the server that is private to the user; the user controls access to this directory.
- **Log-on Script.** A batch or executable file that runs automatically when the user logs on.
- **Profile.** A file containing a record of the user's desktop environment, such as program groups, network connections, and screen colors, that follows the user from one workstation to another. The system administrator can also set up standard profiles that users are not allowed to modify.
- **Account Type.** For most, if not all, user accounts, the type will be global.

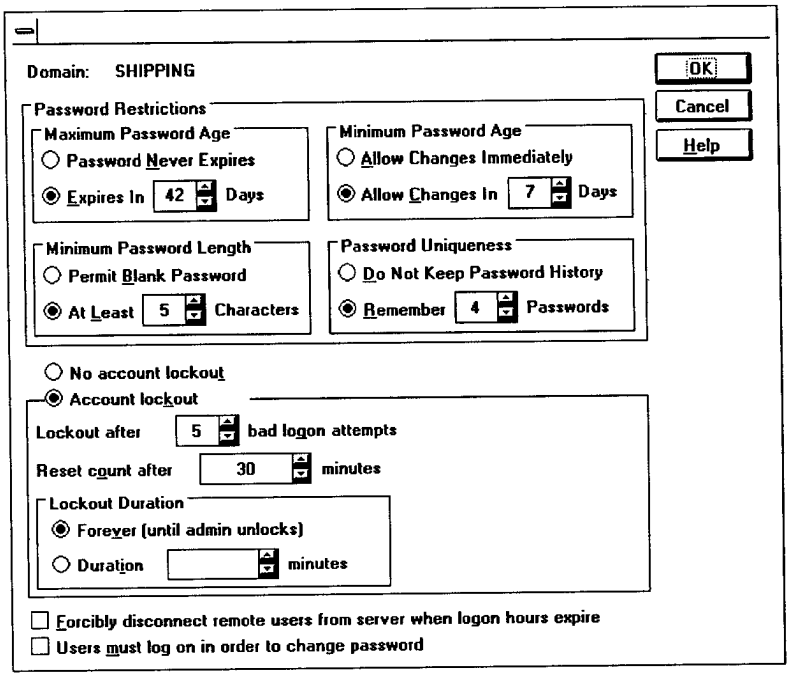
Like UNIX, Windows NT supports the concept of groups. With groups, you can sort users who have similar jobs and resource needs. Groups make granting rights and resource permissions easier; giving a right or permission to a group gives that right or permission to all present and future members of that group.

Even though they are conceptually similar, groups within Windows NT are inherently more powerful than groups within UNIX. Windows NT provides a set of built-in groups that gives members rights and abilities to perform various tasks, such as backing up the computers or administering the network printers. Examples of these built-in groups are: Administrators, Backup Operators, Print Operators, Power Users, Users, and Guests. It is also possible for the system administrator to define new types of groups, although the built-in groups cover most of the standard combinations of rights and permissions you would expect to find. User accounts can belong to more than one group at the same time and will share the combined rights and permissions of all groups to which they belong.

6.6.1.3 Passwords

Windows NT provides features that enable a system administrator to create a very robust account policy. The password policy can set the following limits on user passwords:

- **Maximum Password Age.** Specifies how long a user can use a password without changing it. By default, this setting is 42 days. It can be set to any value from 1 to 999 days, or it can be set to never expire.
- **Minimum Password Age.** Specifies how long a user must wait after changing a password before the user can change it again. By default, users can change their passwords immediately. This setting can be changed to any value between 1 and 999 days.
- **Minimum Password Length.** Specifies how many characters a password must contain. By default, Windows NT permits blank passwords. Many system administrators, however, change this option. A recommended minimum is six characters, but it can be set as high as 14 characters
- **Password Uniqueness.** Specifies how many different passwords a user must use before being allowed to reuse one. With the default setting, a user can immediately reuse an expired password. This setting can be changed to require users to create from 1 to 24 unique passwords before reusing one.



Setting Account Policy

Windows NT has no equivalent to the UNIX **/etc/passwd** file. With Windows NT, passwords are not hashed and stored in a flat file; they are instead integrated into the security model. No direct access to passwords, hashed or otherwise, is provided under Windows NT. Only the system administrator can reset a user's password.

Windows NT also provides an account lockout feature. When this feature is enabled, a user account becomes locked if there are a number of incorrect attempts to log on to that account within a specified amount of time. Locked accounts cannot log on. A locked account remains locked until an administrator unlocks it, or until a specified amount of time passes, depending on how the account lockout feature has been configured. By default, account lockout is disabled.

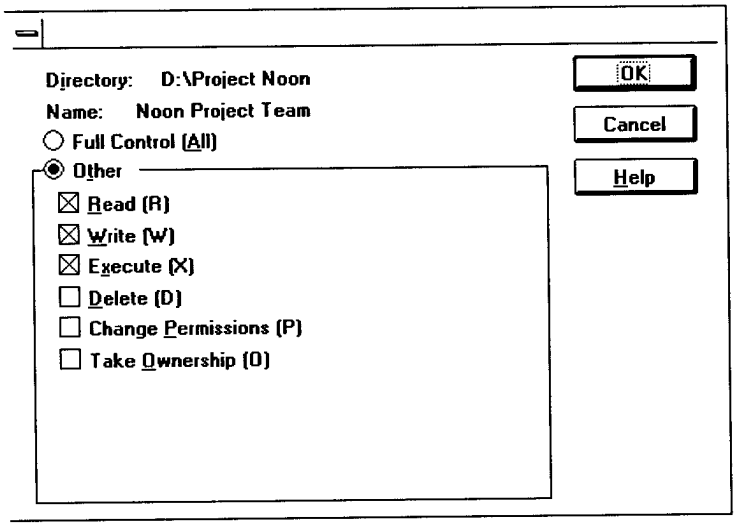
6.6.1.4 File Access (NTFS)

Windows NT supports multiple file systems. The two most commonly used are: the Windows NT file system (NTFS) and the file allocation table (FAT) file system. Permissions work differently on NTFS volumes than they do on FAT volumes. Security is much more powerful on NTFS volumes, and, for that reason, NTFS is the file system of choice for Windows NT.

Windows NT offers a set of standard permissions for files and directories in NTFS volumes. These standard permissions offer useful combinations of specific types of access, which are called individual permissions. Individual permissions are somewhat analogous to UNIX permissions, and consist of: Read (R), Write (W), Execute (X),

Delete (D), Change Permissions (P), and Take Ownership (O). These permissions can be specified either directly, as individual permissions, or indirectly, as standard permissions. Examples of standard permissions are: Read (RX), Change (RWXD), No Access (None), and Full Control (All). As with the built-in groups, it is possible for the system administrator to create new types of standard permissions, although most of the combinations that you would expect to find are covered in the existing ones.

UNIX supports three sets of file and directory permissions: owner, group, and world. This is the familiar -rwxrwxrwx that shows up in the output from the UNIX **ls -al** command. With Windows NT, permissions can be granted to either individual users or to groups. The big difference between Windows NT and UNIX is that, with Windows NT, multiple sets of permissions can be granted to multiple combinations of groups and/or individual users. You are not limited to just three sets.



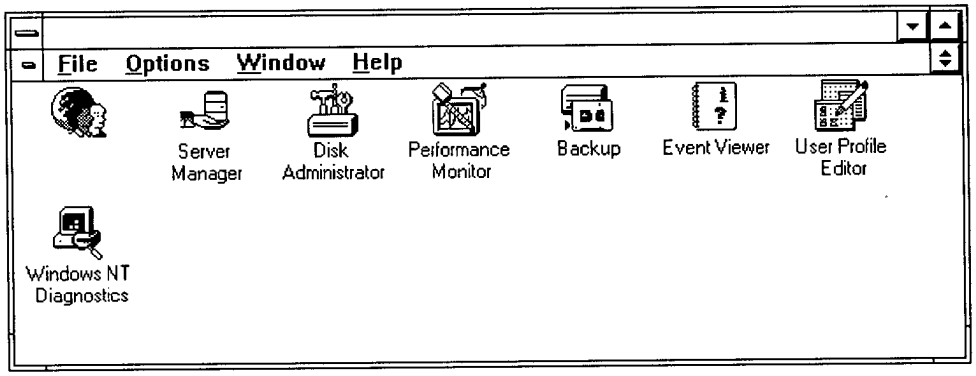
Setting Special Directory Permissions or Taking Ownership

Every file and directory on an NTFS volume has an owner. The owner controls how permissions are set on the file or directory, and can grant permissions to others. File ownership provides a way for users to keep private files private. This is another area where Windows NT differs significantly from UNIX. A system administrator can take ownership of any file on the system, but cannot then transfer the ownership to others, as can be done with UNIX. Therefore, if an administrator wrongly takes ownership of someone's files, that administrator cannot subsequently transfer ownership back to the original owner, and the original owner can easily find out who the new owner is.

6.7 System Administration

6.7.1 Overview

System administration differs significantly between Windows NT and UNIX. Two factors contribute heavily to this difference. First, Windows NT is based on the client/server model rather than the host-based terminal model. This is inherently a more decentralized model, which dramatically alters many of the tasks usually associated with system administration in a host-based terminal environment such as UNIX. Second, Windows NT is fully integrated with its Windows-based, graphical user interface (GUI). Virtually everything a system administrator does on the machine is GUI-based. This is in stark contrast to the command line user interface (CLUI) common for UNIX. There are X-based, system administration tools available on many of the UNIX implementations. However, these GUI-based tools were added as an afterthought, are not well integrated, and, in general, are specific to a particular flavor of UNIX.



Windows NT Administrative Tools

System administration is perhaps the most difficult area in which to make the paradigm shift. It is very hard to move from the "raw power" of the command line interface into the safer, standardized realm of the graphical user interface. There is a feeling of loss of control, and it is at this point that it becomes critical to remember that client/server environment is a different world, requiring different tools and strategies.

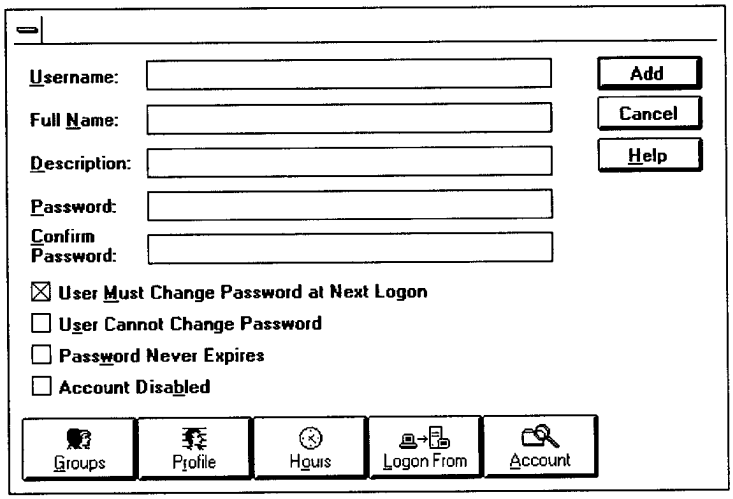
6.7.1.1 Account Management

User Accounts–
Through the magic of domains and trust relationships, users have a single log-on to the network, which gives them access to their resources from any available workstation. This not only reduces the administrative burden on system administrators, but it also directly benefits the users in that they have only one log-on name and one associated password to

remember. In addition, their desktop environments follow them as they move from workstation to workstation.

In Windows NT, user accounts are established and maintained with a Windows-based tool known as User Manager for Domains. It is a far cry from the UNIX method in which you typically use **vi** to manually edit the **/etc/passwd** and **/etc/groups** files. You can use User Manager for Domains to:

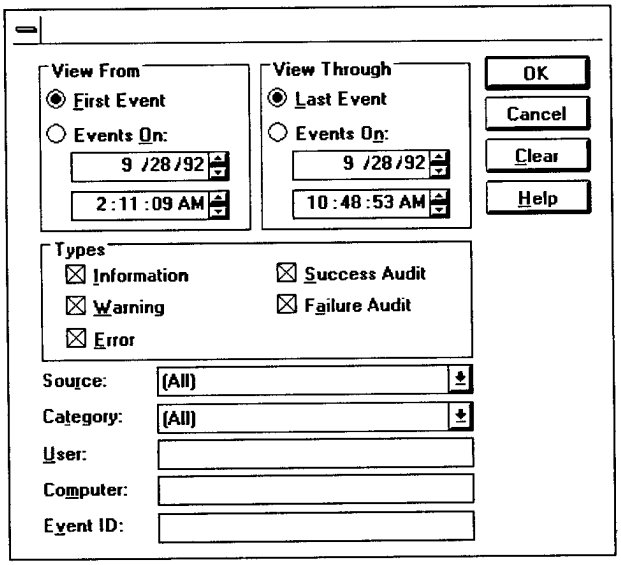
- **Maintain User Accounts.** You can add, modify, rename, disable, and delete users. You can establish and maintain password policy, as well as reset forgotten passwords. You can set up log-on hours, log-on workstations, and account expiration dates.
- **Maintain User Environment Profile.** You can set up or modify the path to the user's profile. You can establish a log-on script for the user, and you can specify the user's home directory. This is similar to setting up **.profile** and **.kshrc** files, and establishing **$HOME** environment variables for users under UNIX.
- **Maintain Groups.** You can add, modify, or delete groups, and you can add or remove users from groups.
- **Maintain the Security Policies.** You can manage the Account Policy, which controls the way passwords must be used by all user accounts and whether user accounts are locked out after so many bad log-on attempts. You can manage the User Rights Policy, which controls the rights assigned to groups and user accounts, and you can manage the Audit Policy, which defines the security events that will be logged.



User Manager for Domains—New User Dialog Box

User Profile policy is established and maintained with another Windows-based tool: User Profile Editor (although it can also be accessed through User Manager for Domains). User Profile Editor is somewhat analogous to using **vi** to modify the **/etc/profile** file on UNIX. However, User Profile Editor gives you complete control over all user profiles on the system, not just the default, global one.

Accounting Information–
Accounting information is also less of an issue with client/server based computing than it is with host-based terminal computing. With auditing enabled, you can use the filter function of Event Viewer to see when a particular user last logged on to the domain. This is how you identify inactive user accounts. With another tool, Server Manager, you can see who is connected to a server, how long they have been connected, and what resources they have open. You can also view this information in different formats. You can see which resources are currently being used, or, if you are interested in just one resource, you can view information specific to it, such as who is connected and for how long.



Filtering with Event Viewer

6.7.1.2 Server Management

Remote Administration–
The client/server model, coupled with domains, trust relationships, and single network log-on accounts, makes it possible for system administration to take place anywhere on the corporate network. Remote dial-in access is provided by a built-in feature of Windows NT known as Remote Access Services (RAS). With RAS, system administration can happen from virtually any location that has access to a telephone.

RAS for Windows NT is based on a client/server architecture, in which a remote RAS client connects to a local RAS server. TCP/IP, IPX, and NetBEUI are all supported, which means you can integrate RAS for Windows NT into existing Microsoft, UNIX, or NetWare networks using the PPP remote access standard.

Further inter-operability is possible. Non-Microsoft PPP clients using TCP/IP, IPX, or NetBEUI can also access a Windows NT-based RAS server, and Windows NT-based RAS clients can connect to existing SLIP-based remote access servers (typically UNIX servers). Microsoft RAS protocol is a proprietary remote access protocol supporting the NetBIOS standard. It has been largely superseded by the newer PPP remote access standard.

Two requirements must be met to make a RAS server:

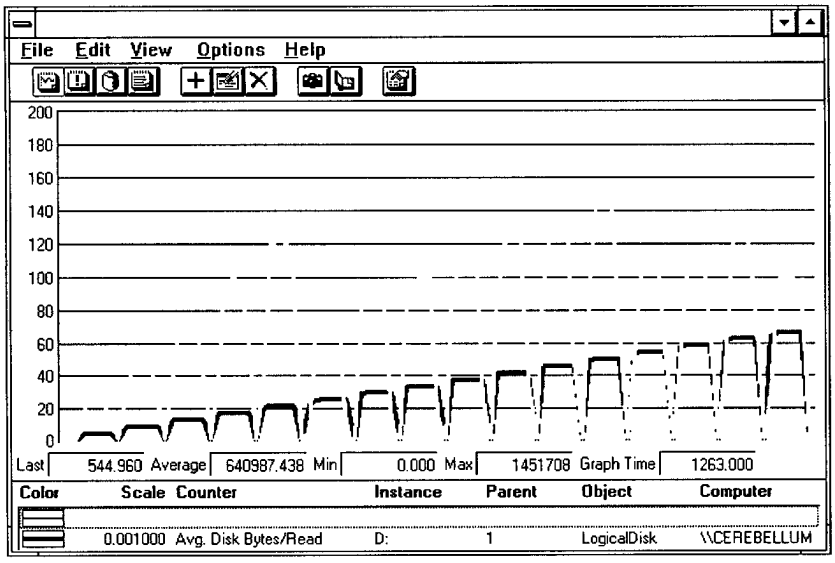
1) the proposed server must be a computer running Windows NT and RAS, and
2) the proposed server must have either a multi-port adapter or modem(s).

When a remote RAS client connects to the RAS server, the RAS server checks to see if the RAS client is using a pre-assigned IP address. If not, the RAS server automatically assigns an IP address to the RAS client from the static range of addresses owned by the RAS server.

Once the connection has been made, the RAS client becomes a full-fledged node on the corporate network, not just a dumb terminal dialing in. The remote system administrator can then use the same Windows-based tools as a local system administrator to access resources such as files, printers, electronic mail, and databases.

Performance Monitoring–
A major design goal of Windows NT was to eliminate the many obtuse parameters that characterized earlier systems. Adaptive algorithms were incorporated in the design so that correct values are determined by the system as it runs. The result is that Windows NT has fundamentally changed how computers will be managed in the future. The task of optimizing the system is not the art of manually adjusting many conflicting parameters. It is a process of determining what hardware resource is experiencing the greatest demand, and then adjusting the operation to relieve that demand.

Windows NT includes a Windows-based tool for tracking computer performance called Performance Monitor, which is similar to tools on UNIX, such as **top** and GlancePlus from Hewlett-Packard. Performance Monitor is based on a series of counters that track such things as the number of processes waiting for disk time, the number of network packets transmitted per second, and the percentage of processor utilization.



Performance Monitor—Chart View

Performance Monitor displays information graphically (through Charts) or as text (through Reports). Data can be displayed in real-time or collected in logs for later display as a graph or report. You can also configure Performance Monitor to generate alert logs. Alert log entries are posted every time a counter exceeds or falls below a user-specified value. They can also be used to trigger Performance Monitor to generate network messages or run programs based on the value of the log entry.

In addition to Performance Monitor, other tools are available for Windows NT. The *Windows NT Resource Kit* is a four-volume set of books with accompanying software. Volume 4, *Optimizing Windows NT*, provides over 600 pages of practical advice on performance tuning for Windows NT, along with additional software tools that compliment the features of Performance Monitor.

File Backup/Restore–
Windows NT supplies a Windows-based, Backup tool, which is similar to the X-based tools found on some versions of UNIX. Its salient capabilities include:

- Backing up and restoring both local and remote files on an NTFS or FAT file system from a local computer with an attached tape drive
- Selecting files for backing up or restoring by volume, directory, or individual filename and viewing detailed file information, such as size or modification date
- Selecting an optional verification pass to ensure reliable backups or restores
- Performing any of the following common backup operations: Normal, Copy, Incremental, Differential, and Daily

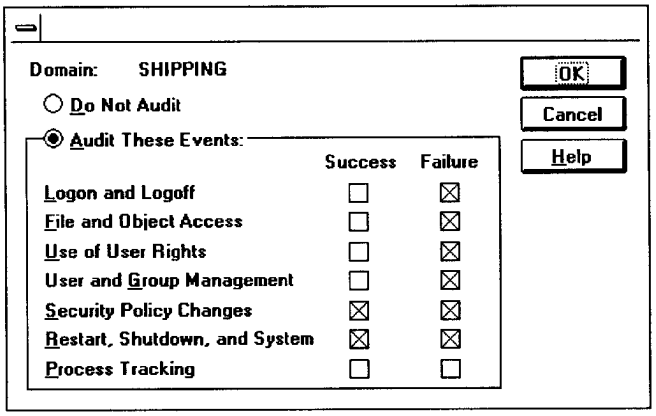
- Placing multiple backup sets on a tape, and spanning multiple tapes with both backup sets and files, since there is no restriction on file size
- Automating the backup with a batch file and the scheduler service
- Viewing a full catalogue of backup sets, directories, and individual files
- Controlling a destination drive and directory for the restore
- Saving log information on tape operations to a file

The Backup tool also provides a Backup Status dialog box that shows the active status of the tape operation. Or, you can use another Windows-based tool, Event Viewer, to view the backup history in the system event logs.

Disk Allocation–
The primary tool for day-to-day administering of files and directories is File Manager. It is a powerful, Windows-based tool that, among other things, enables you to selectively view file listings sorted by name, type, size, or date and time of last modification. Windows NT also includes a command language that is a superset of the MS-DOS batch commands. It provides a scripting capability that is similar to the UNIX shell scripts. With it, you can do finer granularity sorts on files and directories and see additional information, such as date and time of creation or last access.

Currently, Windows NT does not support the concept of disk quotas per se. It is possible to do something similar with judicious use of disk partitions and shared directories, and there are third-party products, such as Quota Manager from New Technology Partners, that provide traditional disk quota features.

Auditing–
Windows NT can record a range of event types, from a system-wide event such as a user logging on, to an attempt by a particular user to access a specific file. Both successful and unsuccessful attempts to perform an action can be recorded.



Setting System-Wide Audit Policy

System-wide audit policy is established and maintained with User Manager for Domains. Individual object access auditing is controlled with either File Manager, for files and directories, or Print Manager, for printers. The audit log entries are examined and manipulated with Event Viewer.

Windows NT records events in three kinds of logs:

- The **System Log** records events logged by the system components of Windows NT. For example, the failure of a driver or other system component to load during startup is recorded in the system log.
- The **Application Log** records events logged by applications. For example, a database program might record a file error in the application log.
- The **Security Log** records security events. This helps track changes to the security system and identify any possible breaches in security. For example, attempts to log on to the system can be recorded in the security log, depending on the Audit settings in User Manager for Domains.

After you select a log for display in Event Viewer, you can view, sort, filter, and search for details about events. You can also archive logs in various file formats.

The following types of events can be audited:

- **Log-on and Log-off.** Entries record successful and unsuccessful log-on attempts, log-off attempts, and the making or breaking of a network connection to a server.
- **File and Object Access.** Entries record attempted access of directories or files set for auditing in File Manager, or system printers set for auditing in Print Manger.
- **Use of User Rights.** Entries record successful uses of user rights and unsuccessful attempts to use rights not assigned to users.

- **User and Group Management.** Entries record changes to groups and user accounts, including changes to passwords.
- **Security Policy Changes.** Entries record changes made to the User Rights, Audit, or Trust Relationship policies.
- **Restart, Shutdown, and System.** Entries record shutdowns and restarts of the computer, the filling up of the audit log, and the discarding of audit entries if the audit log is already full and rollover has been enabled.
- **Process Tracking.** Entries record starts and stops of processes on the computer. These events provide detailed tracking information and are enabled under very rare circumstances.

Background Job Scheduling–
At the time of this writing, the Microsoft corporate data center is using Windows NT to run over 1,000 batch jobs daily on 340 servers world-wide; this includes backing up more than a terabyte of data. The built-in job scheduling features of Windows NT are comparable to UNIX commands, such as **cron** and the **at** command. Windows NT also has a built-in **at** command, and the *Windows NT Resource Kit* has a graphical utility known as the Command Scheduler. These are basic tools, as are their UNIX counterparts. For more sophisticated tools, the kind of tools you need for data center operations, third-party products are available.

6.7.1.3 Network Management

Windows NT combines a sophisticated computer operating system with a fully integrated network operating system (NOS), and the synergy created by this marriage provides the system administrator with an unparalleled wealth of resources for managing the corporate network. We have already covered how DHCP and WINS work together to automate the tasks of IP address administration and name resolution on the network. Additional administrative tools include: Server Manager, Performance Monitor, Event Viewer, Control Panel, Network Client Administrator, and License Manager. All of these enable system administrators to monitor and control various aspects of the corporate network. The *Windows NT Resource Kit* supplies even more tools to compliment the list, such as Net Viewer, Domain Monitor, Browser Monitor, and Process Viewer.

6.8 Desktop Management

Microsoft Systems Management Server–
Installing and maintaining software is a major cost to corporations with distributed networks. Often, the system administrator must install, upgrade, and configure each computer manually. For a large corporation with locations across a wide geographical

area, these installation and support costs may increase exponentially. In fact, most of the cost-of-ownership for a corporate computer system comes not from the initial purchase price of the software, but from software installation, support, and maintenance costs.

If a corporation already has a distributed network in place, it makes sense to take advantage of its wide-area connectivity for managing software for the entire corporation. But, before software can be installed over the network, you must know where it is going. Before software can be maintained, you must know where it is. You need to know what computers are on the network. And, after you find out what computers you have, you need to know information about the computers so you can install or maintain your software correctly. You need to know what hardware they have, what software is already installed, and how the computers are configured. In short, you need an inventory. If you have many computers, you also need a logical way to group them so you can recognize them more easily, such as by location or configuration. You need a structured way to look at the entire corporate network.

Enter Systems Management Server. Microsoft Systems Management Server provides system administrators with a method for centrally managing software and hardware for their corporate networks. It is based on client/server architecture. The server runs on a Windows NT Server-based machine; the clients need not. Systems Management Server is an easy-to-use, integrated system that:

- Maintains an inventory of hardware, software, and configuration of computers across a corporate network
- Distributes, installs, and updates software and files
- Manages network applications (applications run over the network from servers)
- Provides integrated support utilities, including a network monitor, that enables system administrators to view diagnostic information for remote clients and take direct control of them if need be

Systems Management Server maintains a database containing system information and inventory, carries out distribution and installation jobs, monitors the progress of these jobs, and alerts you to important system events. With Systems Management Server you can distribute and install software on clients and servers across your corporate network, set up network applications, automatically collect and maintain hardware and software inventory, provide direct support to users, and monitor your network.

6.9 User Interface and Environment

6.9.1 Overview

Windows NT will be familiar to anyone who has used Windows. The Windows NT, Windows for Workgroups, and Windows 3.1 operating systems all share a common graphical user interface. This interface has become ubiquitous in industry and is standard on more than 70 million desktops world-wide. Virtually all of the tools and facilities of Windows NT use this interface, including the on-line help engine and the print manager.

Windows 95 sports an object-oriented user interface that provides users with a work environment that closely models a traditional office. A good example of the change is illustrated by the task of opening a document for word processing. With the former interface, users selected an icon representing the word processor then, once the program started, selected a file on which to work. By contrast, the new interface represents each document in the directory structure by its own icon. When a user selects the document icon, the word processor initializes and automatically loads the file. Users no longer need be concerned about which programs to run in order to access files. This interface has also been used with the release of Windows NT 4.0.

The transition from the UNIX command line to Windows NT graphical user interface takes some getting used to. One of the keys to successful system administration on UNIX is knowing which flat file to edit for any given configuration change. With Windows NT, configuration information is centrally stored in a database known as the Registry, and virtually all configuration changes are handled with Windows-based tools. The key, then, to system administration on Windows NT is knowing which tool to run, and it is a much easier task than searching the entire file system for an obscure configuration file with equally obscure configuration entries.

However, for typical users on an X-terminal or workstation, the transition to Windows NT can come as welcome relief. If users are already running Windows, Windows NT will be second-nature. For those whose only exposure to a graphical environment has been X, the transition will still be straightforward. However, Windows NT is far more standardized than X. The graphical user interface permeates not only the Windows NT operating system, but also the applications that run on it. In addition, the GUI provides a true graphical environment, not just a graphical shell that overlays the command line. The typical user running Windows NT will never have reason to see or use anything on the command line. Contrast this with the typical X user and the beloved **xterm** window. Routine tasks such as printing and getting help also tend to be much easier for the user. These services are graphics-based and standardized across both the operating system and the applications.

6.9.2 Workstation

A workstation running Windows NT is an intelligent device. It consists of a CPU, memory, and disk, along with a monitor, keyboard, and mouse or other pointing device. On the surface, it bears a resemblance to an X-terminal, but is more akin to a UNIX workstation running X. It runs its own independent operating system, typically Windows NT Workstation, and participates as a client on the network. In general, it is a smaller machine in terms of CPU, memory, and disk, than its server counterparts, but this need not be the case. When compared to a UNIX workstation running X, it is also typically less expensive, both in terms of hardware and software.

6.9.3 Multi-User Support

Windows NT is not a multi-user operating system in the traditional sense of the word. Multi-user is a concept that comes from the one computer, many users paradigm, which is also known as host-based computing. Client/server is a different world. Users connect to client computers, and client computers connect to server computers. The relationship between users and clients is one-to-one; the relationship between clients and servers is many-to-many. So, in a way, a server is multi-user, it is just that the users are client computers, not people.

6.9.4 Log-On Names

The administrator account on Windows NT is the closest thing to super-user or **root** on UNIX. It is the most powerful log on to the system but does not have the carte blanche powers of **root**. Windows NT also provides a **guest** account that is disabled by default.

Log on names for Windows NT can be up to 20 characters in length. Uppercase and lowercase characters are permitted, but the names are not case sensitive. For example, user names, marcg, Marcg, MarcG, and MARCG, all represent the same user. However, if the user is added as MarcG, then that is the way the name appears in listings on the system. The user, however, can log on with any of the case combinations shown. Log on names for Windows NT also differ from those for UNIX in that they cannot contain unprintable characters such as backspace or tab. Other illegal characters are

- [
-]
- ?
- >
- <

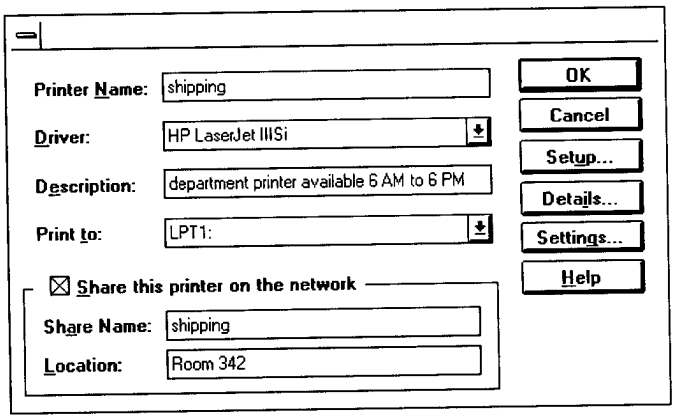
Passwords have similar limitations. Passwords can be up to 14 characters in length, cannot contain unprintable characters, but can contain the illegal characters defined for log on names. Unlike log on names, passwords are case sensitive.

6.9.5 Applications

Most packages written for Windows 3.x or Windows 95 run on Windows NT. This means that there are literally thousands (over 11,000 at last count) of shrink-wrapped, off-the-shelf packages available today, and they all share a common user interface. The same cannot be said for UNIX; any software count depends on which version of UNIX you are running. You can be sure, however, that the user interface between UNIX applications will not be the same, or even similar, in most cases.

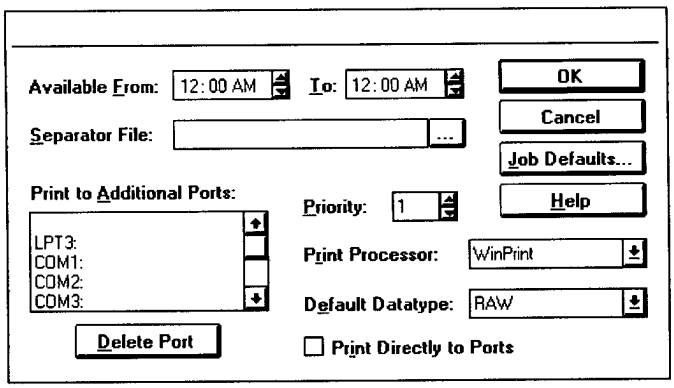
To compliment Windows NT, an integrated suite of Microsoft add-on applications, called BackOffice, provides enterprise functionality, such as a relational database server (SQL Server™), IBM connectivity (SNA Server), enterprise mail messaging (Mail Server), and desktop workstation management (Systems Management Server).

6.9.6 Printing



Print Manager—Printer Properties Dialog Box

Windows NT currently ships with built-in support for over 950 printers. Printers are set up and controlled graphically on Windows NT via the Control Panel and Print Manager applications. Printers can be connected locally to a workstation or, more typically, remotely on the network. With the exception of naming conventions, network printers and local printers function identically. Once the printers are configured, all applications in Windows NT have access to them, and, for the user, printing involves little more than clicking on the Print icon or making a menu selection.



Print Manager—Printer Details Dialog Box

System administration tasks are simplified by the Windows-based tools as well. With the Windows NT Print Manager, system administrators can configure and control the following features:

- The hours a printer is available
- Whether or not to print a separator page showing who submitted the print job along with the date and time
- The creation a pools of printers
- Printer priorities
- The specification of a custom print processor

In addition, system administrators can manage local and remote printers from any workstation on the network. The capabilities include:

- Viewing a list of printers and their respective print jobs
- Purging jobs waiting for a printer
- Holding or releasing a print job
- Restarting a print job from the beginning
- Deleting a print job
- Stopping a job that is currently printing
- Pausing and continuing a printer
- Removing a printer

Printers can also be audited and have usage tracked. For any printer, system administrators can specify which groups or users and which actions to audit. An action's success, as well as its failure, can also be audited.

LPR, LPD–
LPR is one of the network protocols in the TCP/IP protocol suite. It was originally developed as a standard for transmitting print jobs between computers running Berkeley UNIX. The LPR standard is published as Request For Comment (RFC) 1179. Windows NT complies with this standard, as do most implementations of Berkeley UNIX. However, most UNIX System V implementations do not comply with this standard. Consequently, in most cases, Windows NT will not be able to send print jobs to or receive print jobs from System V computers. Exceptions are System V computers that are configured to accept BSD jobs; these computers can accept print jobs from Windows NT.

Using LPR protocol, a client application on one computer can send a print job to a print spooler service on another computer. The client application is usually named "LPR" and the service (or daemon) is usually named "LPD." Windows NT supplies a command line application, the **lpr** utility, and it supplies the LPR Port print monitor. Both act as clients sending print jobs to an LPD service running on another computer. Windows NT also supplies an LPD service, so it can receive print jobs sent by LPR clients, including computers running UNIX and computer running Windows NT.

6.9.7 Getting Help

Getting help on Windows NT is much less of an adventure than getting help on UNIX. There are no **man** pages in Windows NT. Rather, there is a unified, hypertext help system that follows a single, consistent model, and that is used by all programs throughout the system. Windows NT provides both general and context-sensitive help, as well as keyword and topic search capabilities. It also provides the capability to set bookmarks, annotate the text, cut and paste, and print selected topics off-line.

In addition, Microsoft has a technical support line, forums on most of the major on-line services, and ftp, gopher, and Web sites on the Internet. There are also CD-ROM subscription services available, such as the Microsoft Developer Network (MSDN) and the Microsoft TechNet CD.

6.10 Hardware Platforms

6.10.1 Overview

Windows NT is a platform-independent, scaleable operating system. It is designed to take full advantage of the advanced computing capabilities of either the x86 or RISC-based processors on which it runs. In addition, it supports both single processor and symmetric multiprocessor (SMP) systems. There are actually two Windows NT-based operating systems that share a common source-code base: Windows NT Server and

Windows NT Workstation. This is similar to UNIX, which runs on both server and workstation. Typically, the workstation is a scaled-down version of the server in terms of both hardware and software, especially software for system administration. The same holds true for Windows NT.

Hardware requirements for Windows NT can be broken into three main areas: processor, memory, and disk space. As a general rule, you will need more of each for Windows NT Server than for Windows NT Workstation. The minimum processor requirements are a 32-bit x86-based microprocessor (such as Intel® 80386/25 or higher), Intel Pentium®, PowerPC, or other supported RISC-based processor, such as the MIPS® R4000® and Digital Alpha™ AXP™. The minimum memory requirement is 16 MB, although Windows NT Workstation will run with 12 MB on x86-based systems. In general, the minimum disk space requirements for the operating system are in the 100 MB range. This varies by processor type and whether the operating system is Windows NT Workstation or Windows NT Server. For Windows NT Workstation requirements are: 75 MB for x86 and 92 MB for RISC. For Windows NT Server requirements are: 90 MB for x86 and 110 MB for RISC. Additional disk space is required for applications.

6.10.2 Choice

Windows NT is a portable operating system in the true sense of the word. It runs on many different hardware platforms and supports a multitude of peripheral devices; Windows NT gives you choice.

This was the dream of UNIX, which is largely unrealized. In reality, there is no such thing as UNIX; there are flavors of UNIX, and each is slightly different than, and generally incompatible with, the others. Sometimes there are even incompatibilities within different versions of UNIX from the same vendor. For example, an application software bought to run on a workstation version of UNIX will not run "as-is" on the server version of UNIX. To run the application there, a different copy of the same application must be purchased. In most cases, the same holds true with UNIX itself. Once you buy UNIX, you are often locked in to a single-vendor hardware solution, and that vendor is usually the same one that sold you the copy of UNIX.

6.10.3 Cost versus Performance

In the UNIX world, servers tend to be large and to host multiple applications. With Windows NT, the servers are not as large, and there are generally more of them. A single UNIX-based server running a dozen applications might translate into two or three Windows NT-based servers with the applications split among them.

Because it is not an apples-to-apples comparison, cost versus performance analyses become quite difficult. Much depends on the specifics of your environment, such as number of workstations, number and type of applications, and whether or not there is an existing base of one or the other type of system. General data is available from industry research firms, such as the Gartner Group, the Burton Group, the META Group, and International Data Corporation (IDC). Unfortunately, no one-size-fits-all right answer exists, and you must balance the available data with knowledge of your own particular business environment.

6.10.4 Operating System Installation and Configuration

In comparison to UNIX, installing and configuring Windows NT is a walk in the park. You do not mess with the kernel, nor do you "hand" edit obscure files scattered throughout the system. Instead, you simply boot the computer from the setup disk, and setup instructions guide you step-by-step through the process. Setup is a GUI-based program that uses standard dialog boxes to solicit configuration information at various points throughout the process. For example, you are asked which network protocols to install and which file system to use on a specific disk partition. Once setup is complete, all configuration information is centrally stored in the Windows NT Registry database, and installation of the operating system is complete. The entire process, from start to finish, takes roughly 45 minutes for a complete install and roughly 20 minutes to upgrade a previous version of the operating system.

Many common peripheral device drivers are included with Windows NT. Adding a new printer to the system, for instance, is usually a matter of running Print Manager and answering questions in a series of dialog boxes. In other situations, you may need to install additional software. This involves running a setup program and answering a series of configuration questions in dialog boxes. This is the common theme for system administrators. Virtually everything you do involves the same process: run a program, and answer questions in dialog boxes. Contrast this with UNIX in which every new installation of a peripheral device or software is an adventure unto itself.

Because Windows NT is portable, system administration for Windows NT is portable. The tools and processes remain the same no matter where you are. This standardization is one of the most significant differences between Windows NT and UNIX. With UNIX, virtually no standardization for system administration tools or techniques exists across the different versions, and this lack of commonality is glaring.

System administrators can make different versions of UNIX appear similar to the user, but the same cannot be said for system administration. For example, a tool such as the Windows NT Performance Monitor has no common, analogous tool within UNIX. While such tools exist, the names differ from version to version, as do the features, the user

interface, the command structure, and, worst of all, the type of data they present. So, even if you can find and run it, you still might not be able to make any sense of the output, based on your previous experience with similar tools.

6.10.5 Application Software Installation and Configuration

Application software installation and configuration for Windows NT follows the same pattern outlined in the section on installing the operating system. At no time do you touch the kernel or "recompile" the operating system. You run setup and answer questions in dialog boxes. To change configurations, you typically select an *options* menu entry and answer more questions in dialog boxes. If you have ever installed a software package under Windows, you know the process. It is the same one used by Windows NT.

6.10.6 Error Handling

UNIX provides little feedback. When problems occur, more often than not, UNIX simply stops doing what it was doing without so much as a wave good-bye. This is especially true with X. If you set an invalid configuration, X simply ignores it and moves on. It does not indicate anything to you about the problem; you must figure it out, which is, again, an adventure.

Windows NT takes a different approach. Instead of editing flat configuration files, configuration changes are made through carefully controlled dialog boxes. This control significantly reduces the chances of error. And, when an error does occur, Windows NT provides a descriptive error message in a dialog box. Once the message is acknowledged, Windows NT attempts to recover gracefully from the error condition. If it is an application error, the application is terminated, and its resources returned to the system.

NOTICE

The supplemental attachments to DEF'S Response to OPC question #14 are confidential. Specifically, attachments listed below by bates numbers are confidential:

20170272-DEF-OPC-POD 2-14-000235 through
20170272-DEF-OPC-POD 2-14-0000256

Unredacted documents have been filed with the Commission along with DEF's Notice of Intent to Request Confidential Classification dated June 28, 2018.