

**LOS ANGELES COUNTY
INFORMATION EXCHANGE NETWORK**



IEN SYSTEM OVERVIEW MANUAL

VERSION 2.4.1

Prepared for:

**Los Angeles County
Department of Public Works**

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REVISION HISTORY

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Version 2.4.1	3/28/12	Freeway interface & outbound interface updates (IEN V2.4.1)	Chuck Dankocsik

1. INTRODUCTION

1.1 PURPOSE

This document describes the project goals, system capabilities, and concepts of operations of the Los Angeles County Information Exchange Network (IEN). It is intended to be an introduction to the IEN.

Please refer to the following documents for more detailed information about the IEN:

- *IEN System Operators Manual*
- *IEN System Administrators Manual*
- *IEN System Technical Reference Manual*
- *IEN As-Built Detailed Design Document*

1.2 AUDIENCE

The *IEN System Overview Manual* is targeted towards new users who will be responsible for operating and administering the system. This document would also be useful to representatives of Agencies who are interested in connecting to the IEN.

2. OVERVIEW

In 1999, TransCore was selected by the LA County Department of Public Works to establish a coordinated network for sharing information and control of the various traffic control systems throughout LA County using a common network backbone based on the Common Object Request Broker Architecture (CORBA). Sharing information and control throughout LA County is intended to improve coordination between member Agency traffic control systems as well as improve incident response and management activities. TransCore has overall technical responsibility to design, develop, and implement the Information Exchange Network (IEN). What is unique to the IEN is the fact that the primary focus of the system is intersection traffic control as opposed to freeway management. Key components of the IEN include:

- Establishing a common system interface (IDL) which allows the connection of heterogeneous traffic control systems onto the IEN backbone.
- Sharing second-by-second intersection data to support real-time workstation, intersection, and section displays, arterial coordination, and incident response management.
- Allowing smaller Agencies to share control and monitoring for off-hours support and maintenance (thus, a single Agency can serve as the afterhours coordination center for all of the traffic control systems in the region).
- Pop-up control windows that allow operators to change the plan/mode of any intersection.
- Incident and planned event tracking system which allows the Agencies to share incident, planned event, and construction activities.
- Scenario manager, which allows the member Agencies to establish multi-Agency incident response/mitigation plan.

This document describes the IEN Program goals (see Section 3), system capabilities (see Section 4), user interfaces (see Section 5), and the concept-of-operations (see Section 6). Readers can also find information on how to connect to the IEN (see Section 7).

3. PROJECT GOALS

3.1 USE AN OPEN ARCHITECTURE

The purpose of the IEN Program is to establish a network for sharing information and control of the various traffic control systems in the Region using a common network backbone based on the Common Object Request Broker Architecture (CORBA). What is unique to the IEN is the fact that the primary focus of the system is intersection traffic control as opposed to freeway management. The IEN System establishes a common system interface definition language (IDL); so that any traffic control system can connect to the IEN.

3.2 SHARE REAL-TIME DATA

The IEN is also unique because it shares second-by-second real-time intersection data; most other Regional systems deal with slowly changing freeway data and other ITS field elements such as Dynamic Message Signs, while the IEN was specifically designed to share real-time data to support real-time intersection displays, section displays, and arterial coordination. Sharing information and control throughout LA County is intended to improve coordination between systems along the arterials and improve response management in the event of a problem with special events or incidents along the freeway or surface streets throughout LA County.

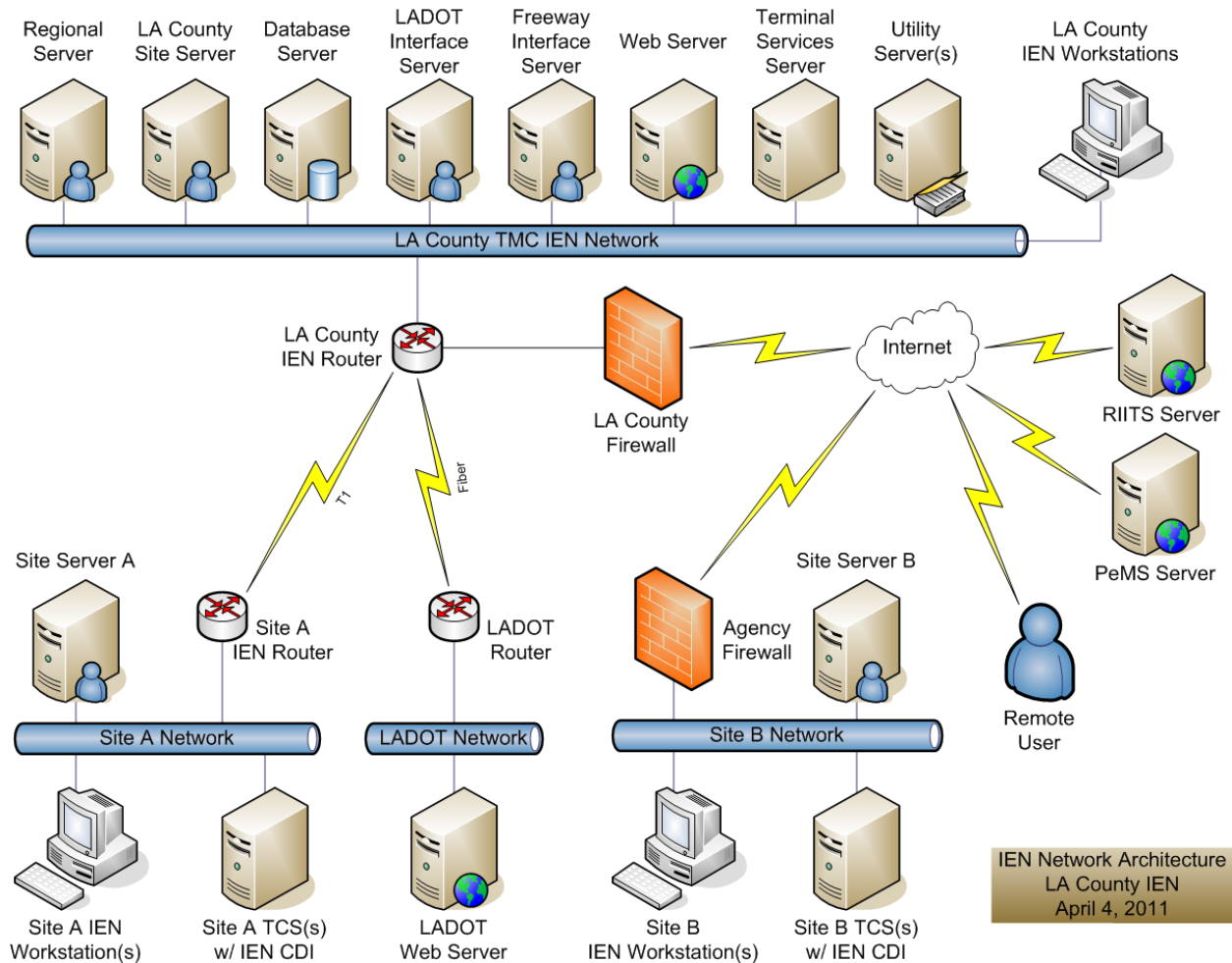
3.3 SHARE CONTROL AND MONITORING

The system also allows smaller Agencies to share limited control of their traffic control system to another Agency for off-hours support. Thus, a single Agency can serve as the afterhour's coordination center for neighboring Agencies.

4. SYSTEM ARCHITECTURE

The Los Angeles County IEN is a multi-tiered, hierarchical system with site, regional, and external interface components.

Exhibit 4.1: Los Angeles County IEN System Architecture



4.1 SITE COMPONENTS

IEN site components are installed at participating Agencies. Typical site components include the following:

- A Site Server to manage the distribution of data between local workstations, local traffic control systems, and the Regional Server.
- One or more Workstations to run the IEN User Interfaces.
- One or more Traffic Control Systems (TCS) with IEN command/data interface (CDI) software. CDI software connects an IEN Site Server and a Traffic Control System.
- A network firewall to enforce secure connections between IEN and Agency networks.

See Section 7 for more information on the site components.

4.2 REGIONAL COMPONENTS

Regional IEN components are located at Los Angeles County DPW and provide the central servers for the IEN System. Regional components include the following:

- A Regional Server to manage the distribution of data between sites. Additional Regional Servers can be added to increase the capacity of the IEN System.
- A Database Server to maintain system configuration information and historical status, event management, and alarm data.
- Utility Servers that provide supporting services for the IEN systems such as Active Directory, DNS, and time synchronization.
- Terminal Services Servers to provide access to the IEN Workstation software for remote users that connect to LA County's Virtual Private Network (VPN).

4.3 EXTERNAL SYSTEM INTERFACES

4.3.1 TCS Command/Data Interface

The IEN has established a specification for CORBA-based¹ command/data interface applications that connect traffic control systems into the IEN. A CDI allows the IEN to read a limited set of intersection, section, and detector data from a traffic control system, and enables the IEN to send a limited set of commands to intersections and sections on the TCS (as permitted by the owning Agency). IEN CDI applications have been developed for the following types of traffic control systems:

- McCain QuicNet
- TransCore Series 2000
- TransCore *TransSuite* TCS
- Siemens i2TMS

CDIs are currently being developed for Kimley Horn KITS and Econolite Centrac systems. LA County intends to develop an XML-based version of the CDI to better leverage national standards and to support traffic control system vendors that do not wish to develop CORBA interfaces to their systems.

4.3.2 LADOT-to-IEN Interface

The following customized interfaces have been developed to share data between LA County's IEN System and the Los Angeles Department of Transportation's (LADOT) Automated Traffic Surveillance and Control (ATSAC) system:

- LADOT-to-IEN Interface: pulls LADOT intersection, system detector, and planned event data from LADOT's Web Server into the IEN.
- IEN-to-LADOT Interface: pulls IEN intersection, system detector, and event data into LADOT's ATSAC system.

¹ Common Object Request Broker Architecture, used to transport dynamic real-time data and static data throughout the IEN. CORBA is required to move the large amount of real-time data generated by the system every second over the relatively low bandwidth links of the IEN's wide-area network.

The LADOT-to-IEN Interface allows the IEN to display status data for all of LADOT's 3,400+ intersections and 11,000+ arterial system detectors. The interface collects intersection and arterial detector data from an LADOT Web Server, translates that data into IEN data, and passes the data to the IEN's internal data distribution subsystems. The LADOT Web Server reports a subset of the data that the IEN typically requests from other traffic control system vendors through their IEN CDIs. Specifically, data such as the intersection controller type, the master and local cycle counters, actual cycle length and offset for controllers running in non-adaptive mode, and vehicle call status are not available for LADOT intersections. In addition to traffic signal data, the LADOT-to-IEN interface also reports LADOT planned event information, which is not included in other standard deployments, since they are limited to traffic signal data. This planned event data can include scheduled road closure information for events such as demonstrations, parades, and sports games.

The IEN-to-LADOT Interface collects intersection and arterial detector data from the IEN using the IEN's internal CORBA-based interfaces. The interface is maintained by LADOT.

4.3.3 Freeway Data Interface

The IEN has developed a Freeway Data Interface application to pull data from the Regional Integration of Intelligent Transportation Systems (RIITS) and PeMS (Performance Measurement System) systems into the IEN. The Freeway Data Interface allows the IEN to report freeway congestion status, incidents, and lane closures to IEN users. The Interface was completed in September 2010.

4.3.4 IEN Web Server

LA County has developed an XML-based web service to provide summary intersection and arterial detector data to authorized external systems. The IEN Web Server is currently not accessible from the Internet. Please contact LA County for more information. The Web Server was completed in September 2010.

4.4 NETWORK CONNECTIONS

Participating Agencies must connect to central IEN servers that are located at the LA County Transportation Management Center (LACO TMC). LA County supports various types of network connections including dedicated network links (T-1, Frame Relay, Wireless, etc...) and site-to-site Virtual Private Network (VPN) connections over the Internet. Each Agency's IEN site components communicate solely with the regional IEN components located at the LACO TMC. They do not communicate with site components at other Agencies. The network link between an Agency and the LACO TMC should have at least 384Kbps of bandwidth dedicated to IEN traffic. The IEN can be configured to support lower bandwidth connections if necessary.

4.5 DATABASE SERVICES

All static configuration data for the IEN is maintained in a relational database on the Database Server. This configuration data consists of the following:

- Security attributes for users and resources
- The set of TCS devices known to the system
- Alarm notification and coordination monitoring configuration

- Locations and attributes of network resources
- Scenario response plans

In addition to the static configuration data, the IEN database stores traffic event data, archived arterial and freeway congestion status data, alarm data, intersection coordination history, and system event logs.

4.6 ACCESS TO IEN USER INTERFACES FROM THE INTERNET

LA County allows authorized users to access the IEN User Interfaces over the Internet through LA County's VPN. The VPN connection can be established using an Internet Browser from any system that has access to the Internet. The IEN User Interfaces are hosted on a Terminal Services Server located at the LACO TMC. The first Terminal Services Server was deployed in Spring 2010. Please contact LA County for further information.

5. USER INTERFACES

The IEN includes a suite of user interface programs, some of which were developed specifically for the IEN and some of which are components of TransCore's *TransSuite* product family. LA County DPW has licensed these *TransSuite* applications for use within the Los Angeles County IEN System.

The IEN User Interfaces include:

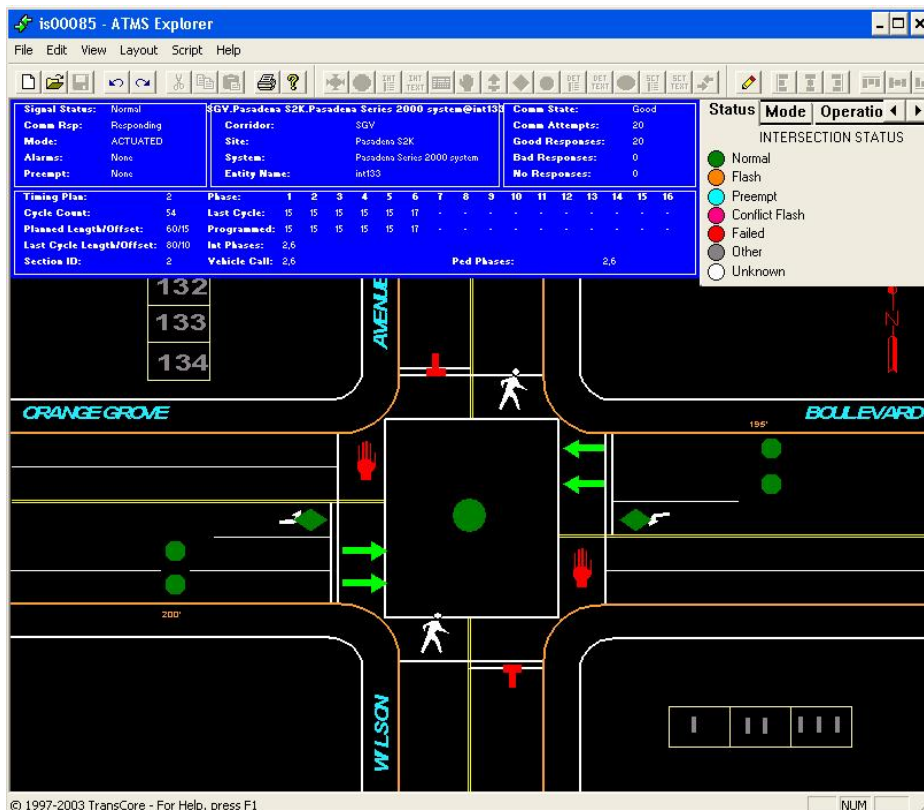
- *TransSuite* ATMS Explorer
- *TransSuite* ATMS Map
- *TransSuite* ATMS System Log Viewer
- IEN Alarm Viewer
- *TransSuite* Incident Management System
- *TransSuite* Scenario Manager
- *TransSuite* Time/Space Diagram

There are also several administrative applications that configure various aspects of the system.

5.1 ATMS EXPLORER

ATMS Explorer is a powerful diagramming platform that can be used to create and display custom views of traffic management equipment such as a diagram that shows the layout, status, and operation of an intersection or a diagram that shows how several intersections along an arterial are interacting.

Exhibit 5.1: ATMS Explorer



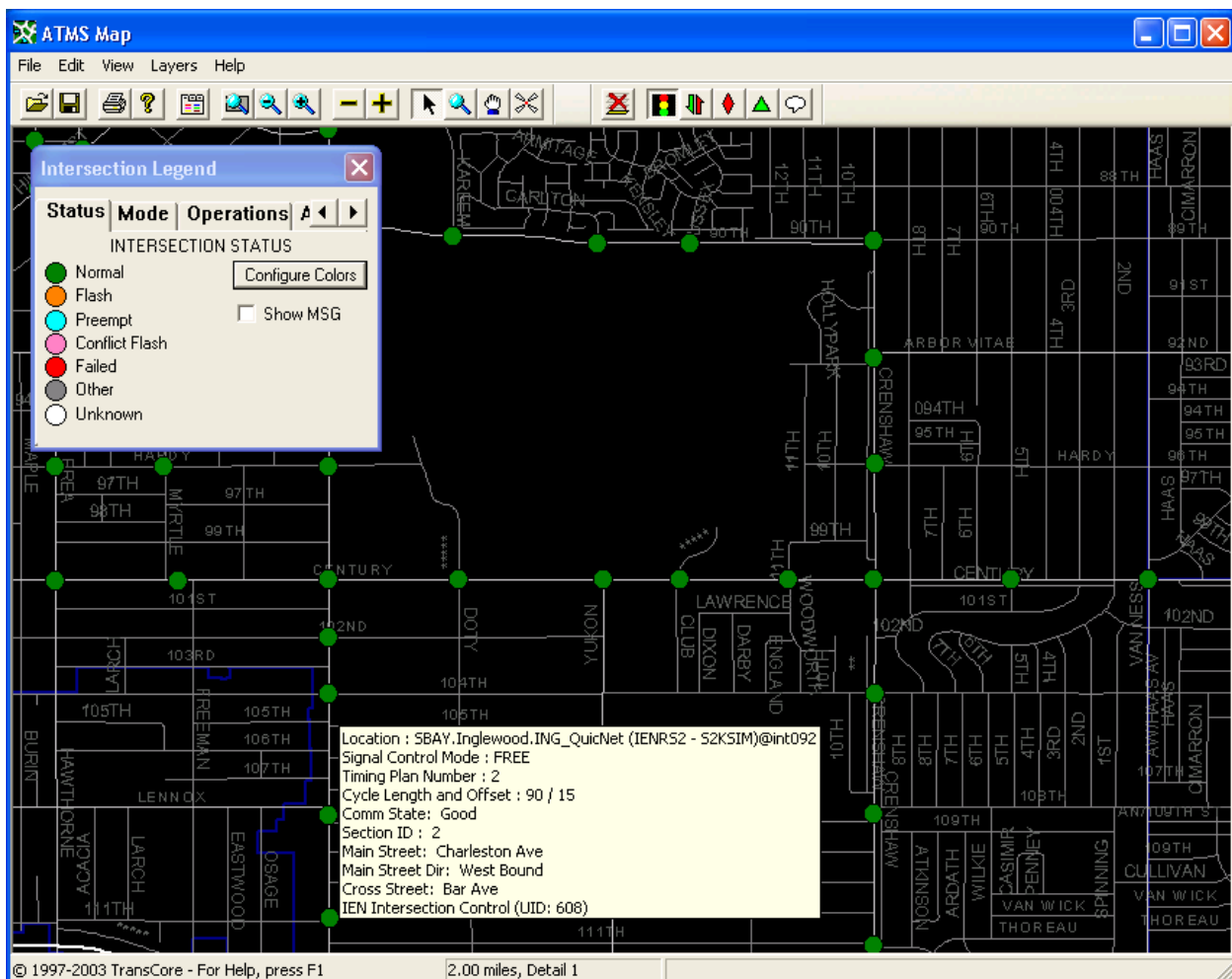
An ATMS Explorer diagram consists of a set of icons drawn on top of a static background. These “icons” can be controls or other types of embeddable objects, such as CorelDraw drawings or Excel spreadsheets. ATMS Explorer includes special support for the following:

- Custom ATMS controls (such as intersection controller icons, green arrow icons, pedestrian icons, and many more)
- Linking diagrams together to allow users to navigate from intersection to intersection even across jurisdictional boundaries
- Integration with other IEN applications

5.2 ATMS MAP

ATMS Map is a geographically accurate display of LA County roadways with overlying layers of dynamic icons that represent various types of devices, congestion links, and traffic events within the IEN.

Exhibit 5.2: ATMS Map



Operators can pan and zoom the map to quickly navigate throughout the roadway network and activate or deactivate the individual layers according to their needs. Operators can interact with the icons to see more detailed information, to update the location or status of an incident, and to issue commands to devices in the field.

The IEN map layers include:

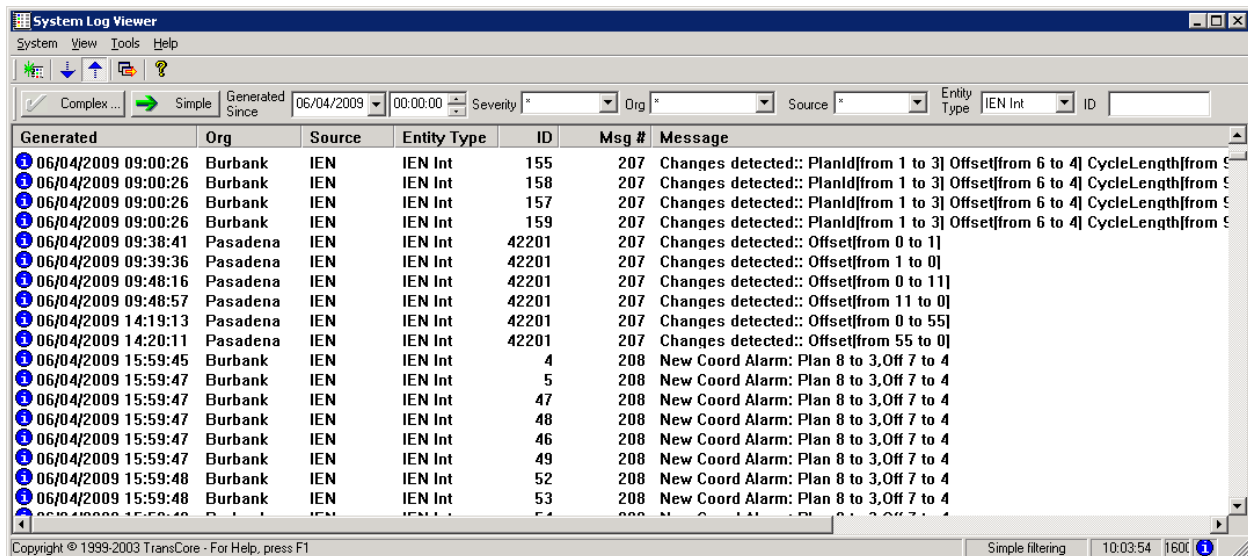
- **Intersection Layer:** Contains icons that represent intersection controllers at their geographic positions. Intersection icons can display various types of operational and timing status and provide command options for authorized users.
- **Arterial Congestion Link Layer:** Displays aggregate volume, occupancy, V+kO, and speed measurements from arterial system detectors along segments of roadway.
- **Freeway Congestion Link Layer:** Displays volume, occupancy, and speed measurements from detector stations on LA County freeways.
- **Incidents Layer:** Shows the location of incidents throughout LA County which have been reported to or entered into the IEN, allowing users to monitor and manage the affect on traffic flow.
- **Planned Event:** Shows the location of pre-planned events that affect traffic flow and can include alternate route notations and other mitigating information.
- **Informational Layer:** Displays user-created textual and graphical annotations on the map.
- **Regional Layer:** Defines discrete areas within LA County so that scenario plans (see Section 5.6) can be associated with geographic locations. Users are able to search the scenario database for plans that affect a particular region.

Additional layers can be added to support new types of information as the IEN expands.

5.3 ATMS SYSTEM LOG VIEWER

The ATMS System Log Viewer displays event messages that have been generated by the IEN applications. Log entries are created for activities that affect the operation of the IEN or that of connected systems. These include event and alarm management activities and sending commands to devices. The ATMS System Log also contains device and application status messages and other information useful for diagnosing problems.

Exhibit 5.3: ATMS System Log Viewer

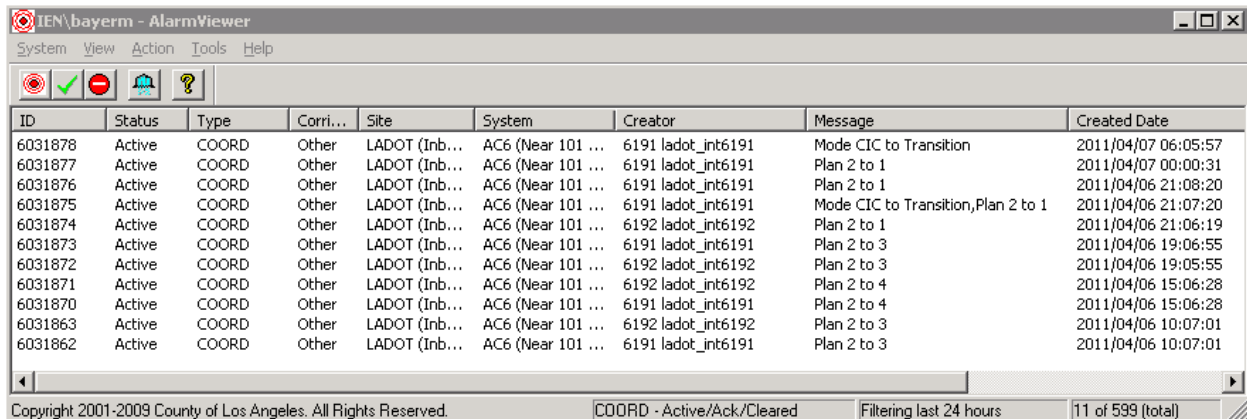


Generated	Org	Source	Entity Type	ID	Msg #	Message
06/04/2009 09:00:26	Burbank	IEN	IEN Int	155	207	Changes detected:: PlanId[from 1 to 3] Offset[from 6 to 4] CycleLength[from 5
06/04/2009 09:00:26	Burbank	IEN	IEN Int	158	207	Changes detected:: PlanId[from 1 to 3] Offset[from 6 to 4] CycleLength[from 5
06/04/2009 09:00:26	Burbank	IEN	IEN Int	157	207	Changes detected:: PlanId[from 1 to 3] Offset[from 6 to 4] CycleLength[from 5
06/04/2009 09:00:26	Burbank	IEN	IEN Int	159	207	Changes detected:: PlanId[from 1 to 3] Offset[from 6 to 4] CycleLength[from 5
06/04/2009 09:38:41	Pasadena	IEN	IEN Int	42201	207	Changes detected:: Offset[from 0 to 1]
06/04/2009 09:39:36	Pasadena	IEN	IEN Int	42201	207	Changes detected:: Offset[from 1 to 0]
06/04/2009 09:48:16	Pasadena	IEN	IEN Int	42201	207	Changes detected:: Offset[from 0 to 11]
06/04/2009 09:48:57	Pasadena	IEN	IEN Int	42201	207	Changes detected:: Offset[from 11 to 0]
06/04/2009 14:19:13	Pasadena	IEN	IEN Int	42201	207	Changes detected:: Offset[from 0 to 55]
06/04/2009 14:20:11	Pasadena	IEN	IEN Int	42201	207	Changes detected:: Offset[from 55 to 0]
06/04/2009 15:59:45	Burbank	IEN	IEN Int	4	208	New Coord Alarm: Plan 8 to 3,Off 7 to 4
06/04/2009 15:59:47	Burbank	IEN	IEN Int	5	208	New Coord Alarm: Plan 8 to 3,Off 7 to 4
06/04/2009 15:59:47	Burbank	IEN	IEN Int	47	208	New Coord Alarm: Plan 8 to 3,Off 7 to 4
06/04/2009 15:59:47	Burbank	IEN	IEN Int	48	208	New Coord Alarm: Plan 8 to 3,Off 7 to 4
06/04/2009 15:59:47	Burbank	IEN	IEN Int	46	208	New Coord Alarm: Plan 8 to 3,Off 7 to 4
06/04/2009 15:59:47	Burbank	IEN	IEN Int	49	208	New Coord Alarm: Plan 8 to 3,Off 7 to 4
06/04/2009 15:59:48	Burbank	IEN	IEN Int	52	208	New Coord Alarm: Plan 8 to 3,Off 7 to 4
06/04/2009 15:59:48	Burbank	IEN	IEN Int	53	208	New Coord Alarm: Plan 8 to 3,Off 7 to 4

5.4 IEN ALARM VIEWER

The IEN Alarm Viewer displays traffic control system, coordination, and operator alarms. The IEN monitors incoming intersection status data and generates a traffic control system alarm whenever a door open, flash, conflict flash, or internal error condition is reported. The IEN can be configured to monitor intersection coordination parameters (communication state, control mode, timing plan, cycle length, and offset) and to generate alarms when an intersection is operating with different coordination parameters that it did at the same time the previous week. Operator alarms are manually generated by users.

Exhibit 5.4: IEN Alarm Viewer



The screenshot shows the IEN Alarm Viewer application window with a menu bar (System, View, Action, Tools, Help) and a toolbar with icons for alarm status. The main area contains a table of active alarms with the following columns: ID, Status, Type, Corri..., Site, System, Creator, Message, and Created Date.

ID	Status	Type	Corri...	Site	System	Creator	Message	Created Date
6031878	Active	COORD	Other	LADOT (Inb...	AC6 (Near 101 ...	6191 ladot_int6191	Mode CIC to Transition	2011/04/07 06:05:57
6031877	Active	COORD	Other	LADOT (Inb...	AC6 (Near 101 ...	6191 ladot_int6191	Plan 2 to 1	2011/04/07 00:00:31
6031876	Active	COORD	Other	LADOT (Inb...	AC6 (Near 101 ...	6191 ladot_int6191	Plan 2 to 1	2011/04/06 21:08:20
6031875	Active	COORD	Other	LADOT (Inb...	AC6 (Near 101 ...	6191 ladot_int6191	Mode CIC to Transition, Plan 2 to 1	2011/04/06 21:07:20
6031874	Active	COORD	Other	LADOT (Inb...	AC6 (Near 101 ...	6192 ladot_int6192	Plan 2 to 1	2011/04/06 21:06:19
6031873	Active	COORD	Other	LADOT (Inb...	AC6 (Near 101 ...	6191 ladot_int6191	Plan 2 to 3	2011/04/06 19:06:55
6031872	Active	COORD	Other	LADOT (Inb...	AC6 (Near 101 ...	6192 ladot_int6192	Plan 2 to 3	2011/04/06 19:05:55
6031871	Active	COORD	Other	LADOT (Inb...	AC6 (Near 101 ...	6192 ladot_int6192	Plan 2 to 4	2011/04/06 15:06:28
6031870	Active	COORD	Other	LADOT (Inb...	AC6 (Near 101 ...	6191 ladot_int6191	Plan 2 to 4	2011/04/06 15:06:28
6031863	Active	COORD	Other	LADOT (Inb...	AC6 (Near 101 ...	6192 ladot_int6192	Plan 2 to 3	2011/04/06 10:07:01
6031862	Active	COORD	Other	LADOT (Inb...	AC6 (Near 101 ...	6191 ladot_int6191	Plan 2 to 3	2011/04/06 10:07:01

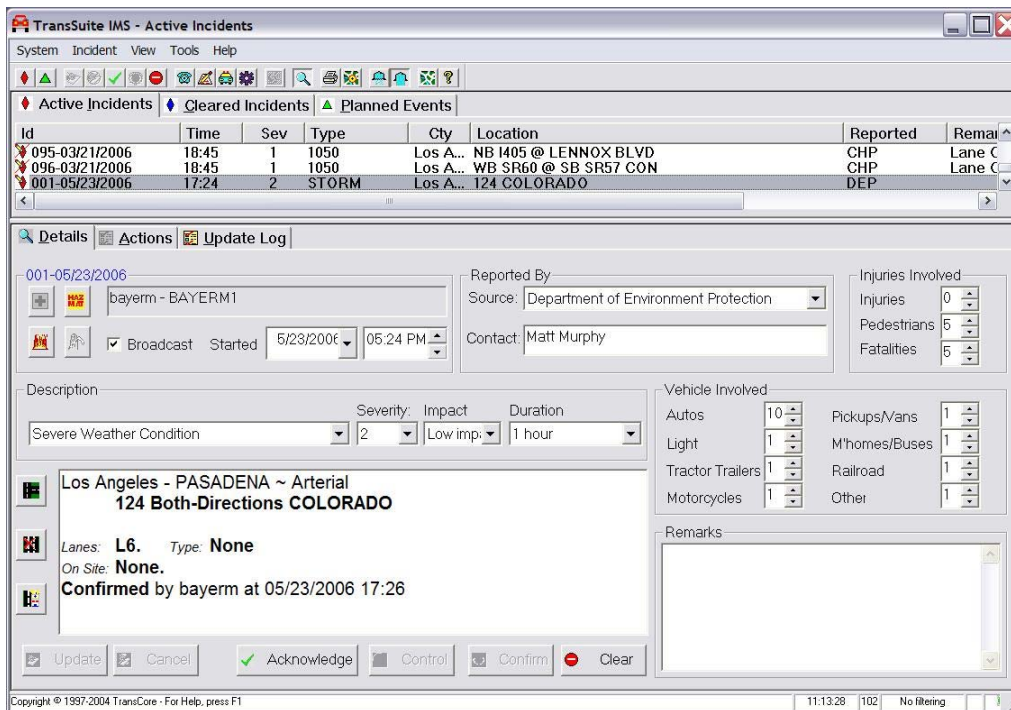
At the bottom of the window, there is a status bar with the following information: Copyright 2001-2009 County of Los Angeles. All Rights Reserved. | COORD - Active/Ack/Cleared | Filtering last 24 hours | 11 of 599 (total)

Traffic control system and coordination alarms are only made visible to operators that hold the view privilege for the generating device. Operator alarms are visible to all other operators. Authorized operators can acknowledge an alarm to indicate that action is being taken to investigate and correct the problem. Alarms are cleared when the alarm condition ends (automatically) or at operator direction (manually).

5.5 INCIDENT MANAGEMENT SYSTEM

The *TransSuite* Incident Management System, or IMS, enables users to view, respond to, and track the incidents and planned events that occur within their roadway network. IMS is a particularly powerful tool when used in multi-jurisdictional systems such as the IEN, allowing multiple agencies to collaborate and coordinate their response efforts.

Exhibit 5.5: *TransSuite* IMS



IMS automatically plots the geographical location of an event and accepts internal and external input. Operators can quickly navigate between event details in IMS and the event location in an ATMS Map display.

Operators can view and maintain detailed information for each incident and event such as the following:

- Operator communications
- Communications between agencies
- Arrivals and departures of on-site responders (e.g., police, fire, ambulance, etc.)

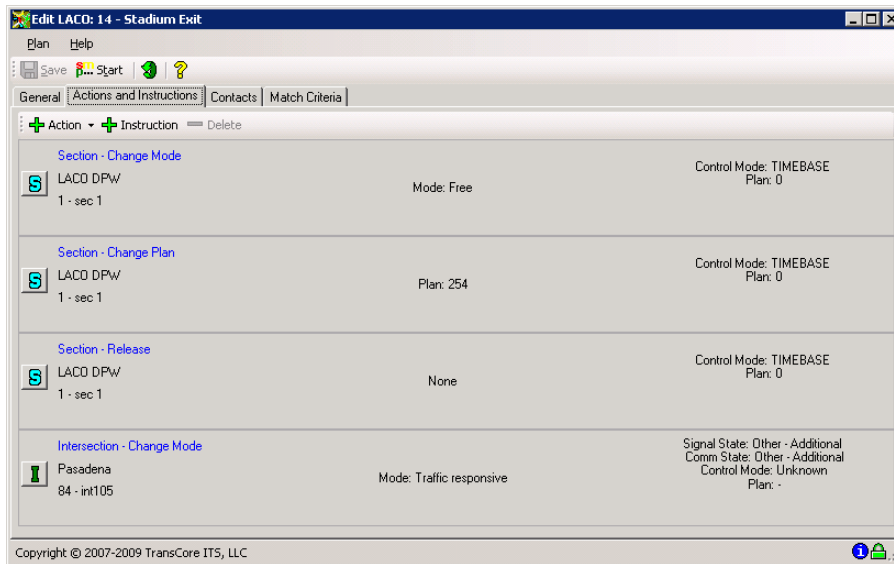
IMS maintains customizable contact information for participating agencies and officials. It also logs all actions and changes for each incident. Printed database reports are available to show various types of event metrics over user-selectable time periods.

IMS supports integrated scenario management. Authorized operators can activate pre-defined scenario plans in response to an event and link the plans to the events so they can be managed together.

5.6 SCENARIO MANAGER

The *TransSuite* Scenario Manager allows operators to define, monitor, and manage scenario plans, which are pre-packaged sets of device commands that are executed together. For example, a “Stadium Exit” scenario plan could include a set of commands that prioritize traffic flowing away from the stadium at the end of an event. IEN scenario plans may include devices from different jurisdictions.

Exhibit 5.6: Scenario Manager

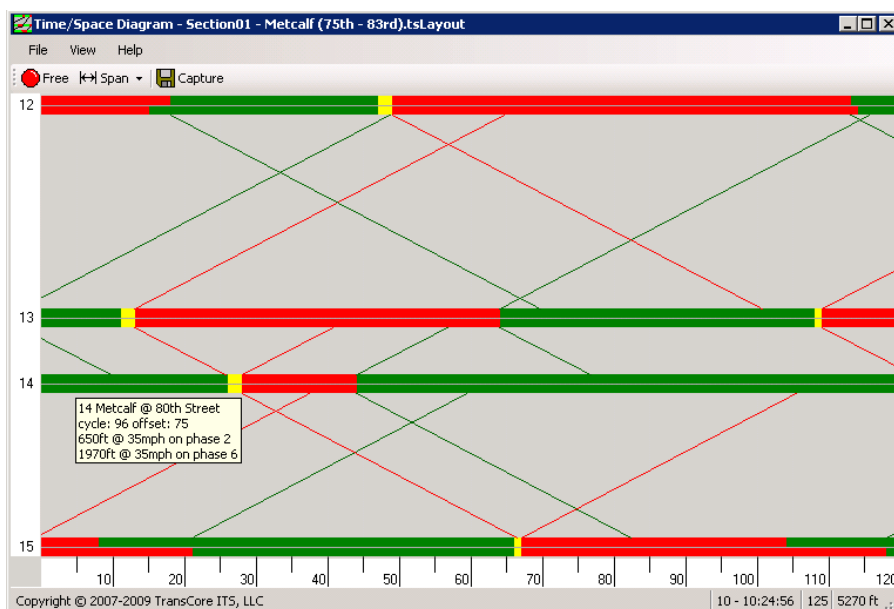


Operators are able to search the database for a plan that meets various criteria such as event type and location, and then activate the plan if they are authorized to do so. The Scenario Manager reports the status of the each action within a plan. Scenario plans will either timeout when their duration expires or they can be deactivated manually.

5.7 TIME/SPACE DIAGRAM

The *TransSuite* Time/Space Diagram application graphs the timing coordination data of a set of intersections along a roadway to simulate how well traffic is progressing from one intersection to the next. This data can be graphed in real-time as it streams in from traffic control systems or it can be captured and replayed at a later time. The Time/Space Diagram can also show how offset changes would affect traffic flow.

Exhibit 5.7: Time/Space Diagram



6. CONCEPT-OF-OPERATIONS

The Cities throughout LA County all manage their traffic signal systems differently. Generally, larger Agencies manage their traffic signal systems daily in a more hands-on manner, while smaller Agencies do not. Likewise, the IEN will be used differently by different Agencies.

Every participating Los Angeles County Agency will get an IEN workstation. In most cases, the IEN workstation will be installed in an Agency's Local City Control Site (LCCS). The location of the LCCS will vary by Agency. For large Agencies the LCCS may be an actual Traffic Management Center (TMC), whereas the LCCS is often the traffic engineer's office.

The IEN will be utilized in two distinct operational modes: locally and regionally. In local mode, the IEN Workstation is one means for an Agency to observe the operation of their traffic signal system (and potentially other ITS devices). There is also a limited control capacity via the local operational mode. In general, control of a traffic signal system and other devices will be done via a traffic control system operated by LA County (with authorization of the local Agency) or by the Agency itself.

The Regional operational mode is where the power and benefits of the IEN can be realized. When used in this mode, Agencies can monitor traffic signal operations and coordinate incident management activities with adjacent jurisdictions. In addition, effected Agencies can be notified in advance of planned events (road work, parades, etc.).

Some of the more common tasks that Agencies will perform while utilizing the IEN include:

- Monitor IEN workstation performance (e.g., workstation operating and presenting live data, etc.), contacting LA County if problems are noted.
- Ensure that the IEN is updated to reflect the real-world implementation.
- Check that field components (controllers, detectors, etc.) are communicating with the IEN and are functioning properly, taking corrective actions as needed.
- Monitor traffic operations as needed/desired using the IEN Workstation (if there is not a local TCS workstation).
- Notify other Agencies and/or LA County of any upcoming planned events that may affect them.
- Work with other Agencies to develop coordinated incident management plans and implement, as needed.

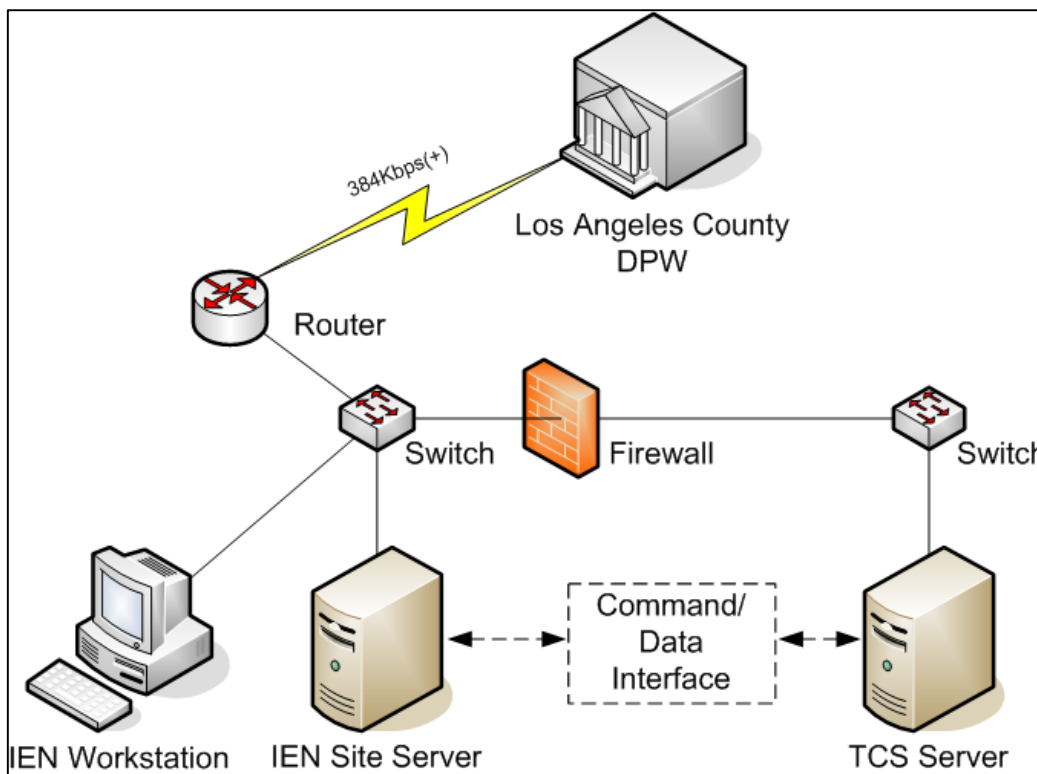
As stated previously, the level of effort that each Agency spends performing these tasks will vary and range anywhere from an hour or two per week for smaller Agencies that have LA County operating their traffic signal operations to one or more full-time staff for Agencies that operate a full traffic control system (where the IEN is a tool in their daily activities).

7. CONNECTION REQUIREMENTS

Agencies that connect to the IEN to share their traffic control data are called IEN Sites. Becoming an IEN Site involves establishing a network connection to the LACO TMC, installing IEN Site Server and Workstation software on systems located at the Agency, and procuring Command/Data Interface software to allow the IEN to communicate with the local Traffic Control System.

Exhibit 7.1 below depicts IEN Site components in a typical configuration:

Exhibit 7.1: Components of a Typical IEN Site



LA County will provide software installation instructions and assist Agencies to configure their IEN systems. With the exception of Microsoft Windows, the installation programs for all required software can be downloaded from the IEN Servers at the LACO TMC. LA County will also work with Agencies to configure the IEN to support their devices and users.

LA County has established a set of test procedures that Agencies can use to verify that their IEN systems are installed and configured correctly.

7.1 NETWORK CONNECTION

LA County will work with participating Agencies to establish network connections between their offices and the IEN servers located at the LACO TMC. This network link should have a Committed Information Rate (CIR) of 384Kbps or better. The following types of inter-Agency connections are currently in use by the IEN:

- Dedicated T1 lines
- Pre-existing Fibers that are used for multiple purposes

- Site-to-Site VPN connections over the Internet (Requires that Agencies have equipment that is compatible with LA County's Cisco ASA-class SSL VPN)
- Wireless connections to LA County's TCS field communications network
- Some Agencies are connected to LA County through connections to other Agencies

7.2 IEN WORKSTATION

Agencies will need to install one or more IEN Workstations at their site to allow local operators to access the IEN User Interfaces. Workstations must be dedicated to the IEN and joined to the IEN Domain. They need network connectivity to the local IEN Site Server and to the Regional, Database, and Utility Servers located at the LACO TMC.

7.2.1 Hardware Specifications

IEN Workstations have the following minimum hardware specifications (as of 3/28/12):

- Core 2 Duo 2.66GHz (1,066MHz bus) CPU
- 80 GB Hard Drive (SATA 7200RPM)
- 2 GB of RAM
- 256MB graphics card

7.2.2 Network Specifications

IEN Workstations require the following network connectivity (as of 3/28/12):

- 10Mbps or greater connection to the local IEN Site Server
- 384Kbps or greater connection to the IEN Regional Server
- 384Kbps or greater connection to the IEN Database Server
- 384Kbps or greater connection to the IEN utility servers

7.2.3 Software Specifications

IEN Workstations require the following software (as of 3/28/12):

- Microsoft Windows XP Pro or Windows 2003 Standard R2
- Oracle 10.2 Client (with patch set 10.2.0.4 or later)
- NTP client
- Microsoft .NET Framework 3.5 SP1
- Microsoft Visual C++ 2008 Redistributable
- Crystal Reports 2008 Runtime
- Crystal Reports 2008 Redistributable
- ESRI MapObjects 2 Runtime (Installed by IEN software installation program)
- Java SE Runtime Environment 6 Update 1 (Installed by IEN software installation program)
- Los Angeles County IEN

7.3 IEN SITE SERVER

Agencies will need to install an IEN Site Server at their locations to manage real-time status data and commands. Site Servers collect data from local traffic control systems and send that data to both local IEN Workstations and to the Regional Server, which then distributes it to other sites. Site Servers also collect data and commands from the Regional Server; distributing data to local workstations and commands to local traffic control systems.

Each Site Server can support multiple local IEN Workstations and traffic control systems. IEN Site Server and Workstation software can run on the same system/computer.

Site Servers must be dedicated to the IEN and joined to the IEN Domain. They need network connectivity to all local IEN Workstations and traffic control systems as well as the Regional, Database, and Utility Servers located at the LACO TMC.

7.3.1 Hardware Specifications

IEN Site Servers have the following minimum hardware specifications (as of 3/28/12):

- Core 2 Duo 2.66GHz (1,066MHz bus) CPU
- 80 GB Hard Drive (SATA 7200RPM)
- 4 GB of RAM
- 100/1000 Ethernet adapter

7.3.2 Network Specifications

IEN Site Servers require the following network connectivity (as of 3/28/12):

- 10Mbps or greater connection to the local traffic control system server
- 10Mbps or greater connection to local IEN Workstations
- 384Kbps or greater connection to the IEN Regional Server
- 384Kbps or greater connection to the IEN Database Server
- 384Kbps or greater connection to the IEN utility Servers

7.3.3 Software Specifications

IEN Site Servers require the following software (as of 3/28/12):

- Microsoft Windows XP Pro or Windows 2003 Standard R2
- Oracle 10.2 Client (with patch set 10.2.0.4 or later)
- Java SE Runtime Environment 6 Update 1 or later (Installed by IEN software installation program)
- Los Angeles County IEN

7.4 COMMAND/DATA INTERFACE

Agencies will need to develop or procure IEN command/data interface software for their particular type of traffic control system. CDIs allow IEN Site Servers to request data from, and issue commands to traffic control systems. Each CDI is designed to interface with a particular type of traffic control system. For example, the *TransSuite* TCS IEN CDI software in use at the Cities of Arcadia, Diamond Bar, and Alhambra can be used by any other Agency that has

TransCore's *TransSuite* TCS; however, it would not support other types of traffic control systems. Similarly, McCain has developed CDI software for their QuicNet Pro system that is in use in West Hollywood, Burbank, Glendale, Inglewood, Gardena, Pasadena, and Santa Clarita. In addition, Siemens has developed CDI software for their i2TMS system that is in use in Downey and Pasadena. Finally, Kimley-Horn has developed a limited CDI software for their KITS system that is in Beverly Hills.

IEN command/data interface specifications will be provided upon request [IEN CDI Recommendations Document (FINAL Revision 6, 2nd Submittal)].

7.5 MISCELLANEOUS NETWORKING COMPONENTS

Agencies will need various types of commercially available networking equipment, such as routers, switches, and cables, to interconnect the IEN Site components. Agencies are asked to isolate IEN components from local Agency networks through the use of firewalls and other secure network practices.

8. STANDARDS COMPLIANCE

Standards are designed to facilitate the integration of system components by providing a predefined and public (open) interface that vendors/developers can design and build their products around. Ideally, when standards are implemented by different developers (software or hardware), their products will work together seamlessly. Some simple but ubiquitous examples of standards in action are the 120V electrical plug, RJ-45 cable connector, and CD-ROM. It is just assumed that you can take one of these items to the appropriate device/receptacle and it will work.

The USDOT's Joint Program Office is supporting the development and maintenance of a number of transportation-related standards as part of the National Intelligent Transportation Systems Architecture framework. These standards are being developed by a number of organizations and are in a various stages of development and acceptance. Even so, use of standards can greatly assist in the decision-making process by reducing the ever-present question of component interoperability ("Will this new device from Vendor X work with that one from Vendor Y?").

An important goal of the Los Angeles County IEN system design is adherence to open industry standards. The following standards are used in the IEN:

8.1 COMPONENT MODEL

The IEN is designed using a component-based methodology. Each "component" is a software object that communicates with other components using a standard interface framework. In general, each component corresponds to an application program or a dynamic link library. The IEN's use of the CORBA (Common Object Request Broker Architecture) and COM (Component Object Model) component model standards is described below.

CORBA: Since one of the IEN's stated goals is to share real-time intersection data (Section 3), CORBA was selected since it is an open standard for implementing distributed object-oriented systems. For more information, visit www.omg.org. Most inter-process communications between IEN software components running on different machines is accomplished using CORBA-compliant interfaces. The standard CORBA Naming Service is used by components to locate other components on the network. The standard CORBA Event Service is used to distribute dynamic data updates throughout the IEN.

COM: Microsoft's Component Object Model (COM) is used by several workstation components that run under the Windows operating system. COM is used for communications between components running on the same workstation.

8.2 TCP/IP

All communications protocols used by the IEN are based upon the standard Transmission Control Protocol/Internet Protocol (TCP/IP) family of internetworking protocols. TCP/IP-based protocols used within the IEN include SNMP, SMTP, HTTP, and IIOP.

8.3 TMDD

Many IEN data elements are based upon elements defined in the standardized Traffic Management Data Dictionary (TMDD) jointly developed by ITE, FHWA, and AASHTO. The TMDD definitions do not map directly to any programming language, and are not intended for object-oriented programming. Therefore, its concepts have been adapted as appropriate for the

IEN system design. The following TMDD-derived conventions are used throughout the design of IEN data elements:

Most objects have a unique "identifier" attribute (text string of up to 32 alphanumeric characters) and a "name" attribute (text string of up to 128 alphanumeric characters). The "identifier" is used internally by the IEN system to keep track of objects, whereas the "name" is something meaningful to system operators.

Geographic coordinates are specified in micro-degrees of latitude and longitude.

Textual data elements have a maximum length specified that matches that of the corresponding TMDD element.

8.4 MS/ETMCC

As part of the TMDD standard, the TMDD committee has also published Message Sets for External Traffic Management Center Communications, the MS/ETMCC. This standard defines a messaging style that is inefficient for the IEN, in which messages exchanged between centers refer to only one type of data. There are independent requests and responses for intersection signal inventory and status, detector inventory and status, and section status. The IEN deals with more types of intersection signal data than those defined in the MS/ETMCC, so in pursuit of efficiency, the IEN requests all of the thirteen data types identified below in a single message, and receives updates for all thirteen data types in a single response.

Several data frames (data structures) contained by messages in the MS/ETMCC are analogous to data types distributed by the IEN and defined as IDL structures. The table below lists the IEN data structures used for data distribution and notes which of them have corresponding data frames defined in the MS/ETMCC.

IEN STRUCTURE	MS/ETMCC DATA FRAME
IntersectionInfo	IntersectionSignalInventory
IntersectionRTSummary	IntersectionSignalStatus
IntersectionRTStatus	None
PhaseStateData	None
PedestrianPhaseState	None
VehicleCallState	None
PhaseTimeDescription	None
LastCyclePhaseData	None
TpPhaseData	None
DetectorInfo	DetectorInventory
DetectorState	DetectorStatus
SectionInfo	None
SectionState	SectionStatus

8.5 SAE LRMS

Location-referencing data elements are based upon the message profiles specified in the Society of Automotive Engineers (SAE) Location Referencing Message Specification. The data elements have been adapted as necessary for use in a CORBA-based design.

8.6 DATABASE CONNECTIVITY

Several IEN components make use of a central relational database to store persistent data. All database access is performed using the industry-standard ODBC (Open Database Connectivity), OLE (Object Linking and Embedding) DB and JDBC (Java Database Connectivity) interface standards. Proprietary database protocols are not used by any applications.

9. GLOSSARY

TERM	DESCRIPTION
AASHTO	American Association of State Highway and Transportation Officials
ATSAC	Automated Traffic Surveillance and Control, LADOT's Traffic Control System
ATMS	Advanced Transportation Management System
CDI	Command/Data Interface
CORBA	Common Object Request Broker Architecture
COTS	Commercial-Off-The-Shelf (Software)
DNS	Domain Name Service
DPW	Department of Public Works
FHWA	Federal Highway Administration
HTTP	Hyper-Text Transfer Protocol
IDL	Interface Definition Language
IEN	Information Exchange Network
IIOP	Internet Inter-ORB Protocol
IMS	Incident Management System
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation Systems
JDBC	Java Database Connectivity
MS/ETMCC	Message Sets for External Traffic Management Center Communication
NTCIP	National Transportation Communications for ITS Protocol
ODBC	Open Database Connectivity
OLE	Object Linking and Embedding
PeMS	PeMS (Performance Measurement System)
RIITS	Regional Integration of Intelligent Transportation Systems
SAE	Society of Automotive Engineers
SNMP	Simple Network Management Protocol
SSL	Secure Sockets Layer
TCP/IP	Transmission Control Protocol/Internet Protocol
TCS	Traffic Control System
TMDD	Traffic Management Data Dictionary
VPN	Virtual Private Network
XML	Extensible Markup Language