

*Technical Memorandum*

SOUTHERN CALIFORNIA REGIONAL ITS ARCHITECTURE  
2011 UPDATE

**Positive Train Control Regional ITS Architecture Elements**

*Prepared for:*



*Prepared by:*



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**TABLE OF CONTENTS**  
SOUTHERN CALIFORNIA REGIONAL ITS ARCHITECTURE – 2011 UPDATE  
POSITIVE TRAIN CONTROL REGIONAL ITS ARCHITECTURE ELEMENTS

|   |           |
|---|-----------|
| <b>1. Introduction .....</b>            | <b>1</b>  |
| 1.1 Background and Purpose .....        | 1         |
| 1.2 Regional System .....               | 2         |
| <b>2. Stakeholders .....</b>            | <b>3</b>  |
| 2.1 Regional Stakeholders .....         | 3         |
| 2.1 Needs .....                         | 4         |
| <b>3. ITS Inventory .....</b>           | <b>5</b>  |
| 3.1 ITS Elements .....                  | 5         |
| 3.2 Market Packages .....               | 5         |
| 3.3 Project Sequencing .....            | 8         |
| <b>4. Additional ITS Elements .....</b> | <b>15</b> |
| 4.1 Operational Concepts .....          | 15        |
| 4.2 ITS Standards .....                 | 15        |
| 4.3 Functional Requirements .....       | 16        |
| 4.4 Interfaces .....                    | 17        |

**TABLE OF CONTENTS**  
SOUTHERN CALIFORNIA REGIONAL ITS ARCHITECTURE – 2011 UPDATE  
POSITIVE TRAIN CONTROL REGIONAL ITS ARCHITECTURE ELEMENTS

**List of Tables**

|  |    |
|--|----|
| Table 1 – Stakeholder Roles and Responsibilities ..... | 3  |
| Table 2 – ITS Elements .....                           | 5  |
| Table 3 – Project Sequencing Update for PTC .....      | 9  |
| Table 4 – Applicable ITS Standards for PTC.....        | 16 |

**List of Figures**

|  |    |
|--|----|
| Figure 1 – Typical PTC System Illustration .....   | 2  |
| Figure 2 – Advanced Railroad Crossing, Local Jurisdictions.....                          | 18 |
| Figure 3 – Railroad Operations Coordination, Arterial Systems .....                      | 19 |
| Figure 4 – Railroad Operations Coordination, Rail Operators .....                        | 20 |
| Figure 5 – ITS Data Warehouse, SCAG ERTMIS.....  | 21 |
| Figure 6 – Vehicle Maintenance .....   | 22 |
| Figure 7 – Transit Traveler Information, SCRRRA.....                                     | 23 |
| Figure 8 – Transit Vehicle Tracking, PTC .....   | 24 |
| Figure 9 – Network Surveillance, Rail Grade Crossing Security .....                      | 25 |
| Figure 10 – Transportation Infrastructure Protection, Rail Grade Crossing Security ..... | 26 |
| Figure 11 – Transit Security, SCRRRA .....   | 27 |
| Figure 12 – Work Zone Safety Management System.....                                      | 28 |

## 1. INTRODUCTION

The Southern California Regional ITS Architecture leverages long standing investments in Intelligent Transportation Systems (ITS) by fostering coordination and cooperation among public agency stakeholders. A Regional ITS Architecture provides a framework for ITS planning that promotes interoperability and communication across jurisdictional boundaries. Projects developed under a regional framework extend the usefulness of any single project by making information easily accessible for operators and users of the system.

In Southern California, there are several ITS architectures that may be applicable to an ITS project, depending on how far reaching the project is. Each County has developed a Regional ITS Architecture. In addition, as the Metropolitan Planning Organization (MPO), SCAG has developed a Southern California Regional ITS Architecture that addresses multi-county issues: those projects, programs, and services that require connectivity across county boundaries or are deployed at a multi-county level. A third “layer” is also in place at the state level: the California ITS Architecture and System Plan addresses those services that are rolled out or managed at a state level or are interregional in nature. Project sponsors are responsible for ensuring that their projects maintain consistency with the regional architectures, regardless of which architecture applies, as a requirement for federally funded projects.

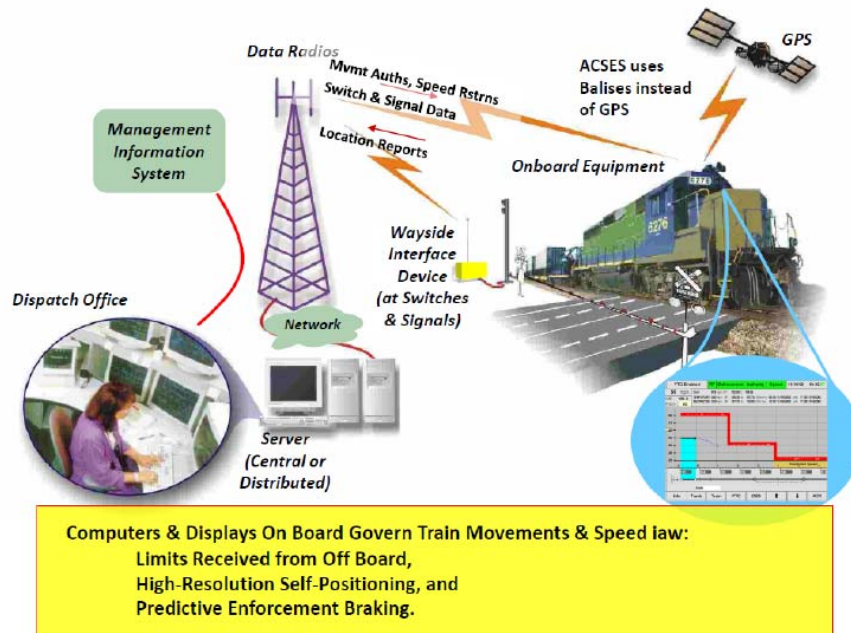
In the time between 2005, when the Southern California Regional ITS Architecture was developed, and 2011, as it is being updated, there have been several changes. The National ITS Architecture has been updated to reflect new user services, Southern California has continued as a national leader in ITS deployment with extensive ITS investments, and new technology applications have emerged. The 2011 update to the Southern California Regional ITS Architecture will reflect changes since 2005 and position the architecture to guide future ITS deployments as new technologies emerge. Topics covered in this 2011 update include express lanes, Positive Train Control, technologies in support of non-motorized transport, and goods movement in addition to the updates for other cross-county services such as to address traveler information, regional data exchange and archiving of regional data. Additionally, recommendations are made to subregional (county-level) ITS Architecture champions for their consideration in the event that changes are desired to be made at the county level for the associated topic.

### 1.1 Background and Purpose

The Southern California Regional Railroad Agency (SCRRA), that operates the Metrolink regional commuter rail, plans to implement a positive train control (PTC) system by 2012, ahead of the deadline set for the end of 2015. Implementation of the PTC system is required by the Rail Safety Improvement Act (RSIA) of 2008. The RSIA requires all Class I railroads, intercity passenger and commuter railroads to implement a PTC system on all main-line tracks where intercity passenger railroads and commuter railroads operate and where toxic-by-inhalation hazardous materials are transported.

The five county members of the SCRRA are jointly funding the development of an interoperable PTC system to improve safety for freight and commuter railroads in the region. PTC is designed to prevent train collisions using GPS tracking to remotely monitor train movements. In a typical PTC system, onboard equipment on the train uses GPS satellites to transmit speed and location data over wireless or hard line communications links to an operations center. A back office system at the operations center analyzes the data using software that determine the likelihood of a collision or derailment. An advance alert is sent by the dispatch center to the locomotive and brakes are automatically engaged if the warnings are not acted on by the train engineer. Federal regulations do not prescribe the type of technology a PTC system uses as long as it can accomplish the functions of preventing: train-to-train collisions, derailment from over speeding, incursions into designated work zone areas and train movements caused by switches left in the wrong position.

Figure 1 illustrates the typical components and functions in a PTC system.



Source: PTC presentation by Alan Polivka TTCL, March 2010, Progressive Railroading Webinar.

**Figure 1 – Typical PTC System Illustration**

The purpose of this Technical Memorandum is to update the Southern California Regional ITS Architecture to include existing and planned elements related to positive train control. This report serves as the positive train control module to the Southern California Regional ITS Architecture.

## 1.2 Regional System

SCRRA is a joint powers authority (JPA) created in 1991 to operate the Metrolink commuter rail system in Southern California. The SCRRA Board is comprised of voting members from the Los Angeles Metropolitan Authority (LA METRO), Orange County Transportation Authority (OCTA), Riverside County Transportation Commission (RCTC), San Bernardino Associated Governments (SANBAG) and Ventura County Transportation Commission (VCTC). Metrolink service operates on railroad tracks throughout the five county region, including portions of the North County Transportation District (NCTD) in San Diego County. Metrolink trains have shared use of tracks owned and maintained by UP, BNSF and NCTD. The result is a high volume of passenger and freight train activity with Metrolink and Amtrak service sharing tracks with BNSF and UP trains. The density of passenger and freight trains operating in the SCAG region call attention to the challenges in implementing a coordinated and interoperable PTC system.

## 2. STAKEHOLDERS

### 2.1 Regional Stakeholders

PTC systems are being developed by SCRRA, BNSF and UP. Additional stakeholders include Amtrak and NCTD, as well as the railroad industry group that is coordinating the development of interoperable PTC standards. To accommodate data exchanges and enable seamless PTC operations, the following stakeholders are included:

- Interoperable Train Control Committee (ITC): Coordinating group comprised of the Class I railroads involved in the development of interoperable standards and specifications for PTC.
- SCRRA: Operates the Metrolink regional commuter rail
- BNSF and Union Pacific (UP): Class I railroads operating in the SCAG region
- NCTD: Operates commuter rail service in North San Diego County; Metrolink is a tenant on a portion of NCTD tracks.
- Amtrak: Operates commuter and intercity rail service as a tenant on regional railways.

**Table 1** provides a summary of the stakeholders involved in the development and future operation of PTC on the regional railway network and their roles and responsibilities.

**Table 1 – Stakeholder Roles and Responsibilities**

| Description | Roles/Responsibilities as Related to Regional PTC  |
|-------------|--|
| ITC         | <ul style="list-style-type: none"> <li>▪ Publishes technical standards and specifications that promote interoperability for PTC systems</li> <li>▪ Defining the Advanced Message Queuing Protocol (AMQP) for interoperable communications</li> <li>▪ ITC Rung 1 functionalities are the requirements that SCRRA is targeting for the Metrolink PTC system</li> </ul>   |
| SCRRA       | <ul style="list-style-type: none"> <li>▪ Acts as host to UP and BNSF trains operating in SCRRA track territory</li> <li>▪ Acts as tenant in NCTD, BNSF and UP track territory</li> </ul>   |
| BNSF/UP     | <ul style="list-style-type: none"> <li>▪ Acts as host to Metrolink and Amtrak trains operating in BNSF/UP track territory</li> <li>▪ Acts as tenant in SCRRA track territory</li> <li>▪ Promoting V-ETMS as the PTC technology in Southern California on which Metrolink will be based on</li> <li>▪ Coordinate train dispatch and center-to-center communications with other railroad operators</li> <li>▪ Participates in the ITC</li> </ul> |
| NCTD        | <ul style="list-style-type: none"> <li>▪ Acts as host for Metrolink, BNSF and Amtrak trains operating in NCTD track territory in San Diego County</li> <li>▪ Coordinate train dispatch and center-to-center communications with other railroad operators</li> </ul>  |
| Amtrak      | <ul style="list-style-type: none"> <li>▪ Acts as tenants operating in SCRRA and NCTD track territory</li> </ul>  |

## 2.1 Needs

The PTC system in Southern California addresses long standing safety issues stemming from the numerous freight and passenger trains operating on the regional railway network. The functionalities supported in the Southern California PTC system will fulfill core safety and interoperability requirements mandated by the 2008 RSIA legislation.

In addition, SCRRRA has the long term goal of utilizing the PTC system as a foundation for closer integration with regional ITS applications. The 2005 Regional ITS Architecture describes future projects for advanced railroad crossing systems and rail network surveillance. Regional ITS projects will be supported by the ability of PTC systems to track train movements and coordinate train control operations. The projects enabled by PTC can serve regional needs for advanced traveler information services, at-grade traffic management and the security of freight rail operations.

### 3. ITS INVENTORY

This section describes the ITS projects for PTC, their associated Market Packages, and approximate timing.

#### 3.1 ITS Elements

The ITS Inventory includes planned PTC systems and describes the ITS elements for PTC components. Metrolink will implement a Rung 1, ITC compliant PTC system that is based on the Vital Electronic Train Management System (V-ETMS) that BNSF and CSX have outlined in their development plans. The V-ETMS is an overlay variant of PTC, meaning that the communications infrastructure will operate over the existing wayside safety system. The elements in **Table 2** describe the core components of the PTC systems that will be deployed in Southern California:

**Table 2 – ITS Elements**

| Element Name                                | Description  |
|---|--|
| Wayside Signal System                       | PTC system overlay will use the existing wayside signal system to obtain data on the status of signals, switches, locking and track occupancy. Wayside devices will communicate with the back office and locomotives over a wireless communications network operating at the 220 MHz spectrum.   |
| On-board PTC Component                      | The on-board equipment package includes a display unit, computer processor, GPS receivers and radios to interface with other PTC components. The computer will determine movement authorities and speed and track restrictions based on information obtained from the back office and the wayside signal system.   |
| Back Office System                          | The back office system stores track geometry, speed restrictions and signaling configurations in a database. The back office communicates movement authorities and track restrictions to all trains in its operating territory. The back office system serves as the communications interface with other back office systems operated in other railroad territories. |
| Work Zone Safety Management System          | Communications from the field to the back office seeking work authority using remote access. Work zone enforcement limits are communicated from the back office to the locomotives to prevent trains from entering or exceeding speed limits in restricted areas.  |
| Train Control and Operations Center         | Houses the back office systems. Staffed to provide computer aided dispatching (CAD) functions. Coordinate response activities and communication exchanges with other train operations centers.   |
| Advanced Traveler Information System (ATIS) | Provides real-time train location and predicted arrival information directly to train passengers. Data can be shared with other users to enhance inter-agency coordination, emergency response and traffic management strategies.  |

#### 3.2 Market Packages

User services and market packages, standard terms defined by the National ITS Architecture, are intended to be comprehensive lists of the potential ITS applications or solutions to transportation problems. Each user service or market package is generic in nature (for example the user service “Pre-trip Travel Information” is a generic description of a traveler information service provided to travelers prior to their trips such as web-based applications). They are intended to be used as a starting point for ITS planning to ensure that all potential solutions are considered. In some regional ITS architecture developments, stakeholders develop solutions that are not addressed by the available lists of user services and market packages, in which case a custom definition would be



developed; this is the case with positive train control, though the national architecture team is currently working on an update to the National ITS Architecture that would add this.

A number of user services or market packages that pertain to PTC are defined in the National ITS Architecture and address some functionalities and services related to PTC. Some of these market packages are included in the Regional and Subregional ITS architectures, but focused on goods movement. Other user services will be identified as the National Architecture is updated by adding PTC services to existing ITS market packages or creating new ITS market packages specific to PTC.

**AD2- ITS Data Warehouse** - This market package includes all the data collection and management capabilities provided by the ITS Data Mart, and adds the functionality and interface definitions that allow collection of data from multiple agencies and data sources spanning across modal and jurisdictional boundaries. It performs the additional transformations and provides the additional meta data management features that are necessary so that all this data can be managed in a single repository with consistent formats. The potential for large volumes of varied data suggests additional on-line analysis and data mining features that are also included in this market package in addition to the basic query and reporting user access features offered by the ITS Data Mart.

**ATMS01–Network Surveillance-** This market package includes traffic detectors, other surveillance equipment, the supporting field equipment, and fixed-point to fixed-point communications to transmit the collected data back to the Traffic Management Subsystem. The derived data can be used locally such as when traffic detectors are connected directly to a signal control system or remotely (e.g., when a CCTV system sends data back to the Traffic Management Subsystem). The data generated by this market package enables traffic managers to monitor traffic and road conditions, identify and verify incidents, detect faults in indicator operations, and collect census data for traffic strategy development and long range planning. The collected data can also be analyzed and made available to users and the Information Service Provider Subsystem. In this task consideration of rail grade crossing security are contained in the market package.

**ATMS13–Standard Railroad Grade Crossing:** This market package manages highway traffic at highway-rail intersections (HRIs) where operational requirements do not dictate more advanced features (e.g., where rail operational speeds are less than 80 miles per hour). Both passive (e.g., the crossbuck sign) and active warning systems (e.g., flashing lights and gates) are supported. (Note that passive systems exercise only the single interface between the roadway subsystem and the driver in the architecture definition.) These traditional HRI warning systems may also be augmented with other standard traffic management devices. The warning systems are activated on notification by interfaced wayside equipment of approaching trains. The equipment at the HRI may also be interconnected with adjacent signalized intersections so that local control can be adapted to highway-rail intersection activities. Health monitoring of the HRI equipment and interfaces is performed; detected abnormalities are reported to both highway and railroad officials through wayside interfaces and interfaces to the traffic management subsystem.

**ATMS14–Advanced Railroad Grade Crossing:** This market package manages highway traffic at highway-rail intersections (HRIs) where operational requirements demand advanced features (e.g., where rail operational speeds are greater than 80 miles per hour). This market package includes all capabilities from the Standard Railroad Grade Crossing Market Package and augments these with additional safety features to mitigate the risks associated with higher rail speeds. The active warning systems supported by this market package include positive barrier systems that preclude entrance into the intersection when the barriers are activated. Like the Standard Package, the HRI equipment is activated on notification by wayside interface equipment which detects, or communicates with the approaching train. In this market package, the wayside equipment provides

additional information about the arriving train so that the train's direction of travel, estimated time of arrival, and estimated duration of closure may be derived. This enhanced information may be conveyed to the driver prior to, or in parallel with, warning system activation. This market package also includes additional detection capabilities that enable it to detect an entrapped or otherwise immobilized vehicle within the HRI and provide an immediate notification to highway and railroad officials.

**ATMS15–Railroad Operations Coordination:** This market package provides an additional level of strategic coordination between freight rail operations and traffic management centers. Rail operations coordination provides train schedules, maintenance schedules, and any other forecast events that will result in highway-rail intersection (HRI) closures. This information is used to develop forecast HRI closure times and durations that may be used in advanced traffic control strategies or to enhance the quality of traveler information.

**MC09–Work Zone Safety Monitoring:** This market package includes systems that improve work crew safety and reduce collisions between the motoring public and maintenance and construction vehicles. This market package detects vehicle intrusions in work zones and warns crew workers and drivers of imminent encroachment or other potential safety hazards. Crew movements are also monitored so that the crew can be warned of movement beyond the designated safe zone. The market package supports both stationary and mobile work zones. The intrusion detection and alarm systems may be collocated or distributed, allowing systems that detect safety issues far upstream from a work zone (e.g., detection of over dimension vehicles before they enter the work zone).

**APTS01- Transit Vehicle Tracking** - This market package monitors current transit vehicle location using an Automated Vehicle Location System. The location data may be used to determine real time schedule adherence and update the transit system's schedule in real-time. Vehicle position may be determined either by the vehicle (e.g., through GPS) and relayed to the infrastructure or may be determined directly by the communications infrastructure. A two-way wireless communication link with the Transit Management Subsystem is used for relaying vehicle position and control measures. Fixed route transit systems may also employ beacons along the route to enable position determination and facilitate communications with each vehicle at fixed intervals. The Transit Management Subsystem processes this information, updates the transit schedule and makes real-time schedule information available to the Information Service Provider.

**APTS05- Transit Security** - This market package provides for the physical security of transit passengers and transit vehicle operators. On-board equipment is deployed to perform surveillance and sensor monitoring in order to warn of potentially hazardous situations. The surveillance equipment includes video (e.g., CCTV cameras), audio systems and/or event recorder systems. The sensor equipment includes threat sensors (e.g., chemical agent, toxic industrial chemical, biological, explosives, and radiological sensors) and object detection sensors (e.g., metal detectors). Transit user or transit vehicle operator activated alarms are provided on-board. Public areas (e.g., transit stops, park and ride lots, stations) are also monitored with similar surveillance and sensor equipment and provided with transit user activated alarms. In addition this market package provides surveillance and sensor monitoring of non-public areas of transit facilities (e.g., transit yards) and transit infrastructure such as bridges, tunnels, and transit railways or bus rapid transit (BRT) guideways. The surveillance equipment includes video and/or audio systems. The sensor equipment includes threat sensors and object detection sensors as described above as well as, intrusion or motion detection sensors and infrastructure integrity monitoring (e.g., rail track continuity checking or bridge structural integrity monitoring). The surveillance and sensor information is transmitted to the Emergency Management Subsystem, as are transit user activated alarms in public secure areas. On-board alarms, activated by transit users or transit vehicle

operators are transmitted to both the Emergency Management Subsystem and the Transit Management Subsystem, indicating two possible approaches to implementing this market package.

**APTS06- Transit Fleet Maintenance** - This market package supports automatic transit maintenance scheduling and monitoring. On-board condition sensors monitor system status and transmit critical status information to the Transit Management Subsystem. Hardware and software in the Transit Management Subsystem processes this data and schedules preventative and corrective maintenance. The market package also supports the day to day management of the transit fleet inventory, including the assignment of specific transit vehicles to blocks.

**EM05 – Transportation Infrastructure Protection** - This market package includes the monitoring of transportation infrastructure (e.g., bridges, tunnels and management centers) for potential threats using sensors and surveillance equipment and barrier and safeguard systems to control access, preclude an incident, and mitigate the impact of an incident if it occurs. Threats can result from acts of nature (e.g., hurricanes, earthquakes), terrorist attacks or other incidents causing damage to the infrastructure (e.g., stray barge hitting a bridge support). Infrastructure may be monitored with acoustic, environmental threat (such as nuclear, biological, chemical, and explosives), infrastructure condition and integrity, motion and object sensors and video and audio surveillance equipment. Data from such sensors and surveillance equipment may be processed in the field or sent to a center for processing. The data enables operators at the center to detect and verify threats. When a threat is detected, agencies are notified. Detected threats or advisories received from other agencies result in an increased level of system preparedness. In response to threats, barrier and safeguard systems may be activated by Traffic Management Subsystems to deter an incident, control access to an area or mitigate the impact of an incident. Barrier systems include gates, barriers and other automated and remotely controlled systems that manage entry to transportation infrastructure. Safeguard systems include blast shields, exhaust systems and other automated and remotely controlled systems that mitigate impact of an incident.

### 3.3 Project Sequencing

The projects to support the implementation of PTC are well underway, with SCRRA coordinating with Amtrak, UP and BNSF to develop an interoperable PTC system by 2012. The projects listed in **Table 3** were identified in the 2005 and 2008 updates to the Southern California Regional ITS Architecture and are related to regional rail operations. Comments are included in the project description to describe the relationship to PTC. Some of the projects may need to be updated to reflect the technology and infrastructure being deployed for the regional PTC system.

**Table 3 – Project Sequencing Update for PTC**

| Project Number | Project Title                         | Market Package(s)                         | Stakeholders      | Description  | Timing |
|----------------|---------------------------------------|---|-------------------|--|--------|
| 2004-AP-3      | Data Archive                          | AD2: ITS Data Warehouse                   | Regional Partners | <p>Provide for a regional archiving capability for long term planning.</p> <p><u>Relationship to PTC:</u><br/>This project would include the track geometries and speed restriction profiles maintained by the PTC back office systems.</p>  | S/M    |
| 2004-AP-4      | Data Dictionary                       | Standards Development                     | Regional Partners | <p>Develop and maintain a data dictionary for the region. The resulting output of the data dictionary will be standards that the region could use to promote consistency of data exchange. No market package is currently available now to describe this project. It might lead to the development of a new market package in Archived Data Management System.</p> <p><u>Relationship to PTC:</u><br/>This project may include interoperability standards to support communications messaging between different PTC systems.</p> | M/L    |
| 2004-AP-8      | Upgraded Passenger Information system | APTS8: Transit Traveler Information       | SCRRRA            | <p>Includes future capital projects entailing the following:</p> <ul style="list-style-type: none"> <li>Electronic passenger information system</li> </ul> <p><u>Relationship to PTC:</u><br/>This project would use real-time train location data to provide predictive train arrival information. The information could be distributed to the public through regional traveler information services such as Go511 and Inland Empire 511.</p>   | M      |
| 2004-AP-9      | Rail Sealed Corridor                  | ATMS 14: Advanced Railroad Grade Crossing | SCRRRA            | <p>Various alternatives will be studied including quad gates for the best line protection to prevent drivers from penetrating the line as trains approach and enhance safety. The first priority locations are the Antelope Valley</p>   | S      |

| Project Number | Project Title             | Market Package(s)                         | Stakeholders | Description   | Timing |
|----------------|---------------------------|---|--------------|---|--------|
|                |                           |   |              | <p>Line and Ventura County Line. These segments are also within the California High Speed Rail Corridor.</p> <p><u>Relationship to PTC:</u><br/>This project would be supported by PTC devices that monitor at-grade crossing safety. Events could trigger alerts that are communicated to the train operator by the computer aided dispatch (CAD) system or wayside signaling system. Onboard computers on the locomotives could apply brakes automatically if alerts or warnings are not acted on.</p>  |        |
| 2004-AP-10     | Quad Gate Synchronization | ATMS 14: Advanced Railroad Grade Crossing | SCRRRA       | <p>Investigate alternate means of clearing the crossing by detecting vehicles that are still in the crossing as the first barrier is lowered and synchronize actions with traffic signal systems in the vicinity.</p> <p><u>Relationship to PTC:</u><br/>This project would be supported by PTC devices that monitor at-grade crossing safety. Events could trigger alerts that are communicated to the train operator by the computer aided dispatch (CAD) system or wayside signaling system. Onboard computers on the locomotives could apply brakes automatically if alerts or warnings are not acted on.</p> | S      |
| 2004-AP-11     | Rail Fiber Communication  | ATMS 15: Railroad Operations Coordination | SCRRRA       | <p>A fiber communication backbone is gradually being installed throughout the system to enable both voice and data transmission linking to central dispatch in Pomona.</p> <p><u>Relationship to PTC:</u><br/>This project would support the additional PTC communication systems and networks.</p>   | S/M    |
| 2004-AP-13     | GPS Train Location System | APTS1- Transit Vehicle Tracking           | SCRRRA       | <p>Project is underway and will be on-going for some time. The completion of the fiber communication is of importance. Human interpretation of information remains of importance in understanding train delays</p>  | S      |

| Project Number | Project Title   | Market Package(s)                   | Stakeholders      | Description   | Timing |
|----------------|---|-------------------------------------|-------------------|---|--------|
|                |   |                                     |                   | before posting of information. There is no fully automated on-time performance system.<br><br><u>Relationship to PTC:</u><br>This project would be supported by the deployment of onboard PTC equipment.  |        |
| 2004-AP-14     | Rail Information Dissemination                          | APTS8: Transit Traveler Information | SCRRRA            | Future real-time information projects including PDAs, e-mail and pagers, displays in trains. The current website has only static displays.<br><br><u>Relationship to PTC:</u><br>This project could be supported by data collected on real-time train movements.  | L      |
| 2004-AP-18     | Rail Automated Maintenance Support                      | APTS 6: Transit Maintenance         | SCRRRA            | Long-term goal as funding becomes available.<br><br><u>Relationship to PTC:</u><br>This project would be supported by the restriction of train movements in work zone areas.  | L      |
| 2004-AP-20     | Emergency Management / Security Region Wide Integration | To be determined                    | Regional Partners | A study under planning to examine the components of integration including concept of operation, roles and responsibilities, functional requirements. To arrive at a regional architecture for the topic plus the identification of the projects.<br><br><u>Relationship to PTC:</u><br>This project would be supported by PTC interoperability.         | L      |
| 2004-AP-21     | Regional Traveler Information                           | APTS8: Transit Traveler Information | Regional Partners | A general project category that covers potential multi-agency initiatives to increase integrated dissemination of traveler information as widely as possible throughout the Southern California Region.<br><br><u>Relationship to PTC:</u><br>This project would integrate real-time train location and predictive train arrival data obtained from PTC | S/M    |

| Project Number | Project Title                                    | Market Package(s)   | Stakeholders  | Description  | Timing |
|----------------|--|---|---|--|--------|
|                |  |   |   | components.  |        |
| 2008 SAP-7     | Traffic Management Center and EMC Communications | <p>ATMS07 – Regional Traffic Management</p> <p>APTS07 – Multi-modal Coordination</p> <p>ATMS03 – Surface Street Control</p> <p>ATMS04 – Freeway Control</p> <p>EM09 – Evacuation and Reentry Management</p> | Caltrans, MPO's, EMC's, Law Enforcement, Local Agencies, Transit Agencies | <p>This project will utilize ITS to develop new and improve existing communication systems between traffic management centers (TMC's) and between TMC's and EMC's through:</p> <ul style="list-style-type: none"> <li>Improving information exchange between all SCAG region Caltrans Districts</li> <li>Improving information exchange between all SCAG region Caltrans Districts and other local agencies</li> <li>Improving communications between Sherriff, CHP, Caltrans, Emergency Operations Centers, and local agencies during emergency events</li> <li>Improving information exchange between and among transit agencies</li> <li>Sharing of traffic information and control among traffic management centers to support a regional control strategy, adding the communication links and integrated control strategies that enable integrated inter-jurisdictional traffic control</li> </ul> <p><u>Relationship to PTC:</u><br/>This project would include PTC data shared by railroad operation centers.</p> | M/L    |
| 2008 SAP-9     | Regional Rail Grade Crossing Security            | <p>ATMS01 – Network Surveillance</p> <p>ATMS14 – Advanced Railroad Grade Crossing</p> <p>ATMS15 – Railroad Operations Coordination</p>  | UP, BNSF, SCRRRA, Amtrak  | <p>Improve rail grade crossing security and response to emergency events by:</p> <ul style="list-style-type: none"> <li>Using sensors and surveillance to monitor at-grade rail crossings</li> <li>Improving highway-railroad intersections with train detectors, advance warning systems and link train detectors to traffic signal system and EMS dispatch</li> <li>Utilizing ITS elements to direct vehicles to alternate routes at and in advance of blocked at-grade rail</li> </ul>  | M      |

| Project Number | Project Title                    | Market Package(s)   | Stakeholders                    | Description   | Timing |
|----------------|----------------------------------|---|---------------------------------|---|--------|
|                |                                  |   |                                 | <p>crossings on major arterials during train events (HAZMAT, derailment, train-vehicle collision)</p> <ul style="list-style-type: none"> <li>Providing the ability to view and control CCTV through a Windows based system that is compatible with Intelligent Roadway / Rail Interface System (IR/RIS) program and sub-regional ATMS and ATIS.</li> </ul> <p><u>Relationship to PTC:</u><br/>This project would be supported by PTC monitoring of at-grade crossing safety. Regional emergency response could be coordinated by exchanging data between the rail operations centers and regional TMCs.</p> |        |
| 2008 SAP-13    | Regional Integrated GIS Database | AD2 – ITS Data Warehouse  | SCAG                            | <p>SCAG shall offer a regional repository of GIS data for use by local agencies in emergency planning, and response, in a standardized format.</p> <p><u>Relationship to PTC:</u><br/>This project would include track geometries, location of wayside elements and other spatial data maintained by the PTC back office systems.</p>   | M/L    |
| 2008 SAP-15    | Rail Infrastructure Security     | <p>EM05 – Transportation Infrastructure Protection</p> <p>APTS05 – Transit Security</p> | UP, BNSF, SCRRRA, Amtrak, EMC’s | <p>Install ITS devices including communication backbone to monitor and secure trains, rail cars, fixed assets (tracks, wayside equipment), highway-rail intersections and personnel with interfaces to traffic and emergency management centers.</p> <p><u>Relationship to PTC:</u><br/>This project would access data collected from various onboard and wayside PTC devices. Data shared using communication interfaces between the railroad operations centers and regional TMCs.</p>  | S      |
| 2008 SAP-20    | Rail Location and Notification   | ATMS15 – Railroad Operations Coordination   | UP, BNSF, EMC’s,                | <p>Provide the ability for rail operators (UP, BNSF) to notify public agencies in SCAG region of manifest data within 24hrs of receiving the data to allow first responders to</p>  | S/M    |



| Project Number | Project Title | Market Package(s) | Stakeholders         | Description  | Timing |
|----------------|---------------|-------------------|----------------------|--|--------|
|                |               |                   | Emergency Responders | <p>properly respond in an emergency event. Implement necessary ITS elements to share train location and ID data with public agencies.</p> <p><u>Relationship to PTC:</u><br/>This project would be supported by real-time train location data gathered by PTC devices.</p> |        |

## 4. ADDITIONAL ITS ELEMENTS

### 4.1 Operational Concepts

The operational concepts in this update to the Southern California Regional ITS Architecture outline the roles and responsibilities of participating stakeholders that are currently or will be involved with in the provision of interregional services related to PTC.

*A concept of operations*, though similar in nature to an *operational concept*, defines in more detail the specifics of how a particular project or system operates in different scenarios. A *concept of operations* is part of a project-oriented systems engineering approach. Evolving from a project development environment, a *concept of operations* describes in detail not only the roles and responsibilities, but the information flows among stakeholders, scenarios for how a system operates, and required interactions and data sharing for a project. It enables later validation of the concept of what the system was meant to do (in addition to system testing to ensure that the system meets the specific requirements that were laid out). *Concepts of operations* for future projects can be developed by project sponsors from the corresponding portion of this *operational concept*.

While the current focus is on designing and deploying the PTC systems, once operational, very little multi-agency interaction is expected. Within SCRRA, the rail dispatch will have communications with the train operator and both will have access to more and better data and controls.

### 4.2 ITS Standards

The Southern California Regional ITS Architecture provides recommended current, relevant standards for each information exchange between ITS projects. Their use is not mandatory. However, in some instances, there may be funding requirements or regional policies that mandate project-specific standards such as for real-time transit information.

**Table 4** identifies the ITS standards that are possible for PTC based upon the identified interfaces and information flows.

**Table 4 – Applicable ITS Standards for PTC**

| SDO                 | Document ID           | Standard Title  | Standard Type |
|---------------------|-----------------------|---|---------------|
| AASHTO/ITE          | ITE TMDD              | Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) | Message/Data  |
| AASHTO/ITE/<br>NEMA | NTCIP 1201            | Global Object Definitions   | Message/Data  |
| AASHTO/ITE/<br>NEMA | NTCIP 1205            | Object Definitions for Closed Circuit Television (CCTV) Camera Control  | Message/Data  |
| AASHTO/ITE/<br>NEMA | NTCIP 1208            | Object Definitions for Closed Circuit Television (CCTV) Switching   | Message/Data  |
| AASHTO/ITE/<br>NEMA | NTCIP 1209            | Data Element Definitions for Transportation Sensor Systems (TSS)  | Message/Data  |
| AASHTO/ITE/<br>NEMA | NTCIP C2C             | NTCIP Center-to-Center Standards Group  | Group         |
| AASHTO/ITE/<br>NEMA | NTCIP C2F             | NTCIP Center-to-Field Standards Group   | Group         |
| APTA                | APTA TCIP-S-001 3.0.3 | Standard for Transit Communications Interface Profiles  | Message/Data  |
| ASTM                | ASTM E2468-05         | Standard Practice for Metadata to Support Archived Data Management Systems  | Other         |
| ASTM                | ASTM E2665-08         | Standard Specifications for Archiving ITS-Generated Traffic Monitoring Data   | Message/Data  |
| IEEE                | IEEE 1570-2002        | Standard for the Interface Between the Rail Subsystem and the Highway Subsystem at a Highway Rail Intersection              | Message/Data  |
| IEEE                | IEEE IM               | Incident Management Standards Group   | Group         |
| SAE                 | ATIS General Use      | Advanced Traveler Information Systems (ATIS) General Use Standards Group  | Group         |

### 4.3 Functional Requirements

Functional requirements described in this update of the Southern California Regional ITS Architecture are high-level descriptions of the functions or activities of the ITS elements related to goods movement. They are developed for two reasons:

- To provide input to the identification of interfaces and information flows of the architecture; and
- To provide a resource for project sponsors in defining activities and functional relationships of the systems that may be developed or upgraded to provide cross-county ITS services.

A list of requirements that describe the functions covered by the architecture is a requisite component of the architecture according to the FHWA Final Rule for Architecture and Standards. **The architecture does not prescribe that future projects meet any or all of the requirements.**

For all projects that are funded with Highway Trust Funds the Final Rule states that the project should be based on a system engineering analysis, and specifically states that the analysis shall include requirements definition. The intent of the functional requirements is to provide a set of requirements that can be used to assist project sponsors in the development of functional requirements definition as required by the Final Rule. This does not preclude future projects from identifying different or additional functions, but rather, provides requirements for implementation of the regional architecture.

Future projects may choose to utilize the lists of requirements as a reference or tool to develop specific requirements that address each individual project's needs. If a project is developed that has additional functions not documented in the current list, future updates of the Southern California Regional ITS Architecture can add those requirements. This update to the architecture assists in identifying the interconnects and information flows that may also be changed, added, or implemented as a result of future technological developments. The interconnects should also be revised in the process of updating the architecture.

#### 4.4 Interfaces

One of the key components of the Southern California Regional ITS Architecture is the definition of interfaces and information flows that define the connections between ITS systems to support the desired operational concepts and services for goods movement. The interfaces are a detailed view of system interconnections. These interconnections are described in diagram, table, and database formats. The information can be generated from a Turbo Architecture database which defines the entire Southern California Regional ITS Architecture.

While the various systems and stakeholders are identified as part of the Southern California Regional ITS Architecture, a primary purpose of the architecture is to identify the *connectivity* between transportation systems. The customized market packages from the previous section represent services that can be deployed, and the market package diagrams show the information flows between the systems. High-level views of the interconnections and data flows for the customized PTC market packages are provided in **Figure 2** to **Figure 12**.

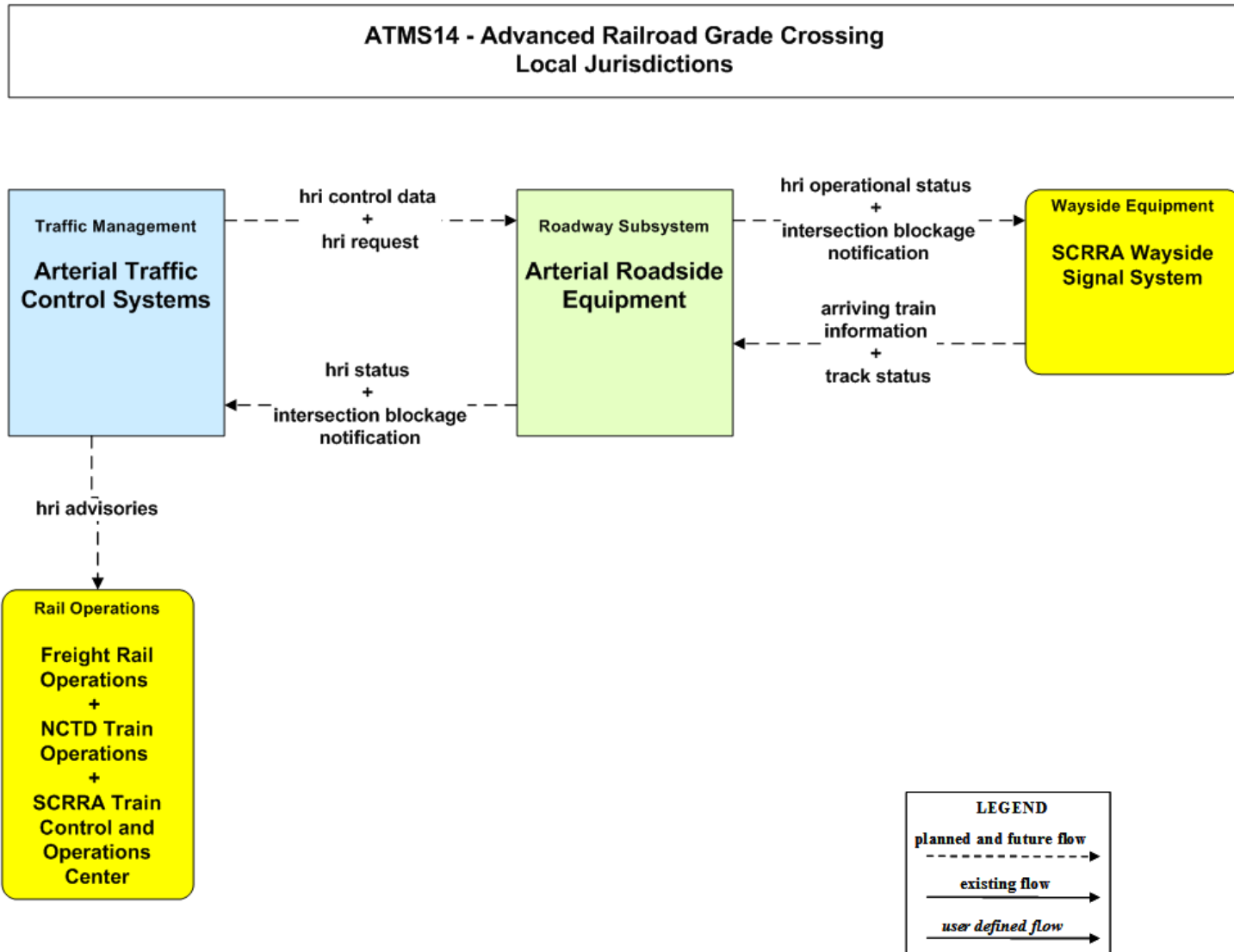


Figure 2 – Advanced Railroad Crossing, Local Jurisdictions

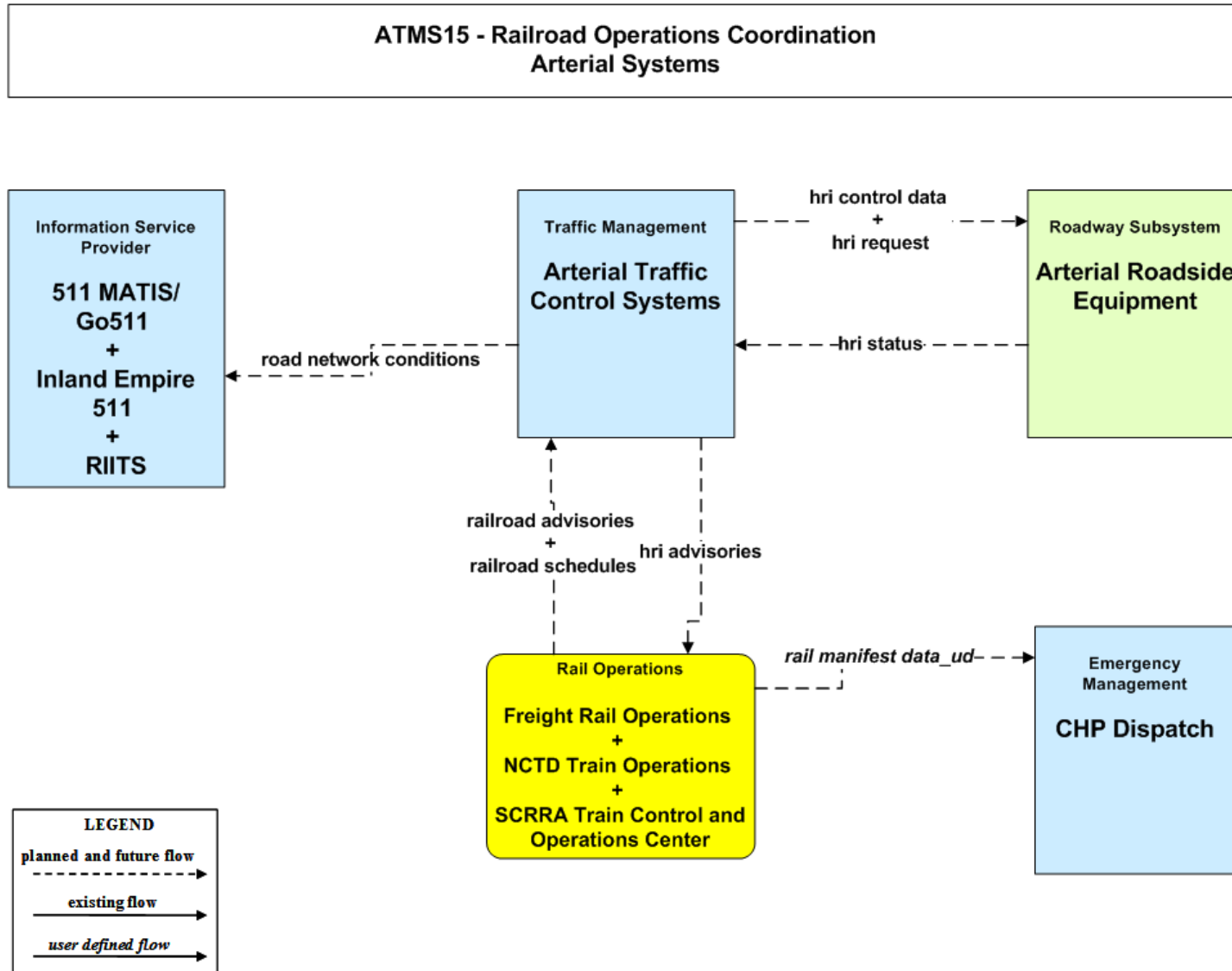
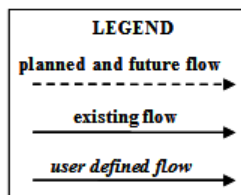
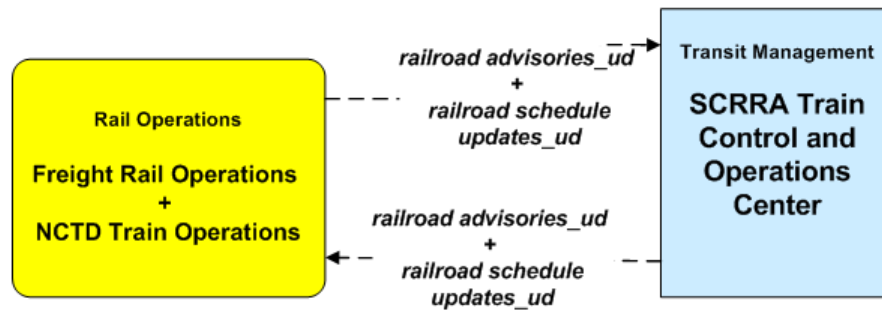


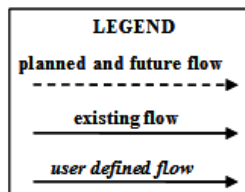
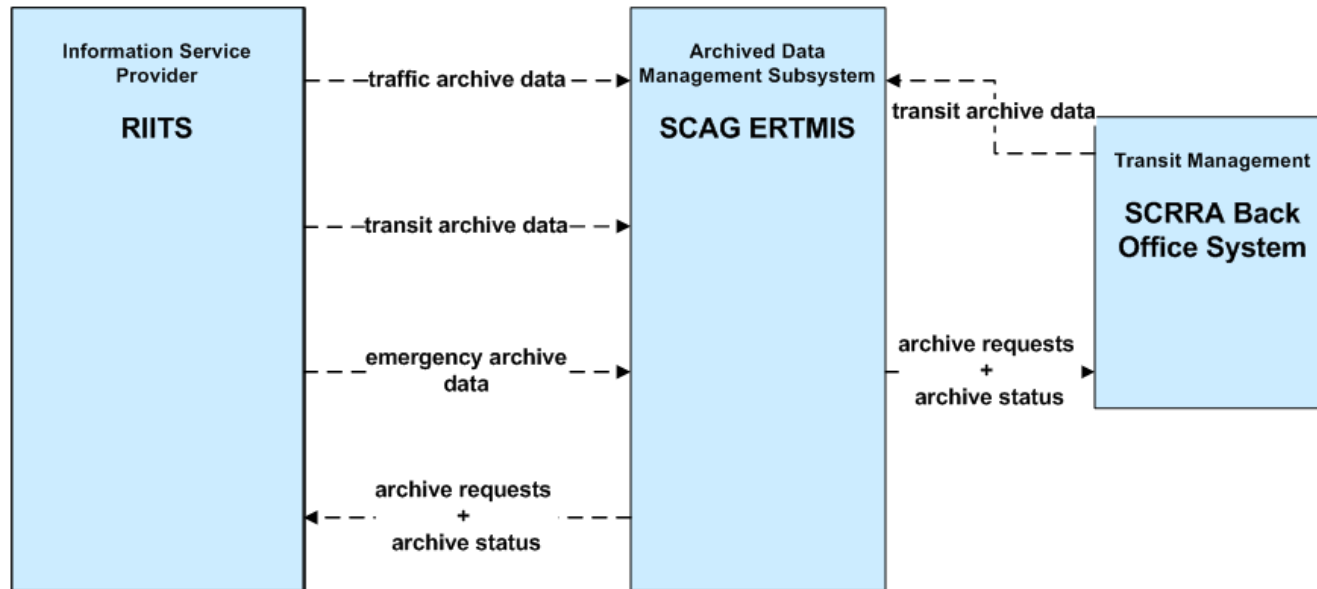
Figure 3 – Railroad Operations Coordination, Arterial Systems

**ATMS15 - Railroad Operations Coordination  
Rail Operators**



**Figure 4 – Railroad Operations Coordination, Rail Operators**

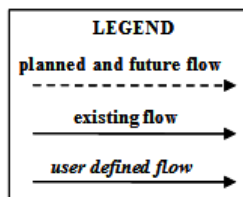
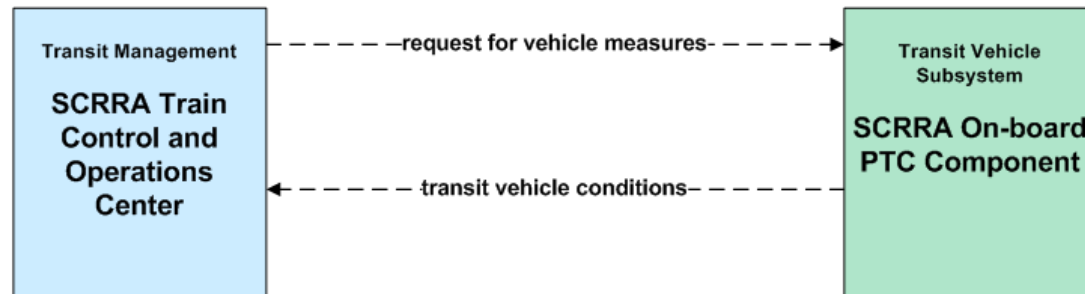
**AD2 - ITS Data Warehouse  
SCAG ERTMIS**



**Figure 5 – ITS Data Warehouse, SCAG ERTMIS**



**APTS06 - Transit Vehicle Maintenance  
SCRRA**



**Figure 6 – Vehicle Maintenance**

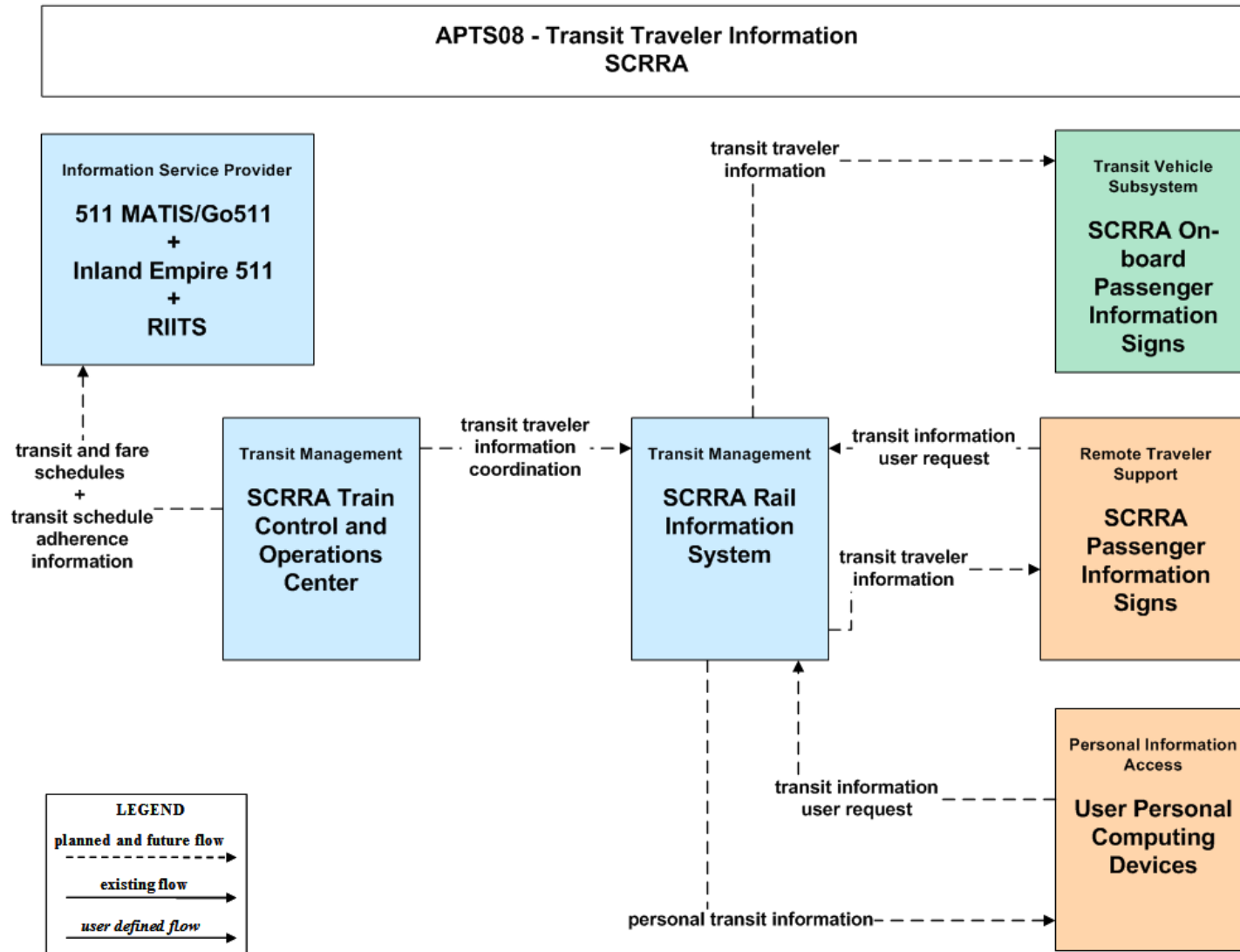
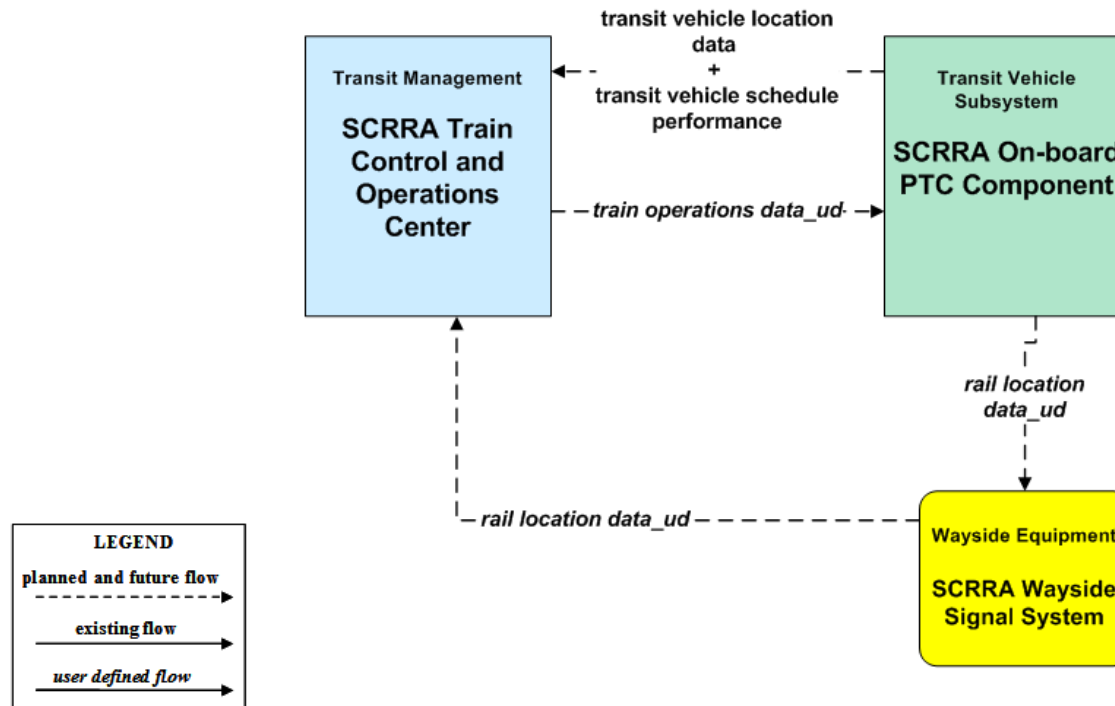


Figure 7 – Transit Traveler Information, SCRRRA

**APTS01 - Transit Vehicle Tracking  
PTC**



**Figure 8 – Transit Vehicle Tracking, PTC**

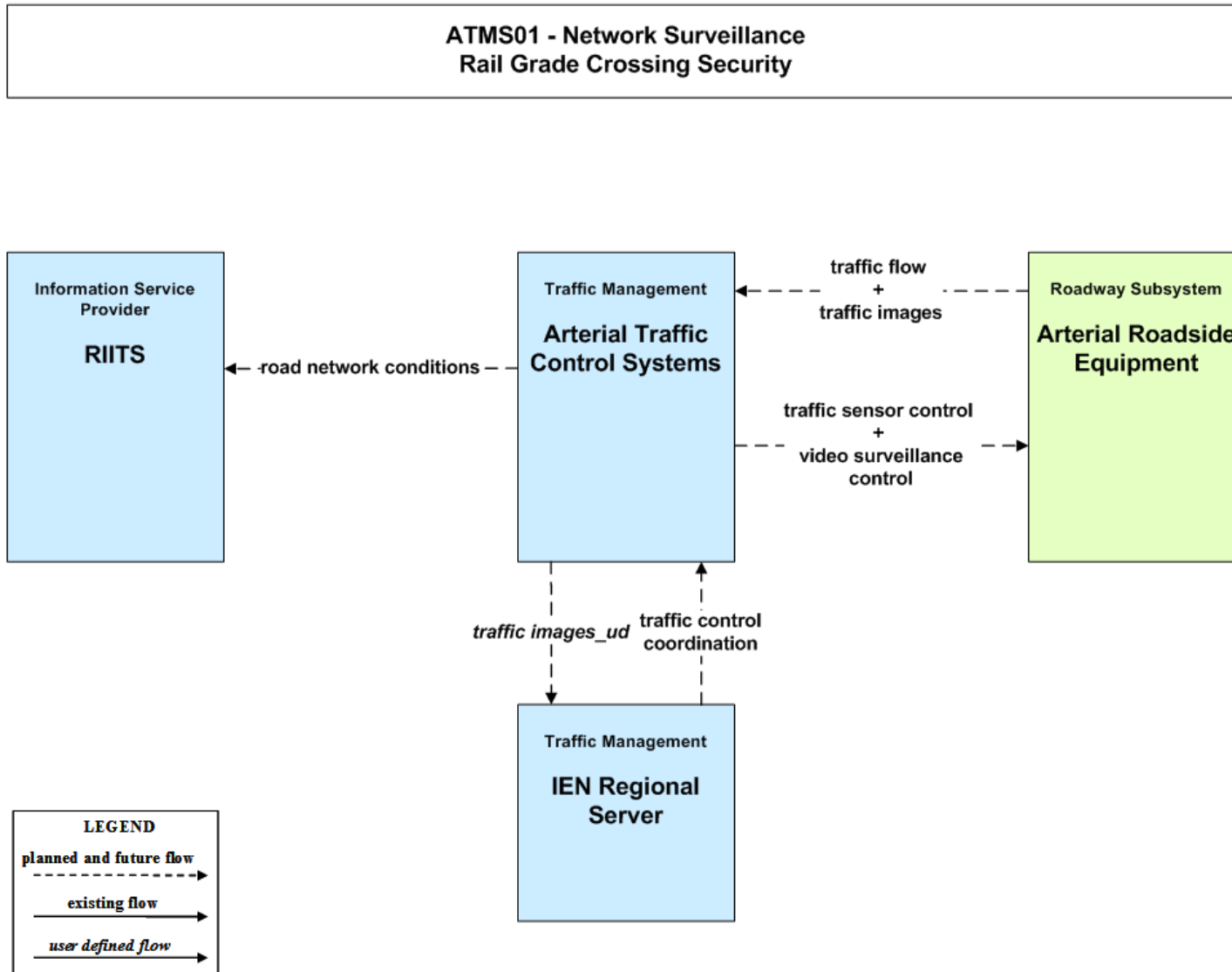


Figure 9 – Network Surveillance, Rail Grade Crossing Security

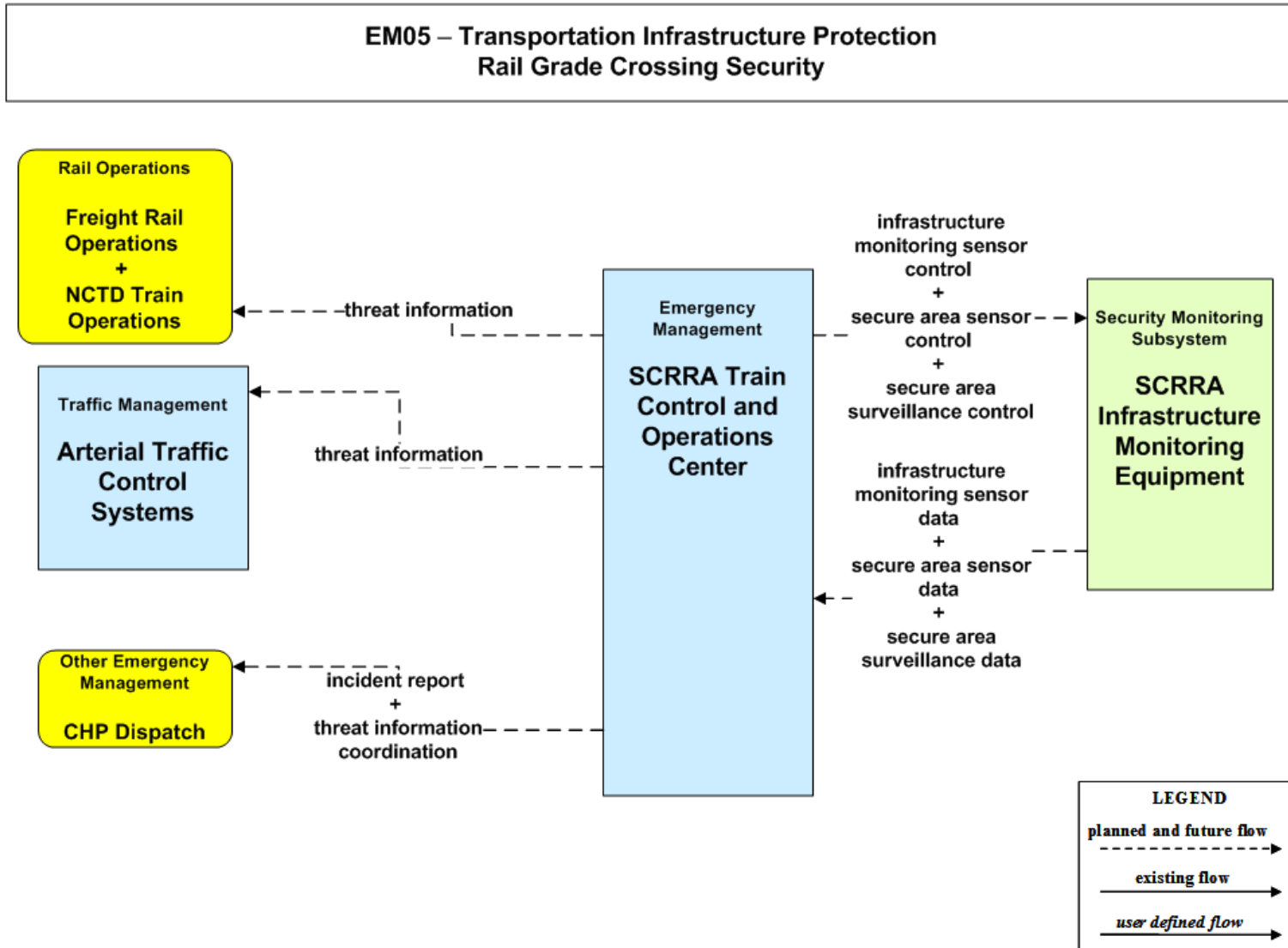
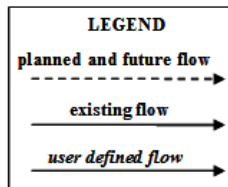
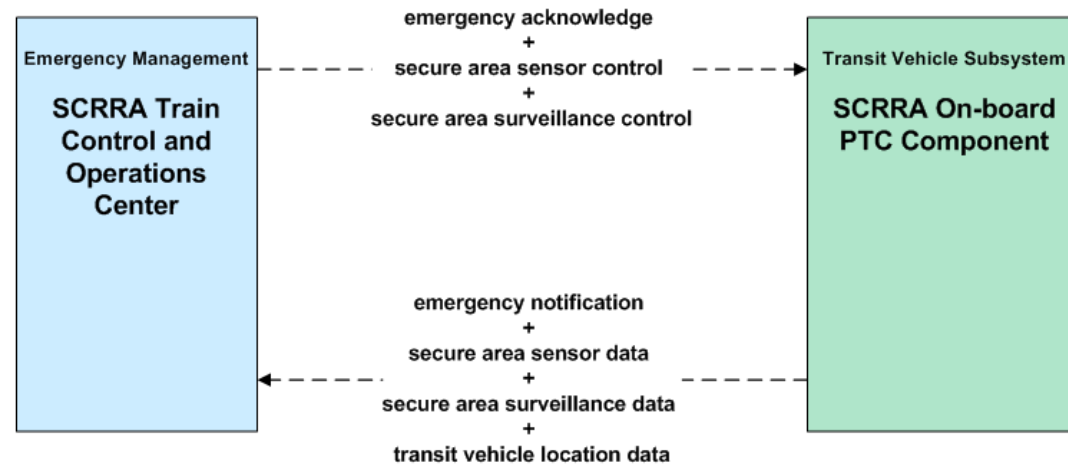


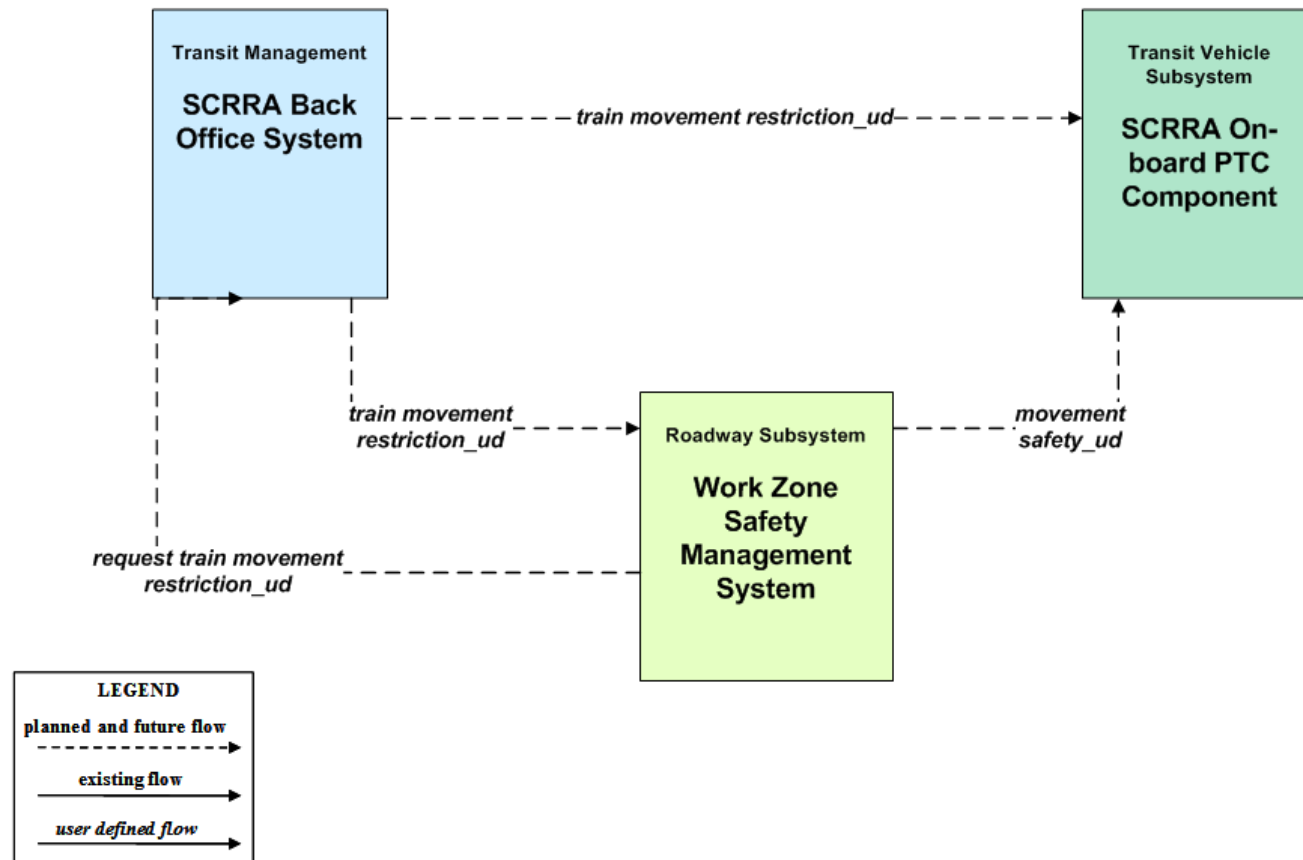
Figure 10 – Transportation Infrastructure Protection, Rail Grade Crossing Security

**APTS5 - Transit Security  
SCRRRA**



**Figure 11 – Transit Security, SCRRRA**

**MC09 - Workzone Safety Monitoring  
Work Zone Safety Management System**



**Figure 12 – Work Zone Safety Management System**