Final Initial Conceptual Projects Descriptions

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SUBMITTED TO: Los Angeles Metropolitan Transportation Authority & Gateway Cities Council of Governments

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Task 3. Final Conceptual Project Descriptions

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date
September 2012
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<td>ACC</td>
<td>Adaptive Cruise Control</td>
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<td>ADT</td>
<td>Average Daily Traffic</td>
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<td>ALPR</td>
<td>Automatic License Plate Reader</td>
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<td>API</td>
<td>Application Programming Interface</td>
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<td>AQMD</td>
<td>Air Quality Management District</td>
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<td>ATIS</td>
<td>Advanced Traveler Information System</td>
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<td>ATMIS</td>
<td>Advanced Transportation Management Information System</td>
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<tr>
<td>ATMS</td>
<td>Advanced Transportation Management System</td>
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<td>BCO</td>
<td>Beneficial Cargo Owner</td>
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<td>BNSF</td>
<td>Burlington Northern Santa Fe</td>
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<td>Caltrans</td>
<td>California Department of Transportation</td>
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<td>CARB</td>
<td>California Air Resources Board</td>
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<td>CCTV</td>
<td>Closed-Caption Television</td>
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<td>CHP</td>
<td>California Highway Patrol</td>
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<td>CMS</td>
<td>Changeable Message Signs</td>
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<td>ConOps</td>
<td>Concept of Operations</td>
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<td>CSTAN</td>
<td>Countywide Significant Truck Arterial Network</td>
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<td>DSRC</td>
<td>Dedicated Short-Range Communications</td>
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<td>EIR</td>
<td>Environmental Impact Report</td>
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<td>EIS</td>
<td>Environmental Impact Statement</td>
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<td>FHWA</td>
<td>Federal Highway Administration</td>
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<td>FRATIS</td>
<td>Freight Advanced Traveler Information System</td>
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<td>FSP</td>
<td>Freeway Service Patrol</td>
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<td>FTE</td>
<td>Full-Time Equivalent</td>
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<td>GCCOG</td>
<td>Gateway Cities Council of Governments</td>
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<tr>
<td>GPS</td>
<td>Global Positioning System</td>
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<tr>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>Hazmat</td>
<td>Hazardous Materials</td>
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<td>HTA</td>
<td>Harbor Trucking Association</td>
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<td>IEN</td>
<td>Information Exchange Network</td>
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<td>ISP</td>
<td>Internet Service Providers</td>
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<td>IT</td>
<td>Information Technology</td>
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<tr>
<td>ITE</td>
<td>Institute of Transportation Engineers</td>
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<td>ITS</td>
<td>Intelligent Transportation Systems</td>
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<td>IV</td>
<td>Intelligent Vehicle</td>
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<td>IVR</td>
<td>Interactive Voice Response</td>
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<tr>
<td>JCCC</td>
<td>Joint Command and Control Center</td>
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<tr>
<td>Metro</td>
<td>Los Angeles County Metropolitan Transportation Commission</td>
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<tr>
<td>LACDPW</td>
<td>Los Angeles County Department of Public Works</td>
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<tr>
<td>MOU</td>
<td>Memorandums of Understanding</td>
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<td>MTO</td>
<td>Marine Terminal Operator</td>
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<td>OCR</td>
<td>Optical Character Recognition</td>
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<tr>
<td>OEM</td>
<td>Original Equipment Manufacturer</td>
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<td>POLA</td>
<td>Port of Los Angeles</td>
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<td>POLB</td>
<td>Port of Long Beach</td>
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<td>PLPP</td>
<td>Private-Public Partnership</td>
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<tr>
<td>PS&amp;E</td>
<td>Plans, Specifications, and Estimates</td>
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<td>RFID</td>
<td>Radio Frequency Identification</td>
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<td>RFP</td>
<td>Request for Proposals</td>
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<td>RIITS</td>
<td>Regional Integration of Intelligent Transportation Systems</td>
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<td>SDK</td>
<td>Software Development Kit</td>
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<td>Software Requirements Specification</td>
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<td>TIS</td>
<td>Transportation Information System</td>
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<td>TMC</td>
<td>Traffic Management Center</td>
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<td>TMF</td>
<td>Traffic Mitigation Fee</td>
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<td>TSSP</td>
<td>Traffic Signal Synchronization Program</td>
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<td>TMDD</td>
<td>Traffic Management Data Dictionary</td>
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<tr>
<td>TWP</td>
<td>Twisted-Wire-Pair</td>
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<tr>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>UI</td>
<td>User Interface</td>
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<td>UP</td>
<td>Union Pacific</td>
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<tr>
<td>V/C</td>
<td>Volume-to-Capacity</td>
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<tr>
<td>WIM</td>
<td>Weigh-in-Motion</td>
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Reader’s Guide/Executive Summary

This report includes the conceptual project descriptions developed for the Gateway Cities Technology Plan for Goods Movement.

INTRODUCTION

To respond to concerns about the current and projected future demands for goods movement in the Gateway Cities subregion, Southern California regional transportation leaders are undertaking the Gateway Cities Technology Plan for Goods Movement. This program represents a significant fusion of Intelligent Transportation System (ITS) and freight operations technologies. Through the integration of traditional freeway, arterial and traveler information technologies, with intermodal freight, port, and truck technologies, this project is studying the potential of providing an end-to-end information support system to improve the efficiency of goods movement in Southern California. This report covers the key planning, conceptual and feasibility activities necessary to support the near-term deployment of these technologies.

The Gateway Cities Technology Plan for Goods Movement is a continuation of the work completed as part of the 2008 ITS Integration Plan for Goods Movement, building on the solid foundation of that earlier study. An ITS Working Group was formed for the 2008 study, which included transportation and freight industry stakeholders in the Gateway Cities subregion. Public-sector stakeholders included Federal, state, and local governments, as well as regional metropolitan planning agencies, ports, commissions, and coalitions. A variety of terminal operators, drayage operators, Class I and short line rail lines, and other private transportation and goods movement organizations and associations also participated. This ITS Working Group provided essential support throughout the planning process, ensuring that the projects identified reflected the real needs of both the public and private sectors in the region. The ITS Working Group has been brought together again to support the new phase of the planning process.

Project outreach and research began in August of 2011 and is anticipated to be completed in December 2012.
PURPOSE, NEEDS, AND OBJECTIVES SUMMARY

With container growth forecasts for the Ports of Long Beach (POLB) and Los Angeles (POLA) anticipated to more than double or triple in the next 25 years and new infrastructure projects many years away from implementation, the Gateway Cities subregion can expect to experience increased truck traffic congestion problems. Without mitigation, these increases in truck traffic could result in negative regional effects related to air quality, noise, mobility, and safety; and freight delays that have a negative impact on the regional economy. In addition, recent policies to promote improved air quality in the Los Angeles basin, including SB 375 (greenhouse gas (GHG) emissions reductions program), the California Air Resources Board (CARB) diesel emission standards program, the Southern California Air Quality Management District’s (AQMD) restrictions on truck terminal queue idling, and the POLB and POLA Clean Trucks Program, together, present major operational and financial challenges to the local dray trucking industry. Severe freight congestion, combined with the regulations on polluting trucks, has the potential to adversely impact the economic competitiveness of the port and intermodal freight industries in the Gateway Cities subregion.

The objective of this study is to identify projects to respond to these concerns in the near term. Building upon the 2008 ITS Integration Plan for Good Movement, a variety of transportation and freight industry stakeholders in the Gateway Cities subregion were interviewed to update the existing conditions and planned improvements, and identify user needs and solutions to address these near-term concerns. Public-sector stakeholders included Federal, state, and local governments, as well as regional metropolitan planning agencies, ports, commissions, and coalitions. A variety of terminal operators, drayage operators, Class I and short line rail lines, and other private transportation and goods movement organizations and associations also participated. The user needs identified during these interviews were then compiled and validated with the ITS Working Group.

The needs identified under Task 2 of this study, Gateway Cities Technology Plan for Goods Movement User Needs Summary, illustrate the complex nature and wide range of challenges facing efficient and safe goods movement in the Gateway Cities subregion (see blue circles in Figure ES.1). They range from straightforward gaps in ITS infrastructure to complex public/private policy issues. The solutions to these issues will only be achieved through a variety of technology projects woven together with institutional partnerships, along with long-term fiscal commitment to operations. These needs, when overlapped with the regional ITS and good movement assets currently in place, along with capabilities of the private sector, provided a path of how these projects could be developed.
This graphic summarizes the User Needs identified for the Gateway Cities region. These issues/needs will help drive the technology solutions/projects which will be developed as part of the Gateway Cities Technology Plan for Goods Movement and implemented in the region to help freight move more safely and efficiently. Each issue/need is grouped into a functional area.

The needs shown here illustrate the complex nature and wide range of challenges facing efficient goods movement in the Gateway Cities subregion. They range from straightforward gaps in ITS infrastructure to complex public/private policy issues. The solutions to these issues will only be achieved through a variety of technology projects woven together with institutional partnerships and fiscal commitment to operations.
This document presents a series of projects designed to address the user needs identified. Some projects will address multiple needs, while others will address only one. Projects were identified and vetted with the ITS Working Group with a focus on implementable, near-term solutions to address high priority user needs for improving freight efficiency, productivity, mobility, and safety. These improvements also will result in reduced emissions and fuel use, promote economic growth and jobs, and improved mobility and reliability to all travelers in the subarea.

**PROJECT PROGRESS**

There is a five-step process in place to develop implementable technology solutions to improve the goods movement environment of the subregion. This document represents the third step, as highlighted in Figure ES.2.

These steps include:

- **Step 1. Conducting Background Research.** This step included interviews with stakeholders, subject matter experts, and vendors; review of applicable ITS plans; collection of existing and future conditions data; and evaluation of peer programs and organizations. This step was completed and summarized in the *Gateway Cities Technology Plan for Goods Movement Background Research Reports* collection.

- **Step 2. Developing User Needs.** As part of the second step, the needs of the Gateway Cities were clearly identified and defined, along with recommendations for key focus areas for technology alternatives. This step was completed and presented in the *Gateway Cities Technology Plan for Goods Movement User Needs Summary*.

- **Step 3. Conceptual Projects Descriptions.** This report is the major deliverable for Step 3. This step includes applying the background research, as well as additional research into new strategy and technology options, to develop a set of possible ITS alternatives to address user needs. This report details the preferred options for the possible core strategic and technology project alternatives. It includes a conceptual description or initial concept of operation for each project. Conceptual descriptions are comprehensive, including elements such as the means and methods to develop functional requirements, equipment requirements, costs, and recommended implementation phasing.
**Figure ES.2 Key Project Steps**

1. **BACKGROUND RESEARCH**
   - **Purpose:** Ensure the latest technology opportunities are identified and used.
   - **Key Products:**
     - Project Needs
     - Background Research Reports
     - Survey Reports

2. **USER NEEDS**
   - **Purpose:** Clearly define the technology needs of the region.
   - **Key Products:**
     - User Needs Report
     - User Needs Infographic

3. **PROJECTS**
   - **Purpose:** Define and develop project opportunities to meet the region’s needs.
   - **Key Products:**
     - Conceptual Project Design Report

4. **CONCEPT OF OPERATIONS**
   - **Purpose:** Demonstrate how the projects will work together in an overall operational program.

5. **BUSINESS PLAN**
   - **Purpose:** Identify best Smart Corridor candidates for preliminary design.
• **Step 4. Concept of Operations.** Following the approval and any necessary revisions to the projects based on ITS Working Group feedback, a unifying Concept of Operations will be developed. This Concept of Operations will describe how these projects will operate collectively on a daily basis; and how they interact, are unified, and leverage information across projects.

• **Step 5. Business Plan.** The development of the Concept of Operations will be followed by an overall Business and Implementation Plan, which will provide a roadmap for project implementation.

The final step is implementation of the projects to address Gateway Cities needs.

**TECHNOLOGY PROJECTS**

Seven key projects are recommended for the initial implementation stage. These projects work together and are unified to collectively and greatly improve goods movement efficiency, productivity, mobility, safety, and reduce freight impacts on the environment in the Gateway Cities subregion. The projects are shown in Figure ES.3. It is important to note that:

• This report covers the recommended initial technology projects to improve goods movement for the Gateway Cities subregion. The projects selected for inclusion are those identified to address the current and future congestion and impacts associated with the anticipated growth in freight movement to and from the Ports, address the user needs, be of medium or high priority, needed to test the viability of potential solutions, and/or implementable. In addition, many of these projects were solutions stakeholders and the ITS Working Group identified or discussed to address their needs. There were other identified project opportunities for the Gateway Cities subregion to address the user needs. However, these project opportunities are not ready for deployment or are of lower priority (e.g., expand capacity of truck parking). In the interest of improving freight efficiency and safety, and addressing the congestion and air quality issues of the subregion today, it is recommended to proceed with these initial projects. In order to advance potential future projects, research can continue for future opportunities, to monitor technology innovations that reduce costs and impacts while enhancing capabilities, and to continue developing the regional partnerships that will be necessary to address these other longer-term issues/projects.

• These projects are intended to address the user needs identified in coordination with regional stakeholders, such as the ITS Working Group, through extensive surveying, and based on the background research and available performance data for the subregion.

• The projects are being developed with consideration of the cutting edge technologies demonstrated as part of the Vendor Showcases that were
needed, and through additional research of private and public sector technology advancements.

- Many of these projects are closely aligned with the Freight Advanced Traveler Information System (FRATIS) Concept of Operations (ConOps), which is being developed by the Federal Highway Administration (FHWA). FRATIS involves freight-specific technology applications to improve freight operational efficiency. Many of the technology projects could be developed under the FRATIS project, and the ultimate program build out can be greatly assisted by the functionality FRATIS would provide. The two application “bundles” under FRATIS include:
  - Freight-Specific Dynamic Travel Planning and Performance. This application bundle will include traveler information, dynamic routing, and performance monitoring elements leveraging existing data in the public domain, as well as emerging private sector applications, to provide benefits to both sectors.
  - Intermodal Drayage Operations Optimization. This application bundle will combine container load matching and freight information exchange systems to fully optimize drayage operations, thereby, minimizing bobtails/dry runs and wasted miles and spreading out truck arrivals at intermodal terminals throughout the day. These improvements would lead to corresponding benefits in terms of air quality and traffic congestion.

- The Gateway Cities Conceptual Projects also includes a Truck Enforcement Network System (TENS) project. This TENS project is evolving through a parallel effort and, therefore, is only summarized briefly in this document. A technical report is under development and will be provided under separate cover for that effort. Key elements of that effort, however, are highlighted in this document, specifically in Section 8.0.

Figure ES.3 shows a visualization of the projects. It is intended to highlight the interrelated nature of the projects. The success of each individual project is closely related to the availability of data and support mechanisms created by its peers. While in some cases these projects can and will function successfully in isolation, if implemented as an entire regional program, they will see much greater success being unified.

- The technology projects are listed on the right-hand side of the diagram, each with an identifying icon. The seven projects all have individual purposes, but work together to collectively support goods movement in the region.
Figure ES.3 Technology Project Conceptual Diagram

- **Freight TIS and Data Warehouse**
- **Freight Traveler Information Dissemination**
- **Arterial Smart Corridors**
- **Freeway Smart Corridors**
- **Automated Truck Research**
- **Container Moves Productivity Improvement**
- **Cargo Container Tracking**
- **Freight Traveler Information Dissemination**
- **Technology Systems within the perimeter**
- **Data Warehouse**
- **An enhanced enforcement network creates a safer environment**
- **Planning can use the data warehouse to better plan for goods movement**
- **Navigation and traffic data vendors will have access to more accurate and timely information**
- **Third parties can use the data from the data warehouse to create apps for their customers**
- **Ride hail traffic providers will have access to more accurate information than ever before**
- **Drayage drivers will have access to freight focused traveler information resources**

Cambridge Systematics, Inc.
• These projects have a very interrelated nature. The success of each individual project is closely related to the availability of data and support mechanisms created by its peers. While in some cases these projects can and will function successfully in isolation, if implemented as an entire regional program, they will see much greater success. Each project, represented by a white disk in the diagram, is shown on a single platform to emphasize this connectivity.

• The Data Warehouse and Freight Transportation Information System (TIS) are at the heart of this program. Data sharing can greatly reduce the operating costs of shippers and carriers by giving them an accurate, real-time picture of roadway and terminal conditions and performance. Each project will feed more relevant and valuable data to the Freight TIS, strengthening it as a resource. The Freight TIS will then share data with freight travelers and dispatchers, as well as Marine Terminal Operators (MTO), 511, California Highway Patrol (CHP), and the media. Key data flows are highlighted in the diagram with white arrows.

• The outcomes of these projects can be of great benefit to the region. The potential outcomes are shown in the grey circles to the exterior of the diagram.

A description of each individual project follows Figure ES.3.

**Freight TIS and Data Warehouse Project**

The Data Warehouse project will create a data warehouse and transfer the useful new and existing freight-focused freeway, arterial, MTO, and container moves data to a freight traveler information database for information sharing and Freight 511 traveler information. This fusion of useful freight data sources will ensure that the traffic management and goods movement operators will have a complete suite of regional real-time data at their fingertips, which they can make use of to suit their information needs.

The second element of this project, the Freight TIS, will provide the software integration applications, hardware, facility, staff, and other equipment to operate a freight-focused transportation information system, which will improve transportation safety and efficiency and traveler information for goods movement in the Gateway Cities. The Freight TIS will not be a traditional Traffic Management Center (TMC) in the vein of the California Department of Transportation’s (Caltrans) District 7 TMC. Its focus will be ensuring the freight-related data that are gathered by the data warehouse and disseminated through outlets, such as the Freight 511 project, function properly; and provide the goods movement community with timely, accurate, and useful freight-focused information. Finally, and equally important, the Freight TIS will act as the clearing house for goods movement transportation and efficiency issues and information in the Gateway Cities and Southern California region.
This project is focused on compiling and processing freight-focused traveler information. This project is not intended to replace or replicate the traffic and incident management functions currently undertaken by the key transportation operations stakeholders in the region; nor would it be a traditional stand-alone control center. However, as a result of this project, traffic and incident management improvements may be realized as a result of having the additional data and information available for use, and staff at the Freight TIS that could assist with incidents or emergencies involving or significantly impacting goods movement.

The project objectives are to:

- Collect and increase the availability, accuracy, and reliability of freight-specific real-time and useful traveler and operational information;
- Improve real-time freight mobility along key freeways and arterials in the region by providing freight-focused traveler information and incident coordination that meet the specialized needs of the freight industry and currently are not provided by other TMCs;
- Improve efficiency and safety for all travelers through more rapid detection of incidents and mobilization of first response agencies, including ability to identify and mobilize resources focused on the freight industry;
- Mitigate congestion on freight routes caused by incidents, road work, and events taking place by reducing incident response times and incident rates, especially secondary incidents;
- Maximize the return of the investment in the Port’s Advanced Traffic Management Information System (ATMIS) by providing ongoing freight traffic operational support.
- Manage a transportation performance measurement program to monitor the return on investment of various technology projects and programs real time; and
- Collect, process, transfer, and archive traveler data supplemented by existing regional ITS programs to provide the ability for stakeholders to proactively manage the transportation network and disseminate information (e.g., including data needed by the private industry for dynamic traveler routing for precise real-time goods movement traveler information).

For a detailed description of the project, including hypothetical operational narratives, recommended project scope, conceptual diagrams, recommended scheduling and phasing, preliminary cost estimates, users and systems involved, the Gateway City user needs to be addressed by the project, and initial steps for deployment (see Section 2.0 of the Gateway Cities Conceptual Projects Description Report).
Freight Traveler Information Dissemination

This project will receive the processed freight static and real-time traveler information from the Freight TIS/Data Warehouse, and disseminate the processed freight traveler information to a variety of users, including drayage and trucking companies, truck drivers, private freight traffic information providers, and public agencies. To accomplish the freight traveler data dissemination, this project will develop a Freight Traveler Information Dissemination System, Freight 511 web pages (freight-focused information housed within the current LA SAFE 511), and a Spanish 511 Interactive Voice Response (IVR). The Freight 511 web pages will provide information in English and Spanish. (It should be noted that LA SAFE currently is testing 511 in Spanish. Therefore, it could be removed from this project as that effort progresses).

It should be noted that many of the technologies demonstrated and discussed at the Vendor Showcases could be one of the keys to the deployment of this project. Specifically, this applies to the navigation, mobile application, and traffic management/data integration arenas. See the Gateway Cities Technology Plan for Goods Movement Vendor Presentations and Collaterals from the January 10 and 11, 2012 ITS Vendor Showcase #1 and Gateway Cities Technology Plan for Goods Movement ITS Vendor Showcase Day 3 Presentations and Materials Document reports for more details. The project objectives are to:

- Increase availability and penetration of real time and useful freight traveler information and ITS products into the freight community, including the Spanish-speaking freight community;
- Improve mobility, reliability, and safety for all motorists along key freeways and truck heavy arterials in the subregion by providing more accurate real-time traveler information;
- Enable and encourage the private sector to develop innovative freight information products and freight-related services;
- Improve efficiencies of the regional freight operations by enabling MTOs, rail yards, drayage dispatchers, and truck drivers to make efficiency improvement decisions; and
- Reduce congestion and air pollution by optimizing drayage operations, reducing idling time and bobtails/dry runs, and reducing truck trips.

For a detailed description of the project, including hypothetical operational narratives, recommended project scope, conceptual diagrams, recommended scheduling and phasing, preliminary cost estimates, users and systems involved, the Gateway City user needs to be addressed by the project and initial steps for deployment (see Section 3.0 of the Gateway Cities Conceptual Projects Description Report). This section also includes descriptions of alternative project options for consideration.
Arterial Smart Corridors for Freight

This project will identify and prioritize arterial corridors within the Gateway Cities study area that serve major freight-related facilities; and will include the deployment or updating of signal coordination, improved signal systems, additional vehicle detection, closed-caption television (CCTV) cameras, and CMSs. These improvements will enable better freight traffic and incident management on arterials by generating data for real-time traffic information for region-wide exchange, dissemination, and use. This effort will be coordinated with Metro’s Countywide Significant Truck Arterial Network (CSTAN) study.

Providing arterial travel times is a new functionality that will be implemented as part of this project. Other improvements will be based on adding ITS improvements and filling gaps on identified routes.

The project objectives are to:

- Reduce recurrent intersection delay and improve travel time reliability and information, fuel consumption, and emissions on designated truck route arterials through cross-jurisdictional signal coordination and updated signal controllers and systems;
- Fill ITS coverage gaps (detection, CCTV cameras, changeable message signs, and communications) along identified truck route arterials for freight traffic management and traveler information;
- Generate data for the provision of real-time traveler information to drivers and freight operators; and
- Improve incident detection and management on arterials, as well as improve freight traffic management and traveler information in response to freeway incidents and emergency situations.

This project will build upon the existing signal system improvement programs in the region, including the Los Angeles Department of Public Works (DPW) Atlantic Blvd / I-710 Corridor, the Telegraph Road / I-5 Gateway Cities project, the Traffic Signal Synchronization Program (TSSP), and IEN, to upgrade traffic signal control systems, enhance signal coordination, address potential communications deficiencies, and install additional ITS detection and signing devices, for the purpose of improving freight mobility through enhanced corridor and incident management.

For a detailed description of the project including recommended initial locations for arterial smart corridors, hypothetical operational narratives, recommended project scope, conceptual diagrams, recommended scheduling and phasing, preliminary cost estimates, users and systems involved, the Gateway City user needs to be addressed by the project, and initial steps for deployment, see Section 4.0 of the Gateway Cities Conceptual Projects Description Report.
Freeway Smart Corridors for Freight

This project will implement additional detection sites, ramp metering traffic monitoring equipment (CCTV cameras) and changeable message signs, to provide for a more complete overall ITS deployment along freeway corridors (including filling existing gaps) that are critical for Gateway Cities freeway traffic management, traveler information, and ultimately for freight-specific freeway travel. Through improving the overall flow of traffic through the project limits, freight traffic will benefit by having more efficient and reliable trips.

It is recognized that I-710 will be reconstructed during the life of this project. The designs developed by this project should be coordinated with I-710 construction to ensure that all ITS components are maintained or replaced, and that continuity of data along the corridor is preserved during construction. Also, ITS gap closures (e.g., Changeable Message Signs (CMS) on other freeways) for other relevant freeway corridors (namely, I-110, I-405 and SR 91) also will be addressed.

The project objectives are to:

- **Improve traffic management.** Additional detection sites, traffic monitoring, and traveler information will allow greater control of incident identification, posting of alternative routes and travel times geared towards freight traffic;

- **Reduce congestion on key freeway freight routes.** Additional detection sites and traffic monitoring will allow for Caltrans to more quickly identify incidents and congestion, and deploy applicable response plans;

- **Increase freight mobility and reliability.** By completing the ITS system and reducing congestion, freight traffic will be able to flow better and more reliably;

- **Provide traveler information.** Additional CMSs will allow for users to receive information and incidents, congestion, and alternative routes; and

- **Improve incident management.** Additional detection and traffic monitoring will allow for Caltrans to more quickly identify incidents and deploy response plans.

For a detailed description of the project, including existing freeway surveillance gaps, hypothetical project operational narratives, recommended project scope, conceptual diagrams, recommended scheduling and phasing, preliminary cost estimates, users and systems involved, the Gateway City user needs to be addressed by the project, and initial steps for deployment (see Section 5.0 of the Gateway Cities Conceptual Projects Description Report).

**Container Moves Productivity**

The Container Moves Productivity project involves the development of a long-term technology and operations program that has a goal of improving the
efficiency of the handoff of intermodal containers between trucking companies, marine terminal operators (MTOs), and railroads, while also improving the bottom line for beneficial cargo owners (BCOs). Improving the productivity of container moves through technologies and operational changes in this program can reduce truck trips and turn times, reduce bobtails and wasted trips, and improve or reduce times within the terminals, improve gate terminal productivity, and improve terminal throughput. In turn, these private sector benefits will directly result in the public sector benefits of congestion reduction and improvements in air quality and safety.

There are three main intermodal transportation modes in which elements of this technology program may be focused:

1. **On-the-Road.** This represents drayage truck movements on public roads. This can involve multiple types of move of containers by trucks, including to/from marine terminals, rail terminals, warehouses, transloading facilities, distribution centers, and other customers. Applications centered on freight-focused traveler information for drayage dispatchers, and drivers are a major focus of this area. Additionally, information can potentially be provided to MTOs that provide real-time summaries of trucks approaching their terminals.

2. **Terminal Approach.** This represents the immediate approach of the truck to the intermodal terminal. Here, the queue – the line of trucks waiting to approach the terminal gate – is the most important factor concerning drayage productivity. Improved information on queues can aid in drayage planning. More extensively, MTO application of appointment scheduling systems could dramatically reduce queues by spreading out truck arrivals across a given day/week.

3. **In the Terminal.** This represents the activities for a container pickup or drop-off in a freight terminal by a drayage truck. Here, the “terminal turn time” is the time from when the truck first enters the terminal (at the gate) to the time when the truck exits the terminal – either carrying a container or empty. Other factors which effect terminal efficiency include ship loading and unloading impacts, container stacking, organization and delivery operations, and closed areas.

The objectives of this program include:

- Develop a long-term program that will result in a series of technology projects and operational changes that will improve container moves overall productivity. Potential focus includes:
  - Provide information to schedule container pick-up or deliveries.
  - Reduce terminal and/or rail yards turn times.
  - Provide information on terminal yard operations.
- Provide information to reduce wait and queue times at terminal gates and multimodal transfer facilities, including:
  » Measuring wait and queue times as metric for improved analysis and evaluation; and
  » Providing real-time wait and queue times and video feeds to the Freight TIS, drayage dispatchers and drivers, for information purposes to improve container moves productivity.

- Provide information for more efficient gate processing.

- Provide real-time and predictive information for port terminals about expected drayage truck approaches. (This would be integrated with the Freight Traveler Information Dissemination Project and FRATIS.)

The overall objective is to move effectively manage the overall movement of containers. A centralized, standardized system that could be used by marine and terminal operators, railroad, and truck drayage companies has the potential to greatly improve the efficiencies for container moves.

- Develop a Performance Monitoring Project, that will result in the measurement of performance metrics over time as technology/operational projects are implemented – allowing for quantitative visibility in how these projects succeed (or fail to succeed) in addressing container productivity improvement goals;

- Develop a key stakeholder guidance group, consisting of public and private partners, and covering dray operators, MTOs and BCOs, that can work together to guide the deployment of this freight technology and operations productivity program; and

- Design the program in a “crawl-walk-run” approach that can build confidence between the stakeholders through early successes, then lead to significant project deployments, and finally resulting in a regionwide container productivity system that benefits all intermodal parties.

For a detailed description of the program elements, including projects flagged as potential early wins, hypothetical project operational narratives, recommended project scope, conceptual diagrams, recommended scheduling and phasing, preliminary cost estimates, users and systems involved, the Gateway City user needs to be addressed by the project, and initial steps for deployment, see Section 6.0 of the Gateway Cities Conceptual Projects Description Report.

**Automated Truck Research**

This project will implement a staged progression of commercial vehicle technologies in order to transition from current research-based automated commercial vehicle demonstration efforts to staged operational testing of a flow efficiency system of trucks along the planned I-710 truck lanes. This project will
build upon the unique operational environment and potential partnerships of the Gateway Cities subregion to promote and enhance truck automated commercial vehicle research by bringing together the applications of automated commercial vehicle and automation technologies with the real-world operational realities of a heavily congested truck corridor. Finally, the project will provide for staged operational testing over time with an eye towards understanding the specific design and operational concerns that impact the future development of the I-710 and its approaches.

This project addresses critical user needs identified in this project’s background research, extensive surveying, and through conversations with the ITS Working Group. It is intended to help address long-term terminal congestion, truck congestion on key roadways (especially in the I-710 corridor), enhance safety, and reduce emissions. The projections for future truck traffic on the I-710 corridor necessitate technology solutions to improve operational capacity even as infrastructure capacity is expanded.

The project encompasses three major areas of effort:

1. **Institutional/Promotional.** In order to realize the long-term vision for a technology-based flow efficiency operation of trucks, it is necessary to establish institutional relationships and partnerships that will endure over the long term. These institutional relationships will need to bring together port stakeholders, regional agencies, Caltrans, Federal entities, research organizations, truck equipment manufacturers, and private shipping interests. The project and partnerships also will require a cohesive and professional marketing and communications effort. Finally, this partnership will have to review and promote enabling legislation over time to support the longer-term corridor vision.

2. **Operational/Design Path Development.** The second major area of effort focuses on building on recent research efforts on truck guidance, intelligent vehicle systems, and automated commercial vehicles to define the details of what operations would look like in the I-710 corridor, given the future cross-section and design alternatives. Technical analyses efforts need to be conducted by an interdisciplinary team, including vehicle technology experts, truck operations experts, experienced drivers, traffic engineers, and highway designers, to develop detailed operational concepts for the I-710 corridor, which can be tested as part of this project.

3. **Staged Testing Applying Available Technologies and Operational Concepts.** The third area of effort involves the actual testing and application of the proposed operational concepts. Testing will include establishment and the recurring use of an approximately 3.5-mile stretch of Route 103 in the Port’s region (or some other route).

The goal is not simply to test the performance of the technologies themselves, but to introduce real operational challenges and concepts specific to the real-world
I-710 corridor environment, and test widely available technologies against those challenges. It is assumed other projects will continue to stretch the boundaries of intelligent vehicle technologies, while the goal of this truck technology flow efficiency project will be to test and realize staged benefits using Original Equipment Manufacturer (OEM) concepts, which can be widely adopted. Thus, the objectives of this project are to:

- Help ensure the future viability of the Ports and Gateway Cities subregion, as well as the I-710 corridor, by realizing the vision for achieving maximum effective capacity within the substantial physical constraints of the regions key truck corridors;
- Build upon ongoing and rapidly advancing intelligent vehicle technologies for trucks to define a detailed and staged ConOps for an effective conveyor operation of trucks on the I-710;
- Develop and support a test site in the region where technology and operational concepts can be tested in conjunction with public and private partners;
- Leverage emerging OEM and Tier 1 vehicle supplier technologies to provide a viable real-world operational model focused on the needs and characteristics of the region;
- Establish an ongoing partnership and environment that attract additional funding opportunities to bridge the gap between research efforts and effective real-world solutions in a real-world freight corridor; and
- Promote the state of the art in truck guidance and flow efficiency with an eye towards effective and widespread deployments using OEM available equipment.

For a detailed description of the project, including hypothetical project operational narratives, recommended project scope, conceptual diagrams, recommended scheduling and phasing, preliminary cost estimates, users and systems involved, the Gateway City user needs to be addressed by the project, and initial steps for deployment (see Section 7.0 of the Gateway Cities Conceptual Projects Description Report). This section also includes descriptions of alternative project options for consideration.

**Truck Enforcement Network System**

This project will develop strategies, concepts, and layouts to truck enforcement that work for the needs of the stakeholders within the study area. This Truck Enforcement Network System (TENS) must meet the needs of CHP’s daily truck enforcement facilities operations; Caltrans as overseer of the transportation system, including Truck Enforcement Facilities (TEF) design; and also the shippers, receivers, logistic, and trucking industries to process safe trucks from point to point in a timely manner. The current approach and practice of truck
enforcement cannot process trucks at a rate that will match the present and future truck volume demands. The challenge is to modify and add to the existing approach of truck enforcement to meet these ever-growing truck volume demands.

The feasibility study for TENS involved finding locations and conceptually developing permanent truck enforcement facilities, and bypass screen/sort sites to process the large number of truck movements per day in the Gateway Cities subregion, plus an approach to truck enforcement that could be automated to maximize the effectiveness and efficiency of the enforcement operations. This automation piece was important to this study; it is with the intention that any permanent truck inspection facilities would be safe and not result in trucks backing up onto any adjacent freeways and city streets from these facilities. These automated functions are to safely process as many trucks as possible through an inspection, weighing, and measuring environment. In addition, there is a need to realign the truck overweight fine structure to be proportional to the damages the vehicles produce to the roadway and bridges.

As mentioned earlier, the TENS project is only summarized briefly in this report, but is provided separately.
1.0 Introduction

To respond to concerns about the current and projected future demands for goods movement in the Gateway Cities subregion, Southern California regional transportation leaders are undertaking the Gateway Cities Technology Plan for Goods Movement. This program represents a significant fusion of Intelligent Transportation System (ITS) and freight operations technologies. Through the integration of traditional freeway, arterial and traveler information technologies, with intermodal freight, port, and truck technologies, this project is studying the potential of providing an end-to-end information support system to improve the efficiency of goods movement in Southern California. This report covers the key planning, conceptual and feasibility activities necessary to support the near-term deployment of these technologies.

The Gateway Cities Technology Plan for Goods Movement is a continuation of the work completed as part of the 2008 ITS Integration Plan for Goods Movement, building on the solid foundation of that earlier study. An ITS Working Group was formed for the 2008 study, which included transportation and freight industry stakeholders in the Gateway Cities subregion. Public-sector stakeholders included Federal, state, and local governments, as well as regional metropolitan planning agencies, ports, commissions, and coalitions. A variety of terminal operators, drayage operators, Class I and short line rail lines, and other private transportation and goods movement organizations and associations also participated. This ITS Working Group provided essential support throughout the planning process, ensuring that the projects identified reflected the real needs of both the public and private sectors in the region. The ITS Working Group has been brought together again to support the new phase of the planning process.

Project outreach and research began in August of 2011 and is anticipated to be completed in December 2012.

PURPOSE, NEEDS, AND OBJECTIVES

With container growth forecasts for the Port of Long Beach (POLB) and Port of Los Angeles (POLA) anticipated to more than double or triple in the next 25 years and new infrastructure projects many years away from implementation, the Gateway Cities subregion can expect to experience increased truck traffic congestion problems. Without mitigation, these increases in truck traffic could result in negative regional effects related to air quality, noise, mobility, and
safety; and freight delays that have a negative impact on the regional economy. In addition, recent policies to promote improved air quality in the Los Angeles basin, including SB 375 (greenhouse gas (GHG) emissions reductions program), the California Air Resources Board (CARB) diesel emission standards program, the Southern California Air Quality Management District’s (AQMD) restrictions on truck terminal queue idling, and the POLB and POLA Clean Trucks Program, together, present major operational and financial challenges to the local dray trucking industry. Severe freight congestion combined with the regulations on polluting trucks has the potential to adversely impact the economic competitiveness of the port and intermodal freight industries in the Gateway Cities subregion.

The objective of this study is to identify projects to respond to these concerns in the near term. Building upon the 2008 ITS Integration Plan for Good Movement, a variety of transportation and freight industry stakeholders in the Gateway Cities subregion were interviewed to update the existing conditions and planned improvements and identify user needs and solutions to address these near-term concerns. Public-sector stakeholders included federal, state, and local governments, as well as regional metropolitan planning agencies, ports, commissions, and coalitions. A variety of terminal operators, drayage operators, Class I and short line rail lines, and other private transportation and goods movement organizations and associations also participated. The user needs identified during these interviews were then compiled and validated with the ITS Working Group.

The needs identified under Task 2 of this study, Gateway Cities Technology Plan for Goods Movement User Needs Summary, illustrate the complex nature and wide range of challenges facing efficient and safe goods movement in the Gateway Cities subregion (see blue circles in Figure 1.1). They range from straightforward gaps in ITS infrastructure to complex public/private policy issues. The solutions to these issues will only be achieved through a variety of technology projects woven together with institutional partnerships, along with long-term fiscal commitment to operations. These needs, when overlapped with the regional ITS and good movement assets currently in place, along with capabilities of the private sector, provided a path of how these projects could be developed.

This document presents a series of projects designed to address the user needs identified. Some projects will address multiple needs, while others will address only one. Projects were identified and vetted with the ITS Working Group with a focus on implementable, near-term solutions to address high priority user needs for improving freight efficiency, productivity, mobility, and safety. These improvements also will result in reduced emissions and fuel use, promote economic growth and jobs, and improved mobility and reliability to all travelers in the subarea.
Figure 1.1 User Needs Summary

This graphic summarizes the User Needs identified for the Gateway Cities region. These issues/needs will help drive the technology solutions/projects which will be developed as part of the Gateway Cities Technology Plan for Goods Movement and implemented in the region to help freight move more safely and efficiently. Each issue/need is grouped into a functional area.

The needs shown here illustrate the complex nature and wide range of challenges facing efficient goods movement in the Gateway Cities subregion. They range from straightforward gaps in ITS infrastructure to complex public/private policy issues. The solutions to these issues will only be achieved through a variety of technology projects woven together with institutional partnerships and fiscal commitment to operations.
PROJECT PROGRESS

There is a five-step process in place to develop implementable technology solutions to improve the goods movement environment of the subregion. This document represents the third step, as highlighted in Figure 1.2.

- **Step 1. Conducting Background Research.** This step included interviews with stakeholders, subject matter experts, and vendors; review of applicable ITS plans; collection of existing and future conditions data; and evaluation of peer programs and organizations. This step was completed and summarized in the *Gateway Cities Technology Plan for Goods Movement Background Research Reports* collection.

- **Step 2. Developing User Needs.** As part of the second step, the needs of the Gateway Cities were clearly identified and defined along with recommendations for key focus areas for technology alternatives. This step was completed and presented in the *Gateway Cities Technology Plan for Goods Movement User Needs Summary*.

- **Step 3. Conceptual Projects Descriptions.** This report is the major deliverable for Step 3. This step includes applying the background research as well as additional research into new strategy and technology options to develop a set of possible ITS alternatives to address user needs. This report details the preferred options for the possible core strategic and technology project alternatives. It includes a conceptual description or initial concept of operation for each project. Conceptual descriptions are comprehensive, including elements, such as the means and methods to develop functional requirements, equipment requirements, costs, and recommended implementation phasing.

- **Step 4. Concept of Operations.** Following the approval and any necessary revisions to the projects based on ITS Working Group feedback, a unifying Concept of Operations will be developed. This Concept of Operations will describe how these projects will operate collectively on a daily basis; and how they interact, are unified, and leverage information across projects.

- **Step 5. Business Plan.** The development of the Concept of Operations will be followed by an overall Business and Implementation Plan, which will provide a roadmap for project implementation.

The final step is implementation of the projects to address Gateway Cities needs.
Figure 1.2  Key Project Steps

1  BACKGROUND RESEARCH

Purpose: Ensure the latest technology opportunities are identified and used.

Key Products:
- Project Needs
- Background Research Reports
- Survey Reports

2  USER NEEDS

Purpose: Clearly define the technology needs of the region.

Key Products:
- User Needs Report
- User Needs Infographic

3  PROJECTS

Purpose: Define and develop project opportunities to meet the region’s needs.

Key Products:
- Conceptual Project Design Report

4  CONCEPT OF OPERATIONS

Purpose: Demonstrate how the projects will work together in an overall operational program.

5  BUSINESS PLAN

Purpose: Identify best Smart Corridor candidates for preliminary design.
Seven key projects are recommended for the initial implementation stage. These projects work together and are unified to collectively greatly improve goods movement efficiency, productivity, mobility, and safety; and reduce freight impacts on the environment. The projects are shown in Figure 1.3. It is important to note that:

- This report covers the recommended initial technology projects to improve goods movement for the Gateway Cities subregion. The projects selected for inclusion are those identified to address the current and future congestion and impacts associated with the anticipated growth in freight movement to and from the Ports, address the user needs, be of medium or high-priority, needed to test the viability of potential solutions, and/or implementable. In addition, many of these projects were solutions stakeholders and the ITS Working Group identified or discussed to address their needs. There were other identified project opportunities for the Gateway Cities subregion to address user needs. However, these project opportunities are not ready for deployment or are of lower priority (e.g., expand capacity of truck parking)). In the interest of improving freight efficiency and safety and addressing the congestion and air quality issues of the subregion today, it is recommended to proceed with these initial projects. In order to advance potential future projects, research to continue for future opportunities, to monitor technology innovations that reduce costs and impacts while enhancing capabilities, and to continue developing the regional partnerships that will be necessary to address the these longer-term projects. These additional projects could include, but is not limited to, the following:
  - Truck enforcement facilities and system;
  - Goods movement efficiencies improvements:
    » Appointment system(s),
    » Transportation management center for goods movement,
    » Operational changes information provision,
    » Container transactions improvements, and
    » Container tracking.
- Comprehensive performance monitoring programs. These projects are intended to address the user needs identified in coordination with regional stakeholders such as the ITS Working Group, through extensive surveying, and based on the background research and available performance data for the subregion.
- The projects are being developed with consideration of the cutting edge technologies demonstrated as part of the Vendor Showcases that were held and through additional research of private and public sector technology advancements.
• Many of these projects are closely aligned with the Freight Advanced Traveler Information System (FRATIS) Concept of Operations (ConOps), which is being developed by the Federal Highway Administration (FHWA). FRATIS involves freight-specific technology applications to improve freight operational efficiency. Many of the technology projects could be developed under the FRATIS project, and the ultimate program build out can be greatly assisted by the functionality FRATIS would provide. The two application “bundles” under FRATIS include:

- Freight-Specific Dynamic Travel Planning and Performance – This application bundle will include traveler information, dynamic routing, and performance monitoring elements leveraging existing data in the public domain, as well as emerging private sector applications, to provide benefits to both sectors.

- Intermodal Drayage Operations Optimization – This application bundle will combine container load matching and freight information exchange systems to fully optimize drayage operations, thereby, minimizing bobtails/dry runs and wasted miles and spreading out truck arrivals at intermodal terminals throughout the day. These improvements would lead to corresponding benefits in terms of air quality and traffic congestion.

• The Gateway Cities Conceptual Projects also includes a Truck Enforcement Network System (TENS) project. This TENS project is evolving through a parallel effort and therefore was only summarized briefly in this document. A technical report is currently under development and will be provided under separate cover for that effort. Key elements of that effort however, are highlighted in this document, specifically in Section 8.0.

Figure 1.3 shows a visualization of the projects. It is intended to highlight the interrelated nature of the projects. The success of each individual project is closely related to the availability of data and support mechanisms created by its peers. While in some cases these projects can and will function successfully in isolation, if implemented as an entire regional program, they will see much greater success being unified.

• The technology projects are listed on the right-hand side of the diagram, each with an identifying icon. The seven projects all have individual purposes, but work together to collectively support goods movement in the region.
Figure 1.3 Technology Project Conceptual Diagram
These projects have a very interrelated nature. The success of each individual project is closely related to the availability of data and support mechanisms created by its peers. While in some cases these projects can and will function successfully in isolation, if implemented as an entire regional program, they will see much greater success. Each project, represented by a white disk in the diagram, is shown on a single platform to emphasize this connectivity.

The Data Warehouse and Freight TIS are at the heart of this program. Data sharing can greatly reduce the operating costs of shippers and carriers by giving them an accurate, real-time picture of roadway and terminal conditions and performance. Each project will feed more relevant and valuable data to the Freight TIS, strengthening it as a resource. The Freight TIS will then share data with freight travelers and dispatchers, as well as MTOs, 511, CHP, and the media. Key data flows are highlighted in the diagram with white arrows.

The outcomes of these projects can be of great benefit to the region. The potential outcomes are shown in the grey circles to the exterior of the diagram.

Each of the remaining sections of the report is focused on the projects. For each project, the following is described:

- **Project Overview.** A snapshot of what the project will look like;
- **Project Objectives.** A detailed list of the goals of each project;
- **Project Description.** A more detailed description of the project;
- **Sample Operational Narratives/Examples.** Fictionalized accounts of how the project may benefit typical users in a typical day;
- **Scope of the Project.** A detailed description of the necessary steps and requirements to make the project a reality, in many cases including conceptual diagrams;
- **Conceptual Diagram.** A high-level conceptual diagram of the project;
- **Schedules and Phasing.** Estimates for how long the project may take and project lifespan (if appropriate);
- **Preliminary Cost Estimates.** Rough estimates for project costs broken out by key components;
- **Users Involved.** An assessment of stakeholders who are likely to be involved in project development, delivery, guidance, and/or partnership;
- **Roles and Responsibilities.** An assessment of the key roles and responsibilities for the users involved;
- **Prerequisites.** Requirements necessary for the project to proceed;
• **Systems Involved.** A listing of the key existing data and transportation operations systems to be included in the project;

• **Potential Challenges and Obstacles.** An assessment of risks to project success;

• **Coordination and Integration with Other Projects.** A brief summary of how each project relates to its peers;

• **Other Options Considered.** A description of potential alternative projects;

• **Outcomes.** A description of desired project outcomes;

• **Initial Steps for Deployment.** The key first steps to be taken; and

• **Needs Addressed.** A review of which user needs (identified through the background research, stakeholder interviews, surveying, and in coordination with the ITS Working Group) are targeted by each project.

The remaining sections are structured as follows:

• Section 2.0 covers the **Freight Transportation Information System (TIS) and Data Warehouse** projects;

• Section 3.0 covers the **Freight Traveler Information Dissemination** project;

• Section 4.0 covers the **Arterial Smart Corridors for Freight** project;

• Section 5.0 covers the **Freeway Smart Corridors for Freight** project;

• Section 6.0 covers the **Container Moves Productivity Improvements** program;

• Section 7.0 covers the **Automated Truck Research** project;

• Section 8.0 provides a brief summary of the **Truck Enforcement Network System (TENS)** project, which will be submitted under separate cover; and

• Section 9.0 provides a summary of the **Conceptual Projects Costs**.
2.0 Freight Transportation Information System (TIS) and Data Warehouse Project

2.1 PROJECT OVERVIEW

This project is comprised of two distinct but very interrelated elements: a freight-related Data Warehouse project and a freight-focused traffic management center (Freight TIS) project. Most of the other projects discussed in this report focus on either the gathering or the dissemination of information. This project focuses on how that information is collected, processed, and packaged for delivery (Data Warehouse); and who is responsible for ensuring the goods movement community is receiving the most accurate, timely, and useful traveler information possible (Freight TIS). An important objective of this project is to provide a one-stop location for information on the full trip that a freight operator makes in the Southern California region, including freeways, arterials, port terminals, and intermodal yards. Another objective will be to provide information for other portions of the goods movement community that would be useful in making their operations more efficient. This would provide a major improvement over the current system, which contains many gaps and requires freight industry personnel to access multiple sources of information on travel conditions along their route and for other goods movement related information.

The Data Warehouse project will create a data warehouse and transfer the useful new and existing freight-focused freeway, arterial, MTO, and container moves data to a freight traveler information database for information sharing and Freight 511 traveler information. This fusion of useful freight data sources will ensure that the traffic management and goods movement operators will have a complete suite of regional real-time data at their fingertips that they can make use of to suit their information needs.

The second element of this project, the Freight TIS, will provide the software integration applications, hardware, facility, staff, and other equipment to operate a freight-focused transportation information system that will improve transportation safety and efficiency and traveler information for goods movement in the Gateway Cities. The Freight TIS will not be a traditional Traffic Management Center (TMC) in the vein of the California Department of Transportation’s (Caltrans) District 7 TMC. Its focus will be ensuring the freight-
related data that are gathered by the data warehouse and disseminated through outlets, such as a Freight 511 project, function properly, and provide the goods movement community with timely, useful and accurate freight focused information. Finally, and equally important, the Freight TIS will act as the clearinghouse for goods movement transportation and efficiency issues and information in the Gateway Cities and Southern California region.

It should be noted that many of the technologies demonstrated and discussed at the Vendor Showcases will also be key to the deployment of the projects in this report. This would include the third-party vendors in the Global Positioning System (GPS) and traffic management/data integration, and performance measurement arenas. See the Gateway Cities Technology Plan for Goods Movement Vendor Presentations and Collaterals from the January 10 and 11, 2012 ITS Vendor Showcase #1 and Gateway Cities Technology Plan for Goods Movement ITS Vendor Showcase Day 3 Presentations and Materials Document reports for more details.

Finally, this project is closely aligned with the Freight Advanced Traveler Information System (FRATIS) Concept of Operations (ConOps), which is being developed by the Federal Highway Administration (FHWA). FRATIS involves freight-specific technology applications to improve freight operational efficiency. Many of its components could be developed under the FRATIS project, and its ultimate build out greatly assisted by the functionality FRATIS would provide. The two application “bundles” under FRATIS include:

1. **Freight-Specific Dynamic Travel Planning and Performance.** This application bundle will include traveler information, dynamic routing, and performance monitoring elements leveraging existing data in the public domain, as well as emerging private sector applications, to provide benefits to both sectors.

2. **Intermodal Drayage Operations Optimization.** This application bundle will combine container load matching and freight information exchange systems to fully optimize drayage operations, thereby, minimizing bobtails/dry runs and wasted miles and spreading out truck arrivals at intermodal terminals throughout the day. These improvements would lead to corresponding benefits in terms of air quality and traffic congestion.

### 2.2 PROJECT OBJECTIVES

- Collect and increase the availability, accuracy, and reliability of freight-specific real-time and useful traveler and operational information;

- Improve real-time freight mobility along key freeways and arterials in the region by providing freight-focused traveler information and incident coordination that meet the specialized needs of the freight industry and are not currently provided by other TMCs;
• Improve efficiency and safety for all travelers through more rapid detection of incidents and mobilization of first response agencies, including ability to identify and mobilize resources focused on the freight industry;

• Mitigate congestion on freight routes caused by incidents, road work, and events taking place by reducing incident response times and incident rates, especially secondary incidents;

• Maximize the return of the investment in the Port’s Advanced Traffic Management Information System (ATMIS) by providing ongoing freight traffic operational support;

• Manage a transportation performance measurement program to monitor the return on investment of various technology projects and programs real-time; and

• Collect, process, transfer, and archive traveler data supplemented by existing, regional ITS programs, to provide the ability for stakeholders to proactively manage the transportation network and disseminate information (e.g., including data needed by the private industry for dynamic traveler routing for precise real-time goods movement traveler information).

2.3 Project Description

Many of the other projects in this report operate around and in conjunction with the data warehouse; and it serves as an overall nexus and enabling platform. Only through the data warehouse do all of these projects achieve a real benefit to goods movement in the region. The data warehouse supports real-time traveler information and goods movement operations, while at the same time creating a freight-focused data archive to support performance measurement and future planning.

The data warehouse provides a real-time platform from which the freight-specific traffic sensors, data sources, enforcement devices, and cameras can provide processed, integrated, and useful information for immediate dissemination to regional TMC operators, Freight 511, and to Regional Integration of Intelligent Transportation Systems (RIITS) for use by others. The data warehouse also provides a platform for archiving and analyzing freight specific historical data for planning and good movement performance monitoring in the Gateway Cities subregion.

The data warehouse will collect a subset of the real-time traffic and port-related information available across the entire region, and focus only on those elements which are of interest to the good movement community. For example, the following is a small sample of some of the types of data the data warehouse would collect and process:

• Travel times on the key truck arterials in the Gateway Cities subregion for traveler information dissemination;
• Queue wait times at MTO gates for traveler information dissemination;
• Container tracking or container appointments, container availability;
• Truck arrival times;
• Real-time information on closed areas within the port terminals;
• Percentage and volumes of truck traffic on a corridor to evaluate historical freight traffic patterns and characteristics;
• Links to other useful freight information sites (e.g., SANDAG’s freight 511 information); and
• Historical overweight data to determine which corridors have the most overweight vehicles.

The Freight TIS is the key operational entity, which will operate and maintain the data warehouse making sure that information is flowing on a consistent basis to customers and third-party providers. The Freight TIS would not replace or replicate the traffic management functions currently undertaken by the key transportation operations stakeholders in the region, such as Caltrans, local cities, or LA County; nor would the Freight TIS be a traditional stand-alone control center with multiple workstations, large video wall, and a stand-alone Advanced Traffic Management System (ATMS). The Freight TIS would consist of two main components:

• A physical space in which the data warehouse and Freight 511 systems could be operated and maintained (Note: This could be cloud based.).
• Staff, whose main function would be to:
  - Maintain the daily functioning of the data warehouse;
  - Operate and maintain the Freight 511 system;
  - Conduct analysis utilizing the historical freight information;
  - Assist with developing or updating incident and emergency management plans with Caltrans, and the County and Cities with specific consideration for goods movement and detours on appropriate truck routes utilizing the traffic management and traveler information from the projects; and finally
  - From an operational perspective, organize, coordinate and promote the efficient movement of goods movement in Gateway Cities subregion.

The concept is, in many ways, similar to the successful staffing and operation of Metro’s LA SAFE 511 program, where there is a small set staff, in a modest facility, that operates and maintains the 511 system; and supported by contractor assistance, when needed.
2.4 **HYPOTHETICAL OPERATIONAL NARRATIVES/EXAMPLES**

*Providing Truck Drivers with Accurate Freight Traveler Information*

It is 6:00 p.m. and trucks have begun to queue at Terminal Y. The data warehouse has been monitoring the queues information it receives from the roadside and now notices that wait times at a certain terminal gate has exceeded a set threshold. The data warehouse passes this information onto the Freight 511 system, which has been displaying the wait times in real time and now creates an alert icon to show it has exceeded a certain threshold. In addition, automated alert notifications are sent to the truck company dispatchers who have signed up to receive information regarding wait times.

Earlier that day at 1:00 p.m., at the Freight TIS, staff receive a notice that there will be planned construction near the Port the following day from 9:00 a.m. till 3:00 p.m. This will impact one of the main arterials in the area and create delays. The Freight TIS staff enter this information into the Freight 511 system. Later that day at 3:00 p.m. as local dispatchers are building their schedule for the next day, they notice this construction alert on the Freight 511 web site. They modify their schedules accordingly and are able to make all their runs on time.

The following week, Freight TIS holds the quarterly meeting of the ongoing Goods Movement Efficiency Committee. This committee, established by the Freight TIS as an outgrowth of the Gateway Cities Technology Plan for Good Movement ITS Working Committee, continues to actively meet and discuss how technology can continue to improve goods movement in the region. At this meeting, the Freight TIS staff are presenting a project that a stakeholder on the committee will soon be commencing. This project received a grant which was prepared with assistance from the Freight TIS staff. Later on, the agenda for the same meeting is the annual performance monitoring report. As part of the Freight TIS' normal operations, they create an annual report on good movement flows in the region. They are able to track key freight traffic congestion, enforcement, and reliability metrics. The stakeholders in the region use the report every year and utilize it (both private and public sector) for their business planning.

2.5 **SCOPE OF THE PROJECT**

1. **Data Warehouse Requirements Definition.** During this step, the project team will work closely with the data dissemination project team and freight traveler data sources – including public agencies and private entities – to achieve the following:

   a. **Data Structure Requirements Definition.** The project team will work with the data sources – public agencies and private entities – to identify the available data structures and evaluate them with regard to what are
desirable to the users and end users as disseminated data. To comply with Federal requirements, the project must consider the open-source requirements by the FHWA. The project team should also consider adopting the Traffic Management Data Dictionary (TMDD) standard by the Institute of Transportation Engineers (ITE) in the definition of data structures and data formats.

b. Network, Communication, and Server Requirements Definition. The project team will work with the agencies providing data and the data dissemination team to define the requirements for the network and communication interfaces requirements. The location and requirements will also be defined for the server that will be hosting the data fusion system. Principal areas of considerations will include the following:

i. Connections and communication interfaces to all regional TMCs, Information Exchange Network (IEN), and RIITS networks will need to be defined; and

ii. The server that will be hosting the data warehouse can be located in the same facility as Freight TIS if hardware and network requirements are met.

2. Data Warehouse Development and Deployment.
   a. The data fusion database will be developed based on the defined data structure requirements;
   b. Software Update and Development. New software will be developed and existing software systems in the region will be updated to support data fusion; and
   c. The developed database and software will be deployed on the data warehouse.

3. Data Warehouse Test, Integration, and Verification. Once the data warehouse system has been developed, testing and verification will be performed to determine if the requirements have been met. This includes the following:
   a. Test and validate that the system is pulling data from the regional TMCs and networks;
   b. Test and validate that the data is being integrated properly;
   c. Test and validate that the system is sending data out to the data dissemination system; and
   d. Develop ongoing process for data validation – this is part of data warehouse but outside confirmation is also needed.

4. Develop Freight TIS Functional, System, Staffing, and Facility Requirements. The functional requirements for the Freight TIS will be developed. It will begin with a detailed Concept of Operations (ConOps)
outlining the specific functions, which the Freight TIS will need to achieve. That ConOps will lead to functional requirements, staffing requirements, system requirements, and finally a series of facility requirements. The staffing requirements plan will identify the number of full-time equivalents (FTEs) needed to perform the anticipated functions during the hours of operations and define positions and duties. Off-peak (24x7) coverage will be required. The system requirements would include the physical hardware requirements developed for the data warehouse. There would also be some general office and limited engineering Information Technology (IT) support requirements for staff. The Freight 511 information dissemination specifications would be developed under a separate project and detailed in Section 3.0 of this report, but would require rigorous coordination with this effort. The facility requirements plan will identify the space needed for staff, IT equipment, workstations, etc. Many TMCs also design their space to accommodate meetings and training; this should also be considered as part of these requirements in light of the recommendation to have a Goods Movement Efficiency Committee to coordinate and keep these projects moving forward.

5. **Identify and Assess Alternatives for Freight TIS Facility.** Once the facility requirements are developed, an assessment can be made as to where best to locate both the Freight TIS and the data warehouse. There are several options in region, including a variety of existing TMCs. Options include:

a. Co-locate with Los Angeles County Department of Public Works Transportation Management Center (LACDPW TMC);
b. Co-locate with City of Long Beach TMC;
c. Co-locate with LA 511; and
d. Co-locate with the ATMIS system at the Joint Command and Control Center (JCCC).

An initial assessment of some of the pros and cons of each alternative is shown below.

<table>
<thead>
<tr>
<th>Option</th>
<th>Benefits</th>
<th>Drawbacks</th>
</tr>
</thead>
</table>
| LACDPW TMC        | • Co-locating with the LACDPW TMC would provide access to an existing, regional, dedicated TMC facility and ready access to Caltrans and LA County traffic information. | • Does not support 24x7 operations.  
• LACDPW focus on arterials.  
• Need for interagency agreement to set parameters for space sharing, reimbursement of costs, access, etc. |
| City of Long Beach TMC | • Has existing communications link to ATMIS.  
• Existing facility. | • Smaller municipal TMC may not offer the off-peak hours and other resources needed to support freight traffic on a regional basis.  
• Need for interagency agreement to set parameters for space sharing, reimbursement of costs, access, etc. |
<table>
<thead>
<tr>
<th>Option</th>
<th>Benefits</th>
<th>Drawbacks</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATMIS</td>
<td>• Has existing communications and existing facility.</td>
<td>• Due to a variety of very valid security concerns, could institutionally be difficult to achieve.</td>
</tr>
<tr>
<td>LA 511</td>
<td>• Existing facility.</td>
<td>• Is not a freight focused center.</td>
</tr>
<tr>
<td></td>
<td>• Would help support information dissemination by locating “at the source”.</td>
<td>• Not located in the Gateway Cities vicinity.</td>
</tr>
<tr>
<td></td>
<td>• Central source for traffic information dissemination.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Provides information services with customer service operators/</td>
<td></td>
</tr>
<tr>
<td>New dedicated facility</td>
<td>• Would be custom-designed to meet the needs of the Ports and freight community.</td>
<td>• Would be difficult to justify cost, given number of existing options and the small number of workstations needed.</td>
</tr>
</tbody>
</table>

Since there are a number of existing TMCs, it is not recommended that a new facility be constructed. One consideration would be to have the Freight TIS equipment and staff co-located with ATMIS, but it would be incorporated into the existing LA 511 system. There may also be other alternative sites not listed here and a first step should be to consider any other viable candidate location put forth by regional stakeholders. For the final alternatives, a rigorous alternatives analysis should be conducted. A simple and understandable quantitative methodology should be created using criteria developed in coordination with all the relevant stakeholders. Criteria could include cost, potential for expansion, access to key communication lines, etc. The final selection should be guided by the quantitative results, but ultimately must be a consensus-driven decision by the relevant stakeholders.

6. **Develop Job Descriptions and Organizational Plan.** The Job Descriptions and Organizational Plan will describe how the Freight TIS is run on a day-to-day basis, and roles and responsibilities of each key staff member.

7. **Freight TIS Build Out.** Build out Freight TIS in selected site and staff up required staff.

8. **Operate and Maintain Freight TIS.** Operate and maintain the Freight TIS as per the Operations and Staffing plans.

9. **Assess Effectiveness of Freight TIS and Monitor Performance and Effectiveness of the Deployed Technologies and Gateway Cities Truck Facilities.** Measures of effectiveness (such as reduced incident response and clearance times, delay, reliability, etc.) should be assessed on an annual basis and as needed for before/after evaluations of deployed technologies or systems.
2.6 **CONCEPTUAL DIAGRAM**

The data warehouse diagram (Figure 2.1) shows the various data sources coming in to the data warehouse for processing and output to a data dissemination server as described in the Information Dissemination project.

**Figure 2.1 Data Warehouse and Freight TIS**

- **Freight TIS**
  - Freeway speeds, volume, incidents, closures, and video feeds
  - Container moves productivity data
  - Incident messages (freight focused), truck parking, enforcement information
  - Operator alerts, third-party weather data

- **Data Warehouse / Dissemination Database**
  - Fused Freight Traveler Information

- **Data Sources**
  - Caltrans ATMS
  - RIITS
  - ATMIS
  - Freight TIS
  - 511
  - LA County/Local Cities
  - CHP
  - 3rd Party Freight Operators
  - TENS
  - MTOs
  - 3rd Party Private Data Vendors
  - Arterial speeds, travel times, volume, incidents, and video feeds
  - Freeway incidents, closures
  - Fleet vehicle locations, speeds, parking availability
  - Enforcement information
  - Goods movement information at terminals and rail yards
  - Speed data, travel times, weather
2.7 SCHEDULES AND PHASING

The following is a tentative schedule. Both of these project components would continue indefinitely beyond the full deployment.

Data Warehouse

The data warehouse development should occur as the Freight TIS concept is being developed. The following tentative schedule assumes the Information Dissemination project is progressing concurrently. Close coordination with the Information Dissemination project will be necessary.

- Month 1 Finalize Requirements – Data Structure;
- Month 1 to 3 Finalize Requirements – Network Connections;
- Month 4 to 8 Database Development, Update or Build Software;
- Month 9 to 12 Installation, Test, Integration, and Verification; and
- Month 13 and beyond Data Dissemination beta- and full deployments.

Freight TIS

- Month 1 to 6 Develop Freight TIS functional, system, staffing and facility requirements;
- Month 6 to 10 Identify and assess alternatives for Freight TIS facility;
- Month 6 to 10 Develop job descriptions and organization plan;
- Month 11 to 15 Build out Freight TIS facility, if necessary; and
- Month 16 and beyond Operate, maintain, and monitor facility.

2.8 PRELIMINARY COST ESTIMATES

Freight TIS

<table>
<thead>
<tr>
<th>Capital Costs</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional, System, Staffing and Facility Requirements Plan</td>
<td>$450,000-$500,000</td>
</tr>
<tr>
<td>Freight TIS Assessment Study</td>
<td>$40,000-$60,000</td>
</tr>
<tr>
<td>Operations Plan</td>
<td>$40,000-$60,000</td>
</tr>
<tr>
<td>Prepare requirements to procure new software</td>
<td>$175,000-$225,000</td>
</tr>
<tr>
<td>Total</td>
<td>$705,000-$895,000</td>
</tr>
</tbody>
</table>
Operations and Maintenance Costs

- Ongoing annual costs  
  $100,000- $325,000 per year
  (at this stage costs could vary greatly based on outcome of planning exercises)

Data Warehouse

Capital Costs

- High Level Requirements  
  $50,000-$90,000
- Detailed Requirements (assume eight interfaces)
  - Data structure requirements  
    $120,000-$200,000
  - Networking, communication, API requirements  
    $120,000-$200,000
- Development and Implementation
  - Data warehouse  
    $300,000-$500,000
  - Software development and upgrades  
    $150,000-$250,000
  - Networking, communication  
    $150,000-$250,000
  - Hardware (servers and networking equipment)  
    $60,000-$150,000
- Total  
  $950,000-$1,640,000

Operations And Maintenance Costs

- Ongoing annual costs  
  $200,000-$300,000 per year

Other Costs

- Addition of new data sources  
  $100,000-$125,000 each

Summary of Estimated Costs

- Freight TIS
  - Capital  
    $705,000-$895,000
  - Operations and Maintenance  
    $100,000- $325,000 per year
- Data Warehouse
  - Capital  
    $950,000-$1,640,000
  - Operations and Maintenance  
    $200,000-$300,000 per year
  - Addition of new data sources  
    $100,000-$125,000 each
2.9 **Users Involved**

The users who will be involved in this project include the following:

- Freight TIS Manager and Operators;
- Freight 511;
- Metro;
- Freight TIS Software Developer;
- Data Warehouse Developer;
- RIITS Developers;
- Caltrans;
- LA County;
- Local cities;
- CHP;
- Third-party data providers;
- MTOs;
- Rail yards; and
- Trucking Companies:
  - Dispatchers, and
  - Truck drivers.

2.10 **Roles and Responsibilities**

The agency that takes ownership of the data warehouse will be responsible for procurement and implementation oversight. This will include significant coordination with ATMIS, RIITS, 511, IEN, and others for the necessary integration efforts.

2.11 **Prerequisites**

Ideally, the arterial, freeway, enforcement, goods movement, and container moves productivity projects should be developed in parallel with the data warehouse and Freight TIS project. However, the data warehouse could be developed utilizing current data sources. Its full potential will only be realized, however, when all the projects have been developed and the Freight TIS is up and running to support its operations.
2.12 **SYSTEMS INVOLVED**

The following systems are involved in the project as sources and/or recipients of the data dissemination:

- RIITS;
- ATMIS;
- Freight 511;
- Caltrans District 7 ATMS – Freeway traffic information collected by Caltrans detectors is fed into the ATMS, and then to the freight data warehouse; and
- LA County IEN – Key arterials corridor traffic information is collected and fed to the IEN, and then to the freight data warehouse.

2.13 **POTENTIAL CHALLENGES AND OBSTACLES**

Institutional risks are high to obtain consensus and agreement on preferred concept.

Technical risks are high in the development of interfaces and data error correction methodologies.

A primary barrier is the apprehension of the private sector to provide data that is proprietary or could give competitors an edge. Pilot demonstration projects under the container moves productivity project should be developed to demonstrate to the private industry that the data provided from and to them can be cleansed to become anonymous data points but nonetheless, the data received by them will be valuable and useful to them for their operation.

2.14 **COORDINATION AND INTEGRATION WITH OTHER PROJECTS**

The freeway and arterial smart corridor projects and the container moves productivity/monitoring projects will provide the new field data processed, monitored and disseminated by the Freight TIS and data warehouse.

The Freight TIS project will be implemented in parallel with the data warehouse. Therefore, it may be necessary to perform integration efforts to add data into the data warehouse and data dissemination systems after the Freight TIS project is completed.

Coordination for truck enforcement will also be needed and an outcome.
2.15 OUTCOMES

The successful deployment of a Freight TIS is expected to contribute to improvements in the following areas:

- Better management of congestion at the Ports of LA and Long Beach, I-710 freeway and the arterial corridors;
- The ability to detect, respond to, and alert others of, freight-impacting incidents;
- The ability to disseminate fused, freight-related information collected by the Gateway Cities freeway, arterial and container moves productivity projects;
- Increased availability of freight traveler information;
- Goods movement (container) productivity improvements;
- Reduced queue and turn times; and
- Enforcement coordination.

2.16 INITIAL STEPS FOR DEPLOYMENT

- Develop stepped approach to deployment.
- Develop and implement pilot demonstration projects as part of the container moves productivity project.
- Secure funding for project development and ongoing Freight TIS operations.
- Identify gaps in ATMIS, Caltrans, and local TMC system functionality and coverage for development of Freight TIS software specific to freight movement.
- Decide whether to move forward with Freight TIS manager position (as discussed by working group). The Freight TIS manager could then be tasked with leading the project forward.

2.17 NEEDS ADDRESSED

- **Lack of Operator and Maintainer for ATMIS.** The Freight TIS project would provide operators who would have access to ATMIS and associated devices (such as Changeable Message Signs (CMS) and detection;
- **Lack of freight-focused TMC.** This project would directly address the need for a freight-focused TMC; and
- **Lack of coordinated, freight-focused incident management.** A function of the Freight TIS will be to provide a freight focus for incident management in coordination with and support for regional partners.
3.0 Freight Traveler Information Dissemination

3.1 PROJECT OVERVIEW

This project will receive the processed (fused) freight static and real-time traveler information from the Freight TIS/Data Warehouse project and disseminate the fused freight static and real-time traveler information to a variety of users, including drayage and trucking companies, truck drivers, private freight traffic information providers, and public agencies. To accomplish the freight traveler data dissemination, this project will develop a Freight Traveler Information Dissemination System, Freight 511 web pages (freight focused information housed within the current LA SAFE 511), and a Spanish 511 Interactive Voice Response (IVR). The Freight511 web pages will provide information in English and Spanish. (It should be noted that LA SAFE is currently testing 511 in Spanish. Therefore, it could be removed from this project as that effort progresses).

It should be noted that many of the technologies demonstrated and discussed at the Vendor Showcases could be one of the keys to the deployment of this project. Specifically, this applies to the navigation, mobile application, and traffic management/data integration arenas. The cutting edge technologies that are being developed today were the foundation of the development of these projects. See the Gateway Cities Technology Plan for Goods Movement Vendor Presentations and Collaterals from the January 10 and 11, 2012 ITS Vendor Showcase #1 and Gateway Cities Technology Plan for Goods Movement ITS Vendor Showcase Day 3 Presentations and Materials Document reports for more details.

Finally, this project is closely aligned and in many ways related with the FRATIS ConOps, which is being developed by the FHWA.

3.2 PROJECT OBJECTIVES

- Increase availability and penetration of freight real-time and useful traveler information and ITS products into the freight community, including the Spanish-speaking freight community;
• Improve mobility, reliability, and safety for all motorists along key freeways and truck heavy arterials in the subregion by providing more accurate real-time traveler information;

• Enable and encourage the private sector to develop innovative freight information products and freight-related services;

• Improve efficiencies of the regional freight operations by enabling MTOs, rail yards, drayage dispatchers and truck drivers to make efficiency improvement decisions; and

• Reduce congestion and air pollution by optimizing drayage operations, reducing idling time and bobtails/dry runs, reducing truck trips, and providing information trucking companies can use to develop dynamic routing capabilities.

3.3 PROJECT DESCRIPTION

Fused freight real-time and static traveler information from a variety of sources (see Section 2.0) will be received and stored in a centralized freight traveler information database that is deployed on secure physical servers or cloud servers. The information will then be disseminated to users via various mediums, including the Internet, interactive voice response (IVR) telephone systems, and smart phone apps. The fused freight real-time traveler information provided will include estimated truck gate arrival times or locations (real-time), port gate queue times, port area closures, arterial and freeway travel times, alternative routes, arterial and freeway incidents, weather alerts, video camera feeds, etc. Static information could include truck parking locations (free truck parking locations and/or those that may be available for a fee with contact information), prohibited truck routes, oversize/overweight prohibited truck routes, etc. A pseudo reverse 911 could be implemented for emergency situations as part of this project through automated notification techniques via e-mail or audio alerts (pushing of traffic data). External public and private service providers will be able to request and receive the data via an API and/or Web services. These external users will be able to utilize the data - or more likely, subsets of the data - for their web sites and mobile apps, and deliver repackaged useful information to their end users in the freight community, such as drayage dispatchers and truck drivers.

Freight-focused 511 web pages in English and Spanish will be developed within the existing LA SAFE 511 system. These web pages will disseminate fused freight traveler information directly to the end users. In addition, a Spanish 511 IVR system will be developed to improve access to freight traveler information by Spanish-speaking callers.
3.4 HYPOTHETICAL OPERATIONAL NARRATIVES/EXAMPLES

Improving the Efficiency of Drayage Dispatchers

Compton Drayage Inc. is a drayage firm with 100 trucks that perform runs to and from the Port of Los Angeles (POLA) and Port of Long Beach (POLB). To make dispatching decisions, the Compton drayage dispatchers rely on a wide array of information sources. They access the 511 IVR phone system and web sites; check traffic conditions on digital maps (e.g., Google Maps), watch traffic camera feeds on the California Department of Transportation (Caltrans) web site, obtain information from truck drivers, and read weather reports on local television news web sites. The fractured nature of these information sources means that the dispatchers often have to navigate among several different sources—a complicated process.

The fused freight real-time traveler data from the Freight Traveler Information Dissemination System provided a good solution. With a moderate budget, Compton Drayage hired an IT development firm to develop a custom web-based system to organize and display the freight traveler information received via an API. They are now able to configure how the information is displayed to suit their priorities. The new customized displays include queue times at the port terminals and congestion conditions for the sections of I-710 freeway and arterial corridors of routes used for drayage runs. As a result, the real-time decision-making process for the routing and scheduling of trucks in real-time by Compton Drayage’s dispatchers has been streamlined, and the company has benefited from significant improvements in operation efficiency. Before the system was implemented, it was difficult for truck drivers to maintain their schedules after their first appointment of the day due to unknown queue times and traffic congestion. The new system fills these information gaps and enables Compton Drayage’s dispatching system to automatically adjust the schedules when the queue times and traffic conditions change. Thus, Compton Drayage’s dispatchers now provide better assistance to help its truck drivers maintain their appointment schedules throughout the day. They can also (by dispatch or by truck) predict location and arrival of a truck to the terminal gate and provide that information to the MTO to coordinate scheduling for container pickups.

Mobile Applications Help Truck Drivers with Accurate Freight Traveler Information

Travel Mobility Inc. is a mobile applications developer currently in the business of providing Los Angeles area commuters and taxi drivers with traffic-related data and dynamic routing via smart phone applications. They have long sought to enter the market to provide freight travel information to truckers, but have not been able to do so due to a lack of high quality and reliable sources of freight
traveler data. The recent deployment of the Freight Traveler Information Dissemination System removed this information gap.

With the data from the Freight Traveler Information Dissemination system, Travel Mobility Inc. developed a series of iPhone and Android applications for truck drivers in the Los Angeles region. Using the software development kit (SDK) to be provided, the company designed and developed these mobile applications to communicate with the dissemination server using API and/or web service. Considering the fact that many truck drivers in the Los Angeles region are Spanish speakers, Travel Mobility designed an English/Spanish bilingual user interface (UI) for these applications.

Jose Gonzalez is one of the Travel Mobility’s customers. Mr. Gonzalez works as a truck driver for a Pico Rivera-based drayage company. On an average day, he makes several runs to the POLA and POLB along the I-710 and key arterial corridors. He is normally able to arrive at the Ports on time for his first appointment of the day, but due to roadway congestion and prolonged queue times, he often misses his subsequent appointments. This was frustrating to him and caused tension between Mr. Gonzalez and his dispatchers. Recently, he decided to download Travel Mobility’s mobile application to his iPhone, and he has been using it ever since to check traffic conditions and terminal queue times at the Ports. Since Mr. Gonzalez is a Spanish speaker, he likes the Spanish UI on the application. Based on his schedules and the current traffic and queue times, the application recommends to him the best routes that minimize his travel time by avoiding the trouble spots, and helps him arrive at the terminal on time. Since Mr. Gonzalez started using the application, he has seen approximately a 10-percent decrease in his total travel time and a 15-percent reduction in his fuel consumption.

A Truck Driver-Friendly GPS

BamBam, Inc. is a manufacturer of GPS navigation devices. The company has recently announced that its HD Traffic service, which displays traffic conditions and rerouting possibilities to help users get to their destinations sooner, is now available on its entire line of live navigation devices. However, many truck drivers who use BamBam’s GPS in the southern portion of the Los Angeles area have complained that the HD traffic information has been mostly limited to the freeways, while traffic information for many key freight arterials routes were blanked out. This was due to a lack of arterial corridor information available to BamBam in the region.

The product managers at BamBam became aware of the Freight Traveler Information Dissemination project at one of the project’s outreach conferences. They realized this project would enable them to include arterial traffic data as part of their HD Traffic service, and this would make their service more desirable to truck drivers. A decision was quickly made at BamBam to become a Freight Traveler Information Dissemination System user in order to obtain the arterial corridor traffic data.
Using the SDK provided by the Freight Traveler Information Dissemination Project, BamBam’s product development team was able to incorporate key arterial traffic data into its HD traffic service. BamBam’s truck driver customers in the southern Los Angeles region are now able to view traffic conditions on arterial routes, such as Alameda Street and Long Beach Boulevard. A survey conducted among these BamBam customers shows that they have seen an average of 5- to 10-percent reduction in travel time since the arterials traffic data became available via the HD Traffic service. In addition, the arterial traffic data also is used by non-freight users of BamBam’s HD Traffic service. These users also are able to avoid congested spots or sections of the roadways, and this has helped further reduce the severity of the congestion in the region.

### 3.5 Scope of the Project

1. **Needs Analysis and Requirements Definition.**
   a. This project will build upon the needs analysis and requirements development performed for the earlier phases of this project and documented in User Needs Summary.
   b. Definition of this project’s system requirements will include the following:
      i. General system description, including features and functions;
      ii. System capabilities, conditions, and constraints; and
      iii. System interfaces.

2. **High-Level Design and Development.**
   a. Freight 511 Web Pages and Spanish 511 IVR Design (in close coordination and consistent with LA 511):
      i. The Freight 511 web page will be designed to provide important freight related traveler information to the English and Spanish speaking freight community. Visitors to the web page will be able to easily choose a language and switch between the two languages. The layouts and structures of the web pages will make it easy for drayage dispatchers and truck drivers to quickly access freight traveler information such as port gate queue times, port area closures, terminal operations, arterial and freeway travel times, arterial and freeway incidents, weather alerts, video camera feeds, etc.
      ii. In addition to the full web browser version of Freight 511, the feasibility of providing a simplified mobile web browser version for mobile users will be explored. This would be intended for mobile users who prefer to use a mobile web browser instead of utilizing an application.
iii. A 511 Spanish IVR for Spanish-speaking freight users will be designed to closely mirror the functionality of the English 511 IVR.

b. Freight Traveler Information Dissemination Database Design. The project team will be working closely with the Freight TIS/Data Warehouse project team to determine the scope and structure of the freight traveler information database and its interface with the data warehouse. The needs of web and mobile developers will be among the key considerations for the design of the database.

c. API and Web Service Development. The project team will research and select a set of proven technology options for the API and web service.

d. SDK Provision. The project team will develop an SDK for web and mobile developers. The SDK will include complete documentation and sample codes.

e. Server, Security, and Scalability Design. While the data warehouse will likely be hosted in a physical facility, the data dissemination server will be deployed on secure server(s) that can be either physical or cloud based. Since the data may be distributed to a large number of providers that make frequent requests to the servers, load-balancing and scalability requirements must be addressed. Cloud hosting options, such as Amazon AWS, Google Cloud Services, or Microsoft Azure, should be considered as they offer highly elastic server capacity and low maintenance costs. If cloud hosting is used, the database in the cloud can be a mirror of the fused freight travel information database that is hosted on the operating agency’s physical server.

f. User Interface Design. A high-level design will be conducted to define the types of user interfaces. The user interfaces should be designed to meet the high-level needs associated with the delivery format for the various categories of users.

g. Software Requirements Specification (SRS). The project team will create a complete SRS document.

3. Detailed Design and Development. A detailed design and development of the Freight Traveler Information Dissemination System will be conducted by a team of software developers, network engineers, and system engineers. It is recommended that both data warehouse and data dissemination projects adopt the TMDD standard by the ITE. It is also recommended that the design and development incorporate LA 511 specifications.

The design and development of the Freight 511 English and Spanish web pages will occur in conjunction with the development of the Freight Traveler Information Dissemination System. Since the web pages will most likely draw heavy web traffic and a large number of data requests during peak hours, the stability and scalability of the web page will be an important design consideration. The web page responses should remain constant
regardless of the web traffic load. To enable such scalability, it is recommended that proven and robust technologies from the Web 2.0 consumer Internet sector be utilized in the development of the Freight 511 web pages. The project team should consider utilizing an experienced consumer Internet technology expert for the development process.

The design and development of the Spanish 511 IVR will occur in conjunction with the modification of the English 511 IVR to include freight-related traffic information. The information provided by the Spanish 511 IVR should simply be a translation of the information provided in the English version. The menu selections should also mirror the options offered in the English version. The project team will need to estimate number of calls that will be received by the Spanish 511 IVR in order to determine how many phone lines will be needed.

4. Testing and Verification. Once the Freight Traveler Information Dissemination System has been developed, testing and verification will be performed to determine if the system meets its design requirements.
   a. Test and validate the database design and server configuration;
   b. Test and validate that the system is pulling data from the data warehouse project; and
   c. Test and validate that the system is pushing data out to users and end users on demand.

Once the Freight 511 web pages and Spanish 511 IVR have been developed, testing and verification will be performed to determine if they meet their design requirements.
   a. Test and validate that the functions, features, stability, and scalability of the completed Freight 511 web pages meet the design requirements; and
   b. Test and validate that the functions of the completed Spanish 511 IVR meet its design requirements.

5. Limited (Beta) Deployment. During this step, the Freight Traveler Information Dissemination System will be further tested with a limited beta deployment.
   a. Selected web site designers and applications developers will be invited to participate in the test. Their web sites or applications will be connected to the system and will pull data via API or web service.
   b. Selected public agencies will be invited to receive data from the system.
   c. The performance of the system with a limited deployment will be measured and evaluated. Problems and issues that arise will be identified and rectified.
Likewise, the Freight 511 web site will also be tested with a beta deployment.

a. While selected users will be invited to participate in the test, the web site will be open to the public. The web site should include a main page indicating that the site is in a beta state of development, and request that users provide feedback on their experiences with the web page. Each page should provide a link by which comments can be easily submitted to the development team.

b. The performance of the web site will be measured and user feedback will be collected. Problems and issues that arise will be identified and rectified.

The Spanish 511 IVR will also be tested with a beta deployment.

a. The completed Spanish 511 IVR will be beta tested by inviting Spanish-speaking users to participate in the beta deployment.

b. The system performance of the IVR will be measured and feedback will be collected. Problems and issues that arise will be identified and rectified.

6. Marketing and Outreach.

a. The project will target Spanish-speaking users in the freight community by conducting a publicity campaign to promote the Spanish Freight 511 and Spanish 511 IVR. Radio, television, print-media advertising, direct mail, and e-mail marketing are some of the options to be considered.

b. The project will reach out to the web and software developer community to promote awareness of the availability of freight traveler information data.

c. The project team will build demo web pages and develop applications to demonstrate how the data can be used to improve freight operations. The web pages and applications will have English and Spanish user interfaces.

d. The project team will highlight successful web sites or applications developed by private companies that utilize disseminated freight travel information.

e. The project team will be able to conduct product design contest campaigns, such as application rodeos for the web and applications development community.

f. The project team will reach out to influential venture capital firms and angel investors that are well connected in the technology community in order to recruit potential startup companies in the web and mobile applications space to develop innovative freight travel information products.
g. The project team will create and maintain an active social media presence on Facebook and Twitter for Freight 511. This will enable the Freight 511 staff to communicate effectively with its users and keep them informed of the latest freight travel-related information and new developments in Freight 511 services.

7. **Full Deployment.** Once the limited beta deployment of the Freight Traveler Information Dissemination System has successfully been completed, the system will be enabled for a full deployment. The system will be ramped up to its full designed capacity and its data will be made available to all users.

The Freight 511 web pages and the Spanish 511 IVR will also be fully deployed in a similar fashion.

8. **Operation, Maintenance, and Support.**
   a. The Freight Traveler Information Dissemination System will be operated and maintained by a team of software, network, system engineers, and system administrators.
      i. Scheduled maintenance will ensure that the system is performing at its designed capacity. Periodic maintenance should be scheduled during times when extremely low traffic is expected.
      ii. Technical support will also be provided to users who operate web sites and applications that utilize the Freight Traveler Information Dissemination System data. This will ensure the users will have the support they need to resolve any issues that may arise between the data dissemination system and their web sites and applications.
      iii. The support staffing levels will depend on the operations budget, and the agency that will eventually be selected or formed to maintain the data warehouse and data dissemination systems. Sharing support staff from other systems, such as RIITS and 511, should be considered.
      iv. The performance of the system will be reviewed on a regular basis.
   b. The Freight 511 web pages will be operated and maintained by the Freight TIS web site administrators. Technical support will be provided to its users by the Freight TIS technicians. It is recommended that technical support be conducted primarily via e-mail, submission forms on the web site, or via live chat. The Freight 511 Facebook page and Twitter page will be used to announce down times for the web pages or possible performance issues to its users.
   c. The Spanish 511 IVR will be operated and maintained by the same staff that operates the English 511 IVR.
3.6 **CONCEPTUAL DIAGRAMS**

Figures 3.1 and 3.2 illustrate the participants and data flows involved in both data warehouse and data dissemination.

**Figure 3.1 Data Warehouse**

[Diagram showing data sources and data warehouse with labels for various data types and sources.]
3.7 SCHEDULES AND PHASING

The following tentative schedule for the following phases for the project, assumes the Data Warehouse project is progressing concurrently. This project would continue indefinitely beyond the full deployment. Close coordination with Data Warehouse project will be necessary.
3.8 **Preliminary Cost Estimates**

As many specifics of the Data Warehouse and data dissemination projects are yet to be worked out, the following list of costs is provided with rough estimates:

### Capital Costs

<table>
<thead>
<tr>
<th>Item</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirements</td>
<td>$80,000-$150,000</td>
</tr>
<tr>
<td>Data Dissemination System Development</td>
<td></td>
</tr>
<tr>
<td>- Database Development</td>
<td>$150,000-$250,000</td>
</tr>
<tr>
<td>- Communication Interface (API/web service/XML)</td>
<td>$400,000-$600,000</td>
</tr>
<tr>
<td>- Server and networking</td>
<td>$110,000-$170,000</td>
</tr>
<tr>
<td>- Software and development tool licenses</td>
<td>$10,000-$20,000</td>
</tr>
<tr>
<td>- System Deployment</td>
<td>$80,000-$150,000</td>
</tr>
<tr>
<td>Improvements to Existing Systems (RIITS and 511)</td>
<td>$80,000-$150,000</td>
</tr>
<tr>
<td>Freight 511 Web Page Development</td>
<td>$40,000-$75,000</td>
</tr>
<tr>
<td>Freight 511 Spanish IVR Development</td>
<td>$500,000-$750,000</td>
</tr>
<tr>
<td>Marketing and Outreach</td>
<td>$200,000-$400,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$1,650,000-$2,715,000</strong></td>
</tr>
</tbody>
</table>

### Operations and Maintenance Costs

<table>
<thead>
<tr>
<th>Item</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ongoing annual costs</td>
<td></td>
</tr>
<tr>
<td>- Data Dissemination System</td>
<td>$150,000-$300,000 per year</td>
</tr>
<tr>
<td>- Freight 511 Web Page</td>
<td>$150,000-$250,000 per year</td>
</tr>
<tr>
<td>- Spanish 511 IVR</td>
<td>$1,200,000-$1,800,000 per year</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$1,500,000-$2,300,000 per year</strong></td>
</tr>
</tbody>
</table>
Other Costs

- Pilot Demonstration Project\(^1\)
  - Capital $360,000-$610,000
  - Operations and Maintenance $75,000-$145,000 per year

Summary of Estimated Costs

- Capital $1,650,000-$2,715,000
- Operations and Maintenance $1,500,000-$2,300,000 per year

3.9 **Users Involved**

The users who will be involved in this project include the following:

- 511 website administrators;
- 511 IVR administrators;
- Caltrans;
- Metro;
- LA County;
- Local Cities;
- California Highway Patrol (CHP);
- Advanced Transportation Management Information System (ATMIS);
- RIITS developers;
- GIS providers, such as Google Map, Navteq, and TomTom;
- Navigation device manufacturers and service providers, such as Garmin and TomTom;
- Web sites and applications developers/operators;
- Drayage and trucking company dispatchers;
- Drayage and truck drivers;
- MTOs; and
- Rail yards.

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\(^1\) The pilot demo project includes demo versions (approximately one-half of the overall) of data dissemination and Freight511 web page, but it does not have a Spanish IVR component.
3.10 **ROLES AND RESPONSIBILITIES**

The agency that operates the data dissemination database and server will be responsible for the maintenance of the system. To ensure that the system provides accurate freight traveler data, the agency should maintain reliable connections between the data dissemination server and data warehouse.

The same agency also will be responsible for providing the API and/or web service that will be used to request and receive data. It should prepare the SDK that will be used for the development of web sites and applications.

The public agencies and private sector service providers that receive the disseminated information will be responsible for the development of their web sites and applications. They will also be responsible for the deployment, hosting, and maintenance of their web sites and applications.

The RIITS and 511 staff will be responsible for making upgrades and changes to their systems to accommodate the disseminated data. Likewise, the 511 staff will be responsible for the development and the operation of the Freight 511 web pages and the Spanish 511 IVR.

3.11 **PREREQUISITES**

1. **Fused Data from the Freight TIS/Data Warehouse project.** The Freight Traveler Information Data Dissemination project is dependent on the availability of the fused data from the Freight TIS/Data Warehouse project. Therefore, completion of the Data Warehouse project is a prerequisite for the Freight Data Dissemination project. In advance of receipt of the data, the design teams for both projects will need to work together to establish the data structure and other database parameters for the interface between the two system. The two project teams should work closely together during all phases of their projects.

2. **Systems that will be providing data to the Freight TIS/Data Warehouse project.** Since the Freight Data Dissemination project is dependent on receipt of fused data from the Freight TIS/ Data Warehouse project, completion of the projects that provide data to the data warehouse and their interfaces to the data warehouse are also pre-requisites for the Freight Traveler Information Data Dissemination project. While some of the data are already available from existing equipment and systems, the Arterial Smart Corridors for Freight project, the Freeway Smart Corridors projects, and Container Moves Productivity Improvements projects all include critical data and information to support the success of this project.
3.12 **SYSTEMS INVOLVED**

The following systems are involved in the project as sources and will be recipients of the Freight Traveler Information Dissemination System:

- **RIITS.** Provides freeway speeds, volume, incidents and video feeds received from Caltrans and arterial traffic and incidents information from the local transit agencies.

- **Caltrans District 7 ATMS.** Provides freeway speeds, volume, incidents and video feeds collected by Caltrans detectors and cameras via ATMS.

- **ATMIS.** Provides port area closures, detector data, video feeds.

- **511.** Provides freeway speeds, volume and incidents received from Caltrans, CHP, and LA County IEN, as well as weather alerts from Weather.com. Will be a recipient of fused data to provide to its end users on the Freight 511 web pages and the 511 IVR.

- **LA County IEN.** Provides arterial corridor speeds, volume and incidents.

- **California Highway Patrol.** Provides freeway incidents and closures.

- **Freight TIS/Data Warehouse.** Compiled and processed data from the various other systems, specific freight alerts, freight detour routes, etc.

- **Local Cities TMCs.** Compiled and processed data or information from local cities such as prohibited truck routes, arterial data, etc.

3.13 **POTENTIAL CHALLENGES AND OBSTACLES**

A potential challenge may be the lack of private sector participation in the project, especially during the initial phases of the project. Efforts should be made to engage the private sector during all phases of the project to generate interest in working together.

The challenge for private sector involvement posed by freight-specific data collection is to alleviate their concerns regarding the anonymity and privacy of any data. This concern can be addressed through data cleansing and written agreements. Pilot demonstrations would be useful in working out these problems and barriers.

Public sector risks are similar to the Freight TIS/Data Warehouse project. This includes obtaining consensus and agreement on the concept and requirements, development of the interfaces, and updating existing systems.
3.14 COORDINATION AND INTEGRATION WITH OTHER PROJECTS

The data dissemination project team will need to work closely with the Freight TIS/Data Warehouse project during all phases of the project.

The Freight TIS project will be implemented in parallel with the Data Warehouse project. Therefore, it may be necessary to perform integration efforts to add data into the data warehouse and data dissemination systems after the Freight TIS project is completed.

3.15 OTHER OPTIONS CONSIDERED

1. An incentive program to encourage private entities to develop applications or disseminate information was considered but not recommended. While dissemination of data via the private sector is important and should be encouraged, scarce public funds probably should not be used at this time to directly fund the private sector to disseminate the data.

2. There were additional channels for the dissemination of freight traveler information to the public that could be used instead of the network to be developed.
   a. ATMIS was considered as a possible primary provider of data dissemination. However, it was not recommended because it is more ports focused rather than regional.
   b. Since 511 is currently supplying traffic data to private traffic information providers, the 511 interfaces also could be used to provide freight-related traffic information to private freight traffic information providers.
   c. RIITS or Caltrans also could disseminate fused freight traveler data to users that are connected via their networks. However, when compared to 511, these systems are not intended for wide distribution of traveler information.
   d. An entirely new freight-focused traveler information site to disseminate the information was considered but not recommended due to the availability of a variety of existing traveler information sites in the region.

3. Rather than hosting the data dissemination system on physical servers at a local site, such as at Metro or ATMIS, a cloud-hosting option could be considered. The data dissemination system could be deployed on secure server(s) that would be cloud based. Since the system will be sending data to a large number of providers that makes frequent requests to the servers, load-balancing and scalability requirements for the system must be considered before a decision is made. Cloud-hosting options, such as Amazon AWS, Google Cloud Services, or Microsoft Azure, should be
considered as they offer highly elastic server capacity and low maintenance costs.

4. Development of a simplified Freight 511 web page for mobile web browser could be considered. Users would be able to access this simplified version of the web pages from their phones, instead of utilizing an application.

5. Invite-only beta tests for the Freight 511 web pages was considered but not selected. This is because an invite-only beta test may not fully reveal potential stability and scalability issues that a beta-test that is open to the public would. However, a pilot demonstration project could be considered and cost estimates have been provided.

3.16 OUTCOMES

When freight real-time and static traveler information is successfully disseminated to the freight community, it is expected to contribute to improvements in the following areas:

- Increased availability of freight traveler information;
- Improved efficiency in drayage dispatching and trucking operations;
- Improved MTO operations;
- Reduced congestion at the POLA and POLB, I-710 freeway, and the arterial corridors;
- Reduced pollution in the Southern California region;
- A gradual creation of a vibrant market of private web and mobile freight travel informational products; and
- Lower shipping costs for goods that will benefit the commerce of the Los Angeles region and the overall economy of the nation and jobs for the region.

3.17 INITIAL STEPS FOR DEPLOYMENT

- Secure funding for data dissemination;
- Assemble a high-level project team; and
- Establish a liaison with Data Warehouse project.

3.18 NEEDS ADDRESSED BY THIS PROJECT

- **LA Safe 511 will be in English and Spanish.** The Freight 511 web pages will be in English and Spanish. There also will be IVR in both English and Spanish for users who call 511 to seek freight traveler information.
• **Arterial traffic data.** Travel time data on key arterials will be disseminated to users in the freight community.

• **More coordinated incident management.** Fused traffic data that is shared with agencies and authorities, and will enable better-coordinated incident management.

• **Long-term funding for communication systems.** Successful dissemination of freight traveler information will help build support by the public and various agencies for communication systems in the region, and increase the outlook for their long-term funding.

**Truck congestion.** Drayage dispatchers and truck drivers will be able to better optimize their runs by making more informed decisions.
4.0 Arterial Smart Corridors for Freight

4.1 Project Overview

This project will identify, collect, and use data from trucks and personal vehicles and/or roadside equipment to determine arterial corridors travel times within the Gateway Cities study area that serve major freight-related facilities; and will include the deployment or updating of signal coordination, improved signal systems, additional vehicle detection, CCTV cameras, and CMSs. These improvements will enable better freight traffic and incident management on arterials by generating data for real-time traffic information for region-wide exchange, dissemination, and use. This effort will be coordinated with Metro’s Countywide Significant Truck Arterial Network (CSTAN) study.

Providing arterial travel times is a new functionality that will be implemented as part of this project. Other improvements will be based on adding ITS improvements and filling gaps on identified routes.

It should be noted that many of the technologies demonstrated and discussed at the Vendor Showcases could be key to the deployment of the project in this section. Specifically, this includes the integrated corridor management and traffic management/data integration arenas. The cutting edge technologies they and others are developing today should be considered in the development of these projects.

Finally, this project is closely aligned with the Freight Advanced Traveler Information System (FRATIS) Concept of Operations which is being developed by the FHWA.

4.2 Project Objectives

- Reduce recurrent intersection delay and improve travel time reliability and information, fuel consumption, and emissions on designated truck route arterials through cross-jurisdictional signal coordination and updated signal controllers and systems.
• Fill ITS coverage gaps (detection, CCTV cameras, changeable message signs, and communications) along identified truck route arterials for freight traffic management and traveler information.

• Generate data for the provision of real-time traveler information to drivers and freight operators for the arterial highways.

• Improve incident detection and management on arterials, as well as improve freight traffic management and traveler information in response to freeway incidents and emergency situations.

4.3 PROJECT DESCRIPTION

This project will build upon the existing signal system improvement programs in the region, including the Los Angeles Department of Public Works (DPW) Atlantic Blvd/I-710 Corridor, the Telegraph Road/I-5 Gateway Cities project, the Traffic Signal Synchronization Program (TSSP), and IEN, to upgrade and repair traffic signal control systems, enhance signal coordination, address potential communications deficiencies, and install additional ITS detection and signing devices, for the purpose of improving freight mobility through enhanced corridor and incident management.

A working group of traffic agency and freight stakeholders will be established to solicit requirements, identify corridors, prioritize actions, and coordinate project efforts. A gap analysis will be conducted to identify the corridors, where additional technology and communications infrastructure are needed; and an implementation plan will be developed to prioritize improvements and develop a realistic plan based on available funding.

Plans, Specifications and Estimates (PS&E) packages will be developed for construction and installation of the field devices, traffic control systems and communications.

Data generated from this project will be made available to the Freight Traveler and Traffic Management System for dissemination to Freight 511, other systems, and third-party information providers. Arterial travel time information could be obtained from third-party data vendors as the first step in this project so this key piece of information is available to truck companies per the user needs. The usefulness of this data to drivers may depend on the efficacy of the predictive traffic algorithms and whether the information is delivered by a push or pull mechanism.

All installed field devices will be owned and operated by their local jurisdiction; with monitoring and control done at their own respective TMC. In some cases this is the LA County TMC. The connection back to the data warehouse will be made through LA County’s IEN system or video distribution network or through direct integration with local TMCs. Figure 4.3 illustrates this relationship.
4.4 HYPOTHETICAL OPERATIONAL NARRATIVES

Using Arterial Information to Make Better Travel Decisions

A truck is heading south on Alameda Street approaching I-105, and the driver sees an alert on a CMS that was posted by the local TMC. The alert informs the driver that the travel time to the POLB will be 40 minutes on the I-710 freeway, or 20 minutes if the driver uses I-110. This information provided on a key arterial truck route informed the driver of the more timely route, and he was able to make his next appointment.

4.5 SCOPE OF THE PROJECT

1. Establish a Needs/Requirements Definition Working Group. Multijurisdictional signal coordination requires significant cooperation between operating agencies. The working group will consist of signal operators and freight stakeholders, who will work together to identify the major freight corridors and jointly oversee the design and implementation of the project. The first task of the working group will be to solidify the requirements for the Arterial Smart Corridors project.

2. Identify and Assess Key Arterial of Significance for Goods Movement. Once the working group has determined the project requirements, the next step is to identify the arterial truck routes that are highest priority for the signal and ITS upgrades for freight traffic management and traveler information. Criteria could include:
   a. Whether route is designated a “key arterial of significance” for goods movement;
   b. Extent of existing ITS and communications;
   c. Key freight arterial routes experiencing V/C ratios approaching (0.90 ≤ V/C < 1.0) or exceeding (V/C ≥ 1.0) capacity;
   d. Proximity to freeways intersecting the project area, and
   e. Whether route is prohibited for trucks by the local agency.

Figure 4.1 presents an initial map of recommended arterials of significance for goods movement in the Gateway Cities area. This was developed based on the following:

- As part of the I-710 Corridor Project EIR/EIS, the I-710 traffic model was used to obtain existing and future (2035) average daily ports and non-ports truck volumes and p.m. period volume-to-capacity (V/C) ratios for local arterial roadway segments within the corridor. The congested arterial segments with existing or future port-related truck traffic were identified and mapped (as contained in the Task 1 Report).
Figure 4.1 Initial Arterials of Significance for Goods Movement
• Several of the truck routes (proposed) for the City of Long Beach were overlaid on those congested arterial segments with truck traffic.

• Gaps in these segments as well as parallel routes to major freeways were assessed to determine feasibility for use as detour routes in the event of a major incident. Where feasible, City and County documentation or web sites were reviewed to determine whether the arterial is designated as a truck route to recognize previously identified truck routes generally likely to be acceptable to the local jurisdiction.

• The arterials of significance for goods movement should be expanded beyond what is shown in Figure 4.1, through discussions with stakeholders, to include more arterials near warehousing districts and the Ports in order to gain adequate roadway coverage for traveler information and dynamic routing.

3. **Determine Status of Signal Timing Plans and Local Traffic Signal Control Systems.** The next step is to determine the status of signal timing plans for the intersections along designated arterial truck routes, and whether or not the traffic signal controllers are connected to a local TCS and TCSs are providing data to IEN.

Most of the signals along key arterials in the region were synchronized as part of TSSP and the Atlantic Boulevard/I-170 project. However, traffic signals along some of the routes were synchronized more than five years ago and may require updating. In addition, some signals may be in need of maintenance in order to obtain maximum utilization of the equipment.

The majority of the traffic signals along these routes have been connected, or there are plans to connect them to a central traffic control system. Additionally, 13 agencies are currently participating in a project to connect their Traffic Control Systems to the LA County IEN. However, a detailed inventory of the central systems and their status are needed.

4. **Inventory Existing ITS and Identify Gaps.** To determine exactly what ITS improvements are needed on the corridors, the locations of existing vehicle detection systems and other field devices, such as CCTV, CMS, and traffic signal controllers, as well as communications, needs to be inventoried and gaps identified.

The Atlantic Boulevard/I-710 and Telegraph Road/I-5 projects inventoried existing CCTV, vehicle detection locations, and traffic signal controllers within the project area; and the results will be posted on the Los Angeles County Department of Public Works (LACDPW) web site (http://dpw.lacounty.gov/TNL/ITS/i710/reports.shtml). This information can be utilized to complete the inventory of existing technology and communications.
An initial review reveals that very few CMSs have been installed on freight arterials. CMS should be provided at decision points prior to freeway on-ramps so that drivers may make a choice about which route to use.

Initial potential locations could include the following interchanges in all direction; some have multiple. They are illustrated in the following figure.

5. **Assess Technology Choices and Develop Recommendations.** For travel times and communications, multiple technology choices are available that must be assessed for applicability to the Smart Corridors for Freight. The LACDPW has completed an extensive communications alternative analysis for their ITS program. Currently, if fiber or TWP lines are not available, LA County uses wireless radio to establish communications from the field device to a communications hub. The cost of design and installing a wireless communication radio at each field device is approximately $15,000 with costs higher depending upon location and vicinity to existing communications infrastructure. Since vehicle classification data is desired by some of the public sector agencies for planning and monitoring purposes, some roadways may be equipped with technology to support purposes beyond travel times while others use other data sources. The first step may involve the purchase of third-party vendor data to expedite the implementation of arterial travel time data collection and dissemination. Later implementation may involve either replacement or supplementation of the vendor data with sensors, detectors, or other technology in order to obtain other desired arterial data such as volumes, truck classification, etc. This may be the most viable approach for the Arterial Smart Corridors. Some of the available technologies to measure travel times are:

a. Third-party vendor data. There are a variety of vendors currently offering accurate arterial speed data which could be converted into travel time data. No infrastructure would be needed for such a solution but other arterial traffic data would not be available from this approach (volumes, vehicle classification counts, etc.). Costs can also be high in comparison.

b. Bluetooth. This is the recommended approach, as it is the most cost effective; however, it does require a certain penetration of users to be effective. Software modules or upgrades may be needed at the local level to utilize the Bluetooth application. This approach also does not collect volume data and can have lower accuracy.

c. Magnetometers. Requires a small device and an Access Point and Repeater to be installed on a pole, resulting in a relatively high cost of installation. It also produces a very high match rate.
Figure 4.2  Initial Locations for Arterial CMS for Strategic Goods Movement Corridors
d. Automatic license plate reader (ALPR) cameras. This has been successfully implemented at various locations to measure travel time; however, the cost of equipment, design, and construction is high compared to other technologies.

e. Loops. Disruptive to install and maintain, but inexpensive. This approach is questionable for use towards deriving travel times.

f. GPS. This requires in-vehicle devices and access to the data, and may not be practical. There are also privacy concerns.

The following technologies are considered as candidates for establishing the necessary communications link between the field devices and the appropriate TMCs:

a. Twisted-Wire-Pair (TWP);
b. Coaxial cable;
c. Fiber Optic;
d. Wireless, leased and owned;
e. Analog phone line; and
f. Leased lines.

6. **Develop PS&E for Each Corridor.** PS&E for constructing field components and communication systems along the selected corridors will be prepared. The design will be consistent with the building codes and regulations of the jurisdictions where the devices are to be located. The PS&E packages will then be put out to bid. The PS & E will include the development and implementation of software needed to assess current travel times, calculate travel times and disseminate that information to drayage dispatchers, truck drivers or other stakeholders via the Freight TIS/Data Warehouse and Data Dissemination Projects. The PS & E will have to address the selection of data collection method(s) and that will impact the required algorithm design for calculating travel times. A model of arterial corridor analysis should define roadway segments that are then subdivided into links between data collection points (nodes). Comparison of the data collected at each of the nodes will then determine the time required for traffic to travel from one node to another. The system will have to be designed to be scalable so as to be capable of being modified to include additional data types and for geographical expansion without the need for major system redesign.

7. **Operational Agreements.** Operational agreements will need to be developed based on the requirements and design established in order for this project to be successful.

8. **Build Out Corridors.** This step will deploy, test, and integrate the equipment on the arterials, including integrating the new field components and communication systems with the local traffic control systems, IEN,
freight data warehouse, and other systems. The new signal timing plans will be developed and downloaded to the controllers.

9. **Operate and Maintain.** New or updated memorandums of understanding (MOU) between local agencies for synchronizing signals and operating ITS infrastructure on a multijurisdictional truck routes will be developed and signed. Depending on the approach selected and deployed, operations and maintenance will vary (e.g., if equipment is deployed, resources will be required to maintain it).

10. **Monitor and Evaluate Results.** This task will establish metrics based on user needs (stakeholders and commercial vehicle operators) and project goals to measure effectiveness. Measurements criteria of improvements will be based on effectiveness by comparing metrics collected before and after improvements are made.

### 4.6 Conceptual Diagram

As shown in Figure 4.3, the conceptual diagram illustrates multiple local jurisdictions with arterial ITS devices and coordinated signals. The information is shared through the IEN, video distribution network, or local TMCs, fused by the data warehouse, and shared with the Freight TIS.
4.7 SCHEDULE AND PHASING

The following tentative schedule is anticipated for the following phases for the project. This project would continue indefinitely beyond full deployment and the evaluation/monitoring tasks.

- **Month 1-2** Establish a Working Group;
- **Month 1-4** Identify and Assess Designated Arterial Truck Routes;
- **Month 1-4** Determine Status of Signal Timing Plans and Local Traffic Signal Control Systems;
- **Month 4-5** Inventory of Existing ITS and Identify Gaps;
- **Month 4-5** Assess Technology Choices and Develop Recommendations;
• Month 6-12  Develop PS&E for each Corridor;
• Month 13-20  Deploy, Test, and Integrate Equipment on Arterials;
• Month 18  Ongoing Operate and Maintain; and
• Ongoing  Monitor and Evaluate Results.

4.8 PRELIMINARY COST

From a preliminary review, the traffic signals along the key truck arterials routes for 13 agencies within the project area have been and will be synchronized by the TSSP program. As part of the IEN and Atlantic Boulevard/I-710 project, the 13 agencies within the project area will be able to remotely control the traffic signals within their jurisdictions, and send the traffic data to a central TCS and IEN.

The following is a planning-level cost estimate for implementing the remaining identified improvements on the key arterial corridors:

<table>
<thead>
<tr>
<th>Capital Costs</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inventory existing equipment</td>
<td>$50,000-$60,000</td>
</tr>
<tr>
<td>Analyze technology gaps</td>
<td>$40,000-$50,000</td>
</tr>
<tr>
<td>Signal synchronization (179 intersections)</td>
<td>$7,500-$15,000 per signal</td>
</tr>
<tr>
<td>Travel time measurement system (19 corridors)</td>
<td>$6,175,000-$7,125,000</td>
</tr>
<tr>
<td>CMSs (9 CMSs)</td>
<td>$250,000-$325,000 per CMS</td>
</tr>
<tr>
<td>Arterial data integration and sharing</td>
<td>$900,000-$1,200,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$10,750,000-$14,050,000</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operations and Maintenance Costs</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ongoing annual costs</td>
<td>$1,075,000-$1,400,000 per year</td>
</tr>
</tbody>
</table>

**Summary of Estimated Costs**

• Capital  $10,750,000-$14,050,000
• Operations and Maintenance  $1,100,000-$1,400,000 per year
Other Costs

- Use of Third-Party Vendor Arterial Travel Time Data
  - Capital $10,000-$20,000
  - Operations and Maintenance $25,000-$50,000 per year

4.9 **Users Involved**

The users who will be involved in this project include Metro, LACDPW, Gateway Cities jurisdictions, POLB and POLA, Caltrans, and freight stakeholders.

4.10 **Roles and Responsibilities**

Roles and responsibilities will include:

- Local Jurisdictions – Planning, Design, Deployment, Operations, and Maintenance;
- LACDPW – Planning, Design, Deployment, Operations, and Maintenance;
- Ports – Planning, Design, Deployment, Operations, and Maintenance;
- Caltrans – Planning, Design, Deployment, Operations, and Maintenance;
- Freight TIS – Operations, Information Dissemination, and Data Warehouse;
- Freight Stakeholders – Information Users;
- Metro – Provide funding, Program Oversight and Performance Measurement; and
- Others – Third-party data providers, other funding partners.

4.11 **Prerequisites**

The Freight TIS, Data Warehouse, and Freight 511 must be deployed and are ready to accept data from the Smart Corridors in order for the information dissemination and incident management functions to be successful.

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2 Estimate based on approximately 170 miles of arterial coverage.
4.12 **SYSTEMS INVOLVED**

The systems that will be involved with this project include:

- IEN;
- RIITS;
- Freight 511;
- Local Traffic Control Systems; and
- Freight TIS.

4.13 **POTENTIAL CHALLENGES AND OBSTACLES**

**Institutional Risk.** Moderate. Some local agencies may not have sufficient staff and/or budget to operate the system. It is critical that operations and maintenance funding be addressed as part of the project.

**Technical Risk.** Low for field devices, moderate for integration with the Freight TIS and RIITS.

4.14 **COORDINATION AND INTEGRATION WITH OTHER PROJECTS**

The Smart Corridors project will provide data for the Freight TIS/Data Warehouse project, and so should be coordinated closely so that the Freight TIS is ready to accept data and device control from the equipped arterials. The schedules for the two projects should be developed in parallel, and the respective project teams kept current on the projects’ progress.

The Freight 511 project will disseminate the information from the arterials. Therefore, the system requirements for Freight 511 need to include acceptance of arterial data, and the project schedule coordinated with the Smart Corridors.

4.15 **OTHER OPTIONS CONSIDERED**

Rather than having multiple jurisdictions operate the key freight corridor signals, it may be more efficient to have a single agency (such as LA County) have sole responsibility for entire corridors. However, this would require significantly more interagency coordination and more detailed MOUs for potentially little benefit if the current operation is sufficient.
4.16 **OUTCOMES**

When additional ITS infrastructure is deployed as a result of this project, it is expected to contribute to improvements in the following areas:

- Improved freight mobility on designated freight route arterials;
- Complete ITS coverage on key freight route arterials;
- Improved travel time reliability due to the availability of arterial traveler information for freight; and
- Improved arterial and freeway incident management through better detection and monitoring, the provision of freight-safe detours, and availability and dissemination of arterial data for dynamic routing capability and use by the private sector.

4.17 **INITIAL STEPS FOR DEPLOYMENT**

Coordination with LACDPW and local jurisdictions to take advantage of existing systems deployed and being operated under Atlantic Boulevard/I-710 signal synchronization program, IEN and TSSP projects.

4.18 **NEEDS ADDRESSED**

- **Freight Travel Data** provide arterial traffic information to Freight TIS;
- **Better Regional Freight ATIS** provide real-time arterial traffic information to regional Internet Service Providers (ISP) for dissemination;
- **Truck Congestion on Key Roadways** provide traveler information on CMSs on arterials; and
- **Signals** synchronize arterial truck routes.
5.0 Freeway Smart Corridors for Freight – Complete Freeway ITS Deployment

5.1 Project Overview

This project will complete and update (including filling existing gaps) the basic Caltrans surveillance, data collection, and traveler information infrastructure on key freight freeway corridors (lane-by-lane) to support traveler information and traffic management activities in the Gateway Cities area. Through improving the overall flow of traffic through the project limits, freight traffic will benefit by having more efficient and reliable trips.

Finally, this project is closely aligned and in many ways related with the FRATIS ConOps, which is being developed by the FHWA.

5.2 Project Objectives

- **Fill technology gaps and expand the ITS system.** Expansion of current data collection devices and adding technologies and infrastructure to provide more and specific truck data on freeways;

- **Improve traffic management.** Additional detection sites, traffic monitoring, and traveler information will allow greater control of incident identification, posting of alternative routes and travel times geared towards freight traffic;

- **Reduce congestion on key freeway freight routes.** Additional detection sites and traffic monitoring will allow for Caltrans to more quickly identify incidents and congestion and deploy applicable response plans;

- **Increase freight mobility and reliability.** By completing the ITS system on the freeway and reducing congestion, freight traffic will be able to flow better and more reliably;

- **Provide traveler information.** Additional CMSs will allow for users to receive information and incidents, congestion, and alternative routes; and
• **Improve incident management.** Additional detection and traffic monitoring will allow for Caltrans to more quickly identify incidents and deploy response plans.

5.3 **PROJECT DESCRIPTION**

This project will implement additional detection sites, ramp metering traffic monitoring equipment (CCTV cameras) and changeable message signs, to provide for a more complete overall ITS deployment along freeway corridors that are critical for freeway traffic management and ultimately for freight-specific freeway travel. It will include more and specific truck data on freeways. The intent of this is to overall reduce congestion by reducing incident identification and clear times, providing travelers with increased information on alternative routes, and improving overall traffic management capabilities. Freight traffic will directly benefit from this project as truck time spent in mixed traffic congestion will be reduced, and travel times will be more reliable.

Along their freeway system, Caltrans currently has deployed ITS to support device control, roadway surveillance, and dissemination of traffic information. ITS devices include ramp meters, CCTV cameras, loop detector stations, CMSs, and highway advisory radio. This project identifies gaps in these existing systems on freeways that service the Ports, rail yards, and major distribution centers. The geographical scope of this project includes freeways and state routes running east-west from I-110 to I-605, and north-south from the I-10/I-5 to the Ports. This includes more than 100 miles of roadway. Priorities will be set and designs developed for these identified gaps. The final step will be the deployment, testing, and integration of the field hardware to the central systems, including the addition of fiber communications, where necessary, to complete the basic infrastructure on missing freeway segments. Gaps include areas where no equipment currently exists, as well as areas where equipment currently is nonoperational. The data from these systems will be transmitted to the Caltrans ATMS, and be disseminated to the data warehouse and others through RIITS.

The project also would identify malfunctioning equipment on existing corridors and institute a refurbishing program to repair and update equipment to bring it back on line. This will increase the availability and reliability of traveler information and roadside devices. For mainline vehicle detection sites, this activity would include recutting loops, resplicing loop lead-ins, repairing homerun cuts, and replacing detector cards or controllers. This new ITS infrastructure will include collection of truck-specific data on all freeways. This would include not only lane-by-lane information for trucks but also the ability to categorize by vehicle classification or vehicle length classification. Within the project limits, there are nearly 400 detection locations, and it is estimated that currently 30 percent are not operational.
It is recognized that I-710 will be reconstructed during the life of this project. The designs developed by this project should be coordinated with I-710 construction to ensure that all ITS components are maintained or replaced, and that continuity of data along the corridor is preserved during construction. This project should consider third-party data during construction as a back-up option in case detection is not implemented under the transportation management plan (TMP) during construction.

Figure 5.1 shows the geographic project area and the primary gaps in ITS coverage on the freeways serving the Gateway Cities subregion. Some additional gaps are discussed in the scope section of this chapter.
Figure 5.1 Illustration of Current Gaps
5.4 **HYPOTHETICAL OPERATIONAL NARRATIVE/EXAMPLE**

*Planned Construction on I-710*

A paving project will be closing down several southbound lanes of I-710 overnight to allow for an overlay to be constructed. It is expected that I-710 southbound will experience heavy congestion and backups during this time. To prepare, Caltrans posts information on several applicable CMSs to provide drivers and freight operators with advanced information about the closure.

During the closure, Caltrans uses data from the newly deployed and existing data collection points on alternative routes to measure traffic and calculate travel times to the Ports on the I-110 and the I-605. Travel times via these corridors are posted on applicable CMSs so that freight operators can make educated decisions on the best path to take to avoid the construction area.

5.5 **SCOPE OF THE PROJECT**

1. **Inventory Existing Technology Infrastructure and Communications.** Each corridor within the project limits will be inventoried for existing ITS devices (CCTV cameras, vehicle detection, CMSs, ramp meters) and communications. The initial inventory for this study will be used as a starting point for further analysis, and will be modified based on information provided by Caltrans.

2. **Analyze Gaps in Existing Technology Systems.** First, criteria will be developed to determine if gaps exist along each corridor (i.e., coverage that is less than detection every one-half mile, CCTV every one mile, CMS approaching each major route decision point, key CMS for use in dissemination of travel times, etc). These criteria will be analyzed against the existing inventoried infrastructure, and a gap map will be created.

   From an initial analysis of the RIITS traffic map and previously developed documents, the following have been identified as key gaps in the existing Caltrans ITS deployment:

   a. **I-710.** From the Ports to SR 91, there is a lack of vehicle detection or CCTV cameras;

   b. **I-710.** North of I-405, there is no existing CCTV camera;

   c. **I-710.** South of I-405, there is no existing ramp meter;

   d. **I-110.** From the Ports to SR 91, there are limited vehicle detection sites;

   e. **I-110.** South of I-405, there is a lack of CCTV cameras;
f. I-110. From I-405 to Pacific Coast Highway, there are limited ramp meters;

g. I-105. From I-110 to I-710, there is no CCTV camera;

h. I-405. From I-110 to I-710, there are limited CCTV cameras; and

i. SR 91. From I-110 to I-710, there are limited CCTV cameras.

3. **Identify Malfunctioning Existing Equipment.** This task will identify existing Caltrans equipment that is not operating, and identify initial issues for troubleshooting. This would include issues, such as no power, no communications, equipment failure, etc. This activity would be coordinated with Caltrans operations and maintenance.

4. **Identify Corridor Needs for vehicle detection, traffic surveillance, roadside traveler information, and equipment refurbishment.** Needs for each corridor will be assessed and recommendations will be made for the infrastructure to be deployed on each corridor within the project limits. Preliminary recommendations would likely include:

a. Additional vehicle detection, CCTV cameras, and ramp metering along I-710;

b. Additional vehicle detection, CCTV cameras, and ramp metering along I-110; and

c. Additional CCTV cameras along I-105, SR 91, and I-405.

5. **Develop Deployment Plan.** From the recommendations of the previous task, the corridors will be prioritized for deployment based on needs. A deployment plan will be developed that describes the sequencing and phasing of deployment of the project corridors, and includes cost estimates for each.

An initial assessment is that the deployment should focus first on the north-south approaches to the Ports (I-110 and I-710), and with a lower priority the east-west corridors.

6. **Select Corridors for Deployment.** Based on the Deployment Plan, a set of corridors will be selected for initial deployment and will go into the design phase.

7. **Develop Design Plans for Each Corridor.** Detailed designs will be developed for construction. Separate designs will be developed for each corridor to allow for flexibility in how the corridors are packaged for bid. There are a variety of vendors currently offering accurate freeway speed data that could be converted into travel time data. No infrastructure would be needed for such a solution.

8. **Develop Contract Design Package.** An overall Contract Design Package will be developed that includes a full request for proposals (RFP) for bid, along
with design plans and specifications. This task will oversee the proposal submittal phase, interviews, contractor selection, and contractor negotiations.

9. **Deploy, Test, and Integrate Equipment on Corridors.** This task will construct the infrastructure, install the required ITS equipment, and make the system operational.

10. **Determine Priorities for Refurbishing.** A plan will be developed to identify priority corridors or areas for refurbishing, or replacing existing Caltrans equipment that are not operational. Sequencing of repairs will be defined based on identified needs.

11. **Establish Refurbishing Program.** A program will be established to conduct the refurbishment or repair of existing equipment. This will assign either a contractor led maintenance crew, or a Caltrans maintenance crew to conduct repairs based on the priorities identified in the previous task.

12. **Refurbish Equipment.** This will be an ongoing task for a repair crew to troubleshoot and repair/refurbish identified sites.

13. **Operate and Maintain.** Caltrans staff will continue their responsibilities use the expand deployment of equipment to better operate the regional freeway system. Existing Caltrans and CHP operations could be expanded to support improved incident management and quick clearance. This project could consider incentives for quick clearance and penalties for delayed clearance, as well as improve communications with local jurisdictions to inform of major incidents that may result in additional traffic on local roadways.

The data generated by the expanded sensor network will be shared with other regional information dissemination systems, including RIITS, Freight TIS, and Freight 511 systems. The responsibility to maintain this new roadside equipment and communications hardware remains the responsibility of Caltrans.

### 5.6 SCHEDULE AND PHASING

The following tentative schedule is anticipated for the following phases for the project. It is anticipated this project would continue indefinitely beyond the full deployment.

**Base Traffic Management**

- Month 1 Inventory/Gap Analysis;
- Month 2 to 3 Develop Deployment Plan;
- Month 3 to 12 Develop Design Plans;
- Month 5 to 12 Develop Contract Design Package;
Refurbishing Program

- Month 1
  - Inventory/Equipment Malfunction Analysis;

- Month 2 to 3
  - Determine Priorities;

- Month 2 to 6
  - Establish Refurbishing Program;

- Month 6 to 12
  - Refurbish Equipment;

- Month 12
  - Review Results and Adjust Priorities; and

- Month 12 to 18
  - Continue Refurbishing of Equipment.

5.7 PRELIMINARY COST

The following is the anticipated planning-level costs for the project:

Capital Costs

- Base Traffic Management: $500,000 per mile (includes design, equipment, and installation).

Operations and Maintenance Costs

- Base Traffic Management: $20,000 per mile;

- Equipment Refurbishing and Repair: $2,500 to $5,000 per site (does not include traffic control); and

- Estimated Annual Cost for Refurbishment and Repair: $60,000 to $120,000.

Assumptions

- Approximately 38 miles of full permanent ITS implementation, and 11 miles of partial permanent ITS implementation;

- Approximately 120 detection sites currently nonoperational;

- 20 percent to be refurbished/repaid each year; and

- Total sites refurbished/repaid each year: 24 sites.

Summary of Estimated Costs

- Capital: $20,000,000-$24,500,000

- Operations and Maintenance: $1,000,000-$1,200,000 per year
5.8 **Users Involved**

The users who will be involved in this project include:

- Caltrans;
- Metro;
- Freight Stakeholders; and
- CHP.

5.9 **Roles and Responsibilities**

The user’s roles and responsibilities will include:

- **Caltrans** – Planning, Design, Deployment, Maintenance, Operations, and Incident Coordination;
- **Metro** – Planning; and
- **CHP** – Incident Management.

5.10 **Prerequisites**

While not required to implement this project, the establishment of the Freight TIS/Data Warehouse and Freight Traveler Information Dissemination projects are a pre-requisite to successfully providing data and information from this project to the Freight community.

5.11 **Systems Involved**

The systems that will be involved with this project include:

- Freight Data Warehouse;
- Caltrans ATMS;
- RIITS;
- ATMIS;
- Freight 511; and
- Others.
5.12 **POTENTIAL CHALLENGES AND OBSTACLES**

The Caltrans ITS system has been long established with proven technology. A challenge with the success of this project is ensuring funding for maintenance is addressed. Another obstacle is ensuring the ITS equipment is preserved or temporary ITS is deployed during I-710 construction to make sure continuous traffic management and traveler information are available for the corridor.

5.13 **COORDINATION AND INTEGRATION WITH OTHER PROJECTS**

This project will need to be coordinated with the data warehouse to ensure that the necessary hardware and software functionality are provided to enable the Freight TIS to meet the functionality of this project.

5.14 **OTHER OPTIONS CONSIDERED**

None.

5.15 **OUTCOMES**

When additional ITS infrastructure is deployed as a result of this project, it is expected to contribute to improvements in the following areas:

- Increased traffic management capabilities for the Freight TIS and Caltrans for all the freeway corridors;
- Reduction in congestion;
- Increased travel time reliability for freight traffic;
- Increased amount of en-route information for freight alternative routes and travel times;
- Faster identification, response, and clearing of incidents; and
- Truck classification and lane-by-lane information.

5.16 **INITIAL STEPS FOR DEPLOYMENT**

- Identify gaps, malfunctioning equipment, and requirements;
- Determine both short-term and long-term needs and phasing;
- Design systems; and
- Develop contract packages.
5.17 **NEEDS ADDRESSED**

This project addresses the following identified needs:

- **Better Regional Freight ATIS** provides travel alerts via CMSs and additional freeway camera images and congestion information that can be disseminated via Freight 511;

- **Truck Congestion on Key Roadways** provides travel time and incident information to help dispatchers and drivers plan trips to avoid congestion; and

- **Incident Management** provides increased freeway monitoring and incident detection capability.
6.0 Container Moves Productivity Improvements

6.1 PROGRAM OVERVIEW

This section covers the development of a long term technology and operations program that has a goal of improving the efficiency of the handoff of intermodal containers between trucking companies, marine terminal operators (MTOs), and railroads, while also improving the bottom line for beneficial cargo owners (BCOs). Improving the productivity of container moves through technologies and operational changes in this program can reduce truck trip times, reduce bobtails and wasted trips, and improve terminal throughput. In turn, these private sector benefits will directly result in the public sector benefits of congestion reduction and improvements in air quality and safety.

Figure 6.1 provides a process map of the Goods Movement/Drayage Processes for the San Pedro Bay Ports – Gateway Cities subregion. This figure illustrates three main intermodal transportation modes in which elements of this technology program may be focused:

1. **On-the-Road.** This represents drayage truck movements on public roads. This can involve multiple types of move of containers by trucks, including to/from marine terminals, rail terminals, warehouses, transloading facilities, distribution centers, and other customers. Applications centered on freight-focused traveler information for drayage dispatchers and drivers are a major focus of this area. Additionally, information can potentially be provided to MTOs that provide real-time summaries of trucks approaching their terminals.

2. **Terminal Approach.** This represents the immediate approach of the truck to the intermodal terminal. Here, the queue – the line of trucks waiting to approach the terminal gate – is the most important factor concerning drayage productivity. Improved information on queues can aid in drayage planning. More extensively, MTO application of appointment systems can dramatically reduce queues by spreading out truck arrivals across a given day/week.
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### Figure 6.1 Goods Movement Process

**Gateway Cities Technology Plan for Goods Movement**

**Goods Movement/Drayage Process Map**

This graphic provides a high-level summary of the import drayage process. It is by no means inclusive. But it does include the major components of a shipment arriving at the ports and then being delivered to its final destination. This graphic also illustrates where the various projects which are being developed as part of the effort overlap with various functional areas of this process.

<table>
<thead>
<tr>
<th>KEY PARTICIPANTS</th>
<th>IN THE TERMINAL</th>
<th>ON THE ROAD</th>
<th>TERMINAL APPROACH</th>
<th>IN THE TERMINAL</th>
<th>ON THE ROAD</th>
<th>TERMINAL APPROACH</th>
<th>IN THE TERMINAL</th>
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<tbody>
<tr>
<td><strong>Shipping Line</strong></td>
<td>Manifest</td>
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<tr>
<td><strong>Drayage Firm</strong></td>
<td>Receives Manifest</td>
<td>Dispatch Driver</td>
<td>Driven on Road to Terminal</td>
<td>Driver Accesses Terminal</td>
<td>Driven Process at Entry Gate</td>
<td>Driver Drops Off Empty (if Carrying)</td>
<td>Driver on Road to Delivery</td>
</tr>
<tr>
<td><strong>Marine Terminal</strong></td>
<td>Receives Manifest</td>
<td></td>
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<td>Parent Process at Entry Gate</td>
<td>Driver Delivers Loaded</td>
<td>Parent Process at Exit Gate</td>
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<td><strong>Consignee</strong></td>
<td>Receives Manifest</td>
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**KEY**

- Information Flow
- Action
- Project Impact Areas

**List of Projects**

- Freight TMC and Data Fusion
- Arterial Smart Corridors
- Freight TMS Information Dissemination
- Freeway Smart Corridors
- Goods Movement Efficiency
- Freight Enforcement Network System
- Truck Enforcement Network System
- Autonomous Commercial Vehicles
3. **In the Terminal.** This represents the activities for a container pickup or drop-off in a freight terminal by a drayage truck. Here, the “terminal turn time” is the time from when the truck first enters the terminal (at the gate) to the time when the truck exits the terminal – either carrying a container or empty. Other factors that affect terminal efficiency include ship loading and unloading impacts, container stacking operations, and closed areas.

The movements of containers across the above three intermodal transportation modes require coordination, transactions or inspections with drayage companies or drivers. Current operations for these container moves can impact drayage operations significantly, creating entrance gate congestion and congestion within terminal yards. For example, with most terminals specifying a four- or five-day free storage option for containers (following unloading from the ship), this typically results in the majority of drayage pickups occurring on the last day - to benefit their BCO customers who can save on warehousing costs – thus, forcing significant queues and congestion issues on the final day.

Congestion at marine terminal gates and within terminal yards at the Ports can also result from dray truckers who arrive to avoid the Traffic Mitigation Fee (TMF) period from 3:00 a.m. to 6:00 p.m. For example, to avoid the fee, many drayage drivers who drop off empties (which have no fee) at terminals between 3:00 a.m. and 6:00 p.m. will not take the option of picking up a container at that time – and instead will return after 6:00 p.m. to pick up their container (no fee). This has the effect of creating an unnecessary trip for each such instance.

Moreover, the Truck Operator’s Survey conducted for this project indicated a strong desire to minimize queue waiting times that would assist dispatchers and drivers in making trips more efficiently. This need was also identified repeatedly in the Gateway Cities Technology Plan User Needs Assessment.

New technologies, combined with operational changes and improved stakeholder coordination, have the potential to support responses to the issues detailed above, and can result in improved container movement productivity. Some initial technology opportunities to optimize container movement productivity in the Gateway Cities subregion are:

- Freight-focused traveler information – to drayage dispatchers and drivers, which is covered in Section 3.0, - Freight Traveler Information Dissemination;
- Measurement, alerts, and predictive algorithms for port terminal queue approaches;
- Two-way information exchange between drayage companies and port terminals to schedule appointments to reduce terminal congestion; and
- Real-time predictive information for port terminals about expected drayage truck approaches.
Through developing technology projects for these areas, truck arrivals at intermodal terminals would be better controlled, thus, spreading out truck arrivals to the terminals throughout the day. These improvements would lead to corresponding benefits in terms of decreased fuel usage, improved air quality, and decreased traffic congestion. Moreover, the FHWA has just awarded some initial funding to begin development of some drayage optimization technologies related to the above three areas – so an opportunity exists to leverage and expand this work based on the next phase in the Gateway Cities Technology Plan for Goods Movement program.

6.2 Objectives

- Develop a long-term program that will result in a series of technology projects and operational changes that will improve container moves overall productivity. Potential focus includes:
  - Provide information to schedule container pick-up or deliveries;
  - Reduce terminal and/or rail yard turn times;
  - Provide information on terminal yard operations;
  - Provide information to reduce wait and queue times at terminal gates and multimodal transfer facilities, including:
    » Measuring wait and queue times as metrics for improved analysis and evaluation; and
    » Providing real-time wait and queue times and video feeds to the Freight TIS, drayage dispatchers, and drivers for information purposes to improve container moves productivity.
  - Provide information for more efficient gate processing;
  - Provide real-time and predictive information for port terminals about expected drayage truck approaches.

The overall objective is to move effectively manage the overall movement of containers. A centralized, standardized system that could be used by marine and terminal operators, railroad, and truck drayage companies has the potential to greatly improve the efficiencies for container moves.

- Develop a Performance Monitoring Project, that will results in the measurement of performance metrics over time as technology/operational projects are implemented – allowing for quantitative visibility in how these projects succeed (or fail to succeed) in addressing container productivity improvement goals.

- Develop a key stakeholder guidance group consisting of public and private partners, and covering dray operators, MTOs, and BCOs that can work
together to guide the deployment of this freight technology and operations productivity program.

- Design the program in a “crawl-walk-run” approach that can build confidence between the stakeholders through early successes, then lead to significant project deployments, and finally resulting in a regionwide container productivity system that benefits all intermodal parties.

6.3 PROGRAM STRUCTURE

While other sections of this document focus on Projects, this section focuses on a Program, which includes a long-term focus that includes three key elements, as described here:

- **Intensive Stakeholder Guidance.** A major finding of the Gateway Cities Technology Plan for Goods Movement study over the past year concerns the lack of general transportation-level coordination between parties involved in drayage operations – drayage fleets, MTOs, and BCOs. Recently, through one-on-one meetings, and leveraging the ITS Working Group, the Gateway Cities lead and the Study Team have been more successful in discussing potential solutions. Based on these emerging efforts, it is recommended that a formal committee of these industry stakeholders be developed to serve, along with very selective public sector participation, as the guidance body for overseeing this Container Moves Productivity Improvements program. This committee – this *Goods Movement Efficiency Committee* – would be kept small enough (perhaps less than 10 members initially) to allow for significant cooperation and real-world project participation decisions to be made – so as to “move the ball forward” within the next two years. While the Study Team can assist the committee in its infancy, the desired outcome would be that the Committee would function as an arm of the private sector intermodal industry (e.g., perhaps three dray operators, three MTOs, and two BCOs), with perhaps two to three public sector entities maintaining involvement (e.g., Gateway Cities, MTA, the Ports).

- **Early Win “Confidence Building” Projects.** To facilitate breaking down the institutional barriers and fostering improved coordination among the intermodal transportation parties (e.g., between MTOs and drayage fleets), and based on the Task 2 User Needs Summary, and on the inputs from the project ITS Working Group, four key Early Win projects have been developed. These projects, which are detailed below, can be planned and implemented within the next 18 months, and represent initial steps towards testing an overall Container Movement Productivity System. The concept here would involve testing these elements with a small number of private sector users, and then utilize (via the Performance Monitoring activity) the utility and benefits demonstrated in the test to make a powerful case to the San Pedro Bay Ports and Gateway Cities freight community, for full-scale
deployment of the technologies, and corresponding supporting operational changes. Moreover, as these projects proceed, the intention is that cooperation between private sector partners in the tests will facilitate improved trust and confidence building among all parties. Finally, it is anticipated that these Early Win projects can be conducted partially in coordination with the FRATIS-Los Angeles/Gateway Cities development and testing project, of which the FHWA has recently assigned funding for.

- **Longer-Terms Projects and Operational Changes.** It is anticipated that after the Early Win tests illustrate positive impacts on container movement productivity, and after the Goods Movement Efficiency Committee develops into a mature and successful public-private partnership, that the momentum of this program and its participants will facilitate potentially full deployment of the Early Win project, while also developing new longer-term technology and operational changes projects. Potentially significant funding, both from public and private sources, should be available between 2 and 10 years from now to support major deployments and long-term projects. Moreover, long-term projects have the potential to be aligned with the new I-710 Goods Movement Corridor, which may enter service in the early 2020s.

- **Performance Monitoring.** A performance monitoring activity will be set up to support each Early Win or long-term project that is developed and deployed under this program. At a high level, in line with recent Federal work, performance measures that are specific to freight and are meaningful to both the public and private sectors should be used including travel time reliability, velocity, profitability, and return on investment. At a project testing level, specific performance monitoring metrics will be developed that address specific intermodal system user needs. The assessment of this data will allow the Goods Movement Efficiency Committee and other stakeholders to measure the success of the project in meeting private sector user needs, as well as in assessing public sector benefits (e.g., reduced trips, air quality improvements). These results can then be used to demonstrate the value of technology investments, thus, garnering further support for future phases and/or projects in the region.

### 6.4 Early Win Projects Description – Container Moves Productivity Prototype

#### 6.4.1 Overview

As detailed previously, the Early Win Projects would consist of the following:

- **Freight-Focused Traveler Information** – To drayage dispatchers and drivers (which is covered in Section 3.0, Freight Traveler Information Dissemination);
- **Marine Terminal Queues Information** – Measurement, alerts, and predictive algorithms for port terminal queue approaches;

- **Container Status Information/Terminal Appointments** – Two-way information exchange between drayage companies and port terminals to schedule appointments to reduce terminal congestion; and

- **Predictive Information for MTOs on Dray Truck Arrivals** – Real-time predictive information for port terminals about expected drayage truck approaches.

Additionally, a fifth project, covering the overall stakeholder guidance, private sector collaboration, information management, and other institutional factors, is being recommended to support the implementation of this program.

The above projects would be fully integrated into an overall Container Productivity Prototype system. In other words, while parts and applications of each project would be designed and tested, in part, separately, the intention here would be to test the integration of these technologies as integrated applications that drayage dispatchers, truck drivers, and MTO operations personal could access and use – both through computer and mobile device applications.

An approach to developing and operating this sort of program was recently developed for the FHWA under the FRATIS Concept of Operations (ConOps). Figure 6.2 presents the overall program concept of how the FRATIS ConOps could be applied in the Gateway Cities to facilitate deployment of the Container Productivity Prototype system. This is just a starting point – future work and refinement to this approach will be required during the development phase of the Gateway Cities FRATIS project, which is expected to kickoff in September 2012.
This approach, which again has been developed to focus on testing in the Gateway Cities subregion, will center on developing and testing several FRATIS delivery applications that the four primary users groups below will interact with during systems testing:

1. **Trucking Company Dispatchers and Operations Managers**, responsible for planning trips and maintaining communications with truck drivers – develop a web-based interface to access the FRATIS services: Real-Time Traveler Information and Alerts; Terminal Queue Status, Prediction and Alerts; Terminal Appointment Status; and data to support private sector Real-Time Travel Planning and Dynamic Routing solutions.

2. **Truck Drivers** are responsible for picking up, transporting, and delivering the container/freight – develop a distraction-safe vehicle/mobile-based interface to access FRATIS services: Real-Time Freight-Specific Traveler Information and Alerts; Terminal Queue Status Prediction and Alerts; Terminal Appointment Status; and data to support private sector Real-Time Travel Planning and Dynamic Routing.

3. **MTO users**, responsible for planning and optimizing drayage truck access to their terminals – develop a web based application and/or a direct data feed...
their terminal operating system that provides status (including alters) and forecast of truck arrivals.

4. **Public sector users**, responsible for generating, collecting, processing, utilizing freight data to support freight planning efforts in the region – provide features to archive and output freight planning performance data.

The data warehouse and data dissemination concept for the Container Productivity Prototype system is provided below in Figure 6.3 (as previously described in Sections 2.0 and 3.0 of this document). The warehouse and dissemination elements outlined here map to the four project elements defined above, and also consistent with the FRATIS approach that has been developed for the Gateway Cities testing program.

**Figure 6.3 Gateway Cities ITS Data Warehouse and Data Dissemination High-Level Architecture**
In this diagram, the **Data Dissemination Database** would function as the interface with the user applications – web applications and mobile/in-vehicle applications. The Container Productivity Prototype system will pull data from various sources using web services and/or APIs, and the user interfaces through both web and mobile/in-vehicle applications will communicate in real-time with the Data Dissemination Database. This is expected to be API based, but the detailed architecture and design will need to be developed and refined in the early stages of development effort. A resource here that can support this activity is the FHWA FRATIS System Requirements document.

The following discussion provides project-level descriptions of each of the projects that make up Container Productivity Prototype.

### 6.4.2 Freight-Focused Traveler Information.

The project level details on this project are covered in Section 3.0, Freight Traveler Information Dissemination. As part of the integration to support the Container Productivity Prototype, some adjustments and enhancements may need to be made to support elements such as private sector freight dynamic routing applications, and travel performance monitoring elements associated with drayage operations by the dispatchers and drivers of HTA member drayage companies. Given the extensive freeway system in the region, coupled with the unusually dense availability of ITS traffic data, the Gateway Cities subregion represents an outstanding test bed for dynamic routing, congestion alerts, and performance monitoring. Also, with most HTA fleets having deployed GPS-based fleet management systems, the potential is there to use these “trucks as probes” to add additional truck-specific travel data. The potential also exists to deploy some ITS sensors on several key arterials to improve the overall FRATIS traveler information data coverage. Again, please refer to Section 3.0 for the detailed project description of these elements.

### 6.4.3 Marine Terminal Queues Information

Trucks arriving at the Port are headed to one of multiple marine and rail terminals. Queues often form at these terminal entrance gates due to congestion at the gate, within the terminal, as well as truckers who are hoping to avoid the Traffic Mitigation Fee (TMF) period from 3:00 a.m. to 6:00 p.m. The Truck Operators’ Survey conducted for this project indicated a strong desire for queue wait time information that would assist dispatchers and drivers in making trips more efficiently. This need was also identified repeatedly in the Gateway Cities Technology Plan for Goods Movement User Needs Summary.

The project would implement a test bed at one terminal for several queue detection technologies, potentially including the following:

- **Radio Frequency Identification (RFID)**. All trucks entering the POLA and POLB are required to be equipped with RFID transponders as part of the PierPASS program. PierPASS is a program implemented at the Ports to help
streamline truck credentialing and fee payment. Currently, the transponders are read as the trucks enter the terminal gate. The system would read the PierPASS transponder as it approaches the gate, and again as it passes through the gate as part of regular inspection. These reads in aggregate will provide a queue time for the terminals. This system has been successfully deployed at the TTI terminal at POLB by request of the operator. The PierPASS system vendor is beginning development of an application that extracts the transponder read information from the credentialing application, and makes it available to third parties for analysis. This would address the issue of accessing sensitive information used for security purposes.

- **In-pavement Detection.** In-pavement detectors have the benefit of indiscriminately detecting vehicles without requiring the vehicles to have any onboard equipment; however, they can be disruptive to install and require regular maintenance and replacement. Options include wire loops or “hockey puck” style detectors.

- **Video Detection Cameras.** Video detection cameras are commonly used for detecting vehicles at intersections in place of in-pavement loops. There can be some challenges in configuring these cameras for queue detection, particularly with trucks. However, recent advancements in processing software have increased the potential of this application.

- **Bluetooth.** Bluetooth readers use antennas to detect Bluetooth devices at the roadside. Each device emits a unique ID, which can be used to infer travel times. However, there is some anecdotal evidence that truck drivers often have older model mobile phones that may not be Bluetooth equipped, limiting the sample size. However, Bluetooth readers do have the benefit of being typically less expensive than transponder readers.

- **Automated License Plate Recognition (ALPR).** ALPR cameras take snapshots of vehicle license plates and use Optical Character Recognition (OCR) to read the characters. These can be difficult to install and configure successfully for trucks due to the large variety of plate characteristics and placements on freight vehicles.

- **Global Positioning System (GPS).** A GPS system was used to calculate time in queue and inside the terminal for the PierPASS turnaround study. This does require trucks to be outfitted with special in-vehicle devices for location tracking or having access to vehicles that are already equipped.
Raw queue detection data and video from the roadside devices would be sent to the ATMIS system or Freight TIS. If from ATMIS, calculated weight times and compressed video would be sent to the data warehouse and, eventually, the wait times would be available on the Freight511 and RIITS as part of the Freight Traveler Information Dissemination project. Third parties could also pick up the information from the Freight TIS and display it through their own services (aka Trucker.com).

After the test bed phase and a preferred technical solution has been found, a full build out would begin. The full build out would provide wait time information and video images for all terminals. (It should be noted that institutionally full deployment will be a challenge, but it is hoped that once its value is shown through the test bed project, other MTOs will join. The full build-out option has been included for planning and funding purposes.)

This information would not only be used for real-time operations, but also to determine the effectiveness of other container move improvement programs.

**Terminal Yard Operations/Turn Times**

This project would also establish technology solutions on operations within terminal yards and provide information on truck turnaround times. In order to accurately calculate truck turnaround times in detail, this project could implement advanced tracking technologies that would enable real-time truck location/activity history reporting.
Proposed Project Alternative

Detecting queues and terminal turn times can be accomplished through a variety of different technologies. In general, detection devices are deployed in the field and/or inside the trucks. Truck Tag ID, Time Stamp and Location information are tracked and recorded throughout every container truck’s movement within the terminals and the vicinity.

All the raw data would then be fed into a centralized database. An Application Server runs algorithms to process the data in order to determine the real-time truck turnaround times and queue. Information would then be shared with traveler information systems in the area, through RIITS, and is recommended to be broadcast to a web portal.

The web portal could comprise a “Performance Dashboard”, which summarizes the tracked and measured container turn-times and queuing information. Enhanced features on the web portal systems could also enable registered drayage providers and truckers to receive alerts based on customizable parameters via e-mail or cellular phone text message when turn-times and queuing exceed a pre-defined threshold. Stakeholders would also be able to generate customized reports on turn-time and queue information to facilitate dispatch schedules and fleet utilization. The optional addition of RFID readers along key truck routes on either freeways or arterials will be able to provide the most comprehensive freight-specific traveler information to the truckers servicing the Ports of Long Beach and Los Angeles.

Information would also be disseminated to safety-conscious in-vehicle devices through a Truck Fleet Communication Program.

6.4.4 Container Status Information/Terminal Appointments

This project, initially, as an Early Win project, would integrate appointment system information that is available from MTOs into the data warehouse and information dissemination components (Freight TIS) of the Gateway Cities ITS. For the longer term, this project would be expanded into a regionwide deployment that would establish a centralized and standardized system for overall scheduling of goods movement centered around the pick-up and drop-off of goods at the Ports of Long Beach and Los Angeles. Stakeholders would be able to access terminal gate booking information as well as other valuable port-wide information (including goods movement performance measures and roadway traffic conditions) from one single point web portal and phone system.

Functionality

The implementation of a centralized scheduling system must be flexible to accommodate all the diverse needs of shippers, terminals, rail, and trucks. In order to make scheduling reliable and accurate, the system should be capable of handling cancellations and reassigning a reserved time that has been missed or
Canceled; provide a ‘buffer’ window for truckers; allow reservations via multiple channels (Internet, telephone, etc.), and allow multiple reservations in sequence across terminals. The centralized reservation system should also be capable of reporting performance measures in terms of overall system reliability and quantifiable metrics related to reduced truck turn-times, improved gate efficiency, and other measures.

The design of the centralized scheduling system web portal should consider all terminal operators’ investments in existing appointment systems (eModal and VoyagerTrack) and integrate them to fit other unique terminal operating practices. The system would also incorporate container tracking and interim and ultimate destination information. The system would track pre-defined schedules as well as incorporate actual resulting schedules experienced in order to actively fine-tune the system over time – both operationally (how it is used by various parties) and functionally (changes needed to the software or processing to achieve better results).

For example, the new centralized scheduling system could provide the following functions and capabilities to process import container pickup and deliveries:

- Shipper notifies terminal operators (via system) of pending arrival of containers and expected arrival date/time.
- Drayage company logs on to web portal and checks availability status of multiple containers across all terminals at the Ports of Long Beach and Los Angeles. Companies can then plan the optimal schedule to conduct multiple container pick-ups or drop-offs at the terminals based on real-time terminal performance measures, roadway traffic conditions and terminal equipment availability.
- Terminal uses the booked demand to coordinate the resources internally.
- Rail companies can track container destined for their trains in real-time to be aware of estimated arrival times and ultimate destinations to effectively manage their resources and increase throughput of the rail yards.

Current Status

There are a number of different container status information systems and reservation systems in existence today. Container status systems such as eModal provide basic information on the current status (e.g., location – on ship, on-dock, in-terminal, etc.) of a container; however, this information is typically not real time (i.e., can be 30 minutes older or more), which limits its potential use. Modern container reservation systems have also been developed. Typically, these are deployed as part of a Terminal Management System. For example, the most common Terminal Management System in the ports region is the NAVIS system; NAVIS has an optional add-on system that can do full terminal reservations for drayage pickups and deliveries. Moreover, NAVIS technology
powers the PierPASS RFID system, which can allow for easy integration of RFID tracking as part of a reservation system.

The rail companies also have existing computer systems that are advanced and are used to manage their respective businesses aggressively based on historical hourly data (e.g., plan for truck arrivals in each hour based on the volume of trucks that arrived during this hour on this date last year, the year before, etc.) and could potentially be integrated with this project concept.

Proposed Project Alternative

While the above provides an ambitious goal for a long-term program, the Early Win testing here of container status/appointments would focus on the following more modest goals:

- Container availability status and appointment status;
- Opportunities for pickup after delivery or reverse (i.e., bobtail reduction);
- Appointment status and appointment changes;
- Location of container in terminal;
- Terminal Condition Alerts (i.e., safety closures of portions of terminal); and
- Integration with terminal queue information from Marine Terminal Queues Information project above.

Further communications with MTOs and NAVIS will be required to develop the technical details for this Early Win project. This can occur both during the next phase of the Gateway Cities Technology Plan for Goods Movement project, and correspondingly as part of the recently awarded the FHWA FRATIS Gateway Cities development and testing program.

Through developing technology solutions for these areas, truck arrivals at intermodal terminals would be better controlled, thus spreading out truck arrivals at the terminals throughout the day. These improvements would lead to corresponding benefits in terms of decreased fuel usage, improved air quality, and decreased traffic congestion.

6.4.5 Predictive Information for MTOs on Dray Truck Arrivals

Ongoing discussions with the HTA and a key MTO has resulted in a concept for a new technology application for this system that would focus on providing real-time predictive information for port terminals about expected drayage truck approaches. This pre-notification information would greatly assist the MTOs in planning and dynamically responding to truck traffic that is either in-route or is planning to access their terminals on a given day.
Pre-notification could potentially be provided via links with the GPS Fleet Management Systems currently being used by most of the HTA drayage fleets. This could be accomplished as follows:

- If the HTA fleets are willing to share GPS location data, then a simple automated method could initially be used that would use basic directional data from a given truck to estimate the likely terminal that the truck is headed towards, and then send an alert to that terminal that the truck is in-route;

- A better solution would be to automatically combine the above GPS location data with the drayage company’s dispatch system – this integrated data could then provide very reliable data on both when the truck is scheduled to be at the terminal, and where the truck is currently in proximity to the terminal;

- The most advanced solution would further provide predictive estimates of the truck’s time of arrival at the terminal, and include travel conditions and congestion (from the Freight TIS) into the predictive calculation.

Further communications with HTA fleets and their Fleet Management and Dispatch System vendors will be required to develop the technical details for this Early Win project. This can occur both during the next phase of the Gateway Cities Technology Plan for Goods Movement project, and correspondingly as part of the recently awarded the FHWA FRATIS Gateway Cities development and testing program.

### 6.4.6 Program Management, Goods Movement Integration Management, and Continuous Performance Monitoring

An agency or agencies and associated locations need to be finalized for operations of the proposed program. This involves providing transportation performance monitoring, air quality management, and goods movement related traveler information and traffic management (where needed). The project would provide much needed project development and support, a forum for continued dialogue among public sector and private companies, and manage the numerous technology projects proposed. Some of the functions may be included in the Data Warehouse/Freight TIS project described in Section 2.0; it will be further refined during the next phases of this project or in future studies. The functions and activities will have to be studied in the next phase to determine its necessity, viability and cost-effectiveness and how this activity will be funded.

Moreover, this project would include contractor support for managing and supporting the Goods Movement Efficiency Committee. As previously detailed, this entity would provide the collaborative public-private guidance for the planning, development, deployment, testing, operations, and maintenance of the Container Movement Productivity Improvements Program.
6.5 **HYPOTHETICAL OPERATIONAL NARRATIVE**

As part of the Gateway Cities Technology Plan for Goods Movement implementation, MTA and its partners created a regional public-private partnership led by the *Goods Movement Efficiency Committee* to deploy the *Container Productivity Prototype* system. The committee included MTA, the Gateway Cities Council of Governments, the Harbor Trucking Association (HTA), major marine terminal operators (MTOs), and several private sector data partners. The Gateway Cities and MTA led the overall coordination effort, directing the activities of all key project partners and ensuring key deadlines were met. Where the time and effort involved to provide data were a concern for private partners, appropriate public sector staff worked on-site with the data providers to create the necessary connections and minimize the burden on participating companies. Two key industry partners, CrossTown Drayage and Acme Marine Terminals, volunteered to serve as the initial test partners for the system.

CrossTown Drayage provides container drayage services for shipping lines operating at the Port of Long Beach. With a fleet of 50 tractors, CrossTown Drayage drays containers from port terminals to a variety of locations, including a BNSF intermodal yard, as well as warehouse/distribution centers throughout the Gateway Cities subregion. Over the years, increased congestion and delay have reduced the number of turns a driver can make, reducing their pay, as well as CrossTown’s overall efficiency.

Acme Marine Terminal has one of the largest container terminals in the Port of Long Beach, and has a history to working closely with CrossTown Drayage. Acme Marine Terminal recently began providing online reservations for pickups and drop-offs, electronic notification of load availability, and camera feeds showing terminal gate queues.

By tying into the web and mobile applications developed in the Container Productivity Prototype system, CrossTown Drayage was able to access all data relevant to its operation. Container availability combined with a pickup time, augmented by terminal queue information allowed CrossTown to immediately improve the efficiency of its drivers by removing (or significantly reducing) unnecessary delay. In addition, for container related data, CrossTown was also able to integrate real-time traffic conditions into its routing decision, avoiding major incidents, events, and congestion. Communication with drivers was accomplished through CB radio and smart phones, based on driver preference.

In this scenario, Acme Marine Terminal provided electronic data feeds of relevant operational data to the Container Productivity Prototype system, including container availability and online terminal appointments. Camera feed data from the terminals, being available on the web, were linked directly to the Gateway Cities Freight TIS data dissemination web server. Traffic conditions were provided through a direct link between this server and Freight 511.
CrossTown dispatchers viewed the information on the Container Productivity Prototype web application from a computer terminal and planned driver work accordingly to minimize bobtails and optimize pickup scheduling while observing required delivery windows.

Use of the Container Productivity Prototype system allowed CrossTown to increase the average number of turns per day for each driver, which in turn improved efficiency and equipment utilization. Further, use of the technology components allowed CrossTown to enhance the efficiency and accuracy of information exchange activities with its primary customers. Fuel savings were achieved by drivers being able to route around congested areas and pick up loads or empty containers when they otherwise would have to bobtail back to the terminal.

Correspondingly, through a special Container Productivity Prototype system application, Acme Marine Terminal operations personnel were able to continually observe in real-time the number of drayage trucks headed towards their terminal. This improved their staffing efficiency, as they were able to dynamically staff gates based on the near-term forecasted demand that this application provided them.

### 6.6 Scope of the Project

1. **Establish a Needs/Requirement Definition Working Group.** Container moves productivity improvements require extensive coordination, agreement and cooperation across the logistics chain. As described previously, this Goods Movement Efficiency Committee would consist of all stakeholders involved in logistic chain that affect container moves and can affect improvement outcomes. This committee will have to work together to identify issues, problems, concerns, and solutions and then jointly oversee the design and implementation of the various projects. The first task would be problems definition coupled with solution/requirements ideas.

2. **Select Technologies for Test Bed.** As described previously for this Container Movement Productivity Improvements integrated set of projects, there are a number of technologies that can be used to deploy the program. The first step will be to determine which technologies should be included in the initial test deployment by undertaking a technology assessment that factors in the physical characteristics of the test bed site, as well as the short- and long-term feasibility of each technology for the combine project grouping. As detailed previously, further research into specific technologies will include specific vendor discussions related to certain goods management technologies – such as NAVIS (appointment system/terminal management system) and XATA (GPS fleet management).

3. **Conduct Site Survey and Inventory of Terminal.** A site survey will be undertaken at the test bed to develop sketch plans that approximate
equipment locations, power supplies, existing communications, and any physical constraints that may impact design.

4. **Prepare Design Documents.** Detailed design plans and documentation would be prepared for the following:
   a. Field Equipment;
   b. Communications;
   c. Application Software;
   d. Information Warehouse and Dissemination; and
   e. Supplemental Equipment

5. **Install, Test, and Integrate Equipment.** Appropriate contractors/vendors should be retained to install, test, and integrate the equipment.

6. **Monitor and Evaluate Results.** Performance monitoring and evaluation should continue for at least a six-month period. Evaluation should include the accuracy and reliability of the information from each technology, as well as the impact on drayage fleet efficiencies and MTO operations efficiencies.

7. **Full Build Out.** If the test bed is deemed a success, final build out of the remaining HTA fleets and MTOs would be the next stage. While it would be a challenge to get buy-in across all MTOs, it is anticipated that a successful demonstration/prototype would lead to greater interest and participation.

### 6.7 Schedules and Phasing

The following is a possible schedule for implementation:

- **Month 1 to 4** Needs/Requirements, Select Technologies, and Survey Test Bed Site;
- **Month 4 to 6** Prepare Design Documents;
- **Month 7 to 12** Install, Test, and Integrate; and
- **Month 12 to 18** Monitor and Evaluate

Full build out would be dependent on how many additional MTOs signed up. Following a successful prototype demonstration, for planning purposes, an installation would take no more than six to eight months (including design), and could be done concurrently across multiple MTOs.
6.8 PRELIMINARY COST ESTIMATES

Phase 1. Test Bed

Freight-Focused Traveler Information

- See cost information provided in Section 3.0.

Marine Terminal Queues Information

- Approximately $26,000 to $40,000 per site for transponder reader hardware and software, plus $1,000 to $1,500 per site per year for maintenance and support. Installation costs will vary by site.
- $2,500 to $3,800 per site for camera installation plus $15,000 to $20,000 per mounting pole.
- $100,000 to $160,000 for technology monitoring and evaluation.

Container Status Information/Terminal Appointments

- Potentially a sunk development and testing cost for the first terminal and trucking fleet of $360,000 to $560,000.
- Requires further research to estimate more detailed costs.

Predictive Information for MTOs on Dray Truck Arrivals

- Potentially a sunk development and testing cost for the first terminal and trucking fleet of $250,000 to $375,000.
- Requires further research to estimate more detailed costs.

Program Management, Goods Movement Integration Management and Continuous Performance Monitoring

- Initial 18-month estimate of $600,000 to $950,000 for six-month support set-up and one-year initial implementation of these functions.

Phase II. Build Out

Freight-Focused Traveler Information

- See cost information provided in Section 3.0.

Marine Terminal Queues Information

- Approximately $26,000 to $40,000 per site for transponder reader hardware and software, plus $1,000 to $1,500 per site per year for maintenance and support. If equipping routes approaching terminal entrances plus BNSF and
UP rail yards, would be approximately 45 locations: Capital costs - $1,170,000 to $1,800,000 plus O&M costs of $45,000 to $67,500 per year.

- Approximately $6,000 to $9,400 per site for pavement detection and related hardware, to be installed at approximately 75 terminal entrances (based on preliminary aerial photo review of POLA, POLB and UP and BNSF rail yards): $450,000 to $705,000.
- $2,500 to $3,800 per site for camera installation plus $15,000 to $20,000 per mounting pole at 75 locations: $1,321,500 to $1,785,000.
- $100,000 to $160,000 for technology monitoring and evaluation.
- Installation and configuration costs will vary by site.
- Beyond the test bed project, the number of gates to be instrumented will depend on the technology chosen and the MTOs who are interested in participating. Some technologies could be installed on approaches to the port (Bluetooth, ALPR and PierPASS readers) and therefore cover multiple terminals. Others (video detection and pavement detection) need to be installed right at the gate itself. Additionally, an analysis of which terminals are most in need of a technology solution would ensure the most efficient use of resources.

Container Status Information/Terminal Appointments

- Implementation cost of $120,000 to $190,000 per terminal, with $20,000 to $32,000 per trucking fleet implementation.
- Requires further research to estimate more detailed costs.

Predictive Information for MTOs on Dray Truck Arrivals

- Implementation cost of $60,000 to $94,000 per terminal, with $32,000 to $50,000 per trucking fleet implementation.
- Requires further research to estimate more detailed costs.

Program Management, Goods Movement Integration Management and Continuous Performance Monitoring

- Estimate of $320,000 to $500,000 per year to support continual operation of these functions.

6.9 **Users Involved**

- HTA/Dray Trucking companies;
- Marine Terminal Operators;
• Local Cities;
• Metro;
• Ports;
• ATMIS;
• Rail Companies;
• Shippers; and
• Beneficial Cargo Owners.

6.10 **ROLES AND RESPONSIBILITIES**
• Metro and Gateway Cities - Oversight, Planning, Implementation, and Monitoring;
• Goods Movement Efficiency Committee - Public-private Partnership that will guide this program over the long-term;
• Test Bed Terminal Operator - Provide property access and support;
• Truck Owners/Operators - If on-vehicle device used to equip vehicles, information users; and
• Ports - Planning, Design, and Construction.

6.11 **PREREQUISITES**
Development of this project should reference the FHWA FRATIS Concept of Operations and Systems Requirements documentation. The Freight TIS/Data Warehouse projects are also needed.

6.12 **SYSTEMS INVOLVED**
• Data Warehouse/Freight TIS – Processing and dissemination;
• ATMIS or Freight TIS – Queue detection and video information sharing;
• RIITS – Data storage;
• Freight 511 – Data dissemination;
• Terminal Operating Systems - Terminal Appointment Systems;
• Truck Fleet Management GPS Systems; and
• Truck Dispatch Systems.
6.13 **POTENTIAL CHALLENGES/OBSTACLES**

Challenges for implementation include the following:

**Institutional Risk.** Significant. MTOs may not be supportive of monitoring queues by terminal.

**Technical Risk.** Low. There are many technology options, most of which are well-proven.

**Design Complexity.** Moderate. Varying MTO configurations/locations and external private systems may pose design challenges.

Challenges on implementation with the private sector are most likely to affect progress for these projects due to the highly competitive nature of the goods movement industry and entrenched and historical operations. Not all terminal operators may support this program and various projects. Terminal operations with respect to union rules may also affect successful implementation. Existing container tracking companies on projects may be reluctant to participate also. However, if container volumes at both ports at least double, improved container moves efficiencies will have to occur.

Close coordination with the POLB and POLA will be necessary for any equipment deployment.

6.14 **COORDINATION AND INTEGRATION WITH OTHER PROJECTS**

The various projects to improve container moves productivity will be processed and disseminated through the Data Warehouse project and Information Dissemination projects.

Additionally, it will be important to coordinate the development and testing of this project grouping with the FHWA planned testing of FRATIS in the Gateway Cities over the next 18 months.

6.15 **OTHER OPTIONS CONSIDERED**

Another approach would be to perform the technology assessment as an analytical study and proceed with the physical installation of one chosen technology, rather than comparing multiple technologies in the field. However, given the strong need for container moves productivity improvements and the physical variations between terminal facilities, it is possible that a combination of technologies would be more effective than one uniform selection.
6.16 **INITIAL STEPS FOR DEPLOYMENT**

The first step would be to start the development and initial meeting of the *Goods Movement Efficiency Committee*.

The second step would be to establish an agreement with a terminal operator and drayage companies for a test bed site and begin the technology assessment.

The third step would be to coordinate the development and testing of this project grouping with the FHWA planned testing of FRATIS in the Gateway Cities over the next 18 months.

6.17 **OUTCOMES/NEEDS ADDRESSED**

- Develop public-private long-term program to lead the regional development of goods movement efficiency projects;
- Data on most effective container movement efficiency technologies;
- Ability to monitor and disseminate queue information to support drayage dispatchers and drivers;
- Real-time information on terminal gate queues;
- Real-time information on trucks approaching terminals;
- Information that reduces number of truck trips and/or reduces bobtails; and
- Freight congestion and emissions reductions in the Gateway Cities subregion.
7.0 Automated Truck Research Project

7.1 PROJECT OVERVIEW

This project will implement a staged progression of commercial vehicle technologies in order to transition from current research-based automated commercial vehicle demonstration efforts to staged operational testing of a flow efficiency system of trucks along the planned I-710 truck lanes. This project will build upon the unique operational environment and potential partnerships of the Gateway Cities subregion to promote and enhance truck automated commercial vehicle research by bringing together the applications of automated commercial vehicle and automation technologies with the real-world operational realities of a heavily congested truck corridor. Finally, the project will provide for staged operational testing over time with an eye towards understanding the specific design and operational concerns that impact the future development of the I-710 and its approaches.

7.2 OBJECTIVES

- Help ensure the future viability of the Ports and Gateway Cities subregion, as well as the I-710 corridor, by realizing the vision for achieving maximum effective capacity within the substantial physical constraints of the regions key truck corridors;

- Build upon ongoing and rapidly advancing intelligent vehicle technologies for trucks to define a detailed and staged ConOps for an effective conveyor operation of trucks on the I-710;

- Develop and support a test site in the region where technologies and operational concepts can be tested in conjunction with public and private partners;

- Leverage emerging Original Equipment Manufacturer (OEM) and Tier 1 vehicle supplier technologies to provide a viable real-world operational model focused on the needs and characteristics of the region;
• Establish an ongoing partnership and environment that attract additional funding opportunities to bridge the gap between research efforts and effective real-world solutions in a real-world freight corridor; and

• Promote the state of the art in truck guidance and flow efficiency with an eye towards effective and widespread deployments using Original Equipment Manufacturer (OEM) available equipment.

7.3 DESCRIPTION

The project encompasses three major areas of effort:

1. Institutional/Promotional. In order to realize the long-term vision for a technology-based flow efficiency operation of trucks, it is necessary to establish institutional relationships and partnerships that will endure over the long term. These institutional relationships will need to bring together port stakeholders, regional agencies, Caltrans, Federal entities, research organizations, and most importantly, truck equipment manufacturers and private shipping interests, to promote a realistic operational vision. The partnership would be held together by centralized coordination and communications efforts with the common good between all interests defined as the long-term savings of time, money, and mobility. The partnership should also be visibly represented and marketed to Federal, state, and private funding opportunities through a cohesive and professional marketing and communications effort. Finally, this partnership will have to review and promote enabling legislation over time to support the longer-term corridor vision.

2. Operational/Design Path Development. The second major area of effort focuses on building on recent research efforts on truck guidance, intelligent vehicle systems, and automated commercial vehicle to define the details of what operations would look like in the I-710 corridor, given the future cross-section and design alternatives. In order to realize viable future growth and maintain reasonable levels of truck and passenger traffic operations, it is necessary to stretch the boundaries of traditional volume/capacity assumptions. The only means to realize this new vision for enhanced effective capacity is to apply intelligent vehicle technologies. Technical analyses efforts need to be conducted by an interdisciplinary team, including vehicle technology experts, truck operations experts, experience drivers, traffic engineers, and highway designers, to develop detailed operational concepts for the I-710 corridor, which can be tested as part of this project. In addition, this team must assess physical and system design impacts for the I-710 truck lanes corridor in light of the planned technologies and operational concepts. This assessment must take into account truck travel and logistics patterns as part of assessing the design and operation needs of the corridor. As part of this assessment, this effort will need to build a comprehensive
simulation model of the considered concepts. The simulation model should cover both the typical traffic engineering perspective as well as the OEM’s models of the trucks. This would represent a unique opportunity to merge vehicle simulation models (often developed by OEMs) with roadway/highway simulation tools.

3. **Staged Testing Applying Available Technologies and Operational Concepts.** The third area of effort involves the actual testing and application of the proposed operational concepts. Testing will include establishment and the recurring use of approximately a 3.5-mile stretch of Route 103 in the Port region (Figure 7.1), or another route. This corridor has many characteristics similar to other major facilities providing access to the Port region and will provide a comparable setting for testing the staged progression of technology and operational concepts. The facility ranges from a six-lane (two-direction) barrier divided highway to a four-lane wide buffer separated highway.

The goal is not simply to test the performance of the technologies themselves, but to introduce real operational challenges and concepts specific to the real-world I-710 corridor environment and test widely available technologies against those challenges. It is assumed other projects will continue to stretch the boundaries of intelligent vehicle technologies, while the goal of this truck technology flow efficiency project will be to test and realize staged benefits using OEM concepts, which can be widely adopted. The three stages of progressive testing currently envisioned include:

1. **Stage 1 – Simple Adaptive Cruise Control (ACC) and Defined Speed Limits.** Focused on the potential for the real-world application of a loosely defined conveyor of trucks using available ACC\(^3\), and possibly braking technology with prescribed operational speeds for a corridor. Previous testing is focused more on intraplatoon performance, but this effort would look at applying test results to overall potential corridor performance.

2. **Stage 2 – Cooperative ACC and Multitruck Communications.** Limitations exist with ACC that is designed mostly to maintain safe distances between vehicles. Tighter spacing may be achieved with Dedicated Short Range Communications (DSRC) and intertruck communications. This approach may allow for tighter spaces between trucks with forewarning of problems several trucks in advance. This also may include roadside DSRC communications stations to provide an overall corridor view of the operations of the conveyor of trucks.

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\(^3\) ACC is an existing technology available currently available on some automobiles. It allows the driver to set and retain a specific vehicle speed, but different from traditional cruise control systems, the system is able to decrease its speed automatically when the preceding vehicle decreases its speed. It also maintains a specific distance from the preceding vehicle that can be set by the driver (IVsource.net, 2011).
Figure 7.1 Potential Area for Truck Flow Efficiency Test Corridor
3. **Stage 3 – Truck Automation Suites with Corridor-wide Optimization.** At this point, it is assumed that truck research efforts have expanded the functionality of available OEM products, and the automated commercial vehicle options are more effectively understood. Lessons learned from Stages 1 and 2 would be applied to enhance vehicle automation, possibly including lateral guidance and control at a greater level with combined cooperative ACC, safety, braking, and vehicle-to-vehicle communications, to establish the most effective conveyor options possible. Again, the end goal may not be the tightest platoons possible for smaller subsets of vehicles, but the overall effectiveness and throughput of the overall corridor. This stage would combine corridor-wide simulation and management concepts, where speeds of vehicles may be managed given the levels of traffic and conditions in the corridor as communicated by vehicle-to-roadside DSRC methods. This stage should also consider the latest updates in DSRC research, application, and decisions on U.S. DOT standards. It is crucial that simulation efforts for the project take into account the varying and dynamic performance of heavy duty trucks as part of assessing methods of ensuring operational efficiency and designs that meet future needs.

### 7.4 Hypothetical Operational Narratives/Examples

**Developing and Using a Test Bed**

A little less than a year ago, the Truck Flow Efficiency Demonstration and Operations Research Group were formed. This group brought together state, regional, and Federal agencies, along with the trucking industry and manufacturers; all of which worked hard to gain the funding and permissions needed to move into operational testing. It is very early in the morning and the drivers are climbing into their trucks, which are being gone over by technicians to ensure all systems are operating. The operational test is simple enough; the three trucks will form a rough group and activate ACC systems with similar speed settings. Three additional trucks will merge into the group and create a tighter grouping. The trick will be testing the reactions of the trucks’ ACC systems under various scenarios of speeds and vehicles leaving the queues. The ACC systems were initially developed to enhance safety and ensure truckers did not follow too closely, but the truck systems experts have adjusted the systems to maintain safety and maximize efficiency. Tests a few days from now will determine the benefits of truck to truck communications, where the vehicle in the front of the group must slow down for whatever reason and the following trucks must adjust accordingly.
Modeling Corridor Efficiency with Operational Scenarios

Testing has been underway along portions of the test bed corridor for a little over six months with the overall project having started about a year and a half ago. Today, the next big step starts as actual fleet vehicles that have been provided from local freight fleet are going to be part of the testing. The individual systems and operational concepts have been tested, and the project is moving into an extended testing with real trucks carrying real goods and real drivers.

Joe Smith knows what to expect as he has been involved in testing over several months. As Mr. Smith enters the test corridor, everything seems similar to previous tests, but now they are doing their real job of getting goods from Point A to Point B. Somewhere behind the scenes his truck and those of his fellow drivers are sending continuous communications to each other and those strange boxes mounted on some poles alongside the test corridor. Further away, a computer is tracking what occurs and making determinations of what speeds would be most effective to maintaining the overall flow of trucks. Mr. Smith thinks about what Caltrans design engineer told him last month, about how it was good they had done these tests so they could start incorporating the findings into their designs for the new truck lanes. The design engineer told him that the test program results are going to save millions in potential risks and changes to the actual construction project. Mr. Smith cannot wait for those truck lanes to get finished, as the world economy has kicked into high gear and the whole region and Ports need to stay competitive.

7.5 **Scope of the Project**

1. **Detailed ConOps.** The Gateway Cities Technology Plan for Goods Movement will provide an operational framework for this project, but it will not be able to delve into many of the details that will be required to move into actual development and testing for the Truck Flow Efficiency effort. A detailed ConOps will bring together stakeholders to a common understanding of what will be accomplished on the vehicle test bed and corridor test bed. Summary components of the ConOps will help bring in funding and industry partners who want to participate. The ConOps should follow ANSI G-043 standards, and address operations, roles and responsibilities, envisioned technologies for:
   a. Initial Operational Tests Environment. Defining the details of what is needed in the test corridor and test bed vehicles; and
   b. I-710 Environment. Providing an enhanced framework and understanding of how the test results may fit into the I-710 truck lanes environment.

2. **Design Validation and Impact Assessment.** A specific team should review the ConOps and the latest truck technology developments to make an initial
assessment of potential design impacts for I-710 truck lanes, as well as other potential Truck Flow Efficiency roadways and corridors. This assessment should “ask” a series of questions about how the technologies may impact operations and physical design. Each of these questions should be answered as part of the project development, testing, and lessons learned. This task would initiate the simulation development effort to model both the test corridor and the I-710 corridor. This simulation effort can assist in validating design considerations and once testing begins, it can be used to calibrate actual test corridor results with the I-710 simulation model.

3. **Demonstration and Operations Research Group.** The core institutional effort will be to develop an ongoing demonstration and operations group. This group will coordinate and act as overall project supporters and sponsors. The group will represent the partnership between government and private industry.

   a. **Project Charter.** Defining the goals, objectives, and general scope and stakeholder involvement of the project;

   b. **Initiate Coordination Meetings.** Coordination meetings should support remote involvement of truck OEM suppliers and manufacturer;

   c. **Grant/Funding Pursuit.** The project should act as an ongoing concern that seeks not only initial funding, but funding that meets the overall Project Charter goals and continues until the project concepts are deployed in the real-world operational environment;

   d. **Contracting.** The group may serve to oversee project efforts, and some members may need to participate in contracting efforts; and

   e. **Promotional and Marketing.** The group should hire expertise to promote project efforts and objectives for funding, as well as regional acceptance.

4. **Vehicle Test Bed Development.** A set of at least three trucks to start with equipped with appropriate technologies by stage of project development. It may be necessary to make decisions regarding specific technologies or equipment to be installed and used for testing. The primary goal of the project is to test operational concepts with equipment that is anticipated to be widely available to the trucking industry within a five-year period.

   a. **Partnership Truck Availability.** Partners should be sought that would be willing to supply trucks for test participation under certain guidelines/restrictions; and

   b. **Leased Truck Availability.** Some equipment changes or operational test scenarios may require additional trucks that would represent a significant impact to potential partners, so some trucks may need to be leased.

Operational testing is anticipated to ultimately require at least six trucks. Once the initial demonstration segment is underway, the desire would be to
equip a wider range of trucks with the desired equipment. These trucks would use the corridor as part of their regular operations.

5. **Establish Test Corridor.** Several steps will be required to ready the proposed test corridor (Figure 7.1). This corridor is viewed as having substantial excess capacity that could support testing activities, and the corridor also has many similarities to the I-710.

   a. Traffic and Safety Design and Permitting. The test corridor will be reviewed and designs developed for necessary signage, striping, and physical modifications. In addition, permitting processes will be undertaken.

   b. Physical Modifications. Physical, striping, and signage modifications will be contracted, made, inspected, and signed-off.

   c. Equipment Provision and Maintenance. Field equipment that will be part of the testing will need to be provided and secure space arranged. This may also require an on-site field test coordinator that can ensure equipment is maintained and activities properly scheduled. Also, some equipment will require ongoing communications within the test corridor, as well as outside the test corridor.

   d. Return to Original State. Plans should be made to return the test corridor to its original state, unless a determination is made that the changes are viable for the ultimate use of the corridor in regular operations.

6. **Truck/Corridor Integrated Testing and Proof of Concept.** The core of the entire project is the actual testing, which is envisioned to occur in the three stages previously discussed. For each stage, the following basic process would apply:

   a. Test Plan/Coordination. Overall test plans should identify the testing goals, timelines, resources, equipment used, and how the test fits into the overall project effort.

   b. Individual Test Procedures. Detailed procedures should be developed well in advance and applied during actual testing. Procedures or the concepts the procedures represent should be linked to the functions and operations defined in the ConOps and Design Validation and Impact Assessment.

   c. Field Testing/Scheduling. Actual testing should occur along the test corridor using the test bed vehicles. Testing should collect comprehensive data and be subject to independent evaluation and review.

   d. Reporting and Presentation. Lead parties for the testing efforts for each stage or each portion of a stage should provide written overview reports
and presentations of findings to the Demonstrations and Operations Research Group.

7. **Initial Demonstration Segment.** Once the Proof of Concept is in place for the three stages, the project can move to actual operational testing using non-test bed trucks within proper guidelines and restrictions. This effort should only test well proven and safe concepts, and focused on variations in driver use and interactions in a real-world environment. Details of this task would have to be worked out prior to implementation.

8. **Independent Evaluation of Results.** Prior to applying the lessons learned from the Truck Flow Efficiency project to design and operations, an independent review of the final operational concept should be made. This effort should define the ultimate cost-benefit tradeoffs from a corridor, as well as a private industry perspective.

### 7.6 Conceptual Diagrams

Figure 7.2 demonstrate the basic premise of the truck flow efficiency testing project by the three stages discussed earlier in this project description.

**Figure 7.2 Three Project Stages**

- **Stage 1 Concept – Simple Adaptive Cruise Control and Defined Speed Limits**

- **Stage 2 Concept – Adaptive Cruise Control with Multi-Truck Communications**

- **Stage 3 Concept – Truck Automation Suite with Corridor-wide Optimization**
7.7 SCHEDULES AND PHASING

The following is a conceptual schedule for implementation of the truck flow efficiency project effort. It is anticipated this project would end once the evaluation effort is completed. Naturally, the schedule would be:

- Month 1 to 4: Detailed ConOps;
- Month 4 to 12: Design Validation and Impact Assessment;
- Month 1 to Project End: Demonstration and Operations Research Group;
- Month 6 to 12: Vehicle Test Bed Development;
- Month 6 to 12: Establish Test Corridor;
- Month 12 to 18: Truck/Corridor Integrated Testing and Proof of Concept;
- Month 18 to 24: Initial Demonstration Segment; and
- Month 16 to 24: Independent Evaluation of Results.

7.8 PRELIMINARY COST ESTIMATES

The following are preliminary planning and programming level cost estimates. The costs estimates assume that there is substantial leveraging of other automated truck technology research projects, as the goal is to use the lessons from these technology projects and drive a real-world operational model that takes into consideration the design impacts for truck corridors such as the I-710.

Cost estimates should be revised, detailed, and updated as the project proceeds.

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<tr>
<th>Capital Costs</th>
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<tr>
<td>Detailed ConOps</td>
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<tr>
<td>Design Validation and Impact Assessment</td>
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<td>Demonstration and Operations Research Group</td>
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</table>
7.9 **Users Involved**

- **Project Research Group.** Project Ownership and Coordination, including representatives from agencies, truck OEM, and research entities;
- **Caltrans.** Permitting and Design Input/Support;
- **Vehicle OEMs.** Equipment Provision and Testing Support;
- **Freight Fleet Operators.** Vehicle Provision, Operational Input, and Testing Support;
- **Independent Evaluator.** Testing and Evaluation Reporting; and
- **Ports.** Operational Concepts and Input.

7.10 **Roles and Responsibilities**

- Ports - Planning, Design Support, Coordination, and Operational Input;
- Caltrans - Participating in Group for Planning, Operations and Design Impacts and Permitting;
- Vehicle OEM - Direct Participation and Involvement in Project Development, Vehicle Test Beds, and Testing;
- Gateway Cities Council of Governments (GCCOG) and Other Regional Agencies - Contracting, Project Coordination and Hosting, and Grant Application Development;
- Local Jurisdictions - Planning and Permitting; and
- Freight Stakeholders - Operational Review, Testing Involvement, and Project Promotion.

7.11 **Prerequisites**

None.

7.12 **Systems Involved**

This project concept is centered on moving from pure research efforts to operational concepts development and testing in a realistic environment. Current systems are not expected to play any substantial role. The systems that would be involved include:
• Intelligent Vehicle (IV) truck systems. For purposes of guidance, headway maintenance, and platooning, including:
  – Internal on board systems (All Stages);
  – Vehicle to vehicle communications (Stages 2 and 3); and
  – Vehicle to roadside communications (Stage 3).
• Specialized roadside systems and software to be developed as part of this project using DSRC (Stage 3).
• Specialized software applications with logic developed to reflect proper truck platoon formation and/or throughput optimization.
• Wireless Test Equipment. On-board test trucks.
• Wireless-leased communications (All Stages).

7.13 **POTENTIAL CHALLENGES AND OBSTACLES**

Challenges for implementation include the following:

• **Institutional risk – Moderate.** Many stakeholders in the region and in the truck OEM industry will need to cooperate to make the project come to fruition. Allowing the test corridor to be implemented and maintained will take detailed and ongoing coordination and project promotion.

• **Technical risk – Moderate to High.** While many of the technologies have been individually proven, there is the potential that the technologies while combined with operational environment may not provide the benefits desired for ultimate implementation on the I-710 corridor. By the same token, the whole goal of the project is to determine whether or not the operational benefits of the technologies prove themselves and what design considerations should be made for the I-710 corridor to maximize its effectiveness. In many ways, this project would act as risk mitigation for the ultimate design and deployment of dedicated truck lanes on the I-710.

• **Design complexity – Moderate.** The project should moderate physical design considerations, and it should also provide input to mitigate future integrated corridor applications.

7.14 **COORDINATION AND INTEGRATION WITH OTHER PROJECTS**

The Truck Flow Efficiency project is not required to be coordinated with other systems deployment efforts as part of the Gateway Cities Technology Plan for Goods Movement; however, consideration should be given of the results of the project in terms of potential long-term operational impact to other systems.
7.15 **OTHER OPTIONS CONSIDERED**

Other automated truck technology options include the following:

- **Pure truck automated commercial vehicle research effort.** Several research efforts are underway around the world to research the advantages of truck guidance and automated commercial vehicle technologies. Many rely on operational concepts that would represent major changes from current driving environments for both passenger vehicles and trucks. As part of an initial effort for this project, extensive research on these other efforts should be done and reported to the working group, including lessons learned.

- **Development of a detailed operational concept only.** The deployment timeline for the I-710 truck lanes and many of the other efforts that are directly supported by this project are uncertain or set well into the future. There was some discussion that perhaps a detailed operational concept would be adequate at this point with technology lessons drawn from other research and development efforts going on elsewhere. There was some consideration that a near-term test bed and test corridor development could be delayed until the I-710 trucks lanes were closer to actual implementation. However, this option was ruled out as there are significant lessons that can be learned through the full project, as described above, that would not become invalid over time. In addition, early consideration of these issues in a real operational test environment will help ensure that design, operations, and safety lessons learned through the Truck Flow Efficiency project could be readily incorporated into physical design and infrastructure improvements along I-710 and elsewhere.

- **No project.** This option was similar to the one above, but rejected for similar reasons. The Truck Flow Efficiency project represents a unique opportunity to test truck automated commercial vehicle, intelligent vehicle, and related technologies and operations. This opportunity is not readily available in other parts of the nation.

7.16 **OUTCOMES**

- Proven operational and technical concepts to act as inputs to the design and operations for the I-710 corridor, and in particular the truck-only lanes on the I-710 corridor;

- Direct input to the I-710 design based on test results and lessons learned;

- Established research group and partnership that would allow for continued testing and development leading up to the ultimate construction and opening of truck-only lanes on I-710; and

- Development of a system to increase through put of trucks in the I-710 freight corridor and improve safety as well.
7.17 INITIAL STEPS FOR DEPLOYMENT

The first steps towards deployment would be to arrange an agency team that agrees to the project concept. Development of a project charter should follow leading to the involvement of partners from the trucking, shipping, and manufacturing industries. This combined group would undertake the development of the Detailed ConOps. The detailed ConOps would most likely be contracted out to an industry research group. One agency would need to take the lead role in sponsoring grant application and contracting efforts.

7.18 NEEDS ADDRESSED

- **Terminal Congestion.** The ultimate results of this project could be applied not only to the I-710 corridor, but also to terminal access roads, corridor approach roads, etc. The project also integrates well with concepts currently under discussion for future truck electrification efforts.

- **Truck Congestion on Key Roadways.** Modeling efforts for the I-710 corridor have pointed to the need to substantially increase the effective capacity of the traffic lanes. This project points the ways towards maximizing the effectiveness of the truck-only lanes on I-710.

- **Enhanced Traffic and Commercial Vehicle Safety.** The focus of the on-board devices is to enhance vehicle safety and reduce the potential or severity of crashes.

- **Supporting Reduced Emissions.** By enhancing the consistency of truck travel speeds, reducing the accordion effect, and reducing the potential and/or severity of accidents, the project should have substantial long-term benefits in emissions reduction.
8.0 Truck Enforcement Network System

This project will develop strategies, concepts and layouts to truck enforcement that works for the needs of the stakeholders within the study area. This Truck Enforcement Network System (TENS) must meet the needs of CHP’s daily truck enforcement facilities operations, Caltrans as overseer of the transportation system including Truck Enforcement Facilities (TEF) design, and also the shippers, receivers, logistic and trucking industries to process safe trucks from point to point in a timely manner. The current approach and practice of truck enforcement cannot process trucks at a rate that will match the present and future truck volume demands. The challenge is to modify and add to the existing approach of truck enforcement to meet these ever growing truck volume demands.

The feasibility study involved finding locations and conceptually developing permanent truck enforcement facilities and bypass screen/sort sites to process the large number of truck movements per day in the Gateway Cities subregion, plus an approach to truck enforcement that could be automated to maximize the effectiveness and efficiency of the enforcement operations. This automation piece was important to this study; it is with the intention that any permanent truck inspection facilities would be safe and not result in trucks backing up onto any adjacent freeways and city streets from these facilities. These automated functions are to safely process as many trucks as possible through an inspection, weighing and measuring environment. Additionally, there is a need to realign the truck overweight fine structure to be proportional to the damages the vehicles produce to the roadway and bridges.

As mentioned earlier, the Truck Enforcement Network System (TENS) project is only summarized briefly in this document and does not have a full technical section in this report. The TENS project description is contained in a separate report Gateway Cities Technology Plan for Goods Movement Feasibility Study Report for the Implementation of a Enforcement Network System for Gateway Cities and Surrounding Areas.
9.0 Conceptual Projects Estimated Costs

9.1 Freight Transportation Information System (TIS) and Data Warehouse Project

Freight TIS

<table>
<thead>
<tr>
<th>Capital Costs</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional, System, Staffing and Facility</td>
<td>$450,000-$500,000</td>
</tr>
<tr>
<td>Requirements Plan</td>
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</tr>
<tr>
<td>Freight TIS Assessment Study</td>
<td>$40,000-$60,000</td>
</tr>
<tr>
<td>Operations Plan</td>
<td>$40,000-$60,000</td>
</tr>
<tr>
<td>Prepare requirements to procure new software</td>
<td>$175,000-$225,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$705,000-$895,000</strong></td>
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Operations and Maintenance Costs

<table>
<thead>
<tr>
<th>Operations and Maintenance Costs</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ongoing annual costs</td>
<td>$100,000-$325,000 per year</td>
</tr>
<tr>
<td>(at this stage costs could vary greatly based on outcome of planning exercises)</td>
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</table>

Data Warehouse

<table>
<thead>
<tr>
<th>Capital Costs</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Level Requirements</td>
<td>$50,000-$90,000</td>
</tr>
<tr>
<td>Detailed Requirements (assume eight interfaces)</td>
<td></td>
</tr>
<tr>
<td>- Data structure requirements</td>
<td>$120,000-$200,000</td>
</tr>
<tr>
<td>- Networking, communication, API requirements</td>
<td>$120,000-$200,000</td>
</tr>
</tbody>
</table>
• Development and Implementation
  - Data warehouse $300,000–$500,000
  - Software development and upgrades $150,000–$250,000
  - Networking, communication $150,000–$250,000
  - Hardware (servers and networking equipment) $60,000–$150,000
• Total $950,000–$1,640,000

Operations And Maintenance Costs
• Ongoing annual costs $200,000–$300,000 per year

Other Costs
• Addition of new data sources $100,000–$125,000 each

Summary of Estimated Costs
• Freight TIS
  - Capital $705,000–$895,000
  - Operations and Maintenance $100,000–$325,000 per year
• Data Warehouse
  - Capital $950,000–$1,640,000
  - Operations and Maintenance $200,000–$300,000 per year
  - Addition of new data sources $100,000–$125,000 each

9.2 Freight Traveler Information Dissemination

Capital Costs
• Requirements $80,000–$150,000
• Data Dissemination System Development
  - Database Development $150,000–$250,000
  - Communication Interface (API/web service/XML) $400,000–$600,000
  - Server and networking $110,000–$170,000
  - Software and development tool licenses $10,000–$20,000
  - System Deployment $80,000–$150,000
• Improvements to Existing Systems (RIITS and 511) $80,000–$150,000
• Freight 511 Web Page Development $40,000–$75,000
• Freight 511 Spanish IVR Development $500,000-$750,000
• Marketing and Outreach $200,000-$400,000
• Total $1,650,000-$2,715,000

**Operations and Maintenance Costs**

- Ongoing annual costs
  - Data Dissemination System $150,000-$300,000 per year
  - Freight 511 Web Page $150,000-$250,000 per year
  - Spanish 511 IVR $1,200,000-$1,800,000 per year
- Total $1,500,000-$2,300,000 per year

**Other Costs**

- Pilot Demonstration Project
  - Capital $360,000-$610,000
  - Operations and Maintenance $75,000-$145,000 per year

**Summary of Estimated Costs**

- Capital $1,650,000-$2,715,000
- Operations and Maintenance $1,500,000-$2,300,000 per year

**9.3 ARTERIAL SMART CORRIDORS FOR FREIGHT**

**Capital Costs**

- Inventory existing equipment $50,000-$60,000
- Analyze technology gaps $40,000-$50,000
- Signal synchronization (179 intersections) $7,500-$15,000 per signal
- Travel time measurement system (19 corridors) $6,175,000-$7,125,000
- CMSs (9 CMSs) $250,000-$325,000 per CMS
- Arterial data integration and sharing $900,000-$1,200,000
- Total $10,750,000-$14,050,000

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4 The pilot demo project includes demo versions (approximately one-half of the overall) of data dissemination and Freight511 web page, but it does not have a Spanish IVR component.
Operations and Maintenance Costs

<table>
<thead>
<tr>
<th>Description</th>
<th>Range</th>
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</thead>
<tbody>
<tr>
<td>Ongoing annual costs</td>
<td>$1,075,000-$1,400,000 per year</td>
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</table>

Summary of Estimated Costs

<table>
<thead>
<tr>
<th>Description</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital</td>
<td>$10,750,000-$14,050,000</td>
</tr>
<tr>
<td>Operations and Maintenance</td>
<td>$1,100,000-$1,400,000 per year</td>
</tr>
</tbody>
</table>

Other Costs

<table>
<thead>
<tr>
<th>Description</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of Third-Party Vendor Arterial Travel Time Data⁵</td>
<td>$10,000-$20,000</td>
</tr>
<tr>
<td></td>
<td>$25,000-$50,000 per year</td>
</tr>
</tbody>
</table>

9.4  **FREEWAY SMART CORRIDORS FOR FREIGHT – COMPLETE FREEWAY ITS DEPLOYMENT**

Capital Costs

- Base Traffic Management.  $500,000 per mile (includes design, equipment, and installation).

Operations and Maintenance Costs

- Base Traffic Management: $20,000 per mile;
- Equipment Refurbishing and Repair: $2,500 to $5,000 per site (does not include traffic control); and
- Estimated Annual Cost for Refurbishment and Repair: $60,000 to $120,000.

Assumptions

- Approximately 38 miles of full permanent ITS implementation, and 11 miles of partial permanent ITS implementation;
- Approximately 120 detection sites currently nonoperational;
- 20 percent to be refurbished/repaired each year; and
- Total sites refurbished/repaired each year: 24 sites.

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⁵ Estimate based on approximately 170 miles of arterial coverage.
Summary of Estimated Costs

- Capital $20,000,000-$24,500,000
- Operations and Maintenance $1,000,000-$1,200,000 per year

9.5 CONTAINER MOVES PRODUCTIVITY IMPROVEMENTS

Phase 1. Test Bed
Freight-Focused Traveler Information
- See cost information provided in Section 9.2.

Marine Terminal Queues Information
- Approximately $26,000 to $40,000 per site for transponder reader hardware and software, plus $1,000 to $1,500 per site per year for maintenance and support. Installation costs will vary by site.
- $2,500 to $3,800 per site for camera installation plus $15,000 to $20,000 per mounting pole.
- $100,000 to $160,000 for technology monitoring and evaluation.

Container Status Information/Terminal Appointments
- Potentially a sunk development and testing cost for the first terminal and trucking fleet of $360,000 to $560,000.
- Requires further research to estimate more detailed costs.

Predictive Information for MTOs on Dray Truck Arrivals
- Potentially a sunk development and testing cost for the first terminal and trucking fleet of $250,000 to $375,000.
- Requires further research to estimate more detailed costs.

Program Management, Goods Movement Integration Management and Continuous Performance Monitoring
- Initial 18-month estimate of $600,000 to $950,000 for six-month support set-up and one-year initial implementation of these functions.

Phase II. Build Out
Freight-Focused Traveler Information
- See cost information provided in Section 9.2.
Marine Terminal Queues Information

- Approximately $26,000 to $40,000 per site for transponder reader hardware and software, plus $1,000 to $1,500 per site per year for maintenance and support. If equipping routes approaching terminal entrances plus BNSF and UP rail yards, would be approximately 45 locations: Capital costs - $1,170,000 to $1,800,000 plus O&M costs of $45,000 to $67,500 per year.

- Approximately $6,000 to $9,400 per site for pavement detection and related hardware, to be installed at approximately 75 terminal entrances (based on preliminary aerial photo review of POLA, POLB and UP and BNSF rail yards): $450,000 to $705,000.

- $2,500 to $3,800 per site for camera installation plus $15,000 to $20,000 per mounting pole at 75 locations: $1,321,500 to $1,785,000.

- $100,000 to $160,000 for technology monitoring and evaluation.

- Installation and configuration costs will vary by site.

- Beyond the test bed project, the number of gates to be instrumented will depend on the technology chosen and the MTOs who are interested in participating. Some technologies could be installed on approaches to the port (Bluetooth, ALPR and PierPASS readers) and therefore cover multiple terminals. Others (video detection and pavement detection) need to be installed right at the gate itself. Additionally, an analysis of which terminals are most in need of a technology solution would ensure the most efficient use of resources.

Container Status Information / Terminal Appointments

- Implementation cost of $120,000 to $190,000 per terminal, with $20,000 to $32,000 per trucking fleet implementation.

- Requires further research to estimate more detailed costs.

Predictive Information for MTOs on Dray Truck Arrivals

- Implementation cost of $60,000 to $94,000 per terminal, with $32,000 to $50,000 per trucking fleet implementation.

- Requires further research to estimate more detailed costs.

Program Management, Goods Movement Integration Management and Continuous Performance Monitoring

- Estimate of $320,000 to $500,000 per year to support continual operation of these functions.
## 9.6 Automated Truck Research Project

<table>
<thead>
<tr>
<th>Capital Costs</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detailed ConOps</td>
<td>$85,000-$135,000</td>
</tr>
<tr>
<td>Design Validation and Impact Assessment</td>
<td>$360,000-$570,000</td>
</tr>
<tr>
<td>Demonstration and Operations Research Group</td>
<td>$170,000-$270,000</td>
</tr>
<tr>
<td>Vehicle Test Bed Development</td>
<td>$1,900,000-$3,000,000</td>
</tr>
<tr>
<td>Trucks Technology Modifications</td>
<td>$250,000-$350,000</td>
</tr>
<tr>
<td>Establish Test Corridor</td>
<td>$530,000-$820,000</td>
</tr>
<tr>
<td>Truck/Corridor Integrated Testing &amp; Proof of Concept</td>
<td>$980,000-$1,500,000</td>
</tr>
<tr>
<td>Initial Demonstration Segment</td>
<td>$330,000-$520,000</td>
</tr>
<tr>
<td>Independent Evaluation of Results</td>
<td>$110,000-$175,000</td>
</tr>
<tr>
<td>Total</td>
<td>$4,715,000-$7,340,000</td>
</tr>
</tbody>
</table>