GATEWAY CITIES TECHNOLOGY PLAN FOR GOODS MOVEMENT

Background Research Reports

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Task 1: Background Research

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<td>Local Control Center</td>
</tr>
<tr>
<td>LCS</td>
<td>Lane Closure System</td>
</tr>
<tr>
<td>LIDAR</td>
<td>Laser Radar</td>
</tr>
<tr>
<td>LIVIC</td>
<td>Laboratory for the Interactions between Vehicles, Infrastructure, and Conducteurs</td>
</tr>
<tr>
<td>LPR</td>
<td>License Plate Reader</td>
</tr>
<tr>
<td>LTE</td>
<td>Long-Term Enhancements</td>
</tr>
<tr>
<td>LV</td>
<td>Lead Vehicle</td>
</tr>
<tr>
<td>MARS</td>
<td>Mobile Autonomous Robot Software</td>
</tr>
<tr>
<td>MATIS</td>
<td>Motorist Aid and Traveler Information System</td>
</tr>
<tr>
<td>MCP</td>
<td>Mobile Computing Platform</td>
</tr>
<tr>
<td>MdTA</td>
<td>Maryland (Toll) Transportation Authority</td>
</tr>
<tr>
<td>METI</td>
<td>Ministry of Economy, Trade, and Industry</td>
</tr>
<tr>
<td>MTO</td>
<td>Marine Terminal Operator</td>
</tr>
<tr>
<td>NAHSC</td>
<td>National Automated Highway System Consortium</td>
</tr>
<tr>
<td>NATSO</td>
<td>National Association of Truck Stop Owners</td>
</tr>
<tr>
<td>NATSN</td>
<td>North American Truck Stop Network</td>
</tr>
<tr>
<td>NCFRP</td>
<td>National Cooperative Freight Research Program</td>
</tr>
<tr>
<td>NEDO</td>
<td>New Energy and Industrial Technology Development Organization</td>
</tr>
<tr>
<td>NHS</td>
<td>National Highway System</td>
</tr>
<tr>
<td>NHTSA</td>
<td>National Highway Traffic Safety Administration</td>
</tr>
<tr>
<td>NET</td>
<td>Near-Term Enhancements</td>
</tr>
<tr>
<td>O&amp;M</td>
<td>Operations and Maintenance</td>
</tr>
<tr>
<td>OBC</td>
<td>On-Board Computer</td>
</tr>
<tr>
<td>OCTA</td>
<td>Orange County Transportation Authority</td>
</tr>
<tr>
<td>OFM</td>
<td>Office of Freight Management and Operations</td>
</tr>
<tr>
<td>OOS</td>
<td>Out of Service</td>
</tr>
<tr>
<td>OS/OW</td>
<td>Oversize/Overweight</td>
</tr>
<tr>
<td>OSAP</td>
<td>Open Source Architecture Package</td>
</tr>
<tr>
<td>Acronym</td>
<td>Full Form</td>
</tr>
<tr>
<td>---------</td>
<td>-----------</td>
</tr>
<tr>
<td>OV</td>
<td>Other Vehicle</td>
</tr>
<tr>
<td>PATH</td>
<td>Partners for Advanced Transportation Technology</td>
</tr>
<tr>
<td>PANYNJ</td>
<td>Port Authority of New York and New Jersey</td>
</tr>
<tr>
<td>PCS</td>
<td>Port Community System</td>
</tr>
<tr>
<td>PDA</td>
<td>Personal Digital Assistant</td>
</tr>
<tr>
<td>PELOPS</td>
<td>Program for the Development of Longitudinal Traffic Processes in System Relevant Environment</td>
</tr>
<tr>
<td>PeMS</td>
<td>Performance Measurement System</td>
</tr>
<tr>
<td>PFV</td>
<td>Potential Following Vehicle</td>
</tr>
<tr>
<td>PIMS</td>
<td>Port Information Management System</td>
</tr>
<tr>
<td>POLA</td>
<td>Port of Los Angeles</td>
</tr>
<tr>
<td>POLB</td>
<td>Port of Long Beach</td>
</tr>
<tr>
<td>PPV</td>
<td>Potential Platooning Vehicle</td>
</tr>
<tr>
<td>PUC</td>
<td>Platoon Use Case</td>
</tr>
<tr>
<td>RCTO</td>
<td>Regional Concepts for Transportation Operations</td>
</tr>
<tr>
<td>RDF</td>
<td>Relational Database Format</td>
</tr>
<tr>
<td>RFID</td>
<td>Radio Frequency Identification</td>
</tr>
<tr>
<td>RIITS</td>
<td>Regional Integration of Intelligent Transportation Systems</td>
</tr>
<tr>
<td>RITA</td>
<td>Research and Innovative Technology Administration</td>
</tr>
<tr>
<td>ROC</td>
<td>Rail Operations Center</td>
</tr>
<tr>
<td>RSE</td>
<td>Roadside Equipment</td>
</tr>
<tr>
<td>RUI</td>
<td>Regional User Interface</td>
</tr>
<tr>
<td>RTOC</td>
<td>Regional Traffic Operations Center</td>
</tr>
<tr>
<td>RTTM</td>
<td>Real-Time Traffic Monitoring</td>
</tr>
<tr>
<td>SAFETEA-LU</td>
<td>Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users</td>
</tr>
<tr>
<td>SANBAG</td>
<td>San Bernardino Associated Governments</td>
</tr>
<tr>
<td>SARTRE</td>
<td>Safe Road Trains for the Environment</td>
</tr>
<tr>
<td>SCAG</td>
<td>Southern California Association of Governments</td>
</tr>
<tr>
<td>SCIG</td>
<td>Southern California International Gateway</td>
</tr>
<tr>
<td>SDMS</td>
<td>Safety Data Message Set</td>
</tr>
<tr>
<td>SDMS</td>
<td>Safety Data Message Set</td>
</tr>
<tr>
<td>SMBBB</td>
<td>Santa Monica Big Blue Bus</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>SMS</td>
<td>Safety Measurement System</td>
</tr>
<tr>
<td>SNRA</td>
<td>Swedish National Road Administration</td>
</tr>
<tr>
<td>SWTC</td>
<td>Southwest Public Safety Technology Center</td>
</tr>
<tr>
<td>TA</td>
<td>Travel Centers of America</td>
</tr>
<tr>
<td>TDC</td>
<td>Traveler Information Data Collection</td>
</tr>
<tr>
<td>TEU</td>
<td>Twenty-foot equivalent unit</td>
</tr>
<tr>
<td>TI</td>
<td>Traveler Information</td>
</tr>
<tr>
<td>TIC</td>
<td>Traveler Information Center</td>
</tr>
<tr>
<td>TIM</td>
<td>Traffic Incident Management</td>
</tr>
<tr>
<td>TMF</td>
<td>Traffic Mitigation Fee</td>
</tr>
<tr>
<td>TOC</td>
<td>Traffic Operations Center</td>
</tr>
<tr>
<td>TOT</td>
<td>Truck-Only Toll</td>
</tr>
<tr>
<td>TSA</td>
<td>U.S. Transportation Security Administration</td>
</tr>
<tr>
<td>TSE</td>
<td>Truck Stop Electrification</td>
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<tr>
<td>TRP</td>
<td>Truck Replacement Program</td>
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<tr>
<td>TTMD</td>
<td>Traffic Management Data Dictionary</td>
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<td>TTMS</td>
<td>Travel Time Management Systems</td>
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<td>TTSG</td>
<td>TurnTime Stakeholder Group</td>
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<tr>
<td>TWP</td>
<td>Twisted-Wire-Pair</td>
</tr>
<tr>
<td>UMTRI</td>
<td>University of Michigan Transportation Research Institute</td>
</tr>
<tr>
<td>UP</td>
<td>Union Pacific</td>
</tr>
<tr>
<td>USC</td>
<td>University of Southern California</td>
</tr>
<tr>
<td>V2I</td>
<td>Vehicle-to-Infrastructure</td>
</tr>
<tr>
<td>V2V</td>
<td>Vehicle-to-Vehicle</td>
</tr>
<tr>
<td>V/C</td>
<td>Volume-to-Capacity</td>
</tr>
<tr>
<td>VCTC</td>
<td>Ventura County Transportation Commission</td>
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<tr>
<td>VHI</td>
<td>Vehicle Hours Traveled</td>
</tr>
<tr>
<td>VMT</td>
<td>Vehicle Miles Traveled</td>
</tr>
<tr>
<td>VPN</td>
<td>Virtual Private Network</td>
</tr>
<tr>
<td>VSCC</td>
<td>Vehicle Safety Communications Consortium</td>
</tr>
<tr>
<td>WDU</td>
<td>Wireless Drayage Updating</td>
</tr>
</tbody>
</table>
WRI Wireless Roadside Inspection
Reader’s Guide/Executive Summary

This report is part of the Gateway Cities Technology Plan for Goods Movement, which has 13 different feasibility studies as part of the larger project. The project team has organized these studies into five different groups:

1. Data Collection,
2. Transportation Operations and Management,
3. Emerging Goods Movement Technology Applications,
4. I-710 Corridor Advanced Technologies Applications, and
5. CVO Operations Planning.

Development each of these groups is undertaking via a four-step process:

- **Task 1.** Conducting Background Research,
- **Task 2.** Developing User Needs,
- **Task 3.** Developing and Evaluating Alternatives, and
- **Task 4.** Conceptual Design of the Preferred Alternative.

At the completion of all four tasks, a detailed Concept of Operations and Business Plan will be developed for implementation by Gateway Cities and LA Metro.

This report includes the findings for several of these groups as part of **Task 1: Background Research.** While these sections are closely related, each individual section is intended to stand alone and offer a detailed understanding of the particular research area explored.

Upon completing all six sections of this document, you should have a stronger understanding of the background and existing research of the areas being explored that bring greater efficiency, economic growth, safety, and other benefits to the region’s thriving goods movement industry.
1.0 Introduction

To respond to concerns about accommodating growth in regional freight traffic, transportation leaders are undertaking a technology-based project in Southern California – the Gateway Cities Technology Plan for Goods Movement. This program represents the most significant fusion of Intelligent Transportation Systems (ITS) and freight operations technologies attempted to date in North America. Through the integration of traditional freeway, arterial and traveler information technologies, with intermodal freight, port, and truck technologies, this project is studying the potential for an end-to-end information support system to improve the efficiency of goods movement in Southern California.

This report is part of the Gateway Cities Technology Plan for Goods Movement Project, which has conducted thirteen (13) feasibility studies as part of the larger project. The project team has organized these studies into five different groups:

1. Data Collection,
2. Transportation Operations and Management,
3. Emerging Goods Movement Technology Applications,
4. I-710 Corridor Advanced Technologies Applications, and

This Executive Summary Report includes summaries of key topic areas connected with each of these five groups. A review of this document will provide the reader with a strong understanding of the areas being explored to bring greater efficiency, economic growth, safety, and other benefits to the region’s thriving goods movement industry. The longer technical versions of the feasibility studies are available upon request.

The following graphic presents an overall picture of all project components.
1.1 **STUDY OVERVIEW**

While projected increases in international trade through the Southern California ports dipped in 2008-09, monthly container volumes at the Ports of Long Beach (POLB) and Los Angeles (POLA), California, have shown significant growth in 2010 and early 2011. Even with the most conservative growth scenario forecasts, port volumes are still expected to more than double or triple in the next 25 years\(^1\). As the levels of trade continue to rise, and with new infrastructure projects still years away from implementation, the Gateway Cities subregion can expect to experience increased truck traffic congestion problems. Based on recent modeling results, these congestion problems are expected to result in severe truck traffic congestion in and near the port areas, as well as general traffic congestion on metropolitan highways and arterials. Without mitigation, these increases in truck traffic could result in negative regional effects related to air quality, noise, and safety; and freight delays that have a negative impact on the regional economy.

\(^{1}\) 2035 forecast for POLB (28.5M TEU for “Low Growth” scenario and 42.7M for “High Growth” scenario) provided in Initial Feasibility Assessment, I-710 EIR/EIS, MTA, Cambridge Systematics, Inc. and URS, November 16, 2009; current port volumes based on 2009 TEU volumes from POLB and POLA web sites (6.7M TEU for POLA + 5.1M TEU for POLB = 11.8M TEU).
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 Port of Los Angeles’ (POLA) Clean Trucks Program, together, present major operational and financial challenges to the local dray trucking industry – an industry that has historically relied on owner-operators and small fleets “yesterday’s trucks.”

Severe freight congestion combined with the strictest regulations on polluting trucks in the nation has the potential to adversely impact the economic competitiveness of the port and intermodal freight industries in the Gateway Cities subregion. These factors could impact decisions made by international shippers and steamship lines on whether to continue to use the POLA/POLB complex. These decisions will be further impacted by the near-term completion of the Panama Canal expansion in 2014.

To respond to these concerns in the near term, Southern California regional transportation leaders are undertaking the Gateway Cities Technology Plan for Goods Movement. This program represents the most significant fusion of ITS and freight operations technologies attempted to date in North America. 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 current project 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 the earlier study.

The 2008 study identified the ITS needs of the Gateway Cities subregion and the Southern California region, as well as several projects to improve the goods movement system. This ground-breaking project represented a significant fusion of ITS and freight operations technologies. The Plan was initiated by the Gateway Cities Council of Governments (GCCOG), in partnership with the California Department of Transportation (Caltrans) and the Federal Highway Administration (FHWA).

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. Guidance of the ITS Working Group participants is provided at quarterly meetings, where the project direction, preliminary findings, and recommendations are reviewed. The ITS Working Group provides specific input to help shape the final Concept of Operations and Business Plan to meet their unique needs.

The Gateway Cities Technology Plan for Goods Movement will deliver:

- Detailed research on the latest trends, practices, and regional priorities in technology applications for goods movement and other transportation needs;
- Feasibility studies for new and expanded technology applications for Gateway Cities;
- Exploration of technologies supporting emerging alternatives for I-710 corridor improvements; and
- A detailed concept of operations and a business plan to ensure that real-world implementable projects are the outcome of the Plan.

Project outreach and research began in August of 2011 and is anticipated to be completed in December 2012.
Figure 1.1  Map of Study Area
1.2 **ITS INTEGRATION PLAN**


The 2008 Plan identified the ITS needs of the Gateway Cities and Southern California, as well as several projects to improve goods movement. This groundbreaking project represented a significant fusion of ITS and freight operations technologies. This was achieved through the participation of a committed ITS Working Group of public and private sector representatives that developed sustainable solutions. The Plan was initiated by the GCCOG, in partnership with Caltrans and the FHWA.

The ITS Integration Plan identified significant benefits that can be realized if a coordinated, partnership approach is taken on ITS solutions to improve the goods movement system. Figure 1.3 highlights the elements that can combine to create benefits greater than the individual inputs:

**Figure 1.2 Benefits of ITS Solutions**

The 2008 ITS Integration Plan identified fourteen (14) projects that have the potential to address the region’s needs and improve goods movement. Each of these projects addresses the fundamental objectives of the proposed ITS program: filling infrastructure gaps, generating arterial travel information, collecting better truck data, providing more freight-focused traveler information, improving drayage turnaround times, considering a comprehensive goods movement scheduling system, and developing a strategy for truck safety and credentialing. The goal is safer and more efficient goods movement using transportation technology.

The projects identified include:

1. Freeway Detection Infrastructure;
2. Arterial Infrastructure;
3. Arterial Travel Times;
4. Queue Detection And Terminal Turn Times;
5. Goods Movement Transportation Management;
6. Truck Fleet Communications Program;
7. Comprehensive Performance Monitoring System;
8. Existing Sources – Truck Fleet Data Collection And Agreements;
9. Port Reverse 911 Emergency Notification Call System;
10. Comprehensive Goods Movement Scheduling System (Container Tracking);
11. Truck Parking Coordination;
12. Vehicle Enforcement Strategies, Systems, and Sites Study;
13. Congestion Pricing Initiatives; and

These 14 projects represent the core components of the Gateway Cities Technology Plan for Goods Movement. While there has been some restructuring of these projects to reflect the recent evolutions of technology and stakeholder needs, each project will be studied in detail in this current planning effort to generate real-world implementable solutions to improve the safety and efficiency of goods movement in the region.

1.3 **ITS Working Group**

An ITS Working Group was formed for the ITS Integration Plan, which included transportation and freight industry stakeholders in the Gateway Cities region from the public and private sectors. Public-sector stakeholders included federal, state, and local governments, as well as regional metropolitan planning...
commissions, 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 public and private sector support throughout the 2008 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 this planning process. Guidance from the ITS Working Group participants will be obtained through quarterly meetings, where the project direction, preliminary findings, and recommendations will be reviewed. The ITS Working Group will have an opportunity to review key deliverables and, individually, provide input unique to their needs to help shape the final Concept of Operations and Business Plan.

The initial meeting of the ITS Working Group was held on November 30, 2011. It included a project overview, a presentation of related Federal initiatives, and in-depth roundtable discussion of the region’s strengths and weaknesses related to goods movement. Table 1.1 shows the membership of the ITS Working Group.

**Table 1.1  ITS Working Group Members Organizations – ITS Integration Plan**

| Federal | Federal Highway Administration (FHWA) |
|         | Federal Maritime Administration (MARAD) |
| State   | California Highway Patrol (CHP), Southern Division |
|         | ITS Division of Transportation Planning OPAR CA DOT |
|         | Caltrans District 7 |
| Regional| South Coast Air Quality Management District (SCAQMD) |
|         | Southern California Association of Governments (SCAG) |
| Public Sector | Alameda Corridor Transportation Authority (ACTA) |
|             | Los Angeles County Department of Public Works (LADPW) |
|             | Los Angeles County Metropolitan Transportation Authority (Metro) |
|             | City of Long Beach |
|             | City of Los Angeles |
1.4 PROJECT TASKS AND PHASING

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

The first phase of the Gateway Cities ITS Plan found a need for fourteen (14) feasibility studies of potential technology solutions to move goods more safely and efficiently through the region. This second phase involves revisions and modifications to these study areas based on new information and a reassessment of the 2008 study. This reorganization groups the thirteen (13) newly defined feasibility studies into five key report areas. These refinements are described in Table 1.2.

**Table 1.2 Project Feasibility Studies**

<table>
<thead>
<tr>
<th>Updated Feasibility Studies (13)</th>
<th>Includes or Replaces (Relates to 14 Original FS Projects)</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Data Collection Group</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freeway Information and Data</td>
<td>Freeway Detection Infrastructure (FS #1)</td>
<td>No changes, except the study now encompasses both data and information developed from the data, to be consistent with DC-2 for arterials.</td>
</tr>
<tr>
<td>Updated Feasibility Studies (13)</td>
<td>Includes or Replaces (Relates to 14 Original FS Projects)</td>
<td>Explanation</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>----------------------------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Key Arterial Information and Data</td>
<td>Arterial Information (FS #2) Arterial Travel Time (FS #3)</td>
<td>Combines the original FS #2 and FS #3. Note: this is now a dual-purpose FS covering data and information – both original case study efforts are still included in this FS.</td>
</tr>
<tr>
<td>Terminal Queue Information and Data</td>
<td>Queue Detection and Terminal Turn Times (FS #4)</td>
<td>No changes.</td>
</tr>
<tr>
<td><strong>Transportation Operations and Management Group</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goods Movement Transportation Management</td>
<td>Goods Movement Transportation Management (FS #5)</td>
<td>No changes.</td>
</tr>
<tr>
<td>Truck Travel Information Integration</td>
<td>Truck Travel Information Integration (FS #9)</td>
<td>No changes.</td>
</tr>
<tr>
<td>Comprehensive Performance Monitoring Program</td>
<td>Comprehensive Performance Monitoring Program (FS #8)</td>
<td>No changes.</td>
</tr>
<tr>
<td><strong>Emerging Goods Movement Technology Applications Group</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drayage Operations ITS</td>
<td>Comprehensive Goods Movement Scheduling System (FS #11)</td>
<td>Modified to include the specific ITS applications for the truck drayage community in the Gateway Cities region; addresses appointment systems, queue delay notifications, air quality measurement applications, etc.</td>
</tr>
<tr>
<td>Private Sector Fleet Management Information and Dynamic Mobility Applications</td>
<td>Existing Sources – Truck Fleet Data Collection (FS #10)</td>
<td>Encompasses potential ITS connectivity between public and private systems originally in FS #6/Truck Fleet Communications; expanded to develop Dynamic Mobility Applications (DMA).</td>
</tr>
<tr>
<td>Opportunities and Integration with Emerging Federal Programs</td>
<td>Truck Fleet Communications (FS #6)</td>
<td>Replacement special study effort will focus on leveraging Federal programs, such as C-TIP, FRATIS, CVII, and near-term freight Connected Vehicle programs; and will include support to assist LA Metro/GCCOG with applications for Federal opportunities.</td>
</tr>
<tr>
<td><strong>I-710 Freight Corridor Advanced Technologies Applications Group</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-710 Future Technology Infrastructure</td>
<td>Support of Future Infrastructure (FS #14)</td>
<td>Modified to explore technology solutions currently being explored in the I-710 environmental impact statement (EIS)/Environmental Impact Report (EIR), as well as other potential ITS applications to meet the corridor goals/needs.</td>
</tr>
<tr>
<td>Updated Feasibility Studies (13)</td>
<td>Includes or Replaces (Relates to 14 Original FS Projects)</td>
<td>Explanation</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>----------------------------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Advanced Fleet Platooning Concepts</td>
<td>Port Reverse 911 Emergency Notification Call Systems (FS #7)</td>
<td>Develops concepts for Truck Platooning based on current research and testing, focusing on both domestic and international experience; replaces 911 study.</td>
</tr>
</tbody>
</table>

**CVO Operations Planning Group**

<table>
<thead>
<tr>
<th>Truck Enforcement Strategies, Systems &amp; Sites Study</th>
<th>Truck Enforcement Strategies, Systems &amp; Sites Study (FS #13)</th>
<th>No changes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Truck Parking Coordination</td>
<td>Truck Parking Coordination (FS #12)</td>
<td>No changes.</td>
</tr>
</tbody>
</table>

Each of the thirteen (13) study areas is represented by an icon in Figure 1.4. The icons are used regularly throughout the project to clearly identify the study areas.

**Figure 1.3 Feasibility Study Icons**

Note that this report contains research related to several, but not all, of the feasibility study areas. Section 1.4 describes the content of this report in detail.
1.5 OVERVIEW OF TASK 1 REPORT

Overall Project Tasks

The development of each of the study area groups identified in Table 1.1 is being undertaken through a four-step process:

- **Task 1. Conducting Background Research.** Task 1 includes 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.

- **Task 2. Developing User Needs.** As part of Task 2, the needs of the Gateway Cities will be clearly identified and defined along with recommendations for key focus areas for technology alternatives.

- **Task 3. Developing and Evaluating Alternatives.** In Task 3, the study team will apply the background research from Task 1, as well as additional research into new strategy and technology options, to develop a set of possible ITS alternatives for each project. Reports will detail options for the possible core strategic and technology alternatives to fulfill the alternative, along with overall feasibility and functional requirements. The team will provide guidance on which alternative is recommended for development of a conceptual design.

- **Task 4. Conceptual Design of the Preferred Alternative.** The project team, following the selection of a single preferred alternative technical approach, will develop a conceptual design or concept of operation for that project. Conceptual designs will be comprehensive, including elements such as the means and methods to develop functional requirements, equipment requirements, costs, and recommended implementation phasing.

At the completion of all four tasks, a detailed Concept of Operations and Business Plan will be developed for implementation by Gateway Cities and LA Metro.

**Task 1. Report Structure**

This report includes the findings for several of these groups as part of Task 1. **Background Research.** While these sections are closely related, each individual section is intended to stand alone and offer a detailed understanding of the particular research area explored.

Each section discusses the research sources, which, in many cases, overlaps with research for other areas. Several sections draw on the findings of two survey efforts, feedback from the ITS Working Group, a series of stakeholder interviews, and presentations from technology developers as part of this project’s Vendor Showcase events.
Section 2.0, ITS Data Collection and Transportation Management includes the goals of the ITS data collection and transportation management feasibility study areas; a description of the ITS Data and Transportation Management Inventory and Systems serving both the Gateway Cities subregion and greater Los Angeles region; a summary of issues, gaps, and needs identified through the development process; an initial set of potential ITS solutions to address issues, needs, and gaps; and a summary of next steps in this area of the overall project.

Section 3.0, Drayage Opportunities provides background research on the major causes of drayage operations concerns, as well as an overview of potential mitigation methods. It draws on recent surveys, interviews, and past region-specific reports to identify drayage operations issues that are specific to the Gateway Cities subregion. Outputs of this report include a summarized, high-level overview of drayage and drayage import/export processes; a list of key drayage issues and causes identified in the National Cooperative Freight Research Program (NCFRP) 11; an overview of regional drayage issues identified through interviews, surveys, and background research; and discussion of sample technologies and solutions that have been implemented elsewhere.

Section 4.0, Private Sector Fleet Management and Dynamic Mobility Applications identifies and assesses state-of-the-art truck fleet communication systems, dynamic mobility applications, and other technologies deploying ITS connectivity between the public and private systems. It covers U.S. Department of Transportation (DOT) programs and initiatives, fleet management technologies used by stakeholders in the Gateway Cities subregion, and draws conclusions based on review of the key findings and lessons learned from the existing body of knowledge.

Section 5, I-710 Opportunities identifies potential technology applications that could be coordinated with ongoing I-710 corridor projects and investments. The Section identifies the status of vehicle platooning research (and other automation projects) that could be applied to address problems in the I-710 corridor. It further documents truck tolling or other tolling strategies incorporating elements that could be applied to trucks in the I-710 corridor and Port area. These include Truck-Only Toll (TOT) Lanes, Congestion Pricing, Distance-Based Pricing, and other pricing schemes. Provision of additional trucker services is also explored.

Section 6.0, Truck Parking Coordination details the challenges related to truck parking facing the nation and Gateway Cities. Safety and efficiency problems can stem from a severe shortfall of truck parking and the majority of public and private truck parking facilities operating above capacity at peak periods, safety and efficiency.

Upon completing this document, the reader should have a strong understanding of the areas being explored to bring greater efficiency, economic growth, safety, and other benefits to the region’s thriving goods movement industry.
EXECUTIVE SUMMARY

The ITS Data and Transportation Management Section documents existing and emerging transportation data sources and management systems related to freight movement in the Gateway Cities and Port areas. Many of these systems are regional in their scope and coverage. In developing solutions for the Gateway Cities and Port areas, it is important to gain an understanding of how each system operates. Following documentation of existing systems and data sources, this report summarizes needs and potential solutions. This initial set of solutions will provide input to the comprehensive alternatives that will be developed in the later stages of the project and documented in the Concept of Operations and the Business Plan.

The focus of this project area is on the development of data collection and traffic management programs oriented toward truck traffic in the Ports and Gateway Cities areas. There are significant opportunities to build upon existing ITS systems. In large part, this can be accomplished by tying together information and management services to improve traveler information, traffic flow, and drayage efficiency in the Ports and Gateway Cities areas.

This section also documents recent improvements in ITS services, including implementation of the regional 511 Traveler Information and supporting Motorist Aid and Traveler Information System (MATIS) under the auspices of the Los Angeles County Service Authority for Freeways and Emergencies (LA SAFE). LA SAFE also developed the Regional Integration of Intelligent Transportation Systems (RIITS) database, which is being used to integrate data from major ITS systems in the region. LA SAFE’s Freeway Service Patrol (FSP) operation on regional freeways includes “big rig” tow trucks in the Gateway Cities area to provide faster and more effective service to commercial vehicles. Another major deployment is the Advanced Transportation, Management, Information, and Security (ATMIS) system, which involves installation of cameras, detectors, and electronic signs in the Ports and surrounding areas. All of these newer systems and services have the potential to enhance the effectiveness of the largest ITS system in the region, the California Department of Transportation (Caltrans) Advanced Transportation Management System.
Another important development, which is a major focus of this project, is the increasing availability and sophistication of private sector services, including integration of real-time traffic and navigation systems with dispatching systems. These systems and developments are documented in Section 2.2.

Section 2.6 includes a summary of needs identified through review of previous reports, existing information systems and sources, and interviews with stakeholders. The needs or issues are documented in a table, which also includes:

- The source(s) of the need;
- Which components of the Gateways Cities ITS Project are addressed by the need;
- Identification of potential solutions to the identified need;
- Highlighting of solutions that can be implemented in the short term; and
- A cross-reference to similar needs identified in other sections.

Needs were categorized into topical areas; and both needs and solutions are summarized briefly below.

**Arterial Systems.** Stakeholders consider improved arterial system operations and coordination in the Gateway Cities area a major priority. Systems are operated by a combination of LA County and local municipalities, with some signals also controlled by Caltrans. Fragmentation of management and control inhibits the ability to implement signal coordination strategies on major arterials. Stakeholder input indicated that priority routes for freight movement need to be identified. Some freight traffic must use arterials, so coordinated strategies related to timing and management can help to encourage use of those arterials that service key freight destinations, while discouraging use of those that serve residential and commercial areas. Solutions are focused at least in part on the LA County Information Exchange Network (IEN), which provides an opportunity to share arterial system data. Some municipalities that operate their own systems do not belong to IEN, and IEN is not currently linked into the RIITS system. Making these linkages is an important first step in developing and implementing arterial management strategies that can benefit the stakeholders and residents in the Ports and Gateway Cities area.

**Performance Measurement.** Development of management strategies in the Gateway Cities can benefit from a structured performance management system using the large volume of traffic and speed data being collected in the region. There are a number of opportunities identified in this document for collecting more complete and higher quality information on truck volumes and traffic patterns. There are already archived databases in place or under development, including Caltrans’ Performance Measurement System (PeMS) and the LA Metro’s Archived Data Management System (ADMS) at the University of
Southern California (USC), which can be used as the basis for a more extensive performance management system.

**Incident Management.** The LA SAFE system provides wide geographic FSP service on the LA freeway system, including the deployment of “big rig” tow truck routes in the Gateway Cities area. Stakeholders have identified a need to extend coverage of big rig wreckers and provide more contractual flexibility in their deployment. Stakeholders noted that there are potential data sources that can be used to improve response and clearance time in the Gateway Cities area. Data can be mined to help improve truck positioning and better identify the delay impacts of incidents, so that the benefits and costs of different investments can be determined. Stakeholders also identified a need for feedback from the trucking community on their incident management needs. It also was noted that implementing direct communications between the California Highway Patrol (CHP), which dispatches the FSP, and LA Metro/LA SAFE, which manages it, could help to improve response and clearance time. Another important issue to be resolved is the incident management system to be installed on the proposed I-710 freight corridor.

**Traveler Information.** RIITS is providing the most comprehensive source of traveler information data on the public sector side. RIITS can serve as clearinghouse for the specialized information services required in the Gateway Cities area, but it is missing data from the arterials and the Ports. Stakeholders place high importance on information about port terminal queues and other potential delays in port area. Integration of the ATMIS and IEN data into RIITS and the 511/MATIS would be an important first step in achieving this. There also are opportunities to leverage the significant efforts being undertaken in the private sector to collect and disseminate truck-related traveler information. It appears that the private sector is increasingly capable of meeting traveler information needs, but the public sector still needs comprehensive information for management and planning purposes. Information needs identified for the freight market include general truck restrictions, truck routes, oversize (OS)/overweight (OW) restrictions, parking location and availability, truck volumes and travel times, support and repair facilities, and diesel stations. The proliferation of private sector and public sector services can make comprehensive trucking information available through additional dissemination channels, such as smart phone applications and in-vehicle navigation systems, as well as 511. The mix of private sector and public sector roles in this market will depend at least in part on the ability to recover costs for premium information. Another factor is the ability to develop a two-way system, with trucks providing data to the system, and then receiving high quality data and information in return. Other improvements of interest to stakeholders include Spanish language capability on the 511 system and traveler information in general, greater availability of weather information, and wider geographic coverage of roadways for long-distance truckers.
Freeway Management and Operations. Stakeholders identified a need to expand ITS infrastructure on freeways, arterials, and roadways in ports area. While some of this is being accomplished through deployment of ATMIS, the traffic operations and management strategy for ATMIS still needs to be determined. There also is a need to integrate ATMIS with other ATMS in the area and to find ways to provide adequate and permanent operation and maintenance of the systems. Stakeholders also identified a longer-term need to share data between ATMIS and other port traffic information with commercial management/dispatching systems used in the trucking industry such as EModal/Voyager. There also are integration opportunities with the next generation of the PierPass. Current technology limits these opportunities, but in the future, PierPass could be integrated with traffic management systems and tolling systems, providing additional information on traffic conditions both inside and outside the Ports. Improved information on port queues and terminal conditions was cited by stakeholders as another component that would help to integrate various information sources. A clear need was identified for an emergency operations and detour plan for ports area and Gateway Cities, along with the formation of a permanent committee with personnel representing transportation, law enforcement, port operations, emergency response, and municipal government. One of the main issues raised was regarding the condition of the Caltrans ATMS, which is by far the largest collection of ITS equipment and services in the region. Budget limitations are making it increasingly difficult to keep the current system in good repair and replace aging equipment.

Policy/Institutional. On the policy level, there is a need for better integration of freight concerns into planning, deployment, and management of ITS systems. Bringing the Ports’ management and terminal operators (and shippers) into this process would be helpful, but there is a challenge in that much of their information is proprietary for business reasons. Management and quality control of proliferating data sources is another major issue; will management migrate fully to the private sector or will the public sector still have a role? Another important issue is how to keep up with the rapidly changing technology in an area where the planning/design/deployment cycle can be slow. It is important for agencies to work together with research institutions to speed the evaluation and testing process for new technologies. Major advances in technology are scheduled for the I-710 Corridor. There will be major challenges in deployment, management, operations, and maintenance of these systems.
2.1 INTRODUCTION

Purpose within the Context of the Larger Gateway Cities Technology Plan for Goods Movement

This section combines several of the feasibility studies that were proposed as the outcome of the 2008 Gateway Cities ITS Integration Plan for Goods Movement. That study identified unmet needs for transportation information and traffic management services related specifically to goods movement to and from the POLB and the POLA. This work highlighted the fact that, while there are numerous public and private sources of traveler information, they do not fully serve the needs of the traffic traveling to and from the Ports, or the needs of the freight industry in general. Since the previous study was completed, there have been at least two significant events that impact port traffic and the freight industry:

1. Planning and design work for the I-710 corridor have advanced to a point where a preferred alternative could include a separated, four-lane freight corridor (for trucks). The freight corridor, which would be elevated above an expanded 10-lane general traffic section, could include advanced platooning technology to greatly increase vehicle throughput.

2. Another important development is the deployment of the ATMIS at the POLB and POLA. This project has involved installation of detection and surveillance equipment in the port area and on major roads outside of the Ports, including I-710 Corridor. ATMIS has both security and transportation components.

3. In order to optimize the benefits of these and other regional ITS systems, this report document the following feasibility projects:

   a. Data Collection Activities:
      i. Monitoring of arterial roadways to identify congestion and improve performance;
      ii. Additional freeway detectors to identify congested areas and incidents;
      iii. Use of moving trucks as a source of speed and traffic condition data; and
      iv. Detection of queues waiting to enter terminals.

   b. Traffic Management Activities:
      i. A goods movement-oriented traffic management center to collect data and support traffic management activities; and
      ii. Monitoring and data archiving that can be used over time to improve the efficiency of traffic movement to and from the Ports.
Based on stakeholder outreach, review of existing systems, and review of existing documents, these two major projects and five subprojects were consolidated into a single existing conditions report. There are already multiple sources of relevant traffic information in the greater Los Angeles region; and the number of sources, especially on the private side, is growing rapidly. In addition, there are multiple operational centers that currently monitor and manage different parts of the transportation system. Levels of coordination vary between the key management agencies, including Caltrans, Metro, the POLB and the POLA, LA County, CHP, and numerous local municipalities. It is clear from the stakeholder outreach efforts that the transportation data collection and traffic management activities must be viewed together in order to provide a comprehensive freight-oriented ITS program for the Gateway Cities and Ports areas. An important goal is to identify ways in which these existing resources can be better leveraged to meet the needs of stakeholders in the Ports and Gateway Cities areas.

**Purpose within the Context of the Larger ITS Data Collection and Transportation Management Work**

The purpose of this section is to document existing systems and conditions in the Gateway Cities subregion, focusing on traffic data collection and transportation management activities. The research was developed through a review of existing documents and previous studies, as well as extensive interviews with key stakeholders and agency personnel. This section lays the groundwork for future work on the project by thoroughly documenting existing systems and beginning to identify gaps in these systems and stakeholder needs. The remainder of this section includes the following information:

- Goals of the ITS data collection and transportation management project;
- A description of the ITS Data and Transportation Management Inventory and Systems serving both the Gateway Cities subregion and greater Southern California region;
- A summary of issues, gaps, and needs identified through the development process;
- An initial set of potential ITS solutions to address issues, needs, and gaps;
- Synopsis’ of initial research on what other regions or ports have investigated or implemented to address similar issues and needs, as well as some recent Federal research; and
- A summary of next steps in this area of the overall project.
Key Goals of the ITS Data Collection and Transportation Management Work

The key goals of this project are listed and discussed below.

1. **Goal #1. Inventory of the static and real-time ITS and traffic operations data, equipment, facilities and associated systems in the region, both existing and planned.** Development of workable solutions requires a thorough understanding of existing systems, activities conducted by various agencies, and private sector participants in the collection and dissemination of transportation data. Solutions oriented toward freight travel in the Ports and Gateway Cities area will build on existing systems. The types of data, collection methods, processing methodology, and linkages between various data sources need to be clearly documented. This is particularly important in the Gateway Cities area where multiple organizations are involved in collecting and disseminating data.

2. **Goal #2. Document current transportation management systems and performance monitoring activities in the study area, and linkages between them.** Similar to the data collection systems, there are multiple organizations responsible for transportation management and performance monitoring, including Caltrans, the Ports, LA County, Metro, numerous local jurisdictions, as well as private sector companies. Changes have occurred since the 2008 study, including the development of the ATMIS system in and around the Ports. A key goal of this report is to document these stakeholders’ activities, operational strategies, and the technical and institutional underpinnings of relationships and availability of data and information.

3. **Goal #3. Summarize and compare I-710 Environmental Impact Report (EIR)/Environmental Impact Statement (EIS) study planned ITS infrastructure and applications.** The goal in this area is two-phased: to establish needs and infrastructure requirements for established ITS technologies to be deployed on I-710; and to research advanced technologies planned for deployment on the I-710 truck road, including platooning, advanced toll technologies, and in-lane traffic enforcement (and other potential automation technologies). The first is being developed as part of the I-710 design effort, while the advanced research components are part of a separate I-710 research report.

4. **Goal #4. Identify key arterial corridors of significance.** Enhanced data collection and management of arterial corridors have been identified as important management strategies needed in the Gateway Cities and Ports areas. An important goal is to identify priority arterial corridors for reaching major truck destinations, such as the ports and intermodal facilities, as well as corridors or streets where truck traffic could be discouraged.
5. **Goal #5.** Research and explore the emerging private sector data vendors and approaches, and how their products and services might help meet the goals of the project. An important goal of this work is to make sure a clear understanding is obtained of the rapid advances that are being made in traffic monitoring, information dissemination, and data collection, especially in the private sector. Vendor showcases are being held to identify advances in transportation data collection and management, and determine how new methods and technologies can be incorporated to benefit freight movement in the Gateway Cities area.

6. **Goal #6.** Summarize results from special surveys of truck dispatchers/managers and operators focused on port access, port operations, traffic conditions inside and outside the immediate area, and traveler information. Special surveys are being conducted for the project to identify the information needs and preferences of truck drivers traveling to and from the port area. Data collected from this effort will help to inform stakeholders regarding current methods of accessing traveler information, routing and scheduling practices, and unmet needs related to traveler information. This input will be highly useful in developing a program designed to address information and traffic management needs of the freight market. The results from the dispatcher/manager survey are included in this report. The truck operator survey is still in process and the report will be updated when it is complete. **Note:** This effort is currently underway so the results will be made available in a subsequent update of this document.

7. **Goal #7.** Initial list of gaps and needs for ITS data and transportation management in the system/study area. Using the information collected for this study and documented below, an initial set of needs and issues will be identified, along with gaps in current systems that need to be filled in order to meet these needs. This set will form the basis of the proposals to be further developed in the upcoming Needs Assessment and Evaluation Alternatives and Concept of Operations and Business Plan tasks.

8. **Goal #8.** Initial research on ITS data and traffic management practices at other port locations, including performance monitoring, that may help address the gaps or needs. Other ports have implemented new technologies and methods of collecting information and managing traffic. Research into these projects will help to identify new methods that can be adapted for the Gateway Cities and Port areas.

9. **Goal #9.** Lay out next steps to narrow down ideas on potential solutions to key ITS data and transportation management gaps and needs. The ultimate goal of this report is to lay the foundation for development or facilitation of solutions to the key ITS data and transportation management gaps, needs and problems for freight movement in the Port and Gateway Cities areas.
2.2 **ITS DATA AND TRANSPORTATION MANAGEMENT INVENTORY AND SYSTEMS**

This section summarizes the relevant ITS system overviews and inventories for the key existing and planned ITS data and transportation management entities in the Gateway Cities subregion. Where applicable, the inventory includes an overview of the equipment and systems including inventory maps of equipment and diagrams of systems, data and information shared, how the data and information is used, transportation management and monitoring activities, and future planned improvements. In addition, this section includes the planned ITS improvements for the I-710 study and key arterial corridors of significance for goods movement.

This information will be used in future tasks to identify ITS equipment information, management and system gaps, as well as to identify opportunities to leverage existing technology to implement innovative solutions to improve freight movement and freight focused traveler information.

The entities and topics included in this section include:

1. LA Metro/LA SAFE; 
2. Caltrans; 
3. POLA/POLB; 
4. Los Angeles County Department of Public Works; 
5. Other ITS data, equipment, and systems (e.g., CHP, cities, private sector); 
6. I-710 EIR/EIS Planned ITS Infrastructure and System Improvements; and 
7. Key Arterial Corridors of Significance for Goods Movement.

**LA Metro/LA SAFE**

*Motorist Aid and Traveler Information System (MATIS)*

LA SAFE, in partnership with the Orange County Transportation Authority (OCTA), San Bernardino Associated Governments (SANBAG), Ventura County Transportation Commission (VCTC), and Caltrans, implemented the MATIS. The system went into operation in June 2010. This system provides traffic, transit, commuter services, and other related information to the public via web site and interactive voice response (IVR) by dialing toll free 511 within the Los Angeles County, Orange County, Ventura County, San Bernardino County, and Riverside County areas.

MATIS is being implemented in two phases: Phase 1 – Development and Deployment, and Phase 2 – Operation and Maintenance. Phase 1 consists of three steps: Baseline, Near-Term Enhancements (NTE), and Long-Term
Enhancements (LTE). The Baseline phase has been completed and features are being added to the system as part of NTE. The NTE phase developments include personalization, driving directions, general emergency information, airport information, taxi information, and tourist information. The Baseline implementation includes:

- 511 web site (Web Portal Subsystem);
- Traveler Information (TI) Data Collection Subsystem;
- IVR Subsystem;
- 511 Call Center, Call Box/#399 Call Center Subsystems;
- Fleet Monitoring and Reporting Subsystem;
- Traveler Information Center (TIC); and
- Event Reporting Subsystem (ERS).

Figure 2.1 shows an overview of the MATIS. MATIS receives real-time traffic data from Caltrans District 7 (via RIITS, described in more detail in the following subsection), Caltrans District 8, and Caltrans District 12; incident data from CHP Media Computer-Aided Dispatch (CAD); and road closures from the Caltrans Lane Closure System (LCS). The MATIS data collection software assembles real-time data and makes them available to the IVR, Web Portal, and ERS. The system also collects transit information from TripMaster, including a list of transit buses routes, stop numbers, and latitude and longitude of each bus stop.
**Figure 2.1  MATIS Overview**

**Web Portal**

The Web Portal ([http://www.Go511.com](http://www.Go511.com)) integrates traveler information from multiple regional sources, and provides traveler information via the Internet. Figure 2.2 presents the MATIS Web Portal home page. Users can navigate to various pages of the web site, such as traffic, transit, and commuter services via the home page. An area on the lower left of the page is reserved for public service announcements, the top rectangular area is used for advertisements, and the local weather is displayed on the lower right-hand corner. Users also can provide feedback about the system from the web site.
Figure 2.2  Web Portal Home Page

Figure 2.3 illustrates the traffic map page, which displays real-time speed and travel times for main line freeways and high-occupancy lanes (HOV) from data that it receives from Caltrans (D7, D8, and D12). Yellow icons on the map indicate incidents, and red icons indicate road closures. Users can view messages posted on the Caltrans changeable message signs (CMS) in real-time and streaming video from Caltrans cameras (CCTV) on the traffic map. The “Alert” box located above the map is used to scroll important traffic- and transit-related alerts.

LA SAFE is planning to have a 511 mobile application for smart phones developed starting this year. The smart phone application will provide information such as real-time congestion data, incidents, images from cameras, CMS messages, road conditions, road work, park-and-ride lots, alerts, and transit providers.

In addition to traffic information, MATIS web portal provides transit, commuter services, and vanpool information. Users can obtain bus and transit schedules, real-time bus arrival and departure times, transit providers, park-and-ride lots, and other transportation-related information. The trip planner feature allows the users to plan their trip and receive an itinerary.

The Web Portal and IVR interface with the MATIS Traveler Information Data Collection (TDC) in order to retrieve dynamic traffic information and make it available to the public. The TDC stores both static and real-time traffic data in the database. The static data is manually entered and maintained. The TDC collects real-time traffic data from external systems and internal subsystems, and makes the data available for use for MATIS subsystems. The real-time traffic data (speed, travel times, CMS messages, etc.) is stored in the TDC database until it is overwritten by the new set of data, typically within a few minutes. The static data is stored permanently until its value is changed manually. Static data
consists of web page contents, freeway segment information, and system configuration parameters. The active events are stored in the TDC database until the event is closed in the ERS. Incidents are stored in the ERS database. Active incidents are never removed. Closed incidents are preserved for 12 months. Incident data in the ERS are used as follows:

- Displays all events that are not closed (incidents and planned events);
- Displays all events that are no longer active (type independent); and
- Displays all transactions made to an event, filters are available for displaying history for particular events.

This is further described below.

Figure 2.4 illustrates the high-level architecture of the Web Portal subsystem. The TDC receives traffic data from Caltrans Districts 7, District 8, and District 12; CCTV streaming video from a Caltrans headquarters site; and CCTV camera images and streaming video from TrafficLand. The incidents, lane closures, and road conditions are sent to Web Portal via ERS and then TDC. TrafficLand provides live traffic video from hundreds of traffic cameras located along highways and commuting routes.

Table 2.1 summarizes the data sources for MATIS real-time traveler information.

**Figure 2.4 Web Portal High-Level Architecture**

![Web Portal High-Level Architecture Diagram](image)
Table 2.1 MATIS Data Sources

<table>
<thead>
<tr>
<th>Data Source</th>
<th>Los Angeles</th>
<th>Orange</th>
<th>Riverside</th>
<th>San Bernardino</th>
<th>Ventura</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real-Time Freeway Traffic Congestion/Speeds</td>
<td>Caltrans District 7 via RIITS</td>
<td>Caltrans District 12</td>
<td>Caltrans District 8</td>
<td>Caltrans District 8</td>
<td>Caltrans District 7 via RIITS</td>
</tr>
<tr>
<td>Real-Time Freeway Traffic Incidents</td>
<td>CHP (via ERS)</td>
<td>CHP (via ERS)</td>
<td>CHP (via ERS)</td>
<td>CHP (via ERS)</td>
<td>CHP (via ERS)</td>
</tr>
<tr>
<td>Real-Time Freeway Traffic Speeds</td>
<td>Caltrans District 7</td>
<td>Caltrans District 12</td>
<td>Caltrans District 8</td>
<td>Caltrans District 8</td>
<td>Caltrans District 7</td>
</tr>
<tr>
<td>Real-Time Road Conditions</td>
<td>CHP (via ERS)</td>
<td>CHP (via ERS)</td>
<td>CHP (via ERS)</td>
<td>CHP (via ERS)</td>
<td>CHP (via ERS)</td>
</tr>
<tr>
<td>Road Closures</td>
<td>LCS/LCS (via ERS)</td>
<td>LCS/LCS (via ERS)</td>
<td>LCS/LCS (via ERS)</td>
<td>LCS/LCS (via ERS)</td>
<td>LCS/LCS (via ERS)</td>
</tr>
<tr>
<td>Automated Transit Trip Planning</td>
<td>Not collected by TDC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Real-Time Transit Vehicle Status</td>
<td>Not collected by TDC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Real-Time Captures (Snapshot) from Roadway Cameras</td>
<td>TrafficLand</td>
<td>TrafficLand</td>
<td>TrafficLand</td>
<td>TrafficLand</td>
<td>TrafficLand</td>
</tr>
<tr>
<td>Real-Time Weather</td>
<td>Not collected by TDC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Traveler Information (TI) Data Collection Subsystem

The data in the Traveler Information (TI) Data Collection Subsystem (TDC) interfaces to various external systems and internal MATIS subsystems to collect traveler information, and makes the data available to IVR and the Web Portal for dissemination to the traveling public. There are two classes of information: static and real-time traveler information. Static traveler information (e.g., website links, help information, etc.) is manually entered into the TDC. LA SAFE reviews the static content and provides updates to the contractor to post the updates to the Web Portal.

Table 2.2 lists the real-time traffic source systems and Figure 2.5 illustrates the traffic data sources and interactions.
Table 2.2  Real-Time Traffic Data Sources

<table>
<thead>
<tr>
<th>Data Source Name</th>
<th>Description</th>
<th>URL</th>
</tr>
</thead>
<tbody>
<tr>
<td>RIITS (providing data for Caltrans District 7)</td>
<td>TMC XML Services via RIITS.</td>
<td><a href="http://www.riits.net/index.html">http://www.riits.net/index.html</a></td>
</tr>
<tr>
<td>Caltrans Traffic Management Center XML (District 8)</td>
<td>XML Services via dedicated private link to Caltrans District 8 TMC.</td>
<td><a href="http://www.dot.ca.gov/dist8/tmc/index.html">http://www.dot.ca.gov/dist8/tmc/index.html</a></td>
</tr>
<tr>
<td>ERS</td>
<td>Web-enabled application at the 511 TIC that provides TIC operators the ability to declare and manage events specifically for 511. ERS also automates event data collection from external agencies, such as CHP CAD. TIC operators perform quality control on external events prior to publishing information to 511.</td>
<td></td>
</tr>
<tr>
<td>CHP CAD</td>
<td>Ongoing police incidents published by the CHP CAD media feed. CHP CAD incidents are collected via the ERS.</td>
<td><a href="http://cad.chp.ca.gov">http://cad.chp.ca.gov</a></td>
</tr>
<tr>
<td>Lane Closure System</td>
<td>Approved closures from the Lane Closure System via Caltrans Commercial Wholesale Web Portal (CWWP).</td>
<td><a href="http://lcs.dot.ca.gov/lcsprod">http://lcs.dot.ca.gov/lcsprod</a></td>
</tr>
<tr>
<td>TrafficLand.com</td>
<td>Public web site displaying live traffic video from hundreds of traffic cameras located along highways and commuting routes, including Caltrans cameras within Los Angeles County. The TDC collects camera inventory from trafficland.com. Image updates are handled directly by the web site.</td>
<td><a href="http://corporate.trafficland.com/services/xmlfeed.html">http://corporate.trafficland.com/services/xmlfeed.html</a></td>
</tr>
<tr>
<td>Caltrans Live Traffic Cameras</td>
<td>Caltrans has over a thousand cameras monitoring freeway sections across California. The TDC collects and stores the inventory for the cameras. Images are collected and stored on the web servers.</td>
<td><a href="http://www.riits.net/index.html">http://www.riits.net/index.html</a></td>
</tr>
</tbody>
</table>
The MATIS receives the Caltrans District 7 traffic information through RIITS. RIITS is sponsored by the LA Metro, and the primary objective is to promote the exchange of traffic and transportation data between operating agencies in Los Angeles County. These data come from electronic systems that are available to operate, manage, and monitor their systems (e.g., detect incidents when they occur, take actions to alleviate the effects, etc.).

**Call Center for 511, Call Box, and #399**

The MATIS includes a call center to support the 511 system, call box system, and #399 programs. The MATIS call center provides support to the caller when he/she dials 511 within Orange, Los Angeles, and Ventura County limits. The call center performs two key functions:

1. The **511 Call Center** supports the 511 service by providing customer help functions when users are having difficulty interacting with the Interactive Voice Response (IVR) subsystem; and

2. The **Call Box/#399 Call Center** services the call box and #399 program calls. The call box program is a system of roadside wireless telephones that provide motorists with a means of requesting assistance on equipped roadways. The #399 program is similar to the call box system as it allows users to request motorist aid; however, instead of using a roadside call box, the user is able to use their own cell phone and dial #399 to request assistance.
Figure 2.6 illustrates the call center configuration. When a 511 call is transferred to the call center, IVR opens a conference call with a 511 Call Center agent, as needed. An agent speaks with the caller and enters the information for the IVR via an application hosted by the IVR subsystem. Once the call is complete the agent disconnects the call, closing the conference bridge, thereby, placing the caller back into the IVR. The call center agents will not provide information directly to the caller; instead they assist the caller with entering data into the IVR.

**Figure 2.6 MATIS Call Center System Architecture**

Calls from #399 and call boxes connect directly to the call center and do not go through the MATIS IVR. Based on the motorist’s needs, the call is then transferred to 911, CHP, a towing company, or other agency as needed.

**FSP Fleet Monitoring and Reporting (FMR) Subsystem**

LA SAFE provides free towing services and motorist assistance within Los Angeles County area through a service called Metro FSP, a team of tow trucks patrolling freeways that provide assistance to stranded motorists. By quickly moving inoperable vehicles from the roadway, traffic can be kept flowing, thus reducing secondary incidents, saving fuel, and reducing air polluting emissions by reducing stop-and-go traffic. FSP is provided to the public as a free service through the partner agencies of Metro, Caltrans, and CHP, and is funded by
Proposition C, which was passed in 1990 to fund transportation improvements and help reduce traffic congestion.

The FMR Operators at the TIC monitor the FSP vehicle locations and movement to ensure the trucks are patrolling their assigned beats according to the schedule. The FMR Operators perform two primary tasks: the real-time monitoring of the tow vehicles using the WebTech mapping interface, and maintaining the static FSP information. Operators confirm that the vehicles are patrolling in their assigned beats during their shifts; are not traveling outside their predefined geofences; and monitoring other aspects of vehicle operations, such as speeding, long stops, and excessive number of stops. Any anomalous activities observed by the FMR Operators are reported to LA SAFE, as well as CHP, so that corrective actions can be taken to ensure that Standard Operating Procedures are being followed by the tow contractors and their drivers. The secondary task involves maintaining the static information related to the Contractors, contracts and drivers; and updating monthly information related to FSP inventory, driver assists, truck redeployment, and monthly invoice adjustments.

The FMR operators use the following tools to monitor FSP trucks:

- **WebTech Quadrant Fleet Monitoring System.** This system provides access to the WebTech Automatic Vehicle Location (AVL) information, and provides real-time mapping and reporting functions related to the location of the Contractor tow vehicles.

- **FMR System.** This system consists of a web-based application and database that is accessed via a browser interface for the entry and reporting of FSP operations. It captures and maintains current information related to the contracts in place with the Tow Contractors. In some cases, a Contractor may have more than one contract with LA Metro. Similarly, the ‘Driver Information Page’ allows users to add, modify, or delete existing information about individual drivers. The FMR system interfaces with the WebTech server and collects information about tow truck locations every 90 seconds.

There are 25 private tow operators that are contracted by LA SAFE FSP to provide coverage of more than 523 miles of freeway within Los Angeles County from approximately 5:00 a.m. to 7:00 p.m. weekdays, and 10:00 a.m. to 6:30 p.m. on weekend days. Tow trucks are assigned to sections of freeway called beats.

Figure 2.7 lists the details of the beat assignments by Contractor, geographic coverage, numbers of trucks, and shift hours. Figure 2.8 shows the beats geographically within the Gateway Cities area.
Gateway Cities Technology Plan for Goods Movement

Figure 2.7

FSP Beat Information
FREEWAY SERVICE PATROL BEAT INFORMATION

EFFECTIVE: MARCH 2011
BEAT FWY
1

2

110

LIMITS
Martin Luther King Jr Blvd. to Avenue 43

Avenue 43 to Glenarm St.
101 Vermont Ave. to Rte 5 @ Euclid Ave.
101 Rte 10 Eastern Ave. & Rte 101
5

JCT FWY 5/10/101 to Euclid Ave.

CONTRACTOR

FRQ'CY MILES

South Coast Towing

604

Neighborhood Towing 4 U

604

10 Eastern Ave to Jct 10/5/101 Sep.
3
4

10 La Brea Ave. to Rte 60 @ 3rd St.
60 Santa Fe & Mateo to 3rd Street
5

Garfield Ave. to Stadium Way

7.6
4.8
4.4
1.3
0.9

TR U C K S

AM

PM

TR U C K S

MIDDAY

TR U C K S

WEEKEND

5

6:00 to 10:00 3:00 to 7:00

1

10:00 to 3:00

1

10:00 to 6:30

4

6:00 to 10:00 3:00 to 7:00

1

10:00 to 3:00

1

10:00 to 6:30

4

6:00 to 10:00 3:00 to 7:00

2.5
7.6

Neighborhood Towing 4 U

604

Sonic Towing

604

11.1

5

2.5

5:30 to 9:30

1

10:00 to 3:00

1

10:00 to 6:30

3:00 to 7:00

1

9:30 to 3:00

1

10:00 to 6:30

5

405 Venice Blvd./Washington Blvd.to Mulholland Dr.

Tip Top Tow

604

9.1

4

6:00 to 10:00 3:00 to 7:00

1

10:00 to 3:00

1

10:00 to 6:30

6

405 Imperial Hwy.to Venice Blvd./Washington Blvd.

LA's Bestway Towing

604

6.7

3

6:00 to 10:00 3:00 to 7:00

1

10:00 to 3:00

1

10:00 to 6:30

7

101 De Soto Ave. to Coldwater Canyon Ave.

Platinum Tow & Transport

601

10.4

4

6:00 to 10:00 3:00 to 7:00

1

10:00 to 3:00

1

10:00 to 6:30

Pepe's Towing

602

7.8

3

6:00 to 10:00 3:00 to 7:00

1

10:00 to 3:00

1

10:00 to 6:30

8

10 Eastern Ave. to Santa Anita Ave.

9

405 Normandie Ave.to Imperial Hwy.

LA's Bestway Towing

603

7.4

4

6:00 to 10:00 3:00 to 7:00

1

10:00 to 3:00

1

10:00 to 6:30

10

405 Devonshire St. to Mulholland Dr.

EZ Towing

601

9.2

3

6:00 to 10:00 3:00 to 7:00

1

10:00 to 3:00

2

10:00 to 6:30

J&M Towing

602

3

6:00 to 10:00 3:00 to 7:00

1

10:00 to 3:00

1

10:00 to 6:30

3:00 to 7:00

1

9:30 to 3:00

1

10:00 to 6:30

6:00 to 10:00 3:00 to 7:00

1

10:00 to 3:00

1

10:00 to 6:30

11

210 Orange Grove Blvd.to Santa Anita Ave.
134 Orange Grove Blvd to Jct 210 & 710

6.9
0.4

12

10 Santa Anita Ave. to Grand Ave.

Pepe's Towing

602

9.8

3

13

60 3rd Street to Crossroads Prkwy.

Tow Masters

603

10

5

Kenny's Auto Service

603

10.2

3

5:30 to 9:30

3:00 to 7:00

2

9:30 to 3:00

1

10:00 to 6:30

Reliable Delivery Service

603

10.9

4

5:30 to 9:30

3:00 to 7:00

1

9:30 to 3:00

1

10:00 to 6:30

Tip Top Tow

604

8.1

4

6:00 to 10:00 3:00 to 7:00

1

10:00 to 3:00

1

10:00 to 6:30

Bob's Towing

602

9.8

4

5:30 to 9:30

3:00 to 7:00

2

9:30 to 3:00

1

10:00 to 6:30

Kenny's Auto Service

603

13.6

5

5:30 to 9:30

3:00 to 7:00

1

9:30 to 3:00

1

10:00 to 6:30

J&M Towing

602

8.9

3

5:30 to 9:30

3:00 to 7:00

1

9:30 to 3:00

1

10:00 to 6:30

5:30 to 9:30

2:30 to 7:00

1

9:30 to 2:30

1

10:00 to 6:30

6:00 to 10:00 3:00 to 7:00

1

10:00 to 3:00

2

10:00 to 6:30

3:00 to 7:00

1

9:00 to 3:00

1

10:00 to 6:30

6:00 to 10:00 3:00 to 7:00

14

605 Orange County Line to Telegraph Rd.

16

5

17

10 La Brea Ave. to Lincoln Blvd.

18

10 Grand Ave. to San Bernandino County Line/Mills Ave.

19
20
21
23
24
27

Orange County Line/Artesia Blvd. to Garfield Ave.

405 Normandie Ave. to Orange County Line
60 Crossroads Prkwy. to Fairway Dr.
60 Fairway Dr. to San Bernadino County Line
57 Rte 57, Temple Ave. to Orange County Line
710 Firestone Blvd. to Valley Blvd.
5

Roxford to Rte 14/5 Sep.

14 Rte 5/14 Sep. to Agua Dulce Rd.
101 Vermont Ave. N/B on Rte 170

California Coach

602

Bob's Towing

602

Top Notch Towing

601

9
6.2
8.9
2.9
15.1
7.4

4
3
3

South Coast Towing

604

28

210 Santa Anita Ave. to Sunflower Ave.

Hadley Tow

602

11.3

4

29

101 Lindero Canyon Rd. to De Soto Ave.

Classic Club

601

13.2

30

710 Willow St. to Firestone Blvd.

Citywide Towing

603

Sonic Towing

601

Platinum Tow & Transport

601

31
33
34
36
37

170 Rte.134/170 Sep. to Sheldon St.

5

Hollywood Way to Stadium Way

118 Ventura County Line to East JCT St. 210
210 Maclay St UC to 118/210 Sep.
5

Hollywood Blvd. to Roxford St.

5

Roxford St. to Jct 5/210

210 Jct 5/210 to Fair Oaks Ave.
605 Telegraph Road to Huntington Drive

Sebo Towing

601

Lara's Towing Service

601

Hadley Tow

602

210 Sunflower Ave. to San Bernardino County Line
38

71 210/71 Sep. to Mission
105 California Street - Central Avenue

40

105 Central Avenue - Studebaker Road

California Coach

602

2

10:00 to 3:00

1

10:00 to 6:30

10.6

4

6:00 to 10:00 3:00 to 7:00

1

10:00 to 3:00

1

10:00 to 6:30

10.5

4

6:00 to 10:00 3:00 to 7:00

2

10:00 to 3:00

1

10:00 to 6:30

4

6:00 to 10:00 3:00 to 7:00

1

10:00 to 3:00

1

10:00 to 6:30

4

6:00 to 10:00 3:00 to 7:00

1

10:00 to 3:00

1

10:00 to 6:30

3

6:00 to 10:00 3:00 to 7:00

1

10:00 to 3:00

1

10:00 to 6:30

4

6:00 to 10:00 3:00 to 7:00

1

10:00 to 3:00

1

10:00 to 6:30

3:00 to 7:00

1

9:30 to 3:00

1

10:00 to 6:30

15.6
1.1
10.3
1.4
25.3
15.8
1.3

4

5:30 to 9:30

8.9

3

6:00 to 10:00 3:00 to 7:00

1

10:00 to 3:00

1

10:00 to 6:30

10

4

6:00 to 10:00 3:00 to 7:00

1

10:00 to 3:00

1

10:00 to 6:30

Jon's Towing

601

21.5

3

3:00 to 7:00

1

9:00 to 3:00

1

10:00 to 6:30

Roxford St. to Lake Hughes Parkway

EZ Towing

601

16.8

3

6:00 to 10:00 3:00 to 7:00

1

10:00 to 3:00

1

10:00 to 6:30

110 Martin Luther King Jr. Blvd to Carson Street

Frank Scotto Towing

604

12.5

4

6:00 to 10:00 3:00 to 7:00

1

10:00 to 3:00

1

10:00 to 6:30

6

6:00 to 10:00 3:00 to 7:00

2

10:00 to 3:00

2

10:00 to 6:30

6

6:00 to 10:00 3:00 to 7:00

2

10:00 to 3:00

2

10:00 to 6:30

134 Jct Rte 170 to Orange Grove Blvd.
2

91 Vermont Ave. to Orange County Line

91 Orange County Line to 710 (Big Rig)

5:00 to 9:00

2.1
Hollywood Car Carrier

601

Foothill Blvd., to Glendale Blvd.

710 Pacific Coast Highway to 3rd Street (Big Rig)

Source:

2-20

6:00 to 10:00 3:00 to 7:00

3.3

101 Coldwater Canyon Ave. to Jct Rte 170

61

10:00 to 6:30

4

603

5

60

10:00 to 6:30

1

603

42

51

1

9:30 to 3:00

ABA Towing

14 Agua Dulce Rd. to Ave P-8

50

10:00 to 3:00

1

Lara's Towing Service

41
43

1

5:30 to 9:30

9

57 210/57 Sep. to SR 57/60 Temple Ave.
39

5:00 to 9:00

3:00 to 7:00

5.5

5

5:30 to 9:30

13
9.2

ABA Towing

603

14.7

US Tow

603

17.7

Hadley Tow

603

31.5

Los Angeles Metropolitan Transportation Authority, November 2011.

1
2
1
2

5:00 to 8:00

4:00 to 7:00

8:00 to 12:00 12:00 to 4:00
5:00 to 8:00

4:00 to 7:00

8:00 to 12:00 12:00 to 4:00


Figure 2.8 Freeway Service Patrol Beats in the Gateway Cities Area
Depending on the freeway and level of coverage required, each beat has between one and five tow trucks during the peak morning and afternoon shifts with fewer trucks required during the midday shift when freeway traffic is lighter. During the morning and afternoon peak periods, there are a total of 150 trucks patrolling across the 41 beats. There are two beats along heavily traveled truck routes (I-710 and SR 91 freeways) that are equipped with heavy tow trucks to assist commercial vehicles. Motorists request assistance from an FSP truck by calling #399 from their mobile phone (free call), or calling for help from a freeway callbox. In addition, several motorist assists occur from the roving tow truck patrols. The FSP service provides more than 20,000 motorist assists per month.

Figure 2.9 illustrates the AVL data flow for the FSP. Each of the tow trucks are equipped with an AVL transponder, which communicates the vehicle’s location in real-time to the AVL service provider, WebTech Wireless. FMR operators monitor the location of the tow trucks using the WebTech user interface. TDC collects tow truck location data from the WebTech server every 90 seconds. FMR operators have the ability to enter additional information into the MATIS using the FMR user interface. Data saved on the MATIS are available for report generation, performance monitoring, and future data mining.

**Figure 2.9  AVL Data Flow**

![AVL Data Flow Diagram]

**Event Reporting Subsystem**

The Event Reporting Subsystem (ERS) was implemented as part of the Baseline phase and is used by TIC operations to create, manage, and store traffic events, including those from external sources. Using ERS, TIC operators create, review, modify as necessary; and approve incidents, planned events (closures and roadwork), and road conditions using a confirmation and verification process. The managed event information is disseminated to the public via the Web Portal and IVR Subsystems. In addition to event management, the ERS allows...
operators to add events, as well as administer user details and view events through both a map and a list view.

Figure 2.10 illustrates the incidents and lane closure data flow in MATIS. The ERS automatically receives traffic incident information from CHP CAD and LCS through XML feeds, and presents them to the TIC operator for review and approval. Typically, the information received through XML feed from CHP CAD needs to be modified for distribution and use by the general public. TIC operators review and update the incident description and save the record into the ERS database. TIC operators monitor news provided by local television stations and manually add additional events to the system. The TDC automatically receives the new updates from ERS and makes them available to traffic map and IVR. TIC operators typically process about 35,000 incidents per month.

**Figure 2.10  High-Level ERS Subsystem Architecture**

![High-Level ERS Subsystem Architecture](image)

**Traveler Information Center (TIC)**

One of the MATIS goals is to provide accurate traveler information to the public. Often, information automatically received from the external systems is not accurate and/or complete, nor is it ready for public consumption. One of the key responsibilities of TIC operators is to verify incidents, road closures, and road condition, and update this information, as necessary. The operators use the Event Report Subsystem (ERS) to verify the incidents that are automatically reported by CHP CAD and the LCS systems, and enter the updates, as necessary, into the system. Operators use the Alert feature of the ERS to post important messages on the traffic map.
Figure 2.10 illustrates the process of updating and posting incidents on the MATIS:

- ERS receives incident data from CHP CAD through XML feed.
- ERS receives incident data from Caltrans LCS through XML feed.
- Using the ERS user interface, TIC operators review and modify incidents and lane closure information, as necessary, and saves the record.
- ERS subsystem sends the data to TDC, and it makes it available to Web Portal to display on the map and IVR.
- Using the floodgate user interface, TIC operators post floodgate messages on the IVR, and a similar message is posted on the Alert box on the traffic map. The ERS user interface is used to post alerts on the traffic map.

The TIC facility is designed as a small TMC with six flat-panel TV monitors and five work stations for use by TIC operators. The TIC is located in an office building in Irvine and operates from 4:00 a.m. to 11:00 p.m. on weekdays, and from 9:00 a.m. to 9:00 p.m. on weekends. The TIC staff consists of five operators and one supervisor.

Another function of the TIC staff is to review, categorize, and process feedback received from the public. Public feedback is reviewed by LA SAFE and may contribute towards or result in implementing new features and system enhancements. Since TIC operators interface with the public through posting messages on the traffic web site and floodgates, there is an extensive set of Standard of Operations procedures to ensure the messages meet LA SAFE’s standards.

**Interactive Voice Response (IVR) Subsystem**

The MATIS includes an IVR, which allows callers to dial 511 or a toll-free number from their cell phones or landlines and interact with the system using their voice. The IVR Subsystem provides the user with two key functions with the Main Menu serving as the initial function that the caller interacts with after dialing 511. It serves as the ‘call routing’ to direct the caller to their desired feature or transfer destination, whether they have requested traffic or transit information:

- **Traffic.** Callers can select the traffic option to hear traffic incident and travel time information by stating within the IVR a freeway name, number or alias, the freeway direction, and an intersection/cross street.

- **Transit.** Callers can select the transit option to retrieve transit content for the participating counties. They can hear the schedule for the next arriving bus(es) after supplying a bus route and intersection (NexTrip); or they can retrieve a transit itinerary after supplying start and end points (address, intersection, or landmarks), and travel date/time (Transit Trip Planner).
LA SAFE is planning to make a third option available to the public by mid-2012, to provide general information about the I-10 and I-110 Express Lanes. This feature will allow the express lane users to dial 511 and receive general information about Express Lanes.

Figure 2.11 illustrates the data flow within the IVR Subsystem:

- IVR receives traffic information from TDC (incidents, lane closures, speeds, travel times, and road conditions).
- IVR receives transit information from NextBus and TripMaster.
- TIC operators post floodgate messages on IVR using floodgate tool.

**Figure 2.11  IVR High-Level Architecture**
- Callers dial 511 and request traffic or transit information from IVR. If IVR recognizes the caller’s request, it will read the requested information. If the IVR does not recognize the caller’s request, the caller is then transferred to an agent at the MATIS call center. The operator will collect the required information from the caller and enter the data into the IVR subsystem using a web-based tool called “Screen-Pop”. The caller is transferred back to the IVR to hear the requested information.

- The IVR will allow the caller to leave feedback about their experience using the 511 system.

**RIITS**

The overarching objective of the Regional Integration of Intelligent Transportation System (RIITS) is to facilitate the exchange of information between multiple agencies, to improve their current transportation management and operations, and better serve the needs of the traveling public. The RIITS network includes numerous agencies responsible for various public services related to transportation and emergency services, as listed in Table 2.3. The RIITS Network provides the interconnection of these management centers for the exchange of information. The RIITS Network collects transportation-related data from nine management centers owned by seven agencies in the Los Angeles area. These agencies are responsible for transportation and emergency services management. Each agency has, in most cases, a management center facility through which their respective systems are operated.

### Table 2.3 RIITS Level 1 Agencies – Data Providers

<table>
<thead>
<tr>
<th>Agency</th>
<th>Center</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caltrans District 7</td>
<td>Los Angeles Regional Transportation Management Center (LARTMC)</td>
<td>Glendale</td>
</tr>
<tr>
<td>City of Los Angeles Department of Transportation (LADOT)</td>
<td>Advanced Traffic Surveillance and Control (ATSAC)</td>
<td>Los Angeles</td>
</tr>
<tr>
<td>LA Metro</td>
<td>Bus Operations Center (BOC)</td>
<td>Los Angeles</td>
</tr>
<tr>
<td>LA Metro</td>
<td>Rail Operations Center (ROC)</td>
<td>Los Angeles</td>
</tr>
<tr>
<td>CHP</td>
<td>CHP-LA, Inland Empire, Orange County, Ventura County</td>
<td>Public Web Server</td>
</tr>
<tr>
<td>Long Beach Transit (LBT)</td>
<td>Bus Dispatch Center</td>
<td>Long Beach</td>
</tr>
<tr>
<td>Caltrans District 12</td>
<td>TMC</td>
<td>Irvine</td>
</tr>
<tr>
<td>Caltrans District 8</td>
<td>TMC</td>
<td>San Bernardino</td>
</tr>
<tr>
<td>Foothill Transit (FHT)</td>
<td>Bus Dispatch Center</td>
<td>Bus Dispatch Center</td>
</tr>
<tr>
<td>Los Angeles County Department of Public Works (LACDPW)</td>
<td>Information Exchange Network (IEN)</td>
<td>Alhambra</td>
</tr>
</tbody>
</table>
Metro sponsors the RIITS for the region. The other contributing agencies include Caltrans (Districts 7, 8, and 12); LADOT; CHP; LBT; and FHT. All contribute information collected through their ITS to the network using the Los Angeles County Regional ITS Architecture and National ITS Standards. The network supports information exchange in real-time to improve management of the Los Angeles County transportation system and better serve the traveling public in the region. RIITS also provides data to traveler information services of all kinds, both public and private (i.e., SigAlert and other media outlets), which allows them to reach the widest possible audience. Agencies connected to RIITS both provide data for the exchange and consume data from the data providers.

Some agencies provide information to RIITS through a software interface and also receive data from the other agencies through this system. The software interface is hosted on an “Agency Data Server” (ADS), which provides the interface point between agency systems and RIITS. The ADS provides the interface between the agency system data source and RIITS by converting the agency system protocol into a standard regional format (XML), so that partner agencies may access the data. The Regional User Interface (RUI) is a browser-based user interface to allow agencies to view the integrated regional transportation data that is available through RIITS. The real-time data is presented as icons on a street map, which can be “panned” and “zoomed” by the user. These agencies are connected to RIITS over a private, secure network that is protected by two levels of firewalls. There is a firewall server between each agency system that is providing data to RIITS; and second firewall which protects RIITS from unauthorized access from the Internet.

Some agencies, shown in Table 2.4, primarily receive information from other agencies through RIITS. It is also possible for these agencies to enter transportation impacting event information through the RUI that is used to display the received regional data. In general, these agencies access the RIITS Network and receive data through the Internet. Agencies that access RIITS must have an account set up to allow access through the firewalls.

### Table 2.4   RIITS Data Receivers

<table>
<thead>
<tr>
<th>Agency</th>
<th>Center</th>
</tr>
</thead>
<tbody>
<tr>
<td>Los Angeles County Department of Los Angeles County Fire Department (LACFD)</td>
<td>Dispatch Center</td>
</tr>
<tr>
<td>Los Angeles County Sheriff Department (LASD)</td>
<td>Communications Center</td>
</tr>
<tr>
<td>Santa Monica Big Blue Bus (SMBBB)</td>
<td>Bus Dispatch Center</td>
</tr>
<tr>
<td>Los Angeles Police Department (LAPD)</td>
<td>Emergency Operations Center (EOC)</td>
</tr>
<tr>
<td>Los Angeles World Airports (LAWA)</td>
<td>LAX Airport Traffic Operations Center (TOC)</td>
</tr>
<tr>
<td>SCAG</td>
<td>Transit Information Center</td>
</tr>
<tr>
<td>POLB</td>
<td>Operations Control Room</td>
</tr>
<tr>
<td>Access Services Inc.</td>
<td></td>
</tr>
</tbody>
</table>
Selected private transportation companies also may receive access to a subset of the RIITS data. Any entity that will further the goal of disseminating transportation data to the general public can qualify, with qualifications evaluated on a case by case basis by the configuration management committee and voted on by the committee. The available subsets of data include two of the larger datasets, the Caltrans District 7 ATMS data and the CHP incident data. There is a $100 one-time administrative fee for approved companies but no other ongoing charges.

An institutional framework, consisting of a configuration management process and a committee of agency members, has been established to manage changes that are introduced into RIITS over time.

**Data Collection and Dissemination**

Agencies provide information to RIITS through a software interface and also receive data from other agencies through this same system. These agencies have the capability to enter transportation-impacting event information through the same user interface that is used to display the received regional data.

The data within RIITS is available to users through various types of dissemination interfaces:

1. A secure browser-based map accessible through the Internet for authorized users;
2. A browser-based map showing speeds at detector locations, CCTV locations and incidents, which is accessible to the general public ([http://map.riits.net](http://map.riits.net)), as shown in Figure 2.12;
3. XML data feed for public agencies through the Internet with a password; and
4. XML data feed for Information Service Providers (ISP) through the Internet with a password.

Public agencies may also access the data directly from the RIITS backbone if there is access in their respective management centers. Figure 2.13 shows the flow of data between agencies and users within the RIITS system.

Additional information on integrating with RIITS and retrieving data from the XML feed is available from the RIITS web site at [http://riits.net/RetrievingData.html](http://riits.net/RetrievingData.html).
Figure 2.12  RIITS Map View – Device Locations

Figure 2.13 RIITS Data Collection and Dissemination

System Architecture

RIITS consists of an agency-owned, fiber optic, Gigabit Ethernet backbone with nodes in multiple management centers, as well as Virtual Private Networks (VPN) over the public Internet. Equipment is primarily located in four separate agency facilities involved with RIITS including:

- Caltrans District 7/CHP, LARTMC;
- LADOT, ATSAC;
- LA Metro, BOC; and
- LBT, Bus Dispatch Center.

The RIITS System Architecture is depicted in Figure 2.14. RIITS can be thought of as two distinct subnetworks; one subnetwork is a private intranet linking agencies together over agency-owned fiber optics. This subnetwork is referred to as the RIITS Internal Network. The second subnetwork provides connectivity for agencies and ISP users via the public Internet; this subnetwork is referred as the RIITS External Network.
**RIITS Internal Network.** Fiber optic gigabit Ethernet switches are located at Caltrans District 7 LARTMC, LA DOT ATSAC, Metro Headquarters, Caltrans District 8, and Foothill Transit. These facilities house the three backbone nodes interconnected by fiber optic cable to form a regional fiber backbone ring.

**RIITS External Network.** As stated earlier, data consuming agencies receive their RIITS information via the public Internet. CHP provides information to the RIITS Network through their existing web interface to the public. The agencies have been informed with regard to bandwidth requirements and security configurations. As new agencies are granted access to the RIITS external network, they are given the bandwidth requirements and security configurations. For example, agencies that have a security policy that prevents streaming video through the Internet access firewalls may have to reconfigure to allow this traffic to certain computers within their agency network.

**ADMS**

An effort is underway led by the University of Southern California’s METRANS Transportation Center to develop an Archived Data Management System (ADMS) to capture real-time data from the RIITS Network. The objective is to establish a regional transportation data library to store and mine RIITS Network data.
historical data for regional transportation planning, operations evaluation, and transportation policy analysis.

**California State Department of Transportation (Caltrans)**

*Caltrans District 7 ATMS*

Caltrans District 7 operates its Advanced Transportation Management System (ATMS) from its Transportation Management Center located in Glendale. The TMC is manned 24 hours, 7 days per week with trained operators who monitor freeway conditions, support CHP and other field personnel during incidents, and provide information to the public through CMS. In general, there are four operators on duty during peak periods and two operators during off-peak periods. The CMS show travel times to downstream destinations as a default, but are also used to advise motorists on incidents, construction or other activities. The regional ramp metering system is also managed from the TMC. The building houses CHP personnel who provide operators with incident data from their dispatch system. There is, however, no direct link between the CHP CAD system and the ATMS; as a result, TMC operators must enter incidents into the system. Processes for incident detection and posting travel times are largely automated as described below.

Figure 2.15 below shows the large screen displays at the TMC. The video wall is configurable, allowing operators to rotate through different camera views or focus on specific locations to monitor incidents and/or delays. The wall also includes electronic boards showing CMS custom messages and incidents posted from the CHP CAD system. There are also facilities for media broadcasts in the TMC.

Caltrans District 7 operates vehicle detectors on the freeway mainlines and at most ramp locations in the region. These detectors are typically controlled by either a dedicated roadside vehicle detector station or a roadside ramp meter that also serves as a vehicle detector station. Count and occupancy data from the detectors are collected every 30 seconds by a computer called a “front-end processor”. The front-end processor is the only source of lane-by-lane raw freeway detector data including ramp detector data.
Caltrans District 7’s freeway management system (also called the Advanced Transportation Management System or ATMS shown in Figure 2.16) receives raw detector data from the front-end processor and converts it into an hourly volume, average occupancy, and average speed for all lanes combined in each direction at each detector site. These aggregated data are displayed on the ATMS map-based user interface for Caltrans operators. Every minute, the ATMS software uploads speed data to an FTP site, together with the text of messages currently displayed on the changeable message signs. The CMS operated by Caltrans are controlled by the Caltrans freeway management system (ATMS). These data are available for download. The CMS travel times also are available on the Caltrans web site during peak commute times, or via e-mail/text alerts, as shown in Figure 2.17. In addition, ATMS received data from detectors on the ramps and controls influx of vehicles into the freeway using ramp meters.

Closed-circuit television (CCTV) cameras enable Caltrans operators to remotely observe conditions on the region’s freeways in order to improve mobility and assist motorists. Most of these cameras have remote pan, tilt, and zoom controls, although some may be fixed-view cameras used for verifying changeable message sign operations. The video feed is transferred from the camera to the agency’s operation center by a variety of communication links. Figure 2.18 shows a sample camera view. All video feeds arrive at the control center as analog feeds at this time. Caltrans plans to move to a completely digital video system.

Figure 2.15  Caltrans District 7 TMC
Figure 2.16 High-Level Caltrans ATMS Diagram

![Diagram of ATMS system](Image)

Figure 2.17 Caltrans District 7 Travel Time Information

![Travel Time Information](Image)

Caltrans District 7 provides detector and changeable message signs data to RIITS, and RIITS provides the information to MATIS 511 and POLB ATMIS systems.

Existing and planned Caltrans advanced transportation management system equipment are shown in Figures 2.19 to 2.26.
Figure 2.19 Caltrans Detectors – Northern Gateway Cities Area

Source: Caltrans District 7, November 2011.
Figure 2.20  Caltrans Detectors – Southern Gateway Cities Area

Source:  Caltrans District 7, November 2011.
Figure 2.21  Caltrans Ramp Meters – Northern Gateway Cities Area

Source: Caltrans District 7, November 2011.
Figure 2.22  Caltrans Ramp Meters – Southern Gateway Cities Area

Source: Caltrans District 7, November 2011.
Figure 2.23  Caltrans CCTVs – Northern Gateway Cities Area

Source:  Caltrans District 7, November 2011.
Figure 2.24 Caltrans CCTVs – Southern Gateway Cities Area

Source: Caltrans District 7, November 2011.
Figure 2.25 Caltrans CMS, EMS, and HAR – Northern Gateway Cities Area

Source: Caltrans District 7, November 2011.
Figure 2.26  Caltrans CMS, EMS, and HAR – Southern Gateway Cities Area

Source: Caltrans District 7, November 2011.
**Lane Closure System (LCS)**

Caltrans maintains a standardized statewide system of planned and emergency lane closures for the state highways. The LCS is updated every 10 minutes and reports all approved closures planned for the next seven days, including current lane, ramp, and road closures due to maintenance activities, construction, special events, etc. LCS reports are accessible and downloadable via the Internet; and can be generated according to District, county, route, date, and time period ([http://www.lcswebreports.dot.ca.gov/lcswebreports/](http://www.lcswebreports.dot.ca.gov/lcswebreports/)). Figure 2.27 shows a sample LCS report for the I-710 freeway.

**Figure 2.27 Caltrans District 7 Planned Lane Closures**

<table>
<thead>
<tr>
<th>Dir.</th>
<th>Rte.</th>
<th>Begin &amp; End Limits</th>
<th>Facility</th>
<th>Lanes Closed / Total</th>
<th>Start / End Date Time</th>
<th>Type of Work</th>
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<tr>
<td>NB</td>
<td>710</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
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<td>Grinding</td>
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<tr>
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<td>710</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<td>Connector</td>
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<td>02/01/12 09:01 PM 02/02/12 05:01 AM</td>
<td>Bridge Work</td>
</tr>
<tr>
<td>NB</td>
<td>710</td>
<td>NB Long Beach Fwy</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<td>Bridge Work</td>
</tr>
<tr>
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<td>710</td>
<td>NB Long Beach Fwy</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
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<td>02/01/12 10:01 PM 02/02/12 05:01 AM</td>
<td>Grinding</td>
</tr>
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<td>Grinding</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<td>Connector</td>
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</tr>
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</tr>
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<td></td>
<td></td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td></td>
<td></td>
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<td>Connector</td>
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<td>02/01/12 07:01 PM 02/02/12 06:01 AM</td>
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</tr>
<tr>
<td>SB</td>
<td>710</td>
<td>SB Long Beach Fwy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>SB San Diego Fwy, Rte 405</td>
<td>Connector</td>
<td>All of 2</td>
<td>02/01/12 09:01 PM 02/02/12 05:01 AM</td>
<td>Bridge Work</td>
</tr>
</tbody>
</table>


**Performance Measurement System (PeMS)**

Caltrans Headquarters administers the freeway PeMS, a real-time archived data management system for vehicle detector data, toll tag readers, and a variety of other transportation-related data collected from systems throughout the State, including District 7 ([http://pems.dot.ca.gov/](http://pems.dot.ca.gov/)). PeMS collects detector data in real-time, stores and processes this data, and provides a number of web pages
that transportation professionals can use to analyze the performance of the freeway system. It is a source of both raw detector data as collected from the various freeway management systems and processed data. Some of the real-time and archived information available in PeMS includes traffic detectors, incidents, lane closures, toll tags, census traffic counts, vehicle classification, weigh-in-motion, and roadway inventory. Figure 2.28 presents a sample screen for PeMS, which shows real-time speeds, incidents, lane closures, and messages for CMSs on a map.

Figure 2.28 PeMS Real-Time Traffic Information

PeMS is also a source of numerous performance measures and reports on monitored roadways, including current and historical traffic flow, speeds, delay, occupancy, truck proportions, vehicle hours traveled (VHT), vehicle miles traveled (VMT), Q (vehicle-miles-weighted speed or productivity of the link during a single five-minute interval), travel times by segment, travel time index, productivity, detector health, bottlenecks, etc. For instance, Figure 2.29 presents the typical speed a traveler on I-710 northbound experienced on weekdays over the last week by post-mile and time of day. Figure 2.30 shows a sample travel time performance report for a short segment of I-710 northbound.
Figure 2.29  Sample PeMS Average Speed Performance Report on I-710


Figure 2.30  Sample PeMS Travel Time Performance Report on I-710

POLA/POLB

Advanced Transportation, Management, Information, and Security (ATMIS)

The POLA/POLB are enhancing real-time transportation operations in the ports area by implementing and operating various field devices, central management software, and data communications, which together are known as the Advanced Transportation Management Information System (ATMIS). ATMIS uses information technology to better manage the movement of vehicles within and around the Ports area. The objectives are improved incident response time, emergency response, enhanced goods movement, reduced travel delay and emissions, improved reliability and predictability of the transportation system, and improved multimodal mobility.

ATMIS will provide real-time monitoring and control of connected field devices and real-time communication with selected external systems involved in travel information dissemination or cooperative traffic management. Associated procedures will enable a coordinated response to incidents, emergency response, congestion, and special events on Ports facilities and surrounding arterials, and freeways. ATMIS will provide truck and terminal operators with congestion and travel information regarding travel conditions on Ports and surrounding roadway facilities, including CCTV cameras and queue lengths at terminal gates, using automated license plate readers that are being installed as part of the project.

The major grade-separated roadways serving the Ports are the Harbor Freeway (I-110), the Long Beach Freeway (I-710), the Terminal Island Freeway (portions of SR 47 and SR 103), the Vincent Thomas Bridge/North Seaside Avenue, and a grade-separated portion of West Ocean Boulevard. At-grade arterial roadways serving truck traffic to and from the Ports include Sepulveda Boulevard/Willow Street, Pacific Coast Highway (SR 1), Anaheim Street, Alameda Street/Harry Bridges Boulevard, West Ocean Boulevard, and South Harbor Scenic Way. ATMIS focuses on traffic management and information on the roadways serving the Ports.

Figures 2.31 and 2.32 presents the planned ATMIS system’s logical and physical system architecture. The primary server is installed at POLB’s Joint Command and Control Center (JCCC), and the backup server is installed at POLA’s Administration building. The ATMIS system is anticipated to be operational in the fall of 2012.
Figure 2.31  ATMIS System Architecture

Note: The ACTA long train warning system will not be included in the system.
**Figure 2.32 ATMIS Network Logical Diagram**

ATMIS will collect and process data from field devices and external systems, and disseminate traveler information to inform the users of current roadway and traffic conditions via CMS, a web-based user interface, and alerts by e-mail and text messages. ATMIS field devices will consist of CCTV cameras, vehicle detectors, travel time management systems (TTMS), and CMS (CCTV and CMS equipment are shown in Figure 2.33). Users will be able to view live video feeds from roadside cameras in the area and obtain information about current conditions and incidents on a map-based web page. Data collected from field devices on Port property are made available to regional data sharing systems, including the RIITS, the County’s IEN, and Caltrans PeMS. ATMIS plans to provide truck-specific information, such as the number and average speed of trucks traveling between entry points to the area.

**Note:** The ACTA long train warning system will not be included in the system.
Figure 2.33  ATMIS CCTV and CMS Equipment
Travel time management systems are installed at various locations within POLB and POLA areas to measure travel time and vehicle origin-destination. CMS controlled from the ATMIS user interface can be used to alert motorists, and especially truck drivers, of unusual conditions ahead and travel times for various routes. Incident information will be provided by ATMIS to trucking company dispatchers via the ATMIS web page and e-mail/text message alerts, allowing the dispatchers to inform truck drivers and customers of incidents and other unusual conditions that may affect the truck’s route or time of travel, including malfunctioning traffic signals. Traffic signal status information is obtained from the Los Angeles County IEN, and incidents from CHP CAD through the RIITS interface. ATMIS system data will be available to external systems via an XML feed, which will be compliant with Traffic Management Data Dictionary (TMDD) standards.

The Ports have installed extensive wireless and fiber networks as part of their security systems. ATMIS uses this network and established a virtual network dedicated to communication for traffic-related applications and communication between field devices and the central systems. A fiber cable will be installed between the two ports, which facilitates communication between the ATMIS backup and primary servers. In addition, communication over fiber has been established between JCCC and the City of Long Beach traffic management center, and two fiber strands have been allocated for fiber. About 90 percent of the project has been completed. Equipment that is part of the Port Information Management System (PIMS) including CMSs and communications will be integrated into ATMIS.

ATMIS operators will monitor the system, post alerts on the change able message signs and web, and will support other traffic operations activities and generate reports for planning activities. Recognizing that a large proportion of the truck drivers are Spanish speaking, the text alerts and messages will consist of mostly numbers and road names – they plan to use simple canned messages. The ATMIS operator will be able to generate new incident records (real-time incidents or planned) manually; or edit the description, type, and location of existing records.

In the future, there are also plans to add arterial performance monitoring to the ATMIS system.

Finally, it’s important to note that although the ATMIS system is scheduled to go online in the fall of 2012, there currently is no staff dedicated to operating the traffic management component of the system. The port security department will continue to utilize the CCTV images for their mission but will not actively operate any of the other devices. In addition, there may still be gaps related to CCTV coverage, particularly at the terminal gates. These are gaps the Gateway Cities Technology Plan should address.
**PierPASS**

In order to improve congestion, security, and air quality issues at the Ports, the marine terminal operators created the PierPASS program. Under the program, incentives are provided to cargo operators to shift operations to the off-peak through a Traffic Mitigation Fee (TMF) required for most cargo movement during peak hours. Live video images of the terminal gates are available on the PierPASS web site (http://pierpass.org/live/). A Turn Time Study and a TruckTag program have been established under PierPASS with useful truck data and information that could be stored and shared for transportation planning, operations, management, and monitoring purposes. More information on PierPASS can be found in the Drayage Operations section of this report.

**Los Angeles County Department of Public Works (LACDPW)**

The Los Angeles County Department of Public Works (LACDPW) has developed software for integrating individual ATMS for arterial traffic control systems into a regional framework to synchronize traffic signals across jurisdictional boundaries. The IEN is represented in Figure 2.34.

**Figure 2.34  IEN System Architecture**
Agencies are assigned to one of the levels described below based on their desired operational role and needs:

- **Level 1 Agency:**
  - Agency does not operate its traffic signals and wants to be on “Agency B” or other agency’s ATMS;
  - Another agency operates its traffic signals (e.g., Los Angeles County DPW); and
  - Agency is provided with an IEN workstation to monitor traffic signals and incident management activities, and no separate ATMS workstation is provided for the agency.

- **Level 2A Agency:**
  - Agency does not actively operate its traffic signals;
  - Agency typically operates on an exception basis and occasional peak periods, and wants to be on “Agency B” or other agency’s ATMS;
  - Another agency may operate its traffic signals (e.g., LACDPW); and
  - Agency is provided with ATMS workstation to monitor traffic signals and incident management activities and a separate IEN workstation.

- **Level 2B Agency:**
  - Agency actively manages and operates its own traffic signals and ATMS;
  - Actively manages traffic signals during exceptions and peak periods;
  - Passively manages traffic signals during off-peak periods;
  - Agency may also operate some other ITS devices;
  - Agency may “host” another agency’s ATMS functions;
  - Agency houses a local control center to manage traffic signals and incident management activities;
  - Agency is provided with an IEN workstation for the regional view and ATMS workstation for the local view; and
  - A command/data interface between the ATMS and IEN is also provided.

- **Level 3 Agency:**
  - Agency actively manages and operates its own traffic signals, ATMS, and other ITS devices of its own or for other agencies.
  - Typically, AM peak through PM peak operations. It may support 24/7 operations.
  - Agency may operate other agency’s traffic signals (Level 1), and may “host” other agency’s ATMS functions (Level 2A).
• Agency will have a TMC from which to operate ATMS workstations, IEN workstations, and other ITS devices.

• Agency houses a local control center to manage traffic signals and incident management activities.

• Agency is provided with and IEN workstation for the regional view and an ATMS workstation for the local view.

• A command/data interface between the ATMS and IEN is also provided.

The IEN architecture supports traffic signal operations at the local and regional levels. At the local level, the ATMS enables the local agency to carry out its traffic signal operations’ day-to-day activities – signal timing, maintenance, and response to local traffic conditions and events. The IEN server supports interagency coordination and joint signal operations – coordination across jurisdictional boundaries, exchange of local traffic data, and joint response to traffic conditions and events that affect more than one jurisdiction. It permits the arterials of regional significance to be monitored and managed as a single entity (as Caltrans does with the freeway system). Multiagency, cross-corridor data exchange is supported permitting a countywide response to traffic conditions and major events. The physical elements of the architecture are ATMSs, which are physically located at the Local Control Center (LCC). It consists of a Command Data Interface (CDI), which support interfaces between the ATMS and the IEN server, IEN workstations to display shared data.

These components are connected via a communications network known as the IEN. The deployment of the IEN was initially achieved as part of the East San Gabriel Valley (ESGV) Pilot Project. The initial application of this structure in the Gateway Cities area is being done under the auspices of the I-105 and I-5 Corridor Projects, which have jurisdictions in common with the Atlantic Boulevard/I-710 Project.

The County has designed and is in process of installing fiber, wireless, and twisted-wire-pair (TWP) for communicating data from field devices to the agencies and County TMC. Depending on agency level (described above), the data from field devices are either brought back to a central location at each agency, and then via a T1 line or fiber, it is sent to the IEN sever located at the County or directly sent to the County ATMS.

Through the I-5 and I-105 Corridor Projects, a video distribution system has been designed and is being implemented. This includes a video server at each city with installed cameras. The servers in each project’s region are connected to each other, either through agency-owned wireless or fiber links, where available, or through leased T-1 lines, where needed. Agency video viewing will be available through the Internet either via their fiber/wireless connections or leased T-1 lines.
The County operates a TMC at DPW’s Headquarters, located in Alhambra, California (Figure 2.35). The following figure shows the video wall and workstation at the County TMC. Once IEN and ATMS system implementation is completed, staff will receive immediate notification of signal malfunctions resulting in more efficient maintenance responses. Using roadway sensors and CCTV cameras to monitor traffic conditions, staff will be able to better manage congestion caused by incidents and special events. In addition, the County will be able to synchronize signals across several jurisdictions to reduce congestion and delays. Figure 2.36 presents the LA County DPW ITS equipment. Figure 2.36 shows that the southern one-half of the Gateway Cities study area is not extensively served by the LA County DPW ITS equipment.

Figure 2.35  LACDPW TMC
Figure 2.36 LA County DPW ITS Equipment

Source: Los Angeles County Department of Public Works, November 2011.
Other ITS Data, Equipment, and Systems

California Highway Patrol (CHP)

The CHP operates a CAD system that provides automated dispatching and incident management capabilities for CHP communications operators. Incident reports are received from CHP officers in the field, from Caltrans personnel, from other public agencies, and from the public, and logged into CAD by CHP communications operators. The traveling public most commonly reports incidents using a cell phone to call the 911 emergency telephone number, or using a call-box located on the side of the highway. If the CHP 911 operator/dispatcher receives a call concerning an incident not on a CHP-patrolled roadway, the call is forwarded to the appropriate local fire, police, or sheriff.

Both CHP and Caltrans personnel at the Caltrans District 7 TMC have direct access to the CAD incident database. A subset of the information is also made available on the CHP’s traffic incident information web site (http://cad.chp.ca.gov/). This information can be extracted from the webpage for use by other organizations or traveler information web sites. Figure 2.37 presents a sample view from the CHP CAD system.

Figure 2.37  CHP CAD Traffic Incident Information


Cities

The Cities of Los Angeles and Long Beach each operate a traffic signal management system. This system is used to monitor the status of traffic signals (e.g., current color displayed by each phase, current signal timing pattern and mode, and any alarms or faults being reported). The signal management system is also used to issue pattern change commands to the signals on the field; upload and download signal timings; and collect volume and occupancy data from suitable vehicle detectors. The City of Los Angeles uses traffic signal
management software called Automated Traffic Surveillance and Control (ATSAC). The two cities maintain the traffic signals on Port property. Long Beach traffic management personnel also control the timing of the Port of Long Beach signals. Signals on Caltrans highways in the area are maintained by the respective city agencies under agreements.

Separate from the traffic signal systems, each city also operates CCTV cameras at some major intersections. The live video feed is transmitted from the camera to the Long Beach TMC or Los Angeles ATSAC for remote monitoring of traffic conditions. Los Angeles also operates some changeable message signs.

Other cities in the study area that have TMCs or ITS equipment include Downey, Santa Fe Springs, Southgate, Commerce, and Norwalk. For instance, Figure 2.38 presents the Adaptive Traffic Control System (ATCS) developed in conjunction with the redevelopment of the Douglas Park site located in Long Beach.

**Figure 2.38 Douglas Park ATCS**

Source: Metro, Institute of Transportation Engineers (ITE) Conference Presentation, Taking Los Angeles County Forward – Transportation Initiatives and Innovations, March 2012.
Private Sector

The private sector is currently an important source of general traffic data in the Los Angeles area. Companies such as SigAlert (shown in Figure 2.39), [http://www.sigalert.com/map.asp?region=Los+Angeles#lat=33.98417&lon=-118.22335&z=2](http://www.sigalert.com/map.asp?region=Los+Angeles#lat=33.98417&lon=-118.22335&z=2), which provides both general and customized traveler information; and TrafficLand [http://trafficland.com/city/LAX/index.html](http://trafficland.com/city/LAX/index.html), which posts roadway camera feeds on the web (shown in Figure 2.40) are well-established vendors in the Los Angeles traveler information market, and serve both individual customers and other commercial vendors. TrafficLand, for example, provides camera feeds for the LA SAFE’s 511 system. Traffic information is provided through a variety of web sites and media outlets in the region. One site has been identified that provides camera feeds of some of the Port entry gates, LA Trucker [http://latrucker.com/](http://latrucker.com/), as shown in Figure 2.41. The authors of this report were unable to contact the developers of this system after repeated attempts. However, we did discover the following LATrucker facebook page: [https://www.facebook.com/pages/LATruckercom/128368293904787?sk=wall](https://www.facebook.com/pages/LATruckercom/128368293904787?sk=wall).

Figure 2.39  SigAlert Web Site

![SigAlert Web Site](http://www.sigalert.com/map.asp?region=Los+Angeles%23lat=33.98417&lon=-118.22335&z=2#lat=33.87374&lon=-118.24687&z=1, accessed February 2, 2012.)
Figure 2.40  TrafficLand Web Site

On the wall of the LA Trucker site, the system’s developer notes that, in the future, mobile applications will be available on iPhones, Androids, and Blackberry.

Early project stakeholder input indicated that Google maps are used by dispatchers and truckers for routing decisions. More recently, smart phone applications have been proliferating as well.

Activities conducted by private sector vendors include:

- Collection of data on roadway conditions and/or travel times;
- Processing of data for public use; and
- Dissemination of data through web sites, media outlets, mobile devices, or other means.
There are a number of vendors in the market who specialize in one area, while others are vertically-integrated--collecting, processing, and disseminating their own data. As part of the project, a Vendor Showcase was held in January 2012 for vendors to highlight services oriented toward the commercial vehicle market, as well as those supporting project goals in the study area. A second Vendor Showcase is scheduled for early April 2012. An in-depth review of these Vendor Showcases is available upon request, and is summarized below.

The focus of the Vendor Showcases, and the project in general, is the provision of traveler information to commercial vehicles, and improved management of commercial vehicle traffic in the Ports area and Gateway Cities subregion. It is clear that this is a time of great change and opportunity in the private sector traveler information market. Private sector participation in the traveler information market has traditionally been dominated by commercial radio and television, with subsidization through advertising. Media reports tend to focus on real-time conditions on major highways, along with reporting of incidents and construction activity. Radio and television are still the largest private providers of traffic information but their methods of data collection and processing have changed significantly, and the market has become increasingly competitive and diverse. There are different business models being tested, some supported by advertising and others seeking to obtain revenue directly from consumers of the information. There is clearly an interest among the private sector in providing specialized traveler information to the freight industry. The value of time for freight shippers is greater and significantly more tangible than for the general motoring public. As a result, vendors view this market as having significant potential for paid subscription services. While divisions are somewhat arbitrary and lines blurred, three categories of private sector traveler information providers can be identified at this time:

- Companies such as Inrix, Navteq, and Google are focusing heavily on the collection of travel time and road condition data, using probe vehicles and data obtained from public sector ATMS. Probe data allows wider geographic coverage of speed and travel time information, particularly in rural and exurban areas where the deployment of ITS equipment is prohibitive. Collecting and disseminating this information on a nationwide basis requires significant resources and thus attracts larger companies. These organizations, however, use smaller businesses to help process and disseminate the data through various channels. As mentioned earlier, freight-related traveler information is seen as a potential consumer market, particularly if accurate predictive information can be provided (i.e., what is my projected travel time from current location to destination based on historical data and current conditions?). Inrix, for example, is developing a product targeted to the freight market that combines dynamic route travel times with information on truck restrictions.
There are a number of companies that focus on the processing or dissemination of data. Media companies fall into this category, as well as many smaller companies that are disseminating data over the web or through smartphone applications. Media companies now rely more on other businesses for their information, including large companies such as Inrix or Navteq, as well as smaller companies. In areas where public agencies are opening their databases to these developers, there is a proliferation of information now available. One of the challenges for consumers of information, including the freight industry, is to judge the quality and reliability of this information. As the market evolves, it is likely that large amounts of free information will be available on the web or through smartphone applications, while more expensive subscription services will enter the market promising a higher level of quality and reliability. In either case, growth in private sector opportunities to serve the freight traveler information market is likely to continue.

A third set of vendors including navigation companies such as TomTom and Garmin, who see an opportunity to vertically integrate data collection, processing/predictive capability and delivery directly to the freight market. With most long-distance carriers and many short-haul carriers already owning in-vehicle navigation devices (and more to come in the future as the truck fleets modernize), these companies can obtain probe directly, process it to provide real-time and/or predictive capabilities, and deliver it back to the vehicle. There is the potential to enhance their products by using the resources of firms more focused on data collection and processing. These companies are well-positioned to provide specialized traveler information to the freight market, although the financial viability of subscription services is still in question. It should be noted that the evolution of smartphones is providing a similar capability to that of in-vehicle navigation devices.

The three markets identified above are certainly overlapping as larger firms expand into all three areas. They are also very fluid and other areas are likely to emerge. There will continue to be a combination of large and small firms in the market.

Another Vendor Showcase is being planned in which additional vendors will present their services and products. At this point, it is clear that the private sector is offering an increasing array of services in the traffic data and traveler information arena. While many of these services are reliant on public agency sources of information, vendors are increasingly providing real-time traffic data, oriented toward the freight market, using their own resources. There is clearly a system management role for the public sector. Deployment of field equipment, which can also help supply the private market, will continue. The next phase of product development will include more offerings tailored to the commercial vehicle market, with more complete databases on truck restrictions, real-time truck parking availability, trucker services, arterial travel conditions, and
importantly, the ability to predict short-term traffic conditions and provide optimal routing based on these predictions. It is critical that public agencies involved in transportation management stay abreast of these developments, as private vendors have the potential to serve many of the identified needs. This will enable public sector agencies to concentrate their scarce resources on other essential activities such as system and incident management.

**I-710 EIR/EIS Planned ITS Infrastructure and System Improvements**

I-710 Corridor serves as the major freeway route for trucks to and from the POLB and the POLA. The Corridor provides direct access to the Ports area from the north, and also serves as the final leg for traffic accessing the Ports area from several other major freeways, including I-405, SR 91, I-105 and I-10. A number of key arterial roads provide connections to intermodal yards north of the Ports; I-710 serves as the major connector to these facilities as well. Growth in the Ports’ traffic has rendered the current six-lane and eight-lane I-710 freeway inadequate to service the needs of the Ports and the community. Over the past six years, Metro, Caltrans, Gateway Cities COG, and the Ports, along with other local agencies, have been evaluating improvement proposals for the I-710 Corridor. Efforts were initiated in 2005 with a Major Corridor Study that has advanced to the EIR/EIS stage in 2008 (to be finalized in 2013).

The I-710 Alternatives Screening Analysis Final Report summarized the background conditions in the corridor in 2009: “Currently, the POLA/POLB complex is the fifth largest container port in the world with projections showing a substantial increase in the volume of port activity within the I-710 study area over the next 25 years. As a result of current port activity levels, a high volume of Heavy-Duty Truck (HDT) traffic has been traveling along the freeway, which was built prior to the containerization of oceangoing freight. Presently, on certain freeway segments within the City of Long Beach (between Ocean Boulevard and 9th Street), HDTs make up over 30 percent of the traffic stream during the day, as opposed to an average daily truck percentage of 6 to 13 percent on comparable freeways within Los Angeles County. In conjunction with a large growth in population and employment along the I-710 Corridor, these HDT volumes have strained the facility’s capacity, rendering it unable to accommodate current or future traffic demands. The congestion problem is compounded by the freeway’s outdated design and the potential for accidents created by the commingling of HDTs and passenger vehicles.”

The project study area is shown in Figure 2.42 and includes I-710 from SR 60 in East Los Angeles south to the Port of Long Beach, including a two- to three-mile swath on either side of the freeway.

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The specific assumptions related to growth in the corridor were documented in the Screening Report:

- Population growth in the corridor from 1.2 million in 2009 to 1.4 million in 2035;
- Employment growth in the corridor from 503,000 in 2009 to 537,000 in 2035; and
- Goods movement growth in the corridor from 16.0 million TEUs in 2009 to between 28.5 million to 42.7 million TEUs in 2035.³

Through the Major Corridor Study Process, a locally preferred alternative was developed that included expansion of the existing highway from six or eight- to ten lanes, and construction of four additional separated freight lanes for exclusive use by trucks. The placement of the entrances and exits along the separated freight right-of-way is designed to serve use between the intermodal yards and the Ports, as well as to provide movement to and from I-710 from other major freeways and to destinations beyond the I-710 study area. The locally preferred option, identified as Alternative 6, was taken forward into the EIR/EIS stage and subdivided into several additional alternatives. The additional alternatives were developed to take advantage of new and emerging technologies that can enhance the environmental benefits of the project and increase the capacity of the freight lanes to meet future demand. Chapter 5 of this report delves into greater detail on the potential use of advanced technologies to increase the capacity of the freight right-of-way, and by doing so mitigate the impacts of truck traffic on the general freeway lanes, surface streets the Gateway Cities communities. The technologies discussed include:

- Platooning technology to reduce vehicle headways, and provide much greater throughput on the lanes;
- Zero-emission vehicles which will improve air quality in the corridor; and
- Tolling strategies that can be used to fund the project and to provide incentives for other beneficial behavior, including use of zero-emission vehicles and spreading of peak demand.

Figure 2.43 shows the various sub-options under Alternative 6.

³ Ibid.
Figure 2.42  I-710 Project Study Corridor

The research documentation in Chapter 5 focuses on components of the proposed alternatives for the proposed freight corridor for Alternatives 6B and 6C including platooning and tolls. While these technologies have not yet been applied to a specific application like the proposed freight corridor, significant advances are being made on similar projects utilizing these technologies in the U.S., Europe, Asia, and Australia. Given the long lead-time for the project and the rapid advancement of technology, it is likely that these technologies will be greatly advanced by the time the freight corridor is built.

Preliminary utility design work is currently underway on the expansion of the general lanes and the construction of the freight lanes for the I-710 Corridor. The current design effort includes incorporation of ITS technologies and incident management systems, including detection, CCTV, CMS, and infrastructure that can be used for tolling. A set of ITS technology questions are being addressed by the I-710 design team. The consultant team for this ITS project is coordinating with the I-710 utility design teams that are also advancing the structural designs for the freight corridor. Specifically, this ITS project is sharing the results of research into platooning and helping the design teams with sketch-level...
planning concepts of traditional ITS automation and tolling systems that would need to be built into the I-710 infrastructure. This would also include electrification of the freight corridor. It is noted in this report simply as a data point that these two projects are coordinating.

**Key Arterial Corridors of Significance for Goods Movement**

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 traffic (ADT) volumes and p.m. period volume-to-capacity (V/C) ratios for local arterial roadway segments within the corridor. There were 179 separate local arterial roadway segments analyzed within the study area. Heavy-duty Port trucks and non-Port trucks ADT were estimated for the arterial roadways, separated into north-south and east-west. Approximately one-third of the roadway segments currently experience V/C ratios approaching (0.90 ≤ V/C <1.0) or exceeding (V/C ≥1.0) capacity. By 2035, this is estimated to be approximately forty percent. The congested arterial segments with existing or future Port-related truck traffic are highlighted in Figure 2.42 and include:

- **North-south arterial roadway segments:**
  - Wilmington Avenue from Willow Street to I-405;
  - Alameda Street from Pacific Coast Highway to I-405 and from I-105 to Firestone Boulevard;
  - Santa Fe Boulevard from Carson Street to Del Amo Boulevard;
  - Long Beach Boulevard from Del Amo Boulevard to Alondra Boulevard and from Imperial Highway to Firestone Boulevard;
  - Atlantic Avenue between Florence Avenue and Washington Avenue and from Artesia Boulevard to Alondra Boulevard;
  - Eastern Avenue between Florence Avenue and Washington Boulevard;
  - Cherry Avenue between I-105 and Imperial Highway and I-405 to Carson Street;
  - Garfield Avenue from Florence Avenue to Washington Boulevard; and
  - Paramount Boulevard from Rosecrans Avenue to I-105 and from Florence Avenue to Whittier Boulevard.

- **East-west roadways segments:**
  - Anaheim Street west of Alameda Street and from Santa Fe Avenue to I-710;
  - Pacific Coast Highway west of I-710 to west of Alameda Street and between Atlantic Avenue and Cherry Avenue;
  - Willow Street between Atlantic Avenue and Cherry Avenue;
- Wardlow Road between Alameda Street and Atlantic Avenue;
- Del Amo Boulevard west of I-710 to west of Alameda Street and between Cherry Avenue and Paramount Boulevard;
- Alondra Boulevard between Atlantic Avenue and Paramount Boulevard;
- Rosecrans Avenue between Alameda Street and Long Beach Boulevard and between Atlantic Ave and Paramount Boulevard;
- Imperial Highway between Garfield/Cherry Avenue and Atlantic Avenue;
- Firestone Boulevard between Garfield/Cherry Avenue and Atlantic Avenue;
- Florence Boulevard between Garfield Avenue and Eastern Avenue;
- Slauson Avenue west of Alameda Street to Atlantic Avenue;
- Bandini Boulevard west of Alameda Street and between Soto Street and the I-710 interchange; and
- Washington Boulevard between Atlantic and the I-710 and between Garfield Avenue and Paramount Boulevard.

These could be considered the key arterial corridors of significance for goods movement with prioritization towards the higher Port truck volume segments. These arterial highways will be studied along with the rest of the arterial highways in the Gateway Cities as part of Gateway Cities Strategic Transportation Plan to develop a comprehensive plan to improve all arterial highways.

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Figure 2.44  Key Arterials of Significance for Goods Movement
# Table 2.5  I-710 EIR/EIS North-South Daily Arterial Truck Volumes and PM Peak V/C

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Table 2.5  I-710 EIR/EIS North-South Daily Arterial Truck Volumes and PM Peak V/C (continued)

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Source: Draft I-710 Corridor Project EIR/EIS, November 2011.
### Table 2.6 I-710 EIR/EIS East-West Daily Arterial Truck Volumes and PM Peak V/C

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</tr>
<tr>
<td>Santa Fe Blvd</td>
<td>I-710</td>
<td>0 0</td>
<td>0 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-710</td>
<td>Atlantic Ave</td>
<td>0 100</td>
<td>0 200</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atlantic Ave</td>
<td>Cherry Ave</td>
<td>100 1100</td>
<td>300 1200</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Table 2.6  I-710 EIR/EIS East-West Daily Arterial Truck Volumes and PM Peak V/C (continued)

<table>
<thead>
<tr>
<th>Arterial From</th>
<th>To</th>
<th>Roadway V/C</th>
<th>Port</th>
<th>Non-Port</th>
<th>Roadway V/C</th>
<th>Port</th>
<th>Non-Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacific Coast Hwy</td>
<td>West of Alameda St</td>
<td>500</td>
<td>1400</td>
<td></td>
<td>2600</td>
<td>1500</td>
<td></td>
</tr>
<tr>
<td>Alameda St</td>
<td>Santa Fe Blvd</td>
<td>5000</td>
<td>2300</td>
<td></td>
<td>13200</td>
<td>2400</td>
<td></td>
</tr>
<tr>
<td>Santa Fe Blvd</td>
<td>I-710</td>
<td>4900</td>
<td>2700</td>
<td></td>
<td>12700</td>
<td>2900</td>
<td></td>
</tr>
<tr>
<td>I-710</td>
<td>Atlantic Ave</td>
<td>400</td>
<td>1300</td>
<td></td>
<td>1400</td>
<td>1500</td>
<td></td>
</tr>
<tr>
<td>Atlantic Ave</td>
<td>Cherry Ave</td>
<td>400</td>
<td>1700</td>
<td></td>
<td>1400</td>
<td>1900</td>
<td></td>
</tr>
<tr>
<td>Anaheim St</td>
<td>West of Alameda St</td>
<td>1900</td>
<td>1100</td>
<td></td>
<td>2800</td>
<td>1100</td>
<td></td>
</tr>
<tr>
<td>Alameda St</td>
<td>Santa Fe Blvd</td>
<td>5500</td>
<td>1800</td>
<td></td>
<td>7300</td>
<td>2000</td>
<td></td>
</tr>
<tr>
<td>Santa Fe Blvd</td>
<td>I-710</td>
<td>5900</td>
<td>1900</td>
<td></td>
<td>9800</td>
<td>2100</td>
<td></td>
</tr>
<tr>
<td>I-710</td>
<td>Atlantic Ave</td>
<td>600</td>
<td>1100</td>
<td></td>
<td>2100</td>
<td>1200</td>
<td></td>
</tr>
<tr>
<td>Atlantic Ave</td>
<td>Cherry Ave</td>
<td>400</td>
<td>800</td>
<td></td>
<td>1300</td>
<td>1000</td>
<td></td>
</tr>
</tbody>
</table>

Source: Draft I-710 Corridor Project EIR/EIS, November 2011.

2.3 **KEY ITS TRAFFIC DATA SUMMARY**

The following table summarizes the key traffic-related data available for the Ports area and the Gateway Cities subregion.
### Table 2.8  Traffic Data Summary

<table>
<thead>
<tr>
<th>Data</th>
<th>Source</th>
<th>Format</th>
<th>How Processed</th>
<th>Facility Coverage</th>
<th>How Used</th>
<th>Modes</th>
<th>Who Shared/Communicated With</th>
<th>Stored/Archived</th>
<th>Notes/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freeway volumes</td>
<td>Detectors (loops, Sensys and RTMS)</td>
<td>30-second aggregate, 24x7</td>
<td>Raw</td>
<td>Moderate coverage on freeway facilities, mixed flow and HOV</td>
<td>ATMS, Travel times</td>
<td>Vehs</td>
<td>RIITS, PeMS</td>
<td>Short-term 30-second, 5-minute, and 15-minute intervals (approx 7 years)</td>
<td>Traffic classification not available. Data integrity and quality checks regularly.</td>
</tr>
<tr>
<td>Freeway speeds</td>
<td>Detectors (loops and sensors)</td>
<td>30-second aggregate, 24x7</td>
<td>Normalization for speed calculation using volume and occupancy using assumed vehicle length</td>
<td>Moderate coverage on freeway facilities, mixed flow and HOV</td>
<td>ATMS, Travel times</td>
<td>Vehs</td>
<td>RIITS, PeMS</td>
<td>Once per minute</td>
<td></td>
</tr>
<tr>
<td>Incidents</td>
<td>CHP CAD Caltrans D7 TMC</td>
<td>Continuous, refreshed every 60 seconds</td>
<td>Automatically via CHP CAD interface</td>
<td>State freeways and highways, unincorporated county roadways</td>
<td>ATMS, Incident management</td>
<td>RIITS</td>
<td>Confirmed incidents stored in ATMS (approx 7 years)</td>
<td>CCTV inventory data is updated once per day</td>
<td>Caltrans logs incident information in ATMS</td>
</tr>
<tr>
<td>Ramp metering</td>
<td>Detectors (loops)</td>
<td>Once per minute aggregate, 24x7</td>
<td>Raw</td>
<td>Moderate coverage on freeway facilities</td>
<td>By TMC to control congestion</td>
<td>Vehs</td>
<td>RIITS, PeMS</td>
<td>Once per minute</td>
<td>Includes inventory and real-time data.</td>
</tr>
<tr>
<td>CCTV</td>
<td>CCTV Cameras</td>
<td>Video</td>
<td></td>
<td>Moderate coverage on freeway facilities and HOV</td>
<td>ATD7 TMC for monitoring purposes and public web sites</td>
<td>RIITS, MATIS 511, POLB ATMIS, PeMS, media</td>
<td>CCTV inventory data is collected once per day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CMS</td>
<td>Caltrans D7 CMSs</td>
<td>Once per minute</td>
<td>Raw</td>
<td>Moderate coverage on freeway facilities and HOV</td>
<td>Traveler information (travel time, incident, alerts, construction, etc.)</td>
<td>RIITS, MATIS 511, PeMS</td>
<td>CMS inventory is collected once per day.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LCS</td>
<td>Caltrans D7 and HQ</td>
<td>Manually</td>
<td>Coverage on freeway and HOV</td>
<td>Traveler information</td>
<td>RIITS, MATIS 511, PeMS, media (daily bulletins)</td>
<td></td>
<td>Caltrans has bimonthly forum with traffic reporters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RIITS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Gateway Cities Technology Plan for Goods Movement

<table>
<thead>
<tr>
<th>Data</th>
<th>Source</th>
<th>Format</th>
<th>How Processed</th>
<th>Facility Coverage</th>
<th>How Used</th>
<th>Modes</th>
<th>Who Shared/Communicated With</th>
<th>Stored/Archived</th>
<th>Notes/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freeway volumes</td>
<td>Caltrans detectors (loops, Sensys and RTMS)</td>
<td>30 second aggregate, 24x7</td>
<td>Raw</td>
<td>Moderate coverage on freeway facilities, mixed flow and HOV</td>
<td>Data sharing, RIITS map for information dissemination</td>
<td>Vehicles</td>
<td>Public agencies and Internet Service Providers (ISP)</td>
<td>ADMS under development</td>
<td></td>
</tr>
<tr>
<td>Freeway speeds</td>
<td>Caltrans detectors (loops and sensors)</td>
<td>30 second aggregate, 24x7</td>
<td>Normalization for speed calculation using volume and occupancy using assumed vehicle length</td>
<td>Moderate coverage on freeway facilities, mixed flow and HOV</td>
<td>Data sharing, RIITS map for information dissemination</td>
<td>Vehicles</td>
<td>Public agencies and ISP</td>
<td>ADMS under development</td>
<td></td>
</tr>
<tr>
<td>Incidents</td>
<td>CHP CAD Caltrans D7 TMC</td>
<td>Continuous, refreshed every 60 seconds</td>
<td>Automatically via CHP CAD interface.</td>
<td>State freeways and highways, unincorporated county roads</td>
<td>Data sharing, RIITS map for information dissemination</td>
<td>Public agencies and ISP</td>
<td>ADMS under development</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ramp metering</td>
<td>Caltrans detectors (loops)</td>
<td>Once per minute aggregate, 24x7</td>
<td>Raw</td>
<td>Moderate coverage on freeway facilities</td>
<td>Data sharing, RIITS map for information dissemination</td>
<td>Vehicles</td>
<td>Public agencies and ISP</td>
<td>ADMS under development</td>
<td></td>
</tr>
<tr>
<td>CCTV</td>
<td>CCTV Cameras</td>
<td>Video</td>
<td>Moderate coverage on freeway facilities and HOV</td>
<td>Data sharing, RIITS map for information dissemination</td>
<td>Public agencies and ISP</td>
<td>ADMS under development</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CMS</td>
<td>D7 CMSs</td>
<td>Once per minute</td>
<td>Raw</td>
<td>Moderate coverage on freeway facilities and HOV</td>
<td>Data sharing, RIITS map for information dissemination</td>
<td>Public agencies and ISP</td>
<td>ADMS under development</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lane closure information</td>
<td>LCS</td>
<td>Automatically</td>
<td>Coverage on freeway and HOV</td>
<td>Data sharing, RIITS map for information dissemination</td>
<td>Public agencies and ISP</td>
<td>ADMS under development</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bus location and status</td>
<td>Long Beach Transit and Foothill Transit</td>
<td></td>
<td>Data sharing</td>
<td>Transit</td>
<td>Public agencies and ISP</td>
<td>ADMS under development</td>
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<td></td>
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</tr>
</tbody>
</table>

Cambridge Systematics, Inc.
## Gateway Cities Technology Plan for Goods Movement

### Data Source, Format, How Processed

<table>
<thead>
<tr>
<th>Data</th>
<th>Source</th>
<th>Format</th>
<th>How Processed</th>
<th>Facility Coverage</th>
<th>How Used</th>
<th>Modes</th>
<th>Who Shared/Communicated With</th>
<th>Stored/Archived</th>
<th>Notes/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial speeds</td>
<td>LADOT ATSAC detectors</td>
<td>Second by second, updated on site every 4-8 minutes</td>
<td>Automatic</td>
<td>Moderate coverage for LADOT arterials</td>
<td>Data sharing, RIITS map for information dissemination</td>
<td>Vehicles</td>
<td>Public agencies and ISP</td>
<td>ADMS under development</td>
<td></td>
</tr>
</tbody>
</table>

#### POLB ATMIS

<p>| Freeway and arterial volumes | Caltrans/RIITS and ATMIS detectors (loops and sensors) | 30 second aggregate, 24x7 | Raw | Moderate coverage on freeway facilities, and POLB/POLA arterials | ATMIS traveler information and data sharing | Vehicles | RIITS, PeMS, IEN, truck industry | Short-term 30-second, 5-minute, and 15-minute intervals (approx 13 months) |
|-------------------------------|------------------------------------------------------|---------------------------|-----|---------------------------------------------------------------|---------------------------------------------|-----------|-------------------------------|------------------|-------------------|
| Freeway and arterial speeds   | Caltrans/RIITS and ATMIS detectors (loops and sensors) | 30 second aggregate, 24x7 | Raw | Moderate coverage on freeway facilities, and POLB/POLA arterials | ATMIS traveler information, web, and data sharing | Vehicles | RIITS, PeMS, IEN, truck industry | Short-term 30-second, 5-minute, and 15-minute intervals (approx 13 months) |
| Travel time                  | License plate reader cameras, Caltrans/RIITS         | Automatically             | Moderate coverage on POLB/POLA arterials and surrounding freeways | Traveler information on CMS, web         | Vehicles | RIITS, PeMS, trucking industry | 13 months            |
| Origin-destination           | License plate reader cameras                         | Automatically             | Moderate on POLB arterials and 110 and I-710 | Planning purposes                      | Vehicles |                           | 13 months            |
| Incidents                    | POLB TMC/ATMIS, CHP CAD through RIITS               | Continuous                | Automatically | State highways and unincorporated county roads, moderate for POLB/POLA area arterials | Traveler information on CMS, web, e-mail notification | RIITS, PeMS, trucking industry | 13 months            |
| CCTV                         | Caltrans and ATMIS CCTV cameras                      | Automatically             | Moderate | Monitoring via web, traveler information | RIITS, trucking industry               |          |                               |                  |</p>
<table>
<thead>
<tr>
<th>Data</th>
<th>Source</th>
<th>Format</th>
<th>How Processed</th>
<th>Facility Coverage</th>
<th>How Used</th>
<th>Modes</th>
<th>Who Shared/Communicated With</th>
<th>Stored/Archived</th>
<th>Notes/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMS</td>
<td>POLB CMS, RIITS/Caltrans</td>
<td>Once per minute</td>
<td>Raw, through interface with RIITS</td>
<td>Moderate coverage on POLB/POLA arterials and surrounding freeway</td>
<td>Traveler information (travel time, incident, amber alerts, construction, etc.)</td>
<td>RIITS, PeMS, trucking industry</td>
<td>13 months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATIS 511</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freeway volumes</td>
<td>RIITS, D12, D8</td>
<td>30 second aggregate, 24X7</td>
<td>Raw</td>
<td>Moderate coverage on freeway facilities, mixed flow and HOV</td>
<td>Travel times, 511 web portal</td>
<td>Vehicles</td>
<td>Once per minute</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freeway speeds</td>
<td>RIITS, D12, D8</td>
<td>Raw</td>
<td>Moderate coverage on freeway facilities, mixed flow and HOV</td>
<td>Travel times, traffic map</td>
<td>Vehicles</td>
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<td></td>
<td></td>
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<tr>
<td>Incidents</td>
<td>511 TIC/CHP CAD</td>
<td>Continuously updated</td>
<td>Automatically via CHP CAD interface with ERS</td>
<td>State highways and unincorporated county roads</td>
<td>511 Web Portal, IVR</td>
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<tr>
<td>CCTV</td>
<td>Traffic land/Caltrans</td>
<td>Automatically</td>
<td>Moderate coverage on freeway facilities and HOV</td>
<td></td>
<td>511 Web Portal</td>
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<tr>
<td>CMS</td>
<td>RIITS</td>
<td>Once per minute</td>
<td>Raw</td>
<td>Moderate coverage on freeway facilities and HOV</td>
<td>511 Web Portal</td>
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<tr>
<td>Lane closure Information</td>
<td>511 TIC/Caltrans LCS</td>
<td>511 TIC/Automatically</td>
<td>Coverage on freeway and HOV</td>
<td>Traveler information (511 web portal, IVR)</td>
<td></td>
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</tr>
<tr>
<td>LA County DPWI/IEN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Traffic signal data</td>
<td>Controller, sensors</td>
<td>Via local ATMS</td>
<td>Extensive coverage for signals in IEN</td>
<td>Signal operations, interagency coordination, monitoring and management</td>
<td>LA DOT, other cities, RIITS (planned)</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CCTV</td>
<td>LA County and local city CCTV cameras</td>
<td>Automatically</td>
<td>Low to moderate on arterial roads</td>
<td>Monitoring</td>
<td>Local agencies</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data</td>
<td>Source</td>
<td>Format</td>
<td>How Processed</td>
<td>Facility Coverage</td>
<td>How Used</td>
<td>Modes</td>
<td>Who Shared/Communicated With</td>
<td>Stored/Archived</td>
<td>Notes/Comments</td>
</tr>
<tr>
<td>-------------------------------------------</td>
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<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Changeable Message Signs</td>
<td>Local city CMS</td>
<td>Raw</td>
<td>Low on arterial roads</td>
<td>Traveler information</td>
<td></td>
<td></td>
<td>Local agencies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road Closures</td>
<td>LA County</td>
<td></td>
<td>Unincorporated LA county roads only</td>
<td>Traveler information</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Local Cities (e.g., LADOT, City of Long Beach, etc.)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traffic signal data</td>
<td>Controller, sensors</td>
<td>Via local signal system</td>
<td>Extensive coverage for equipped signals</td>
<td>Signal operations, monitoring and management</td>
<td>LA DOT shares with RIITS, some with IEN</td>
<td></td>
<td></td>
<td></td>
<td>Level of coverage, how used, sharing, archiving depends in each city</td>
</tr>
<tr>
<td>CCTV</td>
<td>Local city CCTV</td>
<td>Automatically</td>
<td>Low to moderate on arterial roads</td>
<td>Monitoring</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Level of coverage, how used, sharing, archiving depends in each city</td>
</tr>
<tr>
<td>Changeable Message Signs</td>
<td>Local city CMS</td>
<td>Raw</td>
<td>Low on arterial roads</td>
<td>Traveler information</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Level of coverage, how used, sharing, archiving depends in each city</td>
</tr>
<tr>
<td><strong>CHP</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAD Incident Data Report</td>
<td>CHP dispatch, calls from public, Caltrans</td>
<td>Automatically</td>
<td>Freeways, other CHP-patrolled roadways</td>
<td>Dispatch, information to Caltrans operations</td>
<td>Caltrans, receives report Some information shared with public; and media through web</td>
<td></td>
<td>Yes</td>
<td>MATIS/511 picks up media feed from web and uses to help provide incident data</td>
<td></td>
</tr>
<tr>
<td>Data</td>
<td>Source</td>
<td>Format</td>
<td>How Processed</td>
<td>Facility Coverage</td>
<td>How Used</td>
<td>Modes</td>
<td>Who Shared/Communicated With</td>
<td>Stored/Archived</td>
<td>Notes/Comments</td>
</tr>
<tr>
<td>---------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>---------------------------------</td>
<td>---------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>-------------</td>
<td>-------------------------------</td>
<td>-----------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>SigAlert/total traffic network</td>
<td>Various public and private traffic data sources, including Caltrans and CHP</td>
<td>Web site and customized alerts send by text or e-mail</td>
<td>N/A</td>
<td>Freeways plus limited number of arterials</td>
<td>Displayed on web site with customized alerts offered to customers</td>
<td>Public</td>
<td></td>
<td></td>
<td>The term SigAlert originated with CHP and Caltrans, but service is now provided by private vendor</td>
</tr>
<tr>
<td>Traffic Land</td>
<td>CCTV feeds from Caltrans and other available sources</td>
<td>XML-based control system and live streaming</td>
<td>Freeways and some arterials</td>
<td>Access through web site. Will also provide direct access to commercial customers.</td>
<td>Public and media through web site. Customized feeds available</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LA Trucker</td>
<td>Port cameras</td>
<td>Some POLA and POLB roadways and terminal gates</td>
<td>Web site</td>
<td></td>
<td>Public</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inrix</td>
<td>Probe vehicle data and public sources</td>
<td>Freeways and some arterials</td>
<td>Commercial product</td>
<td></td>
<td>Sold to media, navigation companies, and public agencies</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Navteq</td>
<td>Probe vehicle data and public sources</td>
<td>Freeways and some arterials</td>
<td>Commercial product</td>
<td></td>
<td>Used for Navteq’s mapping products, sold to media, navigation companies and public agencies</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Google</td>
<td>Probe vehicle data and public sources</td>
<td>Freeways and many arterials</td>
<td>Provided to public</td>
<td></td>
<td>Public through Google maps and Google earth</td>
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</tbody>
</table>
A large number of private sector vendors are providing information on web sites. This list is therefore not exhaustive.
2.4 **TRUCK OPERATORS SURVEY**

*Note: The results from the second survey (truck operators) will not be available until April/May 2012. This document will be supplemented with the survey results when available, or delivered under a separate memo.*

A two-part survey is being used to identify traveler information needs of the trucking companies and operators who serve the POLB and POLA. One survey focuses on dispatchers and managers of trucking companies and the other on truck operators themselves. Since many truck operators work independently, it both perspectives were considered important. The surveys covered the following areas of interest:

- How dispatching and routing decisions are currently being made by both truck operators and dispatchers/managers;
- What sources of traffic information are being used to help make routing/discharging decisions;
- What technologies are being used to obtain traffic information and transmit it to others; and
- Gaps and needs in traveler information related to traffic to/from and within the POLB and POLA.

The surveyors also asked basic information about trip patterns and trucking company size to help discern any differences based on these characteristics. The results of the surveys are documented below.

**Dispatcher Survey**

A telephone survey was conducted between January 25 and February 15, 2012 with firms that have trucks travelling within the study area. Respondents represented a range of positions from executives to dispatchers. Interviews were conducted with the person most knowledgeable about the company’s fleet management practices. The overall survey findings have a margin of error of ± 6.5 percent at a 95-percent confidence level. The respondent pool consisted of all Port of Los Angeles Clean Truck Program concessionaires. A list of companies (838) was identified for participation. All potential respondents were contacted by phone and invited to participate. Multiple attempts were made to reach each potential respondent, which resulted in 235 companies participating in the survey.

The survey instrument was designed to elicit responses that would provide insight into objectives. Prior to the pretest, the survey was programmed into a Computer-Aided Telephone Interviewing (CATI) system, which enabled handling of complex skip and rotation patterns in order to minimize survey bias.
The survey consisted of 65 questions and included both open-ended and close-ended responses.

The results of the survey are summarized below, including:

- Profile of Respondents; and
- Trip Distance and Characteristics.

**Respondent Position/Title** Half of the respondents were managers, thirty percent of those surveyed own the company or held top positions such as President, Vice President, or CEO, and 16 percent were Dispatchers/Coordinators. The remaining four percent, fell into the “other” category (see survey cross-tabulations). Respondents’ titles were relatively evenly distributed among firms of different fleet and personnel sizes.

**Figure 2.45  Respondent Profile/Title (Q3)**

![Pie chart showing respondent profile/title distribution]

**Fleet Size (Q3)**

Forty percent of the companies surveyed have one to nine trucks operating out of a facility location, while 32 percent have 10 to 24 trucks operating from a facility. The remaining 28 percent run 25 or more trucks out of a facility location on a routine basis.
Drivers at Location (Q4)

There is a direct correlation between fleet size and number of truck drivers. The percentage distribution is almost identical with 41 percent under 10 drivers, 29 percent at between 10 to 24, and 30 percent with 25 or more drivers.
Distance and Trip Characteristics

Trip Distance (Q5 to Q12)

Almost two-thirds of all firms (62 percent) have average trip distances between 11 and 50 miles. Eleven percent of the firms report average trip lengths of more than 200 miles while 17 percent of trips are between 51 and 200 miles. Ten percent of companies’ trips average 10 miles or less.

Figure 2.48  Trip Distance

Freeway Access (Q10)

The top three freeways used for Port access/egress are the I-710, I-110 and SR 47/103. The most commonly used freeway for port access/egress is the I-710 with 95 percent of respondents traveling on the I-710 freeway in order to either enter or exit the port area. More than two-thirds (68 percent) of trucks use the I-110 during their trip, and 59 percent of the respondents use SR 47/103.
Figure 2.49 Freeways Used for Port Access/Egress

Note: As this is a multiple response question, combined percentages may exceed 100 percent.

Freeway usage is consistent regardless of fleet or driver size, but shows variation when trip distance is considered. Firms with an average trip distance of 10 miles or less are more likely to use SR 57/103, a local freeway. When the average trip length is less than 10 miles, less than one-quarter of firms (21 percent) includes travel on either the I-405, the I-605 or the SR 91. By comparison, firms with average trip lengths that exceed 11 miles use more of the freeway network and, while they are equally likely to use the freeways surrounding the Ports, these firms are much more likely to also travel on the I-405, the I-605, and the SR 91.

Surface Streets Use (Q11 and Q12)

Seventy-three percent of firms use key surface streets in addition to major highways in order to enter or exit the Port area. While a majority of firms use these surface streets, their use declines as the average trip distance increases. When the average trip distance is less than 50 miles, 80 percent of trips involve a surface street. This compares to 55 percent of truck trips greater than 50 miles.

Among the key surface streets used, Alameda Street/Harry Bridges Boulevard is the most commonly mentioned, with 60 percent of firms indicating their trucks travel on that road while getting in or out of the Port. Forty percent of companies also report using Anaheim Street.
Figure 2.50 Use of Key Surface Streets

![Use of Key Surface Streets Pie Chart]

- **Yes**: 73%
- **No**: 18%
- **Driver Decision**: 9%

Note: As this is a multiple response question, combined percentages may exceed 100 percent.

Figure 2.51 Key Surface Streets Used

![Surface Streets Used Bar Chart]

- **Alameda**: 60%
- **Anaheim**: 40%
- **Wilbur**: 28%
- **PCH**: 27%
- **Sepulveda**: 21%
- **H. Ford**: 21%
- **Santa Fe**: 18%
- **Figueroa**: 15%
- **Avalon**: 12%
- **Driver Decision**: 2%
- **Other**: 12%

Note: As this is a multiple response question, combined percentages may exceed 100 percent.
Routing Decisions

*Automated versus Manual Dispatch Systems (Q13 and Q15)*

The most commonly cited dispatch practice is the use of a combination of manual and automated systems (40 percent). Only 3 percent of respondents use a completely automated process, while 37 percent rely completely on manual dispatching. Twenty-one percent of firms report that drivers make the routing decisions.

**Figure 2.52  Trip Routing Systems**

Larger firms are more likely to report that drivers make routing decisions. Twenty-seven percent of firms with 25 or more drivers indicate that drivers control routing. This compares to 18 percent for firms with less than 25 drivers. A similar relationship is seen (29 percent vs. 18 percent) when comparing the number of trucks in the fleet.

Control of routing by drivers is inversely related to trip distance. For firms that have an average trip distance of 0 to 10 miles, almost one-half (46 percent) say that drivers control routing. This drops to 26 percent for firms averaging 11 to 20 miles, and then drops to 14 percent for firms that average over 20 miles.

*Automated Dispatching Systems Used*

One-quarter of the firms (26 percent) reported using an automated system that was proprietary. Trinium (12 percent) was the most frequently mentioned
commercially available system followed by Profit Tools (9 percent) and Sprint Nextel (7 percent). The remaining companies reported using “other” systems.

**Figure 2.53  Automated Dispatching Systems Used**

Note: As this is a multiple response question, combined percentages may exceed 100 percent.

**AVL and Global Positioning Systems (GPS)**

Thirty-eight percent of the companies report they rely, at least in part, on AVL or GPS/technologies for fleet management. Firms with a fleet size of 25 or more were more likely to use AVL/GPS tools than firms with a fleet size of less than 25, with more than one-half of the firms (54 percent) with a fleet size of 25 or more compared to just under one-third (32 percent) for firms with smaller fleet sizes stating they use AVL/GPS.

Among firms using AVL/GPS systems, Teletrac was the most frequently used, with 25 percent of firms having it installed in their fleets. Qualcomm (9 percent) was the second most common, followed by Sprint Nextel (8 percent), Fleetmatics (7 percent) and Garmin (7 percent).
Figure 2.54 Use of AVL/GPS Technology

Yes 38%
No 62%

Figure 2.55 AVL/GPS Technologies

Note: As this is a multiple response question, combined percentages may exceed 100 percent.
Information Sources and Use

Information sources that showed the highest usage were those that were perceived to have the most current information as it related directly to the trip and the Ports. E-Modal scored the highest (84 percent), followed by driver calls (80 percent) and direct communication with the Ports (74 percent). The least used were 511 (7 percent) and SigAlert (25 percent), indicating that dispatchers are looking for information specific to the Port and Port access routes, not information sources that cover a wide area and are oriented toward the general public. It should also be noted that dispatchers/managers are working at a fixed location and thus more likely to use web-based traveler information sources rather than those based on phone calls or messaging.

Figure 2.56 Information Sources Used

E-Modal (Q21)

Eighty-four percent of firms use the E-Modal system, making it the most frequently used information source in truck travel planning. This level of usage
is similarly high in both small firms and larger firms. However, firms that travel longer distances (more than 50 miles) are less likely to use E-Modal (71 percent) than are firms that make trips of less than 50 miles (89 percent).

**Direct Communications (Q37 and Q38)**

Direct communication from the Ports is another frequently used source of information, with almost three-quarters (74 percent) of companies reporting that they rely on direct communications with the Ports for current information. Among those who utilize direct communications other than E-Modal, the most common ways are by visiting the Ports or individual terminals web sites (82 percent), followed by directly calling the terminals or Ports (78 percent).

**Driver Calls (Q17)**

Eighty percent of respondents use driver calls as a means of gathering information for travel planning. Driver calls are more likely to be used at firms with larger fleets (85 percent) than at firms with fewer than 10 trucks (77 percent). Driver calls are most common at firms that allow routing decisions to be made by drivers (94 percent) instead of a central dispatcher (77 percent).

**Traveler Web Sites (Q23 and Q24)**

Sixty-two percent of firms use traveler information web sites. Among traveler web site users, Google is the most common at 64 percent, followed by MapQuest at 47 percent.

**Electronic Highway Signs (Q22)**

Fifty-five percent of firms use information gathered from electronic highway signs. This is particularly the case when drivers are permitted to make the routing decisions. Eighty-six percent of these firms use electronic highway signs, compared to 57 percent of firms with a manual routing system and 39 percent of firms with a combination manual and automated routing system. Not surprisingly, drivers making routing decisions while on the road would be more likely to rely on easily accessible information sources.

**Smart Phones (Q19)**

The majority of trucking firms (51 percent) use smart phones for travel planning. Smaller firms with fewer than 10 trucks (59 percent) are more likely to use smart phones than firms with 10 or more trucks (45 percent).

**Media Reports (Q33 to Q40)**

Media reports are used by a third of firms, consistently across firms of different sizes. Firms that do not use the E-Modal system are more likely to make use of media reports (59 percent) than firms that do (28 percent).
Construction Information (Q29 and Q30)
Construction information is used in travel planning by 32 percent of firms. Firms with fleets of 25 or more (46 percent) are more likely to use this information than are smaller firms (27 percent). Of the information obtained, the highest percentages come from either the E-Modal system (45 percent) or Caltrans (30 percent).

Congestion Maps (Q25 and Q26)
Thirty percent of firms use congestion maps in travel planning and these maps are more likely to be used in larger firms with at least 25 trucks (37 percent) than in firms with smaller fleets (28 percent). Google is the most commonly used congestion map system, with 66 percent of users saying that it is the map system they choose.

Closed Circuit TV (Q27 and Q28)
Closed circuit television feeds have a lower usage rate (25 percent) in travel planning. These feeds are more likely to be used by firms with more trucks (34 percent) than in firms with smaller fleets (21 percent), probably due to the larger firms being more technically advanced. Eighty-four percent of respondents who use these feeds view cameras provided by the terminals and the Ports.

SigAlert (Q20)
One-quarter of companies report using SigAlert in travel planning. Firms with a larger fleet (35 percent) are more likely to use SigAlert than are smaller firms (21 percent). In addition, companies whose trucks travel over 50 miles (35 percent) are more likely to use SigAlert than firms with trucks that travel 50 miles or less (21 percent).

511 (Q18)
The least used form of information is calling 511. Only seven percent of firms call 511 in order to get travel planning information for their truck fleets.

Other Sources (Q39 and Q40)
Of the 13 percent of respondents who referenced other sources for obtaining information, CB radios (33 percent) and e-mail/Internet (30 percent) topped the list.

Use of Information Sources for Making Operations Changes
Trucking companies rely heavily on these information sources to make daily operating decisions.
Gap Analysis

Companies were asked to identify gaps or deficiencies in the current network of information sources. Only 39 percent could identify any specific gaps or deficiencies.

Firms with routes determined by their drivers, however, were more likely than firms with other routing systems to identify gaps existing in traveler information. Fifty-three percent of firms with driver-routed trucks identified informational gaps, compared with 35 percent of firms that controlled routing in-house.
Of the firms that identified gaps or deficiencies, timeliness (63 percent), and accuracy of information (26 percent), were the most frequently cited.

Among those that indicate that the information they receive is not timely and is often out-of-date when it reaches them, many specifically mention the E-Modal system as being slow to update them, or slow to reflect current, real-time information.

Among the respondents that said that the information they receive is often not accurate, concerns range from incorrect information being sent out via E-Modal to incorrect information given out by Port Terminals either in person or on their websites. Respondents also mentioned erroneous information regarding traffic conditions on SigAlert as well as errors in television, radio and online media in reporting on road and traffic problems.

Nine percent of respondents that identified a gap indicated a need for more information to be available for specific sections of the Port. Another seven percent said there are gaps in specific types of information, such as operating conditions at the Ports as well as traffic or road conditions. Two percent criticized geographic coverage or the inconsistency among information sources. Gaps in freeway coverage, inadequate reporting at various times of day, or problems in the way information is displayed were each indicated by one percent of respondents.
Value of Information Sources (Q55 to Q64)

Respondents were asked to rate the value of nine additional information sources using a five-point scale, where 1 is least valuable and 5 is most valuable.

Note: As this is a multiple response question, combined percentages may exceed 100 percent.
The ratings were divided into three tiers using the mean rating for each information source. The top tier was composed of sources that received mean ratings greater than or equal to 3.70, the middle tier received mean ratings of 3.40 to 3.69, and the lowest tier received ratings below 3.10.

A more detailed segmentation of the importance of each information sources is shown in Figure 2.61, Value Analysis Segmentation.

**Queue Lengths** (Q61)

Information sources that have a direct impact on time have the highest overall value to respondents. Knowledge about queue lengths at the port scored the highest at 4.03. Almost three-quarters (71 percent) of the respondents, rate the value of information about queue lengths as either a four or five, where five is most valuable. Smaller firms, those with 10 or fewer trucks, gave a higher mean rating to queue length information which may be a result of having fewer information resources, thus giving smaller firms less flexibility to “fix” problems resulting from delays. Firms that reported trip distances of less than 10 miles were also more likely to assign a higher value to this information source with a mean rating of 4.58.
Real-Time Route Information (Q63)

Real-time route information between origin and destination also has a high value to respondents, with a mean rating of 3.83. Almost two-thirds (65 percent) rated the value of this information source as a 4 or 5. Respondents with longer travel distances, defined as an average of more than 50 miles, assigned a higher value to real-time route information (3.95) than did firms with trips averaging 50 miles or less (3.79). When trips averaged 10 miles or less, the mean value of real-time route information dropped to 3.54.

Freeway Travel and Bottlenecks (Q56 and Q62)

Travel times along freeway segments and information about the location of bottlenecks with travel time through the obstructed area received similar ratings at 3.74 and 3.70, respectively. Companies with 10 or fewer trucks placed a higher premium on travel times along freeway segments and information about travel bottlenecks than firms with larger fleets, which again suggests that smaller firms have fewer resources to address delays than firms with larger fleets and more drivers. Firms who rely on either manual dispatching or a combination system assigned a higher value (3.84) to freeway time information than firms use an automated dispatch system (3.33). Similar scores were observed for information on bottlenecks (3.81 compared to 3.17).
Port/Freeway Cameras and Travel Time to Port (Q55, Q58, and Q59)

Three information sources fell into tier two, additional cameras at the Port (3.67), travel times from the Port to major pick-up and delivery locations or interchanges (3.60) and additional freeway cameras (3.40). Additional cameras at the Port were perceived to be of higher value to companies making trips of 50 miles or less (3.99), compared to a mean rating of 2.85 for fleets making trips of more than 50 miles. This finding suggests that the Port dwell time is a more significant portion of the overall trip, and hence information that yields quicker passage has a greater impact on the trip.

A similar pattern was seen with the value of additional freeway cameras, with those companies making trips of less than 50 miles assigning a higher value to more freeway cameras. The value of travel times from the Port to major pick-up and delivery locations, similar to other travel time-related information sources, had a higher value for firms with smaller fleets (10 or less) and fewer drivers (10 or less).

Surface Street Travel Time and Street Cameras (Q57 and Q60)

Additional information on surface street travel times and more surface street cameras had the least value to respondents, with mean ratings of 3.09 and 2.83, respectively. This finding may suggest that the percentage of total trip time traveled on surface streets is of less significance than the distance traveled on freeways and that surface street travel provides more options to bypass unexpected delays than does freeway travel.

Eighty-four percent of firms use information from such sources as E-modal blasts, traveler information web sites and driver calls in order to make operational changes.

Firms were specifically asked about four different types of operational changes that could be made based on the information sources discussed in the previous section. Of the firms that used these information sources, 83 percent change pick-up or delivery times, and 83 percent also use the information to reroute their trucks prior to departure. A slightly smaller percentage of firms, 81 percent, use this information to reroute trucks while the trucks are on the road. Finally, 64 percent of firms use this information to change driver assignments.
Respondents were then asked if they used the information sources to make any other changes that effected operations. Ninety-three percent did not while, 7 percent of firms use the information to make changes such as determining a day’s work production or prioritizing which containers to pick up, or which terminals to visit first.

Summary of Findings

Respondents represented a range of trucking company characteristics with a mix of small, medium and large companies, and a mix of short-, medium- and long-haul businesses. Dispatchers use a variety of technologies and information sources, but rely most heavily on E-Modal, driver call-ins and Port-related websites. They are clearly more interested in Port-related information and a significant number of respondents noted gaps in this area that could be filled. Use of automation for dispatching and routing is common but a large number of respondents do not use technologies for either. Most indicated that they do act on traveler information to change routes or even assignments. When asked to identify gaps, the majority of respondents, around 60 percent, did not identify any. When asked to rank various improvements, however, most received relatively high rankings. The most desired improvements again were centered around the Port area, particularly information on Port-related queues and delays.
2.5 INITIAL GAPS/ISSUES/NEEDS AND POTENTIAL SOLUTIONS

This section contains a summary of needs identified through review of previous reports, existing information systems and sources, and interviews with stakeholders listed above in the system overviews. These needs also include issues raised during the initial testing of our survey of the traveler information needs of the drayage drivers in the region. The needs or issues and potential solutions are documented in Table 4.1, including:

- Source(s);
- Components of the Gateways Cities Technology Project that address the need;
- Context of the issue or need; and
- Potential solutions.

Needs were categorized into topical areas; and both needs and solutions are summarized briefly below.

**Arterial Systems.** Stakeholders consider improved arterial system operations and coordination in the Gateway Cities area a major priority. Systems are operated by a combination of LA County and local municipalities, with some signals also controlled by Caltrans. Fragmentation of management and control inhibits the ability to implement signal coordination strategies on major arterials. Stakeholder input was that priority routes for freight movement should be identified. Some freight traffic must use arterials so coordinated strategies related to timing and management could help to encourage use of those arterials that service key freight destinations, and discourage use of those that serve residential and commercial areas. Solutions are focused at least in part on the LA County IEN, which provides an opportunity to share arterial system data. Some municipalities that operate their own systems do not belong to IEN, and IEN is not currently linked into the RIITS system. Making these linkages is an important first step in developing and implementing arterial management strategies that can benefit the stakeholders and residents in the Ports and Gateway Cities area. While gaps in the freeway ITS system do exist, the gaps are being filled. The major concern is maintaining equipment already in place. ITS deployments including CCTV and Portable DMS are taking place on some major arterials; however, most are still lacking. Given the cost of these deployments it is not realistic to equip all major arterials in the near future. Therefore, an important need is to identify priorities for arterial deployment, along with realistic funding sources.
### Table 2.7  Data, Traffic Management, and Traveler Information Gaps/Issues/Needs Summary

<table>
<thead>
<tr>
<th>Issue/Need</th>
<th>Source</th>
<th>Context</th>
<th>Potential Solutions</th>
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</table>
| Need for LA Safe 511 to be in Spanish as well as English. (TM-1)          | Survey, LA Metro     | • The ability to provide LA Safe’s 511 in Spanish through the web, signage and IVR, is seen as a significant benefit and one which would directly benefit the commercial vehicle community.                                                                                                                                                                                                 | • Engage the operator of LA Safe 511 in an upgrade project.  
• This represents a very “low hanging fruit” and could be done quickly.  
• This upgrade could be done in coordination with the issues raised in issue 4 of this document.                                                                                   |
| Specific Applications:                                                    |                      | • Regions such as the Bay Area and San Diego currently have their systems in Spanish as well as English. Many 511 software and telephony vendors offer these capabilities as part of their core service.                                                                                                                                         |                                                                                                                                                                                                                                                  |
| Truck Info Integration                                                    |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Need for a greater detail of real-time traffic information around both ports (specifically wait times at the terminal gates). (TM-2) | HTA, PierPass, LA Metro, POLB, ACTA | • The ability to provide more freight or commercial vehicle focused information in and around the ports was seen as a very significant need by a wide range of stakeholders.  
• Although there is currently a web site with CCTV traffic camera images of each gate in the POLB and POLA (latrucker.com); the CCTV picture alone does not provide enough information to gauge wait times at the gate with any certainty.  
• The stakeholders mentioned the need for more access to real-time information about closures and incidents.  
• It should be noted that the deployment of the ATMIS system will great enhance the regions ability to generate and share this type of information. However, operational strategies are not in place to ensure that this data (specifically wait times at terminal gates) are shared with every available public and private traveler | • Add freight-related data elements to LA Safe 511 including location of diesel gas stations and repair facilities, OS/OW restrictions, allowable truck routes, detour routes and truck parking locations.  
• The ATMIS system will be able to provide wait times at all the port gates. Identify methods for making sure this information is provided to the trucking community.  
• The ATMIS system will provide its data in an XML feed to those interested. The exact type of data and format need to be resolved (for example traffic information will be shared but currently incident information will not.  
• Increase the outlets and channels from which goods movement based traveler information could be disseminated by engaging the private sector in developing mobile apps, social networking or other software applications based |
| Specific Applications:                                                    |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Truck Info Integration                                                    |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Queue Detection                                                           |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Arterial Travel Times                                                     |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Need for LA Safe 511 to be in Spanish as well as English. (TM-1)          | Survey, LA Metro     | • The ability to provide LA Safe’s 511 in Spanish through the web, signage and IVR, is seen as a significant benefit and one which would directly benefit the commercial vehicle community.                                                                                                                                                                                                 | • Engage the operator of LA Safe 511 in an upgrade project.  
• This represents a very “low hanging fruit” and could be done quickly.  
• This upgrade could be done in coordination with the issues raised in issue 4 of this document.                                                                                   |
| Specific Applications:                                                    |                      | • Regions such as the Bay Area and San Diego currently have their systems in Spanish as well as English. Many 511 software and telephony vendors offer these capabilities as part of their core service.                                                                                                                                         |                                                                                                                                                                                                                                                  |
| Truck Info Integration                                                    |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

**Cambridge Systematics, Inc.**
## Issue/Need

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<thead>
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<th>Issue/Need</th>
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<tr>
<td>There is a need to identify an ongoing operator and maintainer for ATMIS system. (TM-3)</td>
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### Source

- ATMIS

### Context

- It should be noted that 511 data are not currently exported for third party use, inhibiting the development of private information services for the goods movement industry.
- Possible development of an automated gate pass-through system for approved trucks.
- Possible development of a terminal gates queue detection system which advances that information to truckers or dispatchers approaching the ports.

### Potential Solutions

- on the information the public sector is developing.
- Implement program used in other regions such as the Bay Area in Northern California which have hosted “Innovation Challengers” where third party software developers are engaged in rapidly developing apps for traveler information use.
- Engage the larger private traveler information vendors such as TomTom, Navteq or INRIX. By partnering with them, and sharing information such as wait times at terminals generated by ATMIS, it will enhance the value and marketability of their products as well as open new markets for them.

### Specific Applications:

- Transportation Mgmt.
- Truck Info Integration

### Work in partnership with POLA/POLB to ensure the long-term sustainability and permanent operation and maintenance funding of this regionally significant goods movement-related resource.

### If a resolution is not achieved, at minimum work with other stakeholders to determine the best way to use instrumentation to determine the queues at the gates and generate the wait times.
<table>
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| Need for high quality real-time traffic condition data on major arterials used for goods movement. (TM-4) | LA County, LA Metro, Gateway Driver Survey Pretest                      | • Although some private third part data vendors such as INRIX and Google currently offer arterial traffic data in the study area, the data are not based on high quality detector data and could be considered not “real-time” enough due to latency and other issues (i.e., relying too heavily on historical samples/information).  
  • There is a need for the public sector to instrument the most important corridors for goods movement in the study region and share that high quality traffic data with LA Safe 511, RIITS, and other public and private stakeholders (INRIX, TomTom, etc.).  
  • It should be noted that jurisdictional issues pose a hurdle (i.e., coordinating along corridors which pass multiple jurisdictions). | • Using the key arterials for goods movement identified in the I-710 EIR/EIS as a baseline or truck routes allowed by each city; conduct further analysis which would provide LA Metro and GC with a prioritized list of those key goods movement corridor.  
  • Based on those priorities, develop a series of ITS detection instrumentation projects along those corridors which would provide high quality travel times and congestion information which could then be shared through XML feeds and other mechanism with public and private section traffic information providers.  
  • A pilot project could be the mechanism to prove the viability of instrumenting these corridors.  
  • It’s important to note that the detection and CCTV (Issue 7) pilot projects should be done at the same time. There is no reason to split them up. |
| Need for better signal coordination along major arterials used for goods movement. (TM-5) | LA County                                                              | • Because many of the arterial corridors identified in the I710 EIS/EIR as important for goods movement run through multiple jurisdictions; creating efficient traffic flow through coordinating signal timing and ramp meters can be a challenge. In major freight corridors traffic does not necessarily follow regular commuting patterns and is more variable. Regular signal timing can help move this traffic more efficiently and avoid the negative impacts of frequent stops and resultant idling. Some stakeholders noted that | • Using the key arterials for goods movement identified in the I-710 EIR/EIS as a baseline or otherwise identified by each city; conduct further analysis which would provide LA Metro and GC with a prioritized list of those key goods movement corridor in terms of which are the most critical for signal and ramp meter timing improvements..  
  • Based on those priorities, develop a pilot project which could demonstrate how signal/ramp meter coordination across boundaries could help with |
No TMC in the region is currently focusing on freight transportation operations or archiving goods movement-related data for performance measures. (TM-6)

**Specific Applications:**
- Transportation Mgmt.
- Truck Info Integration
- Performance Monitoring

<table>
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<td>No TMC in the region is currently focusing on freight transportation operations or archiving goods movement-related data for performance measures. (TM-6)</td>
<td>LA County, LA Metro</td>
<td>LA County has established five signal centric coordinating Forums within the County (I-170, I-105, San Gabriel, South Bay, etc.). They do discuss subregional issues including synchronization. These existing standing committees should be leveraged as part of any program designed to address these issues.</td>
<td>not only goods movement but air quality.</td>
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<td>It should be noted however, that there was strong interest in developing the systems, procedures and resources to develop a traffic operations/management program focused on goods movement.</td>
<td>This approach would obviously have to be done in coordination with the extensive and positive work LA County has done and continue to do with its IEN system.</td>
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<td>Some regional stakeholders also noted that their TMCs hours of operations may not line up with freight movement needs (i.e., they staff their TMC only during peak-hour operations). Since much of the regions freight movements occur at off peak hours, there is a need to staff some operators off peak to more closely match traditional freight and goods movement in the region.</td>
<td>A pilot project could be the mechanism to prove the viability of instrumenting these corridors, especially considering the large potential number of regional stakeholders. If the pilot is deemed successful, expand into a larger program.</td>
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<td>Identify resources and programs of current TMC operations that could be used as the basis for a regional freight-oriented traffic management program. Identify missing linkages between TMCs that if connected, could enhance such a program.</td>
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<td>LA Metro is working with USC on developing an ADMS. Options for expanding this system could be explored to include good movement centric data (truck speeds, queue times, etc.).</td>
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<td>This study’s Traffic Management and Performance Measurement tasks will begin to address this issue and propose potential solutions as an outcome of this project.</td>
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<td>Develop a permanent source to build such a center and a permanent source to fund operations and maintenance.</td>
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<td>Issue/Need</td>
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<td>Potential Solutions</td>
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| 7 | Need for additional arterial CCTV cameras on major arterials used for goods movement. (TM-7) | LA County, POLB, ACTA | - Although Caltrans maintains and widely shares its extensive CCTV system deployed on the region’s freeway system; stakeholders noted the need for additional CCTVs on major arterials used for goods movement.  
- These arterial CCTV are helpful in monitoring/managing day to day traffic on heavy freight corridors. These cameras are critical in managing freeway diversions or evacuations during major incidents or emergencies as well as providing more CCTV images on a day-to-day basis which could be shared with private and public sector traveler information outlets.  
- It should be noted that stakeholders said that many of the arterial cameras in the region are fixed (either because they are primarily used for detection or by design). | - Where CCTVs are in need of replacement deploy more fully capable (pan, tilt and zoom) cameras to enhance transportation operations as well as traveler information. It is recommended that CCTV functionality be added to the signal system coordination and arterial detection projects listed above.  
- Utilize the prioritized list of the key goods movement corridors in the region developed as part of Issue/Need TM-4 above and develop a series of new CCTV camera surveillance projects along those corridors.  
- A pilot project could be the mechanism to prove the value of additional CCTV cameras along these corridors.  
- It’s important to note that the detection (Issue 4) and CCTV pilot projects should be done at the same time. There is no reason to split them up. |
| | Specific Applications:  
Transportation Mgmt.  
Truck Info Integration  
Arterial Travel Times | | |
| 8 | Need for more coordinated incident management programs focused on goods movement in the region. (TM-8) | MTA, HTA | - Stakeholders mentioned a number of issues surrounding incident management as it relates to goods movement ranging from the lack of an overarching program to simple towing contract issues.  
- Need for more extensive coverage with “big rig” wreckers used on several freeways, including I-710.  
- Service Patrol beats have separate contracts that prevent shifting from one route to another. This could prevent “big rig” wreckers from being used. | - Negotiate, in the next round of contract negotiations, terms which allow for greater “big rig” response flexibility and if financially feasible, deployment of additional “big rig” wreckers.  
- Implement direct communications links that allow LA Metro and Caltrans to see LA SAFE dispatch activity by CHP in real time.  
- Leverage the archive system described above in Issue/Need TM-6 above to track utilization of equipment over time to help improve operations. |
| | Specific Applications:  
Transportation Mgmt.  
Truck Info Integration | | |
### Issue/Need

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<th>Potential Solutions</th>
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| Integrate ATMIS system with E-Modal and Voyager scheduling programs for port travel time and congestion information. (TM-9) | ATMIS  | where needed in a timely and effective manner.  
- MTA and therefore LA Safe 511 does not get dispatch information directly from CHP. There is sometimes a time lag until all data are reported. More timely reporting would help to speed response and recovery time, particularly for commercial vehicle incidents. It also helps MTA and CHP with strategic placement of response vehicles.  
- There is currently no coordination of FSP with Caltrans TMC, other than general support the TMC may provide around an active incident. This reduces the amount of information available to both commercial vehicle drivers and the general public since Caltrans posts electronic sign messages.  
- Finally, MTA lacks feedback to determine whether FSP is meeting needs of trucking community. | - Combine this with proposed goods movement TMC described above in Issue/Need TM-6 to possibly make such incident coordination the most efficient. |

**Specific Applications:**

- Drayage Operations

**9**
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<th>Issue/Need</th>
<th>Source</th>
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<th>Potential Solutions</th>
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<td>Concern with the funding the longer-term operations and maintenance of</td>
<td>Caltrans,</td>
<td>● Some of the ITS backbone and equipment in the region is either obsolete</td>
<td>● Stakeholders insisted that operations, maintenance, and replacement costs be considered along with any capital expenditures.</td>
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<td>these advanced technology communications systems. (TM-10)</td>
<td>POLB/ACTA</td>
<td>or reaching/beyond useful life. Maintenance and replacement funding</td>
<td>● Stakeholders wanted to explore options for other entities/sources to assist with maintenance and funding of ITS equipment and systems or look at</td>
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<td>has been increasing difficult given the current budgetary environment.</td>
<td>major capital projects as an opportunity to fund ITS improvements and replacements.</td>
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<td>● This will impact the effectiveness of any of the goods movement-</td>
<td>● A new research program should be implemented, or existing programs expanded, to follow new technologies and identify lower-cost methods and</td>
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<td></td>
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<td>oriented information and management system discussed here in this</td>
<td>equipment to carry out ITS functions. A mechanism should be put in place to integrate successful changes into existing programs. Goods movement needs</td>
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<td>report.</td>
<td>should be integrated into the program.</td>
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<td>● Develop programs to permanently and fully fund operations and maintenance costs.</td>
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**Performance Measurement.** Development of management strategies in the Gateway Cities can benefit from a structured performance management system using the large volume of traffic and speed data being collected in the region. There are a number of opportunities identified in this document for collecting more complete and higher quality information on truck volumes and traffic patterns. There are already archived databases in place or under development, Caltrans’ PeMS and Metro’s ADMS at USC, that can be used as the basis for a more extensive performance management system. Private Sector sources should also be considered.

**Incident Management.** The LA SAFE system provides wide geographic Freeway Service Patrol service on the LA freeway system, including the deployment of “big rig” tow truck routes in the Gateway Cities area. Stakeholders have identified a need to extend coverage of big rig wreckers, and provide more contractual flexibility in their deployment. Stakeholders noted that there are potential data sources that can be used to improve response and clearance time in the Gateway Cities area. Data can be mined to help improve truck positioning and better identify the delay impacts of incidents, so that the benefits and costs of different investments can be determined. Stakeholders also identified a need for feedback from the trucking community on their incident management needs. It also was noted that implementing direct communications between CHP, which dispatches the FSP, and Metro/LA SAFE, which manages it, could help to improve response and clearance time. Another important issue to be resolved is the incident management system to be installed on the proposed I-710 freight corridor.

**Traveler Information.** RIITS is providing the most comprehensive source of traveler information data on the public sector side. RIITS can serve as clearinghouse for the specialized information services required in the Gateway Cities area, but it is missing data from the arterials and the Ports. Stakeholders place high importance on information about port terminal queues and other potential delays in port area. Integration of the ATMIS and IEN data into RIITS and the 511/MATIS would be an important first step in achieving this. There also are opportunities to leverage the significant efforts being undertaken in the private sector to collect and disseminate truck-related traveler information. It appears that the private sector is increasingly capable of meeting traveler information needs, but the public sector still needs comprehensive information for management and planning purposes. Information needs identified for the freight market include general truck restrictions, oversize/overweight (OS/OW) restrictions, parking location and availability, truck volumes and travel times, support and repair facilities, and diesel stations or other fueling. The proliferation of private sector and public sector services can make comprehensive trucking information available through additional dissemination channels, such as smart phone applications and in-vehicle navigation systems, as well as 511. The mix of private sector and public sector roles in this market will depend at least in part on the ability to recover costs for premium information.
Another factor is the ability to develop a two-way system, with trucks providing data to the system, and then receiving high quality data in return. Other improvements of interest to stakeholders include Spanish language capability on the 511 system and traveler information in general, greater availability of weather information, and wider geographic coverage of roadways for long-distance truckers.

**Freeway and Drayage Management and Operations.** Stakeholders identified a need to expand ITS infrastructure on freeways, arterials, and roadways in Ports area. While some of these needs are already being addressed through deployment of ATMIS, the traffic operations and management strategy for ATMIS still needs to be determined. There also is a need to integrate ATMIS with other Advanced Traffic Management Systems (ATMS) in the area. Stakeholders also identified a need to integrate ATMIS and other port traffic information with commercial management/dispatching systems used in the trucking industry, such as EModal/Voyager. There also are integration opportunities with the next generation of the PierPass. Current technology limits these opportunities, but in the future PierPass could be integrated with traffic management systems and tolling systems, providing additional information on traffic conditions, both inside and outside the Ports. Information improvements on Port queues and terminal conditions was cited by stakeholders as another component that would help to integrate various information sources. A clear need was identified for an emergency operations and detour plans for the Port areas and the Gateway Cities subregion, along with the formation of a permanent committee with personnel representing transportation, law enforcement, port operations, emergency response, and municipal government. One of the main issues raised was regarding the condition of the Caltrans ATMS, which is by far the largest collection of ITS equipment and services in the region. Budget limitations are making it increasingly difficult to keep the current system in good repair and replace aging equipment. A Goods Movement-oriented Traffic Management Center (TMC) is seen as a method for bringing together various management and information systems that can provide a higher level of service to the trucking companies. Among the functions that could be performed by the TMC are collection and dissemination of specialized traveler information and coordination of traffic management activities between local and regional management systems including ATMIS, Caltrans freeway management systems, and County/local arterial systems. Emergency/evacuation planning is another area where the TMC could provide input, coordination, and critical support during events.

**Dynamic Route Guidance.** One of the major initiatives of private vendors in traveler information, navigation and fleet management markets is Dynamic Route Guidance. Dynamic route guidance uses origin-destination information, historical data and real-time traffic information from various sources to help provide the optimal route to destination. The freight industry necessarily places a much higher value of time on travel and is thus seen as a strong potential market for this service. There is clearly opportunity for public-private
partnerships in this area since much of the information to support this service comes from public agencies. One of the elements necessary to make dynamic route guidance more effective is the ability to forecast traffic speeds and congestion within the next hour or so. This is an important need and a major part of private sector initiatives oriented toward the freight industry.

Policy/Institutional. On the policy level, there is a need for better integration of freight concerns into planning, deployment, and management of ITS systems. Bringing the Ports’ management and terminal operators (or shippers) into this process would be helpful, but there is a challenge in that much of their information is proprietary for business reasons. Management and Quality Control of proliferating data sources is another major issue. This management role could conceivably migrate fully to the private sector, impacting the traditional role of the public sector. Another important issue is how to keep up with the rapidly changing technology in an area where the planning/design/deployment cycle can be slow. It is important for agencies to work together with research institutions to speed the evaluation and testing process for new technologies. Major advances in technology are scheduled for the I-710 Corridor. There will be major challenges in deployment, management, operations, and maintenance of these systems. Another important policy issue is enforcement, a critical function for both the viability of the goods movement industry and the safety of the public. New technologies are emerging in the enforcement area, which needs to be tracked and incorporated in coordination with enforcement policies.

2.6 INITIAL RESEARCH ON OTHER REGIONS AND PORTS

The following lists synopsis’ of initial research from other regions or ports have regarding ITS data, information, and transportation management that has been investigated or implemented to address similar issues and needs to those identified as part of this effort. It also contains information on recent Federal research in these areas. These and others will be investigated further as issues/needs are prioritized and potential solutions advanced.

1. Port of Rochester Intelligent Transportation System (ITS) Project Architecture Case Study Final Report and Concept Plan


Summary: The Genesee Transportation Council (GTC) and City of Rochester performed this study to develop an ITS Project Architecture Case Study and Concept Plan for the Port of Rochester. They recognized that the quality of life for the Genesee-Finger Lakes region is dependent on the mobility and accessibility of people and goods to employment, shopping, and other opportunities as well as increased economic development and information flows.
One way to maintain and enhance the quality of life is through improved operations of the transportation system using ITS. The Port of Rochester ITS Project Architecture focused on two areas: Traveler Information and Border Clearance. The following lists the key relevant ITS components recommended for initial consideration:

- “Smart Room” for Port Operations and ITS computer systems;
- Port ATIS web site;
- Fiber optic connections to the Regional Transportation Operations Center (RTOC);
- Multilingual variable message signs at numerous locations;
- Communication tie to NYS Thruway VMS signs;
- License plate readers;
- Connection to U.S. Customs and Border Protection/Transportation Security Administration (INSPASS biometric readers in terminal and NEXUS readers in disembarking area);
- Ports (U.S. Weather Service) water sensors in the Genesee River and weather sensors on the Terminal roof; and
- Security cameras throughout Terminal and Port area, some possibly infra-red with motion detector software.

Relevance to this Effort: Findings and recommendations from this study could be used to help identify considerations for the conceptual design. This could include ITS components as well as institutional considerations (e.g., engaging and educating stakeholders about ITS early in the process). If and when this system gets deployed, the following issues or lessons learned would be of interest:

- What were the criteria in designing a Port centric ATIS web site? What lessons learned could we ascertain from this in terms of content, design, and functionality?
- What are the lessons learned from the design, to construction and operations for the “Smart Room” TMC? What key factors led to its success? What is important for us to consider in a TMC with these types of functionality?
- What ITS components proved to be the most beneficial for goods movement in and around the port? Why?

2. Regional Intelligent Transportation System (ITS) Study for the Houston TranStar Consortium

Summary: On behalf of the Houston TranStar Consortium, the Southwest Public Safety Technology Center (SWTC) performed an inventory of the technology infrastructure and studied the potential for joint-use of the region’s ITS communications network. The study found that if planned correctly, cost-savings could result from joint-use that could be used for upgrades in equipment and facilities. A variety of prototypes were considered, with the Houston Port Authority (HPA) identified as the initial prototype interconnecting HPA’s visual surveillance capabilities along the Houston Ship Channel with their offices at Houston TranStar. Houston TranStar would provide traffic-related camera outputs to the command and control center at HPA.

Relevance to this Effort: If this prototype was deployed, the following issues or lessons learned would be of interest to this project:

- What lessons were learned regarding cooperative agreements, content, design, and functionality? Was it successful?

- Where other ITS technology components integrated into this joint-use prototype as a result? If so, which components proved to be the most beneficial for goods movement in and around the port? Why?

3. Port Authority of New York and New Jersey Truckers’ Resources


Summary: The Port Authority of New York and New Jersey web site has a site specific to the unique needs of truckers (see Figure 2.63). It includes a variety of commercial vehicle information, including truck restrictions; SeaLink, the Port Authority’s uniform truck driver identification system, and ACES, the port’s Automated Cargo Expediting System (enabling trucks to move quickly and safely through any of the marine terminals); inland transport; the Truck Replacement Program (TRP) to improve air quality/health and safety; and the Drayage Truck Registry.
Relevance to this Effort: This illustrates the limited and static type of information discovered through research. Although helpful, it provides reference material but does not include any traveler information.

4. **511NY Web Site**


**Summary:** The New York State Department of Transportation’s 511 web site contains a specific travel link page dedicated to commercial vehicles, as shown in Figure 2.64. It contains links to key commercial vehicle resource web sites; the U.S. Department of Energy’s Alternative Fueling Station Locator, links to wait times as border crossings, E-ZPass information, links to industry trade groups, links to permits and registration, maps of travel plazas and parking/rest areas, links to clearance, weight, cargo and other restrictions, truck stops, and weather and roadway conditions.
Relevance to this Effort: This site provides a good example of some of the “low hanging fruit” which could be achieved when integrating commercial vehicles into an existing 511 system. However, it does not include any IVR or “freight specific” real-time traveler information or have any queue times at the ports or borders. The following issues or lessons learned would be of interest:

- What criteria was used in designing the commercial vehicle component of this web site? What were the lessons learned in terms of content, design, functionality?
- Are there plans to expand or improve upon this information? If so, what?
- How does the E-ZPass System work? Is it effective?


Summary: As part of the U.S. DOT’s ITS Intermodal Freight Field Operational Test (FOT) Program, the Washington State Department of Transportation (DOT) entered into a partnership with public and private organizations to test and evaluate two freight traffic data ITS projects:

- **Freight ITS Congestion Management System** – This test examined a queue detection system and variable message sign on I-5 approaching the Port of Tacoma, as well as an internet-based camera system installed at three port terminal roadway approaches at the Port of Seattle to monitor gateway and access road queues.

- **Freight ITS Data Collection** – This test looked at vehicle transponders and wireless GPS devices for data collection of regional freight traffic flows.

The three Port of Seattle cameras experienced approximately 2,000 views on each camera in July of 2002. These three cameras have become an integrated component of the overall traffic management system in the greater Seattle region. Another key finding was that despite significant data analysis challenges, the use of real-time GPS and transponder data collected from trucks and state systems showed promise as a means to collect regional freight transportation data; however, further research and system tests will be needed to develop appropriate methods and tools.

Relevance to this Effort: The following issues or lessons learned would be of interest:

- What lessons were learned from the use of the GPS and transponder data collection component in terms of content, design, functionality, and institutional issues?

- Were any further technology deployments or studies performed expanding upon this field operational test? If so, what was done, and what were the lessons learned?

- Was the queue detection system effective?


Summary: Vehicle-to-Vehicle (V2V) Communications for Safety is a key component in the U.S. DOT’s V2V Communications program, and is complemented by research programs that support connectivity among vehicles and infrastructure (V2I) and among vehicles and consumer devices (V2D) to deliver safety and mobility benefits. Since 2002, the U.S. DOT has been
conducting research with automotive manufacturers in order to assess the feasibility of developing effective crash avoidance systems that utilize V2V communications. This research program will result in V2V communications capabilities that complement vehicle-based safety technologies that are currently available or under development throughout the automotive industry. The program areas include:

- Crash scenario framework;
- Interoperability;
- Benefits assessment;
- Application development;
- Driver issues;
- Vehicle-to-vehicle communication policy issues;
- Commercial vehicle operations; and
- Transit vehicle operations.

Relevance to this Effort: Commercial Vehicle Applications are of specific relevance to this effort. The key objective of one of the V2V research tracks is to ensure that unique aspects of commercial vehicles critical to the successful deployment of V2V are addressed. From this research, the following items or lessons learned would be of interest:

- How will the safety benefits from the V2V Commercial Vehicle Applications be considered for Commercial Vehicle Operations (CVO) regulatory decisions?
- How can this technology be used to support the operations and safety of the I-710 freight corridor?

7. U.S. DOT Connected Vehicle Research Applications - Vehicle-to-Infrastructure (V2I) Communications for Safety


Summary: The vision of Vehicle-to-Infrastructure (V2I) Communications is that a minimum level of infrastructure will be deployed to provide the maximum level of safety and mobility benefits for highway safety and operational efficiency nationwide. Importantly, V2I communications have the potential to resolve an additional twelve (12) percent of crash types not addressed under V2V communications. V2I Communications for Safety is a key technology in the U.S. DOT’s Connected Vehicles Program, and is complemented by the V2V communications research. While the primary goal is safety, V2I communications are also significant in improving mobility and environment by reducing delays and congestion caused by crashes, enabling wireless roadside inspections, or
helping commercial vehicle drivers identify safe areas for parking. Among the objectives of the V2I Communications for Safety research program are the development of a rigorous estimation of safety benefits and the development of a regulatory/policy guidance versus market position in support of deployment. Additionally, the research will concentrate on the key FHWA and Federal Motor Carrier Safety Administration (FMCSA) application areas of interest, including intersection safety, run-off-road prevention, speed management, and commercial vehicle enforcement and operations.

Relevance to this Effort: Several objectives of the V2I research tracks are relevant to this effort including traveler information, operations, and policy considerations. V2I research may address the following questions:

- Are there unique V2I applications for Commercial Vehicles?
- What minimum infrastructure is needed for a maximum benefit?
- How to quantify safety benefits that may be realized by deployment of V2I applications?
- How can this technology be used to support the operations and safety of the I-710 freight corridor?


Summary: The vision for the Real-Time Data Capture and Management research is the active acquisition and systematic provision of integrated, multi-source data to enhance current operational practices and transform future surface transportation systems management. Real-time data applications offer an ability to increase safety and operational efficiency. Not only does real-time data allow travelers to make informed travel decisions, but public- and private-sector data on all modes and roads can be used to transform transportation management. Real-time data also have the potential to support a range of multimodal mobility applications. Updated freight movement data assists commercial freight operators with optimizing operations. Overall, the information developed from the Real-Time Data Capture and Management research program will reveal opportunities for achieving greater efficiencies within transportation systems. Types of data that can be captured and managed include: situational safety, environmental conditions, congestion data, and cost information derived from both traditional (traffic management centers, automated vehicle location systems) and nontraditional (mobile devices, connected vehicle equipment) sources. Data can also be collected from sources that generate data on elements of the transportation system such as toll facilities, parking facilities, and transit stations.

Relevance to this Effort: The Real-Time Data Capture and Management research program is of a particular relevance to this effort as related to performance
measurement, and freeway management and operation. The following issues or questions would be of interest:

- What data is available today from both traditional and nontraditional sources? What is the quality of the data?
- How is real-time data captured and managed?
- How could probe data be integrated with traditional data sources to support traffic and freight applications?
- How can data environments support transportation applications and address technical, institutional, and standards issues surrounding the collection and dissemination of data?


Summary: The Dynamic Mobility Applications program seeks to identify, develop, and deploy applications that leverage the full potential of connected vehicles, travelers and infrastructure to enhance current operational practices and transform future surface transportation systems management. Program objectives include:

- Create applications exploiting frequently collected and rapidly disseminated multisource data drawn from connected travelers, vehicles and infrastructure;
- Develop and assess applications showing potential to improve the nature, accuracy, precision and/or speed of dynamic decision-making by both system managers and system users;
- Identify innovative forms of wireless connectivity linking travelers, vehicles and infrastructure supporting these new mobility applications; and
- Demonstrate promising applications predicted to significantly improve the capability of the transportation system to provide safe, reliable, and secure movement of goods and people.

Relevance to this Effort: The Dynamic Mobility Applications research program is of a particular relevance to this effort as it explores questions related to mobility applications research and development, in addition to evaluation and performance measures. The following issues or lessons learned would be of interest to this project:

- Are cross-modal applications effective? Which applications are best for deployment?
- What minimum infrastructure is needed for maximum benefit?
- What public sector cross-modal applications can be developed using data available today and with future data and technologies?
• Which mobility applications require public and/or private sector investments?

• What were the lessons learned from the evaluation of the performance of mobility applications to maximize system productivity and enhance mobility?


Summary: The objective of the AERIS research program is to generate and acquire environmentally-relevant real-time transportation data, and use these data to create actionable information that support and facilitate “green” transportation choices by transportation system users and operators. Employing a multimodal approach, the AERIS program works in partnership with the vehicle-to-vehicle (V2V) communications research effort to better define how connected vehicle data and applications might contribute to mitigating some of the negative environmental impacts of surface transportation. The AERIS program has six major activities focusing on research questions and projects.

Relevance to this Effort: Amidst the major operational and financial challenges accompanying the new policies to promote improved air quality in the Los Angeles basin, the AERIS research program is relevant in questions that encompass the issue of information availability as well as the feasibility of providing greater “choice” to decision-makers. The following issues or lessons learned would be of interest to this project:

• What environmentally-significant vehicle-based data is available and what is the data quality and validity?

• How can vehicle-based data be integrated with existing traffic and emissions data?

• What cross-modal public sector applications are needed and what are their benefits?

• What are the ITS applications/strategies that can effectively reduce/mitigate the negative environmental impacts of transportation?

11. U.S. DOT Integrated Corridor Management (ICM)


Summary: Integrated Corridor Management (ICM) involves the coordination of transportation management techniques among networks in a corridor that together can collectively address congestion and improve overall corridor performance. The objective of the U.S. DOT’s ICM initiative is to demonstrate how ITS technologies can efficiently and proactively manage the movement of
people and goods in major transportation corridors. The ICM initiative aims to pioneer innovative multimodal and multijurisdictional strategies – and combinations of these strategies – to help manage congestion in our nation’s busiest corridors. As part of this initiative, the U.S. DOT partnered with eight “Pioneer Sites,” selected to explore the institutional guidance, operational capabilities, ITS technology, and technical methods needed for effective ICM. In 2008, three of the Pioneer Sites (Dallas, Texas; Minneapolis, Minnesota; and San Diego, California) were selected to conduct Analysis Modeling and Simulation (AMS) of their ICM concepts. Two sites (Dallas, Texas, and San Diego, California) have been selected to demonstrate their ICM systems. These demonstrations are expected to occur in 2013 to 2014 timeframe. ICM facilitates, is complementary to and enhanced by related multidisciplinary, multijurisdictional, performance-driven initiatives, including Active Transportation and Demand Management (ATDM), Traffic Incident Management (TIM) programs, regional concepts for transportation operations (RCTO), and objectives-driven, performance-based planning for operations efforts.

Relevance to this Effort: The ICM program explores questions related to corridor management and operations (including freeways and arterials), incident management, and performance measurement. The following issues or lessons learned would be of interest to this project:

- How does ICM improve corridor mobility and reliability, and what are some of the strategies most appropriate for commercial vehicle performance?
- What strategies improve traffic management under incident operational conditions?
- What are the lessons learned from ICM that provide a long-term capability to continually improve corridor management and implementation?

12. U.S. DOT Short-Term Intermodal Research – Smart Roadside


Summary: The Smart Roadside program is a joint modal initiative between FHWA and Federal Motor Carrier Administration (FMCSA). The Smart Roadside program encompasses technology and information sharing research efforts with commercial vehicle roadside elements. The vision for the Smart Roadside is one in which commercial vehicles, motor carriers, enforcement resources, highway facilities, intermodal facilities, toll facilities, and other modes on the transportation system collect data for their own purposes and share the data seamlessly with the relevant parties, in order to improve motor carrier safety, security, operational efficiency, and freight mobility. This vision will be achieved through the application of inter-operable technologies and information sharing between in-vehicle, on-the-road, and freight facility systems. Whenever
possible, the Smart Roadside will leverage stakeholders’ current technology investments in order to augment existing programs and support new activities.

Relevance to this Effort: The Smart Roadside Program explores questions related to commercial vehicle to roadside technology, data, and information integration and sharing. The following issues or lessons learned would be of interest to this project:

- How does the Smart Roadside facilitate the safety and flow of commercial vehicle traffic?
- How does the Smart Roadside help to prevent and respond to crashes and other incidents in a timely manner?
- How does the Smart Roadside ensure timely transport of goods and help avoid freight delays that have a negative economic impact on the private sector?
- What are the findings from the Smart Roadside research related to reducing unnecessary delays for commercial vehicles, reduced energy consumption and emissions, and thus decreasing the negative regional effects related to air quality?
- How does the Smart Roadside identify key components (e.g., motor carrier, commercial vehicle, commercial driver, cargo) and communicate with commercial vehicles in real-time?
- What is the architecture for the data exchanges expected to occur at the roadside within the Smart Roadside environment towards enhancing the ability to develop a two-way system, with trucks providing data to the system, and then receiving high quality data in return?

13. U.S. DOT International Programs – Active Traffic Management: The Next Step in Congestion Management


Summary: Active Traffic Management technologies are the market-ready technologies and innovative operational approaches for managing traffic congestion within the existing infrastructure. The vision for Active Traffic Management (ATM) research is to allow transportation agencies to increase traffic flow, improve travel time reliability, and optimize available capacity throughout the transportation network. The purpose of the ATM “Planning for the congestion management scanning” study was to examine the congestion management programs, policies, and experiences of other countries that are in the planning stages, have been implemented, or are operating on freeway facilities. The scan sought information on how agencies approach highway congestion, actively manage and operate freeway facilities, and plan for and
design managed lanes at the system, corridor, and project or facility levels. It builds on two other scans that focused on travel demand management and traffic incident response. In addition, the scan assessed European experiences to determine how agencies can integrate managed lane strategies into their congestion management program, network, and corridor planning and how managed lanes fit into the development of highway improvement projects. Application of ATM in the United States provides the ability to dynamically manage congestion based on prevailing traffic conditions. Focusing on trip reliability, it maximizes the effectiveness and efficiency of the facility. It increases throughput and safety through the use of integrated systems with new technology, including the automation of dynamic deployment to optimize performance quickly and without the delay that occurs when operators must deploy operational strategies manually. This congestion management approach consists of a combination of operational strategies that, when implemented in concert, fully optimize the existing infrastructure and provide measurable benefits to the transportation network and the motoring public. These strategies include but are not limited to speed harmonization, temporary shoulder use, junction control, and dynamic signing and rerouting.

U.S. DOT is continuing research on Active Traffic and Demand Management (ATDM). The program builds upon existing research to establish an operational concept and analyze enabling technologies. The initial program efforts will focus on addressing system engineering issues and basic technology and data gaps.

Relevance to this Effort: The ATM European experience and U.S. ATDM projects and plans improve freeway management and operations, performance measurement, and traveler information. The following issues or lessons learned would be of interest to this project:

- How does ATDM improve the mobility and reliability of the freeway systems? Which ATM strategies provide the most effective results?
- How can ATDM optimize existing infrastructure during congestion?
- How can ATDM provide consistent messages to roadway users?
- How can the implementation of ATDM lead to concrete results that facilitate public and policy-maker acceptance?


Summary: The objective of this research was to develop techniques to measure the performance of automobile traffic on urban streets for a range of real-time applications. To satisfy this objective, four alternative techniques were developed for cost-effectively measuring running time, queue length, and delay, as needed for signal control, incident management, and traveler information applications. To the extent practical, each technique uses the sensor, controller, and communication infrastructure required for typical signal systems. The
findings from a review of the literature indicate that the real-time performance measurement of urban streets has many challenges associated with it, many stemming from the complex interaction between traffic flow, signal timing, and adjacent property access. Several approaches were considered with one focused on “signal-based” measurement. Techniques that follow this approach measure performance on a specified street segment by monitoring traffic flow along the segment and the signal timing status of the signalized intersection that bounds the segment. They estimate the performance of the segment with a high degree of accuracy and with a frequency suitable for responsive or adaptive signal control applications. The performance estimates can also be aggregated for traveler information and incident management applications. Travel time or travel speed is not directly measured by any of the techniques. Rather, they are estimated by combining the delay and running time measurements. Of the three wireless technologies considered for direct measurement of arterial travel time (i.e., transponders, telematics, and cell-phone tracking), transponder-based probe vehicles offers considerable promise for obtaining citywide travel time data in a cost-effective manner. Toll-tag technology costs are becoming more affordable and standardized, and the percentage of vehicles with tags is increasing, especially in large cities.

Relevance to this Effort: This study explores questions related to arterial traffic management, incident management, traveler information, and performance measurement. The following issues or lessons learned would be of interest to this project:

- How can the findings or follow-on research support real-time traffic signal control, incident management, traveler information, and system performance monitoring (including data archiving) on arterial facilities?

- Were commercial vehicles a consideration in this research? If so, how were the methods impacted and what were the performance differences, etc.?

15. U.S. DOT – Traffic Incident Management (TIM)


Summary: Congestion can be classified as either recurring or non-recurring. Recurring congestion results from normal peak-hour travel while non-recurring congestion is due to random and unpredictable incidents and events that impede the flow of traffic, such as lane blockage from construction activities, accidents, disabled vehicles, or natural phenomena. These non-recurring incidents can result in large delays that significantly contribute to the total congestion experienced by travelers. Several studies have found that traffic incidents
account for about 25 percent of total traffic congestion. Traffic incident management (TIM) consists of a planned and coordinated multidisciplinary process to detect, respond to, and clear traffic incidents so that traffic flow may be restored as safely and quickly as possible. Effective TIM reduces the duration and impacts of traffic incidents and improves the safety of motorists, crash victims, and emergency responders.

Relevance to this Effort: The following issues or lessons learned would be of interest to this project:

- How can incident data collection and archiving in the Gateway Cities study area be improved? What technologies are needed to support this?
- Are there tools or methods that can be used to help predict the impacts of incidents by time of day on traffic flow (queue lengths, delay, travel time), incident duration prediction, identify diversion routes and the impacts to those routes, etc.? What strategies would be most useful for incident management purposes, particularly on corridors and roadways with high commercial use?

2.7 Next Steps

The systems overviews and ITS equipment information in Section 2.0 will be used to further identify ITS equipment and system gaps. The information will also be used to identify opportunities to leverage existing technology in implementing innovative solutions that address freight movement and freight focused traveler information needs in the Port areas and Gateway Cities subregion. This will result in further refinement of the needs, gaps, and potential solutions matrix, coordination of potential solutions across project areas; and packaging and evaluating alternatives to address the ITS data and transportation management gaps and needs.
3.0 Drayage Operations

EXECUTIVE SUMMARY

Background and Project Need
Efficient goods movement is critical to the quality of life of Los Angeles County residents and the long-term health of local businesses. Local residents benefit from the improved air quality impacts of efficient freight operations, while businesses rely on predictable, timely delivery of products to meet regional and national demand and to improve the “bottom-line”. Truck idling and unnecessary trip legs worsen air quality and cost drayage firms more; costs are then passed on to the shipper and eventually to the consumer.

The Gateway Cities subregion, which is the largest port complex in North America, generates particularly high and growing volumes of drayage trucks. By 2035, port traffic is expected to triple at the San Pedro Bay Ports.\(^4\) The continued increase in truck trips has the potential to result in increased congestion and reduced air quality, presenting a major challenge for the region.

The long-term future of economic and public health in the region will depend on the implementation of ITS strategies and other proactive steps that support the efficient movement of drayage trucks into, out of, and within the Gateway Cities subregion. Due to continued forecasted growth in freight demand, improving productivity of drayage truck operators alone will not eliminate these negative externalities and increased costs. However, improving the flow of information through enhanced communication to drayage truck drivers and dispatchers is a critical step toward minimizing these adverse effects.

Overview of Contents in this Report
This report provides background research on the major causes of drayage operations concerns, as well as an overview of potential mitigation methods. It also draws on recent surveys, interviews, and past region-specific reports to identify drayage operations issues that are specific to the Gateway Cities region. This report provides:

\(^4\) Port of Long Beach and Port of Los Angeles.
• A summarized, high-level overview of drayage and drayage import/export processes;
• A list of key drayage issues and causes identified in National Cooperative Freight Research Program 11 (NCFRP 11);
• An overview of regional drayage issues identified through interviews, surveys, and background research; and
• Discussion of sample technologies and solutions that have been implemented elsewhere.

Key Findings
Stakeholder insight and research indicate that the primary drivers of drayage-related lost productivity include high queue times at marine terminal gates, delay within marine terminals, extra drayage trips that add no value, and truck congestion on key truck routes. Key to mitigating these impacts is the improved data and dissemination of real-time truckers’ information and other useful data, which would assist drayage truck firms in optimizing workflows. For example, better information about queue times and improved dissemination of critical data would support efficient decision-making, while improved coordination and collaboration between marine terminal operators (MTO) and drayage fleets would eliminate queuing and other terminal-related inefficiencies. Ideally, this coordination would include improved sharing of information between all critical members of the supply chain (ocean carriers, MTOs, drayage fleets, railyards, warehouses, and third-party logistics firms (3PLs)).

Next Steps
Now that the issues have been defined and potential next steps identified to help address some of these issues, the project team should use this information to move towards defining drayage ITS system needs in the region. This will involve close collaboration within the project team and with the ITS Working Group to determine which issues should be addressed, and in what way. A key next step will be coordinating with other project tasks, including Truck Parking, Truck Fleet Communications, and ITS Data and Transportation Management, to define which ITS alternatives would best address some of the main themes.

3.1 INTRODUCTION
Efficient goods movement is critical to the quality of life of Los Angeles County residents and the long-term health of local businesses. Local residents benefit from the improved air quality impacts of efficient freight operations, while businesses rely on predictable, timely delivery of products to meet regional and national demand. Truck idling and unnecessary trip legs worsen air quality and cost drayage firms more; costs that are then passed on to the shipper and eventually to the consumer.
In the Gateway Cities subregion, the largest port complex in North America generates particularly high and growing volumes of drayage trucks. By 2035, port traffic is expected to triple at the San Pedro Bay Ports. The continued increase in truck trips has the potential to result in increased congestion and reduced air quality, presenting a major challenge for the region.

The long-term future of economic and public health in the region will depend on the implementation of ITS strategies and other proactive steps that support the efficient movement of drayage trucks into, out of, and within the Gateway Cities area. Due to forecasted growth in freight demand, improving productivity of drayage truck operators alone will not eliminate these negative externalities and increased costs. However, improving the flow of information through enhanced communication to drayage truck drivers and dispatchers is a critical step toward minimizing these adverse effects.

**Purpose and Goals of this Report**

One of the subtasks of the Gateway Cities Technology Plan for Goods Movement is the improvement of drayage operations through ITS solutions. This constitutes the completion of Task 1 of the Drayage Operations subproject. Tasks 2 through 4 will address the development of a conceptual design for an integrated technology solution to improve drayage truck operations through ITS:

- **Deliverable #1, Research Memorandum: Drayage Operations Background Research Memorandum (this document).**

- **Task 2. Define Drayage System ITS Needs and Select Drayage Improvement Focus Areas**
  - Deliverable: PowerPoint presentation highlighting which technology improvements could have a significant positive impact on drayage operations in the Gateway Cities area;

- **Task 3. Development and Evaluation of Alternatives**
  - Deliverable: Technical Memorandum: Report highlighting preferred ITS alternatives for improving drayage operations; and

- **Task 4. Conceptual Design of Preferred Alternatives for Drayage ITS Improvements**
  - Deliverable: Technical Memorandum: Report highlighting the conceptual design of preferred alternatives.

This report identifies current drayage issues and concerns, and potential technology solutions to help mitigate them.

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5 Port of Long Beach and Port of Los Angeles.
The specific goals of this report include:

- Highlight what is meant by the term “drayage”, and present an overview of common drayage practices nationwide;
- Review the common issues and concerns that impact drayage productivity at ports throughout the nation and world;
- Illustrate key drayage concerns in the Gateway Cities area through research, interviews, and survey results;
- Highlight sample technology solutions to common drayage operations issues used elsewhere; and
- Define potential next steps to help mitigate these concerns.

3.2 **Overview of Drayage Operations**

This section explains what is meant by the term “drayage operations.” Answers to the following questions will be presented in this section:

- What is drayage?
- Who are the key players in the drayage process?
- What are they key steps during typical drayage import and export processes?

A thorough review of drayage operations and key barriers to efficiency was conducted by TIOGA in the NCFRP Report 11: Truck Drayage Productivity Guide, released in 2011, which will be referenced as a source throughout this document.

**An Overview of Drayage and Key Players**

**What is Drayage?**

In order to address drayage operations issues, it is critical to understand what drayage is and how drayage movements fit into the overall goods movement supply chain. Drayage movements are generally truck shipments that link goods at seaports with inland distribution points, such as rail terminals and importers/exporters or warehouses. Figure 3.1 illustrates typical dray trip patterns in the Southern California region. As the map shows, the majority of port drayage trips (around 60 percent) occur within 20 miles or so of the ports. This means dray movements are a persistent fixture of local traffic. Generally, these locations are not final destinations for products, but locations from which goods are redistributed to other facilities, stores, manufacturing facilities, and many other destinations.
Who are the Key Players in the Goods Movement Supply Chain? 

Several players in the goods movement supply chain impact drayage truck operators and can contribute to drayage truck inefficiencies that are generally outside of the control of truck fleets.

The key players in the drayage process are:

- **Customers.** These include importers/exporters and 3PLs. The transaction for goods movement generally occurs when customers arrange for shipment of goods to the final destination with the ocean carrier. The primary concern of these customers is timely and predictable delivery of goods to their final destinations at a reasonable cost for services rendered.

- **Ocean carriers.** Ocean carriers are the other one-half of the fundamental business transaction that generates the move of goods to customers. Ocean carriers include major shippers, such as Maersk, Evergreen, APL, and many others.

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6 The focus here is on the goods movement supply chain that includes ocean carriers, ports, and drayage truckers.
• **MTOs.** This group controls marine terminal operations, which has implications for how effectively goods are moved once imports have left the ship, or right before they are loaded on ships for exports. Marine terminal operations, along with drayage movements, are an intermediate step in the delivery of goods. Marine terminal operators must generally cope with movement preferences, policies, and capabilities of the ocean carriers and their customers. Terminal operators focus on the productivity and efficiency of resources under their control, which includes:
  - Labor hours,
  - Container cranes,
  - Yard equipment,
  - Terminal acreage, and
  - Operating dollars.\(^7\)

None of these functions directly align with the drayage operator’s primary goal of efficient, daily throughput. For example, if the most cost-effective way to achieve the desired, optimal level of container throughput in a day is through reduced labor hours, there may be a reduction in staff that could increase terminal turn times and, therefore, decrease drayage fleet moves per day. Also, the primary function of a marine terminal is the loading and unloading of vessels for their primary customer, the ocean carrier. Other functions, such as container yard operations and gate management, are subordinated to vessel handling.\(^8\)

• **Drayage truck fleets.** These fleets are responsible for moving goods from the marine terminals to warehouses and intermodal facilities in the region. As with marine terminal operators, drayage truck fleets are part of an intermediate step in the delivery of goods to their final destination and are independent. Drayage trucking is a highly competitive and fragmented industry. Most drivers of drayage trucks are owner-operators who receive a percentage of the revenue from each move rather than pay by hour or by distance traveled. As a result, drayage fleets are incentivized to make as many moves as possible and minimize nonrevenue time and miles.

• **Dockworkers/teamsters.** Dockworkers and teamsters are the labor unions representing workers who unload vessels and drive drayage trucks, respectively. Not all drayage truck firms serving the San Pedro Bay ports are unionized, but virtually all of the container terminals are. Union rules impact labor hours and schedules, and therefore drayage operations. In keeping with labor contracts, MTOs may have to staff additional clerks, supervisors, and relief workers in order to operate additional gates. This influences their

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\(^7\) NCFRP 11.

\(^8\) NCFRP 11.
decisions about gate capacity. Moreover, labor agreements normally stipulate that staff must be hired for a full shift, which makes it hard for MTOs to vary gate capacity dynamically during the day. By contrast, most draymen are independent contractors and are therefore not able to join a union. However, the Teamsters union is continuing its efforts to organize truckers serving the ports, despite a recent appellate court decision which struck down the Port of Los Angeles’ employee mandate provision (part of its Clean Truck Program). If these efforts succeed in the future, it would impact drayage operations in the region.

What are the Key Steps of a Typical Import and Export Drayage Process?

To better understand some of the drayage issues and next steps discussed in Section 3.0, this section explains typical import and export drayage processes, as presented in NCFRP 11.

Import Drayage Process

Import drayage refers to the process in which goods are ordered by customers for delivery to the United States from abroad; in this case, through the POLA and POLB. Figure 3.3 Figure below highlights the key steps taken in the process, involving the key players discussed earlier.

![Figure 3.2 Generic High-Level Import Drayage Process](image)

Source: NCFRP Report 11: Drayage Productivity Guide, prepared by TIOGA, 2011. Figure prepared under the direction of Nathan Huynh at the University of South Carolina.

The first step is for the customer and the ocean carrier to come to an agreement about shipping cost, date, and other details. After all agreements have been made for shipment, marine terminals receive the manifest that highlights which containers are on a particular ship. This manifest also is shared with the drayage company and the consignee (which can be the beneficial cargo owner or an intermediate receiver of the goods, such as a transloader). Once the container has arrived at the terminal, the drayage firm contacts the consignee to determine

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9 American Trucking Associations (ATA) vs. City of Los Angeles, U.S. Court of Appeals for the Ninth Circuit, September 26, 2011.
preferred delivery date/time, as well as the order of delivery (for multiple containers). The drayage company uses all available systems (such as terminal operator systems, a carrier’s on-line system, or other systems such as eModal) to determine if the container is indeed ready for pickup. Checking that the container is indeed ready (and its location and availability) is an important step in reducing delays.

Upon verification of container availability, the drayage firm creates a “pick-up” order and dispatches a driver to get the load at the marine terminal. Wait times at terminal gates are a critical drayage issue (see Section 2.0). Upon arrival at the terminal, the driver goes through several gate and container yard processes before receiving the load. Once the driver has placed the load on a suitable chassis, the load will be delivered to the consignee or to a rail intermodal terminal. There, the container is unloaded, after which the driver either waits for the same container to be unloaded, or brings back another empty or full container to the marine terminal.

**Export Drayage Process**

Export drayage refers to the process whereby goods are shipped from the U.S. to international destinations. In this case, the shipment would involve drayage movements to POLB/POLA and sea shipment from these Ports to the international destination. Figure 3.3 below highlights the key steps in the export process from a drayage perspective. Under this scenario, the exporting shipper (for example, a manufacturer that exports automobiles to China) creates an export booking. Shipment information and the booking number are passed along to the drayage firm and the marine terminal operators. As a result, the marine terminal operator creates an Equipment Delivery Order (EDO), which allows the drayage firm to pick up an empty container for the export load. The drayage driver picks up the empty container at the Port, travels to the shipper to pick up the load, and returns with the loaded container to the marine terminal for drop off. Inside the marine terminal, the driver will be given instructions on where to drop off the container for shipment.

**Figure 3.3  Generic High-Level Export Drayage Process**

Source: NCFRP Report 11: Drayage Productivity Guide, prepared by TIOGA, 2011. This figure is prepared under the direction of Nathan Huynh at the University of Southern California.
Key Drayage Facilities in the Gateway Cities Region

The Los Angeles area, as a whole, is a major warehousing and distribution center, in addition to being home to the nation’s busiest port complex. These warehouses, railyards, and local customer locations are spread throughout the entire region; however, the majority of shipments leaving the port tend to go to major intermodal facilities that are relatively close to the ports. Figure 3.4 highlights some of the existing key origins and destinations for intermodal traffic in and around the Gateway Cities subregion. These data represent results from a gate survey at the Ports, which asked truck drivers where they were going or from where they came. This includes the following facilities:

- **POLA and POLB.** Located at the southern terminus of I-710 and with direct rail connections to downtown Los Angeles and the rest of the nation via the Alameda Corridor, these Ports are the focal point of drayage truck movements in the Los Angeles region.

- **Intermodal Container Transfer Facility (ICTF).** Operated by Union Pacific Railroad (UP) exclusively, and is generally classified as a “near-dock” yard since it is only located about five miles north of the ports. Access from the Ports is provided via the Terminal Island Freeway (SR 47/103). This facility handles much of UP’s international traffic, along with a variety of on-dock facilities. UP has proposed a modernization project that would more than double the capacity of ICTF by 2035.

- **Hobart Yard.** This is the largest intermodal facility in the region in terms of throughput, and is used by Burlington Northern Santa Fe Railway Company (BNSF) to support its marine customers. A majority of containers (more than 60 percent in 2007) moving through the yard are international containers being moved from the Ports. Unlike UP, BNSF does not currently operate a near-dock facility in the region.

- **East Los Angeles.** This facility is operated by UP, and handles a mix of domestic and international traffic. UP’s primary international loading facility is ICTF.

- **Los Angeles Transportation Center (LATC).** This facility is located across from the Union Station passenger terminal in Los Angeles.

Also, many trucks move between the ports and warehouses/facilities very close to the ports themselves, including the ICTF yard. From the figure, it becomes apparent that many port trucks have destinations and origins currently within the Gateway Cities subregion, which further illustrates the impact that these trucks have on both local highways and arterials in the study area. However, if the container volumes at the ports triple in volume by 2035, the destinations for drayage truck trips are expected to be inland of Gateway Cities where land is available for the needed additional warehouses and distribution centers.

There are plans to significantly expand and modernize ICTF, and to build another near-dock intermodal yard called the Southern California International
Gateway (SCIG) nearby. If approved, these changes could have significant impacts on how drayage shipments move in the region.

**Figure 3.4 Origins/Destinations of Trucks Moving to/from the POLA and POLB, 2010**

![Map showing Origins/Destinations of Trucks Moving to/from the POLA and POLB, 2010](image)

Source: Southern California Association of Governments (SCAG) Goods Movement Study, 2010 Gate Survey Results.

**Other Key Characteristics that Impact Drayage Movements in the Region**

A variety of unique policies, regulations, port programs, and other factors have critical impacts on how drayage trucks can move in the Gateway Cities subregion. Several of the key items are highlighted here.

**PierPass Program**

The primary purpose of the PierPass program is to reduce congestion and improve air quality in the region around the Ports. This is achieved by encouraging the movement of containers coming to and from the Ports during off-peak hours (currently defined as 6:00 p.m. to 3:00 a.m. on weeknights, and 8:00 a.m. to 5:00 p.m. on Saturdays). Since 2005, all terminals have offered off-peak shifts on nights and weekends. A traffic mitigation fee of $60 per twenty-foot equivalent unit (TEU), or $120 per forty-foot equivalent unit (FEU) container, is assessed on containers moving through the Ports during daytime...
hours. As a result, drayage firms and other truckers using the Ports are encouraged to pick up loads during off-peak periods.

There have been some issues as a result of the PierPass program. Since the cutoff time period for paying the fee is 6:00 p.m., long queues are reported at the terminal gate at this time as drayage operators wait outside the terminal gates to avoid paying the fee. In addition, reduced business volumes during the recent recession have led some terminals to reduce staff, which leads to longer turn times for drayage trucks and others. This is an especially pressing issue for drayage truck operators, considering the need to make as many trips as possible to pay for newer clean or retrofitted trucks.

**ATMIS**

The POLB and POLA are enhancing real-time transportation operations by implementing and operating various field devices, central management software, and data communications, known together as the Advanced Transportation Management Information System (ATMIS). ATMIS uses information technology to better manage the movement of vehicles within and around the ports area. The objectives are improved incident response time, emergency response, enhanced goods movement, reduced travel delay and emissions, improved reliability and predictability of the transportation system, and improved multimodal mobility.

ATMIS will provide real-time monitoring and control of connected field devices and real-time communication with selected external systems involved in travel information dissemination or cooperative traffic management. Associated procedures will enable a coordinated response to incidents, emergency response, congestion, and special events on ports facilities and surrounding arterials, and freeways. ATMIS will provide truck and terminal operators with congestion and travel information regarding travel conditions on Ports and surrounding roadway facilities, including queue lengths at terminal gates.

For more details on ATMIS, please see the ITS Data and Transportation Management report.

### 3.3 Key Issues that Impact Drayage Productivity

The issues that negatively impact the efficiency of drayage operations occur for a number of reasons. Lack of communications and coordination between key stakeholders is one example. Business practices that meet the goals of marine terminal operators and/or ocean carriers may create more congestion and reduce

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efficiency and pay for drayage truck operators. The purpose of this section is to highlight what some of the key issues are that negatively influence drayage productivity, both at internationally and specifically in the Gateway Cities subregion.

**Overview of Key Drayage Issues and Causes**

Drayage truck operators tend to operate at three key locations: at ports, on roads that connect the ports to intermodal facilities or warehousing units, and within the intermodal facilities. The purpose of this section is to highlight what research suggests are some of the key reasons for drayage productivity decreases, which provides a framework for potential solutions.

NCFRP 11 assessed and presented information on what key drayage issues are, and what the root causes of these issues are. Table 3.1 below is a snapshot of what some of the key issues are that result in reduced drayage operations efficiency. Note that those issues shaded in grey are areas where ITS and traveler information may help alleviate the issue and improve drayage productivity:

**Table 3.1  Key Issues due to Reduced Drayage Operations Efficiency**

<table>
<thead>
<tr>
<th>Key Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>● General congestion in marine terminal container yards. Congestion can occur here because:</td>
</tr>
<tr>
<td>● Truck arrivals exceed short-term terminal gate capacity;</td>
</tr>
<tr>
<td>● Insufficient container yard capacity exists;</td>
</tr>
<tr>
<td>● Uneven truck flow and truck peaking in the container yard;</td>
</tr>
<tr>
<td>● Inexperienced drivers going to the wrong pickup point or being unaware of procedures;</td>
</tr>
<tr>
<td>● Specific lane blockages from trucks queuing behind a specific crane;</td>
</tr>
<tr>
<td>● Equipment location problems;</td>
</tr>
<tr>
<td>● Lift equipment malfunctions;</td>
</tr>
<tr>
<td>● Errors in communication between the gantry crane operator and driver;</td>
</tr>
<tr>
<td>● Drivers pulling the wrong container in wheeled terminals;</td>
</tr>
<tr>
<td>● Lift equipment transferring the wrong container in stacked terminals;</td>
</tr>
<tr>
<td>● Retrieving containers that require excessive rehandling due to their position in the stack;</td>
</tr>
<tr>
<td>● Labor shift changes; and</td>
</tr>
<tr>
<td>● Redirection of assets from yard operations to ship operations.</td>
</tr>
<tr>
<td>● Congestion on streets and highways around ports. This can include recurring congestion or nonrecurring incidents that cause heavy congestion. The cause of these issues could include:</td>
</tr>
<tr>
<td>● Highway capacity shortfall;</td>
</tr>
<tr>
<td>● Road condition problems; and</td>
</tr>
<tr>
<td>● Accident or SIG alerts;</td>
</tr>
<tr>
<td>● Long morning queues at terminal gates (as a result of a lack of close overnight parking and as a result of driver incentive to get in as many moves as possible per day);</td>
</tr>
<tr>
<td>● Slow terminal gate processing times throughout the day (can be caused by slow or outdated legacy</td>
</tr>
</tbody>
</table>
Key Issues

- Software systems, gate closures for staff breaks, exceptions that take long to process, among others.
- Low gate throughput capacity relative to the marine terminal container yard throughput capacity.
- Low marine terminal container yard throughput capacity relative to gate throughput capacity.
- Dispatch errors and booking errors (can be caused by changing conditions/demands or inaccurate information, for example).
- Marine terminal system errors (as a result of customer practices or transaction complexity, for example).
- Driver error, such as not having necessary paperwork to enter terminals (as a result of driver inexperience or miscommunication, for example).
- Congestion at chassis yards (as a result of ineffective chassis maintenance processes or limited chassis interchangeability, for example).
- Chassis “flips” required (chassis flips are necessary when the container for pick-up is placed on the wrong chassis prior to truck arrival).
- Chassis supply exceptions (these exceptions occur when it becomes difficult to locate, inspect or hook up the chassis).
- Drayage driver delay as a result of having to make an extra trip to drop a chassis at a second location (also known as a split delivery).
- Inefficiency of marine terminal operations (as a result of changes in process or in facilities, for example).
- Natural disasters or other major accidents, which may result in ocean carrier tenant shifts and sudden increases in volume, disrupting marine terminal operations.
- Extra drayage trips with no containers, also known as Dry Runs. This can occur as a result of dispatch/driver error, booking errors or terminal errors, among other reasons.
- Extra empty equipment moves (as a result of empty equipment being in the wrong location due to a variety of factors such as human error, ocean carrier tenant shifts, vessel sharing agreements, and others).
- Marine terminal ability to sustain efficient high-volume trucking operations at the same time a vessel is being served is often lacking.

It becomes evident from the table above that there are a variety of issues that are caused by institutional and other reasons, which ITS or technology solutions would have difficulties addressing. However, as shown in Table 3.1, there are a number of issues that ITS can help address. A necessary first step that will potentially set the stage for addressing those issues is to recommend a more collaborative approach between the key players in the drayage process (drayage truck fleets, marine terminal operators, ocean carriers, and customers).
3.4 **Gateway Cities Drayage Issues and Potential Solutions**

While many ports have operational similarities, the reasons for drayage productivity decreases can vary. The issues presented in Section 3.1 were meant to act as an overview of the types of issues that impact drayage productivity. These issues and causes were drawn from experiences at a variety of ports around the nation, and are not specific to any one region. The next step is to focus on specific drayage productivity issues in the Gateway Cities subregion. As a part of this project, the project team interviewed a variety of stakeholders, conducted a survey, and reviewed previous documents about drayage issues in the region. The following sources were drawn upon to better understand what the major issues are that impact drayage productivity in the Gateway Cities subregion:

- **Survey of members of the Harbor Trucking Association (HTA).** A survey was prepared and distributed to members of the HTA. This survey included questions that sought to understand the key reasons for delay on regional roads, at terminal gates, and within marine terminals.

- **Working Meeting with HTA members, November 15, 2011.** A meeting was held in November 2011 to hear from drayage fleet owners and operators on what they perceived to be the causes of drayage productivity issues, as well as potential solutions that may address the issues.

- **Interviews with key stakeholders in the fall of 2011.** The study team held interviews with a variety of groups, including PierPass, POLA, POLB, ATMIS representatives to better understand drayage issues and ITS solutions from their perspectives.

- **Review of 2008 Gateway Cities ITS Integration Plan for Goods Movement.** This 2008 study performed research and interviews, and provided information about key regional drayage productivity issues. The document reaffirmed several of the issues that were voiced in this round of interviews and the HTA survey.

Key issues, as reported by each of the above sources, will be discussed in more detail in this section.

These sources helped identify the drayage operations issues and needs of the Gateway Cities region, as well as potential solutions. A summary is found at the conclusion of this section.

**High Queue Times at Marine Terminal Gates (DR-1)**

Interviews and surveys revealed that queue times outside marine terminal gates are a major concern that reduces productivity of drayage truck operators, and impacts their bottom-line. This idling also has negative environmental consequences. It should be noted that gate queues are highly variable,
depending on a number of factors, including time of day, time of the week, the economy, ship arrival, staffing, port layout, and for many other reasons. Interviews and surveys revealed that queues at the San Pedro Bay port terminals are worse at the beginning of the week (Monday, Tuesday, and Wednesday) due to the high volume of ships that arrive at this time. In addition, queuing is worse at some terminals during specific hours because of mandated gate staff breaks in the middle of the day. Gate opening times are usually busy (most drayage truck operators want to start early to maximize daily moves) as are peak periods. Other peaking periods include times when ships have just arrived and are being unloaded. PierPass incentivizes moves into and out of the ports in off-peak hours (after 6:00 p.m.), which results in queues at that time to avoid paying the mitigation fee.

Given all of these factors, it should be noted that reducing queue times at marine terminal gates is difficult. Many of the causes of gate queues cannot be addressed within the scope of this study. For example, ITS solutions cannot solve labor concerns that decrease drayage productivity. ITS solutions also will not impact the competitive market in which ocean carriers operate, which leads to clustering of ship arrivals at the beginning of the week. While it is recommended throughout this report that a collaborative spirit is necessary to address these drayage productivity issues, the focus here will be on technology solutions that can make an incremental difference and improve drayage productivity while helping to improve the environment for regional residents.

**Current Situation**

Through interviews and observation, it is evident that queuing is still an ongoing issue at marine terminal gates (and will likely get worse in the future). Respondents to the HTA survey indicated that queues at marine terminal gates do have a significant impact; most drayage truck operators who were surveyed and interviewed communicated that queues at marine terminal gates are the major point of delay in the regional drayage process. Survey respondents also indicated that some of the key reasons for delay at marine terminal gates were as a result of peak traffic periods at the ports, midday breaks by gate staff, and understaffing of terminal gates. Marine terminal operators were not contacted prior to this first memorandum to get input; however, before finalizing next steps it is a goal to contact representatives for the MTOs to understand what they believe are the reasons for delay at terminal gates, and their thoughts are on how to address these issues.

It also is important to note that each terminal gate is different – it was mentioned by stakeholders that there are differences in how effectively (or efficiently) terminals operate. Further insight and discussions with terminal operators are needed to diagnose needs at specific terminals.
Steps to Potential Solution

There are a number of ITS solutions that can be implemented to reduce delay at terminal gates. The next steps that could be taken to get closer to defining these solutions are discussed here in more detail.

- **Attempt to create more collaboration between drayage truck operators and MTOs to resolve issues that decrease drayage productivity.** One of the most important steps to take and to continue to take over the long term is to develop a collaborative approach to solving drayage productivity concerns. It is necessary to convene frequent meetings between key port trucking groups and MTOs to address operations issues from both parties that decrease both drayage truck and marine terminal efficiency at the gates. Currently, the Truck TurnTime Stakeholder Group (TTSG) exists to address concerns about visit times. This group includes trucking companies, MTOs, PierPass, cargo owners, and the two ports. It is necessary to build on this effort to resolve drayage operations concerns.

- **PierPass can cause queues inside and outside the gates once the fee period is over.** Study this impact and consider recommended adjustments (e.g., fines for parking near cost adjustment periods). One of the key congestion periods is around 6:00 p.m., when trucks seek to access the ports since the cost is lower due to the PierPass program’s cut-off. Currently, a truck that enters or leaves a terminal at 5:55 p.m. will pay a mitigation fee of $60 per TEU, or $120 per FEU. If the truck enters after 6:00 p.m., no such fee is assessed for entering or exiting the terminal. As a result, some truck operators wait until 6:00 p.m. to save these costs for their customers, resulting in queues at the marine terminal gates. Through further analysis and by working with PierPass, MTOs, and drayage truck operators, adjustments to PierPass will be recommended to reduce queues for reasons described above.

- **Ship arrival times/days can cause congestion within and around the Ports.** Study impacts and recommend adjustments (including appointment times/penalties). Stakeholders indicated that the most ships arrive in the first days of the week, which increases demand substantially around the Ports. While it is outside of the scope of this study to smooth the distribution of ship arrivals across the week, other solutions such as appointment systems can help mitigate the spiking of traffic during days of heavy traffic.

- **Study improvements to the design of terminal gates and the handling of trouble tickets.** Please note that this potential solution can only be moved forward with the cooperation of MTOs. Without further involvement of MTOs, the study team can suggest best practices related to terminal gate design. NCFRP 14 and 11 highlighted several marine terminal gate designs

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that are superior because of their ability to reduce queues at the gates. Ideally, a gate is able to identify truck operators with “clean” transactions (i.e., no trouble tickets or special processing needed at the gates) early, so that these transactions can be processed quickly. Also, the possibility of an automated bypass through the gates for certain trucks might also be considered and evaluated.

Sample Technology: APM Terminal Gates, Portsmouth, Virginia

This terminal gate was identified in NCFRP 11 as one of the more advanced gate designs around. For one, “clean” transactions are identified early in the process. Most truck operators have appointments (70 percent), and trucks that arrive must have RFID tags to move through the gates. The RFID tag is scanned on the freeway as the truck is approaching, which allows the terminal to prepare for the trucks arrival in advance. After a seal check and inspection, the truck is then assigned to a specific lane – one lane is for trucks with no problems, one is for trucks with trouble tickets or no appointments, and one is for rejected trucks. This separates trucks that may take longer for processing (those with trouble tickets or no appointments) from those that will have a fast processing time (those with appointments and no problems). As a result, a truck with no issues will only be waiting in a queue with other trucks that have no issues to report, making their workflow faster. The NCFRP 11 report identified trucks with trouble tickets as a major reason for delay at most terminals.


- Implement DR-2, DR-4, DR-5, DR-6, DR-7, and DR-8. In addition to the steps taken above, implementing solutions to these issues also will help reduce terminal gate queues.12

Improve Quality and Dissemination of Marine Terminal Gate Queue Data to Drayage Truck Fleets (DR-2)

Aside from actually reducing delay at marine terminal gates based on some of the potential solutions discussed in Section 3.1, another way to improve drayage productivity is by providing current information on wait or processing times on terminal gate queues to drayage fleets. Up-to-date, specific information about queues at a particular location allows a drayage truck operator or dispatcher to make better use of limited operating hours, which improves the bottom line and may reduce queues at gates. For example, if a drayage truck operator has three loads to pick up from the Port on a particular day and is aware that one of the

12Parts of DR-4, DR-5, DR-6, and DR-7 were adapted from the NCFRP 11 Truck Drayage Productivity Guide.
terminals is experiencing significant delay at the moment, the driver may decide to pick up a different load at a different terminal first. Of course, customer demands and priorities also influence whether or not a driver will join a queue. Providing queue time is an additional important piece of information that can help optimize workflows and drayage productivity for a particular driver or fleet.

**Current Situation**

Currently, cameras can be viewed through the PierPass web site and through other sources. A drayage truck operator or a dispatcher can continually look at the queues and estimate the waiting time. Several terminals do not have cameras, and there were issues raised about how well and consistently the cameras function. In addition, it is difficult to determine exactly how much time will be spent in line based on the camera alone. Truck operators or dispatchers do not know how many of the gates are staffed currently or will be staffed over the next hours. As a result, the ideal metric to provide drayage truck operators would be average time required to wait in the queue. Also, currently the only primary way to access this data is through the Internet. Pushing this data and other information out to drayage truck drivers through other specific sources also may increase how much this information is used to make decisions and improve drayage productivity.

**Steps to Potential Solution**

While the current information provided is useful, there are steps that can be taken to better disseminate gate queue information:

- **Attempt to create more collaboration between drayage truck operators and MTOs to resolve issues that decrease drayage productivity.** One of the most important steps to take and to continue to take over the long term is to develop a collaborative approach to solving drayage productivity concerns. It is necessary to convene frequent meetings between key port trucking groups and MTOs to address operations issues from both parties that decrease both drayage truck and marine terminal efficiency at the gates. Currently, the TTSG exists to address concerns about visit times. This group includes trucking companies, MTOs, PierPass, cargo owners, and the two ports. It is necessary to build on this effort and organization and include all issues where the groups could collaborate to address key drayage productivity issues.

- **Determine camera infrastructure gaps and camera quality deficiencies.** A first step is to determine precisely where cameras should be added to improve information about gate queues. Certain terminals do not have such

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information, and for others it may make sense to show different angles and provide flexibility in moving camera angles. Also, the quality of cameras should be checked, and any improvements to quality would improve the usefulness of the data.

- **Place cameras at all marine terminal gates and make available on the web (or through other sources).** Once the step above has been taken, it is important to work with PierPass or other sites that provide on-line camera information to publish this information. Of course, it is important to work closely with the MTOs on this as well. If this is a contentious issue to breach at the outset, it could be brought up later as talks continue between truck operators and MTOs about key needs.

- **Explore opportunities for collecting real-time marine terminal queue length data.** The above two steps could provide additional benefits using existing technology and improving upon that. However, the information provided could be improved by collecting actual marine terminal gate queue length data. The project team should work with MTOs, PierPass, the ITS Working Group and drayage truck operators to determine the feasibility of collecting queue length data.

**Potential Solution: I-87 Queue Detection at Canadian Border, New York State**

The New York State DOT is looking to improve queue detection at its border with Canada on I-87. Basically, queue detectors would collect historical data and use that along with real-time information to alert drivers of the queue length through several VMS signs. A similar approach could be taken at the terminals, with additional functionality to send queue information to TMCs for distribution to drayage truck operators.


- **Explore opportunities for better dissemination of real-time marine terminal queue length data.** Currently, the dispatcher or drayage truck operator needs to go to the PierPass web site (as well as others) specifically for updates on gate queues, or rely on information from dispatchers. Improved dissemination of marine terminal camera feeds and/or marine terminal queue length data also should be explored by the ITS Working Group and project team. For example, new technologies may provide new opportunities to push marine terminal queue length information out to dispatcher or truck operator devices. The key is to work with drayage truck fleet operators and dispatchers to determine an optimal method of delivering the data, while remaining technology neutral.

- **Explore potential development to estimate average (or real-time) wait times.** There are several technologies that could provide both a queue length
measurement, and an estimate of the waiting time from the back of the queue. These include: 1) a system composed of sensors embedded in the pavement and communicating with an Internet-connected roadside access point, or nonintrusive roadside detectors using microwave/radar technology, that could measure queue information; 2) use of PierPASS RFID tags and readers to detect trucks moving past readers stationed at key points approaching the port gates and calculate queue length and wait times; and 3) use of a license plate reader (LPR) system to measure congestion in the gate queue lanes by matching license plate images from different points in the line and convert the video feed data into queue length and wait estimates. The latter two technologies could also be used to track total turnaround time at the terminals. This could be controversial, however, as MTOs tend to regard turn times as competitive information. There are also privacy concerns related to the use of video/LPR technologies. In the longer term, if a potential I-710 expansion involves truck tolling, toll transponders could also be used to estimate queue length and waiting time as they pass by roadside detectors approaching the gates.

- **Ship arrival/departure time development.** The ITS Working Group may wish to consider development of an application that can gather and disseminate ship arrival and departure information in formats useful to the port drayage community. Smart phone applications like this have already been developed, notably at the Port of Amsterdam (see box below). A nonprofit called the Marine Exchange publishes reports detailing vessel arrival and departure times, berths, and other information for the San Pedro Bay Ports on a fee basis; this could be a source of information for such an application. Additional information pertinent to drayage operations, such as turn times or queue length/times, could be incorporated if it is available.
Stakeholders from drayage fleets also indicated that another key area that reduces drayage productivity, aside from outside terminal gates, is congestion within marine terminal container yards. After truck operators move beyond the terminal gates, a variety of factors can cause delay, as suggested in Section 3.1. Reducing congestion and delay within the terminal can be measured by “turn times”, which in this case is the time spent between entering and exiting the terminal (not including queuing at the gates). A reduction in turn time also would improve drayage productivity and help drayage fleets increase revenues. In addition, shorter turn times also would have environmental benefits as a result of reduced idling in the terminal.

**Sample Technology: iamPort iPhone Application at the Port of Amsterdam**

The Port of Amsterdam has made an iPhone application available for download via their Internet page and iTunes. Basically, the application allows those with the application (and an iPhone) to see ship arrival times at the Port. In addition, it provides news updates among other pieces of information. While the application currently does not provide information about drayage turn times, queue times or other data that could also be useful at the San Pedro Bay Ports, providing information through such smartphones is one way that ports are becoming creative in disseminating information to interested parties.

Source: Port of Amsterdam (http://www.portofamsterdam.nl/Eng/%2866%29-Shipping/%2866%29-Shipping-Maritime-information/Arrival-ampamp-Departure/Port-of-Amsterdam-offers-shipping-information-via-your-smartphone-with-the-free-app-iamPort.html).

**Congestion within Marine Terminals (DR-3)**

Stakeholders from drayage fleets also indicated that another key area that reduces drayage productivity, aside from outside terminal gates, is congestion within marine terminal container yards. After truck operators move beyond the terminal gates, a variety of factors can cause delay, as suggested in Section 3.1. Reducing congestion and delay within the terminal can be measured by “turn times”, which in this case is the time spent between entering and exiting the terminal (not including queuing at the gates). A reduction in turn time also would improve drayage productivity and help drayage fleets increase revenues. In addition, shorter turn times also would have environmental benefits as a result of reduced idling in the terminal.
Current Situation

Through interviews and a survey of HTA drayage truck operators, it was determined that the following reasons contribute to delay within marine terminals:

- Uneven truck flow and truck peaking within the container yard.
- Queuing behind a specific crane that is delayed for whatever reason.
- Terminals unexpectedly close down part of the container yard, which creates delays.
- MTO staff breaks; low staffing in general.
- DOT roadability check before exiting creates delays.
- Truckers are parked inside the terminal waiting for a pickup, or waiting for off-peak hours in the PierPass program.
- Peaking of traffic.
- Inadequate supply of suitable chassis equipment in the yards.

By addressing some of these reasons for terminal delay and through additional information about turn times (and other information), progress could be made to improve drayage productivity.

There also has been an effort recently to address concerns about turn times at the Ports. PierPass worked in collaboration with POLA and POLB on a study titled “Taking the Pulse of Ports, Duration of Truck Visits to Marine Terminals”, which highlights turn times and total visit times to the Ports by truck operators. The U.S. DOT provided funding for the study in 2011. The purpose of the study was to measure visit times (gate queue + turn times) at terminals using 250 trucks with global positioning system (GPS) devices installed. The report had the following key conclusions for more than 10,000 monthly data points in October 2010 (see Figure 3.5):

- The median visit time in October 2010 was 51 minutes (31 in terminal, 20 in queue).
- The vast majority of visits take less than two hours: 27 percent are less than 30 minutes, 58 percent are less than an hour, 75 percent are less than one and one-half hours, and 86 percent are less than two hours. A further 12 percent of visits take two to four hours, and 1 percent to 2 percent of visits take between four and eight hours.
- About 91 percent of queue times were under an hour.

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The median queue and visit times include trucks that chose to arrive early to wait for the 6:00 p.m. off-peak to start.

The study found that daytime visits are shortest for trucks that arrive at 3:00 p.m. Median visit time for trucks arriving between 3:00 p.m. and 4:00 p.m. was 45 minutes, while for trucks arriving between 5:00 p.m. and 6:00 p.m. median visit time was 90 minutes; reflecting the 5:00 p.m. meal break.\textsuperscript{15}

The report highlights that peak visit hours are observed primarily around 5:00 p.m. and also around noon.

**Figure 3.5** Visit Time (Queue + Terminal Turn Time), October 2010

Steps to Potential Solution

Key next steps to help mitigate delays within terminals include the following:

- **Attempt to create more collaboration between drayage truck operators and MTOs to resolve issues that decrease drayage productivity.** One of the most important steps to take and to continue to take over the long term is to

\textsuperscript{15}PierPass web site: http://pierpass.org/turn-time-study/.
develop a collaborative approach to solving drayage productivity concerns. It is necessary to convene frequent meetings between key port trucking groups and MTOs to address operational issues from both parties that decrease both drayage truck and marine terminal efficiency at the gates. Currently, the TTSG exists to address concerns about visit times. This group includes trucking companies, MTOs, PierPass, cargo owners, and the two ports. It is possible to build on this effort and organization to include all issues where the groups could collaborate on solutions to key drayage productivity issues.

- **Explore opportunities to mitigate PierPass-induced truck parking within marine terminals that creates congestion within yards, such as stricter enforcement of no-parking rules.** One of the key congestion periods is around 6:00 p.m., when trucks enter the Ports since the cost is lower due to the PierPass program’s cut-off. Currently, a truck that enters or leaves a terminal at 5:55 p.m. will pay a mitigation fee of $60 per TEU, or $120 per FEU. If the truck delays until 6:00 p.m., no such fee is assessed for entering or exiting the terminal.¹⁶ As a result, some truck operators wait until it is 6:00 p.m. to save these costs for their customers, which can result in congestion within marine terminals after 6:00 p.m. Through further analysis and by working with PierPass, MTOs, and drayage truck operators, adjustments to PierPass will be recommended to reduce queues as a result of PierPass.¹⁷

- **Ship arrival times/days can cause congestion within and around the Ports. Study impacts and recommend adjustments (including appointment times/penalties).** Stakeholders indicated that the most ships arrive in the first days of the week, which increases demand substantially around the Ports. While it is outside of the scope of this study to address the distribution of ship arrivals across the week, other solutions such as appointment systems can help mitigate the spiking of traffic during days of heavy traffic.

- **Explore opportunities to improve the efficiency of “roadability inspections” required by DOT inside the marine terminal.** Some stakeholders indicated that the roadability checks performed by the DOT could be improved at the Ports. Currently, roadability inspections in California involve checking an intermodal chassis each time it is released from the marine terminal. This check includes brake adjustments, brake system components and leaks, suspension systems, tires and wheels, lights and electrical system, and others.¹⁸ While these checks are necessary,


¹⁷ A potential future freight corridor, depending on its design capacity, could obviate the need for PierPass, or significantly alter the way it operates.

stakeholders questioned the timing of the check at the end of the process. A step is to analyze whether there are any better times during the process to examine the chassis, potentially during queues or while trucks are waiting.

- **Explore opportunities to improve MTO communication of terminal section closures to drayage truck fleets.** One of the key complaints of drayage truck operators is the lack of warning received prior to closures of certain parts of the container yard, which requires waiting and repositioning to pick up the container within the yard. One step is to investigate the possibility of advanced notification of such moves and closures by the MTOs to the drayage truck operator or dispatcher.

- **Support the congestion mitigation recommendations suggested by PierPass in its port visit time study.** PierPass recommended several key actions to help further understanding of congestion causes within terminals in its study of delay at the Ports. These actions are:
  - Review the management of one-hour breaks (noon, 5:00 p.m., 11:00 p.m.) to minimize productivity gaps and their impacts on terminal velocity and gate congestion;
  - Review the all-or-nothing aspect of the TMF structure to minimize queue congestion in the hours immediately prior to 6:00 p.m.;
  - Consider establishing terminal-specific performance standards, supported by a continuing process of monitoring visit time;
  - Consider measures such as land bridges (pre-removal of containers to off-dock yards) and information exchange between terminals and trucks to streamline operations;
  - Consider detailed study, assisted by METRIS, of where delays occur within terminals, and what measures can be taken to reduce or eliminate long delays; and
  - TTSG should continue to provide a cooperative and constructive forum for identifying and resolving truck-terminal issues.¹⁹

- **Investigate the use of geofencing to assess turn times in real-time.** One way to conduct a detailed study of terminal delays (as recommended by the PierPass study) would be to establish geofences around key origins and destinations for intermodal drayage moves (e.g., ocean terminals and inland railheads), and use truck GPS probe data to track vehicles when they enter or leave the geofenced areas. Such a system could potentially be used to automatically alert drayage company dispatchers when their trucks enter or

leave geofenced locations of interest, allowing them to monitor wait times and exception manage in real-time.

- **Implement DR-5, DR-6, DR-7, and DR-8.** Providing solutions to these other issues/needs also will contribute to reducing delay within port terminals.

### Extra Drayage Trips (DR-4)

Another major issue that increases costs for drayage operators and has negative emissions implications are additional movements that achieve no basic purpose and do not add value for the drayage operator (or the surrounding community for that matter). Instead, they result in increased travel times, costs, and emissions from trucks. Two key categories of extra drayage trips include “dry runs” and “extra empty equipment moves”, titled as such in NCFRP 11.

1. **Dry runs.** This type of extra drayage trip focuses on the situation when a truck operator drives to the marine terminal, but it turns out upon arrival that they are unable to complete the assignment of moving the trucks. Generally, dry runs occur when a portion of the transaction is not complete as a result of driver/fleet inexperience, or because of a lack of communication (or ineffective communication) of the status of the container.

2. **Extra empty equipment moves.** These moves involve shuttling equipment (containers, chassis, etc.) to where they are more useful. For example, if empty containers or other equipment build up at one terminal, there will be a request to drop the equipment at another terminal. Another example is the movement of chassis to where they are most needed; imbalances in chassis locations create the need to move chassis between terminals with no load by drayage operators.

Figure 3.6 below highlights empty equipment moves after dropping a shipment at a warehouse. Ideally, a drayage operator would be able to bring a load back to the Port for export after dropping an import at a warehouse, but this is often not the case. Such movements should be minimized for drayage truck operators due to cost implications they have.
**Current Situation**

Empty truck trip moves is an issue that is seen across most ports. The goal is to reduce these trips as much as possible. Some regions may have better communication systems than others to reduce extra truck trips, but there is no region with perfect information. In the survey, truck operators indicated that having improved technology to match loads and reduce empty moves would be a somewhat beneficial solution to this drayage productivity issue.

The NCFRP 11 study indicated that the key to reducing empty equipment moves is for drayage truck firms and marine terminals to collaborate and share operations plans and data. Currently, at most terminals, communications involve “one-way” marine terminal announcements and web site updates.

**Steps to Potential Solution**

Key next steps to help reduce empty truck trips include:

- **Attempt to create more collaboration between drayage truck operators and MTOs to resolve issues that decrease drayage productivity.** One of the most important steps to take and to continue to take over the long term is to develop a collaborative approach to solving drayage productivity concerns. It is necessary to convene more frequent meetings between key port trucking groups and MTOs to address operational issues from both parties that decrease drayage truck and MTO efficiency. Sharing of operations information can help MTOs and drayage truck operators work together to reduce empty truck movements.

- **Further investigate the use of load matching sites in the region and analyze improvements that can be made.** Load matching allows drayage truck operators to look on-line to see if there are other loads that need to be picked up near their current location. For example, a drayage truck driver could be...
delivering an imported container to a warehouse, but have no load to take back to the Port. Such information could add value to the trucker and reduce the number of truck trips being taken.

- **Goods Movement Transportation Management Center (TMC).** - One of the identified needs in ITS Data and Transportation Management is for a TMC in the region to focus on freight transportation and data archiving. A dedicated Goods Movement Transportation Management Center (GMTMC) might be a clearinghouse where drayage load matching efforts could be focused. A GMTMC would not necessarily have to be stand-alone; it could be integrated into the existing operations of one or more TMCs. The GMTMC would not only address operational issues like load matching, but also archive freight data for planning and performance measurement.

**Sample Technology: Loadmatch.com and Drayage.com**

Loadmatch.com and Drayage.com are two web sites (run by the same company) that provide loadmatching services to the intermodal trucking community. Loadmatch.com provides information to connect buyers and sellers of intermodal transportation services to help them improve equipment utilization by exchanging information on loads, trucks, and equipment. The site pulls together capacity information (truck power with empty equipment, trucking power only, and empty equipment without truck power) and matches it to available loads. Members pay a flat monthly subscription fee to use the service.

Members benefit by posting and receiving information not made available through public access. A drayman can run a report of all their inbound containers scheduled for delivery and do internal matching of containers to be delivered to loads that need to be picked up. Containers that cannot be matched up internally and will come back empty are published on LoadMatch.com so outside users can see what is available for reloading. LoadMatch.com is able to push this data on containers available for reload into client computer systems such as Profit Tools, or people can just visit the web site to see what is available. A screenshot of the Loadmatch.com web site is provided in Figure 3.7.
Not every container will be reloadable, for a variety of reasons:

- The most common cause for containers not being reloaded is the ocean line enforces a mandatory terminate empty policy. Sometimes, the ocean line urgently needs to reposition empty containers into higher demand areas, or the ocean line wants a preferred drayman to get possession of the empty containers.

- Some containers are “lease” boxes; meaning the ocean line is leasing the container, and once empty, a lease box needs to be terminated empty because the leasing company does not know what or when ocean line is going to lease that specific container next.

- Some containers are damaged en-route, and therefore need to be fixed before being reloaded.

- Some containers carry smelly or messy cargo and cannot be reloaded until the inside of the container is cleaned.

Drayage.com is different from Loadmatch.com because not every container is an export load. Every container eventually needs to be outgated from a terminal, but this has nothing to do with matching up an empty container on the street.
To solve that need, Drayage.com is a web site that lists the draymen that serve the terminal and are potentially able to outgate a container. Drayage.com is a phonebook-like directory of draymen, with very detailed profiles on each one. The profiles provide detail such as which draymen have private chassis; which can move hazardous material (hazmat) containers; which have Transportation Worker Identification Credential (TWIC) drivers to serve the port terminals; and how far each drayman will run a container (e.g., the states/provinces they serve or radius from terminal). There are currently 1,780 drayage terminals listed in the Drayage Directory.

Need Better Communication of Issues/Closures at Terminals to Truck Fleets (DR-5)

This was a primary issue brought up within the context of DR-3. It is brought up here to highlight the importance of the issue from the perspective of the drayage truck operators. Drayage truck operators do not receive a warning prior to closures of certain parts of the container yard. As a result, the drayage truck operators must wait and reposition to pick up a container within the yard. The following recommendation is reiterated to reduce the incident of this happening:

- Explore opportunities to improve MTO communication of terminal section closures to drayage truck fleets. One step is to investigate the possibility of advanced notification of such moves and closures by the MTOs to the drayage truck operator or dispatcher.

Need Better Sharing of Information between MTOs and Drayage Truck Fleet Drivers (DR-6)

A common theme in most of the issues described above is that improved collaboration between MTOs and drayage truck operators is necessary. Therefore, this issue is being called out separately to highlight the importance of this issue for improved drayage productivity.

Current Situation

Improved communication and collaboration would help mitigate the following issues:

- Gate queue times,
- Marine terminal delays,
- Extra drayage trips, and
- Communication of closures at marine terminals.

Without continuing a collaborative effort to combat drayage productivity issues, it will be difficult to make significant progress on drayage productivity and the congestion/environment/cost issues that result from these issues. While it is
outside of the scope of this study to define a collaboration plan for these key stakeholders, key initial steps are highlighted below.

It is important to note that there have been steps taken to try to address some of the key issues that impact both MTOs and drayage truck operators. For example, MTOs and truck operators collaborated with PierPass on the creation of PierPass’ report that focused on turn time issues at the Ports. This collaboration was unprecedented and provided valuable insights as to when and why delays were happening at terminal gates and inside marine terminals. The TTSG which includes MTOs and truck operators (among others), was formed to support the report’s recommendations, and to address issues that increase queue time and turn time at the marine terminals.

**Steps to Potential Solution**

Additional steps that can be taken to increase collaboration between these stakeholders:

- **Continued collaboration and more frequent meetings between drayage truck fleet operators and MTOs.** More collaboration on some of the labor, communications, and technology issues that reduce drayage productivity is necessary. Quarterly or semi-annual meetings to address these issues could be called by the TMC once it is set up.

- **Utilize the ITS Working Group to bring together drayage truck operators and MTOs to start collaborative thinking on solving drayage issues.** MTOs participation in the ITS Working Group is critical to finding solutions to key drayage issues.

- **Make a case for which specific information needs to be shared, and how it could benefit MTOs, drayage truck operators, and the region as a whole.** The primary reason that MTOs and drayage truck operators will participate in a particular technology solution is to understand what the benefits could be for them. All parties need to realize that the priorities/needs of the drayage truck operators and MTOs do not currently match up. However, improved throughput provides benefits for all. Such information also could be shared with the TTSG.

**Improved and Expanded Goods Movement Scheduling System to Help Reduce Delay Inside and Outside the Terminals (DR-7)**

One way to help control peak-hour congestion is through improvements (or expansion) of the truck appointment systems that are in use at POLA and POLB marine terminals. The implementation of appointment systems can have benefits for shippers, drayage truck operators, marine terminals, and the general public if implemented correctly. In general, the goal of appointment systems is to reduce truck congestion at marine terminals by regulating how many trucks can enter a terminal each hour. Benefits include:
• **MTOs.** The primary benefit for an MTO is increased control over the flow of trucks moving into and out of their terminal. Improved efficiency means more throughput, which can lead to increased revenues for the MTOs. However, during times of economic recession, it may be difficult to quantify MTO monetary benefits.

• **Drayage truck fleets.** Appointment systems could have a significant impact on truck operators. There would be more predictability in terms of daily pickups, which would be a positive benefit for drayage truck operators who get paid per move. This could also reduce operating costs significantly through less idling and reduced fuel use. In interviews with drayage truck operators, there was positive feedback regarding the idea of appointment systems. However, some mentioned that an appointment system only works if it is fairly implemented. Key complaints/ideas brought up for discussion:
  - The idea that penalties for a missed appointment should go both ways. In other words, if a drayage truck operator schedules an appointment for 2:00 p.m., but they are not able to pick up the load or enter the terminals until 3:00 p.m., there should be a penalty paid by the terminals.
  - Too often, large customers have greater sway over the terminals and are able to skip ahead. This jeopardizes the potential benefits of an appointment system for all medium- and smaller-sized carriers.

• **Customers.** The primary benefit that customers get from an appointment system is that the reliability of shipment date/time should occur. As a result of less traffic and less delay because of terminal management of truck driver arrivals, there should be reduced uncertainty about queue length.

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**Sample Appointment System: Port of Southampton, United Kingdom**

The Port of Southampton implemented an appointment scheduling system that resulted in benefits for the shippers, the carriers, and the MTOs. The truck implemented earlier versions of an appointment system that was voluntary and more difficult to use, which did not help reduce turn times and did not improve landside efficiency. In July 2005, the Port implemented a system called “Simplified Vehicle Booking System (VBS)” that had the following key characteristics:

- Simple, easy to use for ALL users of the system;
- Mandatory (all truck operators are required to use it to enter ports) – “no booking, no entry”;
- Charges apply for peak-hour appointments and for “no-shows”;
- All user interaction is web based;
- Carriers can amend the booking as often as they wish; and
- 24-hour help desk available to assist with any questions or concerns on bookings.

*Source: Steve McCrindle PPT Presentation, Port of Southampton.*
Current Situation

The 2008 Gateway Cities ITS Integration Plan for Goods Movement conducted surveys indicating that current appointment systems were ill used and ineffective. In addition, the appointments systems were only available at four terminals. Further details will need to be gathered from MTOs and vendors regarding the appointment system brands.

Drayage truck operators generally thought appointment systems could be beneficial; however, some noted that it is necessary to ensure that all carriers and customers are treated equally. In addition, penalties for delays or being late should apply to both drayage truck operators and MTOs.

Steps to Potential Solution

The following steps can be taken to move forward on this issue:

- **Explore the willingness of MTOs and regional stakeholders to work together to implement a comprehensive goods movement scheduling system.** Moving forward on a scheduling system will require commitment from several regional stakeholders, including the MTOs, drayage groups, and regional government agencies. A Comprehensive Scheduling System may evolve through a group such as the TTSG, if the case is strong enough.

- **Work with terminals and vendors to better understand the current appointment systems in use.** A better understanding of current appointment systems is important, and further analysis of system deficiencies is also needed. This will involve additional in-depth discussions with eModal, other vendors, drayage truck operators, and MTOs.

- **Work with ITS Working Group to highlight the benefits of a comprehensive scheduling system.** A comprehensive, fair, easy-to-use appointment system would benefit drayage truck operators due to reduced queue times during peak periods. Benefits for other stakeholders such as the MTOs need to be articulated more clearly in order to get support behind this idea.

Provide Railyards/Customers with More Timely Container Arrival Information (DR-8)

The customer is at the end of the import drayage supply chain. The drayage truck operator is responsible for picking up the goods at the Port, and then delivering the goods to warehouses or to railyards. Currently, railyards and warehouses receive information about expected delivery of containers, but this information is not automatically updated on a continual basis. For instance, a delay at a specific terminal may have an impact on when a container is expected to arrive at a railyard in downtown Los Angeles. Ideally, such information and a new estimated time of arrival (ETA) would be communicated to the customers, so that they can plan the building of trains or other shipments in an optimal manner.
Current Situation

Customers are informed that a shipment is coming at a certain date/time. The process for informing clients of delays or changes in delivery date requires further investigation. The benefits that railroads/customers would reap from updated arrival time information should also be identified and articulated.

Steps to Potential Solution

There are several steps that can be taken to address this issue:

- **Investigate current communications between MTOs, drayage operators, and railyards/customers.** In order to improve the workflow, more detail about current workflows is required. Interviews with railyard staff and with customers would provide information on how and if they are updated about late arrivals.

- **Work with the ITS working group, railyards/customers, and MTOs to determine a best practice for alerting railyards/customers of changes in ETA.** The next step is to determine a best practice with key stakeholders, and to design ITS system requirements around this best practice.

Truck Congestion on Key Gateway Cities Roadways (DR-9)

Congestion on roads and arterials outside of terminal gates also are factors that impede drayage truck productivity, especially during peak hours. The truck survey and interviews highlighted a key congested area for truck highways located on I-710 North during peak p.m. hours. While there are more truck bottlenecks that exist, this one was highlighted as a major area of concern.

Current Conditions

SCAG is currently finalizing an analysis that will highlight the key truck bottlenecks in the Southern California region based on a mixture of INRIX, PeMS, and other anecdotal data sources. For I-710, capacity expansion and other improvements are planned on I-710. Please reference the I-710 white paper for more details.

Potential Solutions

- **Familiarize key stakeholders with existing software to avoid delays.** Familiarize the ITS Working Group with some of the current technologies that exist which allow trucks to avoid very congested areas. Examples include TomTom and INRIX data that allows truckers to see incidents and delays. 511 can also be used in advance of a trip.

- **Include dynamic truck routing capabilities in the final ITS project concept.** The final ITS concept should be able to incorporate dynamic truck routing. It is important to note that dynamic routing software technology is already available through a variety of firms in the private sector. Companies such as
TomTom have developed enhanced technologies that will route trucks based on current traffic conditions, size/height/weight restrictions, truck routes, and other critical datapoints that influence the best route for a specific type of vehicle based on current conditions. More widespread use of such technologies on drayage trucks could lead to improved drayage efficiencies. A key next step of concern to the public sector and this project specifically is to determine how to integrate data such as port queues and terminal delay, into devices like the ones provided by TomTom.

**Other Data Issues that Negatively Impact Drayage Productivity (DR-10)**

Section 2 of this document highlights further key data issues that may have a potentially negative impact on drayage productivity. These will not be covered in detail here, but will be listed to highlight their importance. For further information and potential next steps to address these important issues, please reference this report.

### 3.5 **SUMMARY AND NEXT STEPS**

Improving the operations of drayage trucks is a critical step towards improving the bottom line for truck operators, reducing congestion in the Gateway Cities subregion, and reducing freight-related emissions. This report provided more information about drayage processes, drayage operations issues, and potential next steps that can be taken to address these overarching issues. See Table 3.2 in this section for an overview of the issues and steps to potential solutions.
# Table 3.2 Drayage Operations Issues Summary

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<th>Issue/Need</th>
<th>Source</th>
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<th>Potential Solution</th>
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| High queue times at marine terminal gates (DR-1)                           | HTA Meeting, HTA Survey, BNSF Interview | • Queue times outside marine terminal gates are a major concern that reduces productivity of drayage truck operators  
• Each terminal gate is different – it was mentioned by stakeholders that there are differences in how effectively terminals operate.  
• PierPass can lead to queues inside and outside the gates near the time the cost changes.  
• Ship arrival times/days can cause congestion within and around the Ports. | • Forge collaboration between drayage truck operators and MTOs to resolve issues that decrease drayage productivity.  
• Identify best approach(es) for collecting and disseminating current status information (e.g., queue length, time, and real-time/planned staffing of queue gates).  
• Study PierPass impacts and consider recommended adjustments (e.g., fines for parking near cost adjustment periods).  
• Study impacts of ship arrival times on queues and recommend adjustments (including appointment times/penalties).  
• Study improvements to the design of specific terminal gates and the handling of trouble tickets.  
• Implement DR-2, DR-4, DR-5, DR-6, DR-7. |
| Improve quality and dissemination of marine terminal gate queue data to drayage truck fleets (DR-2) | HTA Meeting, HTA Survey | • Up-to-date, specific information about queues at a particular location would allow a drayage truck operator or dispatcher to make better use of limited operating hours.  
• Currently, there are cameras available through a few web sites, such as the PierPass and LATrucker. It should be noted coverage is not universal. | • Encourage collaboration between drayage truck operators and MTOs to resolve issues that decrease productivity.  
• Determine camera infrastructure gaps and camera quality deficiencies.  
• Place cameras at all marine terminal gates make available on the web, and make them more flexible.  
• Explore opportunities for collecting and disseminating real-time marine terminal queue length data. |
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| Congestion within marine terminals (DR-3) | HTA Meeting, HTA Survey, BNSF Interview | - A reduction in turn time would also improve drayage productivity and help drayage fleets increase revenues.  
- A variety of reasons can contribute to delay within marine terminals including issues related to equipment, unloading and loading procedures, and staff availability.  
- PierPass has worked in collaboration with both POLA and POLB to study this issue and made congestion mitigation recommendations. | - Attempt to create more collaboration between drayage truck operators and MTOs to resolve issues that decrease drayage productivity.  
- Explore opportunities to mitigate PierPass-induced truck parking within marine terminals, such as stricter enforcement of no-parking rules.  
- Ship arrival times/days can cause congestion within and around the Ports. Study impacts and recommend adjustments (including appointment times/penalties), including ship arrival information.  
- Explore opportunities to improve the efficiency of “roadability inspections” required by DOT inside the marine terminal.  
- Explore opportunities to improve MTO communication of terminal section closures to drayage truck fleets.  
- Continue to advocate for the congestion mitigation recommendations suggested by PierPass in its port visit time study.  
- Implement DR-5, DR-6, and DR-7. |
| Extra drayage trips (DR-4) | HTA Meeting, HTA Survey | - Dry runs and empty equipment moves result in increased travel times, costs and emissions from trucks.  
- Having improved technology to match loads and reduce empty moves could help limit extra drayage trips. | - Attempt to create more collaboration between drayage truck operators and MTOs to resolve issues that decrease drayage productivity.  
- Further investigate the use of load-matching software in the region and analyze improvements that can be made.  
- Consider GMTMC or clearinghouse for load matching. |
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<th>Issue/Need</th>
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<tr>
<td>Need better communication of issues/closures at terminals to truck fleets (DR-5)</td>
<td>HTA Meeting, HTA Survey</td>
<td>Drayage truck operators sometimes receive limited warning prior to closures of certain parts of the container yard, which requires waiting and repositioning to pick up the container within the yard</td>
<td>Explore opportunities to improve MTO communication of terminal section closures to drayage truck fleets. Develop communication method(s).</td>
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<td>Need better sharing of information between MTOs and drayage truck fleet drivers (DR-6)</td>
<td>HTA Meeting, HTA Survey, BNSF Interview, PierPass Interview</td>
<td>Most drayage productivity problems could be improved by greater collaboration between MTOs and drayage truck operators. Important steps in collaboration have already occurred as part of the PierPass report that focused on turn time issues at the ports.</td>
<td>Continue collaboration and hold more frequent meetings between drayage truck fleet operators and MTOs. Utilize the ITS Working Group as a venue for drayage truck operators and MTOs to start collaborative thinking on solving drayage issues. Identify specific information to be shared, and explain how doing so would benefit MTOs, drayage truck operators and the region as a whole. Develop sharing information concepts.</td>
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<tr>
<td>Improved and expanded goods movement scheduling system to help reduce delay inside and outside the terminals (DR-7)</td>
<td>ITS Integration Plan, HTA Survey</td>
<td>One way to help control peak-hour congestion is through improvements to the truck appointment systems that are in use at POLA and POLB marine terminals. Appointment systems could generate more predictability in terms of daily pickups, which is a positive for drayage truck operators who get paid per move. The primary benefit that customers get from an appointment system is that the reliability of shipment date/time should occur.</td>
<td>Explore the willingness of MTOs and regional stakeholders to work together to implement a comprehensive goods movement scheduling system. Work with terminals and vendors to better understand the current appointment systems in use. Work with ITS Working Group to highlight the benefits of a comprehensive scheduling and container tracking system. Develop comprehensive, reliable scheduling and appointment system.</td>
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<td>Issue/Need</td>
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| Provide railyards and customers with more timely container arrival information (DR-8) | BNSF Interview                        | ● Currently, customers are informed that a shipment is coming at a certain date/time. However, the process used to update these clients of delays or changes in delivery date requires further investigation. | ● Familiarize key stakeholders with existing software to avoid delays.  
● Include dynamic truck routing capabilities in the final ITS project concept.  
● Developing tracking system to determine (or estimate) container arrival times. |
| Truck congestion on key Gateway Cities roadways (DR-9)                      | HTA Meeting, HTA Survey               | ● Congestion on roads and arterials outside of terminal gates impedes drayage truck productivity, especially during peak hours.  
● Ongoing SCAG analysis will help identify the key truck bottlenecks in the southern California region. | ● Collect information on key congested highway segments and arterials in the Gateway Cities area.  
● Recommend mitigation project concept development for high-truck congestion highways and roads.  
● Develop congestion information system to provide real-time trucker information. |
| Other data issues that negatively impact drayage productivity (DR-10)       | N/A                                   | ● There are other key data issues that have a potentially negative impact on drayage productivity.                  | ● See the matrix in Section 2 with TM recommendations.                                                                                       |
The ITS Working Group should also monitor current Federal research and projects regarding freight ITS. In particular, the FHWA is now developing a Concept of Operations (ConOps) for a Freight Advanced Traveler Information System (FRATIS). FRATIS will consist of two application “bundles”:

1. **Freight-Specific Dynamic Travel Planning and Performance** - This application bundle will include all of the traveler information, dynamic routing, and performance monitoring elements identified in an assessment of user needs for FRATIS. The application will leverage existing data in the public domain, as well as emerging private sector applications, to provide benefits to both sectors. For the private sector, this includes truck trip preplanning and dynamic routing with regulatory information. Public sector users would receive enhanced performance monitoring capabilities including real-time assessments of truck bottlenecks and delays, which will also be useful for transportation planning.

2. **Intermodal Drayage Operations Optimization** - This application bundle is a subset of Freight-Specific Dynamic Travel Planning and Performance. It 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.

Given its importance as a national/international freight hub and its advanced ITS capabilities, the Gateway Cities subregion has already been identified as a potential test bed for initial FRATIS deployments.

Now that the issues have been defined and potential next steps identified to help address some of these issues, the project team should use this information to move towards defining drayage ITS system needs in the region. This will involve close collaboration within the project team and with the ITS Working Group to determine which issues should be addressed, and in what way. A key next step will be coordinating with other project tasks, including Truck Parking, Truck Fleet Communications, and ITS Data and Transportation Management, to define which ITS alternatives would best address some of the main themes.

The next deliverable (Task 2) involves the development of a PowerPoint presentation that highlights which technology improvements could have a significant impact on the efficiency of drayage operations in the region. This

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20FRATIS user needs were assessed through a series of Intermodal Freight Technology Working Group meetings held throughout the country in the fall of 2011 and winter of 2012, as well as a scientific survey of more than 300 drayage and long-haul trucking firms.
report touched on some of the key issues and potential next steps/solutions, which is the starting point for arriving at the next deliverable.

- Deliverable #1, Research Memorandum: Drayage Operations Background Research Memorandum (this document).

- **Next: Task 2. Define Drayage System ITS Needs and Select Drayage Improvement Focus Areas**
  - Deliverable: PowerPoint presentation highlighting which technology improvements could have a significant positive impact on drayage operations in the Gateway Cities area.

- Task 3. Development and Evaluation of Alternatives

- Task 4. Conceptual Design of Preferred Alternatives for Drayage ITS Improvements
  - Deliverable: Technical Memorandum: Report highlighting the conceptual design of preferred alternatives.
4.0 Private Sector Fleet Management and Dynamic Mobility Applications

EXECUTIVE SUMMARY

The first phase of the 2008 Gateway Cities ITS Plan found a need for fourteen (14) individual studies of potential technology solutions to move goods more safely and efficiently through the region. The second phase ( commenced in June 2011) involved reassessment of the 2008 study and revisions to the study areas. As a result of the revisions, there are thirteen (13) newly defined feasibility studies, divided into five key report areas. This report is the result of Task 1 (Background Research) for the ET-2 feasibility study, namely, Private Sector Fleet Management Information and Dynamic Mobility Applications. This study resides in the Emerging Goods Movement and Technology Applications Group. The primary objective of this report is to identify and assess state-of-the-art truck fleet communication systems, dynamic mobility applications, and other technologies deploying ITS connectivity between the public and private systems.

Overview

As the name suggests, Fleet Management involves the management of a business’ fleet. Vehicle maintenance, telematics (integration of telecommunications and informatics), driver management, fuel, safety, and health management are amongst some of the functions of fleet management. The goal is to lower the risk a company assumes while improving productivity and efficiency of its operations. Companies that own a fleet of commercial vehicles also are looking to keep costs down and comply with government regulations as they relate to them and their industry. The most basic function in all fleet management systems is the vehicle tracking component. This component is usually GPS based. Once vehicle location, direction, and speed are determined from the GPS components, additional tracking capabilities transmit this information to a fleet management software application.

Companies can either handle fleet management themselves (in-house) or outsource the duties. Many companies utilize fleet management software and systems to manage their fleet. It is used to handle all management-related tasks
from the beginning of the vehicle management cycle to the end of it. It monitors fleet functions from the initial acquisition of a vehicle to its disposal. Fleet management software handles functions, such as vehicle tracking, vehicle/driver profiling, trip planning, dispatch via GPS fleet tracking, vehicle diagnostic reports, etc.

**Truck Fleet Management Applications**

There are many technologies in the market that offer fleet tracking capabilities and several vendor-based systems that offer fleet management services. INRIX, NAVTEQ, Advent, Teletrac, TomTom, and XATA Turnpike are a few vendors that provide fleet management and tracking capabilities. Most of these systems enable companies to provide the following capabilities:

- **Vehicle tracking.** The most basic function in all fleet management systems is the vehicle tracking component. This component is usually GPS based. Companies can track vehicle and driver location at any given time, thereby, providing them better visibility and control. Recent advances in fleet management allow for the addition of over-the-air (OTA) security and control of fleet vehicles. It can provide remote control features, such as geofencing and active disabling, thereby, securing the vehicle while stopped or not in operation, and the ability to safely disable a vehicle while in operation. This allows the fleet manager to recover stolen or rogue vehicles while reducing the chance of lost or stolen cargo.

- **Vehicle diagnostics.** Advanced GPS tracking and management systems can connect to the vehicle’s engine bus and gather data for the user. Details such as mileage, fuel consumption, speed, idling time, and braking data are gathered and related to a management site, depending on the type of hardware installed in the vehicles.

- **Electronic Hours-of-Service (HOS) logs and reports.** Automates truck driver logs for improved reporting accuracy, driver productivity, and fleet compliance. The system can automatically notify managers, dispatchers, and drivers of impending or actual HOS violations. Driver input is significantly minimized as GPS is used to record driving time. Additionally, customized reports (both on-line and pdf/csv formats) allow users to view data in a way that best suits their needs. Reports including driving events (harsh brake, fast turns), excessive idling, speed exceptions, mileage, etc. can be made available as desired.

**U.S. DOT Programs and Initiatives**

There are several emerging U.S. DOT programs/initiatives relevant to fleet management applications and those that focus on ITS connectivity between the public and private systems. Some of them are listed below:
• **Connected Vehicle Research.** Connected Vehicle (previously Intellidrive) research is a multimodal initiative that aims to enable safe, interoperable networked wireless communications among vehicles, the infrastructure, and passengers’ personal communications devices. DOT’s goal is to complete the majority of this research by 2013. In 2013, U.S. DOT also intends to decide whether the applications show enough promise to merit deployment, and to determine whether regulation or other government action will be needed to speed deployment of these applications. Activities have been underway in Japan and Europe. Cooperative Vehicle-Infrastructure Systems (CVIS) is a major European research and development project aiming to design, develop, and test the technologies needed to allow cars to communicate with each other and with the nearby roadside infrastructure.

• **Dynamic Mobility Applications (DMA) Program.** The FHWA’s DMA program (which is one component of the Connected Vehicle Applications) seeks to identify, develop, and deploy applications that leverage the full potential of connected vehicles, travelers, and infrastructure to enhance current operational practices and transform future surface transportation systems management. This research will examine what technologies can help people and goods effortlessly transfer from one mode of travel (car, bus, truck, train, etc.), or route to another for the fastest and most environmentally friendly trip. The research seeks to make cross-modal travel truly possible for people and goods, and enable agencies and companies to manage their systems in light of the fact that people and goods will be changing modes often. The DMA program is comprised of three phases over five years: Foundational Analysis (Phase 1), Tool Development (Phase 2), and Focused Deployment (Phase 3). In 2011, the DMA Program concluded the first phase of activity focused on foundational research and moved into a second phase focused on applications development and testing, initiating coordinated research activities on a portfolio of 10 high-priority mobility applications. As a first step, the DMA Program will seek to partner with the research community to further develop the following ten transformative concepts and to refine data and communications needs. These needs will inform related efforts in the Real-Time Data Capture and Management Program in support of application development to collect, assemble, and provide relevant data resources integrating data from wirelessly connected vehicles, travelers, and roadside/wayside infrastructure. The resulting well-organized data and associated descriptors (collectively known as data environments) will include data from field tests and advanced simulation models and be made broadly available. Later in Phase 2 of the Mobility Program, selected mobility applications will be identified for further development, testing, and benefits assessment utilizing these open data environments.

• **Freight Advanced Traveler Information System (FRATIS).** The FHWA is developing a Concept of Operations (ConOps) and Functional Requirements for a FRATIS. This project encompasses the ConOps for the freight and
commercial vehicle operations (CVO) DMA, which is part of the larger DMA program described above. These Functional Requirements for the FRATIS ConOps programs are leveraging developments in the private sector, including smart phones, Dedicated Short-Range Communications (DSRC) 5.9 GHz, and other technologies, to develop a series of future phased deployment packages. These packages are leading the deployment of freight/CVO DMAs, encompassing freight real-time traveler information, truck dynamic routing, automated OS/OW planning, and real-time load matching for freight pickups and deliveries. The ongoing FRATIS study focuses on three identified freight application bundles, including a Freight Dynamic Route Guidance piece (the other bundles are Freight Advanced Traveler Information with Performance Measures and Drayage Optimization.). This DMA is intended to leverage emerging industry technologies and applications to provide rerouting information in real time. For example, INRIX already has deployed an initial capability that can provide an in-vehicle alert (through a voice alert from an iPhone or Android phone) with rerouting information to a truck driver, thus enabling real-time dynamic route guidance.

As part of this effort, by June 2012, Cambridge Systematics will develop the initial user needs, ConOps and System Requirements for FRATIS. Under the defined vision for FRATIS, U.S. DOT would reach out to the niche private-sector firms that already are designing and deploying revolutionary technologies related to Freight DMA; and develop the FRATIS applications in collaboration with these firms (e.g., iPhone and Android applications for FRATIS traveler information, dynamic routing, and load matching). Anticipated FRATIS application life cycle is six to eighteen months, and is based on continual interaction and feedback with customers/consumers.

Fleet Management Technologies Used by Stakeholders in the Gateway Cities Subregion

Cambridge Systematics conducted a workshop with private-sector stakeholders (mostly trucking companies registered with the Harbor Trucking Association) on November 15, 2011, to learn first-hand about the issues that negatively impact the productivity of truck-based goods movement in the Gateway Cities subregion, and also obtain input on technology and fleet management communications. In addition to this stakeholder workshop, Cambridge Systematics sent an online survey to approximately 100 members of the Harbor Trucking Association (HTA).

During the stakeholder workshop and the online survey process, stakeholders provided information on the fleet management systems used by their companies. The following points summarize the information they provided:
Almost all of the trucks enrolled in the HTA are equipped with latest fleet communication systems. All trucks are smart now (and newer) because of 2008 air quality regulations.

Commonly used Fleet Management Systems are Teletrac, Xata Turnpike (via Sprint), Sysquest, Globalcomm, Qualcomm, etc.

These fleet management systems are equipped with on-board systems and GPS antennas that provide two-way communication and assist in location tracking. These systems also connect to the engine bus and provide fuel use, speed information, and other odometer-based data.

Even though most fleet management systems are modular, the buyer can choose to include whatever data is needed for management purposes. Sample cost of such a system is approximately $500 initially, and then up to $25 per month.

All participants agreed that these fleet management systems have improved their productivity and operational efficiency. Even though they could not quantify it, they believe that it has improved their bottom line tremendously.

At this time, 56 percent of the 47 respondents who took the survey noted that routing decisions are communicated manually via the dispatcher. Five percent of the respondents noted that the decisions are automated via their on-board fleet communication system. Another five (5) percent of the respondents indicated that the drivers make routing decisions based on information heard from other drivers. Two percent of the survey respondents indicated that decisions are made as a combination of dispatch and driver information.

Conclusions

GPS used for fleet management by trucking companies provide probe data that can support a truck performance-monitoring program. There are several private-sector fleet management technologies and systems in the marketplace. There also is significant advancement being made in these systems – the range of functions and the data that these systems provide are continually improving. Effort should be taken to leveraging the existing technologies and data sources. Creating public-private partnerships to collect, analyze, and disseminate data and performance measures using GPS positional data from commercial truck fleets is a route that could be considered. Partnerships can be made with direct aggregator or third-party companies (such as INRIX) and other GPS vendors to acquire fleet management data, and then process those data so they can eventually be used for a network-based truck performance measures program. It is important to note the challenges associated with such partnerships, such as maintaining data confidentiality for the trucking industry partners who are providing the GPS data. The data is actually owned by the providers who govern whether and how it can be shared. Because a large proportion of real-
time information is crowd-sourced, the crowd has to be able to trust that their information will not be misused or shared inappropriately. Most of the private aggregator companies already have developed methods of safeguarding the privacy of individuals and the information they provide. These methods will continue to evolve as the number of channels providing crowd-sourced information grows.

Additionally, outreach is important in order to educate carriers about the partnership benefits to the private sector of allowing better regional freight advanced traveler information systems (ATIS) and connectivity to new applications that the Gateway Cities Technology Plan might offer, such as container pick-up information, real-time terminal queue data, etc. Agreements should be drafted in a way that defines these mutual benefits to parties, while at the same time maintaining the confidentiality of the fleet providers.

**Next Steps**

The fleet management system overviews and information resulting from this background research will be used to further identify gaps, as well as opportunities to leverage existing data sources and related technology to implement innovative solutions to address freight movement and traveler information needs in the ports and Gateway Cities subregion. This will result in further identification and refinement of potential solutions, coordination with recommendations from other project areas, and evaluating and packaging alternatives to address the ITS data needs in the region.

### 4.2 INTRODUCTION

The primary objective of this report is to identify and assess state-of-the-art truck fleet communication systems, dynamic mobility applications, and other technologies deploying ITS connectivity between the public and private systems. This background research report is a result of the literature review conducted as the first task of the feasibility study. A key first step in this process is to assess the existing body of work related to private sector fleet management information and dynamic mobility applications. Understanding the technologies, capabilities, and lessons learned from previous efforts is an important part of this study. This assessment of relevant technologies and systems (both prior and ongoing efforts) fulfills that requirement.

Fleet management in simple terms is essentially the management of a company’s vehicle fleet. Fleet management can include a range of functions, such as vehicle financing, vehicle maintenance, vehicle telematics (tracking and diagnostics), driver management, speed/fuel management, and health/safety management.
Effective fleet management aims to:

- Minimize the risks associated with vehicle investment,
- Improve efficiency and productivity,
- Improve safety,
- Streamline regulatory compliance,
- Ensure customer satisfaction, and
- Reduce overall costs.

The most basic function in all fleet management systems is the vehicle tracking component. This component is usually GPS based. Once vehicle location, direction, and speed are determined from the GPS components, additional tracking capabilities transmit this information to a fleet management software application. Methods for data transmission include both cellular (terrestrial) and satellite. While cellular communication is more common in the private sector, satellite communications, while more expensive, are critical in some public-sector applications. For instance, in military applications, if vehicle tracking is to work in remote environments without interruption, then satellite communication is preferred over cellular. Vehicle tracking component enables users to see actual, real-time locations of their fleet on a map. This is often used to quickly respond to events in the field. Fleet management software, depending on its capabilities, allows functions such as driver, vehicle and trip profiling, two-way communications between driver and dispatch, and remote control features, such as geofencing and active disabling. Current vehicle diagnostic information also can be relayed to a management site, depending on the type of hardware installed in the vehicles. While in the past, custom software would need to be installed per unit, in recent times on-line software platforms are very popular: users no longer have to install software, and they can access the application through a web browser. There are numerous vendors in the market that offer a wide range of fleet management solutions.

There are several U.S. DOT-sponsored programs, including Cross Town Improvement Program (C-TIP), FRATIS, Wireless Roadside Inspection (WRI), and Connected Vehicle, which encompass elements in the dynamic mobility applications realm.

The following sections provide detailed information on truck fleet communication systems, new and emerging U.S. DOT-based programs related to this study, and current systems used by the private-sector stakeholders in the Gateway Cities region.

The remainder of this report is organized as follows:

- Section 4.3, Truck Fleet Management and Dynamic Route Guidance Applications provides an overview of the different technologies in the market that offer fleet communication capabilities. This section also
summarizes several vendor-based, state-of-the-art, fleet management systems that provide truck fleet management capabilities. Additionally, this section also assesses current efforts in the emerging area of dynamic routing for trucks. This includes the C-TIP Dynamic Route Guidance component, as well as applications that have emerged simultaneously in the marketplace, for example, from INRIX. Where applicable, non-freight dynamic routing applications are discussed, while keeping in mind how these applications may differ from the unique requirements for large freight vehicles.

- **Section 4.4, U.S. DOT Programs and Initiatives** summarizes government-sponsored programs that are not necessarily focused on fleet management, but that encompass related components, such as the connectivity between public and private systems, dynamic routing, GPS-based tracking, etc. This summary includes prior implementations, such as Hazardous Materials Truck Tracking, as well as ongoing initiatives, such as C-TIP, WRI, Connected Vehicle, and FRATIS.

- **Section 4.5, Fleet Management Technologies Used by Stakeholders in the GCCOG subregion** provides an overview of the current fleet management systems and functionalities used by private-sector stakeholders in the subregion. This section also summarizes the input provided by private-sector stakeholders during the workshop conducted in November 2011, and the results of the on-line survey of HTA Members soliciting information about their fleet management systems.

- **Section 4.6, Conclusions** reviews the key findings and lessons based on the existing body of knowledge.

### 4.3 Truck Fleet Management and Dynamic Route Guidance Capabilities

There are many technologies in the market that offer fleet management capabilities. Short descriptions of these technologies and relevant vendor-based systems that offer comprehensive automated fleet management are detailed below. This section also assesses current efforts in the emerging area of dynamic routing for trucks.

**Truck Fleet Communication Technologies**

Described below are several generic technologies that offer some form of fleet communication functionality.

*Satellite/Wireless Terrestrial with GPS Communications Systems*

This technology is designed to use satellite-based GPS technology to provide current vehicle positioning, including latitude and longitude readings. Another wireless communication system is a terrestrial-based communication link
designed to allow two-way communications. Both satellite and terrestrial communications are designed to generated vehicle position with every message. Position information can be generated upon request from the dispatch computer, and position-reporting frequency can be configured at the system user’s discretion.

Vehicle position data provided by GPS units has achieved widespread adoption in the trucking and logistics industries due to recognized benefits in terms of shipment visibility, fleet management, and security. Trucks can be located quickly at any time and from any location. Dispatchers can quickly respond to customer inquiries about the location of their loads, while fleet managers can analyze archived positional data to gather actionable business intelligence. From a security perspective, near constant visibility enables faster recovery if a vehicle is stolen.

**Digital Phone without GPS**

This technology permits transmission of integrated work order assignment and status messaging between motor carrier dispatch and driver utilizing a digital cellular handset unit. Software applications allow a carrier the capability to send a driver a load assignment that the driver will accept or reject. Upon load acceptance, the driver is provided with specific details pertaining to the particular load assignment. The software applications enable drivers to send and receive up to five macros (selection options) pertaining to progress conditions for each load assignment:

- Accept/Reject Load assignment,
- Arrived,
- Started,
- Stopped, and
- Departed.

One early test of cell phone-based messaging in the trucking environment revealed significant obstacles in terms of information display (the tested phones had very small screens), poor cellular coverage, short battery life, and the lack of GPS capability.\(^{21}\) However, it is likely that these issues have been overcome since that test. Text messaging is now widely used in fleet applications; for example, to update a carrier’s IT system with load pick up/drop off information, which improves shipment visibility and speeds up the billing process. Moreover, the growing penetration of GPS-enabled smart phones has introduced

new possibilities for in-cab deployments using the phones rather than separate GPS devices.

**Panic Buttons**

“Panic Button” technology enables a driver to remotely send an emergency alert notification message either via satellite or terrestrial communications, and/or utilize the remote Panic Button to disable the vehicle. It can be deployed in different configurations:

- A Panic Button mounted inside the vehicle to send an emergency alert notification.

- A wireless Panic Button that can be carried by the driver to remotely send an emergency alert and/or use the remote Panic Button to disable the vehicle. The wireless Panic Button is carried by the driver and has a range of 150 feet.

Panic buttons are widely accepted in the motor carrier community as a security measure, and are in fact required by the DOT and the U.S. Department of Defense for the transport of certain goods, such as munitions. They can be used to alert fleet management and law enforcement about vehicle security breaches, and can be especially useful in remote areas where cell phone coverage may be poor. Panic buttons can be combined with a vehicle-disabling capability, which allows the driver to respond directly when an unauthorized party attempts to gain control of the truck.

**Global Login**

Global Login is an identification technology that is enabled via the wireless communication system maintained by on-board software. A driver enters login information (consisting of a user identifier [ID] and password) into a cab-based interface. The login information is verified within the truck and remotely using the wireless communication system. If the Global Login fails, alert notifications are sent to the motor carrier for further action, including vehicle disabling. Global Login is able to track driver logins/logoffs and other event types via drivers entering a username and password into an in-cab computer. It ensures driver identity and blocks unauthorized access, assuming drivers’ login information remains secure. Computer logins have the advantage of taking little time to complete and requiring minimal driver training.

**Biometric Global Login**

Biometric Global Login is accomplished via a biometric verification unit in the motor vehicle. The Biometric system consists of a Central Processing Unit (CPU) and proprietary firmware that manages a smart card reader and fingerprint scanner to execute biometric verification on the driver. These systems can be configured to operate with the truck’s on-board communications systems. Like the Global Login, they can track driver identity and other trip events. It also is
more secure since access to the vehicle is controlled by unique biological characteristics of the driver (e.g., a fingerprint), which cannot be easily compromised or duplicated. However, one field test of these technologies found considerable limitations in their real-world usefulness, primarily related to difficulty in obtaining a usable fingerprint read.22

**Electronic Supply Chain Manifest**

The electronic supply chain manifest (ESCM) system is designed to provide positive personnel (chain of custody) identification and load-tracking capabilities for the parties involved with cargo shipments. The ESCM system integrates biometric verification, smartcards, Internet applications, and on-board wireless communications.

The ESCM system is initiated with a shipper biometrically logging onto the system and creating an electronic manifest, as well as identifying the load assignment. Upon completion of the electronic manifest, the shipper transmits the manifest to a secure central server and logs out. All authorized users are notified via e-mail regarding the manifest submission. The hazmat shipment information is then stored and routed through a central database. All authorized users are required to log on biometrically to gain access to the ESCM at any point in the shipment. Also, encrypted “smart cards” containing vital shipper, cargo, and driver information are used to transfer and validate hazmat shipment movement information.

Although test participants recognized the potential of this system in terms of reducing paperwork errors and the duplicative entry of the same shipment information at different times across the supply chain, the 2004 Hazardous Materials Safety and Security Field Operational Test failed to generate significant use during the operational test. This can be partially blamed on the biometric login process, which experienced its own technical issues, as described above. Another problem was that effective use of the system required participation from all supply chain partners, including shippers, carriers, and consignees. Such collaboration was not typically achieved during the test.23

**Intelligent On-Board Computers**

On-Board Computers (OBCs) can be integrated with wireless communications/vehicle operating systems. The OBC permits the motor vehicle to be disabled in the event of a security breach. These disabling techniques include blocking fuel or sending instructions via the wireless communications system directly to the

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23Ibid.
vehicle’s data bus, which causes loss of throttle power to the motor vehicle. The OBC also can be configured to shut down the vehicle whenever there is a loss of satellite signal strength, such as when cables are tampered with or the receiver unit is covered. However, participants in the 2004 hazmat test expressed reservations about shutting down a vehicle while it is in motion with other traffic, and therefore did not view it as a feasible option for real-world operations.24

**Internal Trailer Door Lock**

Internal door locks enable a dispatcher to lock and unlock trailer door locks via an over-the-air command. Upon arrival at the consignee’s location, the driver sends trailer door unlock requests to the dispatcher. The dispatcher then sends an unlock command upon verification of the driver request. Requests to lock and unlock the doors are sent to the dispatcher using the wireless communication system. The OBC then facilitates the execution of the lock and unlock events. A specific button installed in the dash of the truck signals the driver as to when the trailer doors can be securely opened.

Once the unlock command has been sent and the driver has pressed the “door open” button, drivers usually have a certain amount of time – say, 20 seconds – to open the doors before the doors will automatically relock. If the doors relock before the driver is able to open them, the driver must contact the dispatcher to request that the dispatcher resend the door open command. This basic application was deemed to have some merit as a security measure by at least one participant in the 2004 hazmat test, but it is unclear if it has been widely adopted since then.25

**External Electronic Seal**

Wireless electronic tag seal (E-seal) systems are web-based applications designed to automatically generate an alert notification when a cargo seal is compromised without proper authorization. E-seals use short-range wireless communications to interface with a mobile E-seal reader in the vehicle. The mobile reader is connected to the on-board wireless communications device, and the cargo alert notifications are transmitted automatically to the dispatcher. The Hazmat Technologies Field Operational Test found that E-seals were not a realistic option for ensuring shipment security due to the difficulty drivers had operating them, and some technical challenges related to heavy steel doors on cargo trailers that required the devices to be mounted on the side of the trailer far away from the rear doors. However, later tests in Washington State successfully used E-seals to

24Ibid.

25Ibid.
ensure shipments of prohibited food-stuffs remained uncompromised during transit, and to expedite the processing of auto parts from Japan.

**Geofencing**

Internet-based Geofencing and route-monitoring capabilities are designed to allow authorized users to define a risk area or route to monitor. An “electronic fence” can be placed around the route or designated landmark on a displayable Internet-based map. If a driver deviates from a specified route or approaches a risk area, the Geofencing system should notify the dispatcher. If the vehicle enters the risk area, an alert notification should be sent to the carrier’s dispatch center. Other applications include alerts if vehicle is stolen. Geofencing is a potentially powerful tool for asset tracking and security purposes, but positional information needs to be sent frequently enough – and in near real time – to make it actionable for fleet managers. It is likely that the cost of obtaining such data has fallen dramatically in recent years, making this an attractive option for security-sensitive shipments.

**Tethered and Untethered Trailer Tracking**

Tethered Trailer Tracking allows dispatchers to remotely monitor trailer “connect” and “disconnect” events. Tethered Trailer Tracking allows users to view connect and disconnect events by the installed mobile unit and transmit to dispatch across a satellite link with information on the date, time, and connect/disconnect location.

Untethered Trailer Tracking systems are designed to provide real-time trailer identification regarding connect/disconnect time and location, Geofencing, and unscheduled movement. The systems use a multimode Terrestrial Wireless Communications technology designed to provide more geographic coverage by eliminating blackouts and “dead” zones.

In the 2004 hazmat test, dispatchers found it useful to be able to detect trailer connects and disconnects with the Tethered Trailer Tracking, and the ability to track an unconnected trailer as another authorized carrier moved it. More recently deployed private sector systems (such as one from Qualcomm) can track trailer location, whether they are connected to a tractor, and whether they are loaded or unloaded. This information is useful for reducing trailer drops at unauthorized locations and unauthorized use of trailers for storage. Knowing where trailers are in near real-time helps improve asset utilization as well.

**Commercial Off-the-Shelf Truck Fleet Management Systems**

Described below are several vendor-based systems that offer fleet management services in the market.
Qualcomm

Qualcomm has developed a suite of fleet management applications targeted specifically towards commercial vehicles. Qualcomm’s Mobile Computing Platform (MCP) is a safety-focused solution that helps fleets monitor and manage safety and regulatory compliance, and improve asset visibility and productivity. These MCPs enable fleets of all sizes to comply with the FMCSA’s regulations on driver hours, improve performance related to the Comprehensive Safety Analysis (CSA) Safety Measurement System (SMS) scoring methodology, and provide two-way information delivery between drivers and dispatch. In-cab services are delivered through the MCPs that fleets purchase and install on their vehicles. The MCP also can act as Electronic On-Board Recorders (EOBR), which may be an FMCSA requirement in the future. The key fleet management applications include:

- **In-cab navigation.** CoPilot Truck is a customizable navigation application providing digital mapping enhanced with truck-specific attributes and points of interest. Drivers can input desired parameters, such as toll avoidance, routes suitable for 53-foot trailers/twins, and practical miles/shortest miles, or National Network. The software also can provide hazmat routing, route restrictions, and trucker points of interest like weigh stations and truck stops. Drivers can enter up to fifty (50) stops on their itinerary to determine optimal routing, and the software bases routing decisions partially on factors like vehicle size and load type to help minimize tolls and fuel use.

- **Performance monitoring and fuel consumption.** Tracks driver and vehicle performance (e.g., hard braking, idle time, speeding) to identify causes of excessive fuel use and take corrective action. Managers can provide their drivers with the most fuel-efficient routing through a connection with the in-cab navigation feature. The system can quantify the impact of fuel wastage on the firm’s bottom line.

- **CSA safety performance service.** Integrates data from the new Federal Motor Carrier Safety Administration (FMCSA) SMS with existing data feeds

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26Practical miles are generally considered the best routes for large trucks to take, based on roadway characteristics and travel time. Shortest miles (also called ‘household goods miles’) refers to routes that are shorter in terms of distance, but frequently take longer because they use roads of lower functional classifications. Trucking companies usually pay drivers based on shortest distance miles, even though drivers will almost always take the practical miles route to save time.

27The National Network is the network of state and Interstate highways approved for commercial truck use in the U.S., authorized by the Surface Transportation Assistance Act of 1982. Federal width and length limits for commercial vehicles apply on these facilities.
from the Qualcomm services that fleets subscribe to, thus, providing proactive monitoring of key safety metrics that can result in fines or regulatory intervention if left unchecked.

- **HOS.** Automates truck driver logs for improved reporting accuracy, driver productivity, and fleet compliance. The system can automatically notify managers, dispatchers, and drivers of impending or actual HOS violations.

- **Analytics manager.** Generates dashboards, graphs, and tables to monitor fleet performance metrics with the data generated by installed MCPs. Data can be exported in common file formats and queried by date; an enhanced package offers additional capabilities, such as industry benchmarking and comparison of driver/vehicle groups to other driver or vehicle groups.

- **Critical event reporting.** Monitors hard braking, driver-initiated alerts, and key on-board sensor data and sends alerts when critical safety events occur. This information is used to improve driver safety, reduce liability, and develop accurate understanding of critical events and unsafe driving behaviors.

- **Vehicle inspection report.** This application allows drivers to file Vehicle Inspection Reports (as required by FMCSA) electronically through a Qualcomm-hosted application, thus eliminating paper reports and allowing automated searching of reports. E-mail alerts are sent when drivers file tractor or trailer defect information, and drivers are automatically notified when these reports are updated and closed by fleet maintenance personnel. If used in combination with the HOS application, the need for paper logbooks is eliminated.

- **Vehicle maintenance.** Monitors the most common engine fault codes and provides near real-time alerts when they occur. This helps reduce on-road breakdowns and out-of-network repairs.

Other optional services on select MCP models include Circle of Service (automated driver workflow and exception information); Trip Manager (plan, view, and manage trips in near real-time); in-cab fuel services (in-cab fuel stop location and pricing to assist with fuel taxes); in-cab media delivery and document scanning; proof of delivery; video training; Wi-Fi access; and Amber Alerts.

Qualcomm provides another service called Maptuit NaviGo, which provides near real-time navigation, including a dynamic routing feature. This includes near real-time position reporting with rerouting capabilities, as well as a route compliance feature enabling dispatchers to assess how well their drivers are following plans. The GPS tracking capability also can help drivers and dispatchers avoid truck-restricted routes, residential areas, low bridges, and other truck-specific hazards.
Qualcomm also offers an asset management system to keep track of trailer location and utilization. The Trailer Tracks 210 (TT210) platform can show trailer location within the U.S., Canada, and Mexico; whether they are connected to a tractor; whether they are loaded or unloaded; any unauthorized trailer drops; and unauthorized use for storage. Optional sensors can detect the opening and closing of trailer doors and the presence of cargo. TT210 is independent of truck-based mobile information systems.

INRIX

INRIX is a leading provider of traffic information and driver services based in Seattle, Washington. INRIX has more than 200 customers and industry partners internationally, including Ford, Toyota, BMW, Audi, TomTom, Navigon, Motorola, MapQuest, the Texas Transportation Institute, Microsoft, Clear Channel Radio’s Total Traffic Network, TeleNav, the I-95 Corridor Coalition, Garmin, Tele Atlas, deCarta, ITIS Holdings, Mio, Navigon, Telmap, ANWB, ARC Transistance, TNO, and many state DOTs. They fuse traffic data from a variety of sources (DOT sensors, truck fleet GPS devices, and cell phones).

INRIX has the world’s largest traffic network, including more than 10 million GPS-enabled vehicles from more than 400 sources, and encompassing major roadways in 20 countries throughout North America and Europe. Using this data, INRIX has developed mapping and route guidance applications, including its latest Third Generation Routing Engine. This application uses the firm’s Total Fusion technology – which blends real-time traffic flow data from approximately 10 million GPS-enabled fleet vehicles and consumer cellular GPS-based devices with road sensor data – to provide time-intelligent routing services. The Third Generation Routing Engine incorporates real-time, historical, and predictive travel time information, enabling the application to determine how traffic is expected to change during the course of the trip and advise the user accordingly. An example of the INRIX route guidance application is shown in Figure 4.1.

INRIX also has a Fleet Services division providing services in many areas to commercial users:

- Dispatch Services provides access to speed information and real-time incident alerts for city streets, arterials, and major freeways to dispatch staff to enable the best routing decisions.

- Next-Day Planning allows subscribers to optimize delivery schedules using predictive and historical traffic data with real-world expected travel times between stops. Fleet managers can plug typical speed data from INRIX for all major roads into their scheduling engines to identify the best routes.

- Traffic Map Overlays lets users add real-time traffic to existing mapping applications through INRIX’s hosted Traffic Tile Service, which can deliver incident reports, congestion alerts, traffic conditions, and traffic camera views overlayed on customers’ existing map platforms.
Congestion Pricing allows users to adjust pick-up and delivery costs based on expected impacts of traffic on travel time and fuel use.

Fastest Routes and Precise ETAs uses the Third Generation Routing Engine to get precise routes and accurate ETAs.

Driver Services includes traffic within navigation capabilities, traffic along the driver’s route, and traffic maps to allow commercial drivers to avoid traffic delays and maximize efficiency under HOS and other regulations.

Currently, INRIX is working on the fourth generation routing engine, where typical preferred routes of users in local area will be identified and determined for use in routing decisions.

Overall, INRIX specializes in the provision of real-time traffic, incident, weather, and other information (such as gas prices and points of interest). Most of the applications (8 out of 10) are getting real-time data and obtaining it via INRIX. At the moment, it does not appear to offer comprehensive fleet management solutions, which tend to include more specialized freight applications like fuel economy and hard braking events gathered through a connection to a truck’s engine computer. However, INRIX can provide data to interface with a company’s existing fleet management system. For example, a firm could overlay INRIX real-time traffic data on its existing routing application.
NAVTEQ

Like INRIX, NAVTEQ is primarily a data provider. The company specializes in the provision of digital map data for use by automotive GPS systems, wireless devices, and Internet-based mapping applications. NAVTEQ has a Fleet and Logistics division that provides location and map data for use by fleet managers. Specialty fleet data products include:

- **NAVTEQ Transport**, which is designed specifically for the commercial trucking industry with information such as physical/legal restrictions and advance warning of truck hazards like steep grades, sharp curves, and high lateral winds;
- Integrated navigation to connect fleet back office IT systems with in-vehicle navigation, thus enabling two-way communication for route calculation and delivery fleet optimization; and
- A fuel station data set covering more than 17,000 gas stations in Europe with data on accessibility by trucks, type of fuels sold, and payment options.

These applications are typically run on top of a client firm’s existing fleet optimization/dispatch software. For example, Coca-Cola’s European bottler and distributor used NAVTEQ route and location information, in conjunction with ORTEC Vehicle Routing and Dispatch software. This allowed dispatchers to plan optimal routes (minimizing miles and driver hours) in less time while determining better overall delivery strategies. According to a case study on NAVTEQ’s web site, this solution saved Coca-Cola $45 million annually.28

NAVTEQ map and navigation data also have been integrated into asset and cargo tracking systems for logistics companies. GEFCO, a European logistics firm, used NAVTEQ map data (including turn-by-turn directions and travel times), in conjunction with a GPS tracking solution provided by another company to track trucks and cargo across Europe. Truck position information is sent to a server every 15 minutes, improving shipment visibility for GEFCO and its customers. The GPS devices are ‘plug and play’ so they can be easily moved between trucks. One key advantage of the solution is that it offers a single provider for both the telecom and fleet subscription.29

NAVTEQ provides the data set for the Department of Homeland Security (DHS), whose emergency management plans use NAVTEQ maps.

NAVTEQ digital map data is available in traditional GIS data formats, and also in Relational Database Format (RDF), permitting direct integration into relational database applications like Oracle 10G/11G, IBM DB2 and Microsoft SQLServer.

This makes it directly accessible through spatial extensions of those applications, reducing data integration time.

**Advent**

Advent is a software and solutions provider catering to the ocean and intermodal transportation sectors. Advent has provided a number of solutions supporting numerous port entities with their traffic mitigation, clean truck, truck tracking, and truck appointment initiatives. These solutions are supported in conjunction with the flexible and customizable product – the Advent Port Community System (PCS). Additionally, Advent’s core offering includes the following products and services:

- **Products**
  - Chassis.com. On-line portal for the reporting of chassis condition and repair so intermodal equipment providers can remain in compliance with Federal regulations enforced by the FMCSA;
  - Back office operating systems for container and vehicle shipping lines;
  - Marine Terminal Operating Systems;
  - Intermodal Equipment Maintenance and Repair Systems; and
  - Container depot management systems.

- **Services**
  - Custom software development; and
  - EDI Integration and management.

Port of New York and New Jersey is implementing a reservation system with the help of Advent. The project is currently in the requirements gathering phase. It will be portwide system with a common platform. A.P. Møller (APM) Terminals Pier 400 in POLA has been running Advent terminal appointment system for about a year. APM Terminals Pier 400 handles approximately 1.6 million TEU and is the largest single proprietary terminal in the world. The system appears to be well received by the trucking community and, since its implementation, data shows reduced turntimes, which is a huge benefit to truckers using Pier 400.

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Teletrac

Teletrac provides GPS tracking and fleet management solutions for commercial fleets. The firm’s signature product is Fleet Director, a browser-based software package delivered as a subscription service. The software is designed in a modular fashion so that it can be customized to client requirements. The system provides 24/7 truck location data and status updates, such as loading, loaded, or unloading; on route or off route; and detailed start, arrival, and departure times. Integrated security features enable route geofencing and alerts when unauthorized stops occur. Driving behaviors such as speeding, hard acceleration, and hard braking also are monitored. Navigational aids provide verbal directions through an in-cab GPS display. Dispatchers can plan routes automatically by selecting vehicles and entering destinations, after which the system calculates optimal routing and uploads it automatically to the driver’s in-cab unit. The system integrates live traffic data to facilitate better dispatch operations. Teletrac also has an integrated satellite mapping function that provides even greater location detail; for example, to confirm arrival at the correct entrance or loading dock. Vehicles that are designated as Class 8 trucks in the Fleet Director system only receive routes suitable for large trucks.

An engine diagnostic monitoring function is provided as an option. Teletrac captures all pertinent HOS information, which is stored permanently in electronic format, eliminating most of the paperwork associated with regulatory compliance. All data necessary for CSA 2010 compliance is captured. Teletrac also provides a CSA 2010-compliant EOBR.

The firm uses dedicated tracking equipment designed in-house for all applications. These include messaging devices, navigation displays, and GPS tracking systems. All of these are integrated into the Fleet Director software package.

TomTom

TomTom is the world’s leading provider of navigation products. TomTom’s in-vehicle systems generate personalized trip advice, providing real-time information in a tailored, usable form for dynamic decision-making. The personalized trip advice allows individuals to save travel time, avoid congestion, reduce fuel consumption, costs and emissions. Safety features warn drivers about, for example, school zones and lane changes; and help them navigate to emergency services, if needed. The new EcoPLUS component provides fuel efficiency feedback to drivers, as well as measurement reports to fleet managers, assisting with awareness that can result in more efficient driving and measurable fuel savings.

32http://www.teletrac.net/.
TomTom has technology for multiple platforms. These include ‘after-market’ consumer navigation devices, smart-phone applications, fleet management systems, and in-dash solutions. Predictive (based on historical information) and real-time route information also is made available on TomTom’s web platform. TomTom’s back-office systems include the company’s own data fusion technology and provide updated traffic information every minute. The data fusion uses anonymous crowd-sourced GPS speed measurements from devices and smart-phone applications, as well as third-party information on road closures and accidents. Industry standards for data transmission are used and the traffic information can be provided to public and private entities using standard protocols.33

TomTom’s WORKsmart™ fleet management solution enables carriers to inform their customers of arrival times, rearrange schedules in real-time, and manage working hours effortlessly with a single click.

**XATA Turnpike**

XATA Turnpike also offers fleet management and telematics solutions for the trucking industry. Its product suite is divided primarily into two packages, which are described below:

- **XATANET** is the company’s enterprise fleet management package. It can automatically measure MPG, speed, idle time, hard braking, and other parameters, which are reported in a dashboard or graphical format similar to other fleet management systems. The system includes electronic log books and fuel tax reporting. Route management features include planned vs. actual routing and mileage, and a SmartRoute application that monitors delivery status and provides real-time vehicle location maps. Dispatch aids include arrival and departure alerts, two-way and broadcast messaging, HOS status, and key vehicle/driver metrics. A special reefer management application monitors temperature for refrigerated cargo, providing proof-of-temperature throughout the cold chain. The asset-tracking feature updates vehicle location every five minutes with real-time maps and “breadcrumb” (historical location) views. A GPS navigation device provides truck-specific routing with verbal directions. A payroll automation feature tracks and integrates driver hours reporting and syncs it with hours of service and duty status data. Finally, fleet managers can query the data to track performance of individual drivers and vehicles, or groups of drivers and vehicles. A unique ‘black box’ feature reconstructs accidents and near accidents with highly detailed driver behavior and vehicle status data.

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- XATA Turnpike offers some of the same functions as XATANET, including driver performance metrics (speeding, MPG, delay, etc.); vehicle performance and engine diagnostics; automated HOS; fuel tax; and vehicle inspection reports, ‘black box’ accident reconstruction, and asset tracking. Information is delivered through a variety of ‘scorecard’ reports, which are customizable according to user needs.

XATANET runs on several hardware devices, including seven Mobile Computing Platforms produced by three different manufacturers. The company also provides an in-house computing platform. All devices have the option of cellular, satellite, and Wi-Fi (within the truck terminal) connectivity. XATA Turnpike, in contrast, is optimized to leverage existing cell phones, smart phones, and tablet computers deployed by fleets to communicate GPS and engine operational data through a Bluetooth connection to XATA’s RouteTracker device. This makes it a low-cost EOBR solution since most fleets already utilize such technologies to one degree or another. XATA partners with Sprint, AT&T, and Verizon Wireless to deliver XATA Turnpike applications over various wireless devices.³⁴

Table 4.1 below compares these vendors in several common fleet management areas, including GPS tracking, fuel management, safety/compliance monitoring, maintenance/diagnostics, and communications capabilities.

Table 4.1  Vendor-Based Fleet Management System Comparison

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<tr>
<td>• Generates dashboard reports</td>
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<tr>
<td>for individual drivers, trucks,</td>
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<tr>
<td>or groups of drivers/trucks</td>
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<tr>
<td><strong>Maintenance and on-board</strong></td>
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<tr>
<td>diagnostics</td>
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<tr>
<td>• Monitors engine fault codes</td>
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<td>and provides alerts to</td>
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<td>fleet managers in near real-time</td>
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<td><strong>Two-way communications</strong></td>
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<tr>
<td>between dispatch and truck</td>
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<tr>
<td>• On most models</td>
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<tr>
<td><strong>Fuel reporting/management</strong></td>
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<tr>
<td>• Monitors driver behaviors</td>
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<td>that contribute to poor fuel</td>
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<tr>
<td>economy</td>
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<td>• Data can be queried/visualized in dashboards</td>
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<tr>
<td>• INRIX offers fuel price data, but it is not necessarily geared towards trucks</td>
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<tr>
<td><strong>Time keeping (HOS)</strong></td>
<td>•</td>
<td></td>
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<tr>
<td>• Automated log book feature</td>
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<tr>
<td>through MCP</td>
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<tr>
<td>• Alerts managers and drivers of impending or actual HOS violations</td>
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<tr>
<td>• Traffic data can inform decisions to maximize productivity under HOS rules, but there is no automated HOS reporting capability</td>
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<tr>
<td>• Fully automated through MCP</td>
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<tr>
<td>• Real-time violation reporting</td>
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<td><strong>Teletrac</strong></td>
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<tr>
<td>• Real-time truck location and status updates (e.g., loaded/unloaded)</td>
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<tr>
<td>• Integrated satellite mapping</td>
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<tr>
<td><strong>XATA Turnpike</strong></td>
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<tr>
<td>• Real-time vehicle location and delivery status</td>
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<tr>
<td>• Monitored via EOBR with Bluetooth connection to cell phone or MCP with cellular, Wi-Fi, or satellite capability</td>
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<tr>
<td>• Engine bus connection with MCP or Bluetooth-enabled wireless device</td>
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<tr>
<td>• Two-way and broadcast</td>
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<td><strong>Teletrac</strong></td>
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<td><strong>XATA Turnpike</strong></td>
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<td><strong>XATA Turnpike</strong></td>
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<td>• N/A</td>
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<td><strong>Teletrac</strong></td>
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<td><strong>XATA Turnpike</strong></td>
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<td>• N/A</td>
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<td><strong>XATA Turnpike</strong></td>
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<td>• N/A</td>
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<tr>
<td>Gateway Cities Technology Plan for Goods Movement</td>
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<td>-----------------------------------------------</td>
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<tr>
<td>Qualcomm</td>
<td>INRIX</td>
<td>NAVTEQ</td>
<td>Teletrac</td>
<td>XATA Turnpike</td>
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</tbody>
</table>
| **Driver Vehicle Inspection Reports (DVIR)** | ● Drivers file through their MCP  
● Defect alerts automatically sent to maintenance personnel, and to drivers when trouble tickets are closed | N/A | N/A | ● Automated reporting through MCP or cell phone app |
| **Route Optimization** | ● Hazmat routing, toll avoidance, practical miles and shortest miles, trucker points of interest, routes suitable for 53-foot trailers/twins  
● Drivers can enter up to 50 stops and route based on different parameters | ● Next-day planning with predictive traffic data for route planning  
● New routing engine combines GPS probe data with road sensor data to continuously predict travel times  
● Physical and legal restrictions  
● Advance warning of truck hazards | ● Accepts unlimited number of locations for routing  
● Automatically finds the most fuel- and time-efficient routes  
● “Nearest vehicle” locating to identify the truck closest to a move |  
| **Traffic/Incident Data** | ● Not available, but can interface with outside data providers  
● Driver services feature includes traffic within route/traffic maps  
● Users can add real-time traffic to existing mapping applications | ● Provides traffic condition data that can be overlayed on an existing map  
● Live traffic information for dispatchers for on-the-fly rerouting | ● Live traffic information for dispatchers for on-the-fly rerouting  
● ‘Learned Standards’ feature gathers historical time and distance data on key routes to inform route planning |  
| **Safety** | ● CSA compliance package integrates proactively monitors key safety metrics following new FMCSA scoring methodology | N/A | N/A | ● Fleet Director HOS module and engine bus connection captures all data required for CSA 2010 compliance  
● Speed, hard braking, hard acceleration, sudden stops  
● ‘Black box’ accident reconstruction |  
| **Other** | ● Trip views in near-real time  
● Wi-Fi access at truck stops  
● In-cab Amber alerts  
● In-cab fuel price data | ● 3rd Generation Routing Engine is considered state of the art  
● Data applications typically run on top of a client’s existing fleet management system  
● Dedicated in-house tracking equipment for all applications  
● iPad and iPhone mobile access to fleet performance monitoring | ● Temperature sensors for cold chain cargo |  

*Cambridge Systematics, Inc.*
### Other Specific Route Guidance Applications

Described below are specific route guidance applications, some of the applications offer dynamic routing capabilities.

**Google Maps Navigation**

Google Maps is beta testing a new mobile mapping application, providing Internet-connected GPS navigation with voice guidance. Although the application is not freight specific, it can search for alternate routes and provides real-time traffic information and trip times. It also accepts voice commands for destinations and can search by destination name, thus negating the need to know the exact address. The application provides color-coded traffic data describing current traffic conditions on a route. It also can switch to satellite and street views, allowing users to visualize turns using landmarks. The application automatically switches to the street view as a user nears the destination. The application is available for free via the Android Market.

**PC*Miler**

PC*Miler is another trucking-oriented software package that can generate point-to-point, truck-specific mileage, routes, driving directions, and maps covering the highway systems in North America, Puerto Rico, Bermuda, and Greenland. It is considered a leader in this field and is used by 96 of the top motor carriers in the United States.\(^{35}\) It also is used by government agencies, including the FMCSA, as a distance standard for auditing purposes. Mileage generated by the software relies on numerous sources, including FMCSA, official state highway maps, state DOT maps, county maps, local maps, historical truck traffic and

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related GPS sightings, and information from industry contacts. Like Qualcomm, PC*Miler can provide practical routing, shortest routing, and National Network routing. These can be combined with restrictions related to toll avoidance and 53-foot long/102-inch high trailers. A separate hazmat module can generate point-to-point distances and driving directions for hauling hazardous materials and dangerous goods while ensuring compliance with applicable regulations in the U.S. and Canada. Routes can be generated for general hazmat, as well as caustic, explosives, flammable, inhalants, and radioactive materials.

From a routing perspective, users can enter a route with an unlimited number of stops. The software calculates miles between stops, cumulative miles from origin, cumulative trip cost, and cumulative drive time. Toll costs also can be calculated using a separate module. Truck-restricted roads are highlighted in yellow on PC*Miler maps, but can be overridden manually. A detailed route report provides road type information (state, toll, or free road); direction of travel; route; segment distance; driving time; interchange point; leg mileage and time; cumulative trip mileage; and total trip time. A route-resequencing feature reorders the stops entered in the route entry window, keeping the origin the same, to provide the optimal order of stops. Users can optimize by total time, total distance, toll distance, or National Network distance.

Garmin

Garmin produces a series of GPS navigation aids designed for truckers. All of them can provide voice prompts with spoken street names, though none can be operated by voice command. All of them are “traffic compatible,” meaning they are able to route trucks around traffic. Truck-specific routing can be customized taking into consideration height, weight, length, and hazardous materials. A “trafficTrends” feature available on some models calculates routes and arrival times based on predicted traffic flows. Truck-specific capabilities on some models include the International Fuel Tax Agreement (IFTA) fuel logging; HOS violation warnings; exit services (food, fuel, etc.); and an external input for backup cameras. The devices can auto sort multiple destinations to find the most direct route; and can provide alternate routing by different criteria like fastest time, shortest distance, avoiding highways, or avoiding tolls. The devices also warn truckers of upcoming hazards, such as steep grades, high cross winds, and sharp curves.

Rand McNally

Rand McNally also provides truck routing software. Its IntelliRoute software package leverages the company’s long history in the commercial truck routing market (it has provided services to the industry, including household goods and practical miles routing, for more than seventy (70) years.). The software uses a street-level routing database, including about 6.7 million miles of truck attributed roads, which it uses to develop point-to-point routing for the United States,
Mexico, and Canada. Routes can be customized by different trailer configurations, such as 48-foot, 53-foot, hazmat, and double/triple. Like other mileage/routing packages, it can calculate both practical and shortest miles. Truck-specific tolling data allows fleet managers to estimate toll costs, while a ‘RoadWork’ feature provides construction project information, updated every two weeks. The software can optimize multipoint routing, and can provide lowest cost routes based on maximizing fuel economy or controlling toll expenditures. Hazmat routing can be optimized to any one of ten (10) hazmat classifications. The firm claims to have 35 percent more truck restrictions in its data set than other solutions.

The firm also produces GPS devices for truckers. The IntelliRoute in-cab devices feature driver-controlled auto rerouting capability that allows the driver to pause and resume rerouting calculations, reducing unnecessary in-cab voice and directional activity. A traffic predictor incorporates historical traffic patterns into route recommendations, and a live traffic feed is enabled via an accessory. They also provide a ‘junction view’ with lane guidance, helping truckers navigate complex interchanges in 3-D. The system can automatically cross-reference to Rand McNally’s printed road atlas. Like the Garmin series, these devices can warn drivers about speed limit changes, steep grades, and sharp curves.

4.4 U.S. DOT PROGRAMS AND INITIATIVES

There are several prior and emerging U.S. DOT programs that leverage wireless communication to provide fleet management information. U.S. DOT and other government programs/initiatives relevant to fleet management applications and those that focus on ITS connectivity between the public and private systems are described below.

Hazmat Truck Tracking

A 2004 U.S. FMCSA study concluded that smart truck technology (such as GPS tracking, wireless modems, panic buttons, and on-board computers) will be highly effective in protecting hazmat shipments from terrorists, and produce a huge security benefit and an overwhelmingly positive return on investment for hazmat carriers. The FMCSA study led to the U.S. Transportation Security Administration’s (TSA) Hazmat Truck Security Pilot. This congressionally-mandated pilot program was undertaken to demonstrate if a hazmat truck tracking center was feasible from a technology and systems perspective, and to determine if existing truck tracking systems can interface with government intelligence centers and first responders. The pilot proved that a hazmat truck tracking center is technically feasible, and that smart truck technology can be crafted into an effective and efficient system for tracking hazmat shipments. In a different initiative, the U.S. Environmental Protection Agency (EPA) is interested in implementing an electronic manifest rule that would allow companies to use electronic manifests instead of paper manifests for their hazardous waste.
shipments. The U.S. EPA estimates that the use of electronic manifests instead of paper manifests has the potential to generate more than $300 million per year in cost savings.

In 2007, the Kentucky Transportation Center (KTC) of the University of Kentucky led a project funded by DHS to evaluate TSA and U.S EPA needs. The project was designed to assess the feasibility of establishing the North American Transportation Security Center in Kentucky.

The Transportation Security Center, as envisioned by the KTC project team, will serve as the implementing tool for a model hazmat regulatory program in Kentucky that will require:

- High-risk hazmat transporters to install “smart truck” technology on their vehicles;
- Shippers and carriers to send electronic manifests and electronic route plans to the Transportation Security Center;
- Carriers to report vehicle location and alerts to the Transportation Security Center (real-time XML data feed); and
- Companies to pay hazmat regulatory fees.

Figure 4.2 illustrates the hazmat tracking features of the proposed Transportation Security Center.

This project will most likely be modeled after Singapore’s Hazmat Transport Vehicle Tracking System (HVTS).36

- A “smart truck”, equipped with an on-board computer, GPS receiver, and a wireless modem, will use an Internet connection (satellite or cellular) to interact with the Transportation Security Center and a commercial fleet tracking data center.
- E-manifest transactions between the carrier and the Transportation Security Center will provide the Transportation Security Center with information on the types and quantities of materials the transporter is hauling, as well as shipment status (i.e., awaiting pickup, in transit, etc.).

Data from the carrier’s fleet tracking data center will provide the Transportation Security Center the carrier’s exact location at all times. The shipper and/or carrier also will submit route plans. Alerts from the shipper or carrier will be generated when different events occur.

The Transportation Security Center will merge e-manifest, vehicle location, route, and alert data to provide government officials real-time visibility into the security status of hazmat shipments. In the event of a security incident, the Transportation Security Center will interact with state and Federal operations centers.

The KTC and its partners are expanding upon the work completed under the Hazmat Truck Security Pilot by building a functional prototype of a hazmat truck tracking center. A multistate implementation program will support development of the hazmat truck tracking center into full operational status. This work began in late 2008 through the National Institute for Hometown Security and is ongoing.
Cross-Town Improvement Project (C-TIP)

C-TIP was first conceptualized in 2004 as an “intermodal move database” that would help coordinate cross-town drayage moves between rail terminals, thus helping to reduce empty moves. This would reduce some of the noise, emissions, and congestion impacts of cross-town truck traffic. Over the years, stakeholders from the Intermodal Freight Technology Working Group (IFTWG, where the idea first originated) coalesced around a more detailed conception of C-TIP functionalities, culminating in a 2009 Concept of Operations that outlined the following five key elements:

1. **Intermodal Move Exchange (IMEX).** An open architecture port that allows for a collaborative dispatch management model among rail lines, truckers, and facility operators;

2. **Wireless Drayage Updating (WDU).** Utilizes low-cost wireless technology as an interface between drivers and dispatchers, and between the core functions within C-TIP and its users;

3. **Real-Time Traffic Monitoring (RTTM).** Real-time monitoring and distribution of route- and location-specific travel time and congestion information and control of traffic management systems and devices;

4. **Dynamic Route Guidance (DRG).** Uses inputs from RTTM, a dedicated Geographic Information Systems (GIS) source and specially developed simulation tools to provide truckers with real-time visual routing around congested areas; and

5. **Chassis Utilization Tracking (CUT).** An application that allows for collaborative use and management of intermodal chassis among railroads and trucking companies.37

Tests of different C-TIP components were carried out in 2010 and 2011. Table 4.2 provides high-level summaries of the test results. (Note that CUT was not included in the testing program.) As the table shows, C-TIP demonstrated productivity benefits in terms of bobtail reduction and time-savings, as well as emissions and fuel savings. Some of these results were derived from operational tests of C-TIP components, while others were estimated based on simulations (the IMEX tests in Kansas City and Chicago had to be simulated because of lack of participation by the railroads).

The following sections discuss the C-TIP component tests in more detail, along with the benefits and challenges associated with each.

## Table 4.2  Summary of C-TIP Test Results

<table>
<thead>
<tr>
<th>Test</th>
<th>Location</th>
<th>Dates of Test</th>
<th>Description of Test</th>
<th>C-TIP Modules Deployed</th>
<th>Test Results</th>
<th>Emission Reductions (in Percentage)</th>
<th>Fuel Savings (in Gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IXT Drayage Optimization</td>
<td>Kansas City, MO</td>
<td>6/28/2011-8/31/2011</td>
<td>Deployment of iPhones to optimize drayage moves</td>
<td>IMEX, WDU</td>
<td>Actual</td>
<td>13% bobtail reduction</td>
<td>8</td>
</tr>
<tr>
<td>Pride Logistics Drayage Optimization</td>
<td>Chicago, IL</td>
<td>6/1/2011-9/30/2011</td>
<td>Deployment of automated dispatching system with Android smart phones to optimize drayage moves</td>
<td>IMEX</td>
<td>Actual</td>
<td>52% bobtail reduction</td>
<td>N/A</td>
</tr>
<tr>
<td>Dynamic Route Guidance</td>
<td>Kansas City, MO</td>
<td>12/1/2010-4/30/2011</td>
<td>Deployment of RTTM/DRG-enabled iPhones</td>
<td>WDU, RTTM, DRG</td>
<td>Actual</td>
<td>21% travel time improvement</td>
<td>10</td>
</tr>
<tr>
<td>Real-Time Traffic Monitoring</td>
<td>Kansas City, MO</td>
<td>12/1/2010-4/30/2011</td>
<td>Deployment of RTTM/DRG-enabled iPhones</td>
<td>RTTM</td>
<td>Actual</td>
<td>19% travel time improvement</td>
<td>6</td>
</tr>
<tr>
<td>Kansas City IMEX Simulation</td>
<td>Kansas City, MO</td>
<td>10/1/2010-01/31/2011</td>
<td>Simulated matching crosstown railroad container moves</td>
<td>IMEX</td>
<td>Simulated</td>
<td>135 empty trips eliminated</td>
<td>N/A</td>
</tr>
<tr>
<td>Chicago IMEX Simulation</td>
<td>Chicago, IL</td>
<td>1/1/2011-4/30/2011</td>
<td>Simulated matching crosstown railroad container moves</td>
<td>IMEX</td>
<td>Simulated&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1,654 empty trips eliminated</td>
<td>N/A</td>
</tr>
</tbody>
</table>


<sup>a</sup>  Results assume three-hour delivery window.
Real-Time Traffic Monitoring

Real-Time Traffic Monitoring was designed to provide real-time congestion information and travel times on key intermodal routes through an iPhone interface, as shown in Figure 4.3.

Figure 4.3  Sample iPhone RTTM Alternate Route Instructions

Source: SAIC.

RTTM provides real-time predicted travel time information for defined primary and alternate routes, with route recommendations when warranted. Drivers can access this information pre-trip by entering their origin and destination, after which the phone returns predicted travel times on the primary and alternate routes for that origin and destination pair. Truckers then select the route they want to take based on this information, with turn-by-turn directions provided by voice command from the iPhone.

An RTTM operational test was conducted in Kansas City from December 1, 2010 to April 30, 2011. The test involved six drivers making cross-town drayage trips on five key intermodal lanes. Key test metrics were captured and evaluated using RMI Vantage software.\(^\text{38}\) The test did prove the concept that such an

\(^{38}\)Vantage is a business intelligence tool developed for intermodal operations that provides users the ability to monitor, measure, and manage key intermodal performance metrics in real time.
application could be deployed in a commercial trucking environment, with measurable benefits. For instance, on one lane (from the Burlington Northern Santa Fe (BNSF) rail terminal to a shipper called Musician’s Friend), RTTM was queried for travel times 17 times during the test. On all 17 occasions, it provided an alternate route recommendation that the driver then followed, saving an average of six minutes in travel time. Since emissions are a function of, among other things, distance traveled and speed, RTTM also was able to achieve reductions in diesel emissions during the test period on the two lanes where alternate routes were offered.

There were some issues with primary and alternate routing definitions within RTTM, which led to no alternate routes being offered on some lanes during the test. For instance, on the UP to Toyota lane, drivers never followed the RTTM recommended routes because the point of origin for these trips was not the UP yard (as defined in RTTM), but a terminal consolidation point five miles away. This made it impossible to evaluate travel time-savings on this lane since the drivers were not taking the routes for which travel times were calculated.

Given that the Kansas City test only involved six drivers, it is reasonable to expect that the benefits would be greater if C-TIP were deployed more widely, especially in larger intermodal markets like Chicago. As part of the FHWA evaluation of C-TIP, a targeted Delphi study was conducted to assess the potential benefits of a theoretical C-TIP deployment. The consensus opinion of the Delphi panel (which was composed of intermodal industry experts, including railroads, trucking firms, and terminal managers) was that RTTM could achieve travel time-savings of 5 to 10 percent per trip on average if implemented in Chicago.

**Dynamic Route Guidance**

Using the same iPhone interface as RTTM, DRG provides truckers with real-time travel time information for key cross-town intermodal routes and can reroute them around congestion through in-cab voice commands, thus eliminating potential driver distraction issues. DRG basically extends the RTTM functionality so that it can redirect truckers when the vehicle got to within three miles of predefined “decision points” along the cross-town route. When approaching a decision point, the mobile device would request travel time information from the C-TIP server; RTTM/DRG would then perform the calculations for the primary and alternate routes (from the point of redirect) and advise about the shortest route. The iPhone would report location, heading, and speed throughout the trip, and the display was locked out for safety.

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Delphi is a research method that attempts to quantify expert opinion on a given topic through iterative polling.
DRG was tested in Kansas City concurrently with RTTM. The C-TIP DRG application was able to achieve time-savings on some cross-town routes in Kansas City. For instance, there were 18 total trips on the Toyota to Grainger route during the test period, 13 of which were redirected to avoid congestion. Drivers followed the reroute 77 percent of the time, saving an average of five minutes in travel time. These redirects also led to emissions reductions.

Like the RTTM function, the limited participation in the C-TIP test meant that the measured benefits were rather modest. Nonetheless, C-TIP DRG worked as a “proof of concept”; successfully showing that time savings and emissions benefits could be achieved with dynamic routing technologies. Moreover, interviews with drivers involved in the C-TIP test revealed that they generally liked the idea of having a smart phone application with routing information. One driver also reported a specific example where DRG successfully routed him around congestion on I-35, saving about five minutes in travel time. Finally, the C-TIP Delphi assessment found that industry experts generally thought travel time-savings of 5 to 10 percent per trip on average could be achieved if DRG were implemented in Chicago; suggesting the application would be scalable to a larger intermodal market where greater benefits could be achieved.

**Intermodal Move Exchange**

IMEX uses data feeds from railroads and drayage firms to produce a daily work plan, which will optimize container and chassis flows. Due to a changing business climate and the retirement of a key C-TIP champion from a Class I railroad, the railroads in Kansas City did not participate in the C-TIP test. Therefore, a simulation was conducted to assess the potential benefits that could have been derived, had all stakeholders followed the IMEX work plan for a four-month period (October 2010 through January 2011) in Kansas City. The simulation found that the system could have eliminated 135 bobtail trips in Kansas City over a four-month period, thereby, eliminating more than 1,000 empty truck miles and saving 180 gallons of diesel fuel. This would have reduced greenhouse gases by about 2.6 million grams and criteria pollutants by almost 19,000 grams, if C-TIP were fully utilized by all stakeholders.

Another simulation was conducted with gate move data from Chicago, which is the nation’s largest intermodal market. The data covered a four-month period from January 2011 through April 2011. This simulation also accounted for variance in container dwell time by evaluating potential load matching for 24-hour, 12-hour, 3-hour, and 15-minute ‘windows’. Each time window represents the total time available to make the cross-town delivery from container deramping at the originating terminal to the 5:00 p.m. cutoff at the receiving terminal.

The results clearly show that the potential is much greater in a large intermodal market like Chicago. Assuming the three-hour window is the most realistic, the system found more than 1,600 matches that would save 41,000 empty miles and cut fuel use by nearly 7,000 gallons. Emissions savings totaled 82 million grams.
of carbon dioxide (CO\textsubscript{2}) equivalents and about 620,000 grams of criteria pollutants. This suggests that substantial benefits could be realized even under real-world operational constraints, such as tight cutoff times for cross-town freight. It also is important to note that the Chicago simulation only includes data for two cross-town railroads; if all six Class I railroads that operate in Chicago participated fully in IMEX, the savings would likely be much greater.

**C-TIP Open Source Architecture Package**

The lack of railroad participation in the Kansas City IMEX test led to the development of the C-TIP Open Source Architecture Package (C-TIP OSAP) by the C-TIP integration contractor. Unlike IMEX, C-TIP OSAP is targeted towards drayage operators, with the goal of letting them use the software to achieve efficiency improvements. C-TIP OSAP provides dispatchers with real-time driver location data, along with wireless notification when a container is released for pickup. Dispatchers are, therefore, able to assign work orders to drivers who are nearby and not carrying a load, thus, eliminating a bobtail trip. C-TIP OSAP was deployed with drayage industry partners in Kansas City and Chicago.

The Kansas City test was conducted with International Express Transportation (IXT) from April 1 to August 31, 2011. The control period was defined as April 1 to June 27, with an operational test period from June 28 to August 31. IXT is a drayage services provider in Kansas City, specializing in moving freight between intermodal terminals and customer locations in the metropolitan area. IXT utilized the C-TIP OSAP deployed on in-cab smart phones to help optimize its cross-town drayage moves by minimizing unproductive bobtail moves. IXT uses Profit Tools to manage its business processes, so the evaluation team was able to purchase dray event data from Profit Tools to analyze bobtail activity before and after the introduction of the phones. The results, provided in Table 4.3, show that there was a reduction in bobtail records in July and August, corresponding with the introduction of the phones. Moreover, this reduction coincided with steady to moderate growth in revenue loads.

**Table 4.3 IXT Drayage Optimization Test Results by Month – Kansas City Locations Only**

<table>
<thead>
<tr>
<th>Month</th>
<th>Bobtail Records</th>
<th>Percent Change</th>
<th>Revenue Loads</th>
<th>Percent Change</th>
<th>Telephones Deployed</th>
</tr>
</thead>
<tbody>
<tr>
<td>April</td>
<td>837</td>
<td>-</td>
<td>1,099</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>May</td>
<td>865</td>
<td>3%</td>
<td>1,141</td>
<td>4%</td>
<td>0</td>
</tr>
<tr>
<td>June</td>
<td>1,061</td>
<td>23%</td>
<td>1,388</td>
<td>22%</td>
<td>0</td>
</tr>
<tr>
<td>July</td>
<td>999</td>
<td>-6%</td>
<td>1,326</td>
<td>-4%</td>
<td>4</td>
</tr>
<tr>
<td>August</td>
<td>924</td>
<td>-8%</td>
<td>1,346</td>
<td>2%</td>
<td>12</td>
</tr>
</tbody>
</table>

Source: CS analysis of Profit Tools/IXT truck movement data.

Note: All trips greater than 40 miles, outside of the Kansas City metropolitan area, or with no reported miles have been eliminated.
Another C-TIP OSAP test was conducted in the Chicago region involving Pride Logistics, LLC, which is a provider of intermodal transportation services located in Palos Heights, Illinois. Flatirons Two, Inc., a technology company specializing in network/database administration, system integration, and smart phone applications, developed an Android smart phone application allowing Pride drivers to upload their daily work order assignments directly to the phone, enter status updates directly into Pride’s IT system, and obtain schedule updates automatically. Two truck drivers were provided with Android smart phones during the test, which ran from June through September 2011 (with September being the operational test phase).

Flatirons Two also developed a computerized dispatch system for Pride, which enables dispatchers to automatically sort work orders by origin, destination, and driver itinerary. This substantially reduced the manual effort (and potential human error) associated with the T-Card system that was used previously. This system involved manual sorting of cards with pertinent work order information throughout the day, with dispatchers attempting to find the best allocation of equipment and human resources under constantly changing conditions.

The results (as measured and reported by Pride) are shown in Table 4.4. During the September operational test, the percent of total miles in bobtail status fell from 8.9 percent in August to 4.7 percent in September. Although total miles fell by 8.4 percent in September, bobtail miles fell even faster (more than 50 percent), leading to substantial improvement in this metric. Meanwhile the percent of total trips as bobtails fell from 9.1 percent to 4.1 percent on a consistently growing number of total trips. Driver productivity also improved, from an average of 40 loads per driver in June to 46 loads per driver in September. Although the bobtail and driver productivity benefits in this test flowed from the automated dispatch platform, Pride did report business process improvements associated with the smart phones, mainly related to faster billing and improved shipment visibility for customers.

Table 4.4  Pride Logistics Test Bobtail and Driver Productivity Metrics

<table>
<thead>
<tr>
<th></th>
<th>June</th>
<th>July</th>
<th>August</th>
<th>September</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bobtail Miles</td>
<td>1,967</td>
<td>2,136</td>
<td>2,196</td>
<td>1,061</td>
</tr>
<tr>
<td>Total Miles</td>
<td>20,280</td>
<td>23,479</td>
<td>24,677</td>
<td>22,593</td>
</tr>
<tr>
<td>Percent of Miles in Bobtail</td>
<td>9.7%</td>
<td>9.1%</td>
<td>8.9%</td>
<td>4.7%</td>
</tr>
<tr>
<td>Bobtail Trips</td>
<td>51</td>
<td>53</td>
<td>58</td>
<td>28</td>
</tr>
<tr>
<td>Total Trips</td>
<td>522</td>
<td>586</td>
<td>635</td>
<td>690</td>
</tr>
<tr>
<td>Percent of Trips in Bobtail</td>
<td>9.8%</td>
<td>9.0%</td>
<td>9.1%</td>
<td>4.1%</td>
</tr>
<tr>
<td>Total Loads</td>
<td>522</td>
<td>586</td>
<td>635</td>
<td>690</td>
</tr>
<tr>
<td>Drivers</td>
<td>13</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Average Loads per Driver</td>
<td>40</td>
<td>39</td>
<td>42</td>
<td>46</td>
</tr>
</tbody>
</table>

Source:  Pride Logistics, LLC.
Wireless Roadside Inspections for Trucks And Buses (WRI)

The FMCSA WRI program is evaluating different strategies for identifying and inspecting commercial vehicles at the roadside using a mix of technologies, including DSRC, satellite-based technology, and license plate reader technology. FMCSA is coordinating and will be evaluating three separate deployments of the WRI architecture in the States of Kentucky, Tennessee, and New York. Inspection results will be made available in real-time to motor carriers, as well as state and Federal enforcement personnel. This program is viewed as a key building block for FMCSA’s objective of significantly expanding the number of inspections that are conducted each year, and the base of data on which to make performance-based enforcement decisions.

A “wireless inspection” is a process where public-sector entities (people and systems) examine the condition of the vehicle and driver by assessing data collected by on-board systems. The data used in the assessment is termed the “Safety Data Message Set” (SDMS), which will be delivered using wireless communications in real time to the public-sector infrastructure. The SDMS will contain basic identification data (for driver, vehicle, carrier, container, and cargo); record of duty status; and vehicle condition data that are typically available to safety inspectors during current roadside inspections. The roadside enforcement sites that will query and receive SDMSs from CMVs are envisioned to include fixed weigh stations, unmanned remote sites on bypass routes and state borders, and mobile police cruisers. Depending on the availability of enforcement resources, interdiction strategies acting on the SDMS will include real-time and nonreal-time scenarios.

The concept was significantly differentiated from current electronic prescreening programs in that real-time information about the condition of the vehicle (e.g., brake, tire diagnostics; etc.) and the driver (e.g., HOS status) would be transmitted to enforcement agencies. Current prescreening programs, such as NorPass and PrePass, only transmit a unique ID number (via the on-board radio frequency identification (RFID) tag, which is then cross-referenced to a U.S. DOT number in an off-board operation. Further, the proposed concept would call for driver- and vehicle-specific ID information to be transmitted, thus, facilitating the implementation of more sophisticated and accurate screening strategies.

The Wireless Roadside Inspection for Trucks and Buses project currently has completed the proof of concept and is in the pilot-testing phase. Once pilot testing is complete, a field operational test (FOT) will be conducted involving several states and commercial vehicles. The FOT will evaluate the policy, economic, and IT viability of performing such wireless inspections on a much larger scale. Figure 4.4 provides an overview of the Wireless Roadside Inspection System.
Connected Vehicle

Connected Vehicle (previously Intellidrive) research is a multimodal initiative that aims to enable safe, interoperable networked wireless communications among vehicles, the infrastructure, and passengers’ personal communications devices. Connected Vehicle research is being sponsored by U.S. DOT to leverage the potentially transformative capabilities of wireless technology to make surface transportation safer, smarter, and greener. Connected vehicle technologies are envisioned to ultimately encompass safety applications, mobility applications, and environmental applications.

Connected vehicle applications provide connectivity among vehicles to enable crash prevention; between vehicles and the infrastructure to enable safety, mobility and environmental benefits; and among vehicles, infrastructure, and wireless devices to provide continuous real-time connectivity to all system users.

Connected vehicle applications are being developed to address real-world problems. Research is currently being conducted into the following technologies:

- **Vehicle-to-Vehicle (V2V) Communications for Safety.** The vision for the U.S. DOT’s V2V Communications for Safety research program is that each vehicle on the roadway will eventually be able to communicate with other vehicles, and that this rich set of data and communications will support a new generation of active safety applications and systems. Research for V2V systems has been divided into eight tracks, one of which focuses on the
unique operational characteristics of freight vehicles. The key objective of this track is to ensure that unique aspects of commercial vehicles that are critical to the successful deployment of V2V are addressed. Once estimates of safety benefits are validated, the safety application will be considered for CVO regulation decision. A preliminary analysis revealed that V2V systems could potentially address 71 percent of all crashes involving heavy trucks (more than 10,000 pounds weight rating) each year.\textsuperscript{40} Starting in August 2011, the FHWA began a series of Safety Pilot Driver Clinics to assess user acceptance of new V2V safety applications. These clinics also will include two trucks equipped with wireless crash warning devices. Subjective feedback from a cross-section of truck drivers will be obtained regarding their acceptance of integrated safety systems and driver-vehicle interfaces.

- **Vehicle-to-Infrastructure (V2I) Communications for Safety.** Vehicle-to-infrastructure communications for safety is the wireless exchange of critical safety and operational data between vehicles and highway infrastructure, intended primarily to avoid or mitigate motor vehicle crashes, but also to enable a wide range of other safety, mobility, and environmental benefits. The National Highway Traffic Safety Administration (NHTSA) has found that V2I systems could address 15 percent of all truck-involved crashes annually.\textsuperscript{41} The U.S. DOT’s research agenda in this field consists of six program tracks designed to lay the groundwork for eventual deployment of V2I applications. For the commercial vehicle enforcement applications, this plan establishes research and demonstration activities to support enforcement regulations and real-time parking information in a wireless environment.

- **Real-Time Data Capture and Management.** Real-Time Data Capture and Management is the creation and expansion of access to high-quality, real-time and archived, multimodal transportation data that is captured from connected vehicles (automobiles, buses, trucks, fleet); mobile devices; and infrastructure. U.S. DOT is presently in the second phase of a three-phase research program for Real-Time Data Capture and Management designed to assess existing data sources, including overall data quality; and determine exactly how vehicle probe data can be integrated with traditional data sources to support specific transit, freight, and traffic applications.

**Dynamic Mobility Applications.** The Dynamic Mobility Applications (DMA) program seeks to identify, develop, and deploy applications that leverage the full potential of connected vehicles, travelers and infrastructure to enhance current operational practices and transform future surface transportation systems.

\textsuperscript{40}National Highway Traffic Safety Administration, *Frequency of Target Crashes for IntelliDrive Safety Systems*, October 2010.

\textsuperscript{41}Ibid.
management. There are six program tracks in the DMA research plan, including one for applications development and testing, of which the FRATIS ConOps is a part. The DMA program is comprised of three phases over five years: Foundational Analysis (Phase 1), Tool Development (Phase 2), and Focused Deployment (Phase 3).

Six major tracks span the five-year program duration: 1) Stakeholder Engagement, 2) Mobility Application Development, 3) Proof-of-Concept Tests, 4) Demonstrations, 5) Evaluation and Performance Measures, and 6) Outreach and Technology Transfers. A Program Support track (0) is also included. In 2011, the DMA Program concluded the first phase of activity focused on foundational research and moved into a second phase focused on applications development and testing, initiating coordinated research activities on a portfolio of ten (10) high-priority mobility applications. As a first step, the DMA Program will seek to partner with the research community to further develop the following ten transformative concepts and to refine data and communications needs. These needs will inform related efforts in the Real-Time Data Capture and Management Program in support of application development to collect, assemble, and provide relevant data resources integrating data from wirelessly connected vehicles, travelers, and roadside/wayside infrastructure. The resulting well-organized data and associated descriptors (collectively known as data environments) will include data from field tests and advanced simulation models and be made broadly available. Later in Phase 2 of the Mobility Program, selected mobility applications will be identified for further development, testing, and benefits assessment utilizing these open data environments.

- **Road Weather Management.** Road Weather connected vehicle applications are the next generation of applications and services that assess, forecast, and address the impacts that weather has on roads, vehicles, and travelers. The applications and services are intended to capitalize on the previous Clarus Initiative research that has delivered a network of road weather information by integrating existing data sources.

- **Applications for the Environment: Real-Time Information Synthesis (AERIS).** The objective of the AERIS research program is to generate and acquire environmentally-relevant, real-time transportation data, and use these data to create actionable information that support and facilitate “green” transportation choices by transportation system users and operators.

Connected Vehicle systems and applications are based on existing wireless communications and information technologies. The research is focused on refining these technologies and testing their use in surface transportation; developing Connected Vehicle safety, mobility, and environmental applications; determining actual benefits in the field; and developing consensus standards that will ensure the inter-operability of Connected Vehicle applications and system components.
The U.S. DOT is committed to the use of Dedicated Short Range Communications (DSRC) technologies for Connected Vehicle active safety applications. This includes both vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) active safety applications. DOT intends to explore the full range of wireless technologies (including DSRC, as well as other options) for their applicability to other (non-active) safety, mobility, and environmental applications.

The DOT’s goal is to complete the majority of this research by 2013. In 2013, U.S. DOT also intends to decide whether the applications show enough promise to merit deployment, and to determine whether regulation or other government action will be needed to speed deployment of these applications. Activities have been underway in Japan and Europe. Cooperative Vehicle-Infrastructure Systems (CVIS) is a major European research and development project aiming to design, develop, and test the technologies needed to allow cars to communicate with each other and with the nearby roadside infrastructure.

The Connected Vehicle Core Systems Engineering project provides updated baseline documentation for the connected vehicle technology platform. This work refined the existing ConOps, system architecture, user requirements, and critical deployment risks. The Connected Vehicle Core System will support safety, mobility, and sustainability applications for all modes, including trucks.

Privacy and trustworthiness between communicating parties have been a critical issue driving the overall vision for the Connected Vehicle Core System and the entire connected vehicle environment. Maintaining the privacy of participants, including those from the freight sector, is crucial. This is done mostly through anonymous communication protocols. In fact, the Core System is planning anonymity into the data exchange process to achieve the appropriate balance between privacy and security/safety.

The National Highway Traffic Safety Administration (NHTSA) has determined that V2V and V2I technologies warrant consideration for possible regulatory action because of the potential transformative impact they could have on traffic safety. Accordingly, the agency has stated their intent to make a key regulatory decision about these technologies by 2013 (for passenger vehicles) and by 2014 (for trucks). The agency decision could include one of several options, including future regulatory action that may require manufacturers to include equipment to support V2V and V2I safety applications in new vehicles by some future date.

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Sample Connected Vehicle Freight Project: I-95 Corridor Coalition/New York State DOT Commercial Vehicle Infrastructure Integration

Under the Commercial Vehicle Infrastructure Integration (CVII) project funded by the I-95 Corridor Coalition and led by New York State DOT, 5.9 GHz DSRC is being utilized to enable low-latent, secure communication between commercial vehicles and other vehicles, and between commercial vehicles and infrastructure components.

Past programs that utilized DSRC primarily involved passenger vehicles. CVII was the first project to utilize DSRC in a commercial vehicle environment. The CVII project has been performed in two primary phases:

- **Phase 1**
  - Traveler Information/Probe Data. Establish baseline functionality for DSRC in a commercial vehicle, extending what was done in the VII proof-of-concept to add focus on traveler information that is useful to commercial vehicle operators while minimizing driver distraction.
  - Driver Credential Verification. Interact with the driver and Roadside Equipment (RSE)/Back Office Applications to verify that a driver’s credentials are valid and up-to-date. If the driver’s credentials do not check out, they cannot start the truck.
  - Wireless Roadside Inspection. Gather vehicle data and driver data to exchange with the roadside infrastructure to perform quick but thorough safety checks of commercial vehicles. Vehicles that check out can bypass the station; others must pull in.
  - Commercial Vehicle/Maintenance Vehicle Interaction. Maintenance Vehicles (e.g., snow plows) that are equipped with DSRC can send out a Roadside Alert/Emergency Vehicle Alert to inform commercial vehicle operators of an upcoming hazard. This could result from a snowplow in low-visibility situations or a roadside construction crew.
  - Outfit New York Maintenance Vehicles with DSRC On-board Equipment.

- **Phase 2**
  - V2V Safety Applications. Commercial Vehicle and light-duty vehicles exchange the SAE J2735 BasicSafetyMessage at 10 GHz to enable applications, such as:
    - Blind Spot Warnings,
    - Hard Braking Events,
    - Tailgate warnings,
    - Unsafe-to-merge,
    - Unsafe-to-pass, and
» Railroad grade-crossing warnings. DSRC-equipped railroad grade crossings warn commercial vehicle drivers of approaching trains.

Upcoming activities include the development of interoperable compliance screening between existing mainline screening systems (915 MHz) and trucks using 5.9 GHz. Future applications include development of real-time geo-based routing applications for 5.9 GHz DSRC and smart phones.

**Freight Advanced Traveler Information System (FRATIS)**

The FHWA Office of Freight Management and Operations (FHWA-OFM) is developing a ConOps and Functional Requirements for a FRATIS. This project encompasses the ConOps for the freight and CVO DMA, which is part of the larger DMA program presently being developed by the FHWA. These Functional Requirements for the FRATIS ConOps programs are leveraging developments in the private sector, including smart phones, DSRC 5.9 GHz, and other technologies to develop a series of future phased deployment packages. These packages are leading the deployment of freight/CVO DMAs, encompassing freight real-time traveler information, truck dynamic routing, automated OS/OW planning, and real-time load matching for freight pickups and deliveries.

The general concept involves the U.S. DOT focusing the Freight DMA effort on a more flexible and responsive program that works hand-in-hand with the commercial sectors. These commercial sectors, covering consumer devices and freight information exchange, currently are deploying applications and technologies that can be tailored (though interaction with the Connected Vehicle program) to meet the requirements of the three FRATIS areas.

The ongoing FRATIS study focuses on three identified freight application bundles, including a Freight Dynamic Route Guidance piece (the other bundles are Freight Advanced Traveler Information with Performance Measures and Drayage Optimization). This DMA is intended to leverage emerging industry technologies and applications to provide rerouting information in real time. For example, INRIX already has deployed an initial capability that can provide and in-vehicle alert (through a voice alert from an iPhone or Android phone) with rerouting information to a truck driver, thus enabling real-time dynamic route guidance.

Summaries on the three FRATIS applications are provided below.

- **Freight Real-Time Traveler Information with Performance Measures.** Much of the traveler information components of this application already are emerging today in the marketplace, with one key provider (INRIX) having already deployed a Freight DMA system that serves multiple tucking fleets. What is missing is the connection to transportation systems performance monitoring. Based on this need, a successful approach to deploy this component must leverage the emerging industry applications, while also partnering with industry to ensure inclusion of performance monitoring and
specialized freight operations information (e.g., rest-stop locations, OS/OW routing, air quality monitoring).

- **Freight Dynamic Route Guidance.** This DMA should be developed based on incremental enhancement to the “Freight Real-Time Traveler Information with Performance Measures” DMA described above. Here, the results of the C-TIP test point out how it would be preferable to leverage emerging industry technologies and applications versus trying to develop this from the ground up by government contractors. For example, INRIX already has deployed an initial capability that can provide and in-vehicle alert (through a voice alert from an iPhone or Android phone) with rerouting information to a truck driver, thus enabling real-time dynamic route guidance. Based on these factors, the focus of this project should be on partnering the development of the ConOps with private industry, and then ensuring that the public-sector freight performance monitoring needs (e.g., assessing air quality through route diversion) are met.

- **Drayage Optimization.** Again, much of this functionality also is available in the freight marketplace today. A lead firm in this area, Loadmatch.com/Drayage.com, has a mature web-based container load matching system that has been in place for over a decade, and which is used by more than 1,700 drayage providers. This includes a software application called “ProfitTools,” which automatically feeds empty container availability data into the system and sends out push alerts to prospective drivers. What is missing here is the connection to an appointment system, which would allow for major benefits to be achieved in terms of queue delay reductions at terminals (benefitting both the public and private sectors). Based on this need, a successful approach to deploy this component must both leverage these industry applications, while at the same time providing a method on exchanging information with intermodal terminals. For this information exchange piece, a company called RMI has been leading the way, and has operational systems deployed today at rail intermodal terminals that provide key information on container status. So, the goal here in addressing this area would be for the integration of load matching and freight information exchange systems into an integrated application that could fully optimize drayage information, thereby, reducing bobtails and spreading out the traffic arriving at terminals throughout the day, which would result in reduced trips, reduced miles, and corresponding improvements in air quality.

U.S. DOT requires a flexible development and deployment program for FRATIS that can result in deployments of DMA applications in relatively short periods of times (e.g., in 1.5 years versus 5 years). To facilitate this program, U.S. DOT recently awarded the FRATIS ConOps to Cambridge Systematics. Under this effort, by June 2012, Cambridge Systematics will develop the initial user needs, ConOps, and System Requirements for FRATIS. Under the defined vision for FRATIS, U.S. DOT would reach out to the niche private-sector firms who already are designing and deploying revolutionary technologies related to Freight DMA,
and develop the FRATIS applications in collaboration with these firms (e.g., iPhone and Android applications for FRATIS traveler information, dynamic routing, and load matching). Anticipated FRATIS application life cycle is six (6) to eighteen (18) months, and is based on continual interaction and feedback with customers/consumers.

For the integrated FRATIS, another program need is the migration of any initial set of applications and technologies developed from ConOps to future versions that could work seamlessly with the Connected Vehicle program’s Vehicle to Infrastructure (V2I) and Vehicle-to-Vehicle (V2V) 5.9 GHz DSRC and SmartRoadside technologies. Any initial deployments of FRATIS components must be designed in a “future proof” environment to allow them to support future interaction with vehicle-to-roadside and vehicle-to-vehicle DSRC 5.9 GHz technologies. Early deployments of FRATIS are anticipated to be smart phone-based requiring communications between smart phones and DSRC 5.9 GHz systems.

GPS Partnerships

There have been some public-private partnerships in recent years to collect, analyze, and disseminate data and performance measures using GPS positional data from commercial truck fleets. Chief among these at the national level is the FHWA Freight Performance Measures (FPM) project. This project, led by the American Transportation Research Institute (ATRI), the research arm of the American Trucking Associations, developed and tested a national system for monitoring freight performance on the nation’s highways. The program includes the FHWA-sponsored studies of truck travel times in freight-significant corridors to measure the performance of the freight transportation system. Truck travel times indicate how well the intercity highway network is performing; data are being used to calibrate network assignment models, and to understand activity by time of day. Performance measures include average truck speed by time of day, travel time, and reliability. Figure 4.5 shows an example of average truck speeds on 25 Interstate freight corridors developed by ATRI using this data.

The project involves collection and scrubbing of GPS data and analysis of patterns and trends on major corridors around the U.S., Canada and Mexico. The data consists of GPS data from trucks (truck position records), scrubbed of individual company identity. The actual data is obtained from a variety of sources, including fleets, GPS vendors, and telecommunication companies. ATRI prepares reports of data analysis and results, including derived performance measures for corridors and regions with congestion or delays. GPS data is collected in near real-time electronically from partners. Public updates are made regularly to FPMweb, which is a site administered by ATRI and sponsored by U.S. DOT, to provide aggregated results from the FPM project, such as travel speeds by three-mile corridor segments.
One key challenge associated with this project is maintaining data confidentiality for the trucking industry partners who are providing the GPS data. ATRI thus serves as a trusted third-party data repository. Actual GPS unit positional data is not provided to the public, or to users contracting with ATRI, such as the U.S. DOT and state DOTs. Rather, users obtain a license for “data products and services”, so that performance measurement users may receive ‘dashboards’ developed by ATRI, which comply with the underlying agreements that ATRI signs with data providers. The data is actually owned by the providers, who govern whether and how it can be shared. This certainly limits the real-time freight data available to agencies; however, it is unlikely most carriers would agree to participate without these protections.

### 4.5 FLEET MANAGEMENT TECHNOLOGIES USED BY STAKEHOLDERS IN THE GATEWAY CITIES REGION

Cambridge Systematics conducted a workshop with private-sector stakeholders (mostly trucking companies registered with the HTA) on November 15, 2011, to learn first-hand about the types of issues that negatively impact the productivity
of truck-based goods movement in the Gateway Cities subregion, and also to obtain input on the fleet communications technology being used.

In addition to this stakeholder workshop, Cambridge Systematics sent an on-line survey to approximately 100 members of the HTA. The on-line survey was developed as a follow-up to the workshop, and it covered detailed questions intended for a wider audience. We received 47 responses, almost a 50-percent hit rate, which is considered good for this type of survey. The on-line survey results corroborated the information provided during the workshop.

During this workshop and the on-line survey process, stakeholders also provided information on the fleet management systems used by their companies. The following points summarize the information that they provided:

- Almost all of the trucks enrolled in the HTA are equipped with latest fleet communication systems.
- Majority of the companies have new equipment. All trucks are smart now (and newer) because of 2008 air quality regulations.
- Commonly used Fleet Management Systems are Teletrac, Xata Turnpike (via Sprint), Sysquest, Globalcomm, Qualcomm, etc.
- All these fleet management systems are equipped with on-board systems and GPS antennas that provide two-way communication and enable location tracking. These systems also connect to the engine bus and provide fuel use, speed information, and other odometer-based data.
- Even though most systems are modular, buyers can choose to include whatever data is needed for management purposes. Sample cost of such a system is approximately $500 initially, and then up to $25 per month.
- One participant particularly highlighted that it is helpful to know where the truck is as a result of communications technology – it helps with tracking hours of service. He believed that eventually tracking of trucks will be a requirement for hours of service. The information also helps him understand how a truck operator is driving the truck, how fuel is utilized, how braking occurs. All the systems have idle time reports, speeds, etc. that one could chose to receive.
- All participants agreed that these fleet management systems have improved their operational efficiency. Even though they could not quantify it, they believe that it has improved their bottom line tremendously.
- At this time, 56 percent of the 47 respondents who took the survey noted that routing decisions are communicated manually via the dispatcher. Five percent of the respondents noted that the decisions are automated via their on-board fleet communication system. Another five (5) percent of the respondents indicated that the drivers make routing decisions based on information heard from other drivers. Two (2) percent of the survey
respondents indicated that decisions are made as a combination of dispatch and driver information.

4.6 CONCLUSIONS

GPS used for fleet management by trucking companies provide probe data that can support a truck performance-monitoring program. There are several private-sector fleet management technologies and systems in the marketplace. There also is significant advancement being made in these systems— the range of functions and the data that these systems provide are continually improving. Effort should be taken to leveraging the existing technologies and data sources. Creating public-private partnerships to collect, analyze, and disseminate data and performance measures using GPS positional data from commercial truck fleets is a route that could be considered. Partnerships can be made with direct aggregator or third-party companies (such as INRIX) and other GPS vendors to acquire fleet management data, and then process those data so they can eventually be used for a network-based truck performance measures program. It is important to note the challenges associated with such partnerships, such as maintaining data confidentiality for the trucking industry partners who are providing the GPS data. The data is actually owned by the providers, who govern whether and how it can be shared. Because a large proportion of real-time information is crowd-sourced, the crowd has to be able to trust that their information will not be misused or shared inappropriately. Most of the private aggregator companies already have developed methods of safeguarding the privacy of individuals and the information they provide. These methods will continue to evolve as the number of channels providing crowd-sourced information grows.

Additionally, outreach is important in order to educate carriers about the partnership benefits to the private sector by allowing for better regional freight ATIS; and connectivity to new applications that the Gateway Cities ITS might offer, such as container pick-up information, real-time terminal queue data, etc. Agreements should be drafted in a way that defines these mutual benefits to both parties while at the same time maintaining the confidentiality of the fleet providers.

The summarized needs and potential solutions are documented in Table 4.5 below.
### Table 4.5 Private-Sector Fleet Management Issues Summary

<table>
<thead>
<tr>
<th>Issue/Need</th>
<th>Source</th>
<th>Context</th>
<th>Potential Solution</th>
</tr>
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</table>
| Need for public-sector to obtain better freight travel data (TF-1) | MTA    | ● There are several private-sector fleet management technologies and systems in the marketplace.  
   ● There is significant advancement being made in these systems – the range of functions and the data that these systems provide are continually improving. | ● Evaluate trucking community as a source of probe data  
   ● Consider partnerships with aggregators or 3rd party providers to obtain data  
   ● Utilize vendor showcases to get more information on the data services offered, pricing information and potential for partnership  
   ● Identify best practices for mitigating privacy restrictions and exclusivity issues  
   ● Determine how to integrate various information sources into a coalesced truck traveler information system  
   ● Determine how a GMTMC would be the clearinghouse for this information |
| Private-sector need for better regional freight ATIS (TF-2) | HTA    | ● Trucks in the region are frequently equipped with latest fleet communication systems.  
   ● Study participants agreed that fleet management systems have improved their productivity and operational efficiency. | ● Conduct outreach to educate private-sector on benefits to sharing data by allowing for better ATIS and connectivity to potential new applications (container pick-up info, real-time terminal queue data, etc.)  
   ● Utilize the ITS Working Group to bring together private-sector truck operators and public-sector agencies to collaboratively address data interchange needs and solutions  
   ● Determine how to integrate various information sources into a coalesced truck traveler information system  
   ● Determine how a GMTMC would be the clearinghouse for this information |
4.7 **Next Steps**

The fleet management system overviews and information resulting from this background research will be used to further identify gaps, as well as opportunities to leverage existing data sources and related technology to implement innovative solutions to address freight movement and traveler information needs in the Port areas and the Gateway Cities subregion. This will result in further identification and refinement of potential solutions, coordination with recommendations from other project areas, and evaluating and packaging alternatives to address the ITS data needs in the region.
5.0 I-710 Freight Corridor Opportunities

EXECUTIVE SUMMARY

In order to address the issue of using technology to manage and operate the proposed I-710 Freight Corridor, this section incorporates recent and ongoing research related to vehicle platooning technologies, truck tolling strategies and other potential automation needs. The I-710 freight corridor is designed for conventional trucks and zero emission trucks. For the zero emission option, to be able to process as many trucks as possible, truck platooning needs to be implemented to increase throughput. Additional automation technologies may also need to be examined with respect to operations, potential electrification, enforcement and tolling. Vehicle platooning technologies are part of the broader topic area of intelligent vehicles. The concept of intelligent vehicles (IV) is not new; many transportation research centers have been studying various concepts that fall under the topic of IV for many years. The information in this section focuses on commercial vehicle platooning studies and demonstrations from the 1990s to the present as well as ongoing and planned demonstrations. It also highlights key aspects of platooning studies, other vehicle types, and the work of relevant research organizations in the United States and abroad.

Some key takeaways from this research are:

- Safety was and continues to be a major impetus for many of the intelligent vehicle projects included in this research.
- User acceptance is a major challenge to be faced when trying to implement vehicle platooning technologies.
- One of the major benefits of implementing some of the vehicle platooning technologies is the relatively small infrastructure investment that is required.

The truck tolling strategies research addresses the question of how the proposed to I-710 Freight Corridor – construction of new facilities, operation, and maintenance – will be funded. Examples of the following major tolling strategy types are described in detail: Truck-Only Toll Lanes, Congestion Pricing, Distance-Based Pricing, and “Other Pricing Schemes”. The case studies included in each strategy type provide information on the context in which each tolling solution was implemented and possible issues and topics to consider.
5.1 **INTRODUCTION**

The I-710 corridor serves as the major freeway route to and from the Ports of Long Beach and Los Angeles. The highway provides direct access to the Port area from the north and also serves as the final leg for traffic accessing the Port area from several other major freeways, including I-405, SR 91, I-105, and I-10. A number of key arterial roads provide connections to intermodal yards north of the Port; I-710 serves as the major connector to these facilities as well. Growth in Port traffic has rendered the current six or eight-lane I-710 freeway inadequate to service the needs of the both the Port and the community. Over the past six years, Metro, Caltrans, Gateway Cities Council of Governments (GCCOG) and the Ports, along with other local agencies, have been evaluating improvement proposals for the I-710 corridor. Efforts were initiated in 2005 with a Major Corridor Study and then advanced to the Environmental Impact Report/Environmental Impact Statement (EIR/EIS) stage in 2008 (to be finalized in 2013).

The I-710 Alternatives Screening Analysis Final Report summarized the background conditions in the corridor in 2009: “Currently, the POLA/POLB complex is the fifth largest container port in the world with projections showing a substantial increase in the volume of port activity within the I-710 study area over the next 25 years. As a result of current port activity levels, a high volume of Heavy-Duty Truck (HDT) traffic has been traveling along the freeway, which was built prior to the containerization of oceangoing freight. Presently, on certain freeway segments within the City of Long Beach (between Ocean Boulevard and 9th Street), HDTs make up over 30 percent of the traffic stream during the day, as opposed to an average daily truck percentage of six to thirteen (13) percent on comparable freeways within Los Angeles County. In conjunction with a large growth in population and employment along the I-710 Corridor, these HDT volumes have strained the facility’s capacity, rendering it unable to accommodate current or future traffic demands. The congestion problem is compounded by the freeway’s outdated design and the potential for accidents created by the commingling of HDTs and passenger vehicles.”

The project study area is shown in Figure 5.1 and includes I-710 from SR 60 in East Los Angeles south to the Port of Long Beach, and including a two- to three-mile swath on either side of the freeway.

The specific assumptions related to growth in the corridor were documented in the Screening Report as follows:

- Population growth in the corridor from 1.2 million in 2009 to 1.4 million in 2035;

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• Employment growth in the corridor from 503,000 in 2009 to 537,000 in 2035; and

• Goods movement growth from 16.0 million TEUs in 2009 to between 28.5 million to 42.7 million TEUs in 2035."}

Through the Major Corridor Study Process, a locally preferred alternative was developed that included expansion of the existing highway from six or eight to 10 lanes and construction of four additional separated freight lanes for exclusive use by trucks. The technology applications discussed here are for the proposed freight corridor only. The placement of the entrances and exits along the separated freight right-of-way is designed to serve use between the intermodal yards and the Ports, as well as to provide movement to and from I-710 from other major freeways and to destinations beyond the I-710 study area. The locally preferred option, identified as Alternative 6, was taken forward into the EIR/EIS stage and subdivided into several additional alternatives. The additional alternatives were developed to take advantage of new and emerging technologies that can enhance the environmental benefits of the project and increase the capacity of the freight lanes to meet future demand. These include:

• Platooning technology to reduce vehicle headways, and provide much greater throughput on the lanes;

• Zero-emission vehicles which will improve air quality in the corridor; and

• Tolling strategies that can be used to fund the project and to provide incentives for other beneficial behavior, including use of zero-emission vehicles and spreading of peak demand.

Figure 5.2 shows the various suboptions under Alternative 6.

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44Ibid.
Figure 5.1  I-710 Project Study Corridor

This report focuses on two aspects of the roadway planning and design of the platooning and toll components of the proposed alternatives for the possible freight corridor only for Alternatives 6B and 6C. This effort focuses on advanced research since neither vehicle platooning nor truck-only tolling has yet been implemented in an operational setting of this kind. Significant advances are being made in both areas, however, in the U.S., Europe, Asia, and Australia. Given the long lead-time of the project and the rapid advance of technology, it appears that these technologies will be greatly advanced by the time the freight corridor is built.

Section 5.2 summarizes recent and current research on vehicle platooning strategies that are relevant to the I-710 corridor. Section 5.3 includes a similar evaluation of truck tolling strategies being tested and planned both domestically and internationally.
5.2 **VEHICLE PLATOONING STRATEGIES**

The purpose of this section is to identify vehicle platooning strategies that can be applied to the I-710 Freight Corridor. This information was obtained through a review of literature published within the past 20 years, with an emphasis on the most recent research that is applicable to commercial vehicle traffic. Additionally, interviews were conducted with researchers in the field of intelligent vehicles and professionals within the industry. The search identified both organizations active in platooning research and specific demonstration projects relevant to the I-710 freight corridor. This is an area of rapid development that needs to be tracked closely on an ongoing basis. While a number of demonstration projects are in the planning or initial development stages, four projects, or related groups of projects, were identified that have relevance to the I-710 freight corridor and have produced results. The projects are featured in Section 5.2, following a brief overview of intelligent vehicle/platooning technology. Section 5.3 provides a summary of other domestic and international organizations active and other planned projects.

**Intelligent Vehicle/Platooning Technology**

To best understand vehicle platooning strategies, it is helpful to begin with a brief background and definition of “intelligent vehicles.” “Intelligent vehicles” (IV) or “intelligent vehicle systems” (IV systems) are general terms that refer to cars, trucks, or other vehicles equipped with technology that gathers information from the driving environment and provides that information to the driver or assists the driver in optimal vehicle operation. These IV systems are involved with the tactical part of driving, including steering, braking, and working the throttle rather than the strategic part of driving that includes route choice. Other technologies such navigation systems help with the strategic aspect. Both the tactical and strategic aspects are relevant to vehicle platooning and its potential use in the I-710 freight corridor.45

While this section focuses on vehicle platooning strategies, a subset of intelligent vehicles, some basic principles and details about intelligent vehicles are included in this report. The concept of intelligent vehicles (IV) is not new. IV and related concepts have been researched for many years both in the United States and in other countries. A major goal in employing this technology is to improve roadway safety. Many countries have implemented safety-related programs over the past few decades with the goal of reducing roadway crashes and reducing the overall cost of transportation to society. Some of these programs are highlighted in Sections 5.2 and 5.3. One key turning point in this field of research occurred in the 1990s, when transportation professionals started to realize that they could obtain affordable info, sensor technologies, and

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computing. The new accessibility of this information helped lead to the growth of Intelligent Transportation Systems (ITS).\textsuperscript{46} Since then, much research has been done related to the concepts of IV, automated vehicles, and other topics in this area of transportation. While the goal of this paper is on commercial vehicle platooning, related research, even if not focused solely on commercial vehicles, was incorporated if it could inform the I-710 freight corridor discussion.

**Major Demonstrations**

Five major demonstrations are described in this section, including:

- A series of platooning studies and demonstration conducted by the University of California Partners for Advanced Transportation Technology (PATH) program between 1997 and the present.
- Two demonstrations being conducted under the auspices of the European Union, the SARTRE program and the CHAUFFEUR/CHAUFFER2 programs.
- The MARS autonomous vehicle program and the DARPA Grand Challenge being conducted by the U.S. Defense Advanced Research Projects Agency (DARPA).
- The Autonomous Truck Hauling system operated by the Rio Tinto company in Australia.

Figure 5.3 shows a timeline of major events related to vehicle platooning beginning in the 1990s.

**California Partners for Advanced Transportation Technology (PATH) Platooning Demonstrations**

California Partners for Advanced Transportation Technology (PATH) is a program administered by the Institute of Transportation Studies (ITS) at the University of California at Berkeley, in collaboration with Caltrans. PATH includes staff and students from universities across California and is multidisciplinary in nature, including areas such as transportation policy, economics, electrical engineering, information technology and others. The program’s main goal is to use research to solve the State’s surface transportation problems. PATH has done much research in the area of connected vehicles/intelligent vehicles. Four experiments are highlighted below for their relevance to the I-710 freight corridor project:

- **1997.** At the widely publicized National Automated Highway System Consortium (NAHSC) Demonstration in August 1997, on I-15 in San Diego,

\textsuperscript{46}Ibid, page 2.
PATH proved the technical feasibility of implementing an eight-vehicle platoon using passenger vehicles (Buick LeSabre).

- **2003.** Using Freightliner trucks, PATH conducted testing with two-truck platoons for a project with Caltrans.

- **2004.** PATH studied the feasibility of using Cooperative Vehicle-Highway Automation Systems (CVHAS) in the Chicago area to facilitate intermodal freight movements.

- **2011.** Using Freightliner trucks, PATH conducted testing with three-truck platoons.

Since the 1997, 2003, and 2011 platooning projects are related, these are discussed first, followed by a discussion of the 2004 Chicago CVHAS project. The key topic areas addressed in these studies are summarized in Table 5.1.

### Table 5.1 Topics Addressed in the CHAUFFEUR and PATH Projects

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<td>Environmental impact of commercial vehicles</td>
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<tr>
<td>Working conditions/comfort</td>
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</table>

* The first phase of the project (CHAUFFEUR) included some of these topics; the CHAUFFEUR 2 project added onto the shorter list, so this column incorporates all topics addressed in either the first or second phase.

Source: This incorporates information from multiple sources including Richard Bishop’s book *Intelligent Vehicle Technology and Trends*; discussions with Steven Shladover; and other research from California PATH. In the CHAUFFEUR project, a 5.8-Ghz intervehicle communication system was used. The truck trailers had infrared markers on the back of them that could be detected using an image processing system. The lead vehicle was driven by a human driver while a vehicle controller was used to operate the “follower” or “towed” vehicles.
1997 National Automated Highway Demonstration

At the NAHSC’s demonstration in August 1997, eight Buick LeSabre passenger vehicles equipped with sensors, actuators, and onboard intelligence were used to demonstrate vehicle platooning capabilities on the I-15 HOV lanes in San Diego. In this demonstration, vehicles traveled at 5.5 meters (18 feet) apart from one another at all speeds up to highway speed. If that were multiplied out to roadway capacity (e.g., numerous eight-car platoons at 65 mph with 60 meters (200 feet) between platoons), 5,700 vehicles per hour would be able to travel on the roadway. Assuming a 25-percent reduction in capacity to allow for entering and exiting the platoon would reduce that number to 4,300 vplph.\(^{47}\) For reference, the standard highway throughput is 2,000 vplph. Regarding drag, moderate benefits can be achieved at a spacing distance of 5.5 meters, but it is more dramatic if cut in half. While there have been advances in wireless platooning technology since this demonstration, the basic principles of subsequent demonstrations have not changed.

This demonstration used forward-looking radars to measure the distance and speed difference between consecutive vehicles and a radio communication system that provided vehicle speed and acceleration updates by each vehicle 50 times per second. Maneuverability was coordinated between vehicles. For example, when changing lanes, vehicles communicated with one another so that they knew not to occupy the same space at the same time. When a vehicle joined or removed itself from the platoon, the vehicles decreased the amount of space when joining and increased the amount of space when leaving the platoon.\(^{48}\)

A steering (lateral control) system kept the vehicle within a few inches of the lane center under most conditions. In the lateral system, boundaries were defined so a vehicle was aware of the boundaries it should follow. The vehicle used sensors to understand its location with respect to the road, and onboard intelligence commanded the steering to follow the road. As part of this system, there were magnetic markers in the road four feet apart. The PATH steering system used these markers to define the roadway. Additionally, magnets encode information on roadway characteristics including road geometry, milepost locations, and entrance and exit information. Magnetometers below the car bumpers detected the magnetic field and received information telling the car its location relative to the road center. The information was sent to a control computer, which issued commands to an actuator in the steering column and the vehicle steered according to that command. The margin of error was less than three inches.

\(^{47}\)Ibid.

\(^{48}\)California Partners for Advanced Transportation Technology (PATH), (no date), “Vehicle Platooning and Automated Highways”.
speed and spacing (longitudinal control) were designed to provide a smooth ride.\textsuperscript{49}

The fault management system was another key element of this technology. Its purpose was to detect and handle failures of both sensors and actuators.\textsuperscript{50} A malfunction was usually detected within a fraction of a second and self-corrected with vehicles increasing spacing up to 15 meters between itself and the car in front of it. If the actuator were to fail (which would be rare), the driver would be instructed to intervene. In the case of an error or malfunction, all vehicles in the platoon could receive the message that something had occurred, with the objective being to avoid a crash. The car interior included buttons on the steering wheel to activate and deactivate the automatic functions (engine, braking and steering control). The vehicles used in the demonstration did not include the full suite of functions that would have to be contained in the full automated highway system. One of the key findings taken from the 1997 project was that it is possible to operate standard automobiles at highway speed close together to potentially increase roadway capacity and thus make a major contribution to relieving congestion. Some rough calculations show that when this technology is employed on a wide scale, each lane can carry twice as much traffic as during average conditions. Another benefit of this technology is that it reduced drag, lowering fuel consumption.\textsuperscript{51}

The major potential benefits of this technology were that it was simple and economical and worked well in both fair and foul weather.\textsuperscript{52}

### 2003 PATH Truck Platooning Demonstration

In the 2003 experiment, wireless communication was used in Freightliner trucks equipped with sensors, radar, and lasers to demonstrate platooning technology. The test track was on the runways of Crow’s Landing, an old airfield in California’s Central Valley.

The experiment set out to answer the following questions:

- Is it possible for one truck to communicate with and follow another?
- If so, how well does it work?
- How much fuel and emissions could be saved?

\textsuperscript{49}Ibid.

\textsuperscript{50}“Actuator” is a general term for a mechanical device that moves or controls something. (Merriam-Webster Dictionary). In this context, there are different types of actuators. For example, there are brake actuators and steering actuators; each type of actuator deals with the control of that particular component of the system.

\textsuperscript{51}California PATH, “Vehicle platooning and automated highways.”

\textsuperscript{52}Ibid.
In the 2003 experiment, vehicles formed into two-truck platoons were tested on the track at Crow’s Landing in an attempt to answer the questions described above. Results showed a significant fuel savings, but the data showed no clear trend in emissions results. The emissions generation processes are more complicated, and it was not clear how accurate the emissions measurements were. In addition, the emissions measurements depended on the use of a special trailer equipped with emissions monitoring equipment. That trailer was a different size from the trailer pulled by the other truck and the large generator that was needed to power its equipment required that the rear end of that trailer be left open, which introduced significant distortions to the air flow pattern around the trailer. Other challenges with the experiment included the length of the runways; the runways were short, which resulted in short trials. By the time the vehicles reached cruising speed, they were only able to cruise for 20 to 30 seconds before they reached the end of the runway.53

Three major conclusions were drawn from the 2003 truck platooning tests, as follows:

- If the system is designed well, the speed of trucks can be controlled.
- This is possible with both an empty and full trailer.
- Fuel savings were found in both the lead and following vehicle, but were significantly larger for the follower.54

Figure 5.3 below illustrates the equipment included on the trucks for the 2003 tests.

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53 Shladover, S. (Discussion and correspondence in December 2011 and January 2012.)
54 Shladover, S. (Discussion and correspondence in December 2012.)
2011 PATH Truck Platooning Demonstration

In the 2011 experiment, Dedicated Short Range Communications (DSRC) technology was used for vehicle-vehicle communications in place of the WiFi technology used in 2003. DSRC are wireless communication channels that allow for the short-range transfer of information between vehicles and roadway infrastructure. In 1999, the Federal Communications Commission (FCC) allocated 75 megahertz of spectrum for the use of intelligent transportation services. The FCC decided to use the 5.9 GHz band because it is appropriate for these short-range applications. This allocation was part of the U.S. DOT’s ITS program.\textsuperscript{55}

The 2011 experiment studied the feasibility of platooning with more than two vehicles; in this case, three-vehicle platoons were tested with a focus on auto speed and spacing control. The purpose was to increase roadway capacity and find out how close together the vehicles can travel and how much fuel they could save, as well as to evaluate maneuvering capabilities and the ability of the platooned vehicles to drive on different grades.

\textsuperscript{55}Federal Communications Commission, 1999, FCC Allocates Spectrum in 5.9 GHz Range for Intelligent Transportation Systems Uses.
Some details about the testing are included below.

- 2003 to 2011. The testing location was in central Nevada on a 5+ mile stretch track and used 5.9 GHz DSRC communication. Regarding infrastructure, the same Freightliner trucks used in the 2003 study were used here.

- Similar to the 2003 study, the trucks were first tested at a distance of 10 meters from one another, then the spacings in subsequent test runs were gradually decreased to 4-meters between vehicles. The assumptions for this research were that these trucks would operate in a dedicated truck lane to prevent cut-ins from passenger cars.

In the 2011 experiment, one major conclusion was that creating a three-truck platoon was much more complicated than a two-truck platoon. This is related to the concept of string stability and making sure that in a platoon, errors are damped out. In the concept of platooning, string stability is a desired state, in which errors decrease along a string of vehicles. If errors were to grow, they could eventually lead to collisions between vehicles further back in the platoon.56

This research was completed under the FHWA Exploratory Advanced Research Program, so in order for this type of project to be implemented on a large scale, further research and funding would be required. Another challenge is fault recovery maneuvers. Barriers to implementation include achieving consistent results with three-vehicle truck platoons and difficulties in defining maneuvers that are guaranteed to be safe (challenges that apply to all truck platoon concepts).57

In summary, the 1997 vehicle platooning demonstration was part of a demonstration aimed at proving the feasibility of this concept. It was conducted by the NAHSC and responded to a provision in the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991. The 2003 and 2011 experiments built upon knowledge that vehicle platooning was possible and applied it specifically to commercial vehicles.

**Chicago Intermodal Freight Project**

Another study published by PATH in 2004 is focused on the feasibility of using CVHAS in the Chicago metropolitan area with a focus on intermodal freight and bus rapid transit (BRT). Problems addressed in this study included the lack of connection between the eastern and western railroads and much congestion on local streets in area between the eastern and western railroads due to freight traffic. With regard to intermodal freight, four operational concept alternatives were tested along with a baseline alternative. The impacts of a CVHAS system were tested and analyzed. Results showed that all of the alternatives are

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57. Shladover, S. (Discussion and correspondence in December 2011 and January 2012.)
economically feasible and the CVHAS technologies would help improve operations. The study recommended further research about one of the freight-related alternatives. That alternative recommended the opening of a truck-only facility before 2015, which would eventually be transitioned to exclusive use by automated trucks when the cost of the truck automation technology comes down.\textsuperscript{58}

Although these cases are specific to Chicago, they illustrate that CVHAS can lead to significant benefits in a major metropolitan region for specific issues such as congestion. One major finding was that the platooning vehicles were beneficial in reducing the future capital cost of building additional truck lanes. Platooning allows many more vehicles to fit on the roadway at one time, thus putting off the need for building more capacity as truck traffic grows. Another benefit is that it reduces drag, thus reducing emissions and saving fuel.

**CHAUFFEUR AND CHAUFFEUR 2**

The CHAUFFEUR project (including both CHAUFFEUR and CHAUFFEUR 2 phases) was a joint European project, begun in the mid-1990s and completed in 2003. It was led by DaimlerChrysler in partnership with IVECO, CRF, and Renault. The project’s purpose was to develop “electronic tow-bar” technology, which allows trucks to follow one another as an automated platoon. Project goals included reducing fuel consumption and general environmental impacts, improving traffic flow, improving comfort for drivers, and increasing safety. Another possible benefit is reduced labor costs if the technology allows for the follower vehicles to operate without a driver present.

The CHAUFFEUR 2 project researched additional issues including the interface of humans and machines; system evaluation; safety; traffic simulations; freight logistics concepts; cost/benefit analysis; user-related issues; and legal issues. CHAUFFEUR 2 also demonstrated additional maneuvers related to heavy truck platooning. Findings and other project information are detailed in Section 5.3.\textsuperscript{59}

The problems addressed by both of these projects are summarized in Table 5.1 above.

In the CHAUFFEUR 2 project, three-vehicle platoons were tested at highway speeds. They were spaced 10 meters apart. Maneuvers tested included: coupling with and de-coupling from the platoon, changing lanes, accelerating from a stop, and braking to a stop. This project evaluated platoons as large as 10


trucks, but only in computer simulations. In this phase, the vehicles were electronically actuated which is also known as “drive-by-wire”.

Components include a distance controller and a lateral controller. The distance controller used data from sensors in the truck itself as well as sensor data from the lead vehicle and the vehicle directly in front of it. The lateral controller used the inputs of the infrared image processing of the infrared pattern on the back of the vehicle directly in front of it. In summary, in this system, the vehicle follows the vehicle directly in front of it rather than the road.

Based on this research, it was expected that the use of CHAUFFEUR and CHAUFFEUR 2 technology could lead to reductions in fuel consumption; reduction in travel times; reduction in operating costs; and increased safety. The additional benefits shown by CHAUFFEUR 2 included greater flexibility in operations, applicability for small vehicle fleets, and less work for the driver.

Challenges included platoon safety and platoon stability. As with any large-scale technology change, the human adaptability aspect will be a challenge as well. This vehicle technology was designed specifically for commercial vehicles and is therefore directly applicable to commercial vehicle fleets. This research was significant because it showed new capabilities in truck automation. At the time of the research, many experts believed that the implementation of truck platooning would not be expected in the near future because it would require the use of dedicated truck facilities. CHAUFFEUR 2 included a “Chauffeur Assistant” that provided driver assistance rather than full automation or platoon capabilities, which could be implemented without any infrastructure changes. Given that I-710 has dedicated freight corridor lanes as planned, the Chauffeur Assistant feature would not be essential, but it could be a helpful feature if there is any interaction between the platoon and vehicles outside the platoon.

**Safe Road Trains for the Environment (SARTRE)**

In Europe, a project called Safe Road Trains for the Environment (SARTRE) began in 2009 and is scheduled to run for three years. It is funded in part by the European Commission and includes involvement from seven project partners: Fundacion Robotiker – Tecnalia; IDIADA Automotive Technology SA; IKA (a university in Aachen); Ricardo UK Ltd; SP Technical Research Institute of Sweden; Volvo Car Corporation; and Volvo Technology AB. There was a successful test track run in January 2010 in Sweden. One key feature that’s

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61Ibid.

Cambridge Systematics, Inc. 5-15
relevant to I-710 is creation of a vehicle platooning/road train system that can operate without changes to roadway infrastructure.\textsuperscript{64}

Project goals include:

- Define platooning strategies that will work on public highways without infrastructure changes;
- Create prototype platooning system that can be tested in real-world scenarios;
- Illustrate benefits of the system; and
- Illustrate how to encourage/incentivize platoons for lead vehicle operators and other members of platoon.

The SARTRE project addresses three major problems: safety, the environment, and congestion. There is a focus on changing personal transportation through platooning, with a major focus on achieving this change without major infrastructure modifications. The “human factor” is given significant consideration in this research, particularly the topic of “acceptability” of this technology and major change in transportation and the human experience with regard to platooning. The project is scheduled to culminate with a platooning demonstration in 2012.\textsuperscript{65}

Safety considerations include the fact that roadway accidents and many fatalities are due to driver inattention. The introductory paper that describes the SARTRE project cites a study reporting that 18 percent of roadway fatalities are due to driver inattention.\textsuperscript{66} The SARTRE concept calls for a professional driver to be present in the lead platoon vehicle, while the vehicle is under autonomous control. Allowing the cars to be under automatic control will allow the drivers to cede control of their vehicles. The specific objective is to decrease the number of incidents caused by driver inattention.\textsuperscript{67}

To address the problem of congestion and the environment, the SARTRE concept hopes to improve overall traffic flow by reducing the speed variability of cars and trucks. Reducing congestion would have a positive effect on the environment through emissions reduction.

Figure 5.4 summarizes SARTRE’s work plan.

\textsuperscript{64}http://fleetowner.com/trucking_around_world/archive/truck-platooning-test-0124/.

\textsuperscript{65}\textit{http://www.sartre-project.eu/en/about/Sidor/default.aspx}.


\textsuperscript{67}Ibid.
The first phase was the concept phase characterized by the following activities:

- **WP2 Concept Definition.** Determine requirements and system architecture such as:
  - Commercial requirements such as business model, financial transaction processes, security of the system, and acceptability;
  - User requirements such as usability of the system and implications of other road users (that are not part of the platoon);
  - Safety requirements;
  - Technical requirements and other components that are necessary in order for the system to function; and
  - Legal implications, including compliance with existing legislation and new legislation such as that related to training new lead drivers.

- Determine system architecture activities:
  - Identify the uses for platoon and nonplatoon vehicles (e.g., “normal use,” “alternative uses,” and exceptions). It will be necessary to narrow down the various “use cases” to be demonstrated.
  - Do traffic simulation to determine the impact of this system on other road users and vice-versa.
  - Study human factors by simulating platooning maneuvers to determine how humans might react and test different parameters.
  - Conduct safety analysis.
  - Define the system design and system requirements.

- **WP3 Implementation.** This phase includes the development of system with three cars and two trucks. Major activities in this phase include safety analysis; developing lead vehicle systems for trucks as well as following
systems for both trucks and cars; developing vehicle-to-vehicle communication systems, developing remote systems that complete functions such as “find platoon”; and testing the systems. The major functions that will be completed by the various elements in the system are:

- Actuation;
- Communications;
- Human machine interface;
- Platoon management;
- Safety monitoring;
- Sensing;
- Sensor fusion; and
- Vehicle automation.

**WP4 Validation.** Platoon performance will be tested. More specifically, on-vehicle systems, end-to-end system, and fuel consumption performance will be tested.

**WP5 Assessment.** This phase assesses the nontechnical aspects of platooning, including commercial viability, impact on infrastructure and the environment, and impacts on policy. Stakeholder assessments will be completed in this phase, including feedback on the results of the platooning demonstration.68

At the time this paper was presented, some initial results were reported, mostly related to the concept phase. These results were in the form of program assumptions. A few examples are listed below:

- “There are no changes to road infrastructure.”69
- “A minimal platoon is one LV (Lead Vehicle) and one FV (Following Vehicle).”70
- “A platoon has a maximum size. If a PPV (Potential Platooning Vehicle) wants to join a platoon of maximum size, join will not be allowed.”71

Based on these prerequisites and numerous others, many “use cases” were defined. The “high-level” use cases are as follows: Create Platoon, Join Platoon,

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68 Ibid.
70 Ibid, page 7
Maintain Platoon, Leave Platoon, Dissolve Platoon, Register, Guide to Platoon, Handle Platoon Status, and Charge Platooning Vehicle.\textsuperscript{72}

**Technologies Tested**

The SARTRE concept includes a number of different technologies. One key point relevant to the I-710 freight corridor project is that implementing a platooning system is a complex undertaking. This complexity is underscored by Table 5.3 Summary of Use Cases: PUCs and Table 5.4 Summary of Use Cases: BUCs. There are two types of “use cases” or scenarios that may arise in platooning behavior: Platoon Use Cases (PUCs) and Back Office Use Cases (BUCs). First, terminology is defined in Table 5.2. The SARTRE project is the only research project to date that has defined the full range of activity required to operate a dedicated truck platooning system such as the one proposed for I-710. The tables below provide a good starting point checklist for the items that must be addressed in implementing an I-710 platooning system. Although the SARTRE project is testing specific technologies, most of these issues cut across any technology that would be considered.\textsuperscript{73}

Table 5.3 below shows a few examples of PUCs, which deal with structure and primary operation. BUCs, shown in Table 5.4 below, deal with activities related to infrastructure, including charging and navigating to a platoon.

\textsuperscript{72}Ibid.

\textsuperscript{73}Bergenhem, C., Q. Huang, A. Benmimoun, and T. Robinson, 2010, Challenges of Platooning on Public Motorways.
<table>
<thead>
<tr>
<th>Concept</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autonomous Driving</td>
<td>Both lateral and longitudinal autonomous control. The technical equipment controls the vehicle without driver involvement. This is only possible for an FV.</td>
</tr>
<tr>
<td>BO (Back Office)</td>
<td>Back Office is an infrastructure unit that supports the back office administration. BO also covers toll booths.</td>
</tr>
<tr>
<td>BUC (Back Office Use Case)</td>
<td>Back Office Use Case concerns services for making platooning economically feasible, hire charging, and guiding vehicle to suitable platoon.</td>
</tr>
<tr>
<td>FV (Following Vehicle)</td>
<td>A vehicle, truck, bus, or car in a platoon behind a LV. FV is controlled without driver involvement while in the platoon.</td>
</tr>
<tr>
<td>LV (Lead Vehicle)</td>
<td>LV is the lead vehicle of a platoon and is a truck or bus. LV is controlled by a driver.</td>
</tr>
<tr>
<td>OV (Other Vehicle)</td>
<td>A vehicle that will never join a platoon but may affect it.</td>
</tr>
<tr>
<td>PFV (Potential Following Vehicle)</td>
<td>A PFV is not currently platooning, but may do so. When in a platoon this vehicle is an FV.</td>
</tr>
<tr>
<td>Platoon</td>
<td>A platoon is a number of vehicles that are traveling together and electronically connected (e.g., via wireless communication). There is one LV and one or more FVs. The FV(s) of a platoon are controlled autonomously while the LV is controlled manually.</td>
</tr>
<tr>
<td>PLV (Potential Platoon Vehicle)</td>
<td>A vehicle that may be included in a platoon. PPV is controlled manually. A PPV is either a FV or LV.</td>
</tr>
<tr>
<td>PUC (Platoon Use Case)</td>
<td>A UC concerning the behavior of a platoon.</td>
</tr>
<tr>
<td>PV (Platoon Vehicle)</td>
<td>A LV or FV. In the case of FV it is controlled autonomously.</td>
</tr>
<tr>
<td>System</td>
<td>A system is here a logical grouping of platoon and Back Office Use Cases containing the overall required behavior.</td>
</tr>
</tbody>
</table>

Source: The contents of this table are from Table 1: Definitions for platooning, p. 3 of “Challenges of Platooning on Public Motorways.” Bergenhem, C., Q. Huang, A. Benmimoun, and T. Robinson, 2010.
Table 5.3  Summary of Use Cases: PUCs

<table>
<thead>
<tr>
<th>PUC Groups</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create Platoon</td>
<td>The UCs in this group are invoked when a PLV and PFV wish to initiate a new platoon. The PLV driver is properly trained. Back Office services are normally used for identifying a target LV, guidance to it, and financial transactions. However, it also is possible that the PFV can find a target LV by chance. One PLV and one PFV are involved.</td>
</tr>
<tr>
<td>Join Platoon</td>
<td>The UCs in this group are invoked when a PLV or PFV wish to join a platoon. The platoon consists of one LV and are least one FV. Back Office services are normally used for identifying a suitable platoon, guidance to it, and financial transactions. However, it also is possible that the PLV/PFV can find the platoon by chance. One PLV or PFV and one platoon are involved.</td>
</tr>
</tbody>
</table>

Source: The contents of this table are from Table 1: Definitions for platooning, p. 3 of “Challenges of Platooning on Public Motorways.” Bergenhem, C., Q. Huang, A. Benmimoun, and T. Robinson, 2010.

Table 5.4  Summary of Use Cases: BUCs

<table>
<thead>
<tr>
<th>BUC Groups</th>
<th>Description</th>
</tr>
</thead>
</table>
| Register | The UCs in this group are relevant for a vehicle interested in becoming a member of a platoon. The following functionality is supported:  
1. To register information, e.g., platoon is created, number and type of vehicles, and destination; and  
2. To check if truck/bus driver is platoon trained. |
| Handle Platoon Status | The UCs in this group are invoked when platoon status has changed and Back Office needs to be informed. Examples of change includes platoon dissolution, FV or LV leave, and emergency situations. |
| Charge Platoon | The UCs in this group are invoked when financial transactions (payment and crediting) shall be made. Principles for financial transactions are not specified. It could be handled in advance, partial or full, or afterwards. An example of functionality is FV payment to LV via the BO. |
| Guide to Platoon | The UCs in this group are invoked when road guidance is needed. The following functionality is supported:  
1. Find target PLV-PFV and give guidance information to PFV driver how to find PLV.  
2. Find target platoon-PFV and give guidance information to PFV driver how to find the platoon. |

Source: The contents of this table are from Table 1: Definitions for platooning, p. 3 of “Challenges of Platooning on Public Motorways.” Bergenhem, C., Q. Huang, A. Benmimoun, and T. Robinson, 2010.

Analytical tools used includes simulations run using a tool known as PELOPS (Program for the Development of Longitudinal Traffic Processes in System Relevant Environment). PELOPS combines a submicroscopic traffic model with a submicroscopic vehicle model which allows users to look at the interaction between the driver, vehicle, and traffic. This tool was developed in PROMETHEUS with the cooperation of BMW. PELOPS has been updated.
numerous times since 1989. Figure 5.5 below illustrates the components of PELOPS.\(^{74}\)

**Figure 5.5 PELOPS Model**

![Diagram of PELOPS Model](image)

Note: This is a recreation of the PELOPS structure featured on page 6 (Figure 2) of “Challenges of Platooning on Public Motorways”, Bergenhem, C., 2010.

Previous projects such as the German-government led KONVOI project that focused on commercial vehicle platooning have helped inform the enhancements made to PELOPS.\(^{75}\)

PELOPS uses the defined use cases and creates simulations to test different scenarios and actions. One example of how this tool was used was to test the “join” maneuver. Vehicles may join a platoon from difference approaches, including the side or rear of a platoon. This tool helps simulate various approaches and report the results with regard to performance and efficiency. PELOPS has been customized for its use in simulating vehicle platooning.

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\(^{74}\)Ibid.

\(^{75}\)Ibid.
Customizations include using it in tandem with visualization software. Figure 5.6 shows the entire platooning simulation process.76

**Figure 5.6 Simulation Process**

![Simulation Process Diagram]

Note: This is a re-creation of Figure 3 (PELOPS simulation environment for platooning) from page 7 of “Challenges of Platooning on Public Motroways.” Bergenhem, C. (2010).

Many different scenarios have been simulated to test the platooning capabilities. Preliminary results have been summarized. Functions tested thus far include the space needed to join or leave a platoon, string stability, and fuel consumption among others. For example, in the “Create Platoon” use case, various combinations can be tested, including the I-710 four-lane exclusive freight corridor.77

While the final demonstration of the SARTRE project has not yet been reached, there was a successful, publicized demonstration of the platooning vehicle concept with trucks and passenger vehicles in Gothenburg, Sweden, in January 2011. Many hurdles have yet to be addressed, including the issues of governance and implementation, particularly as it relates to more than 20 countries in the European Union (EU) with different laws and structures.78

**U.S. Defense Advanced Research Projects Agency (DARPA) MARS Project**

The U.S. Defense Advanced Research Projects Agency (DARPA) has been involved in intelligent vehicle research. The 2020 Mobile Autonomous Robot Software (MARS) project aims to develop perception-based autonomous vehicle driving and navigation for a variety of real-world environments using high-performing vehicle intelligence close to human levels. Because military actions often take place in cities, where other cars and pedestrians are present, DARPA would like for these vehicles to be able to perform in a variety of environments, including: basic highway, advanced highway, hybrid road/cross-country, basic

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76 Ibid.
77 Ibid.
78 Ibid.
urban driving, and advanced urban driving. This effort is relevant to the I-710 freight corridor project because if the technology that would allow the vehicles to operate in advanced urban driving conditions is successful, it could be applied to commercial vehicles traveling on the I-710 freight corridor. Advanced urban driving conditions include congested facilities on which traffic is unpredictable and vehicles and other pedestrians are present. While that description does not match I-710 conditions exactly, the technology could be modified to work well in the I-710 freight corridor.\textsuperscript{79}

This project achieved its goal by developing and implementing a MARS architecture in which the operator gave commands about the proposed destination that were then translated into routes and vehicle behaviors. Tools and technologies used included radar, lidar, and machine vision. Vision was used to detect pedestrians, signs, intersections, and ramps. In 2004, a test was completed in the form of a trip from Denver to New Orleans. The system achieved almost 100 percent automated vehicle detection. The test parameters included the absence of road construction and medium to light traffic.\textsuperscript{80}

The vehicle that made the trip from Denver to New Orleans, known as the “Voodoo Tour,” used radar and color vision in order to accomplish “road following” and “car following,” which includes maintain a gap. Additionally, the car had “automatic exiting” capabilities based on sensing the specific lane markings in cooperation with a digital map with the route encoded in it. The vehicle was a 1998 Jeep Cherokee with throttle, brake and actuation steering added to it. The autonomous system was disabled when extreme weather or dense urban traffic were encountered. The trip was 1421 miles and took 28 hours at an average speed of 58 mph. The computer successfully drove for 99.4 percent of the time/distance.\textsuperscript{81}

Another relevant project is the DARPA Grand Challenge, which is a competition intended to be a catalyst for autonomous vehicle research and development. It was created in response to directives from Congress and the Department of Defense. The event involves field testing vehicles created by researchers and other across many industries with a cash prize as an incentive. The first challenge was held in 2004, but the $1 million prize was not claimed as no one completed the course.

However, the 2005 DARPA Grand Challenge showed greater success when a team from Stanford University won the competition using its car named “Stanley,” completing the 132-mile desert course in less than seven hours. Many

\textsuperscript{79}Bishop, R., Intelligent Vehicle Technology and Trends.

\textsuperscript{80}Bishop, R., Intelligent Vehicle Technology and Trends.

components comprised “Stanley,” a Volkswagen Touareg that was retrofitted for this competition. These components included: forward-facing laser range finders, a radar system to “see” over a long range, stereo cameras, and a monocular vision system. The vehicle also took measurements using the following technologies/systems: a Global Positioning System (GPS), an inertial measurement unit (with six degrees-of-freedom), laser radar (LIDAR), and a wheel speed measurement system. The software also was critical to the success of this vehicle given the large amount of data collected, so “Stanley” was equipped with seven Pentium M computers. Six custom software modules were used to gather and interpret data and three artificial intelligence (AI) modules processed the data to determine what lay ahead in the road.82

A major challenge in creating such a complex system is successfully integrating the various hardware and software systems. Some of the issues found in “Stanley’s” code related to road boundaries. For example, if the road were very wide, the guidance system would crash. This touches upon a larger issue within this field, which is the successful integration of systems. Car manufacturers are faced with this challenge all the time. The lack of standardization in vehicle systems is an issue. Automakers are constantly feeling pressure to update software, but because of the lack of standardization, it is difficult to connect the pieces correctly.83

Australia Rio Tinto Autonomous Haulage System

In Australia, mining company Rio Tinto has implemented the use of driverless trucks for its operations in West Angelas Mine, East Pilbara operation, in Western Australia. The trucks were manufactured by Komatsu. The system is an Autonomous Haulage System known as FrontRunner that involves dump trucks as well as other machines such as an excavator, bulldozer, wheel dozer, and motor grader. These trucks have the capability to haul a load of 320 U.S. tons without a driver. Instead, they are controlled by a computer in a remote operations center. From the supervisory computer, one can review all data from the trucks used at the mine. Data include location of vehicles and running status.84 As of November 2011, Rio Tinto increased its fleet of autonomous


83Ibid.

trucks from 10 to 150 for its Western Australia mine in order to be able to meet its productivity goals.\(^{85}\)

The supervisory computer sends data about target course and speed to the (driverless) dump trucks. Data about the trucks’ positions are collected using a GPS device. In order to load the dump trucks, the dump truck determines the location of bucket of the excavator or wheel loader and moves to that spot. The course taken by the dump truck to loading location is sent by the supervisory computer. Benefits of this technology include increased safety due to fewer collisions with other dump trucks or other equipment. In terms of safety, the obstacle detection system directs the truck to reduce speed or stop when it detects an object in the vehicle’s hauling course. For the purposes of mining, this technology also offers better reliability of operations, particularly when dealing with an extreme climate such as arid Western Australia or areas at high altitudes. Additional goals of employing this technology include reducing maintenance costs, energy use, and CO\(_2\) emissions.\(^{86}\)

The ability of this technology to control heavy trucks precisely and use intelligence to avoid obstacles or stop in the case of unexpected activity are relevant to commercial vehicle platooning in the I-710 freight corridor. These attributes are desirable in a commercial vehicle fleet as they could help provide efficient goods movement in a safe manner.

**Additional Research Organizations in Vehicle Platooning**

This section identifies and provides brief descriptions of organizations involved in vehicle platooning research in the U.S. and other countries. For the most part, these organizations have not implemented technical demonstrations such as those described in Section 5.2. However, these organizations are active in the promotion of such research or in coordinating efforts between various stakeholders, including FHWA, state and local agencies, automobile OEMs, and communications companies. As work advances on the I-710 freight corridor project it important to track the activities of these organizations, particularly research and standards development efforts.

**RITA Connected Vehicle Program**

The U.S. DOT has been conducting connected vehicle research for several years, mainly through the division known as RITA (Research and Innovative Technology Administration). The goal of the connected vehicle research is to create a robust technological platform to support a multimodal, safe

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transportation system and operations. There are four subareas: Connected Vehicle Technology, Connected Vehicle Applications, Connected Vehicle Technology and Policy and Institutional Issues; and Use of Dedicated Short Range Communications (DSRC). Recent research includes a paper related to safety applications entitled “Frequency of Target Crashes for IntelliDrive Safety Systems” and broader issues such as governance. The report published by the FHWA Joint Program Office in August 2011 (Connected Vehicle Environment: Governance Roundtable Proceedings from June 20, 2011) summarizes the roundtable proceedings of the connected vehicle environment from 2011. At that meeting, experts on the topic of governance were engaged in an all-day session. Topics included defining governance, addressing governance with regard to the Connected Vehicle program and discussing the challenges and risks involved with developing governance.

RITA’s work on governance addresses aspects critical to the implementation of commercial vehicle platooning such as technical standards, regulatory governance, public policy governance and values as well as international governance.87

**Connected Vehicle Trade Association**

The Connected Vehicle Trade Association (CVTA) is a nonprofit business league that works to facilitate communication among stakeholders in the vehicle communication industry. Membership is open to organizations, companies, government agencies, and others that are involved in bidirectional vehicle communications. The CVTA communicates with stakeholders about topics within the vehicle communication industry, including social and policy concerns and engages stakeholders in a dialogue about developments in the industry in an attempt to come to a consensus. The industry has determined that communication standards are an important step to success, which was an impetus for the creation of the CVTA. Because this is a global topic, the CVTA works internationally, not just within the United States. It is helpful to be aware of the policies and topics discussed by the CVTA because many of them such as technology and communication standards affect commercial vehicle platooning.88

**University of Michigan Transportation Research Institute (UMTRI)**

UMTRI was awarded $14.9 million in project funding in 2011 to conduct safety product model deployment of vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) in Ann Arbor, Michigan. The entire project is 30 months, with 12-month testing phase. It is part of an ITS safety initiative. One key

87 http://www.its.dot.gov/connected_vehicle/connected_vehicle.htm.

88 http://www.connectedvehicle.org/.
element is that the testing will be in a “real-world” environment. Wireless communications among vehicles and roadside equipment will be tested. Vehicles will include passenger cars, commercial trucks, and transit buses equipped with a variety of V2V and V2I systems. One potential outcome of this research and technology is crash prevention.\footnote{http://www.umtri.umich.edu/divisionPage.php?pageID=505.}

The remainder of this section documents related projects in Europe and Asia. Summaries are organized by Country.

\textbf{France}

France has emphasized safety as a major focus area within transportation in the last several years. A major research center in the country is the Laboratory for the Interactions between Vehicles, Infrastructure, and Conducteurs (LIVIC). Among its areas of focus are developing concepts and advancing new technology. Its general philosophy involves two components: assistance for drivers on all road types for safety and automation on constrained roads for comfort, capacity, and safety purposes.\footnote{Bishop, R., 2005, Chapter 10. \textit{Intelligent Vehicle Technology and Trends}.}

LIVIC conducted truck platooning research and testing for possible use on a major north-south roadway within the country. Because of the consensus that automated trucks should not be mixed with standard traffic, it was determined that automated truck lanes would be built. Three scenarios were considered: one involving automated trucks but no platooning, one that employed CHAFFEUR-type operation that allowed for platoons to form outside the road that was being studied, and CHAFFEUR-TYPE operation in which platoons formed dynamically. Many tests on speed, distance, and safety maneuvers were conducted with up to four trucks per platoon. Spacing was tested at a distance of 15 meters. There was not a significant gain in truck throughput, but the tests did show fuel and emissions savings. Due to a number of reasons, including the high cost of building a dedicated truck way and the poor reception among people regarding platooning, this project was not implemented.\footnote{Bishop, R., 2005, Chapter 10. \textit{Intelligent Vehicle Technology and Trends}.}

\textbf{Sweden}

Sweden has played a significant role in ITS research. The organization that leads that research is the Swedish National Road Administration (SNRA). Sweden has made a huge commitment to promoting safety, especially with regard to speed compliance. Its “vision zero” program aims to eliminate road fatalities. A major focus within IV is Intelligent Speed Adaptation (ISA), which involves monitoring speed on a vehicle as well as the speed limit and warning the driver if he/she
exceeds the speed limit. Sweden has done thorough testing of ISA in the late 1990s and early 2000s, with particular attention to driver attitudes and system use, road safety, and how it might be implemented on a large scale. The tests were deemed to be successful.\textsuperscript{92}

\textit{China}

Much of the research and development for intelligent vehicles in China is done by universities. At the National Center of ITS Engineering and Technology, autonomous, prototype vehicles were developed that drove based on machine vision. Other technologies used include laser scanner sensors. As of the mid-2000s, China was developing an Intelligent Highway System (IHS) with vehicular and roadway communication. Phasing was planned with the first phase offering safety assistance and the next phase involving control systems.\textsuperscript{93}

\textit{Japan}

There have been two major Japanese government-related projects over the past 20 years: AHSRA and ASV/ASV-2. AHSRA was founded in 1996 and involved the evaluation and implementation of Cooperative Vehicle Highway Systems (CVHS)\textsuperscript{94}. Japan preferred CVHS to on-board sensor systems because those systems cannot detect all hazards. For example, in a mountainous country such as Japan, there were some functionality issues with the sensors. The first phase ended in 2003, with a focus on information and controls. It culminated in an event called “Demo 2000”, in which seven major functions were demonstrated, related to safety. Examples of the functions included preventing lane departure and prevented pedestrian collisions among others. The phase in which automation was the focus came later.\textsuperscript{95}

The second major effort, ASV, focuses on autonomous active safety systems. The first phase was from 1991 to 1995 and the second phase took place between 1996 and 2000. All Japanese automakers participated and highlights include forward obstacle collision avoidance and full-speed range ACC among others. Phase 3, which ran from 2001 to 2005 focused on user acceptance and developing systems that rely on V2V communication.\textsuperscript{96}

\textsuperscript{92}Bishop, R., 2005, \textit{Intelligent Vehicle Technology and Trends}.
\textsuperscript{93}Bishop, R., 2005, \textit{Intelligent Vehicle Technology and Trends}.
\textsuperscript{95}Bishop, R., 2005, \textit{Intelligent Vehicle Technology and Trends}.
\textsuperscript{96}Ibid.
Japan is currently in the midst of a large project with a focus on “Energy ITS”. The main objectives are reducing energy and carbon dioxide emissions emitted through road transportation. The project began in 2008 and is scheduled to run through March 2013. The project, with an estimated cost of 5 billion yen ($60 million), is funded by the Ministry of Economy, Trade, and Industry (METI) as well as the New Energy and Industrial Technology Development Organization (NEDO). Contractors working on the project include the Japan Automobile Research Institute as well as other research institutes, universities and the private sector. This project is in response to increasing levels of CO₂ emissions. Japan has seen success in past ITS projects with regard to congestion reduction and CO₂ emissions reduction. Project types include Integrated Traffic Control Systems (ITCS) and Electronic Toll Collection (ETC) among others.97

While past projects completed in Japan have shown the benefits of reducing CO₂ emissions and saving energy, no previous ITS project has focused on energy and the environment in Japan as the main objective. Past experiences have shown that automated driving systems have been very effective at helping to meet the energy and environmental goals. Automated truck platoons is the main area of focus within the Energy ITS study, accounting for 90 percent of its budget. Technologies being researched include cooperative automated vehicles with no roadside cooperation. Longitudinal control systems include radar and laser sensors as well as vehicle-to-vehicle communications and lateral control includes lane marker detection. To date, one successful demonstration in March 2011 included a three-truck platoon (with heavy trucks weighing 25 tons) at 80 kilometers per hour. The testing roadway was 8 km long and trucks drove at 80 kilometers per hour with a 10-meter gap between the vehicles. The project goal is to demonstrate an automated platoon with three heavy trucks and one light truck traveling at 80 kilometers per hour with 4-meter spacing between vehicles.98

South Korea

Major efforts in South Korea include ITS traffic management and vehicle safety testing as well as safety technology development. Major IV areas of focus include collision avoidance and vehicles that will be capable of platooning. Another major research area is ASV. As of the mid-2000s, there were plans to build an Advanced Safety Vehicle (ASV) test and evaluation center at the Korean Automotive Testing and Research Institute.


98Ibid.
Other Planned/Proposed Research Projects

As SARTRE nears completion, it will be interesting to learn what the next steps are. SARTRE is a large project with implications for many countries, which could have great implications on the world of vehicle platooning. Lessons learned from it can hopefully inform plans in the I-710 freight corridor.

Additionally, car manufacturers around the globe are investing much time and energy into developing new technologies related to platooning for commercial or passenger vehicles.

One example in the near term is a project in coordination with the U.S. DOT in which Mercedes/Freightliner is heavily involved. It is called The Connected Vehicle Demonstration and is a partnership between the U.S. DOT and the Crash Avoidance Metrics Partnership (CAMP), which includes Ford, General Motors, Honda, Hyundai/KIA, Mercedes-Benz, Nissan, Toyota, and the Volkswagen Group of America.

Finally, as mentioned earlier, Connected Vehicle Research is an area of focus within the U.S. DOT. An ongoing joint effort between the U.S. DOT and car manufacturers is summarized below.

Since the early 2000s, the United States Department of Transportation and numerous passenger vehicle manufacturers have been working together on a research effort known as the Vehicle Safety Communications Consortium (VSCC). The consortium is studying the use of wireless communications for vehicle safety applications. In the current phase, the VSCC is focusing on user acceptance of safety applications. Eight car manufacturers have collaborated with the U.S. DOT to hold six driver safety clinics across the country in 2011 to 2012. Clinics took place in the following states from August 2011 through January 2012: Michigan, Minnesota, Florida, Virginia, Texas, and California. The driver clinics were aimed at gauging user acceptance of the technologies. Approximately 100 drivers were hired to take part in each of these clinics after a thorough screening process. These drivers were first given information about the functions of the connected vehicle system and the scenarios they were to experience during the driver training sessions. After the sessions, they were asked to complete a survey about their experience. In addition to the driver trainings, a few demonstrations were held in which attendees were able to ride in the vehicles while the specific safety applications were demonstrated. These included lane change warnings and forward collision warnings among others. While the focus of these demonstrations was on passenger vehicles, at least one demonstration that addresses user acceptance of safety applications on commercial vehicles is planned in the near future.99

A major objective of this project is to provide data that will inform the NHTSA rulemaking scheduled to occur in the near future. As the body that has the authority to establish Federal Motor Vehicle Safety Standards (FMVSS), NHTSA is scheduled to make a decision about standards and protocols for vehicle-to-vehicle communication safety systems in 2013.100

Related Efforts

While this section focuses on commercial vehicle platooning, it is important to note that research and development in the more general topic of autonomous vehicles is happening at a fast pace. For example, Google developed a fleet of seven autonomous vehicles and has been testing them since 2010. The fleet has covered more than 140,000 miles. Sebastian Thrun, a member of the winning team in the 2005 DARPA Grand Challenge, heads Google’s Driverless Car program. Components of Google’s autonomous vehicles include (see Figure 5.7): Google Street View data, camera data, LIDAR, and RADAR data. These combined data inform the vehicle of its position on a map. Though autonomous, human drivers are present in the case that intervention is needed.101

The accomplishments of the Google project highlight the fact that in a short period of time, significant progress has been made in the field of autonomous vehicle research. In 2004, no winner emerged at the DARPA Grand Challenge on a course that covered less than 200 miles in the desert, whereas to date, Google’s vehicles have driven more than 140,000 miles at speeds greater than 60 mph. Many automakers have also made great strides in the field of autonomous vehicle research including BMW; Audi, which sent an autonomous vehicle up Pike’s Peak; VW; Toyota; and General Motors. Safety is a major impetus behind many projects, but in the case of Google, transforming mobility is another goal. One of Google’s major functions is to collect data; that is also the case with its autonomous vehicles. In this context, however, the data are specific to transportation. The autonomous vehicles record what they see and the car’s algorithm’s figure out the rules. Google views the car as a large computer, that can learn from the data it collects.102


Challenges Facing Autonomous Vehicles

While technological advances have been made, a number of critical issues have emerged and are trying to be addressed through research and development efforts. User acceptance is a key ingredient to the successful adoption of autonomous vehicles. Throughout the years, many processes within cars have become automated including cruise control and anti-lock brakes among others. However, the transition from humans as drivers to humans as merely passengers in a car that drives itself is a major one. Legal issues have also been a common topic of discussion. Who would be sued in the case of an incident with an autonomous vehicle? Nevada is currently the only state where it is legal for autonomous cars to be driven on state highways; that is another hurdle that must be addressed by each state. Hawaii and Florida have also just recently introduced similar legislation. Legal circles are also beginning to focus on this issues. Just recently (January 2012), the Law Review and High-tech Law Institute at Santa Clara University hosted a symposium on issues surrounding autonomous vehicles. Sebastian Thrun, Director of Google’s autonomous vehicle research program, participated in that program. The passenger safety of these vehicles is a major focus area and technologies still need to be improved in some cases. For example, cameras and radar are negatively affected by ice and snow, so issues of extreme weather and other environmental-related issues must be addressed where those conditions exist. There is also the question of freedom. Do autonomous vehicles take freedom from drivers or do they allow more
freedom, as in the case of people with physical disabilities who would not be able to drive otherwise? These are some of the major questions that will need to be answered in order for a large-scale deployment of autonomous vehicles.

**ICC Research**

Other intelligent technologies such as Adaptive Cruise Control (ACC), while not part of a platooning system, act as a partial autonomous system and therefore are relevant to the vehicle platooning discussion. Numerous car manufacturers have developed ACC in Asia and Europe; Japan has been focusing on this technology for a number of years. In late 2011, American car buyers were offered the option to order ACC on the Lexus 430. The base model is priced at $54,000, but a model complete with all technologies and amenities is priced at $68,500.

ACC allows the driver to set a speed and the car maintains that speed. If a car in front of it is driving at a slower speed, ACC makes sure the vehicle’s speed decreases to match that speed and includes a gap that can be set by the driver. Lexus’ system uses laser technology, whereas many other systems use radar sensing, often at 77 GHz. This ACC system is similar to the system Toyota introduced in 1997. Additional convenience features on the Lexus include “intuitive parking assist”, windshield wipers that sense rain, and a voice-activated navigation system. Within the industry, radar systems are more common for this technology, in part because of the perception, particularly in the United States, that lasers are dangerous and in part because there was a concern that lasers would not perform well in inclement weather. Toyota, however, has chosen to use laser technology.

Mercedes offered adaptive cruise control in certain vehicle models in the fall of 2008. The technology was touted as a comfort feature rather than a safety feature. In the Mercedes-Benz system, the electronic control and braking systems are connected to a Doppler radar (77 GHz), which allows the radar-equipped vehicle to maintain a safe driving distance from the car in front of it. John Vaughan, who works in business development for the sensor manufacturer, M/A-Com, Inc., described ACC as “the first system in a network of sensors.” Mr. Vaughan predicted that eventually, a sensor field will surround the vehicle.

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103 Ibid.
105 Ibid.
and the vehicle’s intelligence will use the sensor field. He also described this technology as the “beginning of the microwave era in automotive electronics.”

Numerous other manufacturers have been testing ACC in other markets, but are waiting to gauge customer reactions before offering them in the United States. These companies include Mercedes Benz, Jaguar, and BMW. Nissan is the next projected manufacturer to offer this technology in the United States on its MY2001 Infiniti model.

Southwest Research Institute (SwRI)

The Southwest Research Institute (SwRI) is an independent, nonprofit, applied research and development organization headquartered in San Antonio, Texas. SwRI has worked on projects related to autonomous vehicles, including a demonstration at ITS America in 2009 and at the ITS World Congress in Florida in October 2011.

At the ITS World Congress in October, SWRI demonstrated a technology, called the SwRI Environmental Management System, which collects and communicates real-time traffic emissions data. The system sends emissions information to a central Advanced Traffic Management System (ATMS) using vehicle-to-infrastructure communications technology. These emissions data help inform the ATMS of “hot spots” on the roadway, at which point the ATMS can apply congestion management techniques at those locations in order to reduce negative impacts on the environment.

Summary of Findings including Challenges and Obstacles

Large research and development efforts are ongoing throughout the world related to vehicle platooning and other automated systems. While safety has been a major impetus for these efforts, particularly those conducted by governments ranging from the U.S. DOT’s initiatives to those in Asia and Europe, environmental benefits, reduced congestion, and greater driver comfort also have become major reasons for this research. These reasons are consistent with the goals of the I-710 freight corridor project.

The range of technology across experiments is great. Some technical options for platooning are simpler than others. For example, the PATH technology and that from the CHAFFEUR and CHAFFEUR2 projects focus on commercial vehicles,

107 Ibid.
108 Ibid.
109 Duncan, T. correspondence in February 2012.
while the integration of both passenger and commercial vehicles in the SARTRE project adds a level of complexity.

Actions and processes in the various platooning concepts will have to be rigorously tested through many simulations and field tests in order to ensure that this technology is safe for those in the platoon and other roadway travelers. The issue of string stability within a platoon is important and a comfort level must be reached with this technology. This brings up a larger issue of acceptability, mentioned in particular by SARTRE researchers. There is an important human element; people are being asked to make a significant change in their daily lives with regard to transportation. This is the case to an even greater degree in Europe with the possibility that passenger vehicles will be part of an automated platoon. Structuring a system that uses dedicated truck lanes for commercial vehicle platooning would minimize the issue of interaction with nonplatooning vehicles, but it would still be possible for a vehicle that was not part of the platoon to get into the dedicated lane. With regard to commercial vehicles, another aspect is the desire or financial capacity of people within the trucking industry to purchase vehicles or add the necessary technology to their vehicles that would allow them to be part of vehicle platoons on certain routes such as I-710.

A major factor that works in favor of this technology is the relatively small infrastructure investment required. Some infrastructure would be required to enable vehicle-to-infrastructure communication, but relative to large capital transportation projects, the capital cost is small. Operating costs, however, are unknown and could be significant depending on the level of human monitoring required of the system. Maintenance requirements also are likely to be very stringent since failure of key components cannot be tolerated; a factor that will impact ongoing costs. Management of such a system may be more similar to air traffic control that current highway operations in that redundant, fail-safe systems will be required since the consequences of failure are so severe.

It is interesting to compare the differences between the various experiments. For example, with SARTRE, there is a lead driver operating the vehicle, while in Japan’s current effort, the lead vehicle is automated. Various issues come up when looking at the implications of these differences. For example, what if the lead driver goes off the road? How does the system prevent other vehicles from following when there is very minimal time to respond? The SARTRE project requires that the vehicles must coexist with other traffic, while other studies do not have that requirement. The German project called KONVOI involved a four-truck platoon on the Autobahn with a main objective of fuel savings. Findings were that the fuel savings were small with the presence of other cars and issues with cut-ins and speed changes and closing the gap again after the interruption.111

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111 Shladover, S. (Discussion and correspondence in December 2011 and January 2012.)
Another topic of note related to the SARTRE project is that it the implementation aspect is a complex one because the European Union includes dozens of countries with different laws. Overcoming legal barriers could be a complicated and difficult process. While the United States also would have to address legal issues, we only have to address one set of Federal laws, which works in our favor.

It should be noted that this entire section differs greatly in its intent and mission from the other sections, in that all the other sections had the goal of finding needs in the region surrounding their specific subject area. This section is truly a summary task, summarizing research and current practices. Therefore, we are not including a summary matrix in this section.

**Application to I-710**

A common goal in many of these research projects included in this section is to increase throughput on roadways. Another major impetus is to promote safety. Both of these are major issues that need to be addressed on I-710, so as the research shows, platooning can help alleviate these problems. As noted in particular in the PATH and CHAUFFEUR studies, the vehicle-to-vehicle communication that takes place is powerful. Given the technological advances as more and more demonstrations take place, this technology could be used on a large scale, allowing for more throughputs on roadways.

Much of the research points to the importance of vehicle-to-vehicle communication. More recent efforts such as the Google car, the various DARPA challenges, and the more recent U.S. DOT efforts highlight the use of vehicle-to-vehicle communication.

While a complete move to autonomous vehicles on I-710 would take some time, gradually phasing in autonomous components could be feasible. The story of the progression of automated components in car manufacturing addressed in the *Wired* article provides a great example of how cars have become increasingly more automated and that because the progression has been slow – different parts have been phased in over time beginning with anti-lock brakes, cruise control, and further to intelligent cruise control – people have had time to get used to it. With regard to I-710, that could mean phasing in dedicated truck lanes in which only automated trucks travel at first. Once manufacturers begin to produce automated passenger vehicles, they could be phased in as well.

**Next Steps**

The following list describes next steps with regard to vehicle platooning:

- Monitor research on vehicle platooning. In particular, monitor news from the SARTRE project as well as new products and research from automakers.
- Monitor U.S. and state policies related to autonomous vehicles. Recently, Nevada approved regulations for autonomous vehicles. Follow the news on
the U.S. DOT rulemaking about autonomous vehicle standards scheduled for 2013.

- Seek opportunities to partner with research organizations to conduct a platooning demonstration in the region.
- Discuss the idea with stakeholders. Promotion of the idea of vehicle platooning is critical to eventual user acceptance.

## 5.3 Truck Tolling Research

It is likely that construction, operation, and maintenance of the I-710 freight corridor will be funded, at least partially, by tolls collected from users of the facility. There are both policy and technical questions related to the tolling scheme, and with opening of the facility not scheduled for a number of years, changes in technology are likely to impact this decision. Over the past 20 years the toll industry has evolved from traditional manual toll collection methods to a state where most toll road users now pay electronically without stopping, many at full highway speed. Innovations such as variable time-of-day pricing and HOT lanes (facilities that allow single occupant vehicles to buy their way into a HOV lane by paying toll) have become more common as well. While dedicated, tolled truck roads have been discussed for some time, the proposed I-710 freight corridor is breaking new ground in this area. This section documents developments in truck tolling, tolling technology in general, that will help to identify and frame the key decisions required to implement a toll system on the I-710 freight corridor.

It should be noted that there is already a peak period fee system in place in the Ports of Long Beach and Los Angeles, known as PierPass. The PierPASS Off-Peak Program was instituted at the Ports in order to alleviate truck traffic congestion on highways around the ports and at port facilities and improve air quality in the region. The PierPASS Off-Peak Program was created by marine terminal operator at ports in 2005 to encourage cargo owners and carriers to move cargo during night-time periods or on weekends in order to reduce congestion on highways, alleviate congestion at the ports and reduce air quality impacts from high peak-period truck traffic volumes. The program incentivizes these off-peak movements through the imposition of a Traffic Mitigation Fee on containers entering or exiting marine terminals at the ports by truck during the daytime shifts (3:00 a.m. to 6:00 p.m., Monday through Friday). Current technology uses an RFID tag that can only work in close proximity with a reader on the terminal gate. This technology cannot be used for highway tolling but compatibility with electronic tolling should be considered in future generations of the PierPass technology.

The remainder of this section documents truck tolling or other tolling strategies incorporating elements that could be applied to trucks in the I-710 corridor and
Port area. These include TOT Lanes, Congestion Pricing, Distance-Based Pricing, and other pricing schemes.

**Truck-Only Toll (TOT) Lanes**

Truck-only toll (TOT) lanes are highway lanes that are reserved for the use of commercial vehicles, primarily trucks and buses. In the United States some states have dedicated truck lanes in operation (e.g., Oregon’s I-5 truck bypass lanes, I-5 in Los Angeles County at the State Route 14 split, and Southbound I-5 in Kern County at the State Route 99 junction near the Grapevine) or have imposed lane restrictions that prohibit heavy vehicles from traveling on certain lanes. There are no TOT lanes in operation in the United States, although some states have analyzed the feasibility of implementing them.

Proposals for dedicated truckways would have them built next to existing roadways, but barrier separated from general traffic to improve safety. The implementation of TOT lanes in the U.S. has been controversial, especially within the trucking industry arguing that mandatory enforcement of these facilities would be equivalent to “double-taxation.” In many cases TOT lanes can be constructed so that truckers can carry more weight than is currently permitted in most states. In theory, truckers would be attracted to use TOT lanes because the toll cost would be offset by the additional safety and productivity.

Variable pricing is the mechanism most often considered to be implemented in these facilities, which is similar to the same concept used on HOT lanes. HOT lanes have been widely used in the United States and were implemented with the objective of charging SOV for the use of an HOV lane. With this pricing scheme, trucks could also pay a variable toll based on demand. The tolls change throughout the day according to real-time traffic conditions to manage the number of trucks TOT lanes and keep them free of congestion, even during rush hours. Therefore, the variable pricing serves to keep the TOT lanes performing at a level of service that provides more reliable travel. Truckers would be provided with information on how much travel time using TOT lanes can save and what the fee is. Under this variable pricing scheme, higher fees would be paid if congestion levels are high; similarly, lower levels of congestion result in lower fees. Other studies have incorporated a truck diversion rate from TOT lanes to free local roads to determine the optimum toll rate.

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112 Parsons, Brinckerhoff, Quade & Douglas, Inc., Truck Only Toll Facilities: Potential for Implementation in the Atlanta Region.


TOT lanes have been studied in several regions of the country. Examples of proposed TOT applications include:

- **Tampa, Florida.** The nation’s first truck-only toll lanes is being built in the Ybor City area of Tampa at a cost of $395 million to link the Interstate 4 freeway and the Selmon Crosstown Expressway toll road (Figure 5.8). The connector is one-mile long and will be an elevated exchange between the two roadways. The facility will provide dedicated truck lanes for direct access to the Port of Tampa. All traffic will pay electronic tolls to use the Connector using the statewide Sunpass system. The estimated completion date for the connector is fall 2013.

**, Figure 5.8 Project Area – I-4/Selmon Expressway Connector**


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Funding for the connector involves toll and fuel tax revenues. Therefore, moderate fares are contemplated. The preliminary toll schedule puts car tolls at $1.00 for S-moves to or from the east on I-4 and from or to the west on the Selmon Crosstown Expressway, and $0.50 only for the Z-move to or from the west of I-4 and from to the east on the Crosstown Expressway. Other classes of vehicles are charged by the (N-1) axles formula so that a five-axle tractor-trailer pays four times car rate. T-moves by trucks going to or from the port/I-4 pay a $1.00 toll regardless of their axle count. Table 5.5 shows the toll rate schedule for the different types of movements and Figure 5.9 shows a schematic of the interchanges.

- **I-70 corridor spanning Missouri, Illinois, Indiana, and Ohio.** The States of Missouri, Illinois, Indiana, and Ohio are proposing the implementation of truck-only lanes along the 800-mile segment of I-70. The I-70 Dedicated Truck Lanes Feasibility Study conducted in 2011 indicates there is a business case supporting the construction of dedicated truck lanes (DTL) and that DTL’s could improve safety, reduce congestion and benefit the regional economy more than either keeping the corridor as-is, or by adding general purpose lanes. The Feasibility Study did not make any final decisions, but explored a range of funding options, including public/private partnerships, special fees, tolling, as well as the possibility of traditional Federal and state funding.

- **Atlanta Metropolitan region.** In 2005, the Georgia State Road and Tollway Authority (SRTA) conducted a feasibility study for TOT lanes in the Atlanta region. The use of TOT lanes was assumed as voluntary based on recommendations from the trucking industry, and projected truck demand levels that would exceed TOT lane capacity. Overall, the study found that TOT lane users could realize travel time savings and congestion in the general purpose lanes would be reduced, although additional analysis of the concept was recommended. Later the Georgia DOT conducted a study on dedicated truck lanes, but did not consider TOT lanes.

- **Virginia I-81.** In 2002, the Virginia DOT solicited proposals from private entities for improvements on the I-81 corridor. The selected bidder, STAR Solutions, proposed four lanes on each direction - trucks segregated from cars in two inner lanes each direction and cars having two outer two-lane roadways each direction.\(^\text{116}\) STAR Solutions initially proposed that only the truck lanes would be tolled. The proposal experienced significant opposition from the trucking industry since there was no provision to allow them to run longer and heavier loads to generate the higher productivity needed to pay tolls. In 2006, TOT lanes were eliminated from the proposed improvements.

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Table 5.5 Preliminary Toll Rate Schedule

<table>
<thead>
<tr>
<th>Axle</th>
<th>A (S-Move) I-4 to/from East Selmon Expressway to/from West</th>
<th>B (Z-Move) I-4 to/from West Selmon Expressway to/from East</th>
<th>C (T-Move) I-4 – 22nd Street to/from South</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sun Pass</td>
<td>Toll-by-Plate</td>
<td>Sun Pass</td>
</tr>
<tr>
<td>2</td>
<td>$1.00</td>
<td>$1.25</td>
<td>$0.50</td>
</tr>
<tr>
<td>3</td>
<td>$2.00</td>
<td>$2.50</td>
<td>$1.00</td>
</tr>
<tr>
<td>4</td>
<td>$3.00</td>
<td>$3.75</td>
<td>$1.50</td>
</tr>
<tr>
<td>Each additional axle</td>
<td>$1.00</td>
<td>$1.25</td>
<td>$0.50</td>
</tr>
</tbody>
</table>


Figure 5.9 I-4/Selmon Expressway Interchange (Connector)


- **Miami port-to-airport area.** In 2007 the Reason Foundation conducted a preliminary study on the feasibility of an east-west TOT roadway to provide better access for truck movements from the Port of Miami and the eastern part of the metro area to the rail yard and distribution centers located west and northwest of Miami International Airport. Four possible routes were considered for the basic truckway, from the Port of Miami to the Florida East Coast (FEC) Hialeah Yard, west of the airport. Any of the four alignments...
would provide a barrier-separated two-lane roadway permitting nonstop, high-speed access from the Port Tunnel to the Florida East Coast intermodal rail yard west of Miami International Airport, and beyond that to the warehouse and distribution center area northwest of the airport in Doral and Medley. The western end of the truckway would connect to the Homestead Extension of Florida’s Turnpike. Each alternative uses a combination of elevated, tunnel, and surface routes. The Reason Foundation assessed the feasibility of financing the cost of the truckway via tolls because the cost of such a truckway would be in the billion-dollar range and conventional funding sources are unlikely to be available. Calculations showed that, under the assumptions made, toll truckway revenues could support 54 to 58 percent of the project’s cost, yet other revenues would be needed to fully support the project. Studies beyond a preliminary feasibility analysis were not found. Figure 5.10 shows the four possible routes considered.

Figure 5.10 Possible TOT Corridors from the Port of Miami to Points West of the Miami International Airport


Concentration Pricing

Congestion pricing is used to describe the forms of charging users for using the roads with the intention of reducing congestion and managing traffic demand more efficiently. Anticipated results with congestion pricing mechanisms include: 1) decrease vehicular traffic during peak hours; 2) increase the efficiency of moving goods with the appropriate vehicle sizes; and 3) promote the use of
alternative modes (especially the movement of passengers). Below are the most commonly used mechanisms.

**Time-of-Day-Based Pricing**

The objective of time-of-day tolling is to help ease traffic congestion on busy corridors and to encourage motorists to travel outside peak hours. Toll rates under this approach are fixed by time-of-day and day-of-week. Typically the highest toll rate is paid during the peak hours on weekdays. Pricing schemes are generally adjusted every few weeks based on hourly volumes.

At the national level the Port Authority of New York and New Jersey (PANYNJ) introduced time-of-day-based toll price schedules in 2001 as a means for reducing congestion, increasing the use of mass transit and E-ZPass, and facilitating commercial traffic management. Following the imposition of time of day pricing on the PANYNJ facilities, there was a significant shift, in both auto and truck traffic, to the hours just before and after peak-hour toll rates. Tolls are collected in the eastbound (New York bound) direction only. Currently, the peak-hour toll rates are in effect on weekdays from 6:00 a.m. to 10:00 a.m. and 4:00 p.m. to 8:00 p.m., as well as on weekends from 11:00 a.m. to 9:00 p.m. Overnight hours for Trucks are Sundays thru Thursdays from 10:00 p.m. until 6:00 a.m. the following morning. Table 5.6 shows as an example the current toll rate for different vehicle types during the peak and off-peak periods.

**Table 5.6 PANYNJ Current Toll Rates**

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Number of Axles</th>
<th>Cash</th>
<th>E-ZPass Off-Peak</th>
<th>E-ZPass Peak</th>
<th>E-ZPass Trucks Weekdays Overnight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car</td>
<td>2</td>
<td>$12.00</td>
<td>$7.50</td>
<td>$9.50</td>
<td>NA</td>
</tr>
<tr>
<td>Carpool Plan, 3 or more people</td>
<td>2</td>
<td>n/a</td>
<td>$3.50</td>
<td>$3.50</td>
<td>NA</td>
</tr>
<tr>
<td>Low Emission Vehicle</td>
<td>2</td>
<td>n/a</td>
<td>$4.00</td>
<td>$9.50</td>
<td>NA</td>
</tr>
<tr>
<td>Trucks</td>
<td>3</td>
<td>$39.00</td>
<td>$27.00</td>
<td>$30.00</td>
<td></td>
</tr>
<tr>
<td>Trucks</td>
<td>4</td>
<td>$52.00</td>
<td>$36.00</td>
<td>$40.00</td>
<td></td>
</tr>
<tr>
<td>Trucks</td>
<td>5</td>
<td>$65.00</td>
<td>$45.00</td>
<td>$50.00</td>
<td></td>
</tr>
</tbody>
</table>

Source: Cambridge Systematics, Inc., adapted from the Port Authority of New York and New Jersey.

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117 Evaluation Study of Port Authority of New York and New Jersey’s Time-of-Day Pricing Initiative (2005) by Dr. José Holguin Veras, Dr. Kaan Ozbay, and Dr. Allison de Cerreño.
A more recent example is the Maryland’s Intercounty Connector (ICC) in the northern suburbs of the Washington, D.C. region, which is currently under construction. The ICC (also known as MD 200) is the State’s first all-electronic toll road that creates a new east-west route between the I-270 and the I-95/U.S. 1 corridors within Montgomery and Prince George’s counties. The time-of-day pricing scheme has gained attention as a travel demand management strategy by providing incentive to travelers with more flexible departure time to travel during off peak period, thereby shifting peak travel demand. Dynamic pricing has not been considered, at least not initially. Toll rates will be set by Maryland (Toll) Transportation Authority (MdTA) executive secretary within the authority-approved ranges, and periodically adjusted by the executive secretary with ten days notice of a proposed change in toll rates. Weekday peak hours will be from 6:00 a.m. to 9:00 a.m. and from 4:00 p.m. to 7:00 p.m., excluding Federal holidays. Overnight hours are from 11:00 p.m. to 5:00 a.m.\textsuperscript{118,119}

International examples include the M6 Toll Road in the United Kingdom and the Sydney Harbour crossings. Opened in 2003, the M6 runs for 27 miles and toll prices vary according to the vehicle class, the toll plaza, and the time of the day. Compared to weekends, rates on weekdays are higher. Users with electronic transponders benefit from a five percent discount per trip.\textsuperscript{120} On the Sydney Harbour crossings time of day tolling came into effect in January 2009. The move aims to help ease traffic congestion on the busy corridor and to encourage motorists to travel outside peak hours where possible. The introduction of time of day tolling is the first time the toll has been increased on the Harbour Bridge since 2002 but only motorists traveling from 6:30 a.m. to 9:30 a.m. and from 4:00 p.m. to 7:00 p.m. on weekdays faced an increased toll.\textsuperscript{121}

\textit{Dynamic Pricing}

A popular congestion pricing strategy in the U.S. is the use of dynamic toll lanes, such as HOT lanes. HOT lane facilities charge SOV for the use of an HOV lane. Drivers have the option the option to pay to drive in uncongested toll lanes or drive for free in the un-tolled, but congested lanes. Access into the HOT lane remains free for transit, vanpools, and carpools. This could also apply to the I-710 freight corridor that could be tolled, and the general purpose lanes that would not be tolled.

\textsuperscript{118} Maryland ICC to Toll Cars 10 cents to 35 cents per mile – first all electronic toll road in eastern U.S. (http://www.tollroadsnews.com/node/4499).


\textsuperscript{120} M6 Toll web site, http://www.m6toll.co.uk/.

Dynamic Pricing adds a level of traffic management sophistication over time-of-day pricing. Tolls for the HOT lanes change based on real-time traffic conditions to keep the lanes free flowing. Electronic signs in advance of entry points provide drivers the latest toll rates. Drivers typically see two electronic message signs before they enter the HOT lanes giving them time to choose whether to use HOT lanes or travel on the regular lanes.

U.S. cities that have HOT lane facilities with dynamic toll prices have proven to provide faster, more reliable travel times. For example, users in I-95 along the HOT lane corridor in Miami-Dade County were traveling below 20 MPH during rush hour periods before the opening of the express lanes. After the opening, speeds improved to 40 MPH in the local lanes and 50 MPH in the express lanes along the northbound and southbound directions during the rush hour periods.\(^\text{122}\) In Seattle, on SR 167, HOV lanes were converted to HOT lanes in 2008. A northbound SR 167 HOT lane driver saves an average of nine minutes in the peak hour for a $1.75 toll.\(^\text{123}\) Table 5.7 shows some locations where HOT lanes have been implemented.

**Table 5.7   HOT Lanes in the U.S.**

<table>
<thead>
<tr>
<th>Facility</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-95 Express Toll Lanes in Miami, Florida</td>
<td>2008</td>
</tr>
<tr>
<td>I-25 Express Lanes in Denver, Colorado</td>
<td>2006</td>
</tr>
<tr>
<td>I-15 Express Lanes Pilot in Salt Lake City, Utah</td>
<td>2006</td>
</tr>
<tr>
<td>I-394 in Minneapolis, Minnesota</td>
<td>2005</td>
</tr>
</tbody>
</table>

Source: Cambridge Systematics, Inc.

**Area/Cordon Pricing**

Cordon Area Tolling is a demand management strategy to alleviate congestion and reduce travel time of users. Cordon tolls are fees paid by users to drive within a particular area, usually a city center. Singapore was the first urban region in the world to implement this pricing scheme in 1975. The concept was later introduced in 2003 in the central business district of London. Payment of a daily charge allows drivers to make an unlimited number of trips from, to, within, or between charging zones. The charging hours are between 7:00 a.m. to

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\(^\text{122}\) Florida Department of Transportation, 95 Express (http://www.95express.com).

\(^\text{123}\) Washington State Department of Transportation (http://www.wsdot.wa.gov/Tolling/SR167HotLanes/).
6:00 p.m. on working weekdays. Stockholm recently instituted a cordon-pricing scheme as a means to mitigate congestion in the City (2006). For special locations such as ports, a variation of the cordon pricing can be studied. Trucks may be charged depending on their payload within a limited area. This concept is probably not relevant to the I-710 freight corridor project.

**Distanced-Based Pricing**

A relatively new pricing strategy being developed and applied in several European countries is Distanced-Based pricing, aimed primarily for trucks. Given the limited length of the I 710 freight corridor, this strategy may not be directly applicable (but could be), but could eventually become part of a regional truck pricing scheme. This pricing scheme imposes fees to trucks based on the number of miles or kilometers traveled in a designated area. Some countries have also integrated the number of axles and the emission category of the vehicle into the equation. While the main objectives of distance-based pricing are to manage heavy vehicle traffic and raise funds for infrastructure improvements, a major reason European countries have for implementing this system is to ensure that truckers not registered in the host nation – and that use their roads – pay their share of infrastructure costs. Other goals, which may have applicability in the Port areas and Gateway Cities subregion, are to shift freight into other modes and create an incentive for trucks to reduce their emissions.

Countries such as Germany, Austria, and Switzerland have implemented this tolling system. In the case of Germany, the Federal government introduced the distance-based truck toll in 2005 for all heavy commercial vehicles with a permissible total weight of 12 tons or more. The level of the toll is based on the emission class and number of axles on the truck and on the distance traveled on the toll route. The Federal Trunk Road Toll Act assigns each vehicle to one of four categories, A to D, based on its emission class. Trucks with the latest-generation exhaust systems and those that have been upgraded with particle reduction systems pay significantly less than high-emission vehicles.

To pay for the toll, truck drivers log on for the planned route at one of about 3,500 toll station terminals or over the Internet. The log-on procedure at a toll station terminal is similar to purchasing a ticket. The driver enters all the relevant vehicle information, departure time, starting point, and destination. The toll station terminal then calculates the shortest route within the toll road network. The user can accept this route or choose an alternative one by entering other waypoints. Truck drivers also have the option to log-on to the automatic system developed by Toll Collect, the private company awarded by the German Federal government to collect road use charges. The automatic system is based

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on an innovative combination of mobile telecommunications technology (GSM) and GPS. The main element of the automatic log-on system is the On-Board Unit (OBU). With the aid of GPS satellite signals and other positioning sensors, the OBU automatically determines how many kilometers have already been driven on the toll route, calculates the toll based on the vehicle and toll rate information that has been entered, and transmits this information to the Toll Collect computer centre for further processing. Table 5.8 summarizes the distance-based heavy vehicle fees in place in Germany, Austria, and Switzerland. Payment options vary slightly among the countries.

Table 5.8  Distance-Based Heavy Vehicle Fees in Germany, Austria, and Switzerland

<table>
<thead>
<tr>
<th>Start</th>
<th>Austria</th>
<th>Germany</th>
<th>Switzerland</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 2004</td>
<td>January 2005</td>
<td>January 2001</td>
<td></td>
</tr>
<tr>
<td>Tolling Technology</td>
<td>DSRC</td>
<td>GPS/GSM Manual (POS)/Internet</td>
<td>Tachograph/DSRC</td>
</tr>
<tr>
<td>Type of roads tolled</td>
<td>Motorways</td>
<td>Motorways</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td>Some expressways</td>
<td>Some Federal highways</td>
<td></td>
</tr>
<tr>
<td>Tolled Vehicles</td>
<td>&gt;3.5 t</td>
<td>&gt;12 t</td>
<td>&gt;3.5 t</td>
</tr>
<tr>
<td>Differentiation of fees</td>
<td>No. of axles</td>
<td>No. of axles</td>
<td>Max. allowable weight</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Emission class</td>
</tr>
<tr>
<td>Fee</td>
<td>Two axles are charged €0.130, three €0.182 and four or more axles are charged €273/km.</td>
<td>€0.09 and €0.14 per kilometer depending on their emission levels and number of axles</td>
<td>2.26ct and 3.07ct per kilometer and weight depending on the emission level</td>
</tr>
<tr>
<td>Use of Revenues</td>
<td>Motorways</td>
<td>Federal Transportation infrastructure</td>
<td>Transportation Sector</td>
</tr>
</tbody>
</table>

Sources  Adapted from http://www.ibtta.org/files/PDFs/Kossak_Andreas.pdf; the Swiss Federal Custom Administration; and Toll Collect (http://www.toll.collect.de/frontend/HomepageVP.do;jsessionid=883157ECF64BEEE0208DC16456DDFF73.app02.).

Other Pricing Schemes

Discount Toll Program

Facility pricing is the most common pricing mechanism used in countries around the world enforced as a toll on roadways. Tolled roadways are expected to mitigate congestion as roadway users may switch to other non-tolled routes to minimize transportation costs. Some variations of toll congestion management strategies were presented previously. In Virginia, on the Chesapeake Expressway – a 16 mile long, four-lane divided highway linking Interstate 64 in Chesapeake to North Carolina – “express lanes” allow users with E-ZPass transponders to pay the toll without stopping through open-road technology. As
an alternative, the Chesapeake Expressway offers their frequent users the option to enroll in a discount toll program. The discount program requires users to pay an upfront membership fee and is then entitled to tolls that are significantly discounted from the regular tolls. The membership fee currently starts at $20 for the first 6 months and $3.33 per month thereafter. Table 5.9 shows the pricing scheme on the Chesapeake Expressway.

Table 5.9 Expressway Toll Structure

<table>
<thead>
<tr>
<th>Axles</th>
<th>Regular Tolls</th>
<th>Peak Weekends</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cash Rate</td>
<td>E-ZPass Rate</td>
</tr>
<tr>
<td>2</td>
<td>$3.00</td>
<td>$3.00</td>
</tr>
<tr>
<td>3 or More</td>
<td>$4.00</td>
<td>$4.00</td>
</tr>
<tr>
<td>Motorcycle</td>
<td>$1.00</td>
<td>$1.00</td>
</tr>
</tbody>
</table>

Note: “Peak Weekend” is defined as the period beginning 12:01 a.m. on Saturday through 12:00 midnight Sunday beginning the Saturday before Memorial Day weekend to the Sunday after Labor Day weekend.

Next Steps

This overview and summary of the tolling approaches currently being pursued will act as a foundation upon which, the study team, working with the project leaders from Gateway Cities Council of Government and Metro will develop an recommendation of which is the best way to move forward for the I-710 tolling option. Part of that, will be a technological assessment of the toll tag, reader and back office technology existing in the market today and an assessment of where that technology is going in the future.

5.4 Platooning and Tolling Reference Documents


125 City of Chesapeake Virginia (http://www.chesapeakeexpressway.com/E-Zpass/Discount-Program.htm).


Automated road train is easy on the driver: self-driven close-formation convoys on motorways could be the reality in 10 years, say Ricardo and Volvo, November 4, 2009, Professional Engineering Magazine, retrieved from Academic OneFile on December 1, 2011.


California Partners for Advanced Research (PATH), National Automated Highway System Consortium (NAHSC) Results, retrieved from http://www.path.berkeley.edu/nahsc/.

Cambridge Systematics, Inc., 2010, Pricing Options, Policy Impacts and Market Research – Memorandum, SCAG.


PELOPS web site, retrieved from http://www.pelops.de.


SARTRE project to develop road trains, March 2010, Traffic Engineering & Control, retrieved from Academic OneFile on December 1, 2011.

Shladover, S., Automation Technology to Improve Heavy Truck Efficiency, PowerPoint presentation, December 2011.


6.0 Commercial Vehicle and Operator Rest Area Options – Long-Term, Staging, and Ancillary Services

EXECUTIVE SUMMARY

The primary objective of this Section is to provide background information on the national issues of commercial vehicle and operator rest options at public and private truck stops and rest areas; provide current, relevant information since the 2008 Gateway Cities ITS Integration Plan Study findings; present current truck parking projects/initiatives/technologies/services/issues; and identify potential solution areas of consideration going forward. For purposes of this document truck parking is defined to include two segments – 1) long term which includes overnight or duration satisfying Hours of Service regulations (for both drayage and long-haul); and 2) staging which includes short term stops/holds relatively near a commercial operator’s destination such as a port or distribution center. As the duration of the long term/staging parking event is not always a differentiating factor in the discussion, the term truck parking is used to encompass both. Trucker services are also addressed and the ability to provide them.

California is home to major international Ports in Long Beach, Los Angeles, and Oakland; and represents the second largest border crossing between Mexico and the U.S. with the State’s highway providing critical commercial links from these ports of entry to the nation. California’s highways carry more commercial vehicle truck traffic than any other state in the U.S. In spite of this record volume of trucks, the Gateway Cities region has only 18 total public and private truck stops (no rest areas) and 135 facilities (private, public, rest areas, weigh stations) within 100 air miles of the region (based on the Long Beach area).\textsuperscript{126} Local dray operators have agreements with the two ports in the Gateway Cities region and

\textsuperscript{126}Truck Master Fuel Finder.
are required by that agreement to provide overnight parking for their trucks. However, medium (20 to 300 miles) and long haul (300+ miles) operators are met with limited parking and services options in the region. Providing these operators with reliable options to stage in relative proximity to the ports could benefit the Gateway Cities region with improved safety, air quality, and community goodwill with the potential to reduce arterial congestion during peak travel periods. Also, staging areas for trucks near the ports could reduce queue gate congestion at terminals and create an opportunity to potentially provide some services for the truck drivers: These services could include, but not limited to, travel kiosks, fueling stations, restrooms, etc. Public and private stakeholders must work together on conflicting priorities and cross-purposes in developing solutions to the complex issues of truck parking. The basis for this complexity lies in finding solutions representative of the following primary factors:

- End user (commercial vehicle driver) needs;
- Regulatory compliance;
- Enforcement resources;
- Geography;
- Economic forces;
- Port concessionaire agreement;
- Long haul vs. short haul needs;
- Truckers Services; and
- Enforcement versus other trucker services needs and regulations.

These factors are considered in the proposed solutions further in this document. Convergence of these factors simultaneously is the optimal goal; the reality of doing so is the nature of the challenge in finding realistic solution(s). These factors also represent the national truck parking dialogue but are increasingly exacerbated in the Gateway Cities region by the sheer volume of truck trips and numbers of trucks, the presence of two primary U.S. ports, and highway congestion.

The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) governs Federal surface transportation funding through 2010 (and includes current Continuing Resolution). Specifically, SAFETEA-LU authorized $25M for a pilot program to address the shortage of long-term parking for commercial motor vehicles on the National Highway System (NHS). SAFETEA-LU made these funds available to the states to address several freight related issues including:
- Construction of new truck parking facilities;
- Modification of existing truck parking facilities;
- Improving the efficiency of transportation systems through ITS (Section 1305);
- Designation and signage for facilities that provide specific services and free parking for automobiles and trucks (Interstate Oasis) (section 1310), and
- Permission for electrification or other idling reduction facilities and equipment for use by commercial motor vehicles to be placed in rights-of-way on the Interstate System, and allow charging of fees for use (Section 1412).

Notable Federal grants awarded and projected to yield results of value to the Gateway Cities region are highlighted. Further, additional state initiatives of potential interest are provided in summary to inform of the variety of efforts; however, results are not anticipated to be available within the Gateway Cities project timeline but are provided as information only. FHWA is also mandated to submit a Report to Congress on truck parking which is due in May 2012. This report may include interim results of state initiatives.

The Gateway Cities Technology Plan for Goods Movement is being developed by the Gateway Cities Council of Governments and the LA Metro with input from the Ports of Long Beach and Los Angeles, Caltrans, the ITS Working Group and many other key stakeholders. Public-sector participants include Federal, state, and local governments; regional metropolitan planning commissions; ports, commissions and coalitions. The private-sector group included a variety of terminal operators, drayage operators, Class I and short line rail lines and other private transportation and goods movement organizations and associations.

At the conclusion of the 2008 ITS Integration Plan the truck parking topic was somewhat in its infancy and while it was duly noted specific truck parking capacity/shortfall research was not completed, nor was it readily available. Rather, air quality concerns and regulations were cited as a primary impetus to address truck parking issues with potential to reduce idling.

Additionally, truck parking was being considered as a component of the roadside enforcement strategies. With such limitations on enforcement personnel and physical real estate available to safely and properly weigh, inspect, and potentially put a vehicle out of service (OOS), coordination of any common needs across these commercial vehicle functions must be considered in the dense region of Gateway Cities. The CVES study confirmed the need for permanent Commercial Vehicle Enforcement Facilities (CVEFs) near the ports. The CVES study also investigated where the CVEFs could be placed on the I-710 and I-405 Freeways making clear there are limited areas of land adjacent to the I-710 and I-405 in each direction of travel to support a CVEF but they are being studied.
In light of the complexity of truck parking issues and industry needs, and regardless of “public” or “private” truck stop designation and duration of the stop, absent the carrier segment the driver represents, there are two fundamental approaches to addressing the base issue:

6. Increase the number of truck parking locations and spaces available, (emphasizing truck staging and the potential to provide trucker services, as well as emphasizing truck enforcement); and/or

7. Collect and disseminate accurate information about existing locations and available spaces.

Options to achieving these ends are many (high-tech, low tech) and not without obstacle (Statutes, Codes, Regulations, public perception) or cost but can provide relief for truck parking and in turn provide solutions to safety, productivity, and air quality issues exacerbated by truck parking shortfalls. Preliminary programmatic options including pursuit of public-private partnerships; legislative review/repeal to limitations on publicly developed sites; and promotion of a successful demonstration project to potentially test a “pay to stage” business case will be further investigated and expanded over subsequent project tasks in pursuit of prioritized proposed solutions to regional and statewide truck parking strategies.

Preliminary technology-related approaches to accurately inventorying truck parking spaces includes a variety of sensor technologies tested and reported by the U.S. DOT. Technology scans will continue for applicable solutions related to data capture; synthesis, and dissemination methodologies of interest/choice (may include such items as driver distraction mitigation solutions including pre-trip planning systems; interactive voice recognition and speech detect systems). While currently a lack of significant test results and data are available about pilot tests of parking programs and/or technologies, the truck parking information resulting from this background research will be used to further identify gaps in end user parking needs which will be applied to solutions approaches in consideration of feasible strategies. Specifically, Task 2 will provide valuable insight to end user requirements through additional direct survey of medium and long haul operators regarding parking staging and services needs. Task 3 is projected to include California Trucking Association (CTA) interviews to further identify end user needs.

National tests/deployments have revealed and pursuant to available resources, it is possible that not all end user segment (local, short, long haul dray, agricultural haulers, and other intra and interstate users) needs may be met with one solution and not necessarily simultaneously. Coordination efforts will continue with the CVEF development plans and opportunities to leverage existing data sources and related technology from the other Gateway Cities projects. This will be used to identify innovative solutions to address freight
mobility and advanced CVO traveler information needs in the ports and Gateway Cities areas.

6.1 BACKGROUND

The primary objective of this Section is to provide background information on the national issues of truck parking, bring to current relevant information since the 2008 Gateway Cities Study findings, present current truck parking projects/initiatives/technologies/services, and identify potential solution areas of consideration going forward which address both long term and staging parking as well as operator services needs.

At the conclusion of the 2008 ITS Integration Plan, truck parking was identified at a high level as an issue, somewhat prioritized as an air quality concern, and stakeholders showed interest in coordinating truck parking strategies with the development of the Commercial Vehicle Enforcement Facilities. This background research is intended to support these efforts to address the shortage of truck parking and staging facilities. To this end, historical information on the genesis of the state of practice of truck parking and available funding is included. While much empirical data and anecdotal information is yet to be born out, understanding the technologies, services, and systems currently being tested across the nation to mitigate the truck parking issues and related impact on congestion, safety, air quality, public health, and the trucking industry’s productivity will assist to inform options available for the Gateway Cities region. Truck volumes in Gateway Cities region are such that it cannot await national findings prior to pursuing solutions to parking and services shortfalls which negatively impact the region’s safety, congestion, economic, and environmental condition.

The remainder of this report is organized as follows:

- **Section 6.2, Introduction** presents background information on the genesis of the truck parking issues, legislation, funding, corridor and Federal initiatives, and state efforts testing truck parking solution;

- **Section 6.3, Regional Truck Parking** provides information specific to the State of California and the Gateway Cities region related to truck parking, Commercial Vehicle Enforcement Facilities development and coordination, and public and private truck parking facilities.

- **Section 6.4, Truck Parking Stakeholder Groups** includes overall project stakeholders, truck parking specific stakeholders and their associated role(s);

- **Section 6.5, Additional Truck Parking Outreach** includes information obtained from truck parking stakeholders and technology/service providers through face to face interviews; survey mechanism distribution; ITS Working Group Round Tables; and Vendor Showcase conduct; and
• **Section 6.6, Preliminary Strategic Approaches** provides some potential direction for stakeholders to address the issues facing Gateway Cities related to truck parking, staging, and trucker services, including optional approaches to mitigating these truck issues, with conclusions/recommended next steps.

### 6.2 Introduction

Public and private stakeholders must work together on conflicting priorities and cross-purposes in developing solutions to the complex issues of truck parking and other related issues. The basis for this complexity lies in finding solutions representative of the following primary factors:

- End user (commercial vehicle driver) needs;
- Regulatory compliance;
- Enforcement resources;
- Geography;
- Economic forces;
- Port concessionaire agreement;
- Long haul vs. short haul needs;
- Truckers Services; and
- Enforcement versus other trucker services needs and regulations.

Convergence of these factors simultaneously is the optimal goal; with the challenge in finding realistic solutions. These factors represent the national truck parking dialogue but are increasingly exacerbated in the Gateway Cities region by the sheer volume of truck trips and truck volumes, the presence of two primary U.S. ports, and highway congestion. Truck parking and services shortfalls in both public and private rest areas highlight the capacity constraints at existing facilities and limited right-of-way in areas with highest demand for parking. The majority of public and private truck parking facilities operate above capacity at peak periods. Additionally, the negative perception of trucks and truck stops among the general public, affects the ability to expand existing facilities or build new facilities in many areas. Existing truck parking facilities could benefit from redesigns to increase efficiency (e.g., existing lots could be striped to maximize various truck/trailer configurations; improved traveler information could be provided; and electrification services may be added).

The lack of safe, convenient, and accessible parking forces truckers—and law enforcement officers—to make decisions with safety implications. Underutilized parking facilities are often not visible from an exit; advertised with proper signage; and/or located near a driver’s route. A lack of information about available parking at public and private facilities forces truck operators to
drive longer than is safe while searching for a place to stop. A growing number of drivers park in dangerous locations such as highway shoulders and exit ramps, where they become hazards for other vehicles. Law enforcement officers must decide whether to awaken a resting driver and order him/her to continue driving (in potential violation of the hours-of-service regulations), or risk a collision.

Economic realities include the need for truck parking is greatest in areas where land values dictate higher revenue than truck parking lots produce (e.g., the replacement of a Travel Plaza by a Super Target at an exit). Often, the areas/businesses directly generating the demand for truck parking are not able to address the problem due to liability concerns or legal constraints (e.g., municipalities that prohibit overnight truck parking at warehouses and distribution centers outside normal business hours; ports without the authority or funding to address problems outside their gate). Furthermore, the pressure on carriers for “just in time” delivery, be it from shippers, brokers, or per commodity (e.g., agricultural products) dictate behavior often at cross-purpose with safety/regulatory priorities.

Freight forecasts reflect potential to triple truck traffic by 2035 in Gateway Cities with implications on the current capacity limitations. While agreements with the ports requires local dray operators servicing the ports provide parking for their carriers, the medium and long haul companies have limited options to stage relatively near the ports and/or find necessary services such as restroom facilities, food options, and even truck electrification resources. Truck parking is a multifaceted problem which spans public-private and jurisdictional boundaries requiring solutions that involve multiple partners.

**Truck Parking Regulation and Initiatives**

The following sections offer relevant information on the background and genesis of regulatory influence; subsequent Federal grant funding and state initiatives; and regional Gateway Cities characteristics, stakeholders, and considerations for implementable truck parking solution(s).

- Commercial vehicle truck parking demand continues to be influenced by a combination of related aspects including regulatory, economic, and driver/carrier segment (dray, short/long haul, agriculture/HazMat) origin and destination of trips. Continuous support for highway construction and expansion across the country since the 1950s, coupled with deregulation of the trucking industry with the Federal Motor Carrier Act of 1980, promoted the growth of trucking into the dominant mode of freight transport in the U.S.

- Population growth and related increase in demand for goods and services in a region contribute to the number of trucks driving to, from, and within the region. Trucks traveling from outside a region often need a place to spend
the night before or after stopping at a port, warehouse, distribution center, other destinations or manufacturing facility in the region.

- Responding to changes in the national and world economy, manufacturers and retailers rely less on warehouses and more on efficient supply chains to run lean, “just-in-time” production and distribution operations; trucks play the key role in these supply chains. Long-haul trucks traveling from seaports, border crossings, and other points of entry often make multi-day trips across the country and attempt to make their final overnight stop as close as possible to their final destinations.

**Legislative Overview**

Commercial vehicle truck parking regulation dates to the 1939 Hours of Service (HOS) decision which formally addressed the limits of work service a driver performs related to fatigue which may impose safety issues. HOS limitations on the number of hours drivers may legally operate a truck each day and week, have significantly influenced when and where drivers choose to stop to rest. Drivers are currently limited to driving 11 hours during a 14-hour shift after 10 consecutive hours off-duty. Prior to 2003, truckers could drive a maximum of 10 hours during a 15-hour shift after eight hours off-duty, and could extend the 15-hour shift with off-duty time, such as meal and fuel stops (U.S. DOT, 2003).\(^{127}\)

In 1990, the National Transportation Safety Board study indicated a significant number of fatal truck collisions and crashes were fatigue-related and a major contributor to fatigue was the lack of rest areas along the Interstate Highway System (NTSB; 1990). This study brought new found attention to the issue of fatigue in transportation operations and management across all modes. Federal funding through legislation was directed in efforts to address safety and cost implications of fatigue and employ mitigating strategies. Specifically, Federal transportation bills set aside funding to investigate the adequacy of truck parking and rest areas and for programs to address parking shortages and reduce diesel exhaust emissions from idling at rest areas (FHWA, 2005). Subsequently, air quality regulations have brought scrutiny to reducing idling and interest in providing such services as electrification for truck rest areas.

**Federal Authorization**

The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) governed Federal surface transportation funding through 2010 (and includes current Continuing Resolution). Specifically,

SAFETEA-LU authorized $25 million for a pilot program to address the shortage of long-term parking for commercial motor vehicles on the National Highway System (NHS). SAFETEA-LU made these funds available to the states to address several freight related issues including:

- Construction of new truck parking facilities;
- Modification of existing truck parking facilities;
- Improving the efficiency of transportation systems through ITS (Section 1305);
- Designation and signage for facilities that provide specific services and free parking for automobiles and trucks (Interstate Oasis) (section 1310), and
- Permit of electrification or other idling reduction facilities and equipment for use by commercial motor vehicles to be placed in rights-of-way on the Interstate System, and allow charging of fees for use (Section 1412).

A Federal Register Notice soliciting applications was issued in fall 2010; awards to Michigan and Minnesota totaled close to $6.5 million have been made as a result allowing test of satellite technology and 5.9 GHz compliant equipment for communication of truck parking related information.

Another five programs were awarded funding in Fiscal Year (FY) 2010 to Utah (UT), Mississippi (MS), Oregon (OR), Tennessee (TN), and Pennsylvania (PA). Only one of the five obligated their full award (UT), one obligated a portion of their award (TN), and the other three had their funds withdrawn through August Redistribution. Subsequently, one recipient turned back the funds for their project.

Additionally, a broad FHWA solicitation for FY 2011 Discretionary Programs was conducted in the third quarter of FY 2011; Truck Parking was included in this Solicitation. A total of 31 applications representing more than $80M in projects requesting more than $61M in Truck Parking Program funds were received in response to this Solicitation. The review and ranking of the projects were completed and recommendations for funding awards have been developed and are advancing through the FHWA/U.S. DOT approval process. Approximately $7.2M was available to support awards of this solicitation.

The availability of these funds provided for a variety of ITS, capacity expansion, information exchange, and infrastructure deployment test cases in developing/determining effective solutions to the complex issues of truck parking. Results of these tests will be invaluable as the nation as a whole seeks solutions to truck parking issues and related impact on congestion, safety, air quality, public health, and the trucking industry’s productivity. As states embark on approved grant projects in these aforementioned categories results may be shared as lessons learned, synergies may be identified in bundling successful technologies/services, and regional solutions may be deployed and tested.
As previously noted, the Gateway Cities region, at current truck volume and truck trips, is confronted with unacceptable shortfalls of long term and staging parking options and operator services. Absent the luxury of time to await national findings through pilot tests the Gateway Cities region is currently pursuing feasible solutions to address improving the current parking options and services levels. Notable Federal grants awarded and projected to yield results of value to the Gateway Cities region are highlighted below. Further, additional State initiatives of potential interest are provided in summary to inform of the variety of efforts however results are not anticipated to be available within the Gateway Cities project timeline. Additionally, FHWA has been mandated to submit a Report to Congress on truck parking which is due in May 2012. This report may include interim results of state initiatives and more empirical data points than are currently available.

**Corridor and Federal Initiatives**

The following test pilots are independent of one another with no existing plan to coordinate. The efforts are testing technology(ies), operational and/or user needs, and business cases related to parking availability.

**SmartPark**

FHWA and FMCSA—have undertaken an initiative called SmartPark to demonstrate whether an intelligent transportation system (ITS) technology for providing parking availability information in real-time to truckers on the road for diverting trucks from filled to unfilled parking areas. A secondary benefit for drivers is that SmartPark can help them in managing fatigue.

Phase I began in May 2007. Two awards were made to demonstrate a technology to collect data on space occupancy and to analyze the collected data to determine truck parking availability. Research tested auto scope and sensor technologies at one site in MA (not a deployment project).

Phase II included tasks for calibrating parking count, disseminating real-time truck parking availability information, making truck parking reservations, forecasting truck parking availability based on past usage, equipping adjacent truck parking areas in a corridor or region to divert trucks from overfilled to under-filled lots, converting temporary to permanent installation, assigning truck parking based on departure, and compiling a business plan for self-sustainability.

Primary Characteristic(s) and Initial Results: Testing in-ground sensors and controlled access for “in and out” counts to determine capacity/availability. Test conducted in Massachusetts which added a weather/durability element to the technology accuracy results. Evaluation of Phase I indicated accuracy levels on truck count and space availability just below 97% (required threshold for acceptance).
East Coast: I-95 Corridor Coalition

The I-95 Corridor Coalition initiative was funded by FHWA at $5,521,688 for a 5-year period. Eight states along the corridor—participating, and they focused on 8,351 parking spaces to monitor through advanced technology. I-95 will consider similar technology as the I-5 corridor (see project description below) but will also look at park and ride facilities that are not used during the evening hours. The Coalition is also analyzing a capacity augmentation test working with businesses to utilize their parking facilities during the evening hours. The overall effort includes plans to build an additional 250 spaces at a State cost of $4 million. Currently, 2.5 years into project; the technical team has equipped the first site in Maryland. Deployment is currently projected for approximately 25 sites in 8 states; utilizing camera based data collection and dissemination on truck parking availability in public and private lots through telephone, web site; and option to link to state’s 511 (state offered feed, must pay for O&M stateside). Several competing optical imaging technologies are being examined with SightLogix (test installation) utilizing a “hybrid” approach using “in-and-out” component and a second imaging technology being considered focuses on “space-by-space” monitoring. The project team is currently finalizing the development of the user interface including interactive voice recognition (IVR) and website components which build on inputs from a user requirements session with commercial truck drivers, organized by the American Trucking Associations (ATA). The user interface has been designed to emphasize trucker safety and mitigation of driver distraction. The focus is on deployment and proof of concept prior to developing a full, sustainable business case.

Primary Characteristic(s): Testing optical recognition/camera based technology for accurate assessment of lot/space occupancy/availability; information gathered and managed for interactive voice recognition (IVR) and website components allowing for pre-trip planning and auto-callback features; user opt-in participation program, no reservation system; discussions with the National Association of Truck Stop Operators (NATSO) and Travel Centers of America (TA), in preparation for the Tier I deployment

West Coast: California iPark

The California iPark project was funded by FHWA at $5,455,372 for a 6-year period. California plans to identify truck parking spaces at both public and private parking facilities through advanced technology (cameras and sensors) and then communicate the availability of those spaces through advanced technology (cell phones, personal digital assistants (PDA’s), navigation devices, and other appropriate devices). Additionally they will demonstrate a reservation system which will be designed to allow truckers to make an advance reservation for a parking space that more closely matches hours of service. They are currently testing reservation/pay system at four to six sites on I-5 North of San Francisco with focus on the “business case” and whether the concept is
sustainable. Parking Carma is currently talking to Truck Stops of America about doing their reservation system nationally.

The California Department of Transportation funded exploratory research programs to better understand the parking problems and possible solutions in California. The result of these efforts was a successful application to the Federal Highway Administration to fund a Truck Parking Initiative in California along Interstate 5 to provide pre-trip and en-route (real-time) truck parking availability, route-guidance information, and parking reservation capabilities. Caltrans has partnered with NAVTEQ, ParkingCarma™, and the TSRC at the University of California, Berkeley to implement and evaluate the pilot. The project will update NAVTEQ’s map systems to include a database of public and private truck parking with features of importance to truckers (e.g., restrooms, hot food, showers, fuel, etc.). Truck drivers will be able to access this information as well as directions to parking facilities by phone (511 or 800 number), websites (both Internet and WiFi), and possibly satellite radio. Real-time truck parking availability and reservation capabilities will be integrated into the truck parking mapping and routing services by ParkingCarma™. Linking this project to the provision of Truck Stop Electrification (TSEs) may be a promising opportunity to reduce idling and meet California’s air quality and public health goals.

Researchers will conduct an analysis of alternative business cases, including advertising, transaction, and subscriptions models, to determine how a public-private partnership could continue to operate in a steady state, self-financing mode after the prototype project is completed. (Commercial Vehicle Parking in California: Exploratory Evaluation of the Problem and Solutions; California PATH Research Report UCB-ITS-PRR-2010-4)

Primary Characteristic(s): Testing reservation/pay system; utilizing cameras and sensors to assess space availability; updates to NAVTEQ’s map systems to include a database of public and private truck parking; access to information by phone (511 or 800 number), websites (both Internet and WiFi), and possibly satellite radio; Real-time truck parking availability and reservation capabilities will be integrated into the truck parking mapping and routing services by ParkingCarma™.

Additional State Grants and Independent Initiatives

- **Pennsylvania RAPIDs (Rest Area Parking Information Delivery System)** – $2.1 M FHWA grant was awarded to Pennsylvania to link truck parking availability information into TMC activity and integrate with the 511 system; PA and I-95 are currently working with the support of FHWA to coordinate the two efforts’ goals.

- **Florida District 4** – Awarded +$1M for a public/private partnership to expand capacity at a private rest area which will integrate with the state Traffic Management Center and anticipates coordination with the I-95 Truck Parking information in that effort’s Tier II deployment.
• **Kentucky** - Developed the Truck Haven Program that allows trucks to park at weight and safety inspection facilities.

• **Maryland DOT, Maryland Motor Truck Association, and the I-95 Corridor Coalition** – introduced a new pilot program allowing emergency truck parking in select park and ride lots during heavy snow events. A list of park and ride lots that can accommodate large trucks to park during snow storms of six inches or more is available through a new “mobile app” which gives truckers an easy way to navigate to these six new lots and to existing truck parking. Portal site: http://roads.maryland.gov/Pages/Emergencytruckparking.aspx?PageId=856

• **Iowa** - Closed several permanent weigh stations and turned them into truck parking locations, and has rebuilt several public rest areas with expanded truck parking.

A Federal Register Notice soliciting applications was issued in Fall, 2010; awards to Michigan and Minnesota totaling close to $6.5M have been made as a result allowing test of satellite technology and 5.9 GHz compliant equipment for communication of truck parking related information.

Another five programs were awarded funding in FY10 to Utah (UT), Mississippi (MS), Oregon (OR), Tennessee (TN) and Pennsylvania (PA). Only one of the five obligated their full award (UT), one obligated a portion of their award (TN) and the other three had their funds withdrawn through August Redistribution. Subsequently, one recipient turned back the funds for their project.

**Summary/Conclusion**

All projects, less SmartPark, are in preliminary testing phases and have yet to provide results regarding efficacy of technologies or business models; the I-5 and I-95 efforts have both completed ConOps and stages of systems design work. The FHWA Report to Congress in May 2012 may include interim test results of value to the Gateway Cities region. Test results, when available, will include technology performance measures and independent evaluations related to the performance of technologies and the proposed business case. In the case of the I-95 test, evaluation will be solely based on technology (the effectiveness of the technology to accurately count and maintain space availability and transmit this information successfully to the test user group – it will not track the behavior of the user group).

Results will inform decisions on lot space count and availability technologies (e.g., cameras; in-ground sensors); performance measures (e.g., technology performance under various weather conditions, lot and truck configurations, and utility costs and O&M); data dissemination models (e.g., interactive voice recognition; web site database and access; 511, and TMC and VMS integration solutions); and sustainability of business models (e.g., public; private; PPP; pay to park; and provision of driver services).
Given the urgency of finding solution(s) to the Gateway Cities region’s parking and services shortfalls which negatively impact the region’s safety, congestion, economic, and environmental condition, it may be necessary to accelerate the findings of elements of these existing projects. Exploration of the following solutions may yield value for the region:

- Augmentation (expansion of available capacity) through existing privately owned commercial big-box store lots and/or vacant warehouses;
- Augmentation (expansion of available capacity) through public/private park and ride facilities; and
- Expanding business model testing to include “pay for park” for shorter-term staging in the area surrounding the region.

6.3 **Regional Truck Parking and Operator Services Needs**

California is home to major international ports in Long Beach, Los Angeles, and Oakland, and represents the second largest border crossing between Mexico and the U.S. with the State’s highway providing critical commercial links from these ports of entry to the nation. California’s highways carry more commercial vehicle truck traffic than any other state in the U.S.

The Gateway Cities region, comprised of 27 cities, houses the two ports with tremendous freight and truck volume traversing the area. In addition to local and short haul dray operators the region also hosts significant long haul and interstate truck traffic to handle the movement of goods in and out of the ports. Each of these trucking segments represents very different truck parking needs – from nearby port parking and staging to overnight accommodations and services. Amidst this volume of trucks and freight, shortages in truck parking facilities continue to negatively impact economic productivity, roadway safety, air quality, and public health in the region.

At the time of the 2008 Gateway Cities ITS Integration Plan for Goods Movement, Appendix TMI - 80, an interview was conducted with the West Coast Corridor Coalition to discuss project needs. During the meeting participants discussed what was referenced as the “Smart Park” System for Trucks citing the following comments and activity:

- **California has the worst truck parking problem in the nation.** Public parking lots are operating at over capacity, about two times higher than what they are designed for, while private parking lots are operating at about one-half their capacity.

- **National studies have been conducted to quantify the parking demand and issues associated with commercial truck parking by FHWA, NTSB and NCHRP.** Some of
these studies have been researched in depth on a statewide level, but no study has been developed for the State of California.\textsuperscript{128}

At the conclusion of the 2008 study the truck parking topic was somewhat in its infancy and while volume was duly noted specific truck parking capacity/shortfall research was not completed, nor was it readily available. Rather, air quality concerns and regulations were cited as a primary impetus to address truck parking issues with potential to reduce idling.

Additionally, truck parking was being considered as a component of the roadside enforcement strategies. With such limitations on enforcement personnel and physical real estate available to safely and properly weigh, inspect, and potentially put a vehicle out of service (OOS), coordination of any common needs across these commercial vehicle functions must be considered in the dense region of Gateway Cities.

Prior to the 2008 study, the Gateway Cities Council of Governors (GCCOG) Board adopted safety initiatives which, in part, included the development of permanent Commercial Vehicle Enforcement Facilities on the I-710 Freeway. These safety initiatives are to be addressed while maintaining a timely movement of goods through the GCCOG area. As directed by the GCCOG board, a Commercial Vehicle Enforcement Strategies Systems and Sites Study (CVES) was developed, in August of 2008.

The CVES study confirmed the need for permanent commercial vehicle Enforcement Facilities (CVEFs) near the ports. Because traditional static scale weigh stations do not have the capacity needed for high truck volume demand corridors, mainline weighing, dimensioning, credentialing, and sorting are needed on the mainline (freeway) to minimize the volume of trucks that need to enter the CVEF. These CVEFs need to meet or exceed the functional requirements of a Class ‘A’ enforcement facility as per the 2001 Weigh Station Inventory of Needs report prepared by California Highway Patrol (CHP) in cooperation with Caltrans. By reducing the number of trucks that must exit the mainline and wait in queues in the station, CVEFs also would help reduce air pollution and reduce traffic congestion both on the mainline and in the facility. Combining common safety and air quality goals furthers the reason for coordination of enforcement and parking/services related efforts.

\textsuperscript{128} Since then, March 2010, the California PATH Program of the University of California, in cooperation with the State of California Business, Transportation, and Housing Agency, Department of Transportation, and the United States Department of Transportation, Federal Highway Administration completed the “Commercial Vehicle Parking in California: Exploratory Evaluation of the Problem and Solutions”, UCB-ITS-PRR-2010-4 California PATH Research Report.
The CVES study also investigated where the CVEFs could be placed on the I-710 or I-405 Freeways making clear there are limited areas of land adjacent to the I-710 or I-405 in each direction of travel to support a CVEF.

One of the five focus areas of the current phase of the Gateway Cities Technology Plan for Goods Movement is CVO Operations Planning and Truck Enforcement which is continuing the coordination effort between enforcement and operational activities. Potential synergies are being sought among shared resources (enforcement personnel; facilities/assets) as well as in consideration of behavioral aspects of the commercial vehicle operator which have implications to both operations and enforcement. Observed/historical driver behavior is a primary predictive tool used by enforcement personnel in making actionable decisions – from planning decisions for placement of enforcement resources (personnel and facilities/assets) to anecdotal identification of gaps in user needs (e.g., truck repeat offenders parked in neighborhoods or shoulders near ports due to lack of adequate staging facilities).

The Gateway Cities/LA Metro project area is challenged by 16 hours a day port operations (which may increase to 20 to 24 hours a day) with two ports, infrastructure limitations, and over 90,000 projected truck trips per day projected in the I-710 freeway corridor and 140,000 truck trips projected in the port area (2035 projections). The sheer volume demands application of as much technology/automation as possible to assist in enforcement efforts and mobility applications; a network is proposed to coordinate the activities on the mainline, at Virtual Weigh Facilities, and at fixed commercial vehicle enforcement facilities. Ultimately, a Commercial Vehicle Enforcement Network (CVEN) that is envisioned will focus, coordinate, and leverage human and technological enforcement resources to better address the critical mass of truck and freight volume in the region and operate on a comprehensive data network. While enforcement activities are primarily thought to be safety vehicle inspections, electronic screening, and weight and/or credentials verification; illegal truck parking and HOS violations are direct safety related enforcement actions. Provision of accessible, legal commercial vehicle and operator rest options in and around the Gateway Cities region will reduce enforcement burden for illegally parked vehicles; remove these vehicles from unsafe locations and residential communities; and potentially reduce commercial vehicle idling emissions (when electrification services or alternate fueling stations are provided).

The research team toured the port area and potential Truck Enforcement sites in August 2011 and two sites (710 N/S; 405 N/S) remain proposed for specific development and estimated at approximately $100 million each. With conformance to State Codes, but with the need for some legislative changes, it is envisioned that these full fixed sites could ultimately offer ancillary services beyond just enforcement such as park-n-ride, driver amenities, refueling stations, truck staging area and possibly truck parking beyond Out of Service (OOS) vehicles. This task is ongoing and progress will be available under separate cover
when the layouts reach a sufficient refinement for discussion with the relevant stakeholders.

Public and Private Truck Parking Facilities – Characteristics

Differences and locations among public and private truck parking facilities vary greatly. For purposes of this preliminary assessment all viable truck parking options are included in review and inventory of assets.

Many public rest areas tend to be located in more remote areas where there is considerable lack of services restaurants, gas stations, motels, and other traveler services nearby. The locations of these rest areas are usually marked by signs on the highway indicating distance to and exit number for access. Some rest areas have visitor information centers, maps, tourist information, and even highway patrol or state troopers staffing and general services such as vending machines, restrooms, telephones, and ATMs. The standards and upkeep of State rest areas facilities also vary but generally most have parking areas allotted for buses, tractor-trailers, and recreational vehicles (RVs).

Privatized commercial rest areas are generally adjacent to the freeway, offer more parking spaces than public rest areas, and take a form of a “truck stop” including services such focused toward truck drivers such as gas/diesel, shower facilities, and fast food/cafeteria/food court. As competition for drivers increases, these private truck stops have expanded these primary services to now include amenities such as Internet access and even truck stop electrification (TSE) technology. These private truck stops gained momentum during the building of the Interstate Highway System and the National Association of Truck Stop Operators (NATSO) was formed in 1960 (NATSO, 2005). It is generally more difficult to see/find private truck stops as these facilities tend to be relegated to property “just off” the public freeway requiring navigation; public rest areas are usually postured to not compete with private businesses.

It is California’s policy to maintain existing public rest areas, but no longer build new ones due to the cost and difficulty of staffing and maintaining them. Rest areas have a (mis)perception of being unsafe, especially at night, situated in remote areas. Many California public rest stops have Highway Patrol quarters and improvements such as lighting and security cameras for added safety. None the less, there is appears to be bias against rest areas and truck stops and communities can apply a great deal of political influence against additional facilities.

California’s public rest areas in Southern California (see Caltrans map of Southern California facilities, Figure 6.1) are maintained and funded by Caltrans. California has a law that explicitly prohibits private retailers from occupying rest stops. A Federal statute (relevant clause of 23 United States Code § 111 below) passed by Congress also prohibits states from allowing private businesses to occupy rest areas along Interstate highways:
• “The State will not permit automotive service stations or other commercial establishments for serving motor vehicle users to be constructed or located on the rights-of-way of the Interstate System”.

Attempts to remove the Federal ban on privatized rest areas have been generally unsuccessful due to resistance from existing businesses which have previously made significant capital investments. The origin of this clause was protection of small town businesses dependent upon providing roadside services but contrarily the private truck stop and travel plaza industry has dominated in light of the prohibition to partner services. Notably, this clause was followed by an exception for facilities constructed prior to January 1, 1960.

**Figure 6.1 Southern California Rest Areas**

In 2003, the Administration’s Federal highway funding reauthorization bill contained a clause allowing states to start experimenting with privatized rest areas on Interstate highways. The clause was fiercely resisted by the National Association of Truck Stop Owners (NATSO), which argued that allowing such rest areas would shift revenue to state governments (in the form of lease
payments) that would have gone to local governments (in the form of property and sales taxes). NATSO also argued that by destroying private commercial truck stops, the bill would result in an epidemic of drowsy truck drivers, since such stops currently provide about 90 percent of the parking spaces used by American truck drivers while in transit.

California has also recognized additional legislative impacts per relatively recent environmental and health legislation in the State. Legislation emphasized the need to reduce diesel exhaust emissions from idling. The Scoping Plan for the 2006 Global Warming Solutions Act (Assembly Bill [AB] 32) identifies electrification of accessories to reduce diesel exhaust from truck idling as one of the measures necessary to reduce two million metric tons of CO2 annually by the year 2020.

California’s air quality is among the worst in the nation. Diesel exhaust contributes significantly to air pollution and has serious effects on human health. The California Air Resources Board estimates that current statewide levels of diesel exhaust contribute to $19.5 billion in annual health care related costs. Many trucks idle their engines while stopped in order to generate electricity needed to run in-cab appliances. A heavy-duty diesel engine burns about one gallon of fuel every hour while idling and nonessential idling accounts for about nine percent of on-road diesel exhaust emissions (The Union of Concerned Scientists, 2005). Truck parking shortages can result in drivers seeking out alternative spaces near their routes, which are often located on residential streets and next to parks near ports (The Modesta Avila Coalition, 2005; West Oakland Environmental Indicators Project, 2003) directly exposing residents to high levels of diesel exhaust.

California, as well as a growing number of other states and localities, limit truck idling with stringent restrictions placed on the idling of all diesel-fueled commercial motor vehicles greater than 10,000 pounds traveling in the state including:

- Five-minute operating limit at any location;
- Certification of diesel fueled auxiliary power systems; and
- Automatic shutdown systems on all 2008 and subsequent heavy-duty diesel engines (U.S. DOT, 2005; California Code of Regulations, Section 2485).

Subsequently, in September 2007, California also passed Assembly Bill 233 – The Healthy Heart and Lung Act— to improve the enforcement of diesel emission regulations which specifically raised the penalty for heavy-duty truck idling.

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(longer than five minutes) from $100 to $300 and requires operators to clear all citations before renewing their registrations.

Public and Private Truck Stop Facilities – Inventory

While beyond the Gateway Cities region proper, the surrounding areas serve as long haul and interstate feeder routes to/from the region and ports and may not be dismissed in considering truck parking issues. Specifically, the 800 mile I-5 corridor carries between 15,000 and 40,000 trucks a day, which represents five to 30 percent of its total average daily traffic. I-5 is a critical commercial link between California’s ports of entry and the rest of the nation.

According to the 2010 Caltrans study, cited previously, available data indicates that public truck parking is at capacity along the I-5 corridor, but private truck parking does have excess capacity. See Figure 6.2 for a map of the I-5 corridor, including the location of public and private rest stops.
Figure 6.2  Map of the I-5 Corridor in California

Source: March 2010, the California PATH Program of the University of California, in cooperation with the State of California Business, Transportation, and Housing Agency, Department of Transportation, and the United States Department of Transportation, Federal Highway Administration completed the “Commercial Vehicle Parking in California: Exploratory Evaluation of the Problem and Solutions”; UCB-ITS-PRR-2010-4 California PATH Research Report.
Additionally, the map provided in 6.3 depicts the truck stops in the immediate Gateway Cities region followed by a table, Table 6.1, of these mapped locations including information on services and parking availability, when provided. There are no public rest areas in the region proper. As evidenced by the parking information in the table, just over 100 truck parking spaces are available in the Gateway Cities region and a majority of those are rented/reserved on a monthly basis and therefore not available for short or long term parking to the general commercial truck traffic which frequents the region on a daily basis. In most cases truck stops are fuel and service provision locations rather than long or short term rest/parking facilities.
Figure 6.3  Map of the Truck Stops in the Gateway Cities Region
Table 6.1  Gateway Cities Region Truck Facilities

<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
<th>City, State</th>
<th>Amenities</th>
<th>Number of Spaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Pacific Pride</td>
<td>I-710 Ex 13</td>
<td>Bell, CA</td>
<td>Fuel</td>
<td>Only allow case by case parking for a few hours max. - recently leased the space out</td>
</tr>
<tr>
<td>2 Webb’s Auto &amp; Truck Service</td>
<td>I-710 Ex 15</td>
<td>Bell Gardens, CA</td>
<td>Fuel</td>
<td>No parking of any duration</td>
</tr>
<tr>
<td>3 Speedy Fuel</td>
<td>I-710 Ex 17c</td>
<td>Commerce, CA</td>
<td>Scales: Axle Scales; Certified Scales; Platform Scales</td>
<td>No parking of any duration</td>
</tr>
<tr>
<td>4 Commerce Truck Stop</td>
<td>I-710 Ex 20</td>
<td>Commerce, CA</td>
<td>Financial: ATM, Food: Deli / Fast Food Restaurant, Lodging Motel Nearby</td>
<td>No overnight or long term parking; 30 minutes max. parking for customers only</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Office: Copy Machine; Fax Machine; TripPak Express Shipping, Payment: American Express, Discover; Mastercard; Visa</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Repairs: CB, Tire, Scales: Axle Scales; Certified Scales; Platform Scales</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Store: Travel Store Truck Store, Wash: Truck and Trailer Wash Nearby</td>
<td></td>
</tr>
<tr>
<td>5 24 Hour Cafe</td>
<td>I-710 Ex 1d</td>
<td>Long Beach, CA</td>
<td>Entertainment: Trucker’s Lounge; TV Lounge; Video Games Room, Food: Restaurant - 24 Hours, Hygiene: Private Showers, Office: Copy Machine; Fax Machine, Parking Spaces: Lighted Parking, Overnight Parking, Overnight RV Parking, Paved Parking, Parking Trailer Drop, Payment: American Express, Diner’s Club, Discover; Mastercard; Visa</td>
<td>Approximately 25 spaces max.; $10 per overnight on first come first basis; customers allowed to stay for a few hours at courtesy</td>
</tr>
<tr>
<td>6 Speedy Fuel</td>
<td>I-710 Ex 1</td>
<td>Long Beach, CA</td>
<td>Scales: Axle Scales; Certified Scales; Platform Scales</td>
<td>No parking of any duration</td>
</tr>
<tr>
<td>7 Harbor Truck Stop</td>
<td>I-710 Ex 2 (Hwy1)</td>
<td>Long Beach, CA</td>
<td>Financial: ATM, Payment: TCH Card, TCH Check, Scales: Axle Scales; Certified Scales; Platform Scales, Truck Wash Trailer Wash</td>
<td>No parking of any duration</td>
</tr>
<tr>
<td>8 Pacific Pride</td>
<td>I-710 Ex 2</td>
<td>Long Beach, CA</td>
<td>Fuel</td>
<td>No parking of any duration</td>
</tr>
<tr>
<td>Name</td>
<td>Address</td>
<td>City, State</td>
<td>Amenities</td>
<td>Number of Spaces</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------------------------</td>
<td>--------------</td>
<td>---------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Long Beach Travel</td>
<td>I-710 Ex 2 (Hwy1)</td>
<td>Long Beach, CA</td>
<td>Fuel; Food/Restaurant</td>
<td>No parking of any duration</td>
</tr>
<tr>
<td>Center</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Port Petroleum</td>
<td>I-710 Ex 1b (Pico Ave)</td>
<td>Long Beach, CA</td>
<td>Fueling; convenience store, necessities, sandwiches, etc.</td>
<td>A few spaces available for parking up to one hour, first come first serve</td>
</tr>
<tr>
<td>Loren Scales</td>
<td>I-710 Ex 2</td>
<td>Long Beach, CA</td>
<td>Scales only</td>
<td>Approximately 10 spaces rented by the month for $150 – renters rarely give up their leases</td>
</tr>
<tr>
<td>Pacific Pride</td>
<td>Hwy91 Ex 14a</td>
<td>Long Beach, CA</td>
<td>Fuel</td>
<td>No parking of any duration</td>
</tr>
<tr>
<td>Valero</td>
<td>I-5 Ex 128b</td>
<td>Montebello, CA</td>
<td>Fuel; convenience store; CAT scale</td>
<td>Approximately 30 spaces but rented by the month</td>
</tr>
<tr>
<td>Dewitt Petroleum</td>
<td>I-5 Ex 126b (Slausen E/N on Chapin)</td>
<td>Montebello, CA</td>
<td>Fuel; convenience store</td>
<td>2 spaces; $10 for overnight parking; first come first serve but they would hold a space upon request if you prepay</td>
</tr>
<tr>
<td>Montebello Public</td>
<td>I-5/Washington Blv</td>
<td>Montebello, CA</td>
<td>Scales: Axle Scales; Certified Scales; Platform Scales</td>
<td>Approximately 50 spaces; 6 month minimum rental for $75 outside gate and $125 inside gate; also allow passenger cars</td>
</tr>
<tr>
<td>Scales</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pacific Pride</td>
<td>I-710 Ex 10 (Rosecrans Ave)</td>
<td>Paramount, CA</td>
<td>Fuel</td>
<td>No parking of any duration</td>
</tr>
<tr>
<td>Pacific Pride</td>
<td></td>
<td>Santa Fe Springs, CA</td>
<td>Fuel</td>
<td>No parking of any duration</td>
</tr>
<tr>
<td>Vernon Truck Wash</td>
<td>I-710 Ex 17a (Bandini) Or I-710 Ex 17b</td>
<td>Vernon, CA</td>
<td>Financial: ATM Hygiene: Private Showers Office: Copy Machine; Fax Machine Parking: Overnight Parking; Paved Parking Pay To Park; Trailer Drop Payment: Comdata Card; Comdata Check; Discover EFS Card; EFS Check; Mastercard; T-Chek Card; T-Chek Check; TCH Card; TCH Check; Visa Repair: Lube Facility; Mechanic / Parts; Minor Engine Repair; Tire Repair; Towing Service Truck Wash Tank Wash Trailer Wash</td>
<td>16 spaces available for 12 hour minimum rental for $10; first come first serve, no reservations</td>
</tr>
</tbody>
</table>
As seen in Table 6.2 below, there are 135 truck stops (combination of private and public rest areas and weigh stations) within a 100 mile air radius of the city of Long Beach in the Gateway Cities region. In the second round of stakeholder surveys the study team will be inquiring among medium and long haul operators the desired distance from destination considered acceptable for participating in staged parking. This desired distance would reflect a relative level of confidence that the operator could reach the driver’s destination on time and would translate to a behavioral shift to utilize staging facilities. Information gathered through the survey mechanism in Task 2 will be utilized for robust interview with members of the California Trucking Association in Task 3 to gain further information and data points.

Table 6.2  Truck Facilities within 100 Air Miles of the Gateway Cities

<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
<th>City</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acton Unocal 76 Truck Stop</td>
<td>Hwy14 &amp; Crown Valley</td>
<td>Acton</td>
</tr>
<tr>
<td>Weigh Station</td>
<td>Hwy14N</td>
<td>Acton</td>
</tr>
<tr>
<td>Pacific Pride</td>
<td>I-5 Ex 110a (S Harbor Blvd)</td>
<td>Anaheim</td>
</tr>
<tr>
<td>A-Z Gas Station</td>
<td></td>
<td>Azusa</td>
</tr>
<tr>
<td>Mettler Renegade Shell</td>
<td>Hwy99 Ex 3 (Hwy166)</td>
<td>Bakersfield</td>
</tr>
<tr>
<td>Pacific Pride</td>
<td>Hwy99 Ex 3</td>
<td>Bakersfield</td>
</tr>
<tr>
<td>Weigh Station</td>
<td>I-10W</td>
<td>Banning</td>
</tr>
<tr>
<td>Weigh Station</td>
<td>I-10E</td>
<td>Banning</td>
</tr>
<tr>
<td>Flying J #614</td>
<td>I-15 Ex 178</td>
<td>Barstow</td>
</tr>
<tr>
<td>Pilot Travel Center #282</td>
<td>I-15 Ex 178 (Lenwood Rd)</td>
<td>Barstow</td>
</tr>
<tr>
<td>TA Barstow #227</td>
<td>I-15 Ex 178 (Lenwood Rd)</td>
<td>Barstow</td>
</tr>
<tr>
<td>Rest Area</td>
<td>I-10W</td>
<td>Beaumont</td>
</tr>
<tr>
<td>Pacific Pride</td>
<td>I-710 Ex 13 (Firestone Blvd)</td>
<td>Bell</td>
</tr>
<tr>
<td>Webb’s Auto &amp; Truck Service</td>
<td>I-710 Ex 15</td>
<td>Bell Gardens</td>
</tr>
<tr>
<td>Pacific Pride</td>
<td>Riverside &amp; Industrial</td>
<td>Bloomington</td>
</tr>
<tr>
<td>Four Corners Union</td>
<td>Hwy395 &amp; Hwy58</td>
<td>Boron</td>
</tr>
<tr>
<td>Pilot Travel Center #200</td>
<td>US395 &amp; US58</td>
<td>Boron</td>
</tr>
<tr>
<td>Rest Area</td>
<td>Hwy58E MM 195</td>
<td>Boron</td>
</tr>
<tr>
<td>Rest Area</td>
<td>SR58W MM 195</td>
<td>Boron</td>
</tr>
<tr>
<td>Name</td>
<td>Location</td>
<td>City</td>
</tr>
<tr>
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<td>I-15 Ex 141 (US395)</td>
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<td>Yucaipa</td>
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For carriers/drivers seeking parking and services information, the FHWA’s website also provides easy links to the following reputable Private Truck Stops in addition to link to state-specific truck stops inventories (as seen above for California). These Private Truck Stop links provide comprehensive information to carriers/drivers included (when available) but not limited to sites by State; number of spaces; services/amenities; fees; directions; and membership information (as required), hours of operation, types of fuel available, food options, retail stores, communications options offered, repair shop availability, permit services, availability of scales, and financial services offered.

- AMBest Truck Stops;
- Commercial Fueling Network;
- Flying J Travel Plazas;
- GoComchek.com;
- North American Truck Stop Network (NATSN);
- Petro Stopping Centers;
- Professional Transportation Partners, LLC;
- Travel Centers of America;
- Truck Stops Direct; and
- The Trucker’s Friend.

While not referenced on the FHWA site, the TruckMaster® Fuel Finder™ Truck Stop Locator allows the user to find truck stops by route, state/province, interstate or affiliation and returns the user current prices, amenities, maps, reviews and other information such as truck stops within 100 miles of the users selected location.

### 6.4 Truck Parking Stakeholder Groups

With assistance from the LA Metro and GCCOG truck parking related stakeholders from public (key industry segments) and private (operators/service/technology providers) domains have been engaged through one-on-one topic-specific interviews and surveys.

These key stakeholder interviews are were conducted at the direction of the LA Metro and GCCOG as the project team seeks input, expertise, context, and anecdotal information to augment research findings and as recommendation scenarios are developed and vetted. Stakeholders often play key roles in more than one of the GC/LA Metro 13 Feasibility Studies and/or the five study areas of Data Collection; Transportation Operations and Management; Emerging
Goods Movement Technology Applications; I-710 Freight Corridor Advanced Technologies; and CVO Operations Planning and Truck Enforcement. To this end, and in an effort to maximize efficiency and minimize burden to stakeholders they are often contacted for interview or survey which will yield results/input toward multiple applications. For example, commercial vehicle operators were engaged to provide input regarding data such as parking or routing information they would like to receive through a particular technology application/delivery method such as a state 511 system or their dispatch. In this example, information obtained potentially affects each of the five study areas. As such duplication of project-specific stakeholders will be seen across related efforts.

Specifically, truck parking stakeholders are, and will be, engaged considerately throughout the life cycle of the project to provide:

- Validation of determined user needs – including but not limited to: short-term and long-term parking, parking quantity, parking location, other trucker services (such as fueling or charging stations), etc.;
- Understanding of particular operational segments and nuances;
- Insight and potential implications on agencies and communities;
- Assistance in developing, discussing, and vetting initiatives; and
- Input into feasible scenarios and proposed solutions/deployments.

Additionally, as initiatives are developed, the stakeholder community may be engaged to participate in development and approval of outreach materials.

The stakeholder list will evolve over time and will continue to be maintained.

Public-sector representatives provide council with oversight to State and Federal programs and preserve the vested interests of their agency(ies) and constituents. Public sector stakeholders available for truck parking related input/reaction currently include:

- Caltrans (manages more than 50,000 miles of California’s highway and freeway lanes; works with local agencies; improves mobility across California with Highway Transportation, Transportation Planning, Administration and the Equipment Service Center; valuable volume and truck trip data);
- CHP (by statute, the California Highway Patrol (CHP) is the only agency with authority to enforce California Vehicle Codes on commercial vehicles in the State);
- Port Authority of Long Beach (drayage operations; gate queueing/staging/appointment systems insights and information exchange to carriers);
- Port Authority of Los Angeles (drayage operations; gate queueing/staging/appointment systems insights and information exchange to carriers);
- DMV (registration of commercial vehicles; potential cross check for credentials in enforcement action/revocation);
- SCAG (the nation’s largest metropolitan planning organization, representing six counties, 191 cities and more than 18 million residents. SCAG undertakes a variety of planning and policy initiatives to encourage a more sustainable Southern California now and in the future; would provide political influence for/against proposed parking scenarios); and
- FHWA; FMCSA (State and Federal Headquarters insight to national truck parking grants progress/results).

Private industry stakeholders currently include representatives of the following sectors:

- Trucking industry (input on end user truck parking and related information needs: fleets, owner operators, associations; local dray; short haul dray; long haul dray; agricultural haulers);
  Shippers; receivers; warehouse and distribution center operators; intermodal terminal managers/operators associated with dray operations (influence driver pick-up and delivery; potential to integrate information with appointment systems and coordinate to parking information for staging purposes and long-haul destination);
- Private truck stop operators (information on location, capacity, reservations, fee, amenities/services); and
- Technology providers (gather and disseminate availability data; end user devices – personal and in-cab; development of new technologies/systems).

### 6.5 Additional Truck Parking Outreach

**Interviews**

Face to face meetings were held with key stakeholders during which issues and anecdotal information related to Truck Parking emerged; notable comments include:

- **LA Metro (511, FSP, RIITS); October 19, 2011** would like to understand trucking communities needs if FSP is serving their needs. Acknowledge towing concerns due to insurance if load is damaged; language barriers; potential fear of FSP tie to CHP. Also, limited detour/truck routes and parking facilities if they take a vehicle off of the freeway. LA Metro would like to include other information in RIITS or 511 such as where diesel gas stations are located (also include this for FSP patrols so they can help direct truckers), OS/OW locations, alternative routes for autos and trucks, time restrictions on roadways, width restriction, truck parking locations and availability and provide this via all possible sources - mobile apps,
dispatchers, 511, e-mail, text, etc. LA Metro is also interested in investigating the SANDAG commercial vehicle component of their 511 system.

Take Away/Carry-on Item(s): Integration and Dissemination of Commercial Vehicle Operations Traveler Information through the 511 System.

- **Port of Long Beach and ACTA; October 20, 2011.** At the city level, most planners are confronted with management of trucks on their roads yet most cities do not want trucks. As example, in Pasadena all truck parking is prohibited, but they still come because they have deliveries to make. The idea of interfacing local road restrictions with local arrival information was noted. A related idea was development of a “reverse appointment system” for the warehouse side.

Take Away/Carry-on Item(s): Investigation of Appointment Systems concept and Off-hours Delivery Systems.

- **Harbor Trucking Association (HTA); November 15, 2011.** HTA has had discussions with terminal operators about congestion inside the gate with a primary complaint of truckers entering the gates at 3 or 4pm (with appointments) but no intention to leave with the cargo until later due to the mitigation fee benefits for waiting (after 6PM). As a result, trucks stay inside the terminal and create queues. One participant noted communications technology is helpful in tracking hours of service, believing this will become a requirement for hours of service enforcement. Participants agreed that an offsite parking area outside the port to reduce congestion inside would be beneficial. One participant highlighted that such a truck parking facility would be especially helpful for trucks coming in from outside areas such as the San Joaquin Valley (they currently are just pulling over).

Drayage truck fleets must have parking available at their facilities outside of the ports per agreement with the ports. Most drayage fleet operators own land used only for their drayage truck parking. Some participants were not in favor of a truck parking facility if it were to be subsidized noting a multi-use facility would subsidize other truckers, when others have invested heavily in truck parking facilities for large fleets and not seeing any revenue. Additionally, participants cited concern over their drivers talking to other company drivers to exchange information.

When asked if charging truck operators to park would level the playing field and ease subsidy concerns, participants noted enforcement of truck parking rules at the terminals would be required. Parking is restricted in the cities around ports (for example in Carson a fine of $200 is levied on truckers if they park). Ideas discussed for potential charges per truck to park included $10 to $15 overnight or 24 hours at a facility offering connection for APUs, bathrooms; some would pay more than $10 to $15. The T&A in Ontario, CA was offered as a benchmark example charging up to $25 for one day.
One truck operator mentioned that reefer trucks just want to get plugged in at the Port and have mechanics available, given the perishable nature of their goods so not sure a truck stop could help meet those needs.

Take Away/Carry-on Item(s): Integrate HOS and Pier Pass information with enforcement inside the gate to move parked vehicles; investigate staging parking area outside gates; Remain cognizant of local dray investments in parking.

- **PierPass; November 16, 2011.** Noted as unintended consequence, some trucks wait at the port to get PierPass benefits and in turn create congestion inside the gate (a “reverse staging” of sorts). Talk of fines for parking in the terminal to alleviate the issue were discussed.

Take Away/Carry-on Item(s): Integrate HOS and Pier Pass information with enforcement inside the gate to move parked vehicles; investigate staging parking area outside gates; Remain cognizant of local dray investments in parking.

**Survey Mechanism**

The project team has been collaborating with the Harbor Trucking Association (HTA) to better understand regional drayage concerns and to come up with solutions to improve operations.

HTA graciously provided support to the project team in disseminating the first of three concise on-line surveys to its members in January 2012. Two additional surveys will be similarly administered during 2012 and include pointed inquiries to the medium and long haul operator communities. Additional follow-up with respondents via e-mail will include questions to identify end user requirements related to staging and traveler services needs and will inform the guided development of proposed project solutions reflective of this input. This initial survey focused on fleet communication, truck parking, and drayage productivity issues.

The President of the HTA personally forwarded the survey request which yielded great response. HTA members were selected to participate in the survey to help take action against congestion, fuel costs, and emissions in the Gateway Cities region with a stated goal to improve drayage truck operations in the Gateway Cities region and develop an end-to-end information support system to improve how goods travel through Southern California including integrating traditional real-time road and traveler information technologies with new intermodal freight, port, and truck transportation and information technologies.

Survey responses directly related to Truck Parking availability and interest yielded the results below. It is important to note respondents indicated representation as follows:
Drayage/crossborder (short distance) – 18 of 28; Medium distance (20 to 300 miles) – 15 of 28; and Long distance (300+ miles) – 10 of 28.

This breakdown (Figure 6.3) suggests this user group may be provided parking as required for local drayage operators and therefore are not interested in common parking facilities.

**Figure 6.3 Truck Parking-Related Survey Questions**

Would you be interested in using common truck parking facilities in the region?

<table>
<thead>
<tr>
<th>Answer</th>
<th>Response</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>9</td>
<td>32%</td>
</tr>
<tr>
<td>No</td>
<td>19</td>
<td>68%</td>
</tr>
<tr>
<td>Total</td>
<td>28</td>
<td>100%</td>
</tr>
</tbody>
</table>

Which areas in the region do you think would benefit most from truck parking facility(ies)?

<table>
<thead>
<tr>
<th>Answer</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-710 North</td>
<td>7</td>
</tr>
<tr>
<td>I-710 South</td>
<td>8</td>
</tr>
<tr>
<td>I-110 North</td>
<td>2</td>
</tr>
<tr>
<td>I-110 South</td>
<td>2</td>
</tr>
<tr>
<td>I-605 North</td>
<td>2</td>
</tr>
<tr>
<td>I-605 South</td>
<td>2</td>
</tr>
<tr>
<td>405</td>
<td>2</td>
</tr>
<tr>
<td>I-5</td>
<td>1</td>
</tr>
<tr>
<td>SR 91</td>
<td>6</td>
</tr>
<tr>
<td>I-10</td>
<td>1</td>
</tr>
<tr>
<td>Other areas</td>
<td>4</td>
</tr>
<tr>
<td>Port of LA</td>
<td>12</td>
</tr>
<tr>
<td>Port of Long Beach</td>
<td>15</td>
</tr>
</tbody>
</table>

ITS Working Group Round Tables

During the course of the November 30, 2011 ITS Working Group Meeting participants were asked to discuss and report-out on eight primary topics (regional strengths; assets; business challenges; road/city problems; recommended strategies (2); and anticipated challenges (2)).

One group (comprised of stakeholder representatives from MARAD; CHP; Metro; City of Long Beach; FHWA) and a second group (comprised of stakeholder representatives from Caltrans, CHP, BNSF Railroad, Port of Long Beach, County of Los Angeles, FHWA) predominantly indicated Truck Parking issues in discussions related to “roadway or city problems encountered” citing trucks parking on shoulders, in neighborhoods (left idling), and under freeways. The second group noted Truck Parking as the primary challenge affecting their business/agency and endorsed the deployment of “Smart” truck parking solutions.

Take Away/Carry-on Item(s): Safety concerns related to trucks parked illegally near/around the ports of issue to enforcement and communities; staging area(s) and/or appointment systems coordination may mitigate

6.6 PRELIMINARY STRATEGIC APPROACHES

As previously noted, the Gateway Cities region has only 18 total public and private truck stops (no rest areas). The Gateway Cities region, at current truck volume and truck trips, is confronted with unacceptable shortfalls of long term and staging parking options as well as operator services. While local dray operators in the Gateway Cities region are required by agreements with the ports, to provide parking for their trucks however medium (20 to 300 miles) and long haul (300+ miles) operators are met with limited parking and services options in the region. The need to provide these operators reliable options to stage in relative proximity to the ports serves the Gateway Cities region with improved safety, air quality, reduce idling, potential trucker services, terminal operations and community goodwill with potential to reduce arterial congestion during peak travel periods.

In order to address parking and operator services deficits both in the Gateway Cities region and beyond focus will be directed at developing staging facility solutions for those carriers not serviced by local dray operations. To eliminate conflict of interest among the local dray operators who have invested largely in providing their carriers staging facilities it is desirable to seek additional staging facility solutions outside the Gateway Cities region proper. The first step in gathering these specific user requirements for such a provision will be through the Task 2 survey mechanism and follow-up to respondents. In consideration of challenges, as user needs are identified will be opportunities explored to pursue adding these staging facilities through:
• Public/Private partnerships to provide travel services;
• Legislative review/repeal to the current limitations on public sites;
• Further inquiry into the concessionaire agreement between the ports and local dray operators to better understand the (perceived) influence on economic disparity created through provision of parking to medium and long-haul carriers; and
• Staging areas and services development plans.

Strategies also include development of a potential demonstration project concept which may attract the I-5 Parking Carma project team to consider testing an additional business model with the Gateway Cities medium and long haul operators in a “pay to stage” initiative at locations spanning I-5, and other freeways with priority on staging locations identified by the Gateway Cities stakeholders. Such a provision may also alleviate the unintended consequence of “reverse staging” by the Pier Pass participants remaining inside the gate beyond loading. This could be attractive in rounding out the current I-5 project business models being tested which do not include port-related solutions. Additionally, provision of a staging service through the existing I-5 initiative would present no conflict of interest between the Gateway Cities project team and local dray operators.

Options to achieving these ends are many (high-tech, low tech) and not without obstacle (Statutes, Codes, Regulations, public perception) or cost but can provide relief to the truck parking conundrum and in turn provide solutions to safety, productivity, and air quality issues exacerbated by truck parking shortfalls. These preliminary options shown below will be further investigated and expanded over subsequent project tasks in pursuit of prioritized proposed solutions to regional and statewide truck parking strategies. Table 6.2 summarizes some key truck parking issues.

Preliminary technology scans related to accurately inventoring truck parking spaces includes a variety of sensor technologies tested and reported by (U.S. DOT; 2005). Technology scans will continue for applicable solutions related to data capture; synthesis, and dissemination methodologies of interest/choice (may include such items as driver distraction mitigation solutions including pre-trip planning systems; interactive voice recognition and speech detect systems).
### Table 6.2 Commercial Vehicle and Operator Rest Options – Long Term, Staging, and Services Issues Summary

<table>
<thead>
<tr>
<th>Issue/Need</th>
<th>Source</th>
<th>Context</th>
<th>Potential Solution</th>
</tr>
</thead>
</table>
| Need for capacity expansion for truck parking/staging | ITS Integration Study, Regional stakeholders | • The land values and cost of development for parking vs. retail, real estate improvements, etc. often makes truck parking development a challenge.  
 • California code restricting private services on public rest areas (on facilities constructed after January, 1960) prevents certain types of truck parking investment.  
 • Competition for weigh/enforcement/ and commuter needs is high.  
 • Private assets are often not graded for commercial weight/size infrastructure wear and additional liability issues assumed by property owner.  
 • The addition of near-port staging parking creates a competitive disadvantage issue with local dray operators required to provide their drivers parking. | • Pursue development of staging and services facilities outside the Gateway Cities region  
 • Develop potential demonstration test in the region to attract opportunities in Public Private Partnerships  
 • Identify opportunities for conversion of existing (State assets) weigh stations, park-n-ride lots, vacant military bases to provide staging and services facilities  
 • Attract private partners to augment existing parking through utilizing big-box store lots in off-hours, warehouses, distribution centers  
 • Pursue legislative review and potential repeal process which may be necessary for certain development efforts  
 • Maximize utility of available space (enforcing proper lane observation; not parking larger configurations across multiple spaces, adjusting time limits, and restriping parking spaces) |
| Need for greater information exchange regarding existing parking | Regional stakeholders | • Lack of parking and information about the location and availability of parking presents truck drivers with difficult/dangerous choice between illegal parking or noncompliance with HOS laws.  
 • There are varying end user technologies and needs for information exchange (cell phone; dispatcher/in-cab communication; pre-trip vs. en route planning).  
 • Several federal and regional projects (such as SmartPark and California iPark) provide opportunities for advanced truck parking information exchange lessons. | • Study public and private truck parking resources – location and number of spaces  
 • Consider potential reservation systems and membership programs  
 • Study willingness to pay to park and for guaranteeing parking availability; expand concept for “pay to stage”  
 • Explore options for dissemination of information (511, Variable Message Signs, Traveler Information Services, online Services; paper maps at rest areas and through trucking associations) |
Conclusions and Recommendations

The Gateway Cities region currently recognizes an egregious shortfall in truck parking, staging, and services with projections in truck volume far exceeding functional capacity. There is also a shortfall of existing research and test results available from national and state level truck parking initiatives by which to govern implementation decisions to date. Creative solutions must be explored imminently to address the shortfall to merely sustain current systems performance and to mitigate future compromise of safety, air quality, and economic prosperity in the region.

As previously noted, in spite of record truck volume the Gateway Cities region has only 18 total public and private truck stops (no rest areas) and 135 facilities (private, public, rest areas, weigh stations) within 100 air miles of the region (based on the Long Beach area). Of the 18 truck stop facilities less than 100 spaces exist and a majority of these are rented to drivers on a monthly basis yielding them unavailable to the general truck population. On average, sites charge approximately $10 per overnight stay (in sites which do not require monthly rental) with no shorter term staging rental option. Fees of $90 - $150 per month are required for the sites offering minimum monthly rental of space. In spite of driver willingness to pay for parking, the additional truck and driver services provided at these 18 sites are both limited and inconsistent.

Local dray operators have agreements with the two ports in the Gateway Cities region and are required by that agreement to provide overnight parking for their trucks. However, medium (20 to 300 miles) and long haul (300+ miles) operators are met with limited the parking and services options noted above. Providing these operators with reliable options to stage in relative proximity to the ports could benefit the Gateway Cities region with improved safety, air quality, and community goodwill with the potential to reduce arterial congestion during peak travel periods.

Necessity dictates the exploration of all possible solutions to address the parking/staging/services shortfall in the Gateway Cities region, regardless of identified impediments. While it is likely that not all end user segment needs may be met with one solution, and not necessarily simultaneously, simply doing nothing is not an option. The following specific pursuits are recommended for both longer term and staged parking:

- Augmentation (expansion of available capacity) through existing privately owned commercial big-box store lots and/or vacant warehouses;

- Augmentation (expansion of available capacity) though public/private park and ride facilities; and

130 Truck Master Fuel Finder.
- Expanding business model testing to include “pay for park” for shorter-term staging in the area surrounding the region.

The challenges anticipated in these pursuits largely include those related to assumption of responsibility and liability for 1) infrastructure damage incurred on private lots; 2) safety and security; 3) sanitation and general upkeep; and 4) enforcement of use and/or collection of revenue. In some cases obstacles will include existing Statutes, Codes, Regulations, and public perception. Beyond public and private sector willingness to cooperate, additional challenges will be presented by physical limitations of property. For example, in the proposed use of park and ride lots there may be compressed, stacked parking constructed for passenger vehicles only with limited open-air “kiss and ride” access restricted to commuter bus configuration and passenger vehicles only. Additionally, regardless of capacity at park and ride lots to accommodate commercial vehicles, these vehicles would have to exit the lot prior to passenger vehicle arrival.

In addition to exploring the issues outlined above it will be valuable to pursue adding staging facilities and services through exploring the following actions:

- Public/Private partnerships to provide travel services;
- Legislative review/repeal to the current limitations on public sites;
- Further inquiry into the concessionaire agreement between the ports and local dray operators to better understand the (perceived) influence on economic disparity created through provision of parking to medium and long-haul carriers; and
- Staging areas and services development plans.

Coordination efforts will continue with the CVEF development plans and opportunities to leverage existing data sources and related technology from the other Gateway Cities projects.

**Next Steps**

The truck parking information resulting from this background research will be used to further identify gaps in end user parking needs which will be applied to solutions approaches in consideration of feasible strategies, such as staging and provision of operator services.

Task 2 will include implementation of the second survey instrument which will include pointed questions to the medium and long haul operators. Those who respond will receive follow-on inquiry of an additional three to four questions pertaining to their staging and services needs. Such questions may include:

- Do you desire staging facilities nearer the ports?
- How close to the port region do you need to be staged in order to have confidence in access to picking up loads?
- What times of day are most desirable for your staging needs?
• What duration of staging is desired?
• What kinds of services (fuel, restrooms, internet access) are required at a staging site?
• Would you be willing to pay for staging facilities access?

All results of national tests/deployments and available resources will be considered throughout the project and valuable outputs will be applied to the strategies outlined previously and these next steps as deemed appropriate.

As noted previously, it is possible that not all end user segment (local, short, long haul dray, agricultural haulers, and other intra and interstate users) needs may be met with one solution and not necessarily simultaneously.

Coordination efforts will continue with the CVEF development plans and opportunities to leverage existing data sources and related technology from the other Gateway Cities projects will be recognized as we identify innovative solutions to address freight mobility and advanced CVO traveler information needs in the ports and Gateway Cities areas.