Los Angeles-Gateway Freight Advanced Traveler Information System

Prototype Development and Small-Scale Demonstrations for FRATIS

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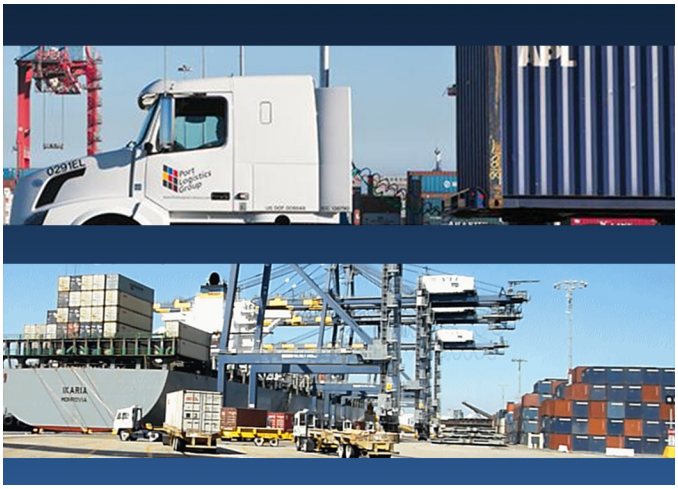

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16. Abstract

This Demonstration Plan has been prepared to provide guidance and a common definition to all parties of the testing program that will be conducted for the LA-Gateway FRATIS Demonstration Project. More specifically, this document provides:

- Planning information that identifies all demonstration elements and site information;
- Experimental information to support the IA Team that includes demonstration hypotheses, testing protocols, and data elements collected; and
- Methods for providing data outputs from this project to the IA Team, and to the USDOT Research Data Exchange.

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1.0 Overview

1.1 Purpose of this Document

This Demonstration Plan has been prepared to provide guidance and a common definition to all parties of the testing program that will be conducted for the Los Angeles-Gateway FRATIS Demonstration Project. More specifically, this document provides:

- Planning information that identifies all demonstration elements and site information;
- Experimental information to support the Impacts Assessment (IA) Team that includes demonstration hypotheses, testing protocols, and data elements collected; and
- Method for providing data outputs from this project to the IA Team, and to the U.S. DOT Research Data Exchange.

The collection of data during this test by the Cambridge Systematics development team will directly impact the ability of the IA Team to assess benefits and analyze the hypotheses presented in this document. Based on this key success factor, the IA Team was consulted during the development of this document so that their data needs and approaches were taken into account.

1.2 Background on the Los Angeles-Gateway FRATIS Demonstration Project

The Los Angeles-Gateway FRATIS demonstration project is focused on:

- Improving communications and sharing intermodal logistics information between the truck drayage industry and port terminals such that terminals are less congested during peak hours;
- Improving traveler information available to intermodal truck drayage fleets so that they can more effectively plan around traffic and port congestion; and
- Employment of an optimization algorithm which will allow for the technologies to work together in a way which optimizes the drayage fleet deliveries and movements based on several key constraints (e.g., time of day, PierPass restrictions, terminal queue status, etc.).

Figure 1 below provides an overview of the anticipated information exchanges that will occur during the operational testing period.

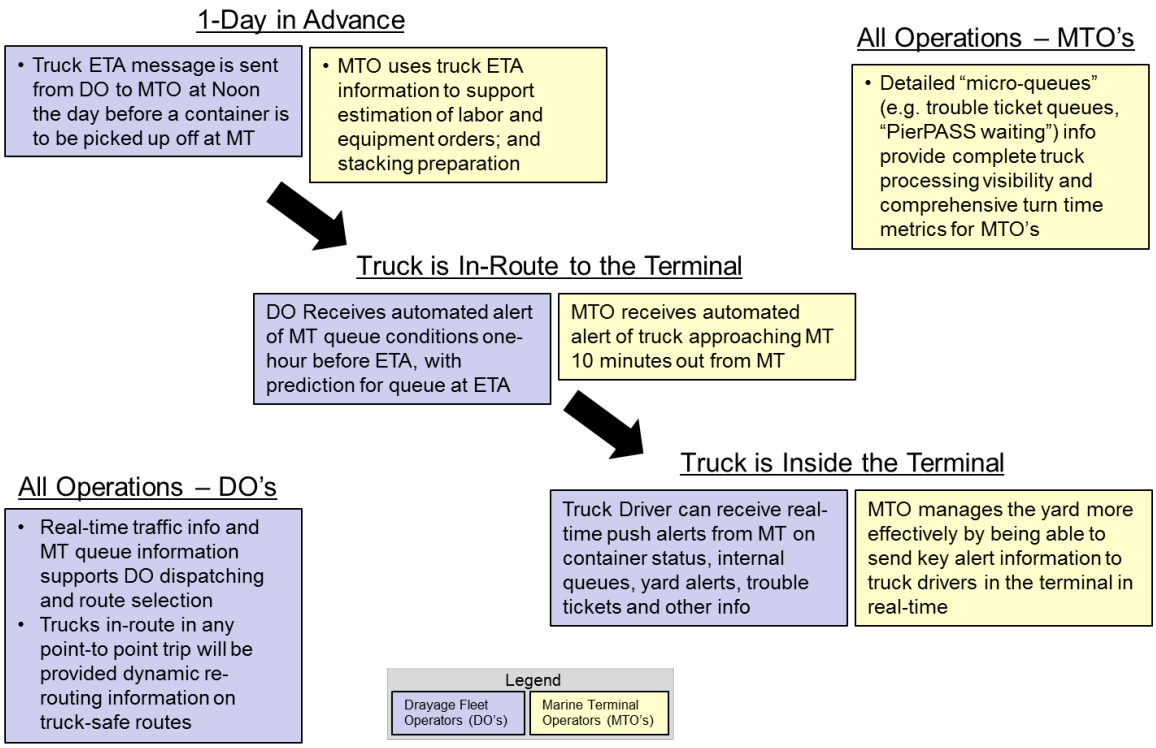


Figure 1. Overview of Anticipated FRATIS Information Exchanges (Source: Cambridge Systematics, Inc.)

Together, these three areas of focus can result in significant improvements in intermodal efficiency, including reductions in truck trips, reductions in travel times, and improved terminal gate and processing efficiency. These benefits, in turn, will directly result in the public-sector benefits of congestion reduction and improved air quality.

The two primary private-sector participants in the Los Angeles FRATIS demonstration project are Yusen Terminals, Inc. (Port of Los Angeles Terminal) and PLG Logistics (regional drayage fleets of 50 trucks). The primary regional public-sector agencies that are supporting the test are LA Metro, The Gateway Cities Council of Governments, and the Port of Los Angeles.

Technologies that will be utilized during the demonstration test include: advanced traveler information (from new Nokia applications), port terminal truck queue-time measurement, including detailed internal terminal queues (from Acyclica Bluetooth/WiFi sensors), automated ETA messaging to the terminals one day in advance of truck arrivals (via a web service linked to the FRATIS Dispatcher web site and the TomTom navigation/messaging devices to be installed on participating trucks), direct messaging of trucks (via dispatch) by terminals (using the same web service), and employment of an optimization algorithm which will allow for the technologies to work together in a way which optimizes the PLG truck deliveries and movements based on several key constraints (e.g., time of day, PierPass restrictions, terminal queue status, etc.).

The primary user interfaces for these technologies will be a web application for drayage truck dispatchers, a mobile application for drayage truck drivers, and messaging/alerts functionality for terminal operators.

This demonstration project currently is in the baseline data collection phase, with six months of operational testing scheduled to begin on October 1, 2013.

1.3 Summary of the Los Angeles FRATIS Application Packages that will be Tested

The following provides a summary of the anticipated three primary applications that will be deployed to support the FRATIS Los Angeles-Gateway prototype system testing:

1. Drayage-to-MTO Communication Application:

    - Dray advance ETA notification message to MTO (one-day advance; noon – day before);
    - Dray 10-minute en-route real-time advance notification message to MTO (potentially using geofence);
    - MTO queue-time information and alerts to dray dispatcher;
    - MTO general messaging and alerts (audible text message) communication to drayage trucks in terminal; and
    - Basic web interface for drayage dispatcher, and either a web interface or an email-driven solution for the MTO operator.

2. Traveler Information Application:

    - Real-time route information and YTI terminal queue information to dispatcher;
    - Real-time audible text message traffic alerts and YTI terminal queue-time alerts for truck drivers (note: interface may be through PLG dispatch);
    - Real-time dynamic routing for truck drivers – simple audible text message notification to driver (note: interface may be through PLG dispatch);
    - Historical route information (to support Algorithm); and
    - Expand Dray web interface to support the above.

3. Drayage Optimization Algorithm Application:

    - Constraints to optimize:
        - PLG container orders/PLG truck inventory/PLG daily planning factors;
        - PLG and Terminals Hours of Operation;
        - One-Day Advance ETA Notification (see Application Package #1 above);
        - Predicted travel times based on historical traveler information;
        - Predicted YTI terminal queue times based on historical Acyclica data; and
        - PierPass schedule/PLG truck practices related to PierPass.
    - Implementation of Algorithm will be simple web/Excel interface, with PLG dispatcher providing detailed specific inputs to the algorithm application on a daily basis.

1.4 Programmatic-Level Goals of the Los Angeles-Gateway FRATIS Program

While the specific technical focus of this project was addressed previously, Cambridge Systematics, U.S. DOT, LA Metro, the Gateway Cities COG, PLG, and YTI also hope to successfully achieve the following programmatic-level qualitative goals of this project:

- Leverage and integrate public- and private-sector data sources, and add the missing pieces;
- Test the benefits of added functionality – beyond what is readily available today;
- Support regional efforts to build trust and establish a new paradigm for cooperation within the intermodal freight industry – potentially leading to regionwide implementation;
- Build institutional support for freight-specific ITS applications; and
- Serve as an incubator for private industry – it is hoped that interested parties will further develop FRATIS functionalities and integrate them into their software offerings.

1.5 Overview of the Site and the Participants

Southern California is by far the most important freight gateway in our nation, and directly affects the success of the U.S. national economy, as well as the global economy. The Ports of Los Angeles (POLA) and Long Beach (POLB), and the freight-centric communities, warehousing/ distribution centers, and transportation infrastructure that serve them – collectively termed the Los Angeles-Gateway Region – handle more than 40 percent of the nation's total import traffic and about 25 percent of its total exports. From the machinery, raw materials, cotton, and other goods being shipped overseas to the clothing, toys, and other products coming into the country, thousands of exporters and importers across the country rely on this region as their primary gateway for trade, with a total value of goods transported by the region exceeding $250 billion annually (2007).[1]

U.S. DOT is sponsoring cutting-edge research into freight ITS solutions in the Los Angeles-Gateway region that can help alleviate congestion, pollution, and delays while promoting improved freight mobility in the nation's major freight gateways. The purpose of the project is to develop a prototype of the Freight Advanced Traveler Information System (FRATIS) bundle of applications, and conduct a small-scale prototype demonstration for assessing the effectiveness and impacts of a regional-based FRATIS implementation. "Before" and "after" data will be collected from the small-scale demonstration to support the FRATIS assessment activities. A range of public- and private-sector partners in the Los Angeles-Gateway region is participating in FRATIS.

The key participants in the FRATIS Los Angeles-Gateway test are summarized below (more detail on test participant roles can be found in Table 1).

[1] Gateway Cities Council of Governments, 2007.

Intermodal Freight Industry Test Participants

- **Port Logistics Group (PLG)** is a 50-truck drayage firm in Rancho Dominguez serving the Ports of Los Angeles and Long Beach. PLG has agreed to deploy both equipment and software for the FRATIS project, which will allow for the full testing of the FRATIS drayage applications, including deployment of TomToms on its entire fleet, and daily implementation of the Drayage Optimization Algorithm. PLG moves about 25,000 containers annually and will be the primary test fleet for the FRATIS deployment. PLG has eight facilities in the Los Angeles region, that serve both ports, with three million square feet of space and a complete range of services, including drayage, transloading, cross-docking, warehousing, distribution, and 3PL services. Mike Johnson, the lead at PLG that is supporting the FRATIS prototype testing program, has been a leader in working with the U.S. DOT, LA Metro, and the Gateway Cities COG in advancing the FRATIS and related ITS efforts; Mr. Johnson also is president of the Harbor Trucking Association.
- **Yusen Terminals Inc. (YTI)** is a major marine terminal operator (MTO) at the Port of Los Angeles, which has agreed to deploy a queue measurement system for FRATIS, as well as two-way communications between YTI and PLG. YTI's operates a state-of-the-art 185-acre terminal on Terminal Island at the Port of Los Angles which handles 1,400 containers per week. This intermodal container "grounded/stacked operations" terminal includes four Super Post-Panamax cranes, four Post-Panamax cranes, and two Panamax cranes. The facilities include a 22,000-square-foot administration/in-gate building, a 24,000-square-foot maintenance and repair building with 10 bays, a 5,000-square-foot marine building, 1,200 wheeled slots (including 500 reefer plugs), 16 entry lanes with 6 scales, 7 exit lanes, and a near-dock rail facility. Doug Hansen, the YTI lead for the FRATIS test, has been involved in major recent regional developments to improve the communications and information exchange between marine terminals and drayage fleets, and has been a leader in working with the U.S. DOT, LA Metro, and the Gateway Cities COG in advancing the FRATIS and related ITS efforts.

Public-Sector Test Participants/Stakeholders

- **LA Metro** is the public-sector test partner which will use FRATIS data outputs to help plan for infrastructure improvements in the region to facilitate goods movement; LA Metro is the major regional transportation agency that funds the Los Angeles freeway network infrastructure.
- **Gateway Cities Council of Governments** is a key public-sector sub-MPO (covering the port region and the I-710 freeway, and encompassing two million citizens living in Southeast Los Angeles) stakeholder which developed the Gateway Cities Technology Plan for Goods Movement – this plan laid the institutional groundwork for the FRATIS Los Angeles-Gateway test.
- **Port of Los Angeles –** the largest port in North America – is a key supporter and stakeholder for this project. Port personnel have been working closely with U.S. DOT and YTI concerning potential deployments of FRATIS and related ITS in the region.

Development Team Participants

- **Cambridge Systematics, Inc.** is the prototype development (PD) contractor lead, responsible for overall task management and project coordination and ensuring that all data requirements to facilitate the impacts assessment are met.
- **Productivity Apex, Inc.** is the software development and systems engineering lead, responsible for all Agile software development and testing.
- **The University of Washington (UW)** is acting as the formal coordinator between the PD contractor team and the IA team.
- **TomTom** is providing the fleet tracking, fleet management, and in-cab navigation/ communication suite to facilitate drayage optimization, truck dynamic routing, and two-way communications features of FRATIS.
- **Nokia-Navteq** is providing traffic data to support the drayage optimization algorithm and traffic reporting features of FRATIS.
- **Acyclica** is supplying the queue measurement technology being deployed at YTI.

1.6 Document Organization

The remainder of this document is organized as follows:

1. **Demonstration Site Plan (Section 2.0).** This section identifies the demonstration participants and their roles and responsibilities in the test; describes the required hardware and software components for the demonstration, including plans for installation and removal of test equipment; provides a site plan layout describing the test location, including key driver routes, the location of PLG and YTI terminals, and any infrastructure equipment; describes the acceptance criteria for the FRATIS prototype prior to the start of demonstration activities; and provides a high-level test schedule, including planning, preparation, and test activities.
2. **Demonstration Experiment Plan (Section 3.0).** This section identifies the test hypotheses for the small-scale demonstration (developed in conjunction with the independent IA contractor); defines the overall technical approach for prototype testing, including FRATIS components to be tested, data needs and transmission protocols, data sharing with the IA contractor, and analytical tools needed for data collection during the demonstration; and describes the general approach for surveying FRATIS users regarding customer satisfaction and system usability. This section also covers plans for data storage and archiving during the test as well as the transmission of test data to U.S. DOT at the conclusion of the project.
3. **Monitoring the FRATIS Los Angeles-Gateway Region Test (Section 4.0).** This section provides detail on how the CS team intends to manage the operational test, including: monthly data reporting to the IA contractor; keeping PLG management and staff engaged throughout the process, including predeployment testing of the FRATIS applications packages as well as user training; and monitoring test participants' use of the applications during the test, and taking corrective action if needed to boost participation.

2.0 Demonstration Site Plan

2.1 Demonstration Participants and Roles

The main demonstration participants and their roles are presented in the Table 1 below.

Table 1. FRATIS Participants, Roles, and Responsibilities

Participant	Roles and Responsibilities
Consultant Team, PD Contractor (Lead – Cambridge Systematics)	Project and systems engineering and development management and implementation, data collection, interfacing with the IA Team (CDM Smith) and U.S. DOT DMA Support Contractor (Noblis).
Productivity Apex, Inc.	Systems engineering and software development lead; developer of the Drayage Optimization Algorithm; deployment of TomTom devices.
Port Logistics Group (PLG)	Test fleet for the Los Angeles-Gateway region FRATIS deployment. PLG is a dray trucking firm, with a fleet of 50 vehicles, which moves approximately 25,000 TEUs per year. They already have provided access to GPS-based truck data (XRS fleet management suite) and recently agreed to utilize the TomTom WebFleet system for the FRATIS test. They also will provide manifest information and will be the primary test fleet for the FRATIS test, including implementing the Drayage Optimization Algorithm.
Yusen Terminal Inc. (YTI)	Major intermodal terminal, which is located on Terminal Island at the POLA, and which handles 1,400 containers per week, has agreed to voluntarily participate in testing of the FRATIS system; they also will allow for queue measurement sensors to be placed at their terminal approach, at the gates, at key points within the terminal, and at the terminal exit.
Los Angeles Metropolitan Transportation Authority	Public-sector agency who will use FRATIS performance measures for freight infrastructure planning and investment decision-making.
Gateway Cities COG	Sub-MPO for the 27 cities that encompasses all of the intermodal freight movements moving through the Ports of Los Angeles and Long Beach, and nearly all of the associated intermodal industries. They developed the Gateway Cities Goods Movement Technology Plan which is being leveraged for this effort.
Port of Los Angeles (POLA)	Location of many of the drayage moves, overall port statistics, and data for the IA team.
In-Vehicle and Traffic Information and Data Vendors (Nokia-Navteq and TomTom)	In-vehicle device and traffic services information vendors who will provide truck-safe dynamic routing, historical traffic and incident data, and data support during the testing period.

Participant	Roles and Responsibilities
Acyclica	Vendor installing the queue length measurement system at the Yusen Terminal which will be used to send alerts to PLG regarding expected queue times and turn times.

2.2 FRATIS Components to be Tested – Test Focus Areas

As detailed previously, the Los Angeles-Gateway FRATIS demonstration project is focused on:

1. **Drayage-to-MTO Communications Improvements –** Improving communications and sharing intermodal logistics information between the truck drayage industry and port terminals such that terminals are less congested during peak hours.
2. **Freight-Focused Dynamic Traveler Information –** Improving traveler information available to intermodal truck drayage fleets so that they can more effectively plan around traffic and port congestion.
3. **Drayage Optimization –** Employment of an optimization algorithm which will allow for the technologies to work together in a way which optimizes the drayage fleet deliveries and movements based on several key constraints (e.g., time of day, PierPass restrictions, terminal queue status, etc.).

The following three subsections provide the information on the FRATIS components to be tested across these three areas. Additionally, the reader is encouraged to reference Figure 1 (see page 2) as they review these subsections.

Drayage-to-Marine Terminal Operator Communications Improvements

This component develops a communications linkage between the drayage dispatchers and the Yusen terminal operators at the port. This technical focus area of the Los Angeles FRATIS project has been rated by both Los Angeles regional terminal operators and the regional Harbor Trucking Association as the most important need and focus that they would like to see in the FRATIS system. Moreover, the focus on this area by YTI, PLG, the Harbor Trucking Association, the Port of Los Angeles, and several other marine terminals (e.g., ITS at the Port of Long Beach), has led to a significant recent détente between MTOs and drayage fleets in the region, as this element of FRATIS has proffered a means to move beyond the historically contentious relationship between these groups – to successfully work together in cooperation to solve key intermodal operational issues at the ports.

The elements associated with this component include:

- Dray advance estimated time of arrival notification messages to the marine terminal operators (one-day advance; noon – day before);
- Dray 10-minute en-route real-time advance notification message to marine terminal operators (potentially using GPS-based geofences);
- Marine terminal operators queue time information and alerts to dray dispatcher;

- Marine terminal operators general messaging and alerts (audible or text message) communication to drayage trucks in terminal – to be routed through PLG dispatchers who will have decision as to whether to give the information to the driver; and
- A basic web interface for drayage dispatcher, and either a web interface or an email-driven solution for the marine terminal operator.

Test participants will include approximately 50 PLG drivers (who would likely receive the information via the PLG dispatchers), 3 PLG dispatchers, and a few select YTI management and operations staff who are engaged in daily terminal operations.

According to PLG, they send about 10 trucks per week on average to YTI. This small volume likely will not be enough to materially affect how YTI plans vessel unloading and container stacking, however we do expect to be able to prove the concept. Interviews with YTI staff and other stakeholders will illuminate the potential benefits of a wider deployment with more drays and terminals participating. (Notwithstanding the above, the drayage optimization algorithm will optimize for all 50 of PLG's participating trucks, not just those going to YTI.)

Freight-Focused Dynamic Traveler Information

This component focuses on all of the traveler information, dynamic routing, and performance monitoring elements associated with drayage operations by the dispatchers and drivers of PLG. This component will facilitate the linkage of these different traveler information systems and ensure the FRATIS participants are both knowledgeable of and have access to these systems as appropriate to their roles. These systems include:

- **Traveler information 'one-stop shop' with real-time truck route and YTI terminal queue information for PLG dispatchers –** This will be a FRATIS web site which would include real-time traffic updates, incidents information, expected terminal wait times, and predictive travel time or arrival at destination information. PLG dispatchers will access the system via a desktop interface. This system will be largely based on Nokia-Navteq data, supplemented by Acyclica data for YTI terminal wait times.
- **Dynamic route guidance for PLG drivers –** Routing, including real-time truck-safe dynamic routing provided by TomTom. Simple route guidance will be delivered audibly or using text through in-cab the TomTom Pro 7150 Truck units. Similar real-time audible text message about Yusen terminal queue-time alerts also will be pushed to truck drivers via the TomToms. Information on recommended, accepted, and actual routes, will be archived in the FRATIS system for eventual consumption by the IA Team.
- **Public-sector freight performance monitoring –** LA Metro desktop users will be able to generate reports describing truck routes, speeds, and congestion on major freight roadways by time of day and day of week – via using the Nokia-Navteq information provided in FRATIS. Additionally, periodic PDF downloads of truck movement data generated on truck routes (recommended and taken routes) from the TomTom system also will be made available to LA Metro. Data of this type can be useful for freight infrastructure planning and investment decision-making.[2] Additionally, a FRATIS

[2] Please note that in a full FRATIS implementation, company-identifying data from participating firms that would be shown to the public sector would be cleansed to protect privacy.

demonstration will be held in fall 2013 for select Los Angeles regional and California State-level public-sector planning staff to illustrate the usefulness of FRATIS-derived data for planning and infrastructure funding decisions.

Drayage Optimization

This component will involve employment of an Optimization Algorithm which will allow for the technologies to work together in a way which optimizes the drayage fleet deliveries and movements based on several key constraints. The baseline starting point for this effort is the Productivity Apex (PAI) Drayage Optimization Algorithm, which was provided as a requirement in the FRATIS development RFP.

Going well beyond the RFP, Cambridge Systematics has brought on PAI as the primary software developer for the FRATIS Los Angeles-Gateway system. As a full partner with Cambridge Systematics in this test, PAI will deploy the most advanced version (in comparison to the other FRATIS tests and Memphis C-TIP test) of the Drayage Optimization Algorithm for this test. The optimization in the Los Angeles region, in addition to covering truck-centric constraints that were/are being covered in Memphis, Dallas, and South Florida, will incorporate port terminal information and other major constraints that are associated with the most complex port and intermodal environment in the nation – the Los Angeles ports region.

The constraints that the Drayage Optimization Algorithm will optimize are:

- Port Logistics Group (PLG) container orders, PLG truck inventory and daily planning factors;
- PLG and terminals hours of operation;
- One-day advance estimated time of arrival notification;
- Predicted drayage travel times based on historical traveler information provided by Nokia-Navteq;
- Predicted Yusen Terminal queue times based on historical queue wait data collected by Acyclica – this would provide dispatchers the ability to assign trucks to loads at other terminals where they may achieve a lower turn time; and
- PierPass schedules and PLG truck practices related to PierPass (PierPass is a partnership among the marine terminal operators at the Port of Long Beach and the Port of Los Angeles aimed at easing truck congestion, improving security, and helping air quality).

Implementation of the drayage algorithm will be a simple web or Excel interface, with PLG dispatchers providing detailed specific inputs to the algorithm application on a daily basis. The algorithm will then provide an optimized plan for the day's moves that will accomplish all required moves in the most efficient manner possible, accounting for the business constraints outlined above. PLG dispatchers will have override authority at all times to respond to changing business needs. Dispatch orders will either be communicated to drivers over the phone or at the dispatch window (as they are today), or pushed to drivers through in-cab TomTom navigation/ communication systems.

Due to the unique operating environment in Southern California, bobtail trips are not really a significant problem in the region, with the exception of "artificial bobtails" created by the PierPass peak fee business rules. Nonetheless, based on experience with the C-TIP Drayage Optimization Algorithm in Memphis, the team expects some improvement in bobtail miles from the algorithm approach.

2.3 FRATIS Components to be Tested – Hardware and Software Components

Hardware Components

A primary hardware component that will be tested is the TomTom in-vehicle tracking, traveler information and information exchange system. As detailed in Figure 2, this consists of two primary hardware components – the TomTom Pro 7150 GPS and the TomTom Link 510. These two TomTom devices will be installed across all of the 50 trucks at PLG between late July and early August 2013.

- Track Fleet 10sec/1min (GPS)
- Trace Fleet (GPS)
- 2-Way Communication with Back Office (GSM)
- 2-Way Communication with GPS unit (Bluetooth)
- Driving Behavior (IO cable)
- Driving and Idling time (IO cable)
- Ignition events (Power cable)

- Truck Navigation (GPS)
- Dynamic Routing Type 1
- 2-Way Communication with Link 510 (Bluetooth)
- 2 Way Text Messaging (Bluetooth)
- Work Menu
- IQ Traffic
- Weather
- Speed Cameras

Figure 2. TomTom Link 510 Tracking/Communications and Pro 7150 Navigation (Source: Productivity Apex Inc.)

The FRATIS test deployment in Los Angeles requires the installation of TomTom truck-specific communication and navigation hardware on the participating fleet to enable drayage optimization and two-way communications between drivers and dispatch. All PLG-related testing metrics are to be captured via the TomTom fleet management suite.

The TomTom Link 510 is the basic GPS track and trace unit of the TomTom system and features GPS pings every 10 seconds with two-way back office communications. It also enables the driver behavior, drive/idle time, and ignition event reporting features of the system. The unit is Bluetooth-enabled for communication with the Pro 7150 GPS navigation units.

The Pro 7150 Truck units provide real-time, truck-friendly dynamic routing along with two-way communications between drivers and PLG dispatchers. This unit can display driver orders/ itineraries during the operational test, as provided by the dispatcher via the drayage optimization module. It also incorporates real-time and historical traffic patterns into its routing function, and provides weather reporting.

All communications and fleet reporting functions will be integrated through TomTom WebFleet, which will be accessible to PLG dispatchers through a web portal. If they so choose, dispatchers also will be able to disseminate YTI queue or turn time information to drivers via the TomToms (or using the telephone).

The second major hardware element that has recently (June 2013) been installed by the CS Team at YTI terminals is the Acyclica terminal queue measurement system. This system consists of eight installed WiFi MAC Address Readers that have been deployed at the YTI terminal approach, key choke points within the terminal, and at the terminal exit. The system includes Internet connectivity to the Acyclica server, which is located in Denver. The CS Team, YTI, U.S. DOT, and the IA Team will have login privileges to pull the queue data from this server. Figure 3 shows a typical antenna/reader configuration.

Figure 3. Acyclica Queue Measurement Hardware (Source: Acyclica)

Many fleets/drivers today are using WiFi-enabled wireless mobile devices such as smart phones, in-vehicle systems, and tablets for everyday communications. All of PLG's drivers, for instance, use WiFi-enabled Android smart phones equipped with the XRS fleet management suite to track hours of service and other key metrics, and to communicate with dispatch. The TomTom units to

be deployed for the test also are WiFi enabled. WiFi-based travel-time measurement involves identifying and matching the MAC address of enabled devices carried by truckers as they pass a detector location. Algorithms are used to filter out pedestrians from vehicles (this is not expected to be a significant problem at YTI since there is little, if any, pedestrian traffic).

For the terminal queue measurement process, the Acyclica system we are employing for this test will use readers to match MAC addresses from WiFi-enabled devices at different points approaching and inside the terminal. The data is then automatically scrubbed by the Acyclica system to remove outliers; CS staff will review this scrubbing process to make sure anomalies were not missed (e.g., devices that entered the terminal but did not leave or access the yard, or inordinate time spent in the terminal). As an example of how the automated data scrubbing should work, if a device is detected at 8 a.m. but doesn't leave until the late afternoon (and does not pass by any of the detectors within the yard itself), it can be safely assumed that it was a car and can be thrown out.

Acyclica provides a web interface that will be used to collect the data from the queue measurement systems. Using this interface, the team will develop average metrics for time in queue, time in terminal, and total turn time by time of day and day of week. This data also is expected to enable the development of a predictive queue-time capability. These data are to be processed and displayed online for PLG personnel for use in operations planning.

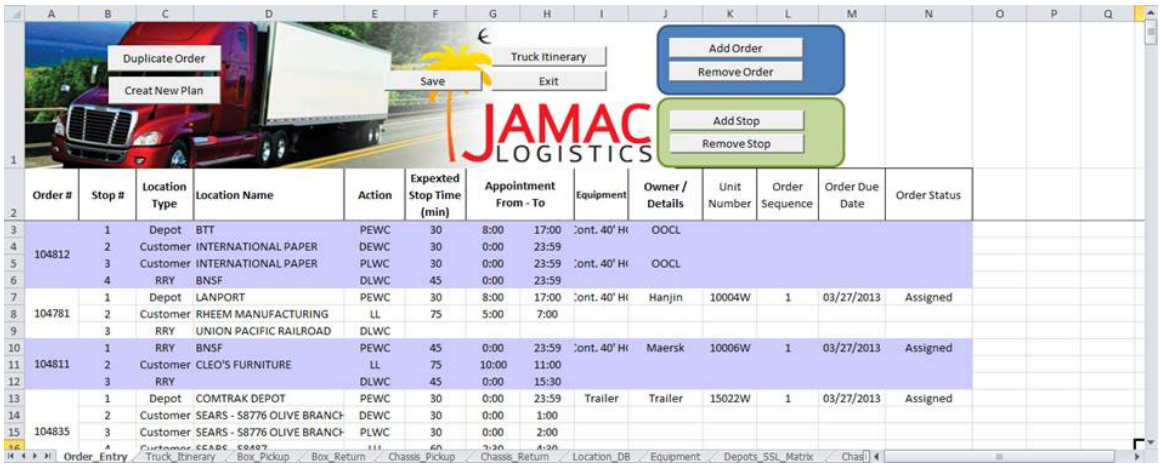
The third hardware component will be existing dispatcher computers located at PLG. The PLG dispatchers will be able to access the FRATIS web site and applications through this computer.

The final hardware component(s) will be operations computer(s) and/or smartphones located at YTI – these platforms can receive the email alerts (or equivalent) from the FRATIS system.

Software Components

A primary software component that will be developed and tested will be the FRATIS PLG dispatcher web site. This web site will provide the 'one-stop shop' traveler information with real-time truck route and YTI terminal queue information for PLG dispatchers. This will include real-time traffic updates, incidents information, expected terminal wait times, and predictive travel time or arrival at destination information. PLG dispatchers will access the system via a desktop web interface. This system will be largely based on Nokia-Navteq data, supplemented by Acyclica data for YTI terminal wait times.

Integrated with the web site will be the Drayage Optimization Algorithm application. The Drayage Algorithm will be a simple web or Excel interface, with PLG dispatchers providing detailed specific inputs to the algorithm application on a daily basis. Order data will include all data inputs required for the algorithm to run, including shipper and consignee locations, freight actions, stop time, time windows, due date, equipment details, and driver data, such as driving availability based on driver's hours of service. The screenshot in Figure 4 (taken from the Memphis test) shows what the order input screen looks like.



Order #	Stop #	Location Type	Location Name	Action	Expexted Stop Time (min)	Appointment From - To	Equipment	Owner / Details	Unit Number	Order Sequence	Order Due Date	Order Status
104812	1	Depot	BTT	PEWC	30	8:00 17:00	ont. 40' H(	OOCL				
	2	Customer	INTERNATIONAL PAPER	DEWC	30	0:00 23:59						
	3	Customer	INTERNATIONAL PAPER	PLWC	30	0:00 23:59	ont. 40' H(	OOCL				
	4	RRY	BNSF	DLWC	45	0:00 23:59						
104781	1	Depot	LANPORT	PEWC	30	8:00 17:00	ont. 40' H(	Hanjin	10004W	1	03/27/2013	Assigned
	2	Customer	RHEEM MANUFACTURING	LL	75	5:00 7:00						
	3	RRY	UNION PACIFIC RAILROAD	DLWC								
104811	1	RRY	BNSF	PEWC	45	0:00 23:59	ont. 40' H(	Maersk	10006W	1	03/27/2013	Assigned
	2	Customer	CLEO'S FURNITURE	LL	75	10:00 11:00						
	3	RRY		DLWC	45	0:00 15:30						
104835	1	Depot	COMTRAK DEPOT	PEWC	30	0:00 23:59	Trailer	Trailer	15022W	1	03/27/2013	Assigned
	2	Customer	SEARS - S8776 OLIVE BRANCH	DEWC	30	0:00 1:00						
	3	Customer	SEARS - S8776 OLIVE BRANCH	PLWC	30	0:00 2:00						

Figure 4. Screenshot of Order Entry Module
(Source: Productivity Apex Inc.)

The algorithm will then provide an optimized plan for the day's moves that will accomplish all required moves in the most efficient manner possible, accounting for the business constraints outlined above. PLG dispatchers will have override authority at all times to respond to changing business needs. Dispatch orders will either be communicated to drivers over the phone or at the dispatch window (as they are today), or pushed to drivers through the in-cab TomTom navigation/ communication systems.

The algorithm will utilize Nokia-Navteq traffic data to assist in developing an optimal daily plan. The Nokia-Navteq data include traffic speeds, travel times, and incidents for all Traffic Message Channel (TMC) coded roads in the Los Angeles region. The algorithm will use historical traffic, traffic incident reporting, real-time travel times with delays, and estimated times of arrival (ETA) calculated for trucks en-route between PLG's terminal and the marine terminals. These data will be made available through API call. (Note that Nokia-Navteq traffic and incident data also will be displayed on the FRATIS web interface for dispatcher use in truck trip planning and resource allocation; TomTom also provides real-time ETA information to the dispatcher through WebFleet.)

2.4 Plans for Equipment Installation, Testing, Use, and Removal

Certain hardware is required to facilitate testing of the three FRATIS components in Los Angeles. This section describes the equipment to be purchased and installed, how it will be used during the baseline and deployment test phases, and contingency plans for removal or abandonment upon conclusion of testing activities.

TomTom Equipment

The TomTom installation and testing schedule is as follows:

- Install/test Link 510 units (with support from PAI) – July 15-31, 2013.
- Begin baseline data collection – August 1, 2013.

- Install/test Pro 7150 truck units (with support from PAI) – October 15-31, 2013.
- Begin deployment test data collection – November 1, 2013.

PAI will procure and ship to Los Angeles 50 Link 510 units, and will install the devices on the PLG trucks in coordination with PLG. The devices will be tested to ensure they are functioning correctly during the installation process. PAI also will procure 50 Pro 7150 Truck units and ship them to Los Angeles PLG staff will be responsible for installing these devices and pairing them with the Link 510s, with appropriate guidance from PAI. As will the Link 510s, the Pro 7150 truck devices will be thoroughly tested prior to beginning the operational test. PAI and CS will jointly develop and furnish to U.S. DOT equipment test/checkout reports at each of these stages, per the statement of work.

Based on previous discussions that U.S. DOT staff have had with PLG staff, it is assumed here that U.S. DOT will arrange to provide an exception to its usual policy of collecting equipment at the end of the test – and that U.S. DOT will thus allow PLG to keep the FRATIS system and TomTom devices. This will support expansion of FRATIS in the Los Angeles region beyond this test. However, if this exception is not granted, CS will work with PLG and PAI to collect the devices and mail them to U.S. DOT.

Acyclica Equipment

The queue monitoring system require the installation of eight WiFi readers at key points approaching, within, and exiting Yusen Terminal. Readers were placed on the approach road (to capture when trucks enter the queue), at the overflow start and overflow exit points, at the ingate and bobtail gate, at roadability start and end, and at the outgate.

The queue/turn-time reader testing schedule was/is as follows:

- Install/test readers (with support from Acyclica) – May 15-May 31, 2013.
- Begin data collection (data to be archived in Acyclica's servers, with regular transfers to Dropbox occurring to support baseline data collection and IA data requirements) – July 1, 2013.

Acyclica already has installed the readers at YTI, and data have been flowing since late May. Acyclica staff have been testing/debugging the equipment on an ongoing basis. As of the end of June all devices were collecting data, although a few required WiFi-Ethernet bridges in order to transmit the data. Once the bridges are installed (expected within the next week) all required queue and time-in-yard data will be flowing and available for PD and IA team use.

It is assumed at this juncture that the equipment will remain in place for use by Yusen Terminals (if desired) upon conclusion of the test. This is in keeping with the approach outlined in the proposal to allow test equipment to revert to private-sector test partners at the end of the testing period.

2.5 Demonstration Site

The following maps show the locations of the demonstration sites. Figures 5 and 6 show a site plan and aerial photo of the YTI terminal, located on Terminal Island, California. Figure 7 shows the location of the YTI terminal within the Port of Los Angeles. Figure 8 shows the I-710 corridor which links the port complex to Interstate 10 east of downtown Los Angeles. Figure 9 shows the location of PLG's truck terminal just west of I-710.

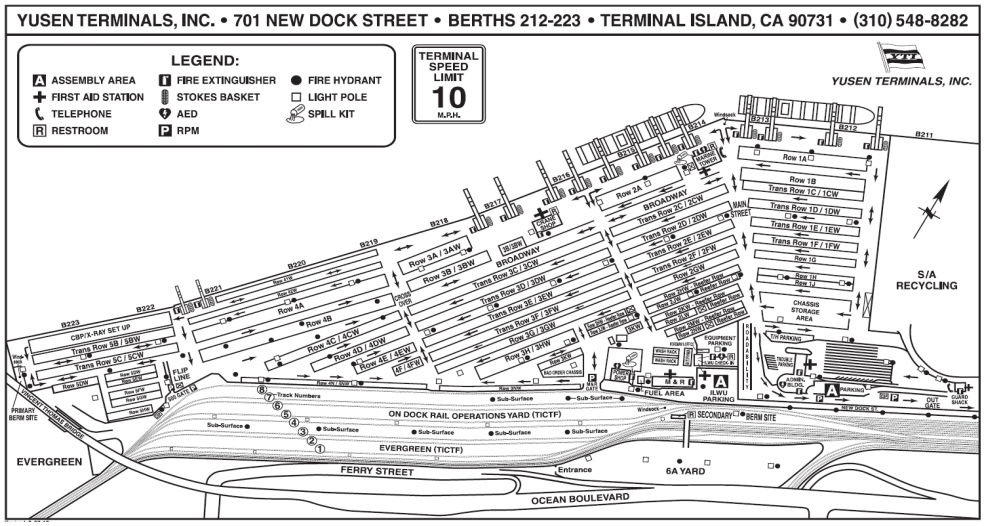


Figure 5. Yusen Terminal Site – Traffic Flow Plan
(Source: Yusen Terminal web site)

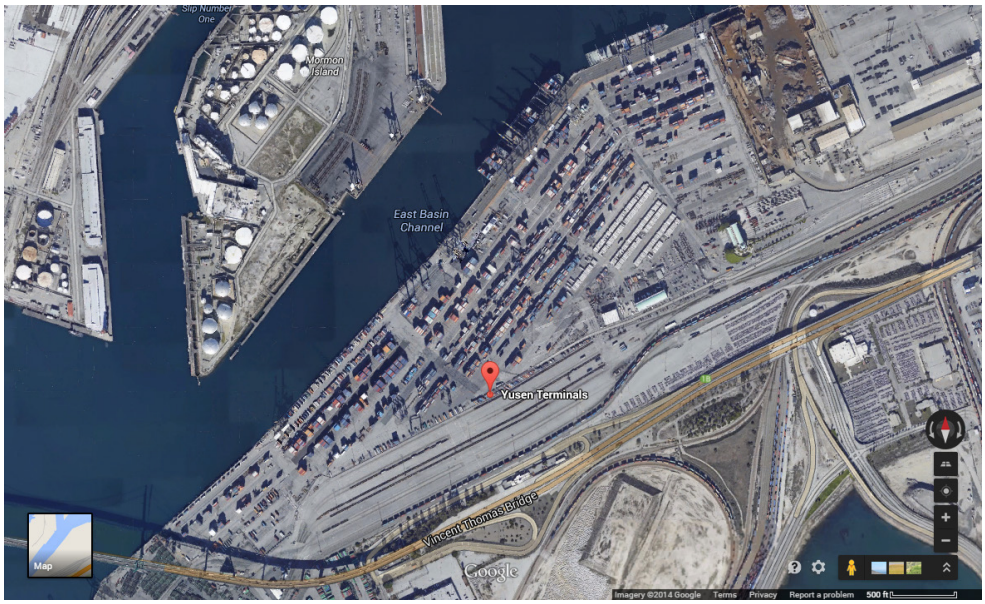


Figure 6. Yusen Terminal Site – Aerial View
(Source: ©2014 Google Inc. All rights reserved. Google Earth™ mapping service is a trademark of Google Inc.)

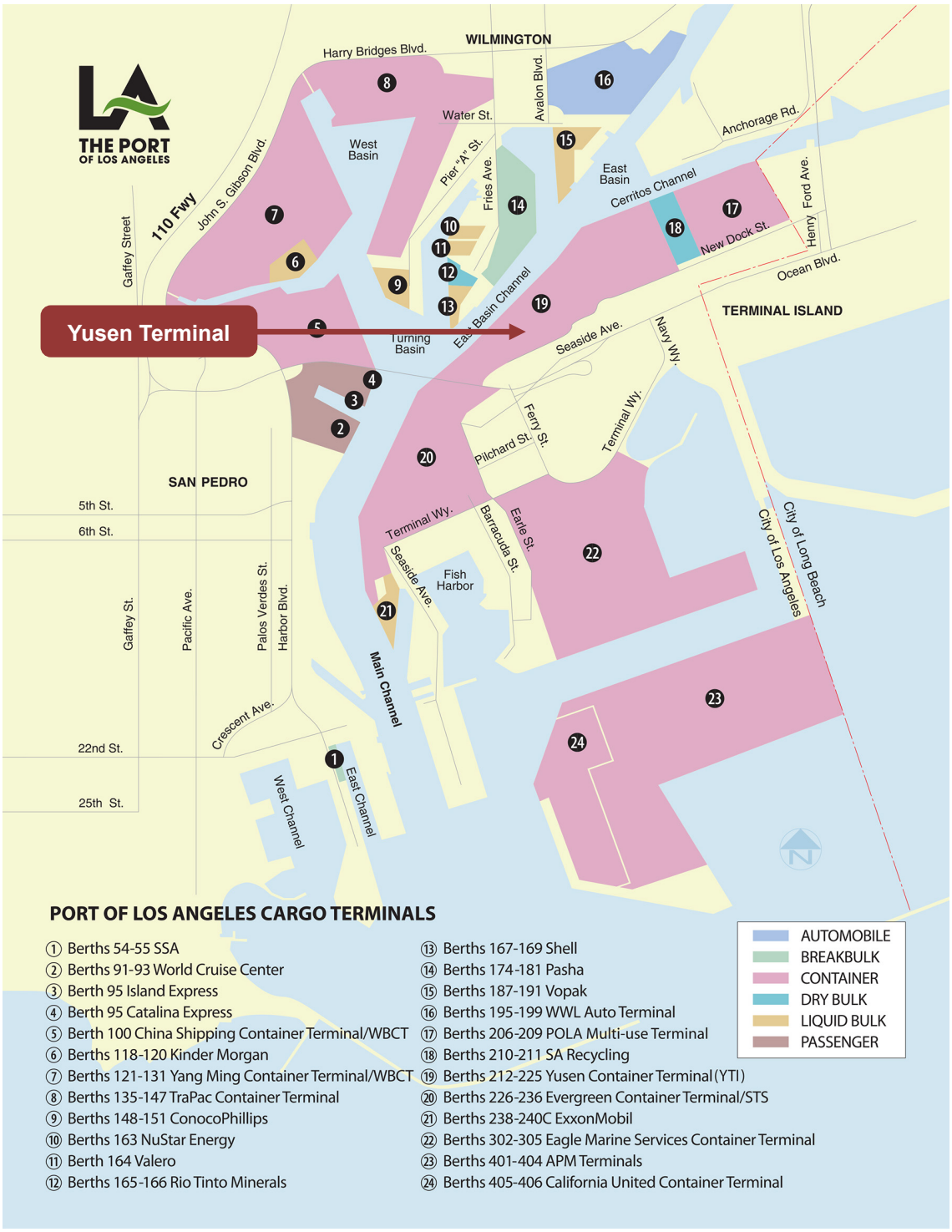


Figure 7. Map of the Port of Los Angeles cargo terminals showing the location of the Yusen Terminal
(Source: Port of Los Angeles web site)

Figure 8. Map of I-710 Corridor
(Source: Gateway Cities web site)

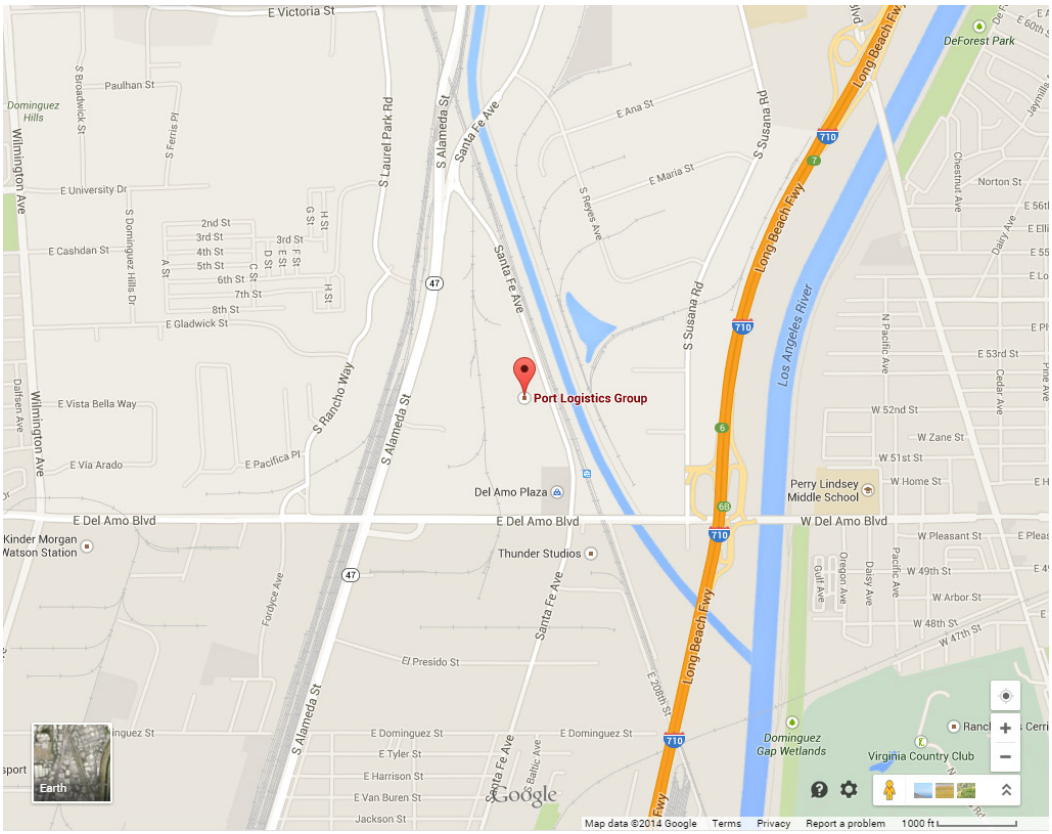


Figure 9. Port Logistics Group Terminal located at 19801 South Santa Fe Avenue, Rancho Dominguez, CA 90221
(Source: ©2014 Google Inc. All rights reserved.
Google Earth™ mapping service is a trademark of Google Inc.)

The majority of the trucks serving the PLG terminal use Interstate 710 which travels north from the port for 23 miles. In addition to travel on I-710, trucks can take parallel and alternative north south routes such as I-110 or the Terminal Island Freeway. Interstate 710 connects to other major regional freeways which also are used by the PLG trucks, including Interstate 410, Interstate 105 and California State Route 91, and these are the predominant corridors for accessing customer locations. In some cases, PLG trucks will use a combination of Alameda Street, the Terminal Island Freeway, and California State Route 47 to get to the port, depending on which terminal they are accessing. This is the predominant truck arterial alternative route to I-710.

2.6 FRATIS Acceptance Test Plans and Criteria

The CS team developed acceptance criteria for each user story contained in the backlog. These criteria will validate successful implementation of each user story through the Agile software development process. The FRATIS acceptance criteria are shown below in Table 2 and are grouped by user type. One key caveat here to note – many of these acceptance criteria assume that certain information is made fully available by terminals and dispatchers; in the event that this data is not made available from private-sector participants to the CS Team, then the relevant acceptance criteria associated with those data issues shall be considered to be voided.

Table 2. FRATIS Acceptance Criteria

User	Acceptance Criteria
Dispatcher	• Can sort available orders by appointment time from dispatcher's computer terminal • Can sort available orders by shipper from dispatcher's computer terminal • Can sort available orders by consignee from dispatcher's computer terminal • Can optimize daily scheduling/work plan from dispatcher's computer terminal • Can view reassignment options from dispatcher's computer terminal • Can view real-time YTI terminal turn time, including gate queues from dispatcher's computer terminal • Can see tractor status and location from dispatcher's computer terminal • Optimization algorithm accounts for driver hours of service and duty status requirements when making work assignments • Can obtain incident information on freeways, port and terminal intermodal connectors, and major freight arterials within the covered region from dispatcher's computer terminal • Can view gate queue video feeds for all terminals (if available) in one place on FRATIS web site • Can obtain historical traffic data by time of day and day of week for freeways, port and terminal intermodal connectors, and major freight arterials within the covered region from dispatcher's computer terminal • Can view current real-time traffic information for freeways, port and terminal intermodal connectors, and major freight arterials within the covered region from dispatcher's computer terminal • Can obtain information on current YTI port terminal closures from dispatcher's computer terminal • Can obtain information on planned YTI port terminal closures from dispatcher's computer terminal • Can see real-time average speeds for freeways, port and terminal intermodal connectors, and major freight arterials within the covered region from the dispatcher's computer terminal • Can obtain real-time point-to-point predictive travel times for freeways, port and intermodal connectors, and major freight arterials within the covered region from dispatcher's computer terminal

User	Acceptance Criteria
Driver	• Drivers receive audible notification when the current/planned route coincides with newly discovered or predicted congestion • Drivers receive spoken directions for alternate routes, if available, when the current/planned route coincides with newly discovered or predicted congestion • Recommended routes are highlighted on a map on drivers' devices • Drivers can receive real-time gate queue wait-time data on their device (when provided by dispatch) • Drivers can listen to gate queue times on their mobile device (when provided by dispatch) • Drivers can receive audible and text information regarding the nature and duration of construction projects on freeways, port and intermodal connectors, and major freight arterials on their mobile device (when provided by dispatch) • Drivers can receive real-time incident information for incidents on freeways, port and terminal intermodal connectors, and major freight arterials within the region on their mobile device • Driver interaction with FRATIS graphical interface is only available when the vehicle is not moving • Drivers can obtain information on when areas within the port terminal will reopen (relayed from dispatcher) • Drivers can obtain information on planned port terminal area closures (relayed from dispatcher) • Driver devices only recommend truck safe routes when offering dynamic rerouting
Marine Terminal	• YTI receives dray truck approach notification of PLG trucks headed to the YTI terminal 10 minutes prior to arrival • YTI receives expected arrival time of PLG trucks headed to YTI by noon on the day prior to arrival • By noon one day prior to arrival, YTI receives information about which container numbers PLG will be retrieving the following day • YTI will have capability to send information or alerts to trucking company dispatcher; dispatcher will have decision whether to send the information to drivers (if desired) • YTI can obtain queue-time data for their gate • YTI can automatically post terminal turn times (if desired)
Public Sector	• Public-sector users will receive login access to the FRATIS Nokia-Navteq system, which will allow for retrieval of a variety for transportation movement data for the Los Angeles-Gateway region, including speed, congestion, and incident information • Public-sector users will receive downloads of summary files in PDF format from the FRATIS TomTom system, which will include information on truck routes recommended, truck routes taken, and alternate routes taken

2.7 Demonstration Schedule for Planning, Purchasing, Preparation, Testing, and Operation of FRATIS Equipment

- Impacts Assessment (IA) Team Baseline Raw Data Collection Feed from Project Team (March 1 through August 31, 2013):
  - XRS fleet management data (flowing as of March 1, 2013) and PLG-automated data.
  - TomTom WebFleet data (to be provided on or before August 1, 2013).
  - Nokia-Navteq monthly travel data summary (currently pursuing contract; access to evaluation data already granted).
- Project Team Baseline Data for Drayage Optimization Development (August 1 through October 31, 2013) – Approach for data collection to be completed by the end of July 2013:
  - Acyclica data has been flowing since May 24.
  - First month is "shake-out period."
  - Currently developing approaches to collect data from PLG.
  - Also to be made available to Impacts Assessment Team.
  - Data collection/system use training at PLG/YTI (planned for the last two weeks of October 2013).
- Operational Test Data Collection (November 1, 2013 through April 30, 2014):
  - PAI is developing automated approach (expected to be complete by September 15).
  - PAI may use special automated tool (note: this is being funded separately by U.S. DOT – please contact Randy Butler regarding the current status and plans for this tool).
  - IA Team to be provided monthly outputs.
  - Major portions of data to support "with" and "without" evaluations by the IA Team.
- Data Interface with IA Team (ongoing):
  - Ongoing coordination between FRATIS team and IA contractor Ed McCormack is serving as the Gatekeeper.
  - A project Dropbox account is setup and is available to all the IA and FRATIS team.

2.8 Drayage Partner Business Process Maps

Business process maps for PLG were delivered to U.S. DOT previously under separate cover.

3.0 Demonstration Experiment Plan

This Experimental Plan provides and input to the IA Team to assist them in their conduct of the Impacts Assessment. The hypothesis and information provided here is the PD Contractor's recommended approach for the conduct of the Impacts Assessment. Finalizing this hypothesis, and assessing data to support or reject these hypotheses is the responsibility of the IA Team. The PD Team's responsibility is to provide the IA Team with access to the raw data, both baseline and operational, which will allow the IA Team to then perform their assessment of impacts.

3.1 FRATIS Experimental Design

The FRATIS Los Angeles-Gateway Cities prototype test hypotheses are developed based on the backlogs as identified in the following areas:

- Drayage optimization;
- Roadway traffic and construction;
- Truck dynamic routing;
- Port terminal information; and
- MTO and Public Sector.

The hypotheses below were developed in full consultation with the IA team and as guided by the most current version of their *Impact Assessment Plan*. The FRATIS test hypotheses and the technical approach for prototype testing are described below.

Table 3. Test Hypotheses

System	Elements	Test Hypotheses
Drayage Optimization	• Order Entry – simple Excel spreadsheet to be populated manually. • Optimization algorithm – Runs through the spreadsheet and provides a daily plan that will maximize productive moves and minimize nonproductive ones, accounting for historical traffic and terminal waiting times. • Dispatch – PLG dispatchers can accept or reject algorithm-recommended moves based on business needs; they will communicate instructions as they do now or using TomTom devices.	• The drayage optimization algorithm will provide an optimized plan for the day's moves that will accomplish all required moves in the most efficient manner possible, accounting for the business constraints – this will result in reduced miles traveled, reduced trips, fewer bobtails, less bobtail miles, and corresponding reductions in emissions.

System	Elements	Test Hypotheses
Freight Traveler Information Dissemination	• Traveler information web site 'one-stop shop' with real-time route and marine terminal operators (MTO) information for dispatchers and drivers. • Dynamic route guidance for drivers – routing, including real-time truck-friendly dynamic routing. • Public-sector freight performance monitoring – web site with freight movement data compiled throughout the test.	• Truck drivers will use dynamic route guidance feature to route around congestion, saving travel time and potentially reducing emissions. • Public agencies will use data generated by FRATIS to assist in freight planning and investment decision-making.
Drayage-to-Marine Terminal Operators Communications	• Dray advance estimated time of arrival notification messages to the marine terminal operators. • Dray 10-minute en-route real-time advance notification message to marine terminal operators. • Marine terminal operators queue time information and alerts to dray dispatcher. • Marine terminal operators general messaging and alerts communication to drayage companies while trucks are in terminal.[a] • A basic web interface for drayage dispatcher, and either a web interface or an email-driven solution for the marine terminal operator.	• This system will develop an effective communications linkage between the drayage dispatchers and the Yusen terminal operators at the port. • PLG dispatchers will use the predictive queue-time information to avoid sending trucks to YTI during the most congested times of the day, resulting in shorter overall turn times for participating trucks. • MTO operations staff will use dray approach advance notification features to better plan labor and equipment orders, and container stacking in the yard (proof of concept only).

[a] Due to liability concerns, both YTI and PLG have stated that they do not want to have direct communications between MTO staff and truck drivers.

The effectiveness of the prototype test hypotheses will include the evaluation of the following system requirements as identified in the backlog process:

- Trucks will bypass congestion through dynamic routing. This will be evaluated by:
  - Surveys of dispatchers at PLG;
  - Interviews or surveys of the drivers at PLG; and
  - Analysis of routing patterns from TomTom WebFleet.
- FRATIS will result in a reduction of the percentage of trucks involved in traffic bottlenecks. This will be evaluated by:
  - Surveys or interviews of dispatchers and drivers at PLG;
  - Analysis of routing from TomTom WebFleet software; and
  - Data from terminal queue detection software.

- FRATIS will result in a bobtail reduction at the drayage companies through implementation of two-way communication between the drayage company and the marine terminal and through implementation of the optimization algorithm. This will be evaluated by:
  - Surveys and interviews of dispatchers and drivers at PLG; and
  - Analysis of PAI's optimization software input and output data.
- FRATIS will result in travel-time reductions for drayage company moves to ports and terminals. This will be evaluated by:
  - Surveys and interviews of dispatchers and drivers at PLG;
  - Analysis of PAI's optimization software input and output data;
  - Analysis of routing from TomTom WebFleet software; and
  - Data from the terminal queue detection software.
- There will be an overall savings of fuel by the drayage company from the operation of FRATIS. This will be evaluated by:
  - Analysis of routing patterns from TomTom WebFleet software combined with standard dray truck fuel economy averages.
- FRATIS will highlight the potential for future reductions in port terminal queues through providing better advance planning information to port terminals concerning truck arrivals. This will be evaluated by:
  - Interviews with YTI terminal operations staff; and
  - Data from the terminal queue-detection software.
- FRATIS will result in an overall improvement in air quality through a reduction in emissions. This will be computed by:
  - Analysis of routing and travel from TomTom WebFleet software and of terminal queue detection software – both using standard dray truck emissions factors for Southern California.
- Each fleet's proprietary information will be protected from unauthorized access and disclosure. This will be evaluated by:
  - Interviews of management staff at PLG; and
  - Interviews of management staff at YTI.
- Information about incidents on the various feeder roads and highways will be useful to dispatchers in making routing decisions and truck reassignments. This will be evaluated by:
  - Surveys or interview of the drivers and dispatchers at PLG; and
  - Interviews of the dispatchers at PLG.
- Information to drivers will be provided primarily audibly, without violating distracted driving initiatives. This will be determined by the IA team.

- Terminal queue information from FRATIS will assist the dispatcher in minimizing terminal wait time. This will be evaluated by:
  - Interviewing the dispatchers at PLG.
- Terminals in Los Angeles will find expected arrival-time information from FRATIS useful in planning their operations. This will be evaluated by:
  - Interviews of YTI terminal staff.
- The use of real-time traffic information by dispatchers and drivers will improve their operations and will save drayage company resources. This will be evaluated by:
  - Surveys of dispatchers at PLG; and
  - Interviews or surveys of the drivers at PLG.

A public-sector test hypothesis derived from public-sector backlogs is:

- Public agencies will find FRATIS data useful in understanding truck movements, average truck speeds, and sanitized truck routes in the region. This will be evaluated by:
  - Interviewing public-sector agency staff.

Technical Approach

The key steps involved in conducting the FRATIS prototype test in the Los Angeles-Gateway region are provided below.

Define test schedule

The test schedule is outlined in Section 2.7.

Table 4. Define Data Needs, Data Format, Data Transmission Protocols, and Data Quality Procedures

Hypothesis	Data Needed to Test	Source(s)
The drayage optimization algorithm will provide an optimized plan for the day's moves that will accomplish all required moves in the most efficient manner possible, accounting for the business constraints – this will result in reduced miles traveled, reduced trips, fewer bobtails, less bobtail miles, and corresponding reductions in emissions	• Daily number of bobtail moves • Daily number of bobtail miles • Daily optimized plan – driver assignments and sequence • Daily execution – driver assignments and sequence	• PLG manifest records • TomTom WebFleet • Daily algorithm plans (spreadsheet or TomTom) • Daily execution (TomTom)

Hypothesis	Data Needed to Test	Source(s)
Truck drivers will use dynamic route guidance feature to route around congestion, saving travel time and potentially reducing emissions	• Truck ID • Date • Start time • End time • Trip duration • Standstill time • Distance • Start location • End location • Fuel consumption	TomTom WebFleet
Public agencies will use data generated by FRATIS to assist in freight planning and investment decision-making	• Anonymous truck movement data – Routes, speeds, alternate routes • Congestion on truck routes • Construction projects on truck routes	• TomTom WebFleet PDF outputs • Nokia-Navteq Access
This system will develop an effective communications linkage between the drayage dispatchers and the Yusen terminal operators at the port	This will be accomplished through demonstrations, training, and interviews	• Software demonstrations and user training • Post-test interviews
PLG dispatchers will use the predictive queue-time information to avoid sending trucks to YTI during the most congested times of the day, resulting in shorter overall turn times for participating trucks	YTI queue time, yard time, and total turn time by time of day and day of week	Acyclica – data are collected on their servers, scrubbed manually or automatically, and displayed on a web site and/or via targeted alerts
MTO operations staff will use dray approach advance notification features to better plan labor and equipment orders, and container stacking in the yard (proof of concept only)	Software demonstration and qualitative information from interviews	'Proof of concept' software demo plus implemented message capability Interviews with YTI staff

Based on the testing hypotheses the FRATIS team will work with the IA team on their data needs to develop the data format/data quality procedures and as guided by the Impact Assessment Plan.

The data will address the following performance measures and quantitative targets:

- **Reduce number of bobtail trips by: 10 percent (near); 15 percent (mid); 20 percent (long).** This is a count of the number of trips in which a truck is not carrying a chassis, trailer, or container. Typically drivers are not paid for bobtails, so they represent

unproductive, albeit sometimes necessary, moves. A key objective of FRATIS is to reduce the number of bobtail trips in the test period compared with the baseline.

- **Reduce terminal queue time by: 20 percent (near); 35 percent (mid); 50 percent (long).** FRATIS is intended to help both the drayage company and the intermodal terminal operator by providing advanced and real-time information about traffic conditions in and around terminals. With the optimization based on historic trends of terminal congestion, the combination of the optimal routings and the ability to use real-time information to dynamically alter arrival schedules at terminals, terminal queue time should be reduced.
- **Reduce travel time by: 15 percent (near); 17.5 percent (mid); 20 percent (long).** This represents the time from an origin (typically a customer with a loaded container) to a destination (a rail or ocean terminal, or the reverse trip of a load from the line-haul carrier to a consignee site). Travel time can obviously vary by time of day and is affected by traffic conditions. The premise is that with better information and optimal and dynamic routings based on FRATIS traveler information and optimization tools the average travel time for a drayage fleet will decrease.
- **Reduce fuel consumption by: 5 percent (near); 10 percent (mid); 15 percent (long).** This is directly related to travel time, but also is affected by unexpected or long delays. The presumption is that fuel consumption will decrease because of dynamic and optimal routings and the ability to find alternate routes in real time that may allow a truck to keep moving and avoid incidents or areas of major congestion.
- **Reduce level of criteria pollutants and greenhouse gas equivalents criteria pollutants by: 5 percent (near); 10 percent (mid); 15 percent (long).** This is directly related to travel time, but also is affected by unexpected or long delays. The presumption is that fuel consumption will decrease because of optimal routings and the ability to find alternate routes in real time that may allow a truck to keep moving and avoid incidents or areas of major congestion.
- **Reduce GHG by: 5 percent (near); 10 percent (mid); 15 percent (long).** If fuel consumption is lower, then the related emissions from the trucks will be lower. In addition, shorter idling time or avoidance of sitting in traffic also will help to reduce emissions.

It is important to note here that FRATIS is by definition a "small-scale test." As such, a main function of the IA Team's assessment shall be to take limited data from this small-scale test, and extrapolate benefits based on a much wider potential use of this system. More specifically, this test involves just one trucking company, and on terminal operator. As such, some benefit goals, such as improved YTI terminal gate planning and equipment utilization due to advance notification container pickup alerts from PLG, will likely not be realized since the number of trucks from PLG servicing YTI may only number about 10 on a given day. Thus, the IA team should plan on develop mathematical relationships than can support development of benefits for a notional case that that entire Los Angeles-Gateway intermodal community deployed FRATIS.

Define or develop analysis tools needed

The analysis tool will be based on data from:

- The FRATIS test drayage tool and resulting measurement, alerts, and predictive algorithms for port terminal queue approaches. PAI's Freight Action at each stop codes include:

  - PE: Pickup Empty;
  - PEWC: Pickup Empty with Chassis;
  - DE: Dropoff Empty;
  - DEWC: Dropoff Empty with Chassis;
  - PL: Pickup Loaded;
  - PLWC: Pickup Loaded with Chassis;
  - DL: Dropoff Loaded;
  - DLWC: Dropoff Loaded with Chassis;
  - LL: Live Load; and
  - LU: Live Unload.

- Truck and fleet travel statistics (travel time, travel distances, etc.) – this will be captured by the TomTom WebFleet system. These data include:

  - Truck ID;
  - Trip travel time;
  - Data and time stamps;
  - Stop time; and
  - Routing Information.

Dispatcher or drayage company daily operating statistics – these statistics will be drawn from data captured by the TomTom WebFleet system; this will assist in recording if alternative or improved routes suggests by the optimization tools are accepted.

- **Yusen terminal queue length statistics as developed by Acyclica.** This data will include:

  - Terminal entry and exit time stamps at reader location noted above;
  - Time in terminal queues; and
  - Time in terminal.

- **Regional travel statistics as provided by the GPS vendor Nokia-Navteq.** These statistics will collect basic regional operating and location information and display summarized outputs that will be available to the assessment team. This information will provide route and corridor conditions that might be impacted by construction, crashes, and incidents.
- **Port authority freight volume statistics.** Where applicable, the assessment team will access publicly available web-based information about operations at the seaports in the Los Angeles/Long Beach areas, including the number of ship call and container movements. These data can be used to adjust for seasonal patterns and/or to estimate potential FRATIS benefits from a regionwide implementation.

The PD contractor will assemble, package, and deliver to the IA team all fleet performance and queue measurement metrics necessary to support the Impacts Assessment. Data will be provided in Microsoft Excel format for the Optimization Algorithm, direct login access for Nokia-Navteq and Acyclica information, and PDF format for periodic TomTom outputs. The IA contractor will be responsible for normalizing month-to-month freight volume data to isolate the impact of FRATIS on PLG/port terminal operations.

Define expected results

The expected results will be based on the test hypotheses as developed by the FRATIS and IA teams. The hypotheses are outlined in Section 3.1 above.

Conduct beta test with selected stakeholders and refine test process

The beta test will be developed based on the concepts as outlined the Agile software development approach.

Install test equipment

As detailed above, PLG will install TomTom devices under the direction of PAI, and the Acyclica queue length detection equipment already has been installed at the Yusen terminal.

Archive and analyze test data and provide a data feed to the IA contractor

A FRATIS project Dropbox account has been setup and is available to the IA and FRATIS team. A data feed from the Yusen terminal queue detection system will be available to the IA team. Beginning August 1, 2013, the Dropbox account will migrate to a fully capably Dropbox for Teams FRATIS account, which will provide access for one year for all test participants, U.S. DOT, the IA Team, and Noblis.

Share data and results with Impacts Assessment contractor

There is ongoing coordination between the FRATIS team and IA contractor. The IA Team is responsible for establishing the context for daily operations, including obtaining real-time or historic traffic data and incident data from publicly available regional systems. The PD team will support the IA and provide daily access to TomTom WebFleet, the Yusen queue information and the drayage optimization software. A member of the FRATIS (UW) team is serving as the Gatekeeper.

3.2 Customer Satisfaction and Usability Survey Test Plan

The FRATIS team is working with IA contractor to develop a survey or interview instrument and a question set. This approach will depend, at least in part, on specifics of the operational test (for example, fleet penetration or use amongst the FRATIS test fleet).

1. Purpose and objectives of the test

The user needs analysis results will provide validation for the usability of FRATIS to the project stakeholders. The specific hypothesis questions that require validation by survey results are indicated the table under Section 4.1 and noted as either interview or survey data requirements.

2. Technical Approach

Key steps for the customer satisfaction and usability survey test are provided below.

Review existing feedback from participants and other projects

This step will collect and review existing feedback from FRATIS participants using face-to-face meetings, if possible, or telephone interviews. Participants will include:

- **Truck driver selected from the PLG driver pool.** There are 50 trucks participating in the test and initial survey will be involve 10 to 15 key drivers and will include both company employees and independent owner/operators.
- **PLG dispatchers.** There are six dispatchers and each will be interviewed.
- **Selected public-sector participants** from the Gateway Cities MPO, the ports of Los Angeles and Long Beach, Caltrans and Los Angeles Metropolitan Transportation Authority.

Develop a survey instrument for FRATIS test participants

The IA team is the lead for developing survey instrument but the FRATIS team will develop some questions to include in the survey. These questions would be related to the user interface and operational experience with FRATIS. A single survey will be sufficient for both teams and assumes that careful survey design will be able to explore FRATIS both for the baseline and after installation.

Develop survey methodology

The survey methodology will be selected by the IA and FRATIS teams. Options include an interview, mail back form, or on-line format. A small pilot survey will be completed to ensure the survey instrument is effective.

Define expected results

This step will be completed in conjunction with the previous step and will be guided by test hypothesis.

Conduct survey

The Impact Assessment contractor will conduct the survey. A web-based survey development software and delivery instrument used at the University of Washington will be available.

Analyze and report results

The Impact Assessment contractor will analyze the survey results, with support as necessary from the Prototype Development contractor.

Document any modifications recommended for future deployments

Based on the results of the survey and any interviews conducted, the Prototype Development contractor will develop a list of recommended improvements, additions, or modifications for consideration in future FRATIS or similar deployments.

3.3 Data Sharing and Archiving

Implementation Plan for Working with the IA Contractor

The FRATIS team will have regular meetings with the IA team and will develop and implement the data sharing approach with the IA team. The FRATIS team will assist the IA in designing an approach to provide for transformative benefits measurement.

Plan for Data Archiving

There is a project Dropbox account for exchanging documents and storing data. This account will be formatted so that any document placed in the Dropbox is a copy and if any data is lost it is easily replaceable.

Use of U.S. DOT Research Data Exchange

As required, the FRATIS deployment team will transfer all nonproprietary and nonconfidential data to the U.S. DOT's Research Data Exchange at conclusion of the test. This is expected to involve a transfer of all data files from the FRATIS Dropbox for Teams Account to the U.S. DOT RDA web site. Data here means all major project deliverables, all data that was collected and provided to the IA team, and all open source software developed by PAI for FRATIS under this contract.

4.0 Monitoring the FRATIS Los Angeles-Gateway Region Test

This section provides detail on how the CS team intends to manage the operational test, including:

- Monthly data reporting to the IA contractor;
- Keeping PLG management and staff engaged throughout the process, including predeployment testing of the FRATIS applications packages as well as user training; and
- Monitoring test participants' use of the applications during the test, and taking corrective action if needed to boost participation.

4.1 Monthly Data Reporting

Each month during the baseline and demonstration test periods, the CS team will collect all data necessary to support the efforts of the IA team. This data was described in the Demonstration Experiment Plan, Section A. These data will be packaged in a format agreed upon with the IA team and delivered each month via the FRATIS Dropbox for Teams account.

Each month CS also will summarize (in bullet format) any known bugs or issues encountered with FRATIS software, hardware, or equipment; any planned maintenance or outages of the FRATIS web portal; and key interactions between the PD team and test participants. This information will be included in CS' Monthly Progress Report to FHWA.

4.2 Implementation Plan

During any technology demonstration, it is important to monitor system use by test participants. This mitigates the risk of nonuse on the part of participants which can result in having little meaningful data for test or evaluation purposes. Nonparticipation can be caused by many factors, including:

- Use of the technology is not convenient for the intended user groups;
- Users perceive the tool as a burden or additional responsibility outside of their normal activities; and
- Users distrust the outputs or recommendations of the technology.

PLG's drivers and dispatchers and YTI's operations managers will be the primary users of the FRATIS application suite, hence our implementation plan focuses primarily on them. Once Agile development activities are complete, CS and PAI will use historical PLG movement data and current load plans provided by dispatchers to compare algorithm outputs with actual order

execution. This will validate whether the algorithm result can improve on what PLG dispatchers currently are doing manually. Once this is established, and any bugs have been addressed, we will work directly with dispatch staff at PLG to raise awareness of the tool and its potential usefulness for their job. These meetings will be carried out ahead of the operational test period, to develop interest on the part of the dispatchers in using the optimization tool to make load assignments.

Concurrently with this effort, we will meet with YTI staff to demonstrate the two-way drayage to marine terminal communications function. One-day advance notifications of expected drayage truck arrivals, as well as 10-minute approach notifications will be shown to YTI staff. Their reaction and thoughts will be incorporated into any further changes required to the marine terminal queue web portal function prior to the operational testing period. We will hold similar meetings with PLG dispatchers and drivers to demonstrate, assess, and raise awareness of the terminal queue web portal for dispatchers and the queue-time push notifications and truck dynamic routing features for drivers.

Any required modifications to the optimization algorithm, freight traveler information dissemination, or drayage-to-marine terminal operators communications pieces will be made by PAI and CS before the operational testing period commences.

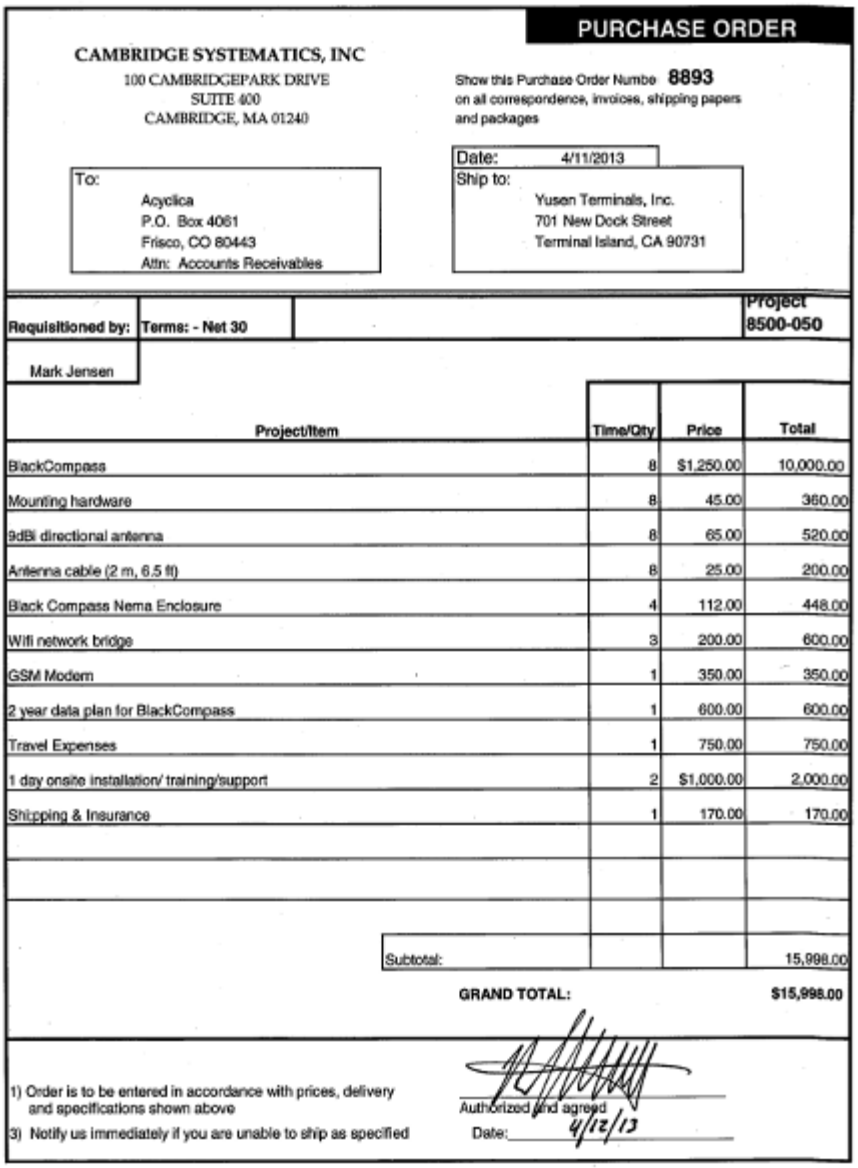
4.3 Monitoring Use of the FRATIS Prototype

During the operational test, it will be important to continuously monitor participant use of the prototype and take corrective action if needed to ensure adequate use of the system for testing and assessment purposes. To this end, the CS team will continue working with PLG dispatchers and drivers as well as YTI staff to ensure they are satisfied with the system's functionality and usefulness. During the test, CS will compare optimization algorithm load plans to daily executed loads during the pilot test to assess dispatcher adherence to plans. If there is significant deviation between optimized plans and execution, CS will work with the dispatch staff to determine the reasons. Based on this feedback the CS team can make modifications if necessary.

For the drayage-to-marine terminal operators communications piece, it will not be possible to compare predeployment container stacking plans with testing period actual operations since no such plans currently exist. However, CS will continue to engage YTI operations staff via regular phone contact and in-person meetings during the operational test to assess their use of the communications functions and make course corrections as needed.

APPENDIX A. Documentation of Materials Purchased

The purchase order for the Acyclica queue measurement system is provided below.



PURCHASE ORDER

CAMBRIDGE SYSTEMATICS, INC
100 CAMBRIDGEPARK DRIVE
SUITE 400
CAMBRIDGE, MA 01240

Show this Purchase Order Numbe **8893** on all correspondence, invoices, shipping papers and packages

Date: 4/11/2013

To:
Acyclica
P.O. Box 4061
Frisco, CO 80443
Attn: Accounts Receivables

Ship to:
Yusen Terminals, Inc.
701 New Dock Street
Terminal Island, CA 90731

Requisitioned by:	Terms: - Net 30		Project
Mark Jensen			8500-050

Project/Item	Time/Qty	Price	Total
BlackCompass	8	$1,250.00	10,000.00
Mounting hardware	8	45.00	360.00
9dBi directional antenna	8	65.00	520.00
Antenna cable (2 m, 6.5 ft)	8	25.00	200.00
Black Compass Nema Enclosure	4	112.00	448.00
Wifi network bridge	3	200.00	600.00
GSM Modem	1	350.00	350.00
2 year data plan for BlackCompass	1	600.00	600.00
Travel Expenses	1	750.00	750.00
1 day onsite installation/ training/support	2	$1,000.00	2,000.00
Shipping & Insurance	1	170.00	170.00
Subtotal:			15,998.00
GRAND TOTAL:			**$15,998.00**

1) Order is to be entered in accordance with prices, delivery and specifications shown above
3) Notify us immediately if you are unable to ship as specified

Authorized and agreed
Date: 4/12/13

The quote for purchase of the TomTom units is provided below.

PRODUCTIVITY APEX INC.

Price Quote for 50 Heavy Trucks

Reference: PLG TomTom/FRATIS LA

Description	Unit Price	Qty.	TOTAL AMOUNT
TomTom PRO 7150 Truck - Item #: 1KJ0.017.01	$329.95	50.00	$16,497.50
TomTom Link 510 – Item #: 1KL001700	$299.95	50.00	$14,997.50
1 Year WebFleet for 50 Trucks	$411.84	50.00	$20,592.00
Installation and Activation	$150.00	50.00	$7,500.00
Shipping and Handling	$300.00	1.00	$300.00
		Total	**$59,887.00**

- All prices exclude sales tax.

Productivity Apex, Inc. • 3505 Lake Lynda Drive, Suite 206, Orlando, FL 32817
Phone: (407) 384-0800 • FAX: (407) 384-0882
www.productivityapex.com

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ITS Joint Program Office-HOIT
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FHWA-JPO-14-180

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