Freight Advanced Traveler Information System

Concept of Operations

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Notice

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16. Abstract

This report describes a Concept of Operations (ConOps) for a Freight Advanced Traveler Information System (FRATIS). The ConOps describes the goals, functions, key concepts, user classes, high-level architecture, operational scenarios, operational policies, and expected impacts of FRATIS. This ConOps is intended as a foundational document for communicating the user needs and system requirements for FRATIS to system developers. Systems engineers will use the ConOps to develop detailed technical specifications that meet the user needs defined herein.

The ConOps defines two separate but interoperable FRATIS application "bundles" covering freight-specific travel planning, dynamic routing, and performance measurement; and drayage optimization. Data sources for the applications include regional Intelligent Transportation Systems (ITS), third party truck movement data, intermodal terminal data, and U.S. DOT Connected Vehicle data. FRATIS basic application functionality will be provided in the public realm using open-source data and services. Enhanced functionality is expected to be available on a subscription basis via value-added commercial applications developed for specific target markets. It is anticipated that development and implementation of the FRATIS application bundles as envisioned will result in private benefits including travel time reduction and fuel savings, as well as public benefits like bobtail reduction and air quality improvements. Public sector data outputs would provide transportation agencies with new tools for freight performance measurement and project evaluation.

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Revision Notice

Identifier	Date of Issue	Summary of Changes
1.0 draft	2/29/2012	Initial draft for FHWA review and comment
2.0 final	3/30/2012	Final draft; addressed feedback from the ConOps Walkthrough, and Noblis comments
2.1 final	4/20/2012	Final draft revised; addressed Noblis Response Verification comments

Preface

The purpose of this document is to describe the Concept of Operations (ConOps) for a Freight Advanced Traveler Information System (FRATIS). The Federal Highway Administration (FHWA) is developing FRATIS as the first freight-centric traveler information system in the U.S.

The development of this ConOps is based on a user needs development process incorporating feedback from potential freight transportation system users (e.g., intermodal freight carriers and companies, particularly including dispatchers/operations managers and drivers), as well as government agencies that both can generate and consume Intelligent Transportation Systems (ITS) data.

This is Version 2.0 of the document; it incorporates comments from FHWA, as well as input received from users at a ConOps Walk-Through meeting held in Los Angeles, California, on March 6, 2012.

This document follows the Institute of Electrical and Electronics Engineers (IEEE) Standard 1362-1998 Template for ConOps. However, not all sections/headings included in the standard are relevant for FRATIS. A list of ConOps elements excluded from the FRATIS ConOps is provided below, with justification for each.

ConOps Element	Reason for Exclusion
Operational Policies and Constraints (Current System)	Not applicable since there is no current system.
Modes of Operation (Current System)	Not applicable since there is no current system.
User Classes (Current System)	Included in Section 2.3, Profiles of User Classes.
Organizational Structure (Current System)	Not applicable since there is no current system.
Interactions among User Classes (Current System)	Included in Section 2.3, Profiles of User Classes.
Support Environment (Current System)	Not applicable since there is no current system.
Changes Considered, but not Included	All user survey and IFTWG meeting recommendations are included in the ConOps.

Motor carrier enforcement operations are not addressed in this ConOps since those functions are being addressed separately under other U.S. DOT programs.

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1.0 Scope

1.1 Identification

Project Title	Concept of Operations and Functional Requirements for Freight Advanced Traveler Information System (FRATIS)
Period of Performance	July 1, 2011 to May 30, 2012

1.2 Document Overview

This document provides a Concept of Operations (ConOps) for a Freight Advanced Traveler Information System (FRATIS). The ConOps is intended as a foundational document for communicating the user needs and system requirements for FRATIS to system developers. Systems engineers will use the ConOps to develop detailed technical specifications that meet the user needs defined herein.

The remainder of this document is organized as follows:

- **Section 2.0 –** Current Situation describes the situation that has motivated the development of FRATIS;
- **Section 3.0 –** Justification for and Nature of Changes outlines the deficiencies of the existing situation and the benefits of the proposed new system;
- **Section 4.0 –** Concepts for the Proposed System is a high-level description of the proposed FRATIS, which would result from making the desired changes;
- **Section 5.0 –** Operational Scenarios contains narrative descriptions of the step-by-step process by which the system could operate and interact with users and external interfaces under given sets of circumstances;
- **Section 6.0 –** Summary of Impacts analyzes the impacts of the proposed system on users, developers, and support and maintenance organizations during operations, development, and installation of the new system;
- **Section 7.0 –** Analysis of Proposed System summarizes the benefits, limitations, advantages, disadvantages, and alternatives/tradeoffs considered; and
- **Section 8.0 –** Notes provides general background information not covered previously, and a list of acronyms/abbreviations.

1.3 System Overview

Objective

The FHWA wishes to develop freight-specific technology applications to improve freight operational efficiency. While there are many advanced traveler information systems (ATIS)[1] geared towards passenger travel, freight has unique operational characteristics that require different data and methods/timeframes of information delivery.
More specifically, the FHWA wishes to develop two FRATIS application "bundles" as follows:

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 the development of user needs for this project. The application will leverage existing data in the public domain, as well as emerging private sector applications, to provide benefits to both sectors.
2. Intermodal Drayage Operations Optimization – This application bundle will combine container load matching and freight information exchange systems to fully optimize drayage operations, thereby, minimizing bobtails/dry runs and wasted miles and spreading out truck arrivals at intermodal terminals throughout the day. These improvements would lead to corresponding benefits in terms of air quality and traffic congestion.

While the above are envisioned as separate application bundles, note that drayage optimization will be fully integrated with Freight-Specific Dynamic Travel Planning and Performance.

To support these application bundles, the FRATIS system will need to integrate data from multiple sources, as illustrated in Figure 1.1 below. Overseen by a regional public-private partnership, FRATIS will pull data from various sources using web services and/or application programming interfaces (API). Note that at this early stage, FRATIS is envisioned as a regional/urban system (rather than a national one, due to the significant disparities between available ITS and freight data among regions. Data sources include:

- Regional ITS data – Such as real-time freeway/arterial speeds and traffic volumes, incident data, truck parking locations and availability, and route restrictions;
- Truck movement data from third parties – Such as truck speeds and position data from Global Positioning System (GPS) devices in trucks;
- Intermodal terminal data – Including real-time queue lengths and container availability updates; and
- Future U.S. Department of Transportation (DOT) Connected Vehicle data – This would include data outputs expected from the U.S. DOT Connected Vehicle program, such as road-level weather information and probe data from Vehicle-to-Infrastructure and Vehicle-to-Vehicle technologies currently under development.

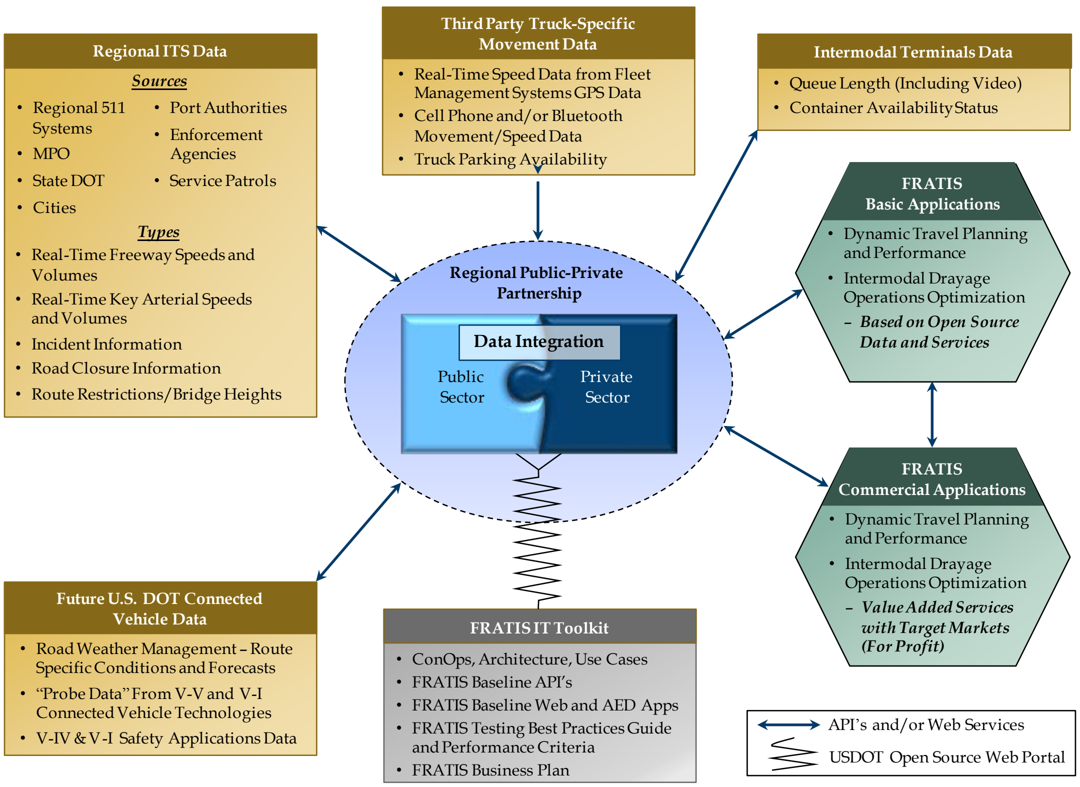
FRATIS would consist of two basic application packages (see right side of Figure 1.1). The first would be basic applications, developed from open-source data and services, and available in the public

[1] ATIS automatically integrate travel data and traffic information from a number of sources and distribute it to users through multiple modes of communication. Examples include 511 telephone systems and web sites, interactive traffic maps, and changeable message signs.

realm. The second would consist of "value-added" commercial applications, targeted towards specific user groups who would subscribe to the service for a fee.

An Information Technology (IT) Toolkit, comprised of background documentation including this ConOps and baseline APIs and web applications, would allow public and private application developers to create the FRATIS applications.

Figure 1-1. Proposed High-Level FRATIS System Concept



Source: Cambridge Systematics, Inc., August 2012.
Note: A larger version of this figure is provided in Section 4.5.1.

It should be noted here that much of the data required for FRATIS will come from secondary sources/users, as detailed in Table 1.1. The primary users of FRATIS (as detailed later in this document) will be trucking company dispatchers/operations managers and truck drivers.

Table 1-1. Secondary Data Sources/Users and Data Provided

Data Source/User Group	Data Provided
Marine and Rail Terminal Operators	Queue information, container status, operational alerts (inside the terminal gates)
State DOTs	Construction information, OSOW routing/permitting, real-time traffic, incidents, emergency information, parking availability
MPOs, Regional 511, Cities	Real-time traffic, road closures, incidents, parking availability
Beneficial Cargo Owners	Container delivery appointments, empty container release and loaded container availability data
Trucking Services Buyers	Timing of deliveries

Stakeholders

The stakeholders for FRATIS and their roles are listed in Table 1.2.

Table 1-2. FRATIS Stakeholders and Key Roles

Stakeholder	Roles
FHWA	Research sponsor; overall project coordination; future data provider
Private Travel Data Providers	Provide advanced location-based data feeds (e.g., truck routing, traffic conditions, incident information)
Local/Regional Travel Information Systems	Provide additional data feeds, such as incident clearance times; potential test bed sites; transportation system performance measurement
State Departments of Transportation	Provide additional data feeds, such as construction information; secondary system users, e.g., for performance measurement
Drivers and Dispatchers	Primary system users – receive and act upon integrated FRATIS data packets
Logistics Intermediaries	System users – carriers, third-party logistics (3PL), customs brokers, etc. May also provide data (e.g., truck GPS probe information)
Intermodal Terminals	Provide data feeds on terminal operations, such as queue length/time and container availability
Fleet Management and Routing System Vendors	Provide satellite tracking systems to support fleet management; provide pre-trip planning routing, and in some cases, dynamic real-time routing
FRATIS Regional Public-Private Partnership	Build, test, operate, and maintain FRATIS system

1.4 Referenced Documents

FHWA, *Request for Technical Proposals (RFTP) No. 2011-04: Concept of Operations (ConOps) and Functional Requirements for Freight Advanced Traveler Information System (FRATIS).*

Cambridge Systematics, *Concept of Operations (ConOps) and Functional Requirements for Freight Advanced Traveler Information System (FRATIS),* Technical Proposal in response to RFTP No. 2011-04.

IEEE standard 1362-1998, Template for Concept of Operations.

StarTran (City of Lincoln, Nebraska), *StarTran Automated Vehicle Location System Concept of Operations,* November 2005.

FHWA, *FRATIS Concept of Operations: Assessment of Relevant Prior and Ongoing Research and Industry Practices,* draft document dated December 23, 2011.

Cambridge Systematics, *User Requirements and ConOps Development Workshop (FRATIS Post-Chartering Session),* presentation delivered February 9, 2012.

2.0 Current Situation

2.1 Background, Objectives, and Scope

Freight routing, scheduling, and dispatch decisions are sometimes made in an ad-hoc fashion, with inadequate data to make a fully informed decision. This is particularly the case for small- to medium-sized firms that may not be able to invest as much in IT as larger companies. This category includes many drayage operators and over-the-road haulers.

The U.S. DOT is therefore engaged in new research to leverage existing and emerging data sources and connected vehicle applications that will improve freight efficiency and environmental performance while mitigating regional traffic problems. A fundamental first step in this effort is to assess the existing processes that impact the movement of freight. This section describes the existing situation as it relates to intermodal freight operations (i.e., the data currently available to support private sector decision-making, current use of technology, and primary/secondary user classes).

2.2 Description of Current Situation

Data Currently Available

Various resources exist which can help with dispatch and routing decisions, but they are of varying coverage and quality and do not always provide freight-specific information. For example, regional 511 travel information systems are almost always designed with passengers in mind, and typically do not contain information relevant for freight operations, such as queue times at marine or rail terminal gates.

Congestion and travel time data are frequently unavailable for non-freeway arterials that are frequented by trucks. Smartphone-based dynamic routing capabilities exist in the private marketplace, but typically do not account for certain route restrictions germane to freight, such as low bridge clearances, posted weights, and tight turning radii. Some firms employ fleet management software packages, which include features like GPS truck tracking, but the position records are not always updated frequently enough to enable 'real-time' decision-making, and may not be integrated fully with load availability functions that would enable better load matching.

Due to a lack of dynamic data on intermodal terminal operations, drayage truckers tend to rely heavily on terminal web sites, which are provided by many terminal operators. However, this information is generally not condition-based, only provides basic status information (e.g., a certain area of the terminal will be out of service on a certain date/time), is not dynamic, and is not published in a way that would allow it to be electronically transmitted to another system. Terminals frequently offer webcams with views of the terminal gates; however, it is hard to deduce anything from the cameras other than a general idea of whether there are a lot of trucks in line, or not so many. Estimates of waiting time are not provided. Trucking companies with movements at several terminals will need to view several web sites for individual terminal information. Moreover, the reliability of information provided by any one terminal is generally not known, although it is likely that many drivers and dispatchers have a sense of accuracy through experience.

For rail terminals, there is virtually no data or information available regarding queue times. Some information is available for container location within terminals, which can reduce driver time to find the container, but in many respects, rail terminals have even less information available than marine terminals. Generally rail terminals have less traffic volume, and have traditionally been more responsive to customer pressure and complaints about queue lines, so consequently time in line is usually shorter at the rail terminals. But significant backups do occur there as well, from time to time.

Route-specific weather information is generally unavailable to either drayage or long-distance truck drivers; even if it is, it may not provide data germane to freight operations, such as high cross-winds or icy road conditions.

Additionally, it is important to note that regional travel information systems may be of limited use to long-haul or less-than-truckload operators traversing longer distances that cross multiple regions. In addition to a general lack of relevant data, the data sources that do exist are not always readily available at the roadside or on mobile devices, complicating access for owner operators that cannot rely on a centralized dispatch operation to filter through and disseminate the data.

Table 2.1 lists the different types of data that are available, along with current sources. Applicable standards are listed where known.

Table 2-1. Current Data Sources for Freight Operations

Data Type	Sources	Applicable Standards
Traffic Sensor Data	State and local traffic management centers Private providers such as INRIX, TomTom, NAVTEQ, ClearChannel, or TrafficCast Highway loops Commercial vehicle information systems and networks (CVISN) Ramp metering devices Traffic signal controllers Technology to identify/measure truck queuesTransit automated vehicle locator (AVL) data Vehicle location/travel data from Radio Frequency Identification (RFID) toll tags and license plate readers	Traffic Management Data Dictionary American National Standards Institute (ANSI) X12 Electronic Data Interchange (EDI) Extensible Markup Language (XML) Universal Traffic Data Format
Incident/event reports	State and local traffic management centers Private providers, such as INRIX, TomTom, NAVTEQ, ClearChannel, or TrafficCast Manual agency reports on events, incidents, and construction	Traffic Management Data Dictionary Universal Traffic Data Format

Data Type	Sources	Applicable Standards
Images	State and local traffic management centers Private providers, such as INRIX, TomTom, NAVTEQ, ClearChannel, TrafficCast, TrafficLand, or Traffic Vizzion Port terminal web cams	Traffic Management Data Dictionary American National Standards Institute (ANSI) X12 Electronic Data Interchange (EDI)
Road/Environmental Sensor Station Data	State and local traffic management centers Private providers such as INRIX, TomTom, NAVTEQ, ClearChannel, TrafficCast, TrafficLand, or Traffic Vizzion National Oceanic and Atmospheric Administration, National Weather Service Atmospheric readings Surface/pavement conditions	Traffic Management Data Dictionary Keyhole Markup Language American National Standards Institute (ANSI) X12 Electronic Data Interchange (EDI) Extensible Markup Language (XML) Universal Traffic Data Format
Parking Data	Private sources, including Parking Data Ventures, ParkingCarma, Parking in Motion, Parkopedia, Streetline	American National Standards Institute (ANSI) X12 Electronic Data Interchange (EDI)
Terminal Data	Marine and rail terminal web sites (examples include http://www.ssamarine.com/locations/pacificSW/terminal_a.asp, http://www.lbcti.com/) Railroads and ocean carriers Truck dispatch platforms, such as Profit Tools and Trinium Chassis movements Airport/seaport terminal systems	American National Standards Institute (ANSI) X12 Electronic Data Interchange (EDI) Extensible Markup Language (XML)
Load Matching and Shipment Information	Shippers/receivers 3PL firms Load matching sites (e.g., www.loadmatch.com)	American National Standards Institute (ANSI) X12 Electronic Data Interchange (EDI) Extensible Markup Language (XML)
Truck Movement Data	Truck GPS probes Location-enabled cell phones	n/a

Note: Data sources that have been excluded are Customs/security information (because it is hard to obtain) and enforcement data (it is treated separately under the Smart Roadside program).

As the table demonstrates, some data are publicly available, but other critical data – such as terminal information – are controlled by private firms. Most operators, especially smaller ones, do not have access to all of this information in one place. There is currently no system in place that can pull together data from disparate sources, and present a more comprehensive and valuable view of the time and traffic conditions for a particular trip. Integrated information about intermodal freight shipments – such as ship/train arrivals, truck movements, chassis availability, empty containers, and load availability – would therefore benefit private firms that move freight by enabling them to better pre-plan trips and dynamically manage trips in progress.

Current Use of Technology in the Industry

There are different levels of technology penetration and use in the goods movement industry today. Surveys conducted by the project team reveal that 39 percent of drayage trucking companies do not use technology-based travel information systems because of a lack of accurate information and inconsistency among sources. The remaining 61 percent of respondents do use technology, but they note significant gaps in terms of coverage (e.g., no information about conditions on arterial streets) and quality (inconsistency between sources, accuracy/timeliness issues).

Use of technology-based traveler information is slightly higher for long-haul truck fleets; however 29 percent of those respondents don't use such systems either, also because of inadequate accuracy. Long-haul respondents who do use technology cite freeway condition information as the most common information gap. Timeliness of information is the most common problem with the data that are available.

The same survey found that 86 percent of drayage companies attempt to match loads (i.e., avoid unproductive dry runs by matching empty containers with available loads). However, there is no universal source of load-matching opportunities; operators use brokers, Internet load boards, telephone calls, e mails, software applications, and manual methods to match loads.[2]

Conclusions

Logistics intermediaries make decisions using a patchwork of information sources, some public and some private, but none offering a complete packet of actionable intelligence. This lack of real-time data contributes to operational inefficiencies, including unproductive bobtail moves, wasted fuel, and increased emissions. Public agencies, for their part, are unable to comprehensively monitor the performance of the transportation network as it pertains to goods movement.

2.3. Profiles of User Classes

The primary user groups for FRATIS can be categorized as follows:

- Trucking Company Dispatchers and Operations Managers responsible for planning trips and maintaining communications with truck drivers; and
- Truck Drivers responsible for picking up, transporting, and delivering the container/freight.

Profiles of these two user classes are provided below. Note that truck owner-operators may encompass both user groups.

[2] Note that the purpose of FRATIS is not to take over load matching or otherwise compete with the private sector; rather, FHWA is conducting research to enhance the concept and facilitate private sector integration of load matching services with freight traveler information and drayage optimization functions as part of a larger FRATIS system.

Dispatchers and Operations Managers

Dispatchers and operations managers have access to the widest array of information sources. From a desktop computer, they can access 511 phone systems and web sites; digital maps with traffic information (e.g., Google Maps); traffic camera feeds; weather reports; and other resources. They can also access any proprietary systems they use, such as vehicle tracking/fleet management software. Dispatchers and operations managers can communicate with drivers in many ways, including two-way radio (CB), cell phone, Short Message Service (SMS) text, and mobile computing platforms in the truck. Dispatchers and operations managers may also use tablet computers or smartphones for fleet tracking, load status updating, and communication with drivers in the field.

Dispatchers and operations managers require information from various other supply chain actors, including terminal operators, shippers/receivers, other carriers, and 3PLs to fulfill their responsibilities. This data can be obtained in an automated fashion if the appropriate systems are in place to do so – which is dependent not only on the trucking company's IT infrastructure, but also on that of its supply chain partners. Otherwise, it must be obtained manually, for instance, by calling a customer loading dock to inquire about the status of a container for pickup.

Dispatchers and operations managers also typically coordinate any permitting activities, such as oversize overweight (OSOW) permits. This has to be done on a state-by-state basis since the specific rules, regulations, and procedures vary by state. Some states have web-based 'kiosks', where companies can enter information, receive/plan a route, and pay fees all in one place. In other states, the process is more manual and requires review by state permitting staff, and perhaps coordination with other DOT departments.

Truck Drivers

Truck drivers interact with the existing systems/processes in a more limited fashion because of regulatory restrictions on what they can do while operating a truck. At a minimum, drivers will almost always have a CB radio (or other two-way radio such as Sprint-Nextel) and a cell phone for communication with other drivers and with dispatchers. Cell phones typically have texting capability, which can be used for sending status updates (e.g., hooks, drops), to dispatch in real time, although drivers are prohibited by law from texting while driving. Dispatchers can also text load availability information to drivers in the field. This information can also be relayed by cell phone, although this introduces the possibility of transcription errors or other miscommunication. Some devices have text to speech (TTS) capability which would alleviate this problem.

If drivers have a smartphone, they can use it to access 511 phone and web services and location-based traffic and routing services, such as Google Maps, INRIX, or NAVTEQ, for current traffic conditions and recommended routes (some services require a subscription). It could also be used to access weather conditions and forecasts along their planned route.

Some fleets are equipped with mobile computing platforms (MCP) for fleet management, so drivers may have a computer terminal in the cab, which can provide routing instructions via GPS, as well as other functions like hours of service monitoring and two-way communications with dispatch. However, these systems are expensive and tend to be limited to large long-distance trucking companies. Drayage firms and small- to medium-sized long-haul carriers, which tend to have lower returns to capital, often cannot afford to invest in these systems. However, many of these smaller companies are now deploying fleet management systems, as the costs of these systems has been trending downwards.

2.4. Other Involved Personnel

There are several other entities that may have some system capabilities to be able to transmit data related to appointments, pickup and delivery requirements, load/empty availability status, and drayage sequence direction; and could be incorporated into a systematic view or solution for a traveler information system or a drayage optimization system. Government agencies will also interact with the system for performance monitoring and regulatory purposes. These entities are described below.[3]

Transportation System Operators

Operations staffs at state DOTs, regional metropolitan planning organizations (MPO), and transportation management centers (TMC) are responsible for the day-to-day management of traffic operations in their regions. These entities typically do not interact directly with truck drivers or dispatchers/operations managers. However, drivers and dispatchers may use resources provided by these agencies (such as web or telephone 511) to assist with daily operations planning. TMC operators would be interested in any freight-specific data that could enhance their product offerings, such as conditions at rail/marine terminals or events reported by freight users. DOTs and MPOs also use available data on freight movement for transportation planning purposes. For example, a state DOT could use FRATIS data on truck movements/volumes to support a freight needs study. Data provided by truckers could also support incident response and recovery activities. Agencies are also interested in transportation performance measurement to track progress towards policy and operational goals. As currently envisioned, FRATIS would have a performance monitoring application, which will provide benefits to agencies in terms of system management, as well as an incentive to provide data.

Enforcement Personnel

State DOTs typically cooperate with their state's highway patrol or police force to enforce regulations concerning the movement of freight. These include weight restrictions, safety checks, payment of taxes, and hours of service (HOS) enforcement. HOS rules are Federally mandated so they are the same in all states, but taxes, safety inspections, and OSOW enforcement vary by state. Enforcement of applicable route restrictions, often for OSOW loads, but also for conventional loads that may exceed height or weight restrictions, is also typically conducted by enforcement personnel. If FRATIS is to include any type of automated permitting or routing function for OSOW loads, it would have to coordinate/interact with appropriate enforcement staff.

Ocean Carriers

Ocean carriers are the primary means by which international containerized freight arrives in the U.S. and therefore influence the volume and timing of container movements. Ocean carriers are also sometimes responsible for providing delivery of a loaded container to a customer's door to fulfill the terms of a shipping agreement. These shipments are commonly referred to as "door deliveries."

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[3] In addition to the parties listed, personnel would be required to set up, operate/maintain, and administer a regional FRATIS system. These personnel would depend on the structure of the regional FRATIS public-private partnership and therefore cannot be identified in advance. However, it is anticipated that these resources would be mostly provided by public sector staff since it is unlikely private firms would do this on their own.

Beneficial Cargo Owners

Beneficial cargo owners include distribution centers, warehouses, and other intermediate locations. Often these beneficial cargo owners are distinct from the shipper or freight forwarder, and do not control the trucking portion of the shipment, but certainly will control the appointment. They also control the method of delivery – whether the driver stays with a container while it is unloaded, or whether he drops the load and returns at a later time to pick up the container, or whether he can drop his load and pull an available empty from the premises. A lot of this is dictated by the size of the facility; for example, if they have the space to store the goods on site or if they need the container for storage. Beneficial cargo owners also control the information about empty container release, that is, notification that a container is empty and ready to be pulled. Likewise, if the facility is loading containers, they would be the initiators of information about when those containers are loaded and ready for pickup. These pieces of information are all relevant to a drayage optimization strategy.

Terminal Operators

Terminal operators control a large piece of the container movement: the ship-to-truck or rail-to-truck transfer. This naturally impacts drivers who may go into a terminal several times in a single day.

Trucking Services Buyers

This category may include ocean carriers, shippers, freight forwarders, or railroads, all of whom control the timing of deliveries, either by day of the week and/or time of day.

Other Government Agencies

Other government entities, besides those directly engaged in transportation policy and management, may also be interested in FRATIS. For example, an economic development agency promoting a new industrial park could use FRATIS to illustrate the performance and management of the regional transportation network to potential new tenants. This information would be a selling point to lure new businesses to the region.

3.0 Justification for and Nature of Changes

This section outlines the problems associated with the current situation, and the desired capabilities that are motivating the development of FRATIS.

3.1 Justification for Changes

As discussed previously, the FHWA seeks to improve the efficiency of freight transportation through the use of technology. This improvement will provide benefits to the private sector in terms of efficiency/profitability, and to the public sector in terms of congestion reduction and improvements in air quality. Although there are many public and private sources of data and information relevant for freight scheduling, routing, and dispatch, there is no single information portal tying it all together. Moreover, the data vary considerably in terms of coverage and quality.

Deficiencies of the Existing Situation

More than 300 private sector trucking companies responded to a survey designed to gauge deficiencies in the current system and user needs for an improved freight travel information system. Respondents primarily represented drayage firms, rather than long-distance truckers (though responses have also been gathered from some over-the-road haulers). Survey respondents were geographically distributed throughout the country, with the most responses coming from larger states such as Texas, California, and Illinois. Respondents represented a mix of terminal managers, dispatchers, and others such as president or company owner. Eighty percent of the responding firms had less than 40 drivers, which represents a trucking demographic that is less likely to have sophisticated technology to aid in routing and scheduling.

The surveys highlighted several key deficiencies with existing freight traveler information:

- Of the respondents, 39 percent reported that they do not use technology-based travel information systems for a variety of reasons. The number one reason is a lack of accurate information. Other issues include inconsistency among sources and poor coverage of freight terminals. This indicates that information quality and coverage are important deficiencies of the current situation that should be addressed with the new FRATIS system. Another reason given for not using technology was simply a lack of awareness of the availability of such tools. This suggests that some effort to make the drayage community aware of the system would improve its use and acceptance.
- Respondents who were users of travel information technology were asked what specific gaps in coverage and information exist. Key coverage gaps in order of importance are terminal information, freeway conditions, and conditions on arterial streets. Inconsistency of sources was the most important data gap, followed by

accuracy and timeliness of data which tied for second place. These results are very similar to those reported by nontechnology users, indicating that the overall deficiencies of the existing system are similar for both groups.

- The matching of empty containers to available loads is currently done in a number of ways, but it is complicated by two key factors. First, the new Compliance, Safety, Accountability (CSA) regulations being promulgated by the Federal Motor Carrier Safety Administration (FMCSA) have become a screening tool for shippers to select "allowed" carriers based on their CSA safety ratings. This means that customers may not allow their freight to be moved by a certain carrier, even if that carrier is the first available to pick up a load. Second, accurate and timely information on empty containers is typically in the hands of receiving warehouses, but they may not provide it to draymen in a way that would enable load matching, and draymen do not want to make a trip only to find out the box is not actually empty and ready for removal. In addition, ocean carrier rules for detention fees typically assess them against the drayage company, upon the return of the container. A movement matching system would require some revision of the rules, or a method of displaying detention charge status when advertising the availability of the empty movement.

Information Content

The survey of drayage companies also assessed the types of information content desired by users for FRATIS:

- **Types of information –** Survey respondents consistently noted the importance of certain types of information they need to make better decisions. These include bottleneck locations with travel times; terminal information (e.g., queue times, turn times); travel times on arterials; travel times on freeways; fastest routing suggestions; weather; and accident/incident data. These are therefore likely to be the kinds of information that need to be acquired and disseminated first.
- **Timeliness and timing of information –** Respondents indicated that traveler information needs to be within 10 minutes of real time for it to be useful in daily operations. This suggests that near real-time data (as opposed to truly real time with zero latency) would be sufficient to realize significant benefits. Most routine traffic data (e.g., freeway conditions, travel times on freeway links, and routing suggestions) can be provided within this time frame. Other data points may or may not meet this criterion. Near real-time terminal information "inside the gates" depends on the quality of information available from terminal operators (and also their willingness to release it); arterial travel times are dependent upon the quality of ITS instrumentation in a given corridor. Users also need to receive information both before and during their trip to enable decision-making and exception management on the fly.
- **Delivery of information –** The information delivery needs to be flexible due to the wide range of technical capabilities on the part of users. Survey respondents reported using a wide variety of technologies and devices to retrieve information, including smartphones, web sites, AM/FM radio, CB radio, on-board computers, highway message signs, and terminal camera feeds. Users should be provided a wide range of information, and then be allowed to choose what they would use or subscribe to based on their individual needs. The preference is for roadway conditions information, such as incidents and crashes, to support routing decisions made internally by the company and drivers. It is important that dispatchers receive

the information as well as drivers; dispatchers make 70 percent of daily routing decisions according to the drayage survey.

- **Coverage of information –** Information needs to be provided for all locations relevant to the supply chain. This includes freeways, arterials (arterial truck routes were particularly noted as an information gap), and terminal operations both inside and outside the gates. (This was the number one data coverage gap according to drayage operators.)

3.2 Description of Desired Changes

The desired user needs/system capabilities (as developed from the surveys and Intermodal Freight Technology Working Group (IFTWG) meetings) can be grouped into specific functional areas, as shown in Table 3.1. User needs are ranked according to the following categories:

- **Critical –** The need is a "must-have" and should be considered essential to the successful development of FRATIS;
- **Important –** The need is a "should-have" or desirable capability for which there is considerable interest, but it is not critical to a successful system; and
- **Optional –** The need is "nice-to-have" and may provide extra desirable functionality (these could potentially become add-on features in future system development).

Table 3.1 identifies all of the desired FRATIS capabilities. Not all of these capabilities will necessarily be feasible in a regional deployment, due to data limitations or other factors. Regional deployments will be customized as required during future design and testing phases.

National deployment of FRATIS is not anticipated at this time due to these differences in data availability and formatting. The need for a common data dictionary is acknowledged in order to facilitate such a large-scale implementation.

A detailed description of the IFTWG meeting results and drayage/long-haul trucking surveys from which these user needs were derived is provided in Appendix A.

Table 3-1. FRATIS User Needs and Functional Areas

ID	User Need/Capability	Ranking	Functional Area(s)
1. Designed for areas with significant freight congestion	FRATIS should be implemented in areas with significant freight congestion or for terminals/border regions with routine lengthy truck queues in order to maximize the public and private benefits of the system. It should be designed for both nonrecurrent and recurrent congestion (with historical data).	Critical	Real-Time Reliable Information for Freeways, Port/Terminal Regions, and Major Freight Arterials Planning, Dynamic, and Regulatory Route Guidance Weather Information (Including Predictive) Terminal Queue Status (Including Video) Appointment Status
2. Comprehensive coverage	FRATIS should provide coverage along an entire land-based transportation supply chain (from marine/rail terminal, to warehouse, to customers), in order to cover a key information gap in existing travel information systems.	Critical	Planning, Dynamic, and Regulatory Route Guidance Appointment Status Real-Time Reliable Information for Freeways, Port/Terminal Regions, and Major Freight Arterials Terminal Queue Status (Including Video) Weather Information (Including Predictive) Container Load Matching
3. Roadway functional classifications	The system should provide coverage on most levels of the roadway network including major arterials and freeways so that information is provided on all key freight routes in a region.	Critical	Real-Time Reliable Information for Freeways, Port/Terminal Regions, and Major Freight Arterials
4. Near real-time	FRATIS should be near real time with roadway conditions and terminal/border queues information no more than 10 minutes old to maximize its usefulness to the freight community. Older, and thus less accurate/relevant information, needs to be clearly indicated.	Critical	Real-Time Reliable Information for Freeways, Port/Terminal Regions, and Major Freight Arterials
5. Targeting of information	FRATIS should provide incident and road condition information to drivers and dispatchers so they can make route planning and navigation decisions internally in keeping with prevailing business practices in the industry.	Critical	Planning, Dynamic, and Regulatory Route Guidance
6. Accuracy	FRATIS needs to be designed to avoid pushing out inaccurate information, and should include robust error checking and data cleaning to encourage adoption of the system in the private marketplace.	Critical	Real-Time Reliable Information for Freeways, Port/Terminal Regions, and Major Freight Arterials

ID	User Need/Capability	Ranking	Functional Area(s)
7. Performance measurement	The system should provide performance measures to public agencies for use in transportation planning and management as an incentive for public sector participation as a data provider and to promote better transportation planning and policy.	Critical	Public Sector Data Output – Performance Measures
8. Information content	FRATIS should suggest routing, travel timing, and scheduling for logistics intermediaries so they have a complete data packet for informed decision making.	Important	Real-Time Reliable Information for Freeways, Port/Terminal Regions, and Major Freight Arterials Planning, Dynamic, and Regulatory Route Guidance
9. External linkages – load matching*	FRATIS should be able to link to systems that support load matching for empty containers and chassis in order to maximize Congestion avoidance, air quality, and efficiency benefits.	Important	Container Load Matching
10. Truck parking**	FRATIS needs to provide real-time information about truck parking locations and availability to drivers and dispatchers to improve safety and compliance with hours of service rules.	Important	Real-Time Reliable Information for Freeways, Port/Terminal Regions, and Major Freight Arterials
11. External linkages – dispatch platforms*	FRATIS should link to existing dispatch software platforms to provide a seamless integration with existing dispatch/routing procedures.	Optional	Appointment Status Planning, Dynamic, and Regulatory Route Guidance

* Dependent upon logistics intermediary willingness to permit linkage and data transfer.
** Need was added through consensus opinion at the FRATIS ConOps walkthrough meeting.
Source: Cambridge Systematics analysis of survey data and IFTWG meeting input.

3.3 Priorities Among Changes

Essential Features

Table 3.2 illustrates the features and capabilities of FRATIS that are deemed essential to successful implementation. The table describes impacts to system effectiveness/usefulness if each feature or application is not implemented. Essential features are defined as the application areas associated with the capabilities described in Table 3.1.

Table 3–2. Essential Features for FRATIS

Feature	Impacts if not implemented
Real-Time Reliable Information for Freeways, Port/Terminal Regions, and Major Freight Arterials	Lack of information about key freight corridors would reduce the usefulness of the system to trucking firms. Older (non-real time) information is less accurate, and therefore less useful. Stakeholders will not use the system if they perceive the information to be inaccurate. Drivers and dispatchers would not be able to use the data to exception manage in real time. Truckers who cannot find adequate parking may be forced to stop on the side of the road, or may violate hours of service regulations.
Planning, Dynamic, and Regulatory Route Guidance	Drivers and dispatchers will not be able to reroute around congestion, incidents, or other issues dynamically, reducing system benefits
	Drivers and operations managers would not have information to make informed routing choices, including all legal/regulatory restrictions, which may reduce safety
Weather Information (Including Predictive)	Drivers and operations managers would be unable to effectively plan for adverse weather.
Terminal Queue Status (Including Video)	Lack of data about terminal queues would reduce the usefulness of the system to trucking firms since terminal entry and exit queues can be a significant share of overall trip time for any single movement.
Appointment Status	Without real-time updates on container availability, truckers will not know the best time to arrive at the terminal.
Public Sector Data Output – Performance Measures	Public agencies would be less likely to participate or provide data if they see no direct benefit for them.
Container Load Matching	System will not be able to reduce bobtails significantly without a working load-match function. Chassis and empties will accumulate in certain locations, requiring additional work to balance supply.

Source: Cambridge Systematics analysis of survey data and IFTWG meeting input.

3.4 Assumptions and Constraints

The project team has identified one assumption and two constraints that may impact FRATIS development. These are discussed below.

Assumptions

- **Major metropolitan regions that have large seaports or intermodal rail terminals are the best locations to deploy FRATIS –** The air quality, freight efficiency, and congestion mitigation benefits associated with the FRATIS applications will not be fully realized in areas with little freight activity. Moreover, it is less likely that private firms in areas with modest congestion would be as interested in the applications, which would limit private sector participation.

Constraints

- **Lack of private sector participation –** There is a risk that private sector logistics firms will exhibit limited interest in the FRATIS suite of applications. This was a problem with the Cross-Town Improvement Project (C TIP) evaluation. In that project, it proved difficult to recruit trucking firms in the test of dynamic routing and real-time traffic applications, which limited the size of the test to approximately 10 trucks in Kansas City. The major railroads in the region declined to participate, other than providing data for a simulation. It will be important, therefore, to design FRATIS applications in a way that will enable them to become self-sustaining over the long run, meaning that early and frequent engagement with private freight stakeholders will be needed to build a business case for FRATIS.
- **Open-source application development –** The U.S. DOT has expressed a desire to develop FRATIS in an open-source code environment. While this is certainly desirable from the standpoint of ensuring maximum flexibility during program development, it may make private sector adoption more challenging, compared to an alternate approach of choosing from multiple systems, architectures, applications, and platforms that are already available in the private sector.

4.0 Concepts for the Proposed System

4.1 Background, Objectives, and Scope

This ConOps is intended to serve as the enabling lynchpin that can focus the U.S. DOT Freight DMA effort on a flexible and responsive technology program that works hand-in-hand with the private sector. The transformative foundation of this ConOps is a new way of thinking about how U.S. DOT can:

- Leverage recent and emerging freight mobility information technologies being developed by the private sector related to freight traveler information, dynamic routing, and load matching;
- Integrate these technologies with public sector ITS and sensor information available for roadways in major metropolitan regions; and
- Facilitate public-private deployment of FRATIS applications within very aggressive time constraints not typically associated with Federally-sponsored programs.

Mindful of this transformative foundation, between October 2011 and February 2012, the CS Team implemented five public-private user needs workshops across the nation as part of the annual Intermodal Freight Technology Working Group series of meetings. Through this process, the following high-level principles for the transformative development of FRATIS were developed:

- **Leverage existing data streams.** FRATIS needs to be based on new connections between existing public (e.g., regional ITS) and private sector systems (e.g., terminal queue data). This would be a collaborative "system of systems," which would leverage existing resources rather than building a new system from the ground up. This approach maximizes the return on investment in FRATIS given limited system development resources.
- **Facilitate use of FRATIS on multiple information delivery platforms.** To encourage system adoption and use, travel information from FRATIS needs to be disseminated on a variety of platforms that match with the variety of information sources currently used by stakeholders. This technical concept here should be broad enough to encompass both existing technology platforms (e.g., smartphones and fleet guidance systems) and future platforms (e.g., DSRC 5.9 GHz in-vehicle devices).
- **Regional deployment by a Public-Private Partnership.** FRATIS would best be deployed as a regional solution, based on collaboration between the public and private sectors. U.S. DOT's role should be to provide overall program guidance, best practices, software and tools, with regional DOTs, MPOs, trucking companies, the intermodal freight industry, and mobile technology vendors, partnering to deploy FRATIS within a freight-critical metropolitan region. This should also include a public information program to encourage use of FRATIS.

Based on the user needs (see Section 3.0) developed from the implementation of the IFTWG outreach meetings, and the survey of more than 300 intermodal drayage trucking dispatchers and operators, this ConOps focuses on the following two primary user groups:

1. **Trucking Company Dispatchers and Operations Managers –** These individuals are responsible for planning trips and maintaining communications with truck drivers; and
2. **Truck Drivers –** These individuals are responsible for picking up, transporting, and delivering the container/freight.

Regarding these two user groups, the primary market focus of the ConOps is on intermodal freight local and regional drayage trucking companies and the intermodal terminals they interface with. However, the FRATIS ConOps is also expected to provide benefit for non-containerized, over-the-road, less than truckload, bulk, long-haul, and HAZMAT trucking companies, as well as related freight and logistics services providers.

Based on the user needs effort, and on the potential functionality of FRATIS, the following two primary groupings of functional areas for the ConOps are:

1. **Freight-Specific Dynamic Travel Planning and Performance –** The goal is to encompass, in a series of applications, all of the traveler information, truck parking, dynamic routing and performance monitoring elements identified in the user needs activity. Much of the traveler information and dynamic routing components of this functional grouping already are emerging today in the marketplace with certain providers having already deployed a freight traveler information and routing system that serves multiple trucking fleets. Correspondingly, a number of major metropolitan regions, such as the Greater Los Angeles region and the Miami/South Florida region, have deployed extensive ITS sensor networks and TMCs, and thus provide a constant real-time source for traffic speed and congestion information. The integration of this information has the potential to improve both the public sector traffic information needs, as well as to provide additional benefits and functionality to private sector FRATIS applications by incorporating real-time traffic into the FRATIS data packet. In addition, the inclusion of performance monitoring and specialized freight operations information (e.g., rest-stop locations, OSOW routing, air quality monitoring) will provide additional critical information to both sectors.
2. **Intermodal Drayage Operations Optimization –** The goal is to integrate load matching and freight information exchange systems into an application that could fully optimize drayage information, including reducing bobtails, balancing chassis, and spreading out the traffic arriving at terminals though out the day – thereby resulting in reduced trips, reduced miles, and corresponding improvements in air quality. While web-based container load-matching systems such as Loadmatch.com are in high use today, what is missing is the connection to the container and chassis availability/information maintained by railroad terminals and steamship line terminals. This functional FRATIS grouping focuses on providing these linkages, and would facilitate seamless information availability among all intermodal parties including current drayage truck load matching and container availability and appointment scheduling at railroad and steamship line terminals.

With regards to the two primary user groups, the ConOps is focused on the following two primary Information Dissemination Methods/User Interfaces:

1. For Trucking Company Dispatchers and Operations Managers, the primary FRATIS information dissemination method will be accomplished electronically over the Internet. The

dispatcher or trucking operations manager could likely be expected to access all FRATIS applications/functionality from a PC or tablet device.

2. For Truck Drivers, the primary FRATIS information dissemination method will be through an Application Enabled Device (AED).[4] The mobile (e.g., smartphone) or in-vehicle (e.g., DSRC 5.9 device) AED would provide visual FRATIS application interfaces for the driver to access when the truck is not moving, and audible-only FRATIS application interfaces for the driver to access when the vehicle is moving.

4.2 Operational Policies and Constraints

Policies

FRATIS will operate based on information sharing, data integration and application development between public sector ITS operators and private sector freight traveler information service operators. The driving force behind the public-private nature of FRATIS is the significant freight congestion, freight logistics, air quality, and other issues associated with major U.S. metropolitan regions. The regions both create the problem set that U.S. DOT and MPOs are interested in solving, and also create a sizable FRATIS services market for private sector companies. Some operational policies warrant high-level consideration at this juncture are:

- **U.S. DOT Open Source Portal.** FRATIS will be developed and be deployed in a region consistent with guidelines established for the U.S. DOT open source portal environment, which are currently under development. These guidelines are expected to enhance public-private collaboration on transportation IT projects through open systems approaches.
- **Federal/state policies for data protection.** There are certain legal requirements for the protection of data provided by firms and individuals to public agencies. These rules vary from state to state, and there are additional Federal requirements. FRATIS will observe all applicable data protection regulations during system development, testing, and implementation.
- **Driver distraction laws.** Driver distraction is a major concern of U.S. DOT, and various laws relating to driver distraction exist in many states. All FRATIS applications will be designed in a fashion that prevents potential safety hazards from distracted driving. There will be an appropriate "lockdown mode" for all in-cab devices which prevents their use while a truck is in motion. Notifications will be provided in a format that does not require the driver to take his or her eyes off the road.

Constraints

The following summarizes key operational constraints for FRATIS deployment and operations:

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[4] The term "Application Enabled Device" or "AED" is defined here in the context of FRATIS to be a device deployed either in a truck or mobile with a driver that can access wireless information and process open-source applications, such as Droid, iPhone, DSRC 5.9 GHz devices, applicable COTS fleet management tracking/info systems, etc. In the FRATIS context, the AED includes a 'lockdown mode" to be compliant with recent/emerging state and Federal driver distraction laws or guidelines.

- **Metropolitan Regional-Level Focus –** For two reasons, FRATIS should be deployed on a regional basis. First, based on the findings from the User Needs assessment, the primary target market for FRATIS applications is local and regional intermodal trucking drayage carriers, with a secondary market being small- and medium-sized local and regional truck carriers (non-intermodal). Secondly, the public sector information sources that will be utilized and integrated into FRATIS by the private sector vary vastly between major metropolitan regions in the U.S., and even within some states.
- **Public-Private Partnership Focus –** By its nature, for the FRATIS concept to succeed, public and private sector freight movement and other data will need to be integrated and managed so as to support the specific data needs of the FRATIS applications. This will require organized cooperation between public sector organizations (e.g., MPOs, DOTs, cities) and private sector companies, which are expected to deploy applications based on FRATIS.
- **Geographic coverage –** In a given metropolitan region, it would be unreasonable to expect that every single possible route that could be used by a truck would have real-time information available to it; FRATIS will need to focus primarily on critical and major freight freeways, arterials and intermodal connectors.

The operational capabilities of FRATIS in a given region will thus be constrained by the data sharing/integration framework that is utilized by the public and private sector. Legal Agreements, Memorandums of Understanding, and Private Sector Return of Investment (ROI) will all need to be addressed by regional data sharing/integration frameworks.

4.3 Description of CONOPS Essential Features, Capabilities and Functions

This section describes the proposed system that results from implementing the previously discussed changes and identified user needs. The proposed system's description is provided in a high-level manner, indicating the operational features/functionalities to be provided without specifying design details or technology-specific solutions.

4.3.1 Real-Time Reliable Information for Freeways, Port/Terminal Regions, and Major Freight Arterials

Essential Function: Real-Time Reliable Information for Freeways, Port/Terminal Regions, and Major Freight Arterials

For the given region it is deployed in, the FRATIS system shall provide real-time information on the freeways, port and terminal intermodal connectors, and major freight arterials. This information will include travel volumes, speeds, point-to-point travel time predictive information, incident information (including clearance estimation), construction information, extended arterial outages, event traffic, truck parking locations and availability, and other information to be determined in the FRATIS development phase. Information shall be displayed in a visual manner conducive to rapid comprehension of travel conditions by dispatchers, as well as audible alerts for drivers. "Real time" shall be defined as information that is not more than 10-minutes old, with 3 to 5 minutes being the desired goal. Reliability measures for the traffic data shall be calculated, and the reliability shall be continually assessed, consistent with the FHWA Office of Operations travel time reliability guidance (see: http://ops.fhwa.dot.gov/publications/tt_reliability/).

4.3.2 Planning, Dynamic, and Regulatory Route Guidance

Essential Function: Preplanning Regional Truck Trips

The FRATIS system will provide the dispatcher or truck driver with an electronic capability of preplanning truck route(s) based on both historical and real-time ITS information available for the region. This requires the ability for a traveler information application resident with the user to be able to access regional ITS systems, and for automated calculation of the most promising route choices to be presented visually to the user. The system shall take into account truck-specific constraints, such as route restrictions, bridge heights, and preferred freeway access paths for trucks.

Essential Function: Congestion Avoidance Dynamic Routing of Trucks

The FRATIS system will provide the dispatcher or truck driver with an electronic capability in real time of avoiding congestion that the system has identified along the truck's current route. This requires two main functions: 1) the ability of the system to continually monitor congestion and incidents on the truck's current/preplanned route; and 2) the ability of the system to calculate and recommend to the dispatcher/operations manager alternate routing to complete the trip, such as to avoid the congestion. Information shall be displayed in a visual manner conducive to rapid comprehension of the dynamic routing choices by dispatchers, as well as audible choices and information for drivers.

Essential Function: Automated Routing and Permitting for OSOW Trucks

Based on user entry inputs from the dispatcher or truck driver, the FRATIS system will provide a legal route for the OSOW vehicle. This requires the ability of FRATIS to link with state and local jurisdictions, and process automated permits for the route based on the OSOW criteria entered by the dispatcher/driver. Note that this function will be constrained based on the region that FRATIS is deployed in – there must be the capability for the state and local jurisdictions to allow for automated permitting.

4.3.3 Weather Information (including Predictive)

Essential Function: Real-Time Route-Specific Weather Conditions and Forecasting

For a given FRATIS programmed route, the FRATIS system will provide dispatchers and drivers both current weather information and forecasted weather information in near-real time (defined as 20 minutes or less). The current information will include temperature, sky condition, precipitation information, humidity levels, and weather-related pavement condition. The forecasted information will include the same categories, and will be timed to include the duration of the trip, which may also include a potential return along the same route. As the type of weather information required varies significantly across the United States, dispatchers and drivers will have the ability to tailor a "weather profile" so that FRATIS can provide the type of specific information required by the users (e.g., Tornado Alerts for Oklahoma; Hurricane Warning for Florida). Information shall be displayed in a visual manner conducive to rapid comprehension of the weather information by dispatchers, as well as audible information or alerts for drivers.

4.3.4 Terminal Queue Status (including Video)

Essential Function: Real-Time Information on Length and Wait Times for Truck Queues at Freight Terminals

FRATIS shall provide drivers and dispatcher with both intermodal terminal queue length, and estimated time from the back of the queue to the gate. This information will be provided: 1) visually to the dispatcher, including video feeds of the terminal queue, with text information also provided; and 2) in the form of audible alerts to drivers based on their approach to a terminal and/or their user profiles concerning the terminals they most often use.

4.3.5 Appointment Status

Essential Function: Real-Time Information on Container Status and/or Pickup/Delivery Appointments at Intermodal Terminals

At a minimum, FRATIS will provide information to the dispatcher and driver concerning the availability status of a container available for pickup. For terminals that support appointments for pickup and delivery of containers, FRATIS will link to the terminal reservation system and integrate the appointment functions of FRATIS with the Terminal Queue Status and Load Matching FRATIS applications. Note that additional research of this functionality is currently being conducted by Cambridge Systematics on the Gateway Cities ITS project in Southern California.

4.3.6 Public Sector Data Output – Performance Measures

Essential Function: FRATIS Open-Source Data Feed to Public Sector Agencies to Assist in Freight Transportation Performance Measurement

FRATIS shall provide a specialized output interface to public sector agencies that will provide open-source data collected in the FRATIS system, such as sanitized route, speed, congestion, and alternate route selection information. This information shall support public sector freight planners and other public agencies in assessing both the needs and impacts of truck traffic in a metropolitan region (e.g., air quality reductions due to FRATIS applications, assessment of the best alternate routes, and information on where to potentially plan new connectors to support better dynamic routing). The format of the public sector output data shall be determined during the FRATIS System Development and Limited Testing phase.

4.3.7 Container Load Matching

Essential Function: Container Load-Matching with Trucks to Support Reductions of Empty Container at Intermodal Terminals

FRATIS will provide enhanced load-matching services to dispatchers and truck drivers that will incorporate connections to terminal information systems, which is not typically available today. This will require several sets of communications to occur among FRATIS, the trucking companies, and the terminal operators. First, the terminal operations system shall inform the FRATIS system every time a loaded container leaves the terminal behind a truck. Based on this information, the FRATIS system would then electronically notify that trucking company to confirm if the container is destined to stay empty following unloading. Following this step, if the response from the truck company is affirmative, then FRATIS will match the truck/container to a load going back to the terminal (assuming the container is in reloadable condition, the driver has enough hours of service to get another load, the reload pays enough money that the reload is worth picking up, and the company paying for reload will actually pay). The user interface for the FRATIS container load-matching functionality shall be provided in detail in a visual information exchange format for dispatchers (and for stationary truck drivers); an audible solution for drivers may not be possible here due to the complexity of load-matching. It is important to note here that FRATIS loadmatching is expected to be accomplished partly through connectivity with existing private sector electronic loadmatching systems.

4.3.8 Traceability of Essential FRATIS Functions to User Needs

The essential functions for each functional areas described in subsections 4.3.1 to 4.3.7 trace back to the user needs identified in Section 3.0, as shown in Table 4.1.

Table 4–1. Traceability of Essential FRATIS Functions to User Needs

User Need ID	User Need Description	Essential FRATIS Function(s)
1. Designed for areas with significant freight congestion	FRATIS should be implemented in areas with significant freight congestion or for terminals/border regions with routine lengthy truck queues in order to maximize the public and private benefits of the system. It should be designed for both nonrecurrent and recurrent congestion (with historical data).	Real-Time Reliable Information for Freeways, Port/Terminal Regions, and Major Freight Arterials Preplanning Regional Truck Trips Congestion Avoidance Dynamic Routing for Trucks Real-Time Route-Specific Weather Conditions and Forecasting Real-Time Information on Length and Wait Times for Truck Queues at Freight Terminals
2. Comprehensive coverage	FRATIS should provide coverage along an entire land-based transportation supply chain (from marine/rail terminal, to warehouse, to customers), in order to cover a key information gap in existing travel information systems.	Real-Time Reliable Information for Freeways, Port/Terminal Regions, and Major Freight Arterials Real-Time Information on Length and Wait Times for Truck Queues at Freight Terminals Real-Time Information on Container Status and/or Pickup/Delivery Appointments at Intermodal Terminals Container Load-Matching with Trucks to Support Reductions of Empty Container at Intermodal Terminals Real-Time Route-Specific Weather Conditions and Forecasting Preplanning Regional Truck Trips Congestion Avoidance Dynamic Routing for Trucks Automated Routing and Permitting for OSOW Trucks
3. Roadway functional classifications	The system should provide coverage on most levels of the roadway network including major arterials and freeways so that information is provided on all key freight routes in a region.	Preplanning Regional Truck Trips Real-Time Reliable Information for Freeways, Port/Terminal Regions, and Major Freight Arterials Congestion Avoidance Dynamic Routing for Trucks

User Need ID	User Need Description	Essential FRATIS Function(s)
4. Near real-time	FRATIS should be near real time with roadway conditions and terminal/border queues information no more than 10 minutes old to maximize its usefulness to the freight community. Older, and thus less accurate/relevant information, needs to be clearly indicated.	Real-Time Reliable Information for Freeways, Port/Terminal Regions, and Major Freight Arterials Real-Time Route-Specific Weather Conditions and Forecasting Real-Time Information on Length and Wait Times for Truck Queues at Freight Terminals Real-Time Information on Container Status and/or Pickup/Delivery Appointments at Intermodal Terminals Preplanning Regional Truck Trips Congestion Avoidance Dynamic Routing for Trucks
5. Targeting of information	FRATIS should provide incident and road condition information to drivers and dispatchers so they can make route planning and navigation decisions internally in keeping with prevailing business practices in the industry.	Preplanning Regional Truck Trips Real-Time Reliable Information for Freeways, Port/Terminal Regions, and Major Freight Arterials Real-Time Route-Specific Weather Conditions and Forecasting
6. Accuracy	FRATIS needs to be designed to avoid pushing out inaccurate information, and should include robust error checking and data cleaning to encourage adoption of the system in the private marketplace.	Real-Time Reliable Information for Freeways, Port/Terminal Regions, and Major Freight Arterials Real-Time Route-Specific Weather Conditions and Forecasting Real-Time Information on Length and Wait Times for Truck Queues at Freight Terminals Real-Time Information on Container Status and/or Pickup/Delivery Appointments at Intermodal Terminals Preplanning Regional Truck Trips Congestion Avoidance Dynamic Routing for Trucks
7. Performance measurement	The system should provide performance measures to public agencies for use in transportation planning and management as an incentive for public sector participation as a data provider and to promote better transportation planning and policy.	FRATIS Open-Source Data Feed to Public Sector Agencies to Assist in Freight Transportation Performance Measurement
8. Information content	FRATIS should suggest routing, travel timing, and scheduling for logistics intermediaries so they have a complete data packet for informed decision making.	Preplanning Regional Truck Trips Automated Routing and Permitting for OSOW Trucks Congestion Avoidance Dynamic Routing for Trucks

User Need ID	User Need Description	Essential FRATIS Function(s)
9. External linkages – load matching*	FRATIS should be able to link to systems that support load matching for empty containers in order to maximize congestion avoidance, air quality, and efficiency benefits.	Container Load Matching with Trucks to Support Reductions of Empty Containers at Intermodal Terminals Real-Time Information on Container Status and/or Pickup/Delivery Appointments at Intermodal Terminals
10. Truck parking**	FRATIS needs to provide real-time information about truck parking locations and availability to drivers and dispatchers to improve safety and compliance with hours of service rules.	Real-Time Reliable Information for Freeways, Port/Terminal Regions, and Major Freight Arterials

* Dependent upon logistics intermediary and terminal willingness to permit linkage and data transfer.
** Need was added through consensus opinion at the FRATIS ConOps walkthrough meeting.
Note that user need #11 External Linkages – Dispatch Platforms was omitted since it is regarded as optional.
Source: Cambridge Systematics analysis of survey data and IFTWG meeting input.

4.4 User Class Profiles and Other Involved Personnel

The User Classes for the FRATIS system are the same User Classes that were outlined in Sections 2.3 and 2.4 for the "Current Situation." This information is repeated here for completeness and traceability.

Primary User Classes Profiles

The primary user groups for FRATIS can be categorized as follows:

- Trucking Company Dispatchers and Operations Managers are responsible for planning trips and maintaining communications with truck drivers; and
- Truck Drivers are responsible for picking up, transporting, and delivering the container/freight.

Profiles of these two user classes are provided below. Note that truck owner-operators may encompass both types of user groups.

Dispatchers and Operations Managers

Dispatchers and operations managers have access to the widest array of information sources. From a desktop computer, they can access 511 phone systems and web sites; digital maps with traffic information (e.g., Google Maps); traffic camera feeds; weather reports; and other resources. They can also access any proprietary systems they use, such as vehicle tracking/fleet management software. Dispatchers and operations managers can communicate with drivers in many ways including two-way radio (CB), cell phone, SMS text, and mobile computing platforms in the truck. Dispatchers and operations managers may also use tablet computers or smartphones for fleet tracking, load status updating, and communication with drivers in the field.

Dispatchers and operations managers require information from various other supply chain actors, including terminal operators, shippers/receivers, other carriers, and 3PLs to fulfill their responsibilities. This data can be obtained in an automated fashion if the appropriate systems are in place to do so – which is dependent not only on the trucking company's IT infrastructure, but also on that of its supply chain partners. Otherwise, it must be obtained manually, for instance, by calling a customer loading dock to inquire about the status of a container for pickup.

Dispatchers and operations managers also typically coordinate any permitting activities, such as OSOW permits. This has to be done on a state-by-state basis since the specific rules, regulations, and procedures vary by state. Some states have web-based 'kiosks', where companies can enter information, receive/plan a route, and pay fees all in one place. In other states, the process is more manual and requires review by state permitting staff, and perhaps coordination with other DOT departments.

Truck Drivers

Truck drivers interact with the existing systems/processes in a more limited fashion because of regulatory restrictions on what they can do while operating a truck. At a minimum, drivers will almost always have a CB radio (or other two-way radio such as Sprint-Nextel) and a cell phone for communication with other drivers and with dispatchers. Cell phones typically have texting capability which can be used for sending status updates (e.g., hooks, drops) to dispatch in real time, although drivers are prohibited by law from texting while driving. Dispatchers can also text load availability information to drivers in the field. This information can also be relayed by cell phone, although this introduces the possibility of transcription errors or other miscommunication. Some devices have Text to Speech (TTS) capability which would alleviate this problem.

If drivers have a smartphone, they can use it to access 511 phone and web services and location-based traffic and routing services, such as Google Maps, INRIX, or NAVTEQ, for current traffic conditions and recommended routes (some services require a subscription). It could also be used to access weather conditions and forecasts along their planned route.

Some fleets are equipped with MCPs for fleet management, so drivers may have a computer terminal in the cab, which can provide routing instructions via GPS, as well as other functions like HOS monitoring and two-way communications with dispatch. However, these systems are expensive and tend to be limited to large long-distance trucking companies. Drayage firms, which tend to have lower returns to capital, normally cannot afford to invest in these systems.

Other Involved Personnel Profiles

There are several other entities that may have some system capabilities to be able to transmit data related to appointments, pickup and delivery requirements, load/empty availability status, and drayage sequence direction; and could be incorporated into a systematic view or solution for a traveler information system or a drayage optimization system. Government agencies will also interact with the system for performance monitoring and regulatory purposes. These entities are described below.[5]

Transportation System Operators

Operations staffs at state DOTs, regional MPOs, and TMCs are responsible for the day-to-day management of traffic operations in their regions. These entities typically do not interact directly with truck drivers or dispatchers/operations managers. However, drivers and dispatchers may use resources provided by these agencies (such as web or telephone 511) to assist with daily operations planning. TMC operators would be interested in any freight-specific data that could enhance their product offerings, such as conditions at rail/marine terminals or events reported by freight users. DOTs and MPOs also use available data on freight movement for transportation planning purposes. Agencies are also interested in transportation performance measurement to track progress towards policy and operational goals. As currently envisioned, FRATIS would have a performance monitoring application, which will provide benefits to agencies in terms of system management as well as an incentive to provide data.

[5] In addition to the parties listed, personnel would be required to set up, operate/maintain, and administer a regional FRATIS system. These personnel would depend on the structure of the regional FRATIS public-private partnership and therefore cannot be identified in advance. However, it is anticipated that these resources would be mostly provided by public sector staff since it is unlikely private firms would do this on their own.

Enforcement Personnel

State DOTs typically cooperate with their state's highway patrol or police force to enforce regulations concerning the movement of freight. These include weight restrictions, safety checks, payment of taxes, and HOS enforcement. HOS rules are Federally mandated so they are the same in all states, but taxes, safety inspections, and OSOW enforcement vary by state. Enforcement of applicable route restrictions, often for OSOW loads, but also for conventional loads that may exceed height or weight restrictions, is also typically conducted by enforcement personnel.

Ocean Carriers

Ocean carriers are the primary means by which international containerized freight arrives in the U.S. and therefore influence the volume and timing of container movements. Ocean carriers are also sometimes responsible for providing delivery of a loaded container to a customer's door to fulfill the terms of a shipping agreement. These shipments are commonly referred to as "door deliveries."

Beneficial Cargo Owners

Beneficial cargo owners include distribution centers, warehouses, and other intermediate locations. Often these beneficial cargo owners are distinct from the shipper or freight forwarder, and do not control the trucking portion of the shipment, but certainly will control the appointment. They also control the method of delivery – whether the driver stays with a container while it is unloaded, or whether he drops the load and returns at a later time to pick up the container, or whether he can drop his load and pull an available empty from the premises. A lot of this is dictated by the size of the facility, for example, if they have the space to store the goods on site, or if they need the container for storage. Beneficial cargo owners also control the information about empty container release, that is, notification that a container is empty and ready to be pulled. Likewise, if the facility is loading containers, they would be the initiators of information about when those containers are loaded and ready for pickup. These pieces of information are all relevant to a drayage optimization strategy.

Terminal Operators

Terminal operators control a large piece of the container movement: the ship-to-truck or rail-to-truck transfer. This naturally impacts drivers who may go into a terminal several times in a single day.

Trucking Services Buyers

This category may include ocean carriers, shippers, freight forwarders, or railroads, all of whom control the timing of deliveries, either by day of the week and/or time of day.

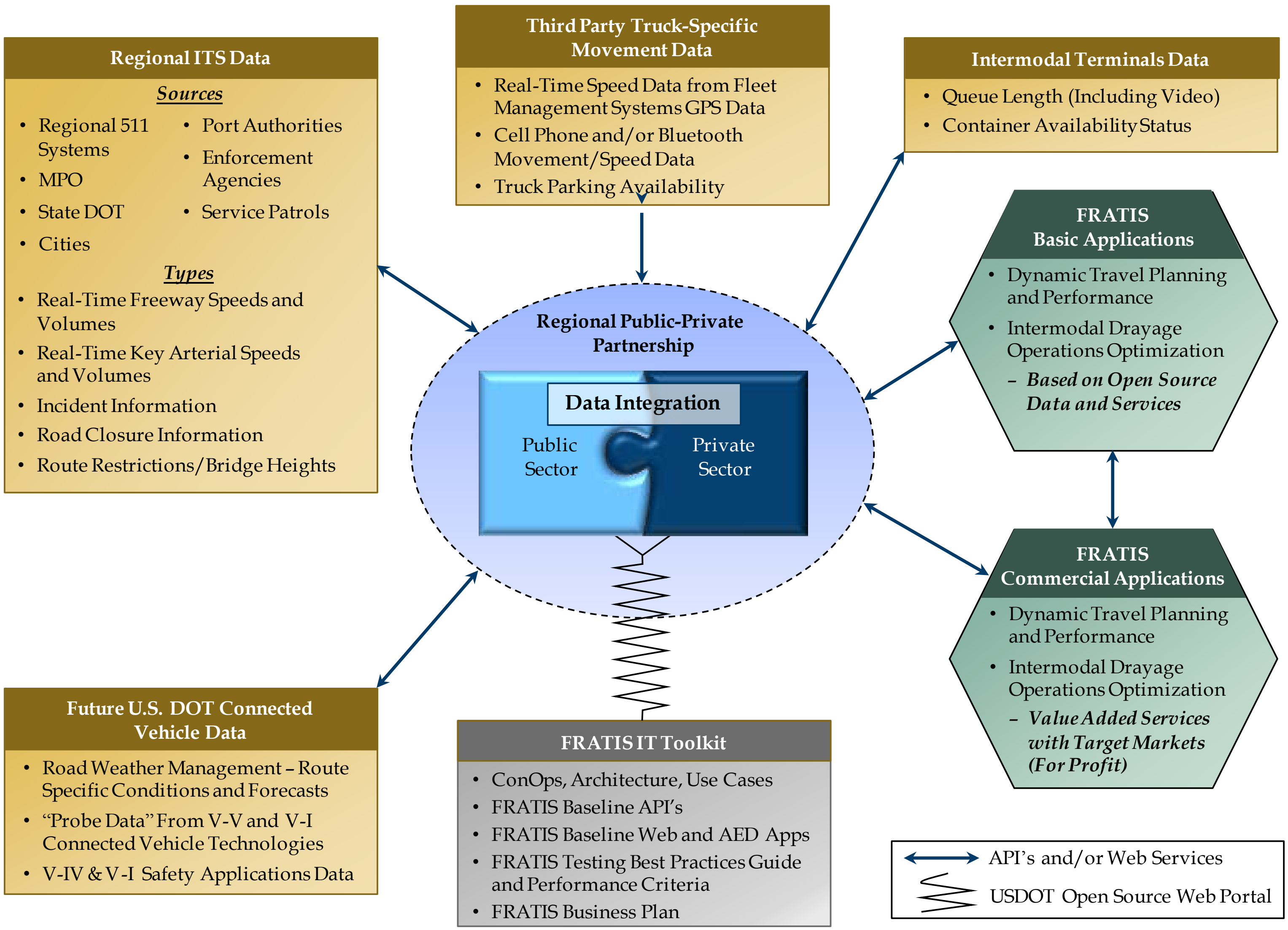
4.5 System-Level Operational Environment and Processes

Based on the previous information presented in this section – FRATIS Essential Functions, Profiles of User Classes, Information Dissemination Methods/User Interfaces, Operational Policies and Constraints – this section provides a high-level conceptual overview of the FRATIS system-level environment and processes.

Operational Environment, System Components, Interconnections, Interfaces

Figure 4.1 provides the high-level conceptual view of the FRATIS system. The diagram is to be construed as a relationship diagram intended to illustrate the key relationships and connections that will make up FRATIS. It is not intended as a detailed system diagram; that will be developed in future phases of the project. This concept includes the following key features.

Figure 4–1. Proposed High-Level FRATIS System Concept



Source: Cambridge Systematics, Inc., August 2012.

- FRATIS basic functionality, addressing each of the seven Essential Features as presented in Section 4.3, would be developed and deployed in a ***Basic Applications Package*** within a given region. The Basic Applications Package is developed from open-source data and services, and available in the public realm – consistent with the U.S. DOT open-source constraint. This package will reside on public sector computer systems under the auspices of the FRATIS PPP. The transportation agencies will be primarily responsible for system setup, maintenance, and administration. As described previously, these applications are accessed by the users through the following two primary interfaces:
    - The dispatcher or trucking operations manager would access all FRATIS applications/functionality through a web site using a PC or tablet device.
    - The truck driver would access all FRATIS applications/functionality through an Application Enabled Device (e.g., smartphone, DSRC 5.9 GHz device); an audible-only mode would be in effect for trucks when they are moving.
- Building upon the open-source Basic Applications Package, it is intended that private sector fleet management/routing/traveler information companies take further steps and deploy customized/specialized "for profit" FRATIS applications for specific markets that they would identify. This ***Commercial Applications Package*** class of FRATIS applications highlights a transformative approach for the engagement of private industry to foster deployment of FRATIS on a large scale.[6]
- A key institutional enabling element to deploy FRATIS in a given region will be the creation or use of a ***Public-Private Partnership (PPP).*** For the FRATIS concept to succeed, public and private sector freight movement and other data will need to be integrated and managed so as to support the specific data needs of the FRATIS applications. This will require organized cooperation between public sector organizations (e.g., MPOs, DOTs, cities) and private sector companies. The FRATIS PPP will be responsible for data and system integration (i.e., "standing up" FRATIS in the region) and project development and ongoing operations.
- ***Data Integration*** from multiple public and private sources will be critical to realizing the potential of the FRATIS system. The FRATIS applications will utilize some form of automated data integration functionality. For example, this could potentially take the form of a physical server, or could also take the form of a virtual system concept with many disparate elements linked over the Internet through a series of virtual application servers.
- Four major classes of data will be required to support the Essential Features defined in Section 4.3. These are:
    - ***Regional ITS Data –*** A variety of data sources containing real-time traffic and ITS information are typically available in major U.S. metropolitan regions, including freeway/arterial speeds and volumes, incidents, road closures, truck parking locations, and physical/regulatory restrictions.

[6] Payment system requirements are to be defined by private sector partners in the Commercial Applications Package. This concept will be further refined in the FRATIS business planning assessment to be carried out in the Design and Limited Testing phase.

- ***Third-Party Truck-Specific Movement Data –*** This will take two forms: 1) real-time private sector truck movement data (sanitized to alleviate proprietary concerns) from third-party fleet management systems such as QualComm and XATA; and 2) for trucking companies who utilize the FRATIS system, truck movement data and other data from the Application Enabled Device can be used to expand the overall FRATIS traffic data (i.e., FRATIS-equipped trucks will be probes).
- ***Intermodal Terminals Data –*** Terminal queue length and timing data (including video) is available for many terminals; terminal management systems do contain container availability information.
- ***Connected Vehicle Emerging Technologies Data –*** Road Weather Management has been identified as a potential information source for FRATIS; Vehicle-to-Vehicle (V-V) and Vehicle-to-Infrastructure (V-I) technologies may also provide useful information to FRATIS in the future. (Note here that these Connected Vehicle technologies are still being developed, and a key regulatory decision about whether to mandate the use of such technologies in heavy trucks is two years away. As such, the relationship of these technologies to FRATIS is currently postulated to be as an external source providing traffic probes data to FRATIS.)

- Based on current IT state-of-the-art practices and technologies, and considering the ITS and private sector transportation databases and systems that would need to be queried or integrated into FRATIS, it is envisioned that the FRATIS system would be a distributed series of databases, applications and systems that would communicate using ***Application Programming Interfaces (API) and Web Services.***[7]
- To support the development and deployment of FRATIS for a given region, it is envisioned that U.S. DOT would provide a ***FRATIS IT Toolkit***, resident on the DMA portal, which would provide the key documentation, software code and other necessary information. Software to be included would consist of: Baseline APIs related to the Essential Features defined in Section 4.3, baseline web site XML coding, and baseline application code for Application Enabled Devices (e.g., a basic FRATIS iPhone App, Droid App and DSRC 5.9Ghz App).

Data authentication will be a key part of any FRATIS implementation. It will be critical to ensure that all data comes from trusted sources. Moreover, it will be important to verify the accuracy of information being pushed out by FRATIS. Any regional test deployment carried out in the Design and Limited Testing phase will require robust error-checking during the initial design stages, before the system goes live.

Performance Characteristics

[7] An application-programming interface (API) is a set of programming instructions and standards for accessing a Web-based software application or Web tool. An entity releases its API to the public so that other software developers can design products that are powered by its service. For example, the API itself could be a chunk of software code written as a series of XML messages. In this case, each XML message would correspond to a different function of the remote service. Web services are a collection of technological standards and protocols, including XML. APIs and Web services are completely invisible to Web site surfers and software users. Their job is to function silently in the background, providing a way for applications to work with each other to get the user the information or functionality he needs. Two examples of ITS data APIs that have been recently included are the San Francisco Bay 511 System API (http://www.programmableweb.com/api/511-driving-times), and the Washington State Traffic Information System API (http://www.wsdot.wa.gov/traffic/api/).

The FRATIS system will be developed and sized individually, based on the freight transportation system needs and ITS data availability in each region that it is to be deployed in. And within a given region, the performance of many of the system functions will depend on several factors, including:

- The scope and reliability of available traffic data on the regional ITS network;
- The scope of the connectivity to regional terminal management systems; and
- The success of the public-private partnership in establishing data exchange with private sector routing, fleet management and traveler information systems.

Many of the FRATIS functions are based on providing the truck dispatchers/operations managers and drivers with “real-time” information. Based on the results of the FRATIS user survey of over 300 drayage trucking firms, users defined “real-time” to be information that is less than 10-minutes old. This generates perhaps the most important performance requirement to the FRATIS system since the system users will perceive the success of FRATIS largely on how timely the information is.

Both the survey and the IFTWG session results showed that reliability of the information was also of major importance to truck dispatchers/operations managers and drivers. The CS Team is currently attempting to quantify what reliability would mean in terms of FRATIS traveler information data; the resulting reliability performance requirement for traveler information data will be included in the upcoming FRATIS System Requirements report.

Additional system performance characteristics such as speed, throughput, bandwidth, etc., will be assessed during the next phase of FRATIS – the System Development and Limited Testing phase. These performance measurements would be defined separately for each regional deployment of FRATIS but based on overall program performance goals. U.S. DOT would provide for an Independent Evaluator during the FRATIS testing phase. The Independent Evaluator will be responsible for ensuring that the programmatic goals of FRATIS are met by assessing the freight efficiency, fuel savings, and air quality benefits associated with the test deployment. U.S. DOT is currently investigating licensing options for its Open Source Web Portal program which will define the overall licensing arrangements for developers to create FRATIS applications.

Cost of Operations and Identified Risk Factors

Cost of Operations of FRATIS are unknown at this point in time. In the next stage of FRATIS development, the Development and Limited Testing Phase, the FRATIS system will be designed and a detailed architecture developed – this information will allow for costs of FRATIS operations to be assessed. Operations costs will be borne by three primary entities:

- Trucking company dispatchers/operations managers will need to install FRATIS at both their offices and on the Application Enabled Devices (e.g., smartphones) of their drivers. Internal training will also be required for both the web and mobile FRATIS platforms. The companies may also elect to purchase value-added commercial versions of FRATIS applications that may be available from fleet management/routing/traveler information private sector vendors;
- Public transportation agencies will need to include a component of TMC operations dedicated to the FRATIS system data exchange. These agencies will also need to provide for implementation and continued operations and support of any freight-specific ITS sensors (e.g., key freight arterials volume/speed sensors). Agencies

responsible for integrated corridor management on freight-intensive routes will need to work together to make sure all relevant data are available and feeding into FRATIS (this could include local traffic signal systems, state DOT freeway management systems, route restrictions, commuter rail train management systems, and other data streams for a particular corridor). Also, these agencies will need to operate the continuous collection and assessment of freight performance information derived from FRATIS; and

- Fleet management/routing/traveler information private sector vendors will need to assign appropriate internal operations resources to manage the data integration associated with open-source data exchange with the regional public sector transportation agencies. It is assumed that such companies will recoup the cost of participation in FRATIS through the development and marketing of commercial value-added FRATIS applications which would likely require paid subscriptions or other pricing/cost recovery methods. For example, a fleet management vendor could conceivably develop a specialized version of FRATIS that would be designed to serve drayage reefer operations for seafood companies.

It is anticipated that a detailed Business Plan for FRATIS will be developed in the Development and Limited Testing Phase.

Identified risk factors for FRATIS include the following:

- Public-Private Partnerships. The development of PPPs to develop and deploy FRATIS is the approach for FRATIS deployment that has been outlined in this report. This creates a significant risk in a given region if the public and private sectors are unsuccessful in working together to establish the necessary relationships and data exchange functions necessary for FRATIS deployment;
- The U.S. DOT's directive to focus FRATIS on a completely Open Source approach creates a risk that some private sector companies may choose not to participate in FRATIS deployment or operations; and
- The linkages to intermodal terminal management systems to support “container availability,” and potentially, container pick-up/drop-off “reservations,” is completely dependent on the willingness of the intermodal terminals to participate in these FRATIS functions.

Quality Attributes

The Quality Attributes of FRATIS will necessarily depend on the data and institutional resources available, as well as the specific deployment needs, within each implementation region. Therefore, requirements related to Quality Attributes will be determined during the system design and architecture development activity, which will occur under the next phase of FRATIS – the Development and Limited Testing Phase. Quality Attributes to be determined will include system reliability, availability, correctness, efficiency, expandability, flexibility, interoperability, maintainability, portability, reusability, supportability, survivability, and usability.

System Safety and Security

The FRATIS system shall have the following functions related to system safety and security:

- Personal and proprietary data from system users shall be protected and secured within the FRATIS system; and
- FRATIS shall have a backup system capability, but the level of backup capability, and the form that this would take, shall be determined by the regional partnership deploying FRATIS. For example, a given region could implement a backup of the core IT platform/server that would provide full FRATIS functionality in the event of a system outage; this backup system would be deployed at a different physical site than the primary FRATIS IT platform/server.

4.6 Modes of Operation

The primary mode of operation for FRATIS will be the ***Normal Operational Mode,*** which is focused on the application of FRATIS functionalities to the transportation operations of drayage and other trucking operations within a metropolitan region of the U.S. This will be the normal, daily operational mode for the FRATIS system, with the primary users of the system being trucking company dispatchers and drivers. Transportation TMC operators, and routing/fleet management private sector companies are also of import to the normal operational mode. In the Normal Operational Mode, these entities will communicate data and information to each other seamlessly and automatically.

A secondary mode of operation for FRATIS will be the ***Peak/Degraded Operational Mode***. For this mode, the functionality is the same as for the normal Operations mode, except that the system is expected to have significantly more resource usage based on certain recurring and nonrecurring events. For example, the unloading of two 12,000 TEU megaships at a port at the same time may generate hundreds of truck trips per hour, which will provide an increased resource load on the FRATIS system. A requirement derived from this mode is that FRATIS shall be designed to anticipate and respond to these peak/degraded conditions, such that ***no visible delay*** in FRATIS functionality is apparent to trucking company dispatchers and drivers.

During the development phase, a technical approach will need to be developed to support the goal of "no visible delay" in the Peak/Degraded Operational Mode. For example, if the system load for dynamic routing calculations at a given point in time overwhelms the ability of FRATIS to respond in a timely manner to recommend an alternate route to the driver, simpler routing algorithms or parametric estimate work-arounds may need to be substituted to approximate an alternate route recommendation for the driver.

Finally, of note here, the Cambridge Systematics team has considered the possibility of the use of FRATIS in an ***Emergency Operations Mode***. For example, in response to a hazardous material (HAZMAT) accident, or in the extreme case of a terrorist attack on port infrastructure, the FRATIS system could potentially be utilized to both collect and disseminate information between trucking operators and public sector agencies. The Emergency Operations Mode may also come into play in the event of a natural disaster.

The exact nature of an emergency response will differ by region, depending on the types of natural disasters most frequently encountered. For example, a minor earthquake could only cause a small disruption in FRATIS operations, especially if major communications links are unbroken. However, a major hurricane has the potential to knock out power and transportation links for days if not weeks. This would require a different emergency plan. An Operational Scenario describing potential FRATIS uses for hurricane disaster preparation and response is provided in Section 5.10. The Cambridge

Systematics team recommends that the need and feasibility of this mode be explored further during the development and limited testing phase of FRATIS.

4.7 Support Environment

The FRATIS system is primarily an automated system. The expected IT environment can currently be defined as follows:

- FRATIS applications utilize data and/or connect to databases from both public and private sources through API and/or Web Services software technologies;
- FRATIS applications will utilize some form of automated data integration functionality – this could potentially take the form of a physical server, or could also take the form of a virtual system concept with many disparate elements linked over the Internet through a series of virtual application servers; and
- The FRATIS user interface will consist of both Web-based applications and applications that will function on Application Enabled Devices such as smartphones.

The FRATIS system is expected to utilize communication and reporting systems according to accepted industry practices. This may include regularly scheduled maintenance along with accepted capital replacement cycles. The support activities for FRATIS will be conducted within each region where FRATIS is deployed. FRATIS will function 24 hours per day and 365 days per year. Communications and reporting systems and scheduled maintenance may be handled in-house by the FRATIS PPP, or alternatively by a support contractor under the direction of the PPP.

It is recognized that FRATIS deployment will entail ongoing operational costs. However, given the nature of this preliminary system planning stage and the many variables involved, it is difficult to assess these costs with any certainty at this time. Since FRATIS will be region-specific, the detailed operations and maintenance, backup functionality, and server design won't be defined until a future design phase. It is anticipated that the FRATIS Business Plan, developed in the next phase of limited system testing, will assess the operational and maintenance expenditures of FRATIS in greater detail, once test bed region IT and other resources are known.

It is anticipated that the FRATIS regional public-private partnership will administer the operations and maintenance of FRATIS, with the private partners primarily acting as data providers with public sector agencies providing labor and physical plant (e.g., server space) to stand up the system. This approach is preferred because it is unlikely private partners will do this on their own, and may need guidance/assistance from transportation agencies. Operations and maintenance may be completed using in-house staff and IT resources, or it may be performed by a government contractor.

5.0 Operational Scenarios

This section presents ten scenarios, summarized below in Table 5.1, that describe situations in which the FRATIS system could significantly improve trucking and freight operations. Each scenario is a step-by-step description of how the proposed system should operate and interact with its users and its external interfaces under a given set of circumstances. The scenarios will tie together the system, the users, and other entities by describing how they interact. Note that these are merely conceptual scenarios; where specific technologies are mentioned, they are intended as examples only, and are not to be construed as defining a technological solution for FRATIS.

Additionally, note that at the request of the Walkthrough Review members, the first two scenarios (i.e., "Getting FRATIS Up and Running"), in addition to providing the technical, operational and user information, provide more specific information concerning the formative steps in developing the framework by which FRATIS could be deployed in a given region.

The FRATIS team would also like to recognize the contributions to the section by Melissa Ackert of the Florida Department of Transportation, and Daniel Pallme of the University of Memphis.

Table 5–1. Summary of FRATIS Scenarios, Essential Functions, Key Features, and Benefits

Operational Scenario	FRATIS Essential Function(s)	Key Features	Benefits
Getting FRATIS Up and Running – Southern California	Real-Time Reliable Information for Freeways, Port/Terminal Regions, and Major Freight Arterials Real-Time Information on Length and Wait Times for Truck Queues at Freight Terminals Preplanning Regional Truck Trips Congestion Avoidance Dynamic Routing for Trucks	Real-time and historical traffic data Terminal camera feeds Audible driver notifications Dynamic routing	Initial deployment and ongoing operations of the FRATIS system in a region Improved drayage productivity Congestion avoidance Reduced idling at terminal gates Reduced emissions and fuel savings
Getting FRATIS Up and Running – South Florida	Real-Time Reliable Information for Freeways, Port/Terminal Regions, and Major Freight Arterials Preplanning Regional Truck Trips Congestion Avoidance Dynamic Routing for Trucks Container Load-Matching with Trucks to Support Reductions of Empty Container at Intermodal Terminals	Real-time and historical traffic data Audible driver notifications Load matching Dynamic routing	Initial deployment and ongoing operations of the FRATIS system in a region Improved drayage productivity Congestion avoidance Reduced emissions and fuel savings Better asset utilization
Improving Logistics Efficiency for a Trucking Company Dispatcher	Real-Time Reliable Information for Freeways, Port/Terminal Regions, and Major Freight Arterials Preplanning Regional Truck Trips Congestion Avoidance Dynamic Routing for Trucks	Real-time and historical traffic data Terminal camera feeds Audible driver notifications	Improved customer service/adherence to delivery windows

Operational Scenario	FRATIS Essential Function(s)	Key Features	Benefits
Increasing the Number of Turns Per Day For a Drayage Driver	Real-Time Reliable Information for Freeways, Port/Terminal Regions, and Major Freight Arterials Real-Time Route-Specific Weather Conditions and Forecasting Real-Time Information on Length and Wait Times for Truck Queues at Freight Terminals Real-Time Information on Container Status and/or Pickup/Delivery Appointments at Intermodal Terminals Container Load-Matching with Trucks to Support Reductions of Empty Container at Intermodal Terminals	Load matching Real-time traffic data Pickup and delivery appointments at a port Route-specific weather Terminal camera feeds Audible driver notifications	Improved drayage productivity Reduced emissions Fuel savings Congestion avoidance Better asset utilization
Operational Scenario	FRATIS Essential Function(s)	Key Features	Benefits
Wind Turbine Regional Delivery	Automated Routing and Permitting for OSOW Trucks Real-Time Route-Specific Weather Conditions and Forecasting	Automatic route/permit generation for OSOW loads Route-specific weather/hazards	Reduced permitting turnaround time Reduced burden on permitting staff Improved trip planning
Developing Freight Inputs to an RTIP	FRATIS Open-Source Data Feed to Public Sector Agencies to Assist in Freight Transportation Performance Measurement	Anonymous truck movement data for planning Freight performance measurement	Improved data for freight planning Enabling a freight-beneficial project to compete for funding Fuel savings Reduced emissions
Improving Performance for a Time-Sensitive Air Cargo Supply Chain	Real-Time Reliable Information for Freeways, Port/Terminal Regions, and Major Freight Arterials	Real-time traffic data Truck parking information	Improved cold chain efficiency for perishable cargo Improved hours of service compliance
Improving Productivity for Intermodal Drayage Moves Over 100 Miles	Real-Time Reliable Information for Freeways, Port/Terminal Regions, and Major Freight Arterials Congestion Avoidance Dynamic Routing for Trucks Preplanning Regional Truck Trips	Real-time traffic data Load matching Dynamic routing	Reduced driver turnover/enhanced driver income Improved regulatory compliance Better customer service

Operational Scenario	FRATIS Essential Function(s)	Key Features	Benefits
Reducing Operational Costs Through Better Asset Utilization	Container Load-Matching with Trucks to Support Reductions of Empty Container at Intermodal Terminals Real-Time Reliable Information for Freeways, Port/Terminal Regions, and Major Freight Arterials	Terminal delay information Load matching	Better asset utilization Reduced idling emissions Reduced fuel expenditure Timely return of chassis
Increasing Emergency Preparedness and Response Efficiency	Real-Time Reliable Information for Freeways, Port/Terminal Regions, and Major Freight Arterials Container Load-Matching with Trucks to Support Reductions of Empty Container at Intermodal Terminals Preplanning Regional Truck Trips Congestion Avoidance Dynamic Routing for Trucks	Real-time traffic data Dynamic routing Load matching Audible driver notifications	Better asset utilization for disaster preparation and recovery Optimization of truck trips and freight deliveries Enhancements to public agency emergency planning strategies

5.1 Getting FRATIS Up and Running – Southern California

The Los Angeles region was recognized early on as a potential test bed site for FRATIS, due to its recognized goods movement, traffic, and air quality issues as well as its early involvement in the project (the Los Angeles County Metropolitan Transportation Authority hosted an IFTWG outreach meeting as well as the ConOps and System Requirements Specifications walkthrough meetings during the early stages of system development). In addition, the region developed the Gateway Cities Technology Plan for Goods Movement at about the same time as the FRATIS ConOps.

The Gateway Cities Technology Plan for Goods Movement provided a blueprint for an end-to-end information support system to improve the efficiency of goods movement in Southern California through the integration of traditional real-time road and traveler information technologies, along with intermodal freight, port, and truck technologies. Since this plan was developed concurrently with the FRATIS ConOps, many of the same key stakeholders were involved in both efforts – this facilitated and enhanced integration of FRATIS into the regional freight ITS solution set.

As part of the Technology Plan for Goods Movement implementation, MTA and its partners created a regional public-private partnership to administer FRATIS in the Gateway Cities region. The PPP included MTA, Caltrans, the Gateway Cities Council of Governments, the Ports of LA and Long Beach, the Harbor Trucking Association (HTA), the UP and BNSF railroads, major marine terminal operators (MTO), and several private sector data partners. The PPP was charged with system integration for FRATIS as well as overall project development and operation. MTA led the overall coordination effort, directing the activities of all key project partners and ensuring key deadlines were met. Where the time and effort involved to provide data were a concern for private partners, appropriate public sector staff worked on-site with the data providers to create the necessary connections and minimize the burden on participating companies.

This regional PPP named the new system the "FRATIS Gateway," and tested and deployed prototypes of the following FRATIS elements within a 12-month period:

- **Freeway, arterial and intermodal connector traffic data.** The regional ITS system, including the portion region's ATMIS, was upgraded to fill in several identified ITS data gaps on the I-710 and SR 91 freeways, and arterial traffic speed and volume detectors were placed at key points along two key north-south arterials and three key east-west arterials.
- **Terminal queue time measurement.** With the priority of the Harbor Trucking Association's data needs focused on terminal queue times for drayage trucks immediately outside of port terminal gates, the PPP worked with the MTO's to initially deploy a prototype automated video detection and queue measurement systems at a terminal at the Port of Long Beach. The system provided data both in two formats: 1) text feeds providing both the current length of the queue and the predicted time from the end of the queue to the gate; and 2) a real-time video output showing the terminal queue.
- **Freight TMC.** In cooperation with the two ports, a FRATIS component of the ports ATMIS system was deployed on a server at the port facility hosting the ATMIS. This newly integrated system fused data from the ATMIS, the new ITS sensors, the terminal queue time measurement system, and Caltrans and regional information

(i.e., through integration with RITTS and LA SAFE 511), and provided outputs of freight-focused traveler information data that would support FRATIS Gateway applications.

- **Freight-Focused Traffic Information Applications.** Based on the data from the Freight TMC, freight-focused traffic information applications, based on the FRATIS concepts of using web applications for drayage dispatchers, and Application Enabled Devices for drayage truck drivers, were developed, tested and deployed in cooperation with the Harbor Trucking Association (HTA).
- **Dynamic Routing.** The FRATIS dynamic routing application was deployed last, and initial testing centered on three drayage fleets, consisting of 400 trucks with 650 drivers. Based on HTA member inputs, the dynamic routing application programmed in the most likely 90% of the freeway, arterial and intermodal connector routes for drayage truck movements in the Port-to-Greater LA region.

The HTA worked with its membership to identify drayage truck fleets to test the initial deployment. Participating fleets received "push alerts" regarding terminal queue status at the initial marine terminal. The information proved so popular and useful to drivers that it reduced institutional tension between drivers and that MTO, which encouraged three additional MTO's to work with the PPP to deploy similar systems.

Due to the extensive network of alternate routes available in Southern California – both concerning freeways and arterials – the results of the prototype testing of the FRATIS Gateway dynamic routing system significantly exceeded expectations, and resulted in an overall reduction of travel times of over 5% across the participating fleets, with between 15% and 20% reductions in trip times being common for specific trucks that accepted the alternate routing recommendations. Based on this success, regional environmental agencies are now attempting to assist the PPP in expanding the dynamic routing system to cover all of the major drayage trucking firms using the two ports.

5.2 Getting FRATIS Up and Running – South Florida

South Florida is home to an established network of roadways that provide the freight industry with access to and from key trade gateways, warehouse and distribution centers, and regional and hinterland markets. These corridors and connectors have become more and more congested as the region has continued to grow. This congestion will continue to increase as South Florida's freight community positions itself to handle an increasing amount of cargo. This will be driven by not only population growth, but also an anticipated surge in international trade driven by significant investments at Port Miami, Port Everglades, and Miami International Airport.

To remain a competitive trade hub, South Florida investigated ways to accommodate the current and expected increase in truck traffic. The South Florida Virtual Freight Network (VFN) concept, developed by a group of South Florida freight stakeholders, is a technology-based system designed to facilitate the movement of cargo between major load centers in South Florida – specifically, truck trips connecting seaports with rail yards and distribution centers, and airports with distribution centers.

The Florida DOT, having participated as a stakeholder in the development of the FRATIS ConOps and system design, was selected by FHWA as an early deployment test site. The VFN concept was modified to incorporate the open source code and data resources available through FRATIS as its foundation. The Florida DOT worked closely with FHWA to customize the system for testing in South

Florida. The VFN was designed to: improve travel time reliability; reduce delay; reduce empty/unproductive movements; enhance real-time system monitoring capabilities; and reducing truck related emissions.

Implementation of the FRATIS-driven VFN required development of communication protocols and tools to assist in real-time traffic monitoring, dynamic routing decisions, improved load matching capabilities, and improved roadside commercial vehicle enforcement. These elements built off of and enhanced the public and private sector ITS deployments previously in place in South Florida. This required integration of the system into regional TMCs, installation of computers at participating hubs and users, and deployment of mobile devices to over 100 truck drivers. In addition, training was provided to all system users and data providers.

A broad range of public- and private-sector stakeholders were required to make the VFN a reality. These stakeholders included: system providers (e.g., Florida DOT's TMC staff), system users (e.g., trucking companies), and operations staff from host locations, such as the Port Miami, Port Everglades, Miami International Airport, and Florida East Coast Railway. In addition, Florida DOT, Miami-Dade MPO and Broward MPO planning staff facilitated system design and implementation, working closely with FHWA.

The South Florida VFN FRATIS implementation consisted of three key components:

- **Dynamic Routing –** The VFN integrated data from public- (e.g., incidents, work zone, weather) and private-sector sources (e.g., commercial vehicle traffic probes) and make these data available to private-sector stakeholders in various formats. For motor carriers that currently use routing and dispatching software, the VFN data is provided in a standardized electronic format that is integrated directly into the firm's current software routing and dispatch software. The data is posted to a secure FTP site every 30 seconds, from which it is downloaded automatically by the motor carrier systems. As roadway conditions change, the motor carrier software will visually identify the firm's vehicle(s) impacted by changing conditions and provide alternate routing to limit the impact of the delay. For motor carriers that do not use routing and dispatch software, travel times for key freight corridors are posted on variable message signs at the exit of intermodal facilities to facilitate real-time routing decisions.
- **Commercial Vehicle Traffic Probes –** The operational characteristics of commercial vehicles operating around South Florida's key intermodal facilities make them prime candidates to serve as effective traffic probes for the region's traffic management centers. These vehicles routinely operate on key components of the transportation network and typically make multiple drayage moves in a single day which help ensure probe data are collected throughout the day. Vehicle location and average speed data are collected via private-sector communication technology (e.g., cellular phones, satellite communication devices) or via public-sector technologies that identify commercial vehicles accurately at highway speeds (e.g., license plate readers, radio-frequency identification (RFID) tags). Vehicle-specific identifiers are not stored as part of the probe data collection effort. Once collected the data are integrated into the region's traffic management centers and factored into current travel time monitoring activities and calculations.
- **Load-Matching Application –** As part of their drayage operations to/from the region's intermodal facilities, commercial vehicles often operate unloaded in one

direction (i.e., they do not have a load for their return trip to/from the intermodal facility). In order to limit the number of empty/unproductive moves by commercial vehicles in the region, LoadMatch & Drayage.com, a private sector web-based load matching service customized its system to test the functionality in South Florida. This application provides a forum for shippers and receivers to post their loads in need of transport and provide an opportunity for commercial vehicles to find a load to haul on their trip back to/from an intermodal facility.

The above components were tested in South Florida over a 12-month period. In order to determine the success of the VFN, an independent evaluation was completed. The evaluation revealed that there was an observable improvement to system predictability and reliability. Further, interviews with system users revealed overall system acceptance. The VFN has moved beyond the pilot test currently is undergoing enhancements to incorporate user input and expand regional coverage of the system.

5.3 Improving Logistics Efficiency for a Trucking Company Dispatcher

ABC Trucking serves the restaurant and hotel industry in South Florida, providing delivery of a mix of food and dry goods. Orders are placed via a web ordering system up until 9 PM the night before delivery. Reliability is critical as any out of stock items result in lost sales or the inability for ABC's customer to provide service to their customers. The company maintains a fleet of 50 tractor/trailers combinations and 15 straight trucks. Over the last several years, growth in congestion has caused ABC Trucking to increasingly miss delivery windows, resulting in lost customers and in some cases penalties. The Chief Information Officer, having recently read an article on the new FRATIS system unveiled in South Florida, approached her lead dispatcher to discuss ways to improve pre-planning activities, real time response to incidents during the trip, and avoidance of key choke points in the system.

Available data on typical roadway conditions were viewed and used to refine delivery routes and schedules. Access to real-time traffic conditions, via the FRATIS Web Portal, was provided to the dispatch staff to support dynamic route modifications mid-trip. Data were customized by dispatch staff to highlight critical corridors and terminals; a mix of e mail and electronic bulletin board postings, along with queues available via camera feeds were used. Finally, drivers installed the FRATIS smartphone application on their personal devices, which were used to communicate the data packets screened and customized by dispatch.

In this scenario, historical and real-time traffic condition data on South Florida expressways and arterials were relayed to the FRATIS system through ITS sensor networks, terminal camera feeds, and private traffic data services available to regional TMCs that were connected to FRATIS. The information was automatically collated and displayed on the FRATIS Web Portal, where dispatch staff were able to access it. Dispatchers were able to use this information to plan routes and schedules more effectively before trips, and to apprise drivers of route modifications after a trip had commenced. Dispatch instructions were automatically converted to audible format through the FRATIS mobile application to prevent distracted driving.

As the FRATIS system was implemented, ABC Trucking reached out to its customer base and presented them with a new set of expectations to illustrate their commitment to customer service.

Within the first month, FRATIS began to show its value by improving on-time performance and decreasing missed appointments. Truckers were able to avoid event congestion surrounding Miami Heat games at the American Airlines Arena in downtown Miami, and re-route around major incidents on I-95 using key arterials, as well as Florida's Turnpike during AM and PM peak periods.

5.4 Increasing the Number of Turns Per Day for a Drayage Driver

CrossTown Drayage provides container drayage services for steamship lines operating at the Port of Seattle. With a fleet of 50 tractors, CrossTown Drayage drays containers from port terminals to a variety of locations, including BNSF and UP intermodal ramps, as well as warehouse/distribution centers throughout the Puget Sound region. Over the years, increased congestion and delay have reduced the number of turns a driver can make, reducing their pay as well as CrossTown's overall efficiency. Having participated the year before in the development of user needs for the FRATIS system, the Operations Manager decided to integrate FRATIS into his operation.

Several of the terminal operators were already participating in FRATIS, providing online reservations for pickups and drop-offs, electronic notification of load availability, and camera feeds showing terminal gate queues. By tying into the FRATIS network, CrossTown Drayage was able to access all data relevant to its operation. Load availability combined with a pickup time, augmented by terminal queue information allowed CrossTown to immediately improve the efficiency of its drivers by removing unnecessary delay. In addition, the load matching functionality allowed dispatch to identify loads in close proximity to a drop-off location, minimizing bobtail movements. In addition to load related data, CrossTown was also able to integrate real time traffic conditions into its routing decision, avoiding major incidents, events, and congestion. Communication with drivers was accomplished through CB radio and smartphones, based on driver preference.

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

Drivers with smartphones who subscribed to the service received audible alerts of road closures and other delays due to weather. Weather delays were previously an issue that had not been addressed as a company procedure or policy. During the winter months, CrossTown used projected weather delays to dispatch in the days before an event if at all possible. They used real-time, route-specific weather information to operate in areas where temperatures and other conditions allowed a truck to be operated safely. Another additional benefit is the company would never try to bobtail in inclement weather from a safety perspective. Besides compromising safety, this would lead to unnecessary moves for the driver during these bad weather events.

Use of the FRATIS system allowed CrossTown to increase the average number of turns per day for each driver, which in turn improved efficiency and equipment utilization. Further, use of the technology components allowed CrossTown to enhance the efficiency and accuracy of information exchange activities with its primary customers. Fuel savings were achieved by drivers being able to route around congested areas and pick up loads or empty containers when they otherwise would have to bobtail back to the terminal. Weather updates were also given real-time with conditions for specific routes. Even though revenue continues to suffer during a bad weather event, the revenue impact was reduced.

5.5 Wind Turbine Regional Delivery

SuperLoad Trucking specializes in the movement of oversize/overweight loads in Southern California. They maintain a fleet of specialized trailers, tractors, and escort vehicles, and typically move extreme OSOW loads between the hours of 10:00 PM and 6:00 AM to reduce traffic impacts. Accurate routing for these loads is critical to protect the shipment as well as the infrastructure. Over the last decade, with the push for renewable energy, SuperLoad Trucking has developed a niche in the movement of wind turbines. These extreme OS loads are picked up at the Port of San Diego and moved inland to wind farms near Palm Springs where they are installed.

Acquiring the necessary OSOW permit(s) is a critical part of SuperLoad's activity. For loads of this nature, field review of the preferred route is often required to ensure the load can be accommodated. This is in part due to the unavailability of current data on bridge clearances, weight restrictions, as well as turning radii along the route.

Having spent significant time and costs over the years to purchase these OSOW permits, the Permit Manager was interested in new tools and technologies that could be used to expedite the process. When the states permitting agency announced it would be testing the FRATIS system – specifically an automated OSOW permitting component, the Permit Manager immediately contacted the state to sign up for the test. This component provided a dynamic routing system that defines a legal route based on a review of real time infrastructure capacity. This required the state to survey (and agree to maintain) a defined set of routes and provide that data in an electronic database. Companies like SuperLoad subscribe to the service and can apply for OSOW permits electronically.

In this scenario, FRATIS received a data feed from the Caltrans OSOW automated permitting system.[8] Through the FRATIS web services portal, the Permit Manager was able to access the OSOW self-service function, where she entered pertinent information about the shipment (dimensions, origin/destination, etc.) and applied for a permit. The OSOW system combined Caltrans highway system data with geo-coded permit map data to automatically generate an acceptable route; the Permit Manager then self-issued a permit and paid the appropriate fees through the web portal.

During this trip, an unusual weather pattern of 75 mph Santa Anna winds were forecasted for I-10 twenty miles west of Palm Springs for 2:00 AM to 6:00 AM by U.S. DOT's Clarus road weather management system. As SuperLoad's truck approached the I-215-to-I-10 interchange, the FRATIS system sent an audible alert to the driver that the truck's route would take it into a severe wind zone within one hour. Based on this information, the SuperLoad truck driver parked the truck in Riverside until the next evening, and saved a $20 million wind turbine from a potentially catastrophic incident.

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[8] Caltrans does not currently have an automated permit system but it is anticipated that most states will implement this capability in the near future.

Use of the FRATIS system, including data exchange with the state's automated permitting system, streamlined the process for both the state and the trucking company by eliminating many of the required field reviews, which speeded the process and saved significant expense for both parties.

5.6 Developing Freight Inputs to an RTIP

The North Central Texas Council of Governments (NCTCOG), which is the Federally required Metropolitan Planning Organization (MPO) for the Dallas-Fort Worth region, was developing a new Regional Transportation Improvement Program (RTIP) to guide transportation system improvements over the next five years. Officials and NCTCOG staff were aware that, as a major logistics hub, the Dallas region needed to invest in projects that benefited goods movement to remain competitive and encourage economic development. However, like many regions, the agency had struggled in the past to develop good data sources that could support freight planning.

Having hosted an outreach meeting early in the development of the FRATIS Concept of Operations, the lead Freight Planner at NCTCOG was aware of FRATIS system and sponsored an implementation in the NCTCOG region. As part of this implementation, the agency began receiving anonymous truck route, speed, and congestion data through the FRATIS public sector output interface, allowing analysts to identify key truck bottlenecks and analyze their impacts on business productivity and air quality. The data was made available under a public private partnership (PPP) arrangement that was facilitated by the FRATIS development in the NCTCOG region.

The rollout of U.S. DOT 5.9 GHz Vehicle-to-Infrastructure (V-I) technologies in the NCTCOG region also provided a supplemental data stream of truck movement information, which was integrated with other regional ITS data by FRATIS. This improved integrated data set revealed a persistent bottleneck near the Alliance logistics park in Fort Worth. Moreover, analysis of road network attributes combined with stakeholder outreach revealed that there were no viable alternate routes nearby which could accommodate large trucks.

A new connector road to solve this problem had been proposed during development of the last RTIP, but did not receive funding due to uncertainty about its benefits. Using the FRATIS public sector performance measurement tool, the Freight Planner pulled peak hour truck delays developed from truck GPS probe data to firmly quantify actual freight delays caused by the bottleneck. This data was plugged into transportation demand and air quality models to assess the benefits of building the new connector versus a no-build option. The new data proved the value of the connector project to officials and stakeholders, enabling it to receive funding in the new RTIP. Trucking firms saved money on fuel that otherwise would have been wasted idling in traffic, and consequently reduced their emissions of diesel particulate matter, oxides of nitrogen, and greenhouse gases.

5.7 Improving Performance for a Time-Sensitive Air Cargo Supply Chain

Florida Refrigerated Trucking is a small regional transportation company focusing on perishable cargoes. A key growth market for the firm in recent years has been handling the domestic land leg of fresh strawberry shipments to Europe, Latin America, and the Caribbean. This requires a continuously monitored cold chain from the refrigerated warehouses around Plant City (where the bulk of Florida's strawberries are grown) to Miami International Airport, and then on to the fruit's final destination. Because of the cargo's perishable nature, these shipments must be picked up almost as soon as they are ready and transferred to the airport immediately (a distance of about 250 miles). This is a time-sensitive process that must be closely coordinated between the farm, Florida Refrigerated Trucking, and the freight forwarder at Miami International that is handling the airborne part of the shipment.

The Operations Manager at Florida Refrigerated Trucking heard about FRATIS through contacts in South Florida where a test deployment was already operational. In addition, Florida DOT had been testing a statewide truck parking availability application which was integrated with FRATIS. Having missed some delivery windows in the past due to not having the right equipment available (refrigerated van and tractor power) to pick up a load of strawberries at the right time, the Operations Manager signed up for this new parking application, as well as FRATIS traffic and routing information in South Florida since his shipments frequently encountered congestion there on the way to Miami for export.

FRATIS soon proved its value when a shipment of fresh strawberries became available for export. During route/asset planning for the upcoming week, the Operations Manager was able to pre-plan equipment and driver availability to pick up the shipment as quickly as possible. As it turned out the load would not be completely ready with all pertinent export documentation until first thing Wednesday morning. A driver that was already scheduled to be operating in Orlando on Tuesday would be available to get the load but would be nearing his Hours of Service limit for the day and would therefore have to stop for rest.

The Operations Manager instructed the driver to use the FRATIS parking application on his smartphone to find suitable parking near the refrigerated warehouse so that he could pick up the fruit first thing in the morning. The driver did so and was able to park overnight, pick up the shipment the following morning, and deliver it to Miami International in time for its scheduled departure. This saved the trouble and expense of having the driver return to the main terminal in Orlando then leave the next day to get the shipment, or alternately having to source equipment from farther afield to fulfill the shipment and meet customer expectations. The driver was also able to use FRATIS real-time traffic information to better plan his journey and avoid congestion in the Miami region.

In this scenario, real-time truck parking availability information was fed into FRATIS by Florida DOT and pushed out to Florida Refrigerated Trucking's drivers via a smartphone interface. This allowed the driver to find available truck parking at a specific location near his next pickup without violating Hours of Service rules. It also improved operational efficiency for Florida Refrigerated by avoiding unnecessary miles. This saved fuel and reduced emissions in the region. Once the driver was in the South Florida region, which already had fully implemented an initial FRATIS capability, he was able to access audible information regarding congestion on his route through data provided by the regional TMC and ITS sensors.

5.8 Improving Productivity for Intermodal Drayage Moves Over 100 Miles

XYZ Cartage is an intermodal drayage provider in Memphis, TN. The company has multiple pickups and deliveries on moves that are over 100 miles in length. Their fleet is mainly comprised of owner operators. It is imperative that each of their drivers average 500 miles a day (2,500 to 3,000 miles a week) to make the pay needed for an owner operator to operate his or her vehicle. The company historically has planned the moves the day before with matching deliveries with pickups to meet the 500 mile goal as well as not violating the hours of service rules (when unexpected delays occur). The company has recently enacted electronic logging mechanisms to comply with the Federal Motor Carrier Safety Administrations regulations. The net result is delays have prevented the owner operator for XYZ Cartage to make the mileage needed to operate which has resulted in increased driver turnover for a lose – lose situation. In an effort to comply with hours of service regulations, the electronic logs mandate, customer requirements, and get the needed miles for the owner operator to sustain their income, XYZ Cartage began using FRATIS to plan accordingly.

By utilizing FRATIS the company was able to route and plan the owner operators' days better to make sure all the customers and drivers needs were met. Since most of the deliveries were 'drops' and pickups were needed by railroad in-gate times, they were able to pre-plan drivers' daily schedules using historical traffic condition data provided by FRATIS. Delivery schedules were changed to reflect patterns of congestion identified with the data, providing better customer service to shippers while allowing drivers to make their mileage each day. Real time traffic conditions were used by XYZ dispatchers to re-route trucks as necessary, allowing for exception management during trips.

In this scenario, the dispatcher used previous congestion time periods to re-route the drivers on certain lanes to insure that the drivers' delays were limited. Additionally, they would monitor FRATIS for changes in routes and delays projected to change routing on specific lanes. Historical and current traffic data is relayed to the dispatcher through the FRATIS web portal, with FRATIS obtaining the data from Memphis area ITS networks and private traffic data providers. The net result was mileage increased for their owner operators which reduced driver turnover. As an added bonus, XYZ Cartage was able to recruit drivers based upon the number of miles their owner operators were driving as compared to the competition.

5.9 Reducing Operational Costs Through Better Asset Utilization

Inglewood Drayage operates a local cartage company in Southern California. They specialize in local moves for various companies around the Los Angeles area. Their fleet is comprised mostly of company trucks. They use cell phones as the primary method of communicating with their driver fleet. The company dispatcher heard about FRATIS through the Harbor Trucking Association and thought the program could help Inglewood Drayage operationally. His first concern is the rising cost of fuel. The dispatcher wanted to use FRATIS to see if he could reduce the amount of idle time waiting at various facilities to pick up and deliver units. Chassis management is another concern. With steamship lines now charging fees for chassis, it is imperative these chassis are returned as quickly as possible. The same issue occurs with empty steamship line containers. It is extremely important for Inglewood to balance all of these factors to insure the profitability for the company.

The dispatcher implemented several features of FRATIS to rationalize operations with the goal of saving fuel and minimizing costs related to chassis and empty boxes. Camera feed data from marine terminals at the San Pedro Bay ports allowed the dispatcher to plan work according to traffic conditions at the gates and identify opportunities to reduce idle time at congested gates by sending trucks to alternate ones that are less congested. This not only saves fuel, but also reduces emissions. When delivery schedules allow, the dispatcher sends trucks to the more congested terminals during off peak hours. Improving the utilization of driver time and tractor power in this way also permits Inglewood to return empty containers and chassis in a more timely fashion, thus reducing unnecessary charges related to equipment. All of the information together makes for the best assessment for the returning of units, as well as reducing fuel use, which is a major expense for the company.

In this scenario, the dispatcher used delays at the various gates and companies with projected wait times as the first and foremost rule when dispatching. This leads to a reduction in delay and wait time which reduces idle time. Terminal information is accessed through the FRATIS web portal with the dispatcher relaying information to drivers via cell phone.

5.10 Increasing Emergency Preparedness and Response Efficiency

XYZ Disaster Relief Agency operates a shipping hub out of Atlanta, GA that services the Southeastern United States in response to natural disasters, specifically major hurricanes. Countless organizations, structures, and peoples' lives depend on the efficient deployment of pre- and post-incident services by XYZ. In the event of a major hurricane, which can cover a vast area and inflict damages on a catastrophic level, it is often difficult for the agency to organize its movements and actions, leaving some thousands of individuals without adequate relief or support.

The XYZ Disaster Relief Agency has standard operating procedures that drive its response in preparation for, management of, and recovery from emergency conditions. Access to and management of real time information on weather conditions, product positioning, and travel conditions is critical. Delay or miss-information can lead to missed opportunities to equip a region with necessary supplies (e.g., water, non-perishable food items, fuel, plywood, generators). These preparation activities often overlap with evacuation activities within a region, further complicating efficient transportation.

Recognizing the potential impact of delays in effectively managing emergency preparedness and recovery activities,, the agency's Chief Operating Officer had been investigating new means of organization and communication when he came across the FRATIS system. FRATIS provided the opportunity to maximize the use of real time travel information, including ability modify routings based on traffic conditions. Its integration with regional TMCs and EOCs ensured users had access to typical daily traffic management activities as well as emergency management activities – including emergency response personnel involved in recovery activities. While the initial FRATIS system does not include hardened elements designed to prevent service outages, XYZ recognized that what it did provide was the best possible link to the information that is available.

The XYZ Disaster Relief Agency decided to begin using FRATIS. This involved installing a computer terminal with streaming FRATIS information in the agency's operations center. It also involved equipping its carriers (third party trucking firms) with computer terminals (dispatch) and their drivers with mobile devices/smartphones. The initial use of FRATIS for XYZ relates to emergency preparedness activities. The system identifies the most optimal and efficient routes for getting supplies into the threatened areas for pre-disaster preparation efforts. This, combined with the agency's data on needs by region, provides a real time element to fleet and carrier management activities.

Within six months of deploying FRATIS, XYZ Agency had an opportunity to test its effectiveness as South Florida braced for a Category 5 hurricane. With a five day notice, the preparations began throughout Miami-Dade, Broward and Palm Beach counties. As residents rushed to Home Depot and Lowes to purchase plywood and generators, and to Publix and BJs to stock up on canned goods and water, the transportation system was strained. As XYZ began to work with its local partners to stock shelters and support the retail giants in the repositioning of key products, the FRATIS system was used to monitor real time traffic information, effectively route trips, and match loads to available power. The real time traffic information allowed XYZ to improve the predictability of load arrival times by reducing the impact of delays. The agency estimated an overall ten percent increase in operational efficiency compared to previous response activities. In addition, it was able to mobilize 85 percent of its supplies prior to the storm hitting, up from an average of 70 percent.

Following the storm, XYZ also used FRATIS to facilitate its recovery activities. While much of the ITS infrastructure was damaged during the storm, and was generally not capable of identifying obstacles like downed power lines and debris in the roadways, it was effective in communicating those roadways confirmed open and passable. In addition, by subscribing to FRATIS, XYZ, as an emergency response partner, had a direct line of communication into the status of recovery activities. At the local level, County Emergency Operations Centers (EOC) manage the recovery efforts. City and State agencies communicate regularly with the EOCs regarding the recovery process. One of these agencies, the Florida DOT, follows a comprehensive emergency plan for recovery that prioritizes roadway segments, with the highest priority being interstates and major arterial corridors. FRATIS is connected to the TMC's Intelligent Transportation (ITS) network and receives updates from the County's EOC. Through the static information on which roads are to be recovered first, and dynamic information such as camera feeds and traffic data collected by FDOT's regional TMCs and the recovery status updates from the EOC, dispatchers are able to access this information and plan alternate routes with greater efficiency, speeding up delivery of disaster relief supplies such as water and fuel for residents stranded by the hurricane.

The system was used to communicate staging areas for trucks moving into South Florida carrying water, ice, food, medical supplies and fuel. As roadways were opened, FRATIS was used to provide route information to the dispatch operations of trucking companies – providing instruction on how to best access the most distressed residents. Dispatchers reached out to their drivers using mobile devices, including smartphones, CB radios, and satellite phones. In addition, as systems came back online, FRATIS truck travel times and routes were updated almost instantly as the first few trucks equipped with GPS probes connected to FRATIS entered the region. Overall, recovery time for South Florida was 8 percent faster than average.

Since the implementation of the FRATIS system, XYZ has been able to more rapidly prepare for and provide relief to regions affected by major disasters. The system has proved itself beneficial by not just measures of homes and businesses still standing, but also in peoples' lives saved due to the coordination of the system. When the hurricane came through soon after XYZ's implementation of FRATIS, XYZ was able to immediately prove the value of the system.

6.0 Summary of Impacts

6.1 Operational Impacts

Anticipated operational impacts of FRATIS revolve around the new system interfaces that would be required for the seven application areas, as shown below. These involve both new user interfaces (previously nonexistent since there is no current FRATIS system), as well as data feeds between FRATIS and its various data sources.

Planning, Dynamic, and Regulatory Route Guidance

As detailed previously, these functions will allow drivers and dispatchers to reroute around congestion, incidents, or other issues dynamically, and in real time. These functions will also allow dispatchers and drivers to make the most informed routing choices before trip outset, including consideration of regulatory requirements, such as truck restrictions (including OSOW).

While these functions will not fundamentally change the dispatch process, it will require dispatcher interface with the new FRATIS application environment. This interface will occur via a web site accessed through a computer terminal or tablet. Drivers will have two different interfaces, depending on whether they are operating a truck when they access the application. While driving, information from this application will be audible-only. While stopped, drivers will have an interface similar to dispatchers and operations managers. This application will require new interfaces between the FRATIS application environment and regional ITS databases, third-party truck movement data providers, and intermodal terminals.

Real-Time Reliable Information for Freeways, Port/Terminal Regions, and Major Freight Arterials

This part of the FRATIS application suite would collect and disseminate accurate real-time travel information for key freight nodes (such as ports or rail terminals) and major freight corridors (freeways and arterials) using the same web and mobile interfaces described above. This information, especially as it relates to terminals and arterials, would fill a major gap in freight ITS data today. Dispatchers and operations managers will interface with the new system using the web application, while drivers would be restricted to stationary access only, or audible alerts if that capability is developed. Assuming users find the data provided to be useful and accurate, widespread adoption is expected. Drivers and dispatchers would be able to use the information to exception manage in real time. This application will require new interfaces between the FRATIS application environment and regional ITS databases, third-party truck movement data providers, and intermodal terminals.

Weather Information (Including Predictive)

Predictive weather information will be provided by the web interface as well. Dispatchers would access this information from a computer or tablet and relay any relevant alerts to their drivers in the affected areas. Drivers would also access the information through the web application, since it is likely this information would be needed primarily during trip planning, rather than during a trip. This application will require a new interface between the FRATIS application environment and weather/road condition data from the U.S. DOT Road Weather Management Program covering route-specific weather conditions and forecasts.

Public Sector Data Output – Performance Measures

Public sector transportation staff will also interface with the system through a new web portal. This portal could be customized with dashboard-style reports, which track freight-specific performance measures for the region on an ongoing basis. Depending on data availability, performance measures could potentially be customized by users. Public agencies will use the information for system management, policy decisions, and agency performance tracking over time. This application will require new interfaces between the FRATIS application environment and regional ITS databases, and state DOT performance indicators.

Terminal Queue Status (including Video)

Terminal queue information, including video feeds for relevant terminals, will be accessed through the web interface. Dispatchers and operations managers will be able to access this information at any time, but drivers will be restricted to viewing the camera feeds while stationary to avoid distracted driving issues. If there is a text-to-speech function, queue length and wait times could be relayed to drivers audibly. With advanced knowledge of terminal queue length and waiting times, dispatchers and drivers will alter schedules, where possible, to avoid inordinate waiting time at the gates. This application will require new interfaces between the FRATIS application environment and regional ITS databases and intermodal terminals.

Appointment Status

An appointment status function would provide real-time updates on container availability at ocean and rail terminals, thereby giving truck drivers, dispatchers, and operations managers better information by which to plan trips and asset utilization. A dispatcher, using the web interface on a PC or tablet computer, would have instant updates on container availability at each relevant terminal. If they know that a driver is or will be in the terminal or nearby to pick the load up, they will contact that driver and advise them of the same. Drivers using a mobile device will access the information through the web interface (while stationary), or will receive audible alerts for container availability and appointment status at terminals relevant to them (if they are operating a truck). This application will require new interfaces between the FRATIS application environment and intermodal terminals.

Container Load Matching

Dispatchers will match containers using the web interface. A terminal operator data feed will supply a loaded container number and trucking firm Standard Carrier Alpha Code (SCAC) whenever a loaded container outgates from the terminal. Dispatchers and operations managers will review this information and coordinate load-matching decisions with the other parties involved (e.g., receivers of freight or the trucking firm moving the import load) on a case-by-case basis. Truck drivers will access the information through the web portal as well, using an enabled mobile device while stationary. Given the complexity of load matching, it is not anticipated that this information would be available in an audible fashion while a driver is moving; however, a dispatcher can relay the relevant information to a driver via CB or other means. This application will require new interfaces between the FRATIS application environment and intermodal terminals.

6.2 Organizational Impacts

Public Sector

Within major metropolitan regions in the U.S., state DOTs, MPOs, and local transportation agencies and operators operate ITS sensor systems, and collect and fuse this information using TMCs or other means of transportation data fusion. The results of these systems support both real-time traffic information in a region (e.g., DOT traffic web site, network of Dynamic Message Sign (DMS)), and historical analysis of traffic data to support transportation planning for the region.
The impact of FRATIS on these public sector agencies would be primarily focused in two areas:

1. Fusion of ITS sensor data (and potential expansion of ITS sensors) and performance measurement on freeways and arterials that are key to freight movement in the region; and
2. Collection (through FRATIS) of sanitized “trucks as vehicle probes” data through links to private sector system.

Public agencies, operating under the auspices of the FRATIS PPP, will be responsible for system setup, operations, and maintenance.

Private Sector

For dispatchers and trucking company operations managers, the organizational impacts of FRATIS could be significant due to the improved efficiencies that could result based on the deployment of the FRATIS functions described in Section 4.0. It is conceivable that FRATIS could automate a measurable percentage of dispatching operations, such as:

- Reducing the time required for pretrip planning;
- Automatically rerouting drivers around congestion (dispatcher time savings); and
- Facilitating automated load matching (dispatcher time savings).

In addition, even in the absence of FRATIS today, a number of private sector firms, such as INRIX and TomTom, have already successfully integrated available real-time public sector ITS data (as described above) into their current route planning and dynamic routing offerings. Based on this, the advent of a FRATIS system would mainly impact these types of private sector companies by providing them access to new markets via intermodal freight-specific services, such as intermodal terminal queue delay measurement, truck terminal reservations, and container load-matching services.

Public-Private Partnerships

As presented in Section 4.0, this ConOps envisions that FRATIS should be deployed at the regional metropolitan level by public-private partnerships (PPP) that include transportation public agencies, transportation data/routing/fleet management companies, and local/regional drayage trucking companies. The organizational impact here would thus be the creation and maintenance of this PPP by the public and private interests.

6.3 Impacts During Development

Impacts to stakeholders during the upcoming system development and limited testing phase are expected to be minimal at first, limited primarily to technical scoping meetings to further refine the system and its capabilities for specific applications/features. As a precursor to the development phase, select groups of FRATIS users and public sector stakeholders are currently asked to attend Walk-Through meetings for this ConOps, as well as the System Requirements Specifications, to provide feedback on the drafts of those documents. This feedback may include information from stakeholders that can further assist in assessing potential impacts of FRATIS during the development phase.

The upcoming FRATIS development and testing phases are expected to involve the following activities:

- Meetings with select stakeholders to review test parameters, partner roles, and conduct of demonstrations;
- Operational impacts during testing include partner labor to connect the necessary data streams to enable a system test, monitoring of application usage during the test, and reporting of results (preferably through an automated data interchange); and
- Test participants may also need to meet with a third-party independent evaluator if such evaluations are conducted for FRATIS tests.

For this ConOps project, additional information on impacts during the development phase is currently being assessed by Cambridge Systematics, and will be included in the upcoming "Assess the Test-Readiness of FRATIS" technical memorandum.

7.0 Analysis of Proposed System

7.1 Summary of Improvements

Since there is no existing FRATIS in place, system-specific changes cannot be described. However, by designing and implementing a system that meets the user needs described above, a number of benefits will be realized, relative to the current situation described in Section 2.0:

- **Reduced empty containers and bobtails –** Better real-time data on terminal conditions (e.g., queue times and expected closures within the terminal) would allow drayage companies to perform their own load matching and reduce bobtails and 'dry runs'. A container matching system would provide more visibility in terms of empty containers potentially available for reloading, allowing trucking firms to optimize daily load planning and minimize bobtails. This will reduce costs to the trucking companies and mitigate congestion associated with truck movements.
- **Air quality improvements –** Major reductions in carbon monoxide, diesel particulate matter, and other pollutants would be achieved by reducing bobtails (which eliminates trips) and smoothing the flow of trucks to and from intermodal terminals (which reduces unnecessary idling). Real-time rerouting of trucks can also reduce emissions from trucks idling in traffic.
- **Real-time rerouting capability –** By receiving travel information before and during a trip, truck drivers and dispatchers can reroute in real time around incidents, congestion, or other delays, thereby improving productivity and on-time performance.
- **Safety –** Rerouting and route planning features of FRATIS will improve safety by ensuring that trucks do not encounter hazards, such as low bridges along their routes. In the case of OSOW loads, these trucks will only be routed along roads that are well equipped to handle such traffic, thereby improving safety for the traveling public.
- **Regulatory compliance –** Better information about regional or local freight movement regulations, OSOW routes, and automated OSOW permitting provided by FRATIS will help ensure better overall compliance with applicable laws and regulations among FRATIS users.
- **Performance measurement –** A major anticipated data output for public agency stakeholders will be performance measures tailored to freight operations in a region. Many regions currently struggle to develop and report adequate freight performance measurements, often due to a lack of adequate data to create meaningful measures.

7.2 Disadvantages and Limitations

Disadvantages and limitations of the proposed system include:

- **User learning curve –** Participating trucking companies will have to obtain FRATIS applications and learn how to use them. For dispatchers, this will involve learning to navigate the web portal and use the different features on the site. Truck drivers will need to learn how to use FRATIS on their preferred device; some drivers may be less familiar with new technologies, creating a steeper learning curve.
- **Rerouting response time –** Dynamic rerouting is an inherently complex operation, which requires considerable computing power. As such, it may not be viable to perform the necessary calculations on a smartphone or other small mobile device; rather, it will more likely have to be done on a central server and then pushed out to user devices. While this concept has already been proven, notably with C TIP, it could introduce some delay/latency into the rerouting process. The precise timing issues associated with this limitation will be more fully explored during the FRATIS testing phase.
- **Geographic coverage –** in a given metropolitan region, it would be unreasonable to expect that every single possible route that could be used by a truck would have real-time information available to it; FRATIS will need to focus primarily on critical and major freight freeways, arterials and intermodal connectors.

7.3 Alternatives and Tradeoffs Considered

During the FRATIS post-chartering meeting, some alternatives and tradeoffs were discussed which affected this ConOps and will likely impact FRATIS. These are:

- **U.S. DOT Open-Source constraint –** U.S. DOT wishes to develop FRATIS using open-source applications. An alternate approach would involve choosing from available commercial sector applications already in the marketplace, and leveraging them to create a value-added FRATIS. It is possible that this approach would lead to more widespread commercial adoption of FRATIS, or a faster transition into mass usage. However, some development flexibility would be lost, and it was decided that an open architecture would better allow independent developers to create new FRATIS applications.
- **Regional focus –** Different regions of the country vary widely in terms of the freight and transportation system operational data available in a format that can be used for FRATIS. Freight-relevant ITS data are gathered in numerous ways, with different update frequencies and different levels of automation. Therefore, it was assessed that FRATIS should be developed regionally by public and private partners versus a national system that would attempt to be all things to all users.
- **Limited primary user groups –** The team limited the primary FRATIS user types to two: trucking company dispatchers/operations managers, and truck drivers. It is recognized that there are many other actors in the freight transportation realm, including 3PL firms, receivers, ocean carriers and rail lines, and regulatory personnel.

Designing a system that responds to all of these groups would likely be complicated, time consuming, and costly. This could potentially result in a deployment scenario where you have a very complex system that tries to do too much, for too many, and is therefore underutilized. In order to ensure that a viable FRATIS can be developed within reasonable time and resource constraints, a determination was made to focus FRATIS on these two primary user groups, supplemented by a series of secondary users as previously described.

8.0 Notes

8.1 Use of RITA/NOBLIS Best Practices Guidance in Developing This ConOps

In developing this ConOps, and in particular, in developing the detailed outline and focusing the level of content to include in each section and subsection, the Cambridge Systematics team relied extensively on the following ConOps example, which was documented in the U.S. DOT-Research and Innovative Technology Administration (RITA) "ITS Lessons Learned Database:

- StarTran AVL Concept of Operations[9] – This ConOps focused the City of Lincoln, Nebraska's experience in using Systems Engineering (SE) practices to define needs for an AVL project.

The best practices and lessons learned guidance from this ConOps were analyzed and documented by Noblis in the RITA ITS Lessons Learned database as follows:

- A ConOps is a useful tool for the initial definition and justification of ITS projects. The StarTran AVL ConOps is a good example of how an SE ConOps should be applied on ITS projects. A ConOps needs to be prepared properly in order to serve its intended purpose. Users need to make sure that the ConOps is written so that the systems engineer or developer will understand precisely what problems users are trying to solve and their purpose for solving them. A ConOps should not include descriptions of system design components, or prescribe technology solutions to address users' problems. A ConOps needs to stay focused on "what" the users need, rather than "how" to design systems to solve user problems.
  - The StarTran AVL ConOps provided a number of examples of the proper development of a ConOps for an ITS project, including the following:
    - Concisely define the system in order to avoid any confusion about what needs to be developed.
    - Remain focused on the operational system without dictating design features.
    - Provide descriptions of the current system, including the inadequacies associated with it. This helps the system developer to understand the problems that the owners/operators need to fix.
    - Write the ConOps with the systems engineer/developer in mind. It is the engineer/developer that will translate the ConOps into an operational system, so it is important for the users to express their needs, such that the engineer/developer can understand the problem and what is needed to resolve it.

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[9] http://www.itslessons.its.dot.gov/its/benecost.nsf/ID/E82598B5DA83AAB9852571A9004AAA1E?OpenDocument&Query=Home.

- Ensure that the needed functionalities of the system are easy to identify. The StarTran ConOps included descriptions of system functionality written as "shall" statements. This feature in the ConOps allows engineers to isolate and extract the required system functionalities more quickly.
- Avoid assumptions about the internal content and structure of the eventual system. This is done to avoid getting lost in details, avoid premature feasibility (mis)judgments, and preclude the early insertion of pet design concepts.

8.2 Acronyms and Abbreviations

Acronym/Abbreviation	Definition
3PL	Third-Party Logistics
API	Application Programming Interface
AED	Application Enabled Device
ANSI	American National Standards Institute
ATIS	Advanced Traveler Information Systems
ATMIS	Advanced Transportation Management and Information System
AVL	Automated Vehicle Locator
BNSF	Burlington Northern and Santa Fe
CB	Citizens Band
CSA	Compliance, Safety, Accountability
C-TIP	Cross-Town Improvement Project
CVISN	Commercial Vehicle Information Systems and Networks
ConOps	Concept of Operations
DMA	Dynamic Mobility Applications
DMS	Dynamic Message Sign
DSRC	Dedicated Short-Range Communications
EDI	Electronic Data Interchange
EOC	Emergency Operations Centers
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRATIS	Freight Advanced Traveler Information System
GHz	Gigahertz
GPS	Global Positioning System
HAZMAT	Hazardous Material
HOS	Hours of Service

Acronym/Abbreviation	Definition
HTA	Harbor Trucking Association
IEEE	Institute of Electrical and Electronics Engineers
IFTWG	Intermodal Freight Technology Working Group
IT	Information Technology
ITS	Intelligent Transportation Systems
MCP	Mobile Computing Platform
MPO	Metropolitan Planning Organization
MTA	Metropolitan Transportation Authority
MTO	Marine Terminal Operators
NCTCOG	North Central Texas Council of Governments
OSOW	Oversize Overweight
PPP	Public-Private Partnership
RFID	Radio Frequency Identification
RITA	Research and Innovative Technology Administration
ROI	Return of Investment
RITTS	Regional Integration of Intelligent Transportation Systems
RTIP	Regional Transportation Improvement Program
SCAC	Standard Carrier Alpha Code
SE	Systems Engineering
SMS	Short Message Service
SwRI	Southwest Research Institute
TMC	Transportation Management Center
TTS	Text to Speech
UP	Union Pacific
U.S. DOT	United States Department of Transportation
V-I	Vehicle-to-Infrastructure
V-V	Vehicle-to-Vehicle
VFN	Virtual Freight Network
XML	Extensible Markup Language

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