FRATIS Concept of Operations

Assess Test Readiness of FRATIS (Task 4)

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16. Abstract

This technical memorandum presents a concise assessment of the key technical and nontechnical issues and limitations related to field-testing the Freight Advanced Traveler Information System (FRATIS) Dynamic Mobility Applications (DMA) bundle and its applications based on a near-term testing window of one year. There are relatively few technology limitations, although private-sector data will be required (and may need to be purchased) to support some FRATIS functionality. Nontechnical issues mainly revolve around establishing, maintaining, and leveraging the appropriate relationships with public- and private-sector stakeholders, and developing the right institutional environment for the FRATIS public-private partnership. The memorandum also identifies challenges and issues related to the near-term performance metrics and goals for FRATIS. Performance metrics are rated based on ease of measurement. Testing of FRATIS in the near term should result in relatively easy to measure benefits related to improved freight-traveler-information, route-planning, and dynamic-routing functions. Benefits related to eliminating unnecessary truck trips and reducing truck-trip times may be more difficult to measure. It will therefore be necessary to develop a measurement approach that incorporates field data as well as an analytical approach to estimate "what if" benefits of a full systemwide regional deployment. Finally, measurement of truck-trip-safety improvements associated with FRATIS will probably be impossible to measure with any certainty; it is therefore recommended that the evaluation focus instead on developing estimates of how such a benefit might be realized.

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Identifier	Date of Issue	Summary of Changes
1.0 draft	6/15/2012	Initial draft for FHWA review and comment
1.1 draft	6/15/2012	Second draft addressing changes to Table 2
1.2 draft	7/19/2012	Third draft addressing Noblis comments

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Figure 1–1 Cambridge Systematics, Inc.

1.0 Assess Test Readiness of FRATIS

1.1 Purpose

The purpose of this task is to present a concise (12 pages maximum) assessment of key technical and nontechnical issues related to field-testing the FRATIS bundle and its applications. More specifically, this document presents:

- An assessment of the technology readiness of the FRATIS bundle and its component elements to be tested in the field over the next year, and to identify which applications may require further research; and
- Based on this near-term testing window, identify challenges and issues related to the recently developed Transformative Goals and Performance Measures for FRATIS.

1.2 Reference Documentation

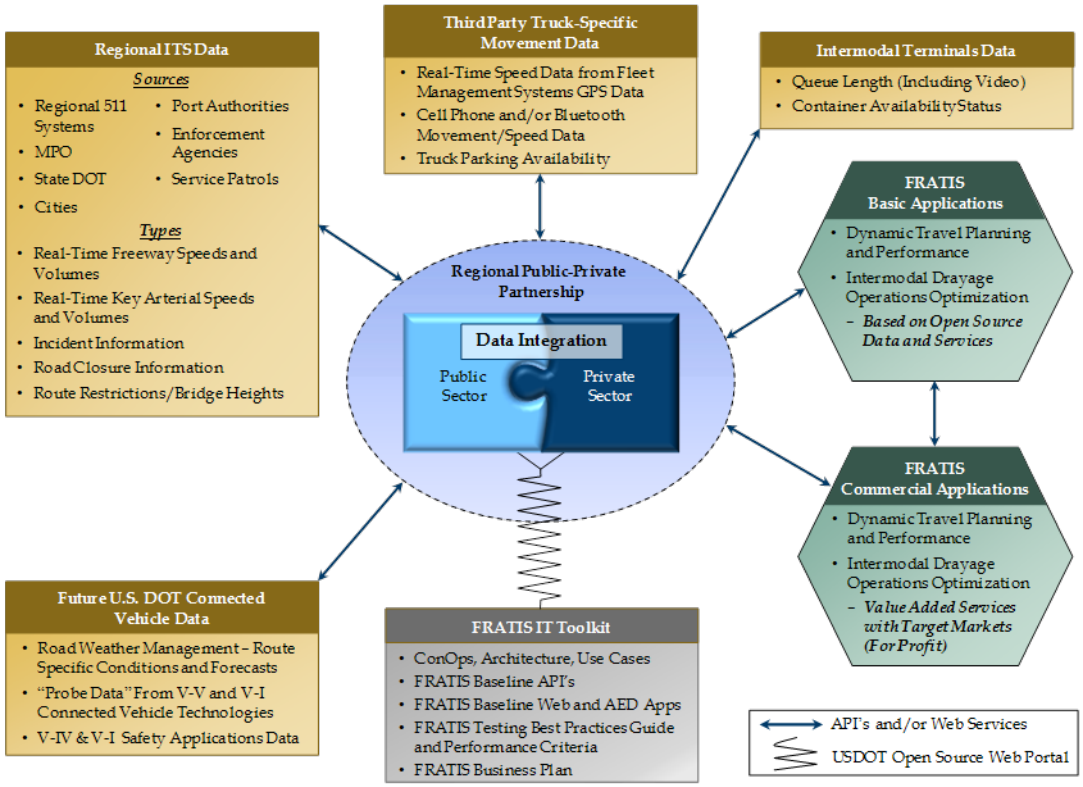
The following documents are referenced multiple times in this technical memorandum. It is recommended that the reader have these three documents available as they review the discussion presented herein.

- *Freight Advanced Traveler Information System Concept of Operations*; Final Version 2.1; April 20, 2012 (hereafter referred to as: FRATIS ConOps).
- *FRATIS ConOps: Assessment of Relevant Prior and Ongoing Research and Industry Practices*; Final; June 13, 2012 (hereafter referred to as: FRATIS SOP, SOP = State of the Practice).
- *Freight Advanced Traveler Information System Functional Requirements*; Version 2.0; May 17, 2012 (hereafter referred to as: FRATIS Sys-Rqmts).

1.3 FRATIS Technology Readiness – Introduction

Figure 1.1 below provides the overall guidance for FRATIS development that was provided in the FRATIS ConOps document. The subsections below are grouped according to the seven boxes in this diagram. For the applications or technical capabilities associated with each grouping, a discussion of the technical and nontechnical issues are discussed, with a particular focus on the readiness of the applications to be deployed within the next 12 months.

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



Source: Cambridge Systematics, Inc., August 2012.

Additionally, Table 1.1 below, which was provided in the FRATIS Sys-Rqmts document (as Table 3), provides the categories of technology essential functions for FRATIS – these also will be referred to in the discussion below. At the end of each of these subsections, recommendations on the readiness of the applications/technologies also are provided. Additionally, the term "System Developer" is used to identify the development and testing team for the next phase of FRATIS, and the term "Independent Evaluator" is used to identify the corresponding evaluation team contractor.

Finally, there are some test readiness issues that are fundamentally global in nature and will vary to some degree between test locations. These include communications protocols, data latency, algorithm development, and data ownership. It is recognized that these factors will have to be dealt with, but they cannot be completely evaluated until a test site is chosen and the unique data and operational requirements of that site are assessed.

Table 1-1. FRATIS Essential Functions

Functional Group	Essential Function
Real-Time Reliable Information for Freeways, Port/Terminal Regions, and Major Freight Arterials	• Real-Time Reliable Information for Freeways, Port/ Terminal Regions, and Major Freight Arterials
Planning, Dynamic, and Regulatory Route Guidance	• Preplanning Regional Truck Trips • Congestion Avoidance Dynamic Routing of Trucks • Automated Routing and Permitting for Oversize Overweight (OSOW) Trucks
Weather Information (Including Predictive)	• Real-Time Route-Specific Weather Conditions and Forecasting
Terminal Queue Status (Including Video)	• Real-Time Information on Length and Wait Times for Truck Queues at Freight Terminals
Appointment Status	• Real-Time Information on Container Status and/or Pickup/ Delivery Appointments at Intermodal Terminals
Public-Sector Data Output – Performance Measures	• FRATIS Open-Source Data Feed to Public-Sector Agencies to Assist in Freight Transportation Performance Measurement
Container Load Matching	• Container Load-Matching with Trucks to Support Reductions of Empty Container at Intermodal Terminals

1.4 FRATIS Technology Readiness – Regional ITS Data

Technical Readiness

In most metropolitan regions, regional ITS data collection is a mature technological capability, and can provide a major source of information to support FRATIS traveler information components, such as Real-Time Reliable Information for Freeways, Preplanning Regional Truck Trips, and Congestion Avoidance Dynamic Routing of Trucks. However, in many cases, significant gaps in ITS infrastructure exist near port and intermodal facilities. Given this, when developing data for the Port/Terminal Regions and Major Freight Arterials FRATIS functions, it may be necessary for the System Developer to deploy ITS data collection technologies to fill in the gaps in the ITS infrastructure. For example, this might include deploying speed and volume sensors on a major arterial that routes port traffic onto a nearby freeway.

A related issue here is data latency, or the time it takes to deliver the information to a trucker or dispatcher via the FRATIS system. Collating and distributing this information in FRATIS will add another layer of data processing and will therefore introduce some latency. The FRATIS ConOps and Sys-Rqmts documents define acceptable latency standards; the ability of regional ITS data resources to meet these standards will have to be assessed early in the development phase.

Nontechnical Readiness

It will be incumbent upon the System Developer to work with public-sector agencies to obtain system access to ITS data feeds. In many cases, the added complexity of having to deal with multiple agencies will present a challenge. Establishing successful programmatic and technical relationships with these agencies will be a major factor in ensuring success on testing FRATIS.

Assessment Recommendations

- Assess and fill gaps in ITS infrastructure necessary to support FRATIS operations.
- Build and maintain successful technical working relationships with public-sector agencies that will ensure access to needed ITS data sources.

1.5 FRATIS Technology Readiness – Third-Party Truck-Specific Movement Data

Technical Readiness

There is a significant potential to enhance the FRATIS ITS public-sector data with private-sector data sources concerning truck-specific movements. Examples of these data sources, which can support the freight traveler information-related FRATIS-essential functions, include:

- Private traffic data providers (e.g., INRIX);
- Vehicle location/travel data from RFID toll tags and license plate readers;
- Truck Fleet Management System real-time GPS travel data (e.g., XATA);
- Location-enabled cell phones (i.e., carried by truckers); and
- Truck dispatch platforms (e.g., Profit Tools).

These data sources already exist as either mature or recently deployed technologies, and should be investigated in detail during the development phase by the System Developer. The mix of the use of these technologies during the testing phase will largely be determined by the gaps in the ITS data for a given region. However, specialized data for some FRATIS applications may only be available from private data sources. As related to the essential FRATIS functions, this includes:

- Automated Routing for Oversize Overweight (OSOW) Trucks – Emerging national-level applications for freight-specific routing (e.g., TomTom);[1] and
- Preplanning Regional Truck Trips – Truck parking data sources (e.g., ParkingCarma).

[1] Note that regional ITS data on truck route restrictions/bridge heights as depicted in Figure 1.1 may be a key data input for automated OSOW routing applications (as well as other FRATIS functionalities), but this data alone will not provide an automated OSOW routing capability. Hence these data/applications will likely need to be purchased from private sources, in keeping with a core FRATIS philosophy of not reinventing applications already available in the private marketplace.

These applications already are being used by segments of the freight industry today. They represent a potential source of critical data that can both support and interface with FRATIS, as covered in the FRATIS ConOps and Sys Rqmts documentation.

Nontechnical Readiness

Key business relationships with the private-sector companies who manage these potential FRATIS data sources will need to be explored and developed by the System Developer. In some cases, information may be obtained voluntarily if the company perceives a benefit to interfacing their data with FRATIS; in other cases, data streams may need to be purchased. Data privacy will be a key consideration here, and will have to be negotiated for any data sharing or purchase agreement.

Assessment Recommendations

- These data sources already exist as either mature or recently deployed technologies, and should be investigated in detail during the test development phase by the System Developer, and then deployed as necessary during the test to address data gaps.
- Where necessary, data steams critical to FRATIS essential functions should be purchased.

1.6 FRATIS Technology Readiness – Intermodal Terminals Data

Technical Readiness

FRATIS data related to drayage optimization will be dependent on private-sector data sources. These data sources already exist as either mature or recently deployed technologies, and should be investigated in detail during the test development phase by the System Developer. As related to the essential FRATIS functions of drayage optimization at intermodal terminals, these applications include:

- Real-Time Reliable Information for Port/Terminals – Terminal web site data;
- Real-Time Information on Length and Wait Times for Truck Queues at Freight Terminals – Private-sector terminal video monitoring and RFID systems, as well as Bluetooth technology and small sensors embedded in the roadway to measure queue length and wait times;
- Real-Time Information on Container Status and/or Pickup/Delivery Appointments at Intermodal Terminals – Deployed terminal appointment systems data (e.g., Advent); and
- Container Load-Matching with Trucks to Support Reductions of Empty Containers at Intermodal Terminals – Mature web-based load matching systems (e.g., Loadmatch.com).

These applications already are being used by segments of the freight industry today. They represent a potential source of critical data that can both support and interface with FRATIS, as covered in the FRATIS SOP documentation.

Nontechnical Readiness

Key business relationships with the private-sector terminal operators who manage these potential FRATIS data sources will need to be explored and developed by the System Developer. In most cases, information may be obtained voluntarily if the terminal perceives a benefit to interfacing their data with FRATIS – it therefore behooves the System Developer to make the benefits case to the terminal operator to participate in FRATIS. Again, data privacy and ownership issues will have to be addressed early on, regardless of whether the data is shared on purchased.

Assessment Recommendations

- These data sources already exist as either mature or recently deployed technologies, and should be investigated in detail during the test development phase by the System Developer, and then deployed as necessary during the test to support FRATIS essential functions.
- The System Developer will need to make the benefits case to the terminal operator to participate in FRATIS – this will be required to facilitate access to the terminal operations system data that can support FRATIS drayage optimization essential functions.

1.7 FRATIS Technology Readiness – Future U.S. DOT Connected Vehicle Data

Technical Readiness

U.S. DOT Connected Vehicle data (e.g., V-I and V-V applications) that could support FRATIS are unlikely to be available in the near term to support FRATIS testing. The Dynamic Mobility Applications Program and the Real-Time Data Capture and Management Program are just beginning to proceed with their test programs.

However, given the critical importance of better localized and predictive weather information for trucking fleets in many regions, the System Developer should coordinate with U.S. DOT to see if there may be an opportunity to conduct tests of the CLARUS Initiative in conjunction with FRATIS testing. Moreover, the FRATIS testing program could benefit from coordination with the Connected Vehicle Safety Pilot as it relates to commercial vehicle safety to identify potential synergies with freight mobility applications.

Nontechnical Readiness

The System Developer should coordinate with RITA during the FRATIS test to monitor future developments in the Connected Vehicle program. In particular, for later phases of FRATIS, Connected Vehicle applications coming out of the Real-Time Data Capture and Management Program may be able to provide enhanced traffic and other travel data to support FRATIS.

With respect to data security, the FRATIS ConOps and Sys-Rqmts documents both state that whatever Connected Vehicle data is used in FRATIS will adhere to the security and privacy requirements of the Connected Vehicle program.

Assessment Recommendations

- Recommendation to move forward with FRATIS development and testing without any data connectivity to any Connected Vehicle technologies, since such technologies are still in their infancy.
- Work with U.S. DOT to determine if elements of the CLARUS weather technology system could potentially be tested alongside FRATIS in the near term, and whether coordination with freight elements of the Connected Vehicle Safety Pilot may benefit an initial FRATIS test.

1.8 FRATIS Technology Readiness – FRATIS Basic Applications

Technical Readiness

As detailed in the FRATIS ConOps, 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 thus likely be expected to access all FRATIS applications/functionality from a PC or tablet device. Correspondingly, for Truck Drivers, the primary FRATIS information dissemination method will be through an Application Enabled Device (AED), which in the near term would likely take the form of FRATIS applications on a Smartphone (in audio-alert-only lockdown mode while the vehicle is moving), or FRATIS applications, on a vehicle routing device (e.g., TomTom).

The basic applications to support the above platforms are based on current IT state-of-the-art practices and technologies. More specifically, 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.

Nontechnical Readiness

The only limiting factor here will be establishing necessary business relationships (or retail interactions) to deploy FRATIS applications on specific industry platforms (e.g., iPhone).

Assessment Recommendations

- Proceed to develop and test FRATIS based on current state-of-the-art APIs best practices and/or Web Services best practices – there are no technical limiting factors for these technologies regarding FRATIS.

1.9 FRATIS Technology Readiness – FRATIS Commercial Applications

Technical Readiness

There are no technical limiting factors to the enhancement of the FRATIS Open Source architecture, data and baseline applications by the private sector into value-added for-profit FRATIS functions.

Nontechnical Readiness

During FRATIS testing, the System Developer should encourage private-sector participants to enhance FRATIS Open Source Applications.

Assessment Recommendations

- No limiting factors – FRATIS testing can be a means to highlight to the private sector the potential for enhancement of FRATIS applications to support their own service offerings.

1.10 FRATIS Technology Readiness – FRATIS IT Toolkit

Technical Readiness

As defined in the ConOps, the FRATIS IT Toolkit would provide the key documentation, software code and other necessary guidance information that a regional public-private partnership would need to deploy FRATIS. Software to be included would consist of: baseline APIs related to the FRATIS Essential Features, baseline web site XML coding, and baseline application code for Application Enabled Devices. These would be accessed through the U.S. DOT Open Source Portal, which currently is under development. The technical model for this worked successfully on a smaller scale recently for the dissemination of U.S. DOT Electronic Freight Management guidance documentation, architecture and software code via a web site with document download capabilities.

These technologies are fully mature, and although the U.S. DOT Open Source Portal is not fully deployed yet, it can be assumed that it will be available to support the FRATIS testing program.

Nontechnical Readiness

There are no nontechnical issues associated with implementation of this technical approach for FRATIS guidance documentation and open-source software dissemination.

Assessment Recommendations

- The System Developer should work with U.S. DOT to facilitate dissemination of FRATIS documentation and software through the Open Source Portal at the conclusion of the FRATIS testing effort.

1.11 FRATIS Technology Readiness – Public-Private Data Integration and Partnership

Technical Readiness

FRATIS has been designed to be deployed based on collaboration between the public and private sectors, with regional DOTs, MPOs, trucking companies, the intermodal freight industry, and mobile technology vendors partnering to deploy FRATIS within a freight-critical metropolitan region. It is anticipated that this public-private partnership will administer the operations and maintenance of FRATIS, with the private partners primarily acting as data providers and public-sector agencies providing labor and physical requirements (e.g., server space) to stand up the system. Operations and maintenance may be completed using in-house staff and IT resources, or it may be performed by a government contractor.

There are no technical limiting factors to this approach.

Nontechnical Readiness

Institutional factors will be of most importance in ensuring the readiness of this approach to support FRATIS testing. In a given region, a credible collaboration of public-agency and private-sector partners will be essential towards successful testing of FRATIS. Therefore, MOUs, data sharing agreements, development and maintenance of a Steering Committee, and other institutional collaborative tools and methods should be implemented here.

Assessment Recommendations

- To facilitate successful testing of FRATIS in a metropolitan region, MOUs, data sharing agreements, development and maintenance of a Steering Committee, and other institutional collaborative tools and methods should be implemented.

1.12 Test Readiness Challenges and Goals Related to the Transformative Goals and Performance Measures for FRATIS

Table 1.2 below has been developed based on Transformative Goals table (Table 9.1) from the FRATIS SOP document. Here, the table has been modified in two key areas to support the test readiness assessment:

- Only the “near-term” goals have been included, since the test readiness guidelines are focused on what might be achieved by FRATIS within a short period of time; in this case, near term was defined by the FRATIS SOP to be less than five years. Thus, the *Transformative Performance Targets* presented here should form the performance goals baseline for the upcoming testing of the FRATIS applications.
- *Ease of Measurement* ratings have been applied. Here, *Ease of Measurement* refers to the level of difficulty in which these benefits might be measured in a pilot test or initial phases of deployment of FRATIS.

Table 1-2. Summary of Initial FRATIS Goals, Performance Measures, and Performance Targets – Near Term
With Ease of Measurement Levels

Goal	Performance Measure	Transformative Performance Target	Predominant Benefit(s)	User-/System-Orientation	Source
Improve travel time	Travel time	15% travel time reduction	Mobility	System-/ User-Oriented	C-TIP
Reduce fuel consumption	Fuel consumption	5% reduction in fuel use	Energy	System-/ User-Oriented	C-TIP
Reduce emissions	Level of criteria pollutants and greenhouse gas (GHG) equivalents	5% reduction in criteria pollutants (near) 5% reduction in GHG equivalents	Environment	System-/ User-Oriented	C-TIP
Reduce bobtail trips	Number of bobtail trips	10% reduction in bobtail trips	Efficiency	System-/ User-Oriented	C-TIP
Reduce terminal wait times outside the gates	Terminal queue time	20% reduction in terminal queue times	Efficiency	User-Oriented	FIRST Evaluation
Improve truck trip safety	Number of freight-involved incidents (e.g., bridge strikes)	30% reduction in freight incidents	Safety	System-/ User-Oriented	ITS Benefits: Continuing Successes and Operational Test Results

Green = Easy to Measure Yellow = More Difficult to Measure Red = Very Difficult to Measure

In Table 1.2, testing of FRATIS in the near term should result in relatively easy to measure benefits related to the improved freight traveler information, route planning, and dynamic routing functions. Depending on the scope of the testing environment, an Independent Evaluator should be able to determine if the goals stated above are met for *Improve Travel Time, Reduce Fuel Consumption, and Reduce Emissions*. For small-scale testing in a limited operational environment, it will be incumbent upon the Independent Evaluator to develop methods and approaches for scaling up limited test results so that a determination can be made of whether these transformative performance goals have been met.

Benefits in Table 1.2 which focus on both eliminating truck trips and reducing truck trip times based on improvements in efficiency of drayage operations will be more difficult to measure. Depending on the scope of testing environment, the System Developer and the Independent Evaluator will likely need to work together to develop a testing and analytical approach that will allow determination relating to achievement of the goals stated above for *Reduce Bobtail Trips and Reduce Terminal Wait Times Outside the Gates*. The measurement difficulties here will be largely due to the likelihood that not all trucking fleets and terminal operators will be participating in the test. Thus, a measurement approach that includes both field measurements of the FRATIS system test results, as well as an analytical approach for estimating full "what if" systemwide benefits based on the test data, will need to be developed and implemented.

The *Improve Truck Trip Safety* transformative goal in Table 1.2 will be very difficult to measure in a limited testing environment. Safety benefits of Commercial Vehicle Operations (CVO) technologies, such as those deployed in multiple test programs by FMCSA over the past decade, have historically been nearly

impossible to measure directly. This is largely due to the contrast between a limited testing environment and limited timeframe for a technology improvement test as compared to a very large statistical sampling over a long period of time that is typically associated with commercial vehicle accident data. In simpler terms, avoidance of accidents due to limited technology testing is extremely difficult to measure with any statistical significance. Based on this, it is recommended that the Independent Evaluator not attempt to measure Improve Truck Trip Safety benefits for this test. Instead, the focus should be on developing estimates of how this safety benefit might be realized. This could be based on a detailed study of how the technology could improve safety, supported by user interviews (e.g., truck drivers) and data collected during the test.

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