Freight Advanced Traveler Information System (FRATIS) – Dallas-Fort Worth

Demonstration Plan

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Leidos

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16. Abstract

This document describes the Demonstration Plan for the FRATIS system. The demonstration component of this task will serve to test the technical feasibility of the FRATIS prototype while also facilitating the collection of baseline and performance data related to the operation and impact of the system. The FRATIS prototype in Dallas will consist of three components: Optimization algorithm, Terminal wait time, and route specific navigation/traffic/weather. This document describes the experimental design plan for each FRATIS component.

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1 Introduction

1.1 System Purpose

The United States Department of Transportation (USDOT) Dynamic Mobility Applications (DMA) program, undertaken in 2009, consistently sought to take advantage of the increasing volume of data generated within the transport system and to build on recent success stories in using these data to improve mobility and efficiency. Through the DMA Program - the FRATIS Concept Development and Functional Requirements task order was undertaken to further engage the freight transportation community in the process of documenting the concept, user needs and high-level requirements for the next generation freight advanced traveler information system (FRATIS) system. The DMA program is currently entering the demonstration phase. The FRATIS Prototype and Small-Scale Demonstration effort will assess the effectiveness and impacts of a regional implementation of the FRATIS solution.

The demonstration component of this task will serve to test the technical feasibility of the FRATIS prototype while also facilitating the collection of baseline and performance data related to the operation and impact of the system.

1.2 Primary Components

In Dallas the FRATIS system will consist of 3 components.

Carrier Optimization

This component will be used by individual carriers to create a daily load plan for each of their drivers that will ensure they perform their work in the most efficient manner. This will have the overall impact of increasing the efficiency of the carrier's entire fleet.

Freight Terminal Wait Time

This component will measure queues at intermodal facilities and communicate that information to carriers so that they may plan their arrivals at the facility in the most efficient manner. This will result in better resource and time management.

Congestion Avoidance Dynamic Routing of Trucks

This component will provide drivers and dispatchers with the most efficient route to their destination taking into account characteristics of the truck, traffic conditions, and weather conditions.

1.3 Carrier Processes

The following charts illustrate the processes in place at the Dallas dray carriers prior to the implementation of FRATIS.

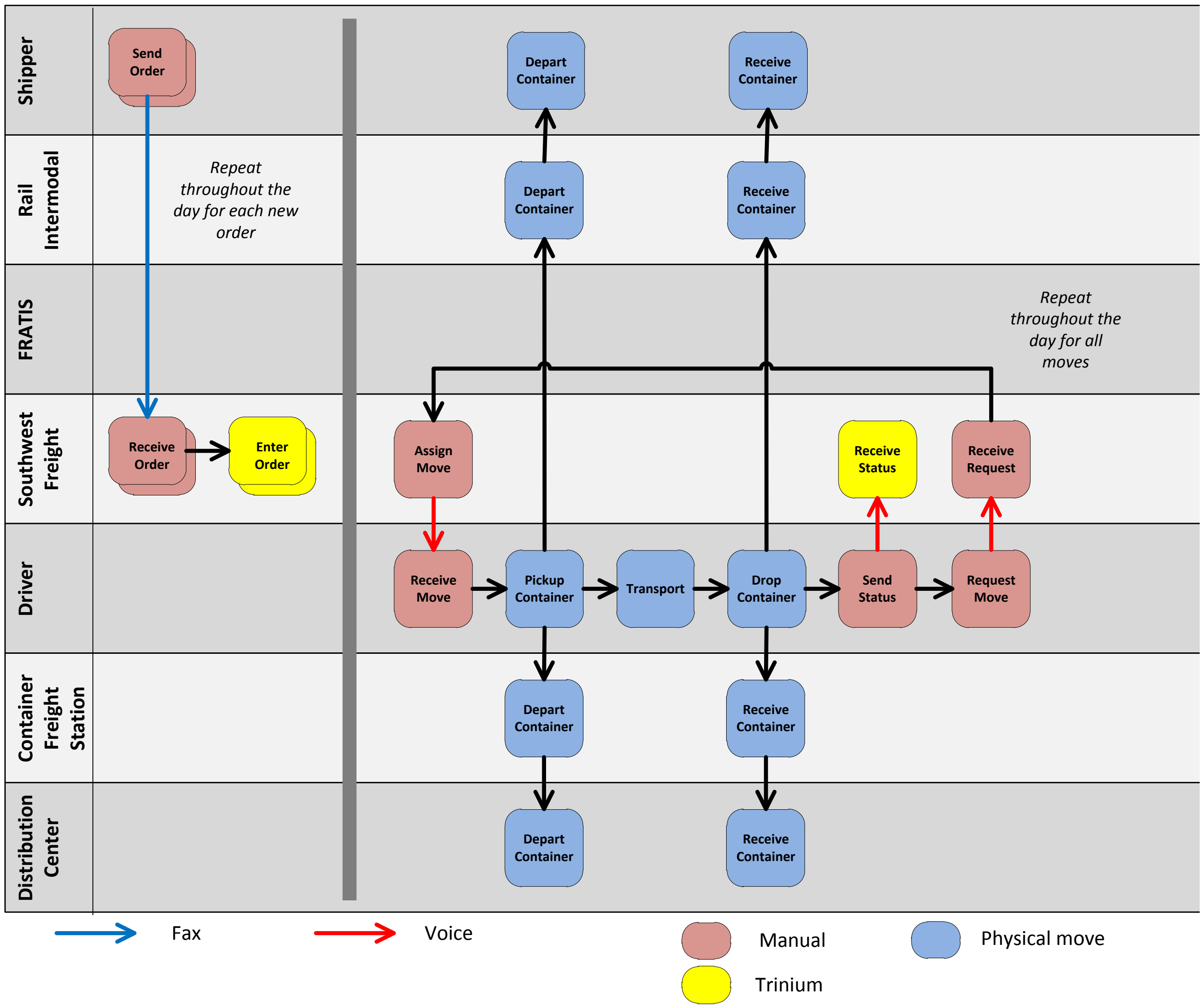

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Figure 1. Southwest Freight Pre-FRATIS

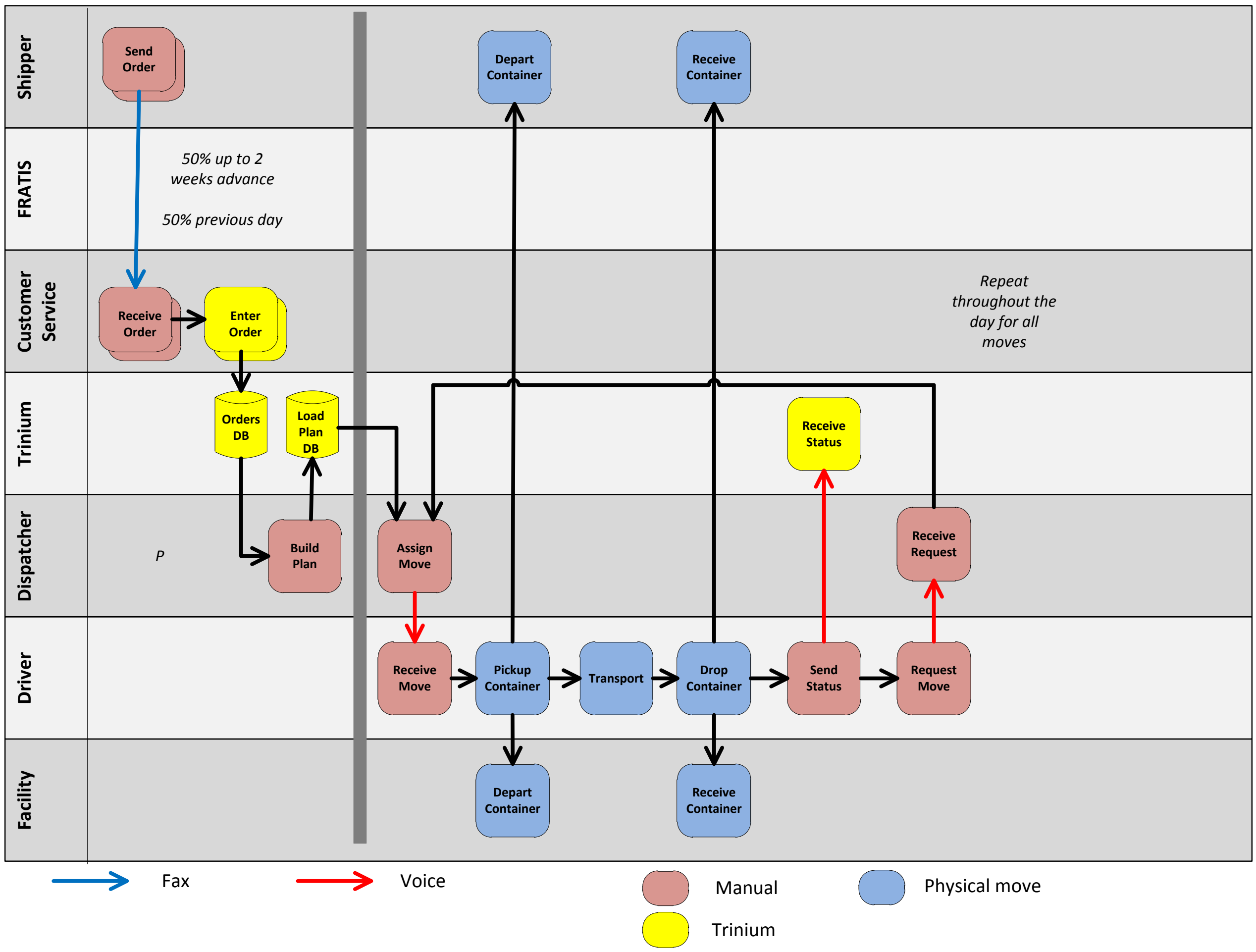

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Figure 2. Associated Carriers Pre-FRATIS

The following charts illustrate the process that will be in place after FRATIS has been implemented.

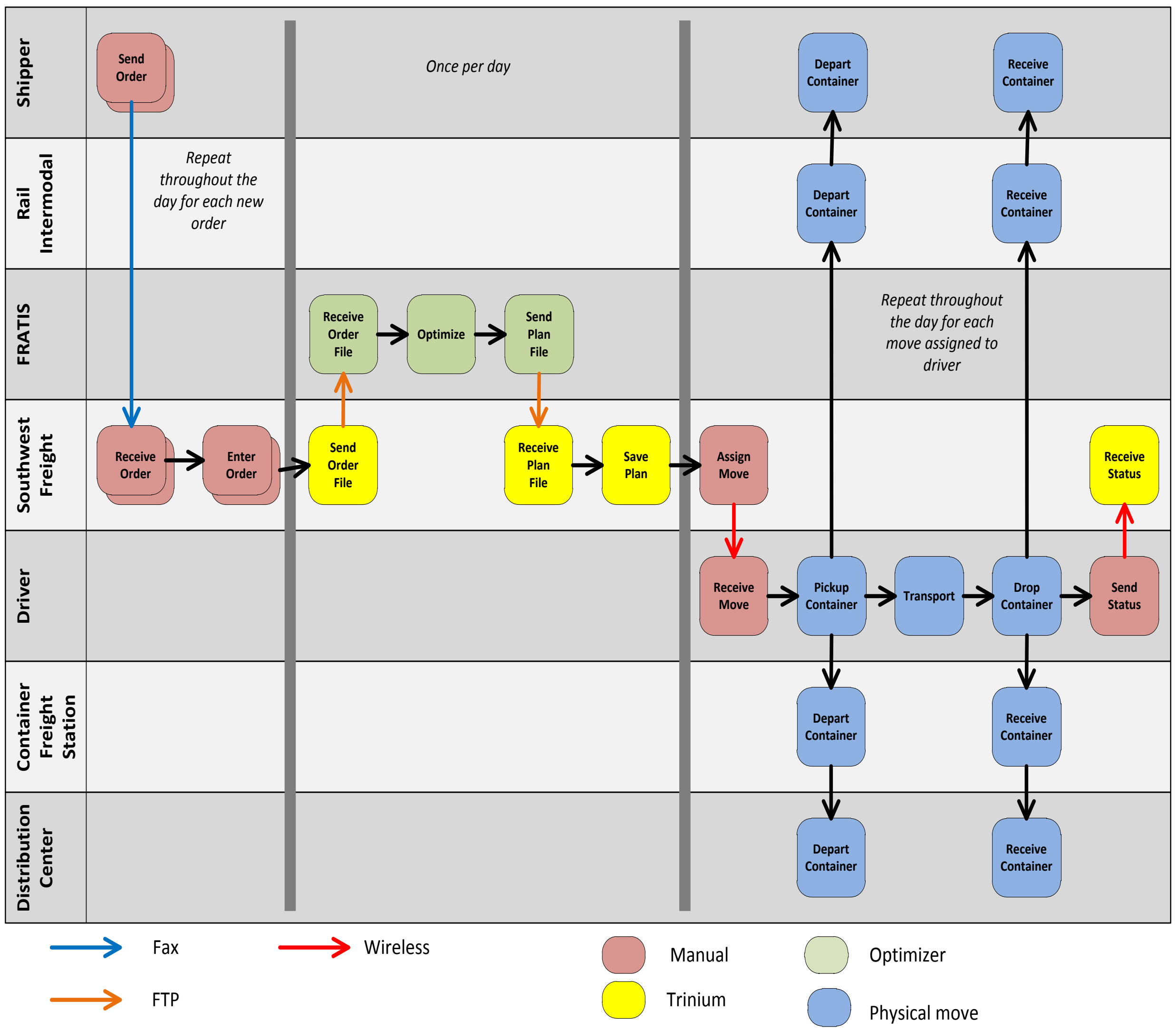

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Figure 3. Southwest Freight Post-FRATIS

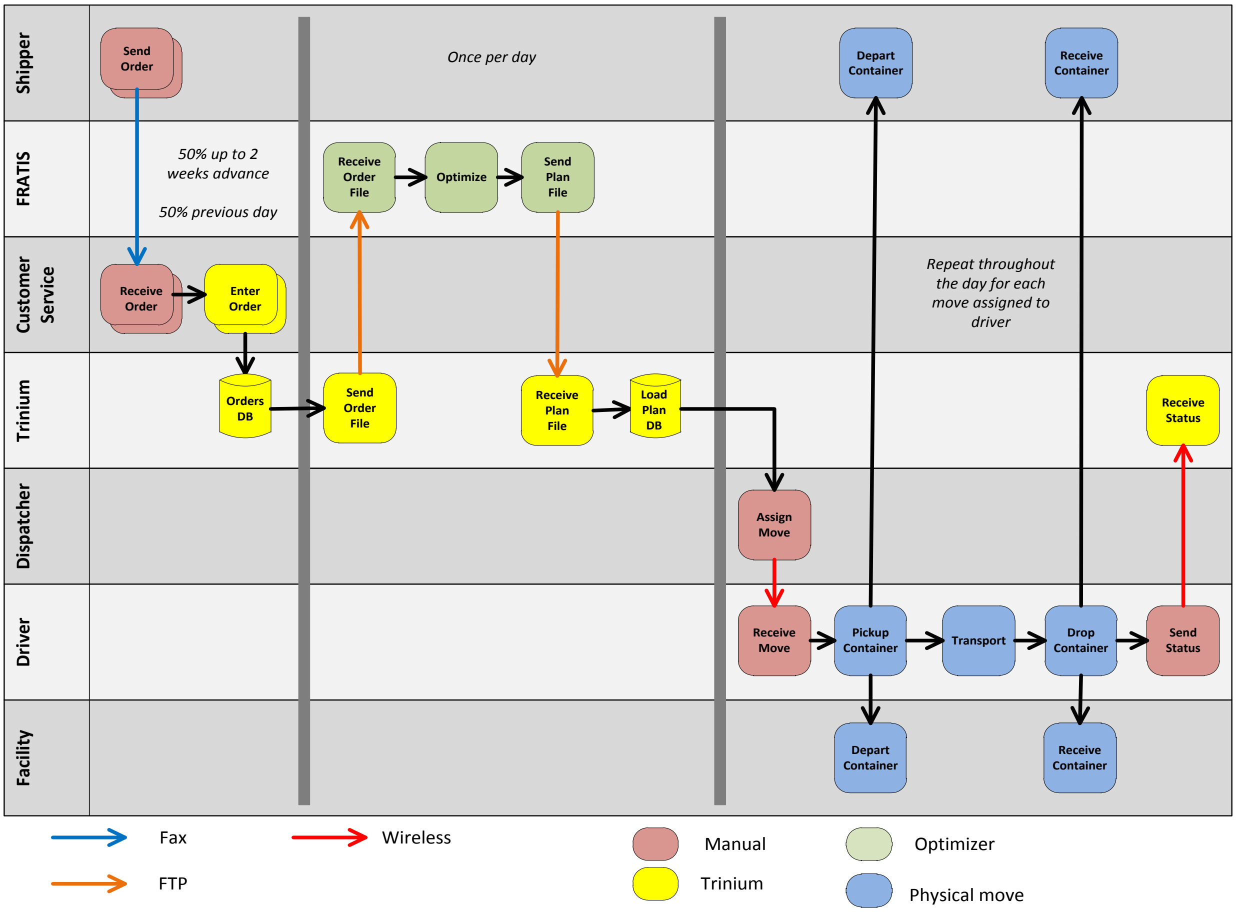

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Figure 4. Associated Carriers Post-FRATIS

2 Site Plan

2.1 Participants

Table 1. Summary of FRATIS Demonstration Participants

Participant	Type	Role
Test Participants		
Associated Carriers	Dray carrier	Participate in pilot of optimization, terminal wait time and routing/traffic/weather
Southwest Freight	Dray carrier	Participate in pilot of optimization, terminal wait time and routing/traffic/weather
IMCG	Container Yard	Participate in pilot of terminal wait time
Contractor Team		
SAIC	Lead Contractor	Overall test oversight, including acquisition of equipment, project management, baseline and prototype data collection, and training of test participants on the prototype
Acyclica	Vendor	Provide Bluetooth and Wi-Fi detectors for terminals
Productivity Apex	Vendor	Provide optimization algorithm that was developed for a carrier in Memphis
TomTom	Vendor	Provide 510 device to capture mileage for evaluation, 7150 device to provide routing, traffic and weather to drivers, provide WebFleet to log and analyze data from 510's for evaluation
Nasco	Sub-contractor	Logistics support, stakeholder coordination
University of Memphis	Sub-contractor	Training of dray dispatchers and drivers
USDOT Team		
USDOT-FHWA	Product Owner	Review of project deliverables and feedback during the development lifecycle; review of final prototype and submitted artifacts to ensure satisfaction of SOW.
Noblis	Program oversight	Review of deliverables and feedback during the development life cycle; review of final prototype and submitted artifacts to ensure satisfaction of SOW.
CDM Smith Team	Impact Assessment	Review of baseline and prototype data; assistance in determining data to be collected.

2.2 Hardware Components

All equipment is procured through the SAIC Shared Services Center following corporate procurement practices. TomTom Link 510 devices will be deployed on 50 trucks to collect baseline data with respect to miles traveled. Blue tooth/wi-fi readers have been procured and deployed at the container terminal to support the terminal queue application. Actual costs for these items are documented below.

Table 2. Actual Purchase Summary for TomTom 510 and Acyclia Wait Time Components

Line	Item	Order Quantity	Unit Cost	Total
TomTom Link 510				
1	Link 510	50	$298.45	$14,922.50
2	Webfleet (1 year subscription)	20	$465.60	$9,312.00
3	Webfleet (1 year subscription)	30	$459.03	$13,770.90
4	Link 510 Activation	50	$174.13	$8,706.00
5	Shipping for Link 510s devices	-	-	$300.00
Total (with 5% discount)				$47,011
Acyclia				
1	CrossCompass	4	$1,500	$6,000
2	14 dBi directional antenna for BlackCompass	5	$168	$840
3	Antenna cable	6	$25	$150
4	Alfa 8dBi omnidirectional antenna	1	$85	$85
5	GSM Modem	1	$265	$265
6	Data Forever for BlueCompass	1	$1,500	$1,500
7	Weather proof enclosure with mounts for CrossCompass	1	$80	$80
8	Installation	-	-	$2,000
9	Travel to installation	-	-	$800
Total				$11,720

We also anticipate purchasing 50 of the TomTom Pro 7150 Truck devices, which have a unit cost of $300/unit; this would total $15,000 plus shipping and installation.

Finally, there will be costs associated with installing dedicated short range communication (DSRC) roadside readers (roadside equipment, RSE) and equipping a to-be-determined number of trucks with DSRC radios (vehicle awareness devices, VADs, which broadcast the basic safety message, BSM). Testing this functionality is currently planned in the optional iteration after the initial prototype release (as described later in this document). Estimates for this equipment will be determined later in the agile development process once the number of VADs and RSEs are determined.

2.3 Site layout

The following diagrams show the site layouts for the prototype participants.

<u>IMCG Intermodal</u>

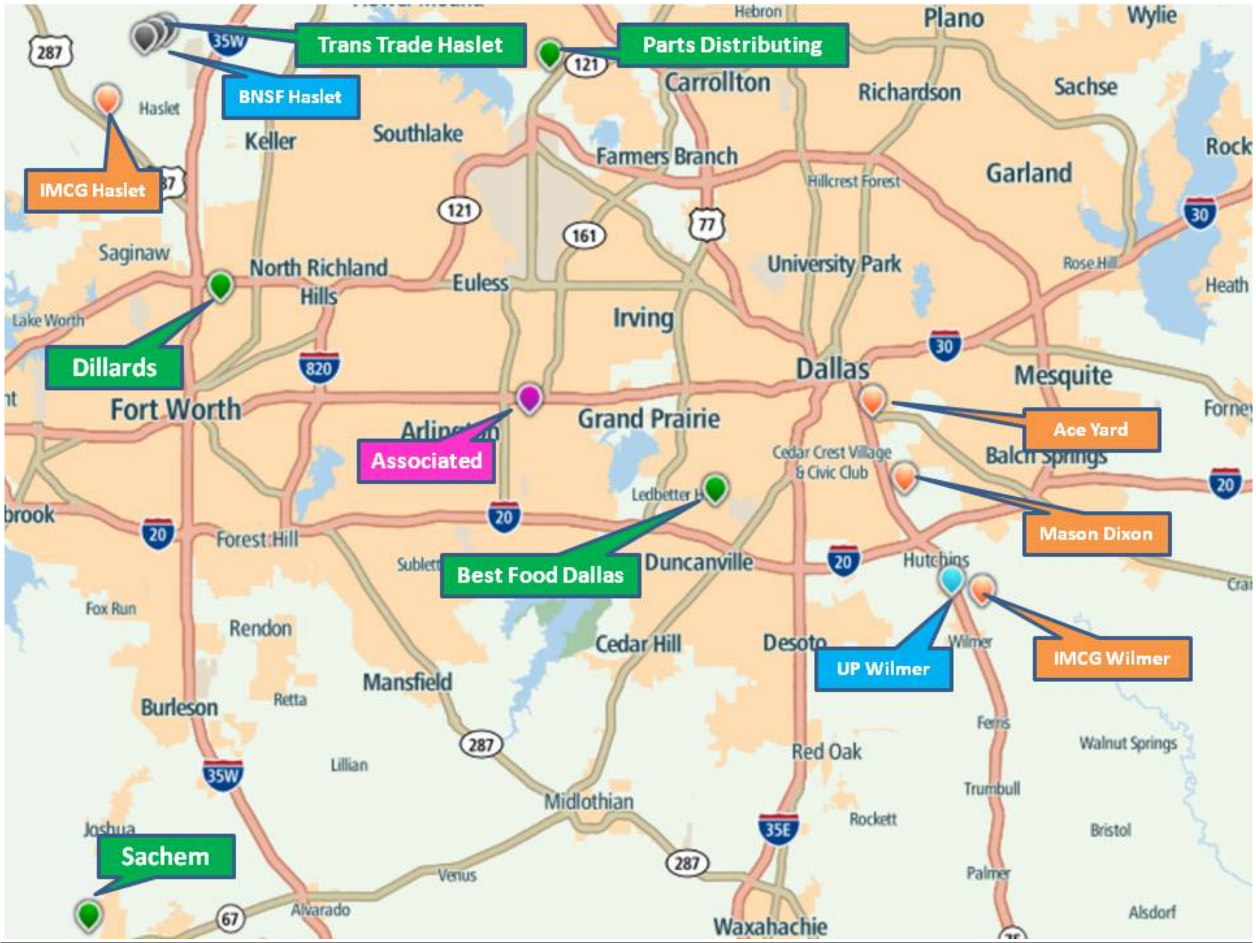
The following site plan shows the location of the Bluetooth/Wi-Fi readers and the category of trucks that the readers will detect.

Google Maps (with Leidos input on flag locations of equipment)

Figure 5. Site plan for IMCG container yard

Associated Carriers

The following site plan shows the location of Associated Carriers within the Dallas area along with the major railroad terminals and container yards they serve. Note, the locations labeled on the map are not inclusive of all start and end locations that Associated serves.

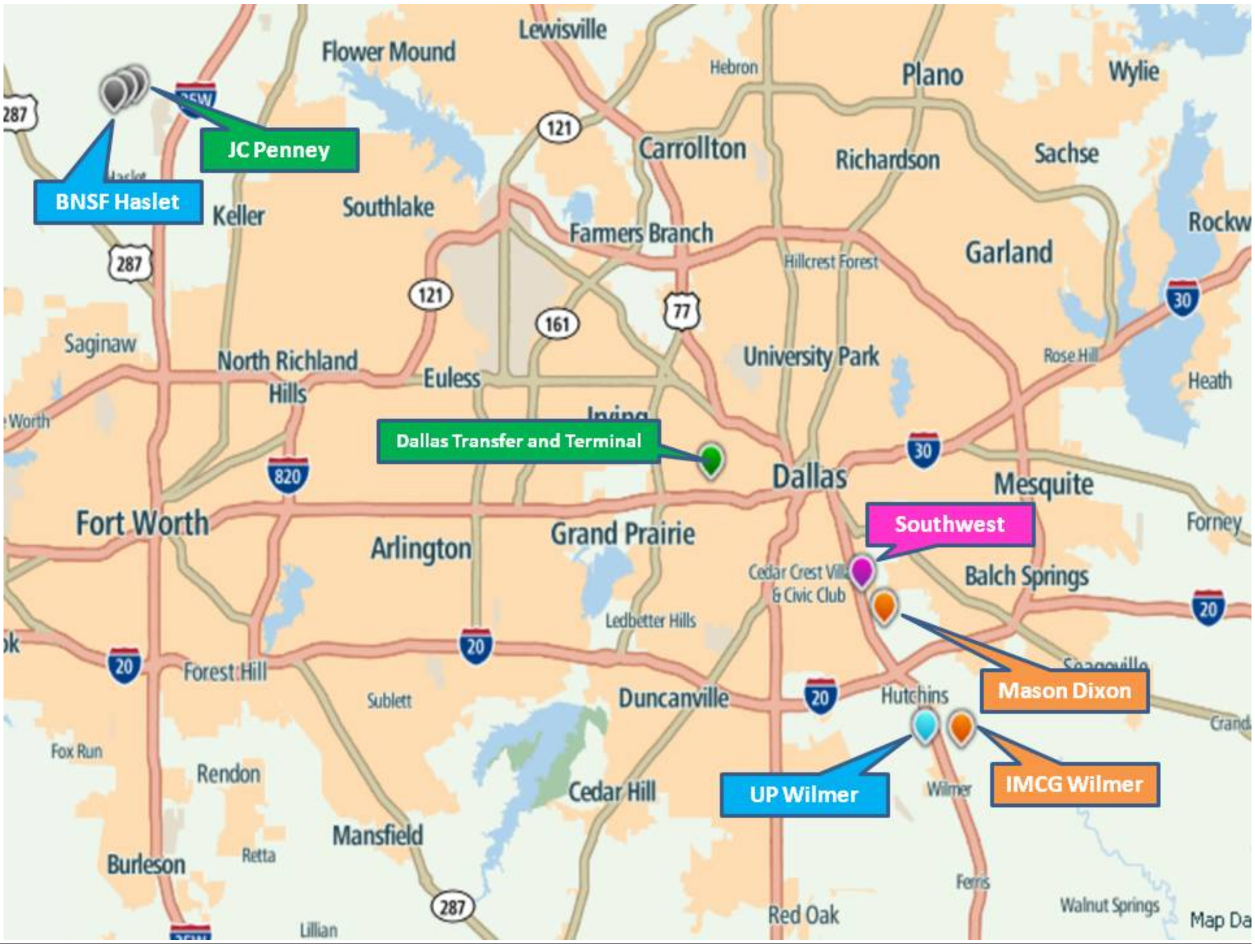


TomTom Webfleet screen capture – Leidos login privileges

Figure 6. Site plan for Associated Carriers

<u>Southwest Freight</u>

The following site plan shows the location of Southwest Freight within the Dallas area along with the major railroad terminals and container yards they serve. Note, the locations labeled on the map are not inclusive of all start and end locations that Associated serves.



TomTom Webfleet screen capture – Leidos login privileges

Figure 7. Site plan for Southwest Freight

2.4 Acceptance Criteria

The backlog of user stories are cataloged from the users perspective: dispatcher, driver, public agency and terminal. For each user story, we have specified criteria for validating the successful implementation of the feature that satisfies the user story. By user type, these criteria are summarized below:

Table 3. FRATIS Acceptance Criteria

User	Acceptance Criteria
DISPATCHER	Get data and information within 10 minutes after they are available at data source
	Uptime of 99% exclusive of maintenance downtime
	Can receive optimization results in Trinium.
	Can receive optimization results in Trinium the day before the orders are scheduled.
	Fleet proprietary information is protected from unauthorized access.
	Real-time queue length at terminals is available with user log-in.
	Terminal queue time information cannot be accessed without proper username and password
	Be able to measure estimated queue wait time with 80% accuracy
	Dispatcher can establish internet connectivity to FRATIS system

	Uptime of 99% exclusive of maintenance downtime
	Can obtain planned/selected truck route information from dispatcher's computer terminal
	Can obtain truck route information from dispatcher's computer terminal
	Can obtain access route designations from dispatcher's computer terminal
	Can obtain route restrictions from dispatcher's computer terminal
	Can obtain bridge height clearance from dispatcher's computer terminal
	Can obtain bridge weight clearance from dispatcher's computer terminal
	Can obtain preferred freeway access paths from dispatcher's computer terminal
	Can obtain toll road information from dispatcher's computer terminal
	Can obtain trip information from dispatcher's computer terminal
	Verify regional real-time traffic information from dispatcher's computer terminal
	Verify regional real-time travel speed from dispatcher's computer terminal
	Can obtain regional real-time point-to-point travel time predictive information from dispatcher's computer terminal
	Can obtain regional real-time incident information from dispatcher's computer terminal
	Can obtain regional real-time construction information from dispatcher's computer terminal
	Can obtain regional real-time extended arterial outage information from dispatcher's computer terminal
	Can obtain regional special event traffic information from dispatcher's computer terminal
	Can obtain truck speed information from dispatcher's computer terminal
	Can obtain alternate route selection information from dispatcher's computer terminal
	Can obtain regional congestion information from dispatcher's computer terminal
	Can obtain historical traffic pattern data from dispatcher's computer terminal
	Can obtain traffic information from dispatcher's computer terminal
	Can obtain construction zone along truck route from dispatcher's computer terminal
	Dispatcher receives updated information and dispatcher instructions within 10 minutes after sending
	Can obtain weather conditions from dispatcher's computer terminal
DRIVER	Driver receive updated information without interfering with driving safety
	Driver receives updated information within 10 minutes after sending
	Driver can hear audible alerts while truck moving at 70 mph
	Graphic user interface interaction passes USDOT safety requirements for moving vehicles
	Get data and information within 10 minutes after they are available at data source
	Personal data are purged before sharing with public agency.
	Driver can obtain traffic information in advance of departure.
	Can obtain weather conditions from driver's OBU display
PUBLIC AGENCY	Registered public agency user can retrieve sanitized truck route data from FRATIS system
	Registered public agency user can retrieve sanitized truck speed data from FRATIS system
	Registered public agency user can retrieve congestion data from FRATIS system
	Registered public agency user can retrieve alternate route information from FRATIS system
TERMINAL	Be able to measure terminal wait time with 80% accuracy
	Authorized can preview and anticipate how many truck being sent to terminal or yard.

2.5 Schedule of Test Activities

The schedule for the FRATIS demonstration is presented below. Baseline data collection is slated to begin on May 31, 2013. In addition, data from the dray companies can be collected for any timeframe specified by SAIC. The dray companies archive this information and can provide a file covering the specified date range requested by SAIC or the Impact Assessment team; therefore, the team left this date on the schedule.

ID	WBS	Task Name	Duration	Start	Finish	% Complete	Baseline Finish
94	3	**Plan Prepare and Conduct Small-Scale Prototype Test**	**253 days?**	**Wed 2/13/13**	**Fri 1/31/14**	**21%**	**Thu 12/5/13**
95	**3.1**	**Plan for Small Scale Demonstration**	**63 days**	**Wed 2/13/13**	**Fri 5/10/13**	**100%**	**Thu 12/27/12**
96	3.1.1	Draft Demonstration Plan	28 days	Wed 2/13/13	Fri 3/22/13	100%	NA
97	3.1.2	USDOT Review	10 days	Mon 3/25/13	Fri 4/5/13	100%	NA
98	3.1.3	Final Demonstration Plan	25 days	Mon 4/8/13	Fri 5/10/13	100%	NA
99	**3.1.4**	**Hardware Purchase**	**20 days**	**Fri 3/8/13**	**Thu 4/4/13**	**100%**	**Thu 12/27/12**
100	3.1.4.1	Identification of Materials	10 days	Fri 3/8/13	Thu 3/21/13	100%	Thu 12/13/12
101	3.1.4.2	Materials Documentation	10 days	Fri 3/22/13	Thu 4/4/13	100%	Thu 12/27/12
102	**3.2**	**Prepare and Install Components**	**101 days?**	**Fri 4/5/13**	**Fri 8/23/13**	**57%**	**Thu 7/25/13**
103	**3.2.1**	**Baseline Data Collection Equipment Preparation and Install**	**45 days?**	**Fri 4/5/13**	**Thu 6/6/13**	**83%**	**Thu 1/10/13**
104	3.2.1.1	Install	40 days	Fri 4/5/13	Thu 5/30/13	95%	Thu 1/3/13
105	3.2.1.2	Training	2 days	Wed 5/1/13	Fri 5/31/13	95%	Mon 1/7/13
106	3.2.1.3	Test/Checkout Report	5 days	Fri 5/31/13	Thu 6/6/13	0%	Thu 1/10/13
107	3.2.1.4	List of Test Participants trained	1 day?	Fri 5/31/13	Mon 6/3/13	0%	Tue 1/8/13
108	**3.2.2**	**Prototype Equipment Preparation and Install**	**70 days**	**Mon 5/20/13**	**Fri 8/23/13**	**40%**	**Thu 7/25/13**
109	3.2.2.1	Install	60 days	Mon 5/20/13	Fri 8/9/13	50%	NA
110	3.2.2.2	Training	5 days	Mon 8/12/13	Fri 8/16/13	0%	Wed 7/24/13
111	3.2.2.3	Test/Checkout Report	5 days	Mon 8/19/13	Fri 8/23/13	0%	Wed 7/24/13
112	3.2.2.4	List of Test Participants trained	5 days	Mon 8/19/13	Fri 8/23/13	0%	Thu 7/25/13
113	**3.3**	**Conduct Small Scale Demonstration**	**176 days**	**Fri 5/31/13**	**Fri 1/31/14**	**0%**	**Thu 12/5/13**
114	**3.3.1**	**Baseline Data Collection**	**88 days**	**Fri 5/31/13**	**Tue 10/1/13**	**0%**	**Thu 6/20/13**
115	3.3.1.1	Data Collection	88 days	Fri 5/31/13	Tue 10/1/13	0%	Thu 6/20/13
116	3.3.1.2	Baseline Data Collection Monthly Data Retrieval Reports	88 days	Fri 5/31/13	Tue 10/1/13	0%	Thu 6/20/13
117	3.3.1.3	Baseline Data Collection Data Retrieved each month	88 days	Fri 5/31/13	Tue 10/1/13	0%	Thu 6/20/13
118	**3.3.2**	**Prototype Demonstration**	**88 days**	**Wed 10/2/13**	**Fri 1/31/14**	**0%**	**Thu 12/5/13**
119	3.3.2.1	Prototype Demonstration Monthly Test Report	88 days	Wed 10/2/13	Fri 1/31/14	0%	Thu 12/5/13
120	3.3.2.2	Prototype Demonstration Monthly Data Retrieval Report	88 days	Wed 10/2/13	Fri 1/31/14	0%	Thu 12/5/13
121	3.3.2.3	Prototype Demonstration Data Retrieved Each Month	88 days	Wed 10/2/13	Fri 1/31/14	0%	Thu 12/5/13

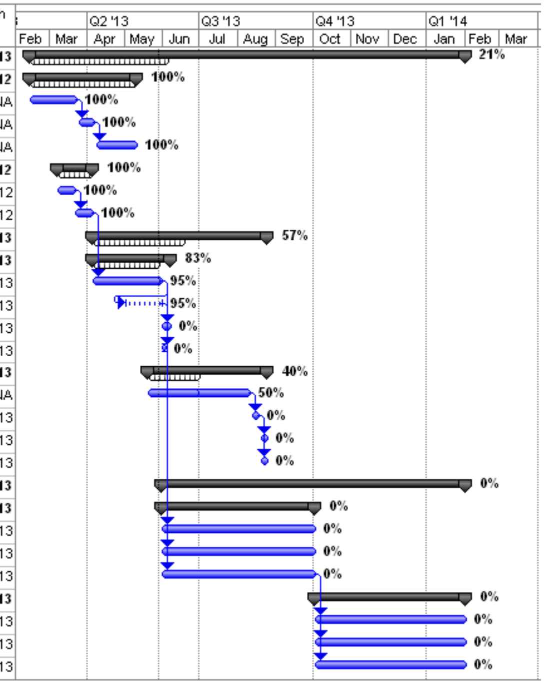


Figure 8. FRATIS Demonstration Schedule

3 Demonstration Experimental Plan

Table 4. Summary of FRATIS Experiment Plan

System	Components	Hypothesis
Freight terminal wait time	• Wi-Fi readers to detect devices passing strategic locations • Data analysis • Web site to display current and predicted wait times to dispatchers and other authorized users • Web service API to exchange wait time with optimization component	Dispatchers will use the information to avoid sending drivers to the terminal when there is a long wait time and they do not have an immediate time commitment at the terminal. Since carriers will be spreading their arrivals over a longer period the typical wait time will be reduced.
Carrier optimization	• Optimization algorithm • Order entry • Administrative tables • File transfer • Dispatch	The optimizer will create a daily plan that minimizes the number of trucks needed and minimizes bobtail miles. If the dispatcher follows the plan the carrier will need fewer trucks and have fewer bobtail miles.
Congestion Avoidance Dynamic Routing of Trucks	• Routing • Navigation • Traffic • Weather	Drivers will take the fastest truck appropriate route that avoids traffic and weather related congestion. This will save driver time and reduce idling time.

3.1 Carrier optimization

Productivity Apex is developing an optimization algorithm for the FRATIS project. The algorithm will create a daily plan that will be used by a carrier to schedule their drivers. The algorithm will focus on minimizing the number of bobtail moves and bobtail miles within a single carrier. The optimizer will not try to match loads between two different carriers. It should be noted that the optimizer may reduce the number of trucks and/or drivers utilized by each carrier during the day; however this may correspond to an increase in the number of bobtails/bobtail miles.

3.1.1 Components

Order entry

Throughout the day orders will be received by carriers and entered into their fleet management system. At the end of the day the entire set of orders will be sent to the optimization algorithm for processing.

File transfer

The optimization algorithm will not be built into the transportation management system used by the dray carriers in Dallas. Therefore, data must be transferred between the two systems. The transfer will occur at least once per day and take place after all of the orders for the next day have been received. The optimizer will develop the plan and transfer the results back to the fleet management system. The carrier will have the option to re-optimize throughout the day. In that case the file will include an assigned driver indicator and the optimizer will need to keep the same driver assigned to that move.

Administrative tables

Administrative tables will contain fixed information used by the optimizer. This could include driver preferences, expected terminal wait times, etc. Some of this information may be in the carrier's fleet management system. In that case the information will need to be transferred as part of the daily file transfer process. If additional information is needed, a direct interface into the optimizer will be provided by Productivity Apex.

Optimization algorithm

The optimization algorithm will accept as input the full set of moves for the next day. It will develop a plan that maximizes the number of revenue moves and minimizes the number of non-revenue moves. Output will be a daily plan that indentifies a driver and sequence for each move.

Post-Processor

The optimization algorithm itself calculates travel time based on the distance between locations. It does not consider traffic implications. Terminal wait time is a fixed value throughout the day for each terminal based on the type of activity planned at that facility. In the post-processor each driver's load plan will be scheduled based on predicted travel time from TomTom Webfleet. Terminal wait time will be adjusted to reflect the predicted wait time at each individual terminal. This may result in a schedule for a driver that does not meet required appointment times for some moves. Those moves will be passed though the optimizer a second time and reassigned to an additional driver.

Dispatch

The daily plan or itinerary needs to be communicated to each driver. The dray carriers in Dallas already have processes in place to do that. Dispatchers will continue to use their existing processes to communicate with the drivers.

3.1.2 Hypothesis

The optimizer has three objectives:

1. Maximize value added moves
2. Minimize non-value added moves
3. Maximize load matching and back hauls

The Dallas dray carriers are typically able to complete all of their moves each day, so any plan will have equal results for objective 1. The main value of the optimizer will be objective 2.

The daily plan produced by the optimizer should include a minimum number of bobtail trips and miles. The processes in place at the Dallas dray carriers rely on the dispatchers to manually minimize bobtails.

If the dispatcher adheres to the plan produced by the optimizer there should be a reduction in the number of bobtail moves and bobtail miles.

3.1.3 Required Data

These data elements will be collected from the fleet management system before and during the test:

1. Daily number of bobtail moves.
2. Daily number of bobtail miles.

These data elements will not contain proprietary or personally identifiable data; these data points can be shared on the USDOT Research Data Exchange (RDE).

These data elements will be collected during the test:

1. Daily plan – Driver and sequence.
2. Actual operation – Driver and sequence.

At the end of the day the fleet management system in use at each carrier will export a file that contains a log of each move completed by each driver. This file will be saved for the duration of the project. The information in this file will reflect the actual operation for the day. The number and length of bobtail moves can be derived from this information. The optimization algorithm will create a daily plan file that will be saved for the duration of the project. Since this data will be sanitized for use by the Impact Assessment Team, this data can also be shared on Research Data Exchange.

3.1.4 Analysis

The ideal evaluation would be to compare operations with the use of the optimizer to what the operation would have been without the optimizer. This is not possible since we cannot know what the dispatchers would have done without the benefit of the optimizer. However, the carriers will be using the plan generated by the algorithm to assign moves during the small scale pilot demonstration. SAIC will be conducting a validation of the algorithm during the prototype development – this will consist of running pre-pilot period data from the carriers through the optimizer to create daily plans for this period and evaluate the effectiveness of the algorithm and solicit stakeholder buy-in for its use during the demonstration.

This validation process may result in modification or enhancement to the algorithm as it is received from PAI. Any enhancements that are made to the algorithm will be included in the version used by the carriers in Dallas during the demonstration period. Because of this validation process, much of the value provided by the optimization algorithm will be known prior to the start of the pilot as we will be comparing the carriers' existing plans to the algorithm plans. We will determine during the pilot if the optimized plans can be followed and if the predicted schedules are accurate. The validation process will provide insight as to the number of bobtails that actually occurred can be compared to the number of bobtails under the plan. This may give a better indication of the potential for the optimizer since the comparison will be against a dispatcher without the optimizer operation.

Once the demonstration begins, the evaluation team will compare the number of bobtails before to those after. They may also be able to compare the number of vehicles and drivers assigned. They will need to develop a way to normalize the data to account for different business and transportation conditions.

The evaluation team will also compare the actual operation to the daily plan to determine if the dispatchers are following the plan.

3.1.5 Quality Assurance

Data will come directly from the fleet management systems at each of the dray carriers. Extracts will be made on demand and can be recreated, if necessary.

3.2 Freight Terminal Wait Time

When a truck arrives at a freight terminal the driver may encounter a queue to enter the facility. Once inside the facility they may encounter a delay to unload or pick up their container. FRATIS will deploy technology that can measure current wait time and predict future wait time at strategic terminals. These terminals need to have periods where they have a lengthy wait time. Ideally these periods would be sporadic and not easily predictable.

The information will be made available to drivers and dispatchers through the FRATIS portal (accessible via the web) and can be available for consumption by the FRATIS optimization algorithm to better schedule arrivals at the container terminal. However, we do not know at this point if the algorithm can incorporate and use this data in its execution. If accommodated, the predicted wait time would help the optimization algorithm to develop a delivery plan that avoids busy times of days at various terminals. The current wait time may cause the dispatchers to deviate from the plan if they become aware of a backup at the terminal during the day.

3.2.1 Components

Wi-Fi readers

Wi-Fi technology is used to do a variety of travel and wait time analysis. It works by reading the MAC address of any Wi-Fi device that passes by a reader. The MAC address is a unique identifier for the Wi-Fi device. It does not identify anything about the device, truck or driver. In the case of a freight terminal we can record when something passed a point on the road into the terminal. Next, we can record when that same device passed through the gate. Finally, we can record when the same device passed through the exit gate. All of that information will be passed to a server for analysis and display.

Data Analysis

Data from the readers will be passed to a server and passed through data scrubbing and fusion algorithms to eliminate outliers and vehicles that are not freight related. After scrubbing, current expected wait time will be calculated. That end result value will be stored and form the basis for daily predicted wait times, allowing drivers and dispatchers to not only know current wait time, but also what to expect the rest of the day.

For predicted wait time, we anticipate initially analyzing the historical wait times by time of day, day of week and month so that correlations may be made. Exact definition of how we will calculate the predicted wait time during the demonstration period will occur during the development process – specifically during the terminal queue time iteration.

Web site for integrated facility time

The FRATIS website will display current wait time and predicted wait time for the remainder of the days for any facility equipped with readers. This will be a secure website and limited to authorized users. Authorized users will be limited to dispatchers and terminal operators.

Web service API for integrated terminal time

FRATIS will provide an API that can be called by the optimizer and any dispatching system that needs to know current or predicted wait times. The API will provide the same type of information as the website.

3.2.2 Hypothesis

Dispatchers will have current terminal wait time information to avoid sending a driver to a terminal when there is a long wait time and they do not have an immediate time commitment at the terminal. Since carriers will be spreading their arrivals over a longer period the average, wait time will be reduced. The total number of daily arrivals and departures will remain the same; however, the trucks will be distributed more evenly throughout the day.

Although it is our understanding that the current optimization algorithm cannot import the wait time from this solution, we will continue to explore incorporating the predicted wait time into the optimizer for the DFW prototype. This would improve the operations of the drays by reducing their time spent waiting and idling outside the terminal while also shortening the queue at the terminal. As mentioned, though, as currently structured, the optimization algorithm assumes a fixed terminal time that is dependent on the type of activity and is the same for all terminals. It is our understanding that the optimization algorithm does not have the capability to vary wait time throughout the day but by analyzing baseline data collected by the system, we may be able to at least edit the terminal times for the terminal where we have deployed the solution to better reflect actual operations.

3.2.3 Required Data

The required data to support the test is the hourly current wait time for each day of the baseline and pilot test. Daily predictive wait times for each day of the baseline and pilot test will also be required. Each time current and predicted wait time is calculated it will be logged in the database. This data will be saved for the duration of the pilot and made available on a weekly basis or as desired by the assessment team. Since this data will not contain any proprietary or personally identifiable information, it will be available for posting to the RDE.

3.2.4 Analysis

To determine the effectiveness of the test the IA team will compare similar periods from baseline and prototype test datasets. Their goal will be to calculate change in mean, median, mode, minimum, maximum, and 95% wait times for comparison periods. To determine the accuracy of the predictive times the IA team will compare actual wait times to predicted wait times. We are anticipating that 15% of the trucks entering the container yard will be picked up by the readers.

3.2.5 Quality Assurance

The evaluation team will perform periodic comparison of manual observed wait times to values in database that resides on the FRATIS server. This database will contain all of the data collected and/or generated from the readers, and will be a MySQL database.

3.3 Congestion Avoidance Dynamic Routing of Trucks

Drivers and dispatchers want to use the most efficient routes that are safe for trucks. If traffic or weather related issues arise they want to be routed around those problems. There are commercially available products that can provide this information to drivers, dispatchers, and software applications such as the optimizer. FRATIS will deploy a COTS application that provides dynamic navigation, routing, traffic and weather information to drivers and dispatchers.

3.3.1 Components

Routing

Routing will be provided by TomTom. This will provide the driver with routing options over truck appropriate roads.

Navigation

Navigation will be provided by TomTom. This will provide the driver with a standard safety compliant GPS enabled navigation interface to their chosen route.

Traffic

TomTom provides real time traffic information that combines public information with their own network of TomTom users to determine travel time in traffic and incident alerts.

Weather

TomTom provides a real time weather service that shows weather conditions along a route.

3.3.2 Hypothesis

Drivers will take the fastest truck appropriate route that avoids traffic and weather related congestion. As traffic changes and incidents occur the driver will be directed to alternative routes, saving driver time and reduce idling time. The key value will be reducing driver time and little savings in fuel usage. Trucks only use about 1 gallon of fuel per hour of idling. They use 1 gallon of fuel per 5 miles of travel. If a truck is routed around an incident and travels an additional 5 miles it would take over 1 hour of waiting to realize any fuel savings. Therefore, the truck will probably consume more fuel by routing around an incident than it would if it remained in traffic. For a driver the time savings will be well worth the additional fuel costs, so there is value to the driver.

3.3.3 Required Data

TomTom can be configured to log location and certain engine diagnostic information. The log will be captured and provided to the IA team. TomTom consolidates individual location messages into a single trip record. The trip record contains:

- Truck ID
- Date
- Start time
- End time
- Duration
- Standstill time
- Distance
- Start location
- End location
- Fuel consumption

Pollutants are derived from the amount of fuel used. The fuel used will be calculated based upon the the miles traveled by the sample trucks. The SAIC expects to provide the miles traveled, but the fuel usage and pollutants will be calculated by the Impacts Assessment Team. This data is logged automatically via pre-arranged reports available through TomTom's web interface, WebFleet. In order to post this data to the RDE, the truck ID would have to be manually removed from the files and the dray carriers would have to provide permission for posting. Based upon these factors, this data may be available for posting if all conditions are met and parties provide the appropriate consent.

3.3.4 Analysis

To be determined by the IA team.

3.3.5 Quality Assurance

Data will come directly from the TomTom logs to support the Impact Assessment activities. Extracts will be made on demand and can be recreated, if necessary.

4 Additional topics

This section discusses additional items, including how the FRATIS DFW prototype demonstration will be monitored and related initiatives and additional components that are being considered for implementation after the initial prototype release is complete.

4.1 Monitoring the FRATIS DFW Demonstration

4.1.1 Monthly Test Reports

Throughout the baseline and demonstration period, the SAIC team will collect data necessary to support the independent Impact Assessment (IA) of the prototype. This data was outlined in Section 3 with respect to each component of the FRATIS DFW prototype. SAIC will package and submit this data monthly to the IA Team. In addition, a monthly test report will be generated to summarize:

- Any issues encountered with each component with respect to the hardware, software and/or equipment associated with the component
- Availability of the FRATIS portal (website) and any planned maintenance and outages
- Interactions between the SAIC team and test participants including site visits and phone calls

4.1.2 Implementation Plan

The biggest risk in demonstrating new technology, especially for a relatively short time period, is non-use by primary system users. This can occur for a variety of reasons, from the solution not being easily available or only available outside the users' primary job tools/systems to the users' distrust of the solution offered to them. The primary user of the FRATIS DFW prototype will be the dray companies – more specifically, the dispatchers at the dray companies. As such, SAIC anticipates that the utility of the optimization algorithm will be the primary component to engage continued use of the prototype by the dispatchers.

To mitigate potential non-use by the dispatchers, SAIC must first demonstrate that the algorithm can provide a better plan than what they currently create manually. Productivity Apex has provided a version of the optimization algorithm to SAIC, but it does not include a capability to import or export data. This is a mandatory capability that will be added by SAIC. There are additional modifications that need to be made to the code itself before it will produce reasonable results during the demonstration period. Once code modifications are complete and the algorithm can produce reasonable results, SAIC will begin applying daily orders from the participating carriers and producing daily load plans. These load plans will be compared to the daily actual moves executed by the carriers. The following data will be compared:

- Drivers – The actual number of drivers used versus the drivers projected by the plan.
- Driver hours – The actual amount of driving hours and standstill hours versus the same values projected by the plan
- Bobtail miles – The number of estimated actual bobtail miles calculated assuming typical routes between bobtail origin/destination versus the number of estimated bobtail miles using the same calculations from the projected bobtail origin/destinations from the plan

SAIC is carefully evaluating the algorithm using historic load plans from the participating drays as compared to results provided by the algorithms and working with Productivity Apex to resolve any abnormalities. Once the SAIC team is satisfied with the results provided by the algorithm and can answer any questions that the dray companies may have, we will begin working with the dispatchers at the participating dray carriers to raise their awareness about the algorithm and the overall FRATIS solution.

SAIC will assist the dispatchers in analyzing the load plans created by the optimization algorithm to determine if the plan could be realistically implemented into their operations. The dispatchers' feedback will determine if the plan offers enough of an improvement to their operation that they would follow it on a regular basis. If that is not the case, SAIC will work with the dispatchers to develop a list of modifications that need to be made to the optimization algorithm in order create a more useful result. SAIC will either work with Productivity Apex to make those modifications or use their internal staff to make the modifications.

4.1.3 Monitoring Use of the Prototype

SAIC will work with the dispatchers on a regular basis until they are satisfied with the results and believe the algorithm could be used on a daily basis for their operations. When the prototype pilot period begins, SAIC will compare the load plans to the actual executions to determine if the dispatchers are following the plan. SAIC will consult on a regular basis with the dispatchers to discuss their use of the plan and make further modifications if necessary.

4.2 Smart Roadside Initiative

SAIC will apply DSRC technology from the Smart Roadside Initiative (SRI) pilot to the FRATIS project, namely the roadside equipment readers (RSEs) and the DSRC radios. SAIC manages the test bed in Michigan and has developed the onboard and server applications that support the use DSRC to communicate truck data for the SRI effort. This development experience will be leveraged to enable the transmission of the basic safety message (BSM) between equipped trucks and an RSE installed at the container yard. Data contained in the BSM will be used to calculate the wait time outside of the terminal – this pilot is described in the sub-section below.

4.2.1 Dedicated Short Range Communication and Use of the Basic Safety Message

A secondary terminal wait time pilot will be conducted at IMCG using DSRC technology. Several trucks will be equipped with a device that can transmit a Basic Safety Message (BSM). One or more DSRC receivers will be installed within the facility that will receive the BSM and send the information to a FRATIS an application. The application will use a geo fence to determine when the truck arrived at the facility, when it passed through the ingate and when it passed through the outgate. From that data the application will calculate wait time, dropoff time and pickup time. The MAC address of the device will change several times during this process and the application will need to determine when that happened and be able to link those addresses together.

4.3 Oversized Permitting

The carriers involved in the prototype in Dallas do not regularly make overweight or oversize moves. They have little need to obtain permits from TxDMV. Since the carriers have no need for permit capabilities we will not include that component in the Dallas pilot.

4.4 Public Sector

The devices that will provide traffic and weather information to drivers and dispatchers have established providers including public sources and do not have a need to add additional public sector sources. We only have a small fraction of the overall truck data in the Dallas area. We do not expect that public agency data from regional traffic management centers would provide significant value to the prototype. However, should schedule and budget permit, the SAIC team may implement additional prototype components for demonstration purposes after the initial prototype is released for use by test participants. These include:

- Integration of the Regional SmartNet System into the FRATIS portal. SmartNet is an application of the Dallas-Fort Worth Integrated Corridor Management (ICM) demonstration.
- Integration of regional weather data from the CASA system into the FRATIS portal
- Integration of the FHWA Freight Performance Measure Data for the DFW region into the FRATIS portal

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