Freight Advanced Traveler Information System (FRATIS)

OPTIMIZATION OVERVIEW

Dr. Sam Fayez

FRATIS Solution

- **Freight Advanced Traveler Information System (FRATIS) Applications:**

  - Freight-Specific Dynamic Travel Planning and Performance
    - Enhances traveler information systems to address specific freight needs
    - Integrates data on wait times at intermodal facilities (e.g. ports), traffic conditions, incident alerts, road closures, work zones, routing restrictions (hazmat, oversize/overweight)
    - Adaptive Communication between Drayage Company, Drivers, and Intermodal Facilities
    - Real-time Information and Dynamic Routing for Drivers

  - Drayage and Truck Routing Optimization
    - Optimize truck/load movements between freight facilities, balancing early and late arrivals.
    - Individual trucks are assigned best time windows for pick-up or drop-off.
    - Utilizes travel information and information on port terminal conditions to optimize operations.

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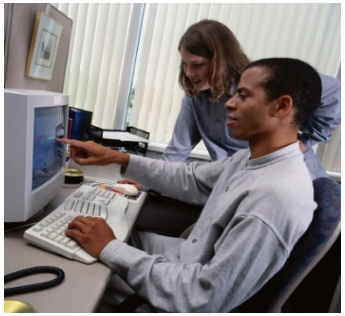
FRATIS Modules



Planning

Execution

Monitoring

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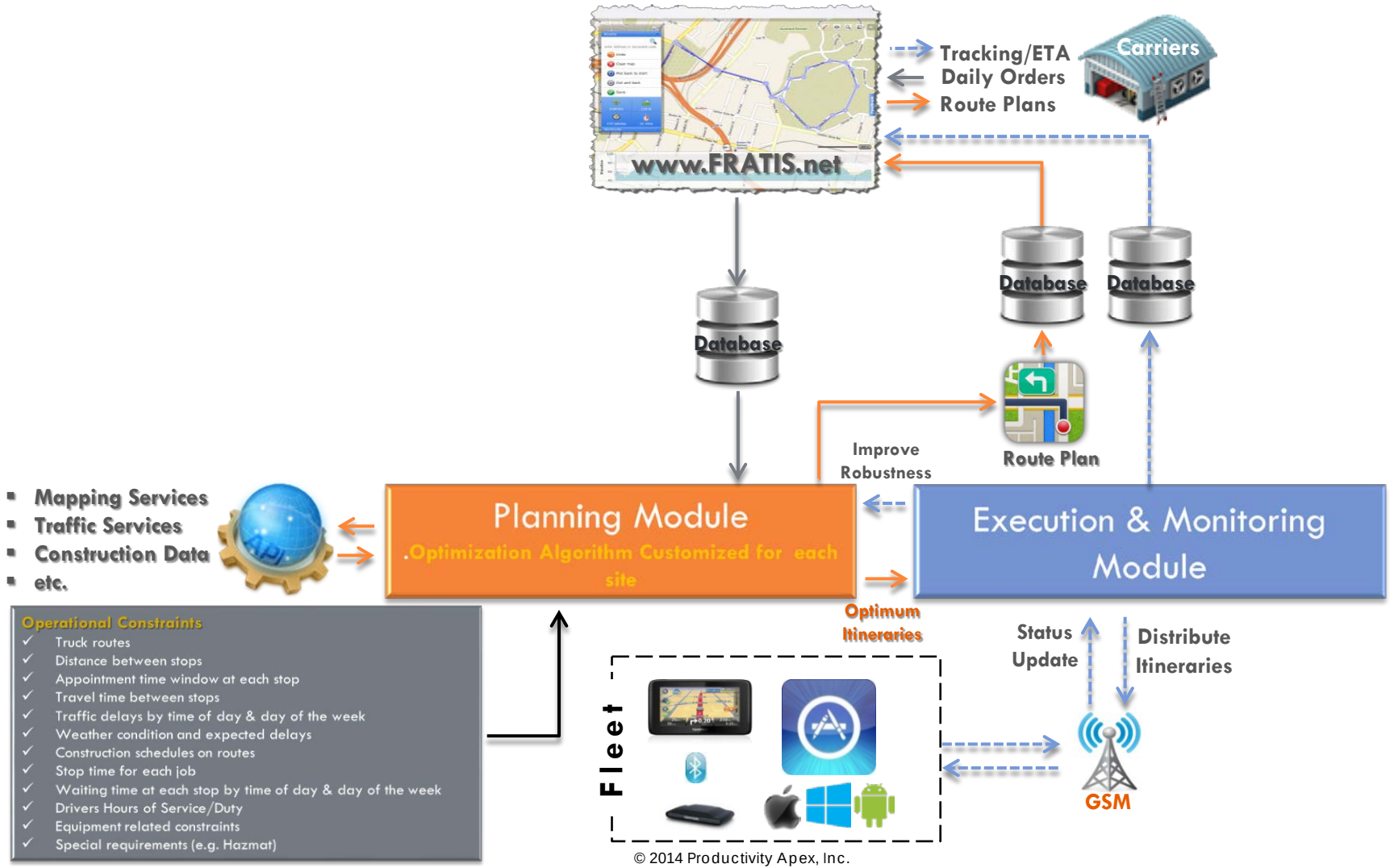
FRATIS Architecture



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Planning

- Receive and Enter jobs into FRATIS
  - Pickup Freight
  - Drop-off Freight
  - Live Load/Unload Freight

- Run the optimization algorithm
  - FRATIS inherits a sophisticated optimization algorithm that evaluates all the possible combinations of moving freight between locations
  - The optimization engine is on the cloud and will recommend the best combination in seconds
  - The optimization will recommend the most efficient, productive, and cost effective execution sequence and timing for each driver/truck at the same time satisfying all the operational and transportation constraints

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Planning

Capture Drayage Operation Constraints

- Truck routes
- Distance between stops
- Appointment time window at each stop
- Travel time between stops
- Traffic delays by time of day & day of the week
- Weather condition and expected delays
- Construction schedules on routes
- Stop time for each job
- Waiting time at each stop by time of day & day of the week
- Drivers Hours of Service/Duty
- Equipment related constraints
- Special requirements (e.g. Hazmat)

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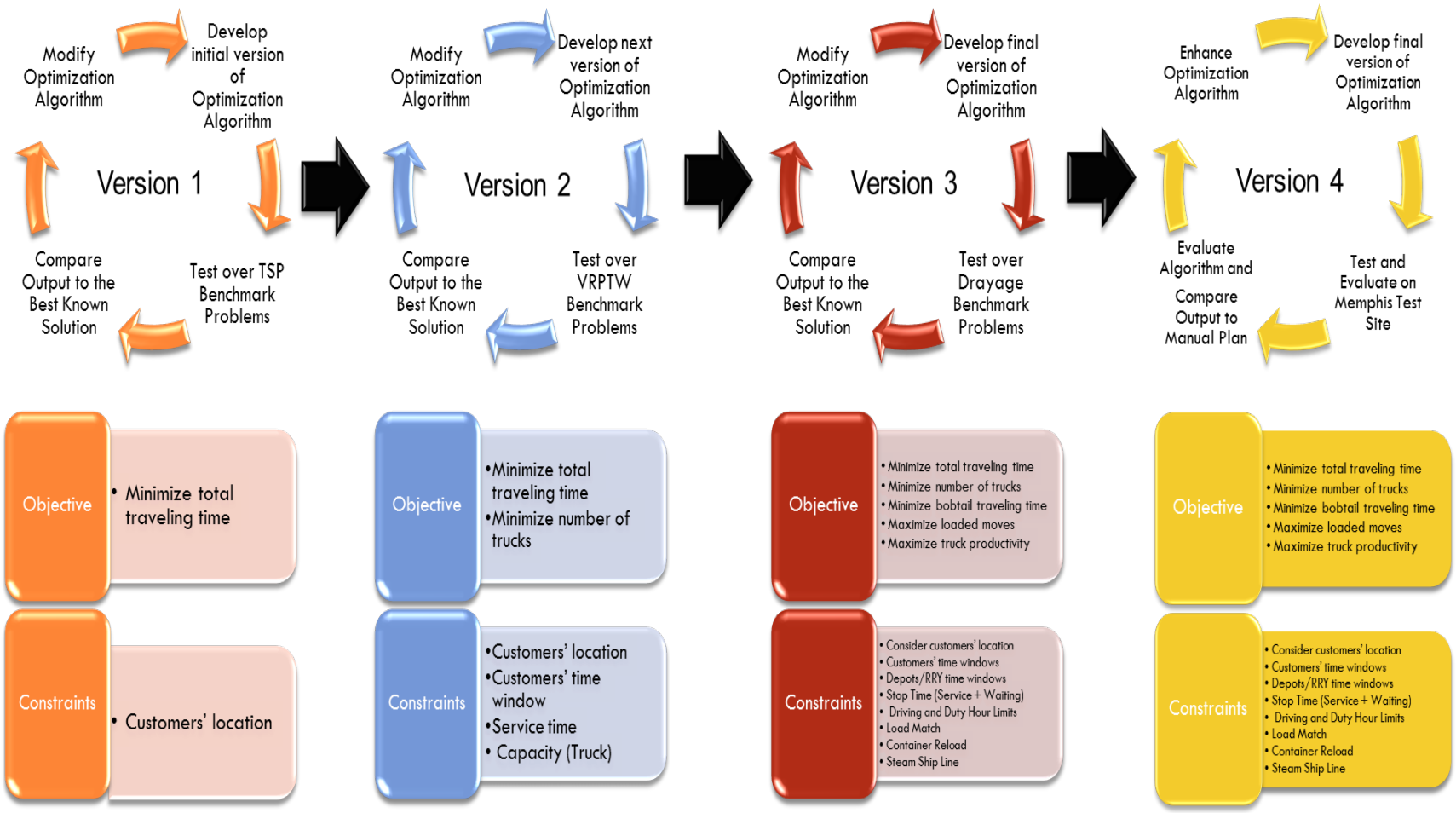
Optimization Algorithm Development Cycle



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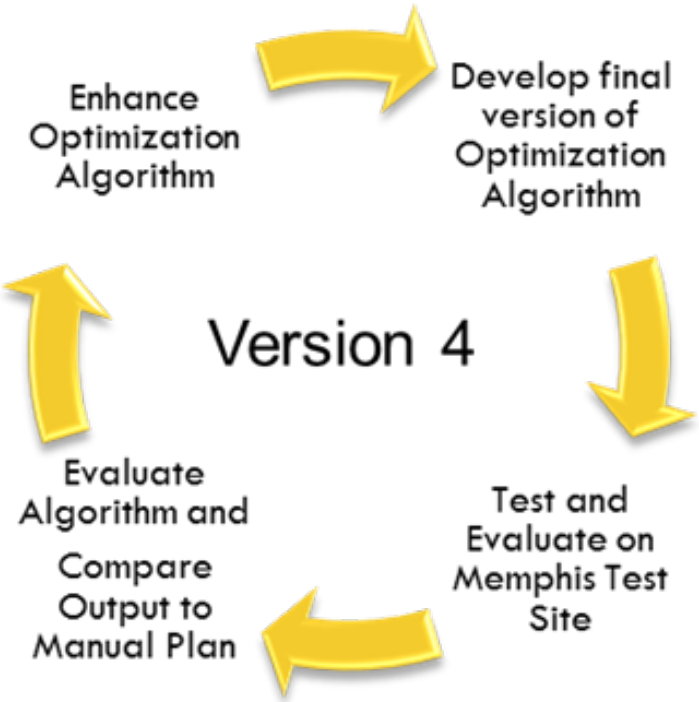
Optimization Algorithm Development Cycle



Objective

- Minimize total traveling time
- Minimize number of trucks
- Minimize bobtail traveling time
- Maximize loaded moves
- Maximize truck productivity

Constraints

- Consider customers' location
- Customers' time windows
- Depots/RRY time windows
- Stop Time (Service + Waiting)
- Driving and Duty Hour Limits
- Load Match
- Container Reload
- Steam Ship Line

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Optimization Algorithm Development Cycle

Version 5: FRATIS LA	
Added Constraints	Waiting Times at Marine Terminal Real Time Traffic provided by Navteq

Version 6: FRATIS South Florida	
Added Constraints	Customized based on integration with TMW Order Management System

Version 7: FRATIS Central Florida	
Added Constraints	Network Traffic Patterns Real Traveling Time provided by INRIX and TMC Receiving Docks Schedules

Version 8: FRATIS TEXAS	
Added Constraints:	Integration with I-35 Traveler Information System developed by TTI

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Planning

- Generate optimal plan
  - The optimization algorithm recommends the best feasible plan that maximizes operational efficiency of freight pickups and deliveries of all the trucks in a given fleet, specifically the plan that will:
    - Maximizes value added moves
    - Minimizes non-value added moves
    - Maximizes load matching & backhauls
    - Minimizes travel time and traffic delays
    - Minimizes waiting time
    - Minimizes required fleet size
    - Maximizes the drivers productivity
    - Maximizes customer service level

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Generated Optimal Plan

Optimized Solution (User-Modifiable)

Send to WebFleet

Plan Performance Measures

Modified Plan $5,115.27

Orders:	30
Total Time:	113:40
Total Miles:	1240.00
Total Bobtail Miles:	568.00
Total Time:	113:40
Driving Time:	28:12
Stop Time:	64:00
Waiting Time:	00:53

Optimum Plan $5,115.27

Orders:	30
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Total Miles:	1240.00
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Drivers Itinerary

Driver	Distance	Jobs				
Francisco Arias	31.00 mi	1125816	1125218-I	1125371	1125847	1125847-E
Aram Boyadjian	177.00 mi	1125182	1125241			
Dillon Bruno	97.00 mi	1125547	1125661	1125661-E	1125620	1125309
Cesar Cabuyales	155.00 mi	1125548	1125546	1125720	1125720-E	
Suren Khachatryan	168.00 mi	1125545	1125308	1125644		
Ruben Lemus	153.00 mi	1125544	1125415-E	1125634-E	1125634	1125620-E
Jesus Gutierrez	85.00 mi	1125300				
Bert Hernandez	173.00 mi	1125133	1125184			
Sergio Mendez	201.00 mi	1124728	1125385	1125542		
New Driver	0.00 mi					

Drivers with Assignments: 9

Accept Plan and Send to WebFleet

Manually Modified Plan

Optimized Solution (User-Modifiable)

Send to WebFleet

Plan Performance Measures

Modified Plan $5,641.83

Orders:	30
Total Time:	125:22
Total Miles:	1260.00
Total Bobtail Miles:	588.00
Total Time:	125:22
Driving Time:	29:07
Stop Time:	64:00
Waiting Time:	01:25

Optimum Plan $5,115.27

Orders:	30
Total Time:	113:40
Total Miles:	1240.00
Total Bobtail Miles:	568.00
Total Time:	113:40
Driving Time:	28:12
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Drivers Itinerary

Driver	Distance	Jobs			
Francisco Arias	28.00 mi	1125218-I	1125371	1125847	1125847-E
Aram Boyadjian	98.00 mi	1125184	1125661	1125816	
Dillon Bruno	97.00 mi	1125547	1125661-E	1125620	1125309
Cesar Cabuyales	155.00 mi	1125548	1125546	1125720	1125720-E
Suren Khachatryan	184.00 mi	1125620-E	1125545	1125308	1125644
Ruben Lemus	151.00 mi	1125544	1125415-E	1125634-E	1125634
Jesus Gutierrez	173.00 mi	1125182	1125300		
Bert Hernandez	173.00 mi	1125133	1125241		
Sergio Mendez	201.00 mi	1124728	1125385	1125542	
New Driver	0.00 mi				

Accept Plan and Send to WebFleet

Planning

- Review the optimal plan and approve
  - The optimal plan will be displayed to the dispatcher including:
    - Plan details for each driver, truck, and shipment
    - Plan summary statistics including miles, time, cost, status miles, utilization, fleet size, etc.
  - The dispatcher will review the generated plan to ensure that the plan can be executed based on the operational constraints of drivers, fleet, and specifics of the pickups and deliveries. Also the dispatcher past experience.
  - The dispatcher will be able to make any changes to the plan. The system will update the plan summary statistics and provide a comparison between the dispatcher modified plan and the system generated optimal plan.

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Planning

- Communicate the plan details
  - Confirm jobs with drivers
  - Send jobs to drivers
  - Send notification to intermodal facilities/customers with plan specifics including the estimated time of arrival (ETA) to each stop location.

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Execution

- Drivers receive and execute Jobs
  - Drivers receive the jobs including stop locations, sequence and timing on their smartphones or navigation device
  - The smartphone or navigation device will identify the best route between current driver location and the next stop location, the best route is determined based on:
    - Specific truck routes
    - Historical traffic information
    - Current traffic conditions
    - Construction schedules
    - Other constraints e.g. Hazmat Shipment, Over size, weather conditions, etc.
  - Estimated time of arrival will be updated and communicated in real time
  - The smartphone or navigation device will identify alternate routes between stops in case of delays/incidents in the current route (dynamic routing)

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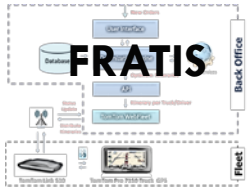
MTO and Drayage Operator Exchange of Information Elements of the FRATIS System

Drayage Fleet Operators (DO's)



Marine Terminal Operators (MTO's)

Container information message is sent from DO to MTO once order information entered in the order management system

Container availability message is sent from MTO to DO once the container is cleared from customs and become ready for pickup

Truck ETA message is sent from DO to MTO one day before a container is to be picked up off at MT, ETA is based on traffic historical data.

MTO uses truck ETA information to support estimation of labor and equipment orders; and stacking preparation

Truck ETA message is sent from DO to MTO once the truck start heading to the MT, ETA is based on real time traffic data.

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Execution

- Dispatcher receives same day jobs
  - Dispatchers will review the new job and enter into the system and update constraints
  - The dispatcher will have several options to add the job to the current plan
    - Locate the closest truck(s) using GPS
    - Enter the job into the system and run the optimization with the new job and the current unexecuted jobs
    - Review the workload of the driver or the output of the optimization
    - Dispatch and send jobs to drivers

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Monitoring

- Monitor the daily operations
  - Dispatchers monitor the execution of all the jobs in real time and ensure proper execution, including:
    - Tracking trucks
    - Traffic conditions, construction, and congestion
    - Arrival times to each location
    - Stop times at each location
    - Waiting times at each location
    - Drivers hours of service
    - Weather condition
  - Dispatcher through FRATIS have access to live information and they can provide information to drivers in real-time

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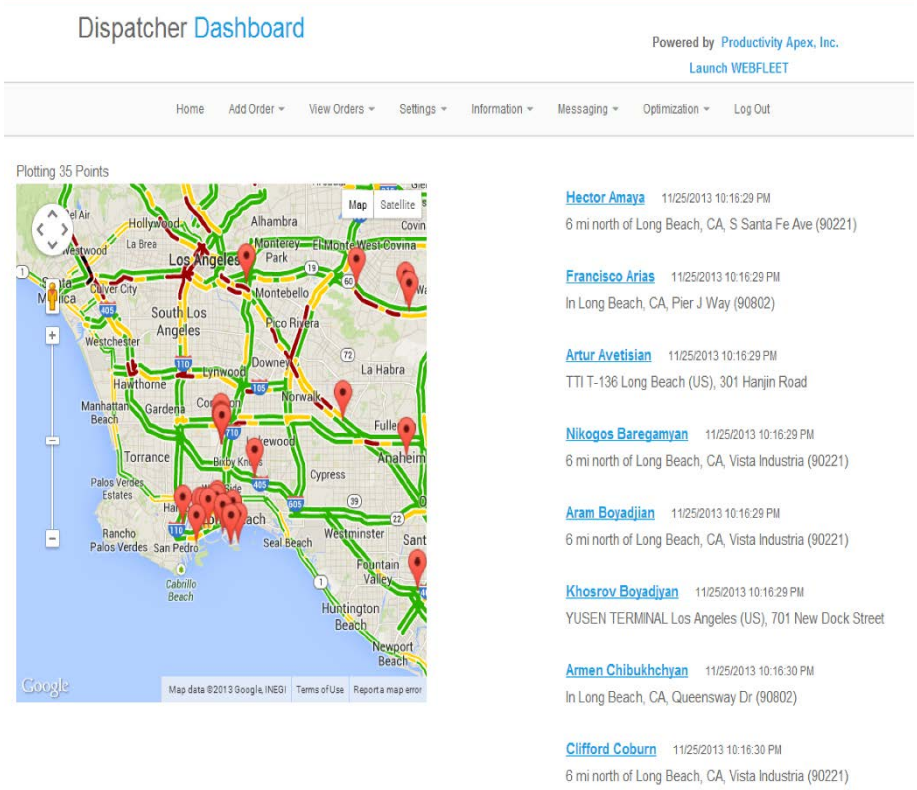
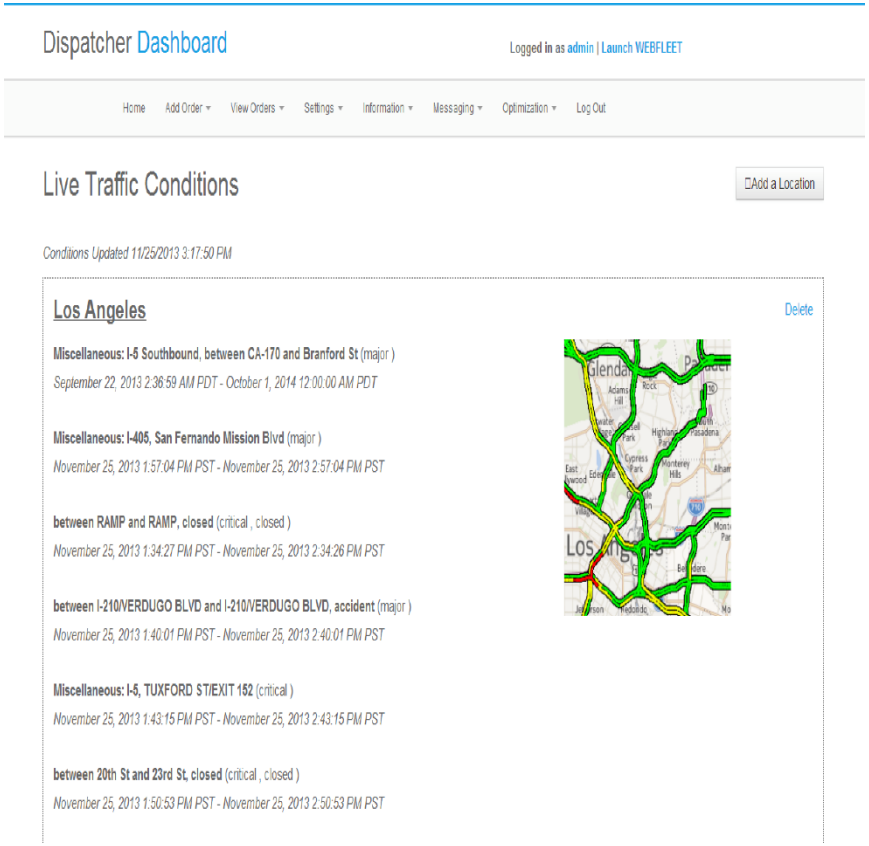
Monitoring

Drivers' availability (available drivers, maximum duty hours, maximum driving hours)



Estimated traffic conditions (travel times under traffic conditions)



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Monitoring

- Improve plan robustness and execution
  - FRATIS has built in comparison modules to compare:
    - Plans vs. Execution
    - Optimal Plans vs. dispatcher modified plans
  - The comparison modules will measure the deviations and will update the planning modules in order to generate more robust optimal plans.

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Discussion

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