Emerging Freight Connected Vehicle Programs in Southern California

presented to
ITS California Annual Meeting

presented by
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October 15, 2014

Transportation leadership you can trust.
The I-710 Freight Capacity Problem

Today

- 25,000 daily truck volumes on I-710
- 16 Million TEU’s

2035

- 80,000 daily truck volumes on I-710
- 43 Million TEU’s
“The 710”

Alternative 6A
I-710 Widening plus Freight Corridor

Trucks
THE 710’S FUTURE – THE PROMISE OF CONNECTED VEHICLES

- **Mobility** = at least double throughput of trucks on the dedicated truck lanes through advances in vehicle automation, V2V, and V2I communications

- **Emissions** = leverage Connected Vehicle technologies and goods movement efficiency (e.g. FRATIS) for substantially improved traffic flow to reduce fuel usage and corresponding emissions reductions

- **Safety** = virtually eliminate truck accidents through connected vehicle technologies and V2V communications
The Gateway Cities Technology Plan for Goods Movement is developing several technology applications and operations improvements to move goods safely and efficiently in and out of the region. These projects were identified as part of the ITS Integration Plan for Goods Movement with the support of a Southern California ITS Working Group. With solutions like these in place to address the growing demand for Southern California goods movements, the region will see less congested roadways, cleaner air, and more capacity for economic growth.
I-710 Concept for Connected Trucks With Automation Capabilities
To achieve truly transformative transportation system benefits, we must integrate vehicle automation technologies with vehicle-to-vehicle and vehicle-to-roadside communication.
CONNECTED VEHICLE PLATOONING
BENEFITS OF CONNECTED TRUCKS WITH AUTOMATION CAPABILITIES

- Safety/collision avoidance
- Drive cycle smoothing
- Platooning - increased fuel economy
- Platooning – increased throughput
- Signal coordination and signage
- More efficient route selection
- Parking space location
- Emissions benefits from the above
- Economic benefits from the above

Goal: Make the I-710 ultra-safe and hyper-reliable to the trucking industry
WORK TO DATE

- Preliminary Research/Planning
- OEM Industry Relationships
- Concept of Operations
- Test Plan Development
- Infrastructure Impact Assessment
OEM AND TEST BEDS ENGAGEMENT
I-710 ConOps for the Zero Emission Freight Corridor

- DSRC-based corridor infrastructure
- Connected Vehicle truck platooning operations – moving towards automation capabilities
- Deployment in mid-2020’s -- leverage test bed opportunities over the next decade
In Tier 1 the I-710 ZE Freight Corridor would have traditional traffic control devices such as:
- Speed/volume detectors
- CCTV surveillance cameras
- CMS for traveler information

The more advanced trucks will come with systems to improve safety and reliability utilizing radars, cameras and other on-board safety systems. These trucks still operate independently and do not communicate with other trucks or anything on the roadside.

Features on fully equipped trucks in Tier I include:
- Adaptive Cruise Control
- Dynamic Brake Support
- Overtaking Assist
- Lane Departure Warning Systems

The driver has overall control and is solely responsible for safe operation of the truck. The driver can choose to cede limited control to the vehicle.
In Tier 2 the traditional traffic control devices would remain, although new in-vehicle systems would begin to provide much of this information.

Trucks with advanced systems would begin to penetrate the marketplace with over half the vehicles having nearly autonomous features such as Cooperative Cruise Control.

In Tier 2 some trucks now begin to have Vehicle-to-Vehicle communication sharing, thereby increasing safety significantly. Even at this level, these technologies support increased reliability and are a benefit to I-710 throughput.

The driver still has overall control and is solely responsible for safe operation of the truck. The driver can choose to cede more control to the vehicle.
In Tier 3 the traditional traffic control devices would not be needed any more. All traveler information (including tolling etc.) would be done in-vehicle.

Trucks now begin to have Vehicle-to-Vehicle and Vehicle-to-Infrastructure communication.

The driver would cede full control over to the vehicle.

Trucks with advanced systems would dominate the marketplace with the trucks having fully autonomous features. At this stage shorter headways could be utilized, thereby creating dynamic platoons of trucks and therefore greater throughput.

Trucks now begin to have Vehicle-to-Vehicle and Vehicle-to-Infrastructure communication.
Human Factors Issues with Partial Automation
TRUCK PLATOONING TEST PLAN

- Initial Proof-of-Concept Testing at test tracks, incorporating up to six intermodal trucks (of differing makes), DSRC 5.9 GHz devices, and associated truck platooning V-V hardware and software.

- Prototype Operation Testing in the Gateway Cities region in 2016-17, incorporating real-world conditions and intermodal trucks (test facilities to be determined.)
FEDERAL HIGHWAY ADMINISTRATION
TRUCK PLATOONING DEMONSTRATION

- Exploratory advanced research program
  - Intended to spur innovation and focus on high risk and high pay-off research

- Topic 1D - Partial Automation for Truck Platooning
  - Truck dynamics and control
  - Operating strategies
  - Customer acceptance

- California-based Public-Private Consortium
  - Using some of the products of this effort
  - Selection announced recently
INFRASTRUCTURE IMPACT ASSESSMENT

- I-710 Infrastructure Impact Report
  - Impacts to Freight Corridor Infrastructure
    - DMS
    - Tolling Equipment
    - CCTV
    - Connected Vehicle Radios (DSRC)
    - Power/Communications
I-710 CONNECTED TRUCKS RESEARCH QUESTIONS

- How can trucks establish platoons before entering a freeway in a coordinated manner with the same destination in mind?

- What is minimum safe truck spacing for a connected vehicle dedicated truck corridor?
  - Maximum case for increased throughput on trucks on roadway?

- What is the trucking industry business case for connected trucks?

- How will non connected vehicle trucks “mix” with connected vehicle trucks? And what about autonomous vehicles?

- How should planners be preparing for connected vehicles?
LOS ANGELES FREIGHT ADVANCED TRAVELER INFORMATION SYSTEM (LA FRATIS)
USDOT - FRATIS Concept of Operations Overview

### Regional ITS Data

**Sources**
- Regional 511 Systems
- MPO
- State DOT
- Cities

**Types**
- Real-Time Freeway Speeds and Volumes
- Real-Time Key Arterial Speeds and Volumes
- Incident Information
- Road Closure Information
- Route Restrictions/Bridge Heights

### Third Party Truck-Specific Movement Data

- Real-Time Speed Data from Fleet Management Systems GPS Data
- Cell Phone and/or Bluetooth Movement/Speed Data
- Truck Parking Availability

### Intermodal Terminals Data

- Queue Length (Including Video)
- Container Availability Status

### Regional Public-Private Partnership

**Data Integration**

- Public Sector
- Private Sector

### FRATIS Basic Applications

- Dynamic Travel Planning and Performance
- Intermodal Drayage Operations Optimization
  - *Based on Open Source Data and Services*

### FRATIS Commercial Applications

- Dynamic Travel Planning and Performance
- Intermodal Drayage Operations Optimization
  - *Value Added Services with Target Markets (For Profit)*

### Future U.S. DOT Connected Vehicle Data

- Road Weather Management – Route Specific Conditions and Forecasts
- “Probe Data” From V-V and V-I Connected Vehicle Technologies
- V-IV & V-I Safety Applications Data

### FRATIS IT Toolkit

- ConOps, Architecture, Use Cases
- FRATIS Baseline API’s
- FRATIS Baseline Web and AED Apps
- FRATIS Testing Best Practices Guide and Performance Criteria
- FRATIS Business Plan

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**API’s and/or Web Services**

- **USDOT Open Source Web Portal**
Background: Gateway Cities Logistics Corridor

- Anchored by Ports of Long Beach & Los Angeles
  - Busiest port complex in North America – 16 million container-equivalents processed per year
    - Over 40% of the nation’s total import traffic
    - 10% of U.S. population lies within 100 miles
- Over 1000 Trucking Companies
  - Harbor Trucking Association (30% of trucks)
- Includes 14 Active Marine Terminals
  - YTI, SSA, TTI, APL etc.
- 694 Million sqft. of regional warehousing space
- Robust transportation network
  - I-710, I-5, I-405, I-605, I-105, SR-91; vast arterial network of over 2300 signalized intersections
- Major Issues in Goods Movement Efficiency
  - Lack of information sharing between trucking and terminals significantly impedes intermodal freight system efficiency
  - Lack of freight-specific traveler information such as terminal wait times and dynamic routing options

**PLANNING CONERN:**
Projected growth in container volumes through this corridor is expected to at least double by 2040
Testing Connected Vehicle Technologies in California – The FRATIS-LA Test

- The Freight Advanced Traveler Information System (FRATIS) Los Angeles Test is:
  - Funded by RITA as part of the USDOT’s Connected Vehicle Program – “Dynamic Mobility Applications” bundle
  - Enabled by a unique regional public-public partnership – the Gateway Cities ITS Working Group – that has develop and overall freight ITS and connected vehicle program plan for the region
    - Facilitated by LA METRO, the Gateway Cities COG and the Harbor Trucking Association
  - Designed based on extensive user feedback from dispatchers, drivers and marine terminal operators
  - Deployed and operated successfully since early 2014, with continuous system enhancements and expanded use over time.
  - An example to the national of how to successful plan, design, deploy and test advanced ITS and connected vehicle technologies
FRATIS-Los Angeles Components

• Drayage-Marine Terminal Operator Information Exchange
  – Two-way messaging between terminal and drayage firm with ETA for dray approaches and MTO-dispatcher messaging and alerts

• Drayage Optimization and Freight-Tailored Traveler Information
  – Daily optimized schedules per driver based on average stop times, predicted travel times, expected terminal wait times, and other constraints
  – Real time terminal queue info, driver messaging, and traffic; dynamic routing for trucks through in-cab navigation TomTom devices
FRATIS-LA System Overview
FRATIS: Drayage Optimization and Freight-Tailored Traveler Information

1. Receive orders
2. Enter orders into system
3. Send advance notification to marine terminal
4. Confirm load status notification with marine terminal
5. Review and approve final output (itinerary)
6. Run optimization algorithm: incorporates many constraints: travel times, routing, HOS, terminal queues, PierPass, etc.
7. Send 1 day in advance notification to marine terminal
8. Dispatch drivers (drivers can dynamically reroute around congestion)
9. Send same day notification with current ETA to marine terminal
10. Execute orders
Application of an Innovative Optimization Algorithm Approach (*Productivity Apex*)

**LA FRATIS Optimization Constraints**
- Distance and travel time between stops
- Appointment time window at each stop
- Traffic delays by time of day & day of the week
- Weather condition and expected delays
- Construction schedules on routes
- Waiting time at each stop by time of day & day
- Drivers Hours of Service/Duty
- Equipment related constraints
- PierPass hours of operation
- Special requirements (e.g. Hazmat)

**LA FRATIS Optimization Outputs**
- Optimum plan for the day for the fleet by truck/driver
- Daily Miles driven
  - Total miles driven
  - Total miles driven per truck
  - Total bobtail miles driven
- Estimated time of arrival
- Order status and estimated order end time per truck/driver
- Total estimated driving time and stop time
- Driving hours, idle time, and standstill per driver

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**Previous Test -- Memphis Drayage Optimization Algorithm Results**

<table>
<thead>
<tr>
<th>Performance Measure</th>
<th>Improvement</th>
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<tbody>
<tr>
<td>Bobtail Miles Reduction</td>
<td>13%</td>
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<tr>
<td>Total Miles Reduction</td>
<td>9%</td>
</tr>
<tr>
<td>Average Miles per Truck Increase</td>
<td>14%</td>
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<tr>
<td>Required Fleet Size Reduction</td>
<td>21%</td>
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FRATIS Optimization Preliminary Results
Two-month Comparison - Metrics Per Order

FRATIS LA Data Comparison: Sept 2013 vs. June 2014

<table>
<thead>
<tr>
<th>Metric</th>
<th>Sept 2013 vs. June 2014</th>
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</thead>
<tbody>
<tr>
<td>Daily Miles/Order</td>
<td>-34.7%</td>
</tr>
<tr>
<td>Time/Order</td>
<td>-15.3%</td>
</tr>
<tr>
<td>Stop Time/Order</td>
<td>-10.4%</td>
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FRATIS: Trucking Fleet to Marine Terminal Operator (MTO) Communications System

1-Day in Advance

- Truck ETA message is sent from DO to MTO at Noon the day before a container is to be picked up off at MT
- MTO uses truck ETA information to support estimation of labor and equipment orders; and stacking preparation

Truck is In-Route to the Terminal

- DO Receives automated alert of MT queue conditions one-hour before ETA, with prediction for queue at ETA
- MTO receives automated alert of truck approaching MT 10 minutes out from MT

Truck is Inside the Terminal

- Truck Driver can receive real-time push alerts from MT on container status, internal queues, yard alerts, trouble tickets and other info
- MTO manages the yard more effectively by being able to send key alert information to truck drivers in the terminal in real-time

Legend

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<tbody>
<tr>
<td>Drayage Fleet Operators (DO’s)</td>
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Benefits of FRATIS Trucking-MTO Communications System Testing

• If deployed on a large scale, and supported by all parties (including shippers), has the potential to radically improved port terminal and trucking efficiencies
  – Through “dynamic appointments”

• Has successfully brought together the trucking and terminal operations communities in the ports region
  – A major positive development
WiFi-based Terminal Queue Measurement System

Booth 5
Booth 3
Bobtail Lane
Exit #1
THANKS!
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80’s Action Stars and Connected Vehicles
Who knew?