FEDERAL HIGHWAY ADMINISTRATION

CONNECTED VEHICLE PILOT DEPLOYMENT PROGRAM PHASE 1

CV Pilots Joint Technical Kickoff Session 1: Site Concepts, Tampa September 30, 2015

FLORIDA! A Bold Vision
JOE WAGGONER
Executive Director, CEO
Tampa Hillsborough Expressway Authority (THEA)
CONNECTED VEHICLE TECHNOLOGIES

Advances that will Transform
Life, Business and Global Economy
We have the Right Resources

INNOVATION
Forward Thinking Transportation Agencies Tampa Hillsborough Expressway Authority (THEA), City of Tampa, Hillsborough Regional Transit Authority (HART) and Florida Department of Transportation (FDOT) District 7

OBJECTIVITY
Nationally Recognized Educational Institutions like Center for Urban Transportation Research (CUTR) at University of South Florida (USF)
Performance Measurements

OPPORTUNITY
Strong Economic Development Council and Supportive Chamber of Commerce
Opportunities

Test Bed for Connected Vehicle (CV), Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I) Systems

SELMON EXPRESSWAY
Opportunities

Test Bed for Connected Vehicle (CV), Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I) Systems

MERIDIAN AVENUE AND BRANDON PARKWAY
Opportunities

Test Bed for Connected Vehicle (CV), Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I) Systems
CONNECTED VEHICLE TECHNOLOGIES

OPPORTUNITIES

FLORIDA! A Bold Vision
Bob Frey, AICP
THEA Program Director and Task 10 Lead - Partnership Coordination
Tampa Hillsborough Expressway Authority (THEA)

• Main Point of Contact for USDOT and Other Pilots
• Facilitate/Moderate Communication between THEA and Consultant Team
• Facilitate Communications with Wyoming and New York City Pilots for Sharing of Data, Lessons Learned, etc.
CONNECTED VEHICLE PILOT DEPLOYMENT – DOWNTOWN TAMPA

Study Area

CONNECTED VEHICLE APPLICATION

V2I SAFETY

- Curve Speed Warning
- Pedestrian in Signalized Crosswalk
- Mobile Accessible Pedestrian Signal (PED-SIG)

V2V SAFETY

- Emergency Electronic Brake Light
- Forward Collision Warning (FCW)
- Intersection Movement Assist (IMA)
- Vehicle Turning in Front of Bus

MOBILITY

- Intelligent Traffic Signal System (I-SIG)
- Signal Priority (Transit)

AGENCY DATA

- Probe-enabled Traffic Monitoring
PILOT DEPLOYMENT ISSUES AND APPLICATIONS RELATIONSHIP

CV APPLICATIONS

- V2I SAFETY
  - Curve Speed Warning
- V2V SAFETY
  - EEBL and FCW
- V2I SAFETY
  - Pedestrian in Signalized X-walk
- V2I SAFETY
  - Mobile Accessible Pedestrian Signal PED-SIG
- V2I SAFETY
  - IMA
- MOBILITY
  - I-Sig
- AGENCY DATA
  - Probe Enabled Traffic Monitoring
- MOBILITY
  - TSP
- V2V SAFETY
  - Vehicle Turning in Front of Bus

USE CASE/NEED

- MORNING BACKUPS
  - REL at Twiggs Street
- PEDESTRIAN CONFLICTS
  - PEDESTRIAN SAFETY
  - Twiggs Street - Courthouse
  - REL at Twiggs Street
- WRONG WAY ENTRIES
  - Meridian Avenue
  - REL at Twiggs Street
- TRAFFIC PROGRESSION
  - MacDill AFB
- BRT OPTIMIZATION
  - TRIP TIMES
  - SAFETY
  - BRT-REL to Marion Street
- STREETCAR/AUTO/PED/
  - BIKE CONFLICTS
  - Channelside
OUR TECHNICAL SUPPORT TEAM

THEA EXECUTIVE DIRECTOR
Joe Waggoner (CDL)

THEA PROGRAM MANAGER
Bob Frey, AICP

THEA COMMUNICATION DIRECTOR
Susan Chrzan

TASK 10
Partnership Coordination & Finalization
LEAD
Bob Frey, AICP (T)
SUPPORT
HTNB

TASK 11
Outreach Plan
LEAD
Susan Chrzan (T)
SUPPORT
HTNB
Global-5
OUR TECHNICAL SUPPORT TEAM

 TASK 9
Participant Training & Stakeholder Education Plan

LEAD
Mary Hamill (G)

SUPPORT
THEA
HNTB
Global-5

TASK 2
Pilot Deployment CONOPS
LEAD
Steve Bahler, PE (H)
SUPPORT
THEA
HNTB
Siemens
Booz Allen Hamilton

TASK 3
Security Management Operating Concept
LEAD
Dominic Garcia (B)
SUPPORT
THEA
HNTB
Booz Allen Hamilton

TASK 4
Safety Management Plan
LEAD
Sara Beresheim, PE, PTOE (H)
SUPPORT
HNTB
Booz Allen Hamilton

TASK 5
Performance Measurement & Evaluation Support
LEAD
Steve Reich (C)
SUPPORT
HNTB
Booz Allen Hamilton

TASK 6
Pilot Deployment Systems Requirements
LEAD
Jason JonMichael (H)
SUPPORT
Siemens
Booz Allen Hamilton

TASK 7
Application Deployment Plan
LEAD
Dwayne Hencelwood (B)
SUPPORT
HNTB
Siemens
Booz Allen Hamilton

TASK 8
Human Use Approval
LEAD
Victor Blue, PE, PHD (H)
SUPPORT
HNTB
CUTR

TASK 9
Participant Training & Stakeholder Education Plan
LEAD
Mary Hamill (G)
SUPPORT
THEA
HNTB
Global-5

TASK 10
Partnership Coordination & Finalization
LEAD
Bob Frey, AICP (T)
SUPPORT
HNTB

TASK 11
Outreach Plan
LEAD
Susan Chrzan (T)
SUPPORT
HNTB
Global-5

TASK 12
Comprehensive Pilot Deployment Plan
LEAD
Jason JonMichael (H)
SUPPORT
HNTB
Siemens
Booz Allen Hamilton

TASK 13
Deployment Readiness Review
LEAD
Steve Bahler, PE (H)
SUPPORT
THEA
HNTB
Siemens
Booz Allen Hamilton
OUR TECHNICAL SUPPORT TEAM

SIEMENS
Steve Johnson, CVP
Task 1 Lead - Program Management
HNTB Corporation

- Point of Contact for Inter-team Coordination and Communication
- Technical Level Communications with Wyoming and New York City for Data Sharing and Lessons Learned
- Critical Path Method Schedule
- Programmatic Reporting
  - Monthly and Annual Reports
  - Project Financials
- Project Controls
- Contribute to Tasks as-needed
PLAN RISK MANAGEMENT: INPUTS, TOOLS AND TECHNIQUES, AND OUTPUTS

**INPUTS**
- Project Management Plan
- Stakeholder Register
- Enterprise Environmental Factors
- Organizational Process Assets

**TOOLS/TECHNIQUES**
- Analytical Techniques
- Expert judgment
- Meetings

**OUTPUTS**
- Risk Management Plan
## Preliminary Risk Register

### USDOT Risk Register Template

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>P1-1</td>
<td>ConOps/ Schedule/ System Requirements</td>
<td>THEA</td>
<td>Unknown System/ Device Compatibility Issues</td>
<td>2 (Low)</td>
<td>2 (Low)</td>
<td>4</td>
<td>Mitigate</td>
<td>Early Engagement with FDOT-TERL and Float in Deployment Schedule</td>
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<tr>
<td>P1-2</td>
<td>Program Management</td>
<td>THEA</td>
<td>Loss of Key Staff</td>
<td>2 (Low)</td>
<td>1 (Low)</td>
<td>2</td>
<td>Contingency</td>
<td>Succession Plan</td>
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<td>P1-3</td>
<td>Stakeholder Education</td>
<td>THEA</td>
<td>Public Opposition/ Privacy or Safety Concerns</td>
<td>2 (Low)</td>
<td>2 (Low)</td>
<td>4</td>
<td>Mitigate</td>
<td>Effective Outreach Plan</td>
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<tr>
<td>P2/3-1</td>
<td>Deployment Plan</td>
<td>THEA</td>
<td>Extended Road Closures - Planned Private Development</td>
<td>4 (High)</td>
<td>2 (Low)</td>
<td>8</td>
<td>Mitigate</td>
<td>Close Coordination with City of Tampa/Developer</td>
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<tr>
<td>P2/3-2</td>
<td>Deployment Plan</td>
<td>THEA/ Stakeholder FDOT District 7</td>
<td>Conflicting Construction Projects - Managed Lanes 2018</td>
<td>3 (Low)</td>
<td>3 (Low)</td>
<td>9</td>
<td>Mitigate</td>
<td>Close Coordination with FDOT District 7 - Opportunity for Shared Cost</td>
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<tr>
<td>P2/3-3</td>
<td>Deployment Plan</td>
<td>THEA/ Partner City of Tampa</td>
<td>Conflicting Construction Projects - City of Tampa Planned Signal Upgrades in Pilot Area</td>
<td>4 (High)</td>
<td>4 (High)</td>
<td>16</td>
<td>Mitigate</td>
<td>Close Coordination with City of Tampa (Pilot Partner) - Opportunity for Shared Cost</td>
</tr>
</tbody>
</table>
Dominie Garcia
Task 3 Lead - Privacy and Security Management Operating Concept
Booz Allen Hamilton

- Currently Leading the Team Developing Security Requirements for DSRC Devices and has Authored Papers about Governance and Policy Needs for Connected Vehicle Security
- Extensive Experience with State and Local Agency Connected Vehicle Development and Implementation Efforts
- The Booz Allen Connected Vehicle Security and Privacy Team has Additional Expertise in Security and Privacy and Strong Relationships with Key Security Industry Technical Experts
Current SCMS Design Includes Protections Against Traceability – the Solution Being Prototyped Now will Include Technical Measures to Protect Privacy and Secure Information Flows

Team will Build off the SCMS Design and Prototype to Plan for Multiple Kinds of Security Threats:
- Internal and External
- Accidental or Intentional

Team will Determine the Roles, Processes, Data Flows, Physical Components and Communications Protocols Necessary for Privacy and Security Operations Using the Connected Vehicle Reference Implementation Architecture (CVRIA) and the SCMS Prototype

Team will use National Institute of Standards and Technology (NIST) Guidance for Identifying Appropriate Levels of Security for all Objects and Information Flows across the System to Ensure Appropriate Levels of Security and Privacy
Booz Allen Hamilton has been Part of the Development of the SCMS for V2V and V2I Safety Applications

Our Security Solution will Address:
- Confidentiality, Integrity, Availability, Authenticity and Non-repudiation Needs Across the Systems
- SCMS and Back-End Interface
- Interface and Coordination with Other Systems
- Measures of Performance
- Data Access Protections

- Understanding of the Technical Design In-depth (Being Prototyped by CAMP Now) and the Policy Needs and Implications
  - V2V and V2I communications are covered but additional applications have not yet been designed into the system
  - For the THEA Pilot, we will ensure protection of all objects, information flows, and applications being deployed

- Ensure Privacy Protection at all Levels:
  - Technical protection based on credential design and certificates
  - Additional protection based on data collection, storage, access and management processes as needed for different applications
The USDOT/NHTSA NPRM is Expected to Contain Security Requirements, which will be the Core of the Security System and Conformance to it

- Booz Allen Hamilton is leading the work to develop performance and security requirements for NHTSA
- Compliance testing is part of this work, and we will use NPRM requirements or recommendations and current compliance testing designs that are being developed within USDOT
- Booz Allen Hamilton has internal Common Criteria and FIPS 140-2 testing labs

Physical Security of Devices and Infrastructure (along with Device Software/OS Security) will be Part of the Overall Security Solution

Misbehavior Detection will be Built into the SCMS Based on the CAMP Prototype and Updated Designs (it is still TBD)
Susan Chrzan
THEA Communications Director and Task 11 Lead - Outreach Plan
Tampa Hillsborough Expressway Authority

• THEA Communications Director Since 2007
• More than 27 Years of Marketing and Communications Experience in Varied Industries
• IBTTA Communications Committee Member and Webinar Training Coordinator
• THEA Coordinator for USF STEM 3 Scholarship and College of Engineering Youth Bridge Building Competition
• Coordination with National Media for Audi Autonomous Vehicle Demonstration on THEA Test Bed Facility
TASK 9: PARTICIPANT TRAINING AND STAKEHOLDER EDUCATION PLAN

- Identify Stakeholders and Participation Groups
- Draft Training and Education Plan
- Solicit Feedback to Evaluate Training
- Identify Participant/Stakeholder Roles and Responsibilities
- Recruit and Engage Participant Groups
TASK 11: OUTREACH PLAN

Interaction and Coordination with USDOT and Other CV Pilots

Public Relations and Marketing Activities

Web and Social Media Presence

Trade Show Strategy and Budgets

Strong Return on Investment

Initiatives to Increase Community Awareness

Crisis Communications Plan
STEVE REICH
Task 5 Lead - Performance Measurement and Evaluation Support
Center for Urban Transportation Research (CUTR) at University of South Florida (USF)

- Measures of Changes in Mobility, Emissions, Safety and Agency Efficiency are Anticipated
- Tailored Approach for Each of the Locations and Use Cases
- Combines Area University Expertise with Connected Vehicle Evaluation Experience
• Work on Earlier Connected Vehicle Phases
• Appropriate Evaluation Criteria
• Data Availability vs. Cost
• Target Development - Analysis and Modeling Simulation (AMS) Tool
• Site-Specific Impacts and Corridor Impacts
• Coordination with Stakeholders
• Benefit/Cost
• Participant Training
• Qualitative and Quantitative Measures
• Mitigation of Confounding Factors
• Data Sharing
Examples of contemplated metrics:

**Mobility**
- Travel Time and Reliability
- Transit Ridership
- Congestion Impact

**Safety**
- Wrong Way Incidents
- Transit/Auto/Pedestrian Conflicts
- Application Acceptance

**Emissions**
- Impact on Criteria and Non-Criteria Pollutants

**Efficiency**
- City TMC Operation Enhancements
- Transit Agency Scheduling and Routing
- REL Operation
POTENTIAL MEASUREMENT APPROACHES

Control vs. Treatment

Systemwide Impacts

User Feedback
(e.g. acceptance, perception of benefits)

Observational

Before and After

Modeling

Benefits Estimation

Applicability to Wider Implementation
STEVE NOVOSAD
System Development Lead (Interim for Jason JonMichael)
HNTB Corporation

• Vehicle Infrastructure Integration (VII) (2003)
• 2011 World Congress Connected Vehicle Demonstrations and SunGuide® Connected Vehicle Software
• Qualification and Certification Testing of IntelliDriveSM (OmniAir Consortium)
• Standards Compliance and Interoperability Certification Program for Connected Vehicle Hardware and Software
• Vehicle to Infrastructure (V2I) Integrated Prototype Development and Deployment
• FDOT Connected Vehicle Activities (2011 – 2015)
• OmniAir Vice Chairman (2013 – 2015)
• Connected Vehicle Working Group (Member)
• Sustainability Transportation Working Group (Member)
PILOT DEPLOYMENT ISSUES AND APPLICATIONS RELATIONSHIP

**CV APPLICATIONS**
- V2I SAFETY
  - Curve Speed Warning
- V2V SAFETY
  - EEBL and FCW
- V2I SAFETY
  - Pedestrian in Signalized X-walk
- V2I SAFETY
  - Mobile Accessible Pedestrian Signal PED-SIG
- V2I SAFETY
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- MOBILITY
  - I-Sig
- AGENCY DATA
  - Probe Enabled Traffic Monitoring
- MOBILITY
  - TSP
- V2V SAFETY
  - Vehicle Turning in Front of Bus

**USE CASE/NEED**
- MORNING BACKUPS
- PEDESTRIAN CONFLICTS
  - PEDESTRIAN SAFETY
- WRONG WAY ENTRIES
- TRAFFIC PROGRESSION
- BRT OPTIMIZATION
  - TRIP TIMES
  - SAFETY
- STREETCAR/AUTO/PED/
  - BIKE CONFLICTS

**LOCATION**
- REL at Twiggs Street
- Twiggs Street - Courthouse
- REL at Twiggs Street
- Meridian Avenue
- MacDill AFB
- BRT-REL to Marion Street
- Channelside
MORNING PEAK HOUR QUEUES

Intersection of Twiggs Street and Meridian Avenue at Reversible Express Lanes Entrance/Exit

ISSUES
- Poor Signal Timing Progression
- Back-to-Back Right Turns
- Queue Backup on Curve

SOLUTIONS
- Curve Speed Warning (CSW)
  • V2I Safety
- Emergency Electronic Brake Lights (EEBL)
  • V2V
- Forward Collision Warning (FCW)
  • V2V
ISSUES

- Unique Intersection Reversible Express Lane Open/Close Dynamic Signing to Drivers

SOLUTIONS

- Intersection Movement Assist (IMA)
  - V2V Safety
- Intelligent Traffic Signal System (I-SIG)
  - Mobility
- Probe Enabled Traffic Monitoring
  - Agency Data
PEDESTRIAN SAFETY

Midblock of Twiggs Street at Hillsborough County Courthouse

ISSUES
- Midblock Crossing with no Protected Left Turn
- Pedestrians Crossing at Unmarked Locations

SOLUTIONS
- Pedestrian in Signalized Crosswalk Warning
  - V2I Safety
- Mobile Accessible Pedestrian Signal (PED I-SIG)
  - V2I Safety
- Intelligent Traffic Signal System (I-SIG)
  - Mobility
BRT/TRANSIT SIGNAL PRIORITY, OPTIMIZATION AND SAFETY

Express Route through Downtown City Streets to Marion Street Transit Station

ISSUES

- Poor Signal Timing Progression
- Passenger Vehicles Blocking Access to Stops

SOLUTIONS

- Intelligent Traffic Signal System (I-SIG)
  - Mobility
- Transit Signal Priority (TSP)
  - Mobility
TECO LINE STREETCAR CONFLICTS

ISSUES
- Streetcar/Ped/Vehicle/Cyclist Conflicts/Safety
  - Afternoon Peak Alternate Routes
  - Special Events

SOLUTIONS
- Vehicle Turning Right in Front of Bus Warning
  - V2I Safety
- Intelligent Traffic Signal System (I-SIG)
  - Mobility
ENHANCED SIGNAL COORDINATION AND TRAFFIC PROGRESSION

ISSUES
- Morning Peak Queuing and Congestion
- Special Events Queuing and Congestion
- MacDill Air Force Base Controlled Access Points

SOLUTIONS
- Probe Enabled Traffic Monitoring
  • Agency Data
- Intelligent Traffic Signal System (I-SIG)
  • Mobility
DETAILS OF APPLICATION TYPES SELECTED AND HOW THEY FULFILL STATED NEEDS

CV APPLICATIONS

- V2I SAFETY
  - Curve Speed Warning
- V2V SAFETY
  - EEBL and FCW
- V2I SAFETY
  - Pedestrian in Signalized X-walk
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USE CASE/NEED

- MORNING BACKUPS
- PEDESTRIAN CONFLICTS
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- TRAFFIC PROGRESSION
- BRT OPTIMIZATION
  - TRIP TIMES
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- STREETCAR/AUTO/PED/
  BIKE CONFLICTS

LOCATION

- REL at Twiggs Street
- Twiggs Street - Courthouse
- REL at Twiggs Street
- Meridian Avenue
- MacDill AFB
- BRT-REL to Marion Street
- Channelside
- WRONG WAY ENTRIES
DAVE MILLER
System Engineering and Deployment Support
Siemens

• Principal Systems Engineer, Siemens ITS
• Part of Mobility Including Rail Grade Crossing Control, Positive Train Control and LRT Manufacturing
• Project Role:
  - Concept of Operations (ConOPs)
  - Pilot Systems Deployment Requirements
  - Pilot Deployments
• Chair of USDOT-Funded NEMA/AASHTO/ITE Joint Committee on Advanced Transportation Control (ATC)
• Chair of NEMA 3TS Technical Committee for Transportation Control Systems
• Member of ITE Connected Vehicle Task Force (Systems Engineering and Policy)
• Member of V2I Deployment Coalition Standards Working Group
• J2735 Harmonization WG for USA, Europe and Japan
• Supplied the Controllers and Software for USDOT CV Test Beds beginning in 2007
• USDOT CV Test Bed Affiliate
THEA THREE PHASE WORK FLOW DIAGRAM APPLIED TO THE SYSTEMS ENGINEERING FRAMEWORK

Source: Systems Engineering for Intelligent Transportation Systems, USDOT, January 2007
USE CASE 1: REVERSIBLE LANE WRONG-WAY VEHICLE

1.1 TOLLING CUSTOMER
- Advanced Wrong Way Warning: Avoid Entering Ramp

1.2 ENFORCEMENT
- Wrong-Way Vehicle Location: Issue Citation

1.3 TOLLING CUSTOMER
- Collision Avoidance Warning: Avoid Oncoming Vehicle

1.4 TOLLING AUTHORITY
- Wrong-Way Event Log: Measure Effectiveness

1.5 MAINTENANCE
- Self Test and Maintenance Log: Verify System Operation

1.6 LEGAL
- Maintenance Logs: Liability Discovery Response

Source: Signal Phase and Timing and Related Messages for V-I Applications ConOps Document, FHWA
Example ConOps Traceable to Needs ID:

“[N1.1] An RSU is connected to an ATC that is programmed to dwell as RED phase approaching the lane entrance. A wrong-way tolling customer will receive a violation warning in advance of entering the ramp via the THEA Smartphone application.”
Jim Barbaresso
Senior Technical Advisor
HNTB Corporation

- More than 37 years of Experience in Transportation Operations and ITS
- Program Manager of One of the Original ITS Operational Field Tests – FAST-TRAC – in Oakland County, Michigan
- Program Manager for the 180-mile Design-Expansion-Integration-Maintenance of the Detroit Area Freeway Management System
- Safety Pilot Outreach Lead
- Author of the Report, “Connected Vehicle Infrastructure Deployment Considerations: Lessons Learned from Safety Pilot and Other Connected Vehicle Programs”
- Co-Author of the USDOT ITS Strategic Plan 2015-2019
- Chairman of the 2014 ITS World Congress in Detroit
- HNTB Lead on the AASHTO Near-Term V2I Transition and Phasing Analysis
- HNTB Lead on the Ann Arbor Connected Vehicle Test Environment
• THEA’s Connected Vehicle Pilot Offers a Synergistic Suite of Safety and Mobility Applications Across Modes and Jurisdictions

• The Goal is to Create and Sustain a Connected Downtown that Offers Unprecedented Safety and Mobility for Pedestrians, Motorists and Transit Users

• Needs-Based and Performance-Driven
• Joint Use TMC

• Condensed Downtown Deployment Area Facilitates Multiple, Concurrent Use Cases

• City of Tampa Traffic Signal Upgrades will Support Deployment with Cost Sharing Opportunities

• Ability to Close the Selmon REL for Closed Track Testing and Demonstrations – No MOT Cost

• Ability to Leverage Lessons Learned from Safety Pilot, AACVTE, V2I Reference Implementation, AASHTO Footprint Analysis and Other USDOT Program Outputs

• MacDill Air Force Base offers Fleet Opportunity and Partnering with DOD

• HART BRT Applications will Leverage a New Pilot Route on the Selmon REL

• Multiple Bus Routes Utilizing Same Egress Corridors Allow for Comparison Data Between Non-Equipped Vehicles vs. Connected Vehicle-Pilot Buses

• City of Tampa and HART Both Offer Large Fleet of Vehicles with Maintenance Shops which Could be Trained to Install/Maintain On Board Unit (UBT)
MULTIPLE APPLICATIONS EFFICIENCY

- Proposed Applications were Selected to Address Multiple Needs, while Optimizing Resources

- USDOT Research Results and AMS Tools Developed by USDOT will be used to Help Identify Logical Combinations of Applications for Deployment, Maximize Impacts/Benefits while Minimizing Capital and Operating Costs
THEA will Deliver a Comprehensive Pilot Deployment Plan that will Provide the Framework for Successful Implementation – On Time and Within Budget

Closing Remarks

Questions and Answers