THEA CV PILOT – PREPARING FOR CV IN COMMUNITIES

Bringing Connected Vehicles to Your Town


Tampa Hillsborough Expressway Authority
WHAT IS THEA?

- **A local, user-financed public agency**
  - Financed through revenue bonds
  - Supported by user tolls
  - No tax funding
  - Tolls stay local

- **Seven Member Board**
  - 4 Appointed by Governor
  - Mayor (or Council Chair)
  - Hillsborough County Commissioner
  - FDOT District 7 Secretary

- **Regional Capabilities**
  - Hillsborough County
  - Adjacent Counties by Invitation
    - Interlocal Agreement(s) in Place with Pinellas County

INDEPENDENT
Agency of the State
THEA STRATEGIC OVERVIEW

**Mission**
Our mission is to provide safe, reliable, and financially-sustainable transportation services to the Tampa Bay region while reinvesting customer-based revenues back into the community.

**Vision**
Our vision is to lead, partner, and implement safe, economically-sound, and innovative multi-modal transportation solutions for our Tampa Bay community.

Provide THEA customers with the safest, most efficient drive possible.

Advance Mobility Technology

Promote Tampa Bay
BENEFITS OF CONNECTED VEHICLE COMMUNICATION

- Improves operational efficiency of the system
- “Security”
- “Safety”

Ability for all residents to experience benefits of technology...
SOLVING REAL PROBLEMS – PILOT DEPLOYMENT ISSUES AND APPLICATIONS

RELATIONSHIPS

LOCATION

REL at Twiggs Street
Twiggs Street - Courthouse
REL at Twiggs Street
Meridian Avenue
BRT-REL to Marion Street
Channelside

TRAFFIC STUDIES

MORNING BACKUPS
PEDESTRIAN CONFLICTS PEDESTRIAN SAFETY
WRONG WAY ENTRIES
TRAFFIC PROGRESSION
BRT OPTIMIZATION TRIP TIMES SAFETY
STREETCAR/AUTO/PED/BIKE CONFLICTS

PRIVATE SECTOR INPUT

CV APPLICATIONS

V2V SAFETY
EEBL and FCW

V2V SAFETY
Vehicle Turning in Front of Bus

V2I SAFETY
Pedestrian in Signalized X-walk

V2I SAFETY
Mobile Accessible Pedestrian Signal PED-SIG

V2I SAFETY
IMA

V2I SAFETY
End of Ramp Deceleration

MOBILITY
I-Sig

MOBILITY
TSP
COMPARTMENTED STUDY AREAS - THEA PILOT DEPLOYMENT AREA
PERFORMANCE MEASUREMENT - PREPARATION

Work completed to support Performance Measurement and Evaluation

- CUTR Server setup (hourly uploads from RSUs)
- SQL Databases (CV and non-CV Data)
- SDC & ITS Public Data Hub data nightly upload
- Data parsing and analysis
- Participant misbehavior detection protocol
- Modeling and inference
- OBU vendor support to validate OBU Data Logs
BENEFITS –
BSM AND RSU: STUDY AREA

- Some RSU receive more BSM than others
- Coverage of entire study area ensured
PARTICIPANT RECRUITMENT

- Total of 1,028 On Board Units (OBU) installations
  - 1,006 are participants.
- Total of 780 participants actively coming to the study area (first two weeks of March 2019)
  - 77.5 percent participation rate
- Continuing support to troubleshoot, install, reinstall OBUs.

<table>
<thead>
<tr>
<th>OBU Type</th>
<th>Count</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants</td>
<td>780</td>
<td>94.9</td>
</tr>
<tr>
<td>Bus</td>
<td>10</td>
<td>1.2</td>
</tr>
<tr>
<td>Trolley</td>
<td>7</td>
<td>0.9</td>
</tr>
<tr>
<td>City of Tampa</td>
<td>13</td>
<td>1.6</td>
</tr>
<tr>
<td>Friend of the Pilot</td>
<td>7</td>
<td>0.9</td>
</tr>
<tr>
<td>Total</td>
<td>817</td>
<td>99.4</td>
</tr>
</tbody>
</table>

Feb. 28 through March 14 Data
<table>
<thead>
<tr>
<th>APPLICATION</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>End of Ramp Deceleration Warning (ERDW)</td>
<td>Alerts driver approaching curve with speed safety warning</td>
</tr>
<tr>
<td>Emergency Electronic Brake Light (EEBL)</td>
<td>Enables broadcast to surrounding vehicles of severe braking</td>
</tr>
<tr>
<td>Forward Collision Warning (FCW)</td>
<td>Warns driver of impending collision ahead in same lane</td>
</tr>
<tr>
<td>Intersection Movement Assist (IMA)</td>
<td>Indicates unsafe (i.e., wrong way) entry into an intersection</td>
</tr>
<tr>
<td>Intelligent Traffic Signal System (I-SIG)</td>
<td>Adjusts signal timing for optimal flow along with PED-SIG and TSP</td>
</tr>
<tr>
<td>Pedestrian Collision Warning (PCW)</td>
<td>Warns driver of impending conflict with pedestrian</td>
</tr>
<tr>
<td>Transit Signal Priority (TSP)</td>
<td>Allows transit vehicle to request and receive priority at a traffic signal</td>
</tr>
<tr>
<td>Vehicle Turning Right in Front of a Transit Vehicle (VTRFTV)</td>
<td>Alerts transit vehicle driver that a car is attempting to turn right in front of the transit vehicle as well as the driver of the car.</td>
</tr>
<tr>
<td>Wrong Way Entry (WWE)</td>
<td>Warns driver of potential and actual Wrong Way travel direction</td>
</tr>
</tbody>
</table>
Forward Collision Warning (FCW)
Emergency Electronic Brake Light (EEBL)
End of Ramp Deceleration Warning (ERDW)
Pedestrian Collision Warning (PCW)
Vehicle Turning Right in Front of Transit Vehicle (VTRFTV)

PHOTO: TAMPA HILLSBOROUGH EXPRESSWAY AUTHORITY (THEA)
TRAFFIC PROGRESSION

Probe Data Enabled Traffic Monitoring

Intelligent Traffic Signal System (I-SIG)

Intersection Movement Assist (IMA)
THEA tasked the Center for Urban Transportation Research (CUTR):

- Perform overall performance measurement and evaluation
- Provide participant recruitment support
- Support Independent Evaluators
- USDOT data sharing
  - Secure Data Commons (SDC)
  - ITS Public Data Hub
PHASE 3 ACTIVITIES - 2019

- Finalize OBU Data Log over-the-air transfers
- Turn-on warnings to Treatment
- Support to participant sample refreshments
- Continue data collection, processing analysis and reporting
  - Finalize dashboard
  - Reporting to AOR designated US DOT entities
  - Internal team and stakeholders
  - SDC and ITS Public Data Hub
- Independent Evaluator Support
- System Impact Assessment
DATA GENERATION

- Data collection Feb – Sep 23, 2018
  - 657 participants
  - 64,430 files
  - 146.8 GB of highly compressed data (uncompressed is 20+ times larger)
- Compiling comprehensive SQL database to process
  - BSM
  - SPAT
  - TIM
  - SSM
  - SRM
  - MMITTS
- OBU Logs (in process)
- Average of 1.7 million BSM/day
- About 0.9 million BSM/RSU
- Weekday travel patterns with a.m. and p.m. peak periods
- Up to 270 participants per hour on average at a.m. peak hour
Big Data

- **70B** connected devices (2050)
- **2.8T** sensors by 2019
- **Autonomous Vehicles (L2)**
  - 80+ processors;
  - 200+ sensors;
  - 100M+ lines of code (GM)

2,500,000,000,000,000,000,000
2.5 Quintillion bytes EVERY DAY
Pre-Deployment Performance Data Collection

- CV Data
  - BSM
  - SPAT
  - TIM
  - MAP
  - MMITTS
  - SSM and SRM
  - OBU Logs

- Non-CV Data
  - Weather
  - Transit
  - Bluetooth
  - City of Tampa Centrax
PRELIMINARY ANALYSIS

RSU 2 – Twiggs and Meridian

• 84% of participant vehicles captured daily
• Coverage extends to Channelside Drive with transmission of up to 10 BSMs/second

RSU 3 – Twiggs and Courthouse

• 52% of participant vehicles captured daily
• Coverage extends to Meridian and REL at 10 BSMs/second
BENEFITS – BSM AND MOBILITY

- RSU collected BSM allow generating mobility performance measures by Use Case
- Cluster analysis of events to spot areas prone to accidents
USE CASE 1 – MOBILITY EVALUATION
USE CASE 1 – MOBILITY EVALUATION

A.M. Peak

Travel Time by Day of Week

P.M. Peak

Travel Time by Day of Week
WHAT WE KNOW NOW -

- Solidified Standards Earlier
- Obtain a Better Understanding of “Available” Applications’ Maturity
- Obtain a Better Understanding of Vendors’ Depth and Resources
- Device Certification Process From Vendors
- Complete Integration Testing Before Private Vehicle Installs Begin
- Identify the Need to Use Traditional ITS Devices as Part of Solution Earlier
- Contracting – Fixed Fee and “Experimental Sole Source” way to go
- Cross functional coordination is absolutely critical
- Importance of face to face progress meetings
- OBUS - DON’T DO IT!!! Hire auto professionals to manage! We need OEM coordination
FOCUS ON WHAT WE CAN CONTROL – INFRASTRUCTURE, PUBLIC TRANSPORTATION, SAFETY
OPPORTUNITIES – ROLE OF INTEROPERABILITY

Source: Siemens Industry Inc.
Tampa CV Data flow to two USDOT Platforms:

1. **ITS Public Data Hub.** This platform hosts data available to the public and research community at large
   - BSM, SPAT, TIM
   - Automated nightly batch uploading
   - Data available since March 5, 2019

2. **Secure Data Commons.** This platform is restricted to UDOT analysts and independent evaluators.
   - BSM, SPAT, TIM
   - Data flowing nightly since Sep. 2018
   - OBU Logs starting April 2019
CAN A LOCAL AGENCY PREPARE FOR PARADIGM SHIFTING TECHNOLOGY?

- “Contract for CUTR study “Tampa Bay: An Automated Vehicle Catalyst?” (THEA Board action 6/24/13)
- THEA hosted multiple AV/CV Summits in Florida & to support the State’s initiatives
- Participating in FDOT’s Statewide initiative by being on working group, bring local and tolling perspective
- Actively marketed Test Bed
  - Audi was the first to test in Florida on facility the week of July 21, 2014
- USDOT CV Pilot
  - THEA lead the Tampa CV Pilot and paid all local matches to bring this technology to Tampa.
  - Created a public/private partnership team on US DOT Pilot Deployment
- Next Steps – How do we create transportation solutions?

LOCAL AGENCIES CAN LEAD INITIATIVES THAT BENEFIT CUSTOMERS, CONSISTENT WITH NATIONAL AND STATEWIDE INITIATIVES.