Connected Vehicle Applications

THEA Proposal for

Connected Vehicle Pilot Deployments
PHASE 1: Concept Development

Technologies

- Wireless/DSRC communications
- On-board vehicle tele-metrics and Driver Assist
- Vehicle to vehicle communications
- Vehicle to infrastructure communications
- Automated vehicle systems

The technology behind automated/connected vehicles can save lives, create jobs and lighten congestion during travel commutes.

TAMPA HILLSBOROUGH
EXPRESSWAY
AUTHORITY

Definitions: Connected Vehicle

- Connected Vehicle: Connected vehicles are vehicles that use any of a number of different communication technologies to communicate with the driver.
  - Human Machine Interfaces such as navigation systems, smart phones etc.
  - V2X, other cars on the road
  - V2V, vehicle-to-vehicle
  - V2I, roadside infrastructure

Definitions: Automated Vehicle

- **Automated Vehicles can be either**
    - **Autonomous (no interaction with other cars or infrastructure) or;**
    - **Connected vehicles as defined in the previous slide.**

- **Function-specific Automation (Level 1):** Automation at this level involves one or more specific control functions.
    - electronic stability control or pre-charged brakes

- **Combined Function Automation (Level 2):** This level involves automation of at least two primary control functions designed to work in unison to relieve the driver of control of those functions
    - adaptive cruise control in combination with lane centering.

- **Limited Self-Driving Automation (Level 3):** Vehicles at this level of automation enable the driver to cede full control of all safety-critical functions under certain traffic or environmental conditions and in those conditions to rely heavily on the vehicle to monitor for changes in those conditions requiring transition back to driver control.
    - The second-generation Google car is an example of limited self-driving automation.

- **Full Self-Driving Automation (Level 4):** The vehicle is designed to perform all safety-critical driving functions and monitor roadway conditions for an entire trip. Such a design anticipates that the driver will provide destination or navigation input, but is not expected to be available for control at any time during the trip. This includes both occupied and unoccupied vehicles.
    - **Level 4 automated vehicles must by regulation also be connected vehicles.**

Potential Benefits

- Transportation safety – reduction in fatalities and accidents
- Environmental considerations - energy reduction
- Convenience – reduction in travel commute times and stress
- Cost – reduction in insurance and other costs of vehicle ownership

Potential to significantly reduce vehicle crashes, improve operational efficiency, and improve mobility bringing a dramatic change in how people drive their vehicles in the future.
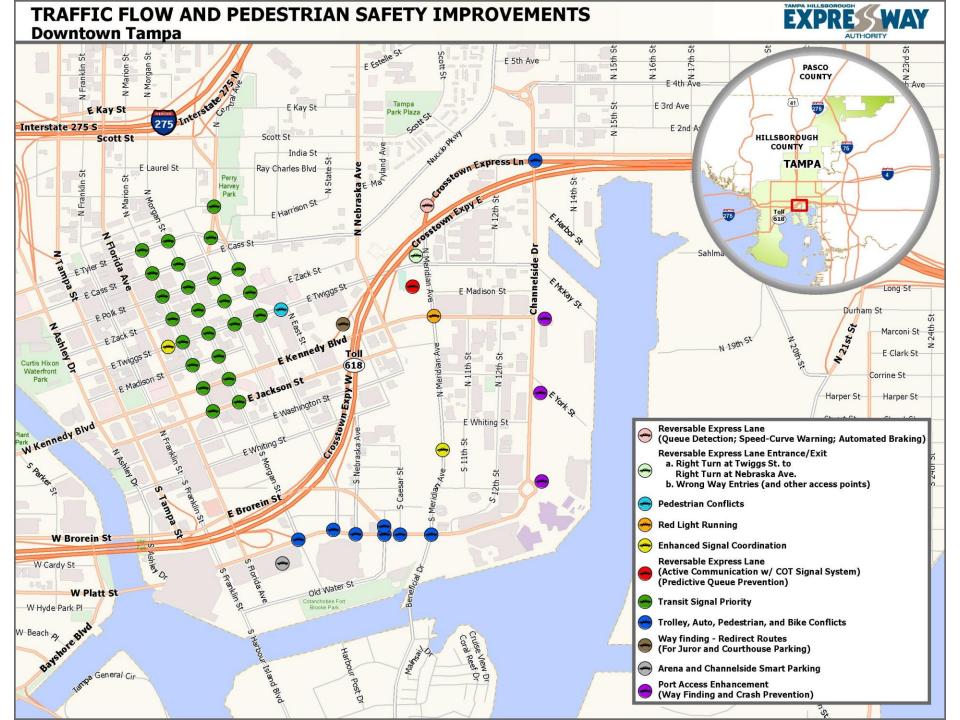

Source: U.S. DOT

THEA Proposal

- THEA's proposal is a concept to demonstrate and measure the impacts of a <u>corridor focused multi-modal</u> connected vehicle applications

- Project local agency/private sector partners include:
  - City of Tampa
  - Hillsborough Area Regional Transit
  - HART
  - Siemens

TRAFFIC FLOW AND PEDESTRIAN SAFETY IMPROVEMENTS
Downtown Tampa

TAMPA HILLSBOROUGH EXPRESSWAY AUTHORITY

Legend

- **Reversable Express Lane** (Queue Detection; Speed-Curve Warning; Automated Braking)
- **Reversable Express Lane Entrance/Exit**
  - a. Right Turn at Twiggs St. to Right Turn at Nebraska Ave.
  - b. Wrong Way Entries (and other access points)
- **Pedestrian Conflicts**
- **Red Light Running**
- **Enhanced Signal Coordination**
- **Reversable Express Lane** (Active Communication w/ COT Signal System) (Predictive Queue Prevention)
- **Transit Signal Priority**
- **Trolley, Auto, Pedestrian, and Bike Conflicts**
- **Way finding - Redirect Routes** (For Juror and Courthouse Parking)
- **Arena and Channelside Smart Parking**
- **Port Access Enhancement** (Way Finding and Crash Prevention)

CV Application 1

Queue detection, speed-curve warning and crash prevention

Location: REL entrance/exit at Twiggs Street

Issue/Need: In the AM peak period, traffic will back up due to poor signal progression and right turn onto Twiggs immediately followed by a second right turn onto Nebraska NB. This causes the queue to back up onto the REL exit and into the curve where rear end crashes and other incidents are occurring in the curve.

Potential CV Technologies: V2I, V2V, CV2AV

Solution for V2I: Develop queue detection; one (1) 5.9 DSRC RSE in the curve for speed-curve warning; cellular data link for advance warning at 34th St exit.

Solution for V2V: Brake warning; speed-curve warning apps using 5.9 DSRC and Cellular data (advance warning)

Solution for CV2AV: Demonstrate warning with no action from driver; AV brakes the vehicle.

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CV Application 2a

REL right turn at Twiggs St. to right turn at Nebraska Ave.

Location: REL entrance/exit at Twiggs Street & Meridian Avenue

Issue/Need: In AM peak period, traffic will back up due to poor signal progression and right turn onto Twiggs immediately followed by a second right turn onto Nebraska NB, which is also congested. This causes the queue to back up onto the REL exit and into the curve where rear end crashes and other incidents are occurring in the curve. There is a need to change to different timing plans based on real-time volumes.

Potential CV Technologies: V2I

Solution for V2I: Develop queue detection; one (1) 5.9 DSRC RSE in the curve for speed-curve warning; cellular data link for advance warning at 34th St exit.

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CV Application 2b

Wrong Way Entries
Location: REL at Twiggs
Issue/Need: Wrong Way Entries caused by unique intersection dynamic signing for reversible express lane open/close procedure and state.
Potential CV Technologies: V2I, V2V, CV2AV
Solution for V2I: Vehicle to traffic signal communications to demonstrate onboard signage alerting driver of potential wrong way entry and correct course to take.
Solution for V2V: Forward collision warning application demonstration.
Solution for CV2AV: Potential demonstration whereby if onboard warning is not heeded, autonomous braking function is enabled.

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CV Application 3

Pedestrian Safety

Location: Twiggs Street @ Courthouse

Issue/Need: Non-signalized mid-block pedestrian crossing combined with no protected left turn into the parking garage for the courthouse, creates pedestrian safety issues as they traverse Twiggs St. Additionally, pedestrians are crossing at unmarked locations, further complicating the pedestrian safety concern.

Potential CV Technologies: V2I, V2V, V2D, CV2AV

Solution for V2I: Equip pedestrian crossing with 5.9 DSRC RSU and/or WiFi Direct technologies to alert driver of potential pedestrian safety issue via onboard signage or other alert.

Solution for V2V: Vehicle to vehicle pedestrian warning

Solution for V2D: Utilize WiFi Direct technologies to communicate safety messages between application enabled smartphones to connected vehicles.

Solution for CV2AV: If pedestrian warning is not heeded by CV driver; autonomous braking function enables vehicle to stop.

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🚘 CV Application 4

Red Light Running
Location: Meridian and Kennedy
Issue/Need: The intersection of Meridian and Kennedy continues to see high rates of Red Light Running, especially during AM/PM peak periods.
Potential CV Technologies: V2I, V2V, CV2AV
Solution for V2I: Vehicle communicates with traffic signal controller to obtain SPAT info. Cooperative Intersection Collision Avoidance System (CICAS) initiates ALL RED condition, allowing errant vehicle to stop or pass thru intersection.
Solution for V2V: Errant vehicle communicates with other nearby vehicles to warn of potential collision.
Solution for CV2AV: Potential demonstration whereby cooperative communications between a connected and autonomous vehicle and a traffic signal controller. TSC alerts vehicle of potential safety conflict, vehicle autonomously brakes.

CV Application 5

Enhanced Signal Coordination and Traffic Progression
Location: Along Twiggs Avenue from REL entrance/exit to Marion Street; Along Meridian Avenue from REL entrance/exit to Channelside Drive.
Issue/Need: A significant amount of queuing and congestion occurs on Meridian and Twiggs Avenues during AM and PM peak periods as well as during special events.
Potential CV Technologies: V2I
Solution for V2I: Equip traffic signals along Twiggs Street and Meridian Avenue with Road-Side Units (RSUs). Vehicles with Vehicle Awareness Devices (VADs) will communicate with traffic signals and traffic management software. Software will analyze real-time data coupled with historical data from VADs to optimize signal progression.

CV Application 6

Predictive Queue Prevention

Location: REL and Twiggs Street; REL and Meridian Avenue

Issue/Need: A significant amount of queuing and congestion occurs on Meridian and Twiggs Avenues during AM and PM peak periods as well as during special events. This queue continues to back up on to the REL during AM Peak periods. Similarly, during PM peak periods, traffic queuing backs up along Twiggs St., Meridian Ave., and Kennedy St.

Potential CV Technologies: V2I

Solution for V2I: Leverage equipment installed at traffic signals along Twiggs Avenue and Meridian Avenue installed as part of CV Application 5. Add additional Road-Side Units (RSUs) at the ends of the REL and at certain access points along the REL. Vehicles with Vehicle Awareness Devices (VADs) will communicate with RSUs. Develop software that will analyze real-time data coupled with historical data from VADs to provide a real-time predictive model that can be used to prepare certain downtown intersections for the influx of traffic during peak periods.

CV Application 7

BRT Transit Signal Priority Optimization, Trip Times

Location: Bus Rapid Transit routes along the REL and city streets (see map)

Issue/Need: BRT offers efficiency gains in moving more people, however, during peak periods, the BRT service suffers from poor signal progression due to heavy volumes and passenger vehicles blocking access to bus stops.

Potential CV Technologies: V2I

Solution for V2I: Connected Bus application (ref: Siemens)

CV Application 8

Trolley/Auto/Ped/Bike Conflicts

Location: Channelside Drive Area

Issue/Need: Channelside Drive experiences many types of safety and mobility challenges due to AM/PM Peak Alternate Routes, Special Events, Trolley/Streetcar and the cruise terminal at the Port of Tampa. Depending on the time and day at least two of the issues identified above have a negative impact on overall safety and mobility in the area.

Potential CV Technologies: V2I, V2V, V2D, CV2AV

Solution for V2I: Equip pedestrian crossings with 5.9 DSRC RSU and/or WiFi Direct technologies to alert driver of potential pedestrian safety issue via onboard signage or other alert.

Solution for V2V: Vehicle to vehicle pedestrian warning

Solution for V2D: Utilize WiFi Direct technologies to communicate safety messages between application enabled smartphones to connected vehicles for pedestrian and bike safety.

Solution for CV2AV: If pedestrian warning is not heeded by CV driver; autonomous braking function enables vehicle to stop.

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CV Application 9

Juror/Courthouse Parking Way Finding

Location: Hillsborough County Courthouse

Issue/Need: Drivers reporting for Jury Duty are unfamiliar with the area typically have issues finding open and unrestricted parking. Most of the parking availability is within the parking garage or adjacent surface lot designated for courthouse parking. Respondent Jurors have issues with navigating to the correct lot.

Potential CV Technologies: V2I, V2D

Solution for V2I: By way of onboard signage geofencing, communicate with driver by providing way finding signs based on specific destination of the courthouse.

Solution for V2D: Develop (or modify existing) way finding application to assist driver with finding suitable parking.

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CV Application 10

Event/Tourism Way Finding and Parking

Location: Amalie Arena/Channelside Area

Issue/Need: The Special Event and Tourism activity in this area creates a specialized mobility and way finding issue. The special events that occur in the South Channelside Drive area pose specific needs for drivers to find suitable parking.

Potential CV Technologies: V2I, V2D

Solution for V2I: By way of onboard signage and geofencing, communicate with driver by providing way finding signs and directions based on specific parking destination at arena.

Solution for V2D: Develop (or modify existing) navigation and way finding application to assist driver with finding passenger drop off locations and suitable parking near Amalie Arena.

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CV Application 11

Port of Tampa Cruise Terminal Access Enhancements: Way Finding and Parking

Location: Amalie Arena/Channelside Area

Issue/Need: The Tourism activity in this area creates a specialized mobility and way finding issue. When the cruise terminals at the Port of Tampa are active for embarking or disembarking passengers, traffic and mobility in the area are negatively impacted. Tourists and other visitors who are unfamiliar with the area do not understand where to park, where to pickup/drop off passengers, and where to pickup/drop off baggage.

Potential CV Technologies: V2I, V2D

Solution for V2I: By way of onboard signage and geofencing, communicate with driver by providing way finding signs based on specific destination at the port.

Solution for V2D: Develop (or modify existing) way finding application to assist driver with finding drop off locations and suitable parking.

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