NOCoE National Operations Center of Excellence

CASE STUDY

GAINESVILLE SIGNAL PHASE AND TIMING (SPAT) TRAPEZIUM PROJECT

By Florida Department of Transportation, State Traffic Engineering and Operations Office

IN THIS CASE STUDY YOU WILL LEARN:

1. How deploying Roadside and Onboard connected vehicle technologies on four roads near the University of Florida improved travel time reliability and safety.
2. How FDOT and the City of Gainesville have become familiar with how V2X applications can be leveraged to address safety and mobility issues, and understand the variables of such a technology deployment.
3. How improvements in bicycle and pedestrian safety through the use of an innovative smartphone-based applications have been made.

BACKGROUND

The Gainesville Signal Phase and Timing (SPaT) Trapezium project deployed connected vehicle (CV) technologies and applications at 27 signalized intersections along four roads. These four roads form a trapezium surrounding the University of Florida (UF) main campus. The routes are SR 121 (SW 34th St), SR 26 (W University Ave), US 441 (SW 13th St), and SR 24 (SW Archer Rd). FDOT in collaboration with the City of Gainesville and UF has implemented the project with goals to improve travel time reliability, safety, throughput, and traveler information. This project also deployed and tested pedestrian and bicyclist safety smartphone-based applications. The project deployed 27 Roadside Units (RSUs) and 71 Onboard Units (OBUs) in two phases (base-package and value-added).

Base-Package Deployment Phase

Vehicle-to-vehicle (V2V) applications:

- Emergency Electronic Brake Light (EEBL)
- Forward Collision Warning
- Do Not Pass Warning and
- Intersection Movement Assist

Vehicle-to-infrastructure (V2I) applications:

- Red Light Violation Warning
- Wrong-Way Entry Application
- Curve Speed Warning
- Work Zone Warning Application
- Speed Limit Warning Application

Value-Added Deployment Phase

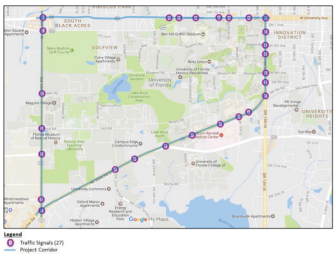
RSU central management system V2I applications:

- Motorist/Pedestrian Communication Smartphone Application
- Virtual/Advanced Queue Detection
- Emergency Vehicle Preemption (EVP)
- Transit Signal Priority (TSP)
- Pedestrian Collision Warning
- Priority Green Light
- Bluetooth Travel Time

GAINESVILLE SIGNAL PHASE AND TIMING (SPAT) TRAPEZIUM PROJECT

Procurement Phase	Number of OBUs	Users *(# of OBUS)*
Base-Package	6	City of Gainesville *(4)*
		FDOT *(2)*
Value-Added	65	UF Research *(5)*
		UF Fleet/Utility *(33)*
		Regional Transit System Buses *(10)*
		Gainesville Fire Rescue *(17)*

The project deployed 71 OBUs on a variety of vehicles including emergency vehicles, transit buses, UF fleet, City of Gainesville vehicles, and research vehicles.



The Trapezium corridors provide access to the UF campus which hosts about 71,354 students and staff. The corridors also serve UF Health, one of the largest health care providers in the state. These corridors experience a high volume of pedestrian and bicycle activities and associated safety and mobility issues. To address these issues these corridors have previously been equipped with standard countermeasures including active arterial management technologies. The SPaT Trapezium project reinforces the existing systems to improve safety and mobility in the following ways:

- Enhance pedestrian and bicyclist safety by deploying a smartphone-based alert system (this is currently being tested for effectiveness by a UF research team).
- Vehicle-to-everything applications to enhance situational awareness and provide the City of Gainesville's traffic management center with enhanced monitoring capability.
- Reduce delay of equipped emergency vehicles, transit buses, and UF utility vehicles.

TSMO PLANNING, STRATEGIES AND DEPLOYMENT

The project was implemented following the V-model of systems engineering that included the creating a concept of operations; determining requirements; developing system architecture; design; implementation, integration, testing, and system verification; followed by active operations, maintenance, and validation of the proposed system. The project included a scope for value-added proposition from the potential vendors. This helped the Department obtain more services than the Department expected at the early development stage of the scope. This allowed the Department to choose from many options and plan for potential future technological enhancements. This project procurement included the value-added feature and later benefited by achieving a wide range of services that were initially thought to be difficult to achieve within the budgeted cost. Ultimately, the project was deployed in two phases: base-package and value-added services.

COMMUNICATIONS PLANNING AND EXECUTION

The project implementation was led by the FDOT's Central Office in close coordination with FDOT District 2, City of Gainesville, and UF. FDOT closely coordinated with the Regional Transit System, Gainesville Fire Rescue, and UF fleet managers to obtain their vehicles and equip them with OBUs. FDOT has been coordinating with the two principal stakeholders of the project, CoG and UF, throughout the life of the project.

A UF research team led by Dr. Lily Elefteriadou and Dr. Sanjay Ranka will conduct the validation testing of the project. FDOT and the City of Gainesville have entered into an agreement to maintain the RSUs and other equipment procured and deployed in the project. FDOT has allocated funds to ensure the system is adequately maintained and operated. The UF research team is also collecting, processing, and storing the data from the project and developing performance measures and visualization tools.

GAINESVILLE SIGNAL PHASE AND TIMING (SPAT) TRAPEZIUM PROJECT

OUTCOME, LEARNINGS AND PUBLIC BENEFIT

The project is completed and is currently being operated and maintained by the City of Gainesville. UF is validating the performance and outcomes of the implemented technologies. FDOT and the City of Gainesville have become familiar with how V2X applications can be leveraged to address safety and mobility issues, and understand the variables of such a technology deployment. FDOT and vendors will continue to provide workforce training and development to support similar initiatives in the future. The City of Gainesville will be capable of enhanced monitoring of these critical intersections and roadways. Improvements in bicycle and pedestrian safety through the use of an innovative smartphone-based applications have been made. This project creates a testbed for emerging technologies in ITS.

Some notable things learned from the implementation of the project to date include:

Most passenger vehicles today are equipped with a controller area network (CAN) bus. The CAN bus can be accessed to communicate with the vehicle to determine its status including acceleration, turn signals, braking, etc. OBU manufacturers should be encouraged to utilize CAN bus connections. The OBU utilized in the Trapezium project was not connected to the CAN bus. The method of monitoring the movement status was accomplished by running individual wires to each element being monitored.

The OBUs initially deployed in the project could only monitor direct current (DC) voltage for inputs and triggers. All City of Gainesville and likely elsewhere, emergency sirens are operated by alternating current (AC) voltage. Some newer emergency sirens have a DC output that will trigger the siren status, but none were available in the Gainesville fire engine fleet. The vendor had to develop a converter to convert AC into DC for sending preemption requests based on siren activation.

Due to the nature and complexity of communication between CV on-board equipment and intersection traffic controllers, there are times when traffic controller firmware needs to be modified or upgraded. It is imperative that the contractor and traffic controller manufacturer coordinate all upgrades with the maintaining agency. This includes prior notification, providing staff for onsite/field support if issues arise, and support after completion.

It is important to ensure the approach lanes are entirely within the lane width of the MAP file during field verification and setup of the project RSUs.