

Simulating Communications with an Automated Shuttle and a Fire Truck

The ability of the smarter intersection to send a message to an automated shuttle and to an emergency vehicle was simulated during the project. Similar approaches were used in both simulations. Since there is not an automated shuttle in College Station, TTI researchers worked with Beep personnel to develop and conduct a simulation with a TTI vehicle equipped with an OBU acting as an automated shuttle. It was not possible to equip an emergency vehicle with an OBU, so a TTI vehicle with an OBU led a College Station fire truck through one of the intersections to simulate the communication capabilities.

The following C-V2X messages are generated by roadside units (RSUs) and are used in the .PCAP file of simulating communications with an automated vehicle. A .PCAP file of the simulation of communicating with a fire truck was not developed but the information obtained was the same as the automated shuttle test.

- A Basic Safety Message (BSM) is broadcast by equipped vehicles and contains the location, direction of travel, and speed of an equipped vehicle.
- A MAP message is broadcast by the RSU and defines the topology of an intersection, including the approaches at the intersection, the stop line for each approach, the lanes available in each approach, and the movements available from each lane at the stop line.
- A Signal Phase and Timing (SPaT) message complements the MAP message by providing the status (green, yellow, or red) for each lane movement defined in the MAP message and the time remaining in the status for that movement.
- A Signal Request Message (SRM) is broadcast by an approaching emergency or transit vehicle and provides information about the request for preemption or priority.
- A Signal Status Message (SSM) is broadcast by the RSU and contains the information sent back to the emergency or transit vehicle to indicate that the preemption or priority request has either been granted or denied.
- A Personal Safety Message (PSM) is usually broadcast by an equipped pedestrian and contains their location, direction of travel, and speed, like the BSM. However, since pedestrians' mobile phones are not ready yet to broadcast a PSM, this project used a Bosch camera to detect pedestrians at the intersection. The

camera sends the information to the RSU, and the RSU generates and broadcasts a PSM to equipped vehicles to alert drivers about the presence and locations of pedestrians at the intersection.

- A Traveler Information Message (TIM) is broadcast by the RSU and is used to send information (advisory and road sign) to equipped devices. TIMs are activated at a specific start and duration period.

The results from the simulation of communicating with an automated shuttle is provided as a separate file .PCAP file. The Wireshark application, available on the internet, can be used to view the file. The SAE V2X Communication Message Set Dictionary (J2735) provides more information on these messages.