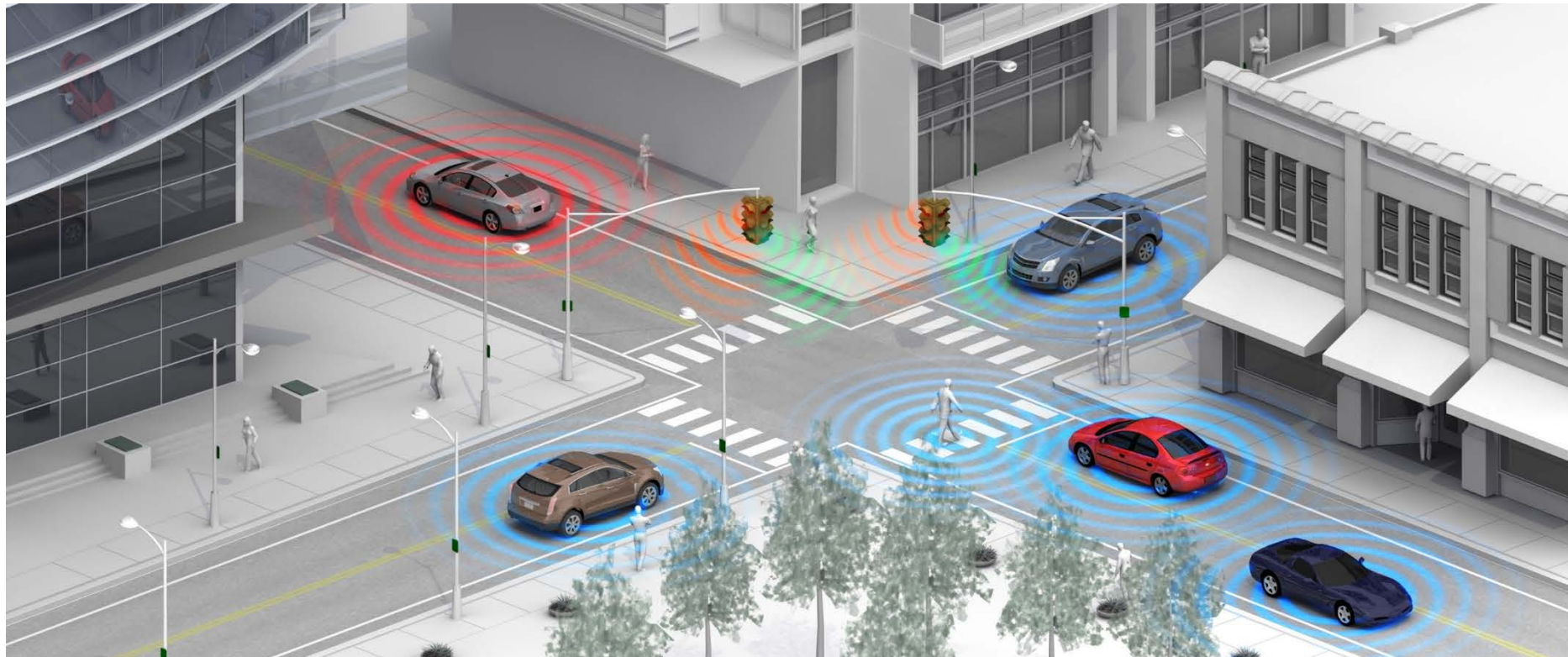


# Vehicle Safety Applications Using V2X

## V2X:

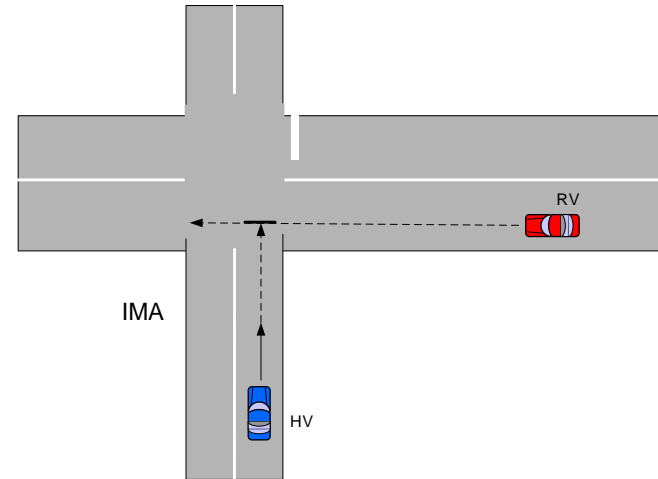
- Vehicle to Vehicle (V2V)
- Vehicle to Infrastructure (V2I)
- Vehicle to Pedestrian (V2P)



# V2V Safety Applications Using Basic Safety Message (BSM) Research & Development Applications

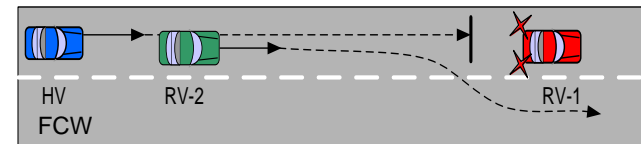
- Scenario in HV: Intersection Movement Assist

HV and RV positioned at marked locations. HV travels at 15 to 20 mph and RV travels at 35 mph. HV stops after receiving IMA warning and cannot enter the intersection. RV continues and passes intersection



- Scenario in HV: Forward collision warning (non line of sight - stopped vehicle reveal)

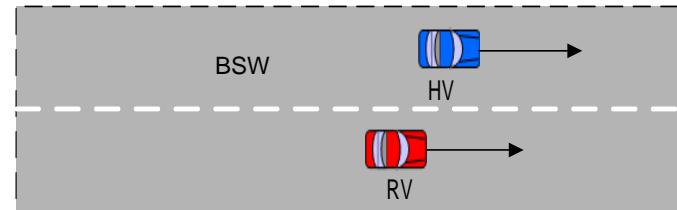
RV-1 travels in lane and stops at end of lane. HV and RV-2 at 35 to 40 mph with spacing about 50 feet; RV-2 makes a lane change and reveals stopped RV-1 to HV. RV-2 can slow down gently; HV slows down to stop behind RV-1 after alert is received in HV



# V2V Safety Applications Using Basic Safety Message (BSM) Research & Development Applications

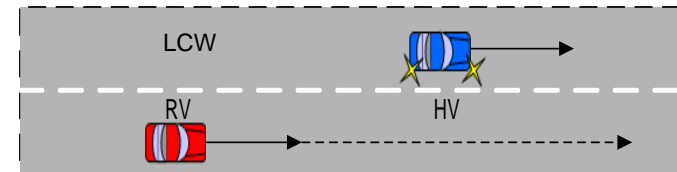
- Scenario in HV: Blind Spot Warning

HV and RV at 30 mph. RV drives in blind spot of HV. HV displays Blind Spot Warning icon in side mirror. HV activates the turn indicator in the side of RV and the icon flashes and haptic seat activates in that side



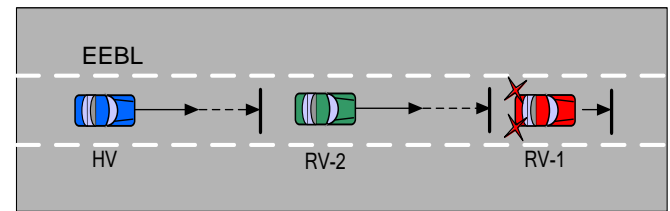
- Scenario in HV: Lane Change Warning

HV at 25 mph and activates turn indicator. RV passes HV in adjacent lane at 45 to 50 mph HV received Lane Change Warning in the side mirror and the icon flashes and haptic seat activates in that side



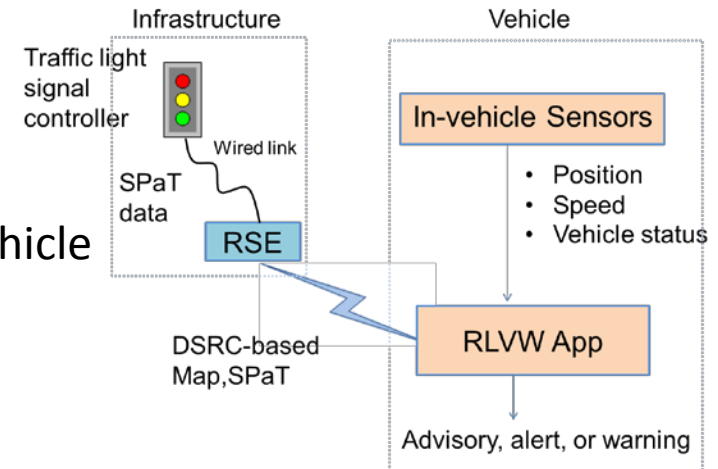
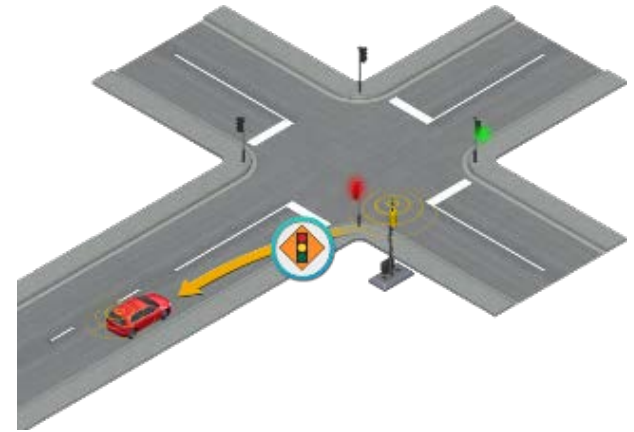
# V2V Safety Applications Using Basic Safety Message (BSM) Similar to 2017 Cadillac CTS Feature

- Scenario in HV: Emergency Electronic Brake Lights (non line of sight)
  - Inter-vehicle spacing about 150 feet; speed 35 to 40 mph, RV-1 brakes firmly hard at END OF LANE (>0.5g).
  - RV-2 should only slow down gently
  - Similar to the feature available in 2017 Cadillac CTS



# V2I Safety Application: Red Light Violation Warning

- Designed to warn drivers of potential red light violation
  - Host vehicle speed
  - Distance to the signalized intersection
- Infrastructure Application Component
  - Roadside Equipment (RSE) connected to traffic signal controller
    - Signal Phase and Timing (SPaT) message,
    - map data (MAP)
- Vehicle Application Component
  - On Board Equipment (OBE) determines if the vehicle is in danger of violating a red light



# V2I Safety Application: Reduced Speed/Work Zone Warning Concept

- Inform drivers of work zone/lane closures
- Warn drivers of potential speed violation in work/reduced speed zones
- Warn drivers of changed roadway configurations
- Infrastructure Application Component
  - RSE connection to TMC and/or local network in work zone
  - Speed limit/work zone information provided to vehicle
- Vehicle Application Component
  - OBE issues alert to driver to reduce speed or change lanes

