Integrated Trucks Safety Applications Development
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Expertise with 5.9 GHz safety applications for light vehicles:

- Vehicle Infrastructure Integration (VII) Proof-of-Concept
- Cooperative Intersection Collision Avoidance – Violations (CICAS-V)
- Vehicle Safety Communications – Applications (VSC-A)
- V2V Interoperability, Security, and Scalability(V2V-I)
- V2V Safety Pilot: Driver Acceptance Clinics & Model Deployment

Our role in this project:

- Develop & Implement V2V Platform on Heavy Trucks (DENSO DIAM)
- Develop Safety Applications for V2V Safety Pilot
- 2011 ITS World Congress
- Refine On-board Systems and Applications

Freightliner "Cascadia" Tractors

2 high-roof sleepers, 1 mid-roof sleeper, and 1 day cab

CCV OBE Functional Description

OBE enables applications for Cascadia trucks by supporting:

- Safety and other applications' processes
- V2X communications
- Vehicle positioning
- Communications security
- J1939 interface for vehicle data
- Data acquisition and recording
- Input of vehicle configuration
- Visual and audible driver notifications

Development Hardware Platform

DENSO Wireless Safety Unit 1.5 (WSU)

– Single board computer and 5.9 GHz DSRC radio

– Supports IEEE 802.11p, P1609.3, P1609.4, P1609.2

– Single automotive connector: power, ignition sense, RS-232 (GPS/PPS/serial data), CAN, Ethernet, USB, GPIO

– Dual RF FAKRA connectors for antenna diversity

– WSU 1.0 software base (Linux 2.6.11 OS)

– Hosts application and framework modules

– Provides an API for additional applications

– Startup on ignition, graceful shutdown

Power, IGN sense, RS-232, GPS Serial Ethernet, 2xUSB1.1, GPIO (3 in, 1 out), Ground, 2xCAN – 38 pin automotive

5.9 GHz DSRC (RX diversity) FAKRA Z – coaxial RF bulkhead

Supporting Devices

CAN Gateway

– Netway 72 used in past DOT projects

– Up to 10 CAN channels with physical layer for J1939 29-bit header
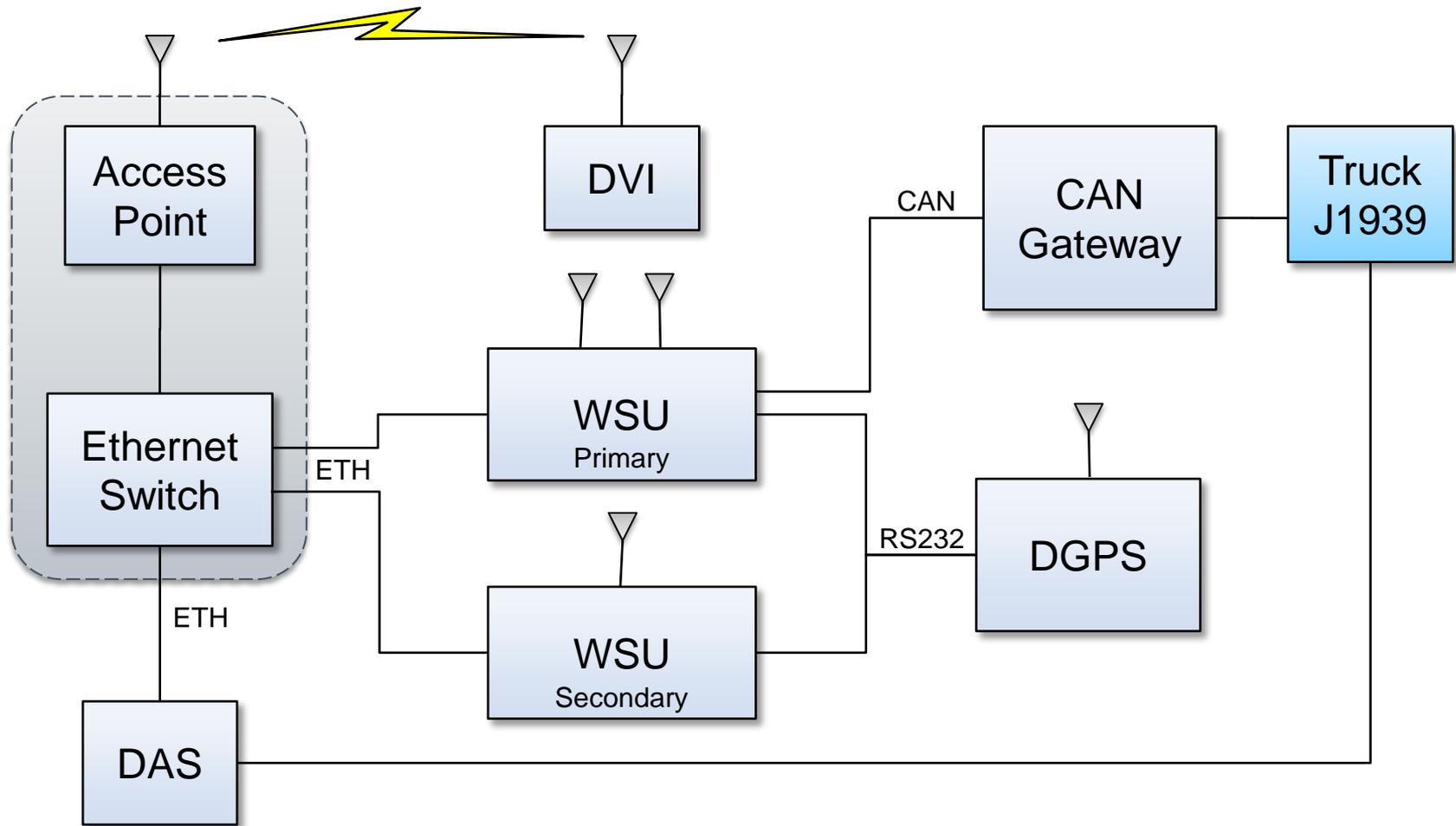
– Programmable via USB to PC

DGPS Receiver

– Novatel OEMV-1 FlexPak-G2-L1

– used in V2V Safety Pilot

– DGPS accuracy
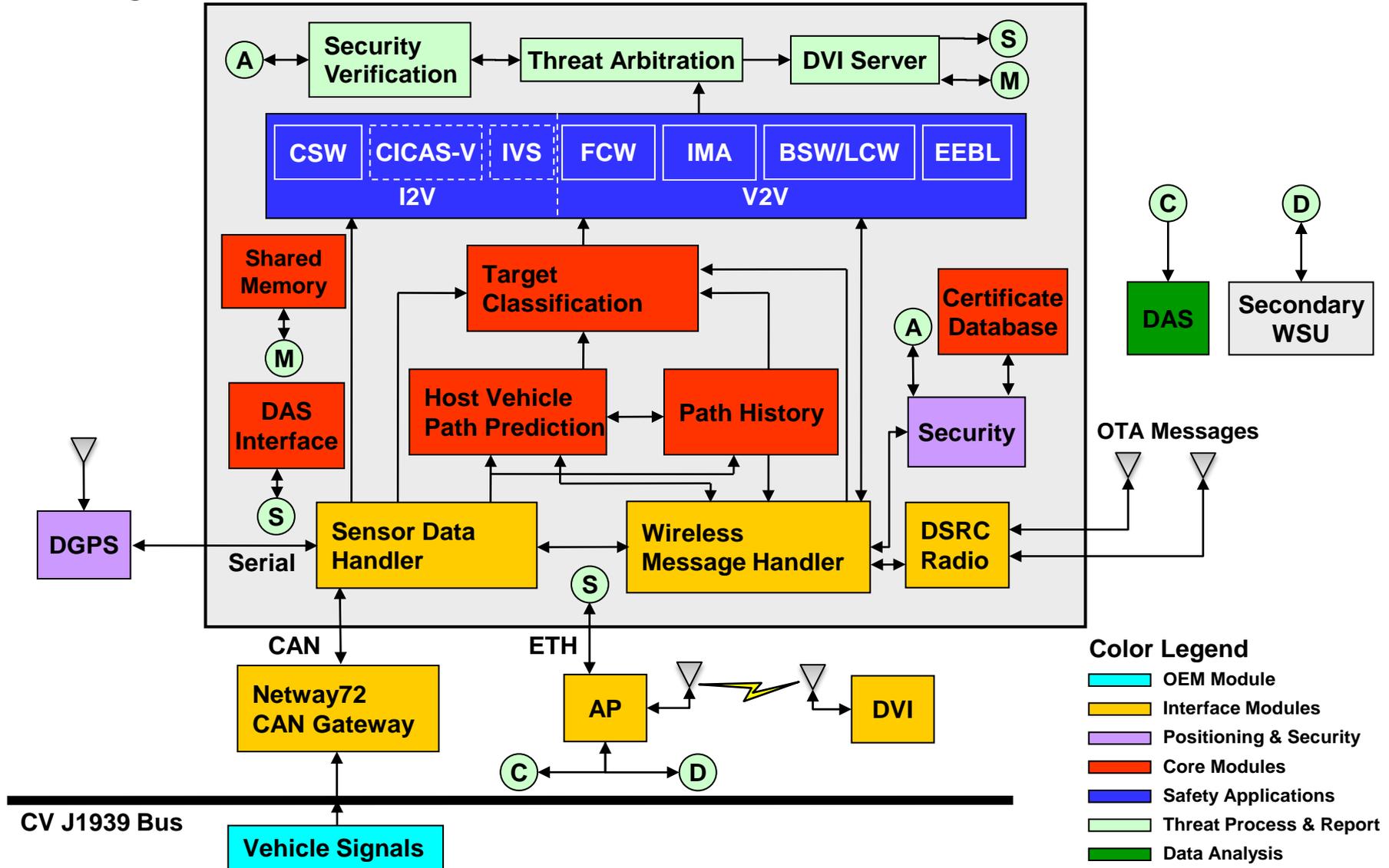
– Standard NMEA messages
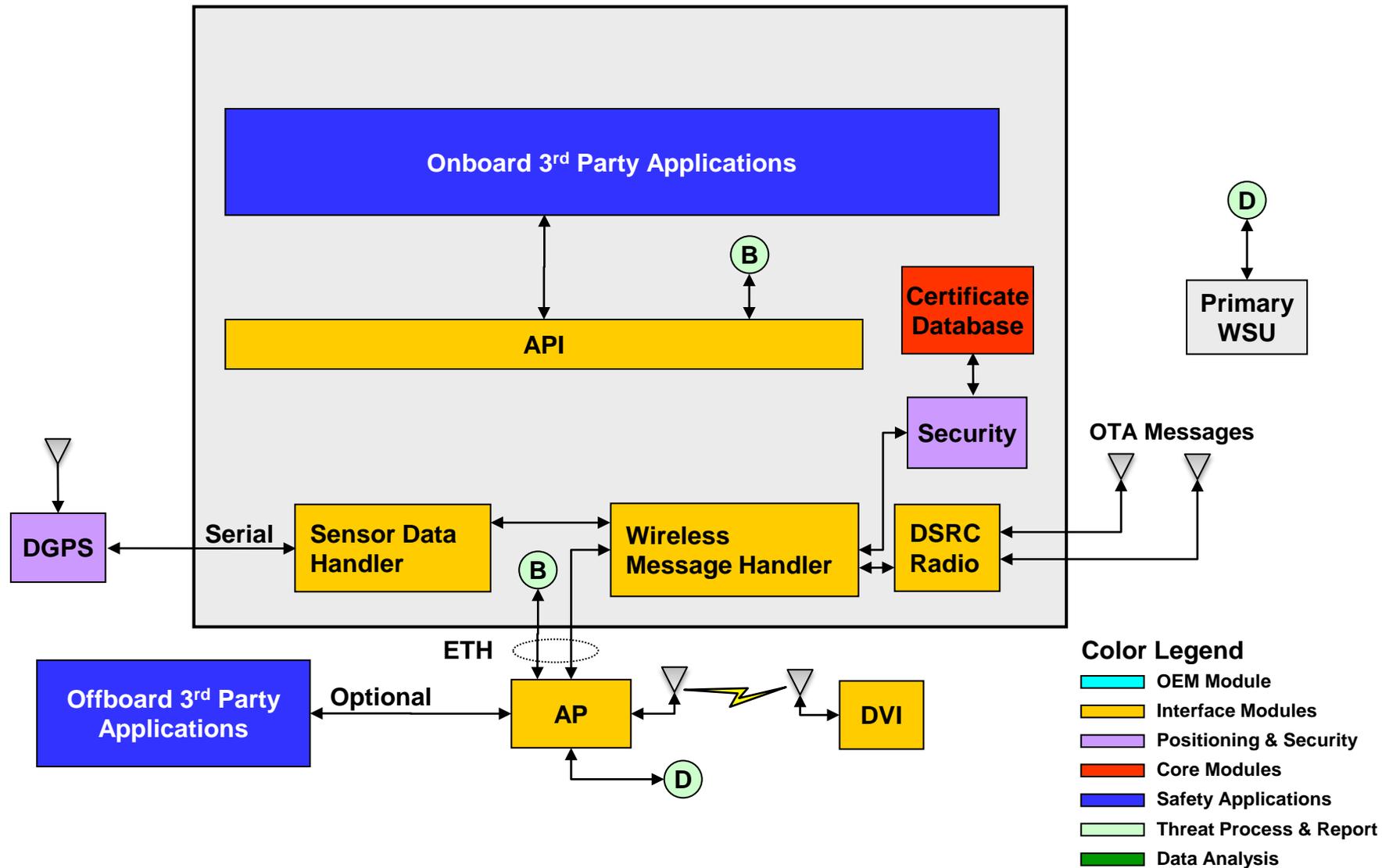
– PPS timing

Driver Vehicle Interface

CCV OBE System Architecture

Primary WSU

Secondary WSU

Onboard 3rd Party Applications

API

B

Certificate Database

Security

D

Primary WSU

OTA Messages

DGPS

Serial

Sensor Data Handler

B

Wireless Message Handler

DSRC Radio

ETH

Offboard 3rd Party Applications

Optional

AP

DVI

D

Color Legend

- OEM Module
- Interface Modules
- Positioning & Security
- Core Modules
- Safety Applications
- Threat Process & Report
- Data Analysis

Safety Applications

Vehicle to Vehicle (V2V)

– Forward Collision Warning

– Lane Change Assist

– Intersection Movement Assist

– Electronic Emergency Brake Light (EEBL)

Vehicle to Infrastructure (V2I)

– Curve Overspeed Warning (spline, speed distribution, or min curve speed methods)

– In-vehicle signage applications (speed limit, construction zone, or other)

Forward Collision Warning

Helps drivers avoid or mitigate rear-end vehicle collisions in the forward path of travel

- Remote vehicle (RV) must be ahead of host vehicle (HV)
- HV above minimum speed threshold
- Two threat levels when range less than threshold
- Warning suppressed if HV brake applied
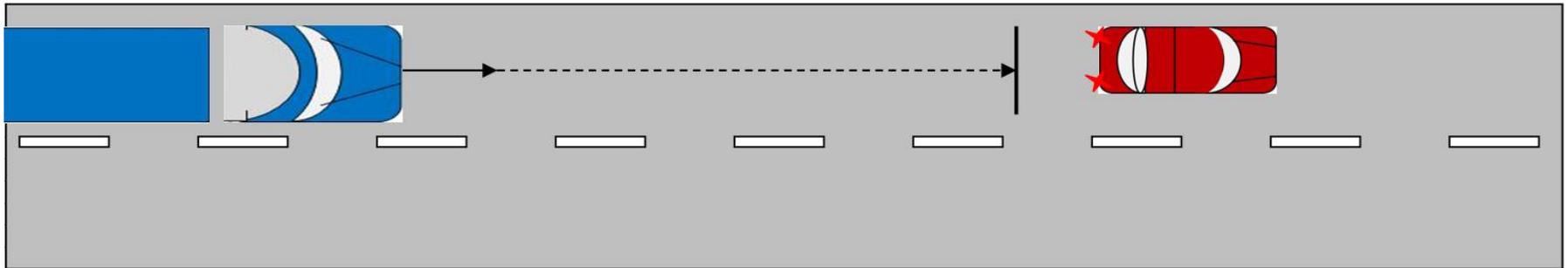
Blind Spot Warning/Lane Change Warning

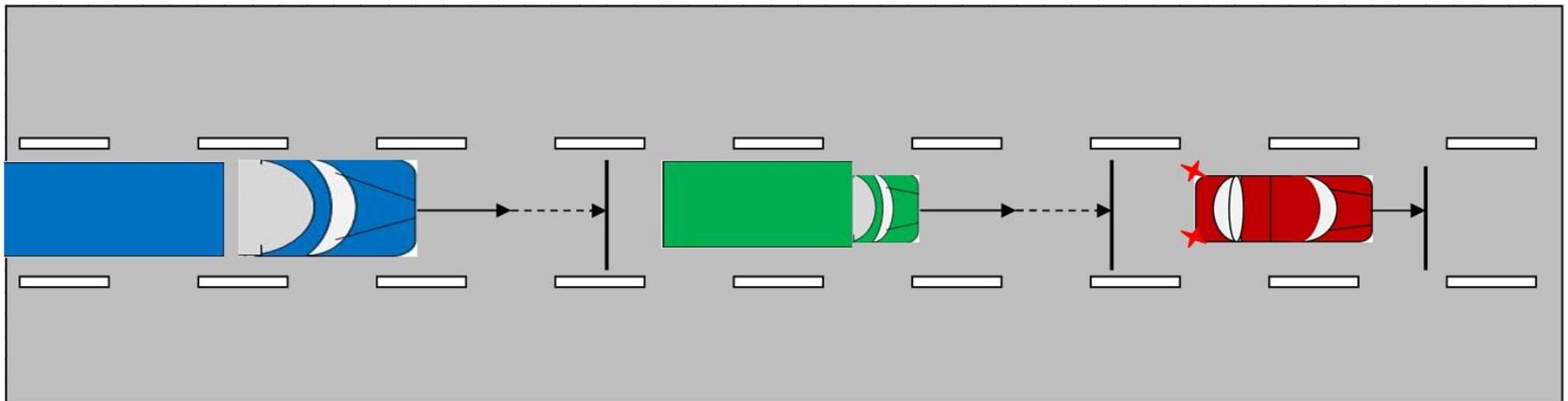## Helps drivers avoid or mitigate collisions with vehicles in or approaching blind spot

- RV must be behind left or behind right to be in blind spot zone
- HV and RV must be above minimum speed threshold
- Two threat levels depending on use of turn signal and RV in or approaching applicable blind spot
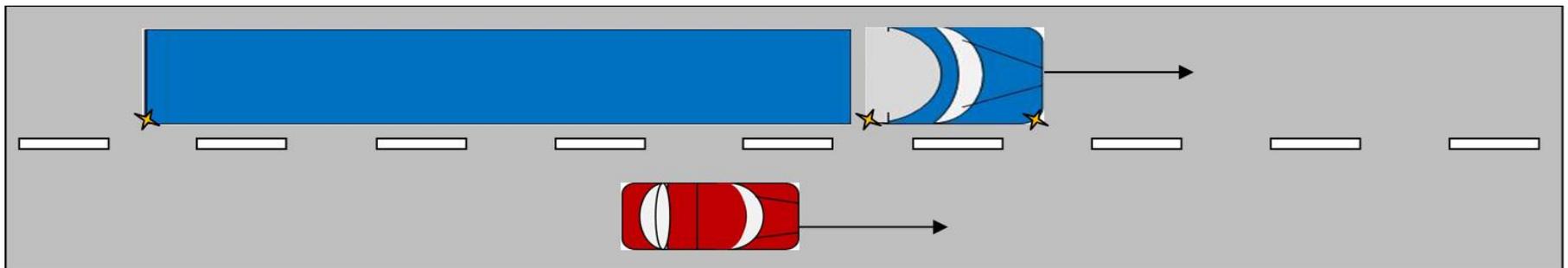
Emergency Electronic Brake Lights

Helps drivers avoid or mitigate rear-end collisions with braking vehicles in the forward path of travel

- RV broadcasts hard brake event and must be ahead, ahead left, or ahead right of HV to be potential threat

- HV must be above minimum speed threshold

- Two threat levels depending on range, RV deceleration, and zone

- Warning suppressed if sufficient HV brake applied

Intersection Movement Assist

Helps drivers avoid or mitigate vehicle collisions at stop sign controlled and uncontrolled intersections

- Vehicles must be intersecting left or right
- Vehicle 1 braking or creeping forward
- Two threat levels depending on scenario
- Warning suppressed if speeds or paths altered enough to avoid collision

V_2

Intersection Point

Vehicle 2

V_1

Vehicle 1

V_2

Intersection Point

Vehicle 2

Vehicle 1