Tutorial of 802.11p/OCB

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Background-Terminology

- ITS = Intelligent Transportation Systems
  - See http://www.iteris.com/itsarch/ for National ITS Architecture
- DSRC = Dedicated Short Range Communication
- WAVE = Wireless Access in Vehicular Environments

Mission

- Vehicle communication to/from proximate device
  - Vehicle to Vehicle (V2V)
  - Vehicle to/from roadside Infrastructure (V2I)
- Applications:
  - Collision Avoidance
  - Road Hazard Safety
  - Mobility
  - Environment
  - Commerce
  - Entertainment
  - ?

Sometimes called "hard" and "soft" safety, respectively

V2V collision avoidance is driving deployment

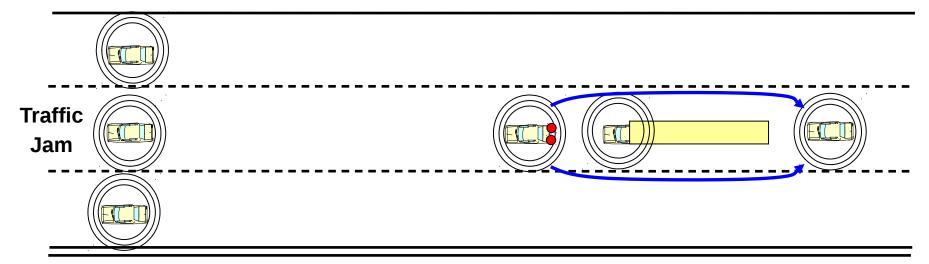# How does it work? (high level)

- Each vehicle broadcasts its core state information in a "Basic Safety Message" (BSM) nominally 10 times/sec.

- BSM is sent 360 degrees using IEEE 802.11p technology (more later)

- Receivers build model of each neighbor's trajectory, assess threat to host vehicle, warn driver or take control if threat becomes acute.

- Example application:
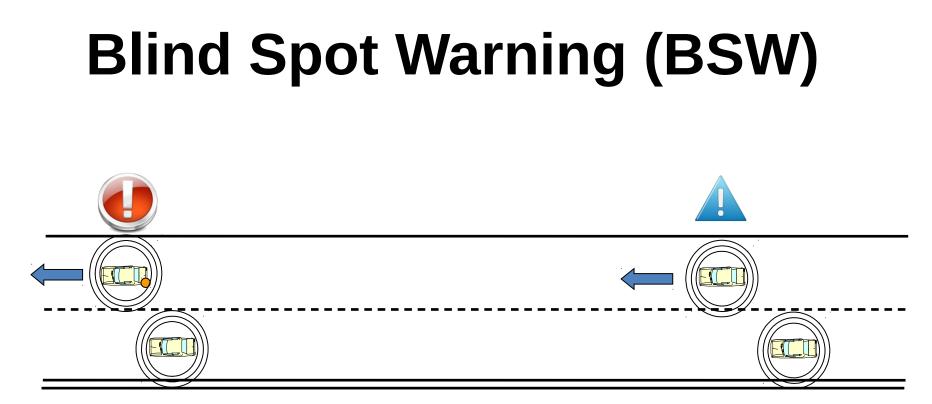 Forward Collision Warning (FCW)

opped

DSRC
communication

If driver of approaching car does not stop, warning issued within car

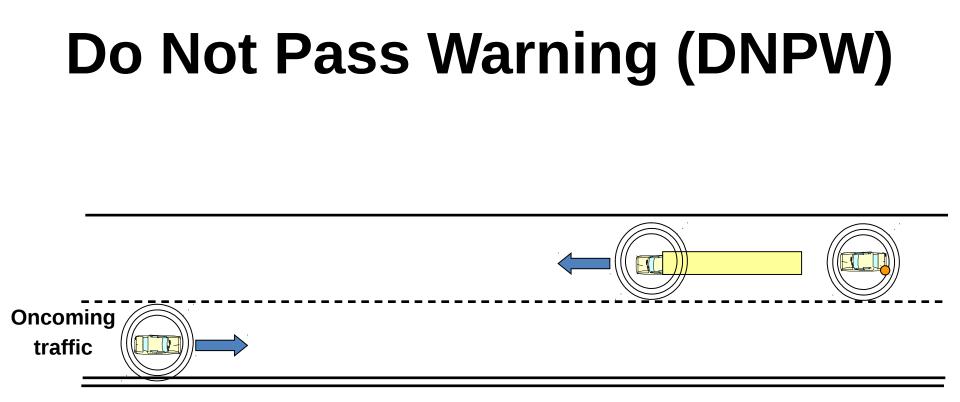# Emergency Electronic Brake Lights (EEBL)

Emergency Electronic Brake Lights (EEBL)

Traffic Jam

High deceleration by car approaching jam. Trailing car Informed via DSRC within 100 msec.

Blind Spot Warning (BSW)

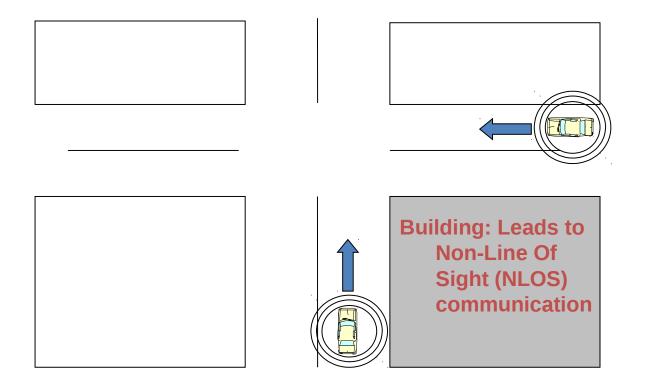**Driver receives warning when showing intent to change lanes**

Normal driving – advisory indicator of car in blind spot

Note: Specific timing, format, or decision logic for advisories and warnings will likely vary for each car manufacturer
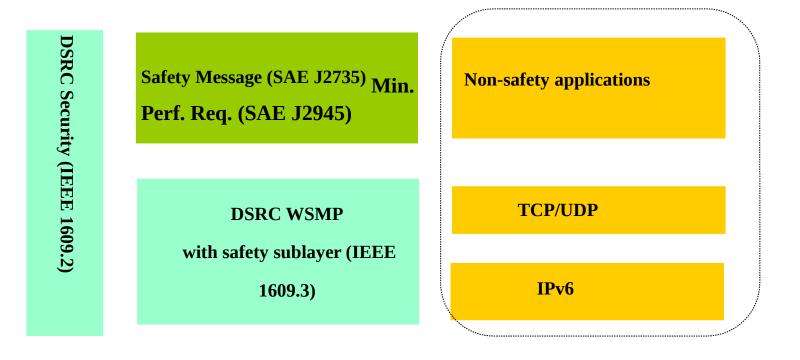
Do Not Pass Warning (DNPW)

Oncoming traffic

When showing intent to move to oncoming lane, driver receives warning if not safe to pass.

Intersection Collision Warning (ICA)

Building: Leads to Non-Line Of Sight (NLOS) communication

If intersecting trajectories are indicated, driver is warned.

How does it work? (details)

DSRC Security (IEEE 1609.2)

Safety Message (SAE J2735) **Min. Perf. Req. (SAE J2945)**

DSRC WSMP with safety sublayer (IEEE 1609.3)
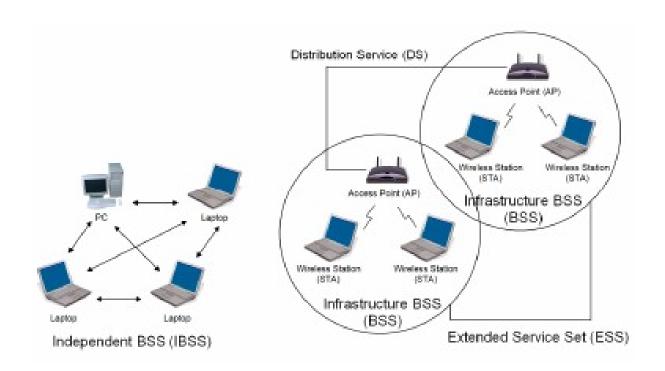
Non-safety applications

TCP/UDP

IPv6

DSRC Upper-MAC (IEEE 1609.4)

DSRC PHY+MAC (IEEE 802.11p)

See: J. Kenney, "DSRC Standards in the United States", Proc. IEEE, July 2011, Vol. 99, No. 7, pp. 1162-1182

802.11 BSS

- BSS: Basic Service Set is a group of IEEE 802.11 stations anchored by an Access Point (AP) and configured to communicate with each other over the air-link. SSID
- IBSS: Ad hoc
- SSID, BSSID

Source: "IEEE 802.11p: Towards an International Standard for Wireless Access in Vehicular Environments", Daniel Jiang, Luca Delgrossi

802.11p/802.11 OCB MAC

Communicating **O**utside the **C**ontext of a **B**SS – **OCB**

– Management information base (MIB) **dot11OCBEnable d is TRUE**

– *A STA is not a member of a BSS*

• A sending STA sets the BSSID field to the wildcard BSSID value

– *STAs are able to communicate directly over the wireless medium*

• Avoid the latency associated with establishing a BSS

– *Does not utilize the 802.11 authentication, association, or data*

confidentiality services

• Any required authentication services would be provided by the station

management entity (SME) or by applications outside of the MAC sublayer

– *For use in rapidly varying communication environments*

• Communication exchanges take place may be of very short-duration

Thanks!