V2V COMMUNICATION
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Introduction

Vehicle Communication Systems:
- This systems are an emerging types of networks in which vehicles and roadside units are the communicating nodes:
  - to provide each other as information, such as safety warning and traffic information.
- Generally vehicular networks are considered to contain two types of nodes:
  - vehicle to vehicle (V2V)
  - vehicle to Roadside (V2R)
Introduction

What is V2V Communication?

- V2V(Vehicle to Vehicle) is an automobile technology designed to allow automobiles to “talk” to each other.
- The system will use a region of the 5.9GHz band using wireless protocol standard IEEE 802.11p for various public safety services.
- V2V is currently in active development by General Motors, which demonstrated the system in 2006 using Cadillac vehicles.
- with a 360 degree awareness of the position of other vehicles
Introduction

- The primary benefit of V2V is to protect vehicles from potential road hazards and improve safety.
- It is Fast and Reliable and provides real time safety.
- It does not need any roadside Infrastructure.
- V2V communication technology uses Dedicated Short Range Communications (DSRC), which in the US utilizes a 75-MHz bandwidth at a frequency of 5.9 GHz.
- It is designed to facilitate communication at distances of up to 1 km.
- The data exchanged may include a vehicle’s position, speed, throttle position, steering angle, brake status, turn signal status, number of people in the vehicle, etc.
Applications

- Safety related: collision avoidance, cooperative merging, etc
- Incident report: dissemination of data regarding accidents on the network or breakdown/blockage of a link, etc
- Route Guidance: en-route guidance about the shortest path, route guidance for gas stations, etc
- Miscellaneous: green light prediction, parking space availability, etc.
The dynamic wireless exchange of data between nearby vehicles that offers the opportunity for significant safety improvements.

- By exchanging anonymous:
  - vehicle-based data regarding position, speed, and location
- Enables a vehicle to:
  - sense threats and hazards with a 360-degree awareness of the position of other vehicles.
  - issue driver advisories or warnings
  - take preventive actions to avoid and mitigate crashes.
Example: **Hazard Warning**

- Vehicles that are in a traffic jam and turned on their hazard warning lights, communicate this information back to other Vehicles.

- This information is much more accurate and reaches upcoming traffic faster than conventional methods.
V2V Communication for Safety

Example: Accident Warning

- Vehicles that are involved in an accident are the most reliable source of information about the very fact that there is an accident.
- If vehicles involved in an accident are equipped with short-range communication, they can send out a warning message to the following traffic e.g. to avoid mass collisions.
- If the driver fails to take action, the V2V system could automatically apply the brakes to stop the car.
Example: *Emergency Vehicle Warning*

- Approaching emergency vehicles send out a warning message to warn vehicles that are in its vicinity.
- Receiving vehicles can automatically mute the radio or the hands-free phone and give an audible or visual warning message to the driver.
V2V Communication for Safety

Example: Traffic Signal Violation Warning

- Vehicles can be warned about an imminent change of a traffic light and if they are in danger of running a red light
- Traffic lights can send out their timing and phase to prevent red light violations and potential accidents
Example: **Adaptive Cruise Control**

- This system is effective when the adaptive cruise control fails to perform correctly due to the radar's line-of-sight scanning.
- When the car approaches a sharp curve, the DSRC system warns the adaptive cruise control system of any slow moving vehicles just around the turn.
V2V Communication for Safety

- According to the National Highway Traffic Safety Administration (NHTSA), 76% of car accidents could be prevented with the help of V2V communication technology.
- Large number of cars on the road must be equipped.
- It does not need any roadside Infrastructure.
- V2V communication technology uses Dedicated Short Range Communications (DSRC), which in the US utilizes a 75-MHz bandwidth at a frequency of 5.9 GHz.
- Communication at distances of up to 1 km.
Technologies

- **WSN** (Wireless sensor networks) - consists of spatially distributed autonomous sensors to *monitor* physical or environmental conditions, such as *temperature*, *sound*, *vibration*, *pressure*, humidity, motion or pollutants and to cooperatively pass their data through the network to a main location.

- **VANET** (Vehicular Ad hoc Networking) – enables communication over multiple wireless hubs, but not necessarily including roadside access points.

- **(GPS/ WiFi/ WiMax)** - In-vehicle digital maps and positioning technologies as sensing systems to accurately identify the vehicle position and interpret the environment.

- **DSRC** (Dedicated short-range communication) - are one-way or two-way short- to medium-range wireless communication channels specifically designed for automotive use and a corresponding set of protocols.
The new tech combines Wi-Fi and GPS to create a new form of communication known as DSRC.

The system works by making each vehicle a node on the network.
Technologies

**DSRC (Dedicated Short Range Communication)**

- DSRC is a multi-channel wireless standard that based on the IEEE 802.11a PHY and the IEEE 802.11 MAC.
- It is targeted to operate over a 75 MHz licensed spectrum in the 5.9 GHz band.

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<tr>
<th>Parameter</th>
<th>Details</th>
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<tbody>
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<td>Bandwidth</td>
<td>75MHz (5.850 – 5.925GHz)</td>
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<td>Modulation</td>
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<td>Channels</td>
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<td>Max Range</td>
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<tr>
<td>Min. Separation</td>
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Current: V2V assisted V2I
VANET (Vehicle Ad hoc Networking)

- VANET is a technology that uses moving cars as nodes in a network to create a mobile network.
- VANET integrates on multiple ad-hoc networking technologies such as WiFi IEEE 802.11p, WAVE IEEE 1609, WiMAX IEEE 802.16, Bluetooth etc.
Technologies

**VANET (Vehicle Ad hoc Networking)**

- VANET turns every participating car into a wireless router or node, allowing cars approximately 100 to 300 metres of each other to connect.
- As cars fall out of the signal range and drop out of the network, other cars can join in, connecting vehicles to one another so that a mobile Internet is created.
- VANET consist of some sensors embedded on the vehicles.
- The onboard sensors’ readings can be displayed to the drivers via monitors to be aware of the vehicle condition or emergency alarms, and also can be broadcasted to the other adjacent vehicles.
- VANET can also be helped by some of Roadside Units like Cellular Base Stations, to distribute the data to the other vehicles.