VANET

- VEHICULAR ADHOC NETWORK

Ad hoc Networks

- A Network with **absence of centralized** and **pre established infrastructure.**
- Ad hoc Networks are a **collection of self governing mobile nodes**
- Establishes **multihops**

Eg: MANET , VANET

VANET –Vehicular Ad hoc Network

- A special type of MANET , in which the mobile nodes are replaced with **vehicles and road side units(RSU)**

- Initially introduced for vehicles of Police, fire brigades, and ambulances for safe travelling on road

- A vehicle communicates with other vehicles that are within the range of **100 to 300 metres.**

- Vehicles consists of **On Board Unit (OBU)** which consists of wireless transmitter and a receiver to communicate within the network.

OBC – On Board Unit

- A device which is present in each vehicle ,which processes the data collected from various sensors fitted in the other vehicles and gives their conditions.

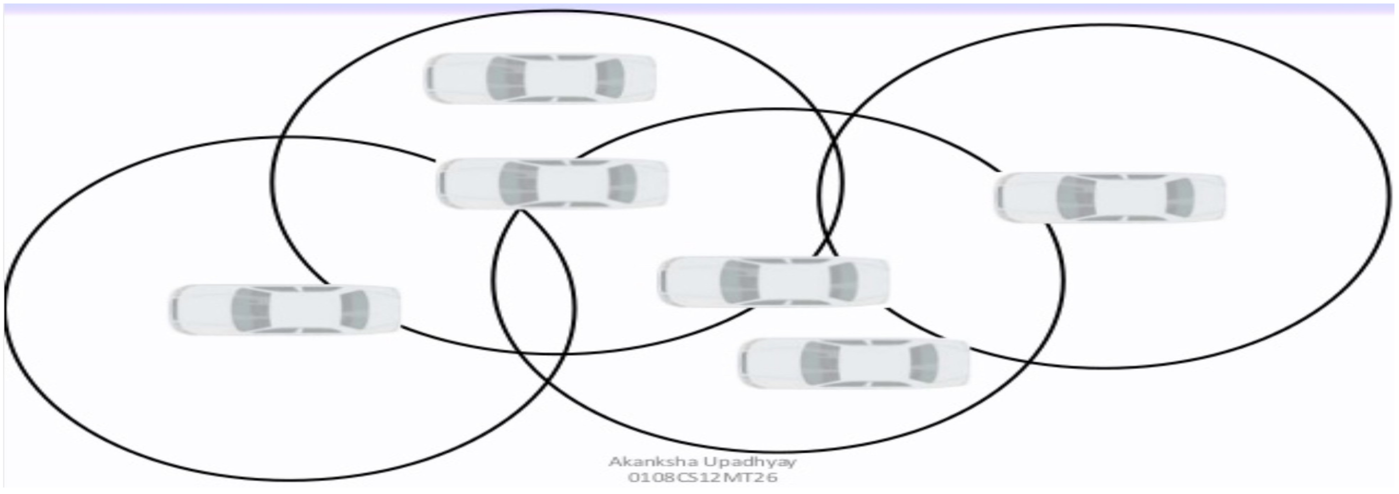
- It is responsible for the communication with outside network i.e with other vehicles and infrastructure.

- **RSU -Road Side Unit**

- Infrastructure between the vehicles for sharing the information from other vehicles

VANET Architecture

- Each vehicle with a WiFi or WiMax device acts as a node in the network
- Unique ID and IP address
- Each node can communicate with any other node in the network
- Any vehicle can register its identity to a roadside WAP.
- Information provided by the vehicles are stored by WAP at a dynamic server database.



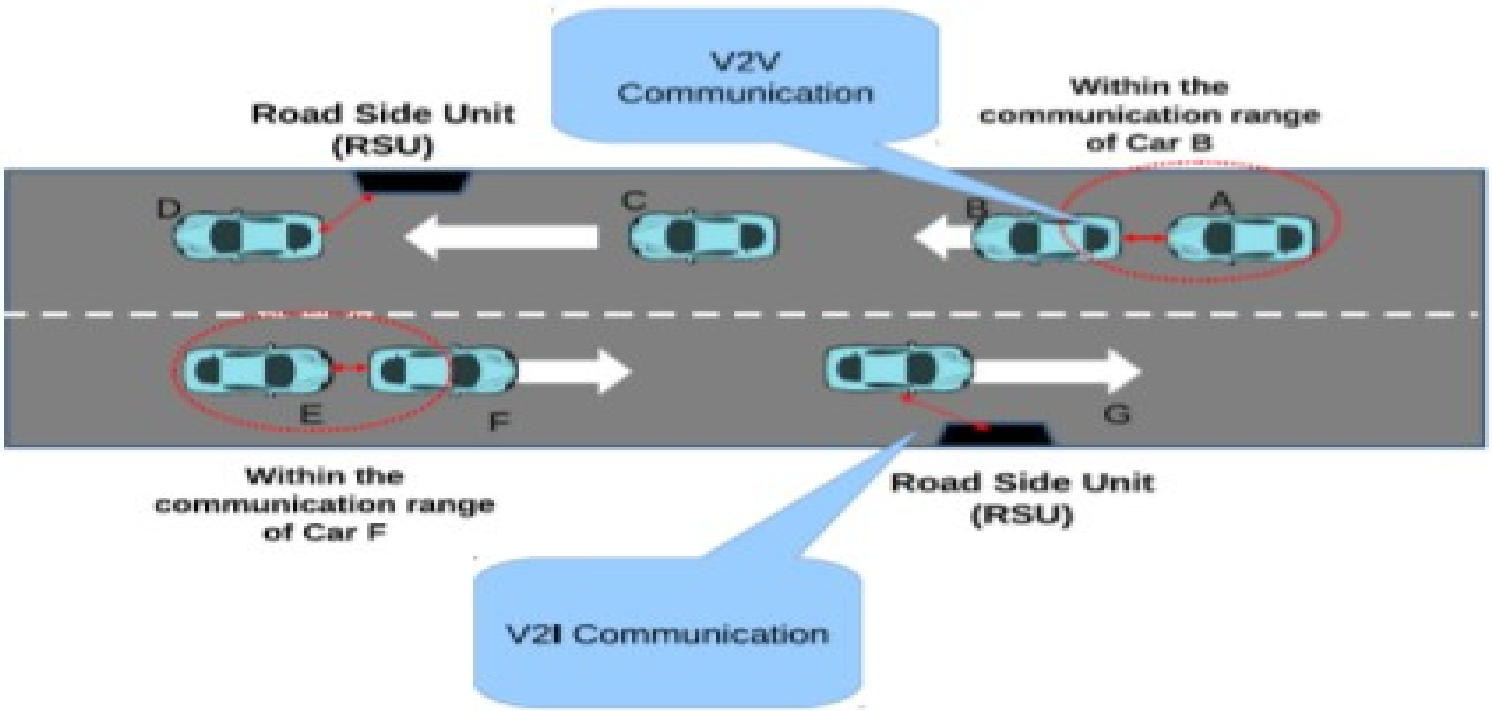
CAR-2-CAR communication consortium reference architecture (C2C CC)

- The in-vehicle domain is composed of an **on-board unit (OBU)** and one or multiple **application units (AUs).**
- The connections between them are usually wired and sometimes wireless.
- However, the ad hoc domain is composed of vehicles equipped with OBUs and **roadside units (RSUs).**
- An OBU can be seen as a mobile node of an ad hoc network and RSU is a static node likewise.
- An RSU can be connected to the Internet via the gateway; RSUs can communicate with each other directly or via multihop as well.
- There are two types of infrastructure domain access, RSUs and **hot spots (HSs)**. OBUs may communicate with Internet via RSUs or HSs.
- In the absence of RSUs and HSs, OBUs can also communicate with each other by using cellular radio networks (GSM, GPRS, UMTS, WiMAX, and 4G)

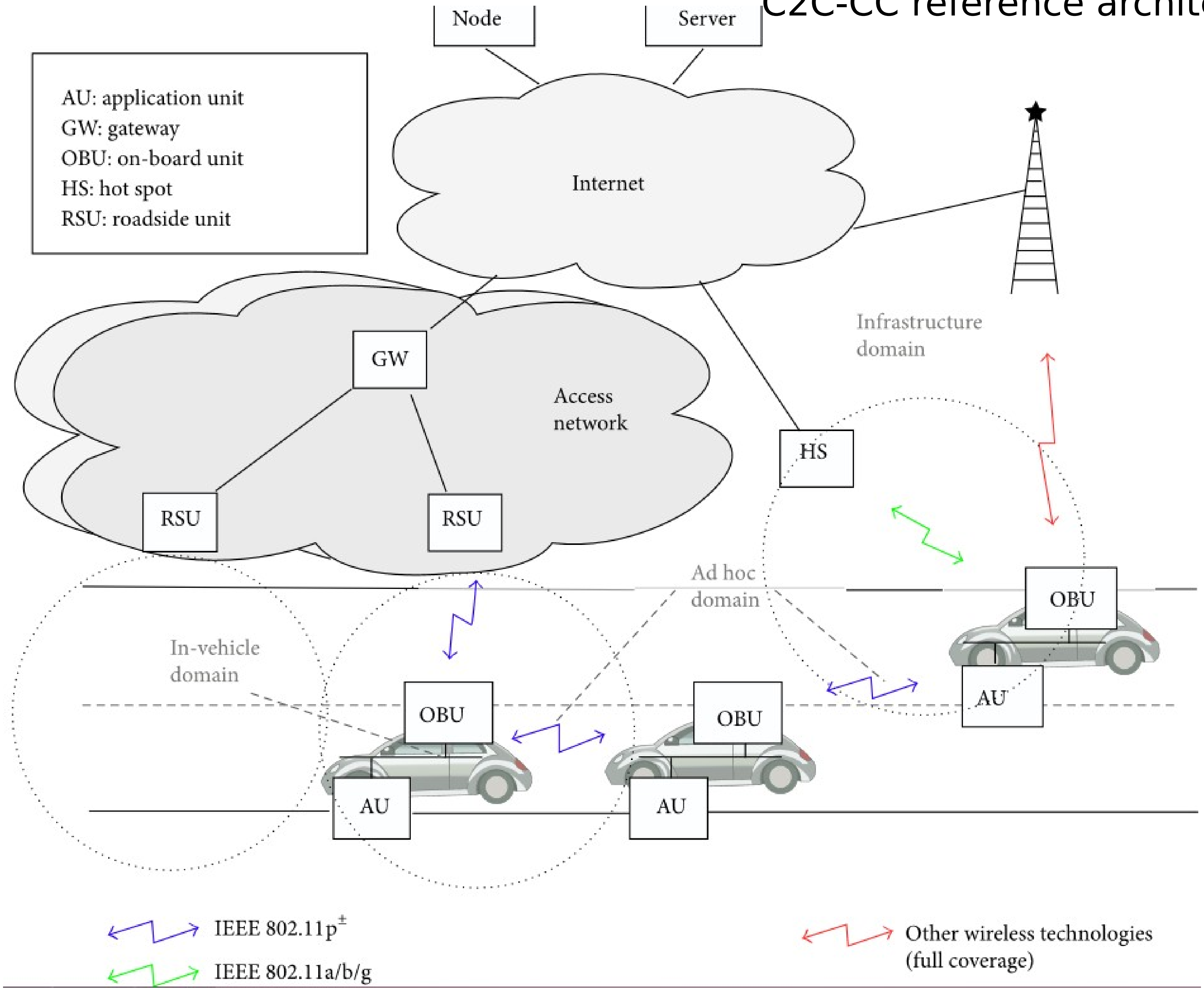
VANET – Types of communication

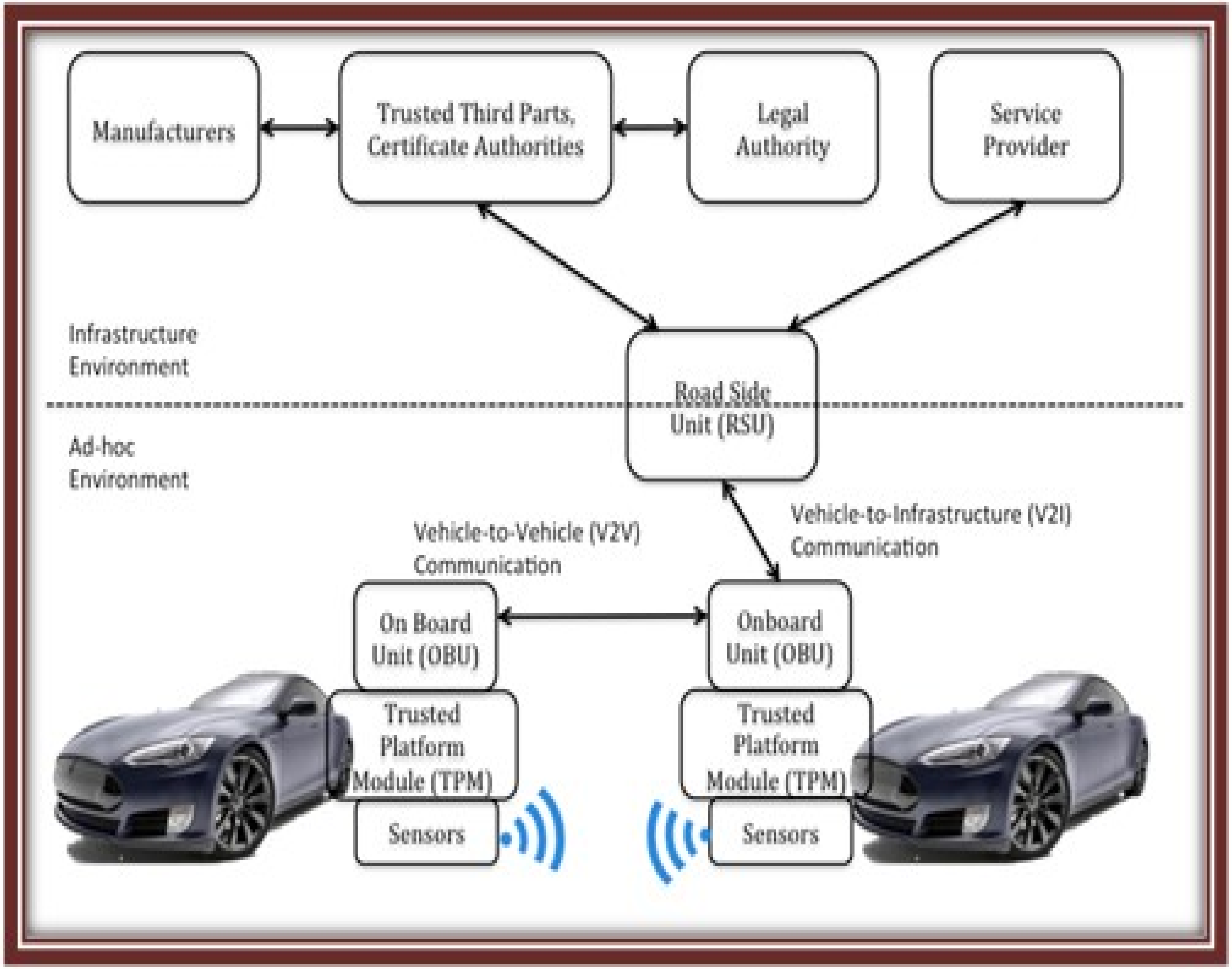
1. Vehicle to vehicle communication (V2V)

2 .Vehicle to infrastructure communication(V2I)

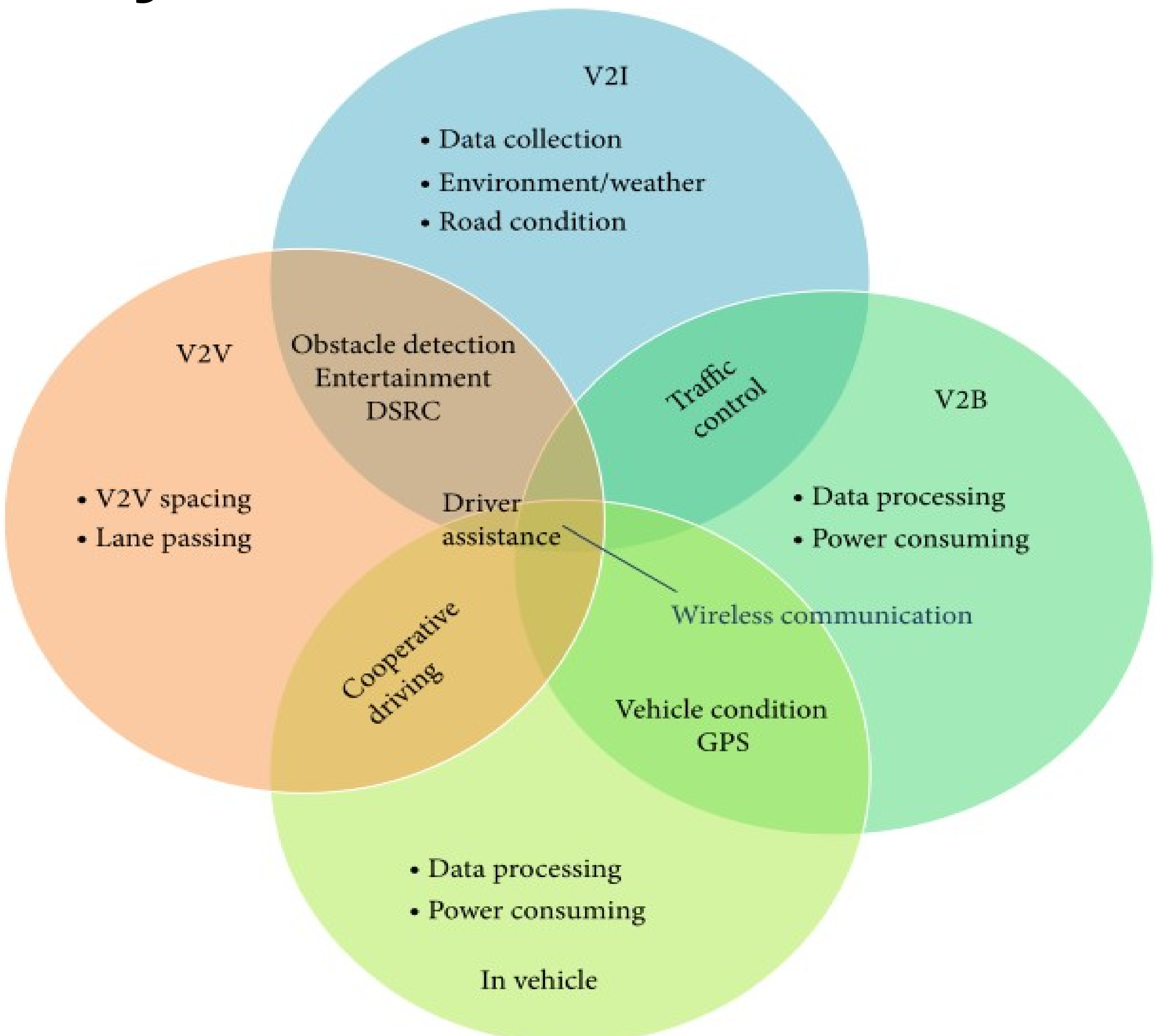

V2V
Communication
Within the
communication range
of Car B
Road Side Unit
(RSU)
D
C
B
A
E
F
G
Within the
communication range
of Car F
Road Side Unit
(RSU)
V2I Communication

C2C-CC reference architecture




Manufacturers
Trusted Third Parts,
Certificate Authorities
Legal
Authority
Service
Provider
Infrastructure
Environment
Road Side
Unit (RSU)
Ad-hoc
Environment
Vehicle-to-Vehicle (V2V)
Communication
Vehicle-to-Infrastructure (V2I)
Communication
On Board
Unit (OBU)
Onboard
Unit (OBU)
Trusted
Platform
Module (TPM)
Trusted
Platform
Module (TPM)
Sensors
Sensors

Key functions of VANET



Key functions of each communication type

- **In-vehicle communication,** which is more and more necessary and important in VANETs research, refers to the in-vehicle domain. In-vehicle communication system can detect a vehicle’s performance and especially driver’s fatigue and drowsiness, which is critical for driver and public safety.

- **Vehicle-to-vehicle (V2V) communication** can provide a data exchange platform for the drivers to share information and warning messages, so as to expand driver assistance.

- **Vehicle-to-road infrastructure (V2I) communication** is another useful research field in VANETs. V2I communication enables real-time traffic/weather updates for drivers and provides environmental sensing and monitoring.

- **Vehicle-to-broadband cloud (V2B) communication** means that vehicles may communicate via wireless broadband mechanisms such as 3G/4G. As the broadband cloud may include more traffic information and monitoring data as well as infotainment, this type of communication will be useful for active driver assistance and vehicle tracking.

Layered architecture for DSRC

(Dedicated short range communication)

Safety applications	Nonsafety Applications
Transport and network layer IEEE 1609.3 **Security** IEEE 1609.2	**Transport layer** TCP/UDP **Network layer** IPv6
LLC sublayer IEEE 802.2	
MAC sublayer extension IEEE 1609.4	
MAC sublayer PHY layer	IEEE 802.11p

Layered architecture for DSRC

- DSRC is specifically designed for automotive use and a corresponding set of protocols and standards
- The US FCC has allocated 75 MHz of spectrum for DSRC communication, from 5.850 GHz to 5.925 GHz
- Different protocols are designed to use at the various layers; some of them are still under active development now. The IEEE 802.11p, an approved amendment to the IEEE 802.11 standard to add wireless access in vehicular environments (WAVE), is focused primarily on the PHY layer and MAC sublayer of the stack.
- IEEE 1609 is a higher layer standard based on the IEEE 802.11p. IEEE 1609 represents a family of standards that function in the middle layers of the protocol stack to flexibly support safety applications in VANETs, while nonsafety applications are supported through another set of protocols.
- In particular, network layer services and transport layer services for nonsafety applications are provided by three quite stable protocols: IPv6, TCP, and UDP

CHARACTERISTICS OF VANETS

1. High number of nodes

Regarding VANETs as the technical basis for envisioned **Intelligent Transportation System (ITS)** it is expected that a large portion of vehicles will be equipped with communication capabilities for vehicular communication. Taking additionally potential road-side units into account, VANET needs to be scalable with a very high number of nodes.

2. High mobility

Nodes potentially move with high speed. Hence in certain scenarios such as when vehicle pass each other, the duration of time that remains for exchange of data packets is rather small. Also,intermediate nodes in a wireless multi-hop chain of forwarding nodes can move quickly.

3. Dynamic Topology

-VANET environment has a constantly changing topology due to high mobility o f the vehicles. The connection between two vehicles travelling with average suburban speed limits in opposite directions lasts for a very short time. This connection time goes much lesser as the speed of the vehicles increases in a freeway/highway environ ment.

3. High application requirement on data delivery

- Important VANET applications are for traffic safety to avoid road accidents; potentially including safety-of-life. These applications have high requirements with respect to real time and reliability. An end-to-end delay of seconds can render a safety information meaningless.

4. No confidentiality of safety information

- For safety application the information contained in a message is of interest for all road users and hence not confidential

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5. Privacy

- Communication capabilities in vehicles might reveal information about the driver/user, such as identifier, speed, position and mobility pattern. Despite the need of message authentication and non-repudiation of safety messages, privacy of users and drivers should be respected in particular location privacy and anonymity.

- **6. Frequent disconnection**s
- - The link connection between the vehicles in VANET has frequent disconnections because of the high movement of the nodes and frequent change in the environment.
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- **7.Use of Other Technology**
- - Most of the vehicles in VANET these days are capable of integrating their own system with other available technologies such as Global Positioning System (GPS)
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- **8. No Power Constraint**
- **-** As compared to other Mobile Ad-hoc Network (MANET) devices, the nodes in VANETs have the privilege of having longer battery life. This can be utilised for efficient processing of complex and computational hungry routing/security mechanisms in the network.
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- 9.**Stringent Delay Constraints due to real time and time sensitive data exchange**
- **-** VANETs are responsible for the delivery of critical medical emergency messages. These messages must be delivered on time in order to save human lives.

GOALS OF VANET

- Improve the road traffic safety(alert the driver in advance)
- Reduces the travelling time and congestion (up-to-date traffic information)
- Comfort and quality road travel (e toll collections)
- Give collision warnings

APPLICATIONS OF VANET

- **1. Road traffic safety**
- **-** A VANET helps drivers to get advance information and warnings from a nearby environment via message exchanges. For example, if two vehicles are involved in a collision, the trailing vehicles get advance notification of the collision ahead on the road. The driver can also get advance information on the road condition ahead, or a warning about the application of emergency electronic brake by a vehicle ahead in the lane.
- **2.** A VANET can help disseminate geographical information to the driver as he continues to drive. For example, the driver would be notified of the nearby food malls or petrol refilling stations,map display etc.
- **3.** Drivers may have the opportunity to engage in other leisurely tasks, such as VoIP with family, watch news highlights, listen to podcasts or even carry out some business activities such as participate in an office video conference session.

- **4.Traffic engineering or efficiency**
- **-**Increase the overall performance of the transport systems by reducing travelling time and congestion.
- **5.Comfort and Quality of Road Travel**
- **-** Provide comfort applications for t ravellers like ‘advanced traveller information systems’, ‘electronic pay ment systems’, ‘variable message signs’ and ‘electronic toll collection’ etc

MANET Vs VANET

Sr.No.	Parameters	MANET	VANET
1.	Cost of production	Cheap	Expensive
2.	Change in n/w topology	Slow	Frequent and very fast
3.	Mobility	Low	High
4.	Node density	Sparse	Dense and frequently variable
5.	Bandwidth	Hundred kps	Thousand kps
6.	Range	Upto 100m	Upto 500m
7.	Node Lifetime	Depends on power resource	Depend on lifetime of vehicle

8.	Multihop routing	Available	Weakly available
9.	Reliability	Medium	High
10.	Moving pattern of nodes	Random	Regular
11.	Addressing scheme	Attribute based	Location based
12.	Position acquisition	Using ultrasonic	Using GPS,RADAR