

IETF-118 IPMON Side Meeting

IPv6 Mobile Object Networking (IPMON): Problem Statement and Use Cases

November 9, 2023

[draft-jeong-6man-ipmon-problem-statement-01](#)

[Jaehoon \(Paul\) Jeong](#), Yiwen (Chris) Shen,

and Sri Gundavelli

Email: pauljeong@skku.edu



Mobile Objects (MO) for 5G V2X

- Urban Air Mobility (UAM), Drone, Vehicle, Motorcycle, Scooter, Pedestrian, Unmanned Aerial Vehicle (UAV), Train & Ship.



UAM (e.g., Flying Car)



Drone



Train



Motorcycle



Vehicle

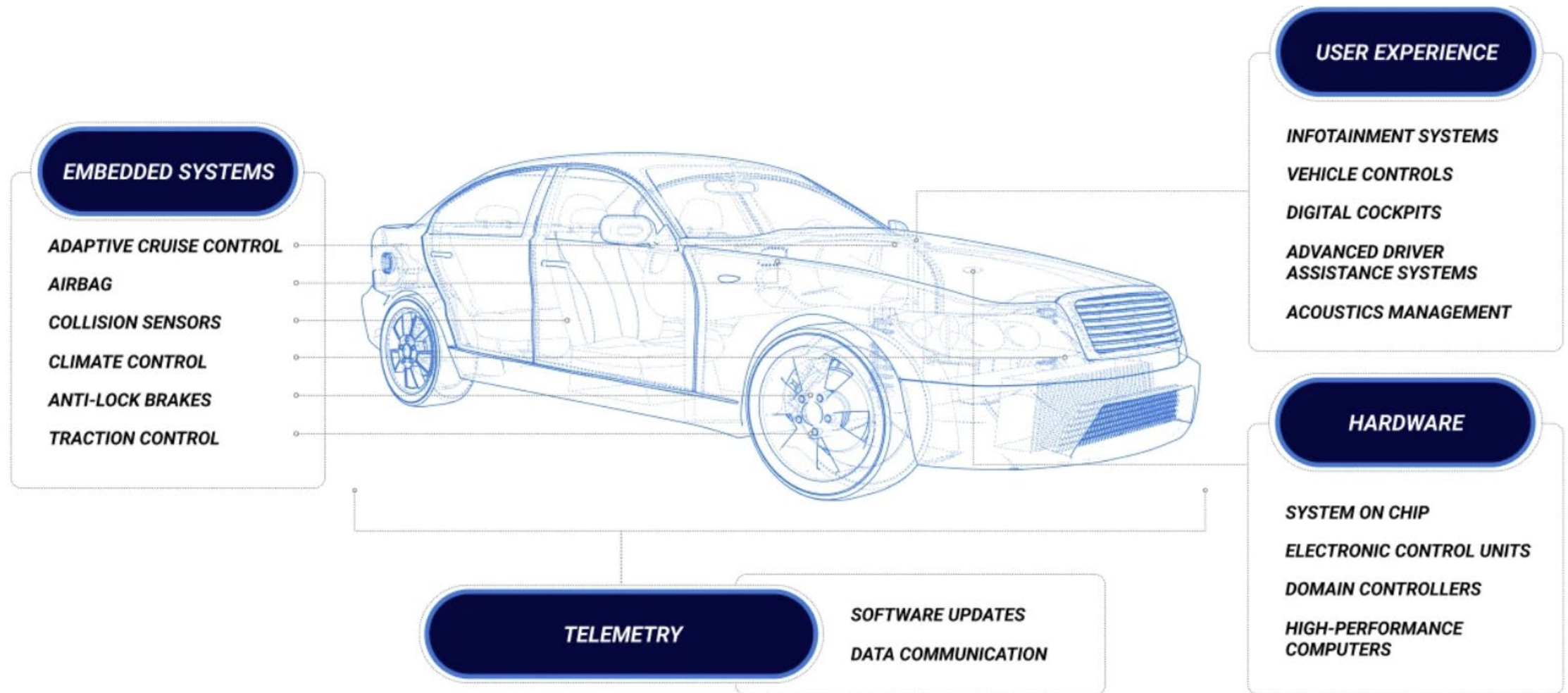


Pedestrian



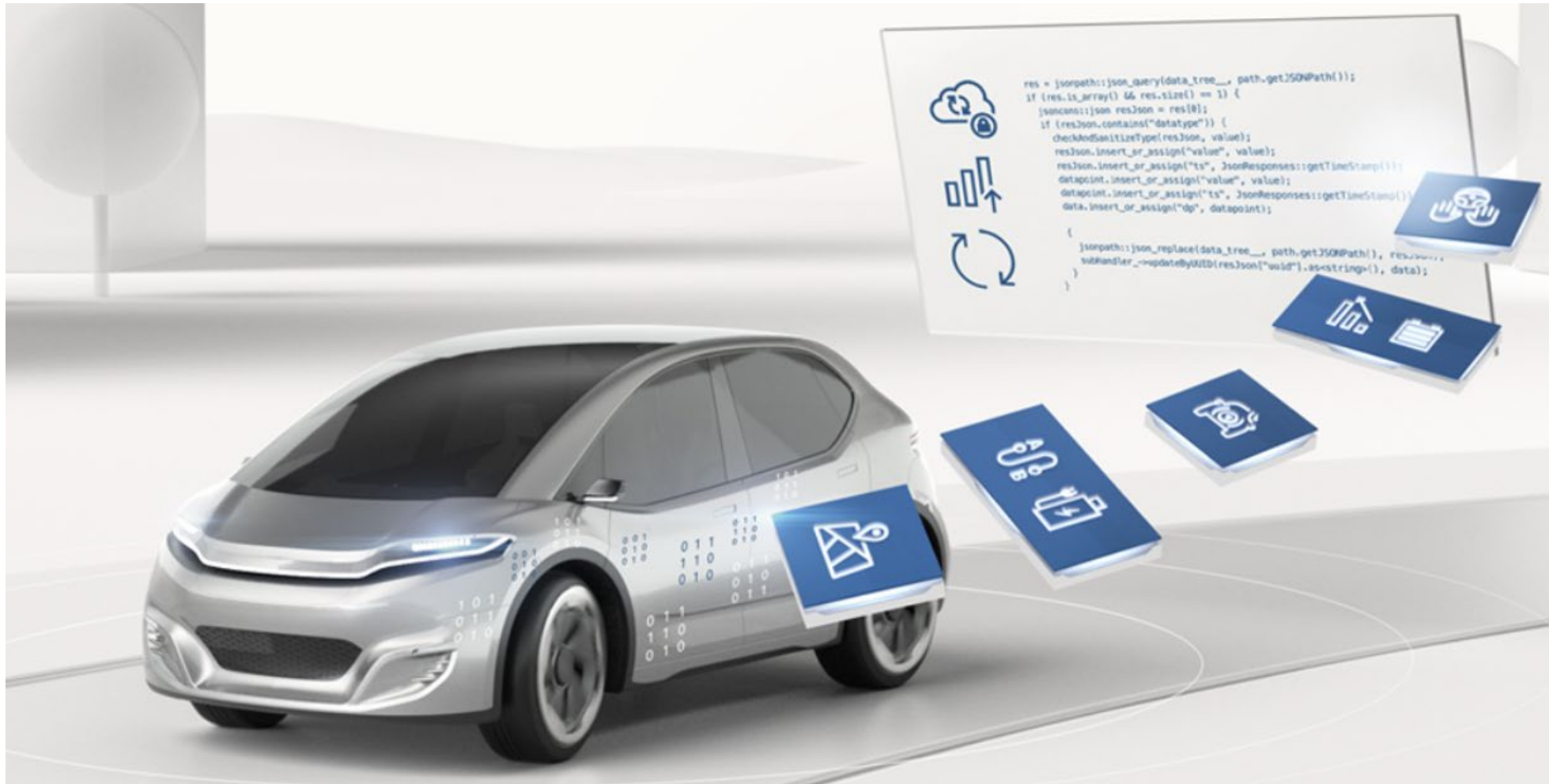
Scooter

Software-Defined Vehicle (SDV) (1/2)



[Source] <https://blackberry.qnx.com/en/ultimate-guides/software-defined-vehicle>

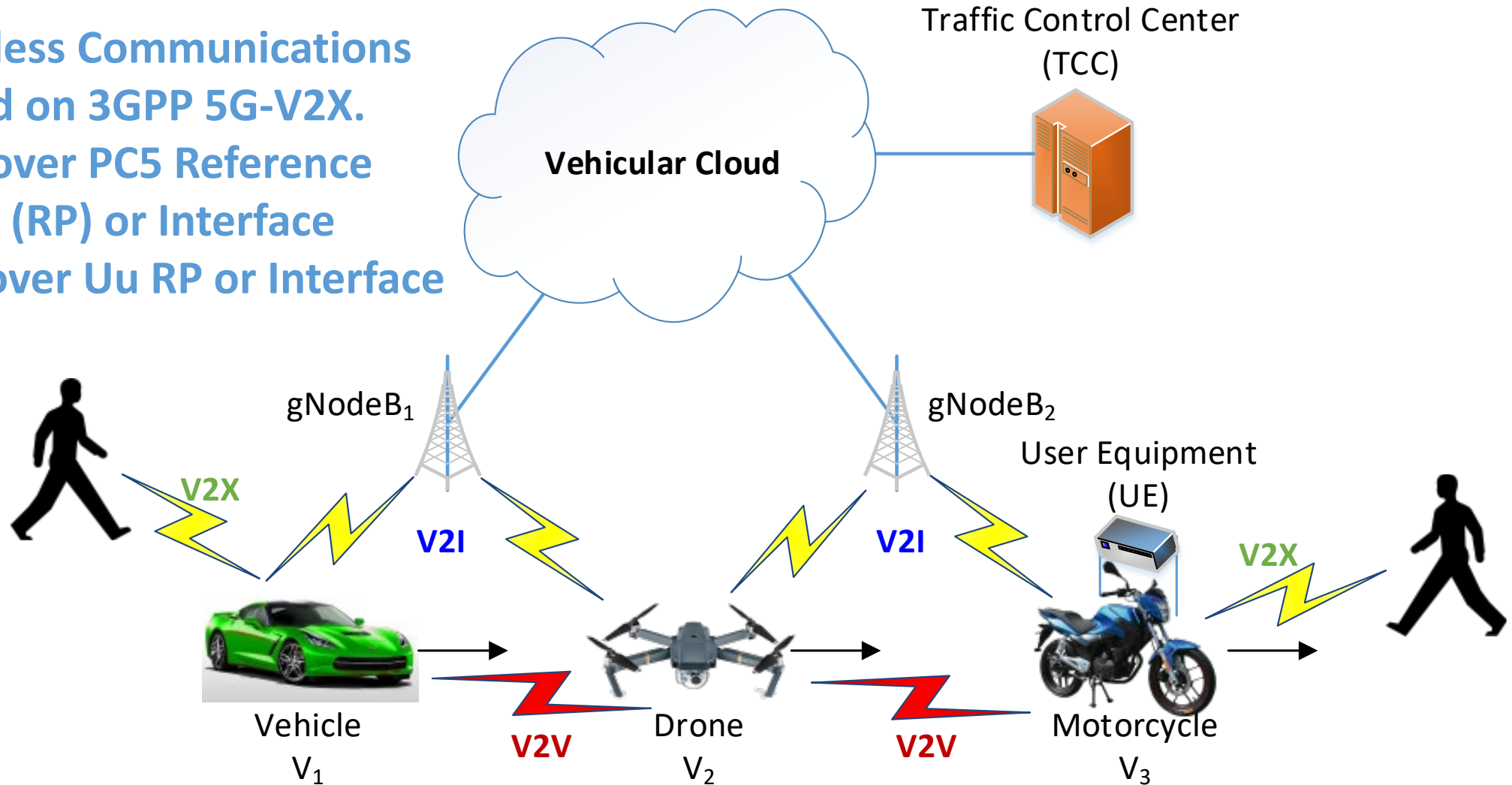
Software-Defined Vehicle (SDV) (2/2)



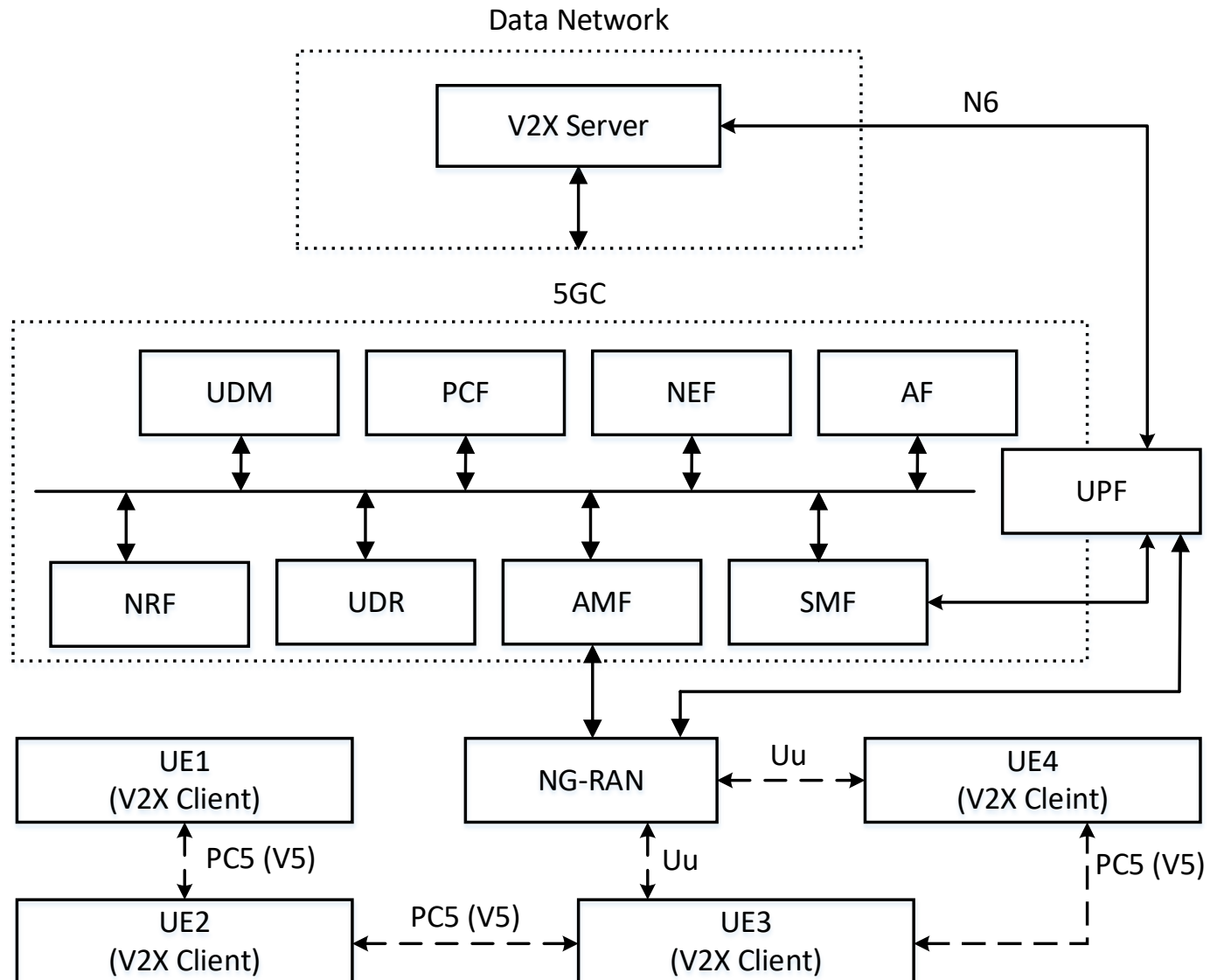
[Source] <https://www.bosch-mobility.com/en/solutions/software-and-services/automotive-device-driver-library/>

IPv6-Over-5G-V2X Networks for SDVs

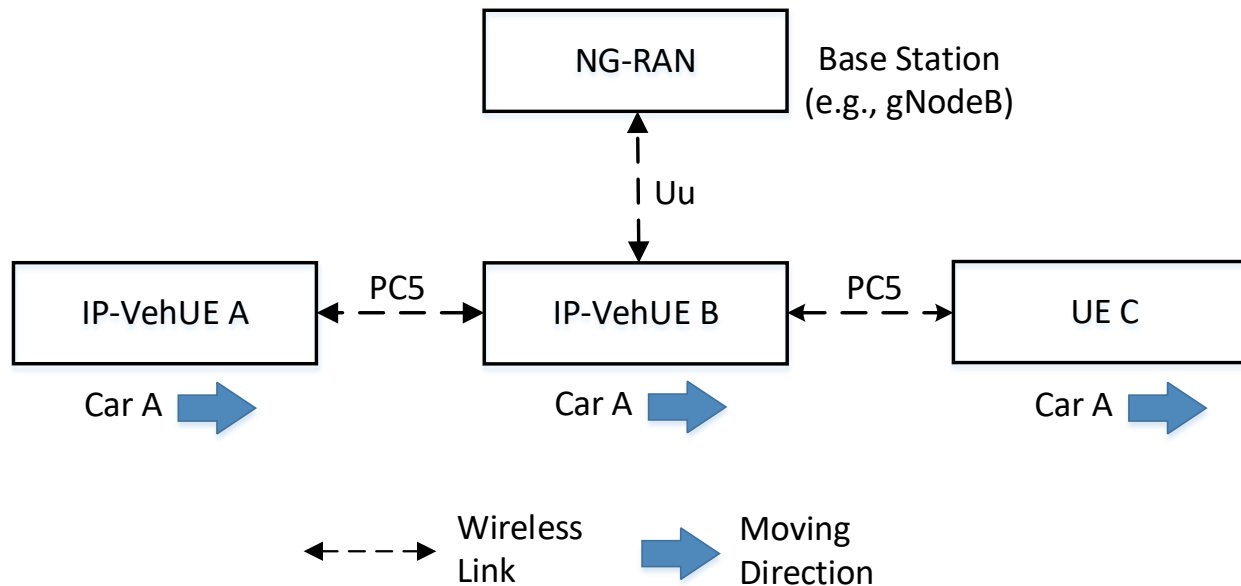
- **Wireless Communications based on 3GPP 5G-V2X.**
- **V2V over PC5 Reference Point (RP) or Interface**
- **V2I over Uu RP or Interface**



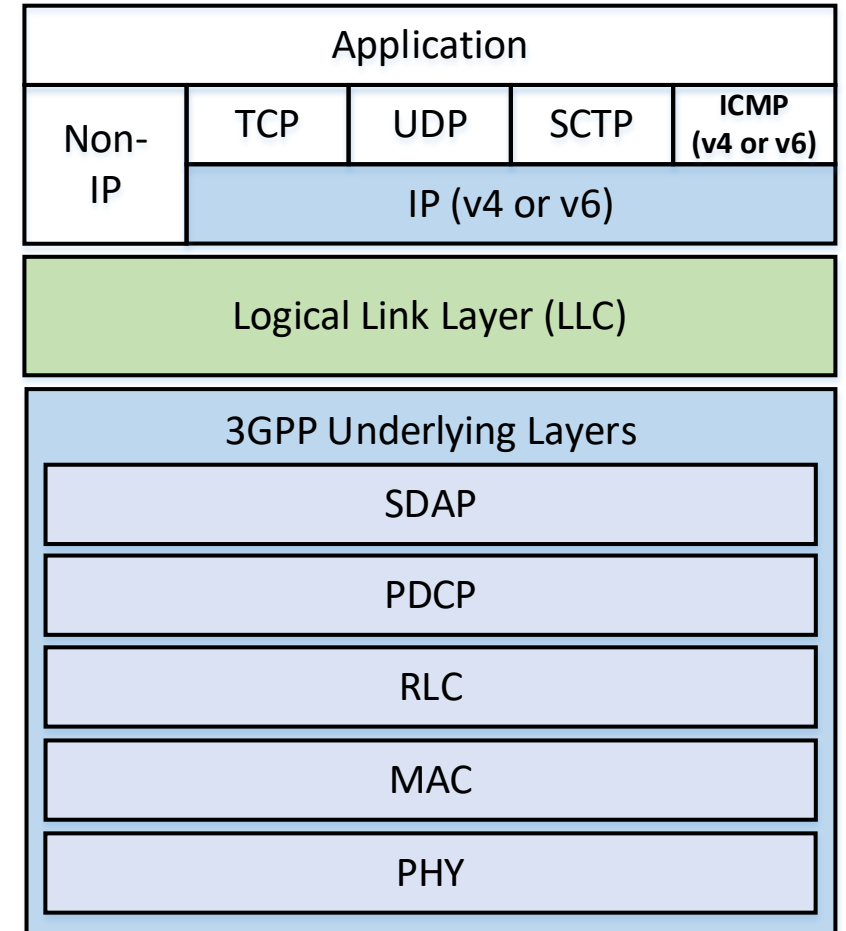
Vehicular Networks with 5G V2X [TS 23.287]



5G V2X Architecture and Protocol Stack

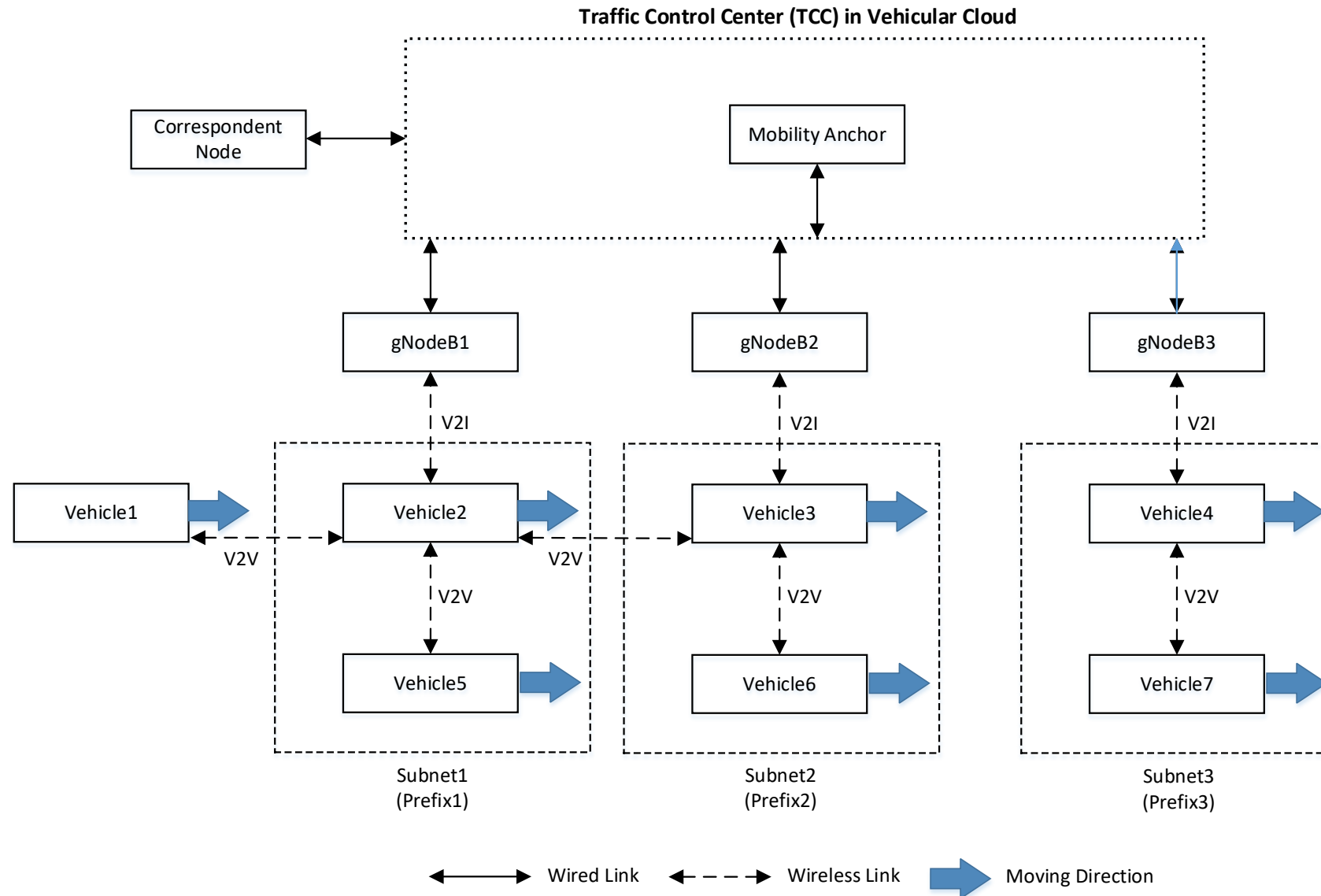


3GPP 5G V2X Architecture



UE's 5G V2X Protocol Stack (Data Plane)

IPv6 Vehicular Networks with 5G V2X



Use Cases of IPv6-Over-5G-V2X

- **V2V Use Cases**

- Context-Aware Navigation Protocol (CNP) for driving safety
- Collision avoidance service for Urban Air Mobility (UAM) vehicles
- Cooperative Adaptive Cruise Control (CACC) on the road
- Platooning on the highway
- Cooperative Environment Sensing (CES)

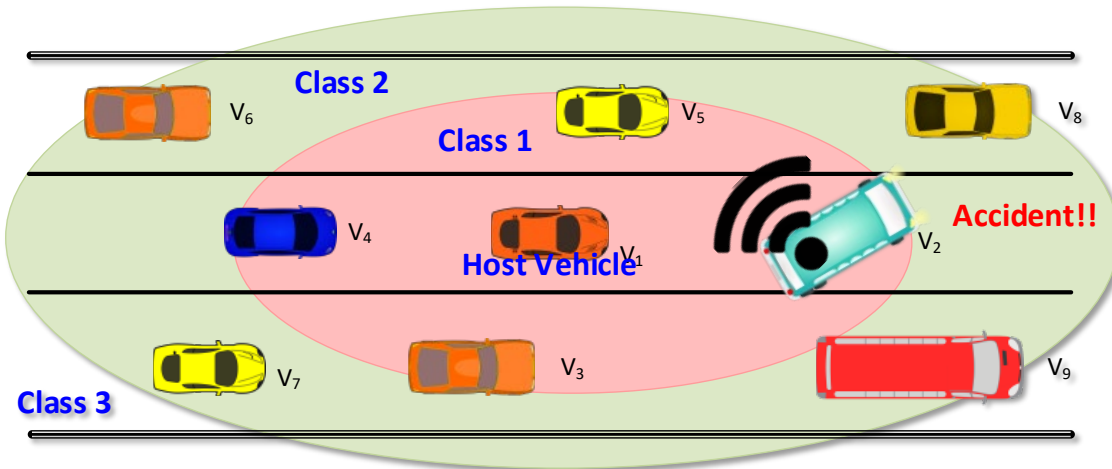
- **V2I Use Cases**

- Road navigation service
- Accident notification service
- Energy-efficient speed recommendation service
- Vehicle charging service

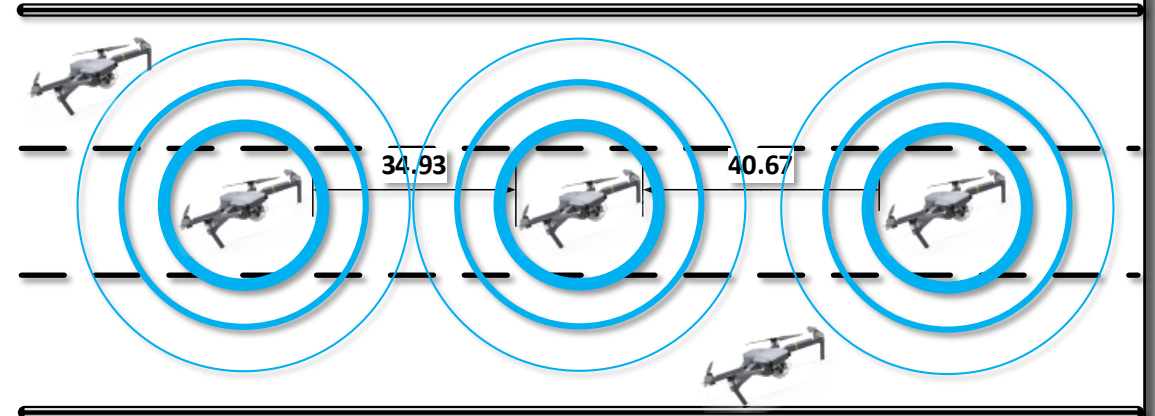
- **V2X Use Cases**

- Pedestrian safety service
- Scooter safety service

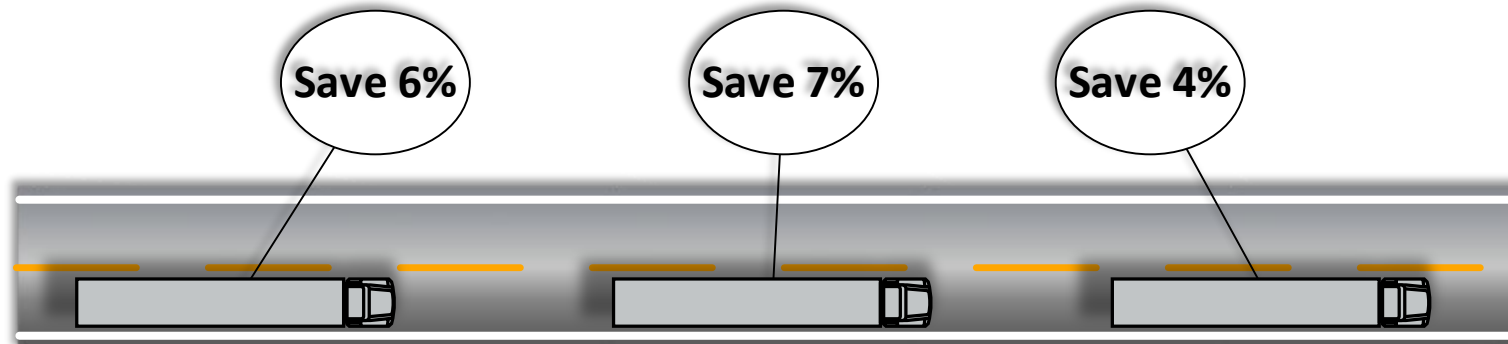
V2V Use Cases



Safe Driving in Road Networks

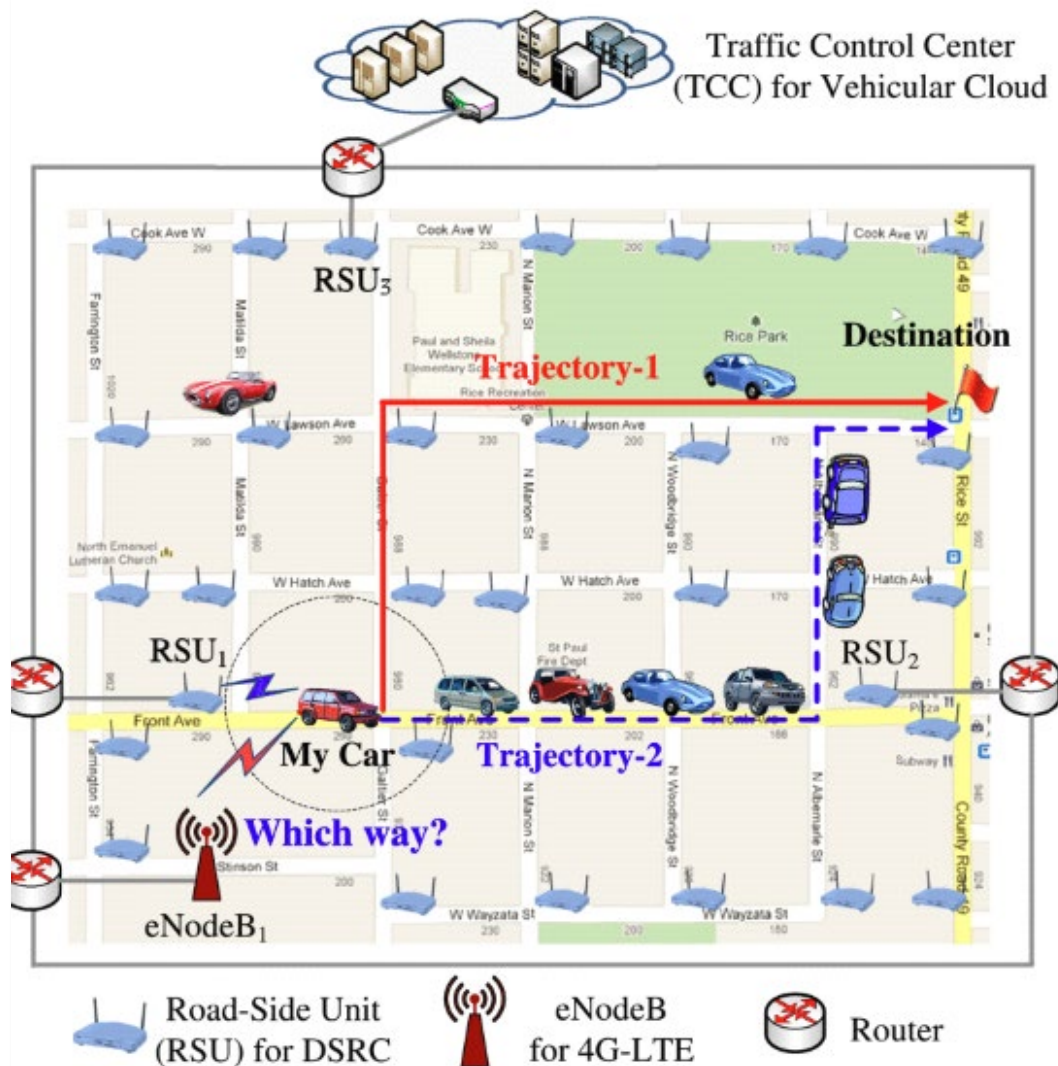


Safe Flying in Drone Networks

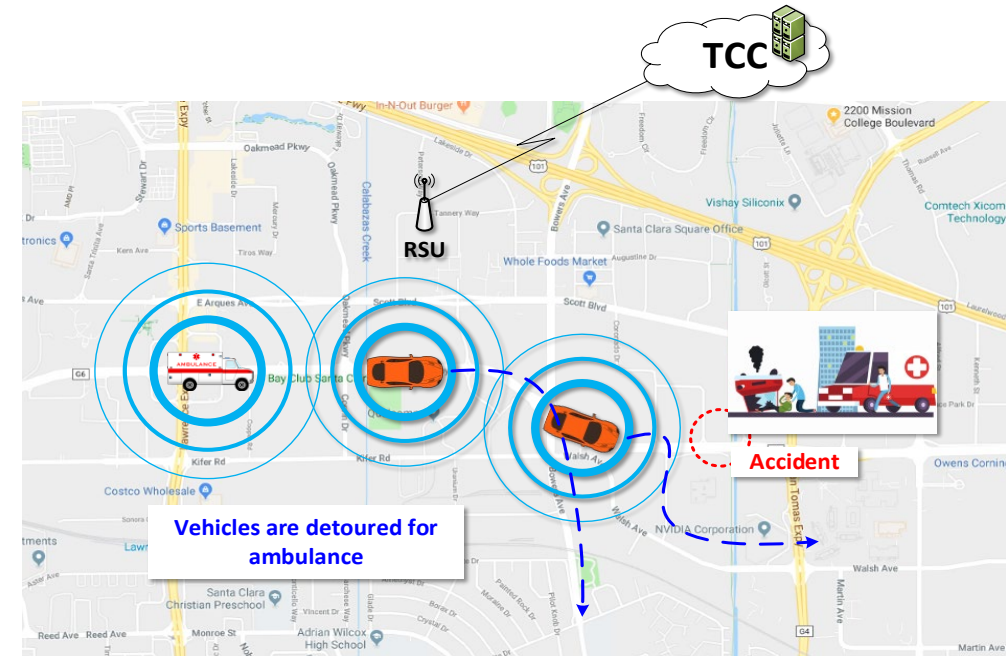


Total energy consumptions are saved by platooning.
Platooning for Efficient Driving

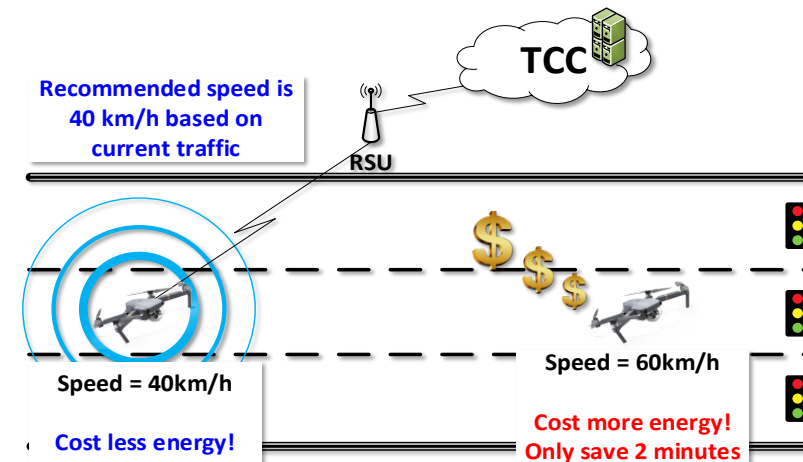
V2I Use Cases



Efficient Navigation for Road Networks

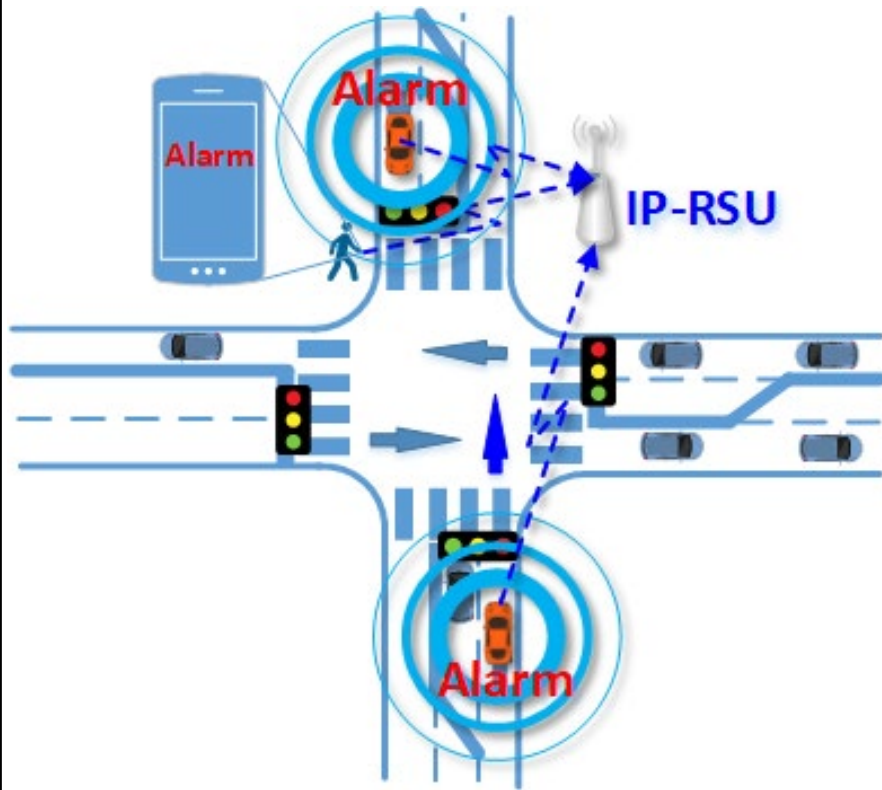


Effective Navigation for Emergency

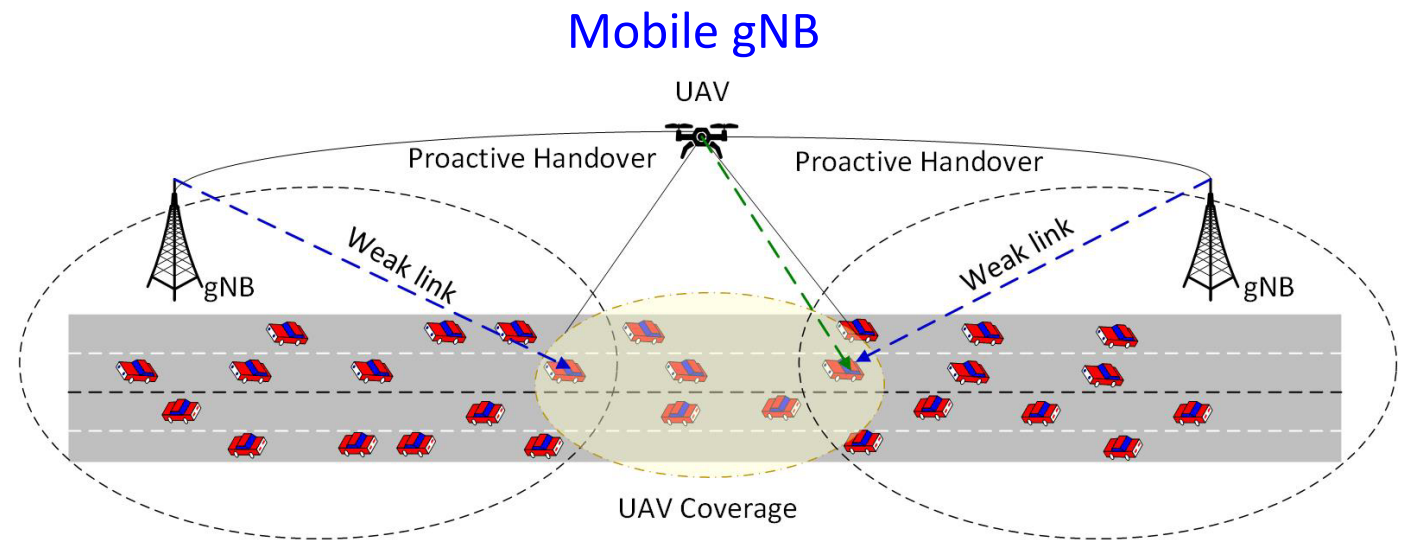


Speed Recommendation for Energy Efficiency 11

V2X Use Cases



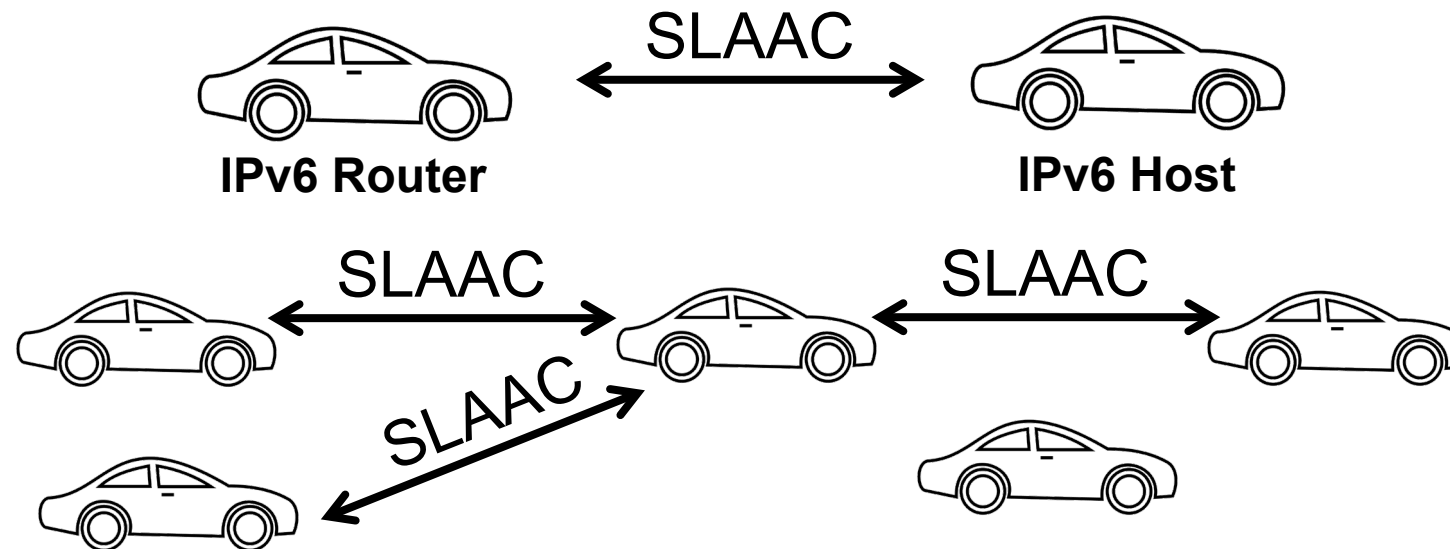
Pedestrian Protection



Blind Spot Coverage in Road Networks with Drones

Observation 1

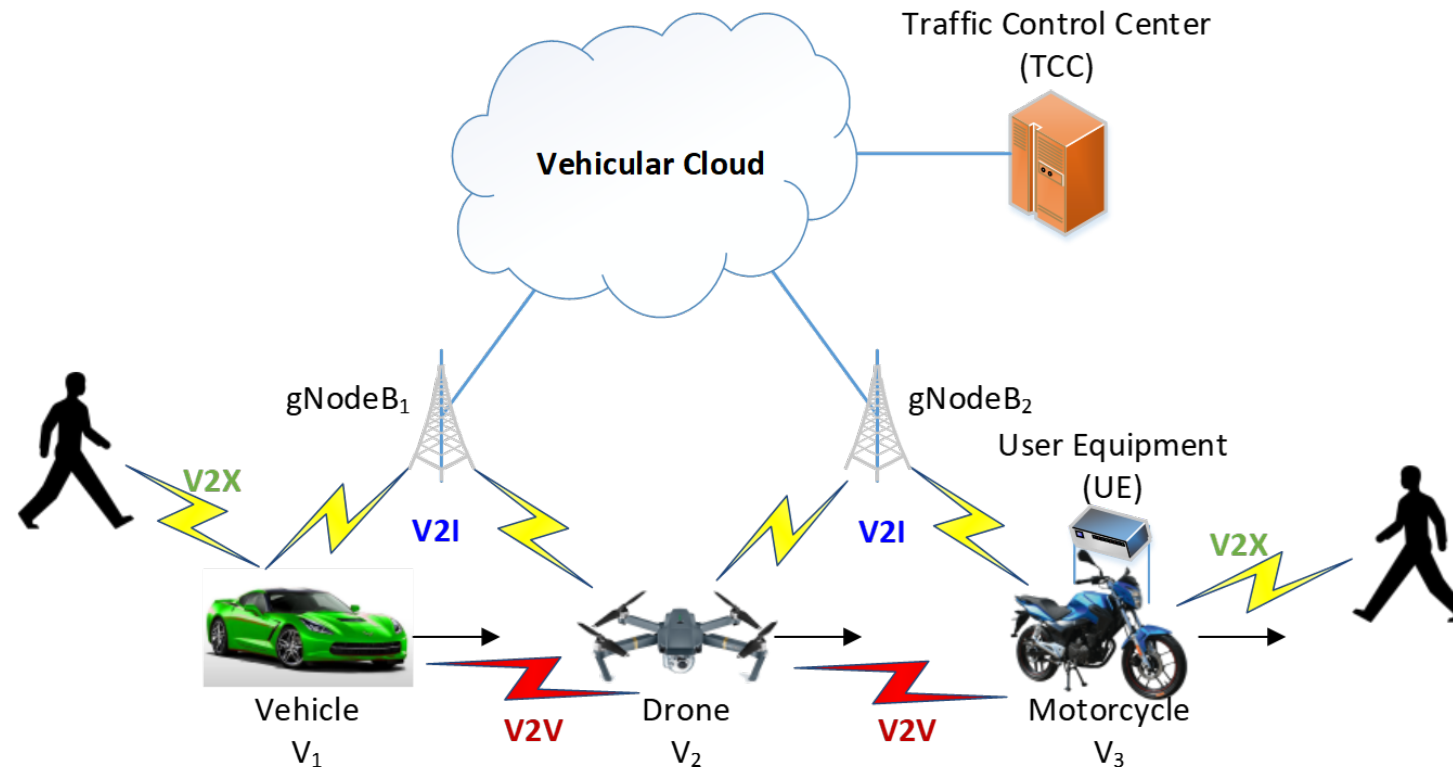
- For 5G V2V by PC5 in **unicast mode**, one vehicle UE (**VehUE**) needs to be an **IPv6 router** for **SLAAC**.



- ✓ Which one shall be the IPv6 router for SLAAC?
- ✓ How many IPv6 addresses/prefixes will a vehicle have in this case?

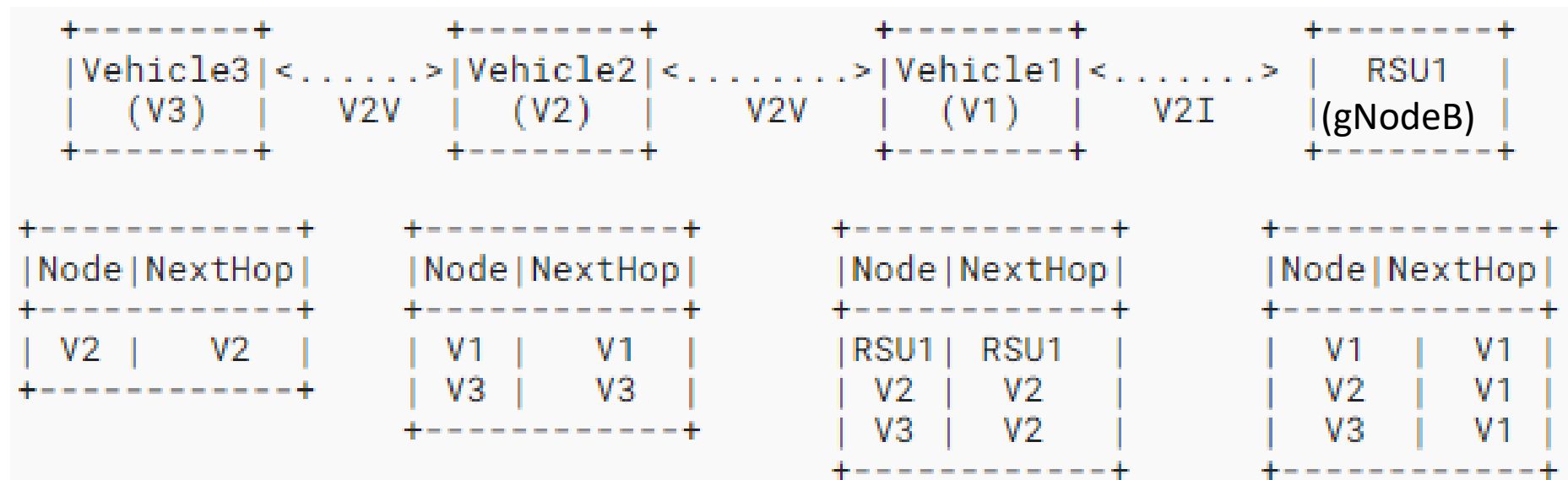
Observation 2

- For V2V and V2I communications in general, will they use the same IPv6 configuration?
 - Using the same prefix?
 - Using the different prefixes?



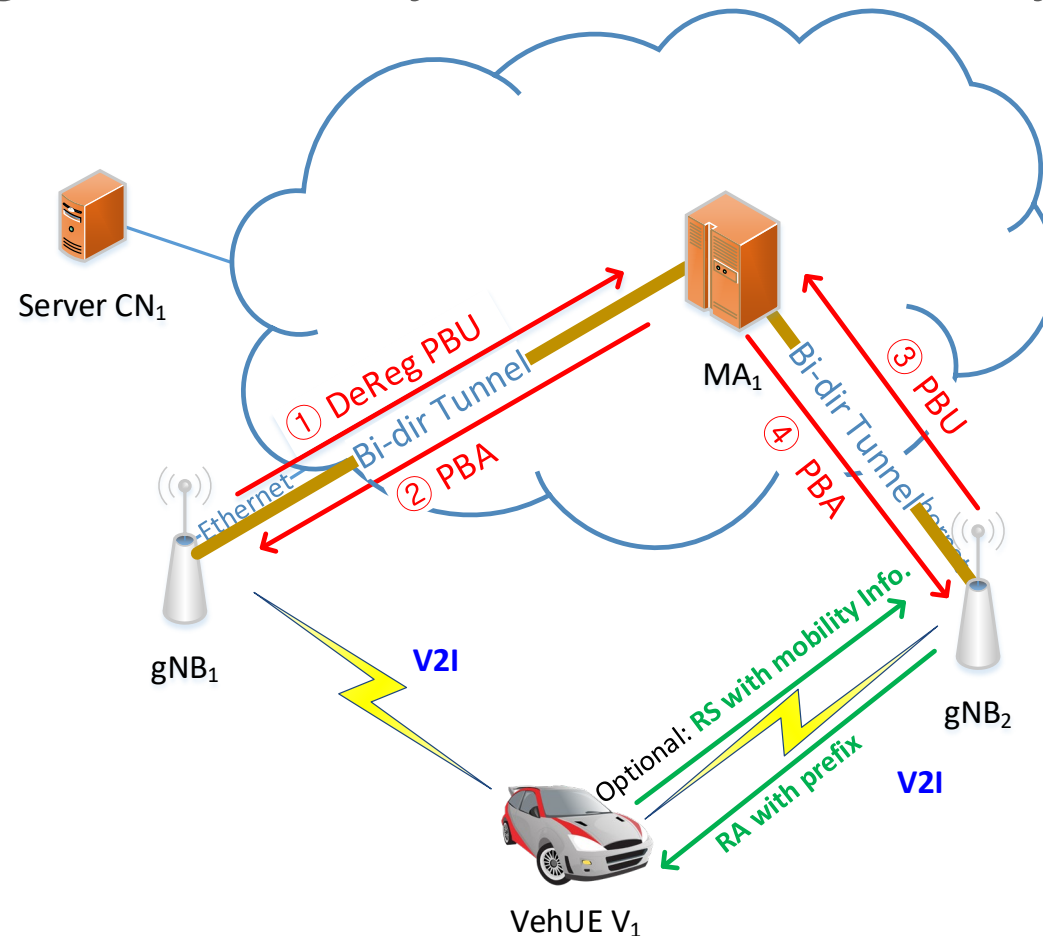
Observation 3

- For multihop V2V and V2I, existing routing protocols are costly to maintain routing table.
 - How to minimize control traffic overhead for both routing and IPv6 ND?



Observation 4

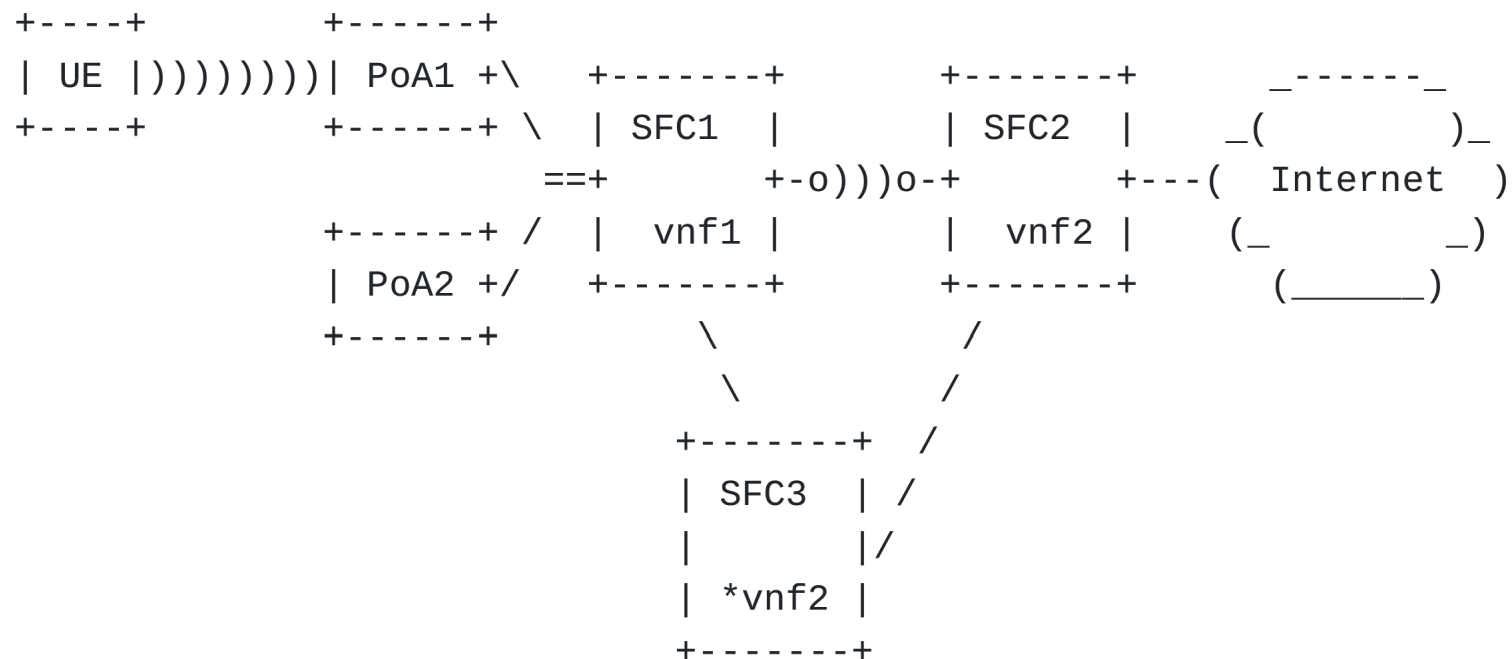
- Mobility Management in 5G V2X is required for the communications between a VehUE and a Server in Internet.
 - How to manage IPv6 mobility of vehicles while they move in roadway?



Observation 5

• Handling of Virtual Mobile Objects

- How can a VehUE get Virtual Objects such as Virtual Network Function (VNF) and Cloud-Native Network Function (CNF) as its computing companion?
- How can mobility management handle the migration of Virtual Objects such as VNF and CNF?

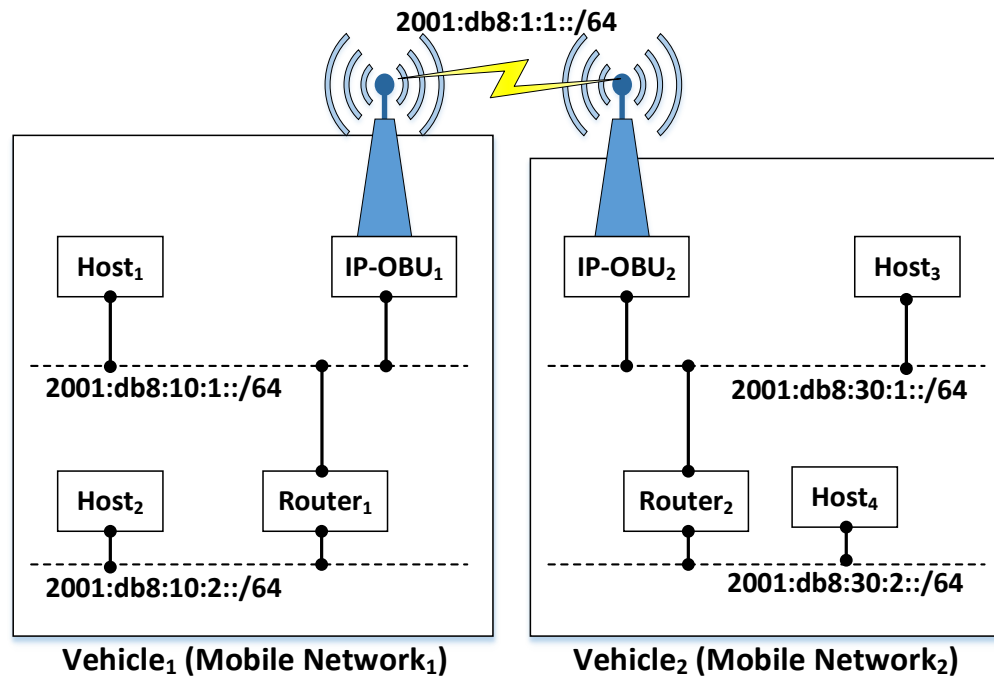


Mobility Scenarios in an Virtualized SFC-enabled Environment

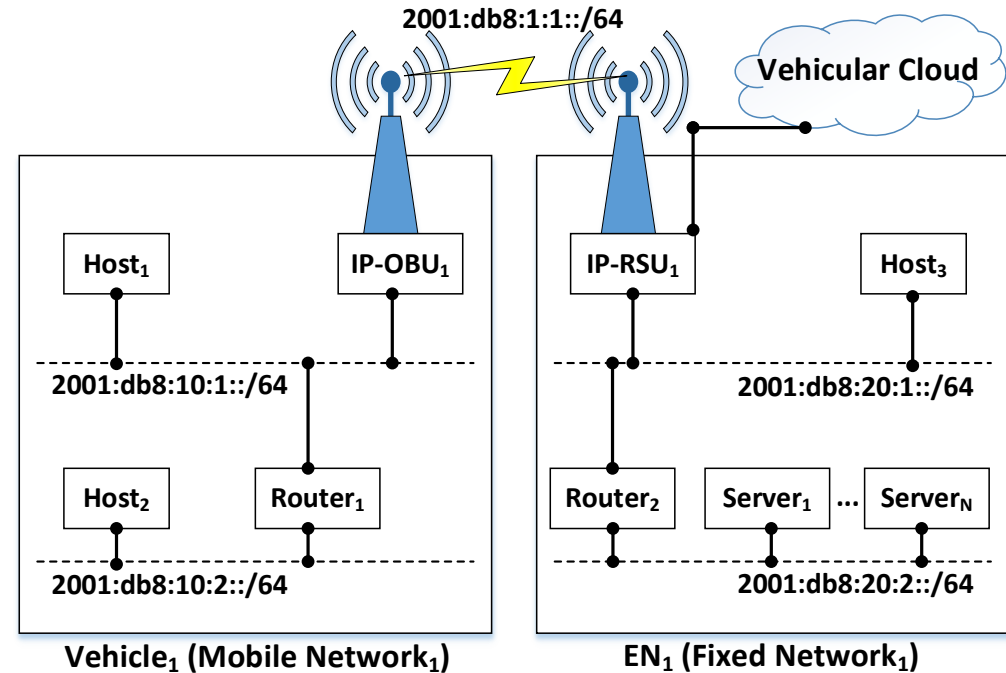
[Source] <https://datatracker.ietf.org/doc/html/draft-bernardos-dmm-mobility-virtualization-02>

Observation 6

- **Vehicle and Edge Network can have internal networks.**
 - How to allocate IPv6 prefix to the internal networks?
 - How to configure and monitor the devices in the internet networks?

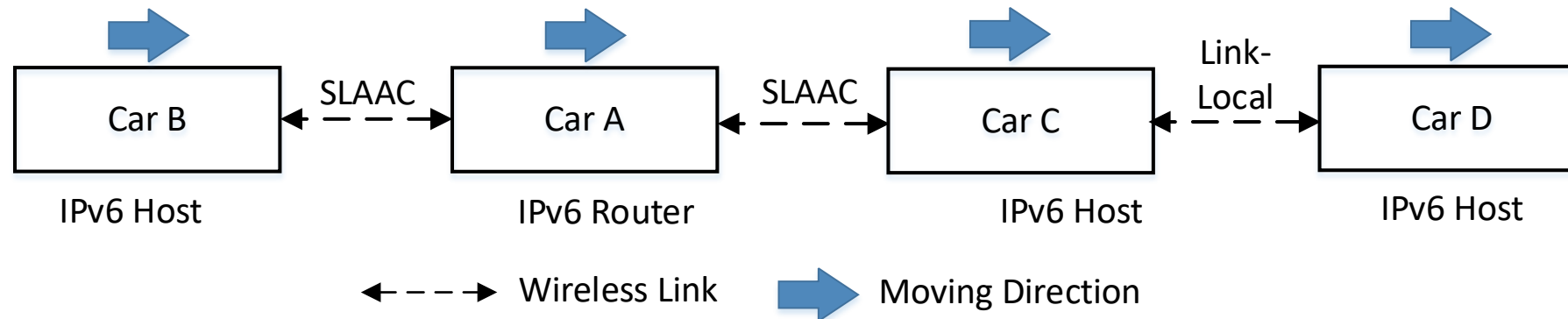


Mobile Network in VehUE



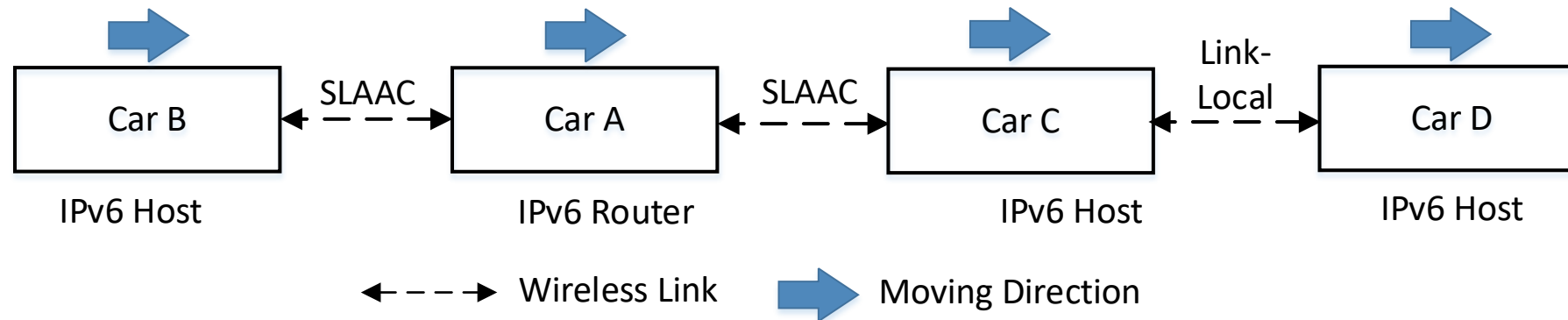
Fixed Network in Edge Network (EN)

Problem Statement (1/3)



- **Which VehUE shall be the IPv6 router for the role to assign IPv6 addresses/prefixes if multiple VehUEs can be or want to be an IPv6 router?**
 - Default VehUE Selection Scheme
- **For a VehUE acting as an IPv6 router, how many IPv6 addresses/prefixes will it assign?**
 - IPv6 Prefix Management by IPv6 Router VehUE
- **For a VehUE receiving IPv6 addresses/prefixes from an IPv6 router VehUE, how many IPv6 addresses/prefixes will it have on the movement?**
 - IPv6 Prefix Handling by IPv6 Host VehUE

Problem Statement (2/3)



- **How much will the role of an IPv6 router burden the IPv6 router VehUE?**
 - Rotation Method of IPv6 Router VehUE
- **How will multihop IPv6 routing be performed among VehUEs in VANET that can be connected to Infrastructure Networks such as Radio Access Network (RAN)?**
 - Routing Optimization Scheme

Problem Statement (3/3)

- **How can a VehUE get Virtual Objects such as Virtual Network Function (VNF) and Cloud-Native Network Function (CNF) as its computing companion?**
 - Virtual Object Selection Scheme
- **How can mobility management handle the migration of Virtual Objects such as VNF and CNF?**
 - Virtual Object Migration Scheme
- **For internal networks of vehicle and EN, how to allocate IPv6 prefix to the internal networks?**
 - Prefix Delegation Interface
- **How to configure and monitor the devices in the internet networks?**
 - Device Monitoring Interface

Next Steps

- We will enhance this draft before IETF 119.
- We will ask for a non-WG-forming BoF for IPMON.
- We will prepare for an IPMON hackathon project for parts of our problem statement in IETF 119.
- We welcome your comments and feedback 😊