



# Cellular V2X Discussion

---

Jim Misener, Senior Director, Technical Standards

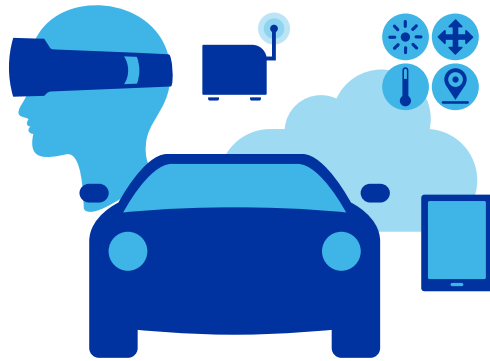
Qualcomm Technologies, Inc

[jmisener@qti.qualcomm.com](mailto:jmisener@qti.qualcomm.com)

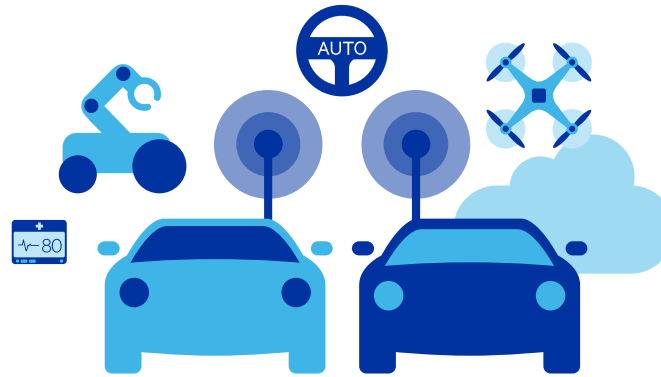


# 5G is important for the automotive vision

Providing a unifying connectivity fabric for the autonomous vehicle of the future



Enhanced mobile  
broadband



Mission-critical  
services



Massive Internet  
of Things

Unifying connectivity platform for future innovation

Starting today with Gigabit LTE, C-V2X Rel-14, and massive IoT deeper coverage

# 5G will bring new capabilities for autonomous vehicles

---

While maintaining backward compatibility





# 5G unified connectivity

Intelligently connecting  
the car to cloud and  
surroundings





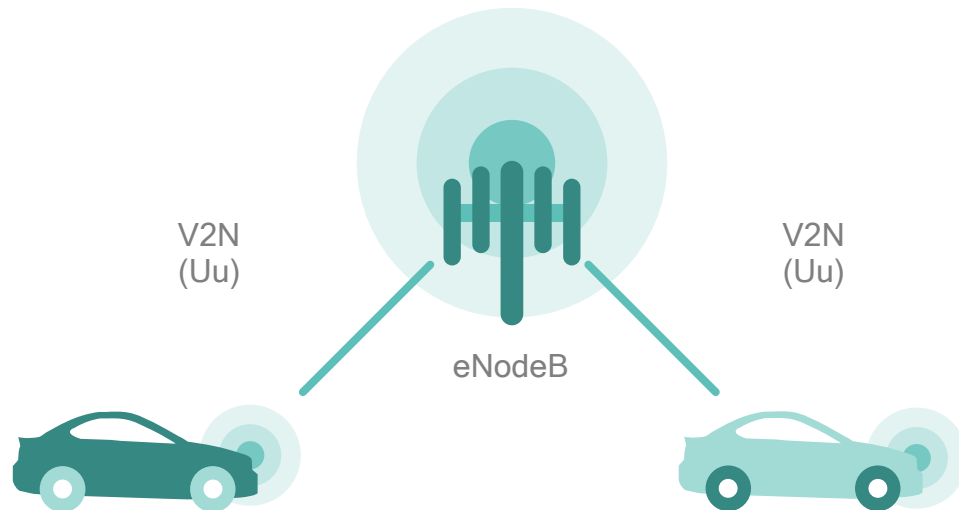
# C-V2X defines two complementary transmission modes

## Network communications

V2N on “Uu” interface operates in traditional mobile broadband licensed spectrum

### Uu interface

e.g. accident 2 kilometer ahead

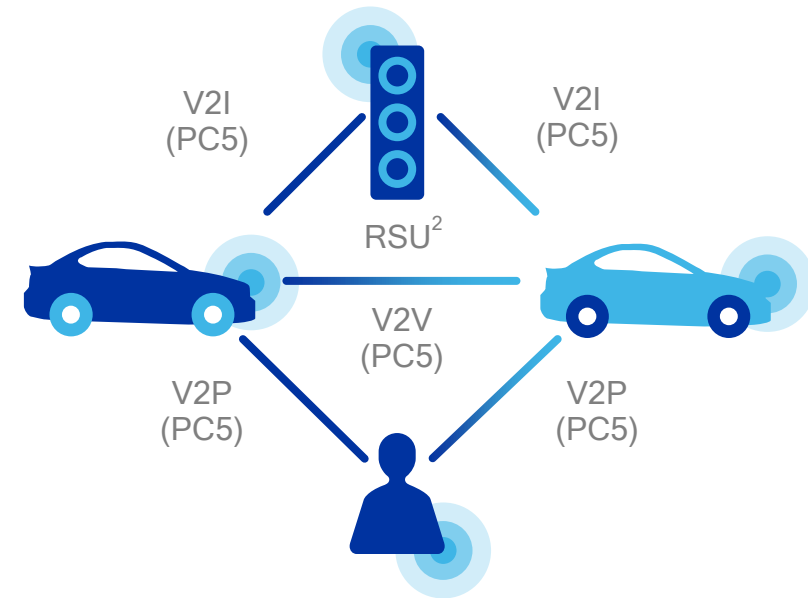


## Direct communications

V2V, V2I, and V2P on “PC5” interface<sup>1</sup>, operating in ITS bands (e.g. ITS 5.9 GHz) independent of cellular network

### PC5 interface

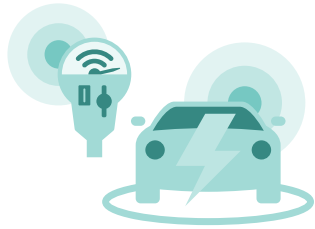
e.g. location, speed



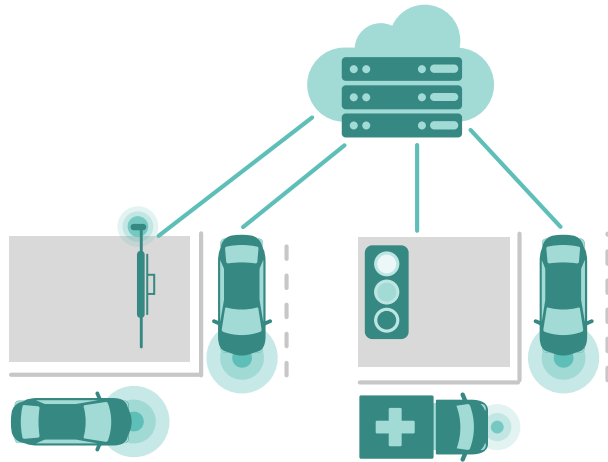
1. PC5 operates on 5.9GHz; whereas, Uu operates on commercial cellular licensed spectrum 2. RSU stands for roadside unit.

# Network communications for latency tolerant use cases

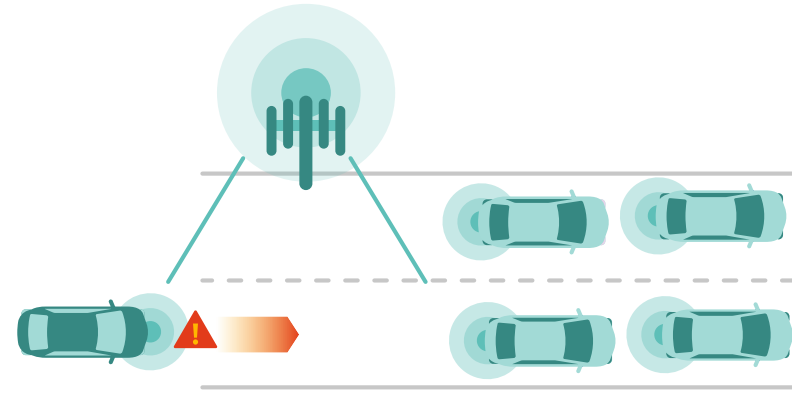
Suitable for telematics, infotainment and informational safety use case



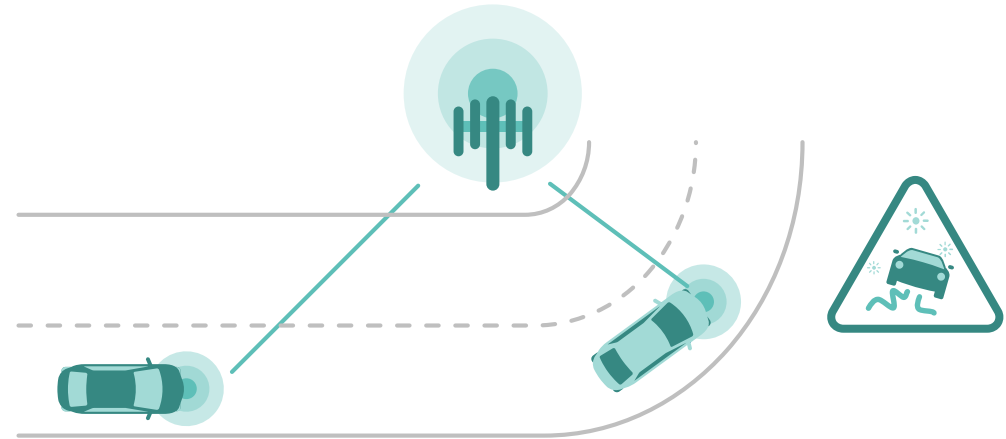
Discover **parking**  
and charging



Cloud-based sensor sharing

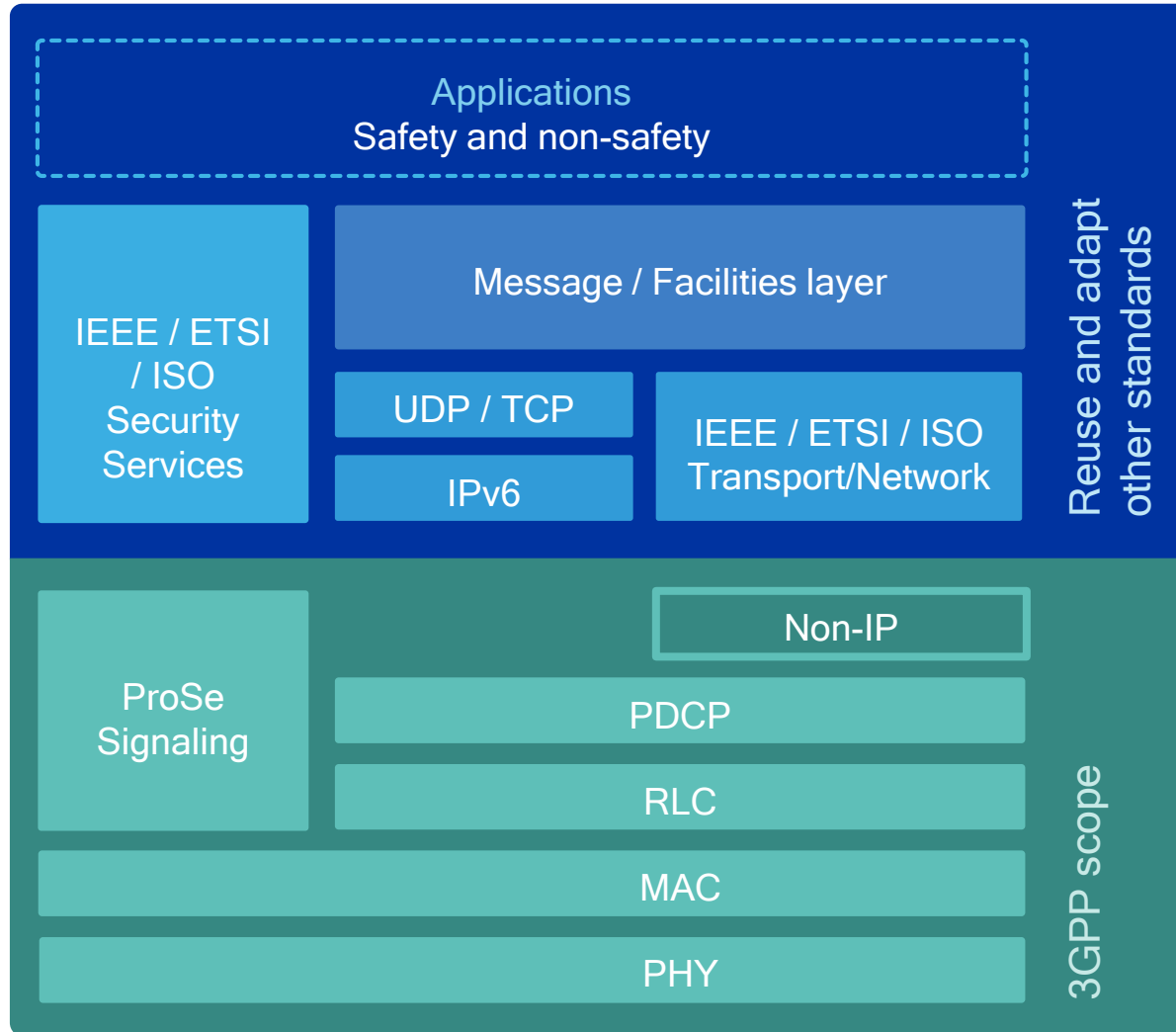


**Traffic flow control/**  
Queue warning



Road hazard warning 1 km ahead

# C-V2X reuses upper layers defined by transportation stakeholders



## Reuse established service and app layers

- Already defined by automotive and standards communities, e.g. ETSI, SAE
- Developing abstraction layer to interface with 3GPP lower layers

## Reuse existing security and transport layers

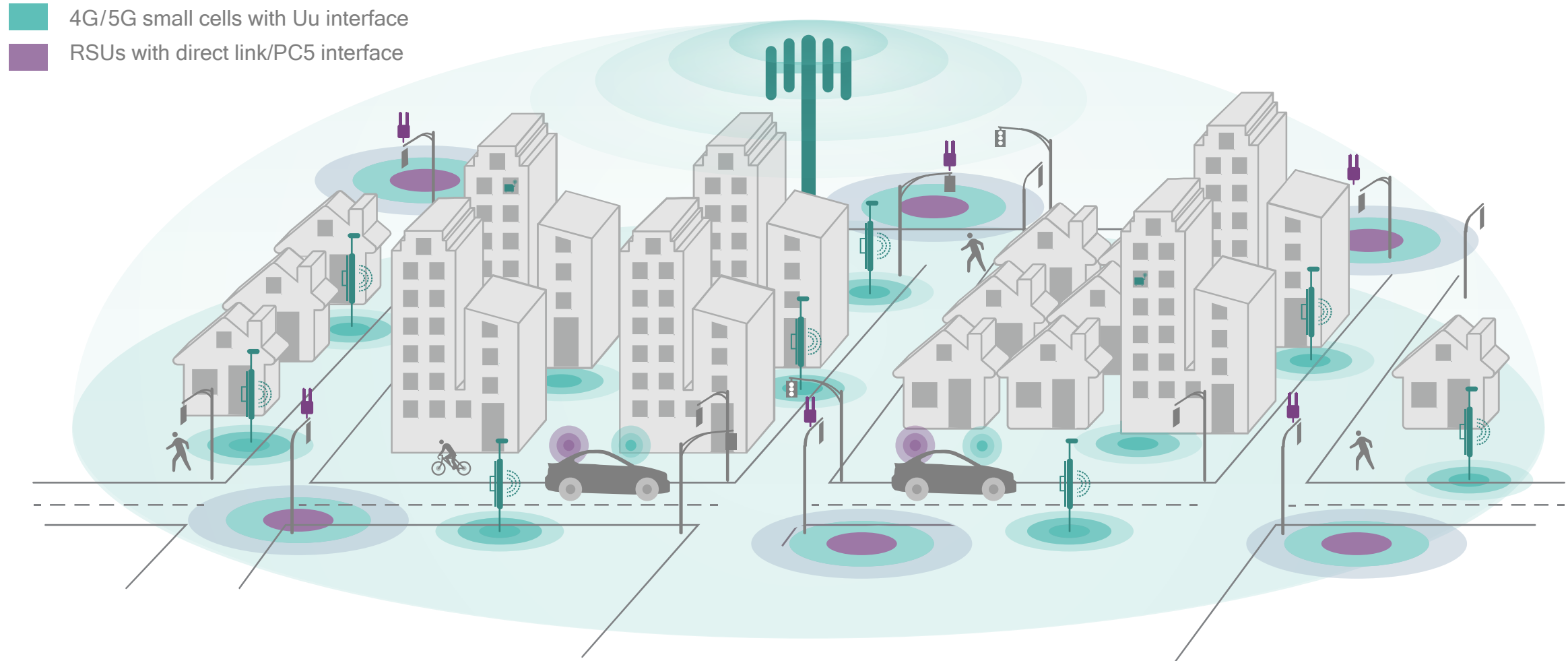
- Defined by ISO, ETSI, and IEEE 1609 family

## Continuous enhancements to the radio/lower layers

- Supports the ever-evolving V2X use cases

# C-V2X reduces cost of infrastructure deployment

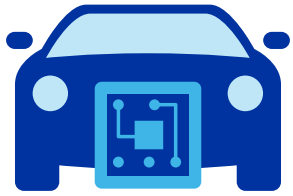
Combined RSUs and 4G/5G small cell, benefiting from cellular network densification





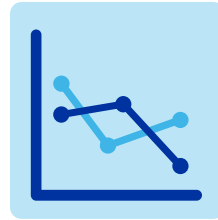
# C-V2X offers new business models and economic benefits

Leveraging existing, ubiquitous cellular networks and mobile ecosystem support



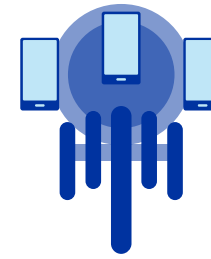
## More integrated solution

C-V2X functionality can be integrated in vehicle's modem to enable most optimal platform



## Reduced deployment cost

Combined RSU and eNodeB infrastructure synergies provide economic benefits



## Mobile ecosystem expertise

Benefits from cellular player's extensive experience in deploying, managing, and maintaining complex communication systems



## New services and business opportunities

Leverages unified C-V2X / telematics offerings and addresses new services for shared mobility and autonomous driving

## Offering new business models and enhancing most use cases

App Server  
e.g. traffic management

V2N (Uu)

V2I (PC5)

V2V (PC5)

V2P (PC5)

---

Uu Interface

PC5 Interface

## V2V mostly for safety and ADAS services

# Thank you

---

Follow us on:   

For more information, visit us at:

[www.qualcomm.com](http://www.qualcomm.com) & [www.qualcomm.com/blog](http://www.qualcomm.com/blog)



Nothing in these materials is an offer to sell any of the components or devices referenced herein.

©2017 Qualcomm Technologies, Inc. and/or its affiliated companies. All Rights Reserved.

Qualcomm is a trademark of Qualcomm Incorporated, registered in the United States and other countries. Other products and brand names may be trademarks or registered trademarks of their respective owners.

References in this presentation to “Qualcomm” may mean Qualcomm Incorporated, Qualcomm Technologies, Inc., and/or other subsidiaries or business units within the Qualcomm corporate structure, as applicable. Qualcomm Incorporated includes Qualcomm’s licensing business, QTL, and the vast majority of its patent portfolio. Qualcomm Technologies, Inc., a wholly-owned subsidiary of Qualcomm Incorporated, operates, along with its subsidiaries, substantially all of Qualcomm’s engineering, research and development functions, and substantially all of its product and services businesses, including its semiconductor business, QCT.