

March 8, 2018

Geneva, Switzerland

Qualcomm

# Future Networked Car Symposium @ Geneva Auto Show 2018

*Accelerating 5G for autonomous driving*

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# All major automakers use Qualcomm Technologies

- Acura • Audi • BMW • Buick • BYD
- Cadillac • Chevrolet • Dodge • FCA
- Ford • Geely • Honda • Hyundai • Infiniti
- Jaguar • Jeep • Kia • Land Rover
- Lexus • Lincoln • Mercedes • Mini
- Nissan • Opel • Porsche • PSA
- Renault • Rolls-Royce • Smart
- Subaru • Toyota • Tesla • Volvo • VW

# 25

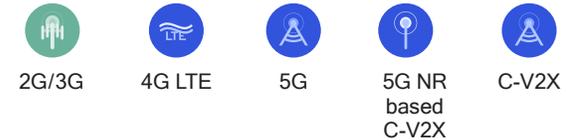
New Infotainment and Telematics design-wins in FY2017

# \$3B+

Design-win pipeline

# Qualcomm

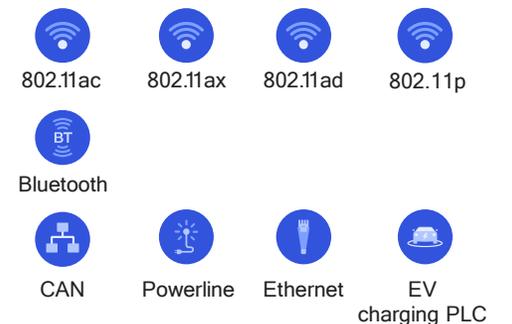
## Telematics / V2X



## Location



## Connectivity





# Superior in-car Infotainment experience

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## 12+ automakers

Have selected Snapdragon Automotive for infotainment

## Billion-dollar+ design pipeline<sup>1</sup>

Focused on premium tier

## Leading in premium

Next-gen premium infotainment design-wins<sup>2</sup>

# C-V2X complements other ADAS<sup>1</sup> sensor technologies

Provides 360° NLOS<sup>2</sup> sensing for higher levels of predictability and autonomy

## ADAS



Radar



Camera



Lidar



Ultrasonic



V2X wireless sensor



3D HD maps



Precise positioning

Brain of the car to help automate the driving process by using:

Sensor fusion | Machine learning

# C-V2X

Intelligently connecting  
the car to surroundings  
and cloud



## V2V

Vehicle-to-vehicle

e.g. collision avoidance safety systems



## V2P

Vehicle-to-pedestrian

e.g. safety alerts to pedestrians, bicyclists



## V2N

Vehicle-to-network

e.g. real-time traffic / routing, cloud services



## V2I

Vehicle-to-infrastructure

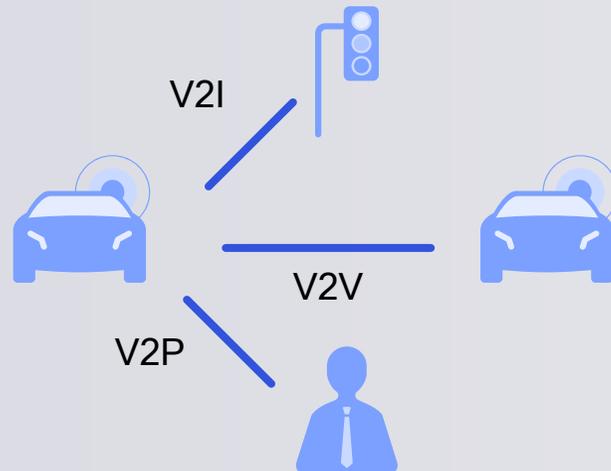
e.g. traffic signal timing/priority

Commercial vehicle deployments coming soon...

# C-V2X defines two complementary transmission modes

## Direct communications (PC5)

V2V, V2I, and V2P operating in harmonized 5.9 GHz ITS bands independent of cellular network or cellular subscription

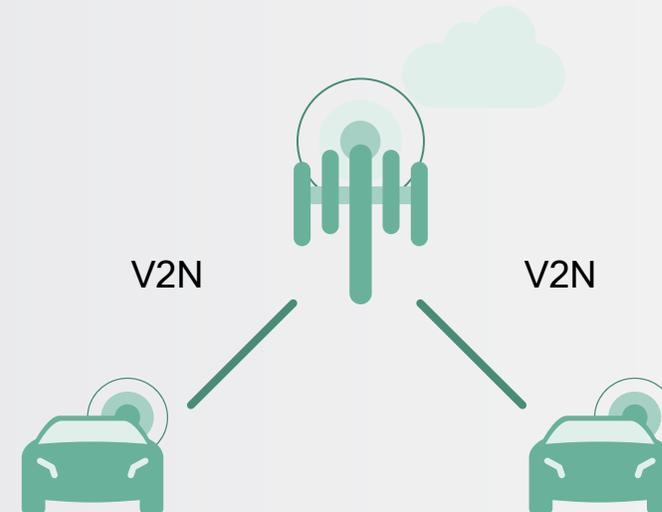


### Active safety

Latency-sensitive use cases, e.g. collision avoidance

## Network communications (Uu)

V2N operating in traditional mobile broadband licensed spectrum



### Informational safety

More latency tolerant use cases, e.g. *accident 2 kilometers ahead*

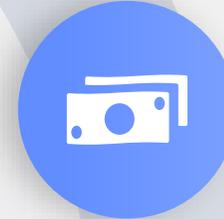
# C-V2X direct communications offers key advantages



Enhanced range and reliability



Up to 500km/h relative speed support



More cost efficient than other technologies



Forward compatible evolution path to 5G

Synergistic with cellular modem already being embedded

Leverages cellular ecosystem

Reuse of SAE / ETSI upper layers

Qualcomm

9150  
C-V2X  
Chipset

# Qualcomm® 9150 C-V2X Chipset

The Qualcomm® 9150 C-V2X chipset with integrated GNSS will be featured as a part of the Qualcomm® C-V2X Reference Design to deliver a complete solution for trials and commercial development

Anticipated Commercial Availability: 2H18

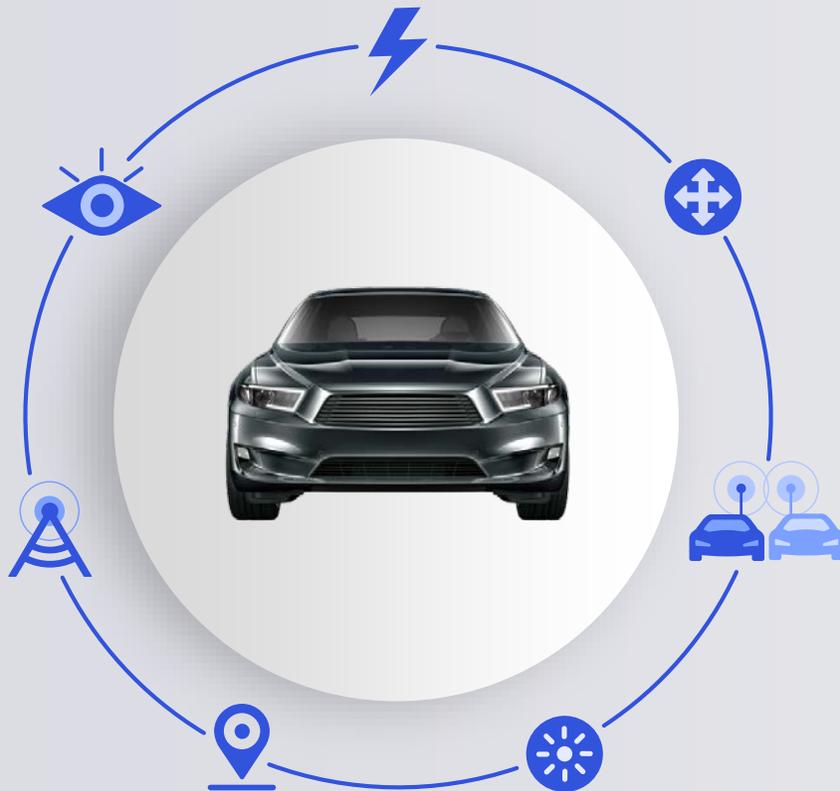


## Driving C-V2X towards commercialization

Qualcomm Technologies, Inc.'s (QTI) first-announced C-V2X solution supports C-V2X PC5 Direct Communications (V2V, V2I and V2P) based on 3GPP Release-14

# C-V2X direct communications is being validated globally

Many trials started in 2017, based upon 3GPP R14



C-V2X specifications completed in 2017

## Example of global trials

### ConVeX trial in Germany

Qualcomm, Audi, Ericsson, SWARCO, U. of Kaiserslautern

### Towards 5G trial in France

Qualcomm, PSA Group, Orange, Ericsson

### Ford trials in US

Qualcomm, AT&T, Ford, Nokia and McCain with SANDAG, Caltrans and the City of Chula Vista

### Nissan trials in Japan

Qualcomm, Continental, Ericsson, Nissan, NTT DOCOMO, INC., OKI

Other trials announced, and some still unannounced in China, Korea, elsewhere

# Ecosystem preparing for commercialization<sup>1</sup> of 9150 C-V2X chipset



Tier-1 suppliers



Valeo



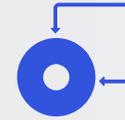
Cellular module manufacturers



Quectel



ZTE



ITS software solution providers



System integrators & test



<sup>1</sup> - February 22, 2018 Qualcomm Press Release: <https://www.prnewswire.com/news-releases/qualcomm-and-leading-automotive-companies-across-the-globe-drive-the-commercialization-of-c-v2x-300602527.html>

Some Supporting Automakers



BMW



Nissan



# C-V2X has a strong evolution path towards 5G NR

While maintaining backward compatibility

Evolution to 5G NR, while being backward compatible C-V2X R14/R15 is necessary and operates with R16

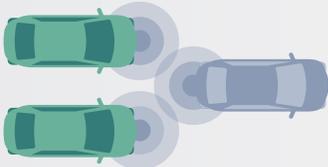
**Basic and enhanced safety**  
C-V2X R14/R15 with enhanced range and reliability

**Basic safety**  
IEEE 802.11p



**Autonomous driving use cases**  
5G NR based C-V2X R16

- Backward compatible with R14/R15 enabled vehicles
- Higher throughput
- Higher reliability
- Wideband ranging/positioning
- Lower latency





# Thank you!

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