Cellular-Vehicle-to-Everything (C-V2X): today and next steps

Maxime Flament, 5GAA Chief Technology Officer
Connected mobility for people, vehicles and transport infrastructure

5GAA bridges the automotive and telecommunication industries in order to address society’s connected mobility and road safety needs

**AUTOMOTIVE INDUSTRY**
Vehicle Platform, Hardware and Software Solutions

**TELECOMMUNICATIONS**
Connectivity and Networking Systems, Devices and Technologies

5GAA unites today 133 members from around the world working together on all aspects of C-V2X including technology, standards, spectrum, policy, regulations, testing, security, business models and go-to-market
**5GAA Priority Areas**

**Trust**
Implement state-of-the-art **security and privacy** by design in the V2X ecosystem.

**Mobile Networks**
Build upon **cellular network deployments** to fast track new mobility services.

**Flexible Service Architectures**
Leverage **distributed cloud and edge computing** capabilities.

**Interoperable, deployable & secure**

**Connectivity**
Connected mobility for people, vehicles and transport infrastructure

**End-to-end connectivity solutions**

**Interoperable Ecosystem**
Satisfy **business needs** for interoperation between devices and services across ecosystem partners.

**Precise Positioning**
Foster advanced **positioning solutions** for all road users.

**Vulnerable Road Users**
Enable **smart devices** to deliver services protecting pedestrians, cyclists, …

**Sustained Technology Evolution**
Accelerate evolution of cellular technologies towards 5G V2X.
What is C-V2X (Cellular-Vehicle to Everything)?

A comprehensive road safety and traffic efficiency solution that allows vehicles to communicate with:

- Other vehicles (V2V)
- Cyclists via smartphones (V2P)
- Pedestrians via smartphones (V2P)
- Mobile networks (V2N)
- Road Infrastructure (V2I)
Cellular Vehicles
Everything
C-V2X has two complementary communication modes

**Direct short-range (= Sidelink)**

V2V, V2I, and V2P operating in ITS bands (e.g. ITS 5.9 GHz) independent of cellular network

- **Short range** (<1 kilometer), location, speed
- Implemented over “**PC5 interface**”

**Network (= Up/Downlink)**

V2N operates in traditional mobile broadband licensed spectrum

- **Long range** (>1 kilometers), e.g. accident ahead
- Implemented over “**Uu interface**”
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It’s ONE cellular technology based on 3GPP

→ fully integrated chipset solution
→ single radio solution
→ one antenna system
→ reduced complexity and cost (on-board & infrastructure)

Short range (<1 kilometer), location, speed
Implemented over “PC5 interface”

Long range (>1 kilometers), e.g. accident ahead
Implemented over “Uu interface”
Understanding vehicle safety needs: Inform, Warn, Act

Yesterday, Today and Tomorrow

Collision Avoidance → Risk Mitigation → Risk Avoidance

Act ← Warn ← Inform

On-board Sensors

V2I and V2V

V2N
C-V2X evolution roadmap towards 5G

**Traffic Efficiency**
4G/LTE (network-only)
- Only using mobile networks (V2N)
- +20 million EU connected cars*
  - Local Hazard Warning
  - Traffic Info (in some markets)

**Basic & Enhanced Safety**
LTE-V2X (+ direct short-range)
- Short-range communications (V2V/V2I)
- China first-mover: 13 OEMs (2020/2021)
- US deployment announced 2022 (Ford)
- Audi US initial deployment Q3/2020

**Advanced Driving**
5G-V2X enhancing Advanced Driver-Assistance Systems (ADAS)
- Direct short-range + network communications
- Backward compatible with LTE-V2X
- Ultra-reliable at low latency (<1 millisecond)
- Almost unlimited data exchange

* Services provided depend on the OEM
5G-V2X services combine 3GPP standards: NR-V2X for advanced driving on top of LTE-V2X for basic safety

**Basic Safety use cases**
- LTE-V2X sidelink
- Rel. 14/15
- Basic messages with Broadcast

**Advanced Driving use cases**
- NR-V2X sidelink
- Rel. 16 and beyond
- QoS with Groupcast

Upper layers
Mapping use cases to transport profile

5G-V2X sidelink
C-V2X deployments announced for 2020-2022

13 Chinese Carmakers Jointly Published Commercial Roadmap: Launching Mass Production C-V2X Car from 2020

Source: Huawei

Audi Newsroom

Audi of America, Virginia DOT and Qualcomm Announce Initial C-V2X Deployment in Virginia

Source: Audi USA, 22 Jan 2020

Ford to deploy C-V2X tech in all new vehicles in 2022

Source: Ford Motor Press Release @ CES, Jan 2019

Source: BMW Group Press Release @ CES, Jan 2020
Thank you for joining!

For more information please contact:

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