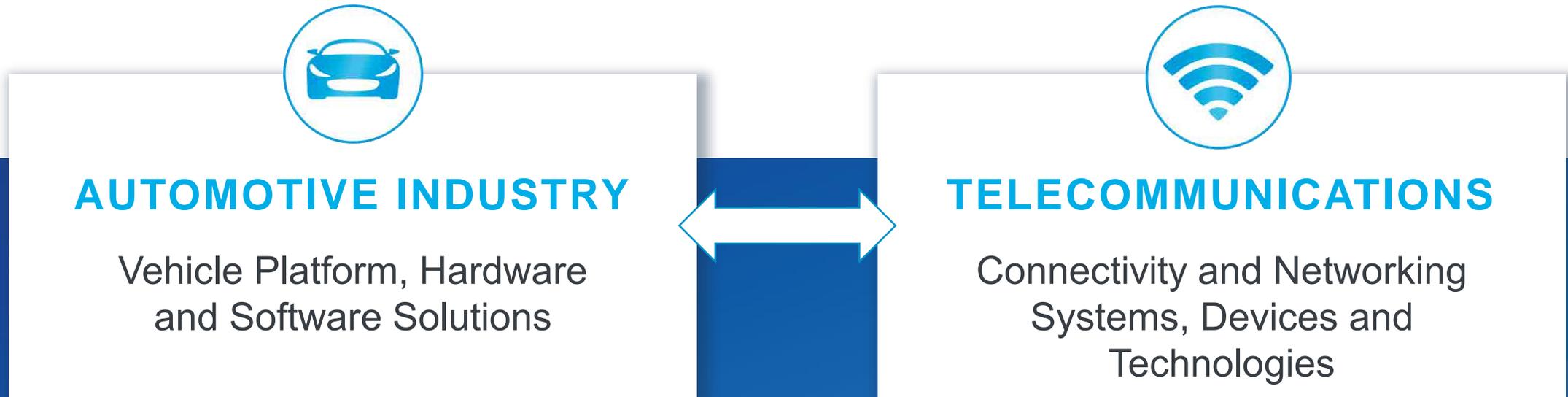




Path towards 5G for Automated Driving

Maxime Flament, CTO
5th SIP-adus conference, Nov 2018

5GAA brings together automotive, technology and telecommunications companies to work closely together to develop end-to-end solutions for future mobility and transportation services



5GAA unites 100+ members* from around the world working together on all aspects of C-V2X including technology, standards, spectrum, policy, regulations, testing, business models and go-to-market





14% of 5GAA members are Japanese-based organizations



EATA

GTI
Global TD-LTE Initiative

CEPT
ECC
Electronic Communications Committee

IMT-2020



5GAA
Automotive Association



ENSEMBLE

5G IA
INFRASTRUCTURE ASSOCIATION

Ecosystem Coopération



VDT
Alliance



Tidaa



Why is 3GPP so important for the Automotive

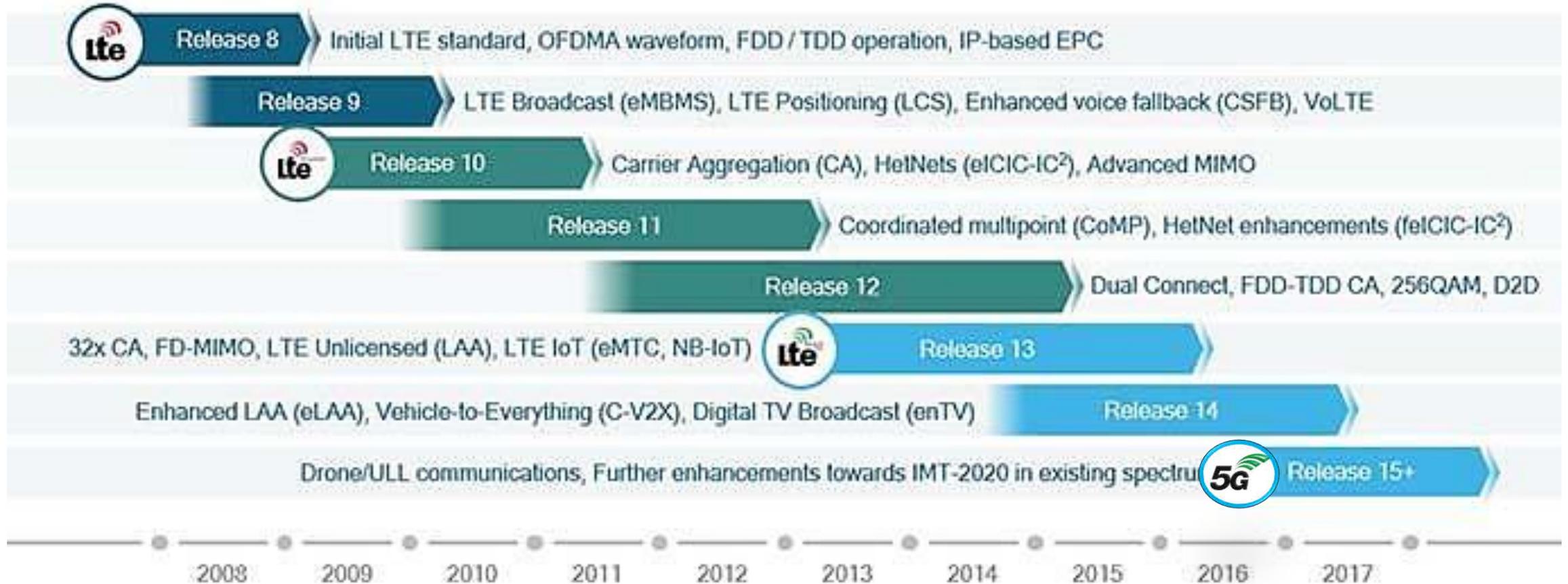
3GPP: A Global Partnership Project



599 member organizations in 41 territories



- A journey towards 5G

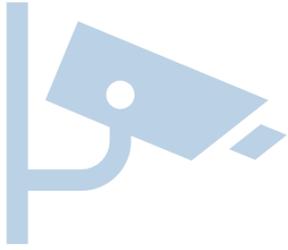


3GPP is steadily building the blocks towards a family of air interfaces embedded in 5G

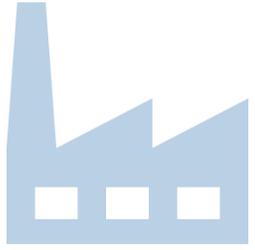
5G Vision: a swiss knife for all industries



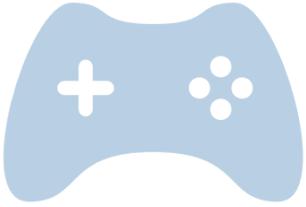
Automotive



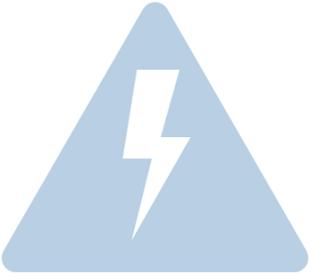
Public safety



Manufacturing



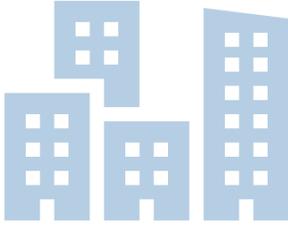
Multimedia & gaming



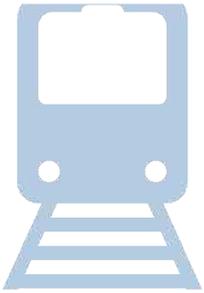
Energy



Health



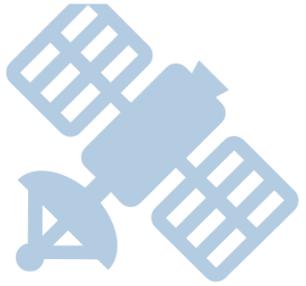
Smart cities



Public Transport

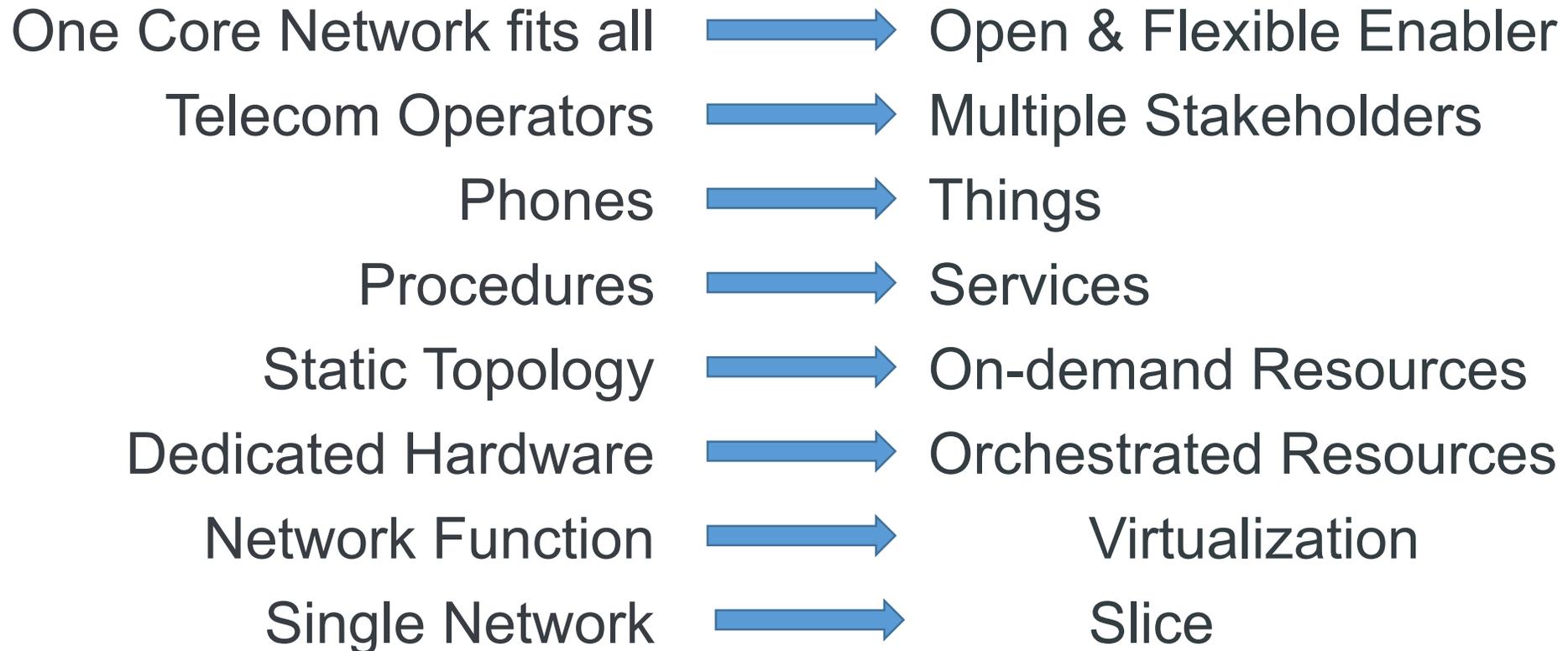


Farming & food

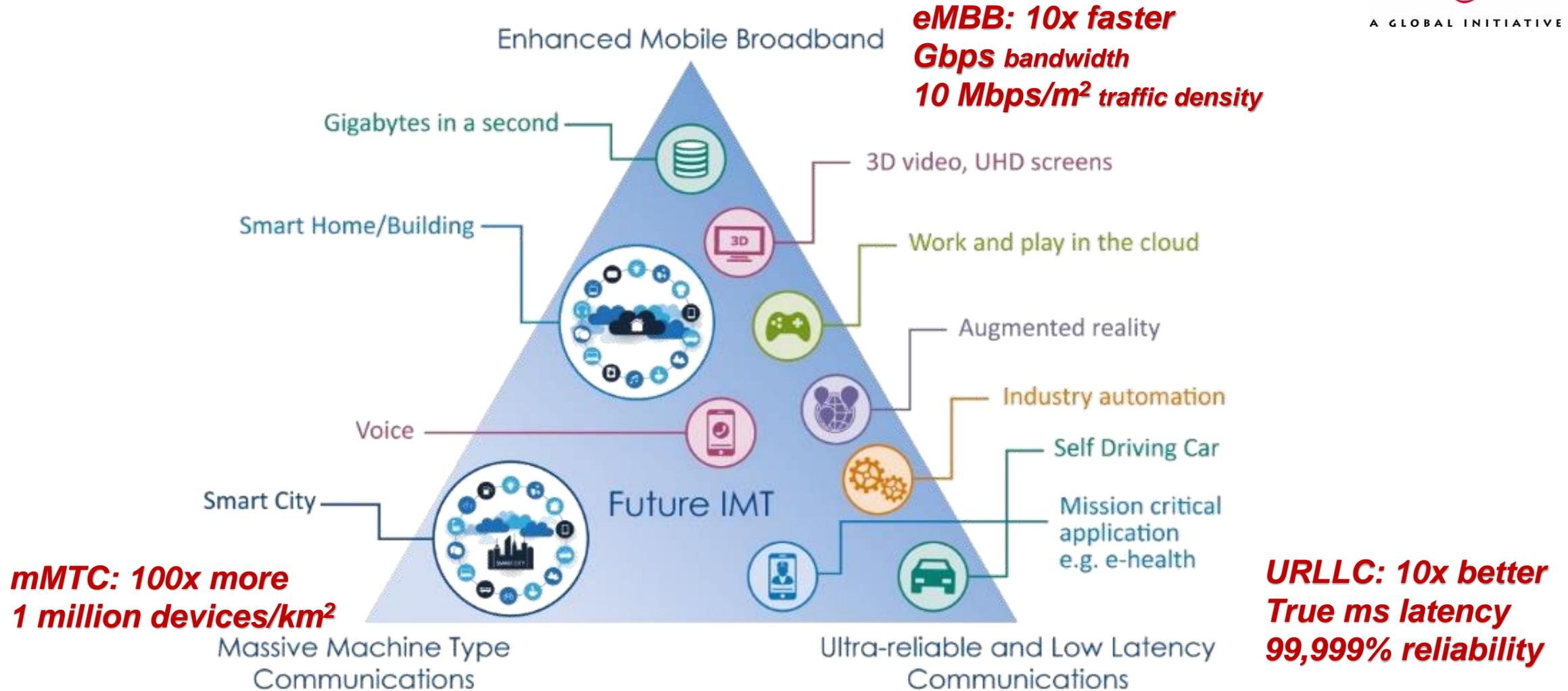


Aerospace

5G Vision: Software & Service Centric Transformation



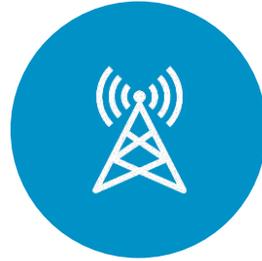
Setting the basis for 5G New Radio (NR) in Rel-



ADAPTED NUMEROLOGIES
AT DIFFERENT FREQUENCIES

NATIVE FORWARD
COMPATIBILITY MECHANISMS

ULTRA WIDE BANDWIDTH



LEVERAGING ON
CUTTING EDGE IMPROVEMENTS



NATIVE SUPPORT FOR
NETWORK SLICING

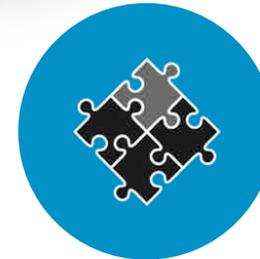
LOW TO VERY HIGH
FREQUENCY BANDS



NEW CHANNEL CODING



NATIVE SUPPORT FOR LOW
LATENCY AND ULTRA RELIABILITY



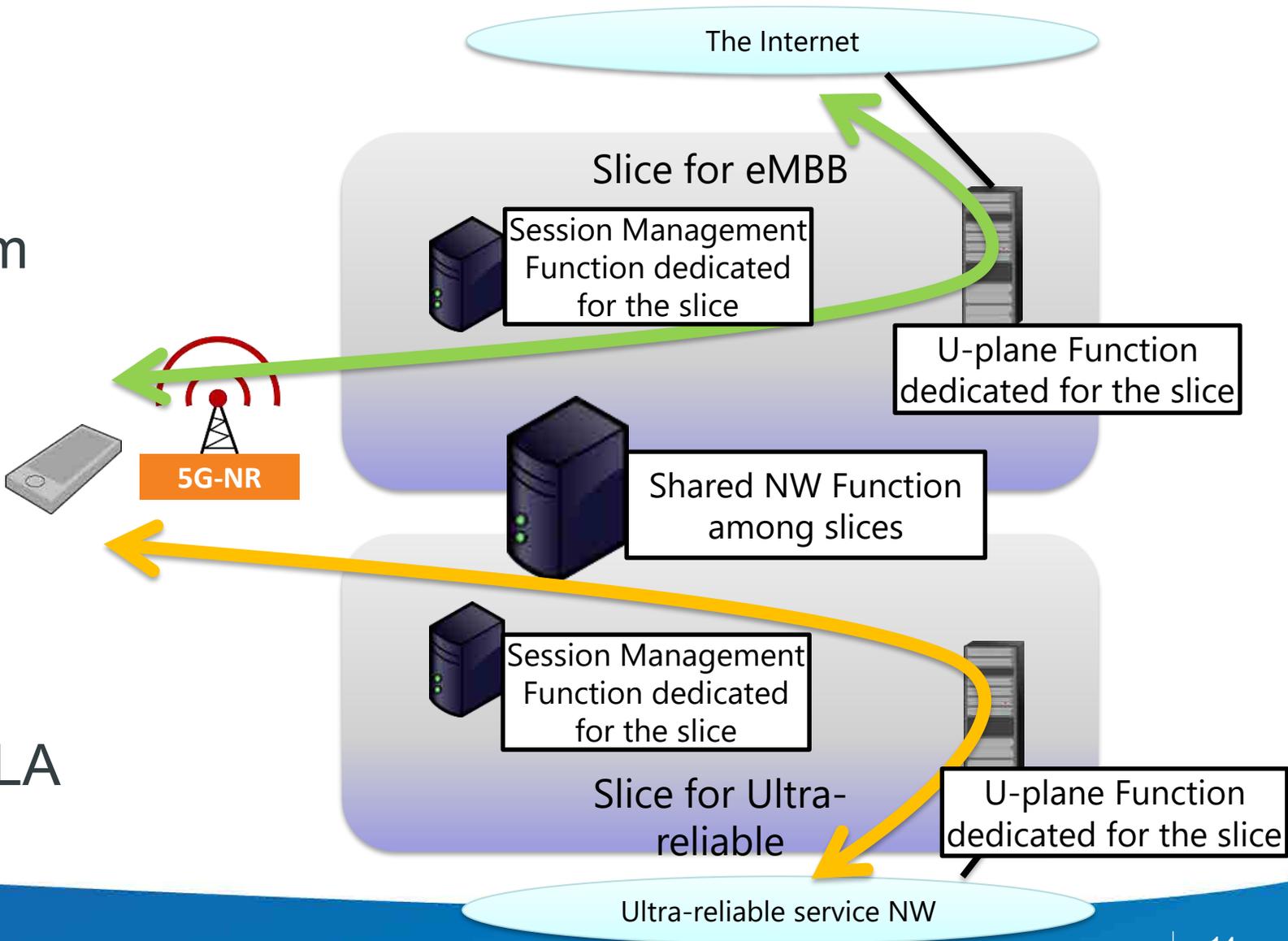
FLEXIBLE AND MODULAR
RAN ARCHITECTURE

Ultra-reliable and Low Latency Communications

Network slicing

Resource isolation from other service
→ No service impact caused by other slices failure

Customized NW functions and/or capacities to ensure SLA

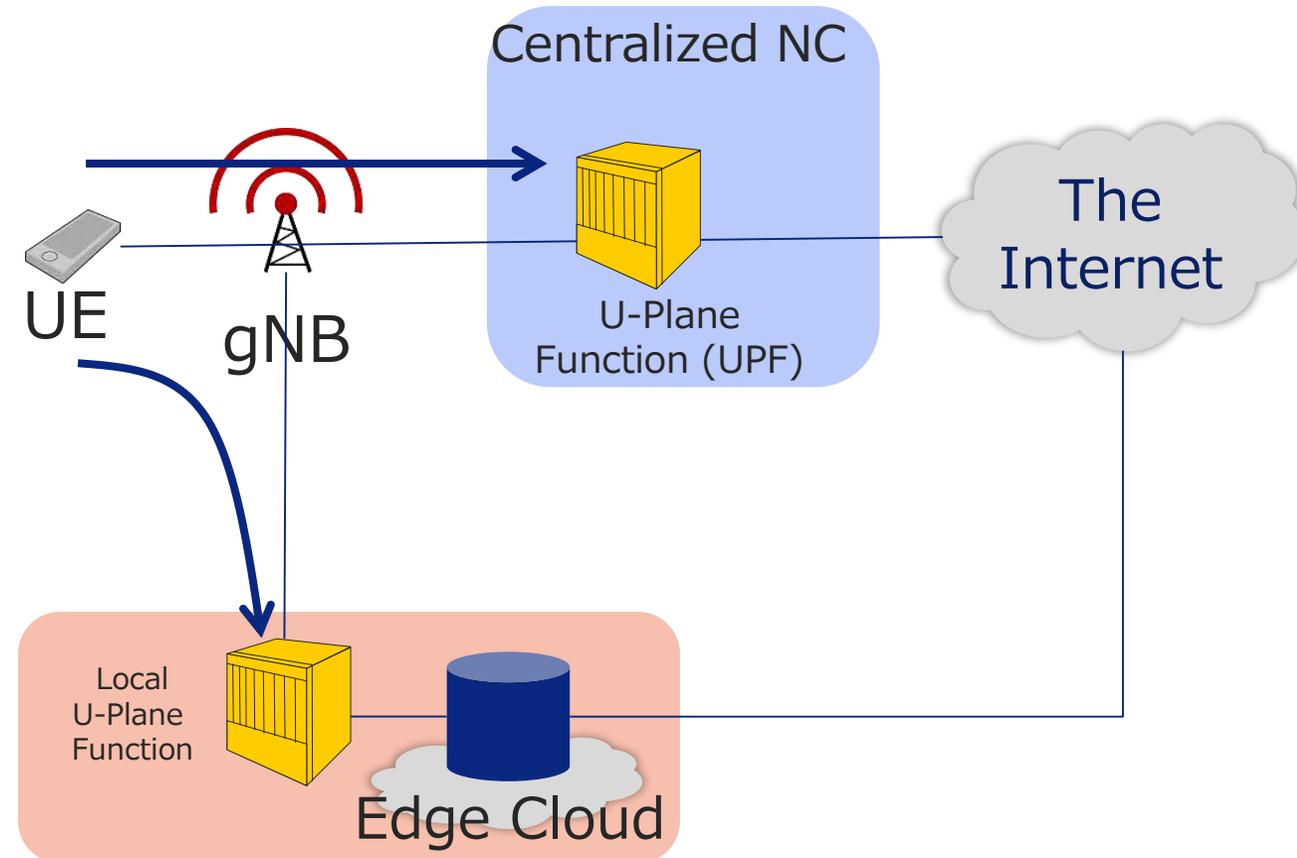


Ultra-reliable and Low Latency Communications

Edge Computing

Applications can be hosted at “Edge-side”

→ Low Latency compared with centralized manner



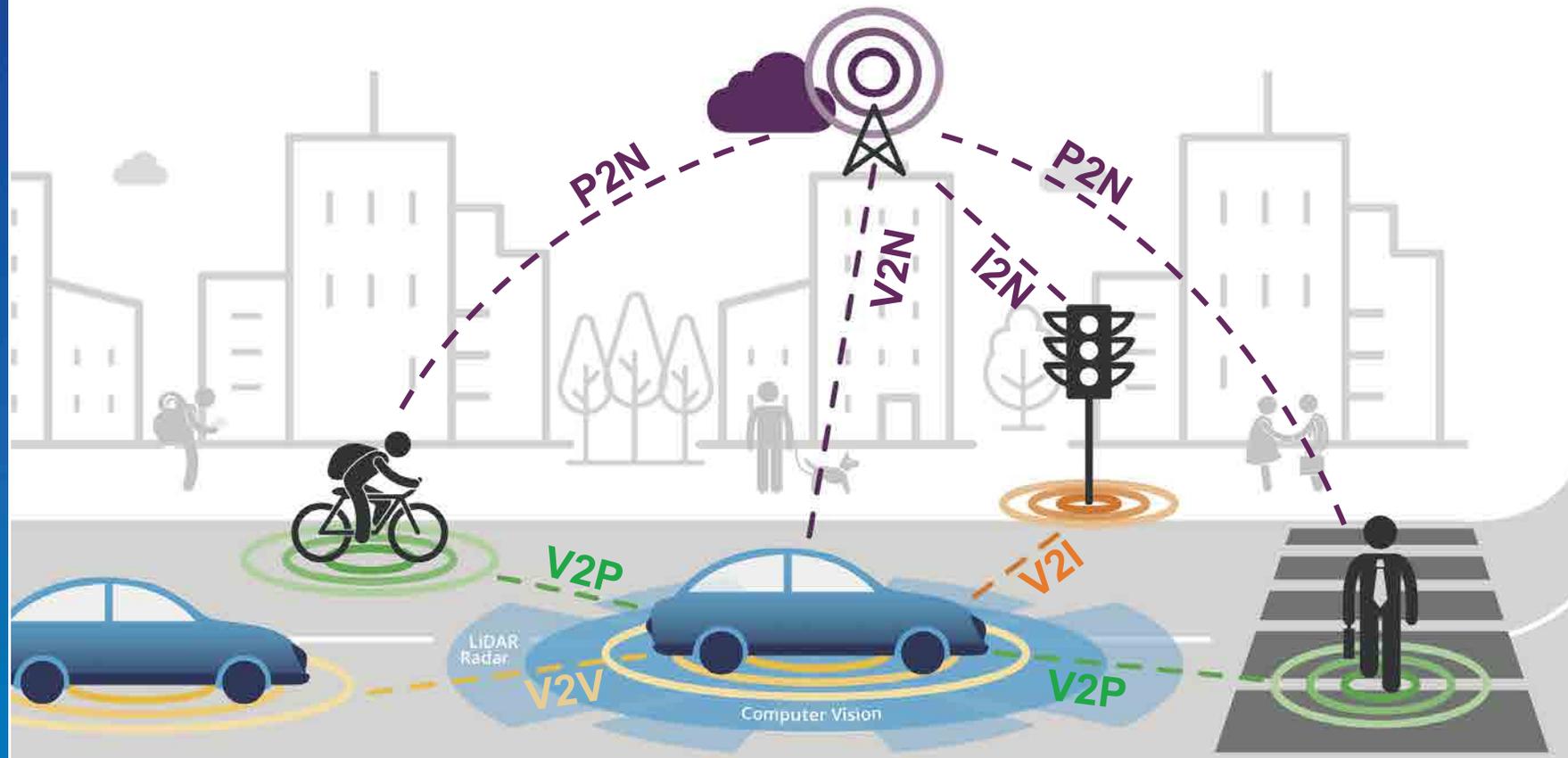


What can 5G do for Automotive

C-V2X is a comprehensive road safety and traffic efficiency solution that allows vehicles to communicate with

- Other vehicles (V2V),
 - Pedestrians and Cyclists via smartphones (V2P),
 - Road Infrastructure (V2I),
- supported by the
- Mobile network (V2N, P2N, I2N)

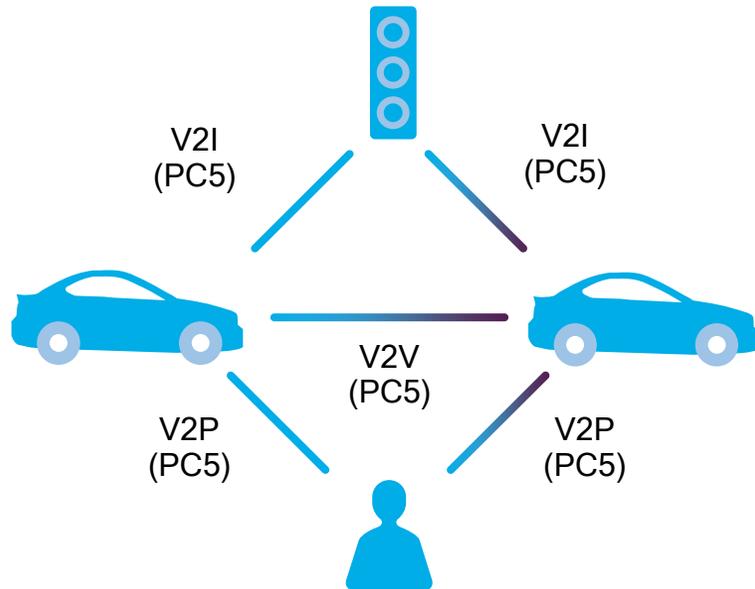
to guarantee full coverage and continuity of services.



C-V2X has two complementary communication modes standardized in 3GPP Rel-14 (and onwards)

Direct (= Sidelink)

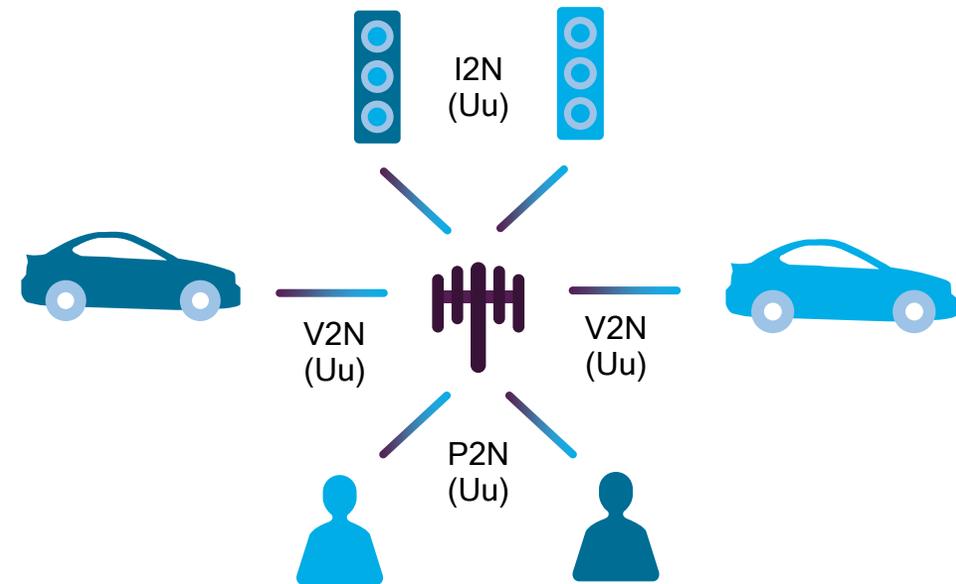
V2V, V2I, and V2P operating in ITS bands (e.g. ITS 5.9 GHz) independent of cellular network



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

Network (= Up/Downlink)

V2N operates in traditional mobile broadband licensed spectrum

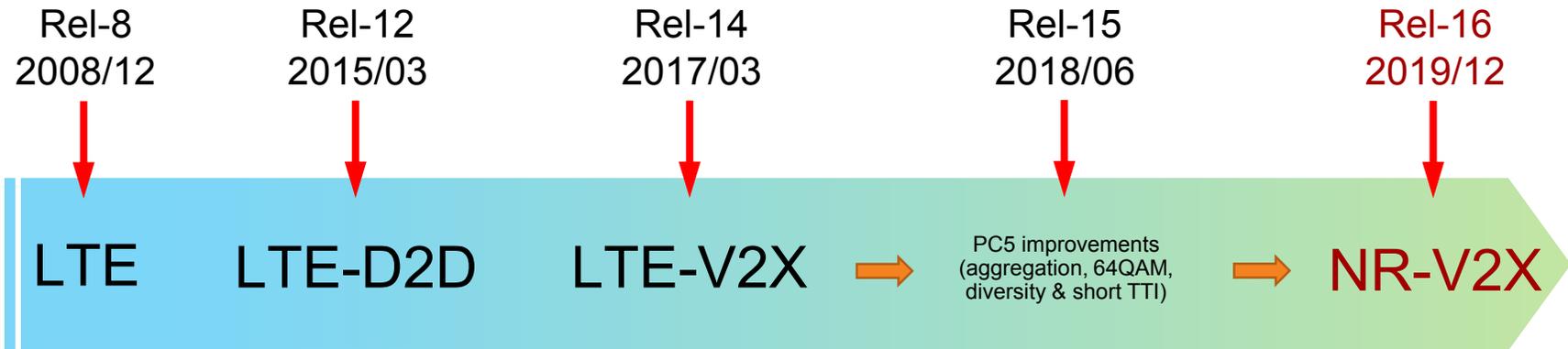


Long range (>1 kilometers). e.g. accident ahead
Implemented over “Uu interface”

3GPP time plan



- ❑ Current version of C-V2X is called **LTE-V2X** as part of 3GPP Rel-14 & 15
- ❑ **NR-V2X** as part of Rel-16 comes as an improvement to support automated driving
- ❑ NR-V2X will **complement and co-exist with** LTE-V2X i.e. operation of NR-V2X alone is not considered.



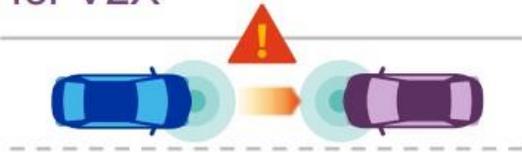
- ❑ NR-V2X **study item** started in **June 2018**.
- ❑ Subsequent NR-V2X work item by **December 2019**.

Evolution to 5G,
while maintaining backward compatibility

Basic safety

802.11p or C-V2X R14

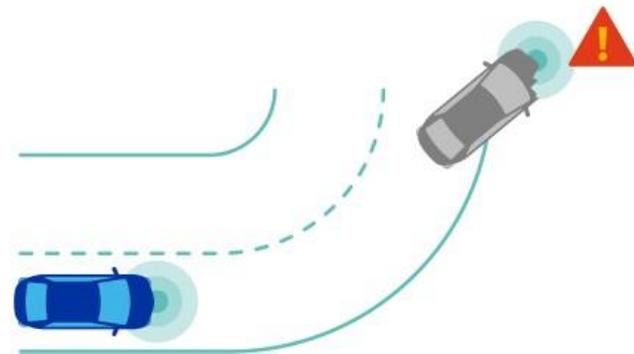
Established foundation
for V2X



Enhanced safety

C-V2X R14/15

Enhanced range and reliability

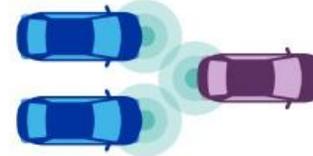


Advanced safety

C-V2X R16 (building upon R14)

Higher throughput
Higher reliability

Wideband ranging
and positioning
Lower latency

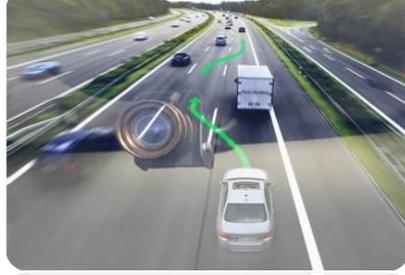


Requirements for autonomous driving

Uses cases for **autonomous driving** applications (SA1 TR22.886)



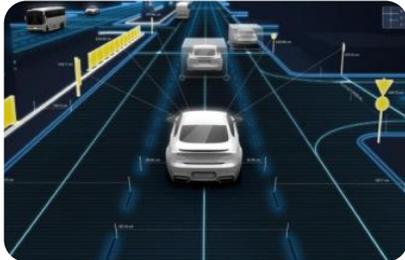
Vehicle
Platooning



Cooperative Operation,
Sensor sharing



Remote Driving



Advanced Driving

NR-V2X requirements for **autonomous driving** (SA1 TS22.186)

Use Cases	E2E latency (ms)	Reliability (%)	Data rate (Mbps)
Vehicle Platooning	10	99.99	65
Advanced Driving	3	99.999	53
Extended Sensors	3	99.999	1000
Remote Driving	5	99.999	UL:25, DL:1
	Lateral (m)	Longitudinal (m)	
Positioning Accuracy	0.1	0.5	

Note: 5GAA may adjust the above requirements according to inputs from car OEMs.



Conclusions

- 5GAA became a global reference association for cooperation between Automotive and Telecom sectors.
- 5GAA helps to meet the interests and needs of the Automotive industry when 5G is being deployed.
- 5GAA works closely with 3GPP as the global leader for standardization of 4G/5G mobile networks
- 5GAA works on 5G enablers for automated driving: Network Slicing and Edge Computing
- C-V2X includes Sidelink and Up/Downlink and will evolve from LTE-V2X (PC5-Uu) towards 5G-V2X
- 5G-V2X will work complementary to the LTE-V2X Sidelink



Thank you!