Using Wireless Technology to Save Lives

STRATEGY ANALYTICS

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WHY 5G MATTERS

- Lower latency communications
- Device to device connections
- Greater reliability
- Network slicing
- Layered, ubiquitous connectivity
- True IoT – network of everything

- New vehicle architecture(s)
- New business models
- New development strategy
- New organizational structure
- New priorities – privacy, security, autonomy
- Changing vehicle ownership and usage

Auto industry to wireless industry:

You've got our attention!

FCC PERSPECTIVE: COMPETITIVENESS OF U.S.

- "5G will require companies to deploy hundreds of thousands of small cells. That's why the FCC is working on modernizing the rules for that kind of infrastructure. If America is to lead the world in 5G, we need to modernize our regulations so that infrastructure can be deployed promptly and at scale.
- FCC's historic preservation rule: One analysis estimated that all of these changes will save $1.6 billion in deployment costs, create 17,000 jobs, and spur the deployment of 57,000 new small cells" - FCC Chairman Ajit Pai
- If it takes you an hour to install some of these new little cells … it should take less than a year to get the permit" - Senator Gardner (Race to 5G Summit)
- "We conclude that the United States underspent China in wireless infrastructure by $8 billion to $10 billion per year since 2015" https://www2.deloitte.com/us/en/pages/consulting/articles/5G-deployment-for-us.html?id=us:2el:3pr:foc:eng:cons:080718
- "Since 2015, China outspent the US by approximately $24 billion in wireless communications infrastructure and built 350,000 new sites, while the US built fewer than 30,000. Looking forward, China's five-year economic plan specifies $400 billion in 5G-related investment. Consequently, China and other countries may be creating a 5G tsunami, making it near impossible to catch up."

WHY ARE WE CONNECTING CARS?

Space Shuttle:

500,000 lines of code

Boeing 777:

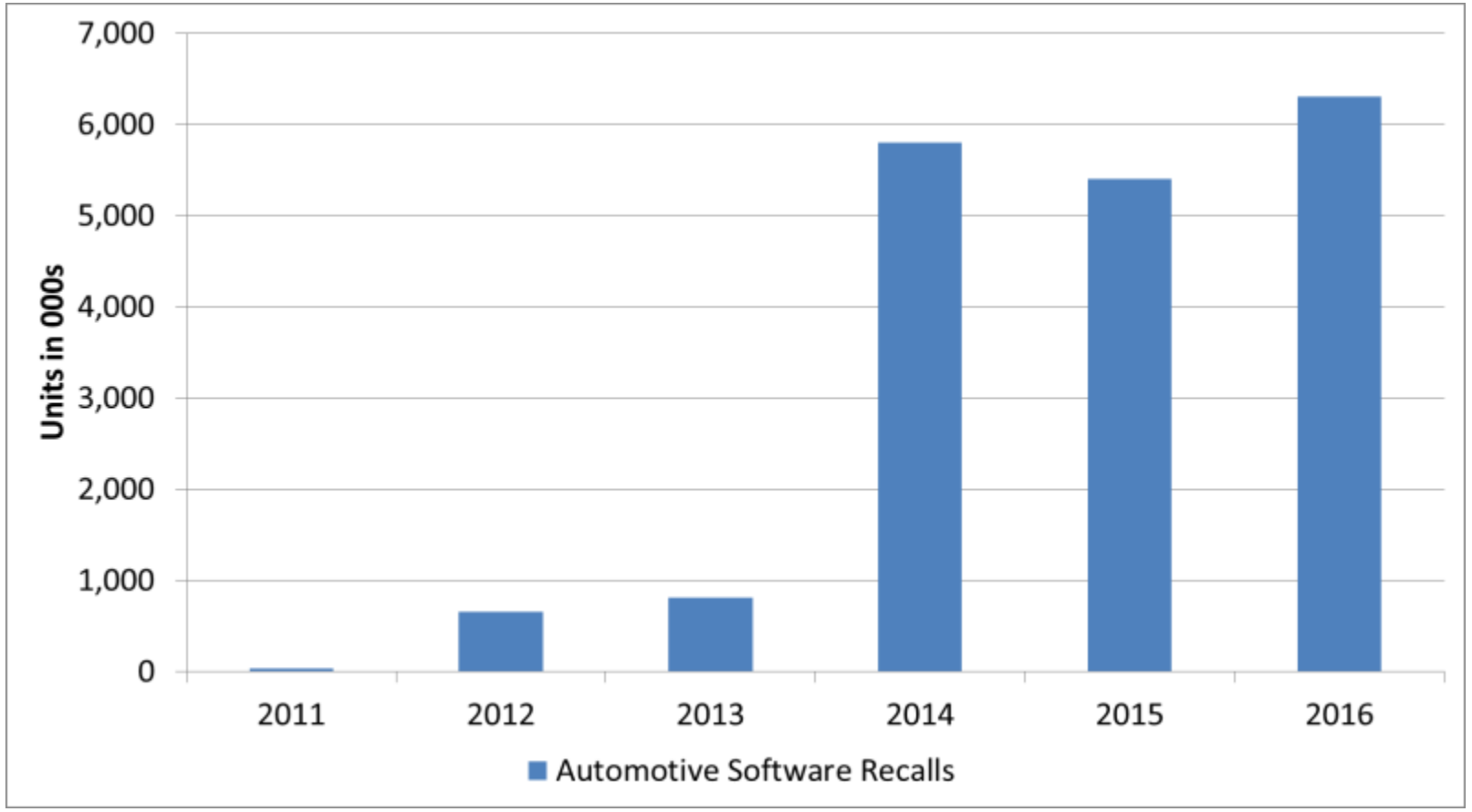
3-4 millions lines of code

Mercedes S Class:

100 million lines of code

SOFTWARE-RELATED RECALLS

Number of Automotive Software-Related Recalls in U.S., 2011 – 2017



Source: CX3 Marketing

- ***Typical (Non-OTA) software updates cost between $300 - $600 per vehicle.***
- ***~ $3 Billion spent by OEMs to do (non-OTA) software updates in the US alone in 2017!***

CONNECTIVITY KEY TO SECURITY

EXPECTATIONS FOR THIS COMMUNITY

Share

- Submit threat intelligence
- Send us information on potential vulnerabilities
- Contribute incident reports and lessons learned
- Provide best practices around mitigation techniques

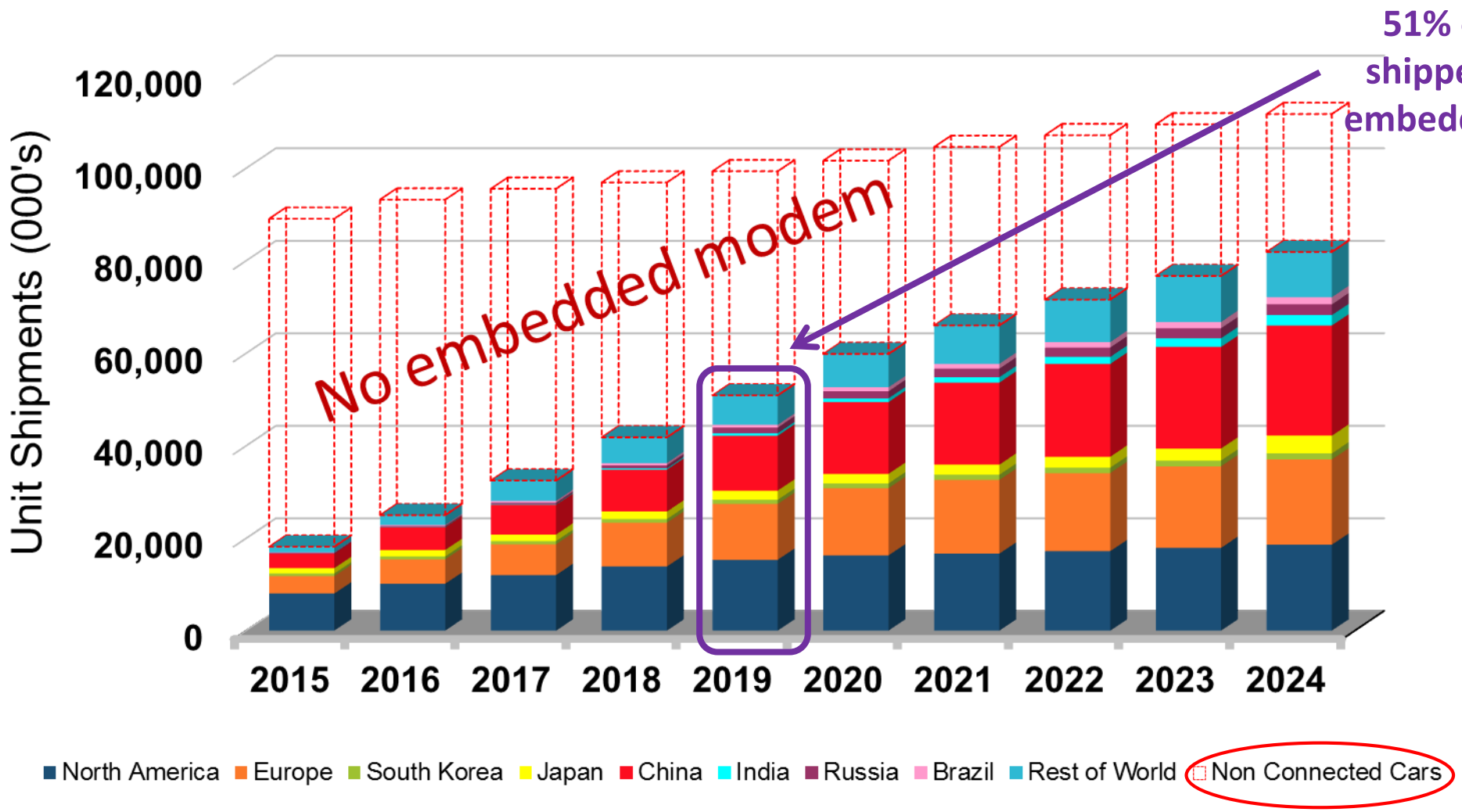
AUTO-ISAC
Automotive Information Sharing and Analysis Center

ROLE OF MAP ←→ NAVIGATION IN LOCATING SELF-DRIVING VEHICLES IS STILL UNCLEAR

→ The self-driving vehicle needs to be able to locate itself with an accuracy of around 10 cm

- A blend of technologies will be required:
  - HD Maps / On-board sensors
  - Satellite positioning
  - Dead-reckoning
- No agreement on exactly how to blend:
  1. **Maps:** What is the balance between survey-vehicle data and user-generated content?
  2. **Sensors:** Do we use all of RADAR, LiDAR (current), Camera etc.? Or just a subset?
  3. **Satellite positioning:** Is current consumer-grade sufficient?
  4. **IMU** (Inertial Measurement Units): Are today's MEMs-based units good enough?

AUTOMOTIVE EMBEDDED MODEMS
GLOBAL ANNUAL SHIPMENTS



Telematics 1.0

Source: Infotainment & Telematics Service

NEW CONNECTIVITY SOLUTIONS ON THE WAY

- Reprovisionable SIM
- Multiple-carrier platform
- Dual SIM Dual Access (DSDA)
- Add car to existing wireless plan
- Global connectivity platform
- Zero-rating of particular data types
- Lifetime subscription

CARRIER PERSPECTIVE – DEUTSCHE TELEKOM

Alexander Lautz from Deutsche Telekom:

- **“Consumers will pay us tens of Euros every month. OEMs will currently pay us €50 to €70 over the lifetime of the vehicle. Who do you think we design the network for?”**
- **“I offered a carmaker €180 flat-rate all-you-can-eat data package for 7 years. They said it was too expensive.”**
- **“Conti charges you €500 for a headunit. Imagine what you could do if you gave me €500.”**

CARRIER PERSPECTIVE – VODAFONE

- 5G and edge computing to support HERE's live HD mapping solutions for V2V: https://www.mobileeurope.co.uk/press-wire/vodafone-and-here-to-drive-5g-automotive-trials-in-germany
- Vodafone and Continental join forces to implement 5G, cellular vehicle-to-everything (cellular V2X) and mobile edge computing: https://www.continental-corporation.com/en/press/press-releases/2018-06-10-continental-vodafone-131938
- Huawei, Vodafone and Bosch use cellular vehicle to everything (C-V2X R14) in combination with Bosch's Adaptive Cruise Control (ACC) driver assistance system on the A9 freeway in Bavaria: http://www.telecomreview.com/index.php/articles/telecom-operators/2139-vodafone-and-huawei-test-connected-cars-using-pre-standard-5g
- Vodafone's 5G Mobility Lab combines mobile radio technology with varied route elements to create a test environment with the Aldenhoven Testing Center: https://www.vodafone.de/innovationpark/5g-mobility-lab.html
- Vodafone to roll out 1,000 5G sites in UK by 2020: https://uk.reuters.com/article/uk-vodafone-5g/vodafone-to-roll-out-1000-5g-sites-in-uk-by-2020-idUKKCN1M02R7

VODAFONE PERSPECTIVE - VODAFONE

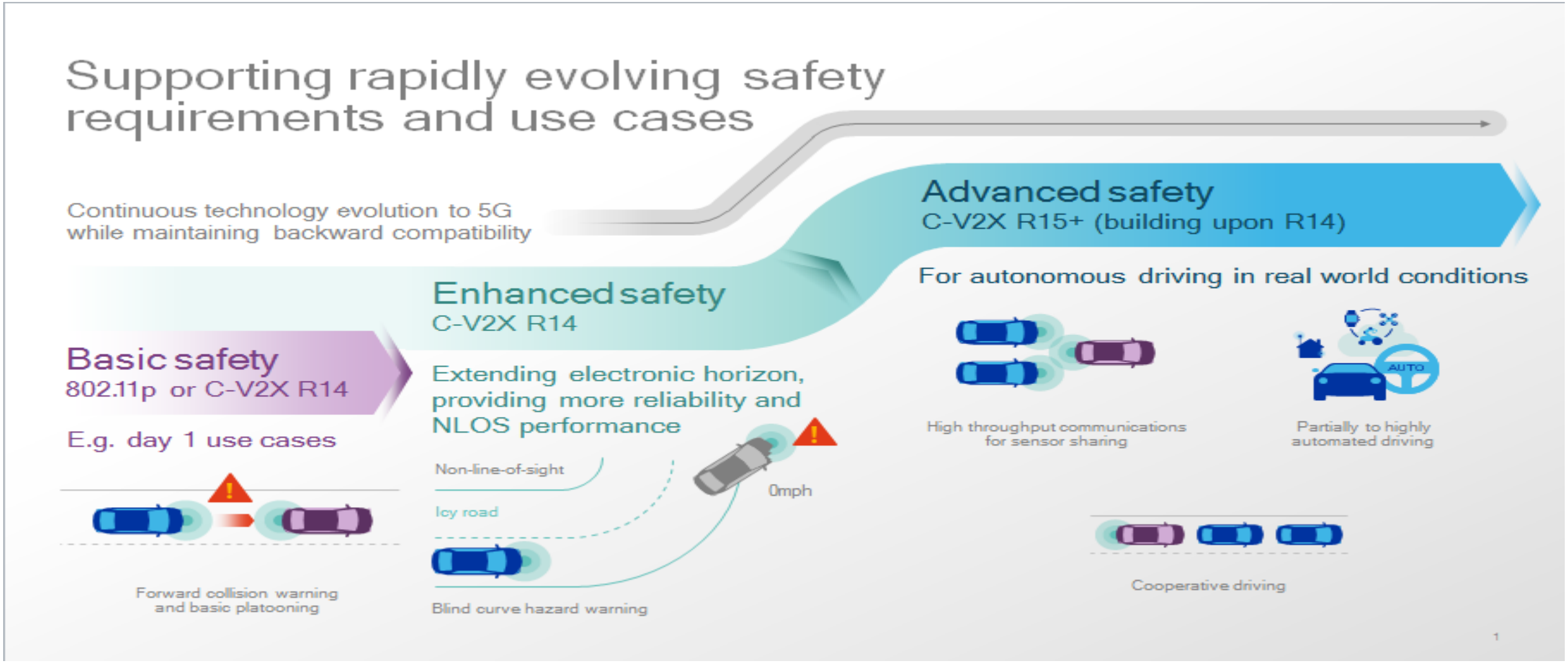
18.3M live vehicle connections

5GAA HAS GROWING SUPPORT

More than 90 Global Members

5GAA Automotive Association

CELLULAR-BASED V2V ARRIVES WITH C-V2X



CORE 5G-ENABLED APPLICATIONS

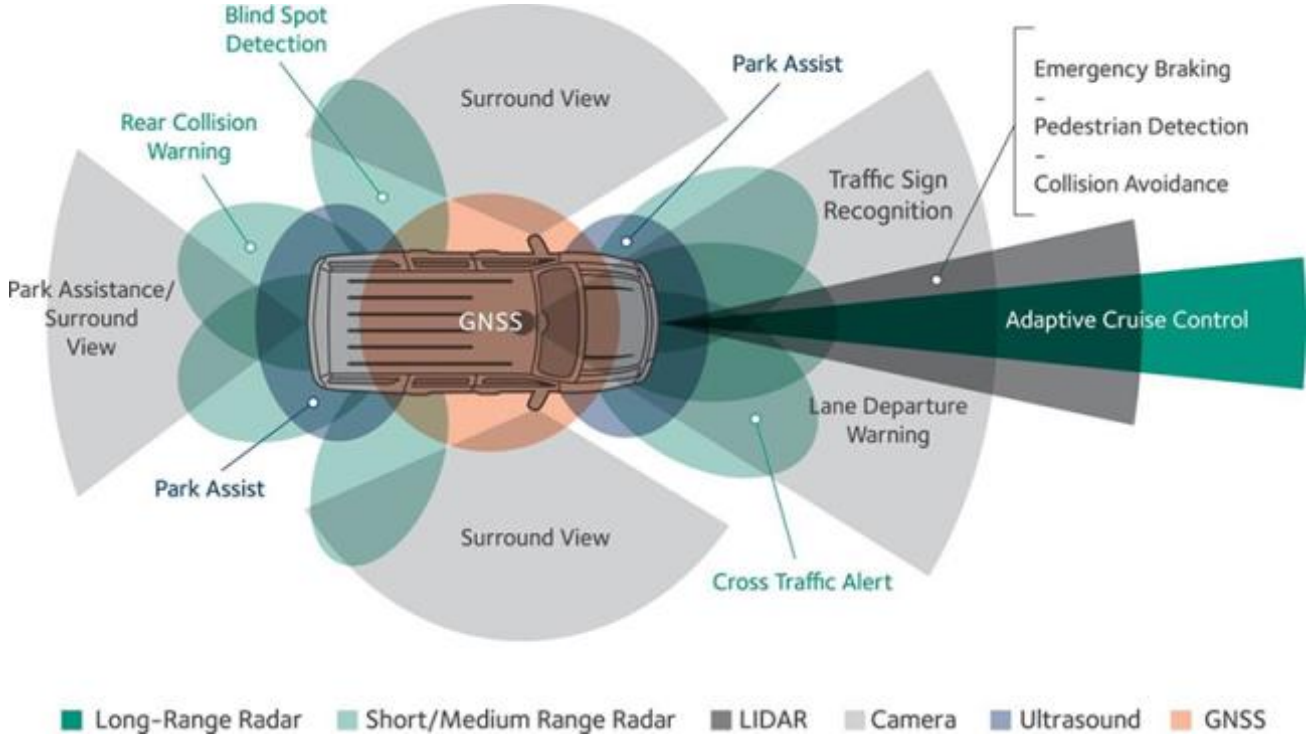
- Autonomous driving
- Remote control
- Platooning
- Collision avoidance
- Inter-vehicle communications (V2V)
- Vehicle to infrastructure communications (V2I)
- Vehicle to pedestrian communications (V2P)
- Over-the-air updates

Regulators are requiring autonomous vehicles be equipped with remote control – it is likely that only 5G can deliver the necessary low latency for this application.

CELLULAR BECOMES MISSION CRITICAL

Example is Safety - There is increasing reliance on:

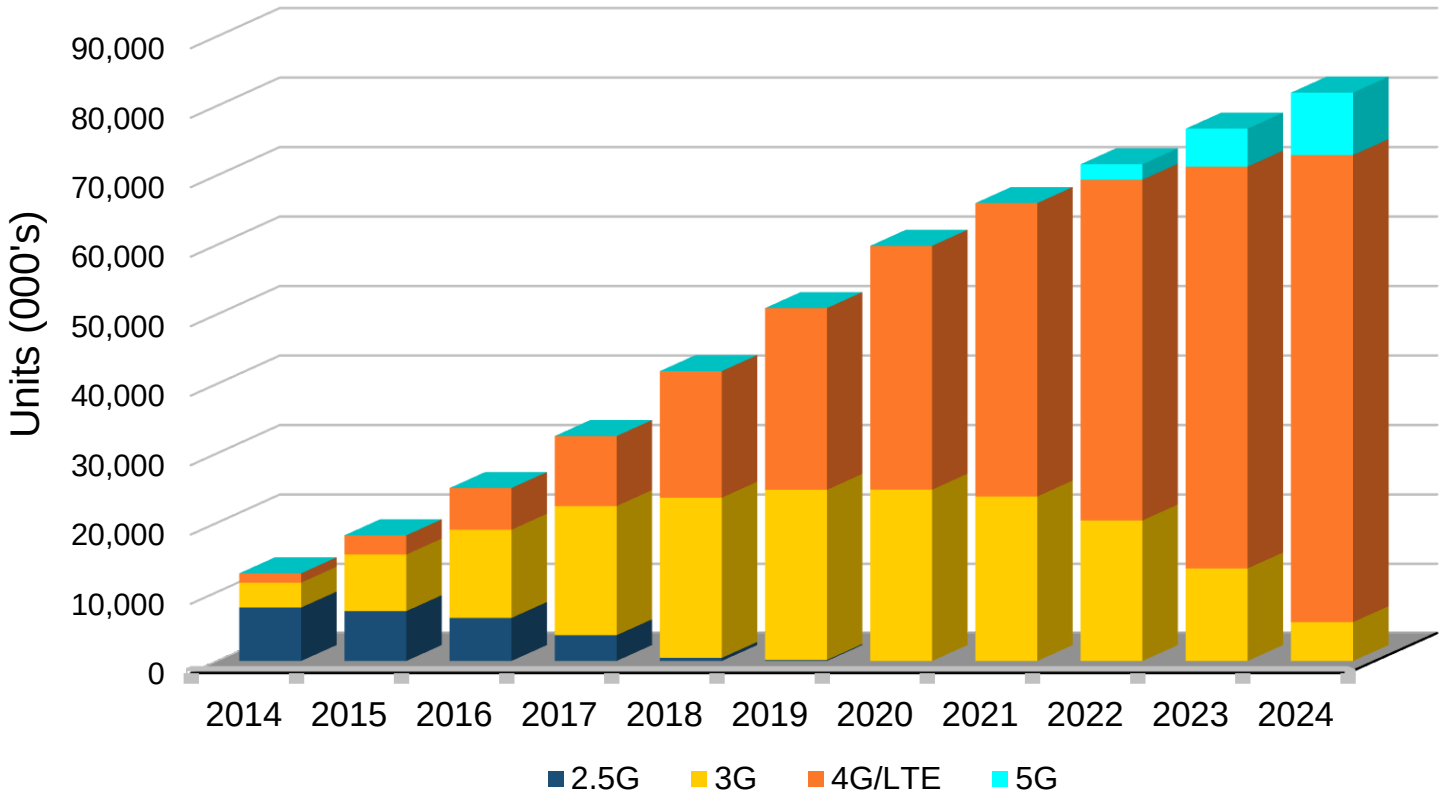
- LIDAR, RADAR
- Cameras
- Contextual awareness with the objective of collision avoidance



…most of these systems have COMPLEX software…

OEM EMBEDDED TELEMATICS
CELLULAR MODEM SHIPMENTS - GLOBAL

Telematics Forecast 2016 vs. 2024 (25 Mil. units → 82 Mil. units)



- **2.5G Network:** 6.3 Mil units in 2016 to 0K units from 2020
- **3G Network:** 12.7 Mil in 2016 units to 5.6 Mil units in 2024
- **4G/LTE Network:** 6 Million units in 2016 to 67 Mil units in 2024
- **5G Network:** 9 Million units in 2024

Source: Infotainment & Telematics Service

Automotive Infotainment & Telematics

THANK YOU

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