Automotive Infotainment & Telematics

STRATEGY ANALYTICS

RESEARCH - FOCUS AREAS

Automotive Infotainment & Telematics

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3

1. SA Introduction
2. Service Overview
3. System Architecture
4. Connected vehicle challenges: IOT/Big data
5. Connected vehicle challenges: Convergence
6. Smartphone Gateway Issues
7. Software and OS

4 IoT Big-data

5 Convergence

8

7

6

9

10

11

8. Ride-hailing & Carsharing
9. Memory/Storage/Cloud
10. Emerging technologies
11. Human Machine Interface
12. China market
13. Market data - Systems
14. Market data - Semis

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13-14

Systems Semis

SA SERVICES OVERVIEW

Supply Side Research and Consulting

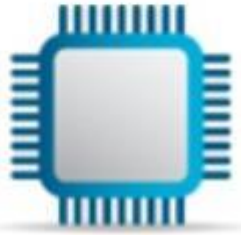
Devices

Automotive

Networks

Media & Services

Enterprise



Components

UX Innovation

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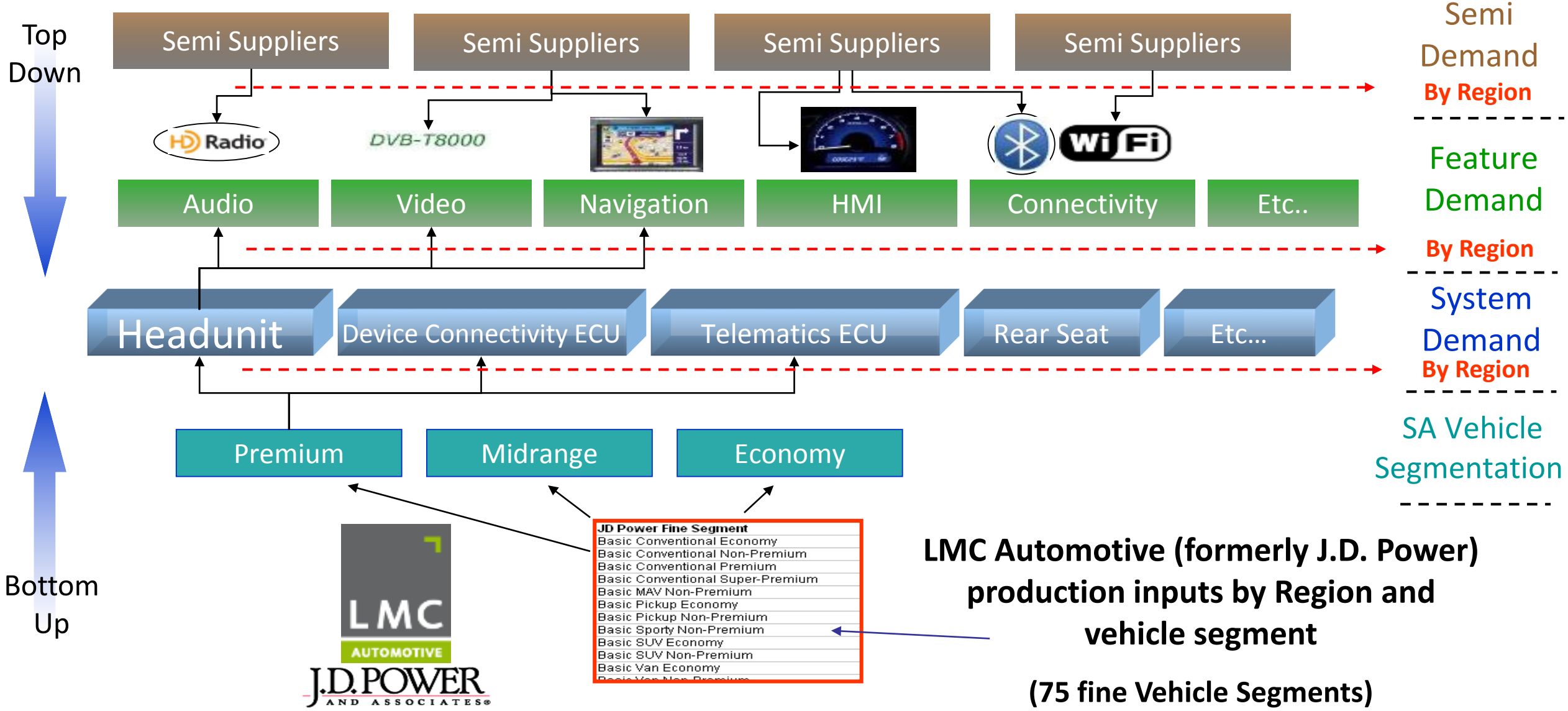
ADDRESSING THE OPPORTUNITY

- **Infotainment & Telematics System & Semiconductor** Demand Forecasts
- **Regional** Analysis and Forecasts
- **Vehicle OEM Level** Demand Analysis
- **Incremental Business** Opportunity Analysis

- Application **Growth Rate** Analysis
- **Average Selling Price** Forecasts
- Impact of **Industry Initiatives** in **Hardware & Software**
- Impact **of Legislation & Standardization** on Future Demand
- Prospects of **Disruptive Technologies** or **New Market Entrants**

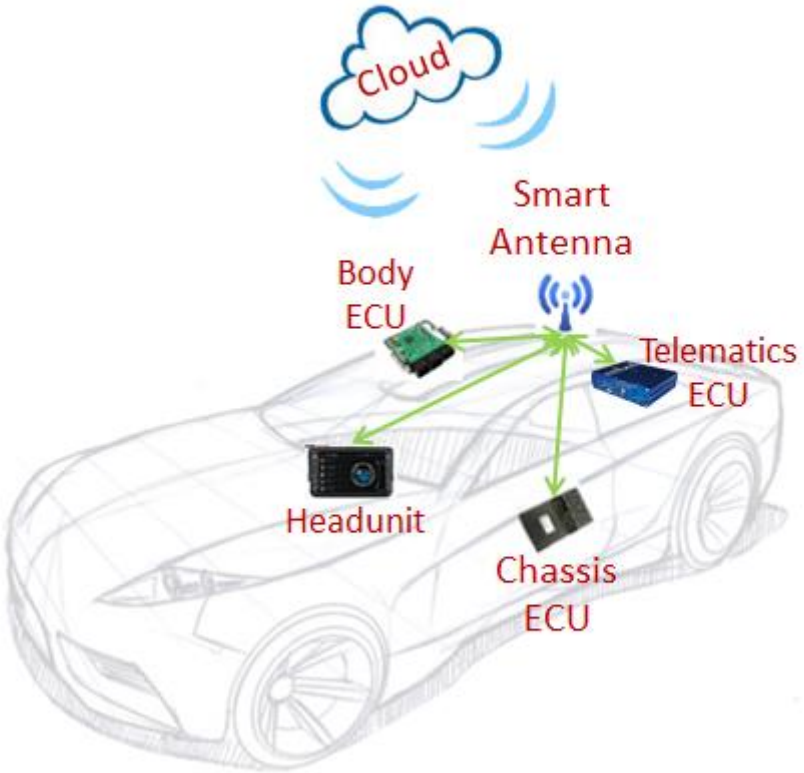
- **Competitive Environment** Analysis, **Strengths & Weaknesses**
- **Market Shares** of Tier 1 & Semiconductor Suppliers
- **OEM - Supplier** Relationships
- **Application Technology** Trends & Vehicle **OEM Preferred Solutions**

SA RESEARCH METHODOLOGY

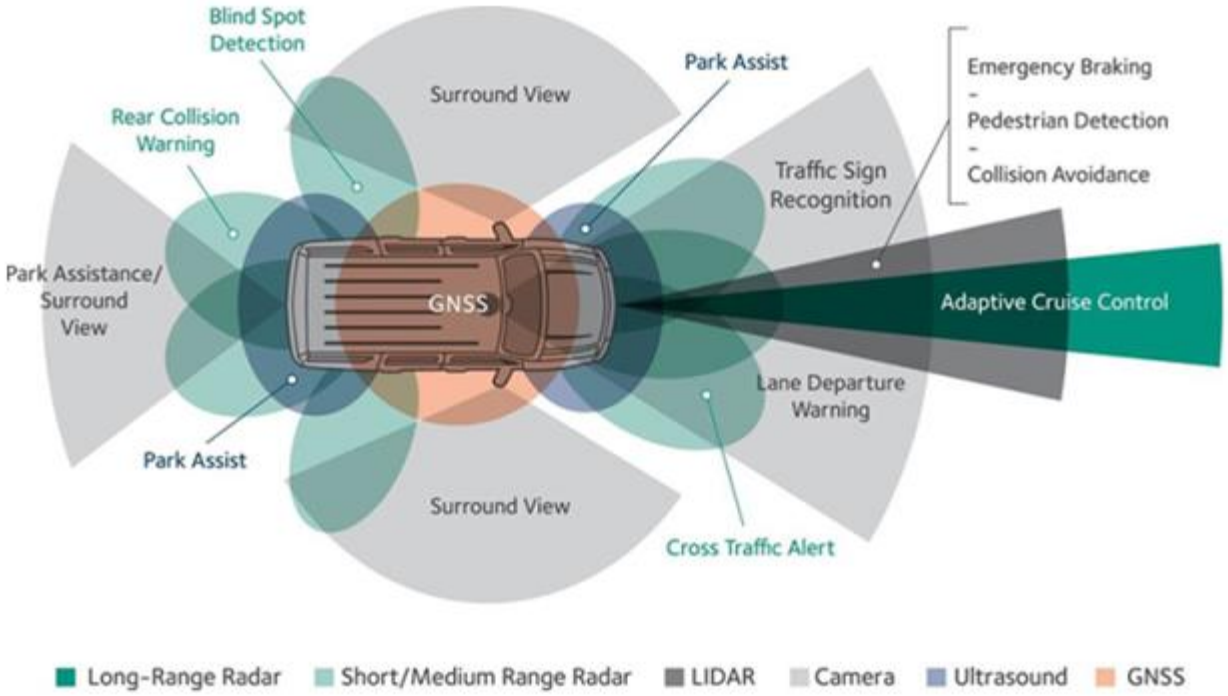


WHAT CHANGES WITH 5G

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

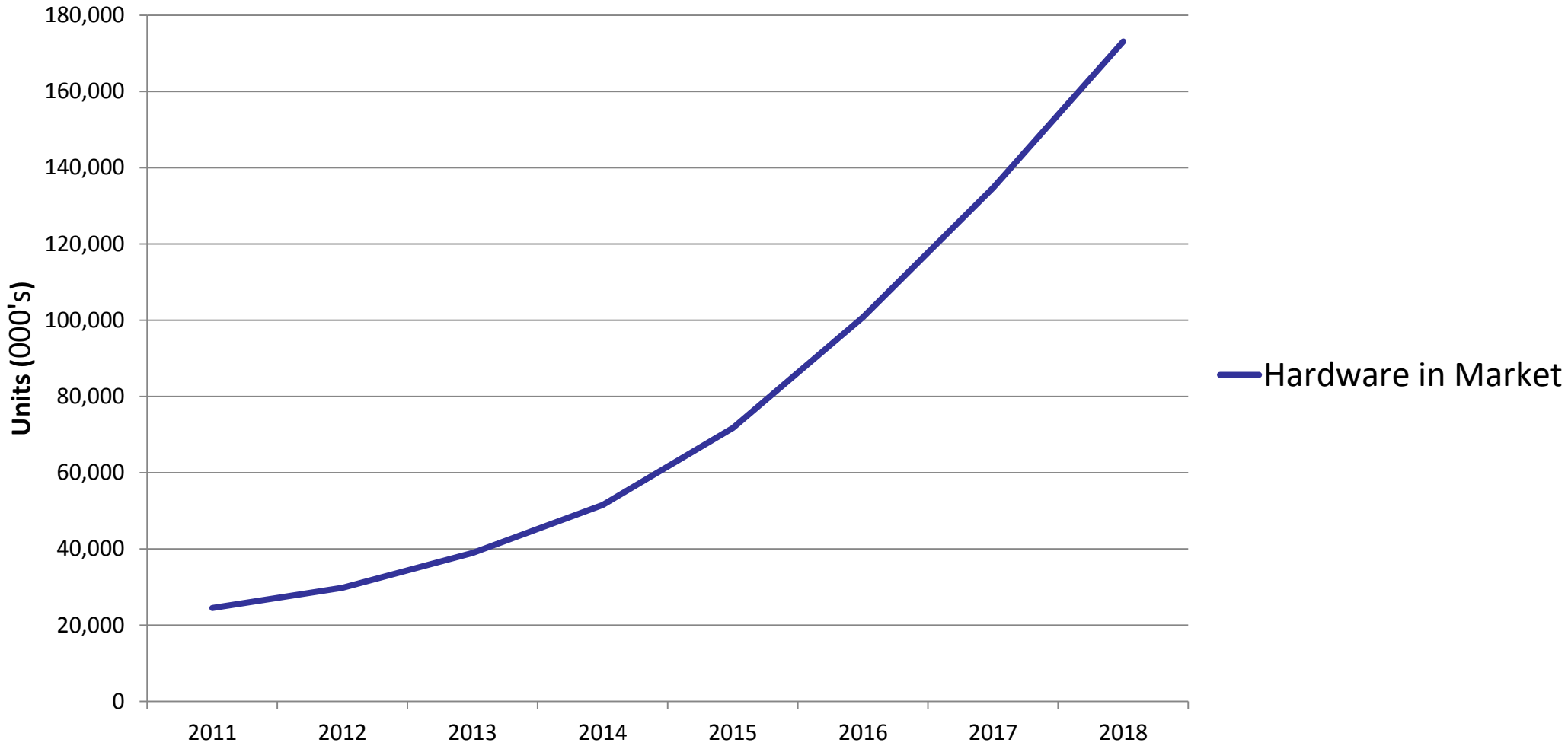


CORE 5G-ENABLED APPLICATIONS

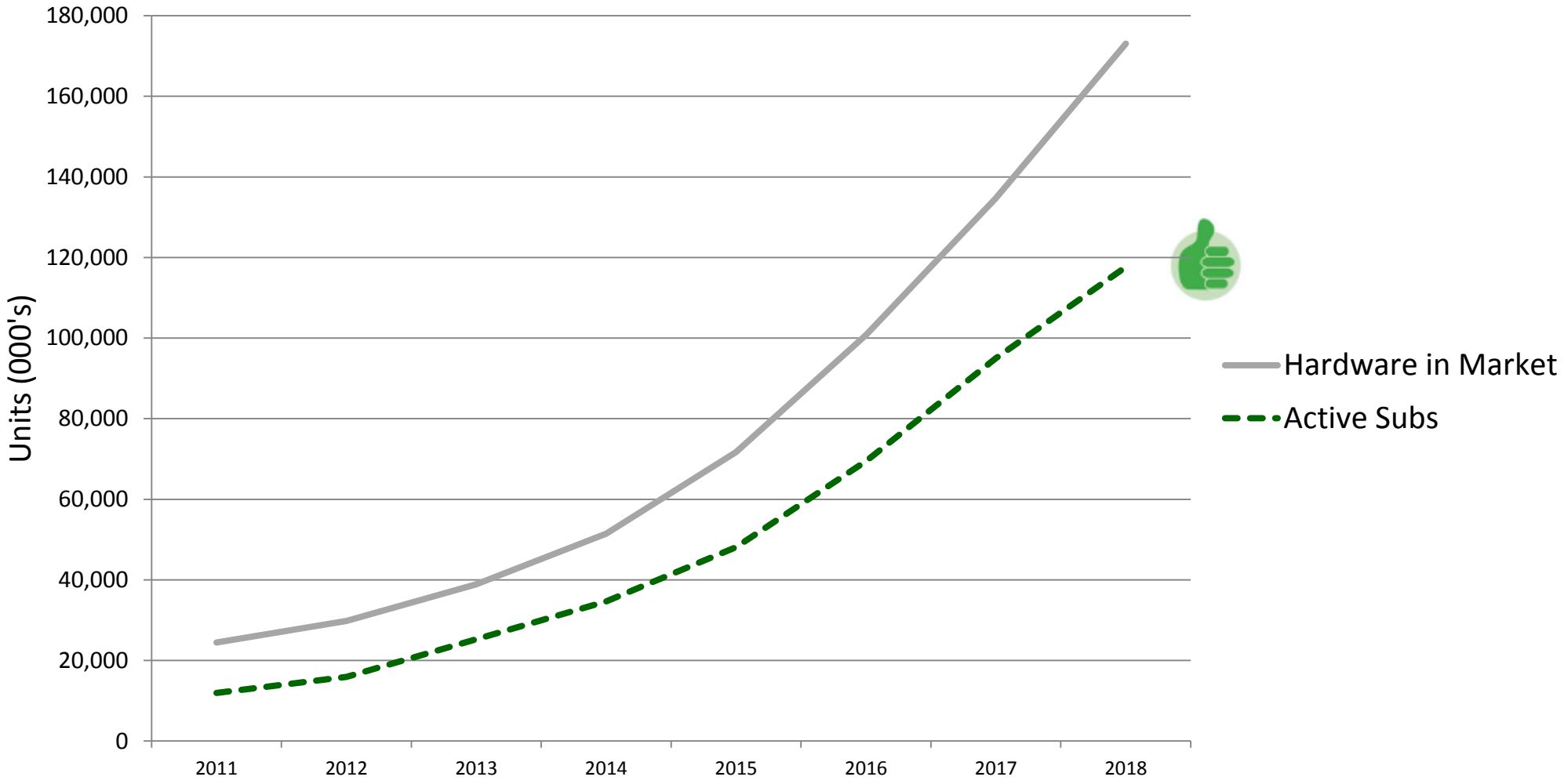


- Autonomous driving
- Remote control
- Platooning
- Collision avoidance
- Inter-vehicle communications (V2V)
- Vehicle to infrastructure communications (V2I)
- Vehicle to pedestrian communications (V2P)
- Over-the-air updates

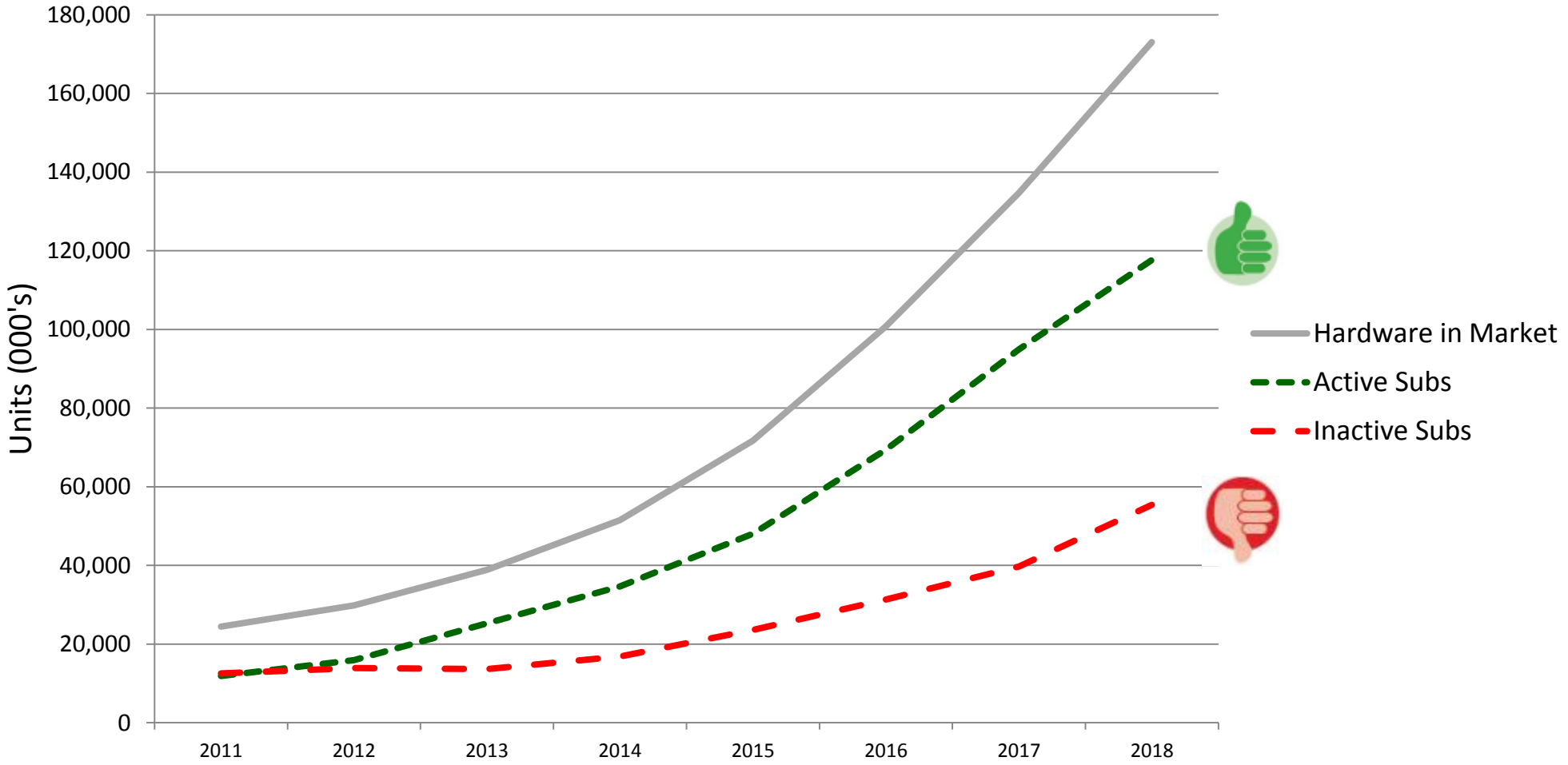
HARDWARE IN MARKET (CUMULATIVE)
OEM EMBEDDED TELEMATICS - GLOBAL



ACTIVE SUBSCRIPTIONS (CUMULATIVE)
OEM EMBEDDED TELEMATICS - GLOBAL

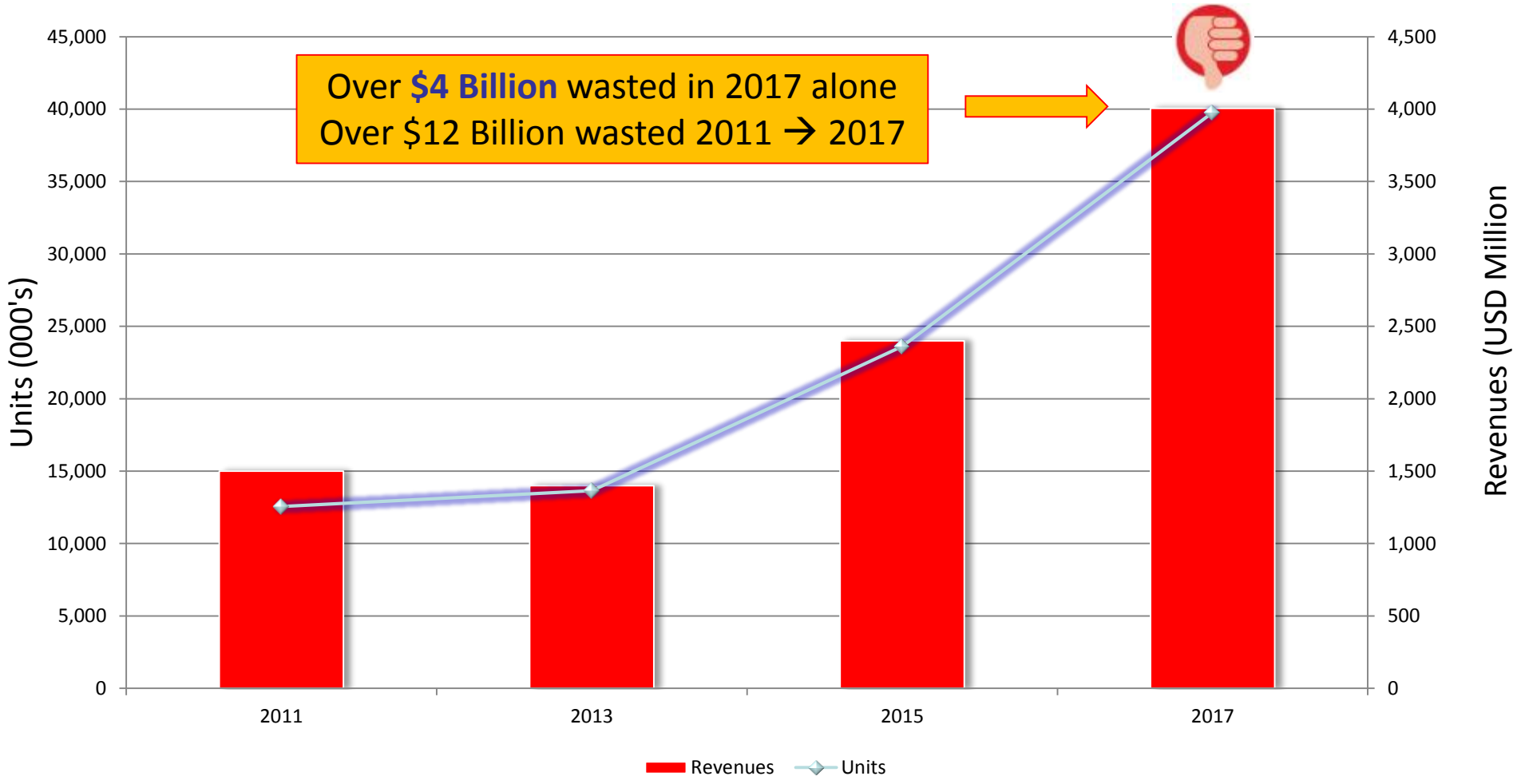


IN-ACTIVE SUBSCRIPTIONS (CUMULATIVE) OEM EMBEDDED TELEMATICS - GLOBAL



Source: Infotainment & Telematics Service

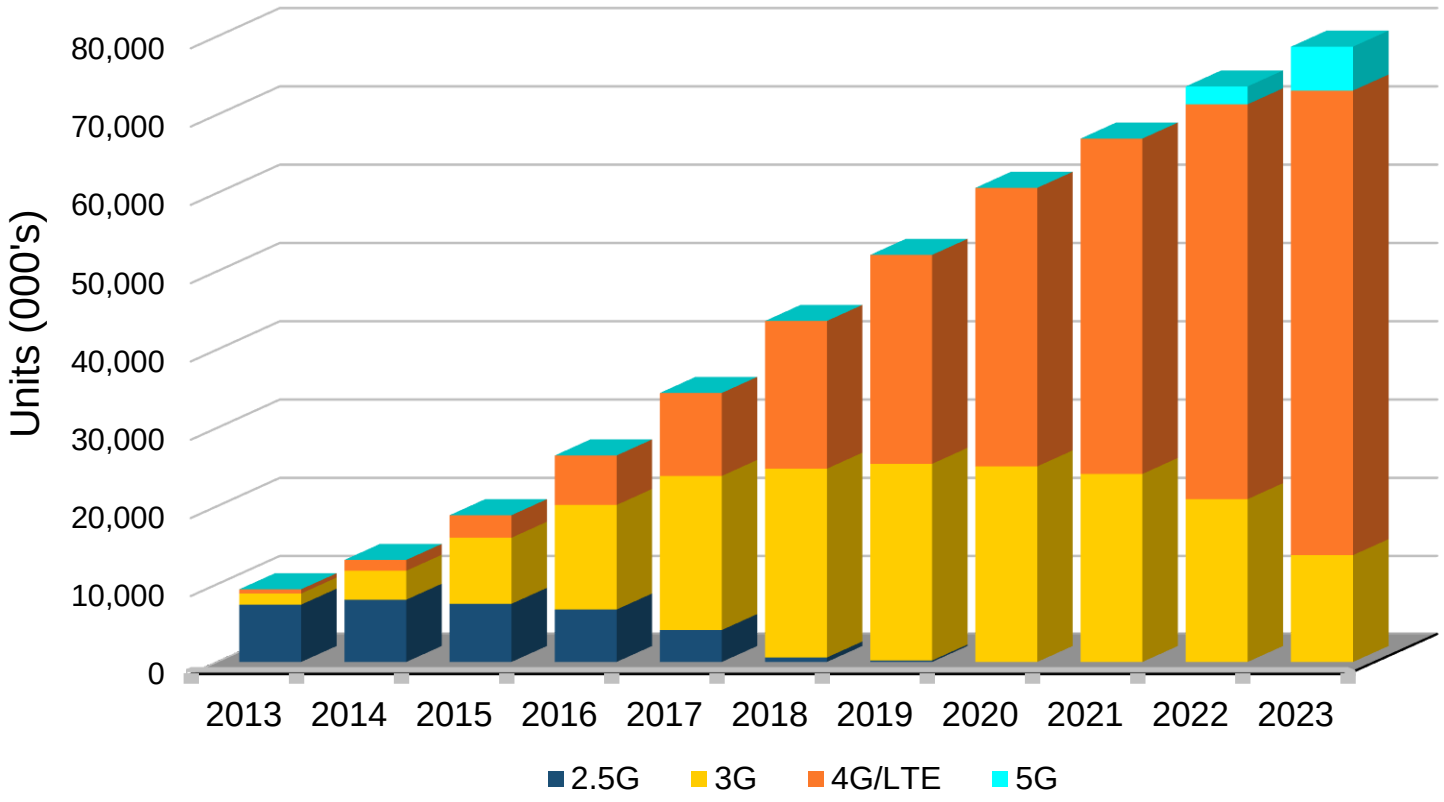
INACTIVE SUBS = DEAD $$$
OEM EMBEDDED TCU'S (UNITS/REVENUES)



Source: Infotainment & Telematics Service

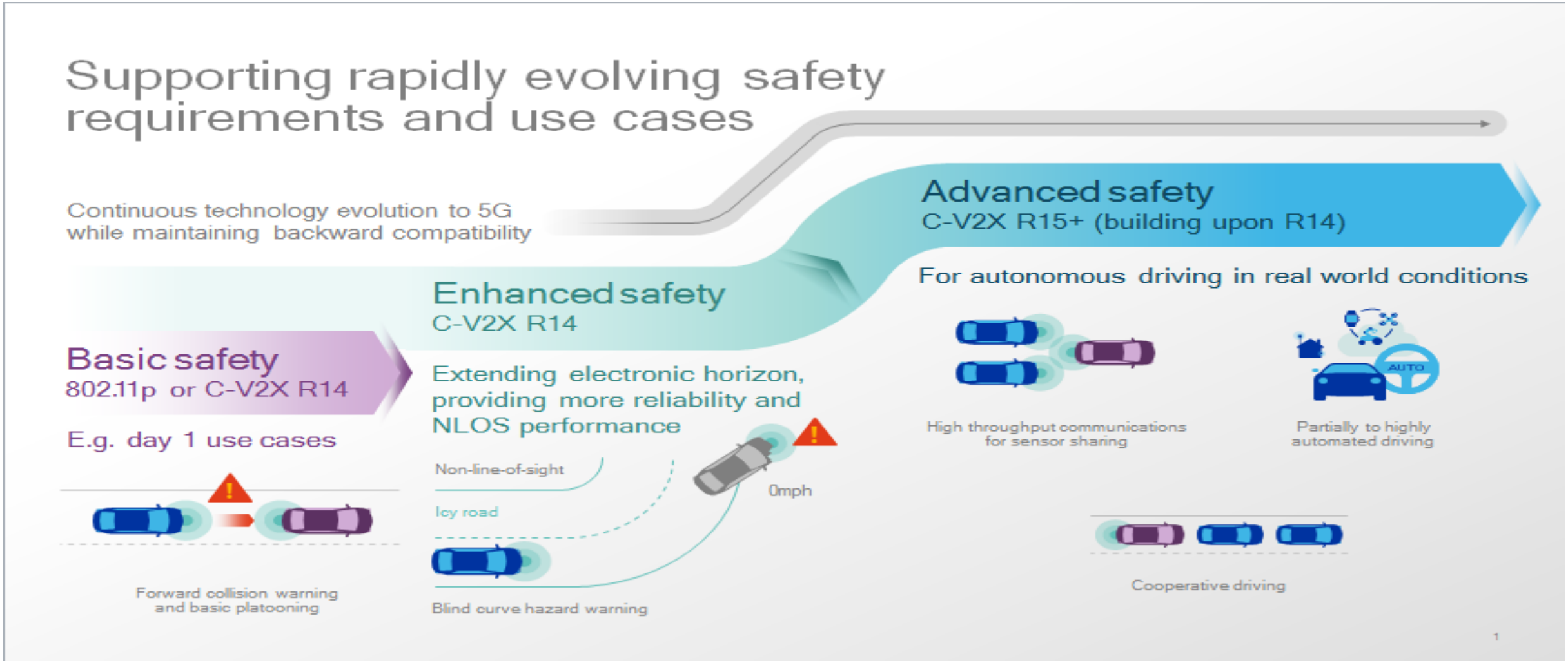
OEM EMBEDDED TELEMATICS CELLULAR MODEM SHIPMENTS - GLOBAL

Telematics Forecast 2015 vs. 2023 (18.8 Mil. units → 78.6 Mil. units)

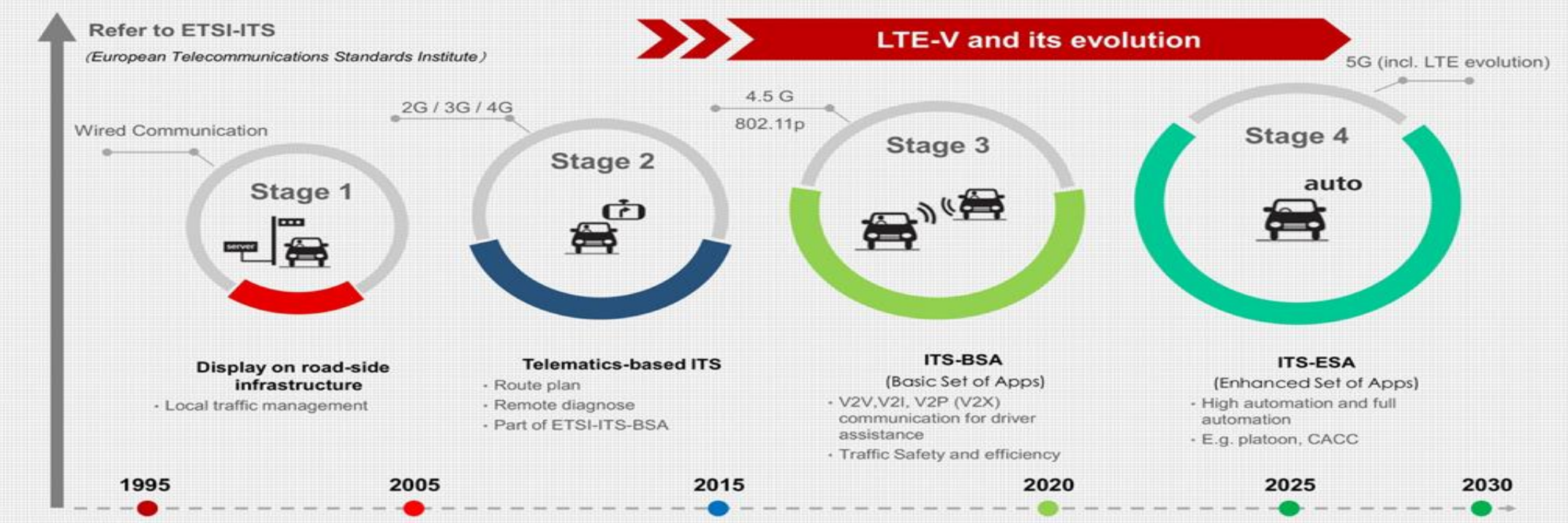


- **2.5G Network:** 7.4 Mil units in 2015 to 0K units from 2020
- **3G Network:** 8.4 Mil in 2015 units to 13.7 Mil units in 2023
- **4G/LTE Network:** 2.8 Million units in 2015 to 58 Mil units in 2023
- **5G Network:** 5.6 Million in 2023

CELLULAR-BASED V2V ARRIVES WITH LTE ADVANCED PRO



C-V2X EVOLUTION

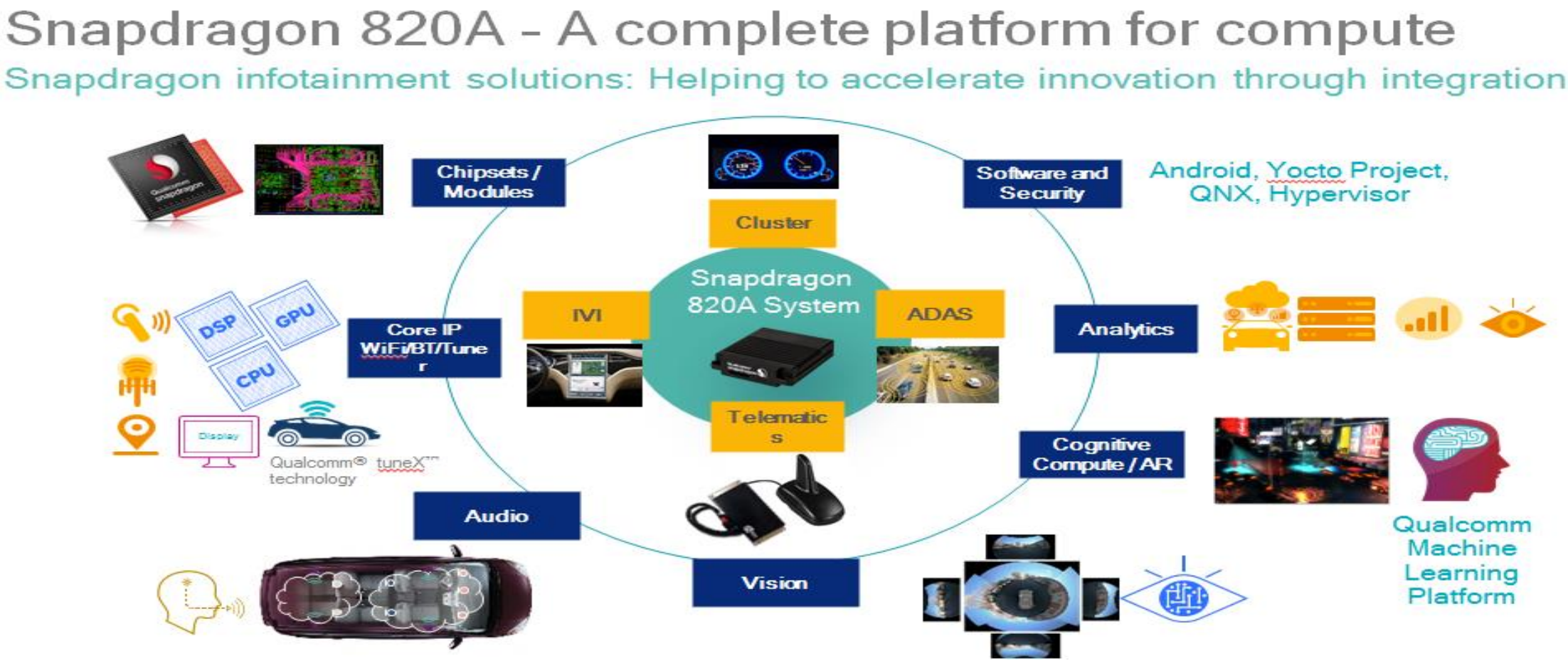


SOURCE: Huawei

5GAA LEADS THE WAY

MEMBERS

QUALCOMM, RENESAS, NVIDIA, INTEL



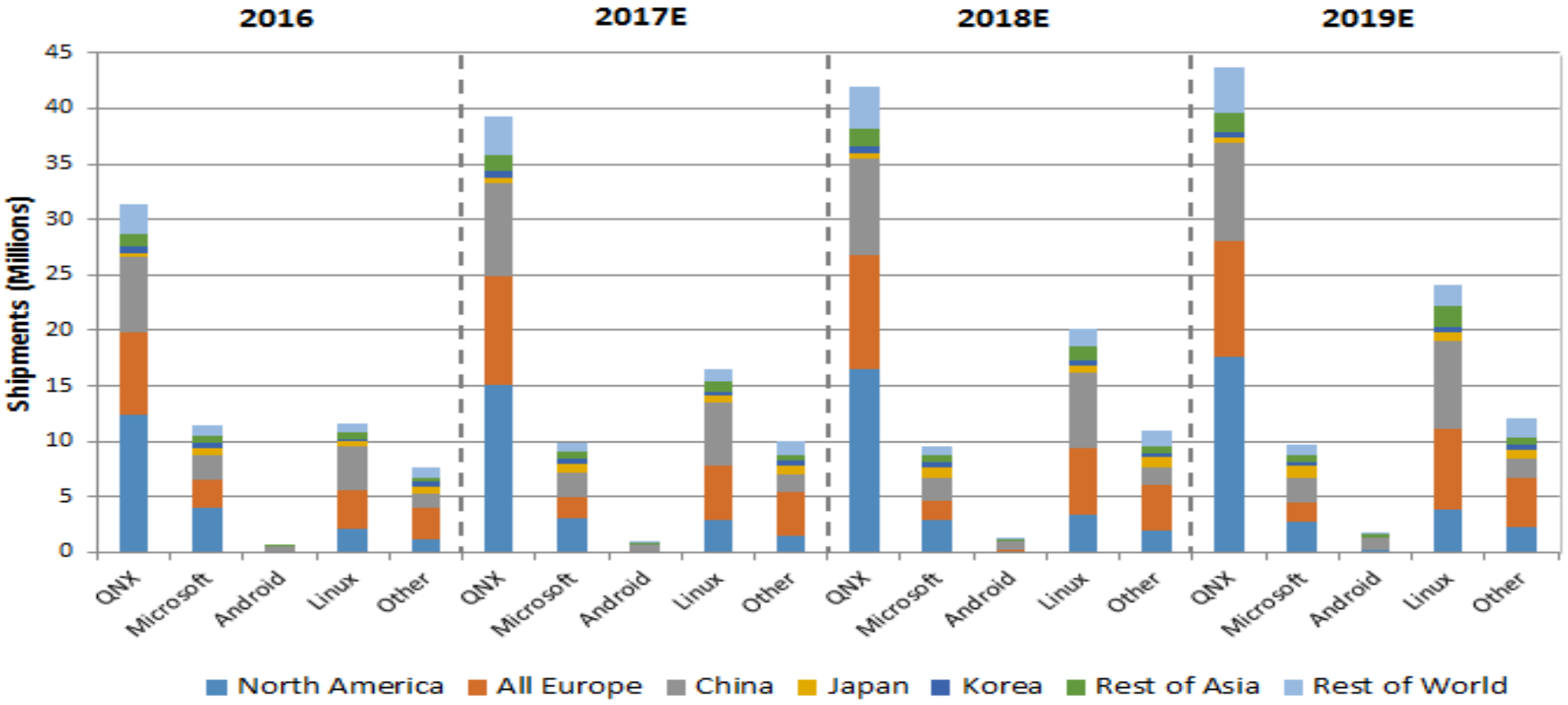
SOURCE: Qualcomm

ARCHITECTURE IMPLICATIONS

- Single processor driving multiple functions
- Introduces embedded Android
- Support for Google Services, Maps, Nav, Search, Updates
- Marks turning point – beginning of the end of QNX in IVI – shift of QNX toward safety domain

- **Android's automotive shortcomings – boot time, power management, security – have been resolved or worked around**

REGIONAL OS DEMAND



- **QNX:** Dominant and growing in all regions (Ford win as key driver)
- **Microsoft:** Declining in all regions (Ford loss as key driver)
- **Linux:** #2 OS choice globally by 2016
- **Android:** Very slow adoption
- **Other Embedded:** VXWorks, Greenhills (#3 in 2017)

Beyond 2019, the outlook changes considerably

ESSENTIAL TOOLS?

- Software updating
- Security
- Data management – security, privacy
- Orchestration of content, code, applications, suppliers, service providers

WHAT WE'RE SEEKING

WHERE WE ARE

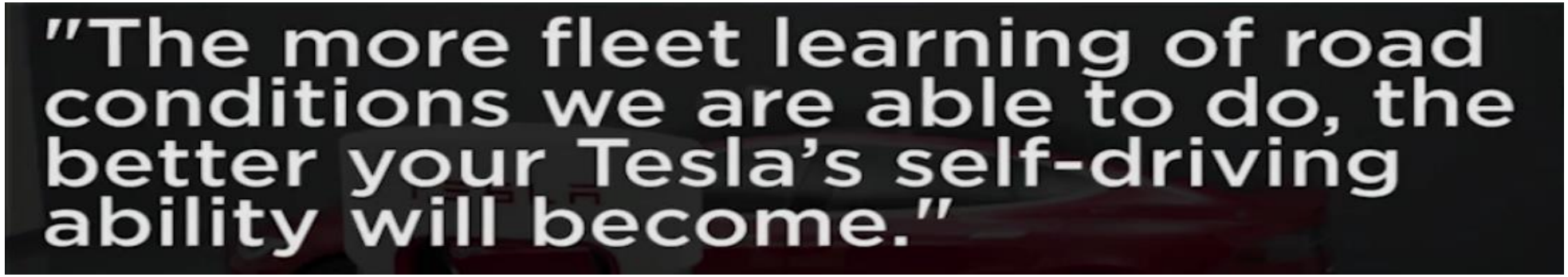
MISSING PIECES

- Ubiquitous connectivity
- Inter-vehicle communication
- Data collection, aggregation, interpretation, sharing
- Monetization of data – data brokering
- Historical -> Real-time -> Predictive
- Artificial intelligence
- Machine learning
- Neural networks

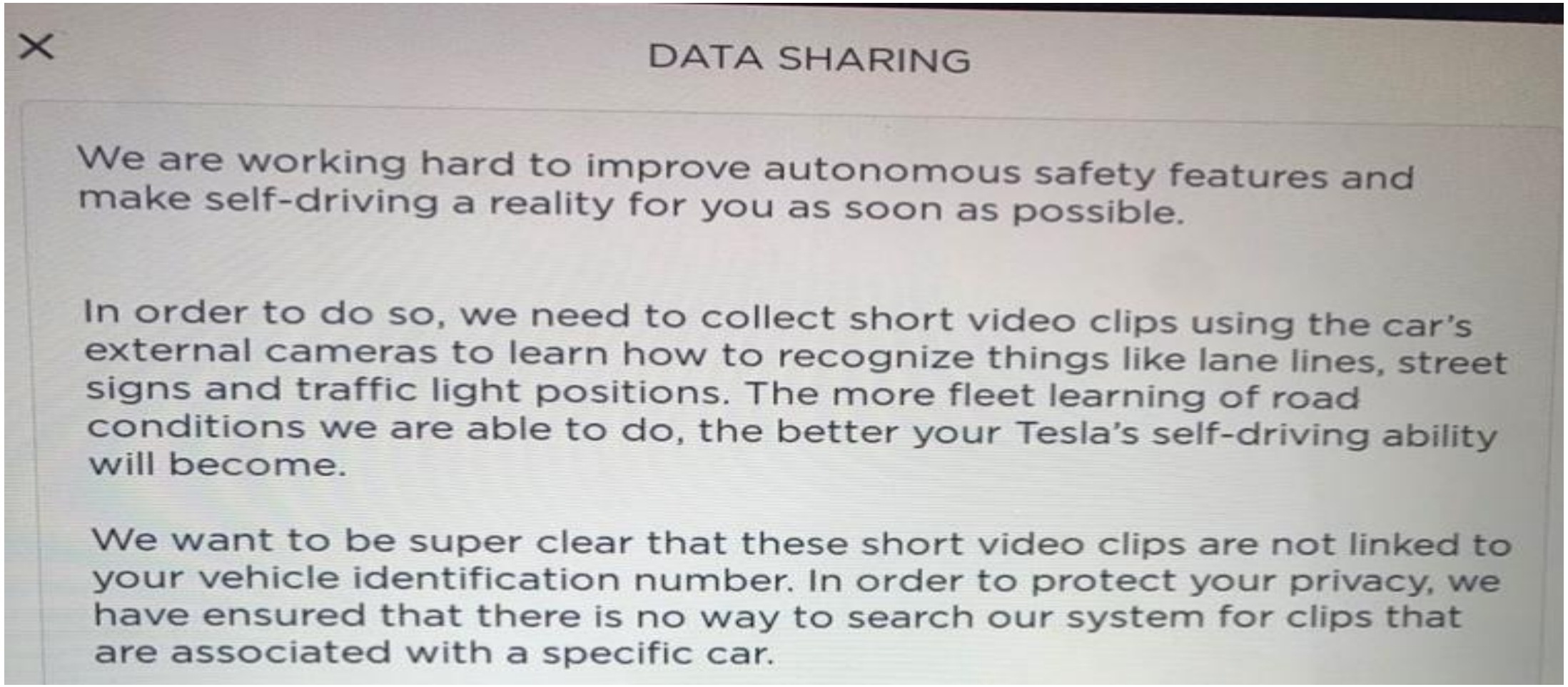
- It’s more than just automotive…

WHAT'S CHANGED? DATA, 5G

- Smartphone on wheels
- "Data" is the new fuel driving the industry
- Driver access to vehicle data
- Driver control of vehicle data
- Transparency + control = trust
- Prioritizing privacy – Europe's GDPR



TESLA UPS THE DATA GAME



DAIMLER DATA EXCHANGE

Allianz, Axel Springer, Daimler, Deutsche Bank with Postbank, Core, and Here to launch joint platform for online registration, e-identity and data services

Frankfurt am Main, May 8, 2017

Press Contact for this Press Release (1)

- **"Master key" planned for online activities and public authorities**
- **Initiative seeks to provide competitive, European response to international platform economy**
- **German federal ministries welcome initiative**

Leading German and European companies have stated their intention to cooperate more closely to establish a joint, pan-industry platform for online registration, e-identity and data services. The aim is to make online registration simpler and more secure for clients. The participating companies have signed a corresponding declaration of intent. The initiative was set up by Allianz, Axel Springer, Daimler and Deutsche Bank with Postbank as well as the technology think-tank Core, and Here Technologies, the location services provider.

WHAT'S AT STAKE?

- True IoT experience – Product Life-Cycle Management
- Access to data
  - E-commerce, banking
  - Insurance
  - Warranty cost avoidance
  - Smart city applications
  - Crowd sourcing – parking, lights
  - Law enforcement
  - Emergency services
- Perpetual product development
- Data brokering
- Always on connectivity
- Monetized connections

POST-MWC 5G OUTLOOK

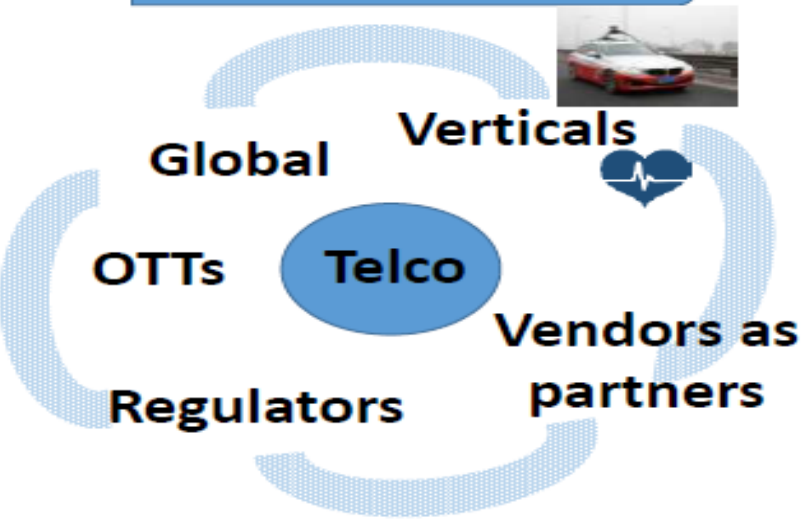
MWC = Mobile World Change : Reinvention

Services Δ

- we are in the middle of service reinvention
  - 3rd party: open APIs
  - Relevant: analytics +AI
  - QoS/slicing
  - Cloud
  - Convergence fixed+mobile

Networks Δ

Ecosystem Δ



Mindset Δ

flexibility / agility / collaboration / innovation /dev ops

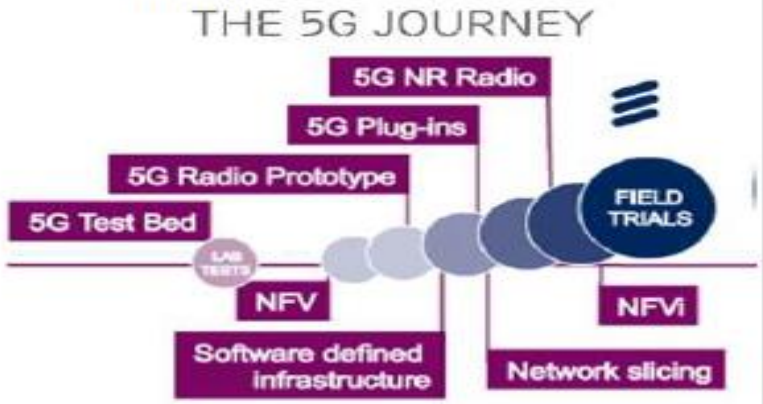
POST-MWC 5G OUTLOOK

Hybrid & Pre-5G Solutions in Commercial Trials with 5G E2E Platforms Emerging

- Gigabit LTE on show in components, smartphones & networks
- Non-standard pre-5G solutions on track for 2017 commercial services, strong fixed wireless support
- Family of 5G modems announced for large-scale trials and commercial deployment in 2019.
- 5G ready E2E platforms unveiled - Cloud RAN, C-RAN and vRAN "virtually everywhere"
- But strong support to accelerate 5G New Radio (NR) Standard

Huawei 4.5G Evolution Bridging to 5G

ZTE BBU



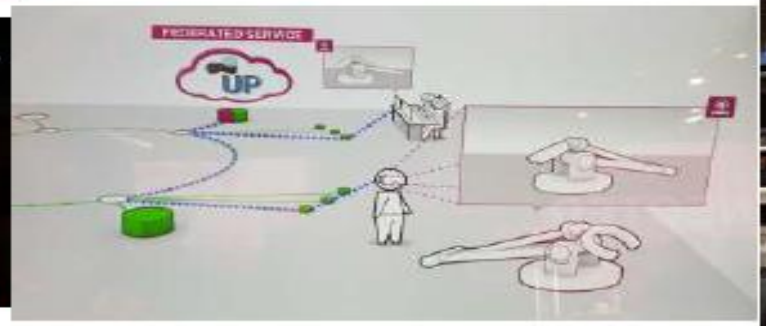
Source: Ericsson '5G Journey'

POST-MWC 5G OUTLOOK

Path to 5G via Network Slicing

Network slicing demos showed potential benefits of 5G

- **Deutsche Telekom live demo of 3 use cases with network slicing**
- **SK Telecom, DT, Ericsson partnered to show federated network slicing**



STEPS ON THE PATH TO V2V

- Vehicle to call center to vehicle (1997)
- Smartphone to smartphone (2007)
- Vehicle to cloud to vehicle (2017) – (2017 Cadillac – DSRC V2V)
- C-V2X – 2020
- Increasingly seen as essential to automated driving

MERCEDES: CELLULAR-BASED V2NOV

[1] Delayed availability. See your dealer.
Car-to-X services operate only where cellular and Global Positioning System satellite signals are available, which are provided by third parties and not within the control of Mercedes-Benz USA, LLC. Five years of the service are included, starting on the original retail sale or lease date from an authorized Mercedes-Benz dealer. System cannot detect and/or report every road hazard, and its effectiveness depends on the presence of other vehicles equipped with Car-to-X Communication. It is the driver's responsibility at all times to be attentive to traffic and road conditions, and to provide the steering, braking and other driving inputs necessary to retain control of the vehicle.

Drivers View

E-Class Car-to-X View

You can't see around corners. But your E-Class can.

World-first "Car-to-X" technology connects your E-Class to a central information resource, to send you in-car updates about driving conditions before you get to them. Your car can also report hazards, to help other E-Class drivers. [1]

DISRUPT CONNECTIVITY

Volvo's vision of V2V

DISRUPT CONNECTIVITY

BMW's vision of V2~~I~~V

VMS to dashboard

At intersections where there are dedicated traffic signals for turns, the activation of the vehicle's turn indicator tells the app of the driver's intention to turn so that only the status of the relevant signal is displayed.

SPAT to dashboard

ConnectedDrive permits a regular automatic navigation map update. The data are transferred "over the air" using the mobile SIM card installed and there are no licence charges or transmission costs for the user.

Map updating, editing

WILL EVERY CAR BUILD MAPS?

… and shares the data it collects

FROM CALL CENTERS TO AI

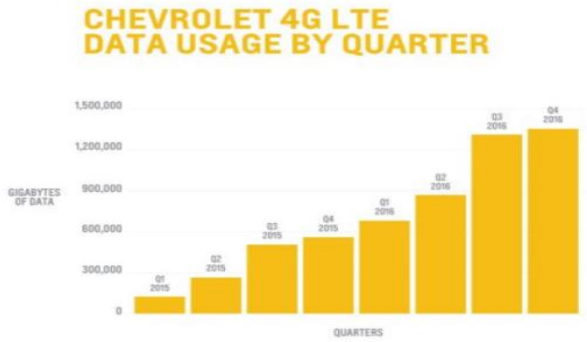
Call Center

amazon alexa

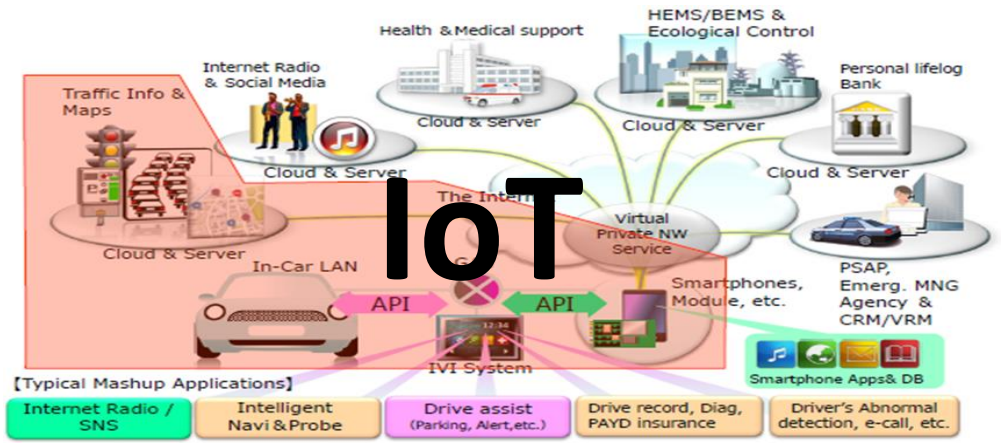
Google

A.I.

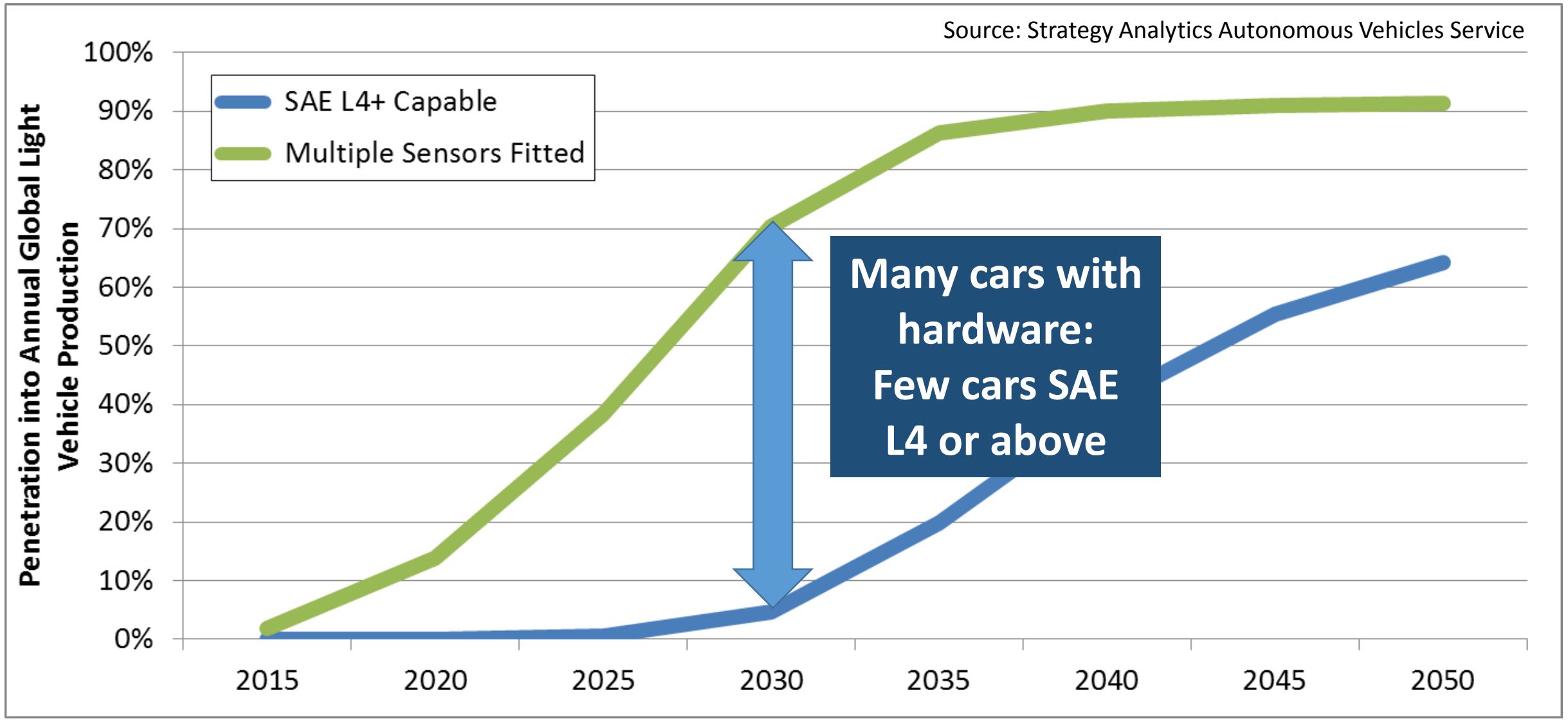
IBM Watson



Wi-Fi



AUTONOMOUS IS A SOFTWARE PROBLEM



LEVEL 4 ON THE ROAD TODAY

Vendor	Areas of Interest
2getthere	Autonomous Vehicle Infrastructure
Auro Robotics	Self-Driving Pods
Aurora Robotics	Civil and Military Robots
CityMobil	Autonomous Vehicle Hardware and Development Platform
EasyMile	Self-Driving Pods
GATEway (TRL)	Autonomous Vehicle Infrastructure
Induct Technology	Information Technology and Services
Local Motors	3D Printed Vehicles
NAVYA	Autonomous Vehicle Infrastructure

LEVEL 4 ON THE ROAD TODAY

Vendor	Areas of Interest
Next-Future-Mobility	Autonomous Vehicle Infrastructure
RDM Group	Manufacturing
Robosoft	Software Solutions for Robotics
Robot Taxi	Fully Autonomous taxi
SB Drive Corp.	Autonomous Vehicle Hardware and Development Platform
Transport Systems Catapult	Research & Tech Institute
Varden Labs	Self-Driving Pods
WePod	Self-Driving Pods
Yandex	Computer Software
Zoox	Self-Driving Pods

V2V/V2X

- Market development HIGHLY dependent upon mandates – C-V2X offers an organic path to market adoption
- 802.11-based approaches seen as having huge business model challenges by Strategy Analytics. Who will pay for new, automotive-specific infrastructure?
- LTE/5G approaches including C-V2X can overcome these issues
  - Latency-critical applications should rely on on-board sensors
  - Yes, network coverage is not universal – but it is a lot wider than a dedicated automotive network could hope to be in any reasonable timeframe
  - 5G peer-to-peer capabilities will allow V2V even without network coverage
- Smartphones and apps
  - Speed to market; Consumer familiarity
  - Ubiquitous usage/device ownership
  - Global Mobile Alert, Haas Alert, Ridar Systems

V2I: THE MISSING PIECE

- To escape geo-fencing – automated driving will need vehicle to infrastructure communications
- Cellular is best positioned to enable V2I at low cost and within a short time horizon
- Cellular infrastructure can be reused as RSU, particularly for C-V2X

THE GOAL!

IF WE FAIL…

CONCLUSIONS

- Ubiquitous connectivity is transforming how vehicles are used and owned
- Monetization of data will pay for connectivity
- Autonomous vehicles are already here – Cellular V2I is the essential application to open up autonomy in urban areas
- Privacy, security concerns must be overcome to enable this new connectivity environment
- Data sharing and inter-vehicle communications are in the process of being resolved today
- 5G collaboration between automotive and wireless industries is a game changer for solving these challenges

ANY QUESTIONS?