CHALLENGES AHEAD IN AUTOMOTIVE ELECTRONICS

Dr.Jean-Luc di Paola-Galloni
Corporate VP Valeo -
President Inside IA
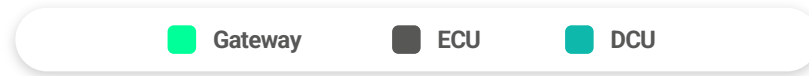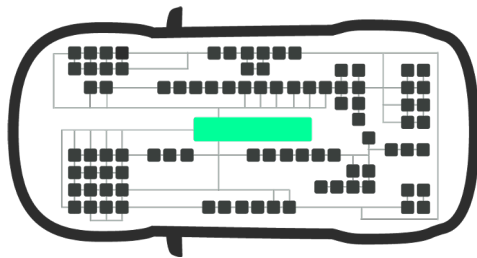**Chair of the Private members board of ECSEL**
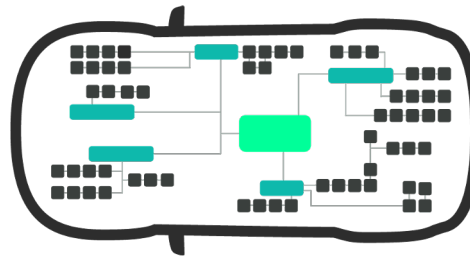
ELECTRIC AND ELECTRONICS ARCHITECTURE IS EVOLVING FROM INDEPENDENT, FUNCTION-SPECIFIC ECUs TOWARDS A CENTRALIZED ARCHITECTURE
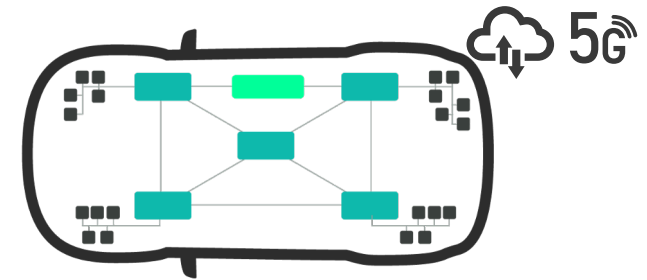
■ Gateway	■ ECU	■ DCU

TODAY **Distributed**	**TOMORROW** **Domain Centralization**	**FUTURE** **Vehicle Centralized / Virtual Domain**

Distinctive hardware platforms, limited HW abstraction　　　*Single software platform, full hardware abstraction*

TECHNOLOGY

· 80-100 ECUs · Multiple CAN, LIN, Ethernet, Flexray, MOST communication links	· 4-5 high-performance DCUs · Multiple sensor/actuator ECUs · 1 CAN bus per zone · 1 Ethernet backbone	· Cluster of high-performance computers · Multiple sensors/actuator ECUs · 1 CAN bus per zone · 1 Ethernet backbone

CHARACTERISTICS

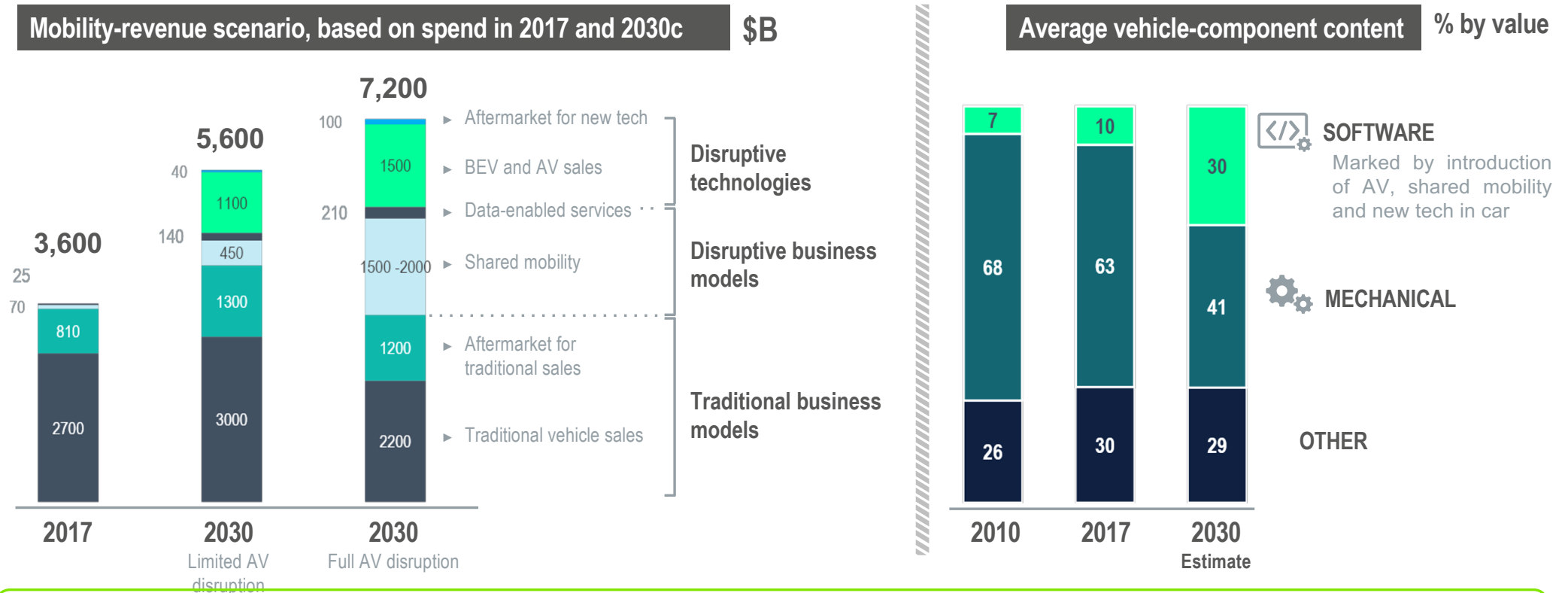|		
· Distributed control · Many nodes · Inter-communication via central gateway	· Dedicated domains · Consolidation of functions in DCUs · Routing between DCUs handled by advanced gateway	· Virtualized functions executed in high performance computers · Zone-dependent sensors/actuator ECUs (domain-independent, scalable) · Routing complexity handled by advanced gateway

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AUTOMOTIVE CONTROL CHIPS EVOLVE FROM SIMPLE MICROCONTROLLER UNITS TO ADVANCED ARTIFICIAL INTELLIGENCE ENGINES

	AUTOMOTIVE MCU	AUTOMOTIVE MCU	AI ENGINE
	16 bit	**32 bit**	**64 bit**
	Legacy Product	**Next Gen MCU**	**AI Engine**
	(e.g. ST Micro ST10)	(e.g. Infineon Aurix)	(e.g. Tesla FSD chip)
CHIP DESIGN	● Single core	● Up to six Tricore CPUs	● 12 CPUS + 2GPU + 2NPU
CHIP SIZE	● 180nm manufacturing node	● 65 and 90nm	● 14nm
PINS	● 144 pin package	● 80-516 pins	● 2,116 pins
CHIP COST	● <10 USD typical	● 10s of USD	● 100s to 1000s of USD
APPLICATIONS	● Monolithic – single task applications	● Wide application range: e.g. domain control, chassis, safety, engine, ADAS	● L4/L5 autonomous driving

INCREASING RANGE OF APPLICATIONS, COMPLEXITY OF ARCHITECTURE, MANUFACTURING AND COST

1990s	2000s	2019

Source: Roland Berger - Computer on Wheels - January 2020

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THERE IS VALUE IN THERE: NEW PROFIT POOLS ARE ON-GOING

Mobility-revenue scenario, based on spend in 2017 and 2030c — $B

7,200
- 100
- 1500 — ► Aftermarket for new tech — Disruptive technologies
- 210 — ► BEV and AV sales
- 1500 — ► Data-enabled services — Disruptive business models
- 1500 - 2000 — ► Shared mobility
- 1200 — ► Aftermarket for traditional sales — Traditional business models
- 2200 — ► Traditional vehicle sales

5,600
- 40
- 1100
- 140
- 450
- 1300
- 3000

3,600
- 25
- 70
- 810
- 2700

2017

2030 Limited AV disruption

2030 Full AV disruption

Average vehicle-component content — % by value

2010
- 7
- 68
- 26

2017
- 10
- 63
- 30

2030 Estimate
- 30
- 41
- 29

SOFTWARE Marked by introduction of AV, shared mobility and new tech in car

MECHANICAL

OTHER

Electric and autonomous vehicles will unlock new potential as revenues fragment from traditional streams and software content increases

Source: Mckinsey - How sharing the road is likely to transform American mobility - April 2019

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AUTOMOTIVE HW/SW MARKET IS EXPECTED TO GROW (ANNUAL CAGR OF 7% UNTIL 2030), DRIVEN BY POWER ELECTRONICS, SW, AND ECUS/DCUS

AUTOMOTIVE SW and E/E MARKET

$ billions
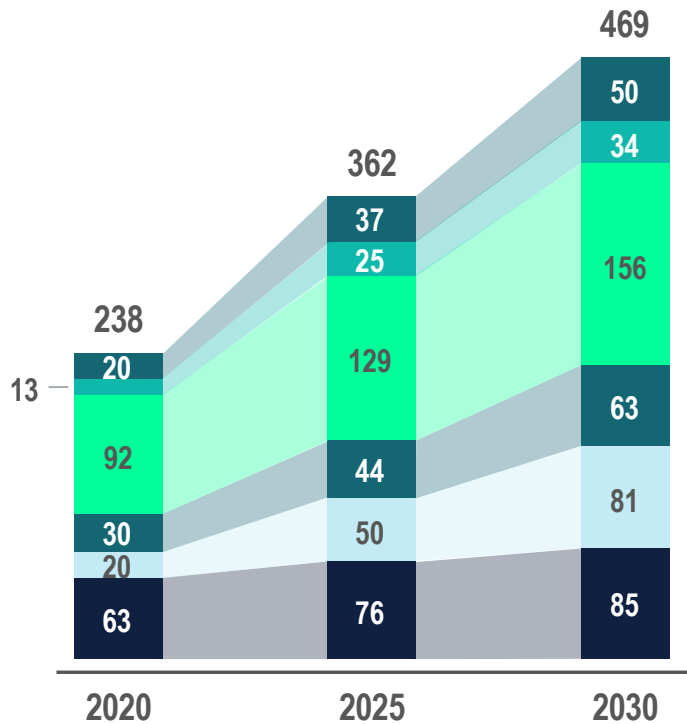
Components	CAGR 2020-30
▸ SW (functions, OS, middleware)	+9%
▸ Integration, verification & validation services	+10%
▸ ECUs/DCUs	+5%
▸ Sensors	+8%
▸ Power electronics (excl. Battery cells)	+15%
▸ Other electronic components (harnesses, controls, switches, displays)	+3%
TOTAL	**+7%**

Total electronics & SW by geography in 2030

🇪🇺	EU	112
🇨🇳	China	161
🇺🇸	US	
🇨🇦	Canada	68
🇲🇽	Mexico	
🇰🇷	Korea	
🇯🇵	Japan	50
🌐	RoW	78
TOTAL		**469**

Automotive sales   **$ billions**

2020	2025	2030
2,755	3,027	3,800

CAGR 2020-30   **+3%**

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AT THE SAME TIME, PROCESSOR COSTS ARE INCREASING
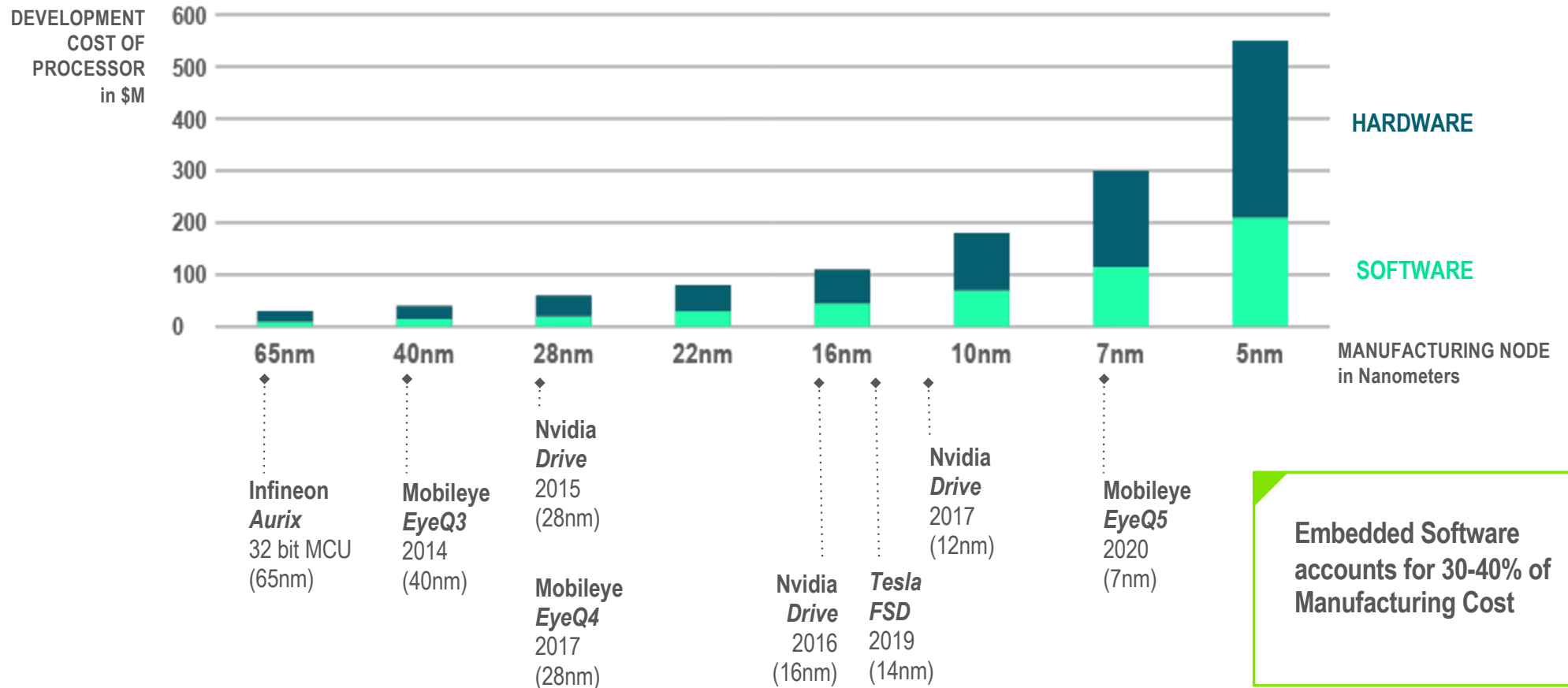
Source: Roland Berger - Automotive disruption radar 7

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CONNECTIVITY IS ALSO BRINGING NEW CHALLENGES & COST ALLOCATIONS

GLOBAL PENETRATION OF CONNECTED CARS

% of new light-vehicle sales by connectivity level

Value Pool

$450B-$750B

45% new revenues
40% cost reductions
15% improved safety & security

General hardware connectivity:
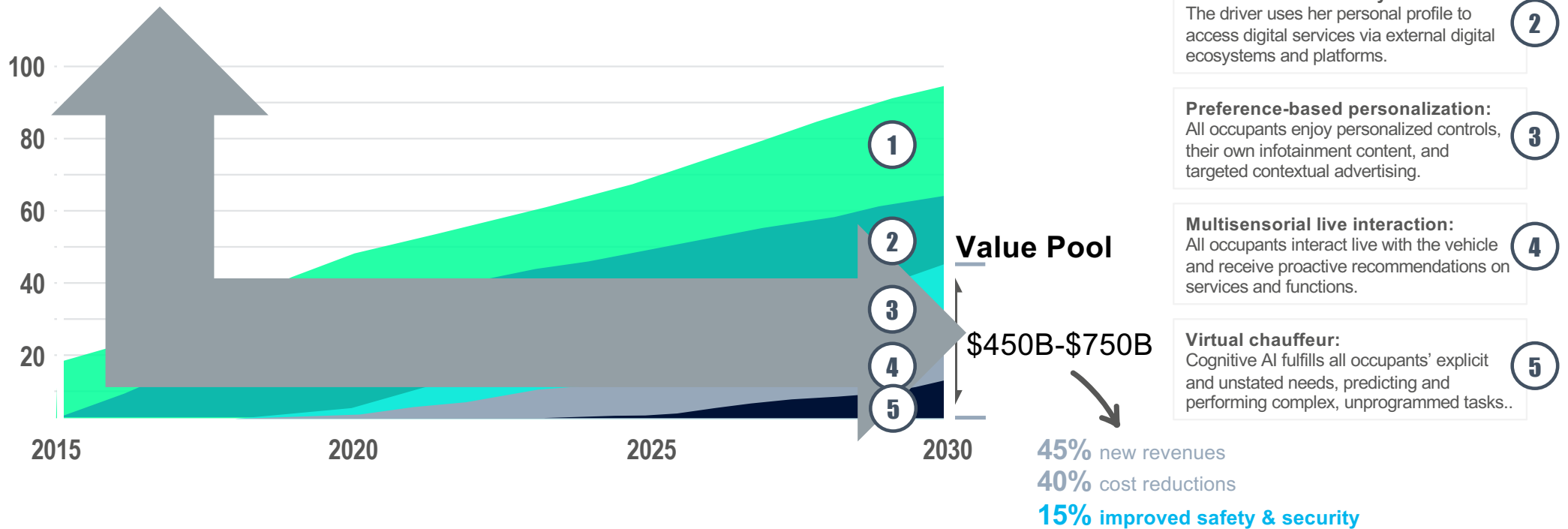The driver is able to track basic vehicle usage and monitor technical status. ①

Individual connectivity:
The driver uses her personal profile to access digital services via external digital ecosystems and platforms. ②

Preference-based personalization:
All occupants enjoy personalized controls, their own infotainment content, and targeted contextual advertising. ③

Multisensorial live interaction:
All occupants interact live with the vehicle and receive proactive recommendations on services and functions. ④

Virtual chauffeur:
Cognitive AI fulfills all occupants' explicit and unstated needs, predicting and performing complex, unprogrammed tasks.. ⑤
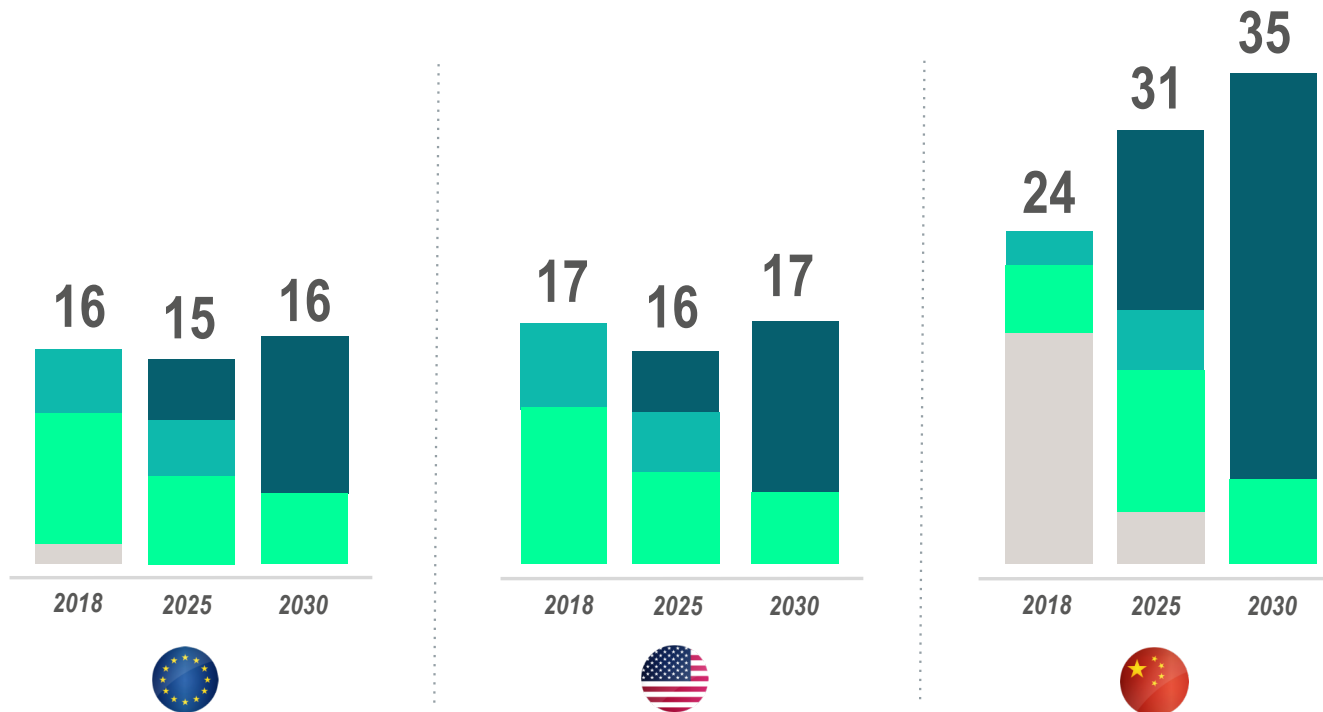
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TECHNOLOGY IS EXPECTED TO SHIFT FROM 3G/4G TOWARDS 5G READINESS

MARKET OUTLOOK OF CONNECTED VEHICLES IN TOTAL NEW VEHICLE SALES BY 2030   M units
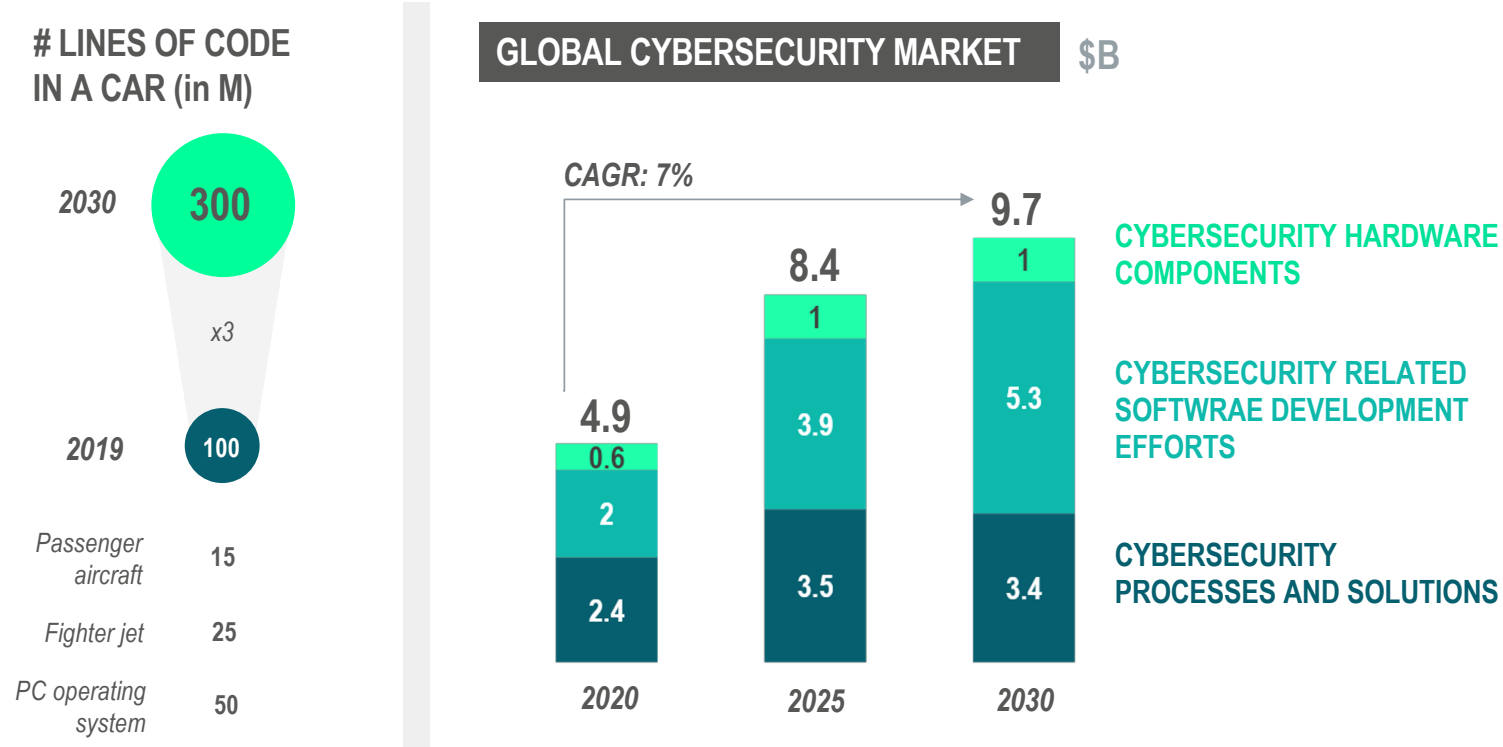

Legend: ☐ 0G ▪ 2G/3G ▪ 4G ▪ 5G

Around 70% of new cars will be 5G connected by 2030 ; 4G will only be a temporary solution

5G will be key enabler for new connected services and shift towards cloud-based vehicle architecture

GROWING SOFTWARE CONTENT AND NEW REGULATION WILL DRIVE NEED FOR CYBERSECURITY STRATEGY IN AUTOMOTIVE VALUECHAIN

LINES OF CODE IN A CAR (in M)

2030 — 300

x3

2019 — 100

Passenger aircraft	15
Fighter jet	25
PC operating system	50

GLOBAL CYBERSECURITY MARKET — $B

CAGR: 7%

2020 — 4.9
- 0.6
- 2
- 2.4

2025 — 8.4
- 1
- 3.9
- 3.5

2030 — 9.7
- 1
- 5.3
- 3.4

CYBERSECURITY HARDWARE COMPONENTS

CYBERSECURITY RELATED SOFTWRAE DEVELOPMENT EFFORTS

CYBERSECURITY PROCESSES AND SOLUTIONS

Cybersecurity will become non-negotiable under the new UNECE WP.29 regulations to obtain vehicle type approval. This will affect 60 countries (~20M passenger vehicles)

Source: Mckinsey – Cybersecurity in Automotive – March 2020

GREEN ECS & DECARBONISATION

Quantification
Limited assessments on electronics components carbon footprint / non-harmonized method and disclosure

End of life management
Products & used materials recyclability evaluation / limited recyclability rates of ECS

RESEARCH NEEDS

Quantification
Build a common shared database and carbon assessment methodology, integrating the role innovation on HW

End of life management
Products & used materials recyclability - need for research projects

Decarbonisation is part of KDT priorities - first workshop organized (June 2021)

Proposal to develop shared use cases & methodology work in KDT upcoming calls

ENABLE SHARED BENEFITS BETWEEN AUTOMOTIVE & ELECTRONICS VALUE CHAIN: PROPOSALS FOR COOPERATION

Reinforce a shared understanding
to cross exchange on HW, SW, architectures, systems optimization, etc.

Share the best talents
Ramping up of recruitment and retention of talents, trained together in order to fit the needs of both sectors

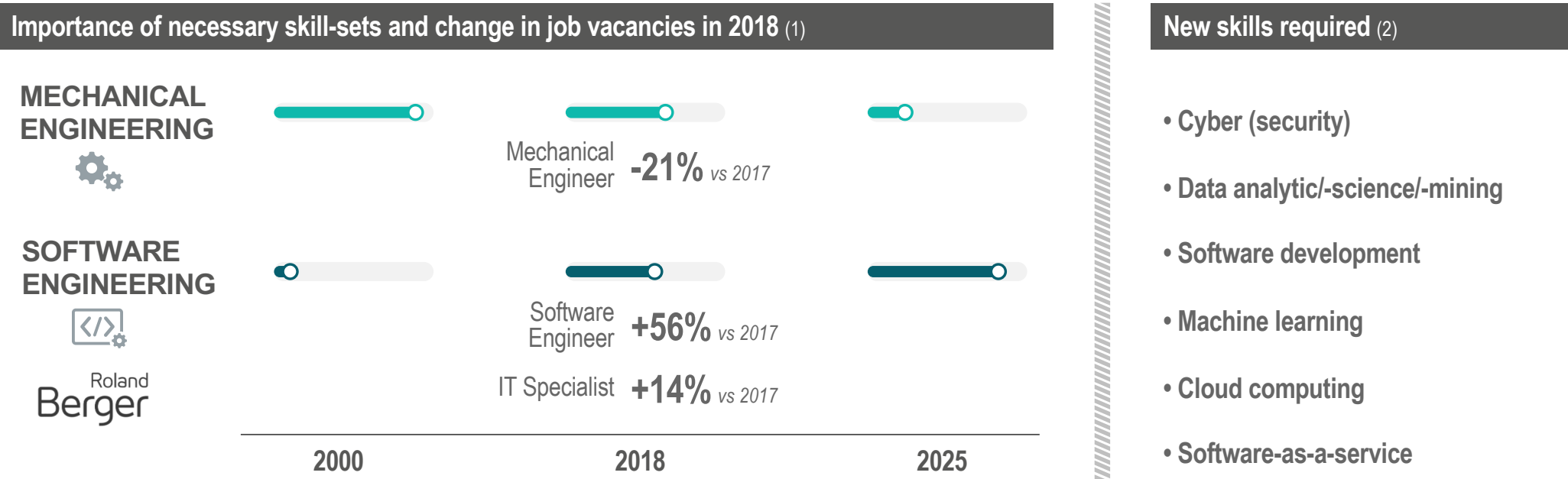**Set up strategic partnerships**
Secure the capacities and shared roadmaps

Build a regional approach
Competition is though, regional approaches will emerge, let's the EU electronics & automotive value chain work together

Sustainability
Address the carbon reduction challenge of electronics

FIND THE RIGHT TALENTS: THE REQUIRED SKILL-SET IS CHANGING

Importance of necessary skill-sets and change in job vacancies in 2018 [1]

MECHANICAL ENGINEERING

Mechanical Engineer **-21%** *vs 2017*

SOFTWARE ENGINEERING

Roland Berger

Software Engineer **+56%** *vs 2017*

IT Specialist **+14%** *vs 2017*

2000   2018   2025

New skills required [2]

- Cyber (security)
- Data analytic/-science/-mining
- Software development
- Machine learning
- Cloud computing
- Software-as-a-service

[3] **According to Mckinsey, by 2030 there will be :**

McKinsey

250K Software development jobs → **~30%** of these Software jobs in ADAS / AD and Infotainment

Source: (1) Roland Berger - Global Automotive Supplier Study 2019 (2) PWC - Digital Auto Report 2019 (3) Mckinsey - Automotive Software and Electronics 2030 - July 2019

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SMART TECHNOLOGY
FOR SMARTER MOBILITY