Semiconductors supporting the evolution of automotive systems

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- Among the world's largest semiconductor companies

- Serving over **100,000** customers across the globe

- 2018 revenues of **$9.66B,** with year-on-year growth of **15.8%**

- Listed: NYSE, Euronext Paris and Borsa Italiana, Milan

- Signatory of the United Nations Global Compact (UNGC), Member of the Responsible Business Alliance (RBA)

- **~46,000** employees worldwide

- **~ 7,400** people working in R&D

- **11** manufacturing sites

- Over **80** sales & marketing offices

As of December 31, 2018

Application Approach

Leverage broad and deep knowledge of automotive systems to develop solutions optimized for targeted vehicle subsystems

- Chassis & Safety
- ADAS
- Powertrain for ICE
- Electro-mobility
- Body & Convenience
- In-vehicle Infotainment
- Telematics & Networking
- Mobility Services

Market Approach

Partnerships with Car Manufacturers, Tier 1's and technology leaders

Partnerships with Distribution Including full kit solutions

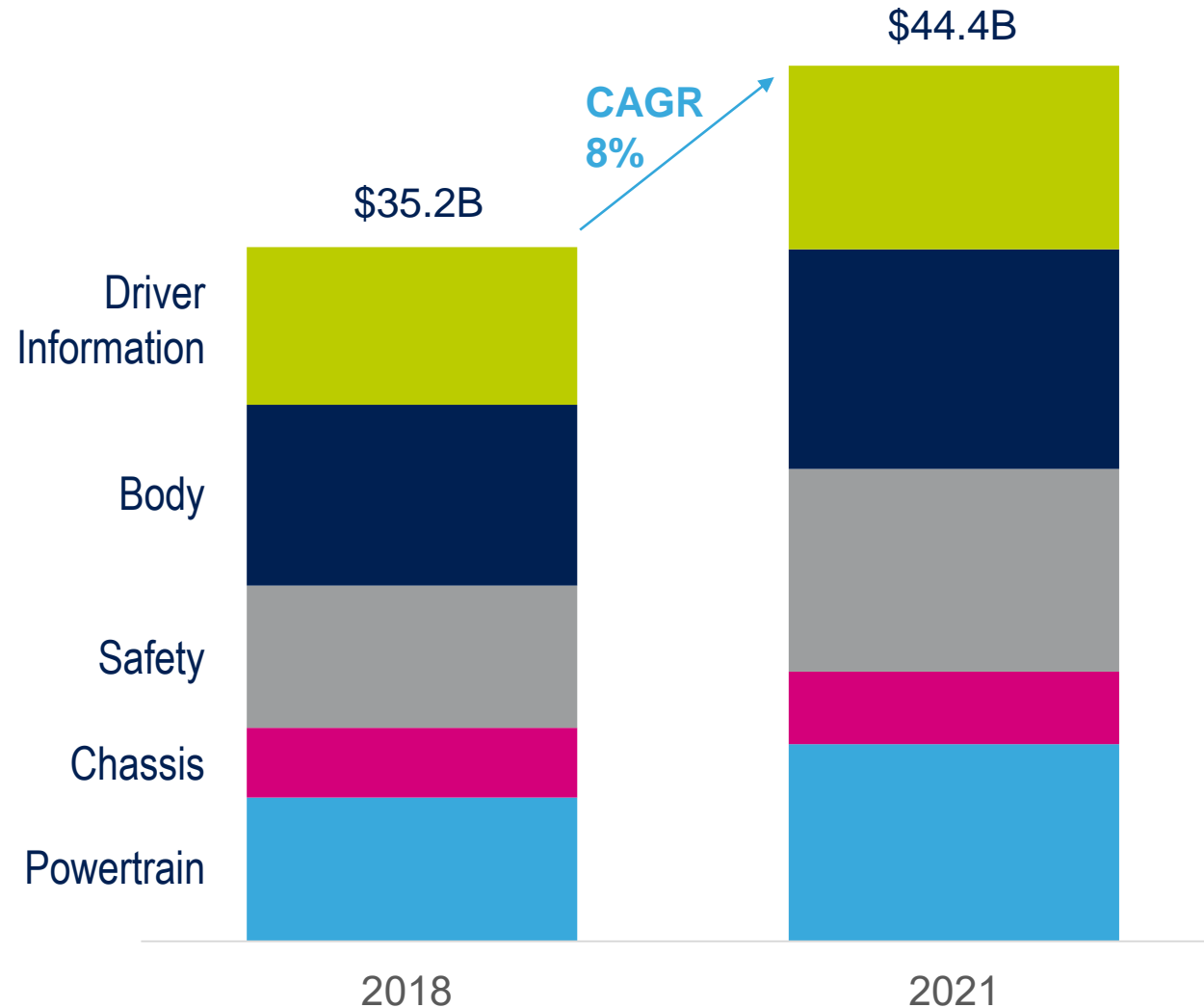Partnerships for long-term success in China

ST Strategy

- Investment in technology, product and manufacturing capabilities to support leadership objectives

- Leverage Silicon Carbide disruption to lead the car electrification transformation

- Leverage car architecture change through advanced Automotive domain controllers (MCU)

- Partnership with ADAS and V2X Leaders

- Continue leadership in traditional areas thanks to product and technology roadmap

Automotive Semiconductor Market
Strong Existing Positions – Building in New Areas

$35.2B (2018) → $44.4B (2021), CAGR 8%

Bar chart categories (2018 and 2021): Driver Information, Body, Safety, Chassis, Powertrain

Rank	Logic
1	STMicroelectronics

Rank	Power
1	Infineon
2	STMicroelectronics

Rank	Analog
1	Texas Instruments
3	STMicroelectronics

Rank	Processors
1	NXP
7	STMicroelectronics

Rank	Sensors
1	Bosch
10	STMicroelectronics

Source: Strategy Analytics

Automotive Market
Content and Volume Growth

Vehicle Production (Million Units)

Year	TRIAD	China	ROW	Total
2018	46	27	22	95
2019	46	27	22	96
2020	47	28	23	99
2021	47	30	24	101
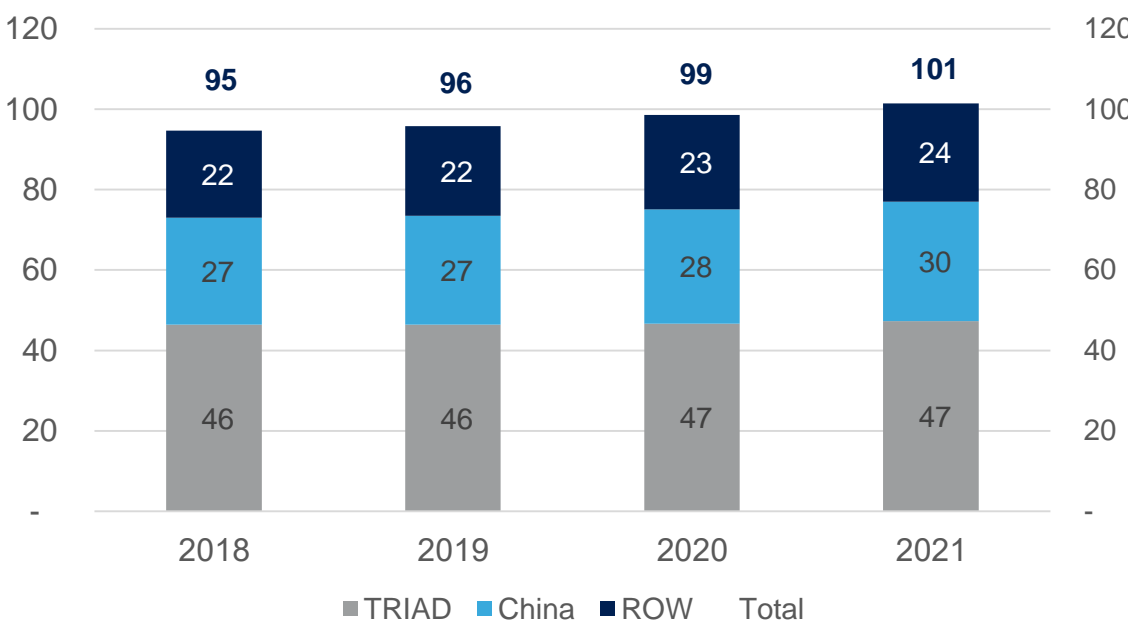
CAGR 2018-2021: **+2.3%**

Semiconductor Content ($)

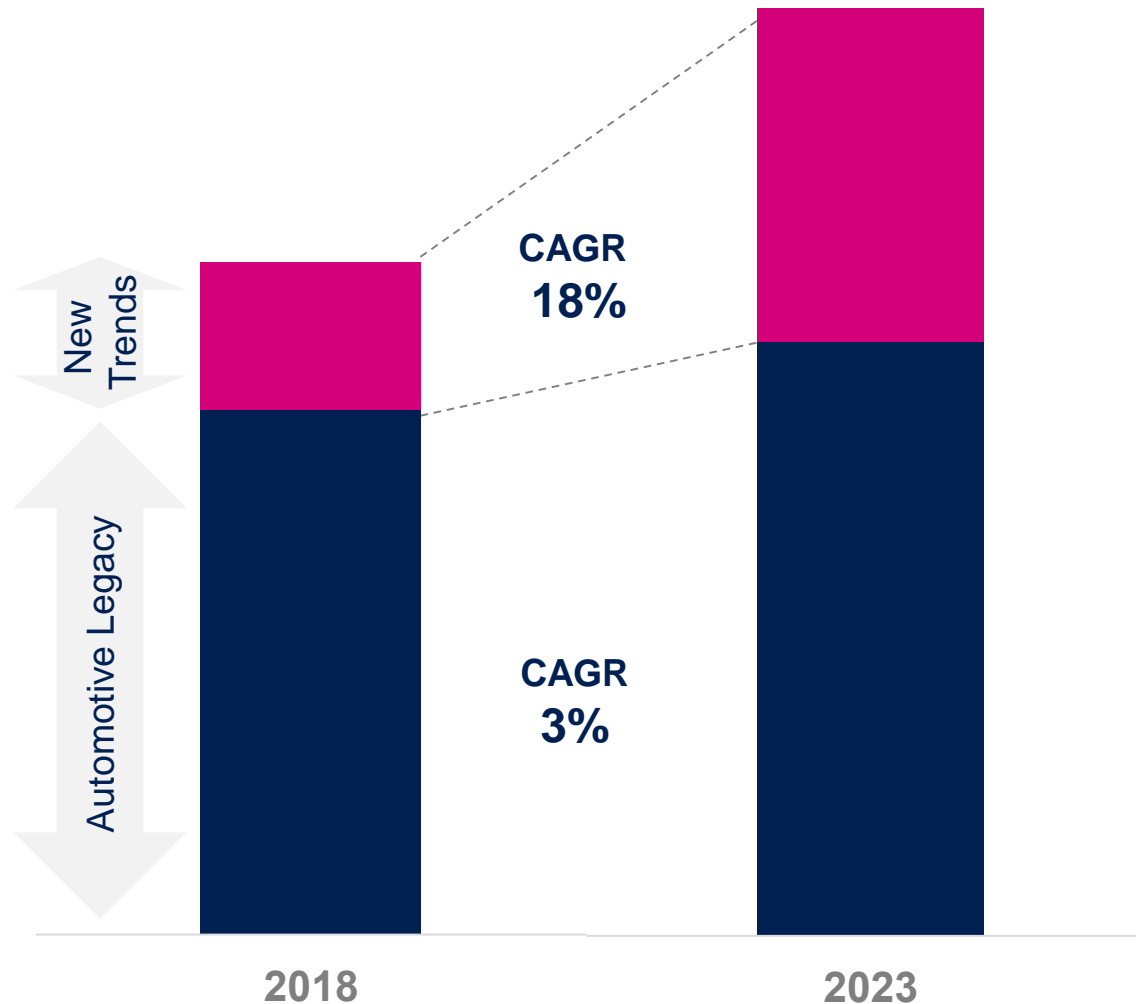| Year	China	TRIAD	ROW	World AVG
2018	$339	$540	$282	$424
2019	$361	$573	$296	$449
2020	$389	$602	$309	$471
2021	$417	$631	$319	$493
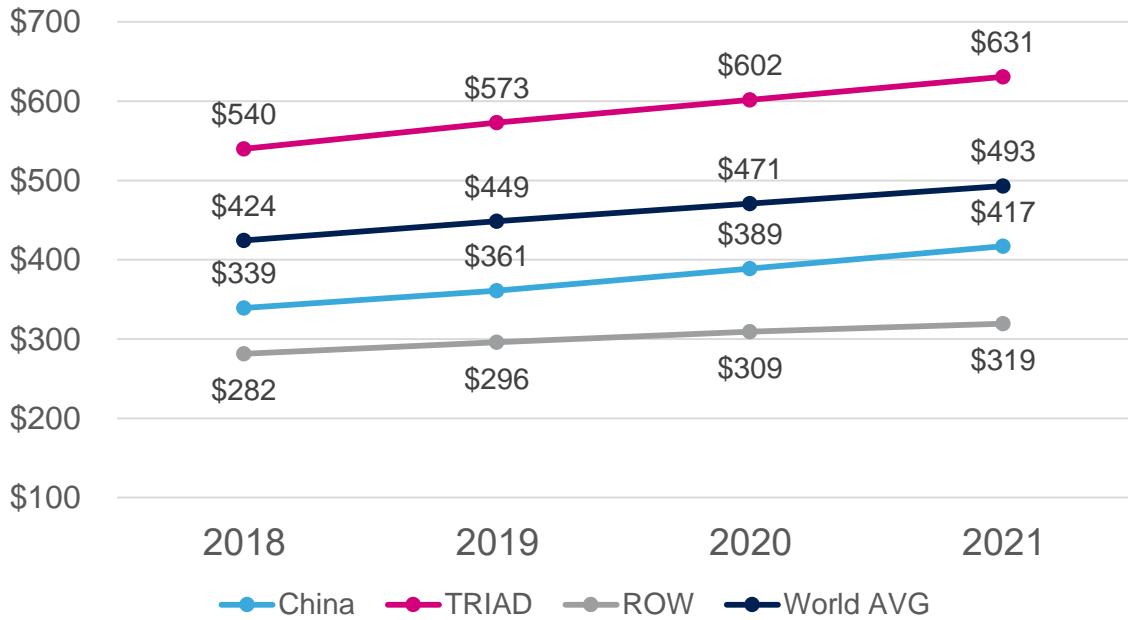
CAGR 2018-2021: **+5.1%**

TRIAD : Europe-US-Japan

Source: Strategy Analytics

Electrification & Digitalization
Driving Growth

**Car Digitalization
& Car Electrification**

Growth driven by silicon pervasion, with smaller impact from growth of car volumes

Automotive Legacy Electronics

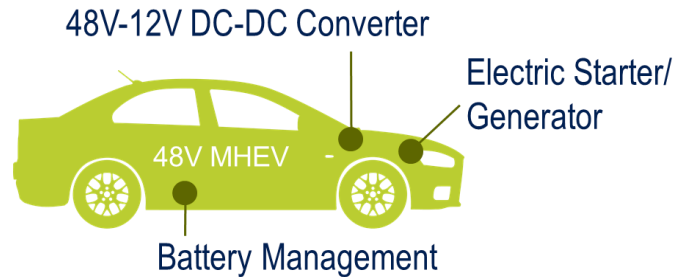Growth linear with the car volumes
Exposed to market cycles

New Trends

Automotive Legacy

CAGR **18%**

CAGR **3%**

2018

2023

Source: Strategy Analytics

Car Electrification
ST Leading with Disruptive Technologies

Mild Hybrid 48V
Low-end entry level electrification

- 48V-12V DC-DC Converter
- Electric Starter/ Generator
- 48V MHEV
- Battery Management

Battery Electric Vehicle
High-end battery-based full electric car

- On-Board Charger
- DC-DC Converter
- Traction Inverter
- BEV
- Charge Station
- Battery Management
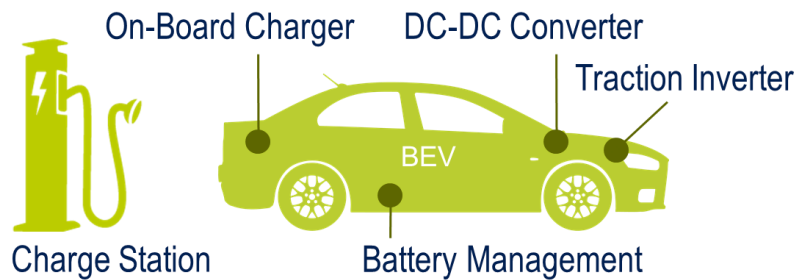
Electric Cars

Electric Car Production (Millions)

2018	2023
7.5	25.4
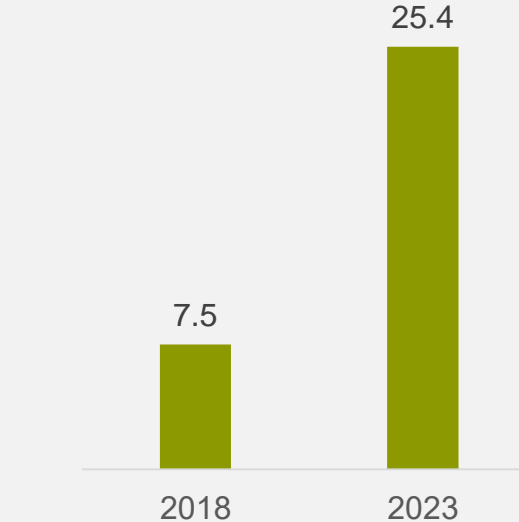
$396 Average Content per BEV/HEV **$493**

Powertrain Electrification

ST SAM

2018	2023
$2.6B	$6.5B

CAGR 20%
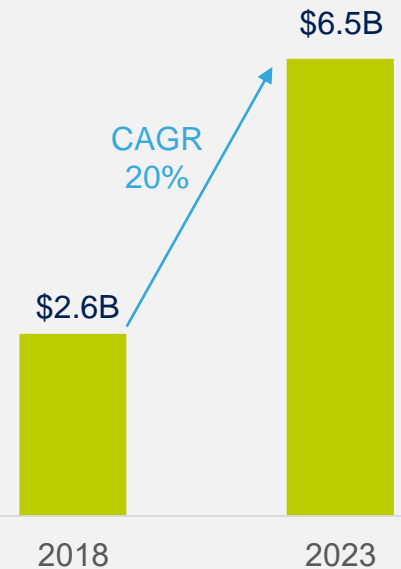
Includes: BEV, mild hybrid, plug-in hybrid, fuel cell electric vehicle, full hybrid

Source: Strategy Analytics

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Silicon Carbide: Business Status

**>$100**^{M}

SiC MOSFETS /Diodes Revenues in 2018

➡ **>$200**^{M}

2019 Projection

>10$^#$ OEM in production with ST SiC MOSFET

8 European Car-Makers ramping-up by 2019-20

RENAULT NISSAN MITSUBISHI

Partnering with **Renault Nissan Mitsubishi** on several SiC projects

HYUNDAI

Cooperating with **Hyundai Kia Motor** on several **SiC** MOSFET & Diodes

ST Strategy and Execution

Next Gen

x2 shrink   **x4** shrink

1st Gen.   **2**nd Gen.   **3**rd Gen.

gate oxide   Poly Gate

SiC   TEOS

Trench Technology

SiC Supply Chain
Vertical Integration Norstel AB

Extended and **Secured** Supply Chain capability through Multi-Year supply agreement with **Cree-Wolfspeed**

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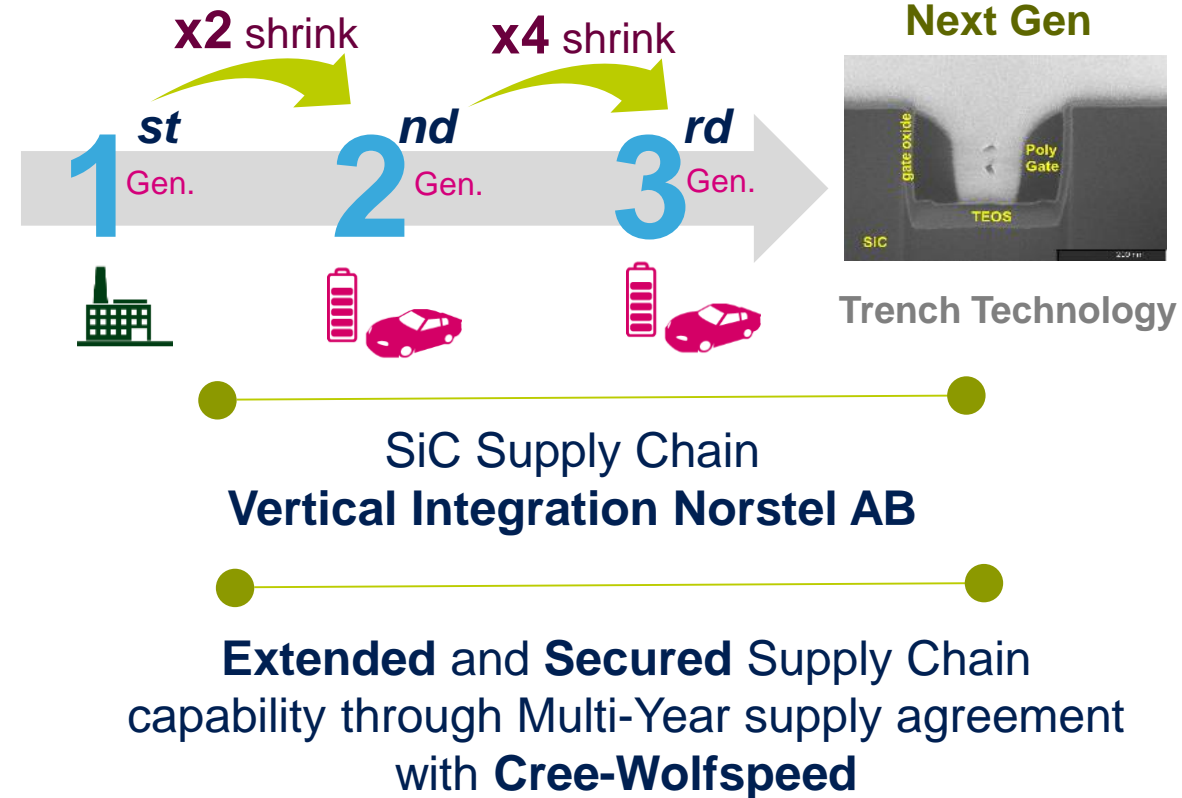
Silicon Power Innovation
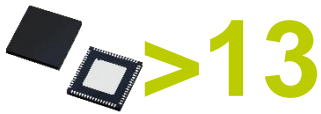## Electrification Beyond Silicon Carbide

Battery Management up to 800V to support the Chinese electrical mobility market

Innovative cell monitoring architecture in cooperation with ~10 Chinese car makers and IMECAS as part of "China 2025" national program
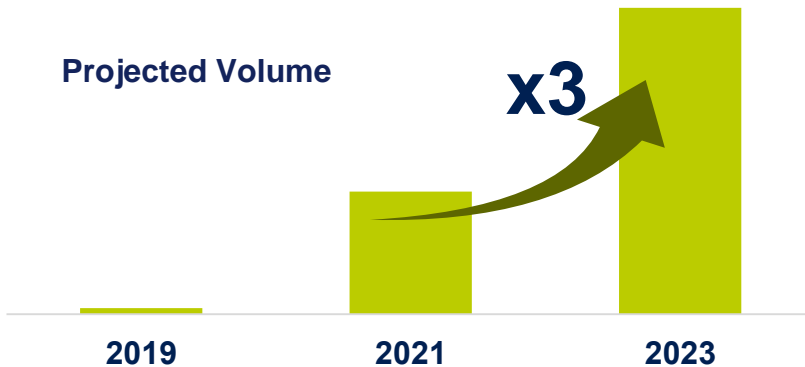
Lithium cell monitoring

Devices per Vehicle

>13

Suitable for **Hybrid** and **Full** Electrical vehicles

Projected Volume

x3

2019　　2021　　2023

IGBT for EV applications

> 15 OEMs in production in '19

Agrate Fab

300mm

STPOWER

Investing in new Facilities to sustain **Power Silicon** solution growth

Solution for Mild-Hybrid vehicle (48V)

Tailored Low Voltage **MOSFET suitable for 48V systems**
➔ Already in production in multiple Hybrid Cars with Top Car Makers in EU, US and Asia

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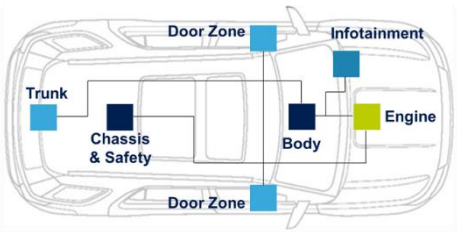
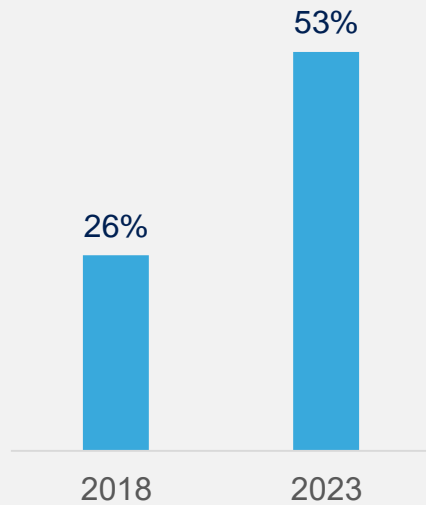# ST Leading with Disruptive Technologies & Partnerships

ADAS

Connectivity

((5G))

WiFi

Domain controllers

Door Zone
Infotainment
Trunk
Chassis & Safety
Body
Engine
Door Zone

ADAS System Penetration

% Penetration
vs Car Production

53%

26%

2018   2023

$350 Average ADAS Content per Car **$900**

Level 2+   Level 4+
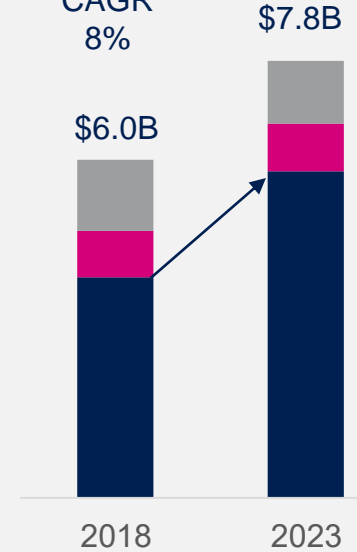
ADAS

ST SAM

$7.7B

CAGR
16%

$3.6B

2018   2023
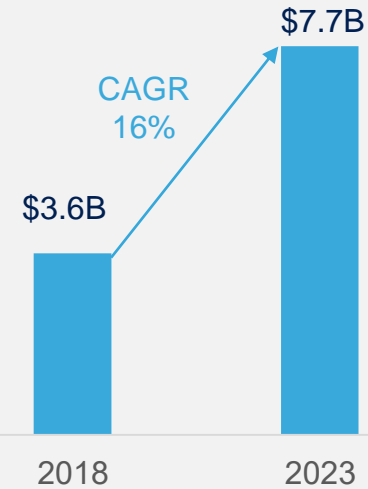
ADAS includes: distance warning, drowsiness monitor, eCall, LDWS, night vision, occupant detection, Parking and other ADAS functions

Automotive MCU Growth

32-bit MCU
CAGR
8%

$7.8B

$6.0B

2018   2023

■ 32-bit MCU
■ 16-bit MCU
■ 8-bit MCU

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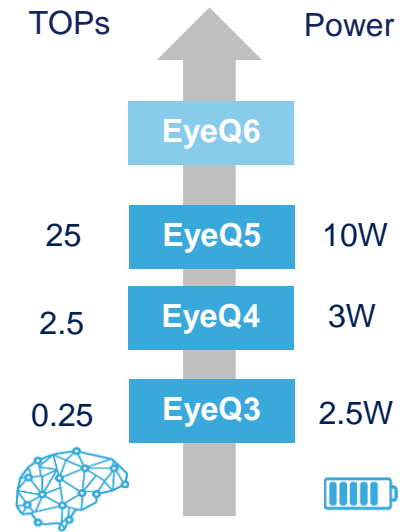
Source: Strategy Analytics

Leading Vision-based system with Mobileye

EyeQ5

1st product designed for Automotive in 7nm FinFET suitable for both ADAS and Autonomous Driving market

TOPs		Power
	EyeQ6	
25	EyeQ5	10W
2.5	EyeQ4	3W
0.25	EyeQ3	2.5W

Moving towards autonomous vehicles with Auto-parking ability

- Advanced solution for mobility and Autonomous Parking
- Co-development leveraging ST Expertise in designing safe and secure Automotive SoCs and Panasonic leadership in image manipulation and system design

# Leading Innovation with 5G Cellular V2X and High Precision GNSS

Market 1st dual-mode solution supporting **5G Cellular V2X**

Single Ics Solution

Cellular
(Automotive low latency 5G)

&

Wi-Fi 11.p
(for Automotive)
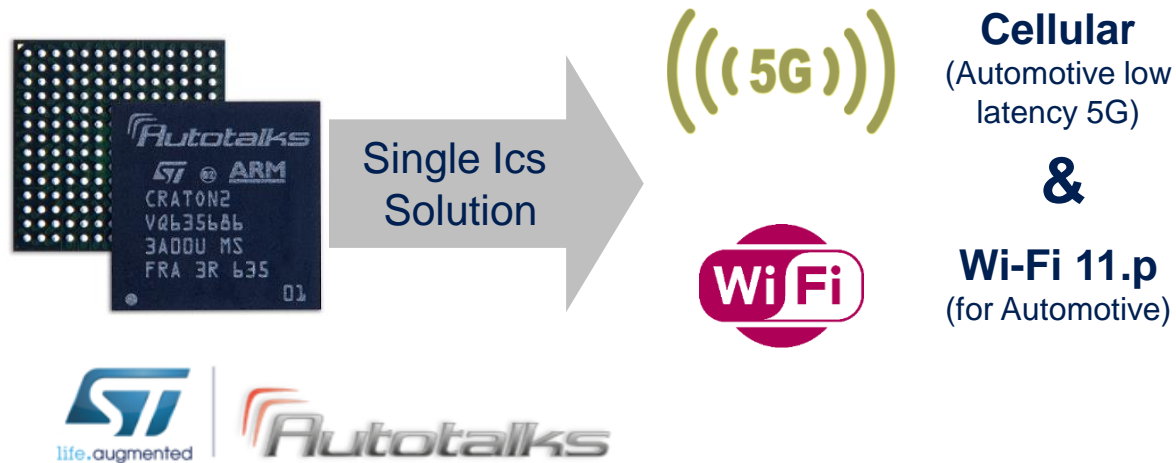
Autotalks solution awarded for production:

- 4 of the top 10 automakers deploy Autotalks V2X solution
- \> 10 Tier1s selected the chipset
- Volume production by 2020

TESEO APP: **Precise Positioning** enhancing Assisted and Autonomous Driving

Full Production

Ramp-up by 2020

Sub-meter positioning

Single-Band

Multi-Band ASIL-D
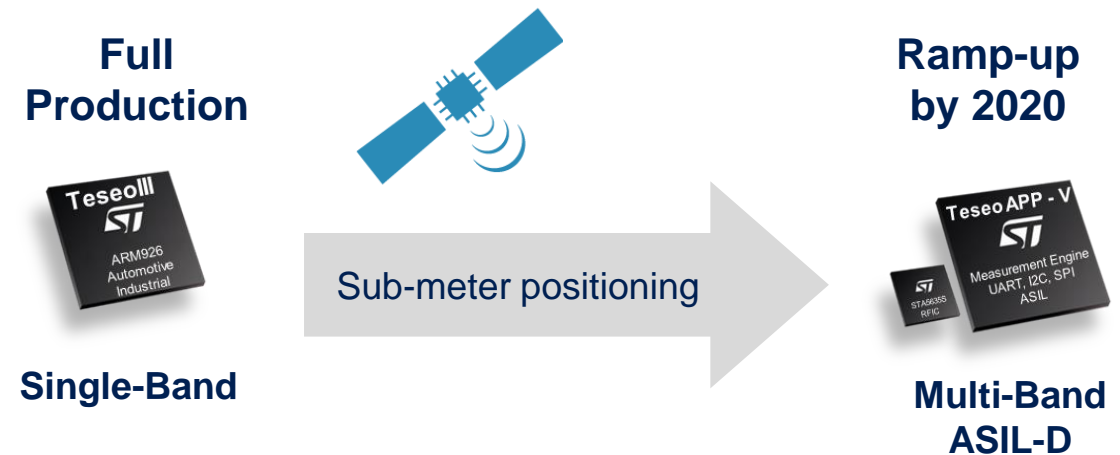
- Sub-meter positioning for Assisted Driving
- Multi-constellation(*) system including now Indian System (NAVIC) with 3 customers certified with ST solution (1st in the market)
- Enabling ADAS (Tolling, Insurance Box, Assisted Driving...)
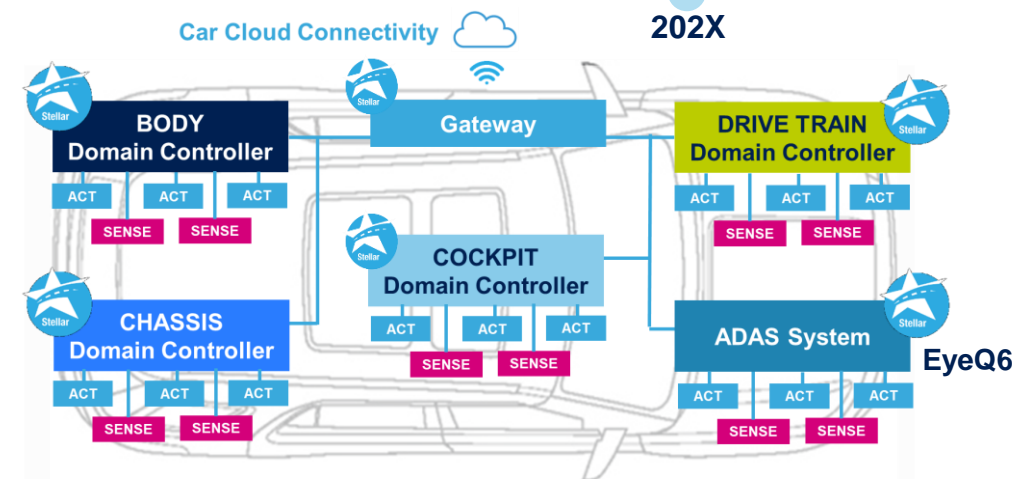
Car Digitalization: New Architectures

2017
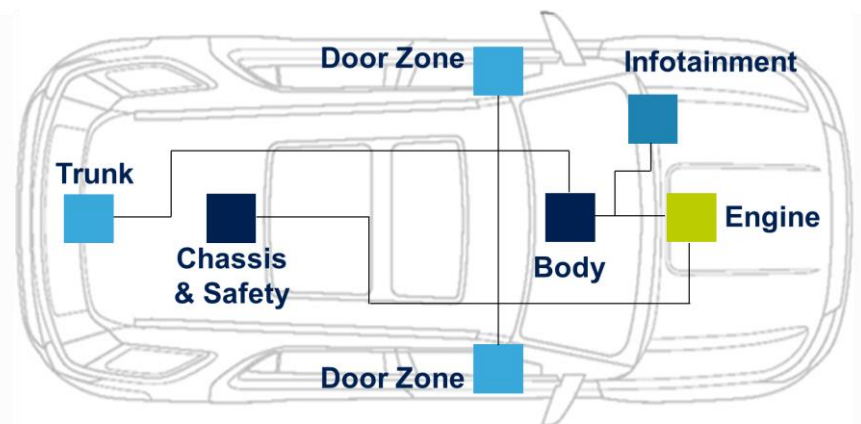
x10
Car Computational Power

202X

Car Cloud Connectivity

Distributed Architecture: 9k DMIPs per Car

- Local Control Units with up to **130 ECUs/Car** (with 8-16-32-bit MCUs)
- Limited connectivity and in-vehicle data flow (up to 10 Mbit/s)
- Heavy and expensive harness
- Extremely complex car software management
- No car functionality upgrade

Integrated Real-time Domain Architecture: 90k DMIPs per Car

- ~5 Domain-Control Units with higher power computation: **+30% Silicon Value**
- Autonomous Driving Super-computer (MPU ext. Memory) ~**100 Trillion Operations per/s.**
- Architecture simplification, SW rationalization, harness drastic reduction
- Easy car functionality reconfiguration and SW upgrades
- High-speed in-vehicle communication
- Over-the-Air Software upgrade capability

➡ ST **"Stellar"** automotive MCUs
- With multiple Arm® Cortex®-R52 cores embedded Phase-Change Memory (PCM)

Israeli partners and customers in Automotive applications

ADAS	Security	Communication

Takeaways

- **ST is an enabler for the automotive industry**: strongly focused on the two megatrends disrupting the design and manufacturing of cars – **electrification, digitalization.**

- **Partnerships and cooperation with very innovative Israeli companies** in key areas: co-design and/or industrialization and manufacturing of their designs, joint marketing.

- **Ramp-up of ST-Up hardware accelerator program in Tel-Aviv to help Israeli startups scale faster**; smart mobility is key.

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