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Solutions for Intelligent Driving

Jerry PENG

Marketing Manager

July, 2024

Content

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We are creators and makers of technology

One of the world's largest semiconductor companies

Over **50,000** employees of which **9,500+** in R&D

$17.3 billion revenues in 2023

Over **80** sales & marketing offices serving over **200,000** customers across the globe

14 main manufacturing sites

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

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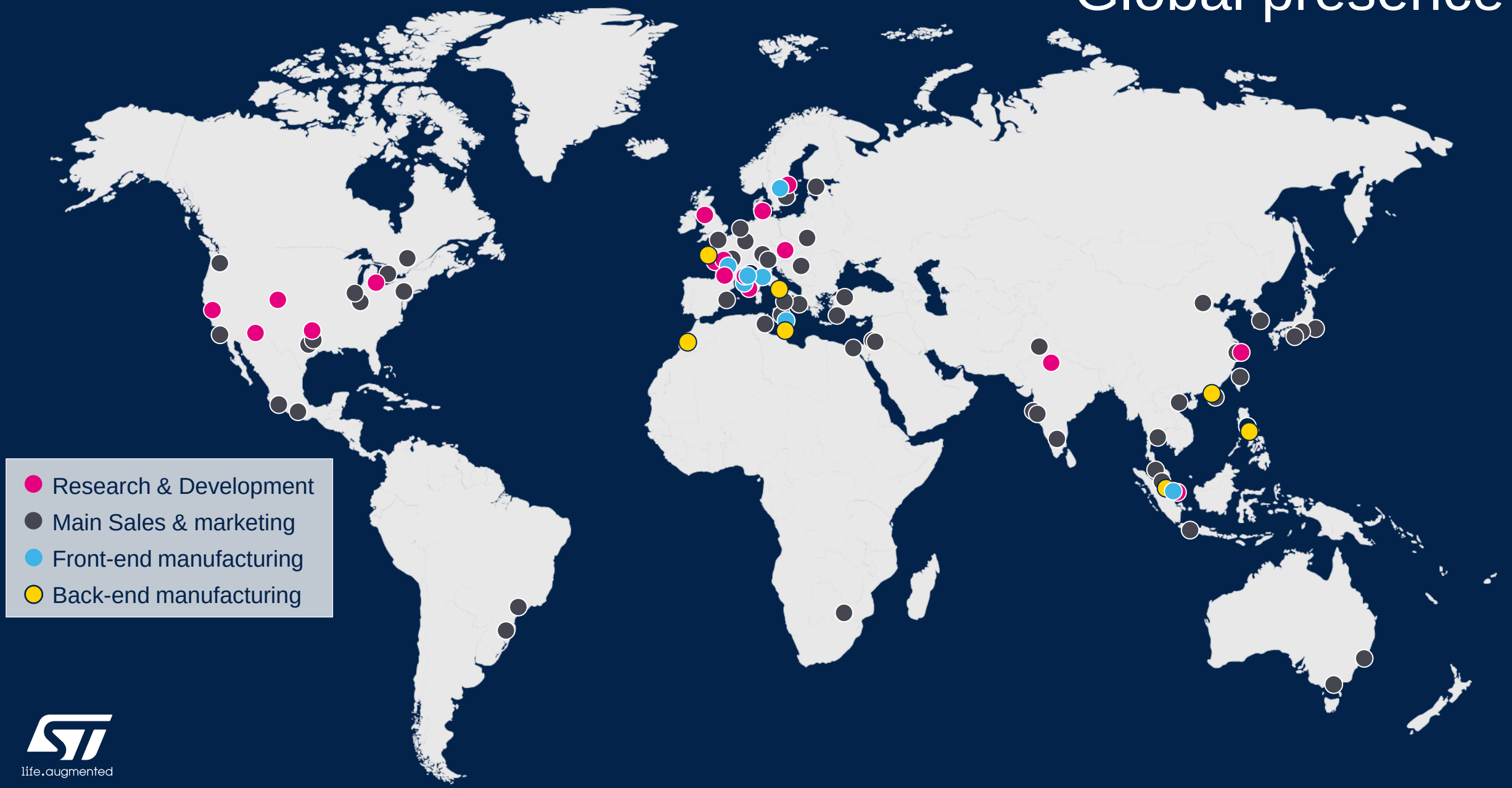
As of December 31, 2023

Global presence



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Our strategy stems from key long-term enablers

Smart Mobility

Helping car manufacturers make driving safer, greener, and more connected for everyone

Power & Energy

Enabling industries to increase energy efficiency everywhere and the use of renewable energy

Cloud-connected Autonomous Things

Supporting the proliferation of secure, connected, autonomous devices enabled by edge AI

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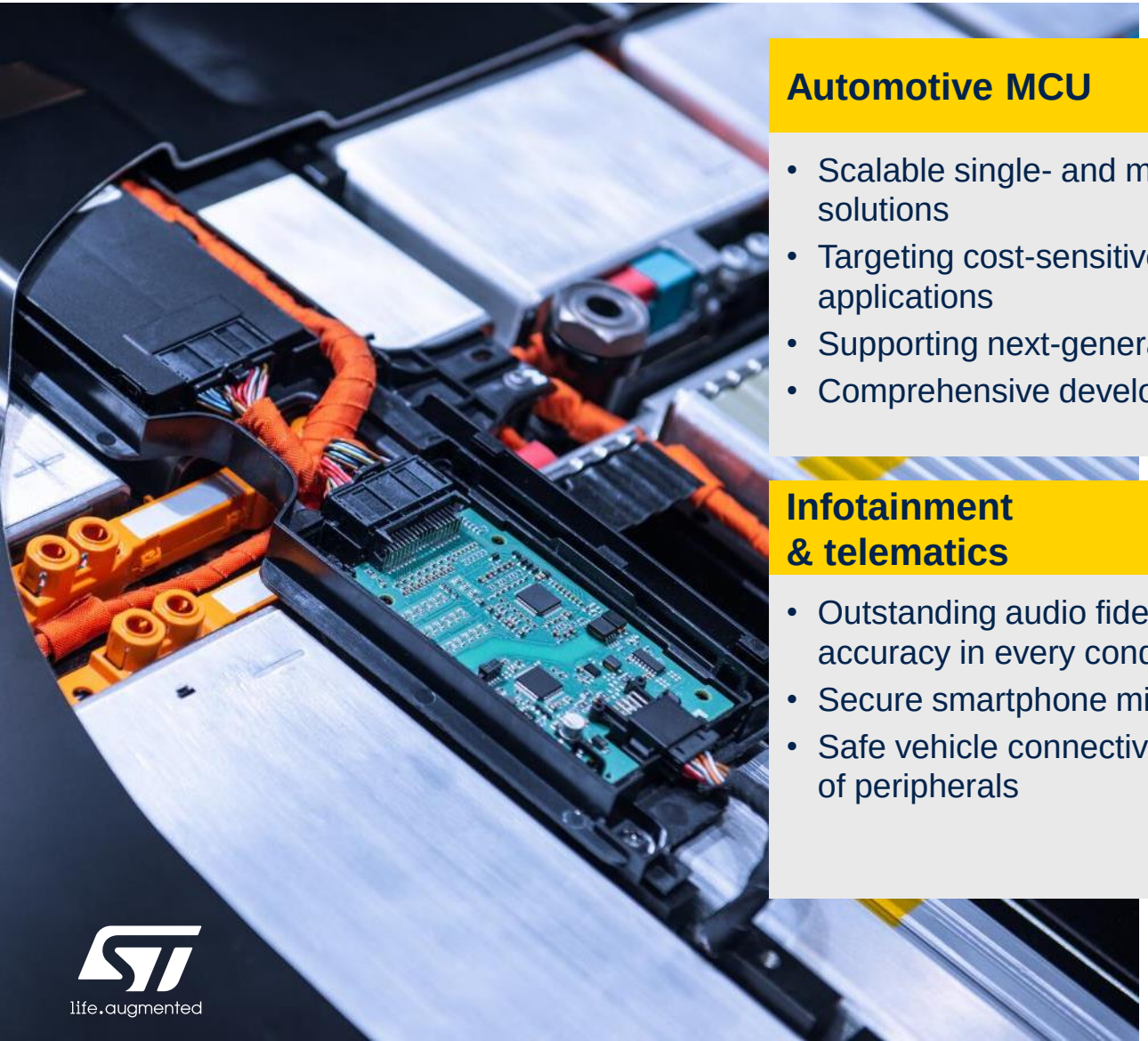
Dedicated automotive ICs



Automotive MCU

- Scalable single- and multicore MCU solutions
- Targeting cost-sensitive to highly advanced applications
- Supporting next-generation architectures
- Comprehensive development ecosystem

ADAS solutions

- Image signal processors
- Radar transceivers
- V2X communication solutions
- Automotive CMOS image sensors
- Automotive Inertial sensors

Infotainment & telematics

- Outstanding audio fidelity and positioning accuracy in every condition
- Secure smartphone mirroring
- Safe vehicle connectivity with wide set of peripherals

Automotive analog & power

- Wide portfolio of analog, power and digital products
- VIPower* HSDs, LSDs & H-bridges and LED drivers
- Complete system kit solutions

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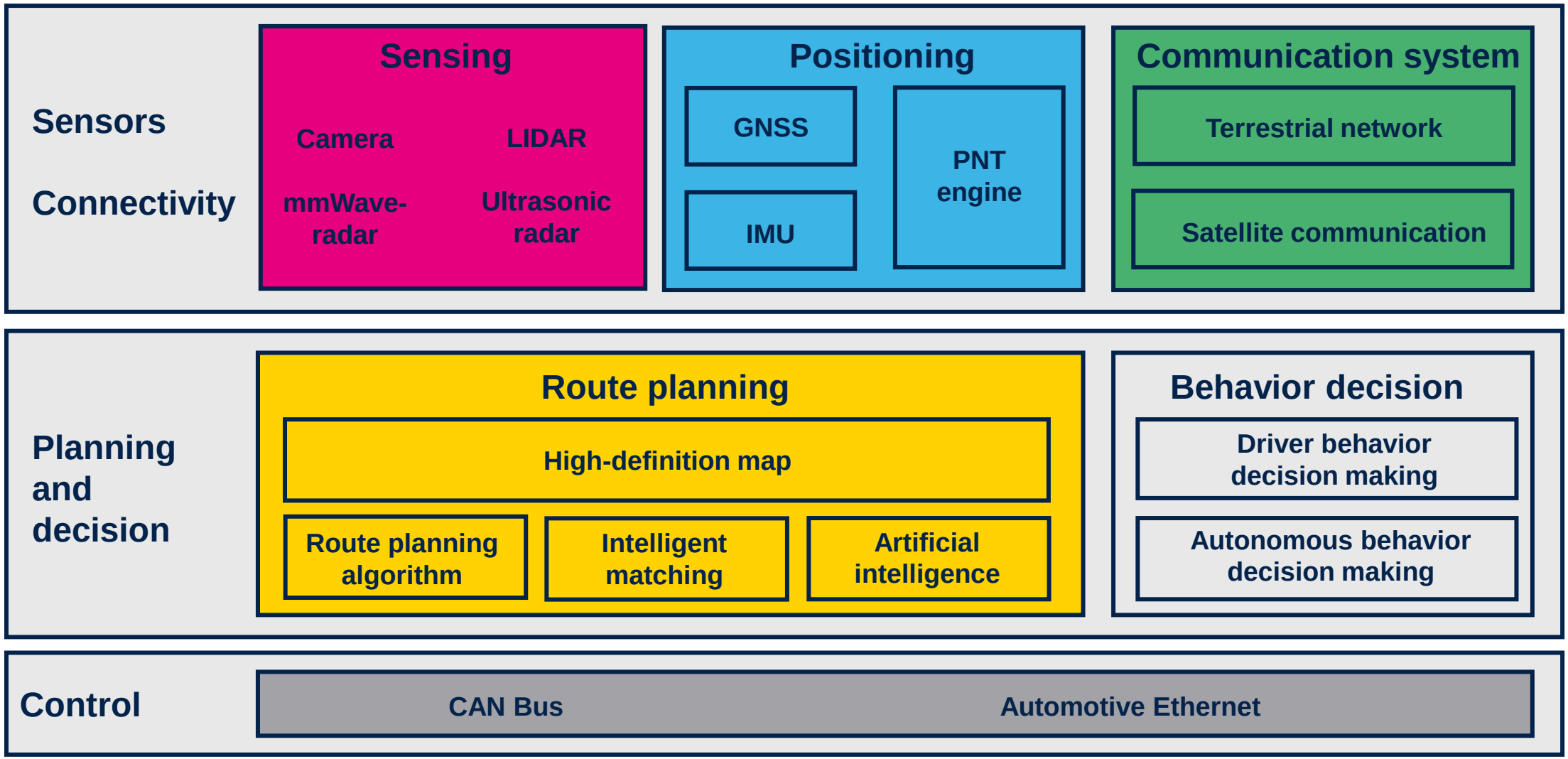
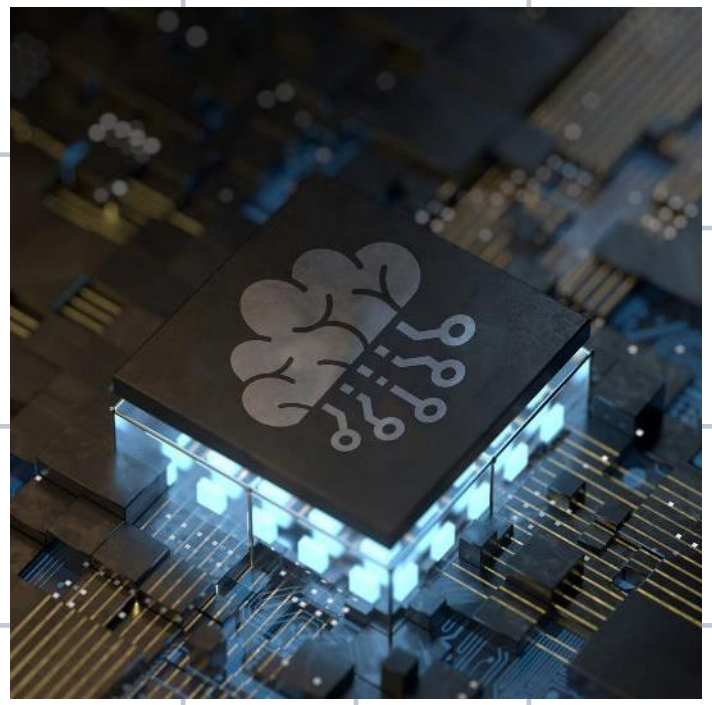
Autonomous / assisted driving system architecture



ADAS segmentation by system type

- Event data recorder
- Adaptive cruise control
- Blind spot & reversing detection
- Park assist
- Lane departure warning & Emergency lane keeping



- Autonomous emergency braking & forward collision warning
- Driver availability monitoring & distraction warning
- Tire pressure monitoring
- Head-up display
- Intelligent headlights

- E-call & B-call

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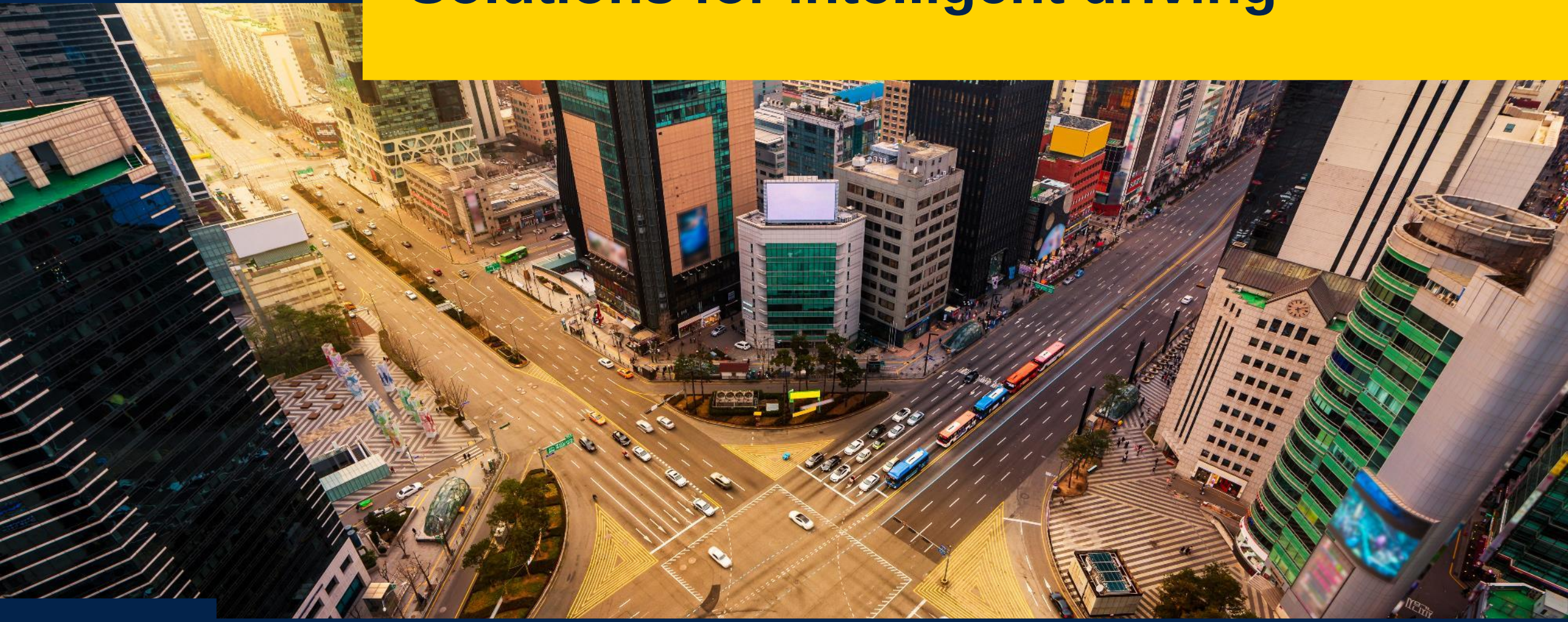
Solutions for intelligent driving



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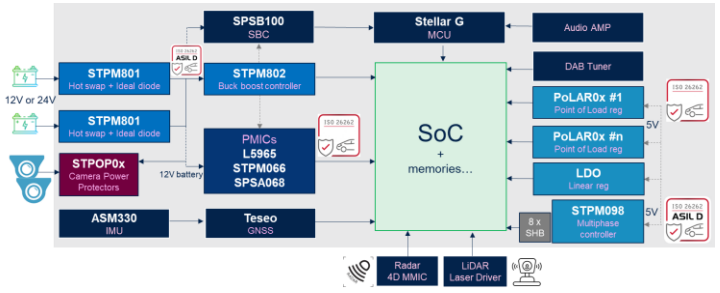
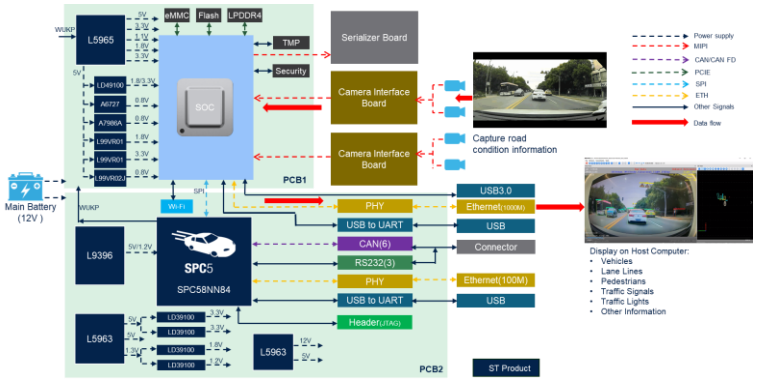
Intelligent driving system

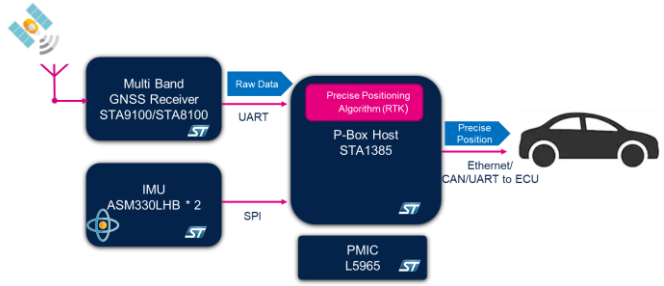
Domain Controller



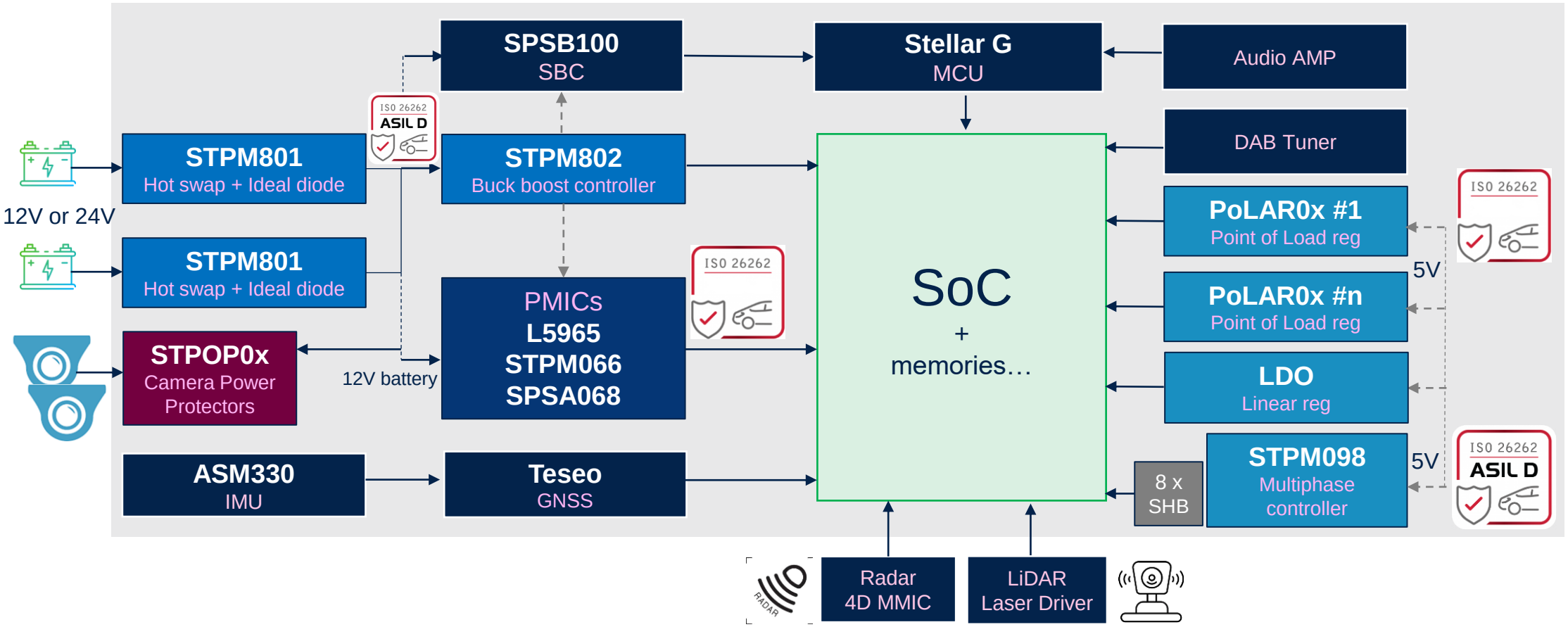
Front-View Device



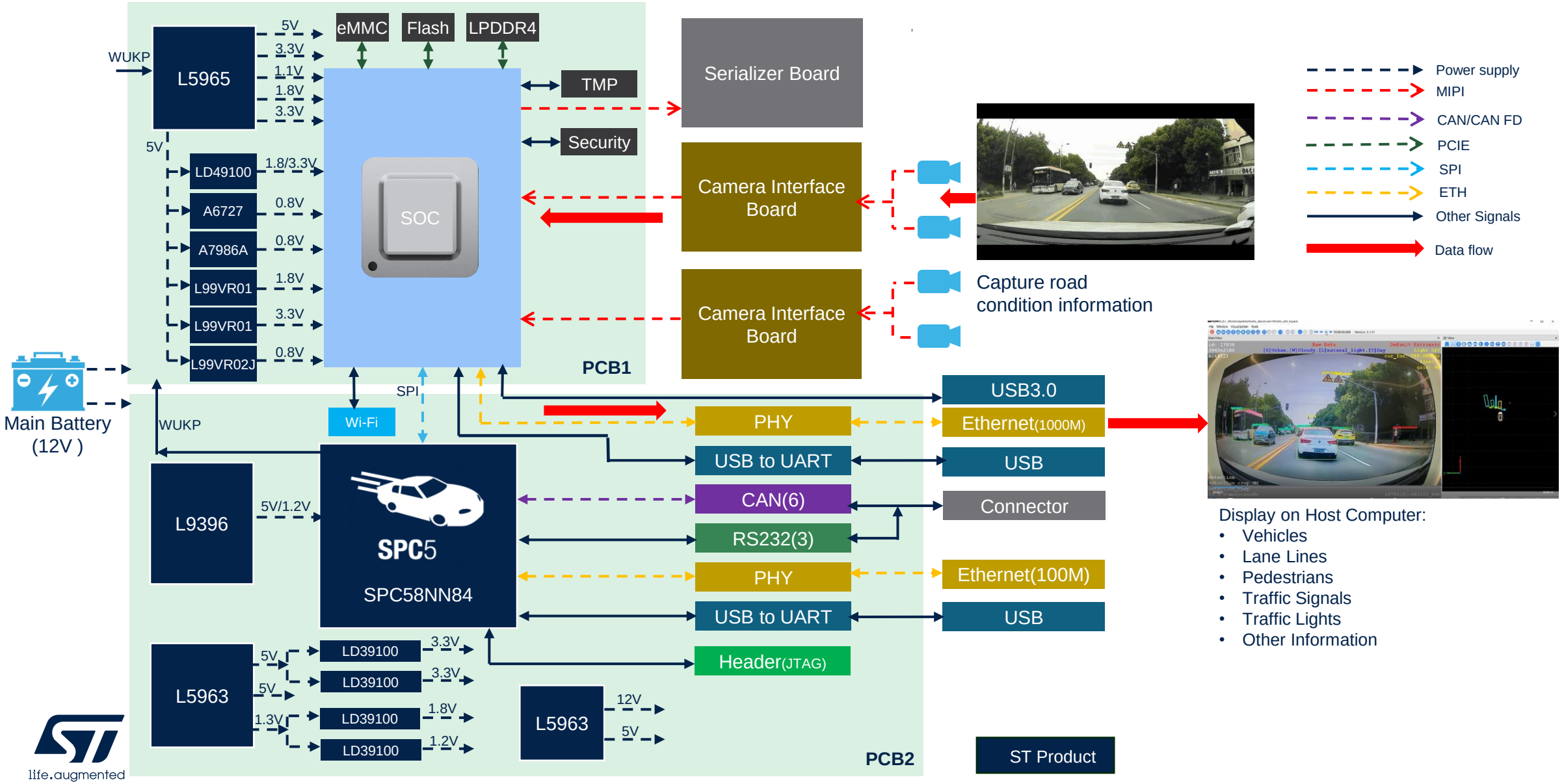
P-BOX



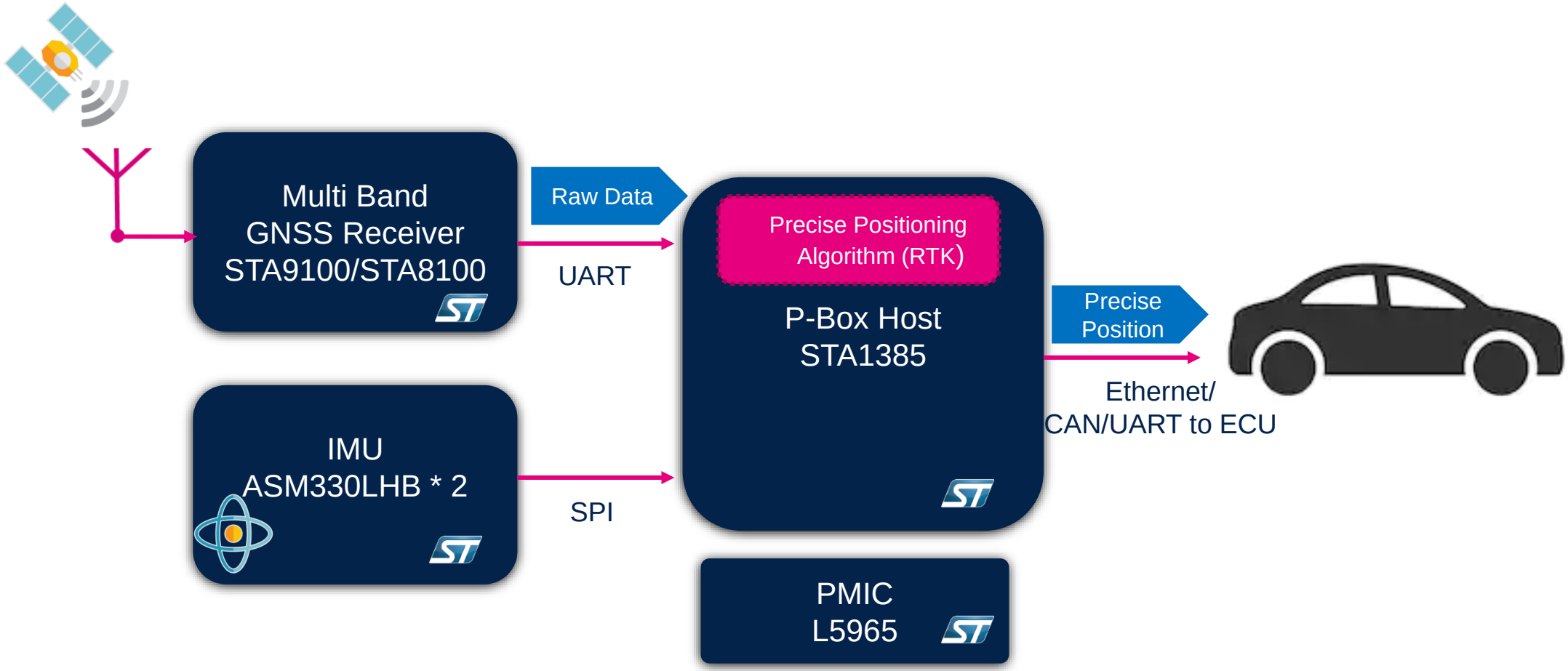
Domain controller



Front-view device



P-BOX


Multi Band
GNSS Receiver
STA9100/STA8100
Raw Data
UART
Precise Positioning
Algorithm (RTK)
P-Box Host
STA1385
Precise
Position
Ethernet/
CAN/UART to ECU
IMU
ASM330LHB * 2
SPI
PMIC
L5965

System highlights and key benefits

Up to ASIL-D, HSM
ISO 21434 ready

Future Proof Open Architecture
Extensible Memory & efficient OTA
Efficient routing Accelerators
Multi-Application Integration

Real-Time Kinematic (RTK)
precise positioning algorithm to provide centimeter-level positioning

ST Solution

Secure, Reliable & Compliance

High Performance MCU

Plenty of Power Supply Devices

High Precision Position

Wide Temperature Range

High current primary power supply solution compliant with functional safety ASIL D.
The rich selection of PMIC、SBC and other power supply ICs can support a variety of scenarios.

Up to 150°C to meet stringent operating temperature requirements

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Power Management Introduction

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Power supplies for advanced processing units

More and more connected and autonomous

Embedding a higher number of very powerful microcontrollers is reshuffling vehicle's E/E architecture

ADAS & CONNECTIVITY

Radar, vehicle-to-everything communication, telematics, gateway, software over-the-air, satellite tuner

NEW E/E Architecture

Domain controller, service-oriented gateway, zone controller

INFOTAINMENT

Instrumental cluster, display audio, HD navigation system, audio box

Power conversion requirements are pushing the necessity of…

Improved efficiency | **Higher flexibility** | **Compact size** | **Scalability**

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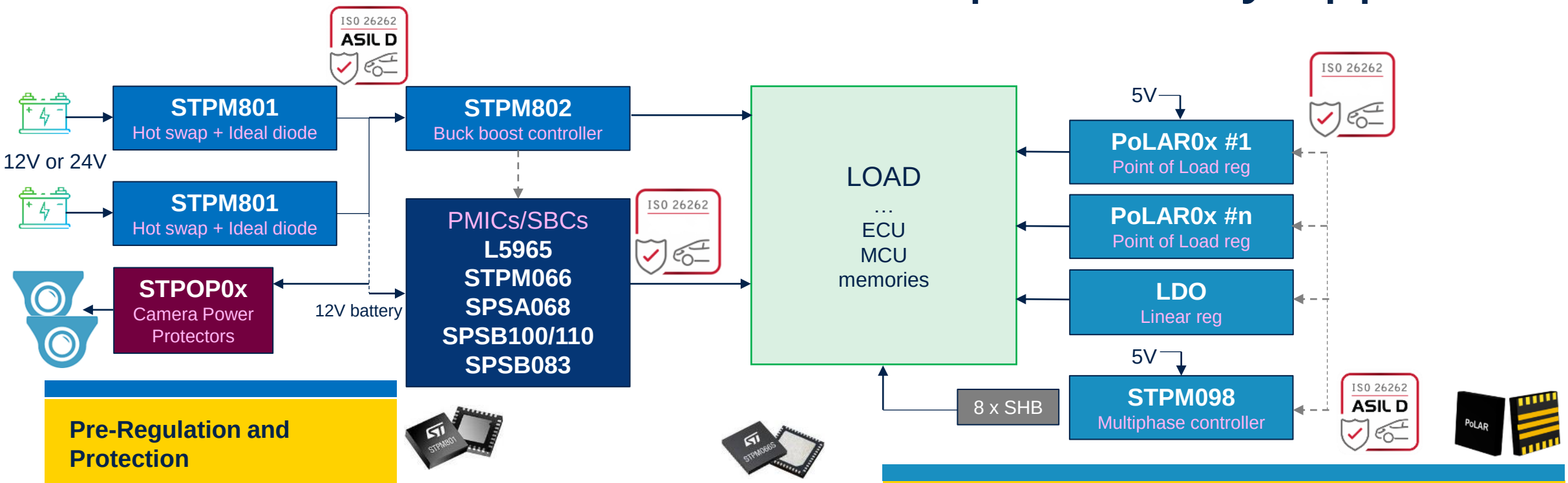
PMIC portfolio by application



Pre-Regulation and Protection

Wide input range, up to 60-65V

STPM801 manages dual supply (back-up) and reverse battery

STPM802 is a single-phase buck-boost pre-regulator

Support for systems up to ASIL-D

Multiple rails power management IC

A portfolio of battery-compatible PMICs and SBCs capable of satisfying various needs

High performance ICs for power distribution

PoLAR is a familly of 2A, 4A, 6A single pwm post regulators in a 3x3mm package, switching at 4MHz, and including parallel mode

STPM098 enables high power delivery with 8 phases and 2 loops

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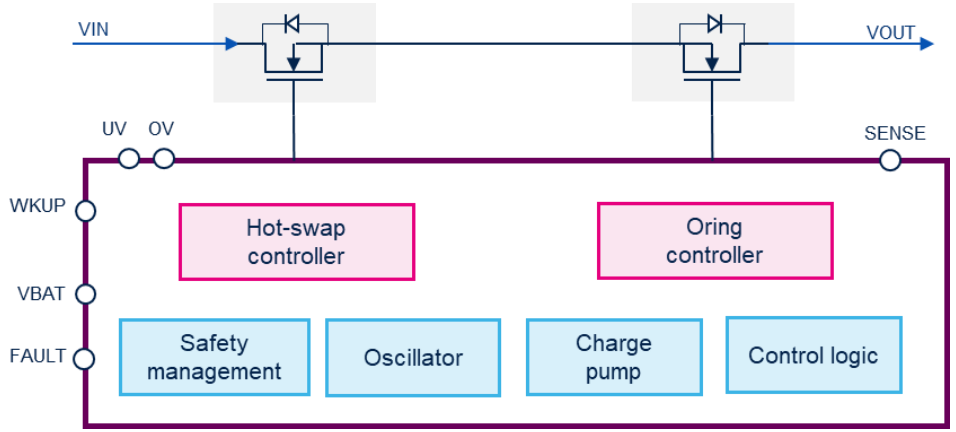
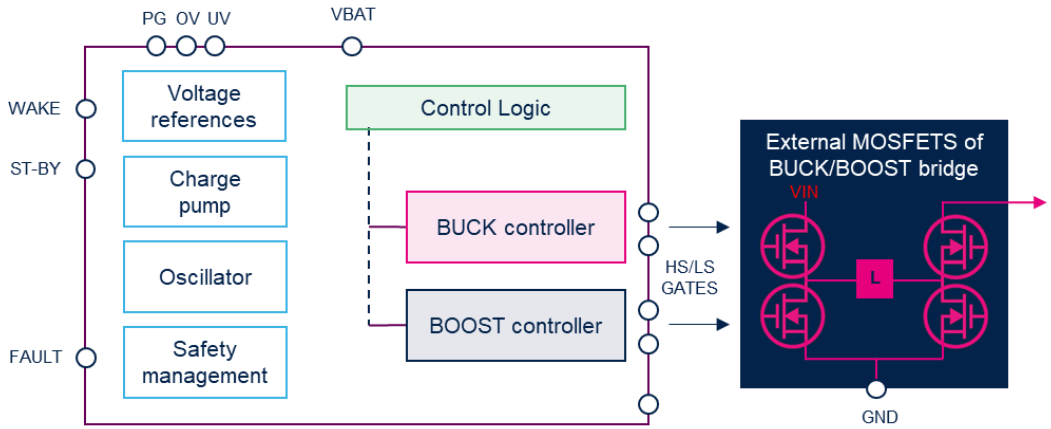
Protection and pre-regulation

STPM801
Hot swap and Ideal diode



- Input from 4V to 65V, with -65V reverse protection
- 2x external N-channel MOSFET pre-drivers
- Stand-by mode, Soft start
- Input overvoltage and undervoltage protections
- Fault pin. Fault Table in the datasheet
- Output overcurrent protection
- Complies with the 16750 AC ripple test requirements (50-25kHz)
- Package: VFQFN32+4L (5x5mm)

STPM802
Synchronous buck-boost controller



- Vin from 4.2 (crank) to 60V (12V and 24V syst)
- External voltage divider network. Vout 3.3 – 14V
- Spread Spectrum, Soft start, 100% duty cycle capable
- Adjustable parameters by external R
- Switching frequency from 177 to 500kHz
- Max output power 250W
- Stand-by function (LPM with lower functionality)
- Package: VFQFN32+4L (5x5mm)

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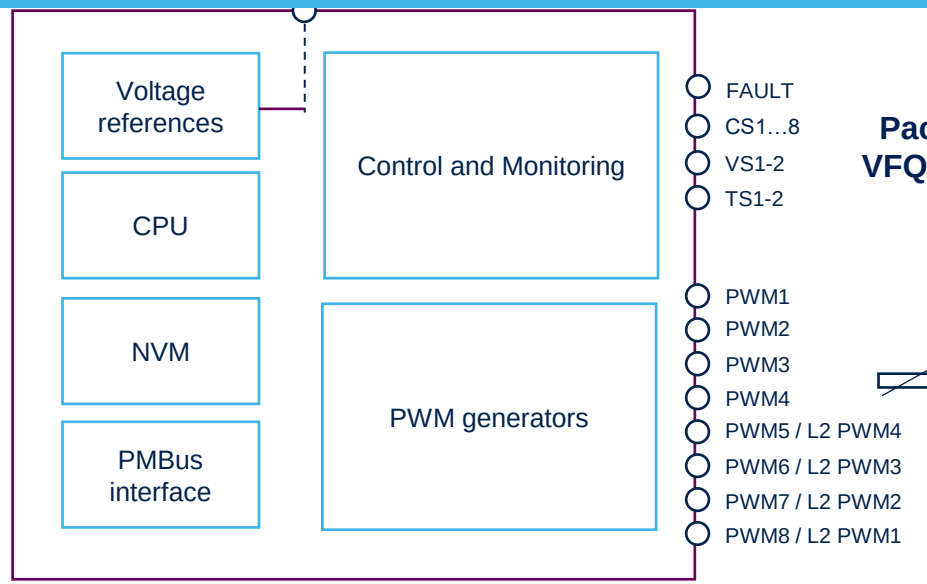
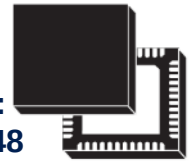
ISO 26262

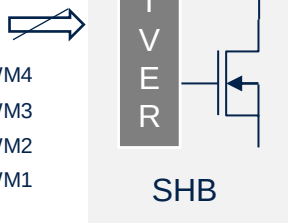
High-power distribution: STPM098C dual loop, 8-phase digital multiphase controller

Advanced control loop architecture based on COT (Constant On-Time) scheme provides fast transient responses and high efficiency.



Package: VFQFPN-48





ISO 26262

- Input voltage 5V (AMR 20V)
- Output voltage range: 0.5V to 2V (0.05V minimum step)
- Switching frequency range: 200kHz to 1.5MHz
- 2x independent voltage loops
- 8x PWM outputs. Phase assignment between two loops: 8+0 to 4+4
- Dynamic phase shedding for light loads managed by embedded CPU ARM Cortex TM M0+ @40MHz for increased efficiency
- Ver.1.2 compliant PMBus for configuration (stored in built-in NVM) and telemetry reporting
- Full input and output telemetry (voltage, current, temperature)
- Full input & output overcurrent, over/undervoltage, thermal diagnostic and protection against loop disconnection, current unbalancing, etc.
- BIST implemented for analog circuitry and digital core
- Dedicated diagnostic pins
- Ground loss diagnostics

Applications

• ADAS • Automotive Processors • Safety

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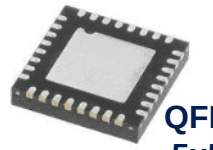
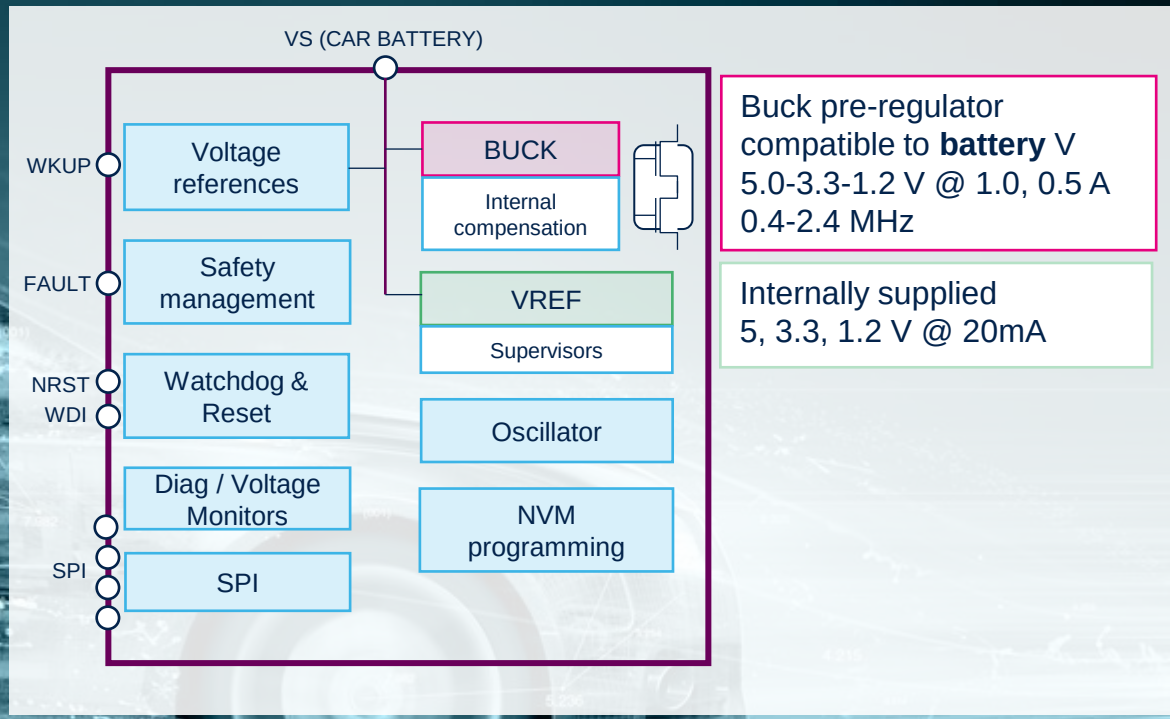
SPSA068
PMIC for single supply microcontrollers

Battery compatible PMIC with main parameters are programmed by OTP



QFN32L
5x5 wet



ISO 26262

Key applications

- ADAS
- OBC
- Connected & Infotainment

SPSA068 is a buck voltage regulator with a precise voltage reference for MCU which requires just a single supply. All the regulators have internal power switches. The LPM allows the operation under light-load conditions reducing the quiescent current down to 50uA (typ).

- Pre BUCK current mode with internal compensation, adjustable via NVM at 5V, 3.3V, 1.2V (2%) or via external R divider at @ 0.5/1.0 A, 0.4/2.4 MHz
- Precise Voltage ref (1%), adj via NVM: 5V, 3.3V, 1.2V @ 20mA track Buck
- Sleep mode (regulators off, Vs=14V) Iq < 5uA
- Low power mode, buck active, Iq from battery < 75uA max (activated by dedicated SPI command and deactivated by the WAKE_LPM pin)
- SPI interface with CRC
- Programmable soft start time, power up phase
- Voltage and current supervisors (UV/OV/OC), Reset and Fault pins
- Spread frequency spectrum en/dis by SPI
- Adjustable window WD (by pin or by SPI) with long open window 200ms typ
- Short circuit protected outputs
- Thermal warning and thermal shutdown

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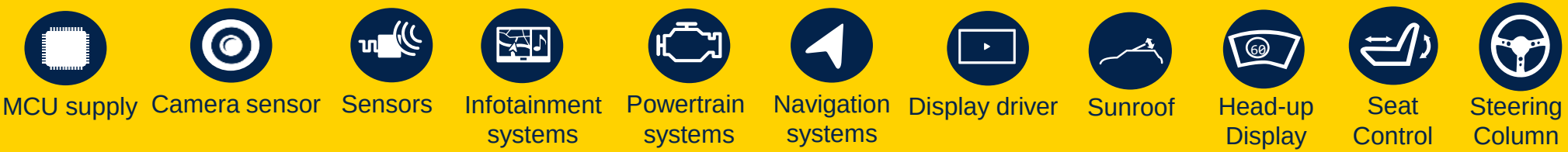
Automotive Linear Voltage Regulators Overview

Low current (Io=50mA-150mA)	Medium current (Io=200mA-300mA)	High current (Io=500mA)
L5050S	L5300GJ	L4995RJ/K
L5050SD	L5300AH7	L4995AJ/K
L5150BN	L99VR01S	L99VR02J
L5150CS/J	L99VR01J	L4995R/J
L5150GJ	L99VR03	L99VR05
		L99VR02XP



Target applications

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ADAS and new E/E architectures

ST Smart Power solutions for all needs: one-stop shop

1 **Fully integrated solution**
Tailored PMIC solutions to protect customer IPs and improve integration

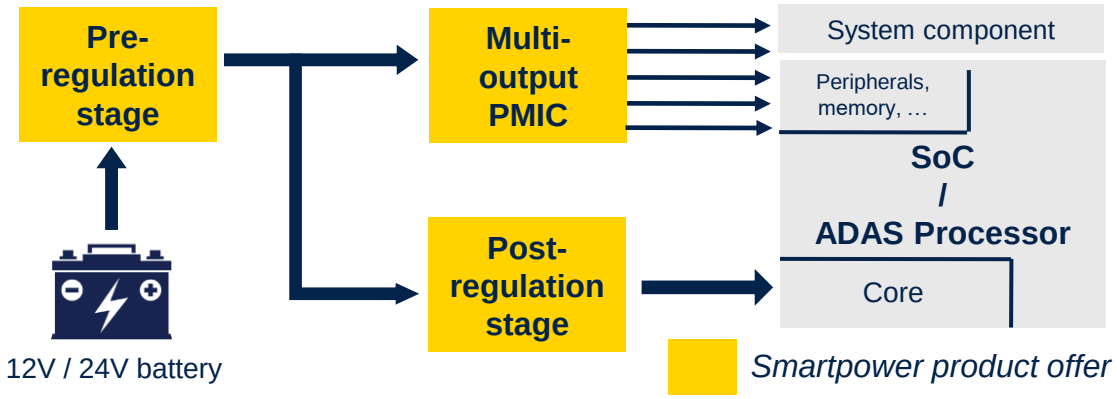
2 **Medium level integration**
Consolidated subset of features served by a mid level of integration and application specific SBCs

3 **Distributed architectures**
High flexibility with distributed architectures for new ideas or not mature solutions

Broad-range power management product offer

- **Tailored integrated PMIC**: addressing high efficiency and high-power demand
- **SPSB1x0**: covering large variety of domains and new architectures
- **SPSB08x & L978S/U:** completing offer including mid/low end options
- **L5965S & STPM066S**: addressing camera & radar
- **SPSA801**: hot-swap & oring protection
- **STPM802**: buck-boost controller
- **STPM098**: multi-phase controller
- **Point of Load voltage regulators**

Example of Smart Power system integration from battery to load



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Stellar P/G - Integration MCU
The Platform to build the future

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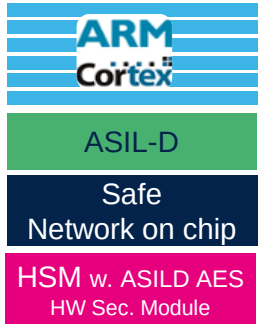
SR6 - Stellar Integration MCU
Innovation with Value

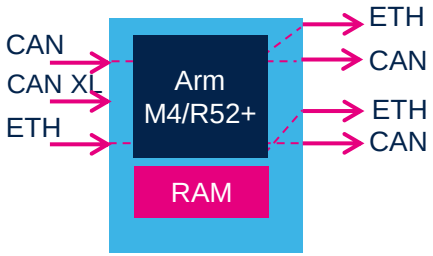
Future Proof Open Architecture



6x R52+
@400MHz

Top Real-Time performance
combined with
lower power, fast start-up
and
advanced Security

Efficient routing Accelerators



Routing subsystem

Ultra real-time IN/OUT
data processing

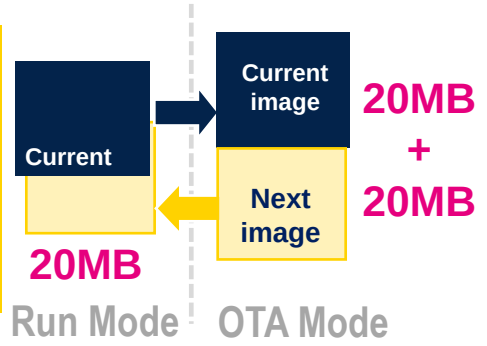
Accelerators offloading
application cores

Stellar
Integration MCU

Extensible Memory & efficient OTA

Built-in **memory duplication provision** for OTA (“X2 mode”)

No cost overhead
No Downtime for running SW code

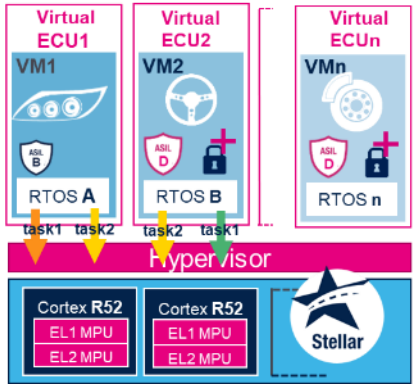


Multi-Application Integration

HW virtualization

to ensure **safety,**

and freedom from interference



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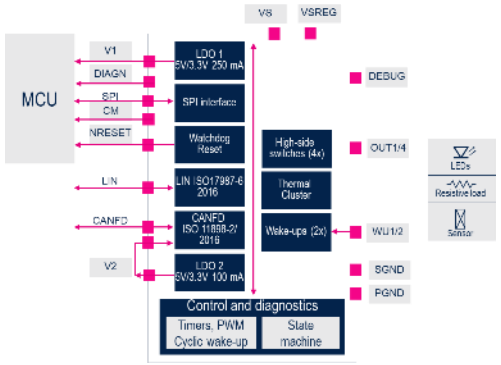
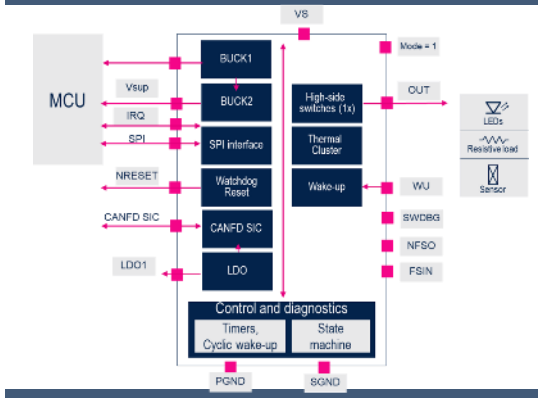
SBC vs MCU fitting

SPSB081



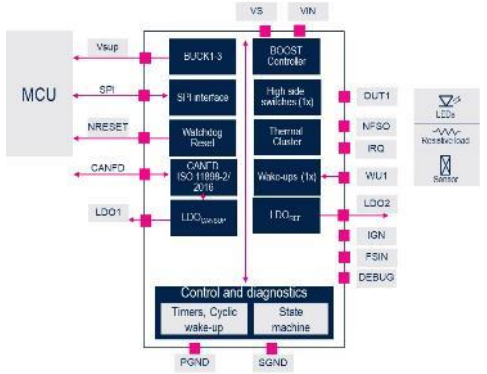
- SPC582Bx
- SPC56x

SPSB083(B) / SPSA068



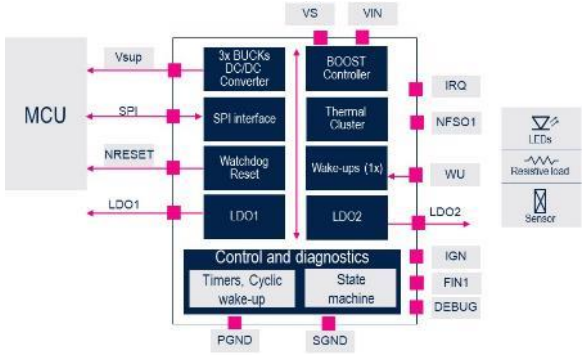
- SR5Ex
- SR6P3
- SPC584Bx
- SPC58xC
- SPC58xE
- SPC58xN
- SPC56x

SPSB100(B)



- SR6G7
- SR6P7
- SR6P6
- SPC58xH

SPSB110



- SR5Ex
- SR6G6
- SR6G3
- SR6P6
- SPC58xG
- SPC58xE
- SPC58xN

GNSS

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Why ST GNSS

Teseo Story of History, Innovation and Value

- **We are part of GNSS history**
  - ST started developing GPS products back in the ‘90s
  - TeseoV is our 5th generation technology
- **Automotive / Industrial are our target markets**
  - Teseo solutions designed into a broad set of Automotive & Industrial products/applications
  - All our HW and FW solutions are designed to meet automotive’s stringent requirements
- **Pioneer for Automotive GNSS multi constellation / multi band receiver**
  - 1st Auto Grade Multi Constellation chipset Teseo2 (2011)
  - 1st Auto Grade Single Chip Dual Band single chipset – Teseo5 L1+L5 (2019)
  - 1st Single Chip Triple Band Support with Teseo5MCM (2021)
- **A value ecosystem built for providing soon the GNSS market with innovation features**
  - Key partners on Precise Positioning Offer
- **Service**
  - Teseo5 is manufactured in ST Fab provide solid/reliable supply chain
  - Support staff / organizations (ie FAEs, Marketing, Sales) well distributed globally

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Additional GNSS constellation signals support

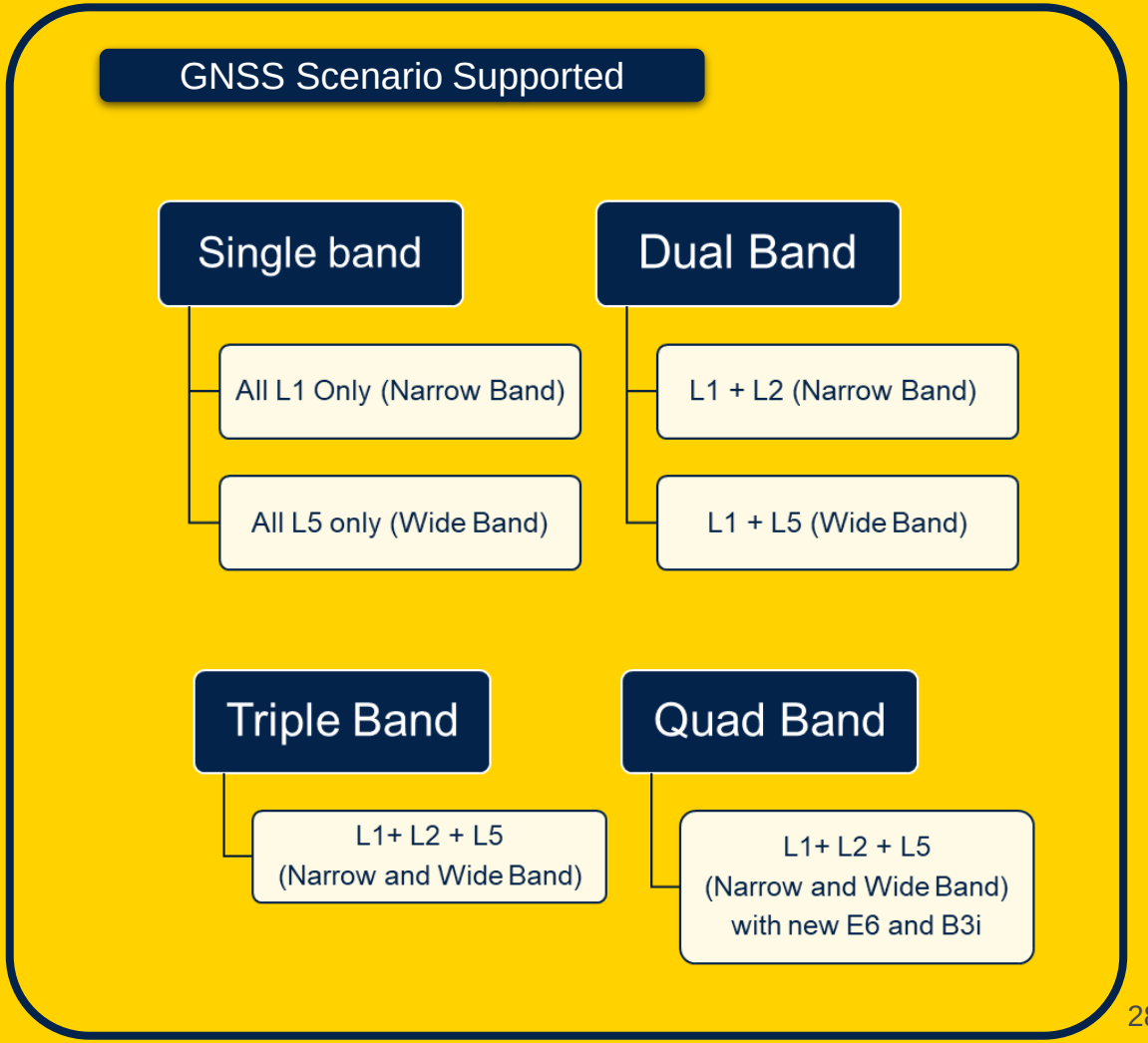
First Triple/Quad Band Single Die GNSS receiver

New Teseo families support all latest GNSS constellation signals planned

GPS	L1C/A , L1C, L2C, , L5	QZSS	L1C/A, LIC/B, L1C, L1S, L2C, L5
Galileo	E1, E5b, E5a, E6	IRNSS	L5
Beidou	B1I, B1C, B2I, B2B, B3i	SBAS	EGNOS, WAAS, MSAS, SDCM, GAGAN, QZSS, KAZZ,
Glonass	L1OF, L2OF, L1OC, L2OC, L3OC		

GNSS Signals planned

New Teseo Families guarantee the largest number of satellites visible in urban canyon



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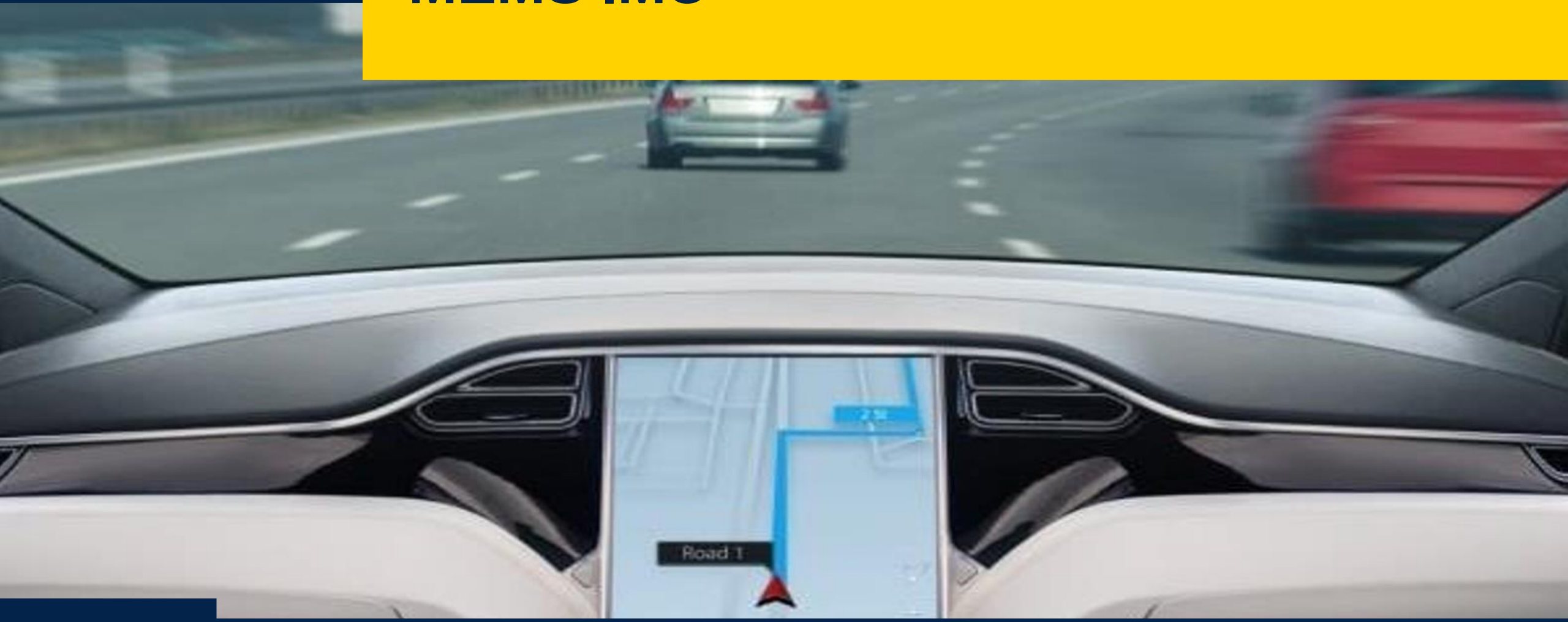
MEMS IMU



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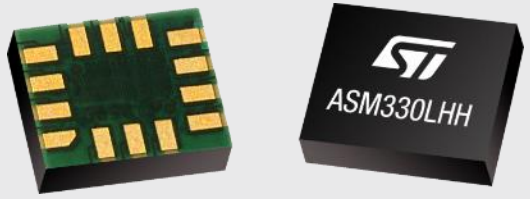
ASM330LHH
6-axis IMU for accurate navigation

Best-in-class accuracy 6-axis IMU

Available



LGA 14L
2.5 x 3 x 0.86 mm

High accuracy, stability & linearity over temperature and time

- Gyro Offset vs T ±0.005 dps/°C (typ)
- Gyro Bias Instability 3°/hr (typ)
- Rate Noise Density 5 mdps/√Hz (typ)
- Axel Noise Density 60 µg/√Hz (typ) – ODR up to 6.6 kHz

Digital features

- SPI & I2C host serial interface
- Six-channel synchronized output
- 9 kB Embedded FIFO

Configurability

- Angular rate range: from ±125dps up to ±4000 dps
- Axel Full Scale: from ±2g up to ±16g

Extended operating temperature range from -40 to +105 °C

Compliant with AEC-Q100

ISO 26262
Road Vehicles - Fuctional Safety

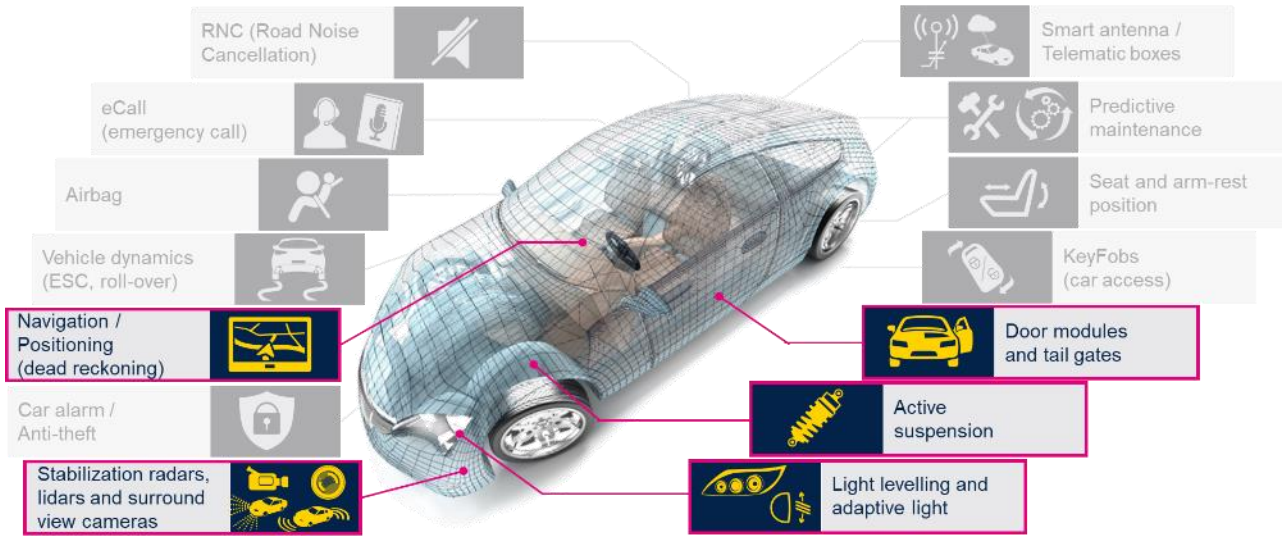
ASM330LHB
A clever solution for any ASIL-B application

High Performance IMU used in combination with dedicated library to be adopted in ASIL-B application

Available

Target applications

- ASIL-B applications



Key features

- LGA-14L (**2.5x3x0.83mm**)
- AEC-Q100 qualified
- Extended temperature range from **-40 to +105 °C**
- Embedded compensation for **high stability over temperature**
- **Support multi mode operation**, High performance and low power modes
- **Sold with companion library developed according to ISO26262**
- **High accuracy 6X IMU:**

Allan Variance		
Accelerometer	VRW – typ.	0.03 m/sec/√h
	BI – typ.	40 µg
Gyroscope	ARW – typ.	0.21 °/√h
	BI – typ.	3 °/h

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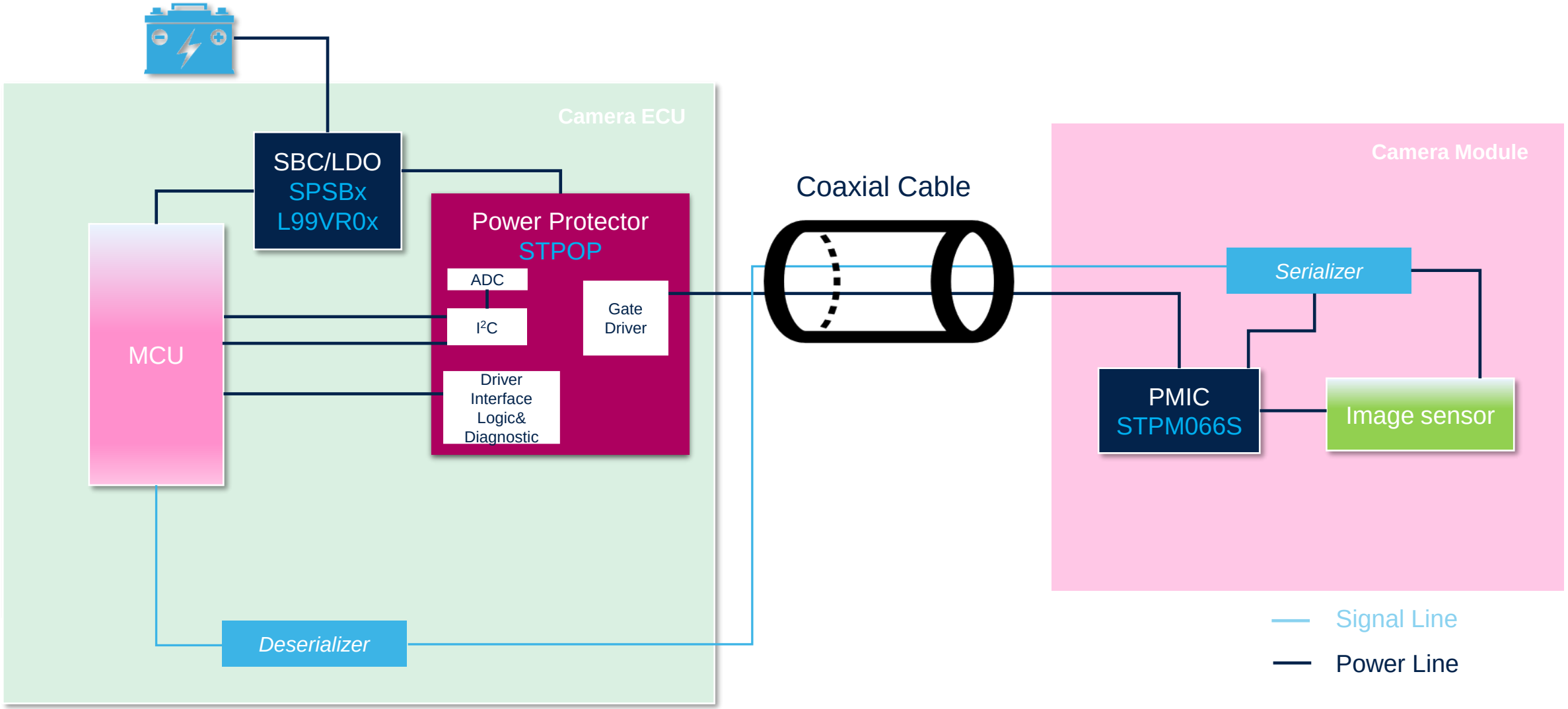
ST Dual/Quad/Octal Rails Power Protector

Automotive Camera Power Protector in the System Applications



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Audio and Tuner for ADAS-IVI Domain

Automotive audio amplifiers portfolio & roadmap

Covering full range of automotive application

- Outstanding performance
- 4- 2- 1CH audio solution
- Wide voltage range
- Advanced diagnostic
- High efficiency
- Automotive grade
- Digital input
- Extremely low noise
- Class D & Class AB
- Supporting all automotive applications

Head unit/ smart cockpit

TDA780X

4-ch -18 V
Fully digital
High efficiency

TDA756X

4-ch -18 V
Analog
High efficiency

TDA7901

4-ch -18 V
Load current monitor
Class G

HFA80A
HFDA80D
2MHz

4-ch -18 V
Analog/Digital
7x7 QFP
Low quiescent

High end / branded sound systems

FDA801/B

4-ch - 25 V
>90% efficiency
Full diagnostic

FDA802A/P

2-ch – 50 &40V V
High power
Full diagnostic

FDA901

4-ch - 25 V
>90% efficiency
Load current monitor

FDA902H

2-ch - 48 V
>90% efficiency
Load current monitor

HFDA808 2MHz

4-ch - 48 V
Load current monitor

Telematics/ EV sound & AVAS

FDA803D/U/Q

1-ch – 3-18 V
>90% efficiency
Full diagnostic in play

FDA903D/U/Q

1-ch – 3-18 V
>90% efficiency
Load current monitor

FDA8/903s

1-ch – 3-18 V
10W – full diag
Load current monitor

HFDA802 2MHz

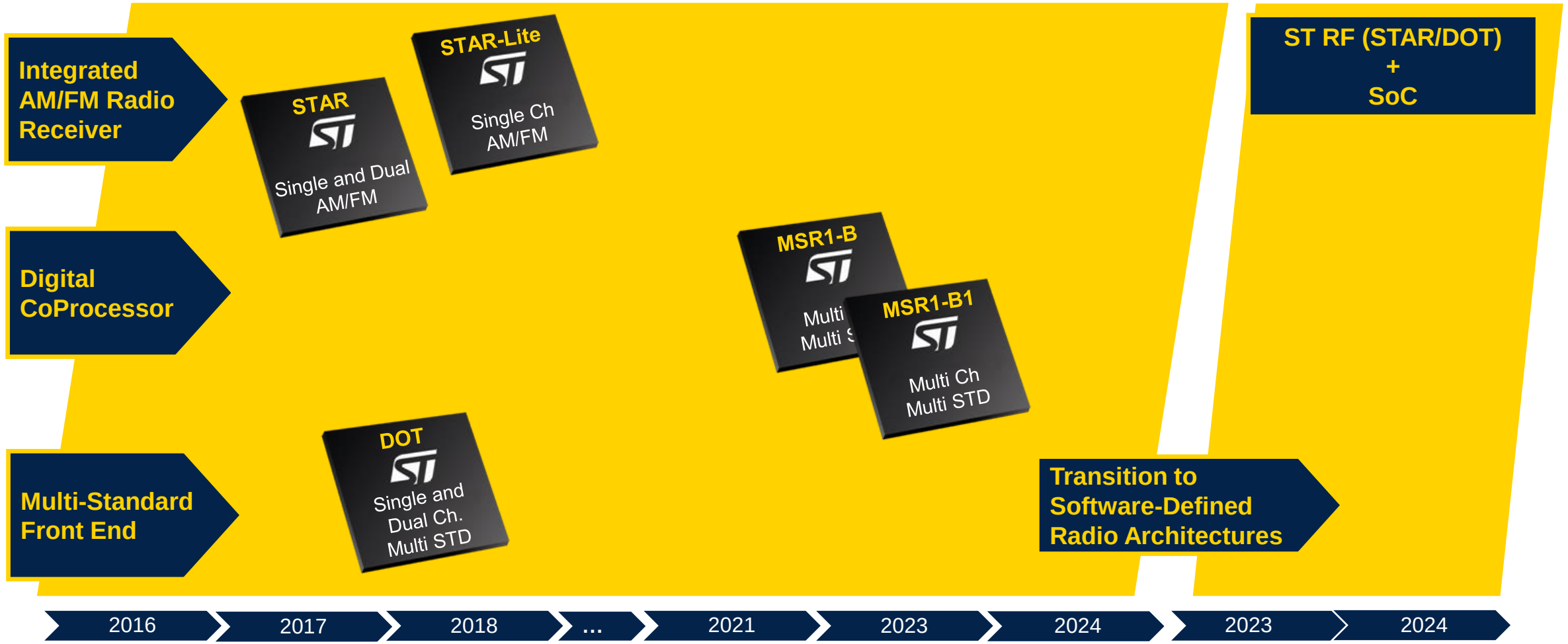
2-ch - 25 V
2MHz PWM
HD ready

Class D

Class AB

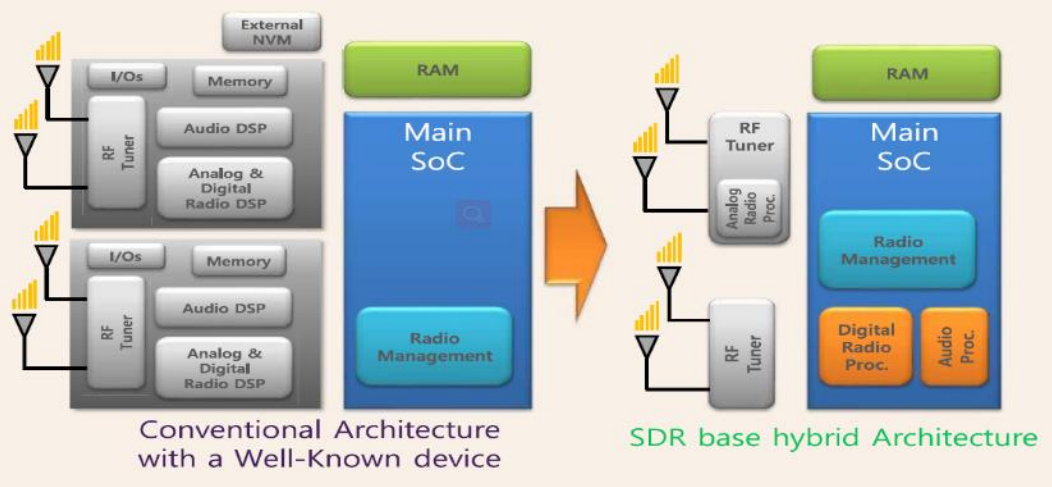
Coming soon

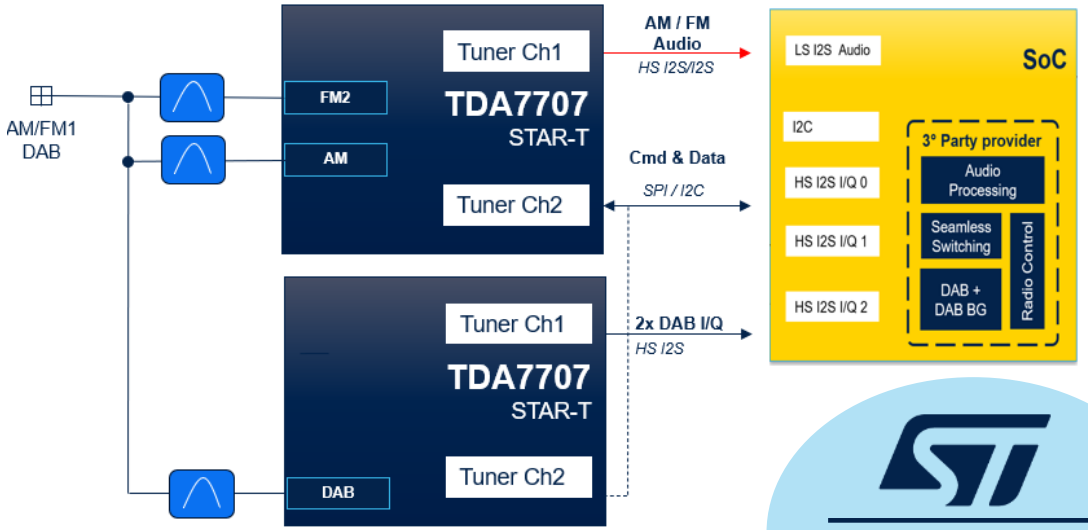
Terrestrial tuner roadmap



Advantages of ST SDR Solution

- ***Flexibility,*** **ST RF + SoC, one hardware design can be compatible global application**
- ***HW platform*****, Minimization and simpleness**
- ***COST,*** ***Save cost up to 50%***
- ***BIT ERROR RATE LOW,*** **Better Performance**
- ***Independence,*** **Improve R&D efficiency**
- ***Scalability*** **,Design ST RF number according to customer's use case**
- ***Upgrading,*** **Very suitable for OTA upgrading of NEV**





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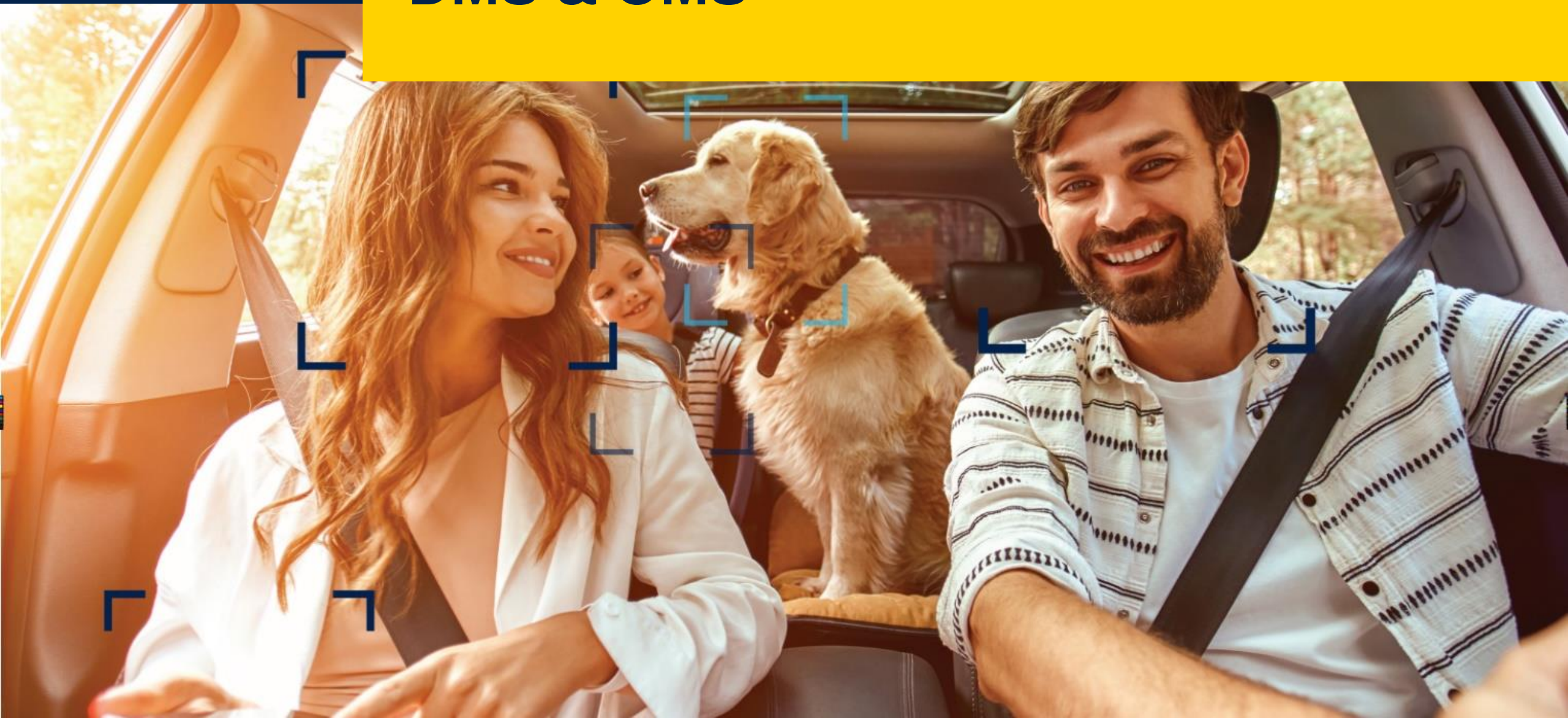
DMS & OMS



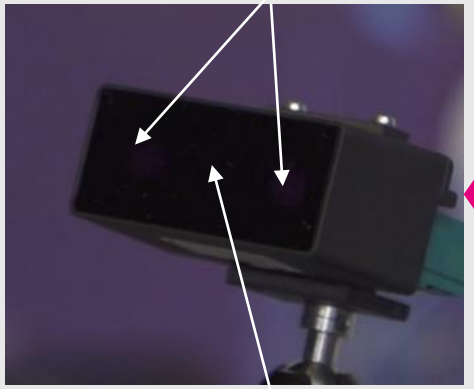
Driver Monitoring Systems (DMS)

DMS

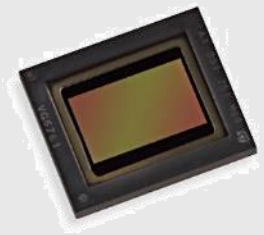
Imaging systems including processing to focus on driver's face to detect drowsiness & distraction (eyelid closure, head position, gaze direction, …)

Hardware

NIR strobe light



Host SOC

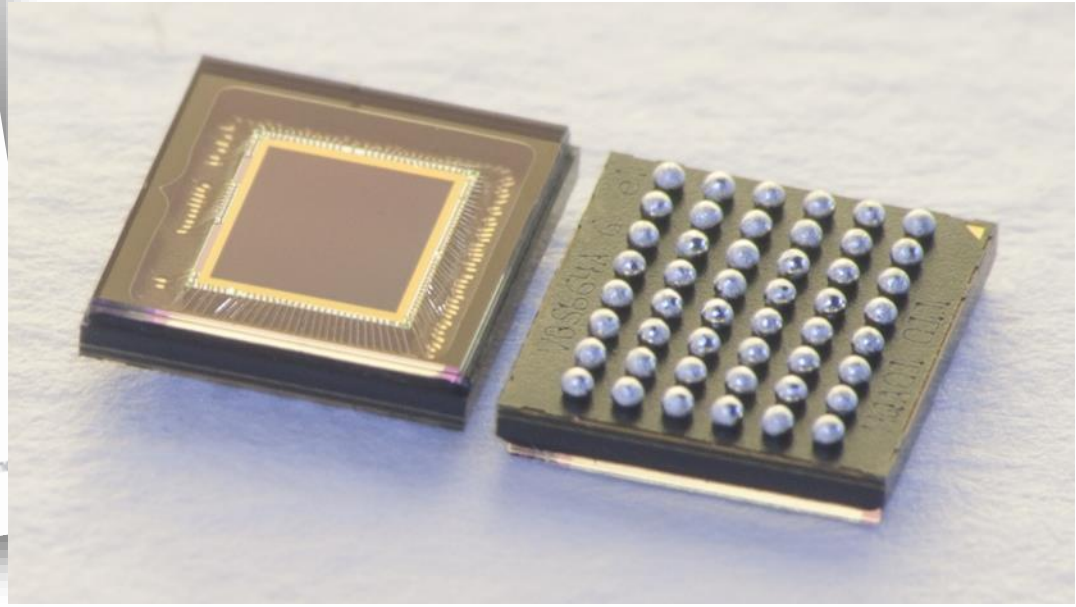


Global Shutter Image sensor

Software

DMS sensor - VB56G4A

Cost Efficient & The Most Sensitive Sensor on the market
Ready for Cyber Security and ASIL evolutions



6.2 mm x 6.9 mm Package – 145mW power consumption

Single LED Operation with the highest performance (incl. glint coverage) => Press Release :
Smart Eye and STMicroelectronics demonstrate high-sensitivity, lower-cost, 1-LED Driver Monitoring System

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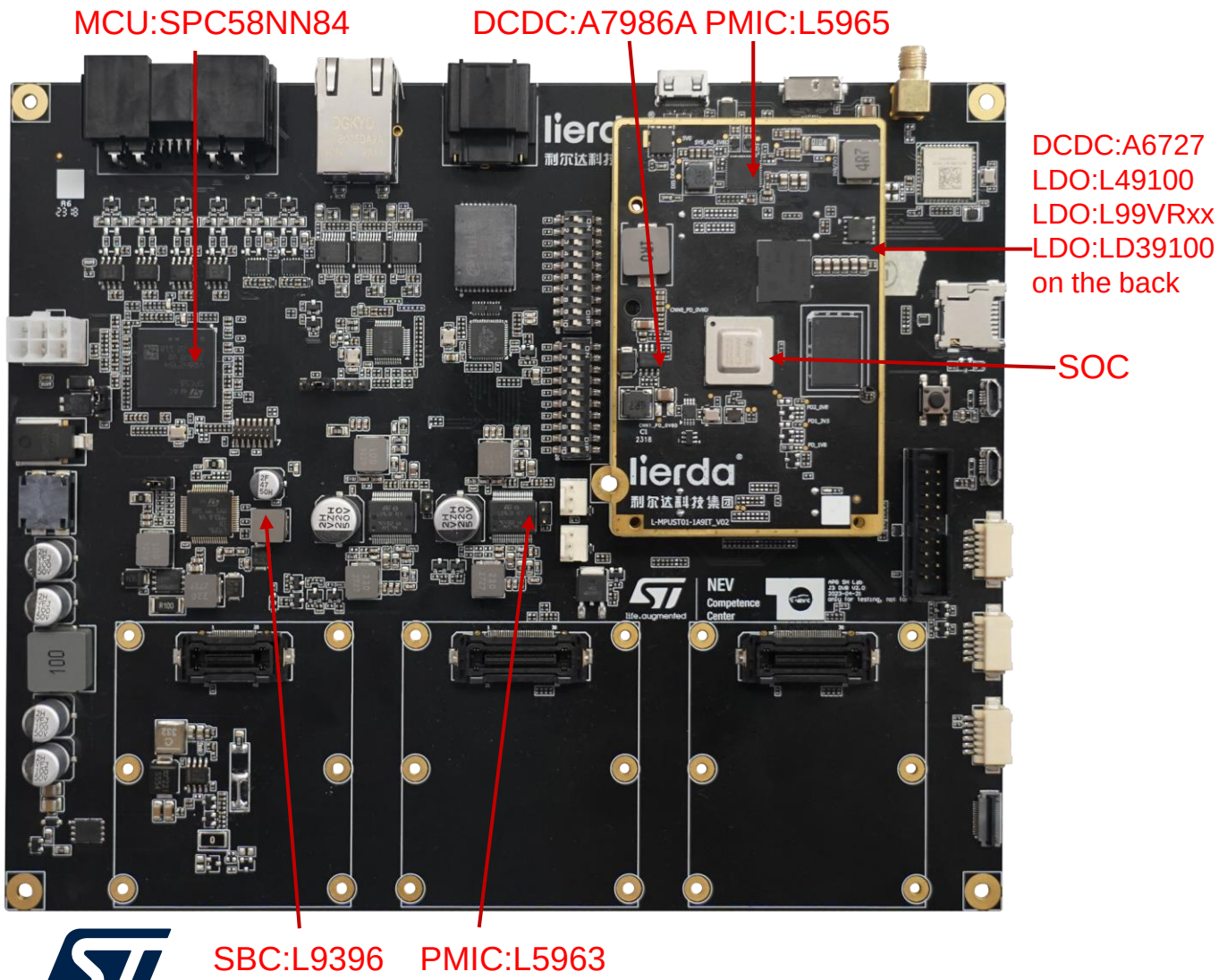
NEVCC and Showcase

ST EVK for Front-View Device



Processor:

- **SPC58NN:** 32-bit Power Architecture VLE compliant CPU cores, five enhanced main e200z4256n3 cores, dual-issue, two paired in lockstep
- dispatching 2000 DMIPS, HSM integrated, secure boot supported, ASIL-D compliant, AEC-Q100 qualified.

PMIC:

- **L5965:** An AEC-Q100 qualified multiple voltage regulator.
- Offers a set of features to support applications to fulfill ASIL A-B-C-D.
- Highly integrated PMIC achieves the compact power tree design
- **L5963:** An AEC-Q100 qualified dual channel single chip switching regulator with LDO and HSD
- Offers a set of features to support applications to fulfil ASIL A-B-C-D.

SBC:

- **L9396:** An AEC-Q100 qualified multiple power supply IC.
- Offers a set of features to support applications to fulfill ASIL D.

DCDC:

- **A7986A:** An AEC-Q100 qualified step-down switching regulator with a 3.7A(min.)current limited embedded power MOSFET
- **A6727:** An AEC-Q100 qualified single-phase step-down controller with integrated high-current drivers that provides complete control logic, protection and reference voltage to realize a general DC-DC converter by using a compact SO-8 package

LDO:

- **LD49100:** An AEC-Q100 qualified 1A,low quiescent current, low-noise voltage regulator with soft start-Automotive grade
- **LD39100:** An AEC-Q100 qualified 1A low quiescent current low noise voltage regulator
- **L99VR01:** An AEC-Q100 qualified automotive linear voltage regulator with configurable output voltage having 200mA current capability
- **L99VR02J:** An AEC-Q100 qualified automotive linear voltage regulator with configurable output voltage having 500mA current capability

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ST EVK for P-Box

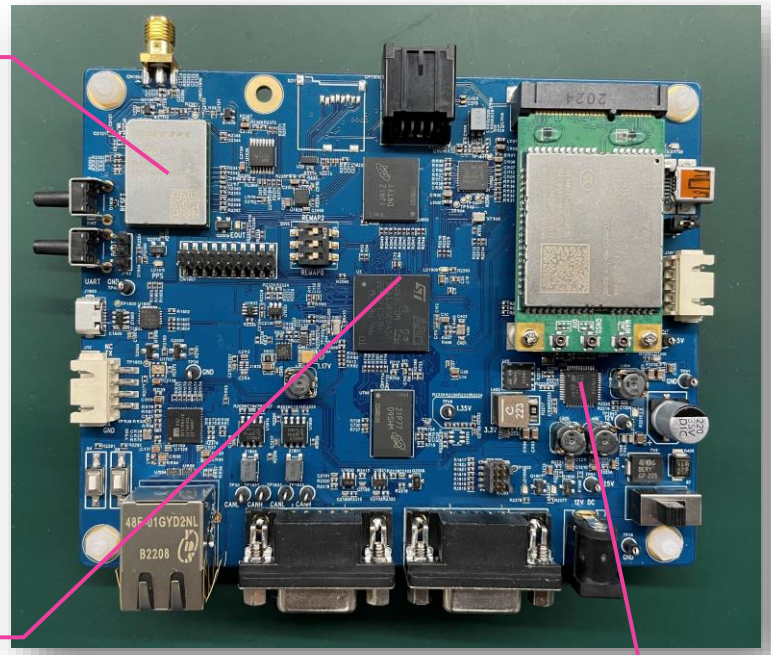
ST Complete System Solutions with Asil B Compliant

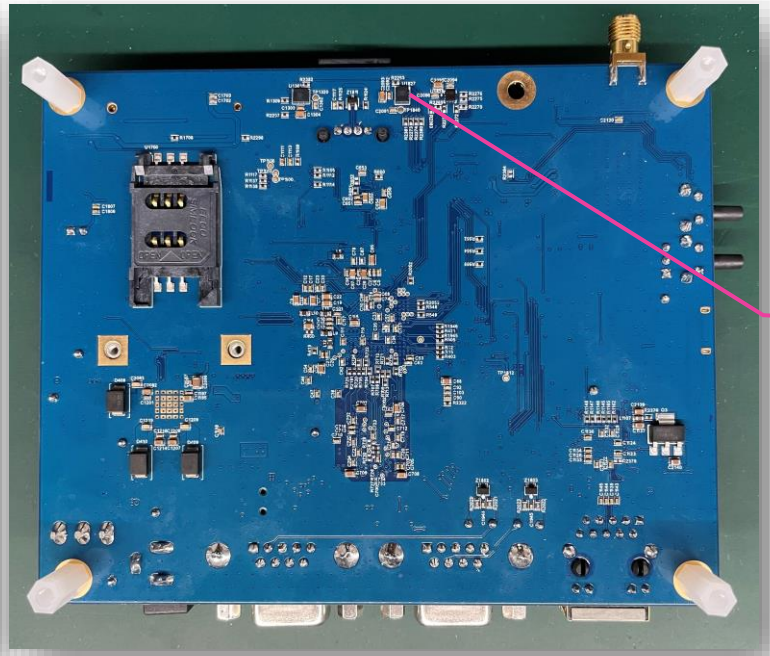
GNSS Module:

- **STA8100:** an AEC-Q100 qualified multi-band multi-constellation positioning receiver
- **STA9100:** an AEC-Q100 qualified multi-band multi-constellation positioning receiver, ASIL-B compliant.

Processor:

- **STA1385:** Cortex-M3 and dual Cortex-A7 ARCH, dispatching 2500 DMIPS, eHSM integrated, secure boot supported, ASIL-B compliant, AEC-Q100 Grade 2.





IMU

- **ASM330LHB:** High performance 6-axis IMU
- Adopted in redundancy (x2) and combined with dedicated safety engine Software to be compatible with ASIL-B systems.

PMIC

- **L5965:** An AEC-Q100 qualified multiple voltage regulator.
- Offers a set of features to support applications to fulfil ASIL A-B-C-D.

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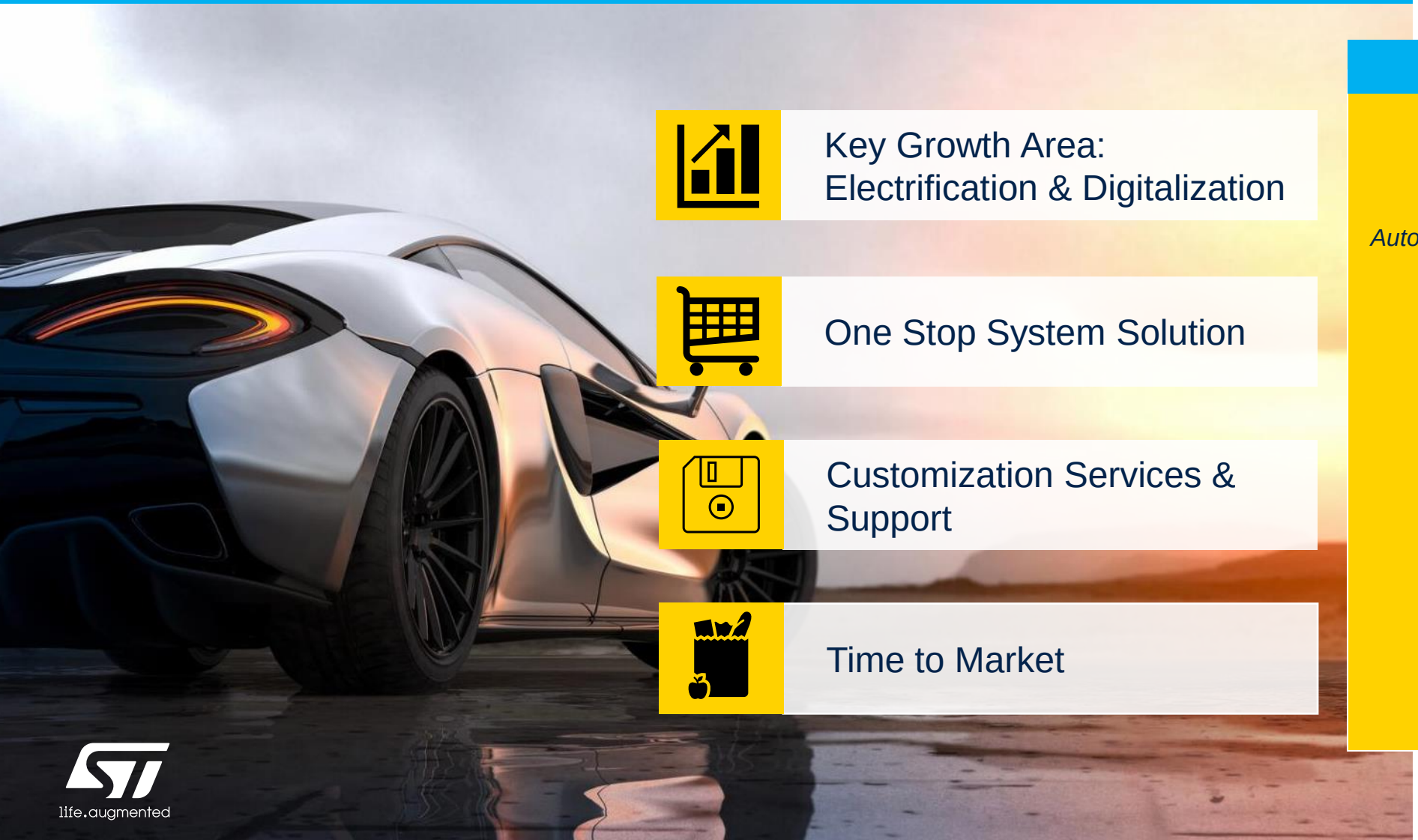
NEV Competence Center
Our Mission

China holding >60% worldwide NEV Vehicle Market Share*



- Key Growth Area: Electrification & Digitalization
- One Stop System Solution
- Customization Services & Support
- Time to Market

Key Enablers

30+Y

Automotive Experience

Product Portfolio

Partners

Talent Pool

*2023 Jan

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Market Mega Trend & Focus Applications

Electrification

Market driven towards Higher Mileage / Fast Charging & High Energy Density

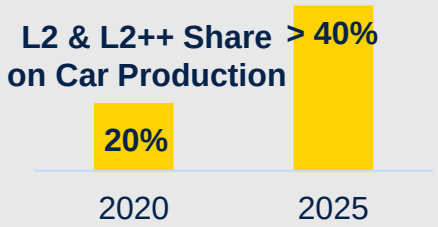
800V system adopted

11/22KW OBC ramping

Multi in 1

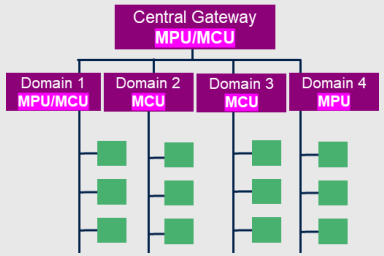
Smart Intelligence

NCAP Regulation (L2) boosting Si content for assisted driving system, increasing safety



New EE/A

- Protected switches require optimized power stage
- ECU Integration required x10 Computational power



Forever Green

- Valid for both Conventional & NEV
- System evolution towards zonal architecture

Smart Door Zone

One Box

Software Defined

Remote, seamless SW update needs new Vehicle Architecture

x10 Computational Power x Car

+30% Digital Silicon Value

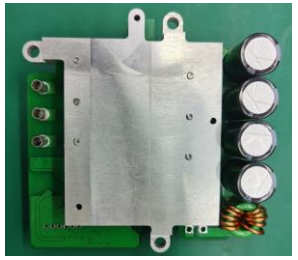
VCU / PDU

OBC

LV DC/DC

Traction Inverter

BMS



EV Compressor

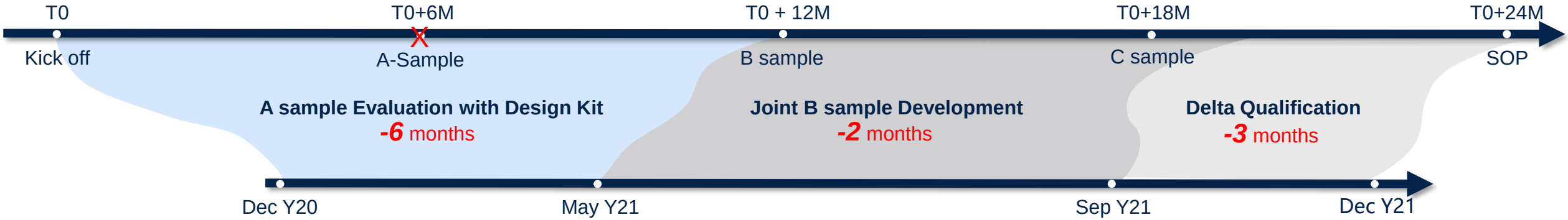
EPS

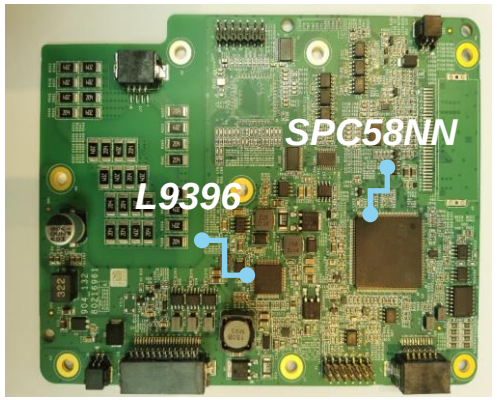
In China for China

Time to Market

Shortest Traction Inverter Project within **13** Month

- ***Adopting*** NEV CC design kit to B sample
  - Sch, layout, LLD, bench test report, CPU loading test report, MCS code
- ***Joint*** development with 3rd party on AutoSAR adaption
  - MCAL configuration, L9396 CDD, joint debug
- ***Kit*** solution with ***L9396 + SPC58NN***





Our technology starts with You

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