



Revolutionary automotive MCU Stellar platform with Ethernet Ring and AI support

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STMicroelectronics

General Purpose and Automotive MCU product portfolio



General-purpose STM32 microcontrollers & microprocessors

Automotive 32-bit microcontrollers

Wireless



Ultra-low power



Mainstream



High-perf.



Embedded MPU



Body & convenience



Zonal architecture



Electrification

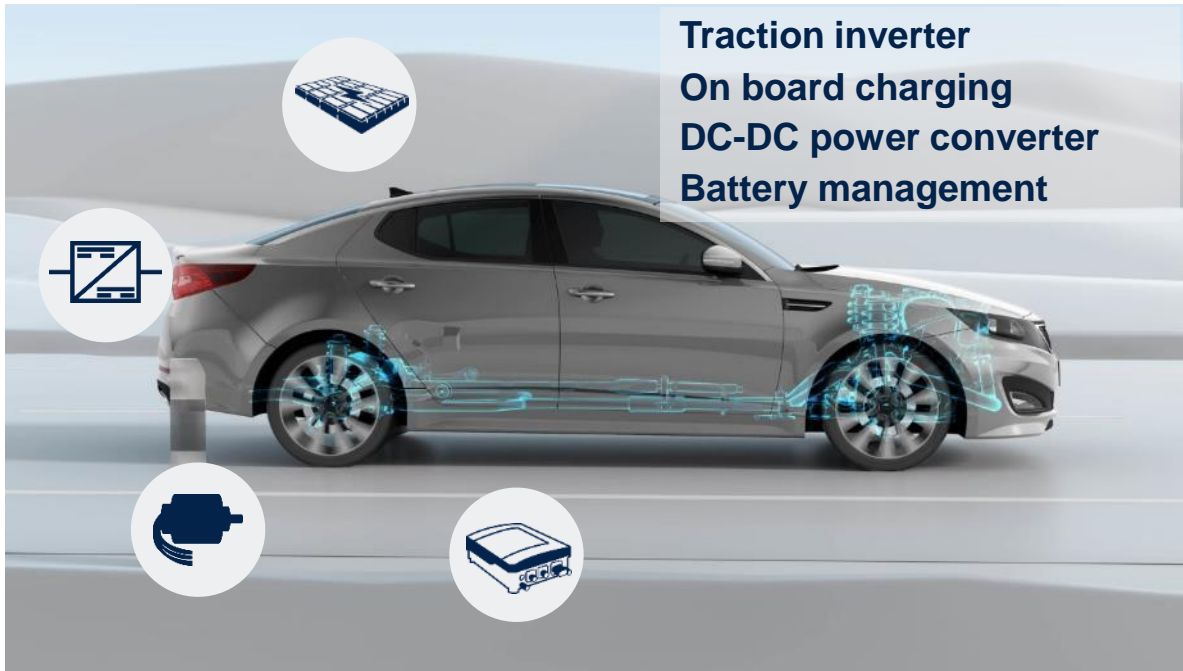


Arranged to enhance synergies and accelerate development on automotive and general-purpose MCUs

Key trends in the automotive market

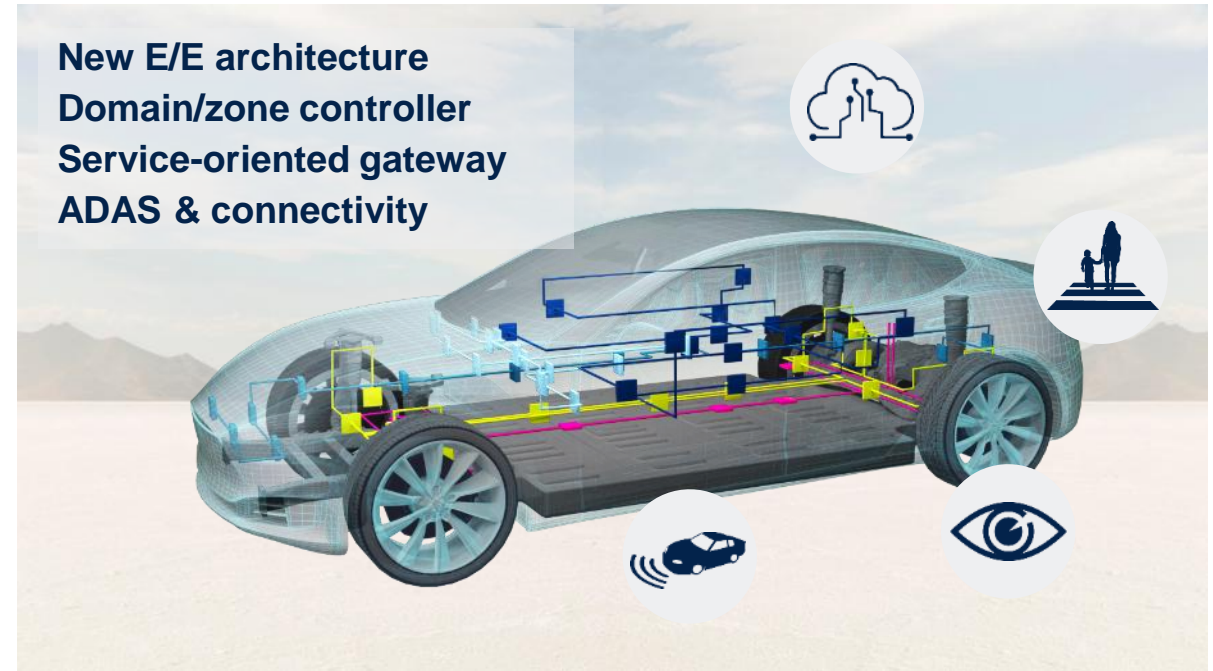
Electrification

Traction inverter
On board charging
DC-DC power converter
Battery management



Digital ubiquity

New E/E architecture
Domain/zone controller
Service-oriented gateway
ADAS & connectivity



Next gen E/E architectures towards SDV

**ACES & SDV pushing E/E evolution (decoupling HW/SW cycles, etc.)
OEMs following different paths, with some communalities**

Central consolidation

Strategic software with frequent updates and less real-time capabilities, to be consolidated in central computers

Zonal & domain consolidation

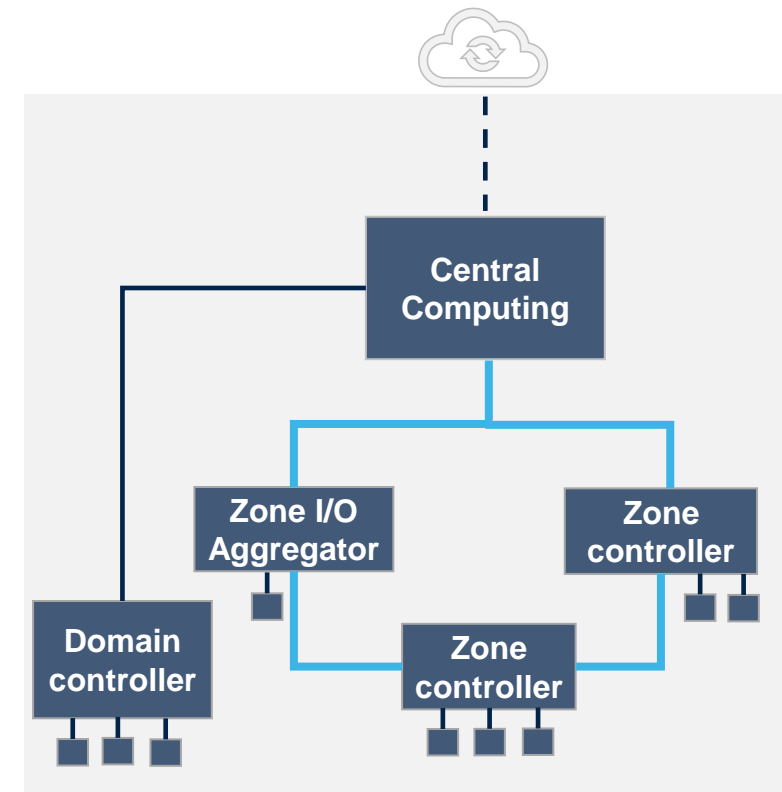
Software consolidation based on logical domains (powertrain, chassis) or physical proximity (zone), or both (X-in-1) to reduce complexity and wiring harness

Safe & secure actuation

Safety relevant ECUs (e.g., braking) not integrated into zone, or partially integrated into domains: strategical software separate from real actuation

Ethernet-centric architectures

Ethernet offers higher bandwidth, advanced security protocols, higher flexibility, and configurability



ST automotive MCUs helping the transition to SDVs

SDV pain-points

More ECU per car

More software running

Manage cost

Shorter development

What's needed

Unified management and networking infrastructure
Ethernet based vs CAN

More HW resources in term of processing and memory to support Xin1/zonal new applications, additional AI functionalities, and OTA-ready

Easy to use tools/modern dev languages
Support for virtualized system/hypervisors
Scalability and compatibility across

Virtual testing from cloud to vehicle
Collaboration tools and strong partner network

ST solutions

MCU processing

Ethernet based systems

Secure, safe, autonomous

Arm® ecosystem

AI edge tool suite

PCM memory best for OTA

Memory extensibility

Standardized env

Hypervisors

Modular/scalable solutions

Virtual environment

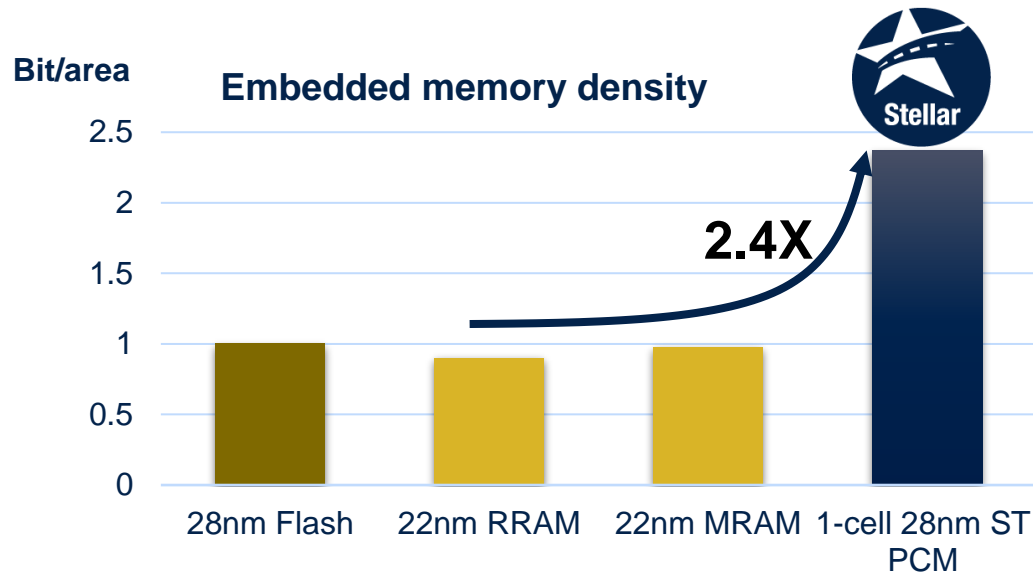
Introducing Stellar with xMemory

Adding a new dimension to scalability

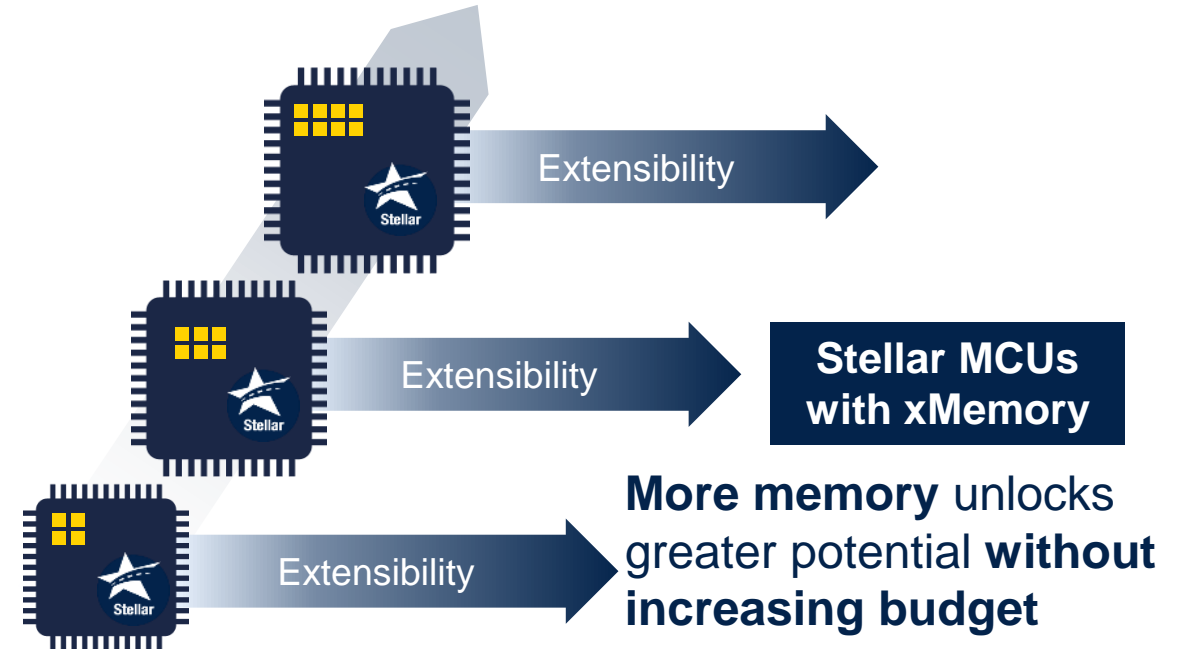
ST PCM technology delivers >2x memory density – more than doubling the capacity in the same space

ST offers more memory @ lowest cost in industry

PCM: densest NVM qualified for automotive



Source: Publicly available industry analysis reports



Stellar with xMemory: Each device with extensible memory capability unleashing software innovation

Stellar with xMemory Innovation and smart savings

**Built on ST proprietary, automotive qualified PCM technology,
Available on all upcoming Stellar P & G. Production starting late 2025**

Innovation



Headroom for product evolution with zero compromises

Operational efficiency



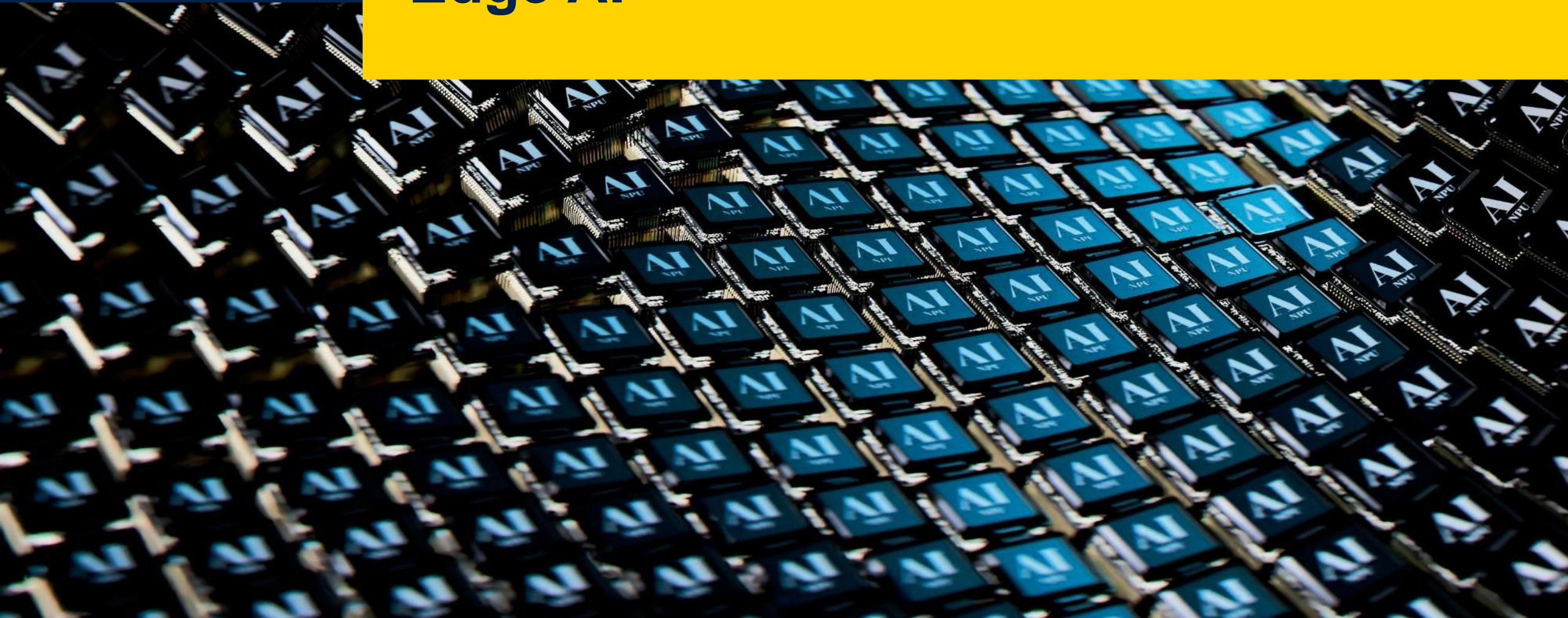
Unified procurement
Seamless development
Effortless deployment

Time to market



Upgrade through software only
One-code development

Edge AI



The evolving role of AI in automotive

AI fundamentally enhances safety, efficiency, and the overall car experience

Conversational AI In-car intelligent assistant



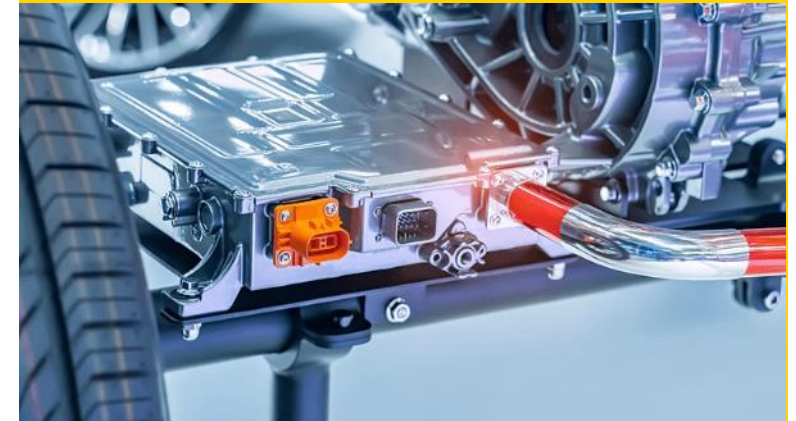
- Voice recognition/Intent recognition
- Natural language generation
- Personalization
- *LLM models*

Autonomous driving



- Object detection and classification
- Object prediction
- Route planning
- *CNN/Transformers*

“Real-time edge AI”



- Virtual sensors and estimation
- Anomaly detection
- Adaptive control (optimize perf)
- *tinyML*

Key AI use cases for MCUs in automotive

Anomaly detection



Increase safety by detect **anomalies** (complementary to traditional algos)

Anomaly detection for ADAS companion chip

Battery vent aperture status from motor current data

Smart anti-pinch window, seat detection

Adaptive control



Augmented processing (e.g., semiactive adaptive suspensions)

Sensor fusions AI processing

Smoother and more **efficient** motor output (e.g., AI soft switch inverter)

Health: accurate battery total **lifetime**

Break preconditioning, etc.

Virtual sensor



Virtual temperature **sensors** (reduce the number of sensors or estimate temp where sensors can't be used)

Tire thread, tire type or pressure detection, weight load estimation

Wipers blade aging detection, frozen wipers, etc.

Proven AI success in industrial applications

Leader in white-goods
Production starting in 2024
for **millions** units



~15-40%
Energy saving per
washing cycle

3x better accuracy

A washing machine uses **advanced motor control algorithms** to weigh clothes and optimize water, detergent, and energy used

New applications

After-market predictive maintenance
intelligent sensor with wireless connectivity

EMEA company
Deployed at **Volvo Trucks**
manufacturing plant



Predictive maintenance
Multisensors and learning on device

Panasonic e-bike
Hundreds of thousands of
units annually, starting in
2024



Virtual sensor
Tire pressure measured
through the e-motor
current consumption

Cost savings

Adding tire pressure detection capability to e-bikes **without adding any new hardware**

Extend lifetime

Industrial pumps learn their own optimal mode of operation and **detect anomalies** by themselves



220%
Reduced
downtime

Seamless integration with existing software ecosystem

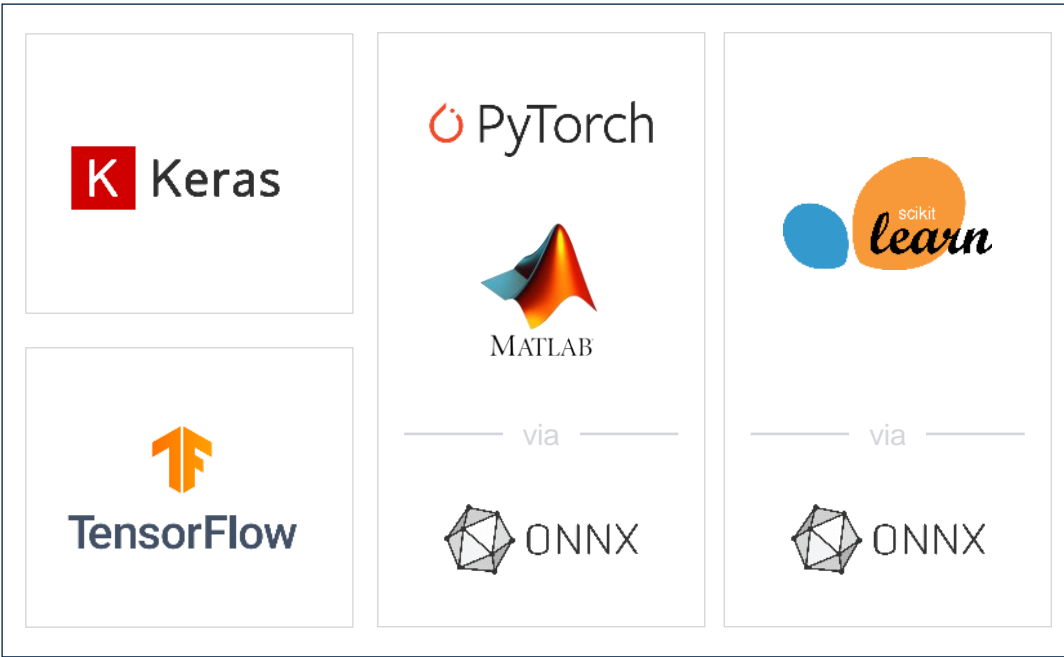


ST Edge AI Model Zoo

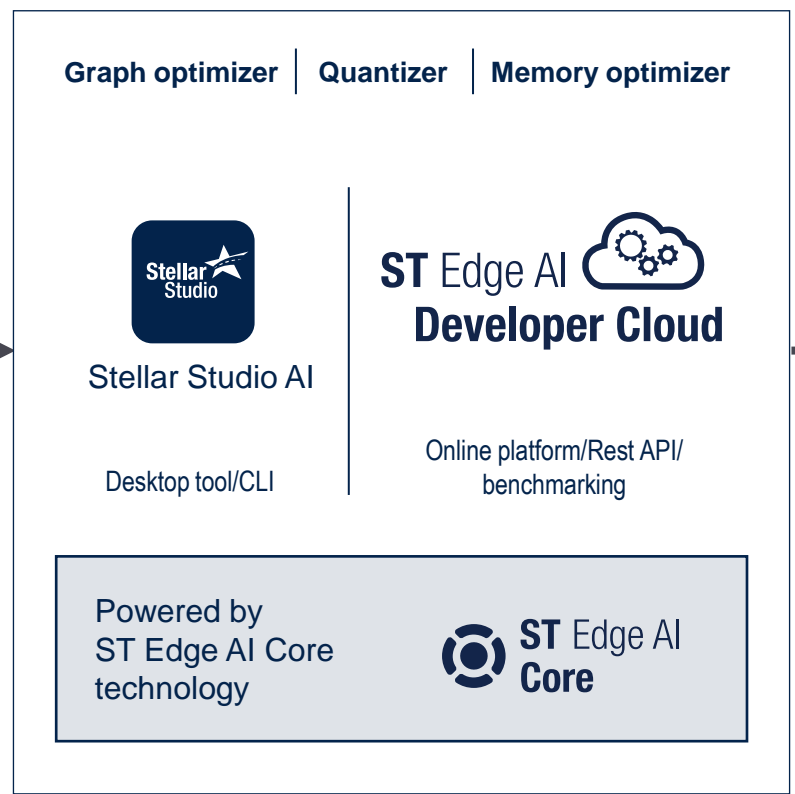


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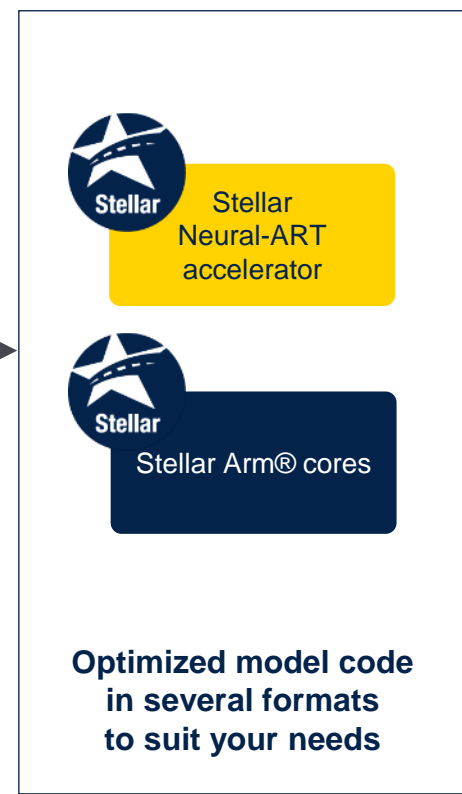
Bring your own model



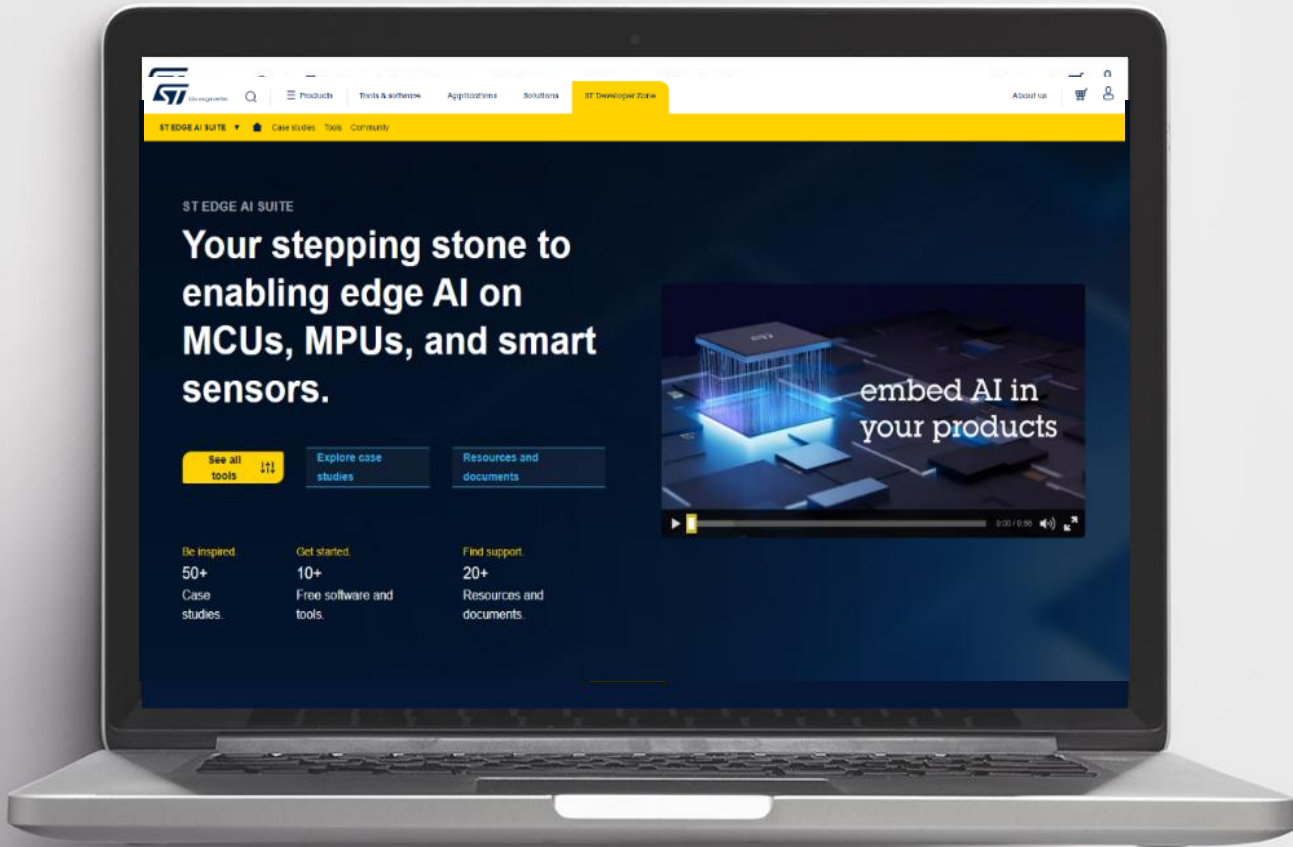
Optimize and benchmark your NN model



Generate optimized code and project files



Reach the full potential of your application



ST Edge AI Suite

50+ case studies

10+ free software tools

Unified ST Edge AI Core technology

ST leadership in automotive edge AI



New AI use-cases are set to transform the automotive industry with better driving experiences, higher reliability, and safer cars.

ST has invested for more than 10 years in edge AI technology and is very well positioned to be the leader in this market.

ST's roadmap provides for further integration of hardware acceleration and streamlined software tools.



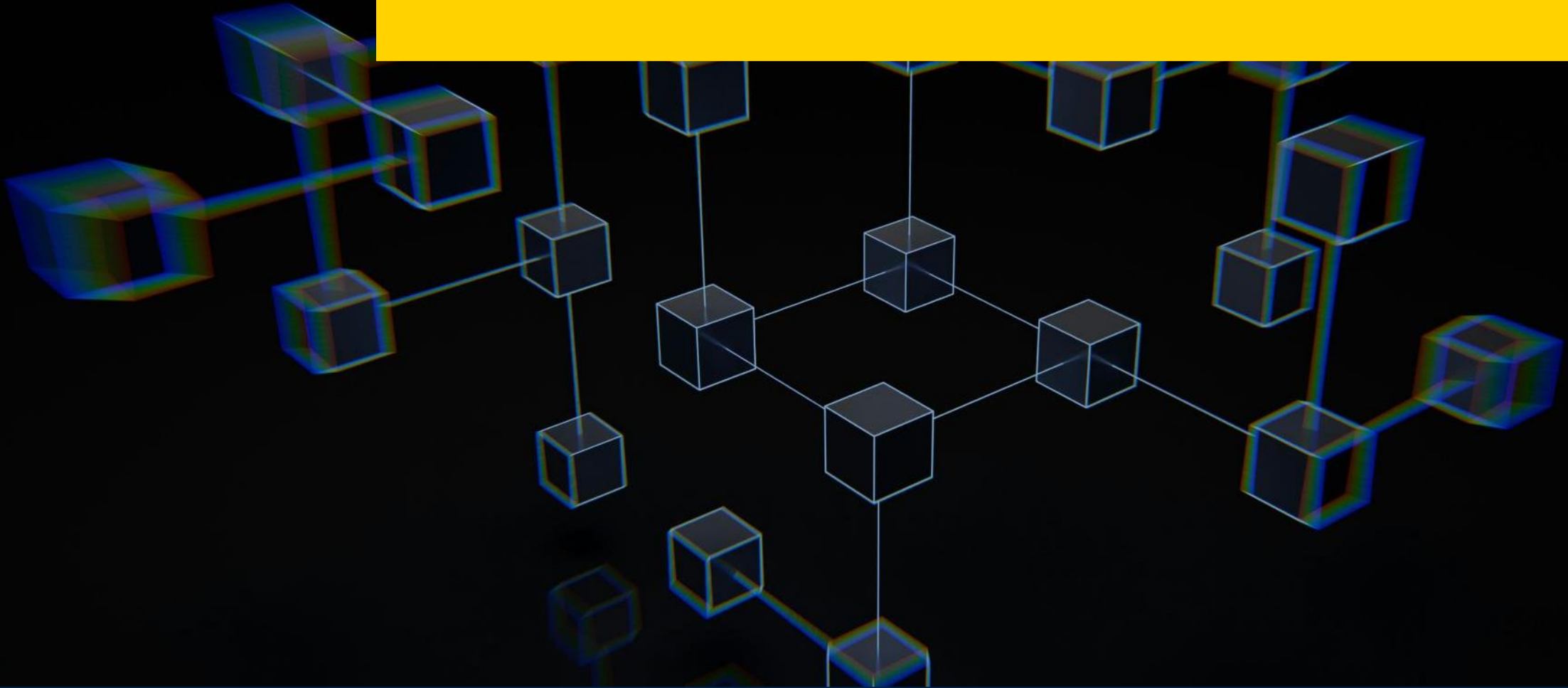
ST Edge AI Suite

ST is leading edge AI development

Best of Breed AI stack with Neural-ART accelerator NPU & ST Edge AI Suite



Ethernet and network topologies





Vehicle configuration & data distribution via Ethernet Ring

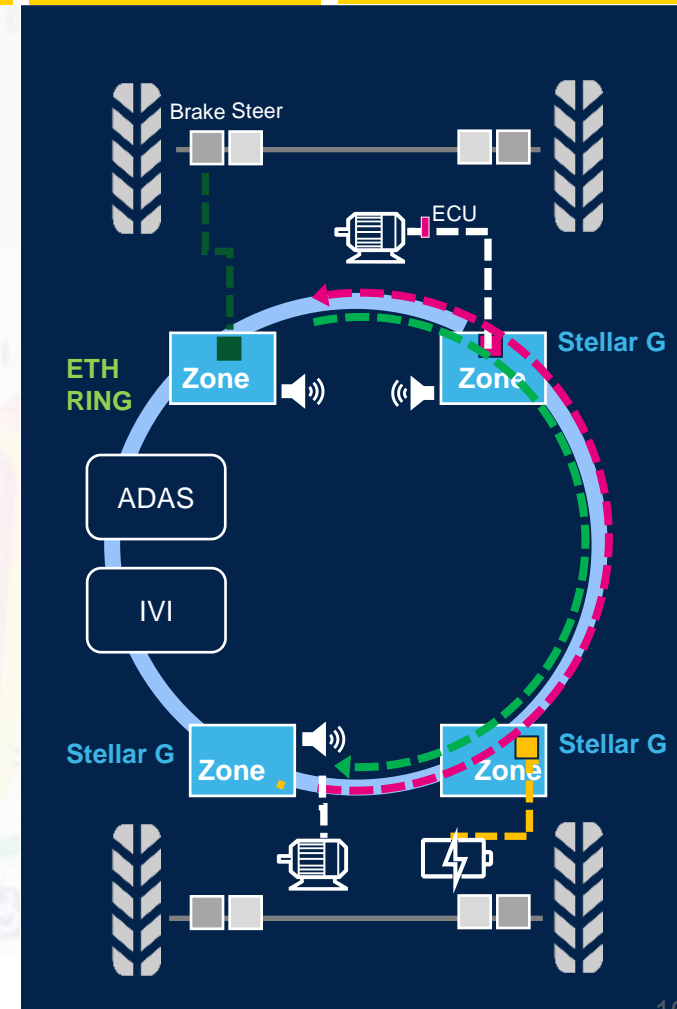
One ring unifying domains, zones, and actuators

Simple

Flexible

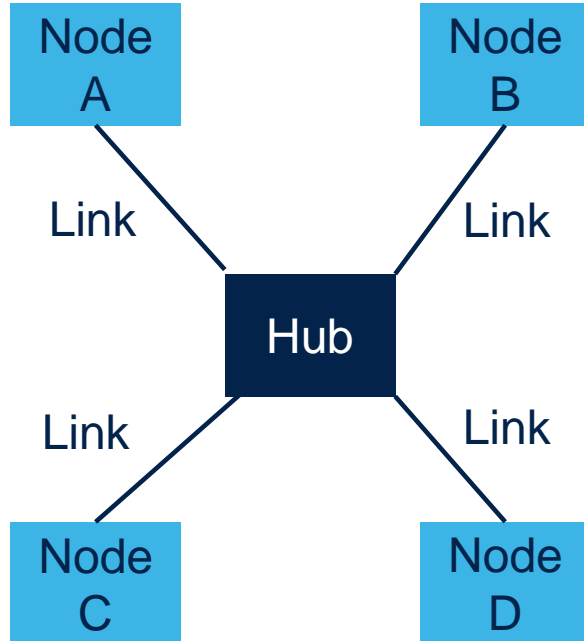
Efficient

1. **Minimum** cost of cabling **while ensuring fault tolerance**
2. **Optimal** messages distribution across the vehicle (all see all)
3. **Easy reconfigurability** of vehicle (add/subtract ECU)



Basic ethernet star and ring

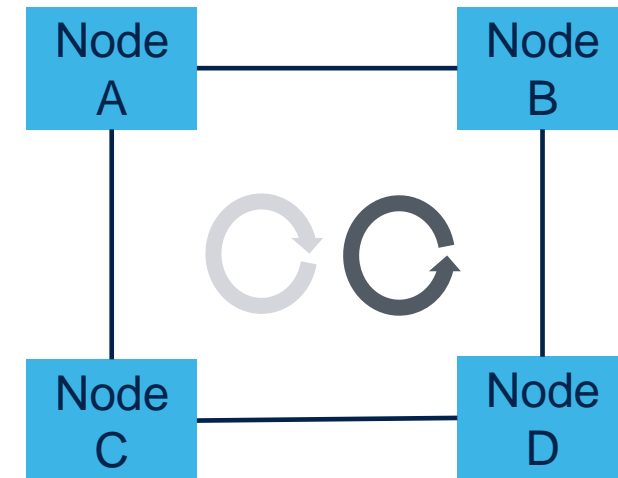
Star: N nodes, N links, 1 hub



Most likely to be used today



Ring: N nodes, N links, N switch

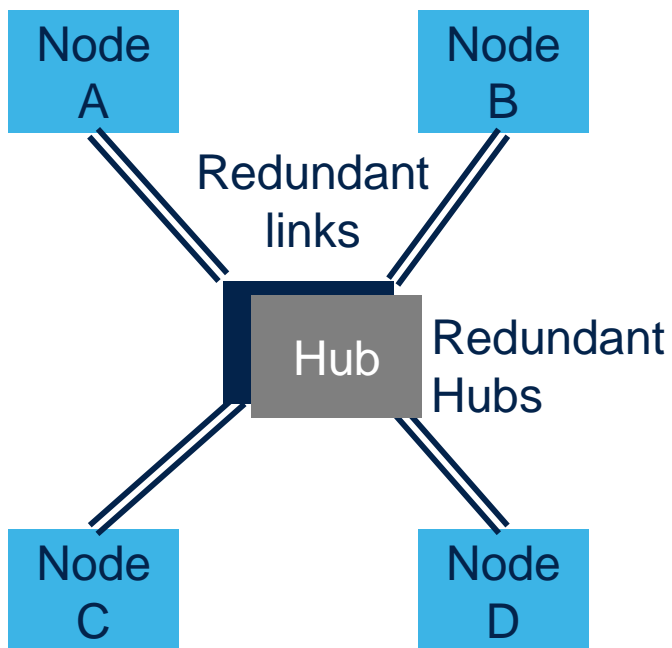


>80% of automotive today is Star
Simple to manage. Minimal cost
Lowest latency. Needs hub. As nodes increase, wiring across vehicle is the limit

<20% of automotive. Manageable costs. Reconfiguration if nodes are added or removed.
Latency concern not substantial vs. Star.
Requires specific protocols (for redundancy and broadcast storm avoidance).

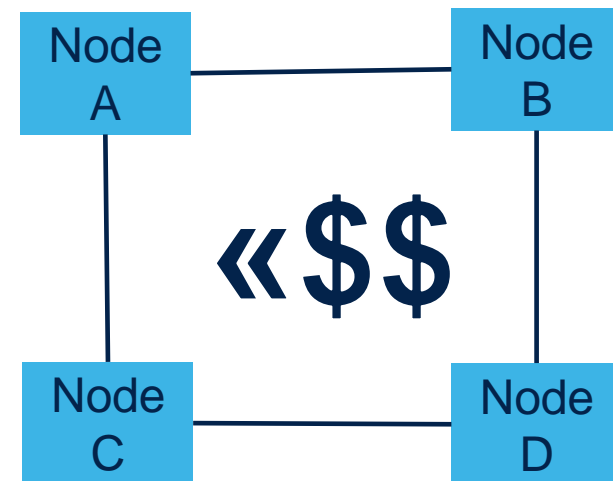
Fault tolerant ethernet star and ring

Star: N nodes, N links, 1 hub*



A fault tolerant Star requires double links and redundant hubs with special protocol to make it look as “single link”.
Cross car wires easily created when Star used

Ring: N nodes, N links, N switch**



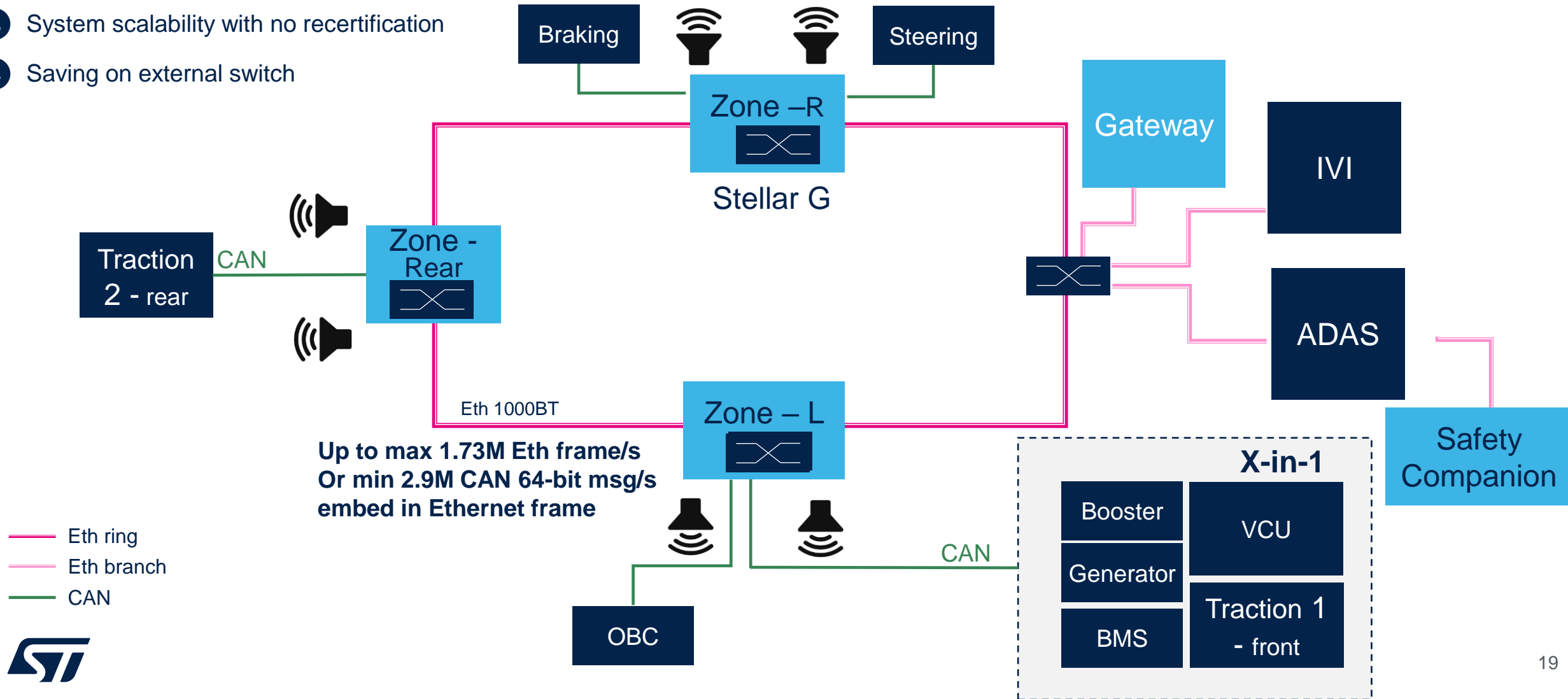
Reduce drastically cost of cabling and connector (>50% possible).
Natively fault-tolerant.
Easily expandable w/o cross wiring
Can build hybrid topology



Generic architecture with Stellar G

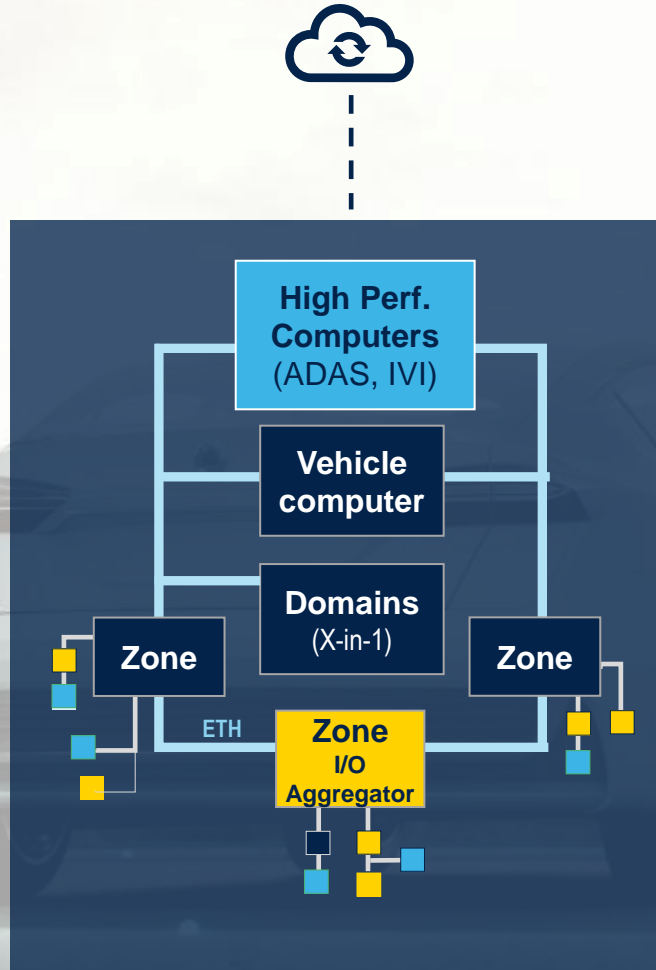
Benefits:

- 1 Efficient fault tolerant architecture with no extra cables
- 2 Cross wiring reduction
- 3 System scalability with no recertification
- 4 Saving on external switch





ST automotive microcontrollers from actuation to centralization



Control & Computing

Actuators & Sensors



High Integration

arm R52+



arm M85/M55



arm M55/M33



Low Integration

Functions integration	Stellar P / G Real-time integration platform	Zone Ctrl (Mid/High)	Vehicle dynamics controllers
		Safety companion	X-in-1 electrification
Safety & security	Stellar X Actuation & precise control ASIL-D	Chassis & safety	Zone I/O aggregator
		Body controllers	Standalone xEV
General purpose	STM32 A ASIL-B	Lighting	Key entry
		Seats	Doors

Stellar automotive MCU family

Points of foundations

Arm® core

General timer module (GTM)

CAN FD/XL

Ethernet 10/100/1000



STM32A – Stellar X
Software compatible
programming Model



Points of differentiations

NVM memory

AI software & accelerator

Ethernet switch

Flexible low power

Freedom from interference architecture

Control loop accelerators

Security

CPU speed (500/700 MHz)

Accelerators/coprocessors

ISO21434 compliance

Absolute I/O number and I/O density

Core flexible configuration



Stellar MCU key values

Stellar P/G

- Functions integration and I/O aggregation (domain, zonal, Xin1)
- Model first (Asar with XML)
- Safe virtualization with hardware support
- High compute performance (6K DMIPS)
- xMemory (based on PCM)
- Ethernet up to 1Gbps and switch
- AI enhanced
- 5V or 3.3V
- SDK

Stellar X

- Cross domain functional integration (zonal, XDom ECU), standalone xEV and HE chassis
- Vertically integrated software OEM (code first)
- Fast & precise coprocessor (low latency domain)
- Very high compute performance (10K DMIPS)
- xMemory (based on PCM)
- Ethernet switch and 10BT1S to 1 Gbit
- AI enhanced
- 3.3V only and high I/O density (small pitch BGA)
- CUBE 2.0

Extensible
memory

Data processing
with AI acc. in RT
zone/domains

Arm® core
consistency

Ethernet
Switch
integration

I/O density



Foundations

Stellar P/G Integration MCU scalable series

- **FD-SOI 28nm with PCM ST process**
- High integration platform for drivetrain and xEV (P), zone (Body, GW) & safe controllers (G)
- Fit for software defined vehicles
- Stellar P (165°C/150°C T_j, 5V), Stellar G (150°C T_j, 3V3)



Safe configurable multicore CortexR52+™ (up to 700 MHz on G9) with *isolation* and *virtualization* (more than freedom from interference)



Scalable series from **5 to >32 MB NVM**. High-end zone to simple I/O aggregation (Stellar G) and X-in-1 electrification (Stellar P)



Efficient acceleration: data routing, analog to digital filtering, smart low power, model predictive control, xEV motor control. **AI with NN accelerator**



NVM extension with advanced OTA



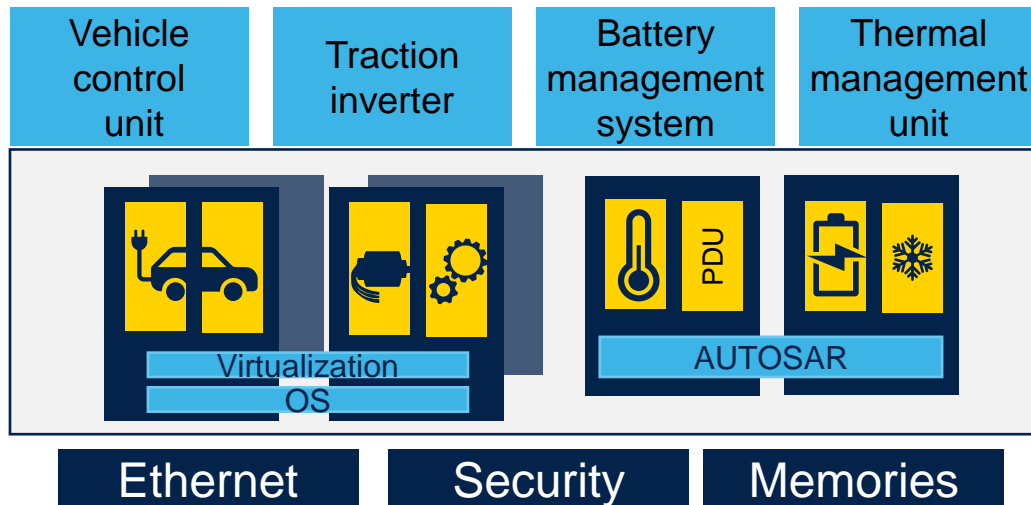
Stellar MCU: a game-changing architecture

Stellar: a foundation of auto MCU growth

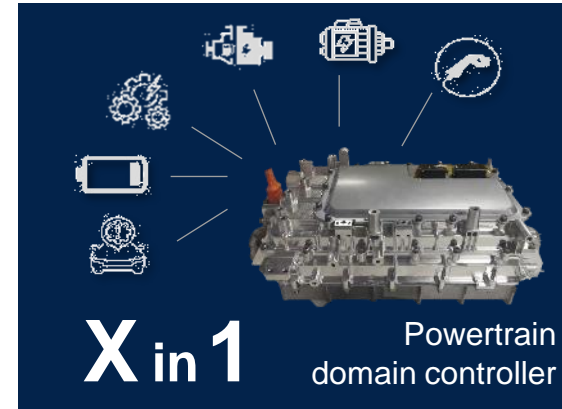
ECU functions integration into MCUs:

New MCUs will become scalable integrated zonal controllers
→ powerful computing capabilities and HW variant scalability.

New SDV paradigm increases OTA updates and software value creation → flexible and scalable NVM resources.



Stellar for X-in-1 and zonal architectures



Stellar P

arm

Integration platform
High performance actuation

Products ready: P7, P6, P3
Multiple additional in roadmap



Stellar G

arm

Data and I/O aggregation
Ethernet centric, including switch

Products ready: G7
Multiple additional in roadmap



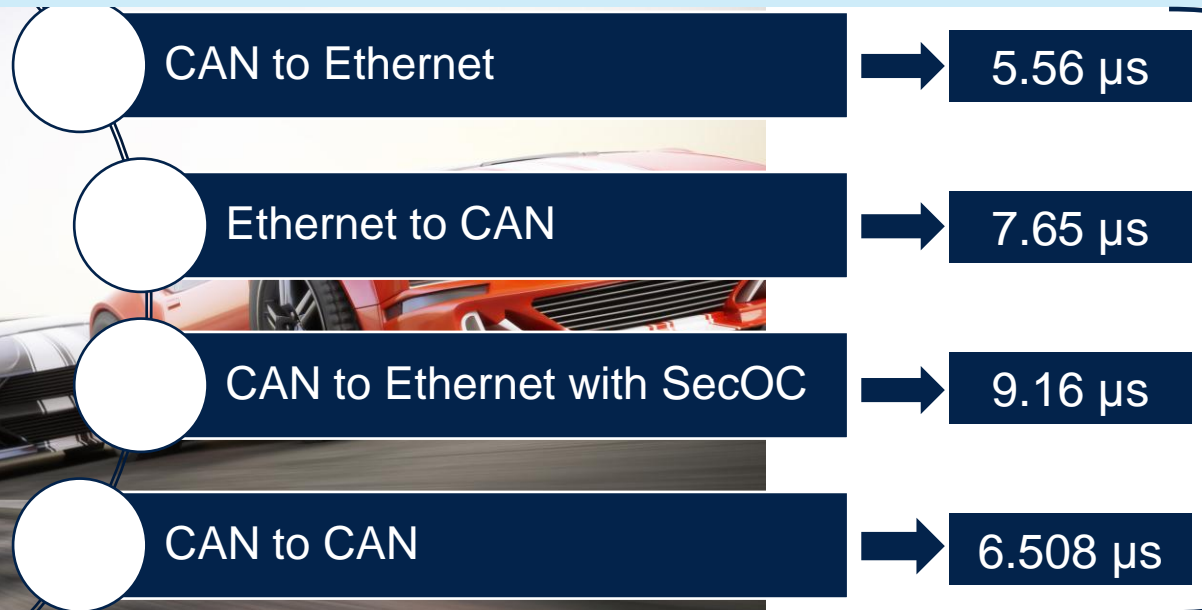


Stellar G efficient routing

Highly efficient and safe data routing system

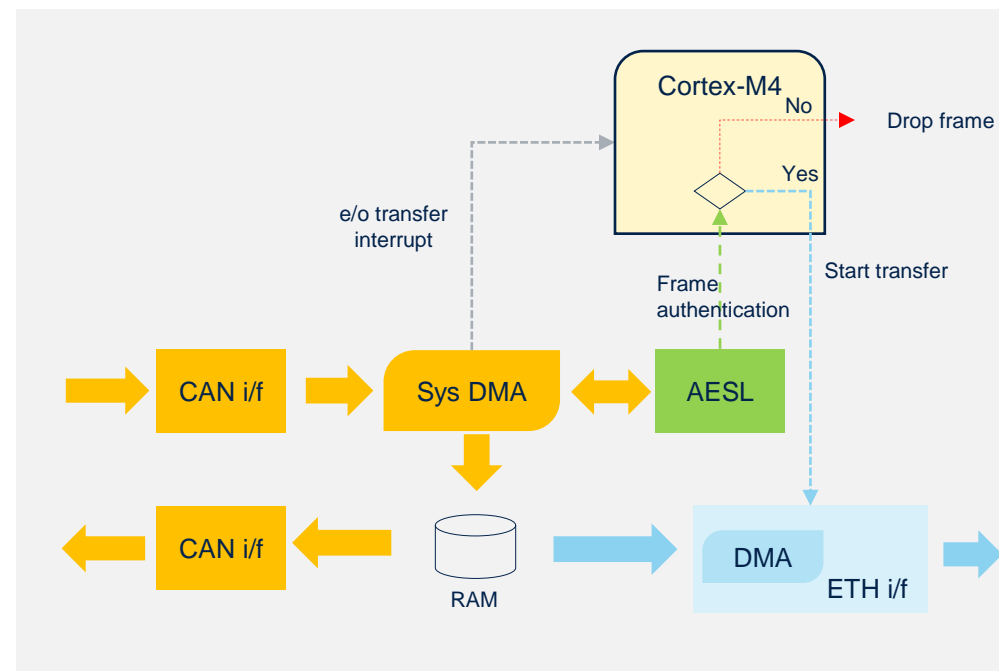


Embedded switch offers lower latency vs alternatives (bridge or full software solutions)



*ACK time = +8 μ s

Pin-to-pin processing time



Stellar G3 use case

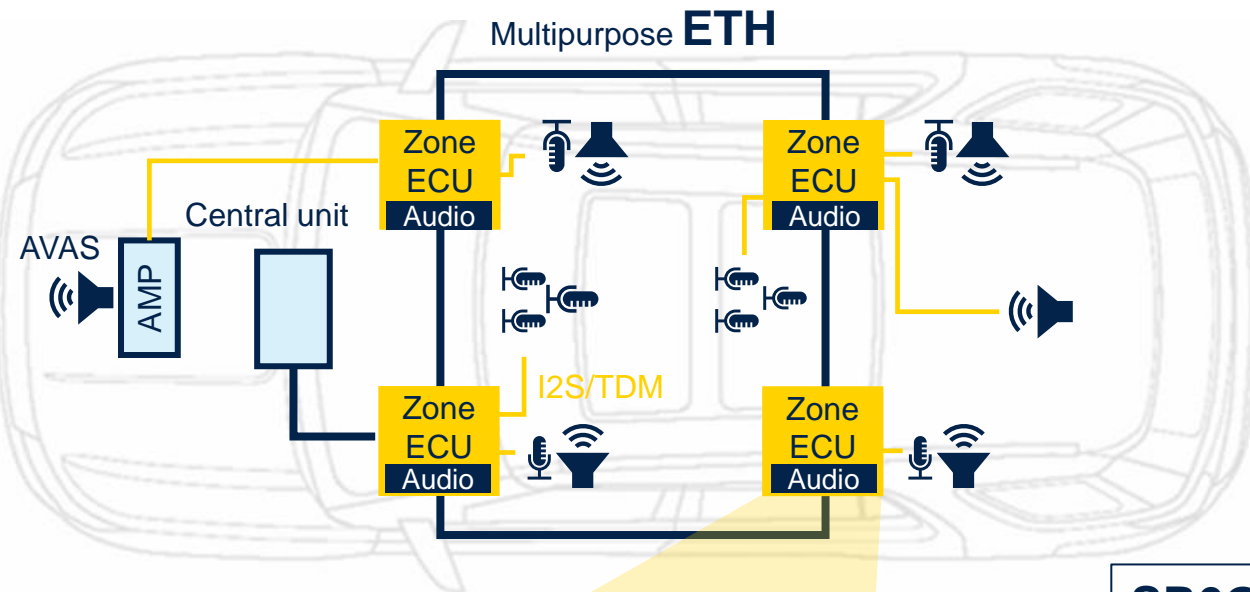
Key values

- Full offloading of MCU main CPU (Cortex R52+)
- Data move engine with Cortex M4 supporting all routing concepts
- Safe routing with protection mechanisms
- CAN/LIN/FlexRay to ETH and vice versa





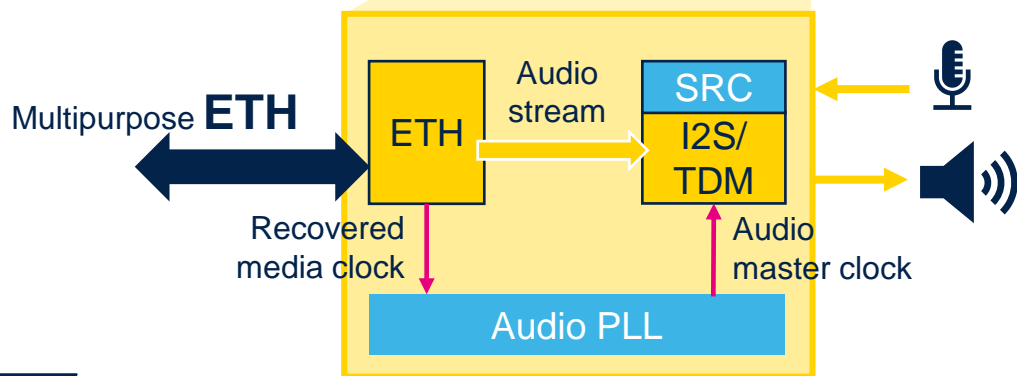
Stellar P/G integration MCU integrated audio over Ethernet



Zone MCU with integrated audio

Enables cost saving integrating audio into zone infrastructure

- Audio over ETH saving extra A2B wiring and components
- AVAS & in-cabin sound concepts integrated in zone ECUs



SR6G6 integration MCU

- SR6's embedded **HW-based virtualization** capability enables safe and efficient integration of multiple applications incl. audio

SR6G6 audio features

- Ethernet AVB, media clock recovery, and **integrated audio PLL**
- 2x I2S/TDM interface
- Integrated **Sample Rate Converter (SRC)** with 6 channel / I2S
- R52+ based audio processing

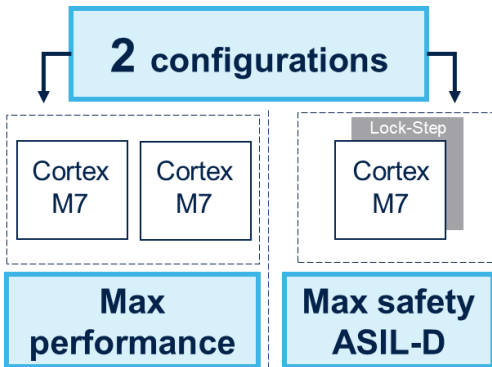




SR5 – Stellar E1 Electrification MCU

Computing platform

Arm Cortex-M7 300MHz
Doubling performance
Safety up to ASIL-D
HSM for security



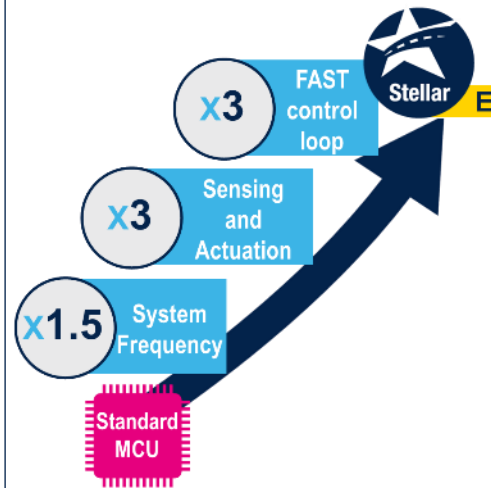
Designed for EV revolution

New energy mobility
SiC and GaN
Power efficiency



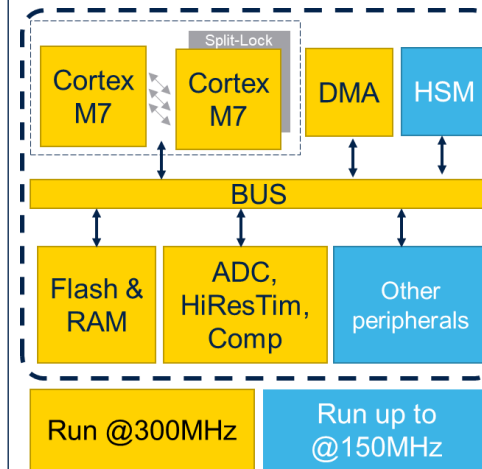
High performance analog

104ps high res timers
16-bit $\Sigma\Delta$ -ADC
2.5MSPS SAR ADC
50ns analog compare



True single frequency

Low latency response
Fast control loop up to 1 MHz

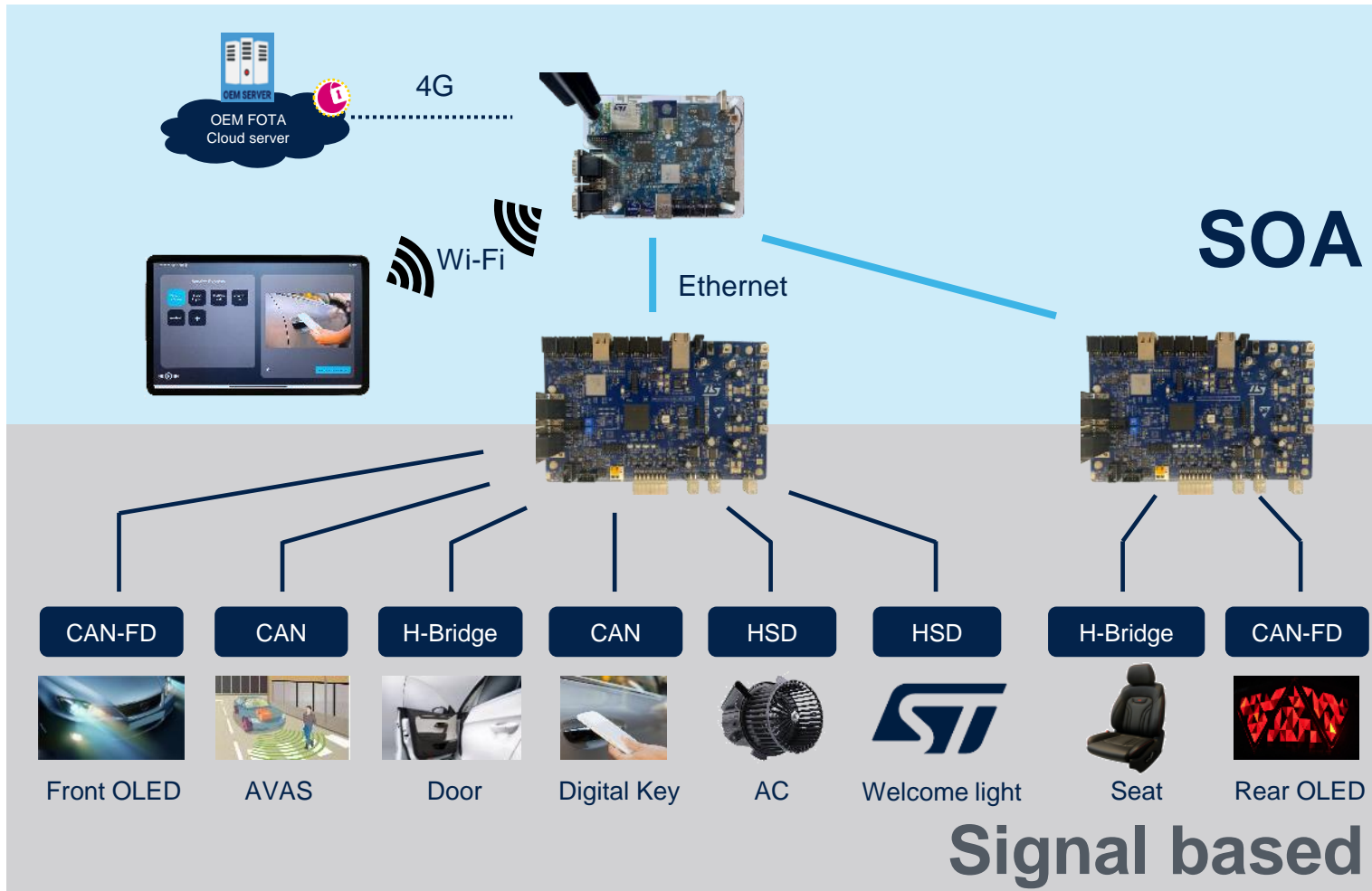


Vertical ecosystem

Combo OBC+DC-DC
Motor control
Traction inverter



ZCU solution demo car



- AVAS ECU, digital key ECU, front and rear OLED, door control, seat control, and welcome lights integrated.
- **FOTA** applied from cloud servers over cellular networks.
- **SOA** supported by DDS protocol.



Our technology starts with You



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