Capital Markets Day 2024

Microcontrollers, Digital ICs and RF products Group

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Agenda

1. Introduction
2. Edge
3. Space
4. Cloud
5. Takeaways

Era of Cloud Connected “Intelligent Things”

Three pillars to make cars & things more intelligent, secure and connected

>$100B SAM in 2027

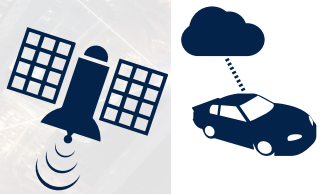
Sources: WSTS

Edge

AI @ the Edge: to more efficiently and autonomously compute and actuate

Security: to identify / authenticate / protect data within device, device2device, device2cloud

Cloud: to enable high data bandwidth to and from the AI-powered infrastructure



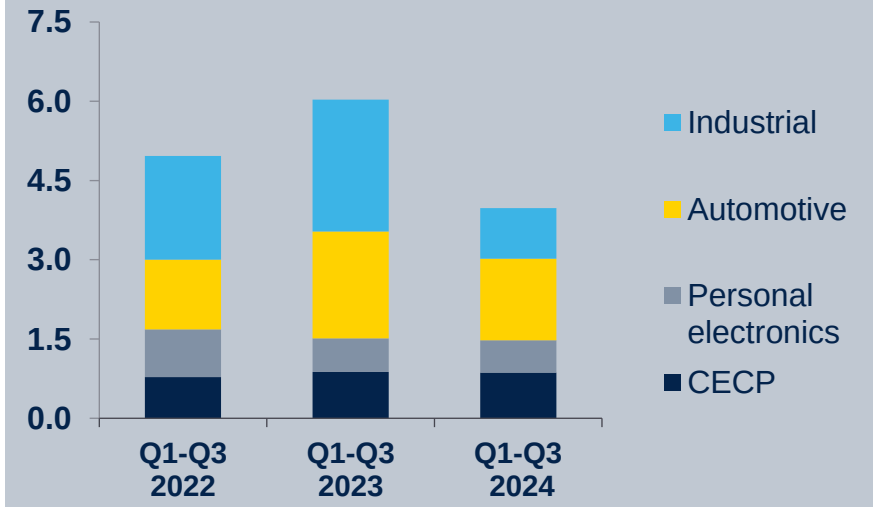
Cloud

Revenue overview - MDRF

MDRF Group revenue $B

First 9 months 2024

$4.0B



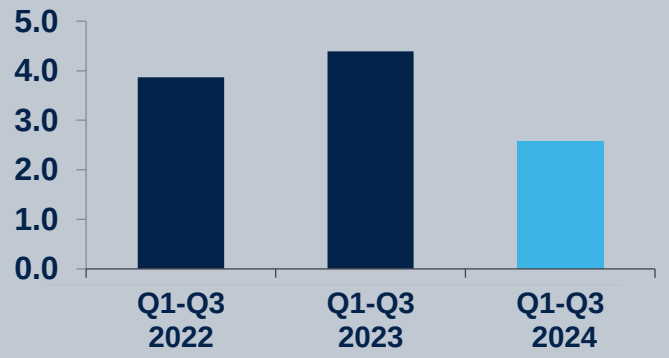
CECP: Communication Equipment, Computer & Peripherals

MDRF Sub-group revenue $B

MCU

First 9 months 2024

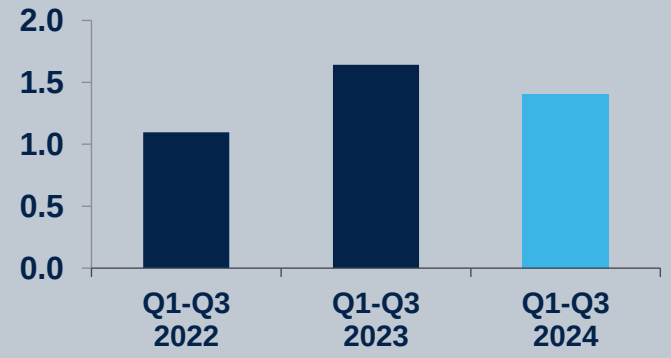
$2.6B



Digital & RF

First 9 months 2024

$1.4B



The trends we intend to benefit from

AI at the (tiny) edge

Enables more energy-efficient & smarter decision making

Reduces decision latency & data transferred to the cloud

Enhances privacy and security

$2.5B AI HW accelerated MCU SAM in 2030

ABI Research

Electrified & software defined vehicles

Are flexible & upgradable: with over-the-air updates & modular improvements

Provide enhanced safety & security: Predictive maintenance & adv. security.

Have innovative features: autonomous driving & personalized experiences.

>$16.5B automotive MCU SAM in 2030

Tech Insights

LEO satellite constellations

Connect the unconnected:

- **Ensure** global coverage
- **Provide** high-speed internet to remote and underserved areas worldwide

>$1.6B LEO semiconductor SAM in 2030

ST estimate

Cloud optical interconnect

Cloud requires increasingly higher comm. bandwidth w/i and between AI data centers (DC)

Cloud power consumption growth has to be mitigated

Silicon Photonics will become the technology linchpin of the AI cloud

$2B photonics foundry SAM in 2030

ST estimate

What has changed since May 2022

Global economic environment

2021-2023: sustained average annual inflation > 6.5%

Interest rates jumping from <1% in 2022 to ~5% in ‘24

US China relationship degrading

Increasing geopolitical tensions: Ukraine, Middle East

Consumer confidence decreasing from ‘21 to ‘24

Lower global economic growth forecast

China GDP growth decelerating from ‘22 to ‘24

Microcontrollers environment

Increasing competition from Chinese manufacturers in Industrial/Consumer

End of shortage and excess channel inventory created during allocations period

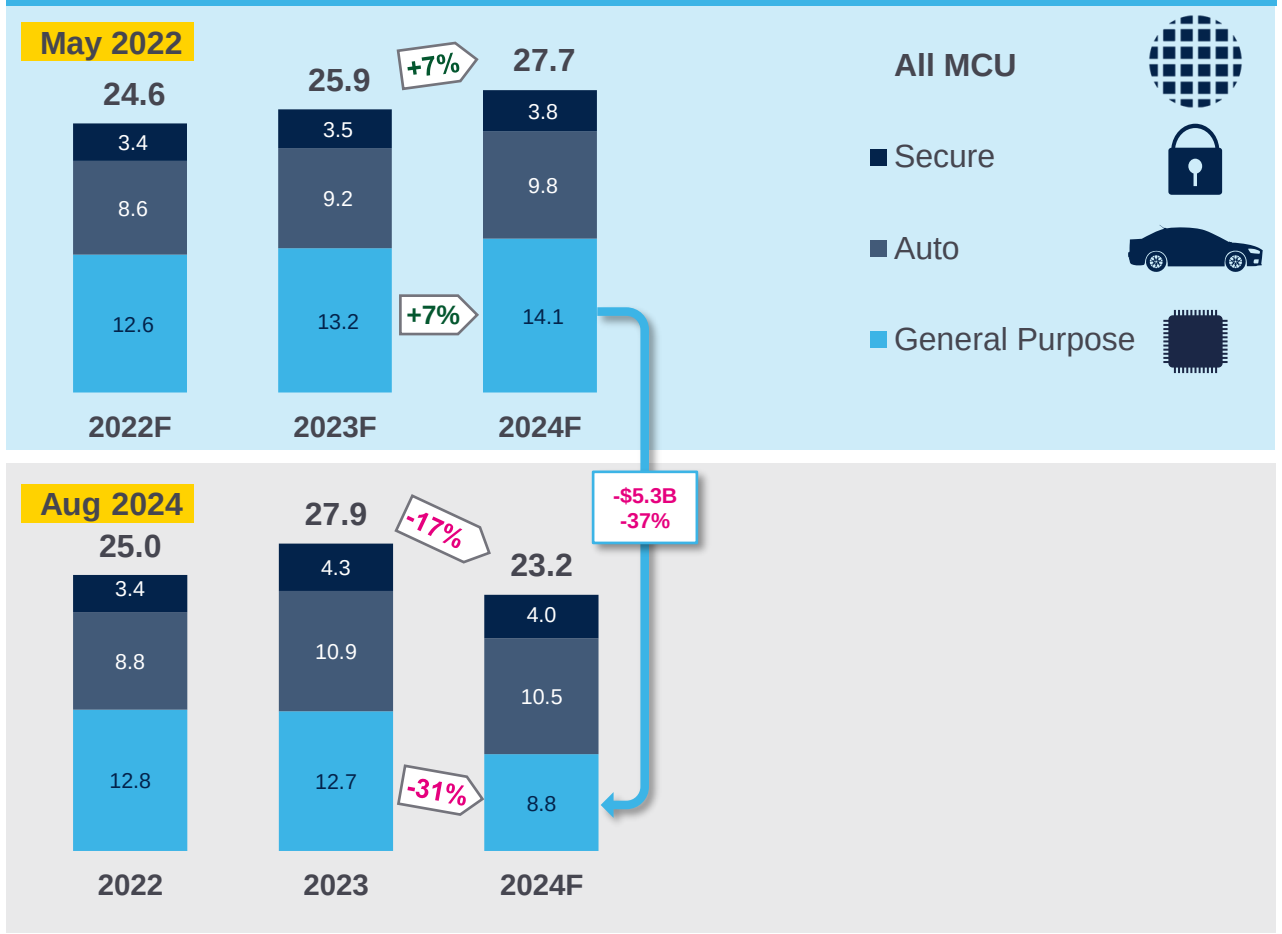
Industrial MCU market down and not recovering yet

- Factory automation declining
- Housing market in China down and slow recovery
- EMEA market slowing down.

Automotive MCU market growing faster than predicted in 2022

From GP/Auto ratio vs total MCU of **45%** / **39%** in ‘23 to **38%** / **46%** in ‘27

WSTS MCU TAM forecast and actual ($B)



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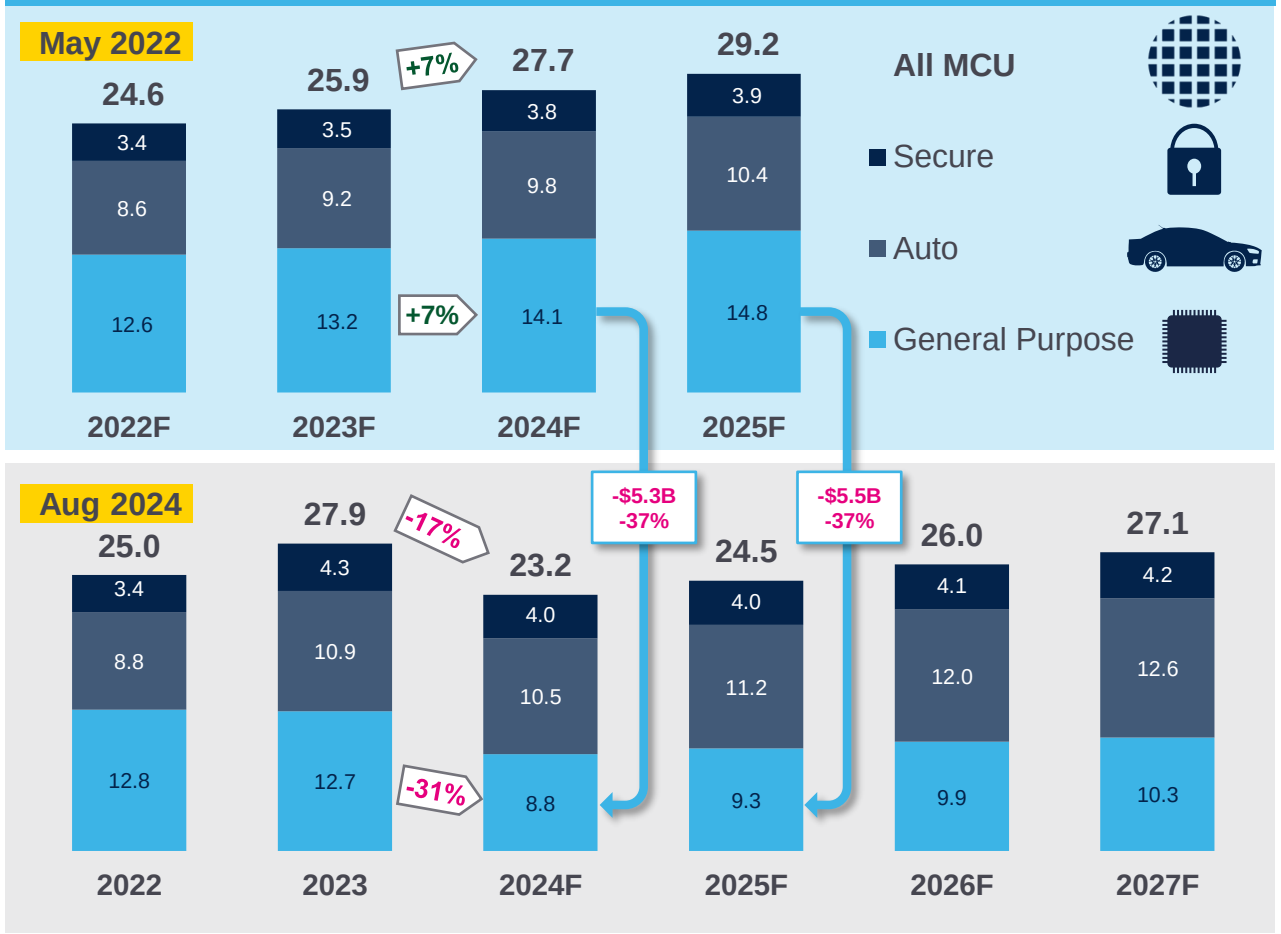
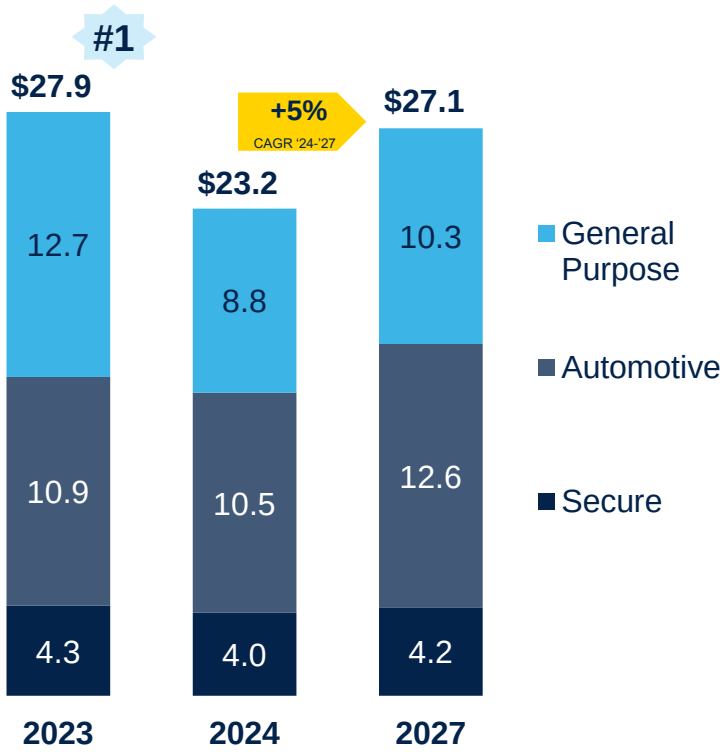
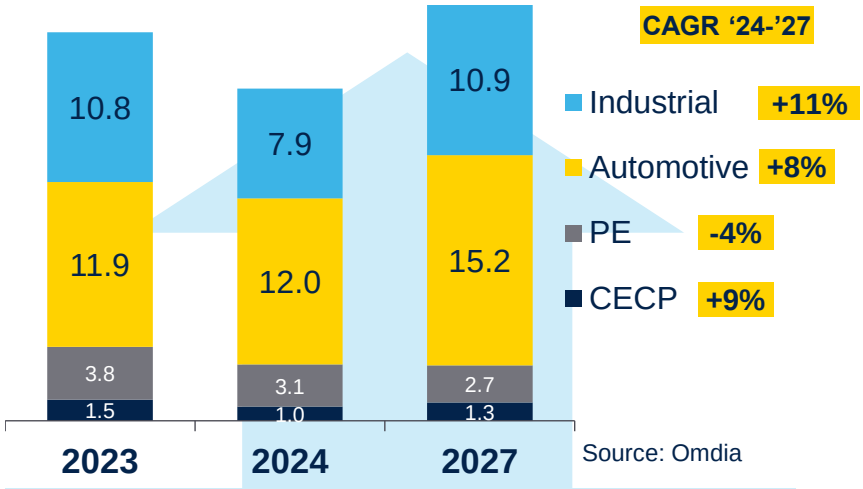


The global opportunity for general-purpose, automotive and secure MCU

MCU TAM ($B): +5% CAGR 2024 to 2027



ST 2023 Ranking



MCU secular growth drivers

Industrial
- Industry 4.0 / Smart robotics
- Power & energy
- Building & home control
- Home appliances
- Power tools

Automotive
- SW-defined vehicle (SDV)
- Vehicle electrification
- ADAS

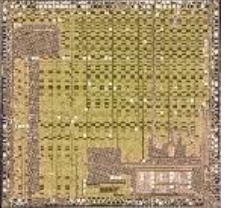
MCU value growth drivers

Edge AI for industrial
- Autonomous decisions
- Data privacy
- Energy efficiency
- Minimize communication to Cloud

Advanced feature pervasion
- HW Accelerators
- Virtualization
- Security

Sources: WSTS, Omdia

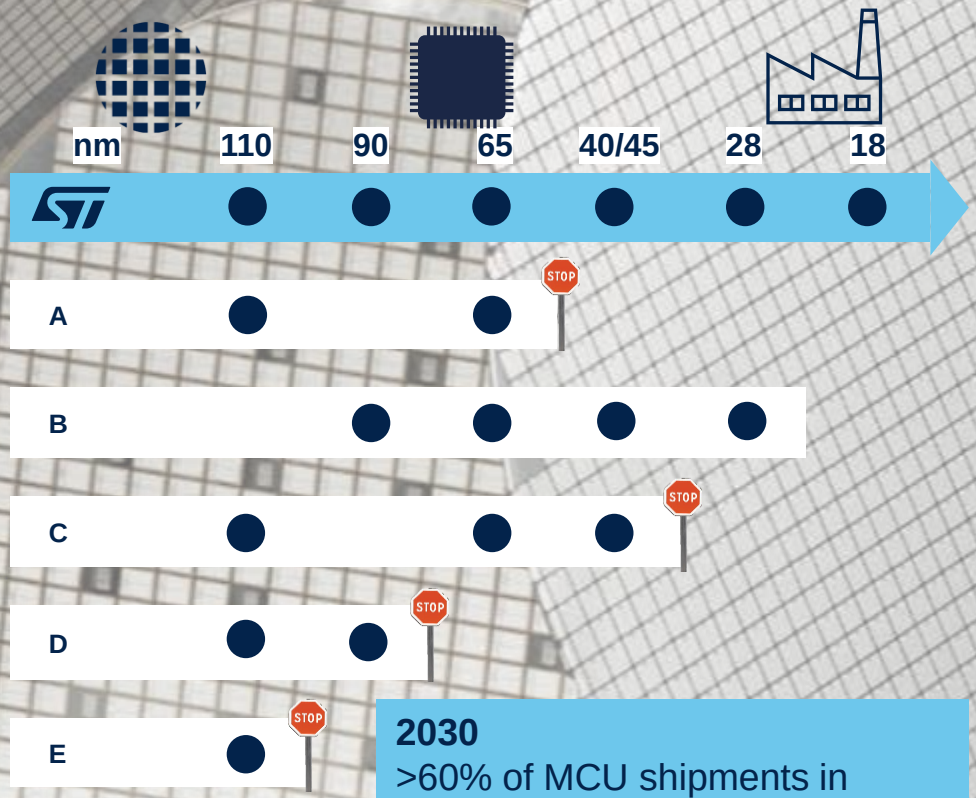
PE: Personal Electronics
CECP: Communication Equipment, Computer & Peripherals



What's unique about ST in microcontrollers

MCU key success factors	Why ST
Manufacturing capacity, and resilience	In-house silicon technology & capacity in Europe, External fab partners, China for China
eNVM technology	40 nm eNVM in production **28 / 18 nm ePCM** ramping
AI HW acceleration & SW stack	Most **comprehensive MCU HW and SW stack** in the industry
Developers' productivity →customer stickiness	Most advanced **MCU ecosystem** >1.2M unique developers
Security	State of the art IP (inc. PQC) for a scalable, future-proof and easy to use MCU security offering
System-level solutions	Wide ST product portfolio: MCU + sensing, analog, power, actuation, etc.

eNVM CMOS process in-house technology

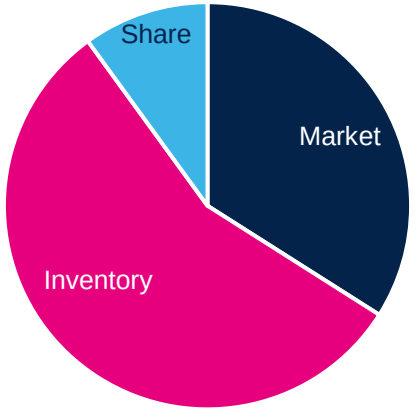


2030
>60% of MCU shipments in technologies at 40 nm and below
Source: Yole Q3'24 and ST estimate

STM32 state of the union

Sales drop in 2024 versus 2023

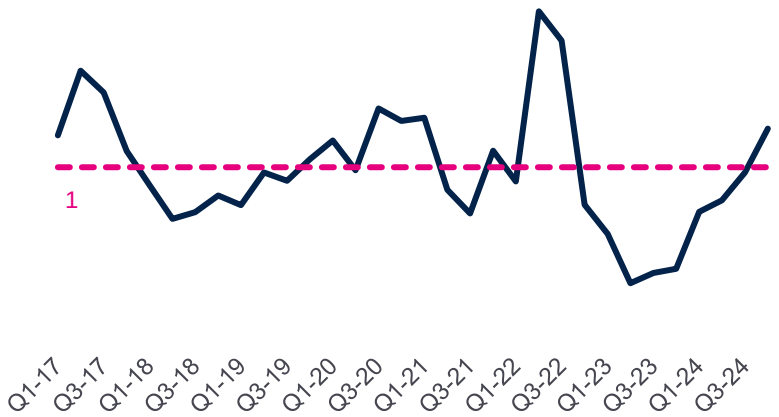
Contributors to GP MCU Sales decline 2024 vs 2023



1) Inventory resorption
2) Market decline
3) Market share decrease due to ‘21-’23 allocation decisions (8-bit micro-controllers, China mass market, consumer applications)

Book-to-bill

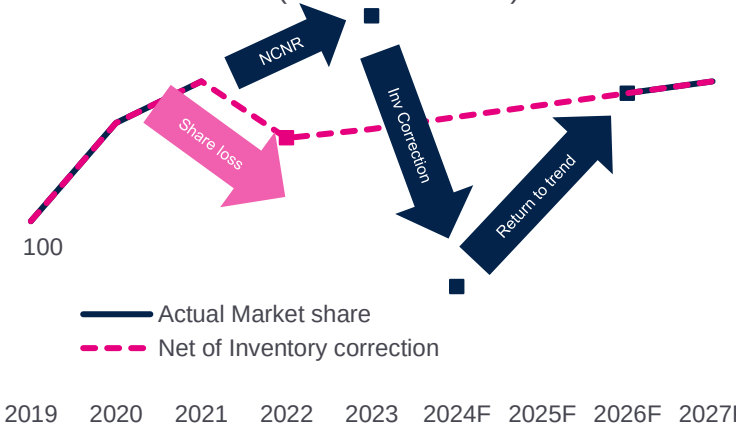
GP MCU book-to-bill



Index showing a progressive recovery of market visibility

Market share

GP MCU market share * (Index 100 = 2019)

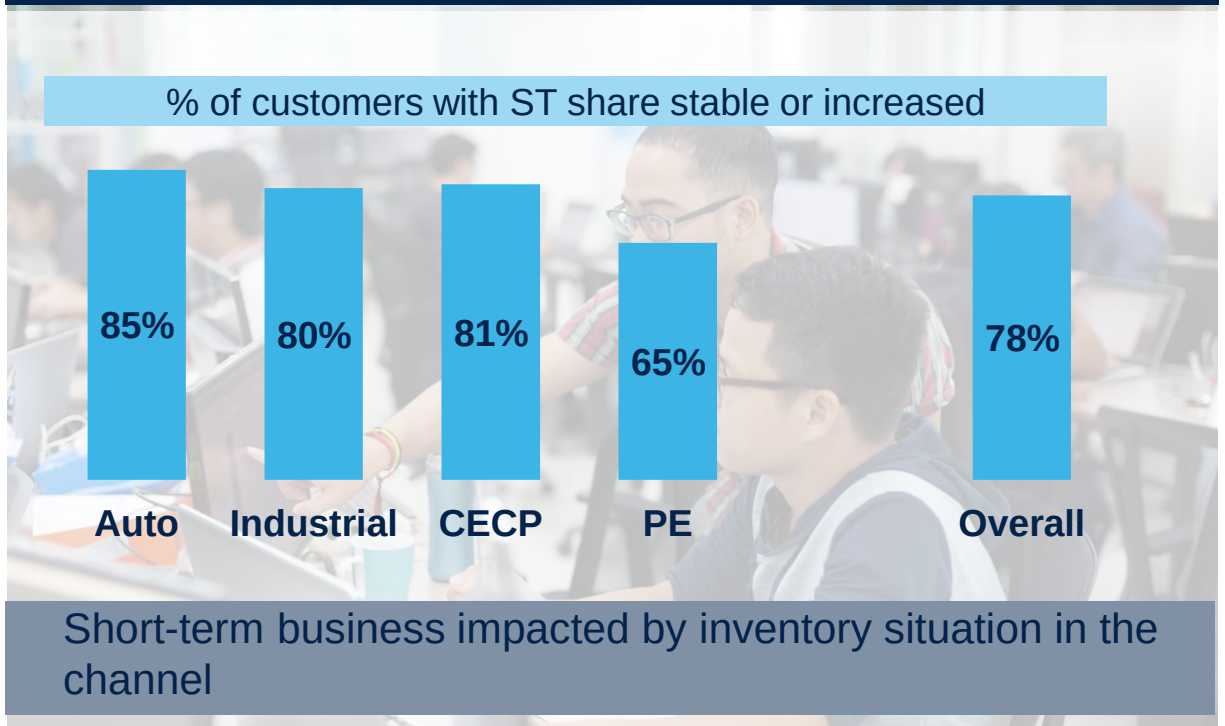


2024/2025 impacted by inventory correction with bottom quarterly share passed in Q2’24 and recovering

(*) Market share based on WSTS & ST estimation

STM32 market share health check
Customer survey

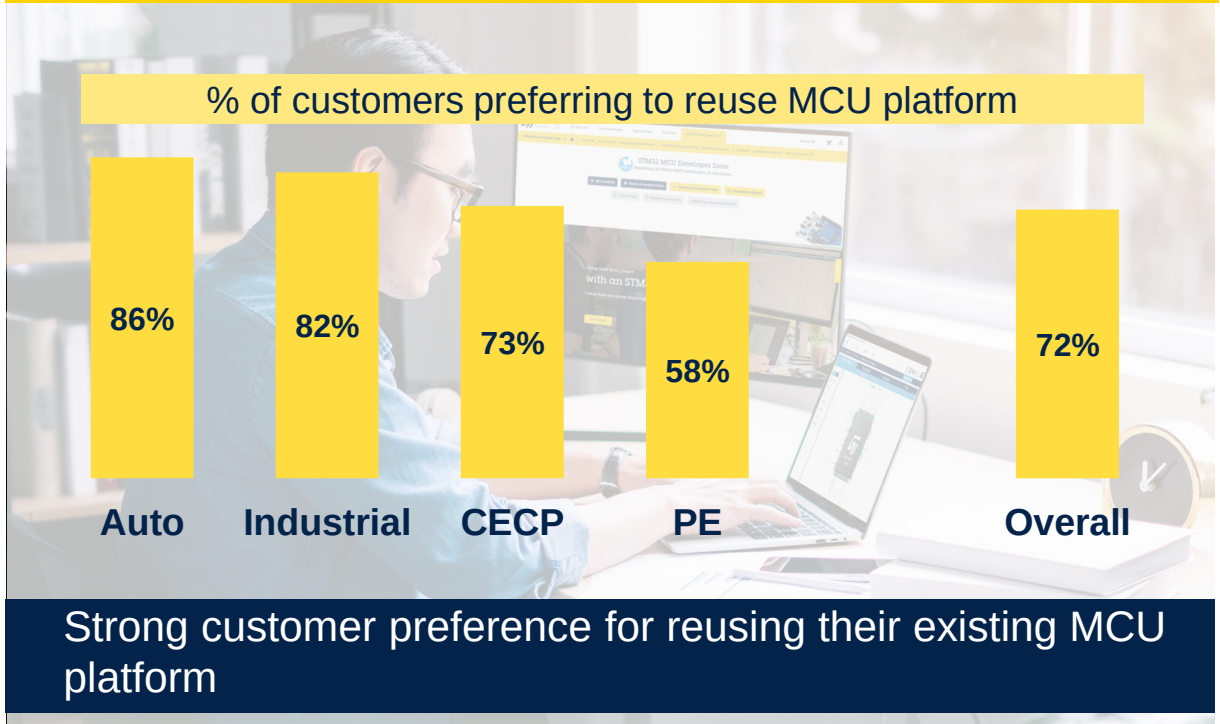
STM32 maintaining or gaining share at ~80% of our customers



Short-term business impacted by inventory situation in the channel

Market share at leading industrial customers confirming STM32 as the reference MCU in the industrial market

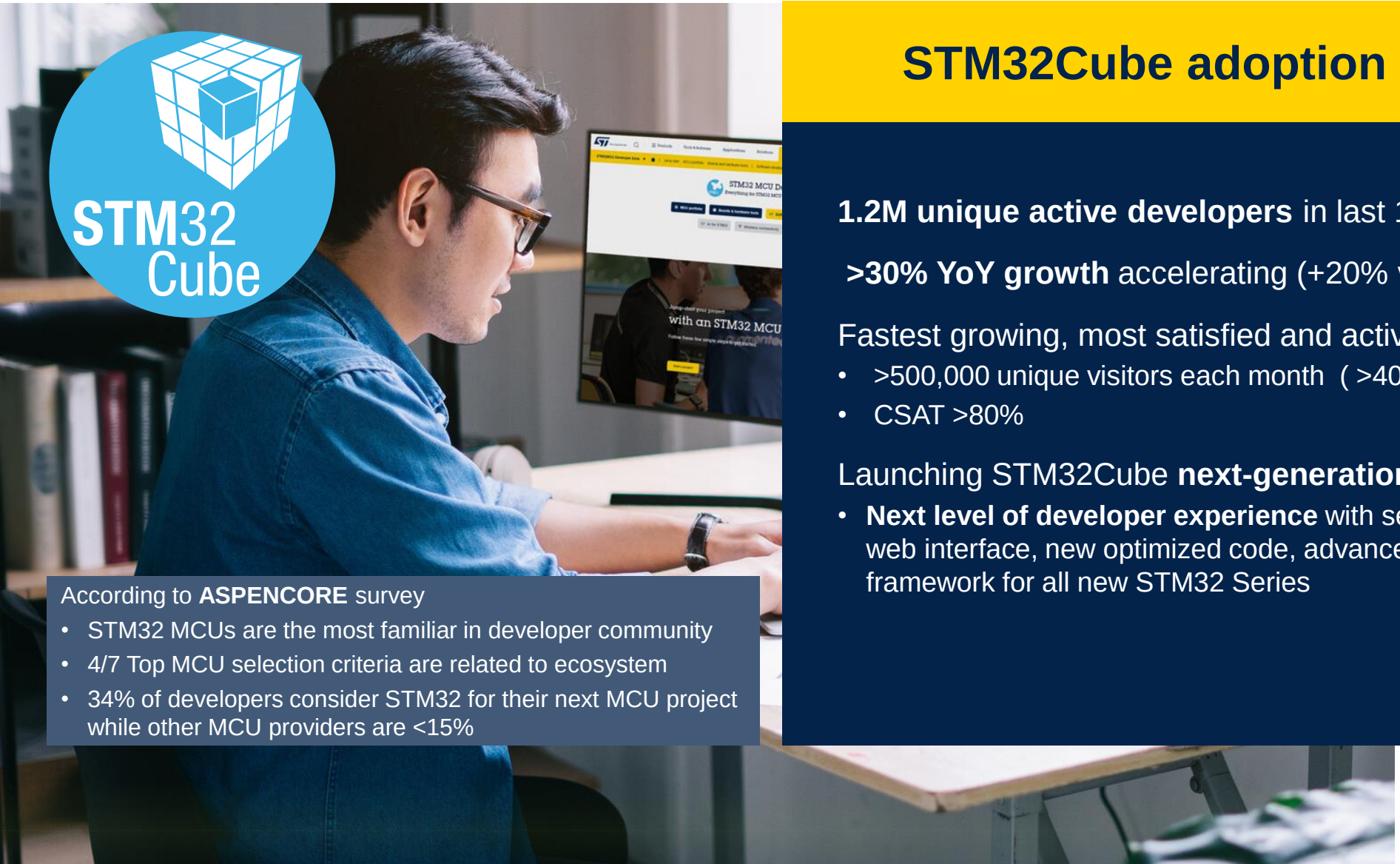
Stickiness of MCU platform development favors the STM32



Strong customer preference for reusing their existing MCU platform

STM32 is the market reference platform with 13+ billion units in lifetime shipments

A developer-first mindset with STM32Cube
The world largest MCU software ecosystem platform



According to **ASPENCORE** survey

- STM32 MCUs are the most familiar in developer community
- 4/7 Top MCU selection criteria are related to ecosystem
- 34% of developers consider STM32 for their next MCU project while other MCU providers are <15%

STM32Cube adoption is accelerating

1.2M unique active developers in last 12 months (was 0.8M in 2022)

>30% YoY growth accelerating (+20% vs previous years trend)

Fastest growing, most satisfied and active **MCU technical community**

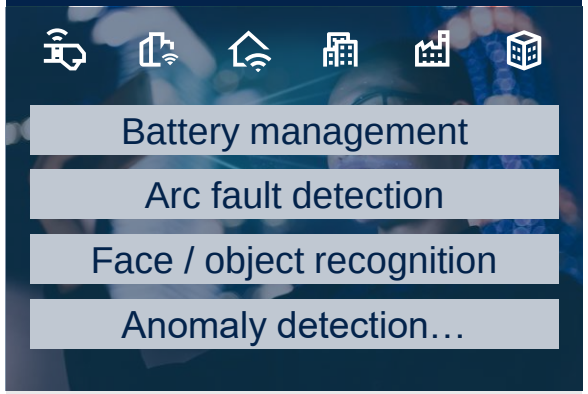
- >500,000 unique visitors each month (>40% YoY growth)
- CSAT >80%

Launching STM32Cube **next-generation platform in 2025**

- **Next level of developer experience** with seamless SW solution access via web interface, new optimized code, advanced configuration and scalable SW framework for all new STM32 Series

Making AI @ the tiny edge… a reality

Increasing adoption of edge AI solutions



↗ 113% CAGR to 2030
for TinyML MCUs
(ABI Research)

More inference tasks will be handled **locally**, which will help **reduce the strain** on the global power grid

Significant growth in developer engagement

+51K **Active projects on ST's AI tools**
by EoQ3 2024

Partnering with AI industry **leaders**

A roadmap for the most challenging workloads

Neural-ART 1
→ up to **4.6 TOPS**
→ 1 to 5 TOPS/W

Neural-ART 2 (D-IMC)
→ **X 4 ***
→ 20 to 40 TOPS/W

Neural-ART 3 (Hybrid)
→ **X 10 ***
→ 50+ TOPS/W

All performances expressed in 8 bits
** Performance gain vs Neural-ART 1*

Introducing STM32N6 with Neural-ART 1

600x Performance gain vs best STM32H7

$100M One of the **fastest** products to reach **$100M** in STM32 history

ST & Qualcomm Technologies collaborating for edge AI powered industrial applications

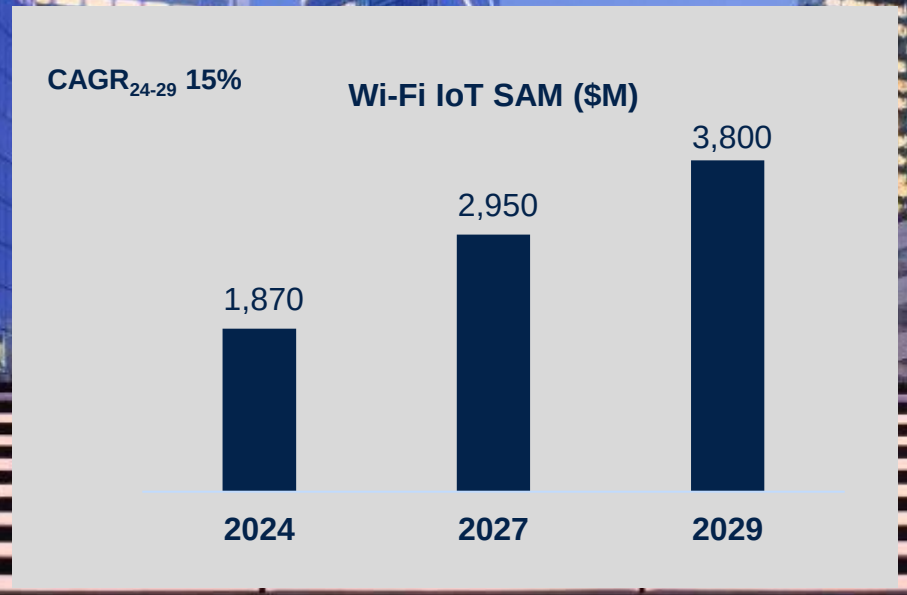
Bringing significant value to 100,000+ STM32 customers

System-level integration with STM32 MCUs

Starting with Wi-Fi/Bluetooth/Thread combo connectivity with self-contained modules

Complementing existing multi-protocol BLE, Zigbee, Thread and sub-GHz product portfolio

Simple, fast, and cost-effective design of next-gen industrial and consumer IoT applications augmented by edge AI



First products to be available to OEMs in Q1 2025, with broader availability to follow

STM32 China-for-China game plan
Growing local customers base 50% in next 5 years

Creating a differentiator that will help us gain market share with Chinese and global customers

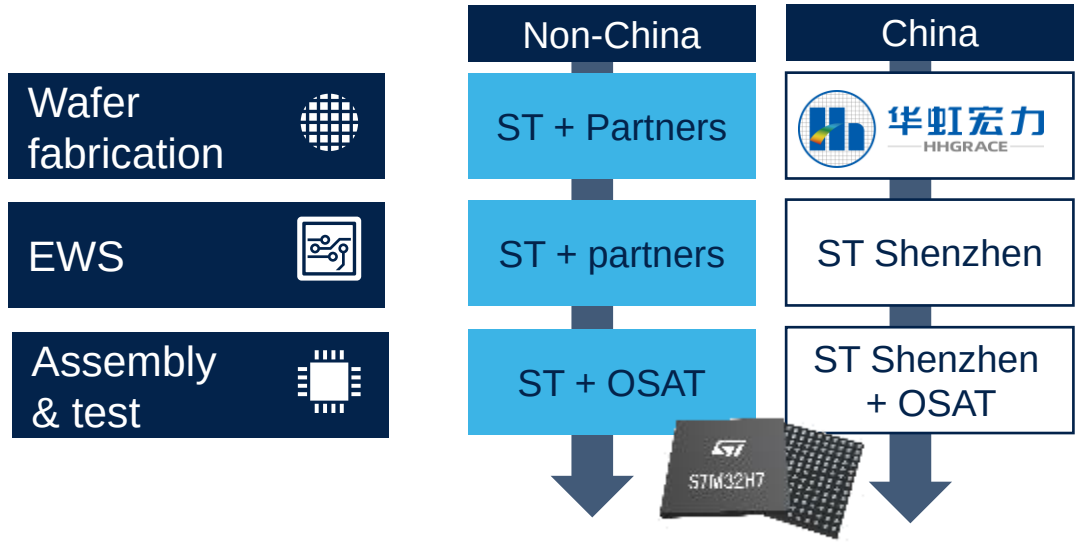
Support growing need of Chinese and global customers for a **fully localized supply chain**

Exact same eNVM 40 nm STM32 manufacturable in Europe or in China (same mask set!)

Objective to serve **majority of eNVM 40 nm STM32 China business from China** in medium term

ST is currently the **only top MCU supplier able provide this**, as early as late 2025 for first products (Latest STM32 high-performance series)

ST eNVM 40 nm dual-supply chain



Examples of supporting Chinese and global customers

Danfoss, Elitech, 锦浪科技 GINLONG, GOODWE 固德威, Gospower, Growatt, HeT 和而泰, 欧陆通 HONOTO, Hisense Broadband 海信宽带多媒体, Husqvarna Group, 盈趣科技 Intretech, invt, jiaxipera 加西贝拉, 精创股份 Since 1996, KCFA, Panasonic, RUKING 儒竞科技, Schneider Electric, SIEMENS

Doubling down on automotive MCUs

ST objective

Grow automotive MCU revenue 2x 2030 vs. 2024

How we achieve this

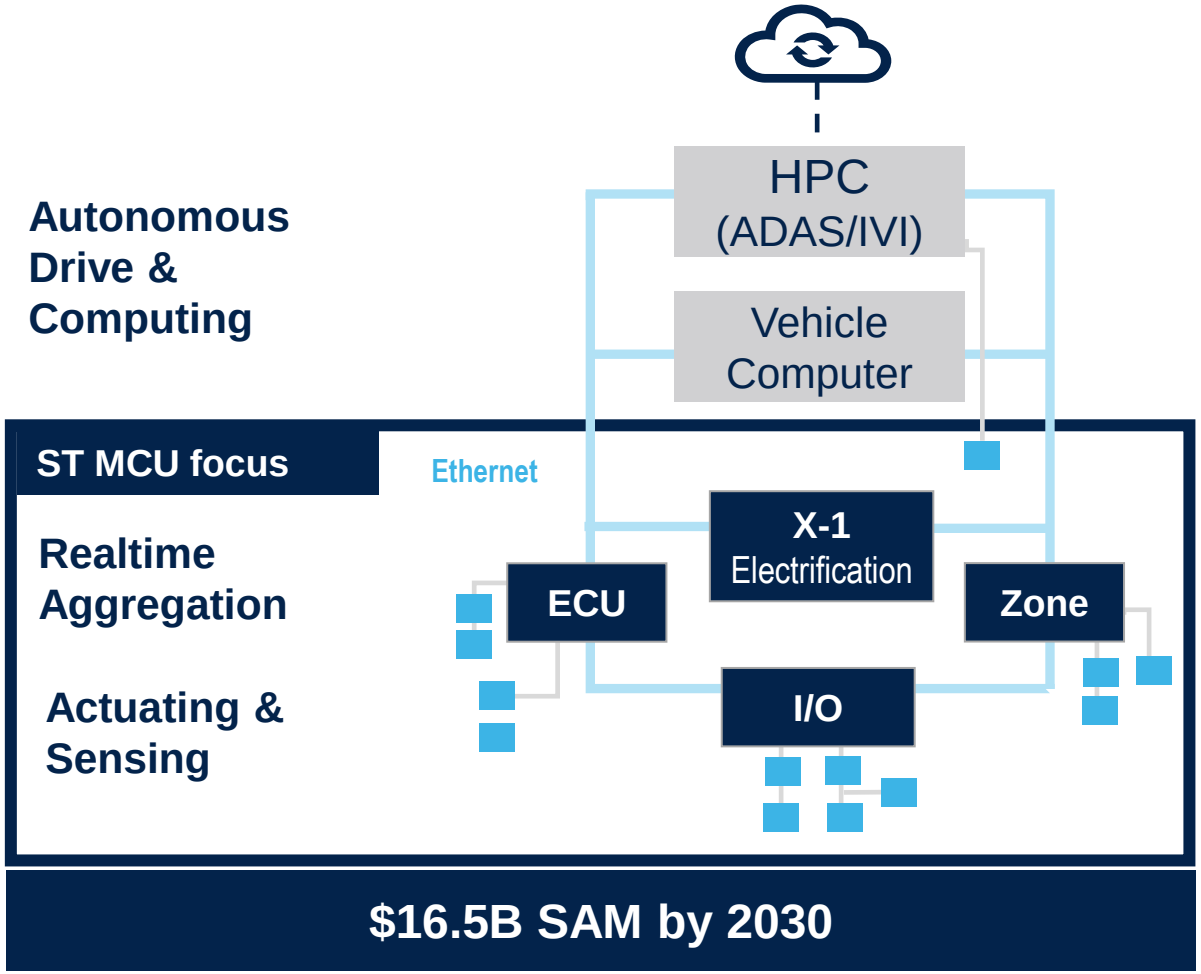
Leveraging ST's **IDM model**

Capitalizing on **ST proprietary eNVM technology**

Introducing a new class of architecture with **Stellar**

Introducing **STM32** into the automotive space

Bringing to market more than **70 commercial part numbers** to market over the next 3 years



ECU = Electronic Control Unit
ADAS = Advanced Driver Assistance Systems
IVI = In Vehicle Infotainment

Source: S&P Q3 2024

Stellar MCU: a game-changing architecture

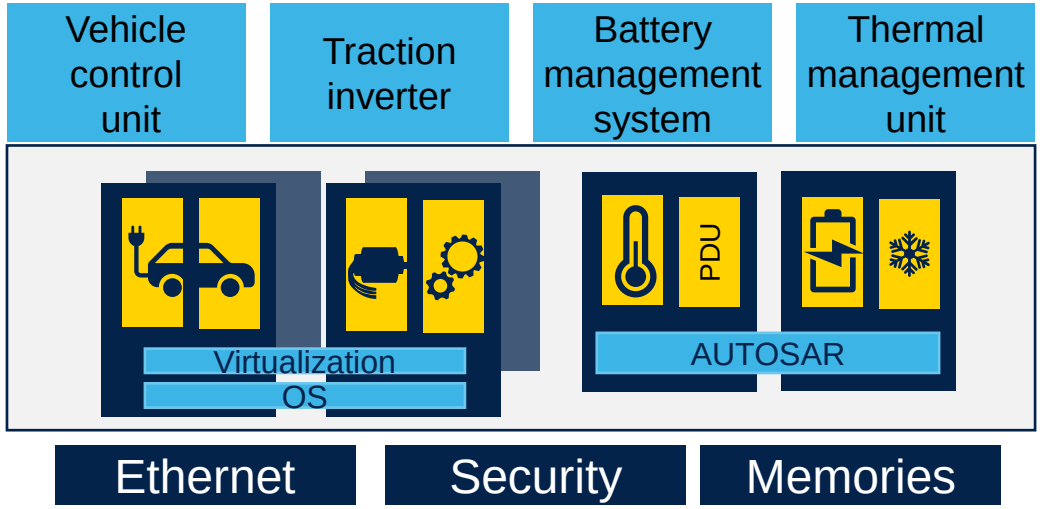
Stellar: a foundation of Auto MCU growth

ECU functions integration into MCUs:

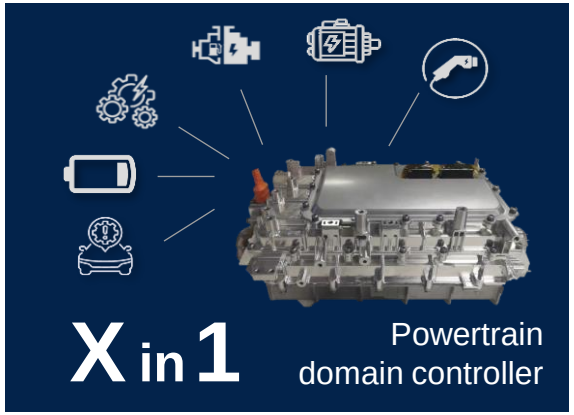
New MCUs will become scalable integrated zonal controllers

→ 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

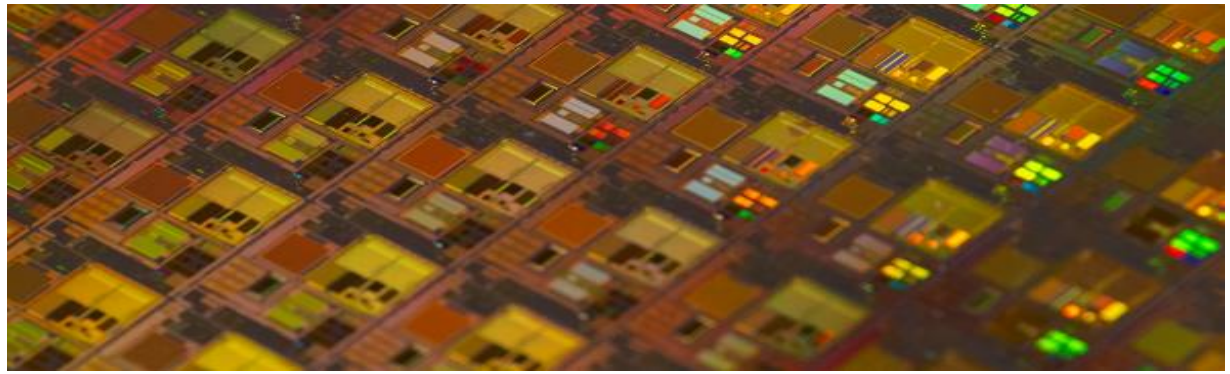
Data and I/O aggregation

Ethernet centric, including switch

Products ready: G7
Multiple additional in roadmap

ST Phase Change Memory (PCM) Redefining eNVM for automotive MCUs

Proprietary PCM technology:
Industry-leading memory density & robustness



Industry smallest embedded NVM cell (28/18 nm)

2x
memory density vs. alternatives

0.019 µm²
per information bit (28 nm)

Best power, performance, area (PPA) index
Versus alternative technologies (RRAM, MRAM, Flash)

	Phase change memory ★★★
Memory cell size	Best-in-class
High Temperature	Achieves automotive requirements for AEC-Q100 operating up to +165°C
Radiation immunity	Best-in-class
Technology power efficiency	Lower consumption at more stringent conditions

"With the embedded Phase Change Memory (PCM) technology, Stellar offers a robust and flexible memory concept to create highly performant, adaptable microcontrollers for automotive usage. The technology provides application advantages compared to other memory technologies, such as RRAM and MRAM."
Axel Aue, Vice President, Bosch

BOSCH

Stellar MCU gaining increasing momentum at top automotive OEMs and Tier1s

OEMs

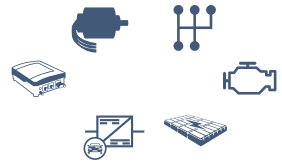
Leading Chinese EV maker
Validated Stellar in latest hybrid platform, with ST's unique PCM over-the-air capabilities

Leading EU premium OEM
Selected Stellar for their vehicle lineup to elevate driving comfort experience

Leading EU OEM
Integrating Stellar for optimized energy management and EV range predictability

Top EU commercial vehicle OEM
Adopted ST for their heavy-duty trucks, to enhance performance and meet stringent emissions

Tier1s

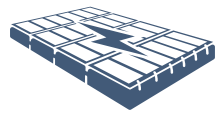


Major EU Tier1
Adopted Stellar for **X-in-1 integration**, driving system BOM reduction for EVs

Major Asian Tier1
Adopted Stellar for **Safe ECU function** integration

Leading Tier1 in US
Chose Stellar for **cybersecurity** in a zonal module

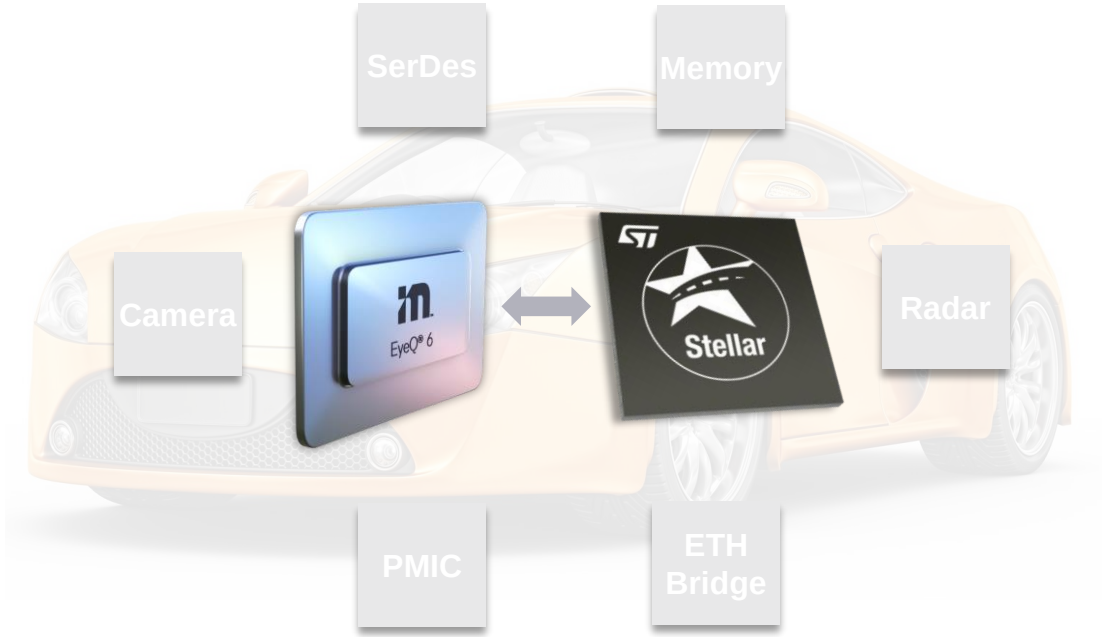
Fast growing Chinese Tier1
Selected Stellar for their **battery management system**



Leading EU ADAS Tier1
Chose Stellar as an **autonomous driving** companion chip

First 500k units already being shipped to lead customers

New Mobileye and ST collaboration Adopting Stellar MCU in next generation ADAS/AV



Mobileye EyeQ System-on-Chip

mobileye™

Broad product portfolio from basic ADAS to autonomous-driving solutions

Market leader with >50% market share 2023

Stellar microcontrollers

Safe & secure high-performance real-time operation

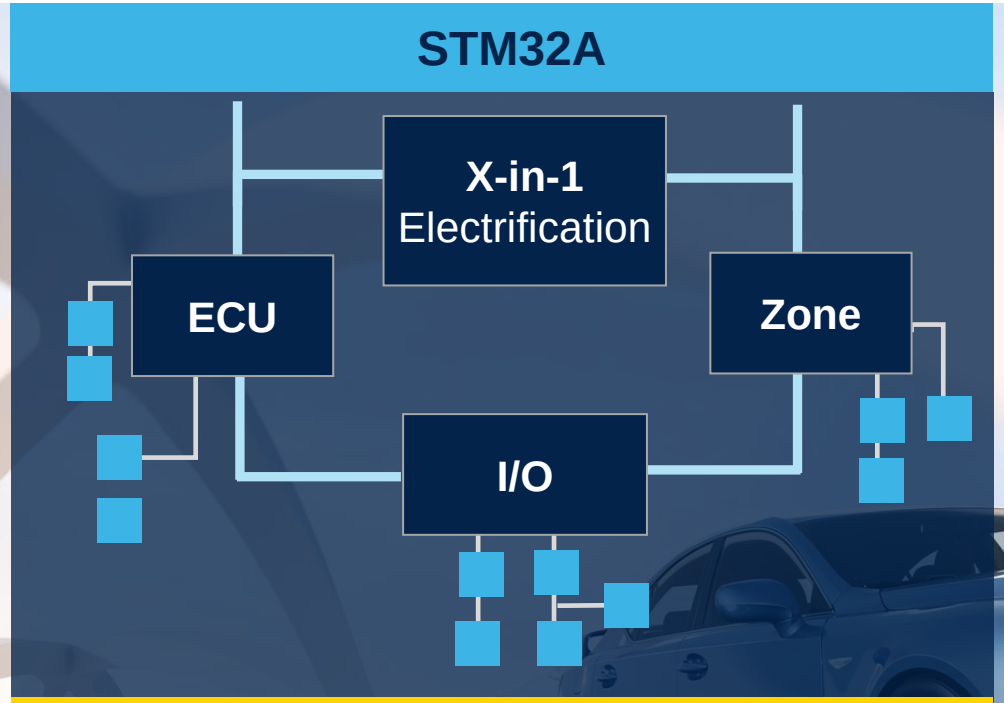
ASIL-D capable

Expanding family of products

“We are broadening up our collaboration with ST through an adoption of Stellar microcontrollers into next reference design EQ6L and EQ6H systems. This integration will enable multiple software applications to co-exist, with real-time high performance. This will increase efficiency and accelerate development times, while securing highest safety standards.”

Prof. Amnon Shashua, President and CEO, Mobileye

Bringing the benefits of STM32 to automotive applications



- Designed for actuation
- Scalable and cost effective
- Adapted for :
  - Car body
  - Convenience
  - EV On Board Charger

Bringing **competitive STM32 platforms** to automotive

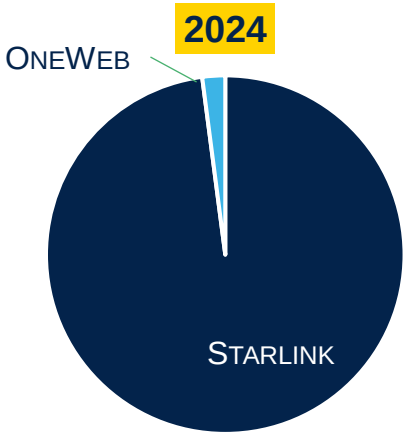
Focus on **ASIL-B-level safety** applications

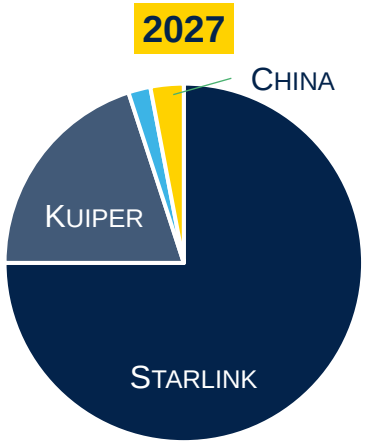
Expanding **STM32 ecosystem** to automotive developers

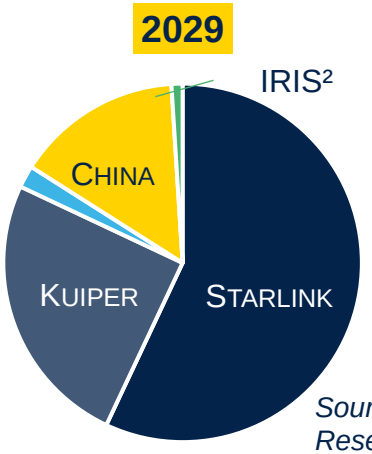
Benefitting from ST **process technologies** and resilient **supply chain**

Making it easy for STM32 **customers** to address **both the industrial & automotive** markets

ST’s opportunity in the fast growing Low earth orbit (LEO) satellite market







Source : ST, Morgan Stanley Research. April 7, 2024

LEO credibility & viability proven by Starlink Understanding of LEO strategic importance **~4M** active customers at Starlink	New constellations being deployed Developments for strategic independence Connectivity to the unconnected **~30M** cumulative User Terminal deployed	China constellation deployment LEO Satellite part of global connectivity systems Further boost in developing countries **~50M** cumulative User Terminal deployed
ST SAM* $630M	**ST SAM $940M**	**ST SAM $1,600M**

How ST wins and grows

BiCMOS competitiveness & high-volume Panel Level Packaging	New BiCMOS generation with increased performance for Ka band	Pervasion to other constellations Pervasion to other geographies

* ST SAM : User Terminal antenna electronics excl. memories

BiCMOS and PLP: the winning combo for LEO user terminal front-end module

BiCMOS

200 mm wafer for high-volume B9MW
300 mm wafer for leading-edge B55X

- **mmW Frequencies** Unbeatable performances up to 30 GHz
- **Ultra low noise** Large bandwidth for more users
- **High gain, low BoM** Cost competitive UT panel for end users

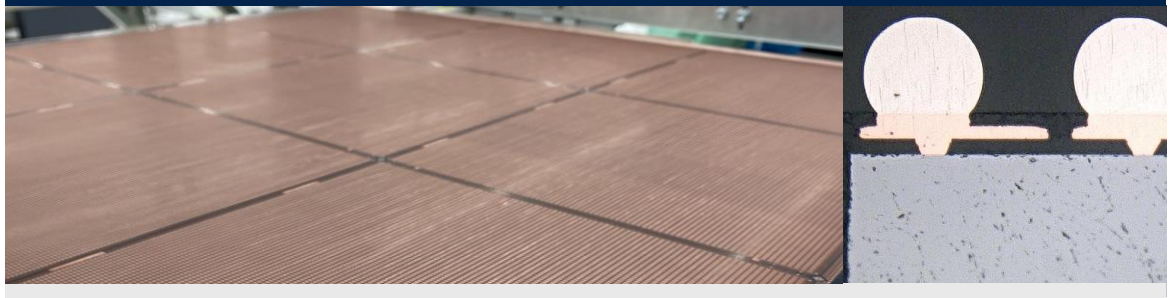
Major B55X product ramp-up in 2025

Best Noise Figure (NF) for RF FEMs

"ST's BiCMOS technology has been a key differentiator enabling Starlink User terminal development. The technology has allowed us to build most power and area optimized RF Front-end modules."
Deepak Bansal, Head of Silicon, Starlink

PLP

Very high volume Panel level Packaging
Versatile packaging compatible with 200 & 300 mm wafers



- **Fast volume enablement** up to 5M units per day
- **Unique packaging versatility** CSP, QFN, multi-dice in one line
- **Application friendly** RF high perf & power cooling

Running production in ST's Muar (Malaysia) facility

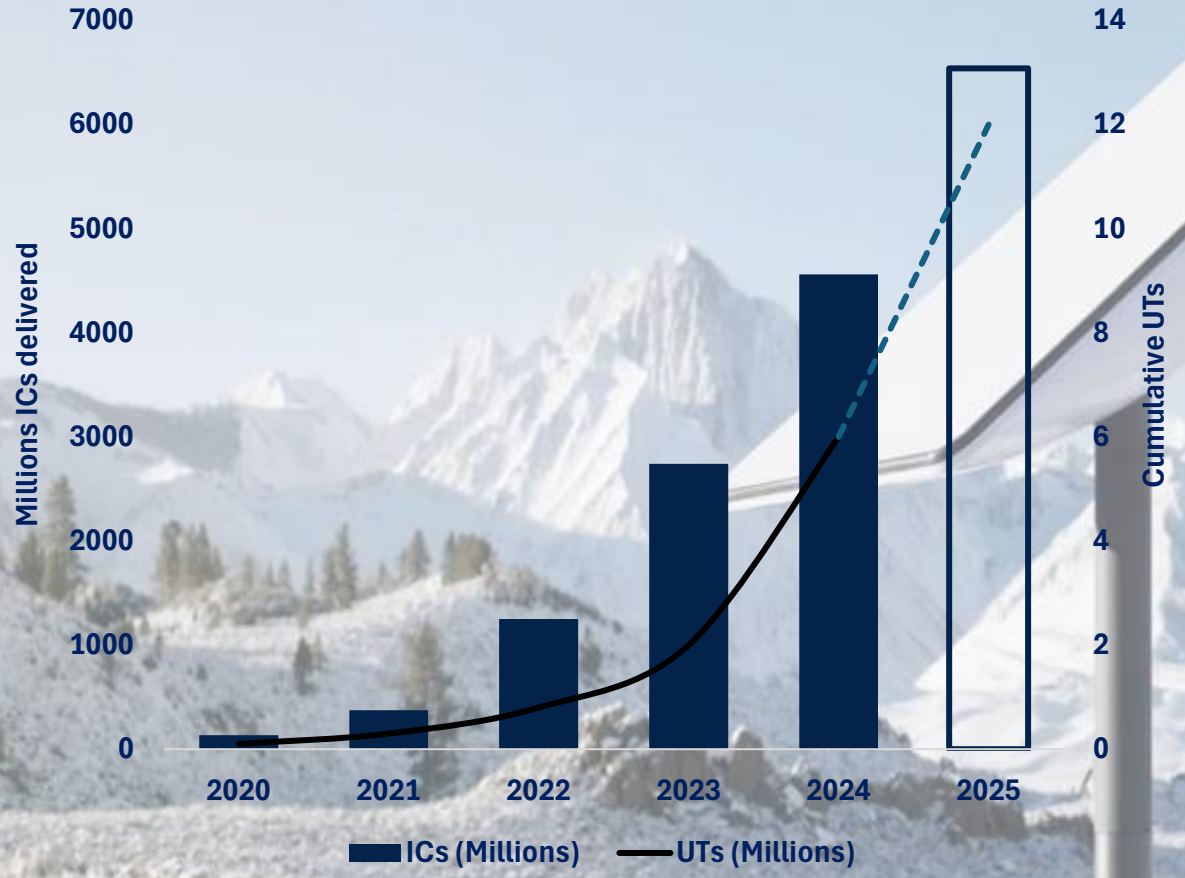
Best cost trade-off for high volume RF FEMs

"ST's innovative panel-level packaging technology has been an impressive enabler to the Starlink program. This technology offers the most cost-effective low impedance interconnect at scale, ensuring the best RF performance in a high-volume fan-out package."
John Federspiel, Head of User Terminal Engineering, Starlink

SPACEX

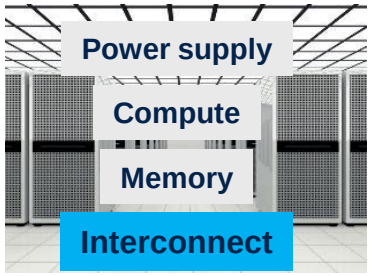
Starlink and ST
What we have accomplished together to date

>4 Billion ICs delivered to date



Silicon delivered

Equivalent size of two American football pitches



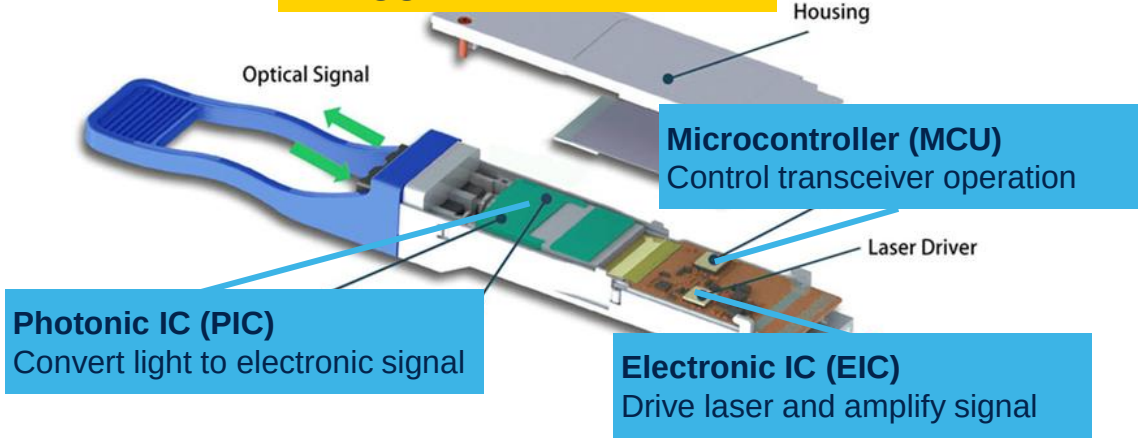
Cloud optical interconnect opportunity

ST addressing the pluggable transceiver market with a Silicon Photonics & BiCMOS foundry offer

ST's BiCMOS high Fmax is key in EIC devices for high throughput transceivers for data center and AI infrastructure and fiber deployment

Pluggable transceiver

Courtesy Innolight

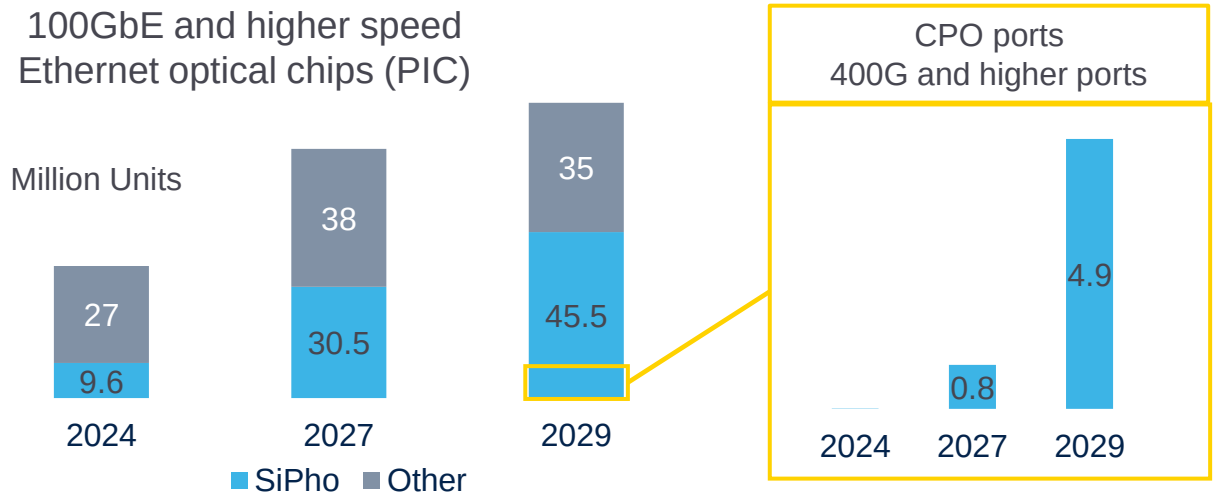


Microcontroller (MCU)
Control transceiver operation

Photonic IC (PIC)
Convert light to electronic signal

Electronic IC (EIC)
Drive laser and amplify signal

Silicon Photonics is the fastest growing technology for pluggable & co-packaged optics (CPO) driven by AI



BiCMOS + SiPho total foundry SAM '30: $2B

Source: LightCounting

Silicon Photonics
The linchpin of next-generation AI factories

SiPho PIC100

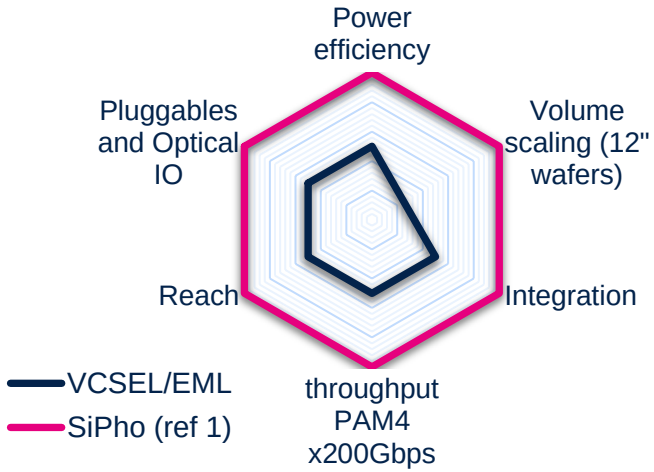
The only silicon-only 300 mm technology able to support 200 Gbps per lane (100 GBaud PAM4)

- **Yield 300 mm** 90%, best-in-class vs 200 mm foundries
- **System on Chip** High-performing compact integration
- **Distance range** cm to 100 km+ best-in-class vs EML/VCSEL

Enable **Edge coupling** thanks to a patented technology stack

200 Gbps silicon-only based, ideal for AI, ramp H2'25

ST's SiPho provides clear advantages over VCSEL/EML for new generation of optical transceivers



Major transceiver manufacturers

Design wins at multiple Silicon Photonics design houses for production ramp-up in H2'25

"AWS is excited to collaborate with ST to develop a new silicon photonics technology (SiPho), PIC100, that will enable interconnection between any workload including Artificial Intelligence (AI), AWS is partnering with ST as they have the assets to make PIC100 a leading SiPho technology for the optical and AI market and we are excited about the innovations this will unlock."
Yaser Mujahed, Senior Principal Compute, AWS

"PIC100 demonstrates high performance modulators and photodiodes, as well as very low loss waveguides making it a technology of choice for Innolight's Pluggable transceiver roadmap."
Oliver Sun, CTO, Innolight

MDRF Takeaways

Continuously focus our R&D on markets where we are or we can become #1 or #2, accretive to ST GM and OM margin targets and leveraging our IDM model

Leverage ST differentiated technology and manufacturing platform to:

1. Grow our GP MCU 1.5x faster than the market over 2017-2027
2. Build a leading position in automotive MCU
3. Sustain our secure MCU position

Stay #1 and continue to expand our presence in the fast-growing LEO market

Become #1 in AI cloud interconnect market through hyperscaler collaborations

Our technology starts with You

Find out more at www.st.com