STM32 MCU updates

South Africa Workshop Sept 2023

Paolo Scanniffio TME

Supply Chain & Manufacturing Capacity

Goal

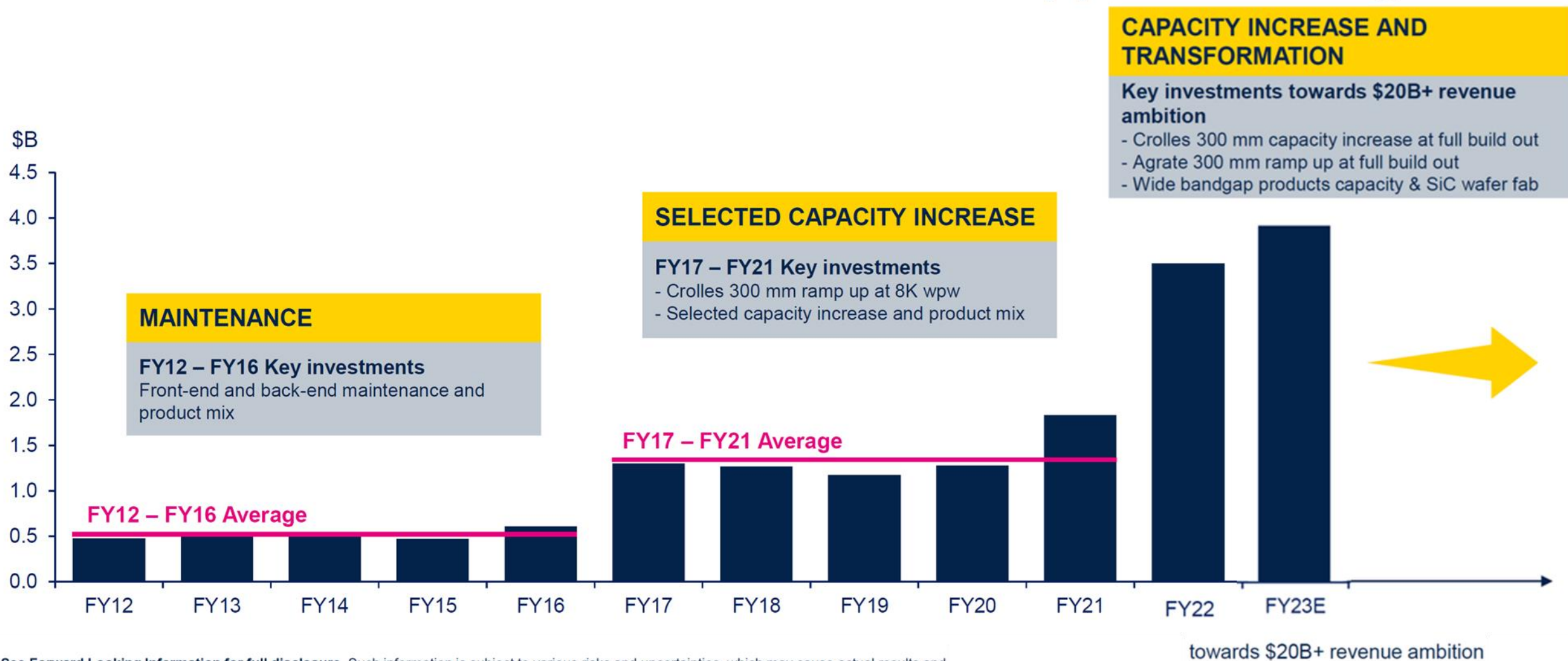Be the reliable, sustainable and long term committed supplier

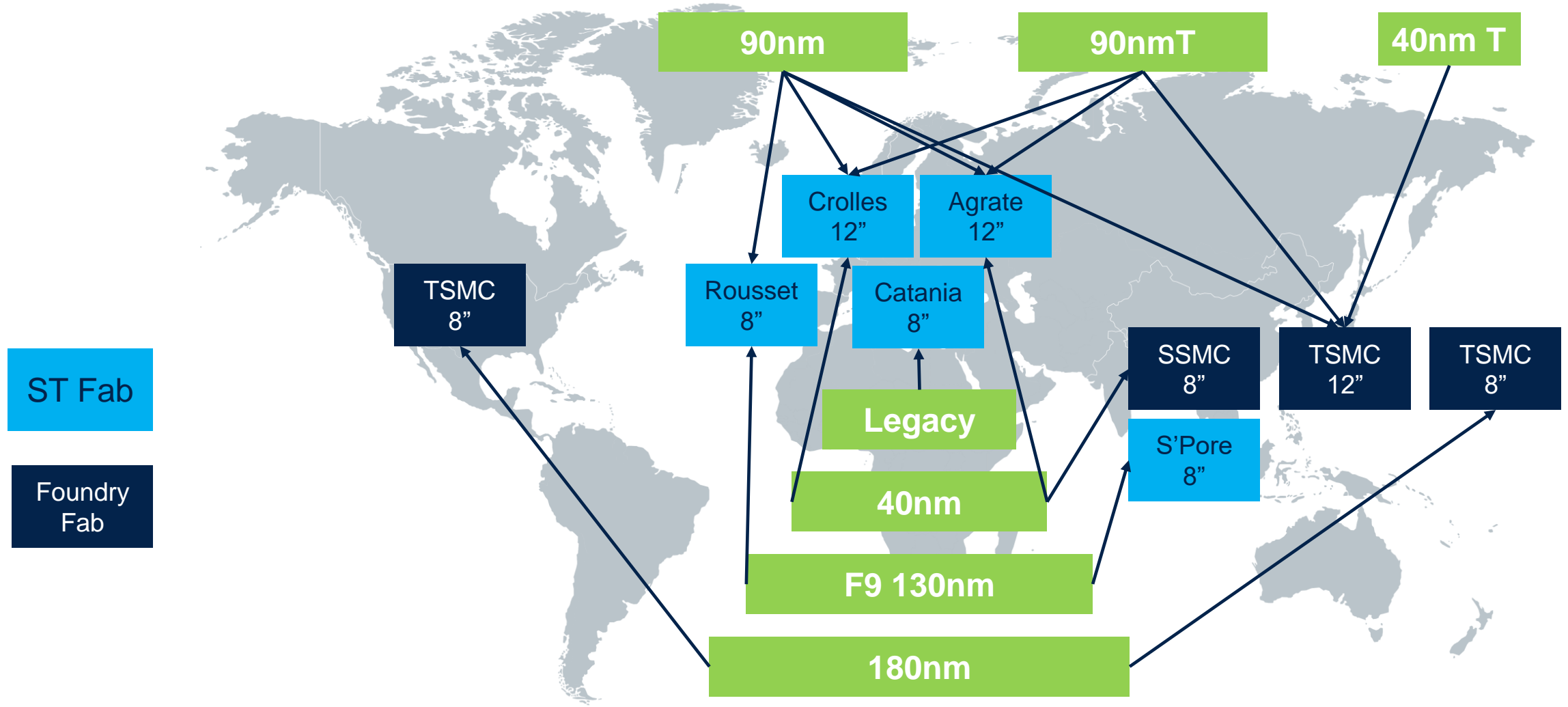# CAPEX to support future growth

$B

CAPACITY INCREASE AND TRANSFORMATION

Key investments towards $20B+ revenue ambition
- Crolles 300 mm capacity increase at full build out
- Agrate 300 mm ramp up at full build out
- Wide bandgap products capacity & SiC wafer fab

SELECTED CAPACITY INCREASE

FY17 – FY21 Key investments
- Crolles 300 mm ramp up at 8K wpw
- Selected capacity increase and product mix

MAINTENANCE

FY12 – FY16 Key investments
Front-end and back-end maintenance and product mix

FY12 – FY16 Average

FY17 – FY21 Average

towards $20B+ revenue ambition

Double sourcing strategy in general purpose Microcontroller
MCU Technologies manufacturing capability per wafer fab

90nm

90nmT

40nm T

Crolles 12"

Agrate 12"

TSMC 8"

Rousset 8"

Catania 8"

SSMC 8"

TSMC 12"

TSMC 8"

ST Fab

Foundry Fab

Legacy

S'Pore 8"

40nm

F9 130nm

180nm

life.augmented

Lead-time update

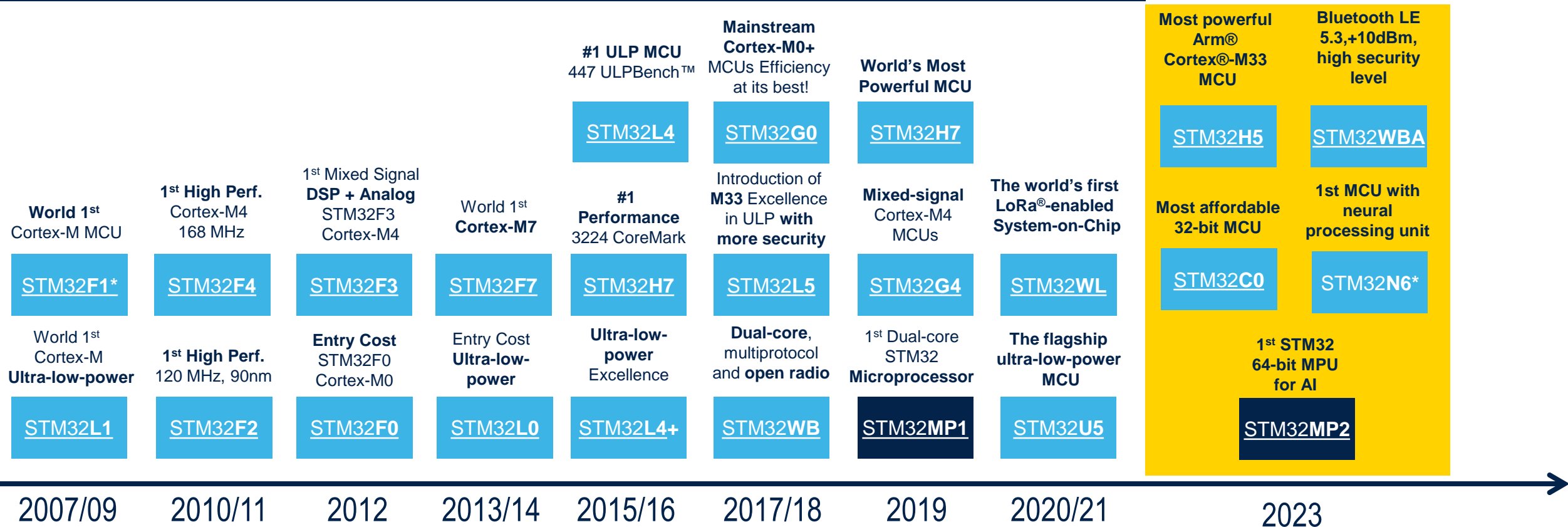| Family	Q422	Q223	2H23	Target
	New orders entry 10k u/month			
STM32F0/F1/F3	22wks	12wks	10wks	<10wks
STM32G0/G4/L4/L5/C0	22wks	12wks	10wks	<10wks
STM32L0/L1	26wks	16wks	12wks	12wks
STM32U5	16wks	12wks	10wks	<10wks
STM32MP1	16wks	12wks	10wks	<10wks
STM32W*	12wks	12wks	10wks	<10wks
Spirit	30wks	20wks	20wks	<10wks
STM32H7	>45wks	35wks	28wks	16wks
STM32F2/F4/F7H5	>45wks	22wks	18wks	16wks
STM8A	>39wks	26wks	20wks	14wks
STM8S/L	52wks	20wks	16wks	16wks

* excluding Spirit

STM32 General introduction

Continuous innovation since 2007

Leader in Arm® Cortex® 32-bit MCU & MPU

2007/09	2010/11	2012	2013/14	2015/16	2017/18	2019	2020/21	2023
				#1 ULP MCU 447 ULPBench™ **STM32L4**	**Mainstream Cortex-M0+** MCUs Efficiency at its best! **STM32G0**	**World's Most Powerful MCU** **STM32H7**		**Most powerful Arm® Cortex®-M33 MCU** **STM32H5**	**Bluetooth LE 5.3,+10dBm, high security level** **STM32WBA**
World 1st Cortex-M MCU **STM32F1***	**1st High Perf.** Cortex-M4 168 MHz **STM32F4**	1st Mixed Signal **DSP + Analog** STM32F3 Cortex-M4 **STM32F3**	**World 1st Cortex-M7** **STM32F7**	**#1 Performance** 3224 CoreMark **STM32H7**	Introduction of **M33** Excellence in ULP **with more security** **STM32L5**	**Mixed-signal** Cortex-M4 MCUs **STM32G4**	**The world's first LoRa®-enabled System-on-Chip** **STM32WL**	**Most affordable 32-bit MCU** **STM32C0**	**1st MCU with neural processing unit** **STM32N6***
World 1st Cortex-M **Ultra-low-power** **STM32L1**	**1st High Perf.** 120 MHz, 90nm **STM32F2**	**Entry Cost** STM32F0 Cortex-M0 **STM32F0**	Entry Cost **Ultra-low-power** **STM32L0**	**Ultra-low-power** Excellence **STM32L4+**	**Dual-core**, multiprotocol and **open radio** **STM32WB**	1st Dual-core STM32 **Microprocessor** **STM32MP1**	**The flagship ultra-low-power MCU** **STM32U5**	**1st STM32 64-bit MPU for AI** **STM32MP2**	

From entry-level to high-performance applications

XXL

XXS

STM32H7

- 240 pins
- 2 Mbytes of flash memory
- 550 MHz

STM32C0

- 8 pins
- 16 Kbytes of flash memory
- 32 MHz
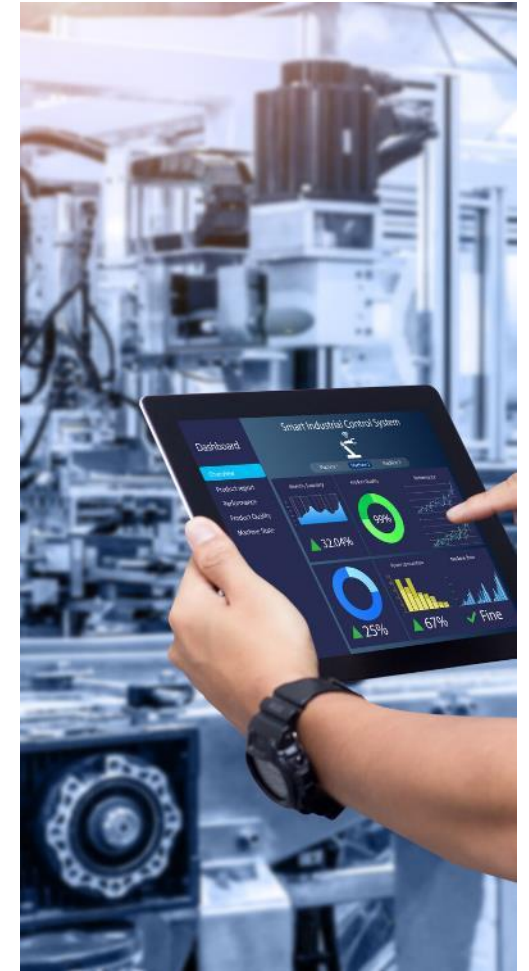
STM32 supports 3 key trends

STM32

More Wireless Connectivity	More Advanced Security	More Autonomous Decisions embedding AI (100-300 GOPS)
	STM32 Trust	

More Application Specific Added Value IPs

More Wired Connectivity	More computing Power 32-bit CPU Arm® Cortex®-M Real time OS (up to two cores)	Flexible Memory Interfaces
Lower Power		More SRAM

More embedded flash   Optional

STM32 portfolio

MPU

STM32**MP1**	STM32**MP2**
Up to 1 GHz Cortex-A7 209 MHz Cortex-M4	Dual 1.5 GHz Cortex-A35 400 MHz Cortex-M33

★ High Perf MCUs

LONGEVITY 10 YEARS COMMITMENT

STM32**F2**	STM32**F4**	STM32**H5**	STM32**F7**	STM32**H7**	STM32**N6**
Up to 398 CoreMark 120 MHz Cortex-M3	Up to 608 CoreMark 180 MHz Cortex-M4	Up to 1023 CoreMark 250 MHz Cortex-M33	1082 CoreMark 216 MHz Cortex-M7	Up to 3224 CoreMark Up to 550 MHz Cortex-M7 240 MHz Cortex-M4	MCU with neural processing unit

» Mainstream MCUs

Mixed-signal MCUs

STM32**C0**	STM32**F0**	STM32**G0**	STM32**F1**	STM32**F3**	STM32**G4**
114 CoreMark 48 MHz Cortex M0+	106 CoreMark 48 MHz Cortex-M0	142 CoreMark 64 MHz Cortex-M0+	177 CoreMark 72 MHz Cortex-M3	245 CoreMark 72 MHz Cortex-M4	569 CoreMark 170 MHz Cortex-M4

Ultra-low Power MCUs

STM32**L0**	STM32**L4**	STM32**L4+**	STM32**L5**	STM32**U5**
75 CoreMark 32 MHz Cortex-M0+	273 CoreMark 80 MHz Cortex-M4	409 CoreMark 120 MHz Cortex-M4	443 CoreMark 110 MHz Cortex-M33	651 CoreMark 160 MHz Cortex-M33

Wireless MCUs

BlueNRG-x	STM32**WL**	STM32**WB**	STM32**WBA**	**TRXs** Spirit1
TBA CoreMark Cortex-M0+	162 CoreMark 48 MHz Cortex-M4 48 MHz Cortex-M0+	216 CoreMark 64 MHz Cortex-M4 32 MHz Cortex-M0+ ●	407 CoreMark 100 MHz Cortex-M33	150-956MHz / 2(G)FSK, GMSK Up to +16dBm

Legend:
- ■ Latest product generation
- ● Radio co-processor only
- ▭ New series introduced in 2023
- ▭ Pre-announcement

life.augmented

STM32 ecosystem
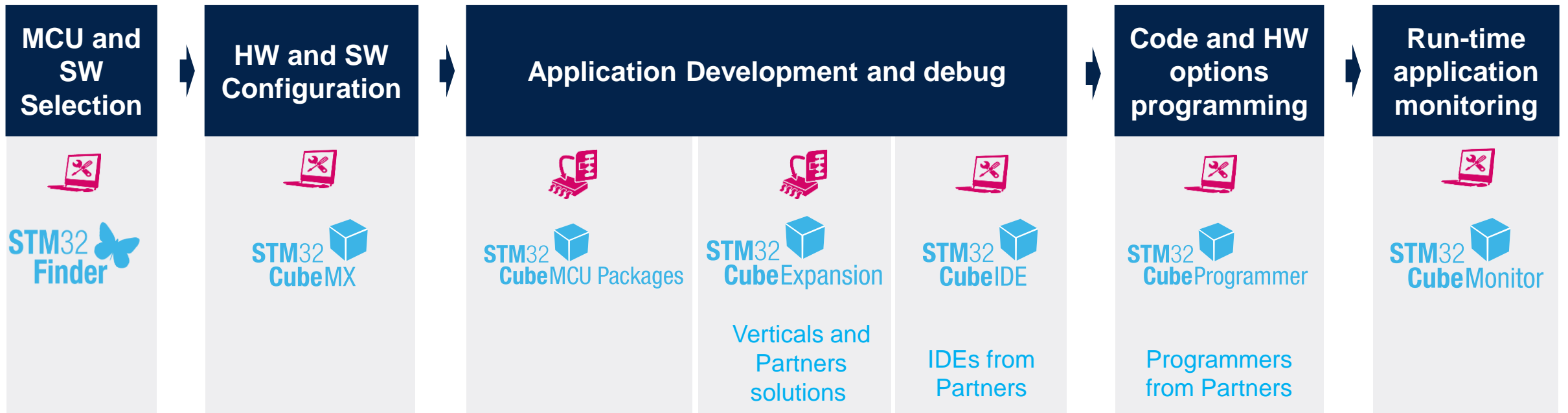
STM32Cube Framework
helping you releasing your creativity

Tools and software that support you during all your design steps

MCU and SW Selection	HW and SW Configuration	Application Development and debug			Code and HW options programming	Run-time application monitoring
STM32 Finder	STM32 CubeMX	STM32 CubeMCU Packages	STM32 CubeExpansion	STM32 CubeIDE	STM32 CubeProgrammer	STM32 CubeMonitor
			Verticals and Partners solutions	IDEs from Partners	Programmers from Partners	

Consistency across the full STM32 portfolio

Inside the STM32Cube ecosystem

Software Tools | **Embedded Software** | **Complemented with Microsoft Azure RTOS**

STM32 CubeMX — Configuration

STM32 CubeIDE — Development

STM32 CubeProgrammer — Programming

STM32 CubeMonitor — Monitor

STM32Cube

STM32 CubeMCU Packages — Packages

User application
Middlewares
Drivers

STM32 CubeExpansion — Expansions

Azure RTOS ThreadX
Real-time operating system

Azure RTOS FileX
FAT file system, fault tolerant

Azure RTOS

Azure RTOS NetX/NetX Duo
TCP/IP stacks

Azure RTOS USBX
USB stack, host and device

Production License for any STM32

STM32 empowered by Cortex®-M33

Cortex®-M compatibility

- Seamless architecture across all applications

Cortex-M0 & M0+	Cortex-M3	Cortex-M4	Cortex-M33	Cortex-M7
Ultra low power	First Cortex®-M CPU	High performance		

Binary and tool compatible   Highest Performance

Cortex®-M33 in brief

arm
CORTEX®-M33

Common Criteria
EAL6+ Certified

TruztZone for Armv8-M

| Nested vectored interrupt controller | Wake-up interrupt controller |
| CPU Armv8-M Mainline |
Memory protection unit	DSP	FPU
2x AHB5	ITM trace	Data watchpoint	JTAG
		Breakpoint unit	
Coprocessor interface	ETM trace	MTB	Serial wire
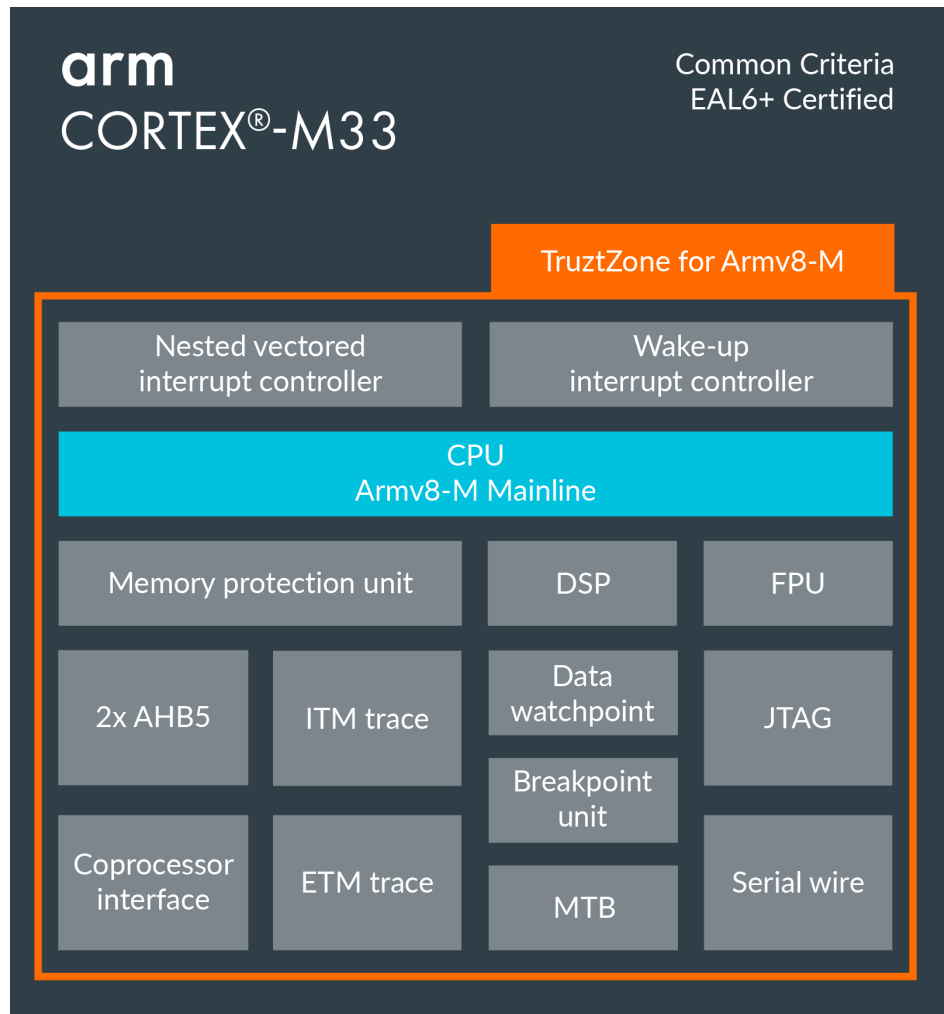
Architecture	ARMv8-M with Mainline extension
Bus Interface	2x AMBA5 AHB (Harvard bus architecture)
ISA Support	Thumb/Thumb-2
Pipeline	Three-stage
SW Security	TZ, SAU up to 8 regions, Stack limit checking
DSP extension	DSP/SIMD: 16/32b MAC, 8/16b SIMD
FPU	SP, IEEE 754 complaint
Co-processor I/F	Up to 8 co-processor units
MPU	Up to 16 regions per security state
Interrupts	NMI + up to 480 interrupts, 8-256 priority levels
WIC	Wake-up Interrupt Controller
Sleep Modes	WFE, WFI, Sleep On Exit
Debug	JTAG & SWD up to 8 beak- & 4 watch-points
Trace	ETM, MTB, DWT, ITM

life.augmented

STM32 based on Cortex®-M33

STM32L5 — First STM32 based on Cortex®-M33 , 90nm

STM32U5 — ULTRA LOW POWER
First STM32 based Arm® Cortex®-M33 40nm

STM32WBA5 — 2.4GHZ MULTIPROTOCOL
First Wireless STM32 based Arm® Cortex®-M33 @ 100Mhz

STM32H5 — HIGH PERFORMANCE
First Arm® Cortex®-M33 on the mkt @ 250Mhz

STM32

Wireless MCU

Entry level MCU

MPU

Ultra Low Power MCU

High- Performance MCU

Analog rich MCU

STM32 ultra-low power MCUs

90nm ULP embedded Flash

STM32L4 MCU

Cortex-M4 up to 120MHz
Up to 2MB Flash

STM32L5 MCU

Cortex-M33 up to 120MHz
512 KB Flash

STM32Ux MCU

Q1'24

Cortex-M0+
LCD segment
Up to 256KB Flash

40nm ULP embedded Flash

STM32U5 MCU

Cortex-M33 up to 160MHz
Up to 4MB Flash

life.augmented

Enabling key new features for embedded developers

High energy efficiency

Innovative power management features
LPBAM*, DMA and IP autonomous in LP mode

High integration

Up to 4Mbytes internal flash memory
Up to 2.5Mbytes RAM
USB HS with integrated PHY

Higher security and safety

AES and PKA, side attack resistant
ECC on flash memory and SRAM

Graphics advanced capacity

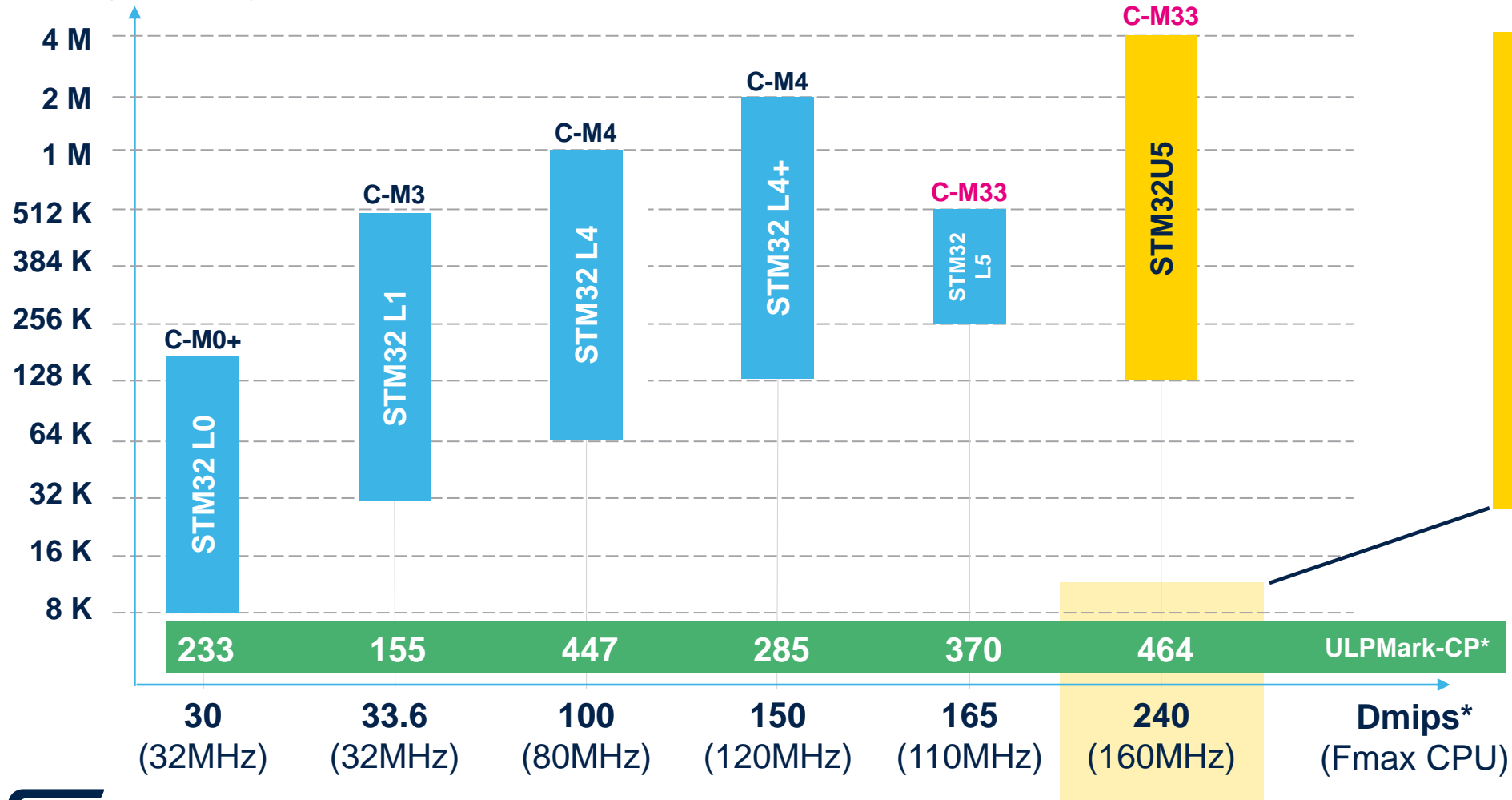First STM32 with advanced graphics accelerators
and NeoChrom GPU

Improved data storage

100 Kcycles for 512Kbytes of Flash

* Low Power Background Autonomous Mode

ST Confidential

STM32U5, the flagship of STM32 ULP series

Memory size (Bytes)

233	**155**	**447**	**285**	**370**	**464**	ULPMark-CP*

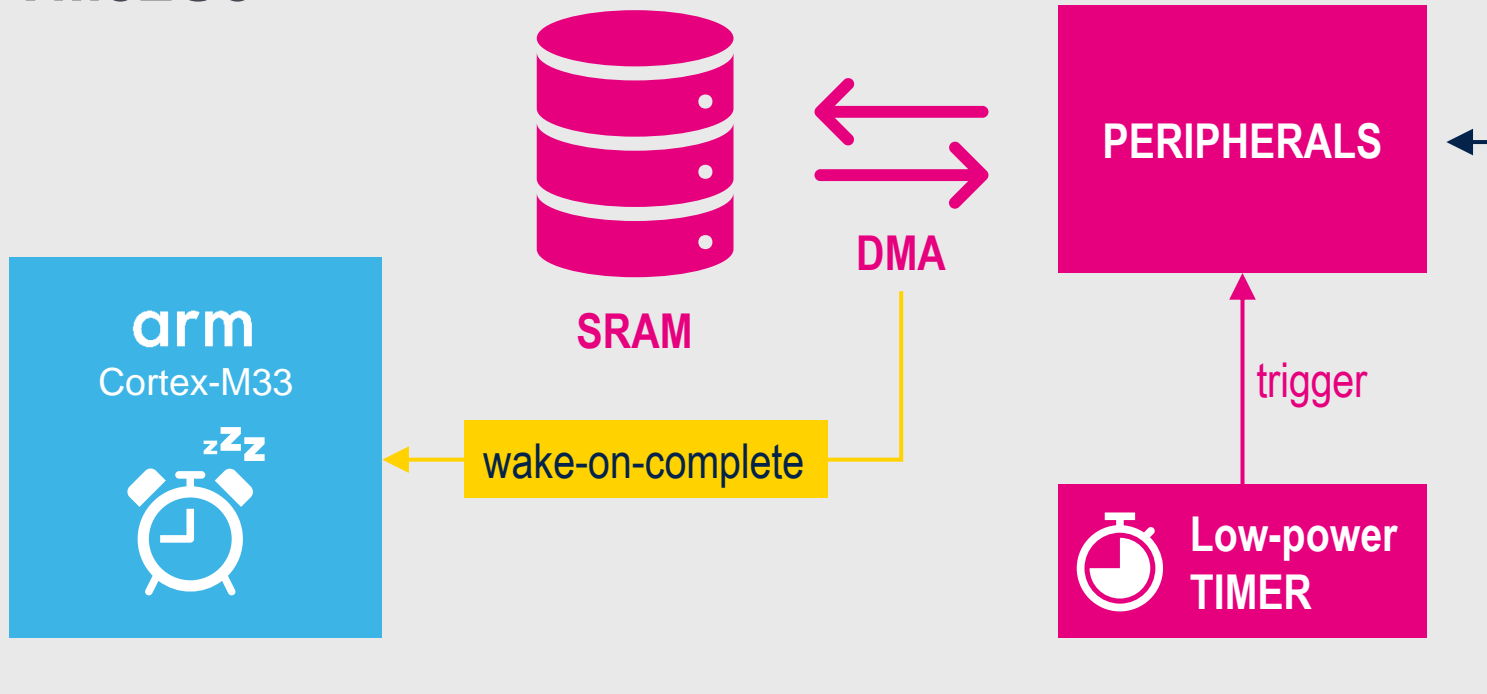| 30 (32MHz) | 33.6 (32MHz) | 100 (80MHz) | 150 (120MHz) | 165 (110MHz) | 240 (160MHz) | **Dmips*** (Fmax CPU) |

STM32U5

🏆

Highest DMIPS
Best ULP

the higher the better

Cut MCU power consumption by 90%*

Low Power Background Autonomous Mode (LPBAM)

STM32U5

arm Cortex-M33

SRAM

DMA

PERIPHERALS

wake-on-complete

trigger

Low-power TIMER

Peripherals:
- I2C master or slave
- SPI / UART reception or transmission
- ADC / DAC
- Voice Activity Detection
- LPTIM
- I/O

* Typical application where peripherals need to acquire data regularly

Extensive functionality to protect your assets

Isolation	Cryptography	Security assurance level
TrustZone® Secure Peripherals Secure DMA	**Side channel AES, PKA** Additional AES, PKA, SHA, TRNG CAVP certified CryptoLib	psacertified™ level three SESIP3

1st STM32 MCU to reach Level 3

Lifecycle	Memory protections	Active tamper	Trust anchor
RDP: **4 protection level states** **Password based regression**	OTP, HDP, WRP, RDP, MPU Ext. Flash encryption OTFDec **Secure Debug**	**4x active pair** of tamper pins. Volt. &Temp. monitoring (**Vbat**) Total tamper I/Os: **8**	TF-M, Secure Boot, Secure Firmware Install **Hardware Unique Keys**

New features for STM32 in bold

STM32 high performance MCUs

90nm embedded Flash

STM32F2 MCU

Cortex-M3 up to 120MHz
Up to 1MB Flash

STM32F4 MCU

Cortex-M4 up to 180MHz
Up to 2MB Flash

40nm embedded Flash

STM32H5 MCU

Cortex-M33 at 250MHz
Up to 2MB Flash

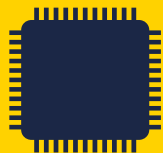# Introducing the **STM32H5** MCU series for high performance designs

Most powerful Arm® Cortex®-M33 MCU
Industry-first 32-bit MCU with Arm® Cortex®-M33 core running as high as 250 MHz

Scalable security to address every need
From the most essential security building blocks to fully certified services maintained by ST
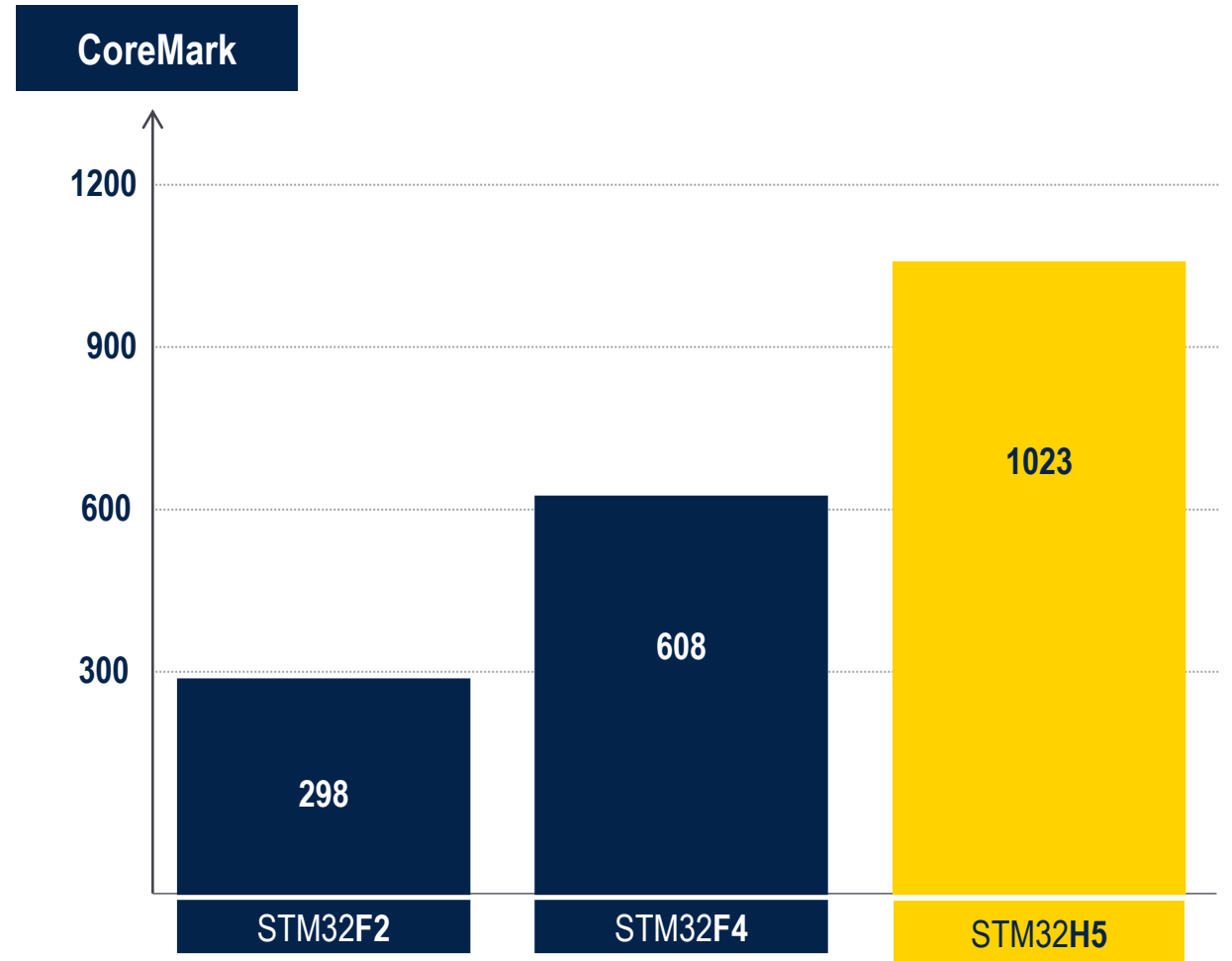
Optimized cost/performance trade-off
Based on ST's optimized 40 nm process technology
Large choice of memory, peripherals, and package options

Boosting application performance

STM32**H5**

- Arm® Cortex®-M33 at **250 MHz** **375 DMIPS & 1023 CoreMark**

- **Instruction and data cache** for internal and external memory (ART Accelerator™)

- Mathematics accelerators: **FMAC** and **Cordic**

CoreMark

	CoreMark
STM32**F2**	298
STM32**F4**	608
STM32**H5**	1023

Efficient power consumption thanks to the switched mode power supply option (SMPS)

V_{BAT} — 420 nA

Standby(RTC ON) — 3.5 µA

Stop (with 16KB RAM) — 51 µA

Stop (Full RAM retention) — 57 µA

Run up to 250 MHz — 61 µA / MHz
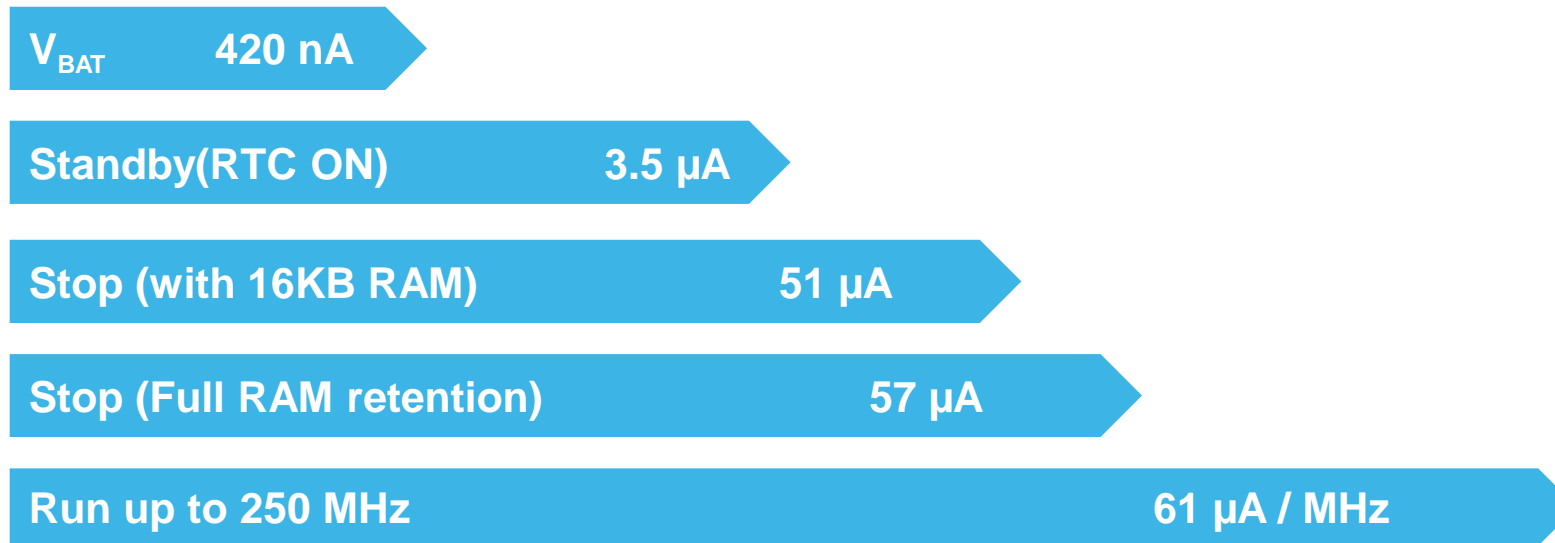
Typical: 25°C, V_{DD} = 3V, SMPS mode

Stronger security

STM32 Trust

Robust hardware features and turnkey SoC software implementations

Memory protections
against illegal access control

OTP, HDP, WRP, MPU
Ext. Flash Decryption OTFDec
Secure Debug
Active Tamper

Cryptography
for hardware robustness

Side channel AES, PKA
Additional AES, PKA, SHA,
TRNG, OTFDec, HUK
NIST - CAVP certified CryptoLib

Platform authentication
during product lifecycle

2 boot stages
Protection level states
Debug authentication

Code isolation
for runtime protection

7 isolation stages
Arm® TrustZone® technology
Dedicated keystores

Turnkey SOC security services

STM32Trust TEE Secure Manager

Easy registration to clouds & servers

Multi-tenant IP protection

Pre-integrated 3rd party PKI lifecycle

Immutable Root of Trust

State-of-the-art security assurance level

SESIP™3

psacertified™
level three

target certifications

Scalable security to accelerate time to market

Secure Manager

A **Trusted Execution Environment** (TEE) integrating core security services
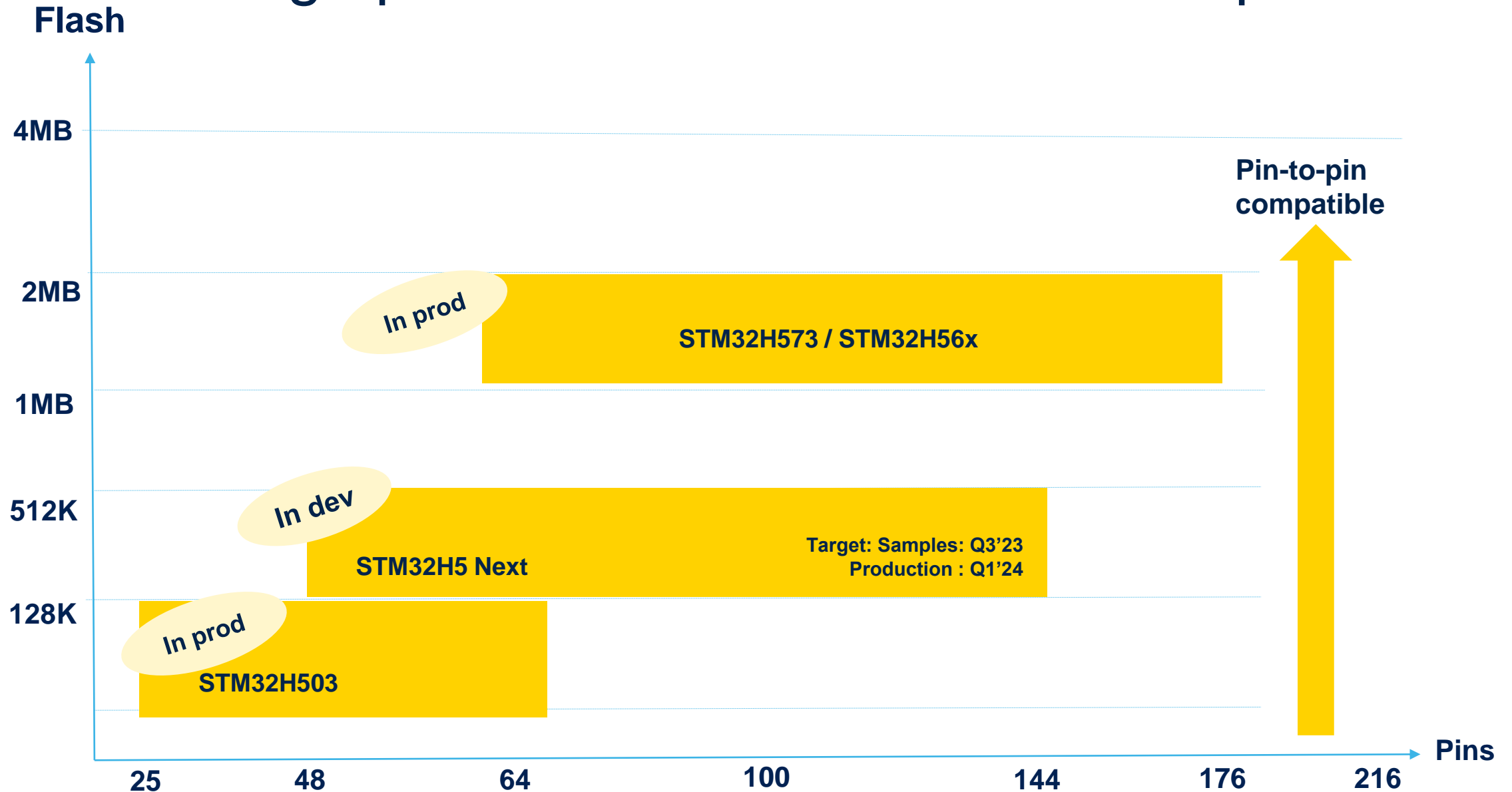
A simplified customer journey

Seamless cloud/server support

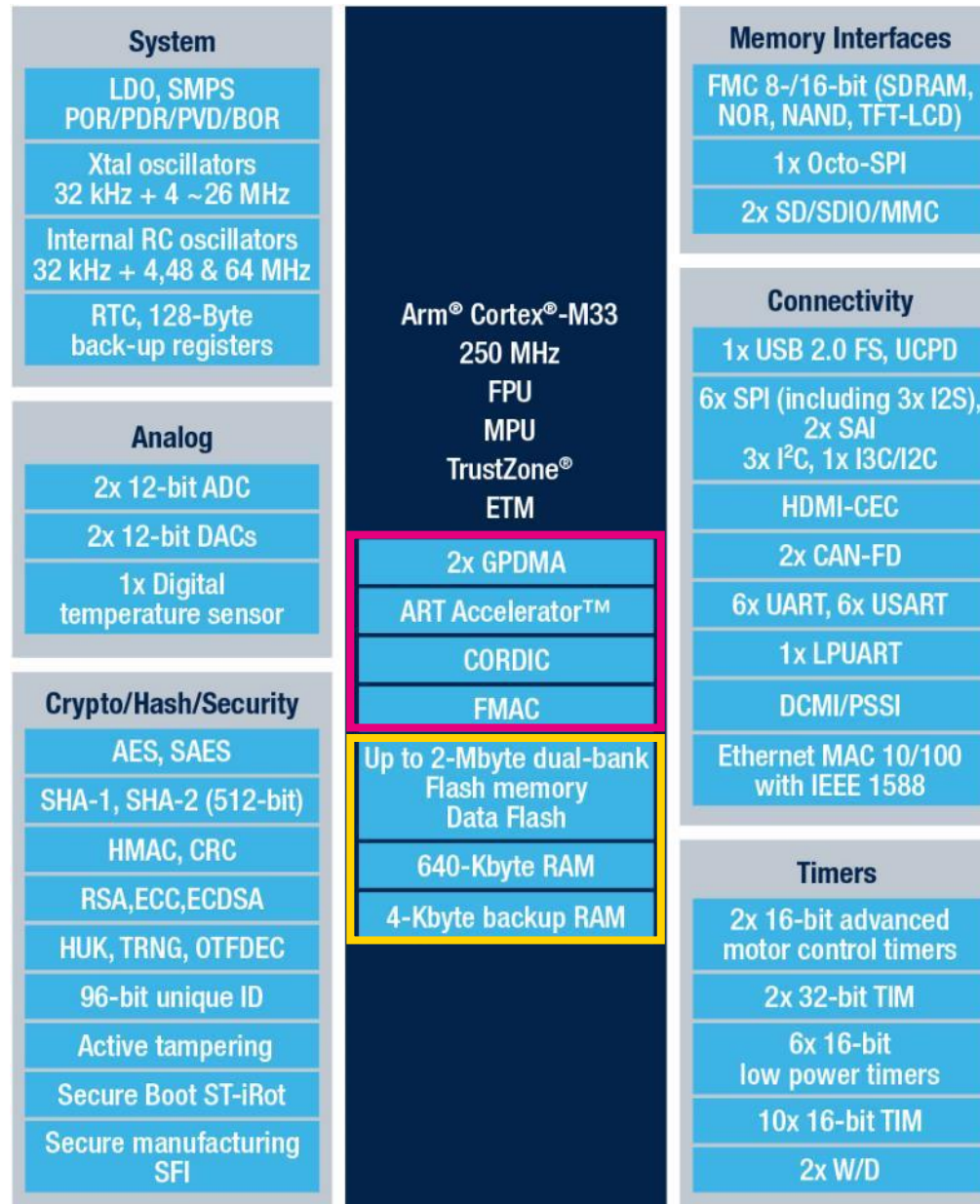Supporting remote provisioning

Multi-tenant IP protection

The first MCU supplier to offer a certified and maintained TEE solution to customers

High performance H5 Baseline complete family

STM32H573 MCU block diagram

System
- LDO, SMPS POR/PDR/PVD/BOR
- Xtal oscillators 32 kHz + 4 ~26 MHz
- Internal RC oscillators 32 kHz + 4,48 & 64 MHz
- RTC, 128-Byte back-up registers

Analog
- 2x 12-bit ADC
- 2x 12-bit DACs
- 1x Digital temperature sensor

Crypto/Hash/Security
- AES, SAES
- SHA-1, SHA-2 (512-bit)
- HMAC, CRC
- RSA,ECC,ECDSA
- HUK, TRNG, OTFDEC
- 96-bit unique ID
- Active tampering
- Secure Boot ST-iRot
- Secure manufacturing SFI

Arm® Cortex®-M33
250 MHz
FPU
MPU
TrustZone®
ETM
- 2x GPDMA
- ART Accelerator™
- CORDIC
- FMAC
- Up to 2-Mbyte dual-bank Flash memory Data Flash
- 640-Kbyte RAM
- 4-Kbyte backup RAM

Memory Interfaces
- FMC 8-/16-bit (SDRAM, NOR, NAND, TFT-LCD)
- 1x Octo-SPI
- 2x SD/SDIO/MMC

Connectivity
- 1x USB 2.0 FS, UCPD
- 6x SPI (including 3x I2S), 2x SAI 3x I²C, 1x I3C/I2C
- HDMI-CEC
- 2x CAN-FD
- 6x UART, 6x USART
- 1x LPUART
- DCMI/PSSI
- Ethernet MAC 10/100 with IEEE 1588

Timers
- 2x 16-bit advanced motor control timers
- 2x 32-bit TIM
- 6x 16-bit low power timers
- 10x 16-bit TIM
- 2x W/D

LONGEVITY 10 YEARS COMMITMENT

▶ Numerous integrated peripherals

▶ Advanced accelerators

▶ Large embedded memory

33

ST Confidential
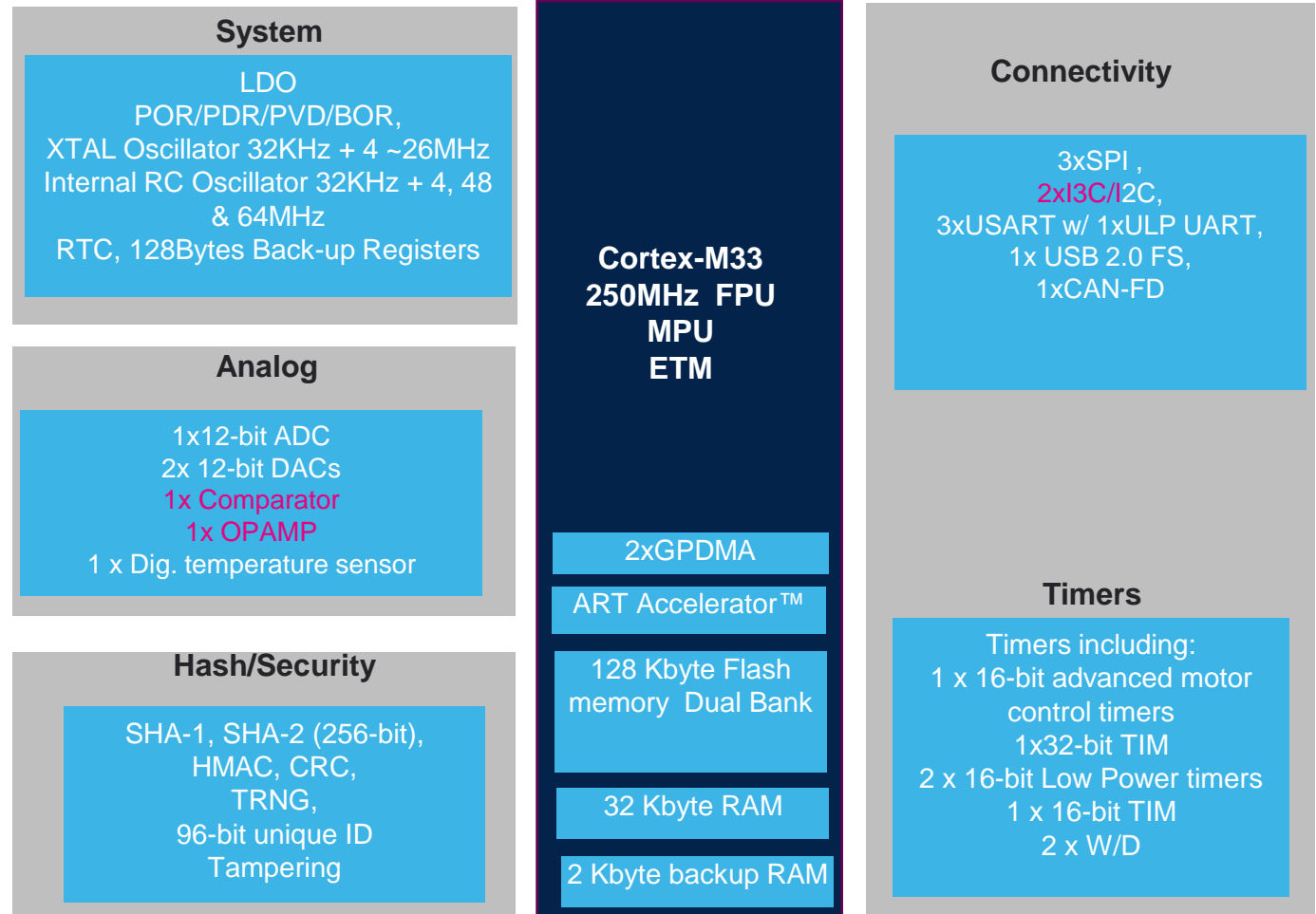
STM32H503 block diagram

Extending STM32H5 product lines with cost effective 128KB device

- CM33 at 250MHz, 375DMIPS
- Enhanced device lifecycle
- Dynamic consumption 90 µA/MHz
- STOP mode : 50µA
- Standby w/RTC: 3,4µA
- VDD 1.7V to 3.6V
- TA: -40°C to 85°C

System

LDO
POR/PDR/PVD/BOR,
XTAL Oscillator 32KHz + 4 ~26MHz
Internal RC Oscillator 32KHz + 4, 48 & 64MHz
RTC, 128Bytes Back-up Registers

Analog

1x12-bit ADC
2x 12-bit DACs
1x Comparator
1x OPAMP
1 x Dig. temperature sensor

Hash/Security

SHA-1, SHA-2 (256-bit),
HMAC, CRC,
TRNG,
96-bit unique ID
Tampering

Cortex-M33 250MHz FPU MPU ETM

2xGPDMA

ART Accelerator™

128 Kbyte Flash memory Dual Bank

32 Kbyte RAM

2 Kbyte backup RAM

Connectivity

3xSPI ,
2xI3C/I2C,
3xUSART w/ 1xULP UART,
1x USB 2.0 FS,
1xCAN-FD

Timers

Timers including:
1 x 16-bit advanced motor control timers
1x32-bit TIM
2 x 16-bit Low Power timers
1 x 16-bit TIM
2 x W/D

STM32H5-2MB & 128KB product lines

	Product line	Dual Bank FLASH (KB)	RAM (KB)	Memory I/F	USB	12- bit ADC 5 Msps	1xOp-Amp/ 1xComp,	CAN-FD	Ethernet	DCMI HDMI-CEC	Power supply	TrustZone	AES/SAES PKA OTFDEC HUK ST-iROT
Cortex-M33 (DSP + FPU) – 250 MHz · ART Accelerator · USART, SPI, I²C, I3C · 16 and 32-bit timers · SHA, TRNG · DMA · DAC · DigitalTemperature sensor · Low voltage 1.62V to 3.6V · Vbat Mode · Unique ID	STM32H573	2048	640	2xSDMMC FMC 1x OctoSPI	USB FS USB UCPD	2		2	●	●	SMPS / LDO	●	●
	STM32H563	2048 to 1024	640	2xSDMMC FMC 1x OctoSPI	USB FS USB UCPD	2		2	●	●	SMPS / LDO	●	
	STM32H562	2048 to 1024	640	1xSDMMC FMC 1x OctoSPI	USB FS USB UCPD	2		1		●	LDO	●	
	STM32H503	128	32	1xSDMMC	USB FS	1	●	1			LDO		

- **STM32H563 /573 line :**
  - LDO option: Ta: -40°C to + 85°C , Tj 130°C
  - **SMPS option : Ta: -40°C to + 125°C, Tj 130°C**
- **STM32H562 line: LDO option:** Ta: -40°C to + 85°C , Tj 130°C

- **STM32H503 : Ta: -40°C to + 105°C/125°C low dissipation, Tj 130°C**

A large offer with multiple package choices

Flash memory size / RAM size (bytes)

	WLCSP25	UFQFPN32	LQFP48/ UFQFPN48	LQFP64	VQFPN68	WLCSP80	LQFP100	LQFP144	UFBGA169	LQFP176/ UFBGA176
2 M / 640 K				STM32H573RI		STM32H573MI	STM32H573VI	STM32H573ZI	STM32H573AI	STM32H573II
				STM32H563RI		STM32H563MI	STM32H563VI ★	STM32H563ZI ★	STM32H563AI	STM32H563II ★
				STM32H562RI			STM32H562VI	STM32H562ZI	STM32H562AI	STM32H562II
1 M / 640 K				STM32H563RG			STM32H563VG	STM32H563ZG	STM32H563AG	STM32H563IG
				STM32H562RG			STM32H562VG	STM32H562ZG	STM32H562AG	STM32H562IG
128 K / 32 K	STM32H503EB	STM32H503KB	STM32H503CB	STM32H503RB ★						

Pin count

Legend: 🟦 Without HW crypto ⬛ With HW-Crypt & ST-iRoT ▢ Additional SMPS option ★ Available now, other RPNs will be available in Q2'2023.

Multiple package options to developer needs

32/48/68-pin QFN
25/80-pin WLCSP

48/64/100/144/176-pin LQFP
169/176-pin UFBGA

3 memory size options

2 Mbytes Flash / 640 Kbytes RAM
1 Mbytes Flash / 640 Kbytes RAM
128 Kbytes Flash / 32 Kbytes

Security options

With hardware crypto and ST-iRoT
Without hardware crypto and ST-iRoT

**More than
30 products**

Development tools for STM32H5 series
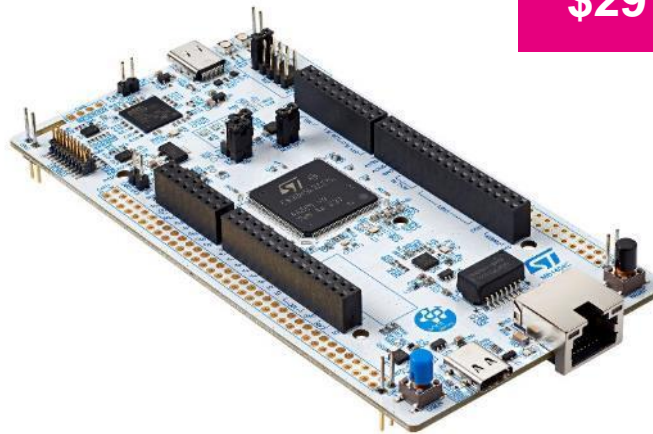
Jump-start your evaluation, prototyping, and design

* $15

NUCLEO-H503RB

Affordable prototyping

USB, Arduino uno IF, 64-pin MCU

* $29

NUCLEO-H563ZI

Affordable prototyping

USB, Ethernet, Arduino uno IF, 144-pin MCU

* $99

Available in Q2'23

STM32H573I-DK

Multi-connectivity kit

USB, Ethernet, MicroSD, Display, 512-Mbit Octo-SPI flash, Audio, Multi-extension IFs, 176-pin MCU

*Recommended Resale Price (RRP)

STM32H5 simplifies the design of secure industrial applications

Smart homes

Air conditioning systems
Fridges
Alarm systems

Factory automation

PLC
Motor control
Industrial pumps

Smart cities

Communication gateways
Light control
Energy conversion

Consumer

Keyboards, tracking devices
Medical accessories

Let's HANDS ON now !

Manuel Marcias FAE