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STM32 MCU & WIRELESS update

STMicroelectronics and AVNET SILICA

Paolo Scanniffio

Technical Marketing Manager STM32

Iberia

AVNET® SILICA

STM32 General introduction

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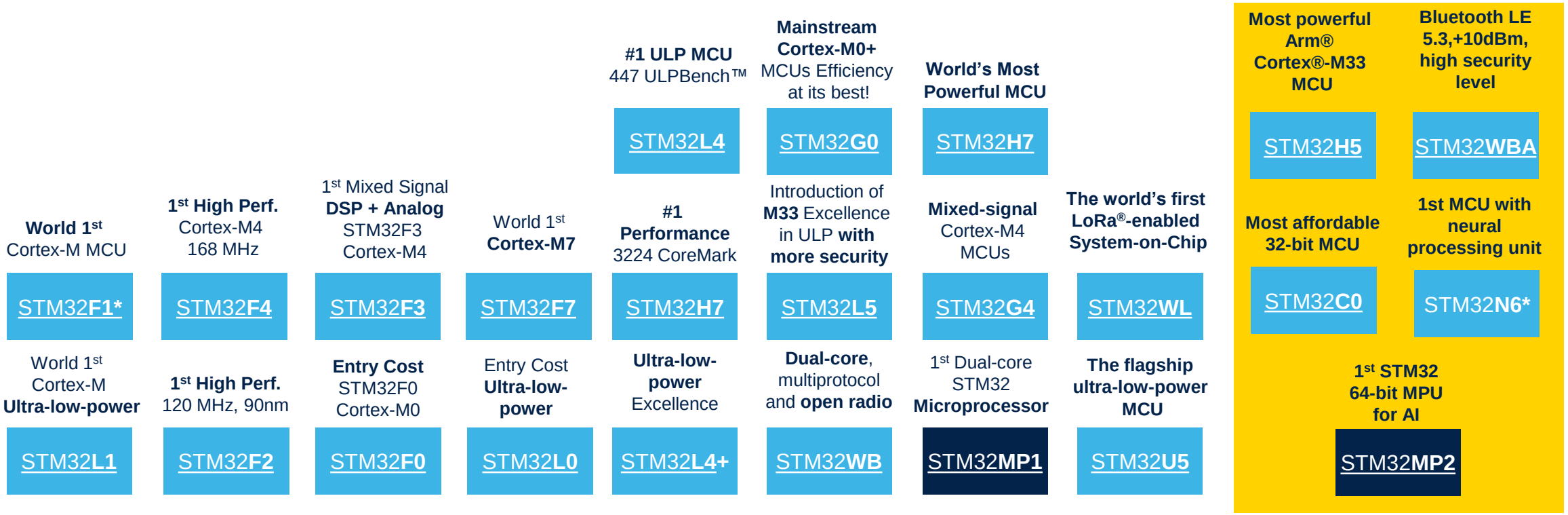
Continuous innovation since 2007

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



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*Pre-announcement

From entry-level to high-performance applications

XXS

STM32C0

- 8 pins
- 16 Kbytes of flash memory
- 32 MHz

XXL

STM32H7

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

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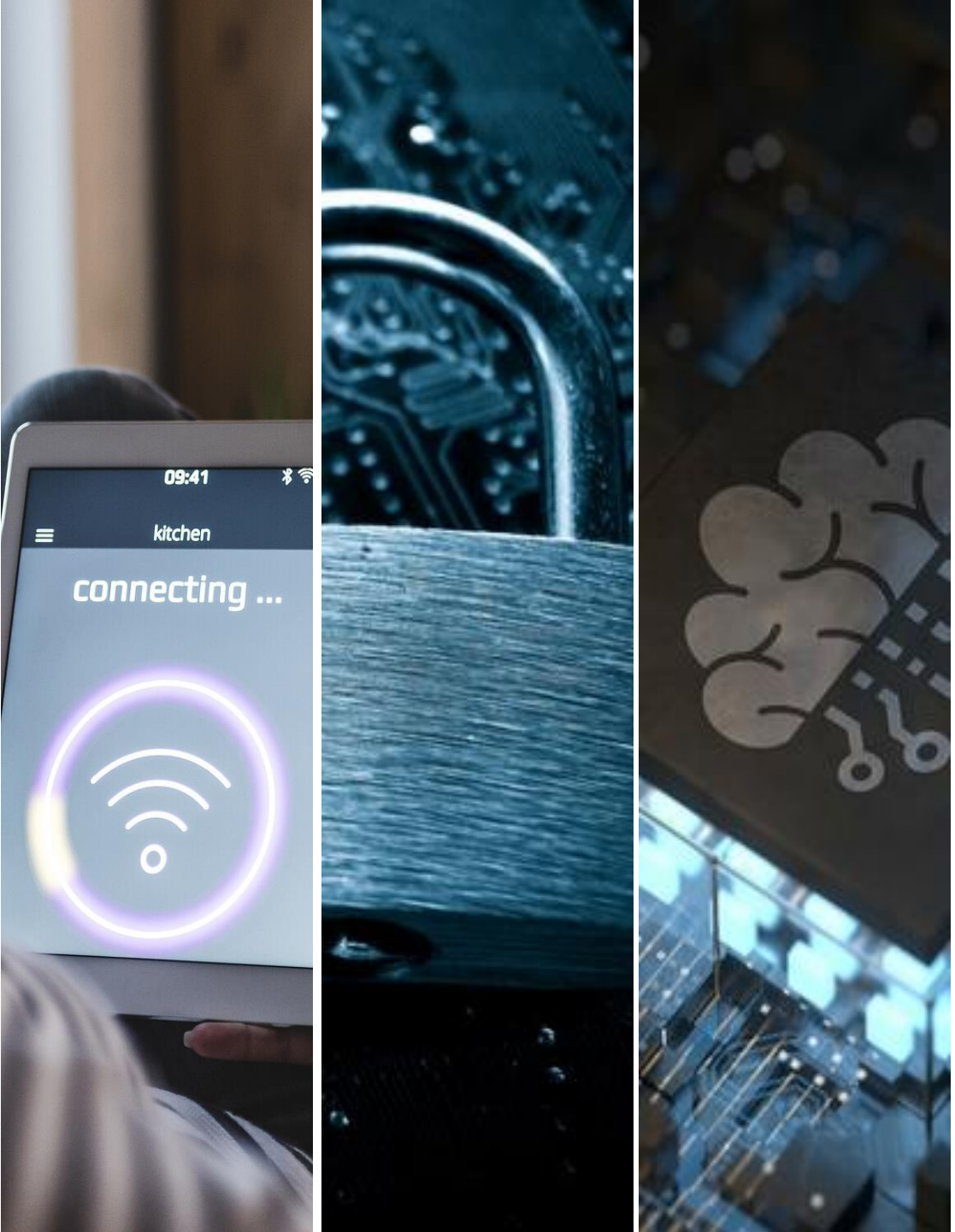

STM32 supports 3 key trends

More Wireless Connectivity

More Advanced Security

STM32 Trust

More Autonomous Decisions embedding AI (100-300 GOPS)

More Application Specific Added Value IPs

More Wired Connectivity

Lower Power

More computing Power
32-bit CPU
Arm® Cortex®-M
Real time OS
(up to two cores)

Flexible Memory Interfaces

More SRAM

More embedded flash — Optional

STM32 portfolio

MPU

STM32MP1
Up to 1 GHz Cortex-A7
209 MHz Cortex-M4

STM32MP2
Dual 1.5 GHz Cortex-A35
400 MHz Cortex-M33

High-performance MCUs

STM32F7
1082 CoreMark
216 MHz Cortex-M7

STM32H7
Up to 3224 CoreMark
Up to 550 MHz Cortex -M7
240 MHz Cortex -M4

STM32N6
MCU with neural processing unit

STM32F2
Up to 398 CoreMark
120 MHz Cortex-M3

STM32F4
Up to 608 CoreMark
180 MHz Cortex-M4

STM32H5
Up to 1023 CoreMark
250 MHz Cortex-M33

Mainstream MCUs

Mixed-signal MCUs

STM32F3
245 CoreMark
72 MHz Cortex-M4

STM32G4
569 CoreMark
170 MHz Cortex-M4

STM32C0
114 CoreMark
48 MHz Cortex M0+

STM32F0
106 CoreMark
48 MHz Cortex-M0

STM32G0
142 CoreMark
64 MHz Cortex-M0+

STM32F1
177 CoreMark
72 MHz Cortex-M3

Ultra-low-power MCUs

STM32L0
75 CoreMark
32 MHz Cortex-M0+

STM32L4
273 CoreMark
80 MHz Cortex-M4

STM32L4+
409 CoreMark
120 MHz Cortex-M4

STM32L5
443 CoreMark
110 MHz Cortex-M33

STM32U5
651 CoreMark
160 MHz Cortex-M33

Wireless MCUs

BlueNRG-x
Cortex-M0+

STM32WB
216 CoreMark
64 MHz Cortex-M4
32 MHz Cortex-M0+

STM32WBA
407 CoreMark
100 MHz Cortex-M33

Spirit1
150-956MHz / 2(G)FSK, GMSK

S2-LP (Spirit2)
413-1055MHz / 2/4(G)FSK, OOK, ASK, 802.15.4g

STM32WL
162 CoreMark
48 MHz Cortex-M4
48 MHz Cortex-M0+

Latest product generation | New series introduced in 2023 | Pre-announcement

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STM32 ecosystem

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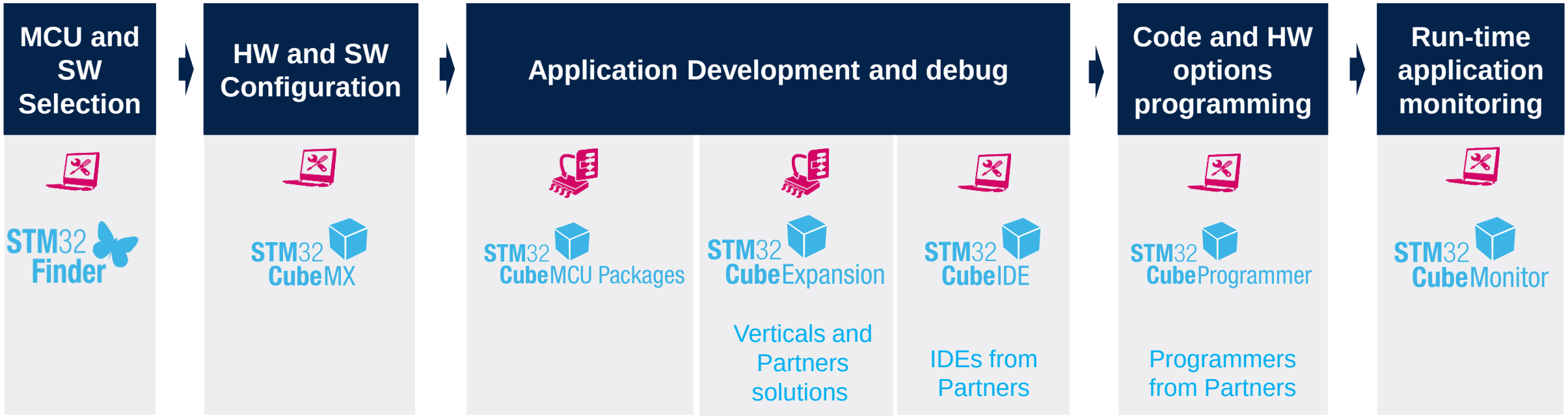
STM32Cube Framework

helping you releasing your creativity

Tools and software that support you during all your design steps



Consistency across the full STM32 portfolio

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STM32 empowered by Cortex®-M33

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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

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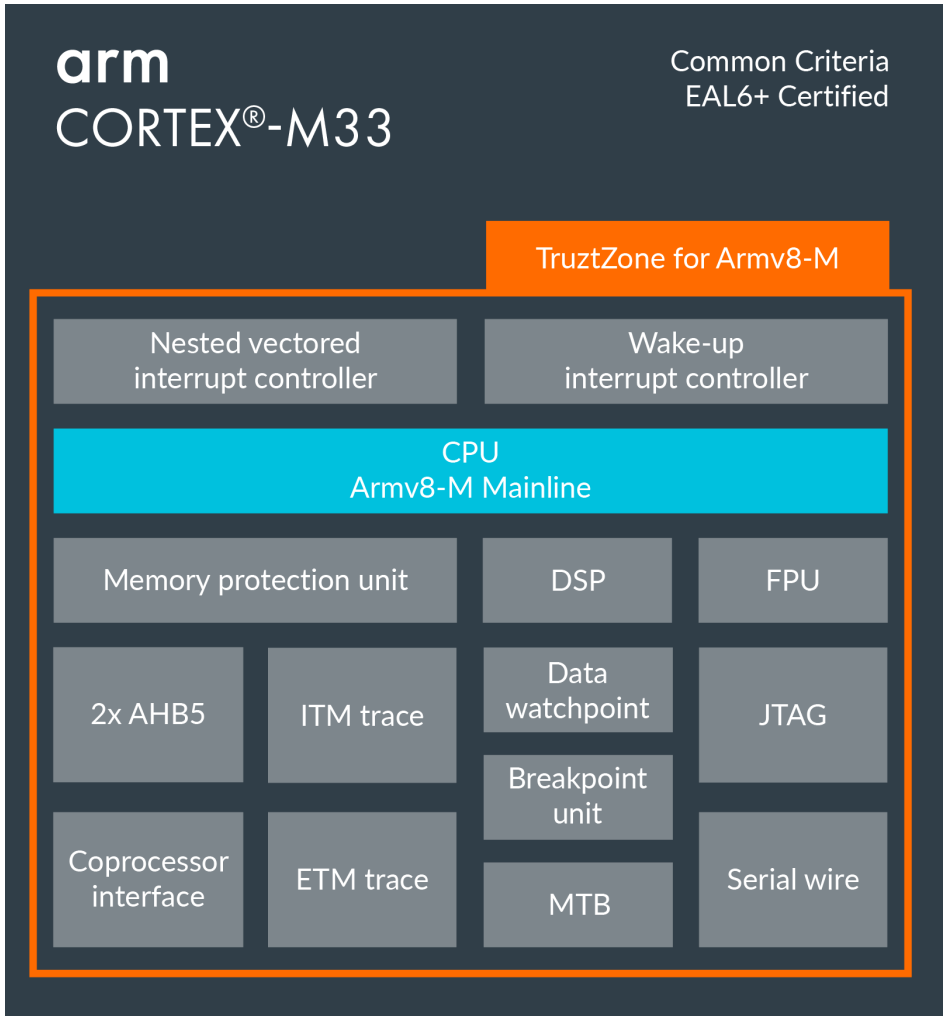
Cortex®-M33 in brief



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

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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

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- Wireless MCU
- Entry level MCU
- MPU
- Ultra Low Power MCU
- **High- Performance MCU**
- Analog rich MCU

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

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STM32H5 MCU series

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

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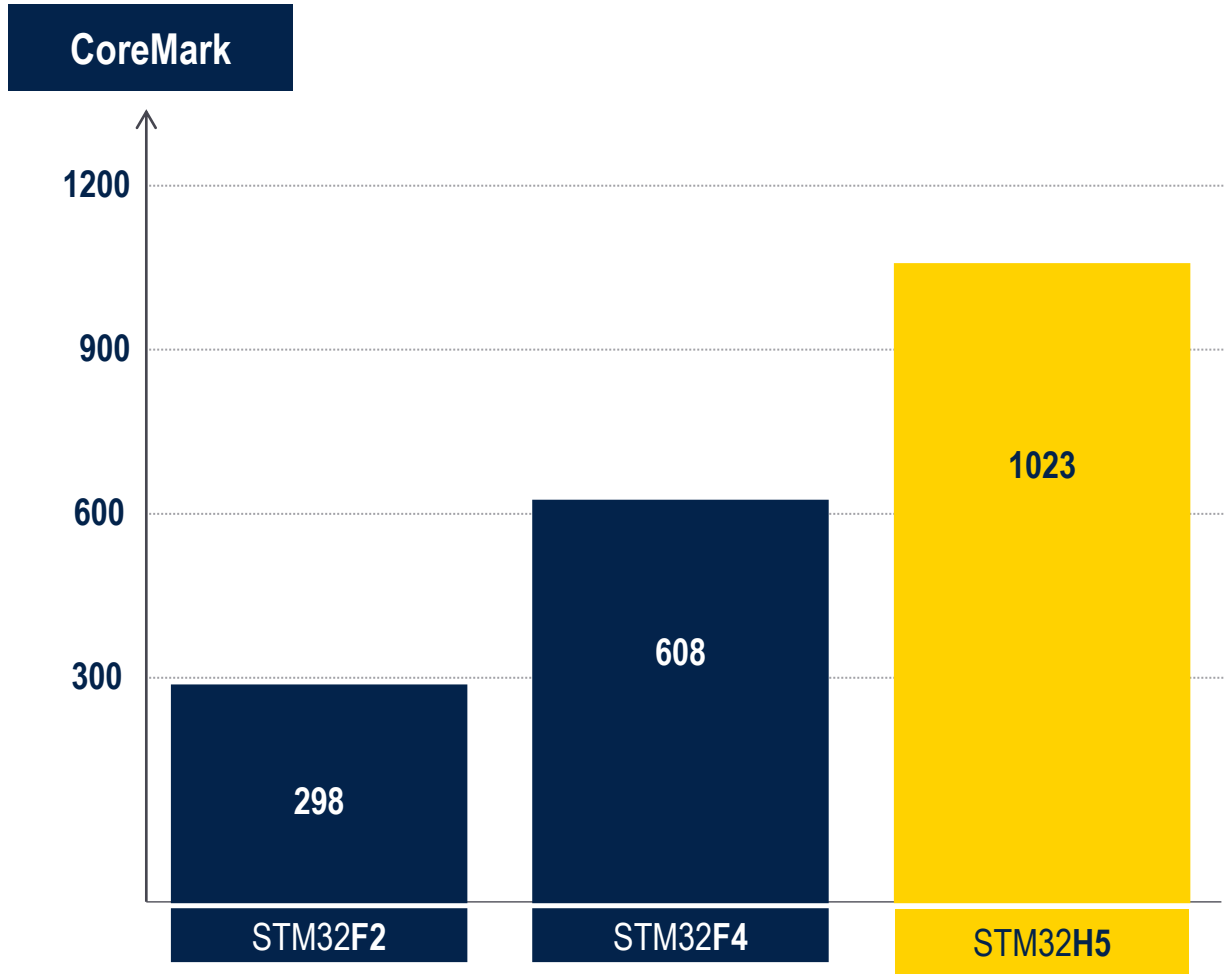
Boosting application performance

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**



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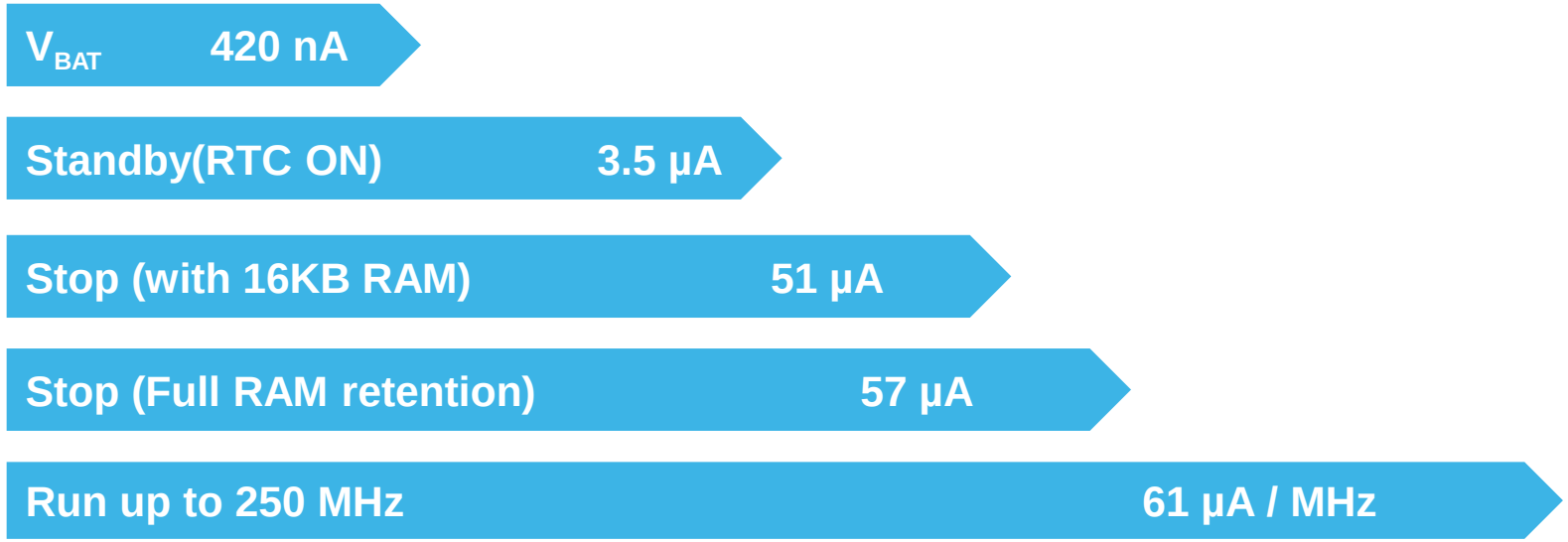
Flexible power modes

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



Typical: 25°C, V_{DD} = 3V, SMPS mode

STM32 Trust

Stronger security

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

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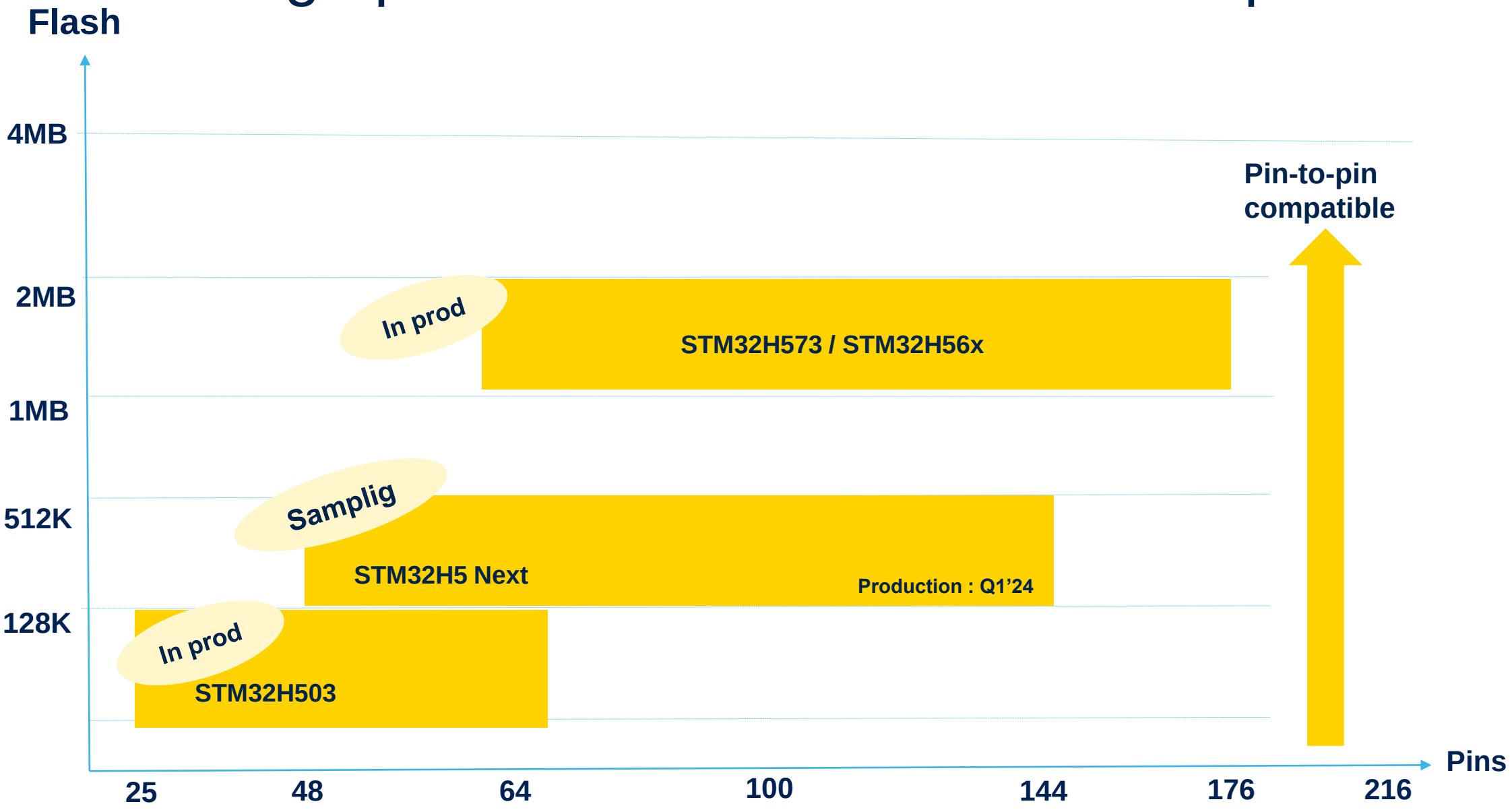
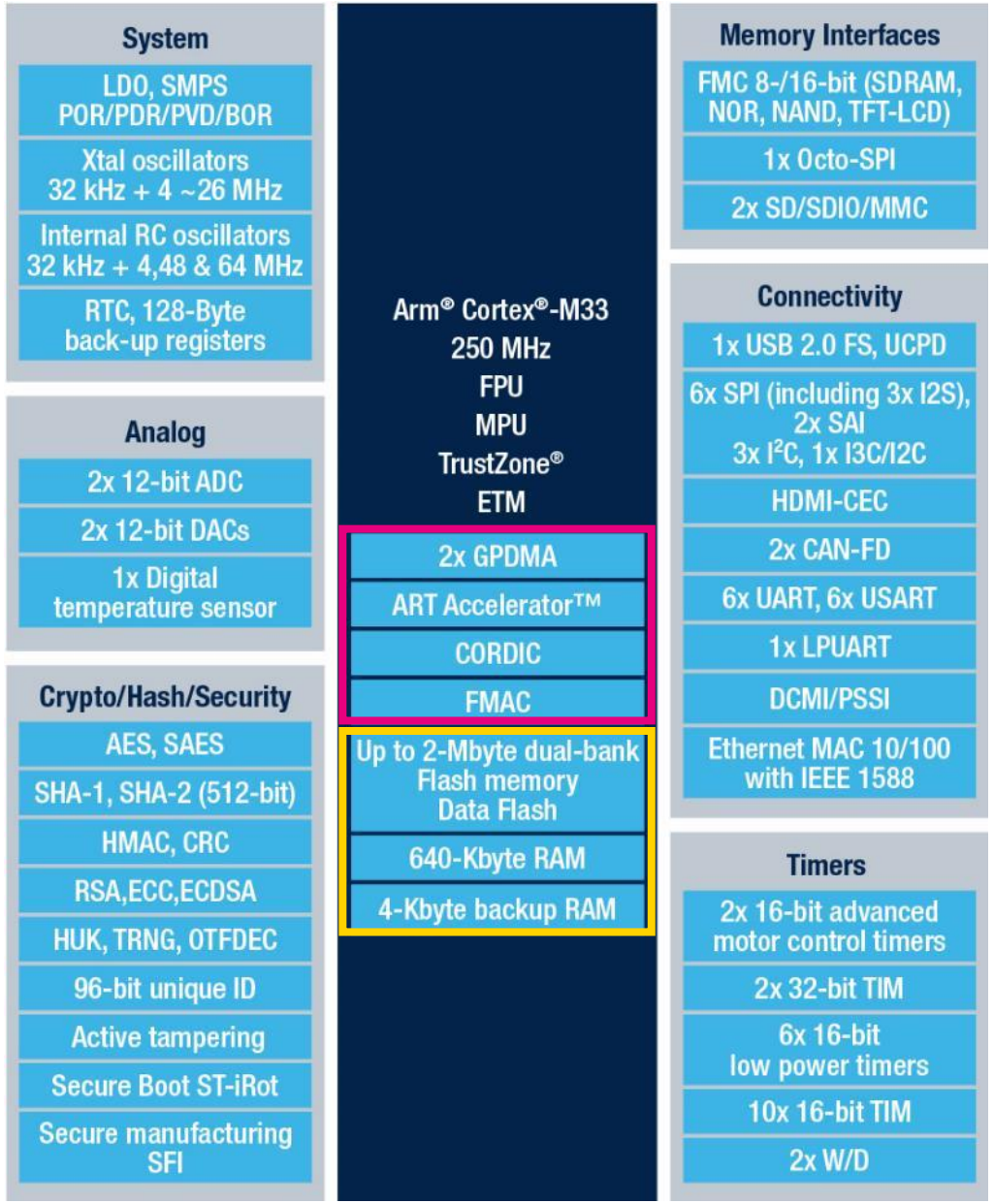
High performance H5 Baseline complete family



STM32H573 MCU block diagram



Numerous integrated peripherals

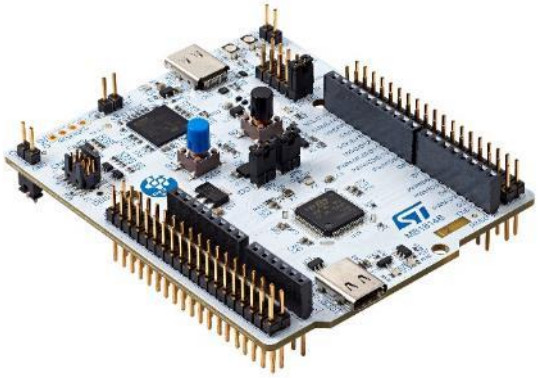
Advanced accelerators

Large embedded memory

Development tools for STM32H5 series

Jump-start your evaluation, prototyping, and design

*** $15**

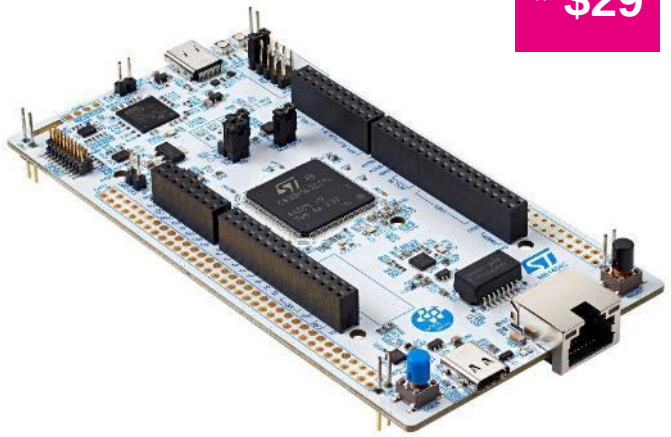


NUCLEO-H503RB

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)*

- 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

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STM32U5 Enabling key new features

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

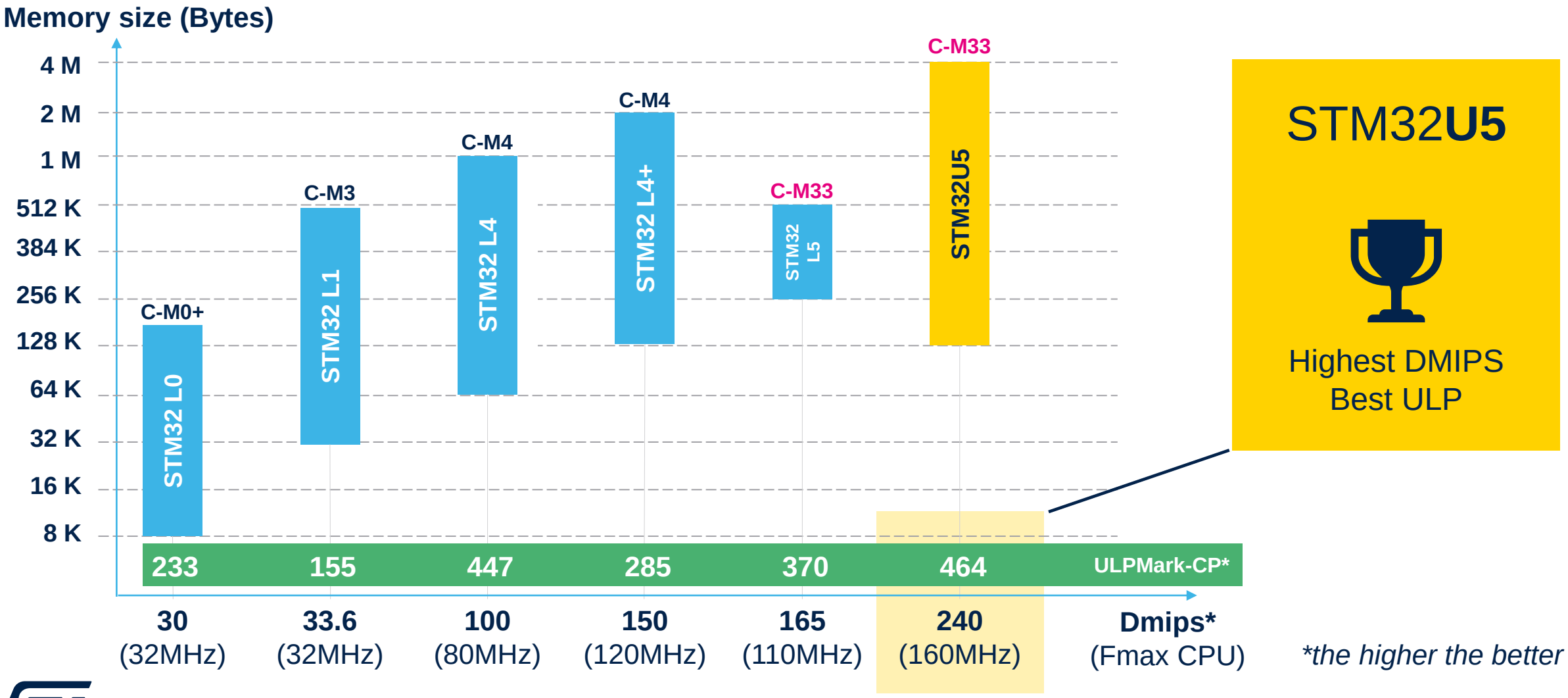
First STM32 with advanced graphics accelerators and NeoChrom GPU

Improved data storage

100 Kcycles for 512Kbytes of Flash

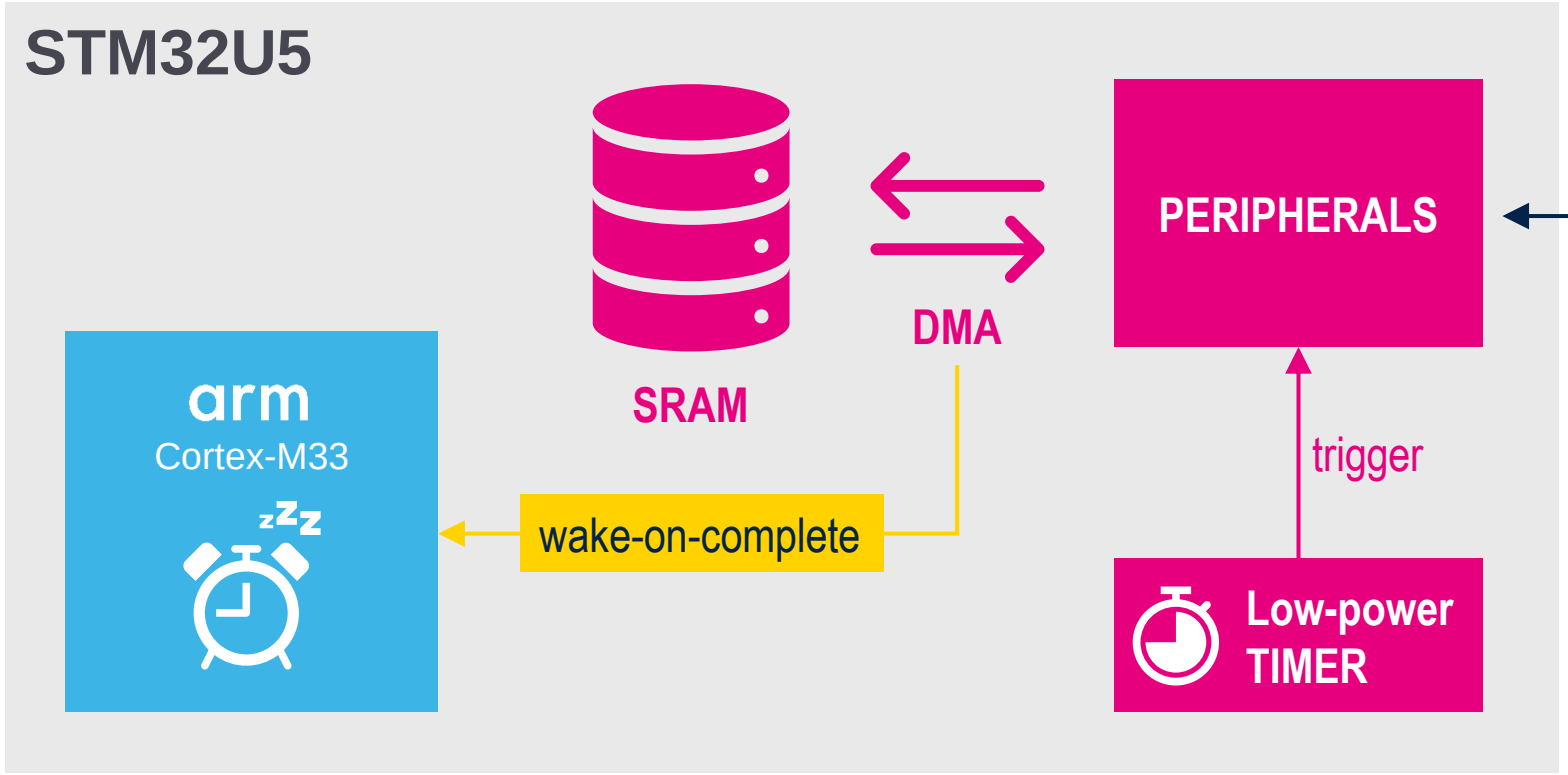
* Low Power Background Autonomous Mode

STM32U5, the flagship of STM32 ULP series



Cut MCU power consumption by 90%*

Low Power Background Autonomous Mode (LPBAM)



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*

Enhanced security

Extensive functionality to protect your assets

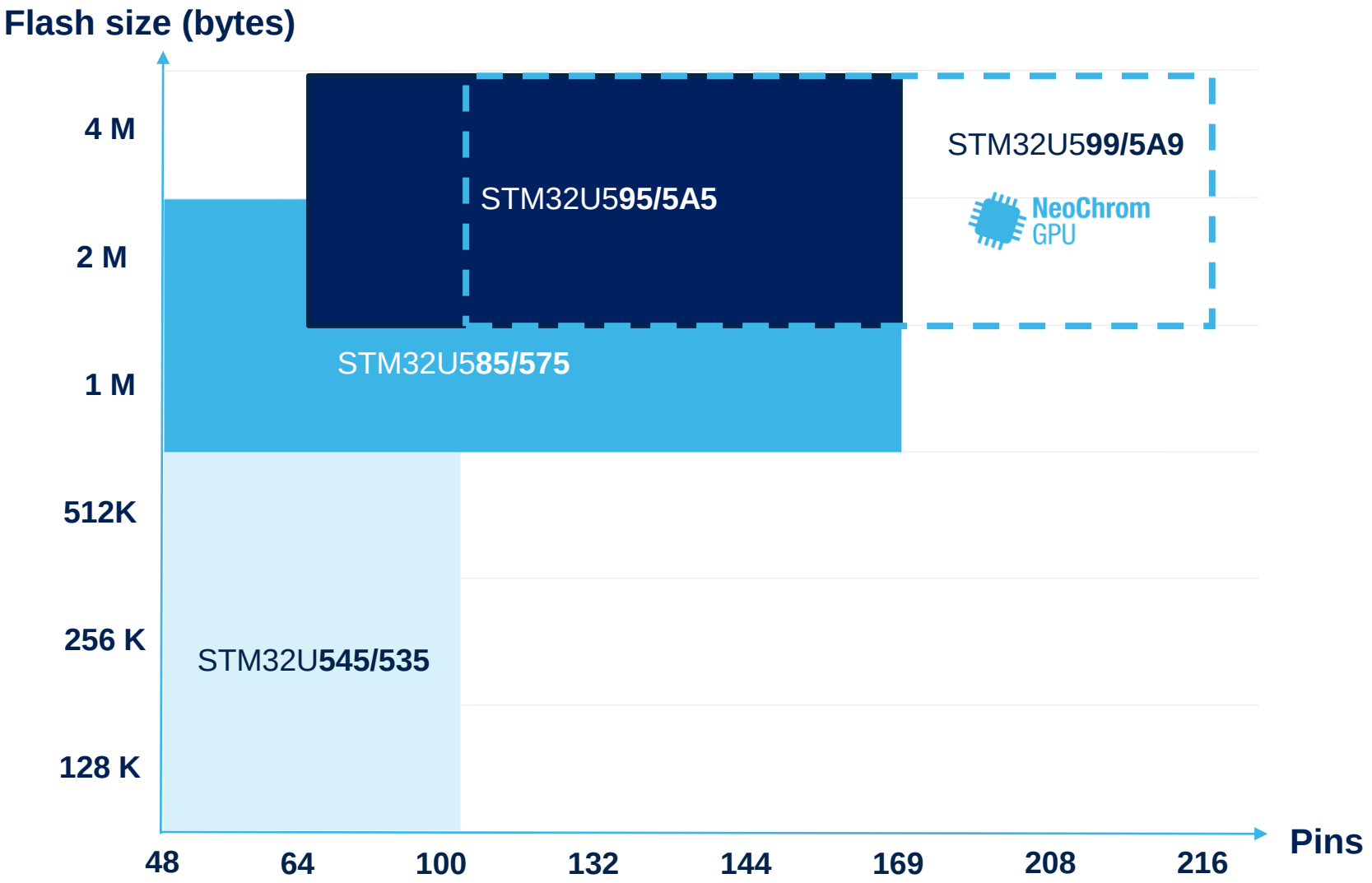
Isolation	Cryptography	Security assurance level
TrustZone® Secure Peripherals Secure DMA	**Side channel AES, PKA** Additional AES, PKA, SHA, TRNG CAVP certified CryptoLib	psacertified™ level three SESIP3

1st STM32 MCU to reach Level 3

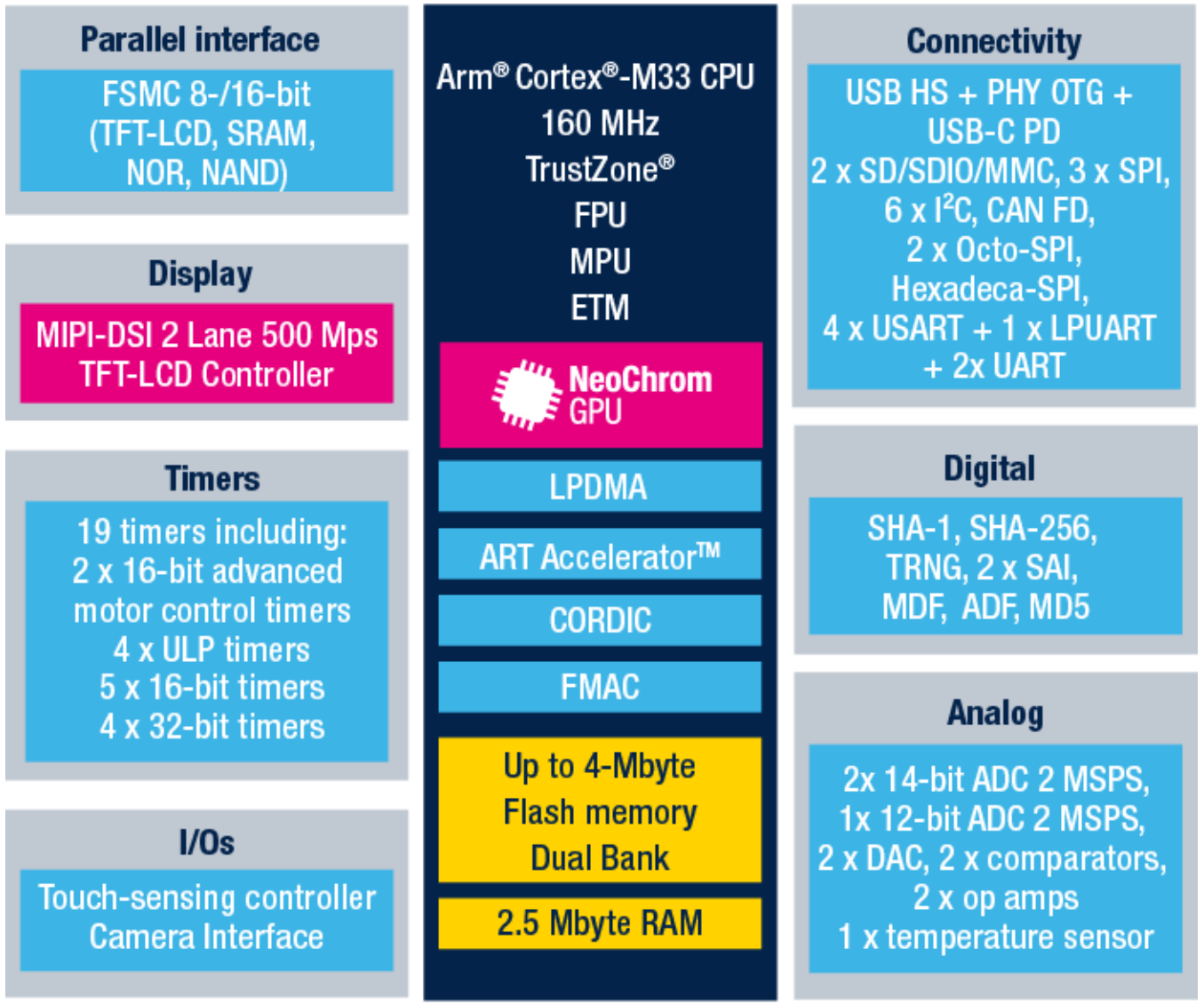
Lifecycle	Memory protections	Active tamper	Trust anchor
RDP: **4 protection level states** **Password based regression**	OTP, HDP, WRP, RDP, MPU Ext. Flash encryption OTFDec **Secure Debug**	**4x active pair** of tamper pins. Volt. &Temp. monitoring (**Vbat**) Total tamper I/Os: **8**	TF-M, Secure Boot,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

New features for STM32 in bold

STM32U5 portfolio



STM32U5 offers high integration



Numerous integrated peripherals

Advanced Graphics

Large embedded memory

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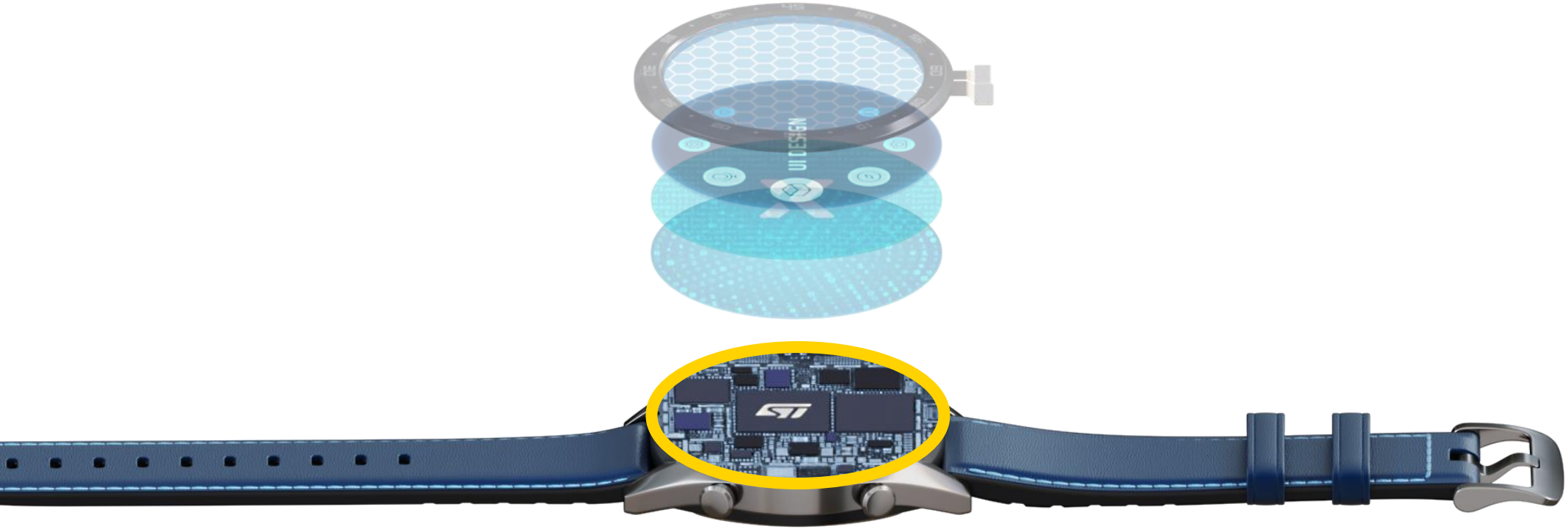
STM32 hardware for graphics



NeoChrom GPU. New STM32 graphics 2.5D accelerator

NeoChrom GPU

Offloads the CPU from graphics tasks
Lower memory consumption
Higher GUI performance – smooth and richer graphics effects:

- Realizing 3D-like graphics on STM32 microcontroller

➔ **The enabling technology**

- Simple Drawing
- 2D Copy
- Alpha blending
- Color format conversion

- **Advanced Drawing**
- **Scaling, Rotation**
- **Perspective correct texture mapping**
- Image format compression

NeoChrom GPU

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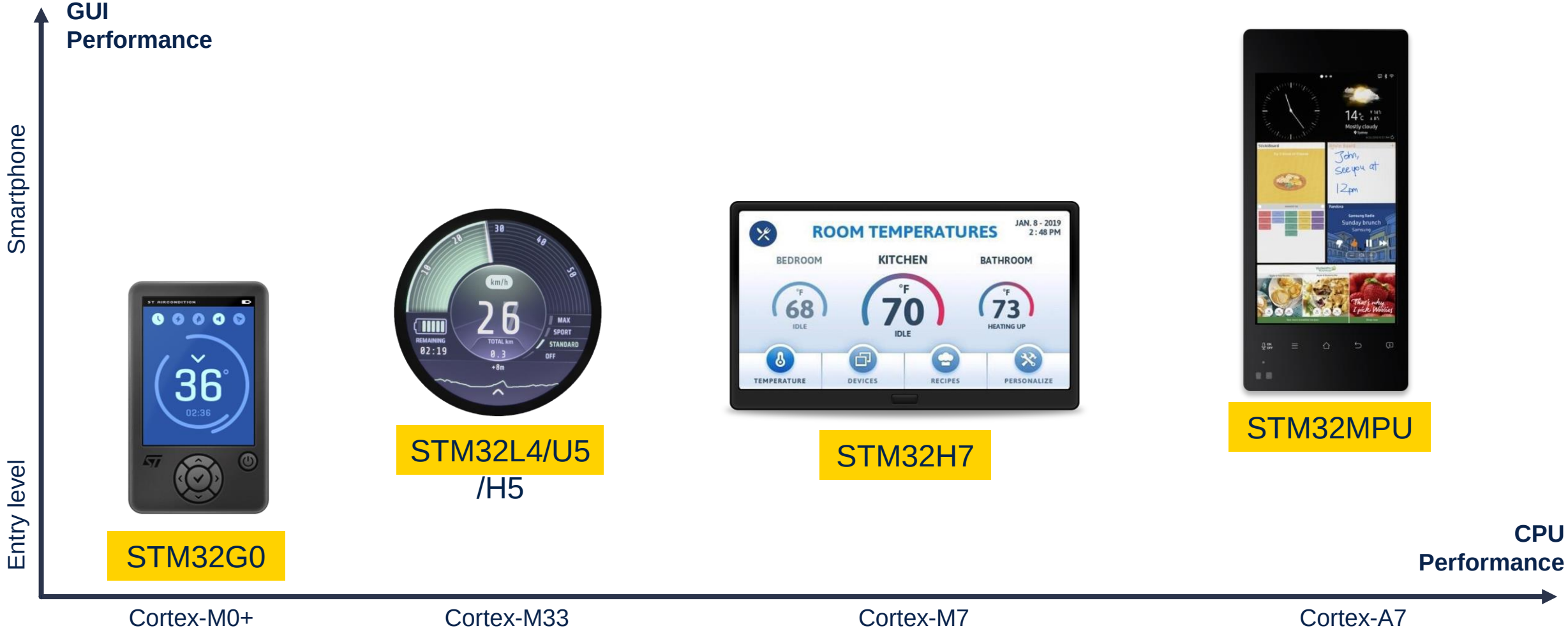
STM32 hardware
MCU/MPU for any graphics needs



STM32 hardware
Supported displays

Display support

Supporting any embedded display
Display sizes **up to approx. 10” with resolution of 1024*768**
Display with and without embedded GRAM

➔ The technology behind

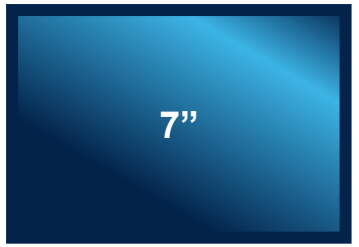
Supporting multiple display interfaces

- LCD-TFT display controller (LTDC)
- MIPI-DSI Host controller
- Parallel (FMC) Interface
- Serial interface

Typical: 400x400

Typical: 320x240

Typical: 480x272



Typical: 800x480

Typical: 1024x600

https://en.wikipedia.org/wiki/Display_resolution

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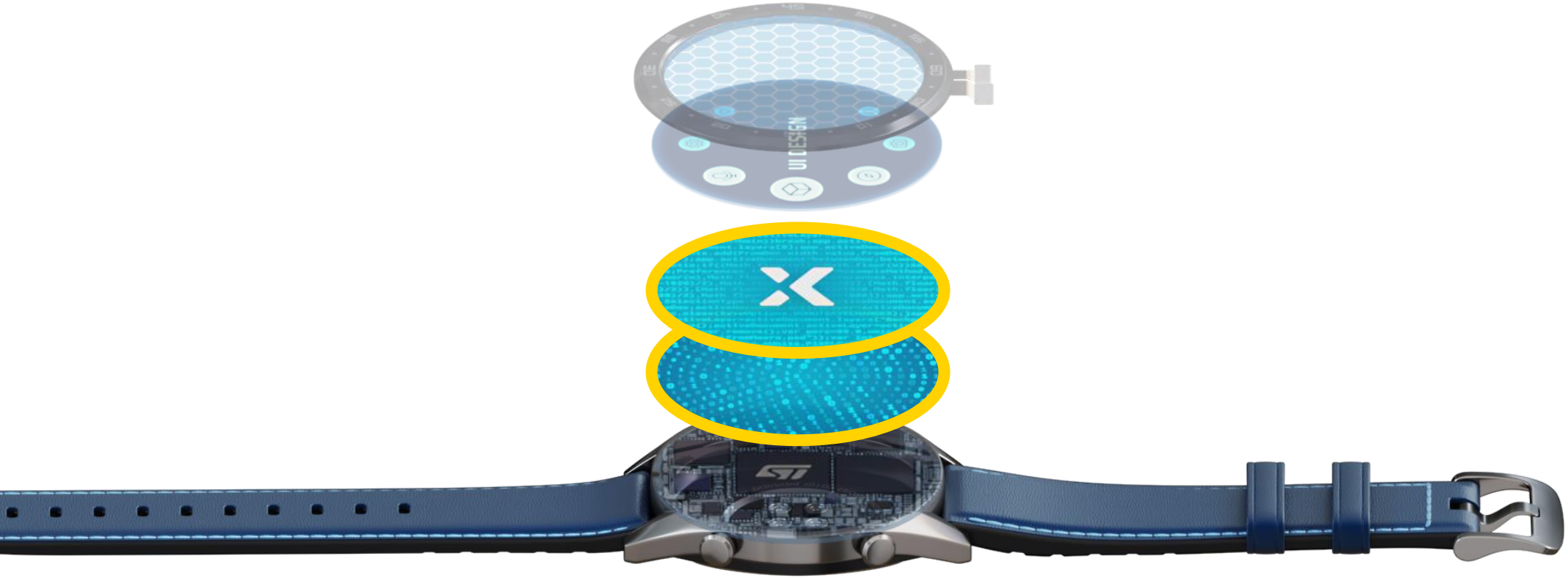
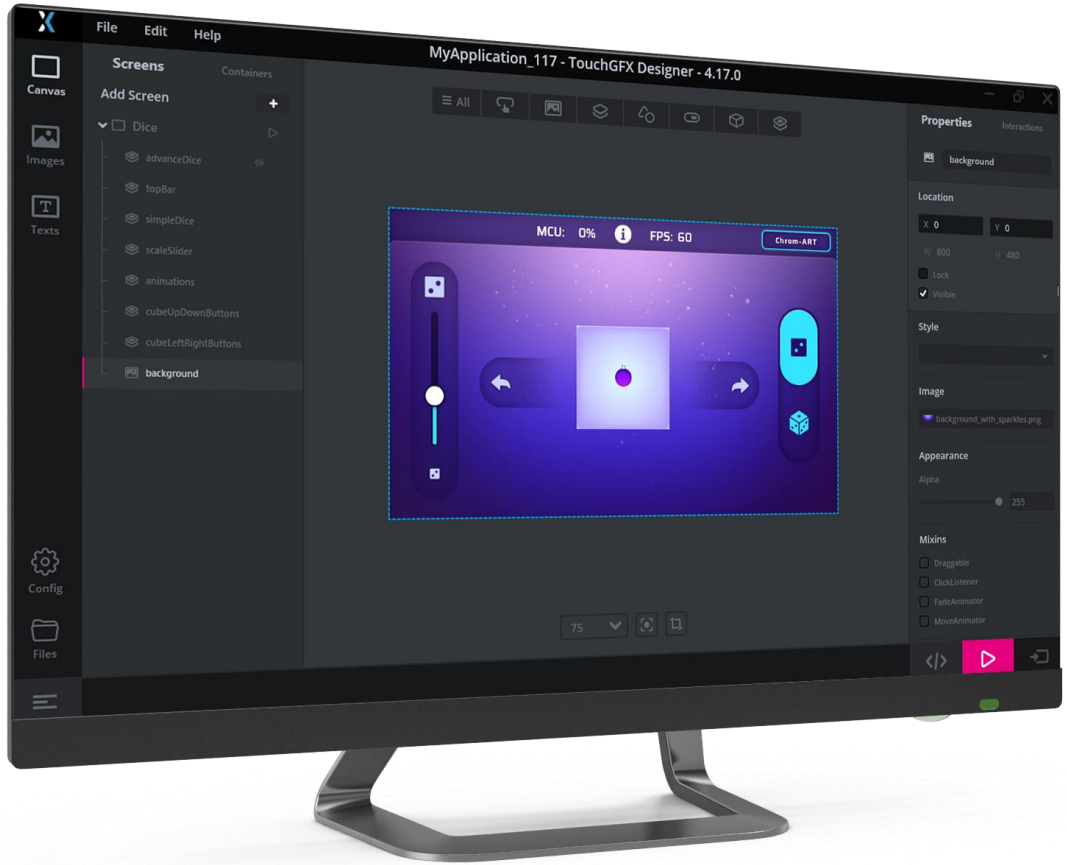
STM32 hardware
Extensive graphics portfolio, >200 part numbers

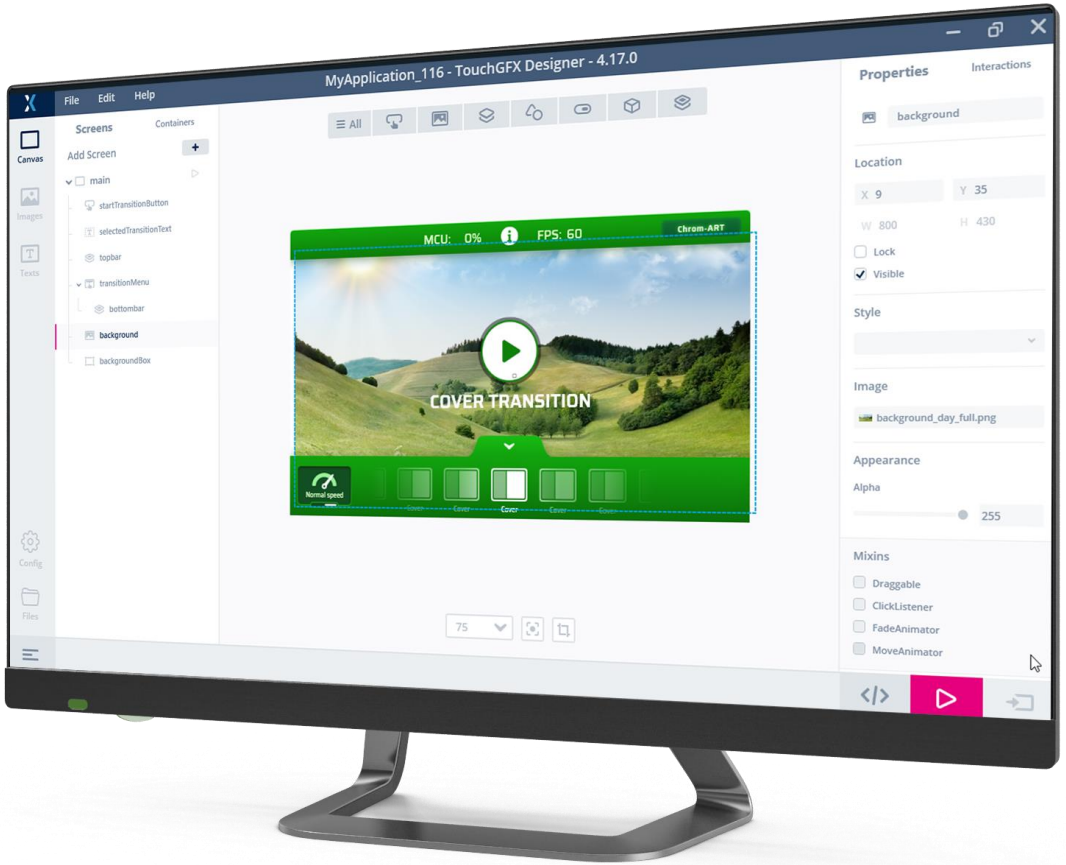
Series	Frequency	Graphics acceleration & optimizer	Display interfaces	Supported Resolutions	Packages
STM32G0 – CM0+	64 MHz	-	SPI	Up to 480*272	QFP, CSP
STM32WB - CM4	64 MHz	-	SPI	Up to 480*272	QFP, BGA, CSP
STM32H5 - CM4 Access lines	100 - 180 MHz	-	Parallel SPI	Up to 1024*768	QFP, BGA, CSP
STM32F4 - CM4 Access lines	100 - 180 MHz	-	Parallel SPI	Up to 1024*768	QFP, BGA, CSP
STM32F4 - CM4 advanced lines	180 MHz	Chrom-ART	RGB-TFT MIPI-DSI	Up to 1024*768	QFP, BGA, CSP
STM32L4 (CM4) Low Power	80 MHz	Chrom-ART	Parallel SPI	Up to 240*480	QFP, BGA, CSP
STM32L4+ (CM4) Low Power	120 MHz	Chrom-ART Chrom-GRC	RGB-TFT MIPI-DSI	Up to 450*450	QFP, BGA, CSP
STM32U5 (CM33) Low Power	160 MHz	Chrom-ART Chrom-GRC Neochrom	RGB-TFT MIPI-DSI	Up to 1280*800	QFP, BGA, CSP
STM32F7 (CM7)	216 MHz	Chrom-ART MJPEG	RGB-TFT MIPI-DSI	Up to 1280*800	QFP, BGA, CSP
STM32H7 (CM7) (CM7 + CM4)	550 MHz	Chrom-ART Chrom-GRC MJPEG	RGB-TFT MIPI-DSI	Up to 1280*800	QFP, BGA, CSP
STM32MP1 (CA7)	800 MHz	3D Graphic PU	MIPI-DSI	UP to 1366*768.	BGA

STM32 graphics software



TouchGFX Designer





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STM32 software
Leveraging all available STM32 HW capabilities

TouchGFX GUI library

TouchGFX DESIGNER

PC GUI-builder and -simulator

TouchGFX GENERATOR

Configure and generate a TouchGFX project

TouchGFX ENGINE

Optimized and hardware accelerated graphics library

Delivered as an X-Cube-TouchGFX Package

STM32 software
TouchGFX GUI software

TouchGFX Designer

Easy development
Develop great GUIs effortlessly with the WYSIWYG GUI builder, the TouchGFX Designer.
Create Anything
The structure and flexibility of TouchGFX gives the Developer control to easily create unique UI designs

➔ The technology behind

- Run on PC-simulator or your target HW
- Combine your user-code with TouchGFX Designer generated code
- Create your own software elements with existing widgets.
- Design your own widgets.
- GUI written in C++.
- The Model-View-Presenter pattern gives way for easy interfacing with other C/C++ application components.

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STM32 software
TouchGFX GUI software

TouchGFX Generator

Faster UI project generation and low-level development
Easy configuration of:

- Memory
- Framebuffers
- Display resolution
- Color depth

Select your preferred IDE
Change to other RTOS or no RTOS

➔ The technology behind

- CubeMX plugin to configure and generate TouchGFX Abstraction Layer (AL) for their STM32-based hardware.
- **TouchGFX AL** enables available graphics HW acceleration and optimization
- **IDE independent**
  Works smoothly with CubeIDE, IAR Workbench, ARM Keil

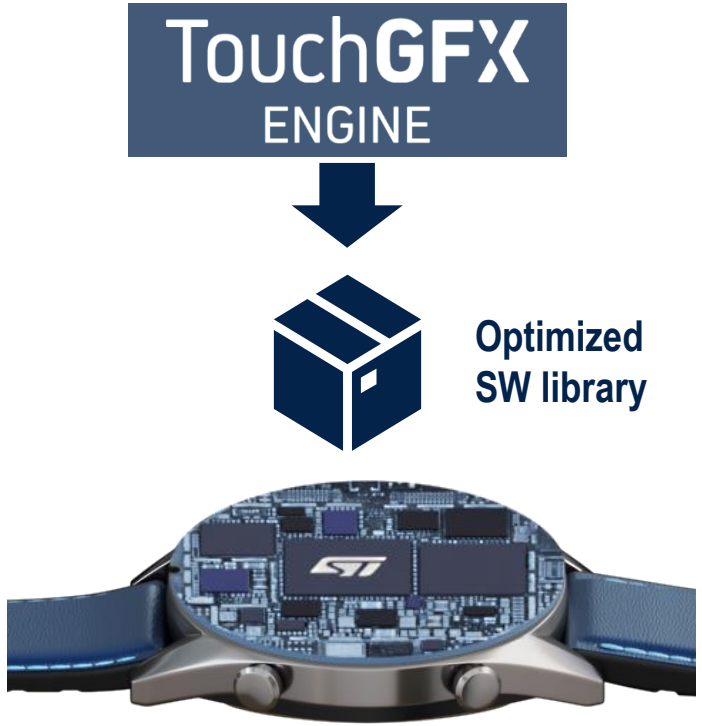
STM32 software
TouchGFX GUI software

TouchGFX Engine

Maximum Performance
The TouchGFX Engine technology enables you to achieve the highest level of smartphone GUI performance on STM32 devices

➔ The technology behind

- **Optimized for Minimum MCU Load and Memory Footprint**
  Compile and Run time Analysis
  Utilization of STM32 hardware acceleration
- **Advanced Rendering Algorithms**
  Optimized visible surface determination algorithm and customized invalidation techniques minimize the number of drawn pixels
- **Advanced Graphical Objects**
  Draw lines, circles, custom shapes, and graphics, or apply scaling and 3D rotation to images at runtime with highly optimized and memory efficient widgets



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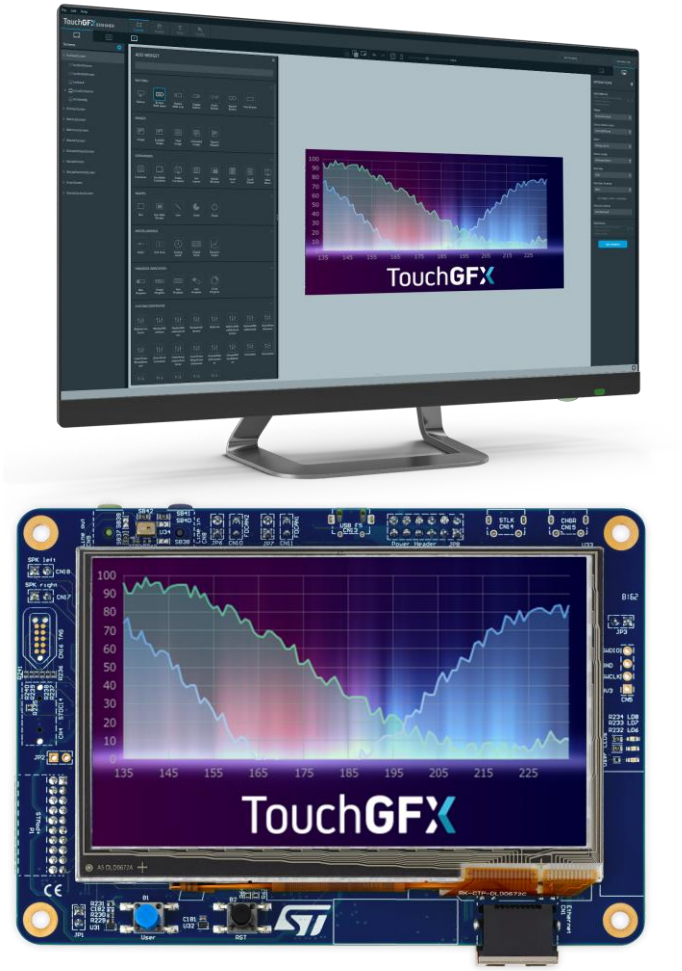
Getting started



1. select the MCU and pick the associated developer kit
2. Open TouchGFX Designer
3. Find your display kit
4. Create/select a demo
5. Flash your display kit

Video: TouchGFX Designer: Design, Implement, Run!

STM32 development tools

Speed up evaluation, prototyping, and design with hardware tools

*$348

*$65

*$89

*$23

Evaluation boards	Discovery kit for IoT node	Discovery kit for graphics	STM32 Nucleo
STM32U5 full feature evaluation	**Direct connection to cloud services**		**Affordable and quick prototyping**
STM32U575I-EV	B-U585I-IOT02A	STM32U5A9J-DK	NUCLEO-U575ZI-Q
			NUCLEO-U5A5ZJ-Q
			NUCLEO-U545RE-Q

*Recommended Resale Price (RRP)

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Let’s HANDS ON now !

Manuel Marcias FAE