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STM32H7R/S high-performance lines

Scalable & secure bootflash microcontrollers

The STM32 portfolio

Five product categories

Wireless MCU

Short- and long-range connectivity

Ultra-low-power MCU

Mainstream MCU

High-performance MCU

32-bit general-purpose microcontrollers: from 75 to 3,224 CoreMark score

Embedded MPU

32- and 64-bit microprocessors





Enabling edge AI solutions

Scalable security

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MPU portfolio

MCU portfolio

STM32H7 portfolio overview

Bootflash Line

STM32**H7R3/7S3**	STM32**H7R7/7S7**
600 MHz	600 MHz
1284 DMIPS	1284 DMIPS
SRAM 620 KB	SRAM 620 KB
64K user flash	64K user flash
ST-iRoT	ST-iRoT
Chrom-ART	NeoChrom + LTDC

New

Dual-core Line

STM32**H745/755**	STM32**H747/757**
480 + 240 MHz	480 + 240 MHz
1027 + 300 DMIPS	1027 + 300 DMIPS
RAM 1 MB	RAM 1 MB
Flash up to 2 MB	Flash up to 2 MB

Single-core Line

STM32**H7A3/B3**	STM32**H742**	STM32**H743/753**	STM32**H723/733**	STM32**H725/735**
280 MHz	480 MHz	480 MHz	550 MHz	550 MHz
599 DMIPS	1027 DMIPS	1027 DMIPS	1177 DMIPS	1177 DMIPS
RAM 1.4 MB	RAM 692 KB	RAM 1 MB	RAM 564 KB	RAM 564 KB
Flash up to 2 MB	Flash up to 2 MB	Flash up to 2 MB	Flash up to 1 MB	Flash up to 1 MB

$ Value Line

STM32**H7B0**	STM32**H750**	STM32**H730**
280 MHz 599 DMIPS	480 MHz 1027 DMIPS	550 MHz 1177 DMIPS
RAM 1.4 MB	RAM 1 MB	RAM 564 BB
Flash 128 KB	Flash 128 KB	Flash 128 KB

Arm® Cortex® core — **Cortex®-M7** — **Cortex®-M7 & -M4**

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“ If only
An MCU could offer the memory scalability and flexibility of an MPU, combined with real-time processing capabilities, all for the price of an MCU.

Opening new innovation possibilities with scalable and secure bootflash microcontrollers

General-purpose Line

STM32H7**R3/S3**

Graphics Line

STM32H7**R7/S7**

Run MPU-like applications on a real-time MCU

Leverage more design freedom

Fast-track your development with a broad MCU ecosystem

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What the STM32H7R/S lines offer

Max performance: 600 MHz bootflash MCU

- Real-time execution from internal or external memories
- High speed serial & parallel memory interfaces up to 200 MHz DTR
- Large internal SRAM

High scalability to optimize your design & reduce costs

- Flexible external memory capacity and performance
- 10 packages: from cost-effective 68 pins to 225 pins

Security assurance: ready for future security directives

- Target security certifications: SESIP Level 3 and PSA certified L3.
- On-the-fly decrypt/encrypt & secure boot

Best-in-class platform for graphics applications

- Powerful 2.5D NeoChrom GPU - smart DMA architecture memory/GPU
- Enabling UIs with up to HD resolution.

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High-performance & multi-purpose MCUs for a wide range of applications

Smart homes & cities

Industrial

Medical

Point of sales

Robotics

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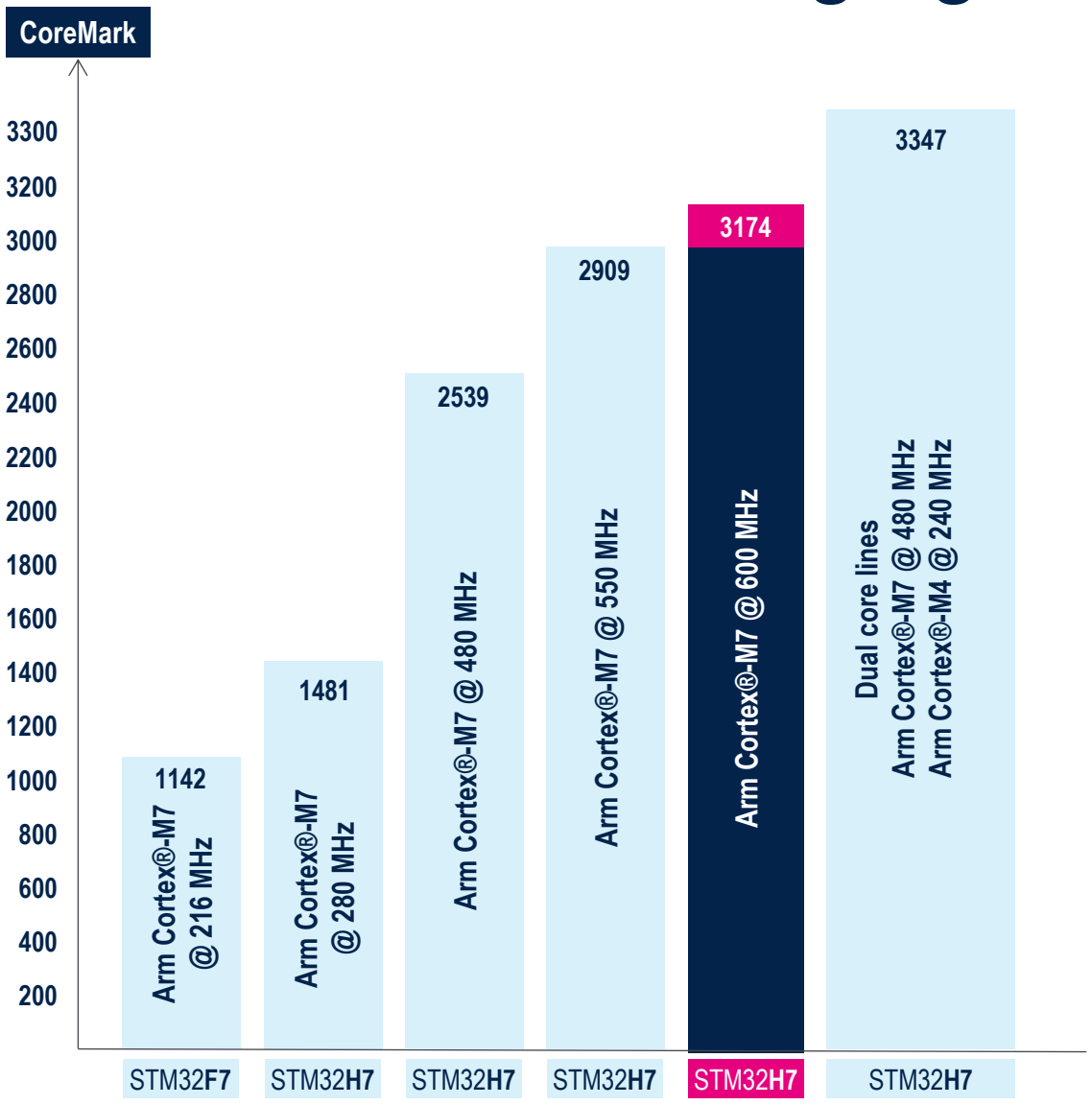
A high-performance architecture leveraging internal and external memories



Arm® Cortex®-M7 @ 600 MHz

- Double precision FPU, MPU, advanced DSP
- 32 Kbytes + 32 Kbytes L1 I/D allowing zero wait-state execution from external memories
- 620 Kbytes of SRAM
- High speed external memory support up to 200 MHz DTR

1284 DMIPS

3174 CoreMark

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“ If only
A single-core MCU could
run multiple applications
requiring graphic capabilities,
connectivity, and sensor control.

Why choose the STM32H7R/S bootflash MCU?

#1 **Lowest cost STM32H7 to-date**

#2 **Fast memory interfaces up to 200MHz DTR**

#3 **More freedom to connect any MCU memory type**

#4 **Load & run code in large internal SRAM for faster execution**

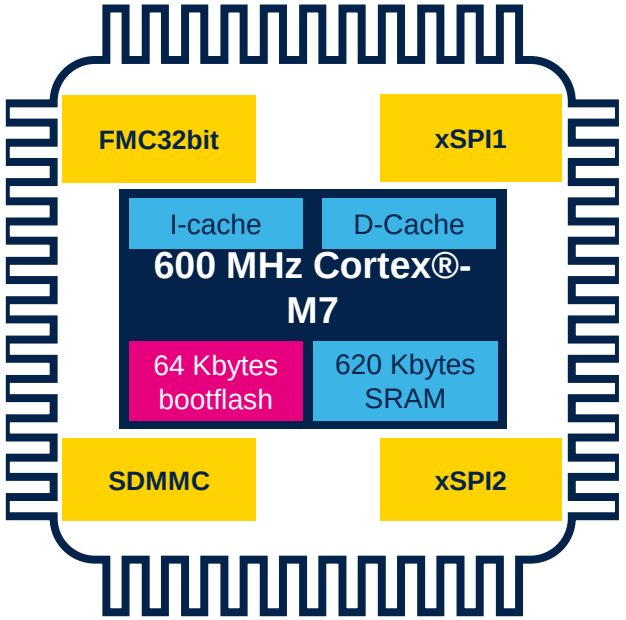
#5 **Enhanced Ecosystem to configure boot, code execution & ext. memories**

The STM32HR/S lines are the most cost-effective STM32H7 MCUs.

They offer fast and secure external memory interfaces to provide more freedom on memory selection and architecture.

Connect most types of **parallel memories**

Up to 32-bit interfaces at 100 MHz



Connect most types of **serial memories**

1-16 bit interfaces
Up to 200 MHz DTR

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Bringing new features to STM32H7 series

200 MHz Hexadeca SPI with PHY and DTR-mode
Fewer pins, more performance

NeoChrom GPU, JPEG Codec and LTDC
Accelerating MPU-like GUIs

Secure code execution from external/internal memory
Securing internal & external code & data

I3C with DMA & USB Fs & HS with PHY & UCPD
Enriched communication interfaces

STM32H7RS power consumption

Flexible low power modes

Cortex®-M7 RUN (VOS HIGH) 600 MHz	112 µA / MHz
Cortex®-M7 RUN (VOS LOW) 400MHz	92 µA / MHz
Cortex®-M7 SLEEP (VOS High) 600 MHz	33 µA / MHz
CM7 STOP (SVOS LOW), Flash low power	265 µA
STANDBY, 3.3V	3.7 µA
vBAT	0.8 µA

Notes:

- IDD RUN, code int flash, TYP SMPS, perip off, cache on
- IDD SLEEP: ECC enabled, perip OFF, VOS High
- IDD STANDBY: IWDG OFF, Backup SRAM Off, RTC & LSE ON, 3.3V
- IDD VBAT: Backup SRAM OFF, RTC/LSE ON

STM32H7RS MCU block diagram

High performance

Scalable security

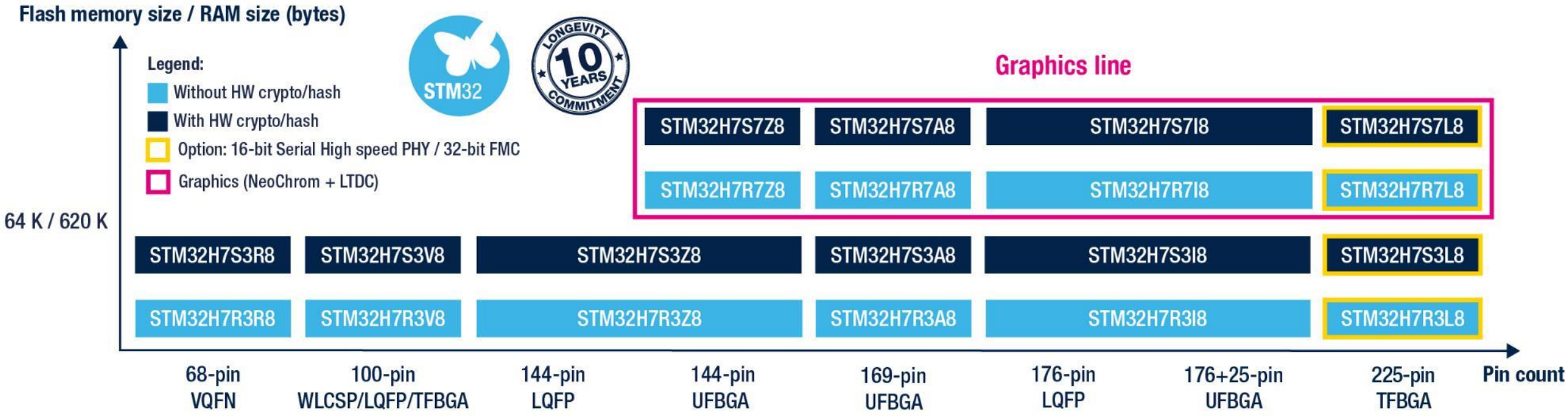
Large embedded RAM memory

Fast & flexible external memory I/F

Advanced graphic capabilities

STM32H7Rx/Sx portfolio

General-purpose & graphics lines, security options, large package offering



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A flexible and scalable memory architecture

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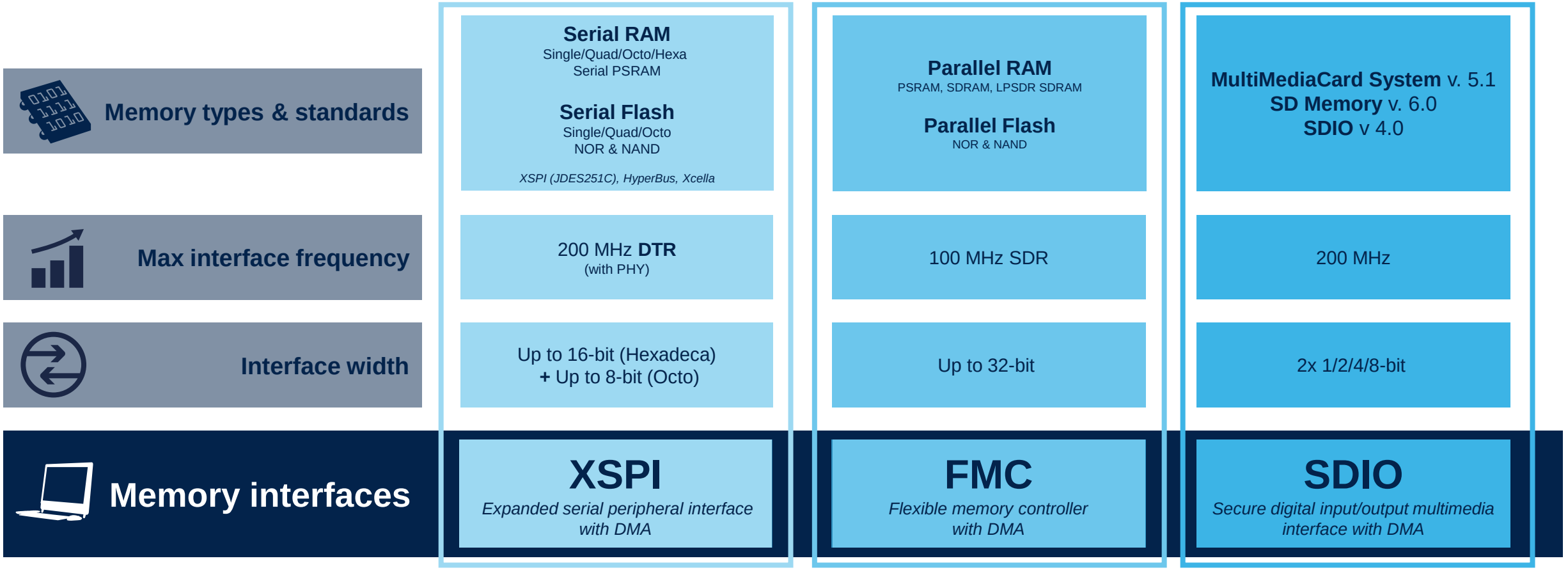
All the memory interfaces you need



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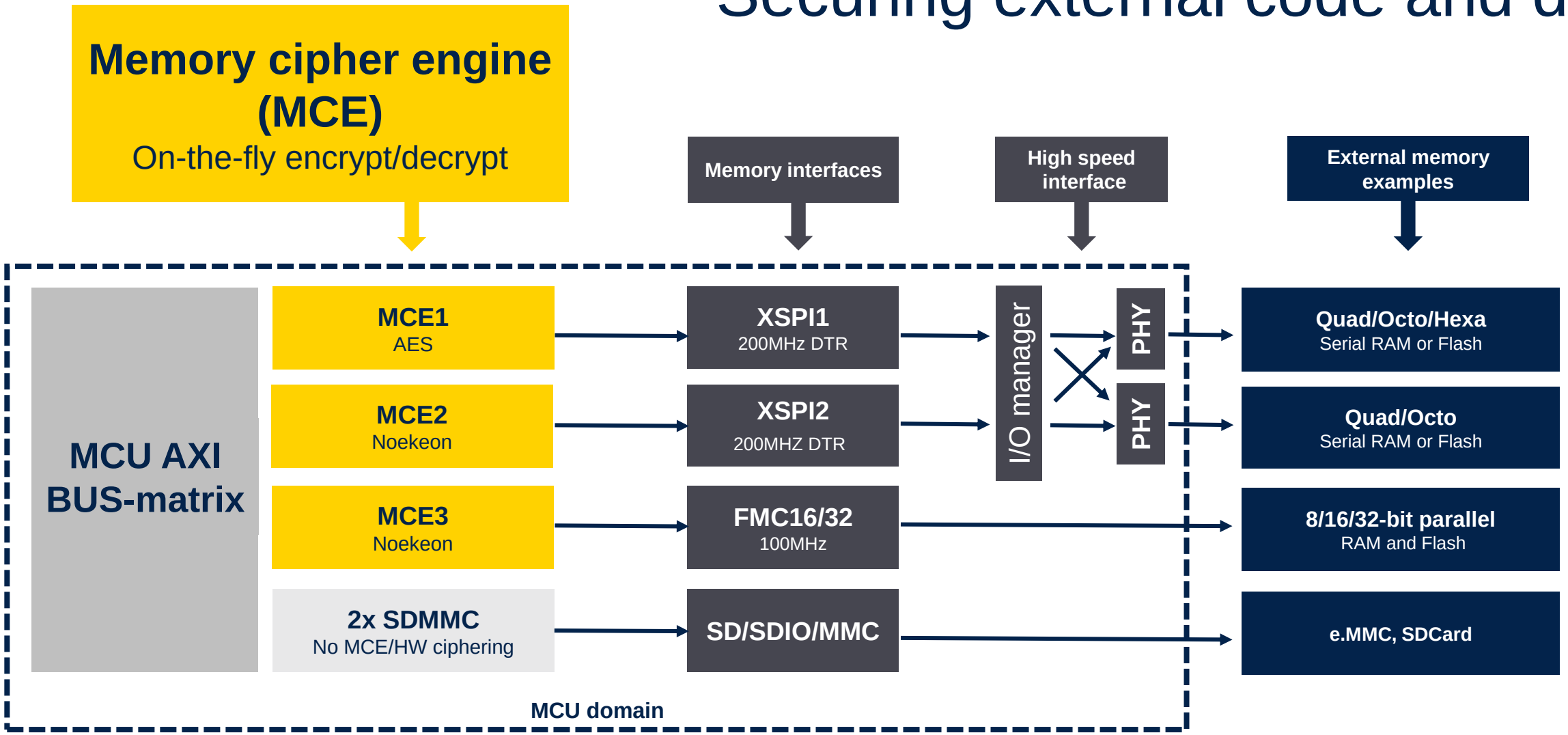
Securing external code and data



Notes:

FMC 32-bit or 16-bit serial memory is only available on the TFBGA225
Only 1 xSPI at a time is configurable in 16-bit Hexadeca mode

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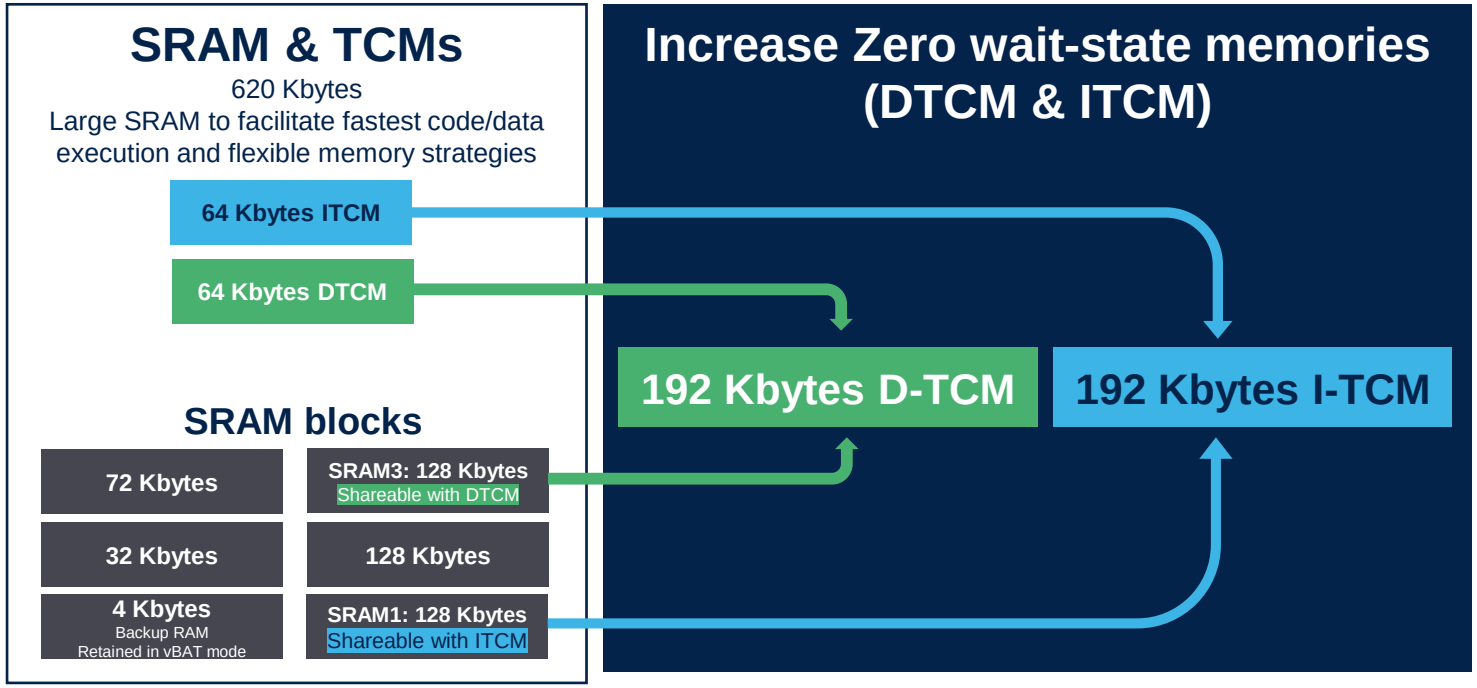
Maximize zero wait-state memories
Remapping SRAM blocks

Critical real-time data such as interrupt service routines or stack/heap memory



Use in parallel for load and store operations

Code and data execution from anywhere
Coremark Results (Keil®)

Code/data placement flexibility

5.3x Coremark/MHz on listed configurations
Aligned to ARMs Cortex®-M7 benchmark

Increase 0 Wait-state memory

Increase D-TCM when needed (up to: 192Kbytes)
Increase I-TCM when needed (up to: 192Kbytes)

I/D Caches for maximum performance

Caches enabled, ensures code and data execution similar to internal memories

Code location	Data location	I-cache state	D-cache state	Coremark/MHz
ITCM	DTCM	Enabled	Enabled	5.3283
		Disabled	Disabled	5.3289
FLASH internal	DTCM	Disabled	Disabled	0.880348
		Enabled	Enabled	5.332986
Octo FLASH	DTCM	Disabled	Disabled	0.33
		Enabled	Enabled	5.326283
HexaSPI SRAM	DTCM	Disabled	Disabled	0.8951
		Enabled	Enabled	5.332933
Octo FLASH	HexaSPI SRAM	Disabled	Disabled	0.33
		Enabled	Enabled	5.32617

arm

Characteristics
Performance efficiency: 5.29 CoreMark/MHz

More info about the Cortex®-M7: https://developer.arm.com/Processors/Cortex-M7

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External serial memory Performance
OctoSPI NOR Flash

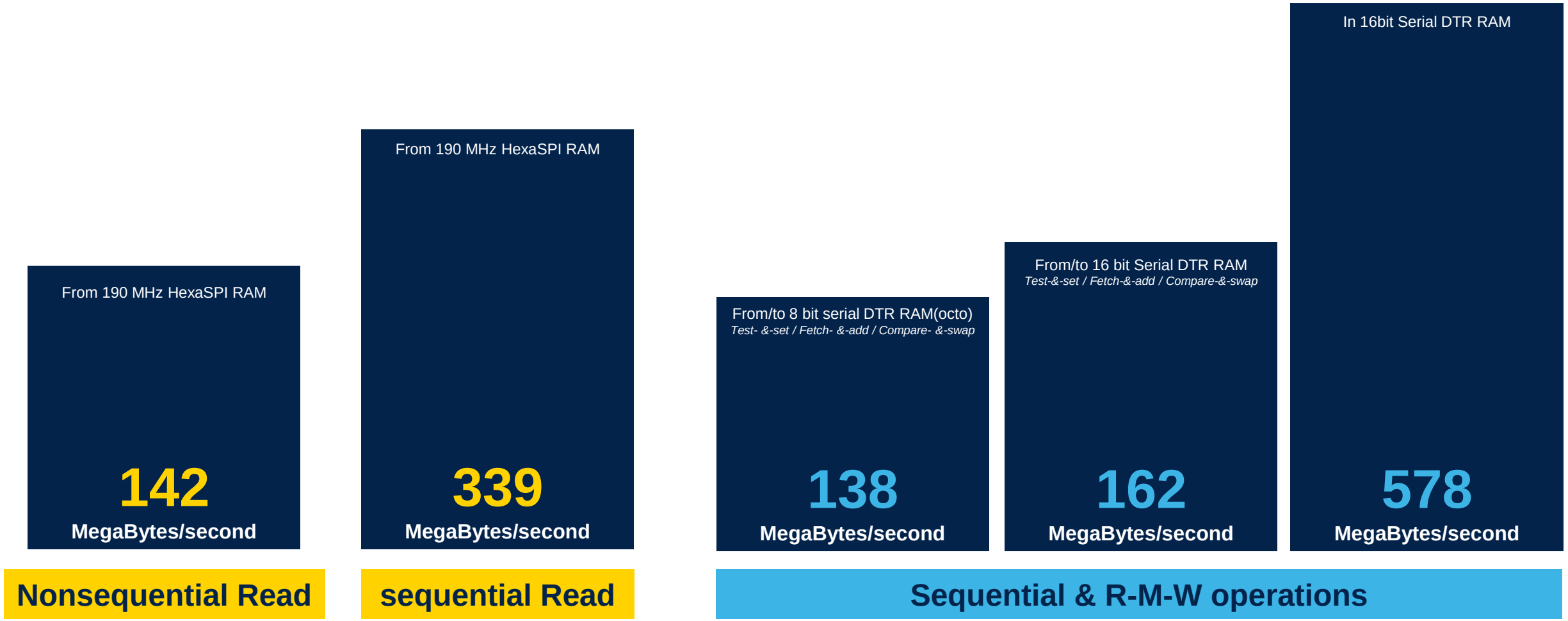
Theoretical

XSPI: 800MB/S

FMC: 400MB/S

16 Kbytes of data pass on sequential and nonsequential transfers

External serial memory performance
OctoSPI RAM & 16-bit serial PSRAM



Theoretical

XSPI: 800MB/S

FMC: 400MB/S

Info
XSPI RAM requires cycles for command phase, address phase, dummy cycles.
After above cycles, the transmission can start.
16Kbytes of data pass on sequential and nonsequential transfers
32 bit XSPI FIFO.

Performance examples using MCE

Code execution from external memory & with data in D-TCM

Maintain high performance using hardware accelerated encryption and decryption of code & data

	CoreMark				Fast Fourier transform (FFT)	
OctoSPI Flash: 200 MHz 16 bit Serial PSRAM: 200 MHz DTR	**Execute: ext. OctoSPI Cache: ON**	**Execute: ext. 16-bit PSRAM Cache: ON**	**Execute: ext. OctoSPI Cache: OFF**	**Execute: ext. 16-bit PSRAM Cache: OFF**	**FFT example Execute: PSRAM/OctoFlash Cache: ON**	**FFT example Execute: PSRAM/OctoFlash Cache: OFF**
No Cipher vs Block AES/Noekeon	0-1%	0-1%	9-16%	15-22%	0-1%	12-27%
No Cipher vs Fast Block AES/Noekeon	0-1%	0-1%	9-16%	15-22%	0-1%	11-27%
No Cipher vs AES Stream	0%	0%	2.4%	3%	0-1%	1-5%

Note: % of impact

MCE Features	MCE1	MCE2 & MCE3
Number of regions	4	
Cipher engines	AES	Noekeon
Derive key functions	Normal & Fast	
Master key	2	
Encryption mode	Block, fast block, stream	Block & Fast block

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Graphics performance comparison

Load & Run vs **execute in place**

Achieve low MCU load in any configuration

Load & run
Loading of TouchGFX firmware code in SRAM
Assets in external flash
Framebuffers in external RAM

	Load & Run		XIP	
MJPEG Video	MCU: 2-3%	FPS: 60	MCU: 5-7%	FPS: 60
Coverflow (texture mapping)	MCU: 6-7%	FPS: 60	MCU: 12-14%	FPS: 60
2D + alpha (main screen)	MCU: 2-4%	FPS: 60	MCU: 10-12%	FPS: 60

Execute In Place
Placement of TouchGFX firmware in external flash
Assets in external flash
Framebuffers in external RAM

MJEGP Video

Resolution 800x480

Coverflow (texture mapping)

Resolution 800x480

2D + alpha blending

Resolution 800x480

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Maximize GUI performance

Smoother and richer graphics with NeoChrom GPU

The NeoChrom GPU offloads the CPU from the graphic computations, freeing up the memory and boosting performance.

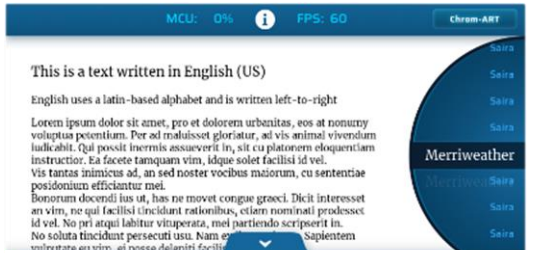
Fully supported by TouchGFX and partner GUI software

NeoChrom GPU

Scale/animate bitmaps

Full screen transitions

360° Bitmap rotations



Text scrolling

Vector graphics (software)

Perspective correct texture mapping

Fast 2D bitmap copy color format conversion

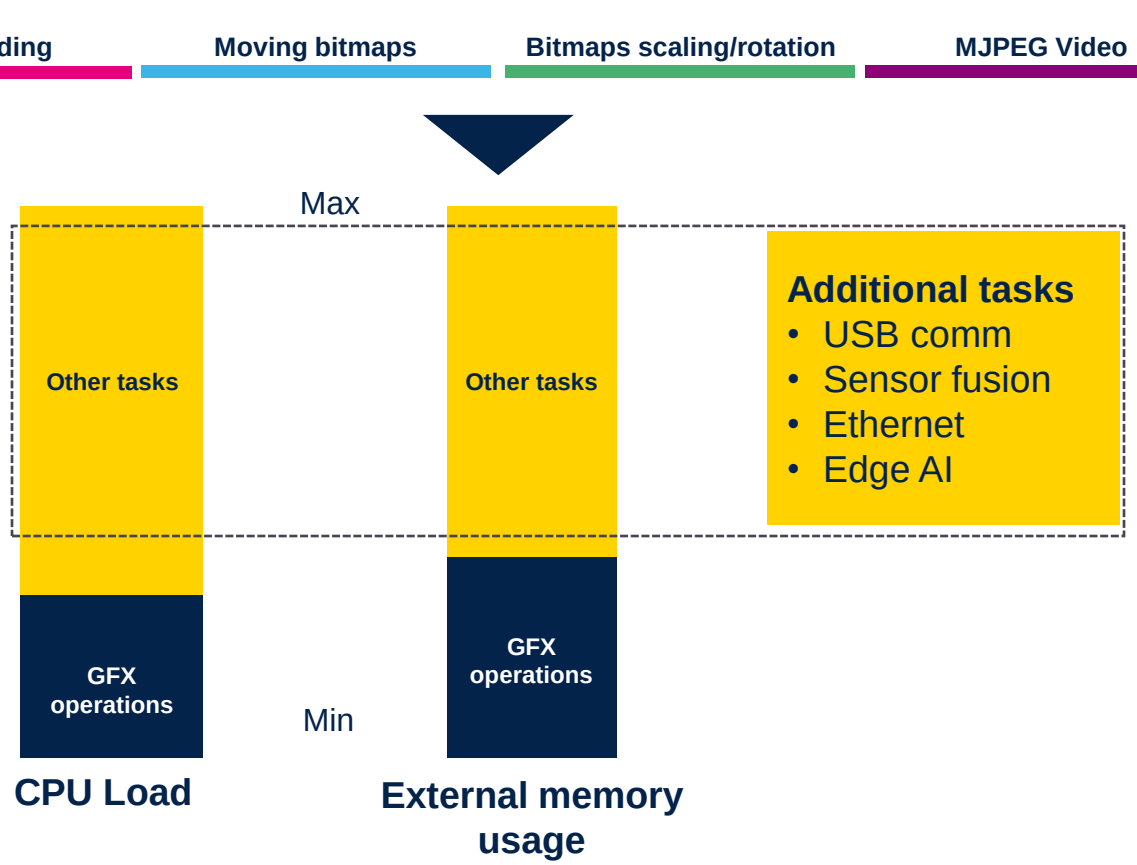
MJPEG videos

GUI application example

MPU-like applications

Run rich GUIs and much more

Watch video now!



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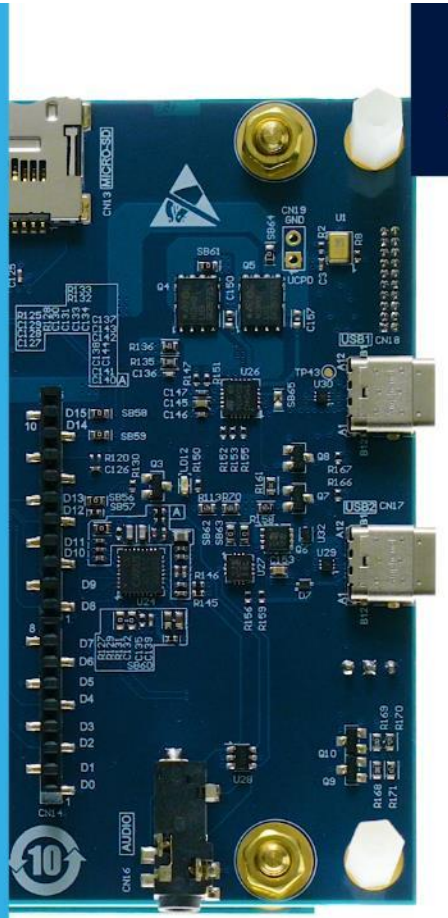
Run GUI and other apps simultaneously

Run MPU-like
GUI applications
on STM32H7RS



Ensure enough memory for framebuffers, Stencil buffer, video buffer, and applications

Display resolution, color depth and framebuffer size

resolution→

bpp ↓ / 2x BUFFER SIZE (Kbytes) ↘	Number of pixels	QVGA (320x240)	WQVGA (480x272)	HVGA (480x320)	VGA (640x480)	WVGA (800x480)	SVGA (800x600)	XGA (1024x768)	HD (1280x800)
8 (256 colors)	76800	150	255	300	600	750	937	1536	4000
16 (high color)	130560	300	510	600	1200	1500	1875	3072	8000
24 (true color)	153600	450	765	900	1800	2250	2812	3500	N/A
32 (deep color)	307200	600	1020	1200	2400	3000	3750	N/A	N/A

2 Framebuffers

+

1x Stencil buffer (VG)
= 1 full framebuffer

+

1x video buffer
= 1 full framebuffer

+

Other application needs

= **Your RAM density requirements**

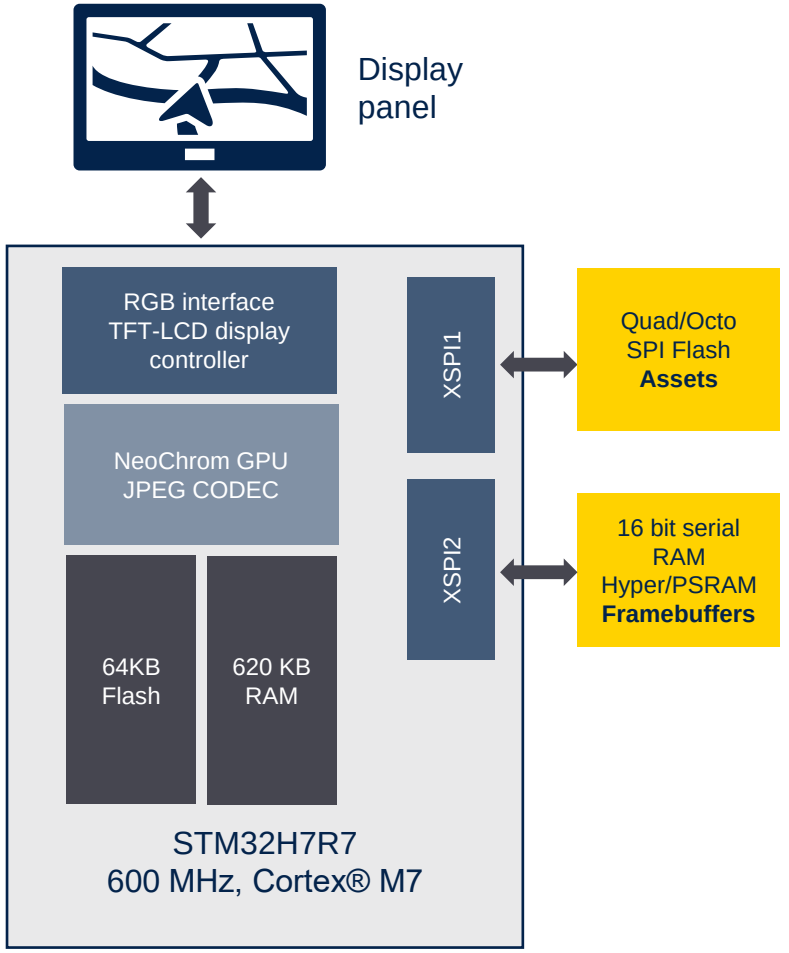
BPP: Bits Per Pixel

Advanced graphics with external RAM
STM32H7R7 with 16-bit serial RAM

Displays up to 10.1” - Approx. 800x480 / 1280x800

Reference

- **STM32H7S78-DK**
  - 5” WSVGA, 800x480 display
  - Preloaded TouchGFX demo
  - LQFP to BGA
- **TouchGFX Designer**
  - Demo in full source
  - TouchGFX Board setup
- **Memory**
  - OctoSPI Flash
  - Hexadeca SPI Serial RAM



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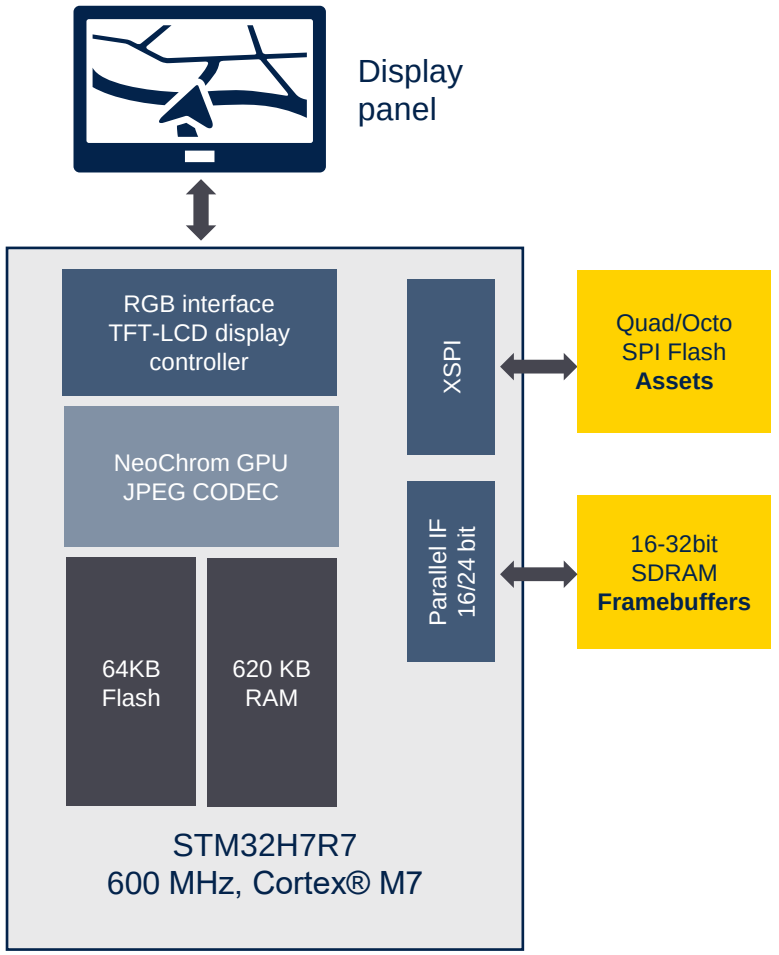
Advanced graphics with external RAM
STM32H7R7 with SDRAM

Displays up to 10.1” - Approx. 800x480 / 1280x800



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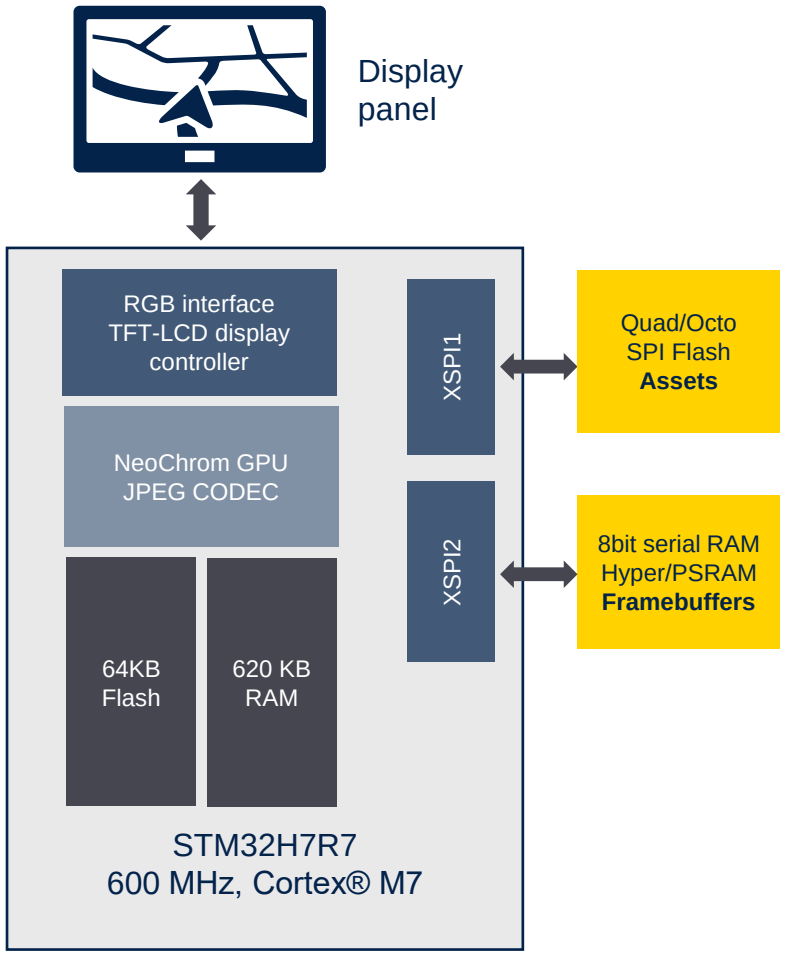
Advanced graphics with external RAM
STM32H7R7 with 2xSerial Octo/Hyper/Xcella Memory

Displays up to 7” - Approx. 800x480/800x600



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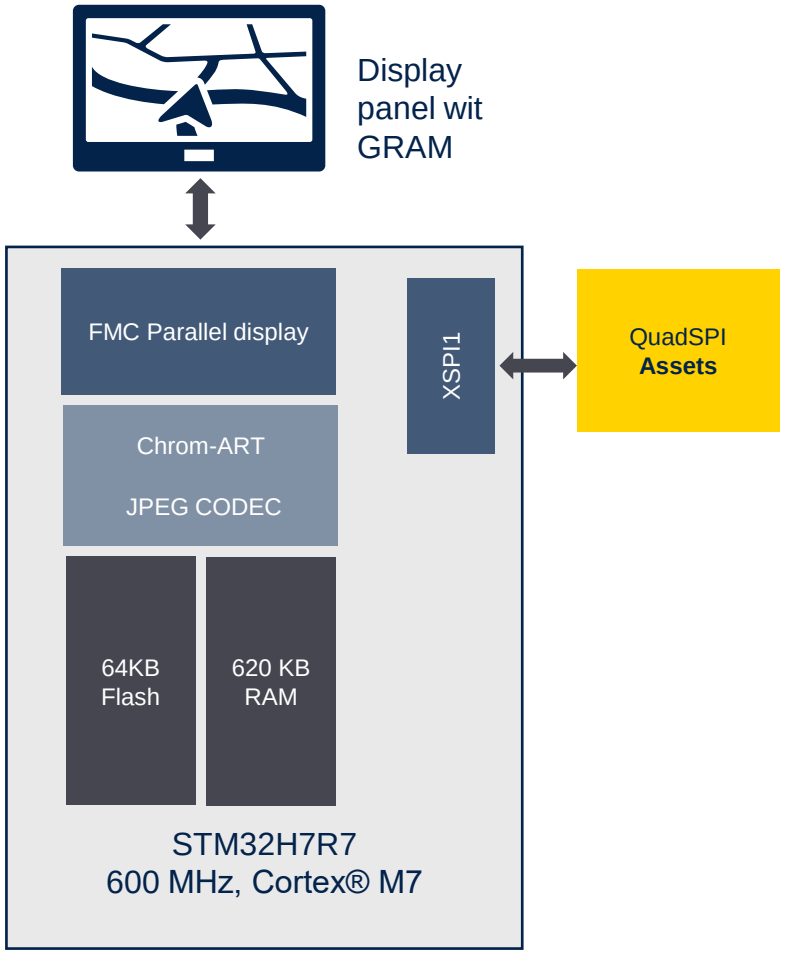
Entry graphics with Internal SRAM+QSPI STM32H7R3 with parallel display

Displays up to 4.3” - Approx. 480x272



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Security

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Scalable security to boost your time to market

How many security building blocks do you need to reach your security goals?

Choose between different security offers

From secure hardware to a full solution owned & maintained by ST

target certifications

STM32 Trust

Stronger security

Robust hardware features and turnkey SoC software implementations

Memory protections
against illegal access control

OTP, HDP, WRP, MPU
Ext. Flash Enc/Dec MCE
Ext. RAM Enc/Dec MCE
Secure Debug, Active Tamper

Cryptography
for hardware robustness

Side channel AES, PKA
TRNG, MCE1, MCE2, HUK
NIST - CAVP certified CryptoLib

Platform authentication
during product lifecycle

2 boot stages
Protection level states
Debug authentication

Code isolation
for runtime protection

3 isolation stages
4 encrypted MCE domains
Dedicated keystores

Turnkey SOC security services

- STM32Trust RoT reference codes
- Hardware Security robustness
- Secure firmware IP installation
- XIP encrypted code
- Immutable Root of Trust

State-of-the-art security assurance level

SESIP™3

psacertified™
level three

target certifications

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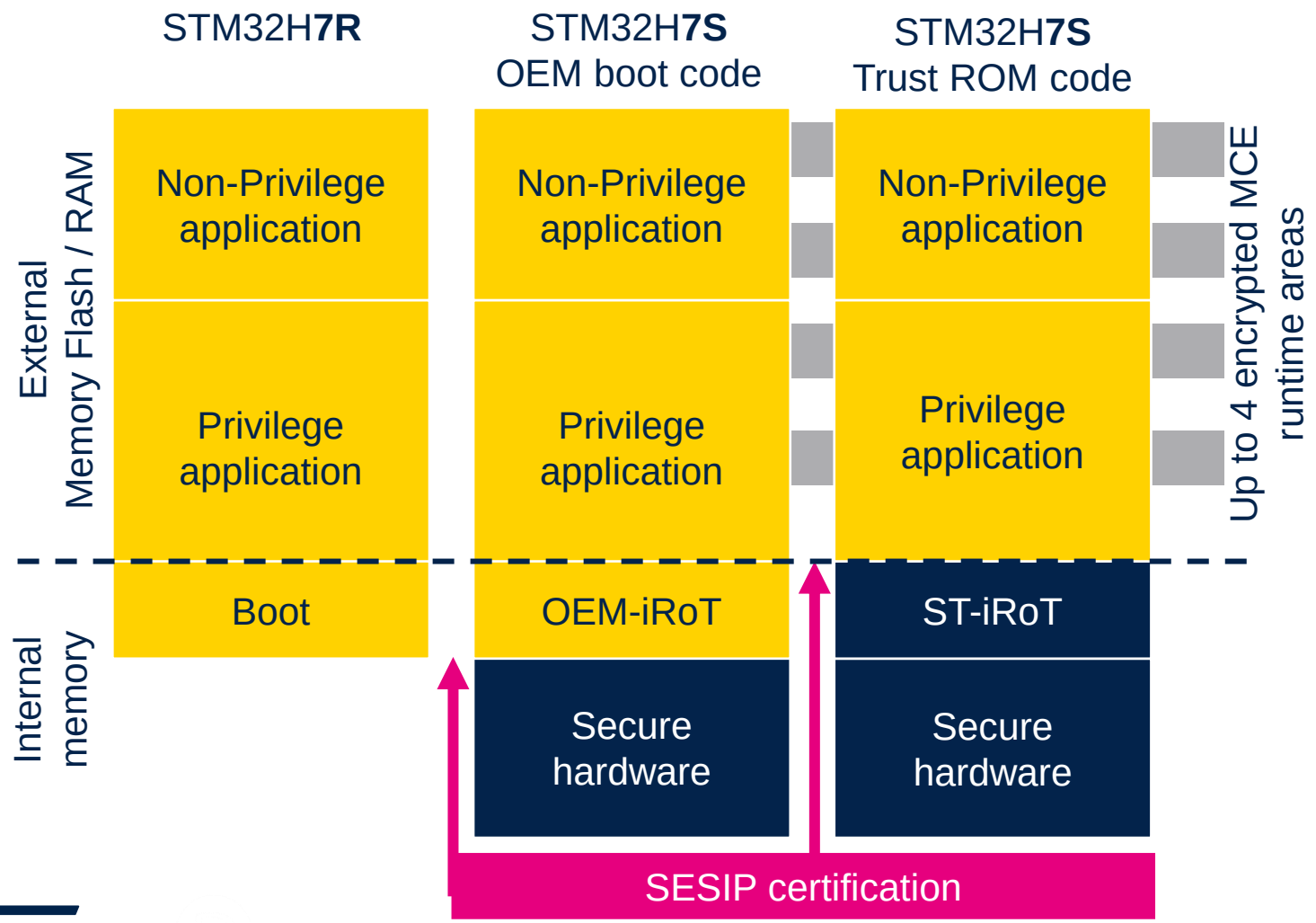
Scalable security to accelerate time to market



- **Scalable configurations**
- **Security for int./ext. memories**
- **Supporting remote provisioning**
- **Ready for device certification**

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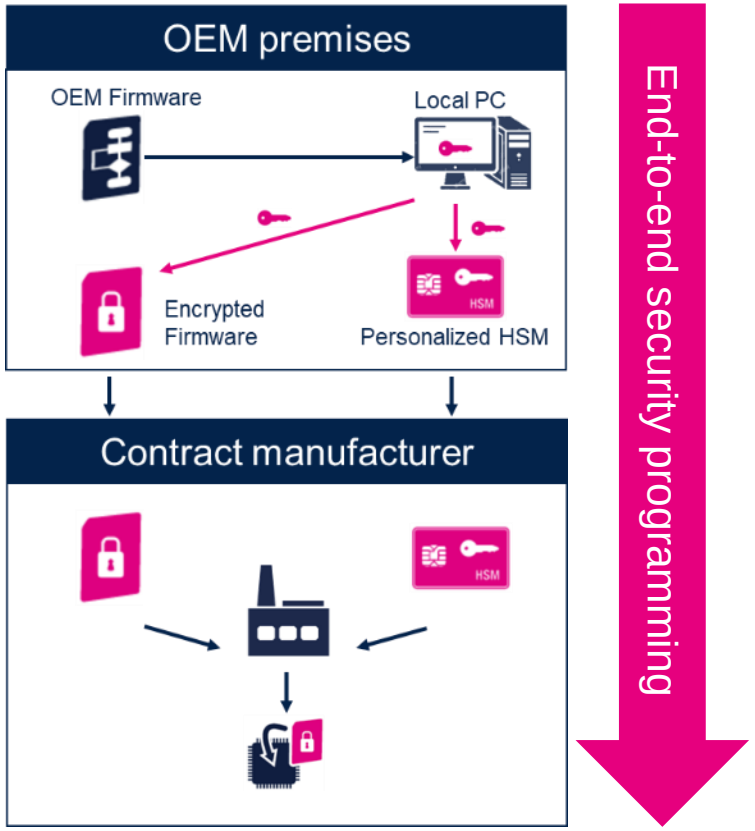
STM32 CubeProgrammer

Secure your production flow secure firmware install (SFI)

Protect application firmware during the manufacturing stage



Complete toolset to encrypt OEM binaries with the STM32 Trusted Package Creator software

Securely flash the STM32 with licenses from a STM32HSM at the programming partner location

Control the number of devices programmed with the firmware

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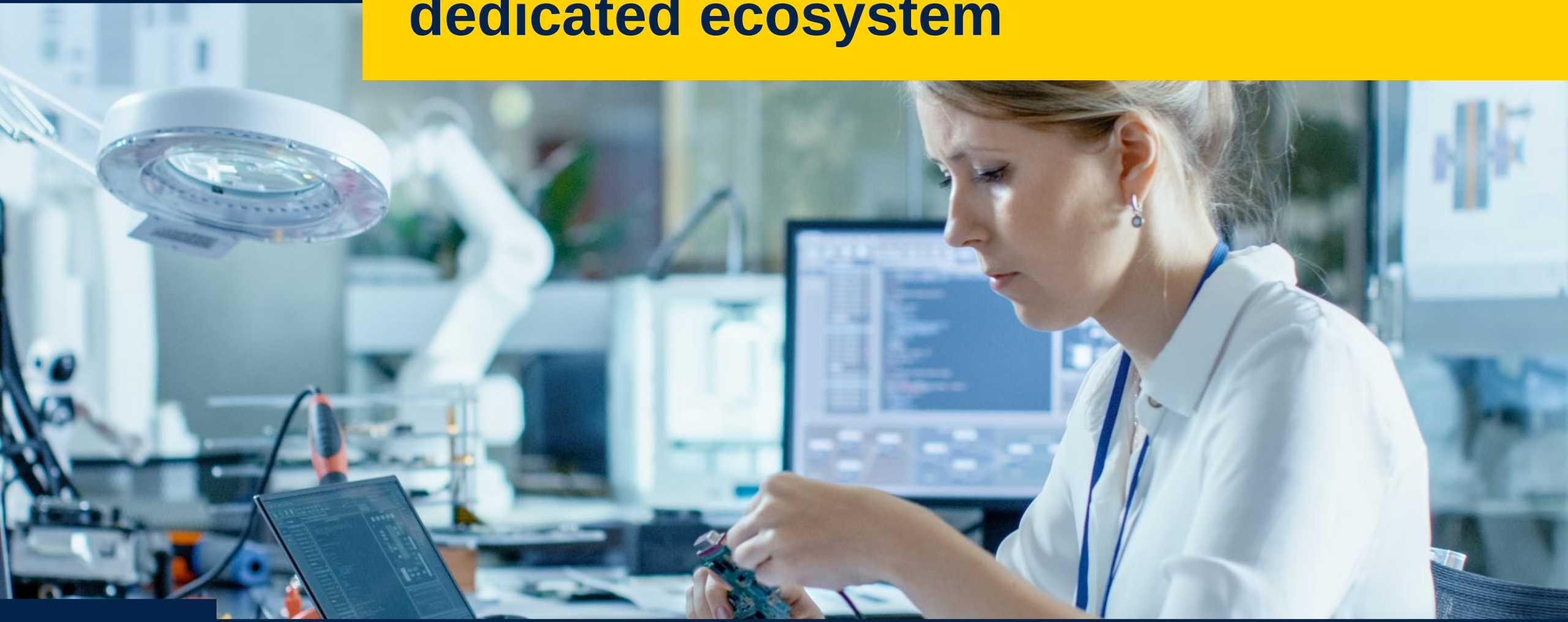
Accelerate your development with our dedicated ecosystem



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STM32Cube framework

Helping developers release their creativity

Comprehensive offer helping you accelerate your development

Focus on quality, compatibility, and stability

Documentations, training and worldwide support channels

Applicative reference implementations

Extension libraries and AI toolkit

Hardware

Embedded SDK

Development tool kit

Development resources

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STM32Cube framework – STM32H7RS support

Tools and software supporting you every step of your design journey

MCU, boards, and software selection	Hardware and software configuration	Application development and debug			Code & hardware options programming	Runtime application monitoring
 STM32 Finder	STM32 CubeMX	STM32 CubeMCU Packages	STM32 CubeExpansion	STM32 CubeIDE	STM32 CubeProgrammer	STM32 CubeMonitor
NUCLEO-H7S3L8 STM32H7S78-DK	Ext mem. Management Boot config Memory protection management	STM32Cube for STM32H7RS based on classic core middleware Ext memory management middleware X-CUBE-AZURE		IDE hierarchical project support with sub projects	Internal and external flash programming Boot chain support	Typical support

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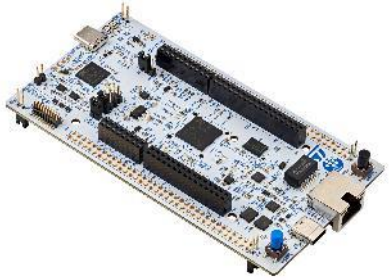
Development tools for STM32H7S lines

Jump-start your development with STM32H7S evaluation kits



*** $35**

NUCLEO-H7S3L8

*** $99**

STM32H7S78-DK

- **Prototyping with STM32H7S Nucleo board**
  - 256 Mbit Octo-SPI NOR Flash
  - Ethernet, USB,
  - STLINK debugger, Arduino UNO extension interface
- **Feature-rich prototyping with STM32H7S discovery kit**
  - 1 Gbit Octo-SPI NOR Flash, 256Mbit Octo-SPI PSRAM
  - WVGA TFT display, Ethernet, USB, microSD, audio, MEMS microphone
  - STLINK debugger, Arduino UNO, and camera extension interfaces
- **Move from idea to implementation in no time**
  - STM32CubeMX assisted project start on STM32H7S Nucleo board
  - Full project template with BSP and ready to call services
  - Preconfigured STM32 clocks, pinout, and peripherals

**Recommended Resale Price (RRP)*

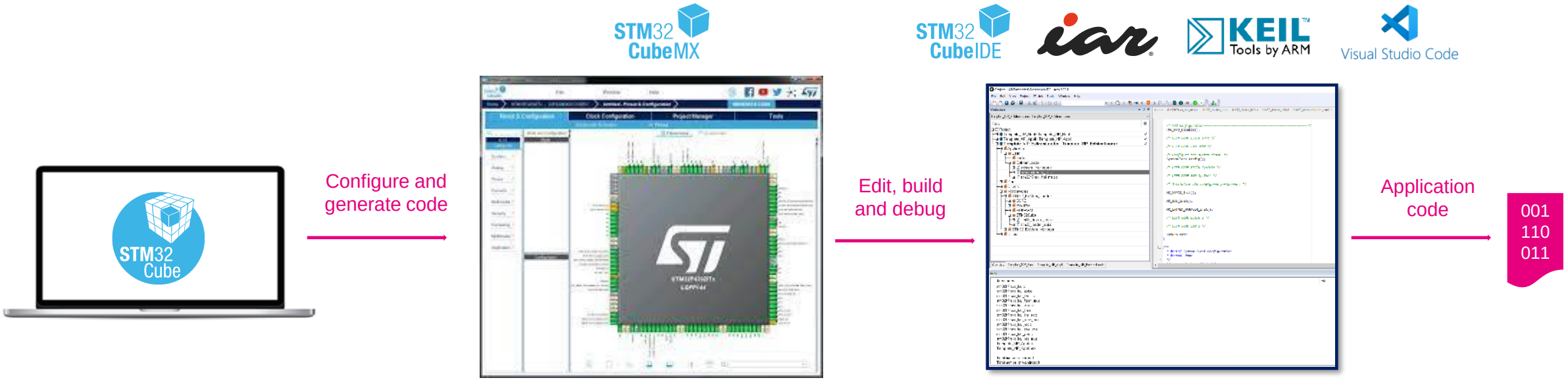
Simplified external memory-based development

Application	STM32CubeMX assisted application project initialization with pinout, clock tree, MCU peripherals and middleware configuration.
External memory loader	STM32CubeMX assisted creation of a memory loader tuned for your selected external memory.
Boot	STM32CubeMX assisted creation of your boot project including access management to your selected external memory with load-and-run or execute-in-place boot options.

Simplified external memory-based development

Application

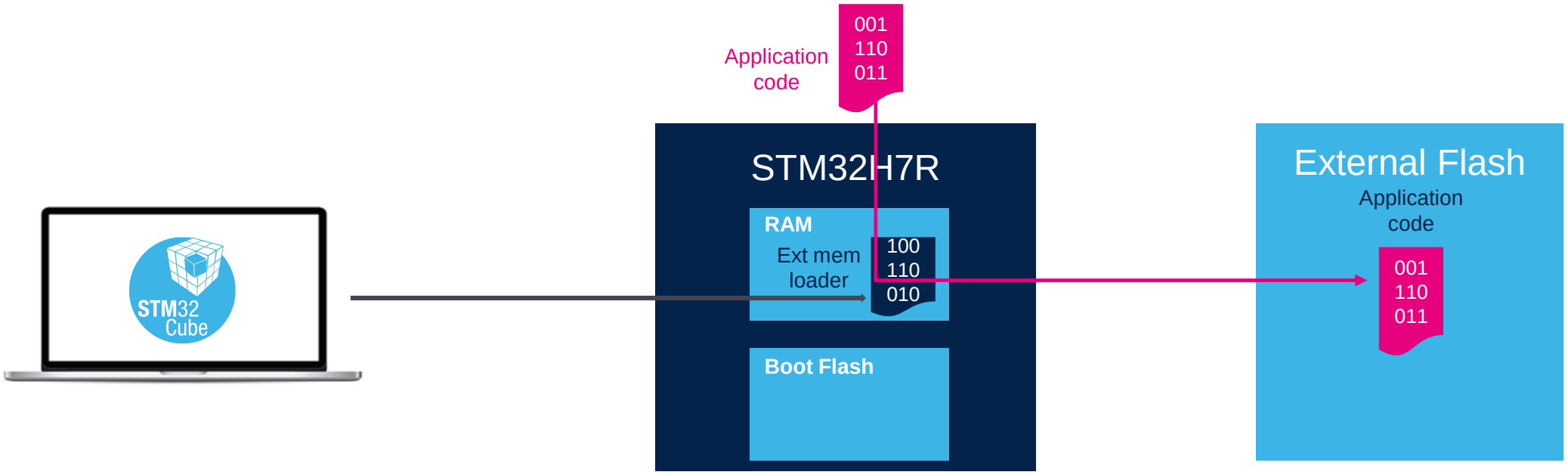
STM32CubeMX assisted application project initialization with pinout, clock tree, MCU peripheral and middleware configuration.



Simplified external memory-based development

External memory loader

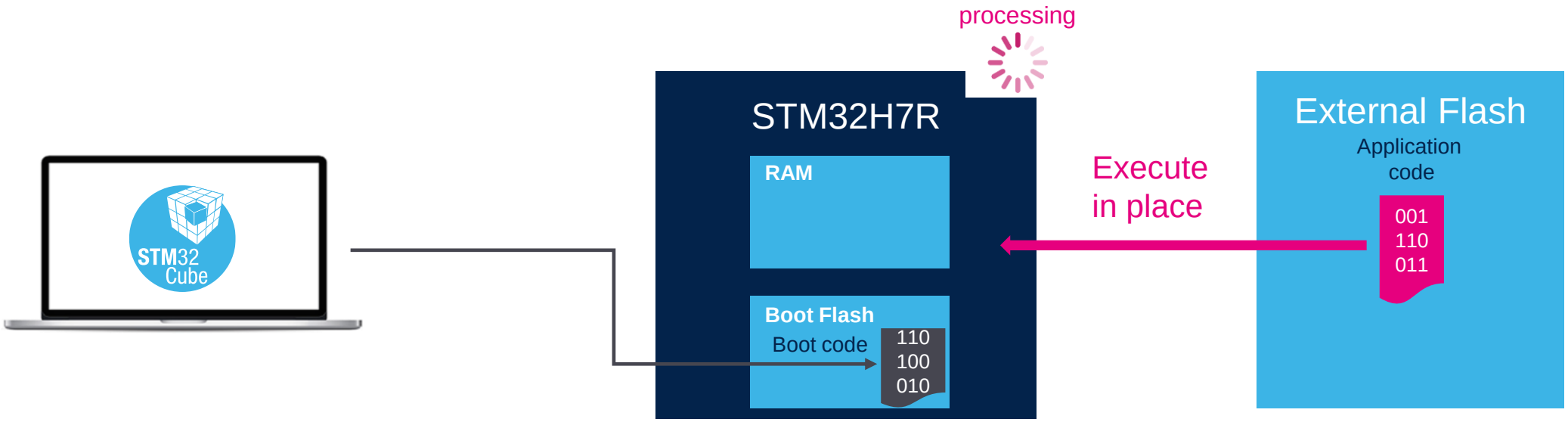
STM32CubeMX assisted creation of memory loader tuned for your selected external memory.



Simplified external memory-based development

Boot

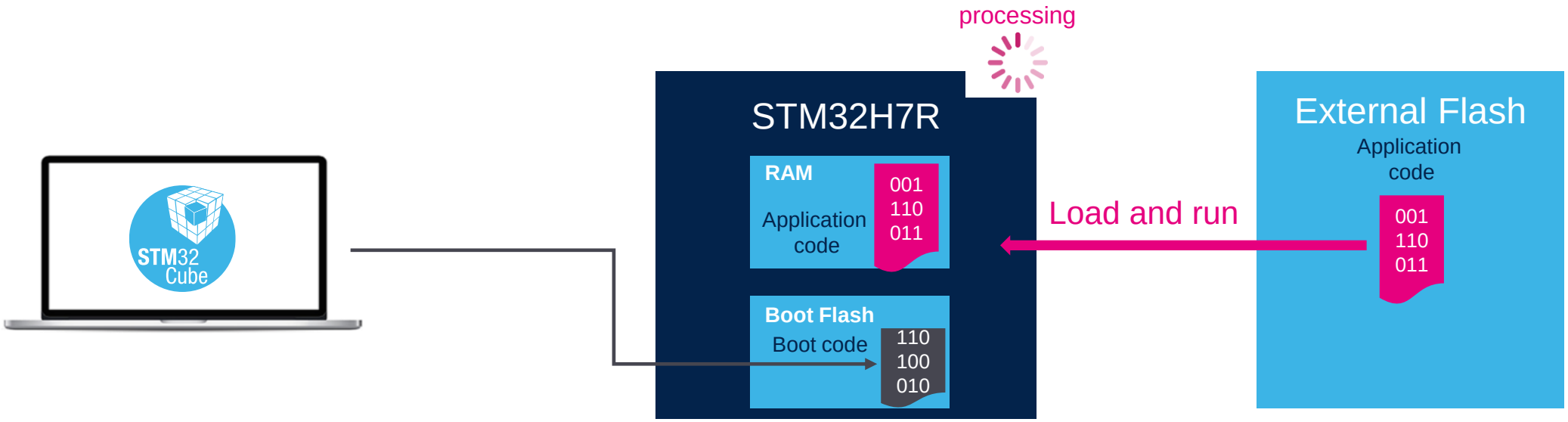
STM32CubeMX assisted creation of your boot project including access management to your selected external memory with load-and-run or execute-in-place boot options.



Simplified external memory-based development

Boot

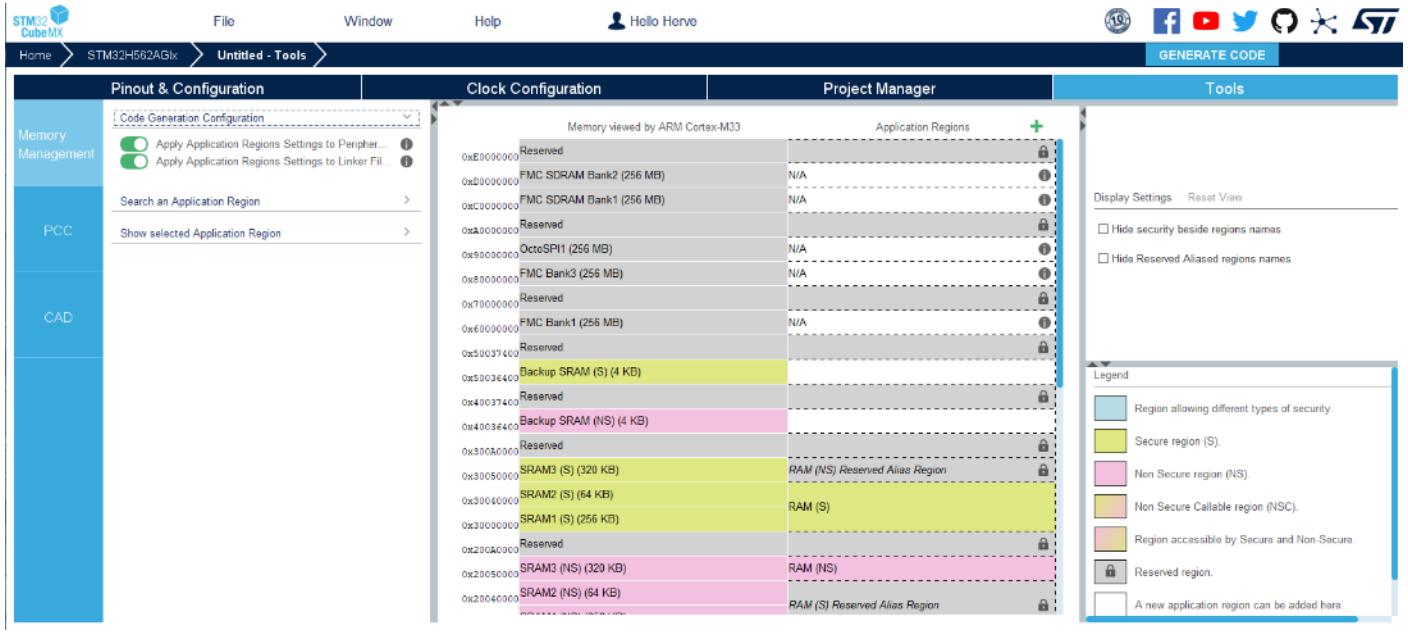
STM32CubeMX assisted creation of your boot project including access management to your selected external memory with load-and-run or execute-in-place boot options.



STM32CubeMX Memory protection

Manage memory protections in a simpler way

- Creates memory regions and configures MCU peripherals accordingly:
  - Memory protection unit (MPU) registers
- Initializes memory setting in the project Linker Files.



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User-friendly hardware and software tools to simplify application development

STLINK portfolio

Debugging & programming

STLINK-V3MINIE

STLINK-V3PWR

ST-LINK/V2

STLINK-V3SET

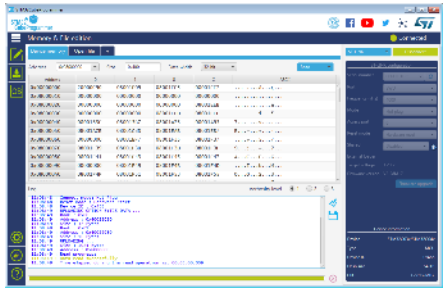
STLINK-V3MODS

and expansion boards

STM32CubeProgrammer SW tool

Code & hardware programming

STM32CubeProg



STM32 CubeProgrammer

STM32HSM Hardware security module

Authentication & license generation

STM32HSM-V2

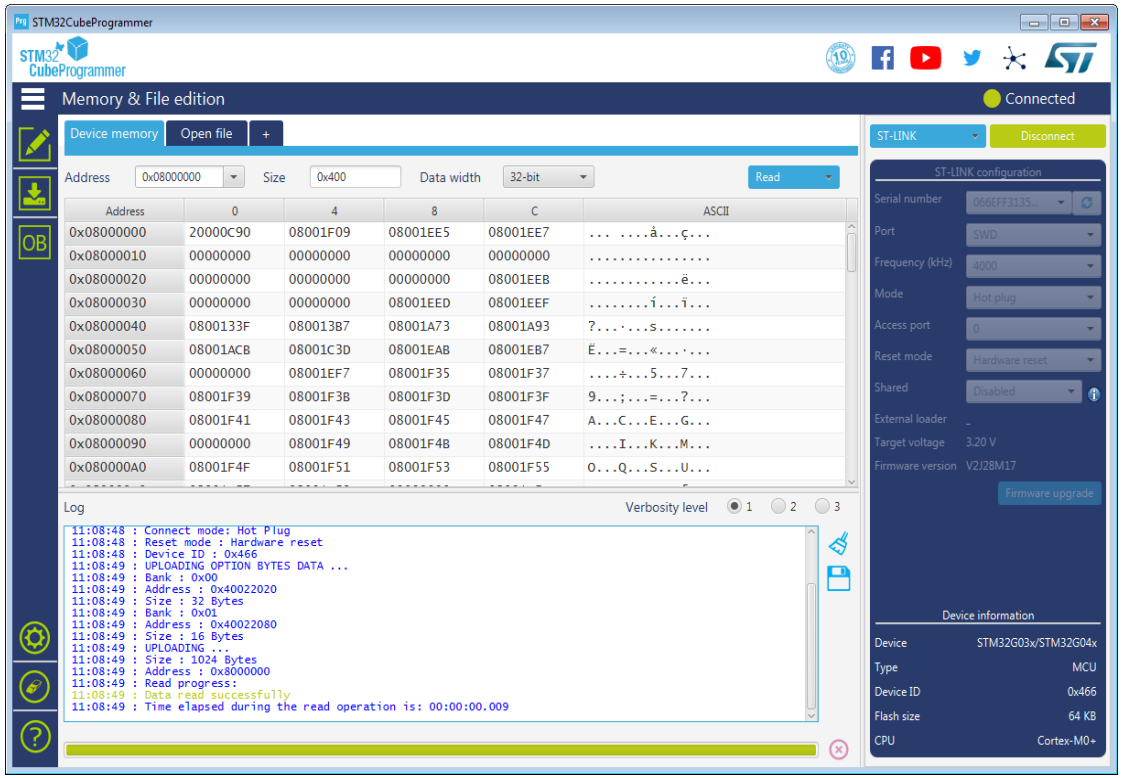
Third-party programming systems

From prototyping to mass production

ACROVIEW · DediProg · Data I/O · Algocraft · BPM · eps · DATAMAN · HI-LO SYSTEMS · PE micro · RK-SYSTEM · Phyton · SECURE THINGZ · SEGGER It simply works! · SMH Technologies · XELTEK

STM32CubeProgrammer software tool

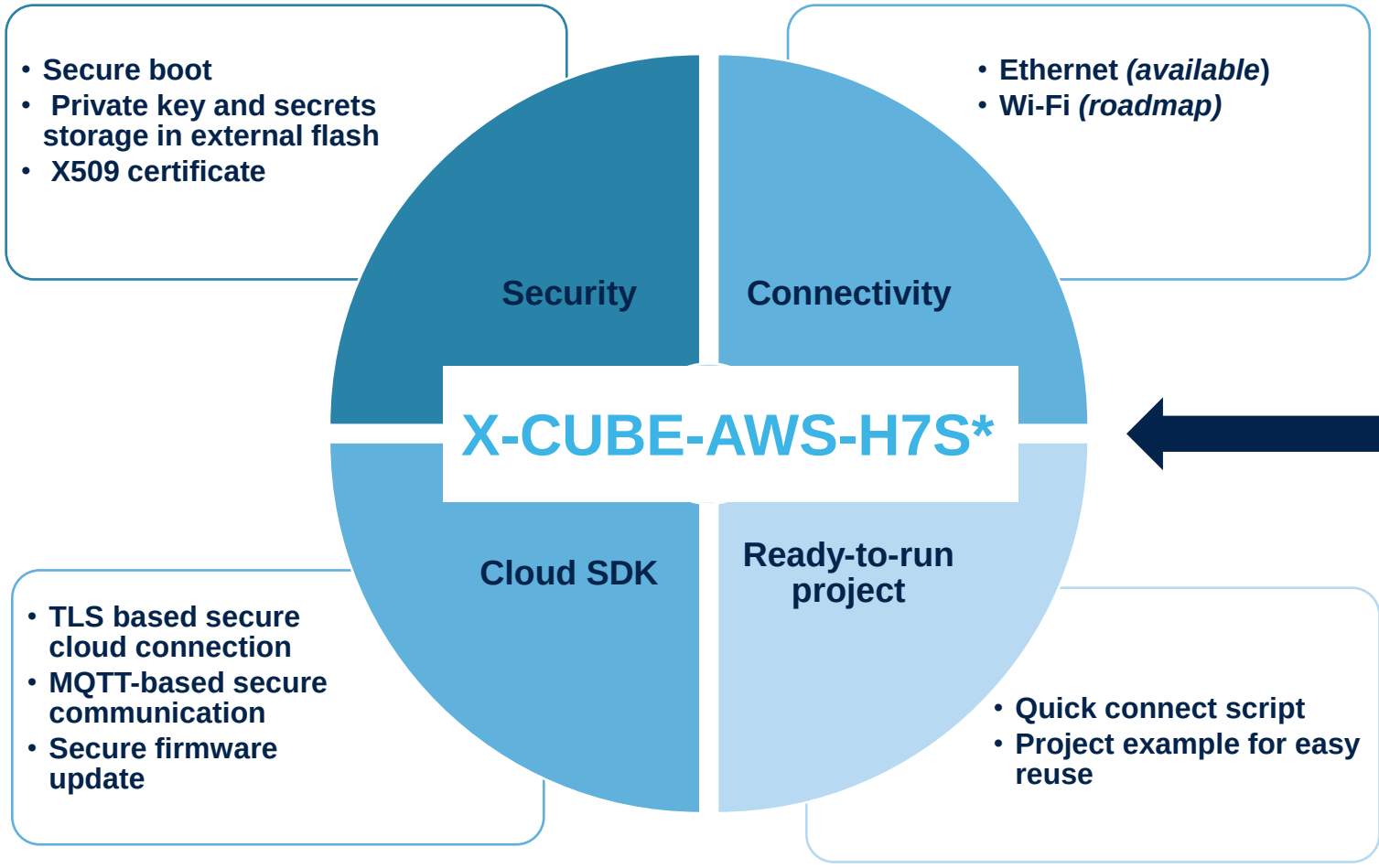
User-friendly tool compatible with multiple platforms (Windows, Linux, macOS)



- STLINK direct support (JTAG, SWD)
- Option bytes program & upload
- Internal / external flash services
- Bootloader interface support (USB, UART, SPI, I2C, CAN)
- Automatic mode
- Command line interface for scripting
- API DLL for custom integration
- Trusted package creator (secure programming)

STM32Cube expansion cloud reference integrations

Easily connect your devices to main cloud service providers



** Available later in 2024*

Useful links

PRODUCTS	SOFTWARE	DEMOS	OTHER
STM32H7R3/S3	STM32CubeH7RS	STM32H7RS TouchGFX	STM32H7RS GitHub
STM32H7R7/S7	X-CUBE-AZRT-H7RS	STM32H7RS USB	STM32H7RS Security Wiki
STM32H7RS	X-CUBE-AWS-H7S	Run GUI & other apps	External memory manager Wiki
HARDWARE	X-CUBE-AZURE-H7S	YouTube playlist	Blog article
NUCLEO-H7S3L8	X-CUBE-PERF-H7RS		
STM32H7S78-DK			

External memory supported (list to be enhanced):

- Micron
- ISSI
- APMemory
- Macronix
- Winbond
- Infenion

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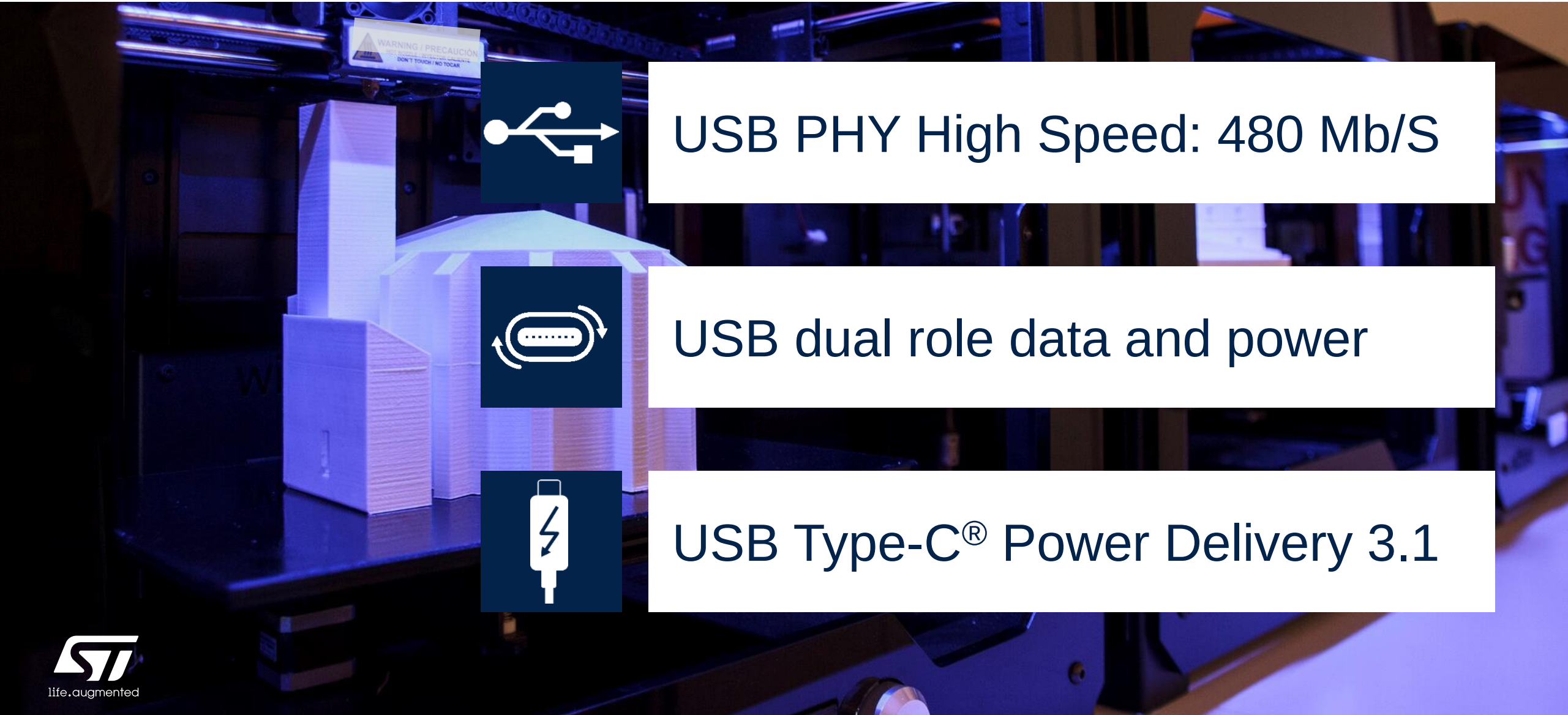
STM32H7R/S USB features



- USB PHY High Speed: 480 Mb/S
- USB dual role data and power
- USB Type-C® Power Delivery 3.1

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STM32H7S78-DK USB Dual-role data and power Demo

Demo – smart home application

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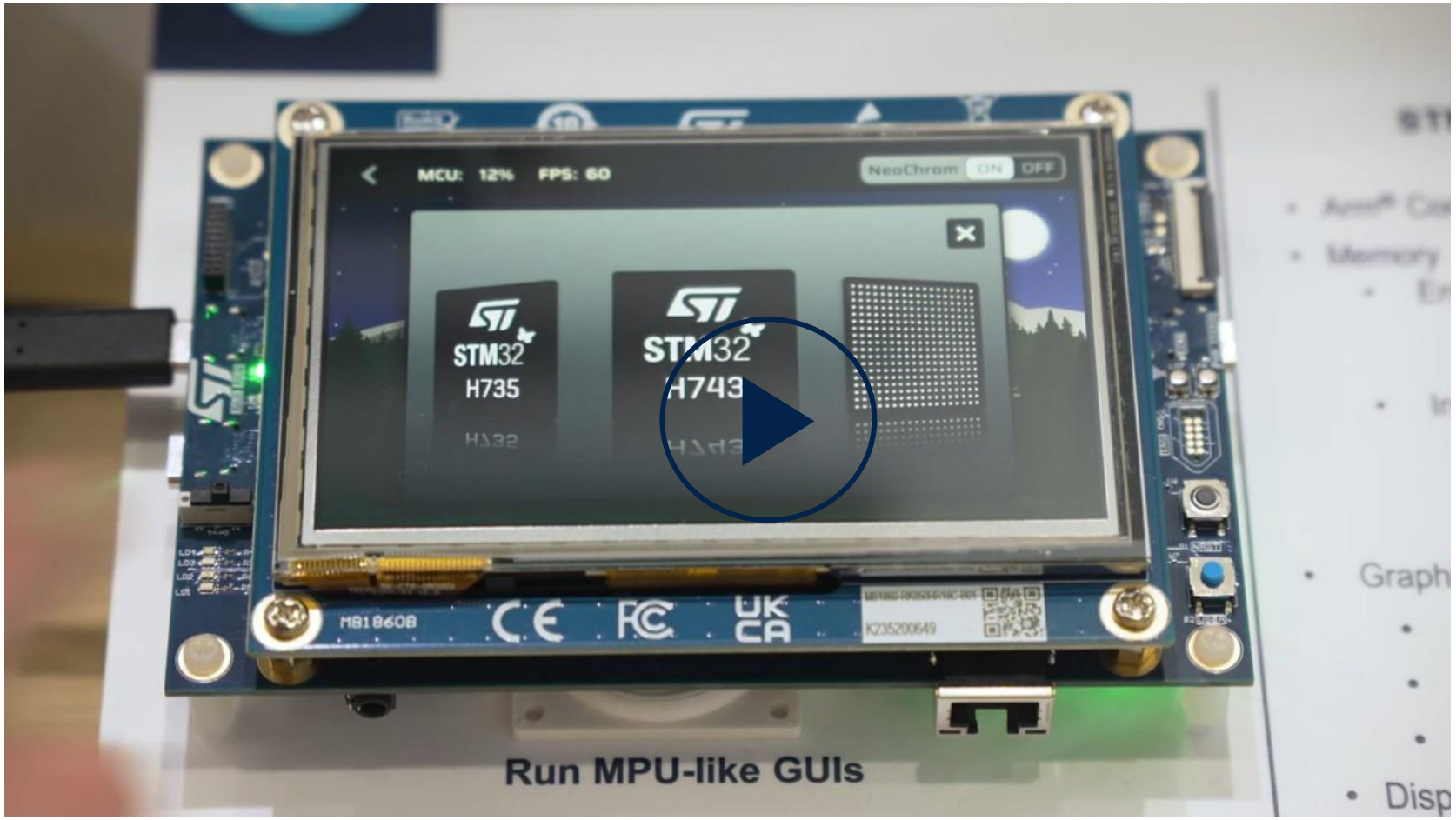
Build MPU-like GUI applications for home automation embedded world 2024



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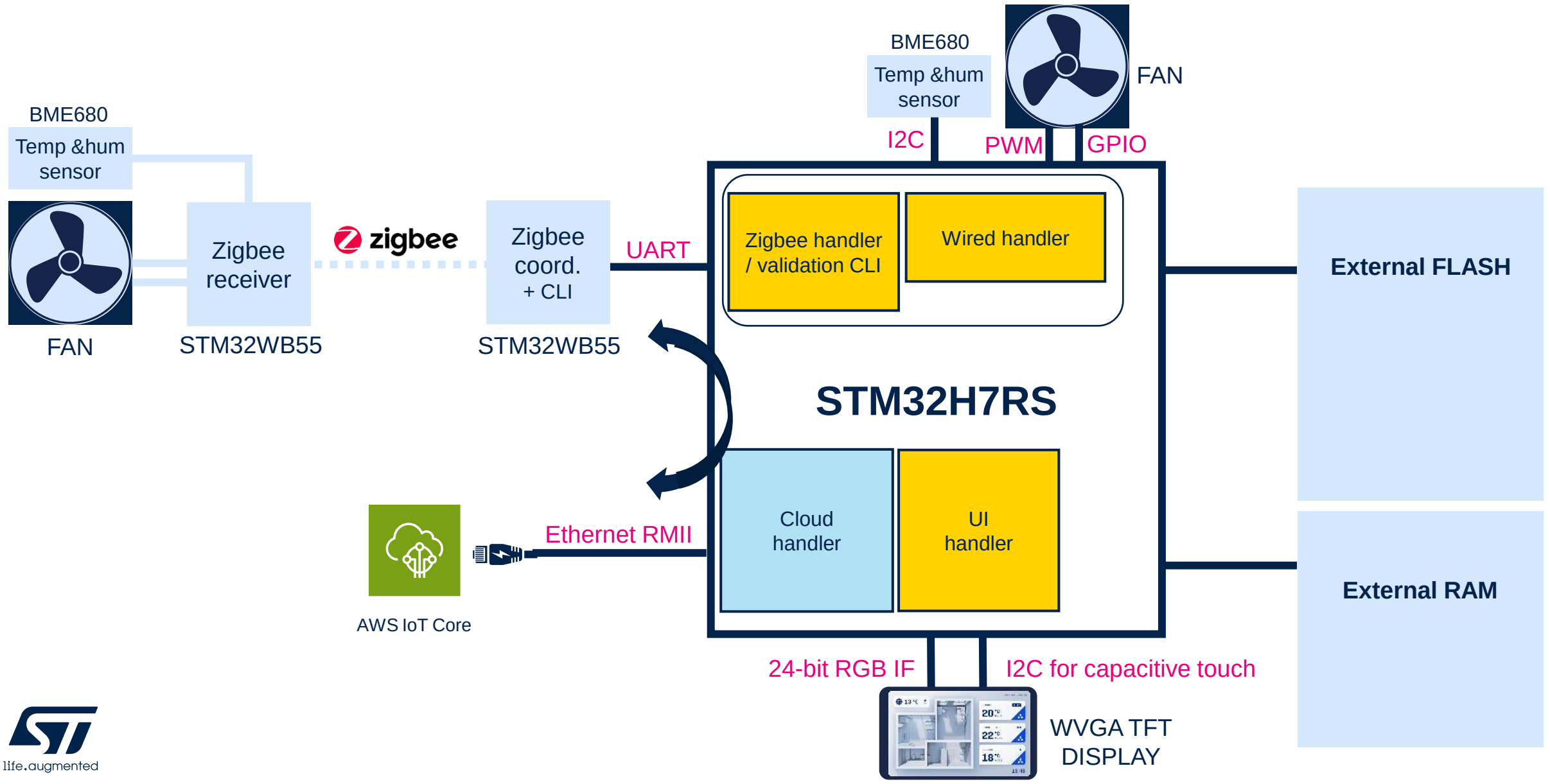
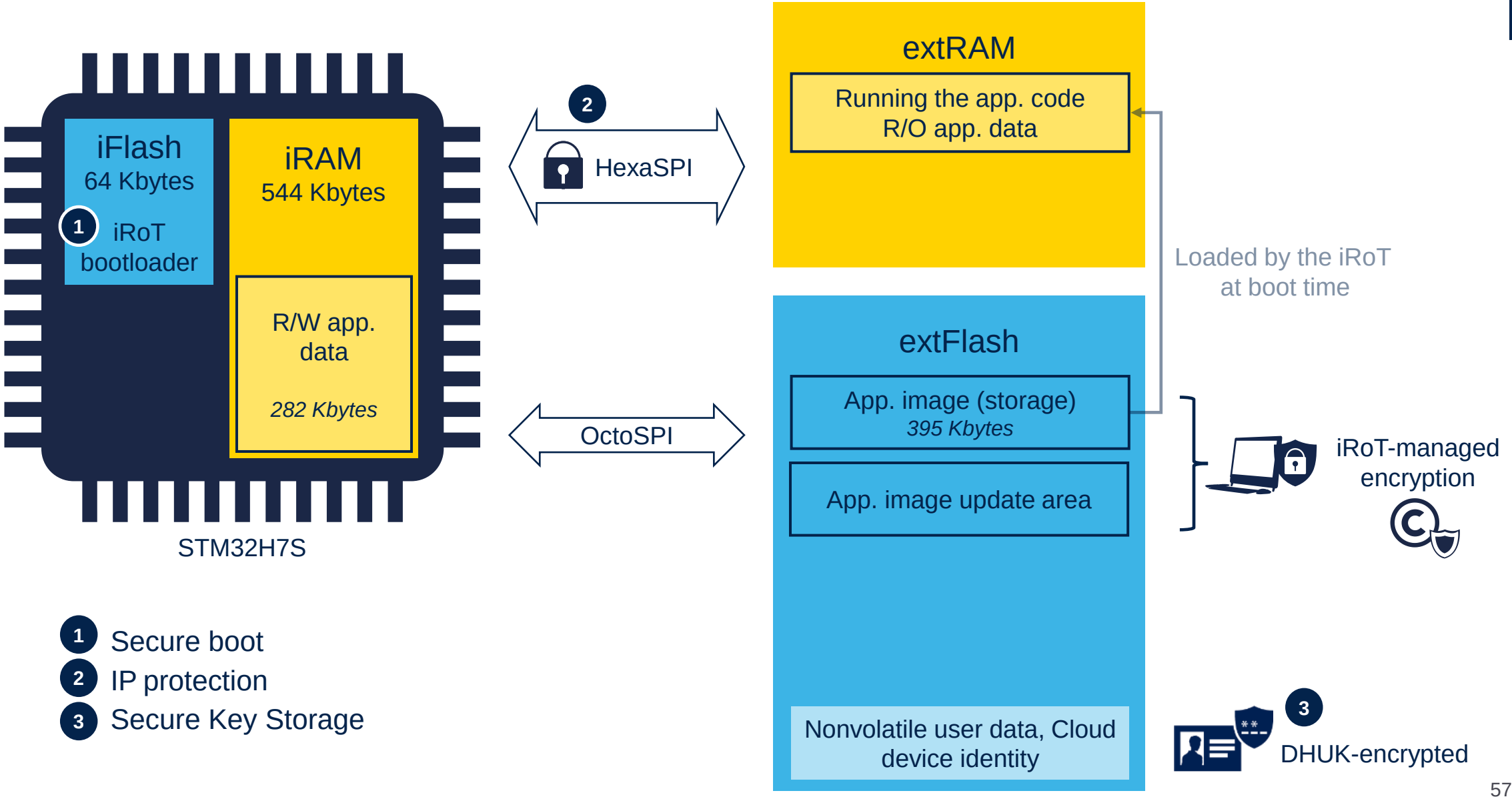
HVAC Demo: Zigbee Applicative Gateway

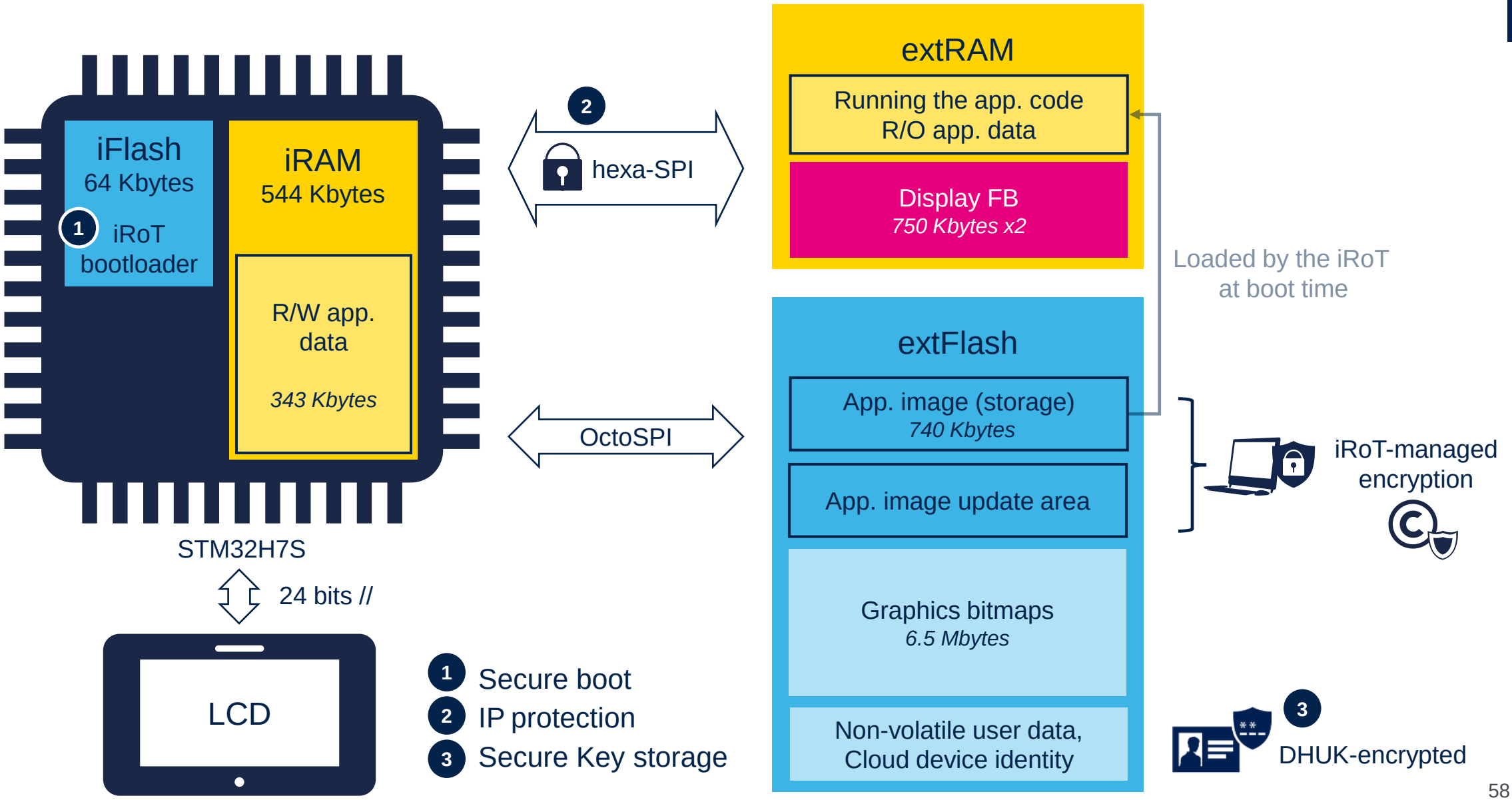


X-CUBE-AWS-H7S: STM32H7S embedded software



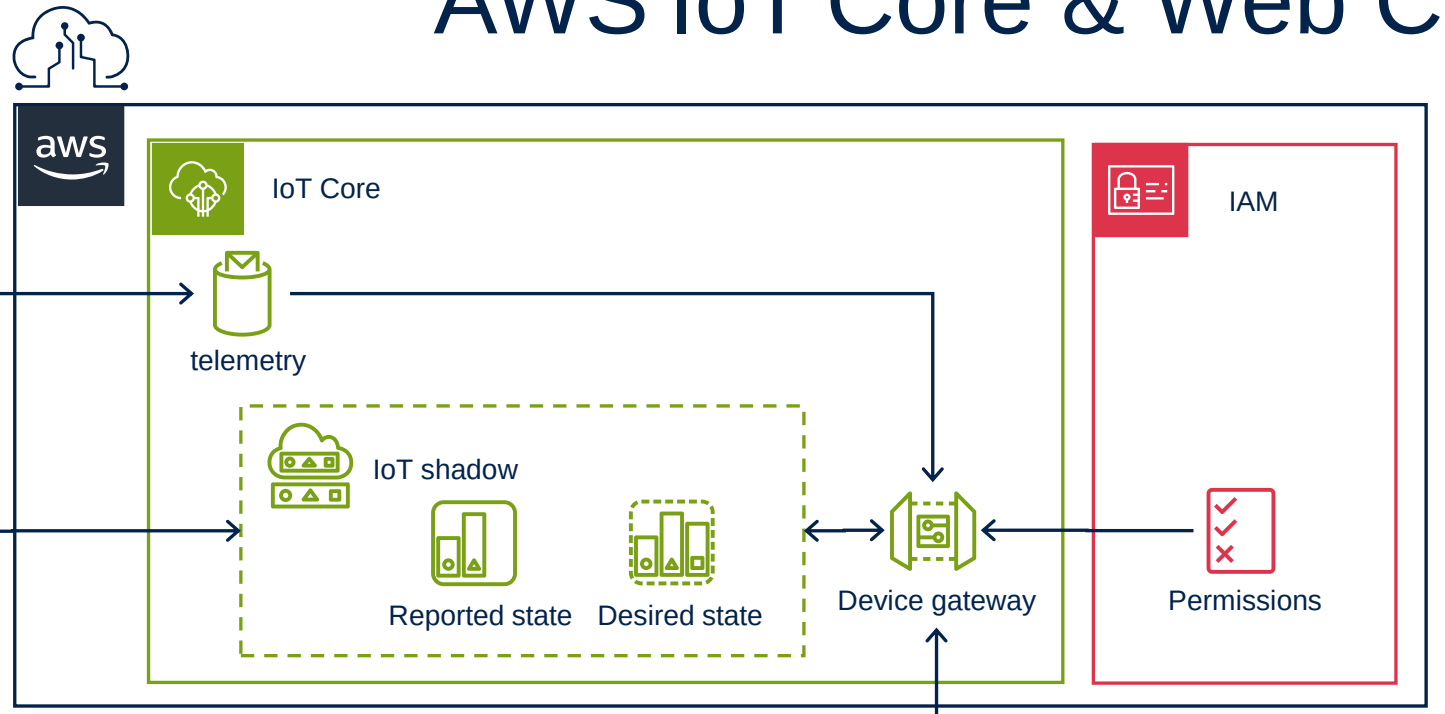
1. Secure boot
2. IP protection
3. Secure Key Storage

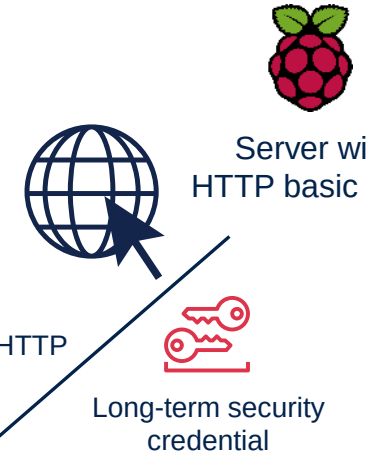
STM32H7S embedded software

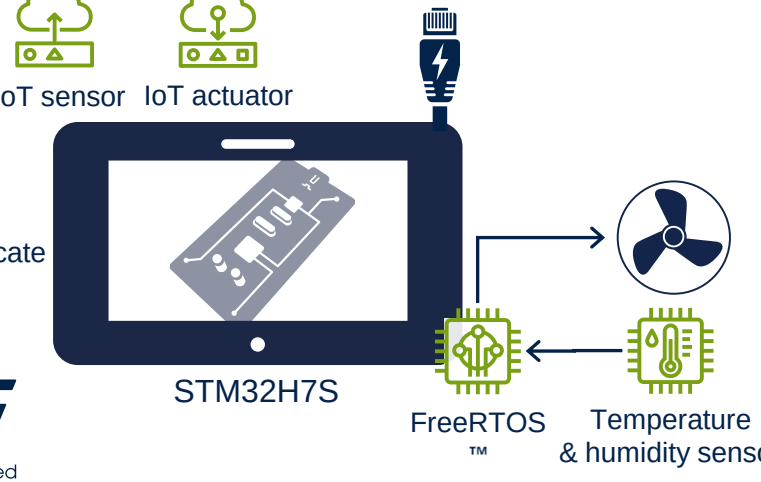


1. Secure boot
2. IP protection
3. Secure Key storage

AWS IoT Core & Web Control Panel







- Get telemetry
- Control the device shadow
- Push weather forecast updates

Static web page

Open-Meteo

mini-css
weather-icons

crypto-js core, hmac, sha256
paho mqttws
morris
jquery
raphael

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Releasing your creativity

@STM32

@ST_World

community.st.com

http://www.st.com/stm32h7

STM32H7RS YouTube playlist

wiki.st.com/stm32mcu

github.com/stm32-hotspot

STM32H7RS blog article

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Our technology starts with You

Find out more at www.st.com/stm32h7rs

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