Introduction to STM32 Dual Core Configuration MCU Series with Arm® Cortex®-M Cores

STM32H7 series

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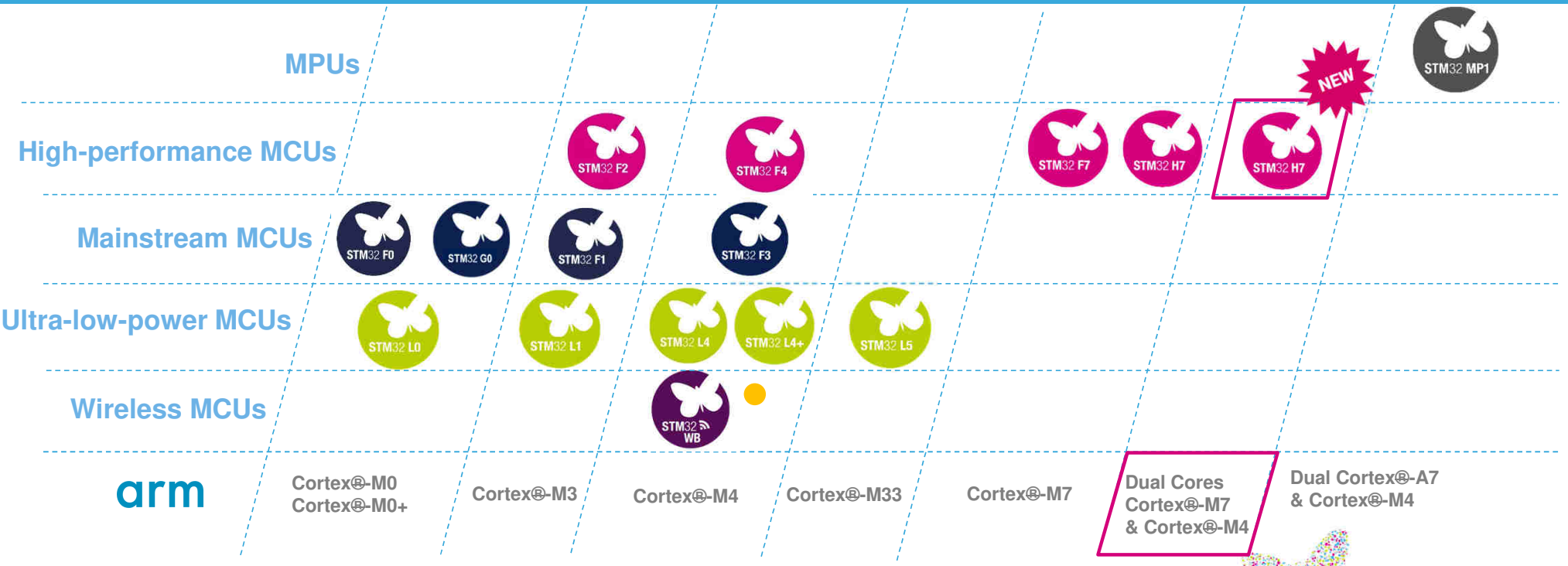
Technology Tour 2019

Toronto, Canada | May 29

Today - STM32 Portfolio Positioning

15 product series / More than 50 product lines



More than
40,000 customers

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Note ● : Cortex-M0+ Radio Co-processor

STM32H7 Target Applications

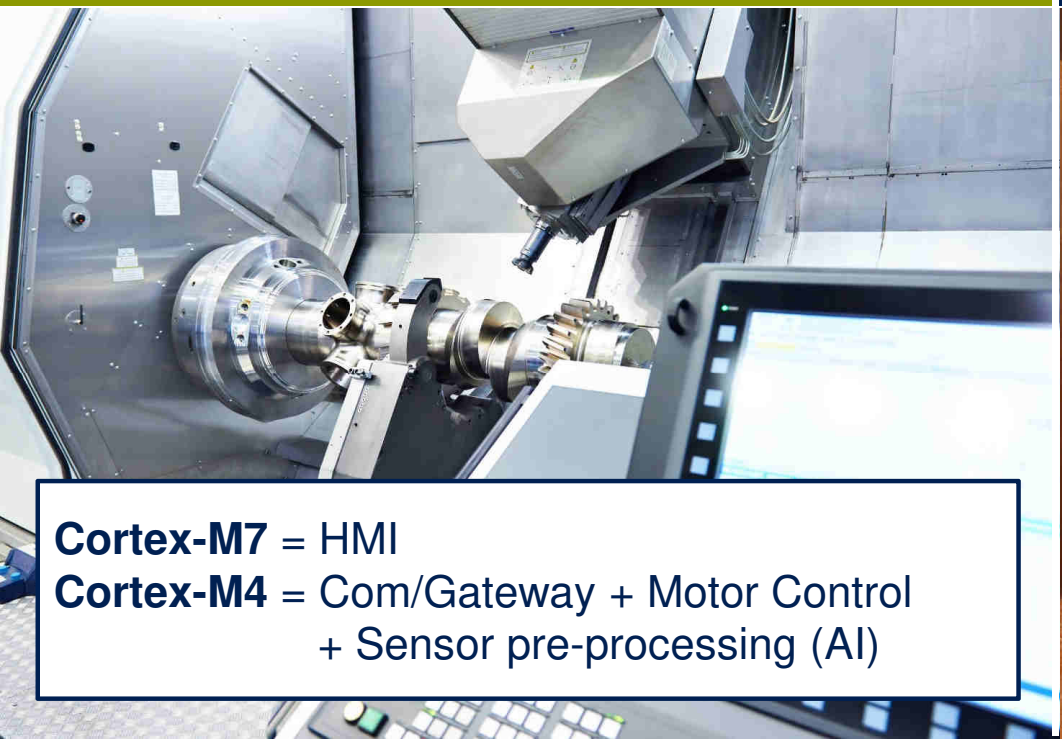
- Industrial
  - Human Machine Interface
  - Communication Gateway
  - PLC
  - Motion control
  - Barcode Reader
  - Inverters, UPS
  - Sensors
  - Asset protections
  - Lighting
- Medical
  - Health and wellness
  - Individual assistance (hearing, respiratory)
  - Measurements and Data logger

- Consumer
  - Advanced IoT edge gateway
  - Access control
  - Home Gateway
  - Appliance
  - Graphic
  - Home Automation
  - Audio
  - Fitness Equipment
  - Drones
  - Portable devices and accessories

and more …

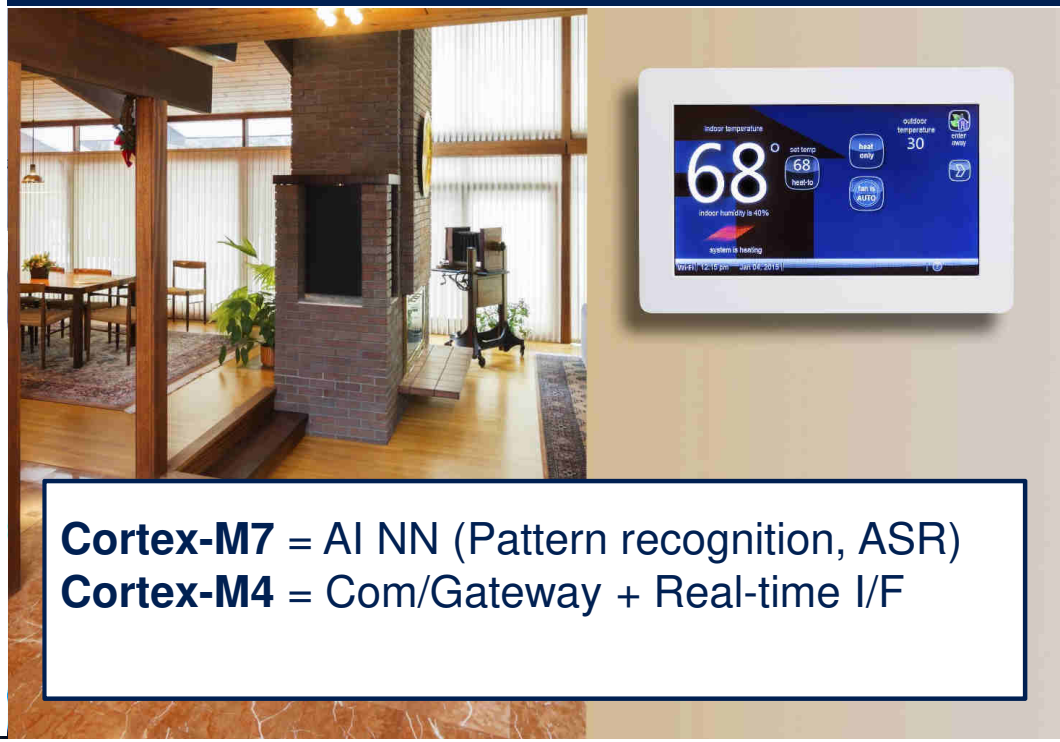
STM32H7 Dual-core – Use case(s)

Industrial tool machine



Cortex-M7 = HMI
Cortex-M4 = Com/Gateway + Motor Control
+ Sensor pre-processing (AI)

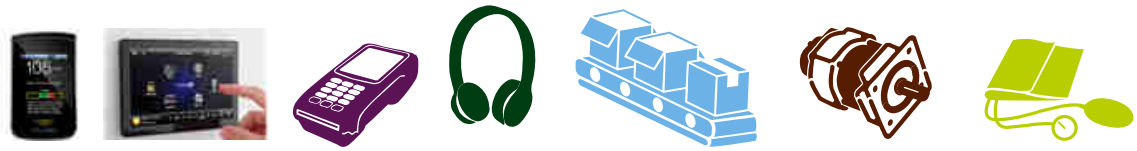
Home automation & security



Cortex-M7 = AI NN (Pattern recognition, ASR)
Cortex-M4 = Com/Gateway + Real-time I/F

STM32H7 Dual Core – Use Case(s)

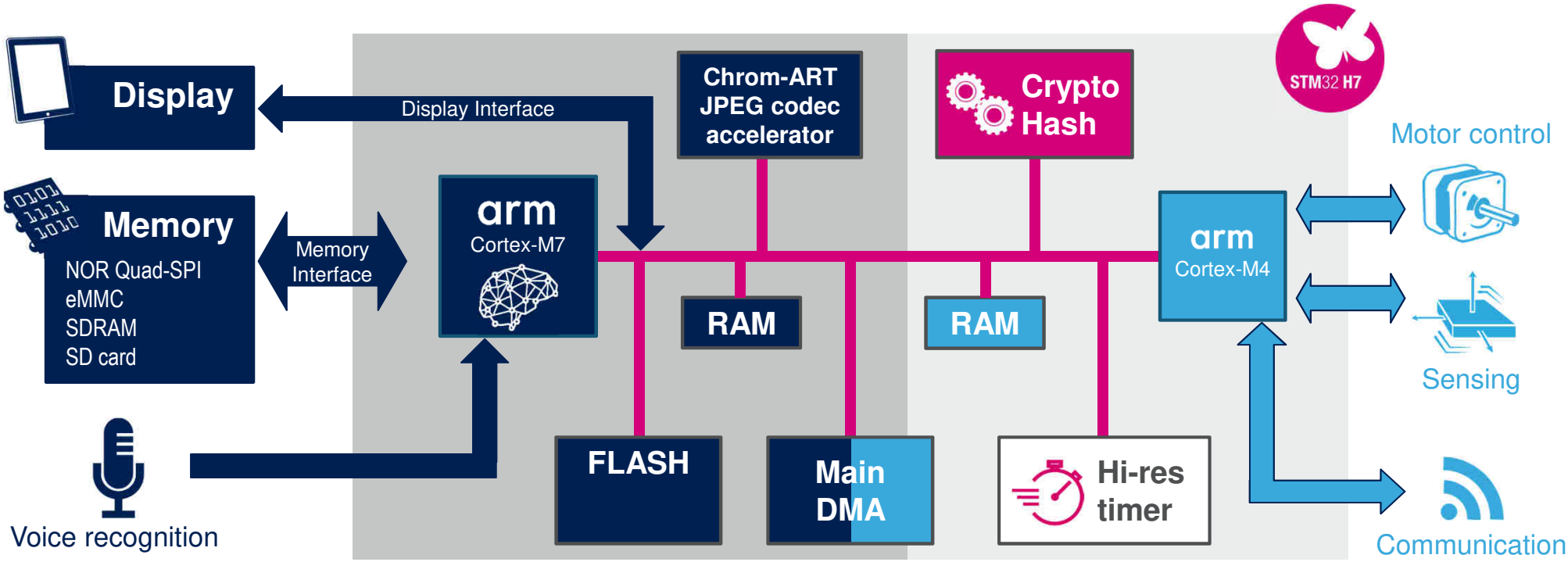
Example of workload enhancement



Core	Consumer	Industrial	Medical
Cortex-M7	Advanced user interface, high performance, Data crunching (DSP, Audio …), Secure programing		
Cortex-M4	Deterministic Sensor control Wireless stack	Real-time control and monitor, Wireless stack	Real-time Wireless stack

STM32H7 Dual Core – Build Complex Applications – Mixing AI and Real-time Control

Connected Kitchen Aid with advanced HMI (Large display and Voice recognition)



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STM32H7 Dual Core – AI – Food Recognition

Fast Downsampling MobileNet Food Recognition on STM32H747 Discovery board

Neural Network

- FD-MobileNet topology from public paper applied to food
- Dataset

Implementation Details

- Exploits Camera in continuous mode or one shot
- Floating Point or mixed model Floating/Fix Point
- 18 food classes

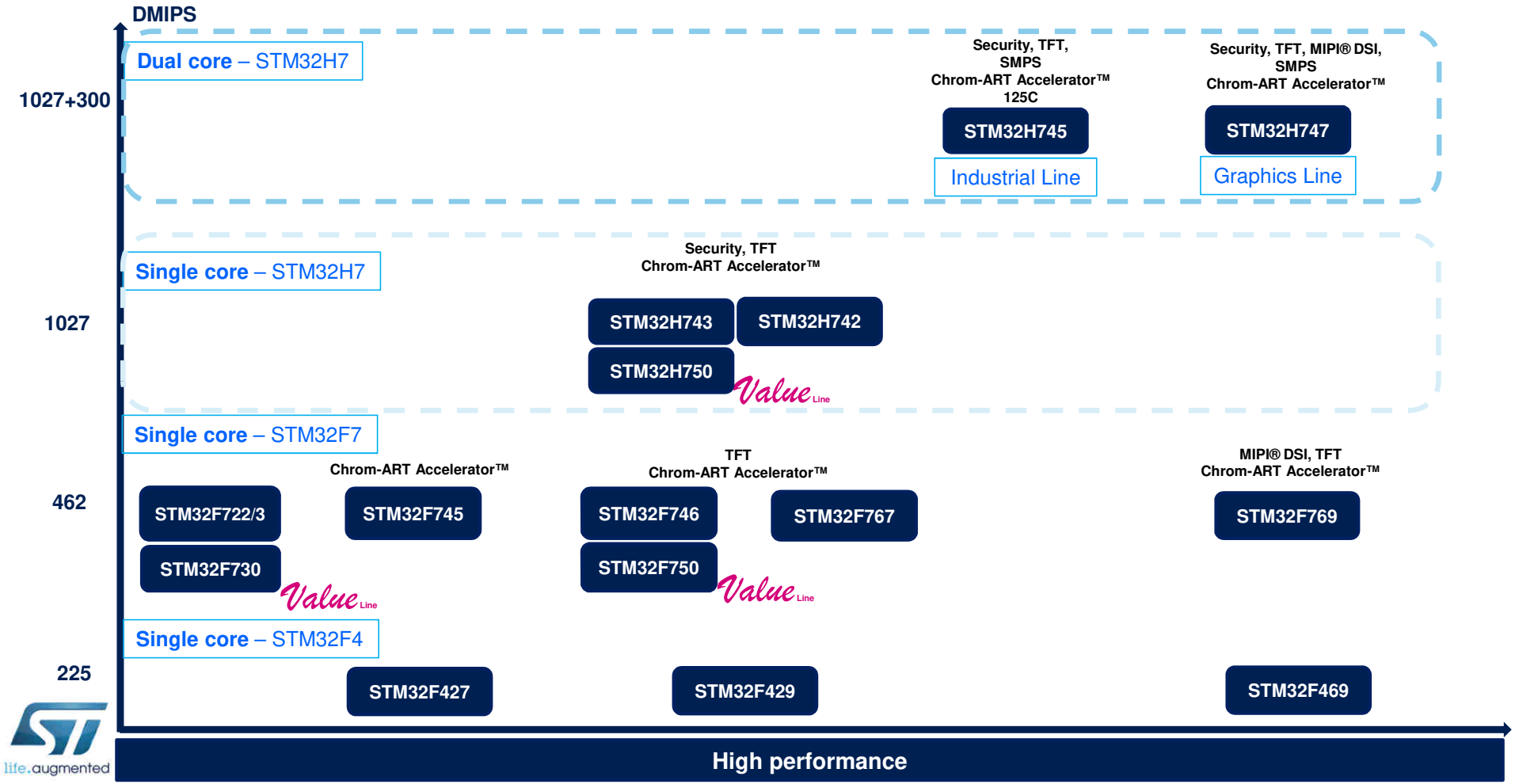
STM32 Cube.AI NN

- Memory footprint: 205 KB RAM, 191 KB Flash

Performance on STM32H747

- 1 inference per image
- STM32H747 400 MHz Cortex-M7F
- Mix model Fix/Floating Point
  - 6.2 MHz / 150 ms per inference
  - Accuracy: 78.8%

STM32H7 Product Portfolio



STM32H7 Dual Core – Key Features

Record Performance	**The world most powerful MCU with Embedded Flash** delivering **2424+800 CoreMark** / 1027+300 DMIPS in **Dual core CM7 & CM4** configuration
High Internal RAM, FLASH, Superior display and connectivity	**1MB Internal RAM**, 2MB Internal Flash, Integrated multiple 16 Bit ADC Peripherals, 35 Communication Peripherals, and Integrated Display and Graphic IP
Secure Boot, Hardware Secure Memory, and IOT Ready	Protect your IP, using built in Crypto, **Secure Hardware Flash**, to protect applications, solutions for **Root-of-Trust enablement** with Secure Firmware Install, Secure Boot, and Secure Firmware update solutions.
Power Efficient	**Power efficiency achieved using multi-power domain** architecture - 350uA/MHz in RUN mode, 200uA/MHz in SMPS mode, 4µA in STDBY Mode.
Great Investment	**Pin-to-Pin and Code compatible** with the STM32 F7 and STM32 Ecosystem. More than 1000 STM32 part numbers. 10 years commitment program.

STM32H7 Product Line Options

Cortex®-M7 480 MHz + Cortex®-M4 240MHz

Core, Memories and acceleration
- Dual core line-up – Cortex-M7 480MHz and Cortex-M4 240MHz
- Single core line-up – Cortex-M7 480MHz
- Flash and RAM acceleration
- SP-FPU and DP-FPU
- 4xDMA

Connectivity
- 2 x USB2.0 OTG FS/HS
- 2xSDMMC
- USART, UART, SPI, I²C
- 2xCAN (1xFD and 1xTT)
- HDMI-CEC
- FMC, Dual Q-SPI
- Ethernet MAC IEEE1588
- Camera I/F
- Analog (Comp, AOP)

Audio
- 3 x I²S + audio PLL
- 4 x SAI
- 2 x 12-bit DAC
- SPDIF-RX

Graphic
- Chrom-ART Accelerator™

Others
- Crypto/Hash (except H742) (*)
- Security services (except H742) (**)
- TRNG
- DFSDM
- 16 and 32-bit timers
- 3 x 16-bit ADC (up to 3.6 Msps)
- Voltage range 1.62 to 3.6V
- Multi power domains

Product line	FCPU MHz	FLASH (Dual Bank)	RAM	Graphic	Power supply	T° range
Dual core lines						
STM32H747 STM32H757 (*)	480 / 240	Up to 2MB	1 Mbyte (128K DTCM, 64K ITCM, 512K+288K SRAM, 64KB bckup1 + 4K bckup2)	TFT-LCD JPEG codec MIPI-DSI	DCDC + LDO	Standard 85°C
STM32H745 STM32H755(*)	480 / 240	Up to 2MB	1 Mbyte (128K DTCM, 64K ITCM, 512K + 288K SRAM, 64KB bckup1 + 4K bckup2)	TFT-LCD JPEG codec	DCDC + LDO	Standard 85°C (Opt. Industrial CPN 125°C***)
Single core lines						
STM32H743 STM32H753(*)	480	Up to 2MB	1 Mbyte (128K DTCM, 64K ITCM, 512K+288K SRAM, 64KB bckup1 + 4K bckup2)	TFT-LCD JPEG codec	LDO	Standard 85°C
STM32H742	480	Up to 2MB	692 Kbyte (28K DTCM, 64K ITCM, 384K+32K SRAM, 16KB bckup1 + 4K bckup2)	No	LDO	Standard 85°C
Value line						
STM32H750	480	128KB	1 Mbyte (128K DTCM, 64K ITCM, 512K+288K SRAM, 64KB bckup1 + 4K bckup2)	TFT-LCD JPEG codec	LDO	Standard 85°C

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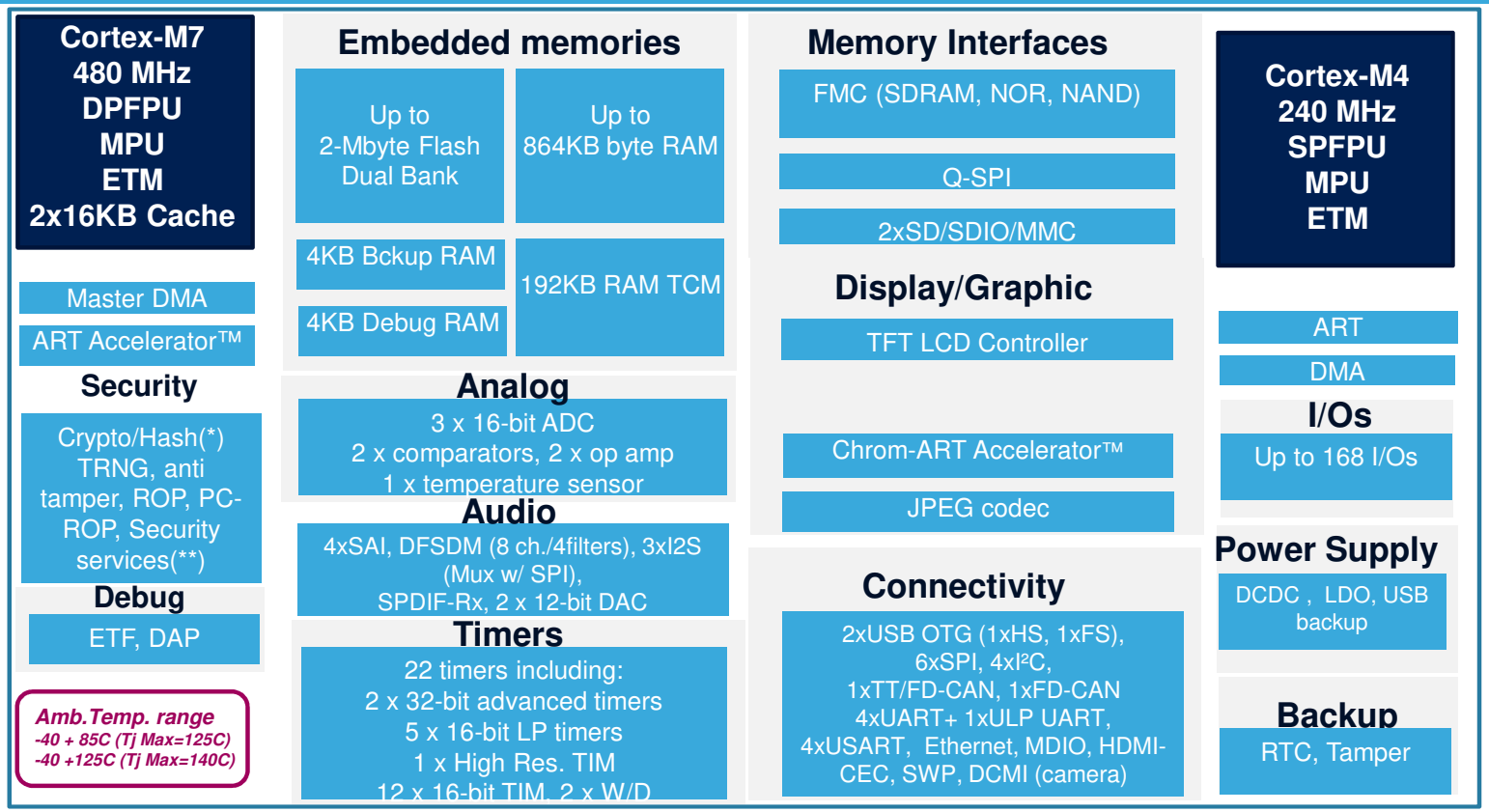
(*) : Dedicated STM32H753, STM32H755, STM32H757 for the Crypto variants, Security Services (SFI and SBSFU) enabled
(**) : SFI and SB-SFU available Mid-2019
(***) : Extended Temp range Max 125C Ambient/140C junction. Dedicated part numbers

STM32H745 Dual Core – Industrial Line

High integration with dual core, large memory size, multiple power domains, SMPS and optional support of extended temperature range



(*) : Dedicated STM32H7**5**3, STM32H7**5**5, STM32H7**5**7 for the Crypto variants, Security Services (SFI and SBSFU) enabled
(**) : SFI and SB-SFU available Mid-2019

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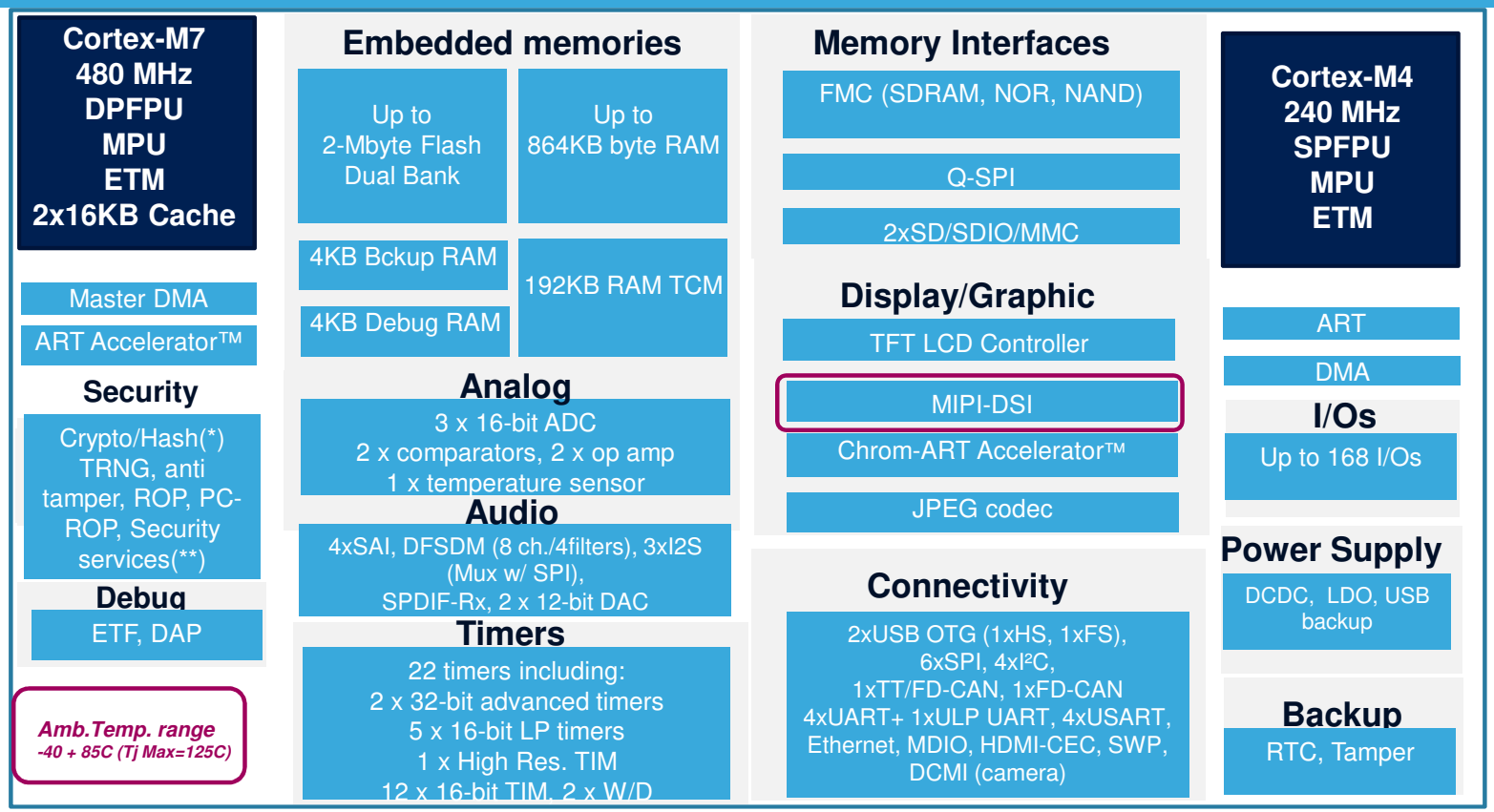
STM32H747 Dual Core – Graphics Line

High integration with dual core, large memory size in small packages, multiple power domains, SMPS and MIPI-DSI support



(*) : Dedicated STM32H753, STM32H755, STM32H757 for the Crypto variants, Security Services (SFI and SBSFU) enabled
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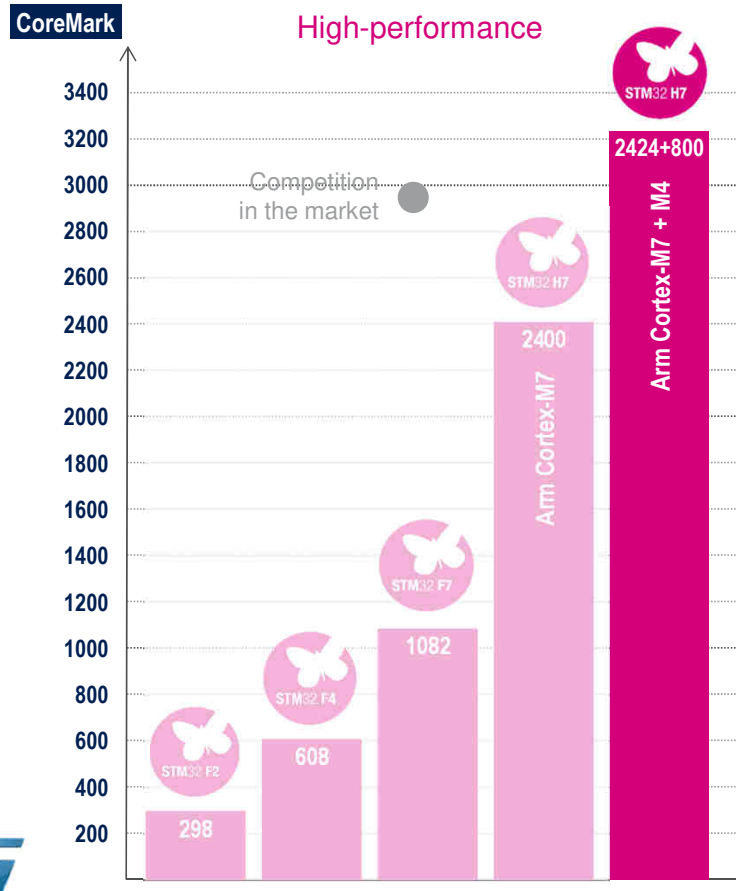
High Performance Range



Arm® Cortex® -M7 @480MHz

Most powerful Cortex core with double precision FPU, MPU, advanced DSP and L1 cache

Arm® Cortex® -M4 @240MHz

Best in class core for **real-time** with single precision FPU, DSP, MPU and ART Accelerator™

* Competition @600Mhz achieving 2950 CoreMark

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Powerful Cores

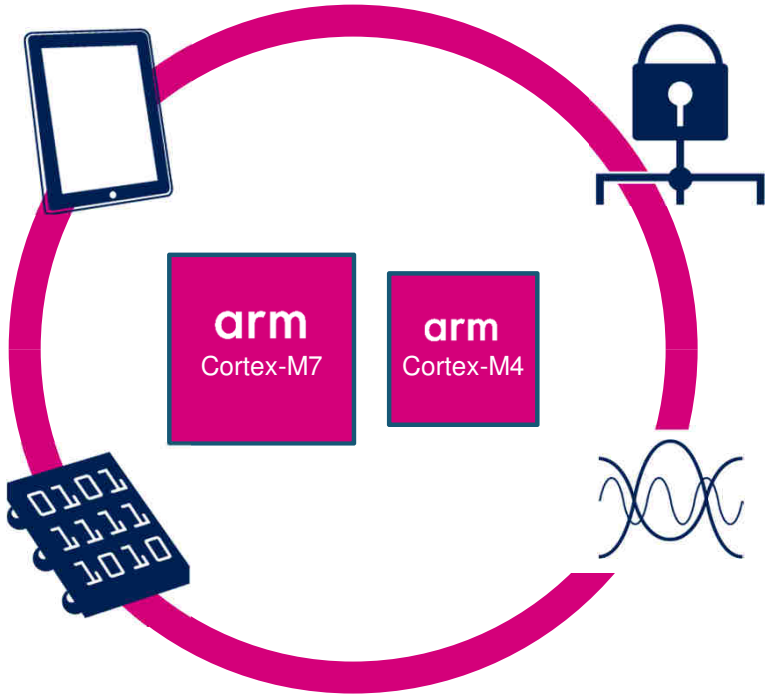
Supported by a Powerful Architecture

Display nice graphic

The Chrom-ART Accelerator
and MJPEG codec
offload the CPU by more than 90%

Manage security

Use dedicated **cryptography**
and **Hashing** HW acceleration
to **offload the CPU by more than 90%**



Transfer data efficiently across peripherals

The Main DMA takes care
of the most complex schemes
between memories and peripherals
with **up to 16 channels to offload the CPU**

Generate complex wave forms

High-Resolution timer (2.1ns)
can generate complex wave forms
synchronized on multiples events,
with no CPU assist

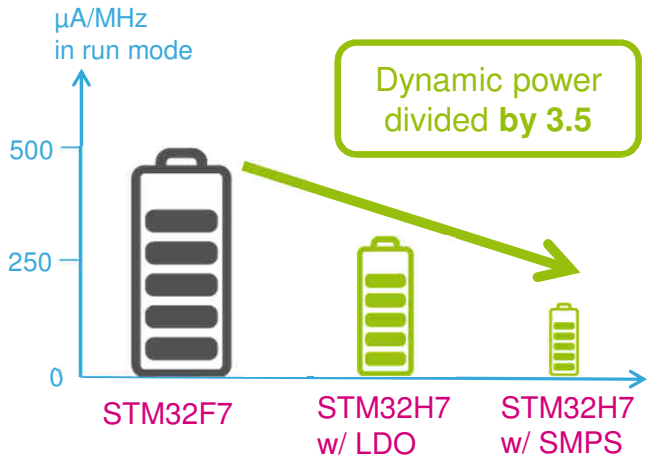
Flexible Architecture for Power Efficiency

Only 60% of the dynamic power of the STM32H7 Single core thanks to the SMPS

Wake-up time		
	CM7/CM4 RUN (VOS1) at 400/200 MHz - PERIPH OFF	145 µA / MHz*
	CM7 RUN (VOS1) at 400 MHz - PERIPH OFF, CM4 idle	121µA / MHz*
38 µs	STOP Mode (D3 STOP, D1 and D2 STDBY)	60µA***
390 µs	STANDBY + 4 KB RAM	3.6 µA / 4.3 µA****
390 µs	STANDBY	2.1 µA / 2.8 µA****
	V_{BAT}	30 nA / 0.75 µA****

Typ @ V_{DD} =3.3 V, @ 25 °C

Notes:
** from Flash (Cache ON and Reg. ON)*
**** VOS5; Flash OFF, no IWDG*
***** with RTC, at 3V*
More details available in product Sheet available at www.st.com



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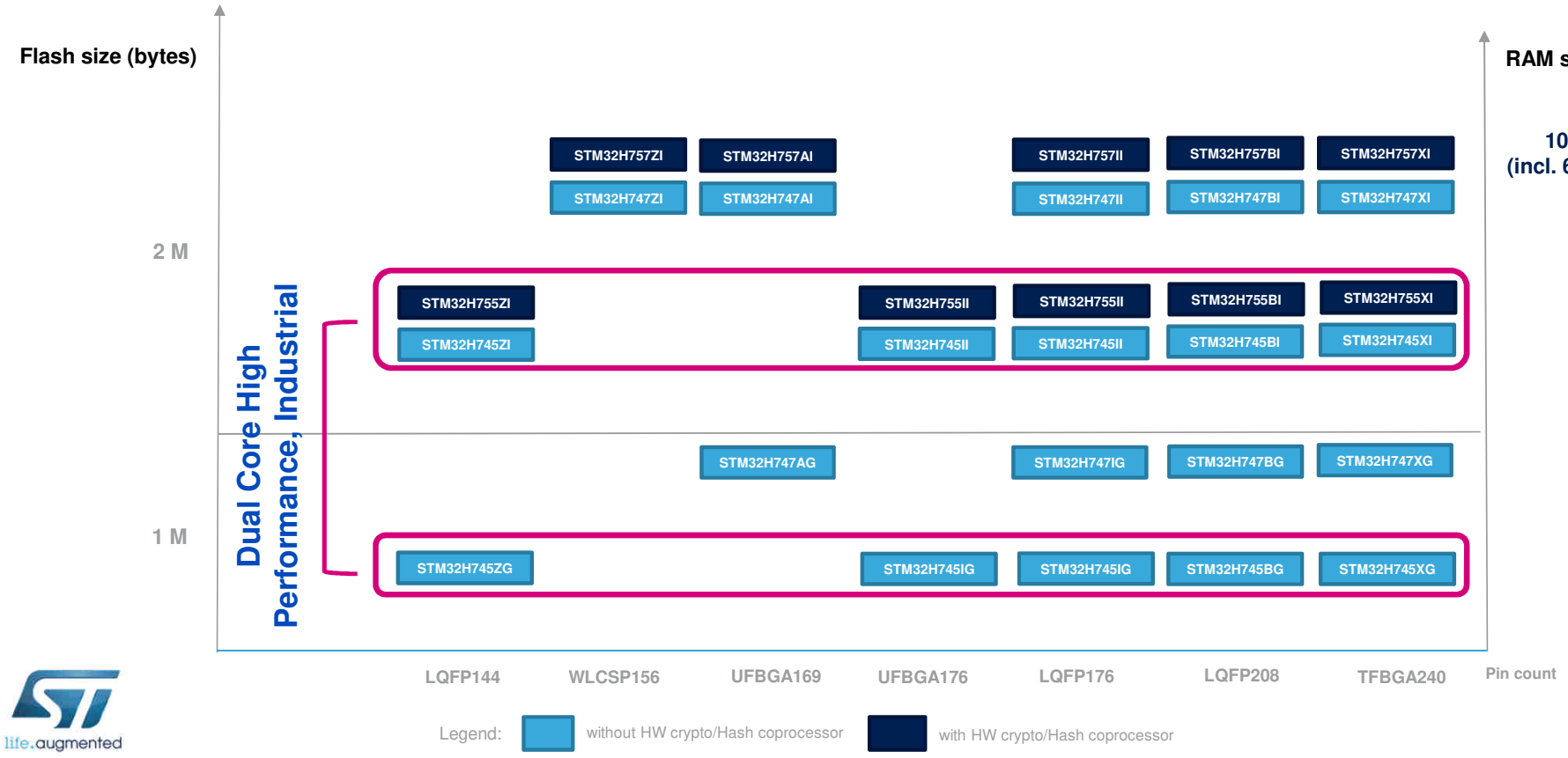
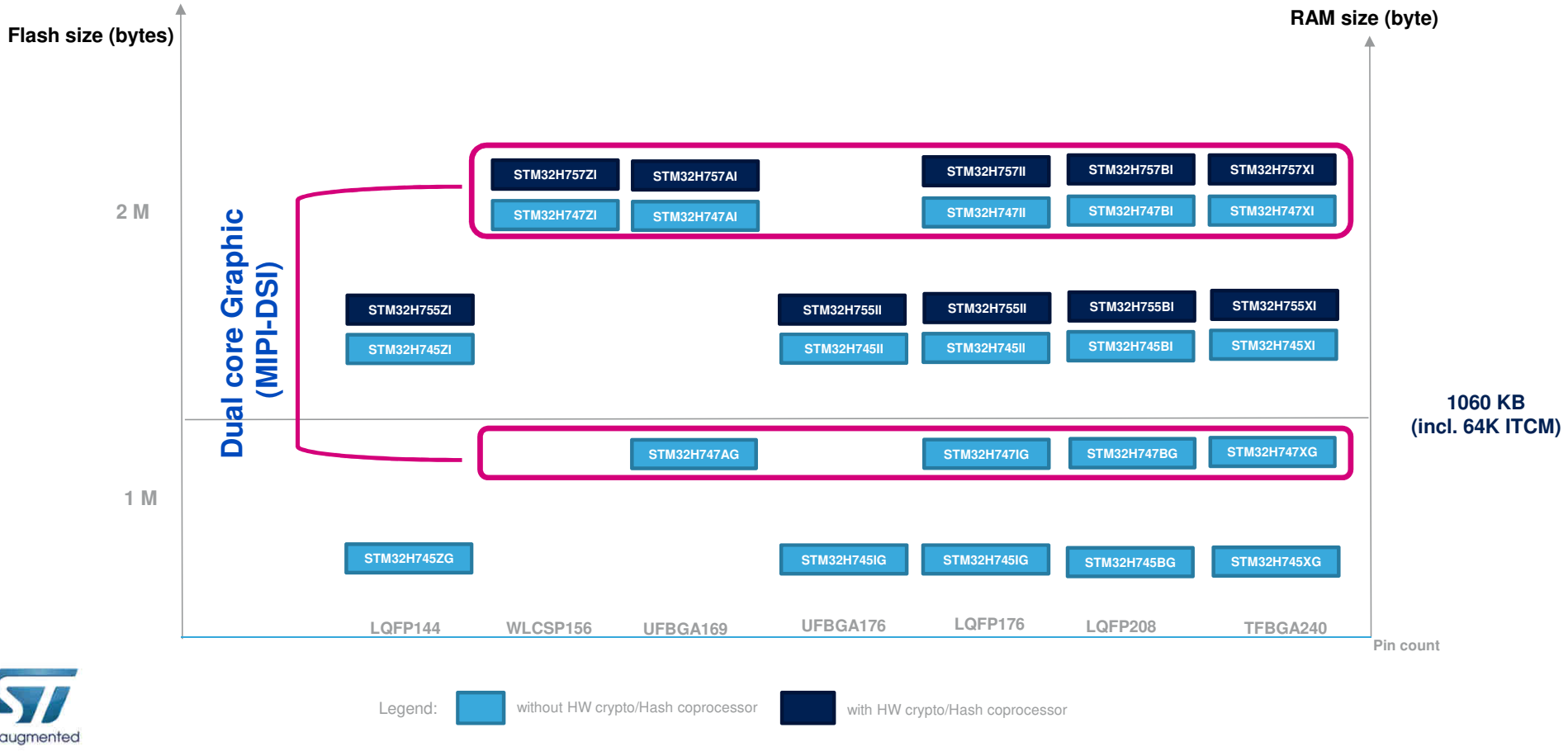
STM32H745 Dual Core – Industrial



STM32H757 Dual core – Graphics



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STM32H7 Embedded IP Protection

for IOT Secure Firmware Install and Update

- **Security Services on STM32H7 product line uses Hardware Crypto, and RSS(Root Security Services).**
- **The SFI, SMI and SBSFU Security Services are available for commercial part numbers STM32H750/753, STM32H755/H757**

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STM32 Built-in Secure Firmware Install

Feature Overview

STM32
Secure Loader

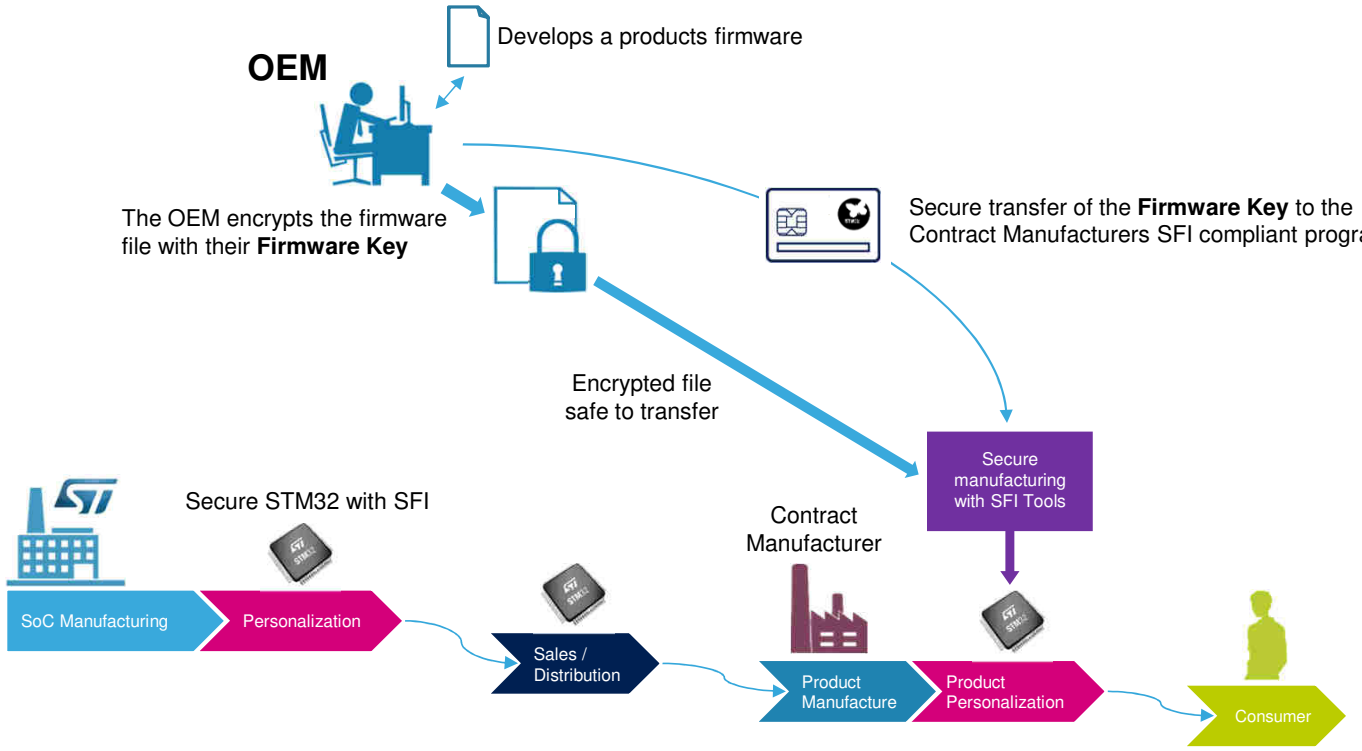
Provides Firmware
Confidentiality / Authenticity

ST Provisioned
Device Certificate

Strong Cryptography
AES, ECC

UART / SPI / USB
Loading Protocols

Secure Firmware Install (SFI)



STM32HSM

Used to securely transfer OEM information

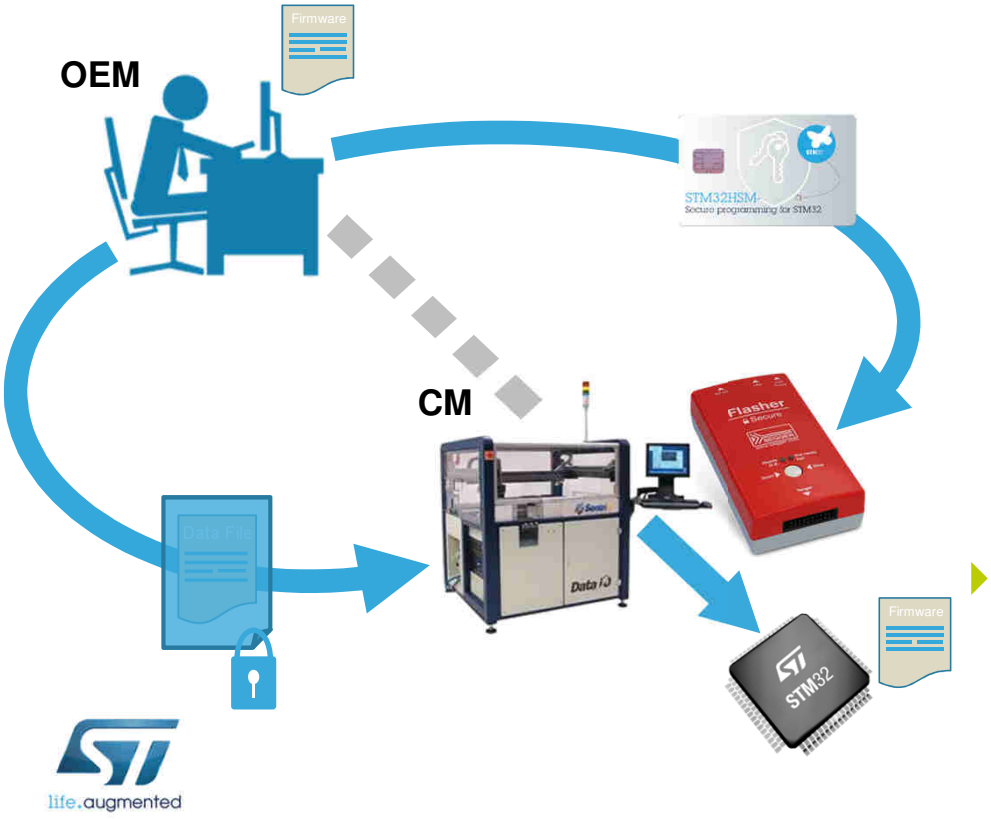
- Secure Microcontroller
  - Supports the SFI HSM functions
  - Supplied in PVC card format
  - Support ISO7816 T=0 / T = 1 API command format
- Used to Store and Transfer
  - Firmware Key
  - Use Count Limit
    - to control the number of boards made
    - Max limit up to 1 million
  - Firmware Identifier
- Purchase
  - Reference on ST.COM : STM32HSMxxx

(3 digits define maximum count limit)

Animated Slide

SFI Ecosystem

The Complete ST SFI Tool Chain Options



For development

Use ST tool chain

TrueSTUDIO for STM32

STM32 CubeProgrammer

For mass production

Partner tool chain

Secure Thingz / DataIO

Segger Flasher Secure

Authorized Partner

SECURE THINGZ

SEGGER

STM32 SBSFU Strategy

STM32 Code Execution
Single Entry Point

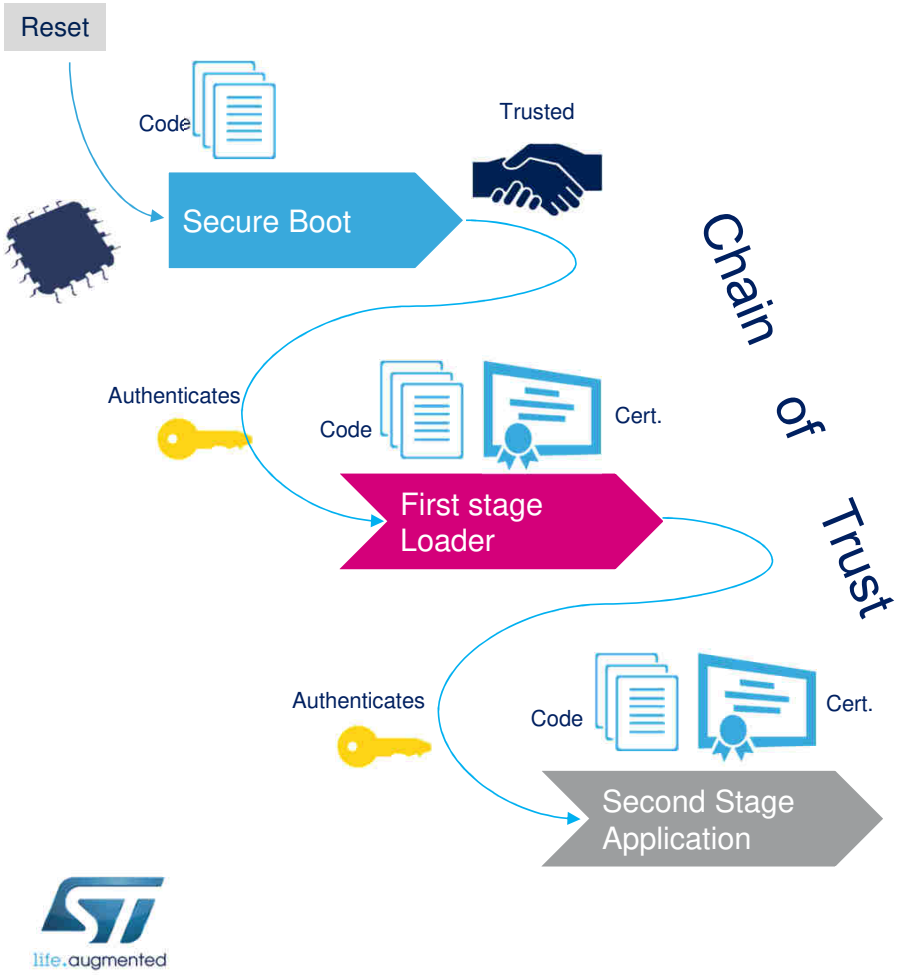
SBSFU Code is
Secret and Immutable

STM32 Protected Enclave

STM32 Debug Lock

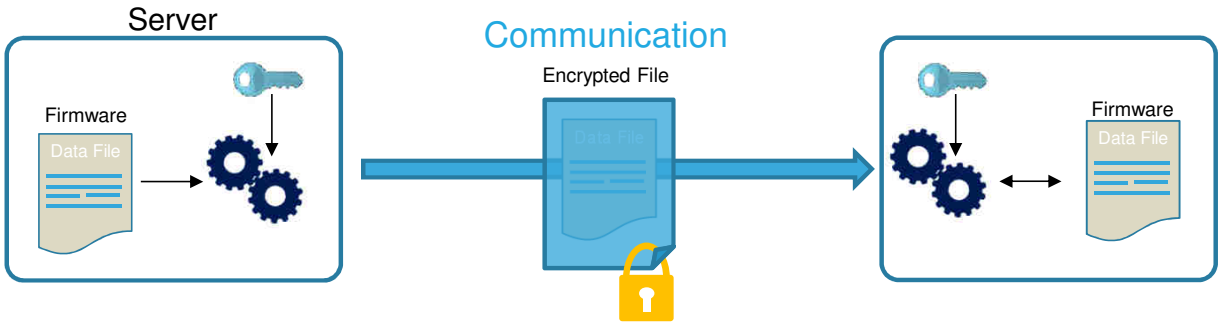
STM32 System Monitoring

Secure Boot



- At RESET, verify platform integrity
- Start secure boot from trusted immutable code
- All components are authenticated and integrity verified
- Next stage code is executed ONLY when components are authenticated and verified

Secure Firmware Update



- A new encrypted firmware image is created and stored in the server
- New firmware image is sent through an untrusted channel
- Server is authenticated, new firmware image is downloaded, checked and installed.
- ST now has ‘X-CUBE-SBSFU’ libraries on our website and these are provided as reference code to demonstrate state-of-the-art usage of the STM32 security protection mechanisms.

STM32H7 Hardware Solutions

Speed-up evaluation, prototyping and design

Startting at **$318**

Starting at **$87**

Starting at **$69**

Starting at **$27**

Evaluation Boards

Full feature STM32H7 evaluation

- STM32H743I-EVAL2
- STM32H753I-EVAL2
- STM32H747I-EVAL
- STM32H757I-EVAL

Discovery Kits

Flexible prototyping & demo

- STM32H745I-DISCO
- STM32H747I-DISCO
- STM32H747I-DISC1
- STM32H750B-DK

Nucleo Boards

Affordable and quick prototyping

- NUCLEO-H743ZI2
- NUCLEO-H753ZI
- NUCLEO-H745ZI / H755ZI
- NUCLEO-H745ZI-Q / H755ZI-Q

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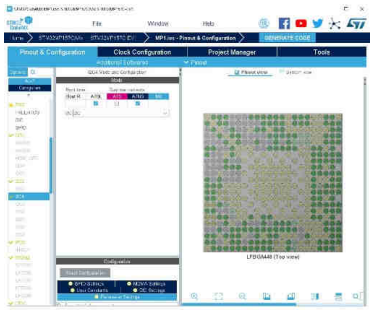
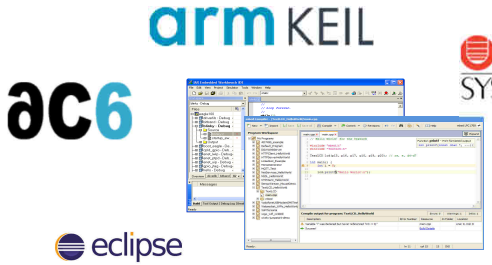
Software Tools for Dual-core Architecture

Complete support of Arm Dual Cortex-M architecture





STM32CubeMX

STM32CubeMX enhanced for Dual-core

- Configure and generate Code
- Multi-core resources allocation
- Peripherals configuration

IDEs
Compile and Debug

Multi-Core Solutions

- Partners IDE
- Free IDE based on Eclipse
- **Multi-core** debugging

STM32 Programming Tool

STM32CubeProgrammer

- Program the application into the chip
- Device information and readout
- Signing tool & Keys generation

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Thanks very much for your attention.

If you have any further questions, please feel free to email your questions to following email address.

Ramkumar.yadavalli@st.com

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