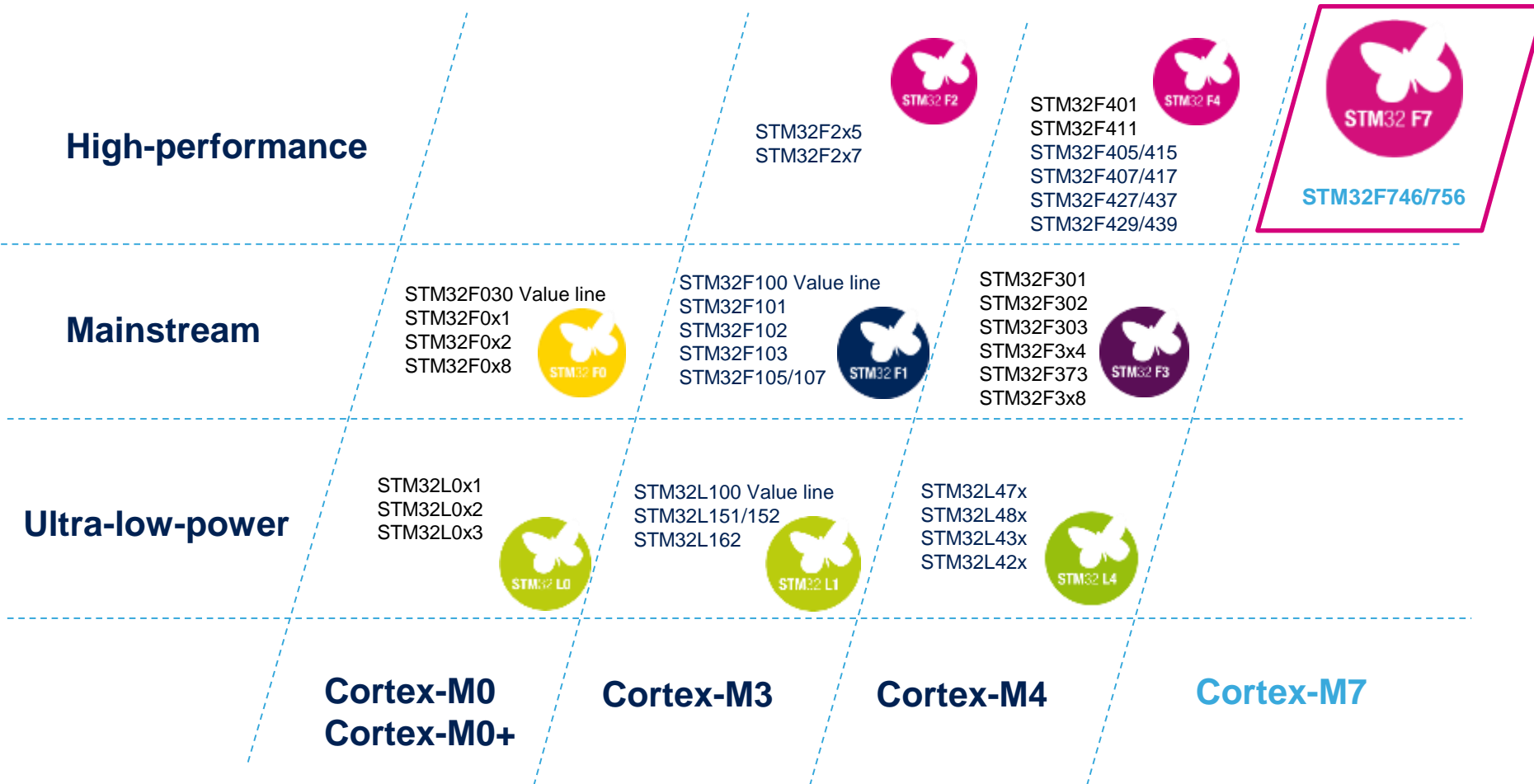




STM32 High Performance Platform

STM32F2, F4 and F7

8 product series / 30 product lines



High-performance platform Cortex Mx

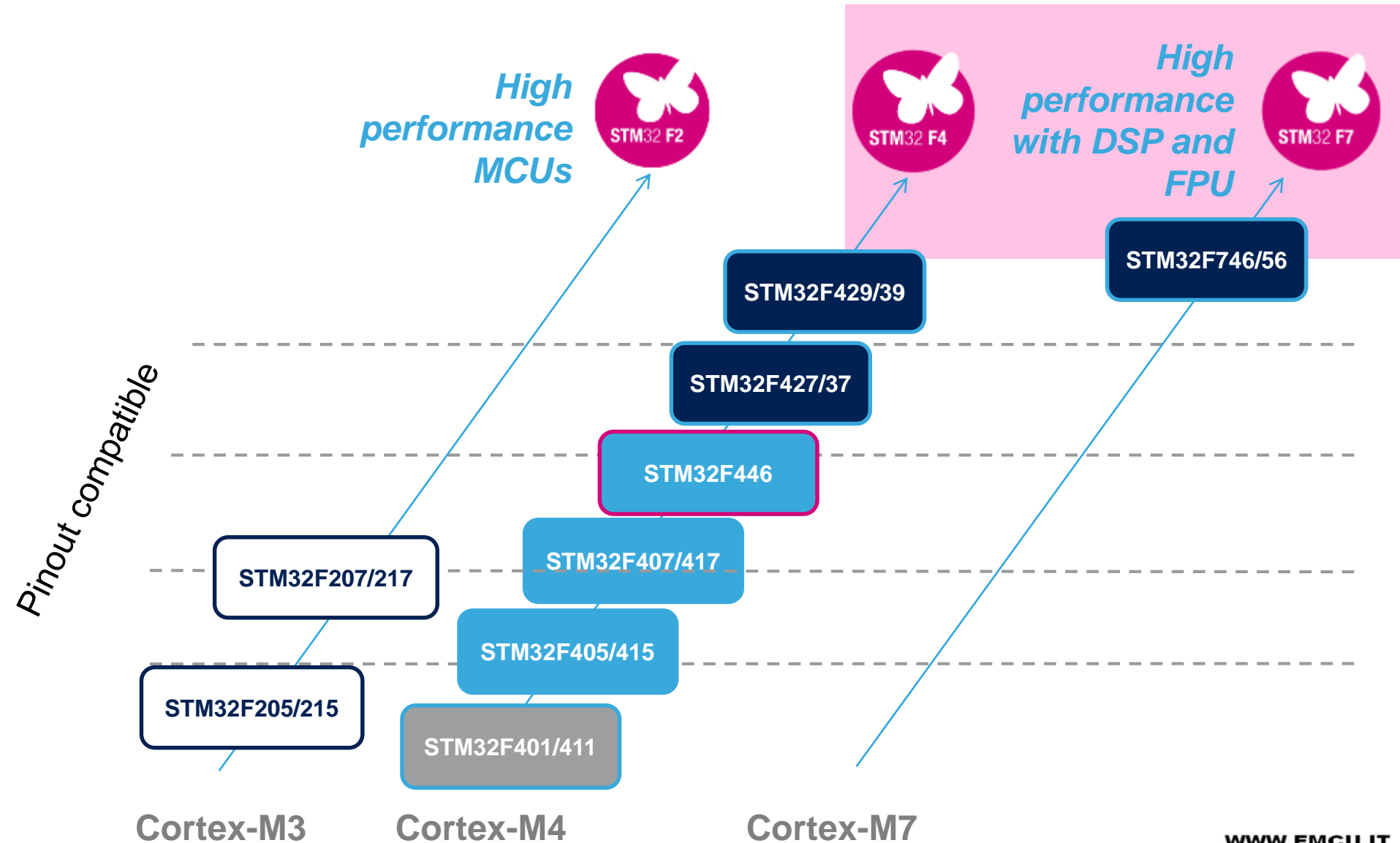
3

Access	Foundation	Advanced
		STM32F749
STM32F401 STM32F411	STM32F205 STM32F207 STM32F405 STM32F407	STM32F427 STM32F429
<ul style="list-style-type: none">• Entry level• Dynamic efficiency	<ul style="list-style-type: none">• Advanced Connectivity• Security option	<ul style="list-style-type: none">• Enhanced Graphic• High memory density• Security option

World's 1st MCU based on new Cortex-M7 w/ FPU
428DMIPS/1000 Coremarks,

- High performance, rich connectivity, high integration, Dynamic Efficiency
- From 105DMIPs up to 429DMIPS, based on Cortex-M3, M4 and M7

High-performance platform

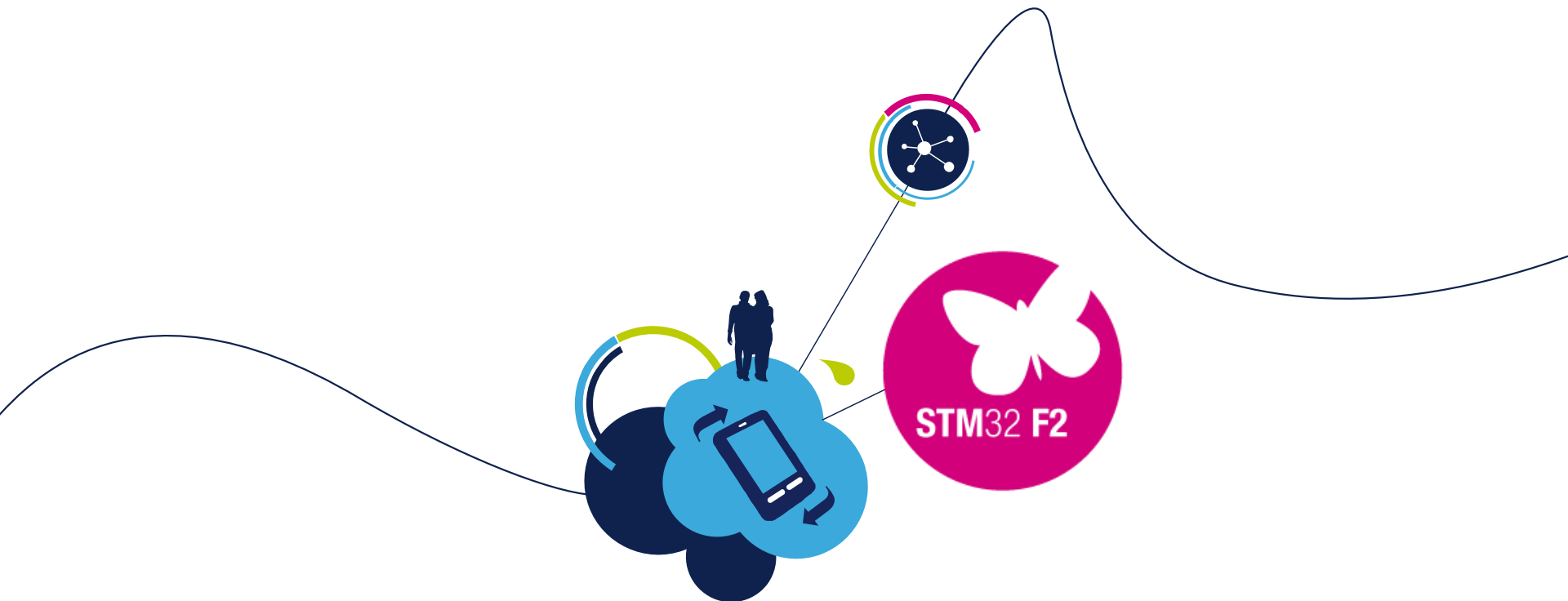


STM32F4 and F7 : #1 in performance Certified by COREMARK

5

<input type="checkbox"/>	Freescall Kinetis K70 90nm	IAR v6.50	150	3.40	510.02	510.02	-	comment	01/09/13
<input type="checkbox"/>	Renesas RX64M	IAR EWRX V2.50.1	120	4.25	510.20	510.20	✓	-	comment 03/12/14
<input type="checkbox"/>	NXP LPC1850	Green Hills Multi 2012.1	180	2.85	513.24	513.24	-	comment	05/11/12
<input type="checkbox"/>	Freescall MPC5674-F	DDCI, GCC 4.2.3	264	1.96	516.31	516.31	-	comment	06/24/13
<input type="checkbox"/>	STMicro STM32F417IGt6	IAR-EWARM-6.50	168	3.37	565.73	565.73	-	comment	11/20/12
<input type="checkbox"/>	NXP LPC4350	Green Hills Multi 2012.1	204	2.92	595.93	595.93	-	comment	05/09/12
<input type="checkbox"/>	STMicroelectronics STM32F427IGt6	IAR 6.60	180	3.38	608.19	608.19	-	comment	07/22/13
<input type="checkbox"/>	Microchip Technology PIC32MZ2048ECH100 MicroMIPS	Microchip MPLAB XC32 v1.33	200	3.18	636.97	636.97	✓	-	comment 09/24/14
<input type="checkbox"/>	Microchip PIC32MZ2048ECH100	Microchip MPLAB XC32v1.31	200	3.27	654.36	654.36	✓	-	comment 01/13/14
<input type="checkbox"/>	Infineon TC1793N-512F270EF AB	GCC 4.6.3 (HighTec)	270	2.45	662.69	662.69	-	comment	05/14/13
<input type="checkbox"/>	Freescall i.MX258	GCC4.7.2	400	1.76	704.32	704.32	PThreads	comment	01/03/13
<input type="checkbox"/>	Freescall MPC5676	DDCI, GCC 4.2.3	180	3.99	717.56	358.78	Proprietary	comment	07/09/13
<input type="checkbox"/>	Freescall MPC8313VRAFFB	GCC 4.2.1	330	2.32	765.48	765.48	-	comment	06/07/10
<input type="checkbox"/>	Freescall MPC8248CVRPIEA	gcc 4.4.6	300	2.76	827.13	827.13	-	comment	11/13/13
<input type="checkbox"/>	Freescall Vybrid MVF61NS151CMK50	GCC4.7.3 armv7L-timesys-linux-gnueabi	500	1.67	832.89	832.89	-	comment	12/31/69
<input type="checkbox"/>	Renesas SH7724	Code Sourcery gcc 4.4.1	500	1.71	856.90	856.90	-	comment	08/25/11
<input type="checkbox"/>	Freescall i.MX35	GCC 4.3.3	533	1.61	860.22	860.22	2:Forks	comment	11/26/12
<input type="checkbox"/>	STMicroelectronics STM32F756NGH6	IAR ANSI C/C++ Compiler V7.30.0.7673/W32 for ARM	200	5.01	1001.79	1001.79	✓	-	comment 09/24/14





STM32 F2 Series

High-performance MCUs

- **High performance Cortex-M3 MCU**, up to 120 MHz/150 DMIPS
- **High integration** thanks to ST 90nm process: up to 1MB Flash/128kB SRAM
- **Advanced connectivity**: USB OTG, Ethernet, CAN



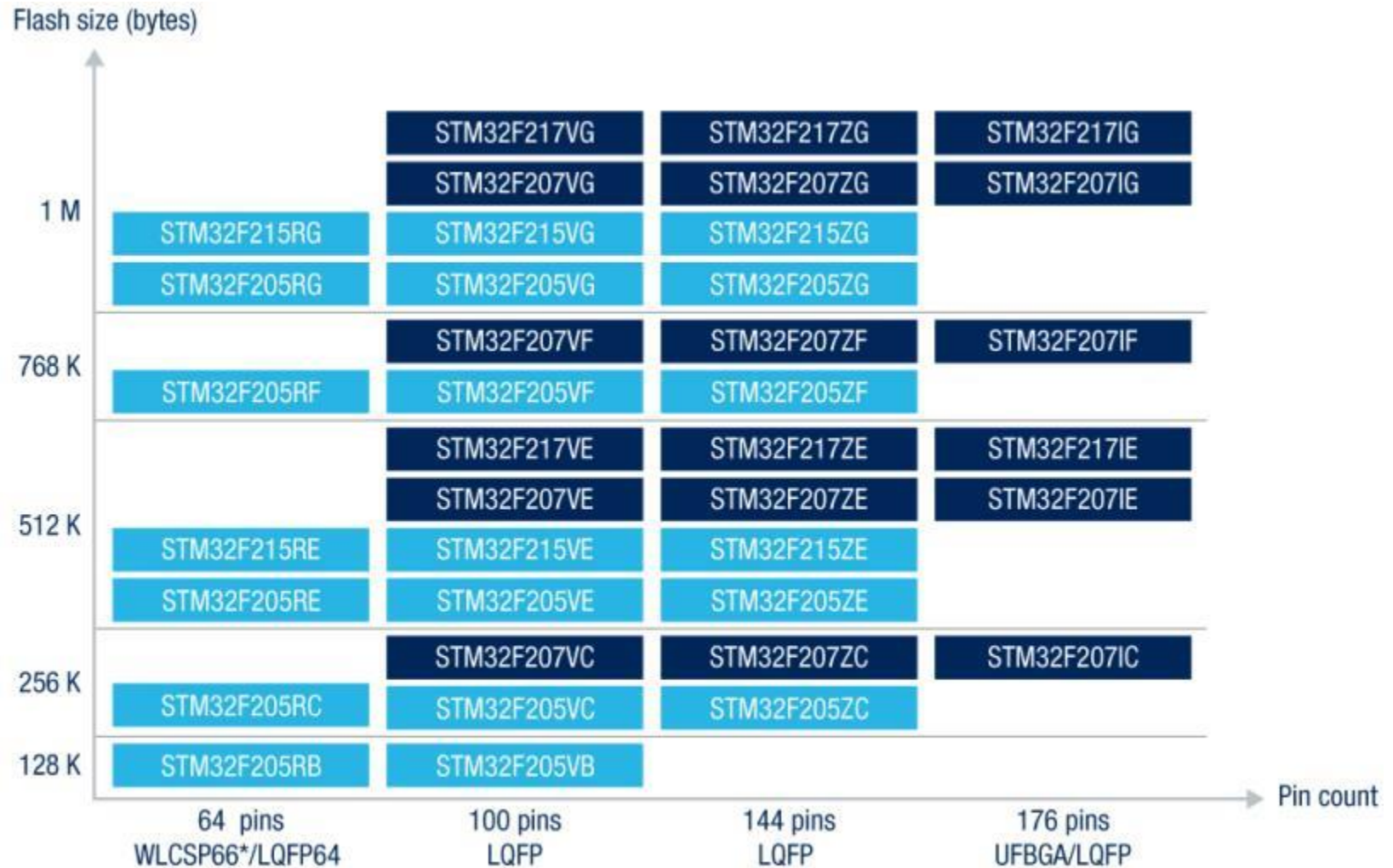


STM32 F2 Product lines

8

Cortex®-M3 – 120 MHz	<ul style="list-style-type: none"> ART Accelerator™ 2x USB2.0 OTG FS/HS SDIO USART, SPI, I²C 2x CAN I²S + audio PLL 16 and 32-bit timers 	Product line	FCPU (MHz)	FLASH (bytes)	RAM (KB)	Hardware Crypto/hash	2x 12-bit DAC	Ethernet I/F IEEE 1588	Camera I/F	FSMC
		STM32F205	120	128K to 1M	Up to 128		•			•
		STM32F215				•				
		STM32F207	120	512K to 1M	Up to 128		•	•		
		STM32F217				•				

Notes: 1/ 1.7 V for WLSCP66 package only and 1.8 V for all other packages
 2/ Hardware crypto/Hash available on STM32F215 and STM32F217 only



Note:

* STM32F205RG and STM32F205RE only

WWW.EMCU.IT



STM32 F2 Block diagram

10

- Packages

- WLSCP66 (<3.7x4mm)
- LQFP64, LQFP100
- LQFP144, LQFP176
- BGA176

- Operating voltage

- 1.7 to 3.6V

- Temperature range

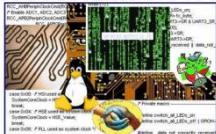
- -40 to 85 °C
- -40 to 105°C



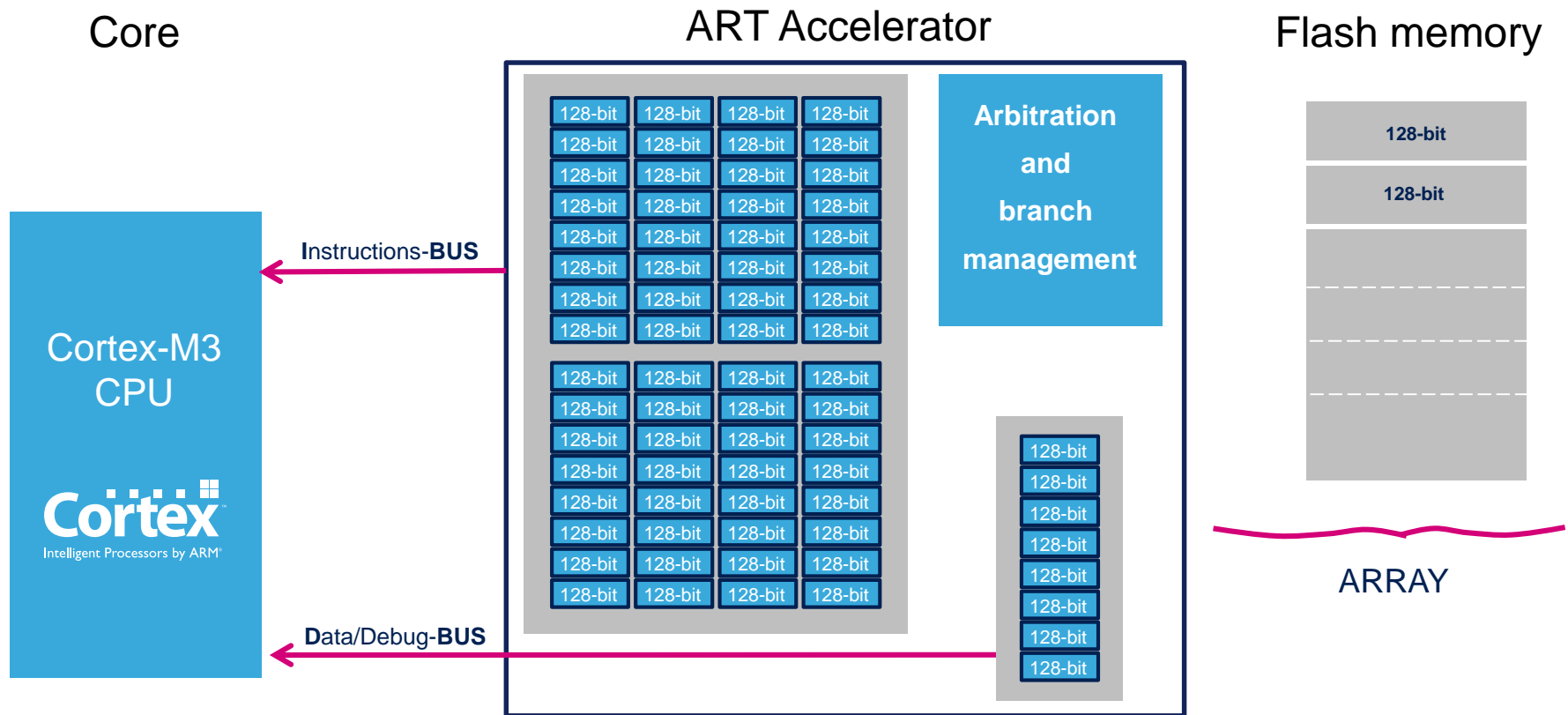
Notes:

1. HS requires an external PHY connected to the ULPI interface
2. Crypto/hash processor on STM32F217 and STM32F215

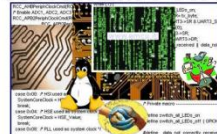
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- ART Accelerator™ for F2 series
 - The ART (Adaptive Real-Time) memory accelerator unleashes processing performance equivalent to 0-wait state Flash execution up to 120 MHz for F2 series



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STM32F2

Providing more performance

12

CoreMark score

398

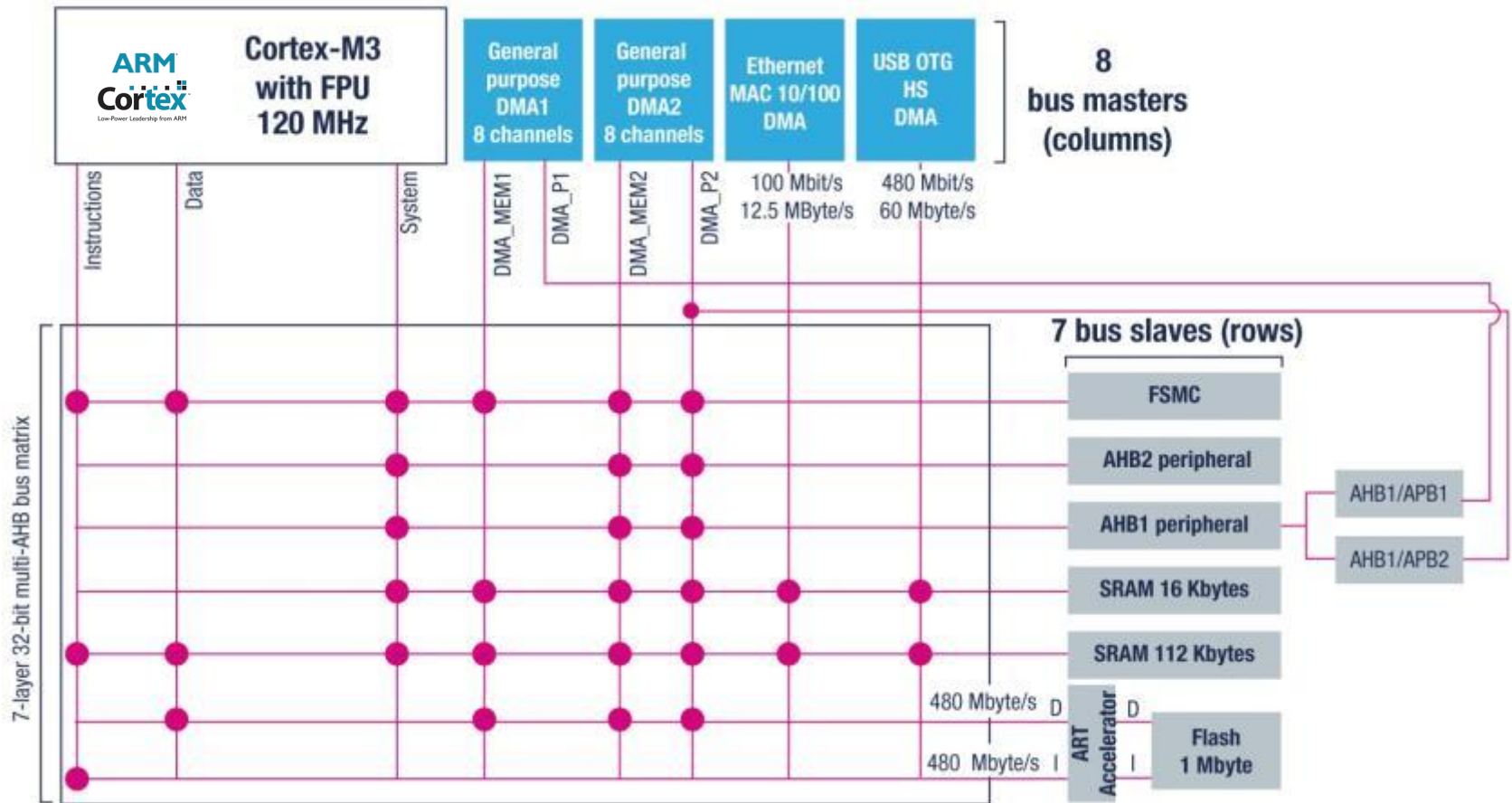
Linear **execution performance** from Flash

- **120 MHz/150 DMIPS** with ART Accelerator™
- **Up to 398** CoreMark Result
- ARM Cortex-M3

CPU frequency

120 MHz

32-bit multi-AHB bus matrix



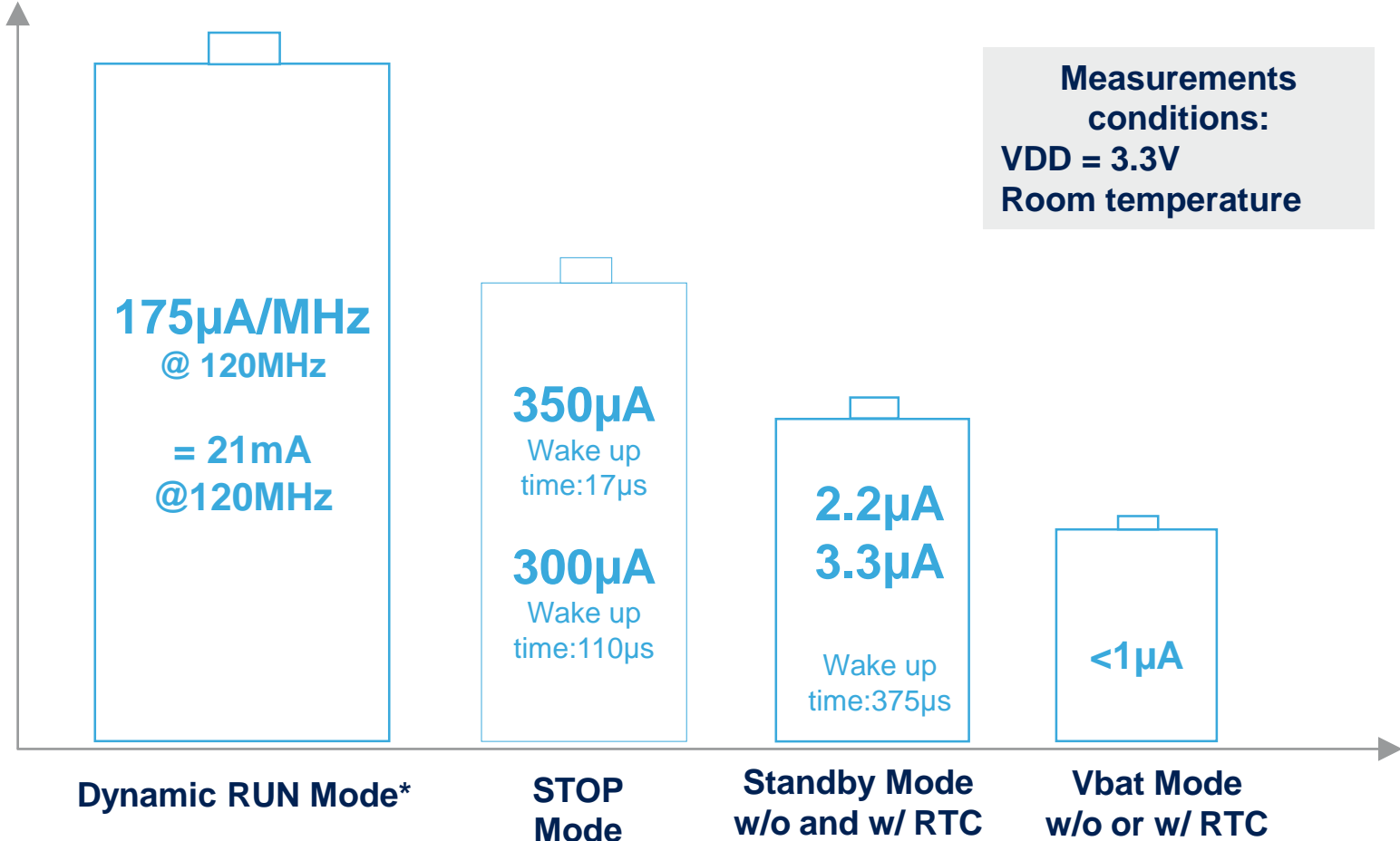
WWW.EMCU.IT



Power consumption figures

14

Typ current
Vdd Range



* Run mode Conditions: Coremark executed from Flash, peripherals OFF

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STM32F2 multiple applications

15



Industrial

- PLC
- Inverters
- Power meters
- Printers, scanners
- Power meters
- Industrial networking
- Industrial motor drive
- Communication gateway

Building & security

- Alarm systems
- Access control
- HVAC



Consumer

- PC peripherals, gaming
- Digital cameras, GPS platforms
- Home audio
- Wi-Fi , Bluetooth modules
- Smartphone accessories

Medical

- High-end glucose meters
- Power meters
- Battery-operated applications



STM32F2-specific tools and Software

16

- Evaluation boards:

- These boards provide connection to all I/Os and all peripherals available in the chip:
 - External memories, Ethernet, two USB OTG connectors, touchscreen TFT display, CMOS camera, audio output...

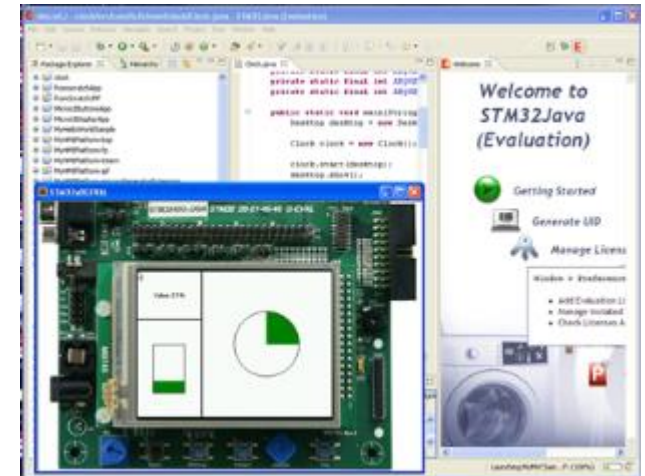


STM3220G-EVAL
STM3221G-EVAL

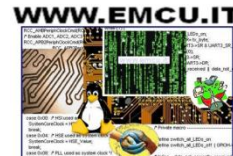
- Java evaluation kit:

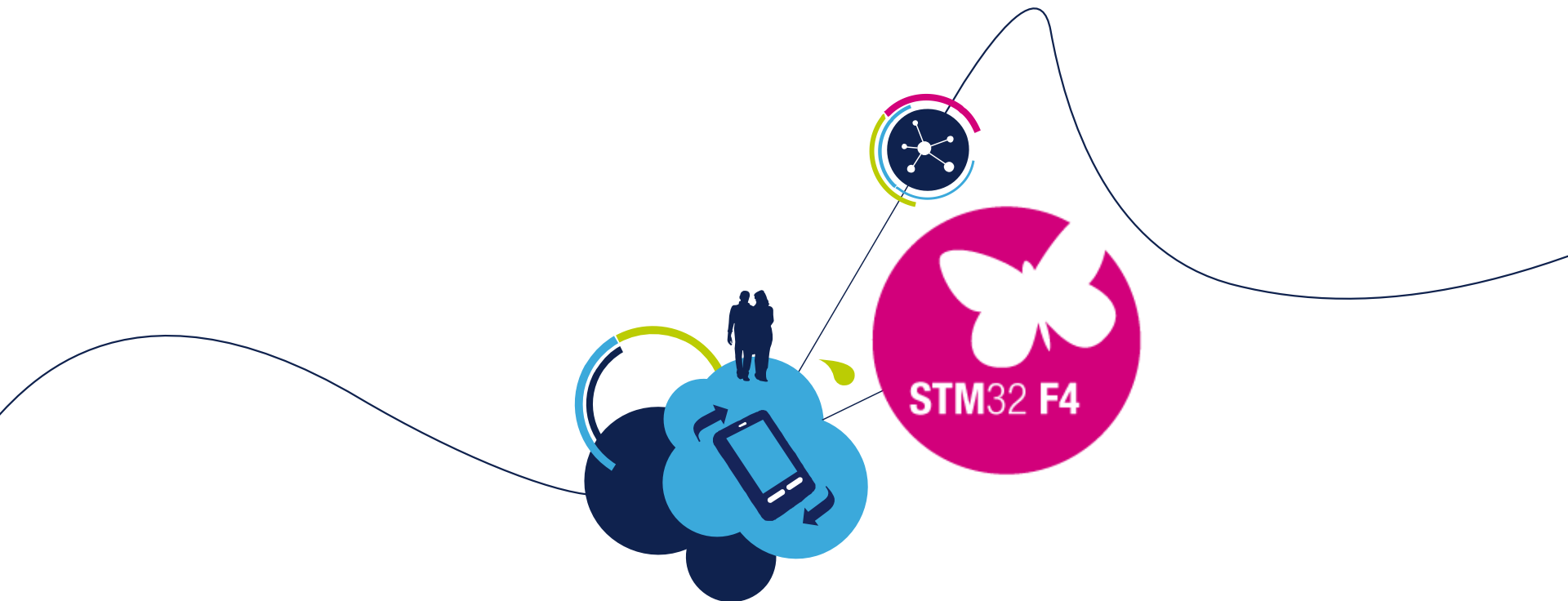
- Complete platform to evaluate the development of embedded applications in Java for the STM32 F2 series microcontrollers.

-> www.stm32java.com



STM3220G-JAVA

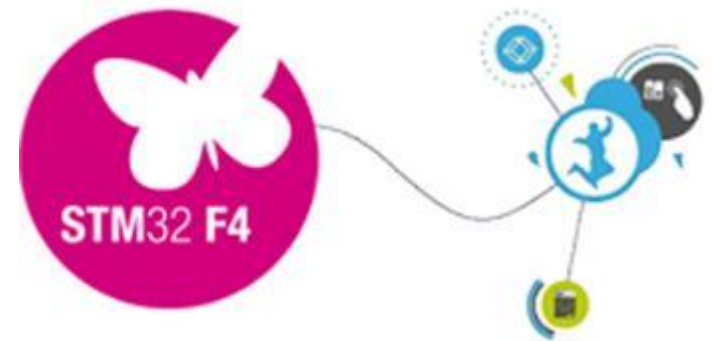


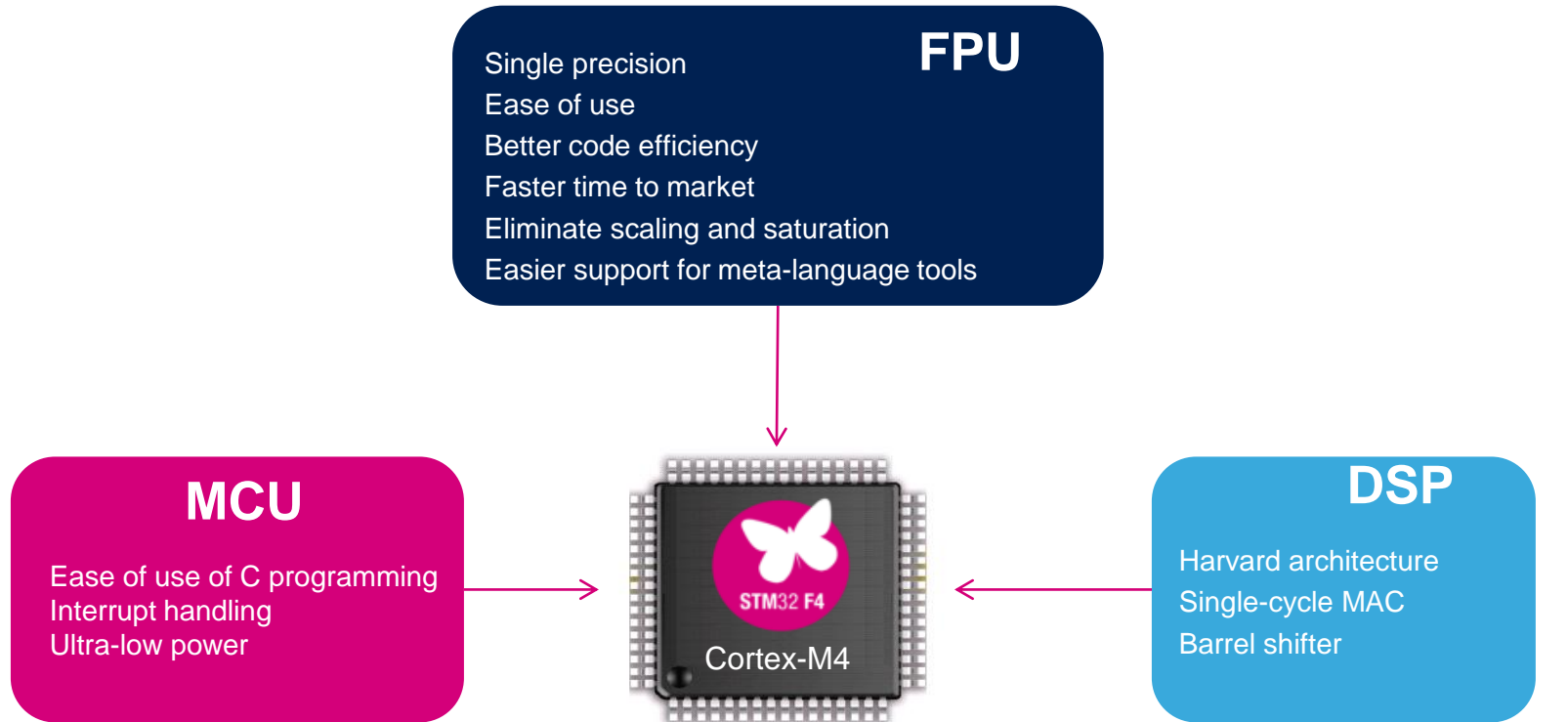


STM32 F4 Series

High-performance MCUs with DSP and FPU

- **World's highest performance Cortex-M MCU** executing from Embedded Flash, Cortex-M4 core with Floating Point Unit up to 180 MHz/225 DMIPS
- **High integration** thanks to ST 90nm process (same platform as F2 series): up to 2MB Flash/256kB SRAM
- **Advanced connectivity** USB OTG, Ethernet, CAN, SDRAM interface, TFT LCD controller





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High-performance platform

20

Access

STM32F401

STM32F411

Foundation

STM32F205

STM32F207

STM32F405

STM32F407

Advanced

STM32F427

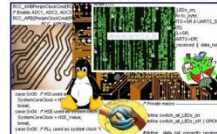
STM32F429

- Entry level
- Dynamic efficiency


- Advanced Connectivity
- Security option

- Enhanced Graphic
- High memory density
- Security option

- High performance, rich connectivity, high integration, Dynamic Efficiency
- Over 300 part numbers in production with close pin-to-pin compatibility
- From 105DMIPs up to 428DMIPS, based on Cortex-M3, M4 w/ FPU



ARM® Cortex®-M4 (DSP + FPU) – Up to 180 MHz	<ul style="list-style-type: none"> ART Accelerator™ enabling 0 wait state executing from internal Flash
	<ul style="list-style-type: none"> Up to 2x USB2.0 OTG FS/HS SDIO USART, SPI, I²C I²S + audio PLL 16 and 32-bit timers
	<ul style="list-style-type: none"> Up to 3x 12-bit ADC (0.41 μs) Up to 2x 12-bit DAC
	<ul style="list-style-type: none"> External memory controller (except for access lines) Low voltage 1.7¹ to 3.6 V

Lines	 Product	F _{CPU} (MHz)	Flash (bytes)	RAM (KB)	Ethernet I/F IEEE 1588	Camera I/F	SDRAM I/F	SAI ³ I/F	Chrom-ART Graphic Accelerator™	TFT LCD controller	MPI DSI
					2x CAN		Dual Quad-SPI	SPDIF RX			
Advanced	STM32F469 ²	180	512 K to 2 M	384	• •	•	• •	•	•	•	•
	STM32F429 ²	180	512 K to 2 M	256	• •	•	•	•	•	•	
	STM32F427 ²	180	1 to 2 M	256	• •	•	•	•	•		
	STM32F446	180	256 K to 512 K	128	• •	•	• •	• •			
Foundation	STM32F407 ²	168	512 K to 1 M	192	• •	•					
	STM32F405 ²	168	512 K to 1 M	192	•						

Line	STM32F4 Access line	F _{CPU} (MHz)	Flash (KB)	RAM (KB)	RUN current (μA/MHz)	STOP current (μA)	Small package (mm)	BAM (Batch Acquisition Mode)
Access	STM32F411	100	256 to 512	128	Down to 100	Down to 12	Down to 3.034x3.22	•
	STM32F410	100	64 to 128	32	Down to 89	Down to 6	Down to 2.553x2.579	•
	STM32F401	84	128 to 512	96	Down to 128	Down to 10	Down to 3x3	

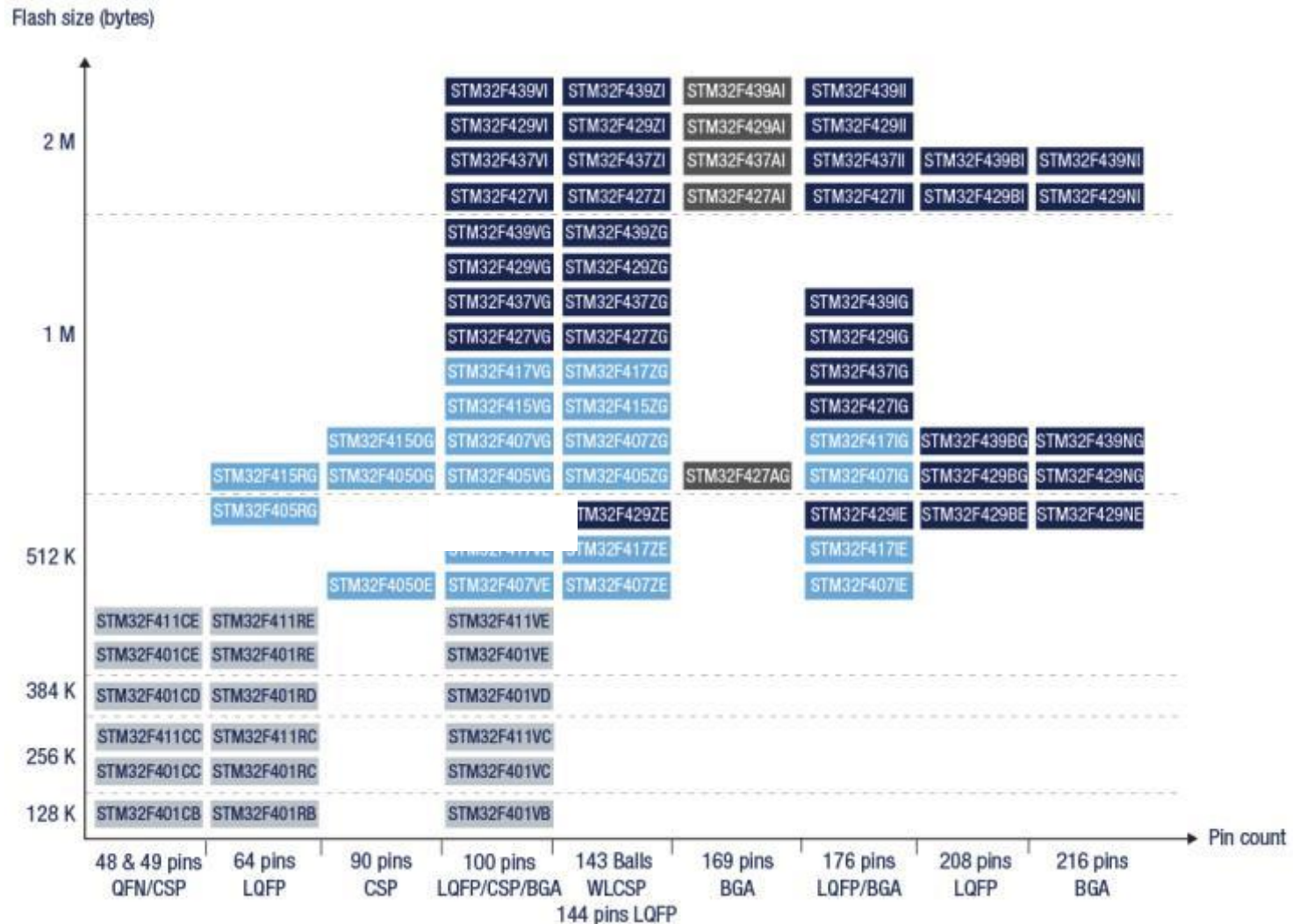
Notes: 1/ 1.7 V min on specific packages
2/ The same devices are also found with embedded Hardware crypto/hash

3/ Serial Audio I/F

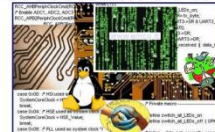


STM32F4 portfolio

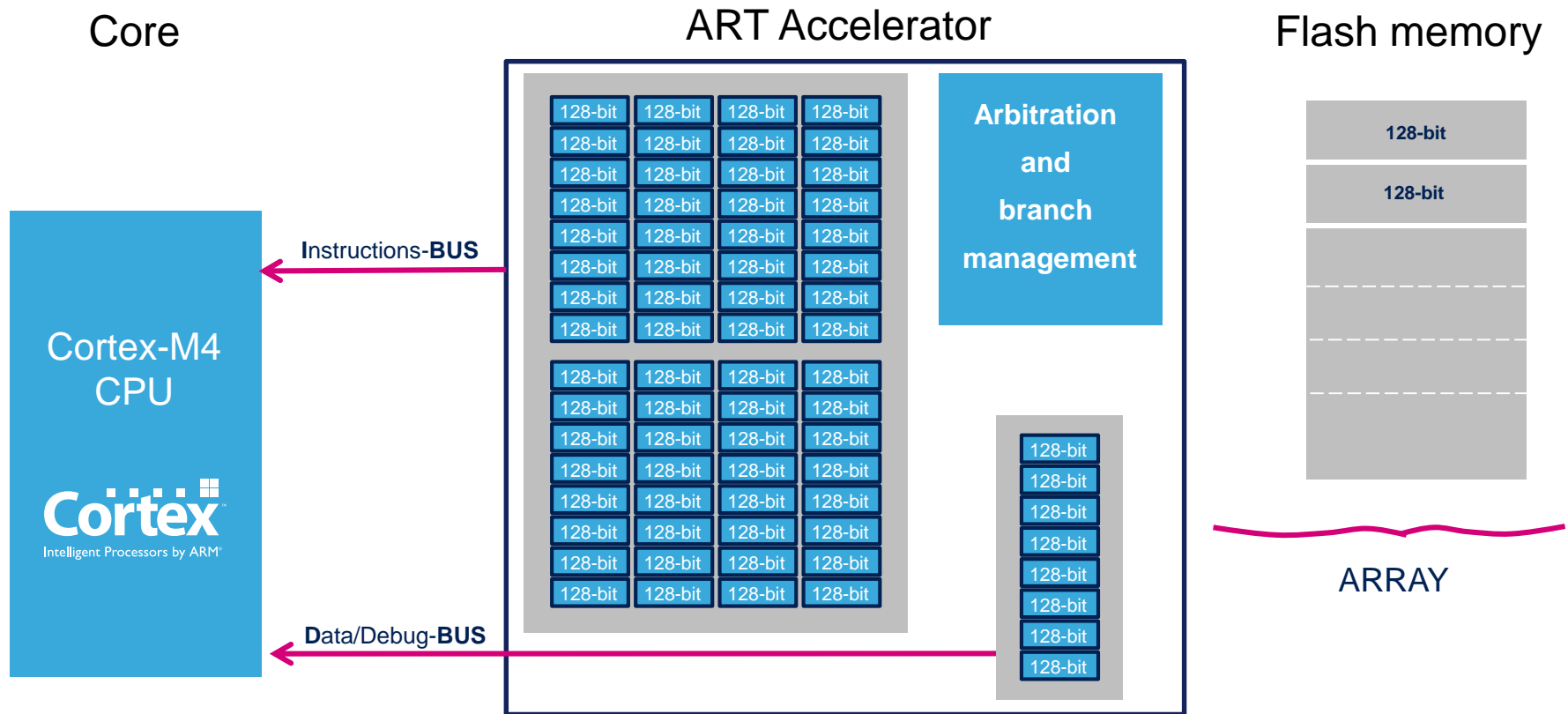
22



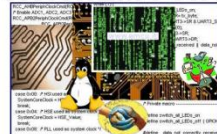
WWW.EMCU.IT



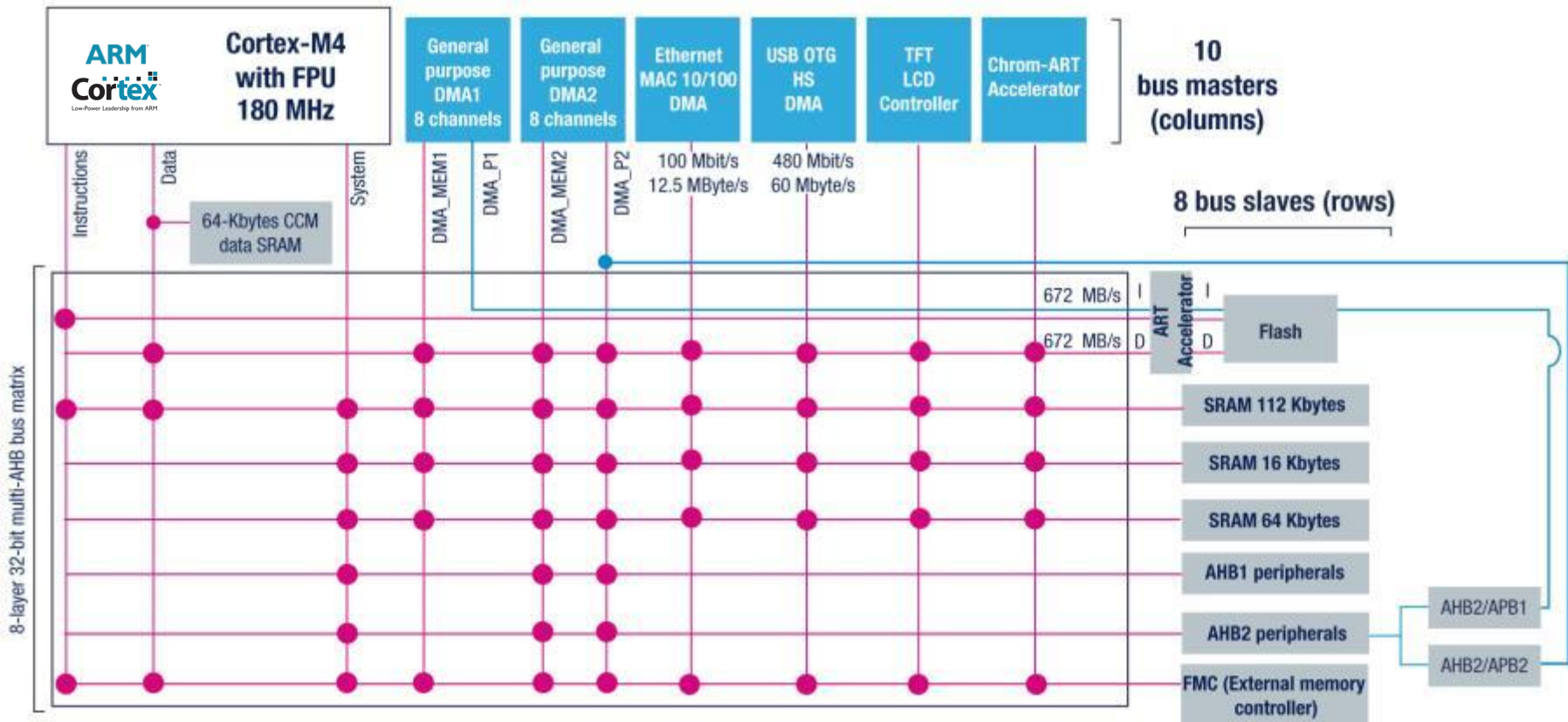
- ART Accelerator™ for F4 series
 - The ART (Adaptive Real-Time) memory accelerator unleashes processing performance equivalent to 0-wait state Flash execution up to 180 MHz for F4 series



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32-bit multi-AHB bus matrix



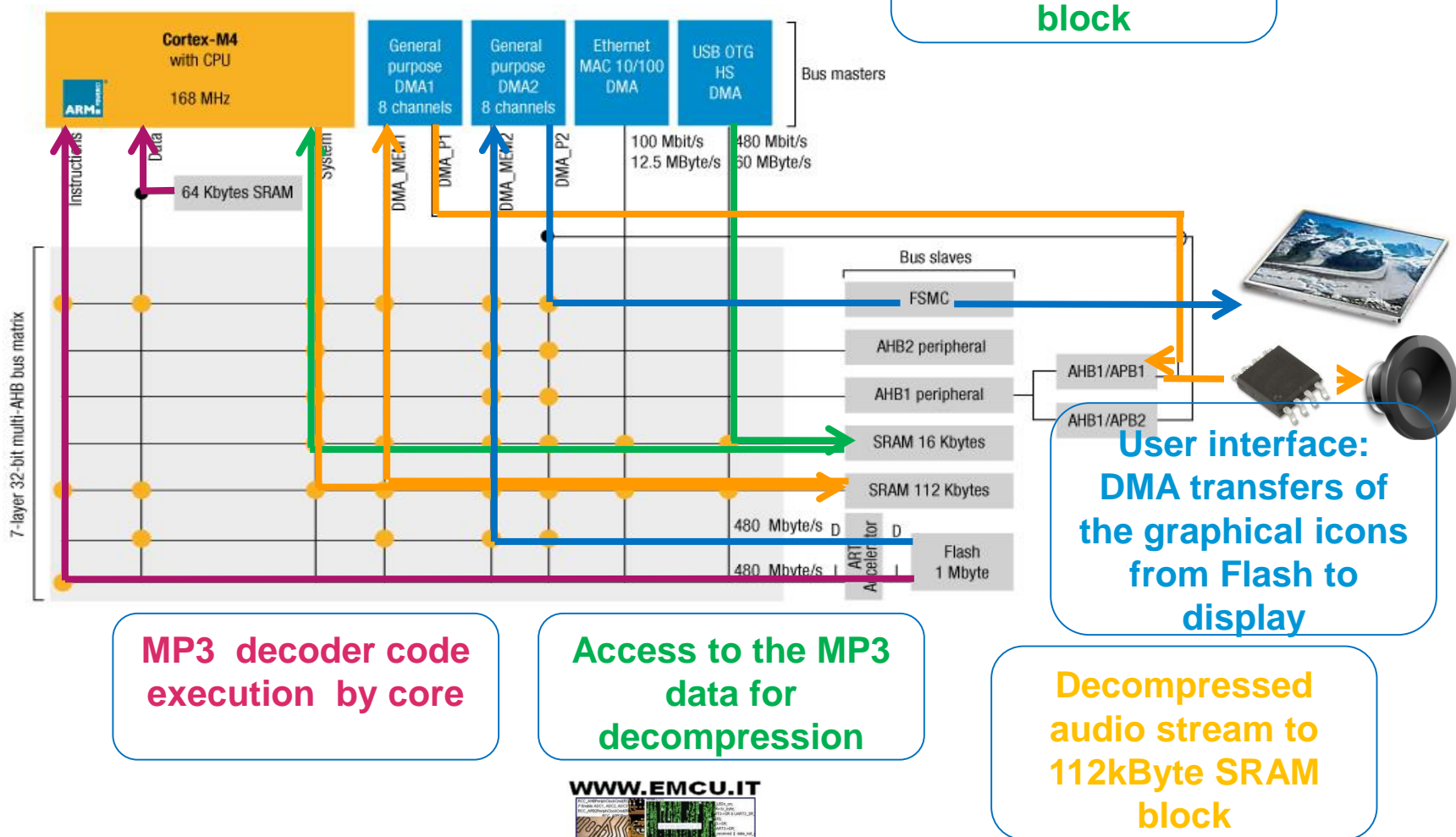
WWW.EMCU.IT



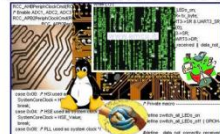


Real-time performance

32-bit multi-AHB bus matrix



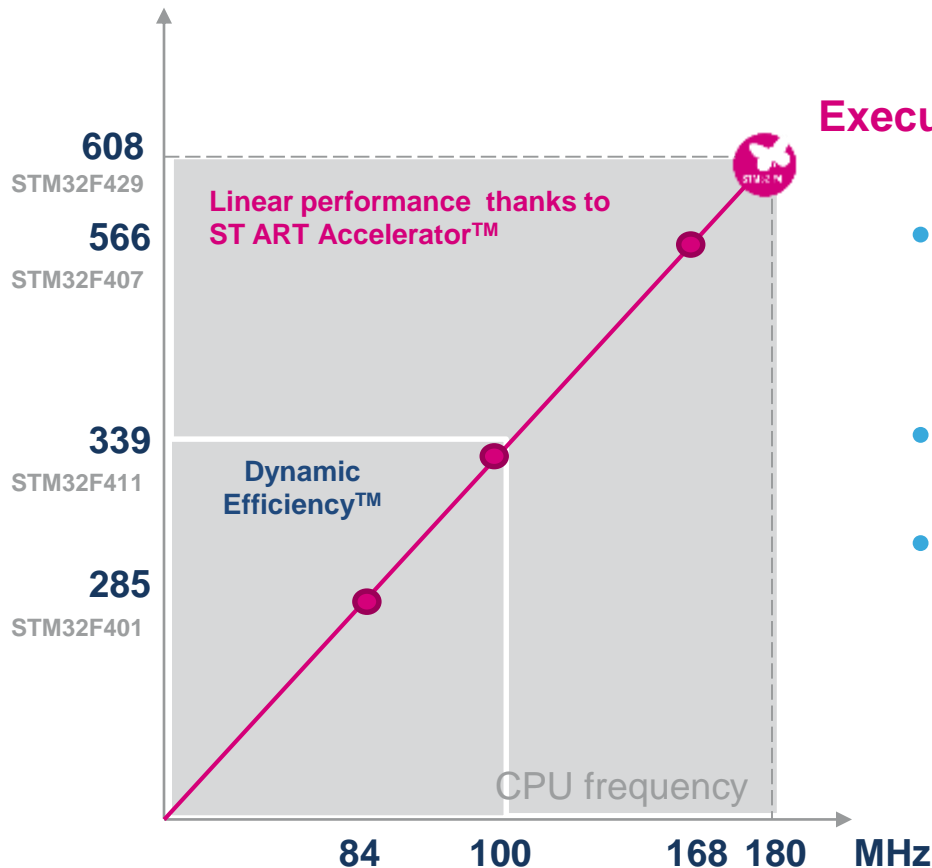
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Providing more performance

CoreMark score



Execution performance from Flash

- **Up to 180 MHz/ 225 DMIPS** with ART Accelerator™
- **Up to 608 CoreMark Result**
- ARM Cortex-M4 with floating-point unit (FPU)

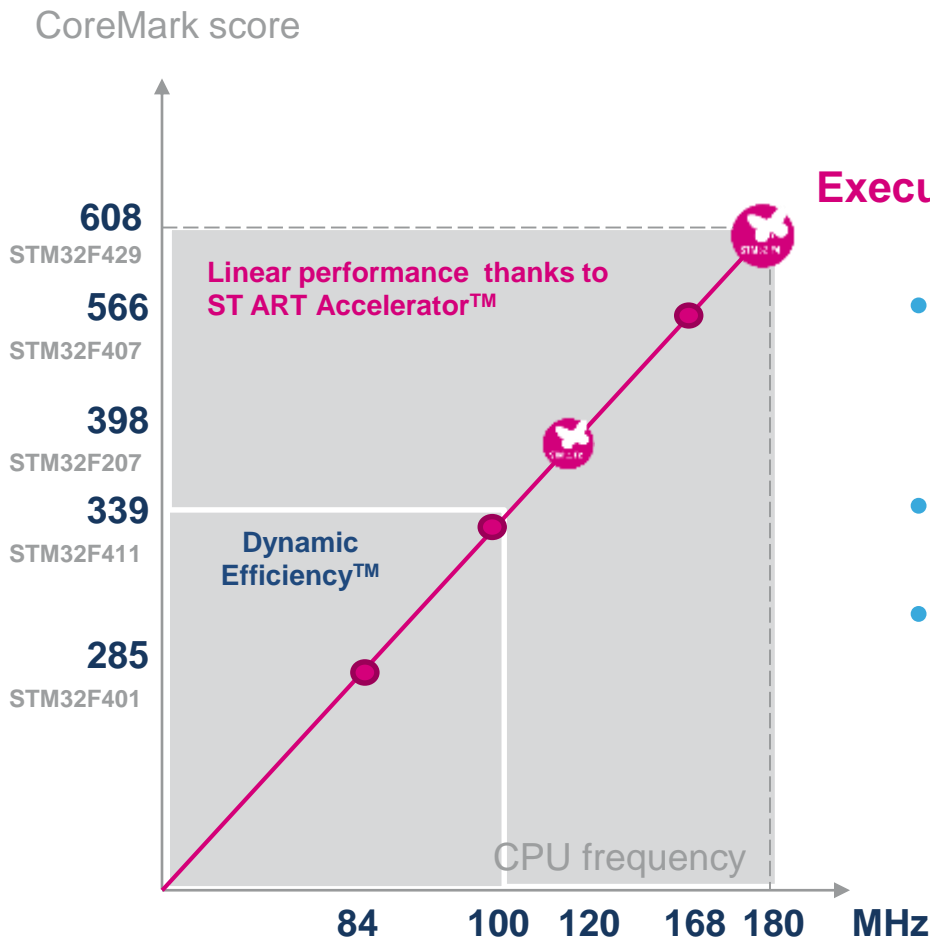




STM32F2 and F4

Providing more performance

27



- **Up to 180 MHz/ 225 DMIPS** with ART Accelerator™
- **Up to 608 CoreMark Result**
- ARM Cortex-M3 and Cortex-M4 with floating-point unit (FPU)



Peripherals	Performance
USB FS / HS	12 Mbit/s / 480 Mbit/s
USART	Up to 12.50 Mbit/s
SPI	Up to 50 Mbit/s
I ² C	Up to 1Mbit/s
GPIO toggling	Up to 90 MHz
3-phase MC timer	180 MHz PWM timer clock input
SDIO	Up to 50 MHz
I ² S and SAI	From 8 kHz to 192 kHz sampling frequencies
Camera interface	Up to 54 Mbyte/s at 54 MHz (8- to 14-bit parallel)
Crypto/hash processor	AES-256 up to 149.33 Mbyte/s
FMC	Up to 90 MHz (8-/16-/32-bit data bus, supports SRAM, PSRAM, NAND and NOR Flash, parallel graphic LCD), SDRAM, LPSPDRAM (Low Power SDRAM)
12-bit ADC / 12-bit DAC	0.41 μ s (2.4 MSPS, 7.2 MSPS in Interleaved mode) / 1 MSPS dual DAC
CAN 2.0B	Up to 2 independent CAN
Ethernet	10/100 Mbit/s MAC with hardware IEEE 1588
LCD TFT controller	Display size : QVGA, QWVGA, VGA, SVGA, XGA with 2-layer blending and dithering



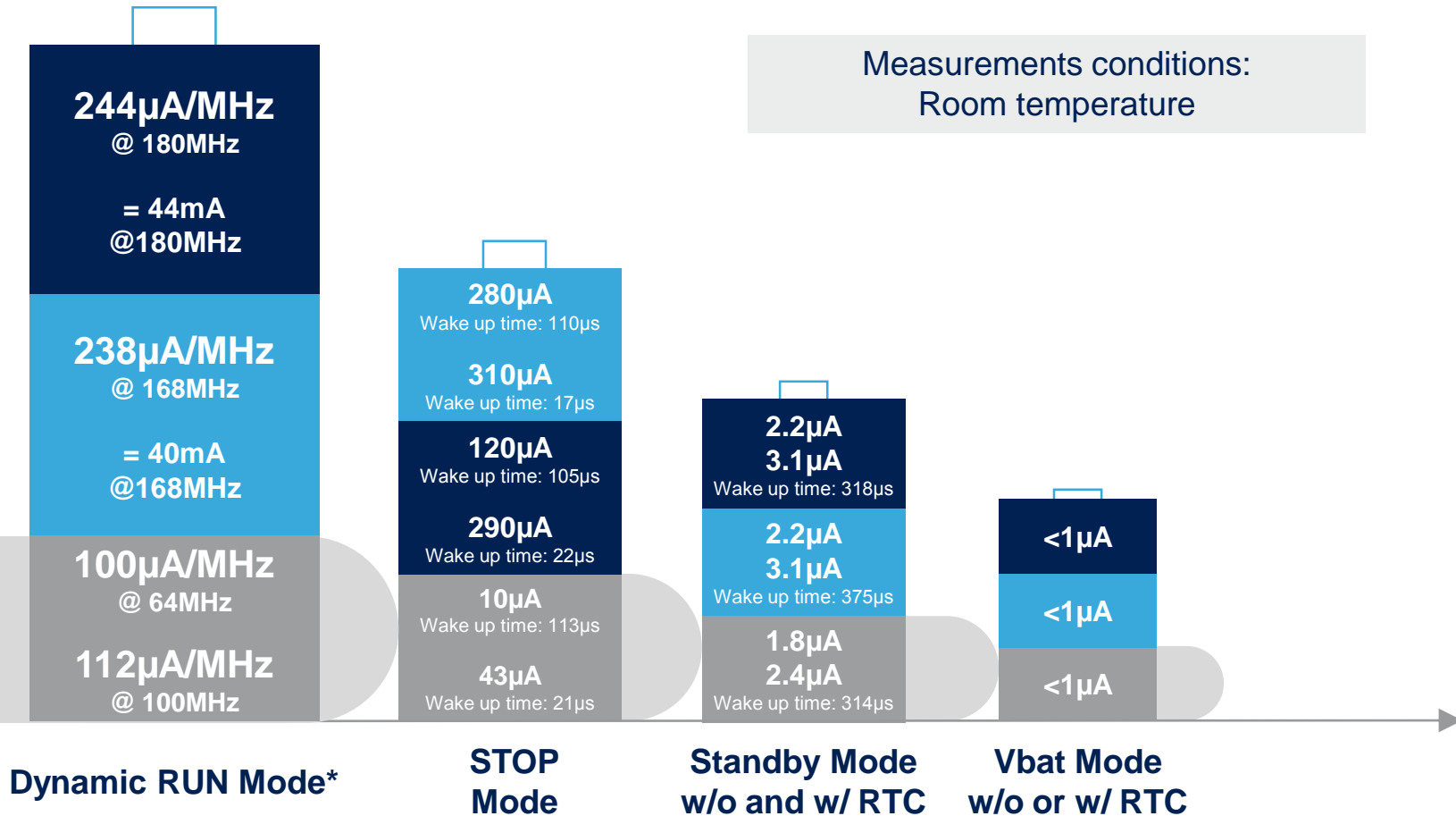
F4 Power consumption figures

29

Typ current

Measurements conditions:
Room temperature

F401**/F411
Dynamic
Efficiency
lines



■ STM32F427/437 and STM32F429/439 ■ STM32F405/415 and STM32F407/417 ■ STM32F401/F411

Legend:

*Run mode Conditions: Coremark executed from Flash, peripherals OFF

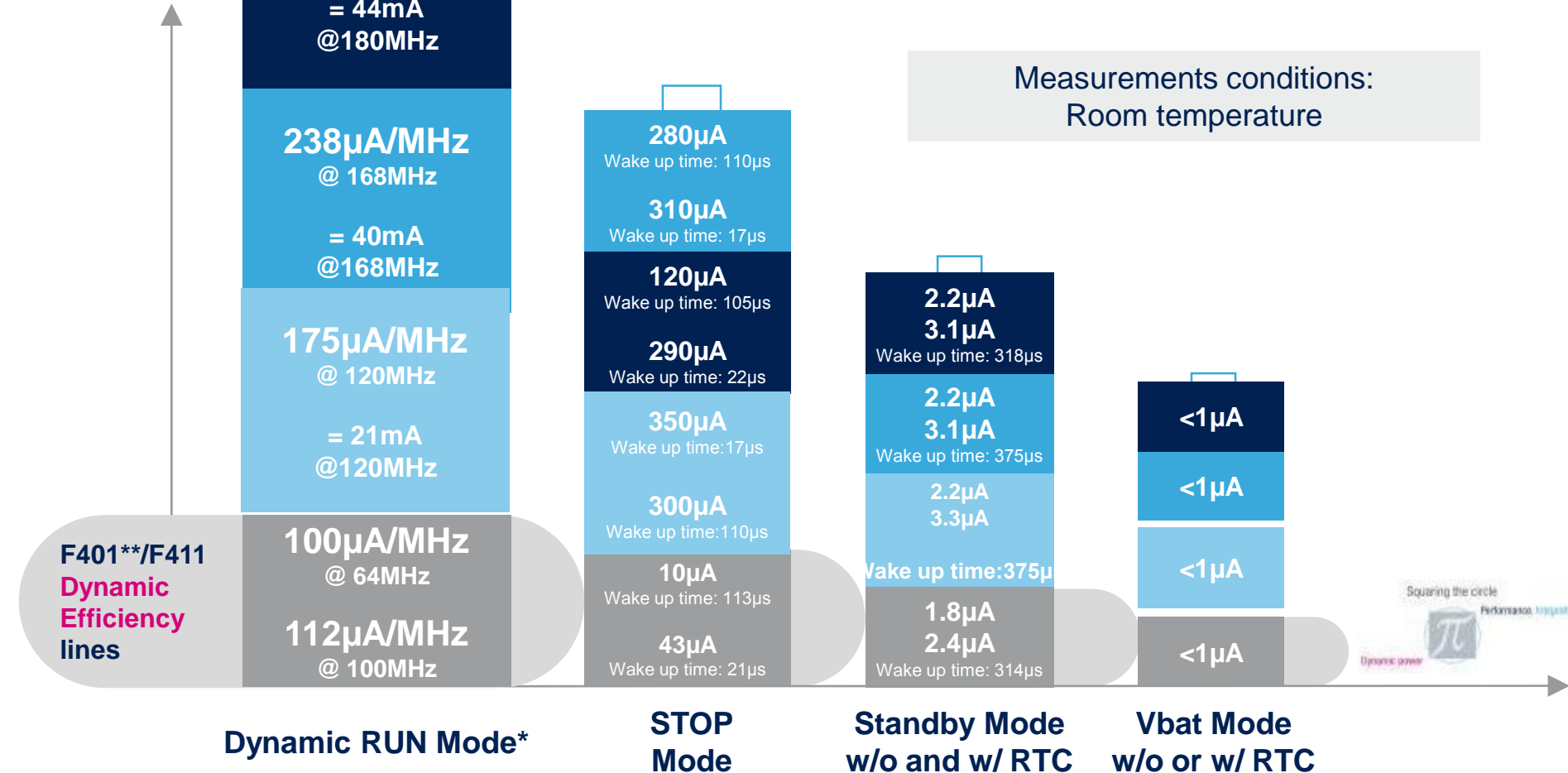
**For STM32F401:128 μ A/MHz @ 60MHz, 137 μ A/MHz @ 84MHz



Power consumption figures

Measurements conditions:
Room temperature

Typ current



STM32F427/437 and STM32F429/439

STM32F405/415 and STM32F407/417

STM32F401/F411

STM32F2x

Legend:

*Run mode Conditions: Coremark executed from Flash, peripherals OFF

**For STM32F401: 128μA/MHz @ 60MHz, 137μA/MHz @ 84MHz

F2 and F4 High integration

31

Series	STM32 High-performance platform	
Flash/SRAM (bytes)	STM32F2	STM32F4
256 K/64 K		WLCSP49 (3x3mm) UFBGA100 (7x7mm) UFQFPN48 (7x7mm) F401
512 K/96 K		WLCSP49 (3.07x3.07mm) UFBGA100 (7x7mm) UFQFPN48 (7x7mm) F401
512 K/128 K		WLCSP49 (3.034mm x 3.22mm) UFBGA100 (7x7mm) UFQFPN48 (7x7mm) F411
1 M/128 K	WLSCP66 (<3.7x4mm) F205	
1 M/192 K		WLSCP90 (<4x4.3 mm) F405
2 M/256 K		WLSCP143 (<4.5x5.6mm) F429





STM32F405/415/407/417

32

- Packages

- WLSCP90 (<4x4.3 mm)
- LQFP64
- LQFP100
- LQFP144
- LQFP176
- BGA176

- Operating voltage

- 1.7 to 3.6V

- Temperature range

- -40C to 85C
- -40C to 105C



Notes:

1. HS requires an external PHY connected to the ULPI interface
2. Crypto/hash processor on STM32F417 and STM32F415



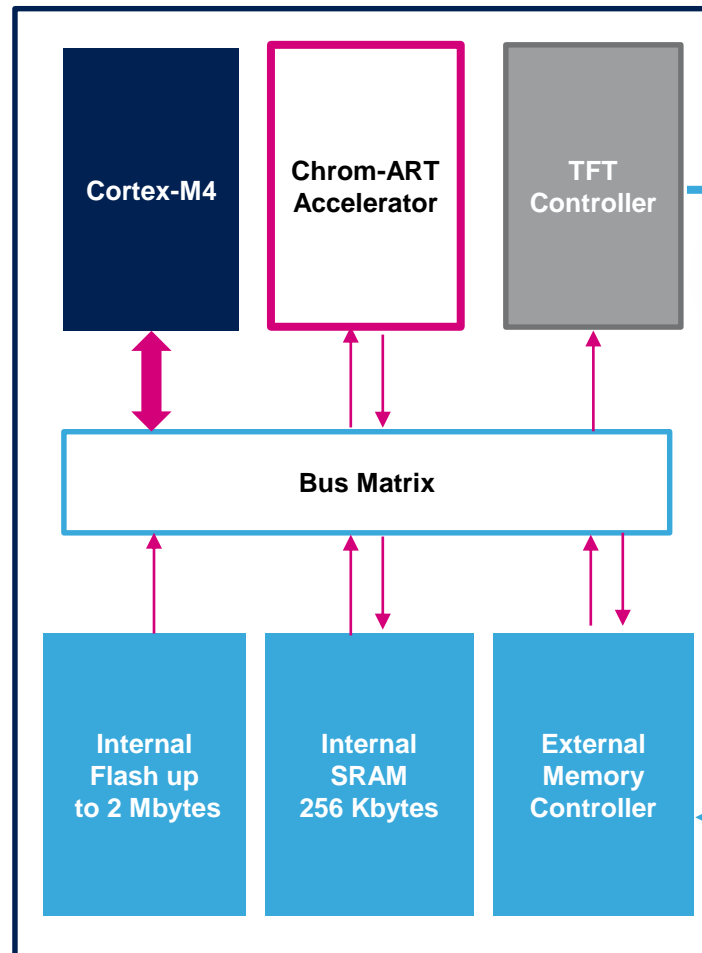
STM32F4 Advanced graphic lines

- 180 MHz/225 DMIPS
- Dual bank Flash (in both 1-MB and 2-MB), 256kB SRAM
- SDRAM Interface (up to 32-bit)
- LCD-TFT controller supporting up to SVGA (800x600)
- Better graphics with ST Chrom-ART Accelerator™:
 - x2 more performance vs. CPU alone
 - Offloads the CPU for graphical data generation:
 - Raw data copy
 - Pixel format conversion
 - Image blending (image mixing with some transparency)
- 100 μ A typ. in Stop mode

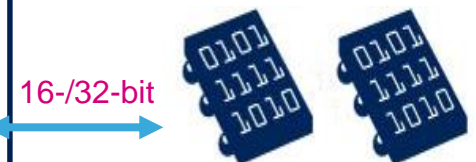
Press release: <http://www.st.com/web/en/press/en/p3357>

STM32F4x9 using Chrom-ART Accelerator, internal or external memory for frame buffer and TFT controller for display

- Up to XGA (1024 x 768)
- 16-/32-bit external memory interface
- Recommended packages: LQFP144, LQFP176/BGA176 or LQFP208/BGA216

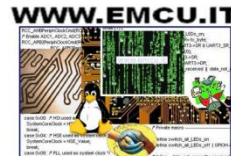


Dedicated TFT interface with fully programmable panel timings



Dedicated interface (up to 32-bit/90 MHz) with Flash, SRAM and SDRAM support

*HMI : Human Machine Interface





STM32F427/437/429/439

36

• Packages

- WLSCP143 (<4.5x5.6mm)
- LQFP100
- LQFP144
- LQFP176
- BGA176
- LQFP208
- BGA216

• Operating voltage

- 1.7 to 3.6V

• Temperature range

- -40C to 85C
- -40C to 105C



Notes:

1. HS requires an external PHY connected to the ULPI interface
2. Crypto/hash processor on STM32F415, STM32F417, STM32F437 and STM32F439
3. With digital filter feature, up to 1 Mbit/second
4. For STM32F4x9 only



STM32 Dynamic Efficiency™

Less Dynamic Power. More performance.

37

- **STM32 Dynamic Efficiency™** stands for the reduction of **P**ower consumption in run mode with a simultaneous increase in **P**rocessing **P**erformance and **I**ntegration (**P²I**).
- **STM32 Dynamic Efficiency™** brings innovation while applying existing ST advanced technologies.

STM32F401 and STM32F411 microcontrollers are the first 2 lines of STM32 Dynamic Efficiency™ devices



STM32 Dynamic Efficiency™

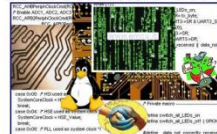
Less dynamic power
More performance

Squaring the circle

Performance. **Integration**



Dynamic power





STM32 Dynamic Efficiency TM

Technologies

39

- ART AcceleratorTM: Highest execution performance from Flash.
 - ST Adaptive Real Time (ART) Accelerator is a prefetch queue and branch cache allowing zero-wait execution from embedded Flash. The performance of the core is then fully unleashed and available to the user. Because it is much smaller in die size than a real cache, performance comes with high integration. Execution from the branch cache reduces the access to the Flash and reduces power consumption.
- ST 90 nm process: Less dynamic power. More integration and performance.
 - Higher integration comes with smaller capacities inside the transistors used inside the STM32 integrated circuit. This translates into faster performance as charge and discharge timings are reduced and into lower dynamic power.
- Voltage scaling: Optimum dynamic power consumption. Whatever your performance needs.
 - By allowing the user to dynamically adapt the core voltage to the performance needs, the user always gets the lowest dynamic current.
- Batch Acquisition Mode (BAM): Always ON data collection, even when the core is stopped.
 - DMA keeps transferring incoming data from peripherals to memory, and wakes up the core only when needed to reach the lowest power consumption. The core can either execute first level data processing from code stored in RAM or resume executing from Flash.



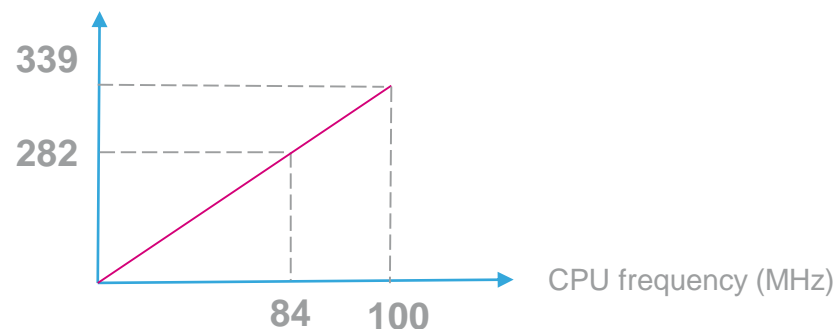
STM32F401/F411 Highlights

40

The best balance

- Performance**

CoreMark score



- Power consumption**



- Integration**





STM32F401 & STM32F411

main specification details

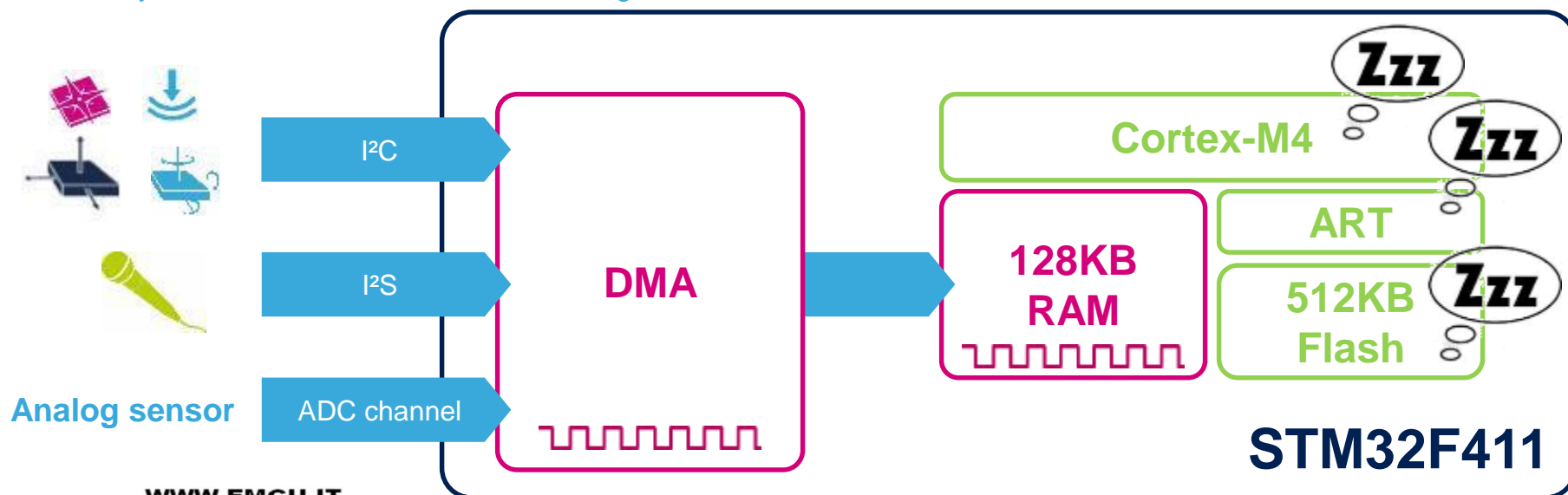
41

Flash low power mode use cases

- Batch Acquisition Mode (BAM) where the MCU core is stopped while interfaces (I²C, SPI, I²S, ...) are fetching data, being able to put the flash in power down will reduce even further the power consumption
- Applications where the MCU core and the RAM are running without the flash

Flash low power mode application example

- MCU core is in sleep mode (core clock stopped waiting for interrupt)
- Interface are running
- Flash is in power down and flash interface (ART[™] accelerator) clock is stopped
- Only DMA channel are enabled and running

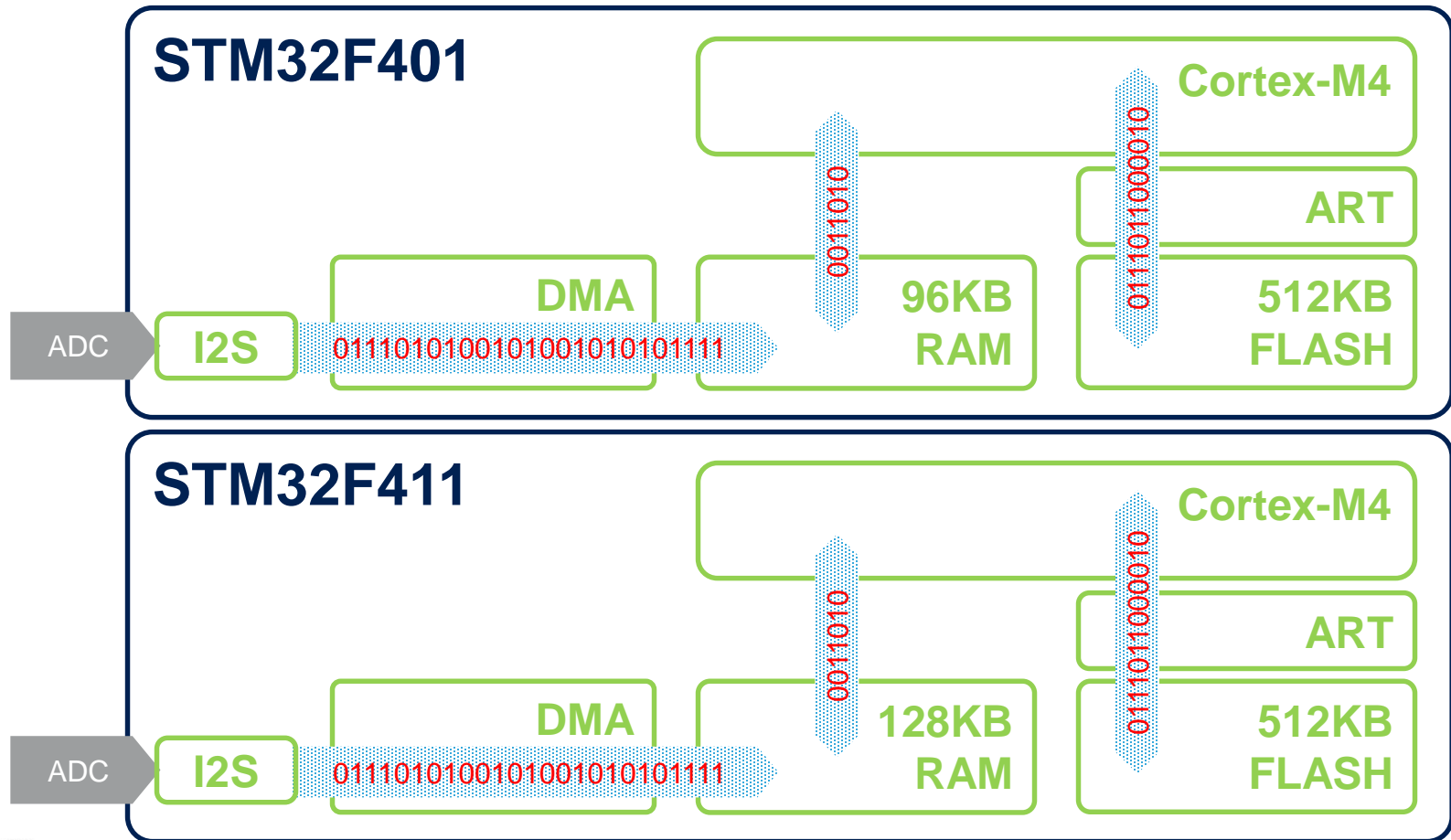


WWW.EMCU.IT

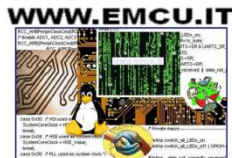
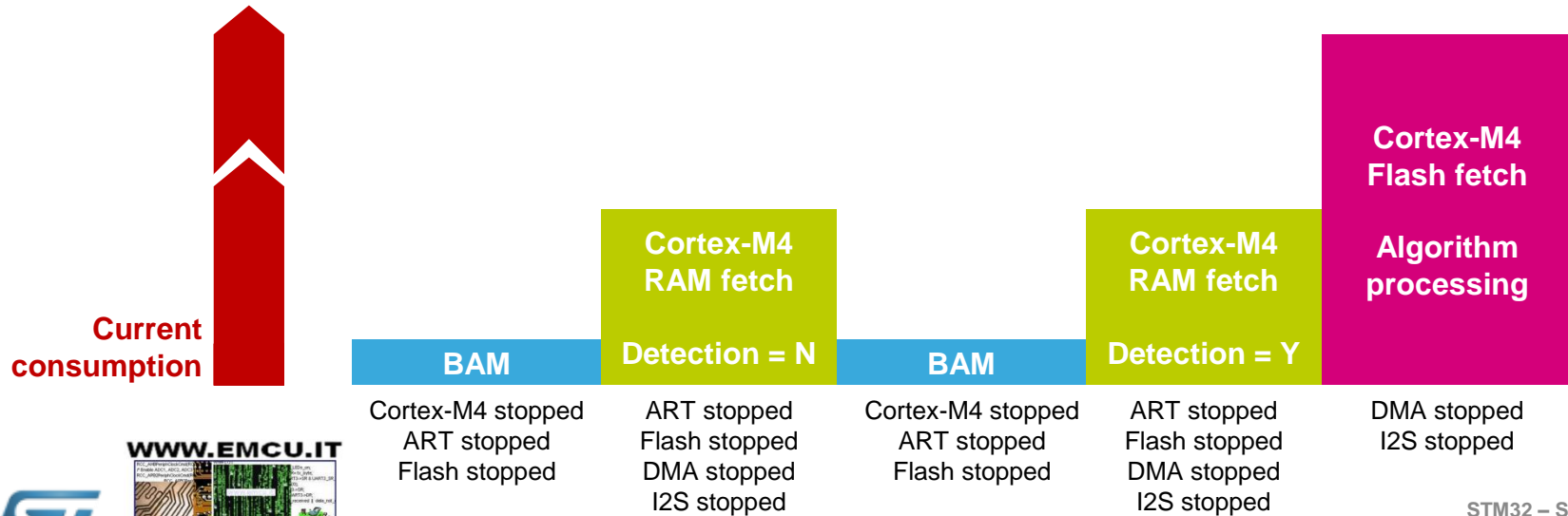
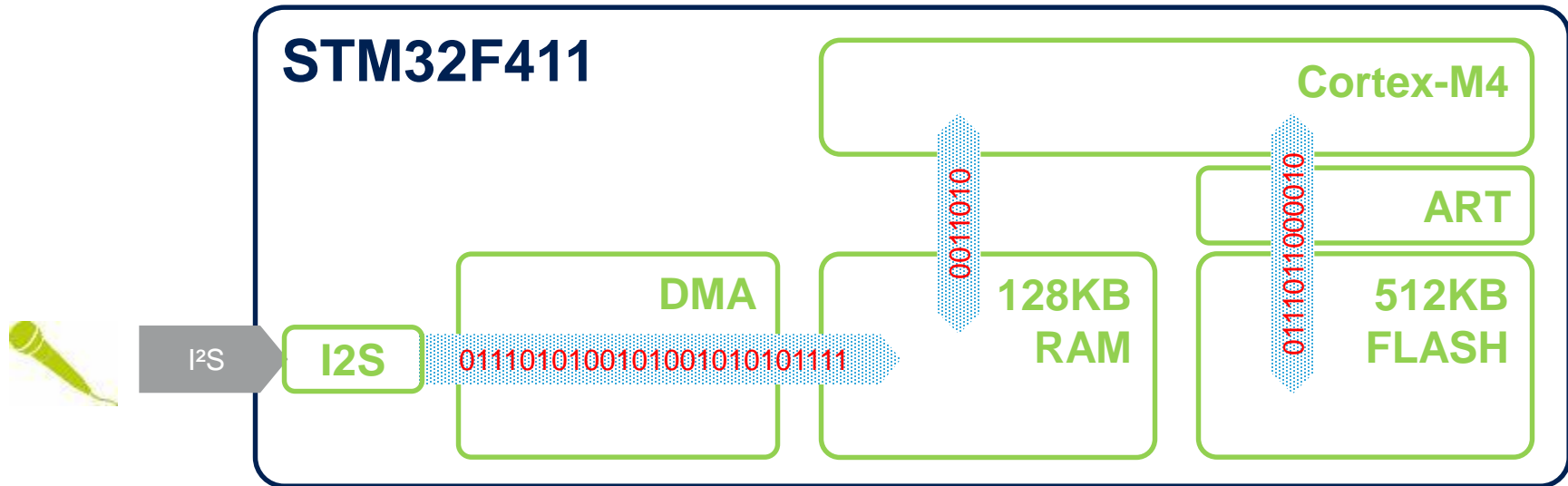


Enhanced peripheral sleep management

42

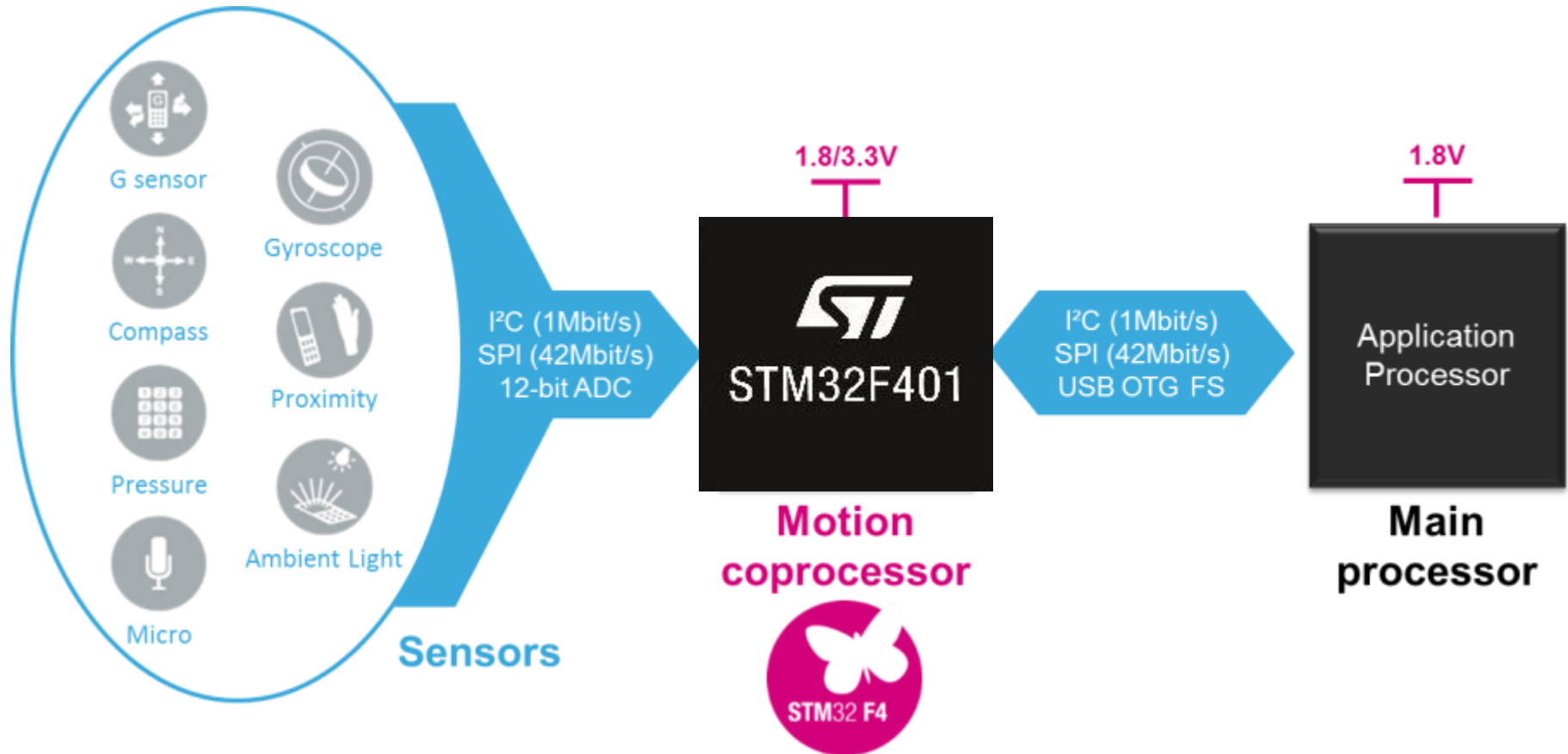


Batch Acquisition Mode (BAM) – Audio ex.



Example: STM32F401 as sensor hub

44





STM32F401 128kB/256kB Flash

Dynamic Efficiency Line

45

- Packages

- WLSCP49 (3x3 mm)
- UFQFN48
- LQFP64
- LQFP100
- BGA100



- Operating voltage

- 1.7 to 3.6V

- Temperature range

- -40C to 85C
- -40C to 105C



Notes:

1. With digital filter feature, up to 1 Mbit/second



STM32F401 384kB/512kB Flash

Dynamic Efficiency Line

46

• Packages

- WLSCP49 (around 3.07x3.07 mm) pin to pin compatible with 128kB and 256kB F401
- UFQFN48
- LQFP64
- LQFP100
- BGA100

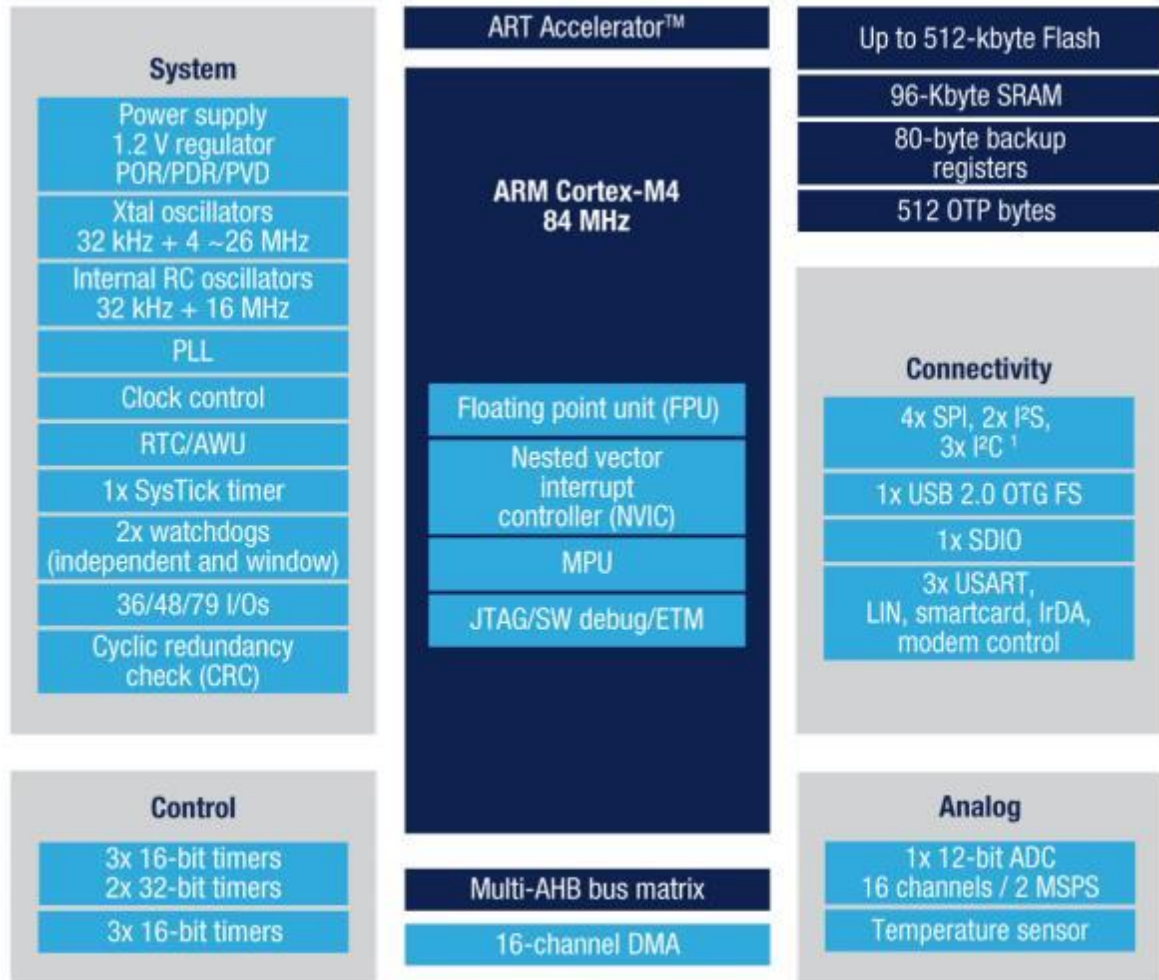


• Operating voltage

- 1.7 to 3.6V

• Temperature range

- -40C to 85C
- -40C to 105C



Notes:

1. With digital filter feature, up to 1 Mbit/second



STM32F411 256kB/512kB Flash Dynamic Efficiency Line

- 100MHz/125 DMIPs from flash
- Down to 100uA/MHz, 10uA typical in STOP mode
- Batch Acquisition Mode (BAM)
- 5 SPI/5 I2S (2 full duplex)
- Packages
 - WLSCP49 (3.034mmx3.22mm)
 - UFQFN48, LQFP64, LQFP100, BGA100
 - Operating voltage
 - 1.7 to 3.6V



Note:

1. With digital filter feature, up to 1 Mbit/second



STM32F4 multiple applications

48



Industrial

- PLC
- Inverters
- Power meters
- Printers, scanners
- Industrial networking
- Industrial motor drive
- Communication gateway

Building & security

- Alarm systems
- Access control
- HVAC



Consumer

- PC peripherals, gaming
- Digital cameras, GPS platforms
- Home audio
- Wi-Fi , Bluetooth modules
- Smartphone accessories

Medical

- High-end glucose meters
- Power meters
- Battery-operated applications



STM32F4 real life applications

49



Smart watch:
Main application controller or sensor hub

Smart phone, tablets and monitor
sensor hub for MEMS and optical touch



Industrial/home automation panel:
Main application controller

STM32F4 real life applications

50



Wi-Fi modules for the Internet of Things: Appliance, Door Camera



+



STM32F4 specific Hardware

51

- Evaluation boards:

Large offer of evaluations boards:

- STM3240G-EVAL
- STM3241G-EVAL
- STM32429I-EVAL
- STM32439I-EVAL



STM32439I-EVAL



STM32429I-EVAL



**32F429IDISCOVERY
32F401CDISCOVERY
32F411EDISCOVERY**



STM32F4DISCOVERY

- Discovery kits:

- STM32F4DISCOVERY
- 32F401CDISCOVERY
- 32F411EDISCOVERY (Q4 2014)
- 32F429IDISCOVERY

- Nucleo kit:

- NUCLEO-F401RE
- NUCLEO-F411RE



**NUCLEO-F401RE
NUCLEO-F411RE**

- Graphical Stack -> www.st.com/stemwin
 - SEGGER and ST signed an agreement around emWin graphical stack. The solution is called **STemWin**:
 - Professional well-known stack solution
 - All emWin Widgets and PC Tools: GUIBuilder, simulator, widgets
 - Free for all STM32, delivered in binary
 - **Takes benefit from STM32F4 Chrom-ART Accelerator! - Week37**
- Audio offer: Full solution optimized for STM32F4
 - Full collection of codecs:
 - MP3, WMA, AAC-LC, HE-AACv1, HE-AACv2, Ogg Vorbis, G711, G726, IMA-ADPCM, Speex, ...
 - **ST Post Processing Algorithms**:
 - Sample Rate Converters
 - Filters with examples like Bass Mix, Loudness....
 - Smart Volume Control: volume increase with no saturation
 - Stereo Widening



- **Beyond C Language !**
- **Java evaluation kit:**
 - Complete platform to evaluate the development of embedded applications in Java for the STM32 F4 series microcontrollers.

-> www.stm32java.com



STM3240G-JAVA

- **.Net Micro framework**
 - Full support for Microsoft .Net Micro Framework
 - Full support for Microsoft Gadgeteer hobbyists initiative



STM3240G-ETH/NMF + STM3240G-USB/NMF

STM32F446

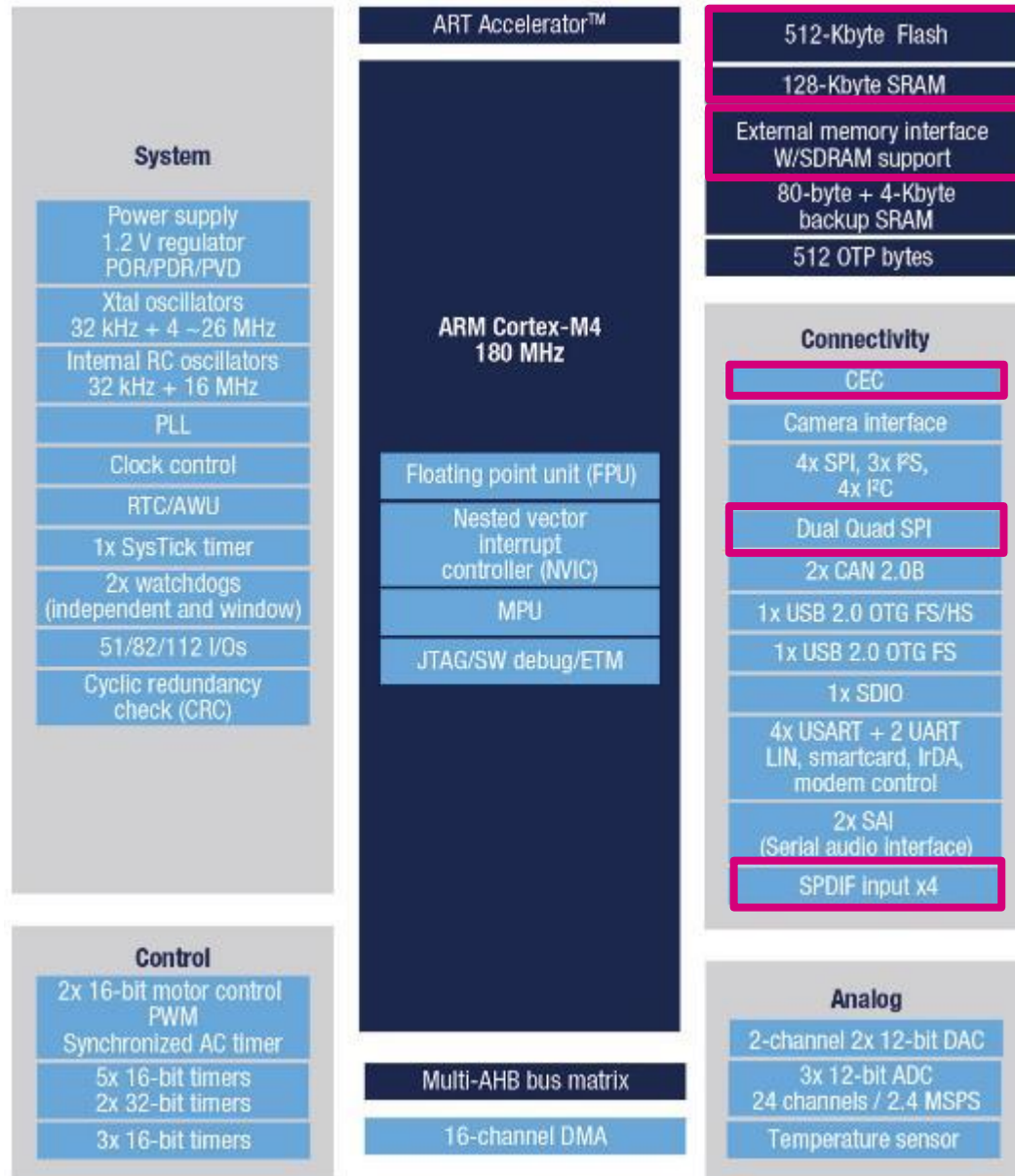
Product highlights



STM32 F4

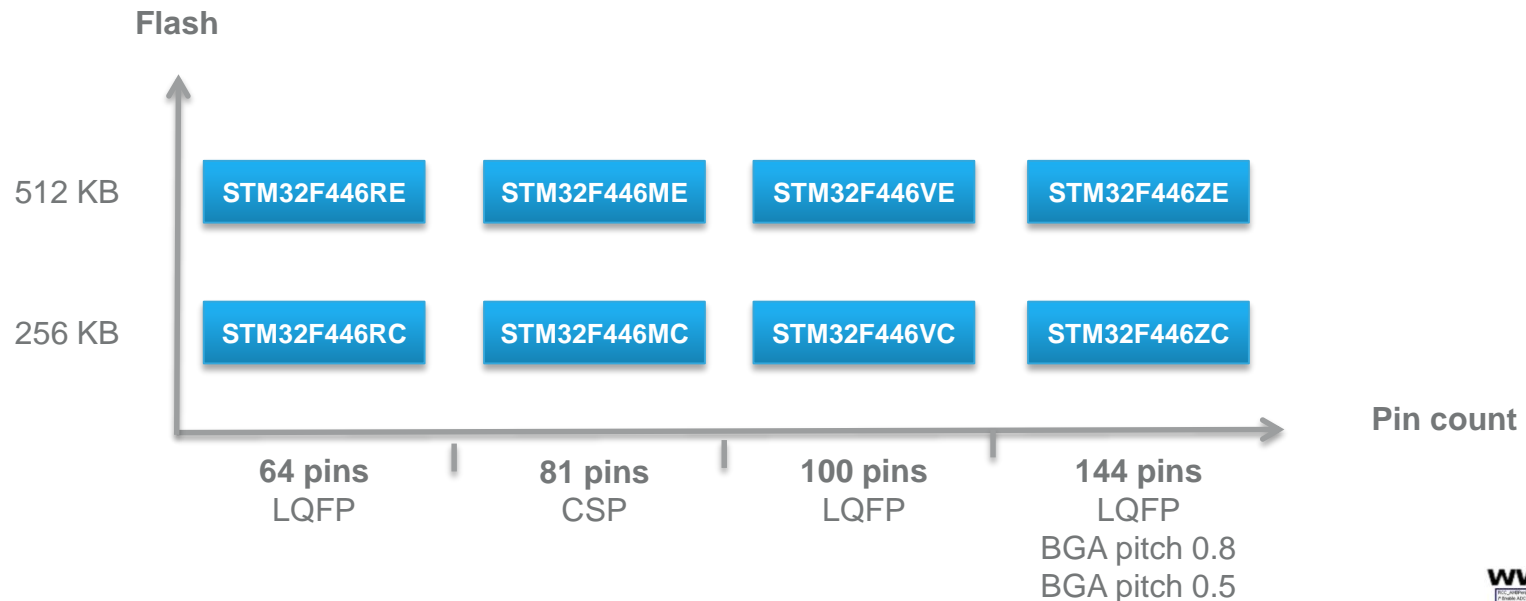
STM32F446 – Block diagram

56



STM32F446 line

- Packages
 - WLSCP
 - LQFP64, LQFP100, LQFP144
 - BGA144 pitch 0.5, BGA 144 pitch 0.8
- Memory size:
 - 256-Kbyte Flash/ 128-Kbyte SRAM
 - 512-Kbyte Flash/ 128-Kbyte SRAM



- High Performance

- Cortex-M4
- DSP and FPU
- **ART™** accelerator allowing zero wait state execution from flash
- Achieving **225 DMIPS** and **608 Coremark** scores

- Compact internal Memory resources

- 512 KB internal Flash
- 128 KB internal RAM

- External memory interfaces

- Flexible Memory controller (FMC)

- Running at 90MHz and supporting memory remap mode to offer higher performance
 - Supporting external SRAM,PSRAM,SDRAM/LPSDR SDRAM, Flash NOR/NAND memories
 - Supporting Intel 8080 and Motorola 6800 LCD parallel interfaces for cost effective Graphical interfaces using LDC with embedded controllers

- Dual Quad SPI interface (QSPI)

- Supporting external single, dual or quad SPI NOR Flash memories
 - Memory Mapped mode supporting up to 256 Mbytes external SPI NOR flash
 - Up to 90 Mbytes/s in SDR mode and up to 120Mbytes/s in SDR mode
 - Dual quad SPI mode allowing higher throughput

- Upgraded USB features
 - Added Dedicated USB power rails.
 - additional support of Link Power Mode (LPM)
 - A new intermediate low power state with short entry and exit times
- Extended Connectivity
 - HDMI CEC controller
 - Up to 7 simultaneous I²S channels
 - 3 I²S Half duplex
 - 2 Serial Audio Interfaces supporting I²S full duplex and Time Division Multiplexing
 - SPDIF input interface
 - Up to 4 parallel SPDIF inputs
 - Supporting analog and optical inputs
 - Up to 12.288 MHz symbol rate
 - Support from 32 to 192KHz stereo streams
 - Support up to 5.1 multi-channel surround sound
- Power efficiency
 - Targeted <100 uA in STOP mode

- Quad SPI interface (QSPI)
 - NOR flash interface requiring a limited number of pins (5 pins in single QSPI mode and 9 pins in dual mode QSPI)
 - Allowing efficient NOR flash extension in small packages and so enabling better BOM costs
- Dual quad SPI mode
 - Allow double the throughput by accessing 2 external QSPI flash memories in parallel
- Possible to have the QSPI Flash memory mapped
 - Allowing to access the QSPI external Flash as an internal flash and so avoiding all memory access implementation overhead
- Coupling the QSPI with the FMC
 - Releasing the application optimization constraints when both external Flash and external RAM are required

- Upgraded USB features
 - Added Dedicated USB power rails
 - Avoiding external PHYs when using USB in low power supply ranges
 - additional support of Link Power Mode (LPM)
 - Allowing finer power management leading to significant power savings
 - Compliency with the latest USB standard updates.
- Extended Connectivity
 - HDMI CEC controller
 - Enabling the control of different HDMI connected devices through a single remote control.
 - SPDIF input interface
 - Allowing an integrated solution offering enabling better BOM cost in consumer audio application using SPDIF interfaces
- Power efficiency
 - Targeted <100 uA in STOP mode

STM32F469

Product highlights



STM32 F4

STM32F469

64

High performance MCU with
Extended SDRAM, Quad SPI and MIPI DSI interface

Advanced

STM32F427

STM32F429

STM32F469



Enhanced Graphic
High memory density
Security

Foundation

STM32F205

STM32F207

STM32F446

STM32F405

STM32F407



Extended Connectivity
& Features
Security

Access

STM32F401

STM32F411



Entry Level
Dynamic efficiency



STM32F469/479 block diagram

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- Packages :

- WLCSP168
- BGA168
- LQFP208
- BGA216
- LQFP 176

- Memory sizes

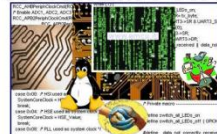
- 2MB Flash, 384KB RAM
- 1MB Flash, 384KB RAM
- 512KB Flash, 384KB RAM

- Cryptography

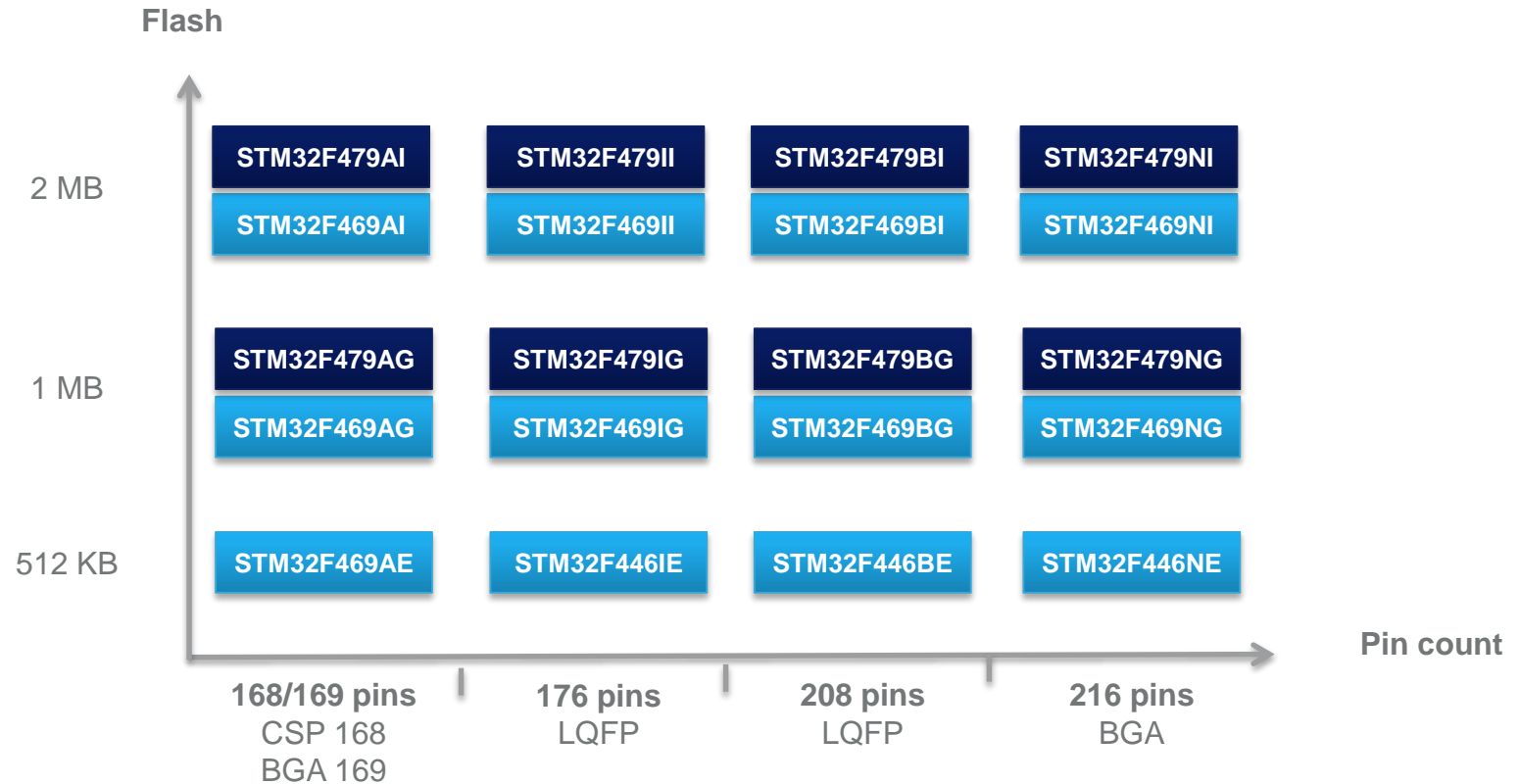
- F479 embeds a HW Crypto processor



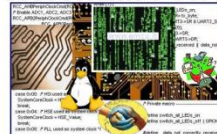
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STM32F469/F479 lines



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- **High Performance**

- Cortex-M4 with DSP and FPU
- **ART™** accelerator allowing zero wait state execution from flash
 - Achieving **225 DMIPS** and **608 coremark** scores

- **Advanced Graphics**

- **Chrom-ART™** HW Graphical accelerator
 - Offloads the CPU from repetitive graphics operations
 - Efficient data copy, transparency effects and pixel format conversion
- **Embedded display Controllers**
 - **MIPI® DSI controller**
 - high-speed differential serial interface
 - Up to 720p 30Hz resolution
 - Interfacing display modules w or w/o on-panel display controller or frame buffer
 - 2 D-PHY data Lanes with up to 500Mbps for each line
 - TFT LCD controller
 - 24-bit parallel RGB interface
 - Up to XGA resolution
 - 2 display layers with dedicated FIFOs
 - Color look-up table with up to 256 24-bit colors per display layer

- **Extended Memory resources**

- Up to 2MBytes internal Flash
- 384 KB internal RAM including 64KB CCM

- **External memory interfaces**

- Flexible Memory controller (FMC)
 - 90MHz I/F with memory remap capability for higher performance
 - SRAM,PSRAM,SDRAM/LPDDR SDRAM, Flash NOR/NAND support
 - Intel 8080 and Motorola 6800 LCD parallel interfaces for cost effective Graphical interfaces using LDC with embedded controllers
- Dual Quad SPI interface (QSPI)
 - SPI NOR Flash (1-bit), quad SPI (4-bit) or dual-Quad (8-bit) SPI NOR Flash support
 - Memory Mapped mode supporting up to 256 Mbytes external SPI NOR flash
 - Up to 90 Mbytes/s in SDR mode and up to 120Mbytes/s in DDR mode

- **Upgraded USB features**

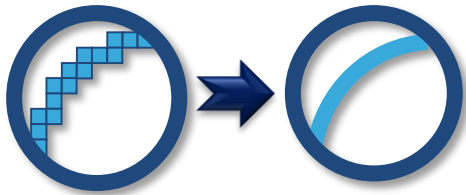
- Added Dedicated USB power rails.
- additional support of Link Power Mode (LPM)
 - low power state with short entry and exit times

F469 Features benefits

69

- **Chrom-ART™** HW Graphical accelerator
 - **BETTER** Graphics with **LESS** CPU load
 - Enabling both advanced GUI and real time processing with a single MCU

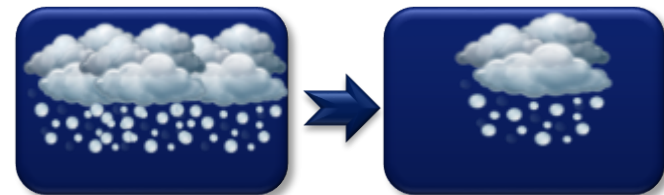
High quality Rendering



Smooth transitions



Motion fluidity



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- **MIPI® DSI controller**

- Advanced Animation and Graphical user interfaces
- Aligned on mobile industry standards
 - Opening the door to next generation displays with higher pixel density
- Only 2 pins for each Lane are requested to interface with the display panels
 - Availability even on small packages => BOM cost saving
- Lower power consumption and less electromagnetic interference

- TFT LCD controller

- Advanced animation and graphical user interfaces
- Drives displays without embedded controllers → BOM cost saving

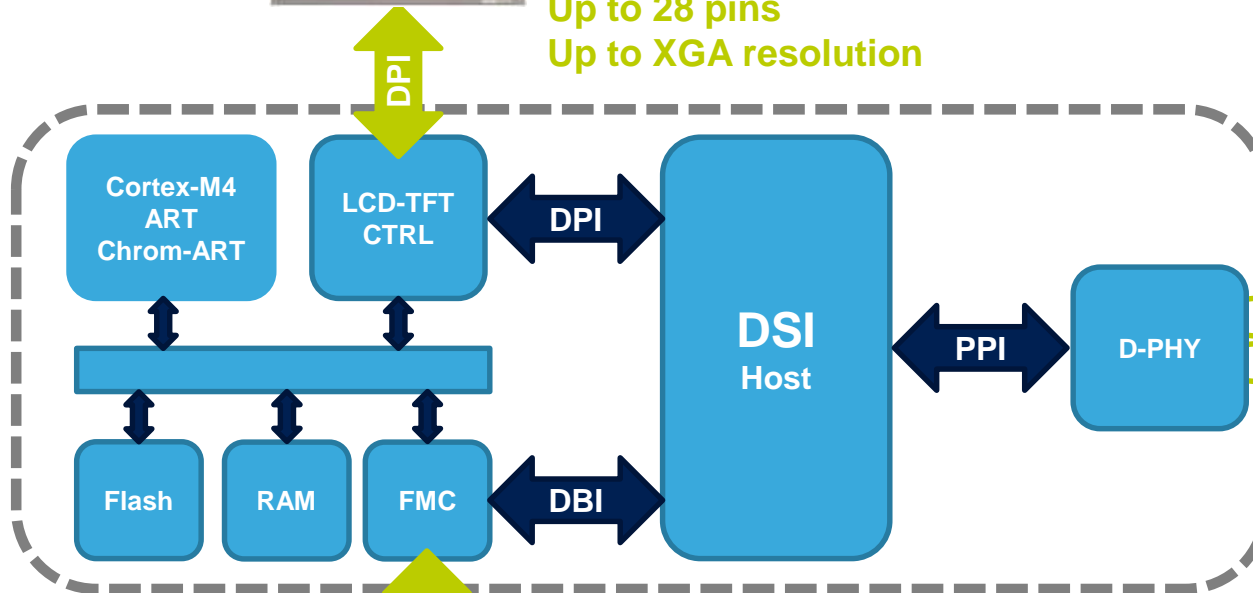
Display interfaces with STM32F469

71

Parallel interface LCD Display Without controller and GRAM



Parallel interface
Up to 28 pins
Up to XGA resolution



DSI Display W or W/O controller and GRAM



Serial high speed interface
Up to 6 pins
Up to 720p 30Hz resolution

Parallel interface
Up to 22 pins
Up to VGA/WQVGA resolution

Parallel interface LCD Display With controller and GRAM



• Extended Memory resources

- Up to 2MBytes internal Flash
- 384 KB internal RAM including 64KB CCM
 - Enables advanced data processing, high integration and higher graphic resolutions

		resolution→						
BUFFER SIZES (Kbytes) ∇		CGA (320x200)	QVGA (320x240)	WQVGA (480x272)	VGA (640x480)	WVGA (800x480)	SVGA (800x600)	XGA (1024x768)
bpp ↓	1 (2 colors)	7.8	9.4	15.9	37.5	46.9	58.6	96.0
	2 (4 colors)	15.6	18.8	31.9	75.0	93.8	117.2	192.0
	4(16 colors)	31.3	37.5	63.8	150.0	187.5	234.4	384.0
	8 (256 colors)	62.5	75.0	127.5	300.0	375.0	468.8	768.0
	16 (high color)	125.0	150.0	255.0	600.0	750.0	937.5	1536.0
	24 (true color)	187.5	225.0	382.5	900.0	1125.0	1406.3	2304.0
	32 (deep color)	250.0	300.0	510.0	1200.0	1500.0	1875.0	3072.0

- Double buffer
- Single buffer
- External memory needed

- Quad SPI interface (QSPI)
 - NOR flash interface requiring a limited number of pins (5 pins in single QSPI mode and 9 pins in dual mode QSPI)
 - Fast and cost effective NOR flash extension available from the lowest pin count MCU packages → lower BOM cost
 - Dual quad SPI mode
 - Double the throughput by accessing 2 external QSPI flash memories in parallel
 - Possible to have the QSPI Flash memory internally mapped
 - Allowing to access the QSPI external Flash as an internal flash and so avoiding all memory access overhead
 - Non exclusive with the FMC
 - Allowing to simplify an application using both external Flash and external RAM.

- Upgraded USB connectivity
 - Added Dedicated power rails supplying the 2 USB peripherals.
 - Enables USB connectivity even when the MCU is supplied at 1.8V
 - Link Power Mode (LPM)
 - Compliant with USB IF specification
 - Finer power management enabling significant power savings

Smart watch

Main application controller



Industrial/home automation panel



STM32F469

Application example

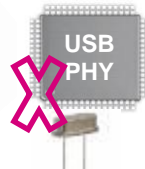
76



No more DSI bridge needed

Saved cost: ~0.8\$

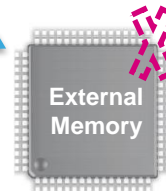
Saved size: ~4.5x4.5 mm



No more external USB PHY needed

Saved cost (including cristal): ~0.5\$

Saved size: ~3.5x3.5 mm



Potentially, no more external RAM needed

Depending on display resolution

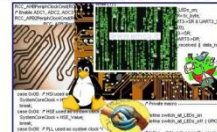
Saved cost: ~0.6-0.7\$

Saved size: ~8x13 mm



Sensors

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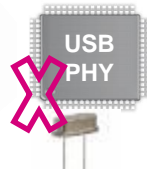
Application exemple



No more DSI bridge needed

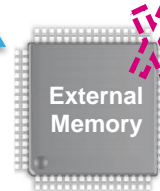
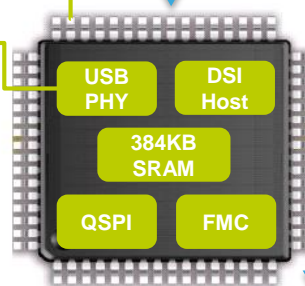
Saved cost: ~0.8\$

Saved size: ~4.5x4.5 mm



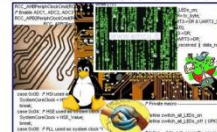
1.8 V

3.3 V



Sensors

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Potentially, no more external RAM needed

Depending on display resolution

Saved cost: ~0.6-0.7\$

Saved size: ~8x13 mm

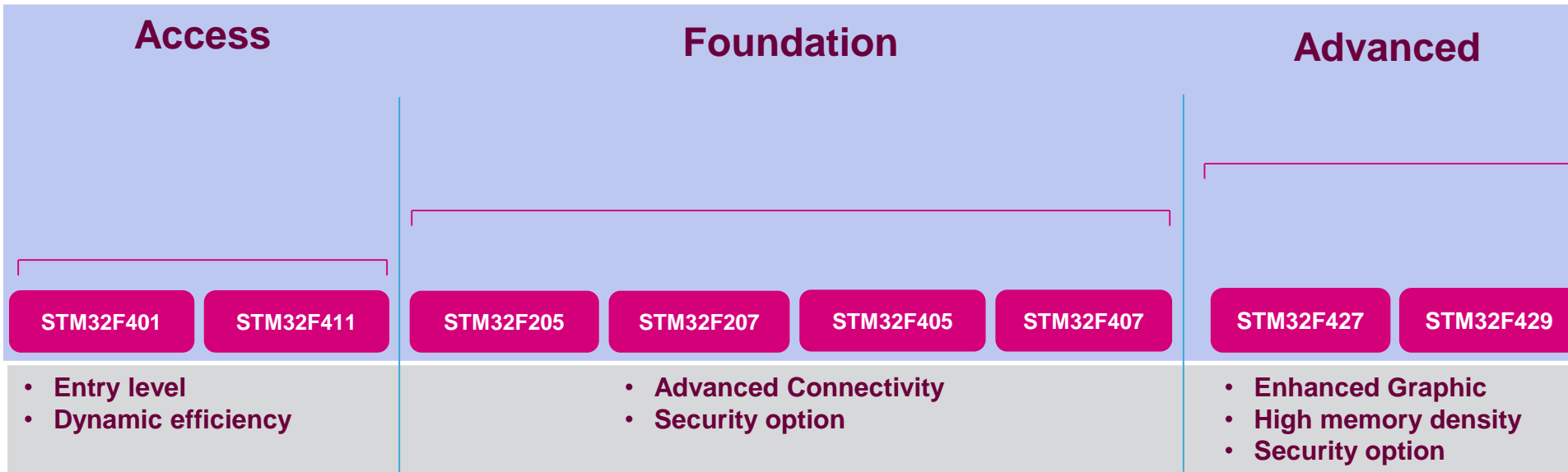
STM32 F7 Series

Product highlights

STM32 F4

High-performance platform

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- High performance, rich connectivity, high integration, Dynamic Efficiency
- From 105DMIPs up to 225DMIPS, based on Cortex-M3 or M4 w/ FPU
- Over 300 part numbers with close pin-to-pin compatibility

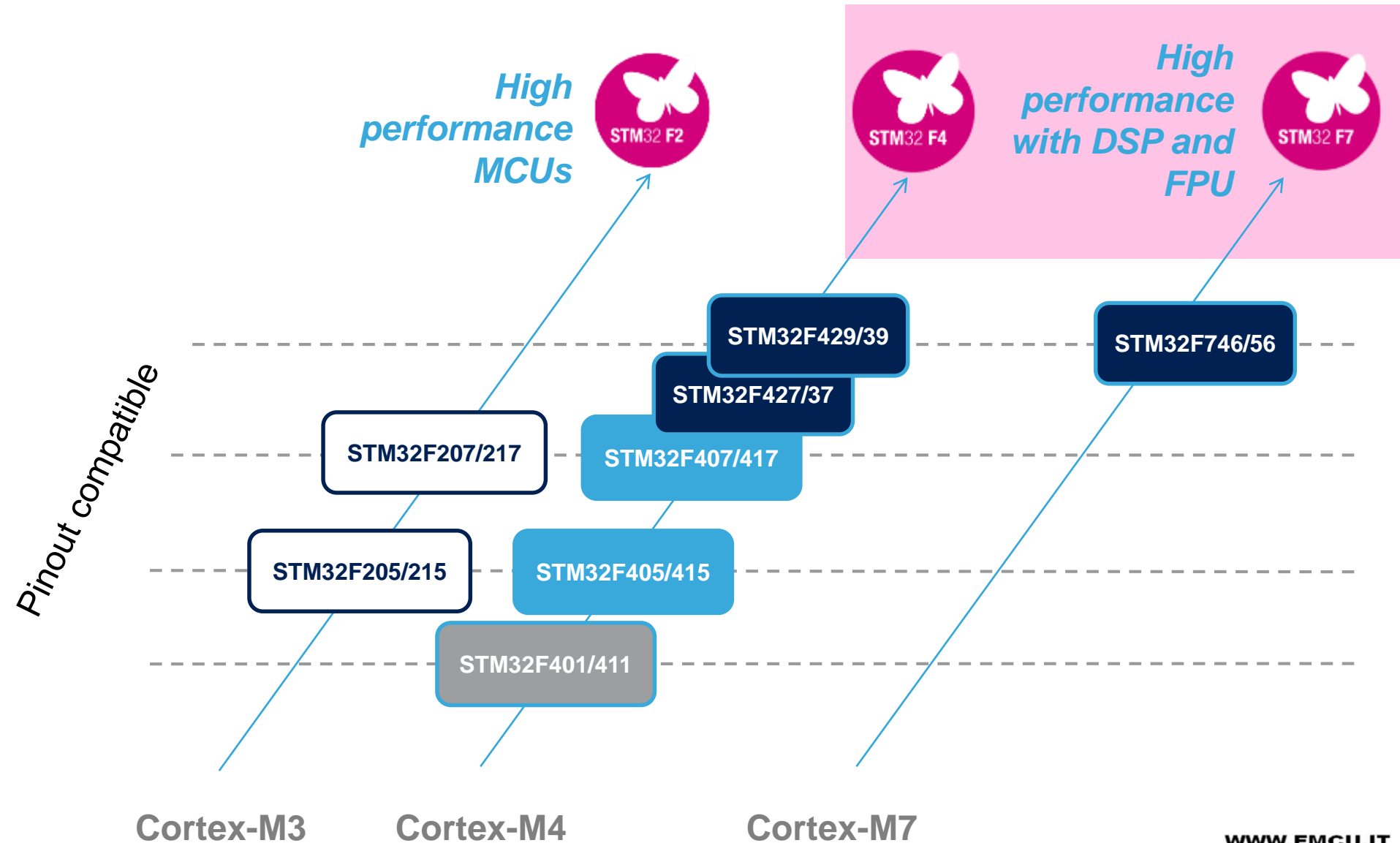
High-performance platform Cortex M7

80

Access	Foundation	Advanced
		STM32F749
STM32F401 STM32F411	STM32F205 STM32F207 STM32F405 STM32F407	STM32F427 STM32F429
<ul style="list-style-type: none">• Entry level• Dynamic efficiency	<ul style="list-style-type: none">• Advanced Connectivity• Security option	<ul style="list-style-type: none">• Enhanced Graphic• High memory density• Security option

NEW STM32F746 is sampling at OEMs
428DMIPS/1000 Coremarks,
World's 1st MCU based on new Cortex-M7 w/ FPU

High-performance platform



STM32 F7 : World's 1st Cortex-M7 based MCU

The smartest STM32 ever

- Twice the performance from **internal** and **external memories** :
 - Create smarter and more responsive applications that were not possible before on an MCU
 - External memory interface with no performance penalty allowing unlimited resources to fit the biggest code and data requirements
- A complete new set of peripherals
 - Benefit from the latest features available in the STM32 portfolio
- Increase the performance, not the power consumption
 - Bring innovation inside power constrained applications





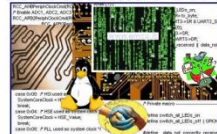
Being smart is not about brain size, it is about connecting the right amount of neurons at the right time.



STM32 F7 is built on the **new state-of-art ARM® Cortex®-M7** core

and

STM32 F7 is about ST's art of **combining and interconnecting the right features** around Cortex-M7 core, to deliver the **smartest STM32 ever.**



Smart-system architecture for performance

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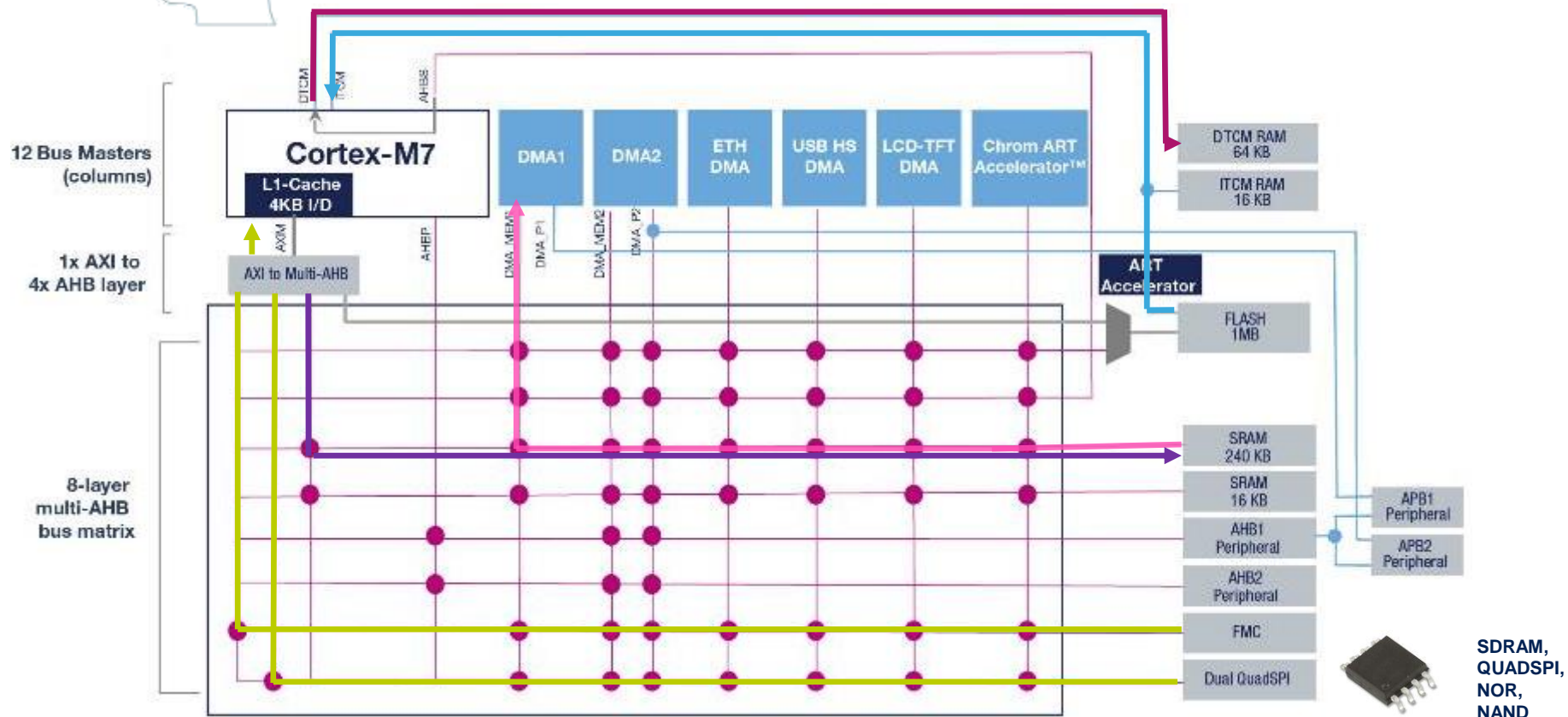
- STM32 F7 uses 2 independent mechanisms to reach 0-wait execution performance:
 - ST ART Accelerator™ for internal Flash memory
 - L1 cache (4 Kbytes + 4 Kbytes instruction and data cache) for external (or internal) memories
- AXI and Multi-AHB bus matrix with dual GP DMA controllers and dedicated DMA controllers for Ethernet, USB OTG HS and Chrom-ART graphic HW acceleration,
- Large SRAM with scattered architecture:
 - 320 Kbytes including 240 Kbytes + 16 Kbytes on the bus matrix and 64 Kbytes of Data TCM RAM
 - 16 Kbytes of instruction TCM RAM
 - 4 Kbytes of backup SRAM





Smart Architecture – Use case

85



Legend:

- ITCM:** Critical Code with deterministic execution
- DTCM RAM:** Critical real time data (Stack, heap ..)
- System SRAM:** Concurrent data transfer CPU or DMA
- External Memories:** Quad SPI, and FMC for data manipulation or code execution

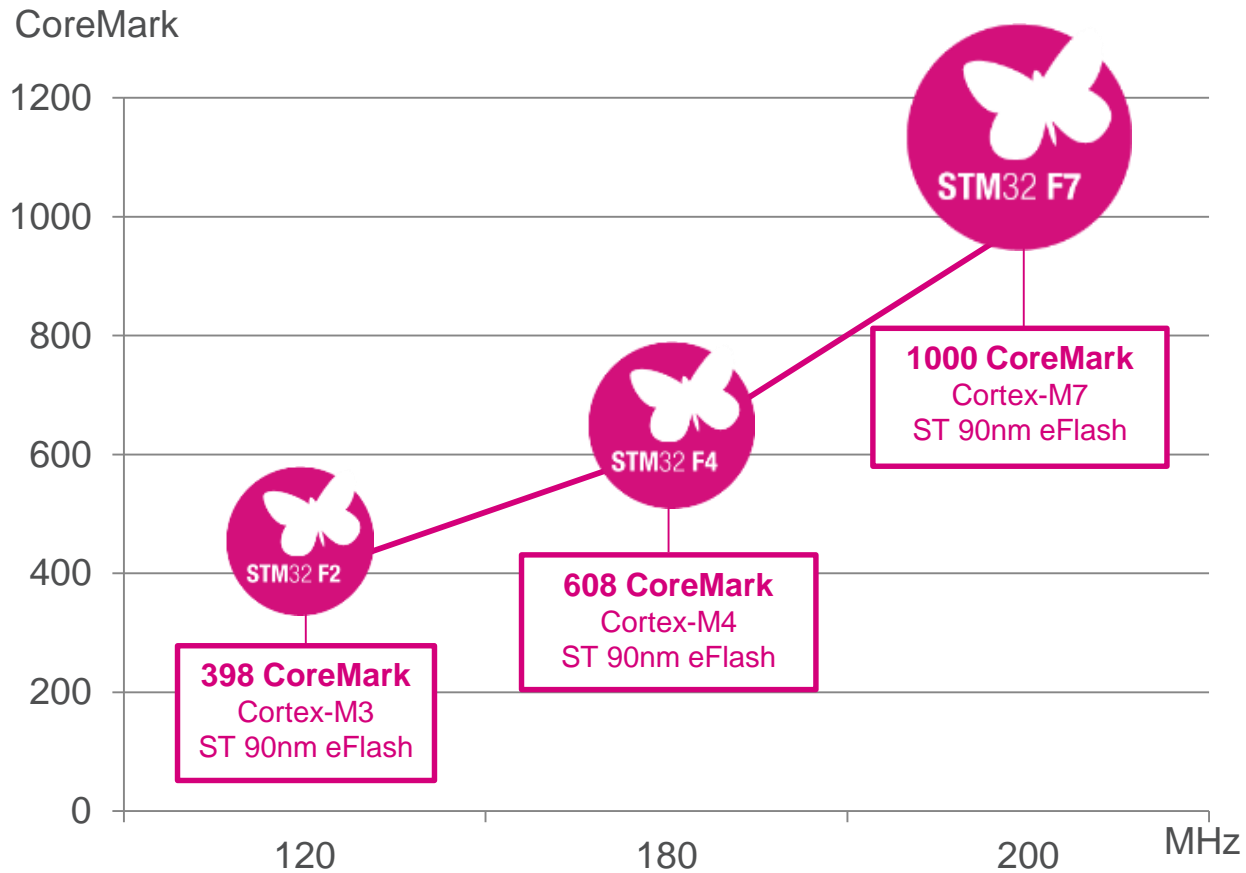
...Unleashed by STM32 F7 Silicon

Benchmark	ARM® data		Measured on STM32 F7 Silicon	
	Cortex-M4	Cortex-M7	Executing from Embedded Flash	Executing from External memory
CoreMark/MHz	3.4	5	5	
DMIPS/MHz	1.25	2.14	2.14	

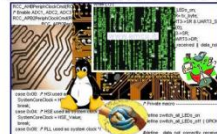
- And : ...
 - Up to twice more DSP performance increase over Cortex-M4
 - ARMv7-M architecture, 100% binary forwards compatibility from Cortex-M4
 - STM32 F7 runs at $F_{CPU} = 200 \text{ MHz} \rightarrow 5 \times 200 = 1000 \text{ CoreMark}$

STM32 F4 = 608 CoreMark , STM32 F7 = 1000 CoreMark

More maths , more signal processing = Up to 2x DSP performance vs STM32 F4 series



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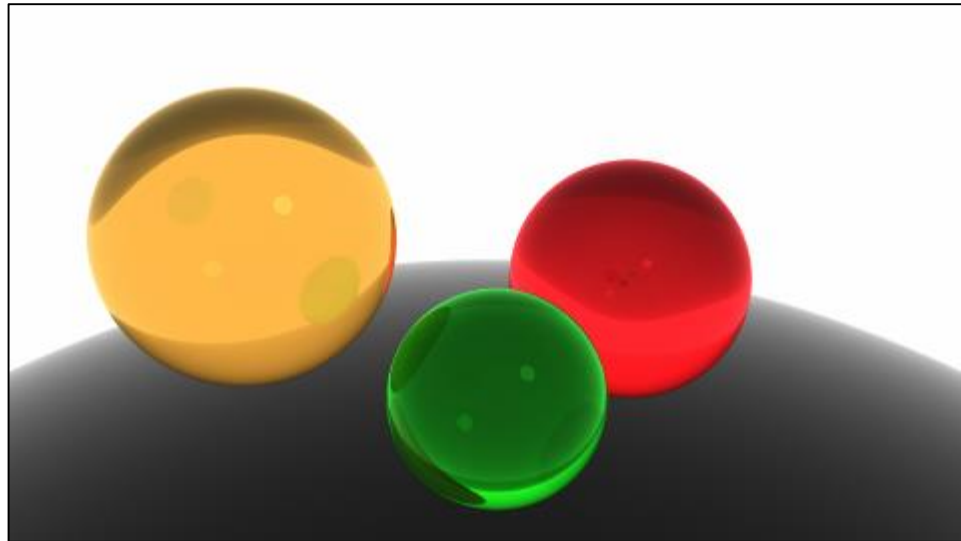
Heavy 3D-vectorial computation benchmark

Demo from ST 1/2

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- Heavy 3D-vectorial computation benchmark: Computes a complete picture from equations to generate a 3D picture.
 - Heavy vector computation based on floats (vector scaler, normalization...etc...)
 - Calculation of reflection and refraction on the objects of the scene
 - Highly recursive (each time an object is hit by a ray, new rays need to be computed for reflection, refraction and lighting)
 - Key performance enablers: FPU, ART Accelerator, L1 cache, memory interface

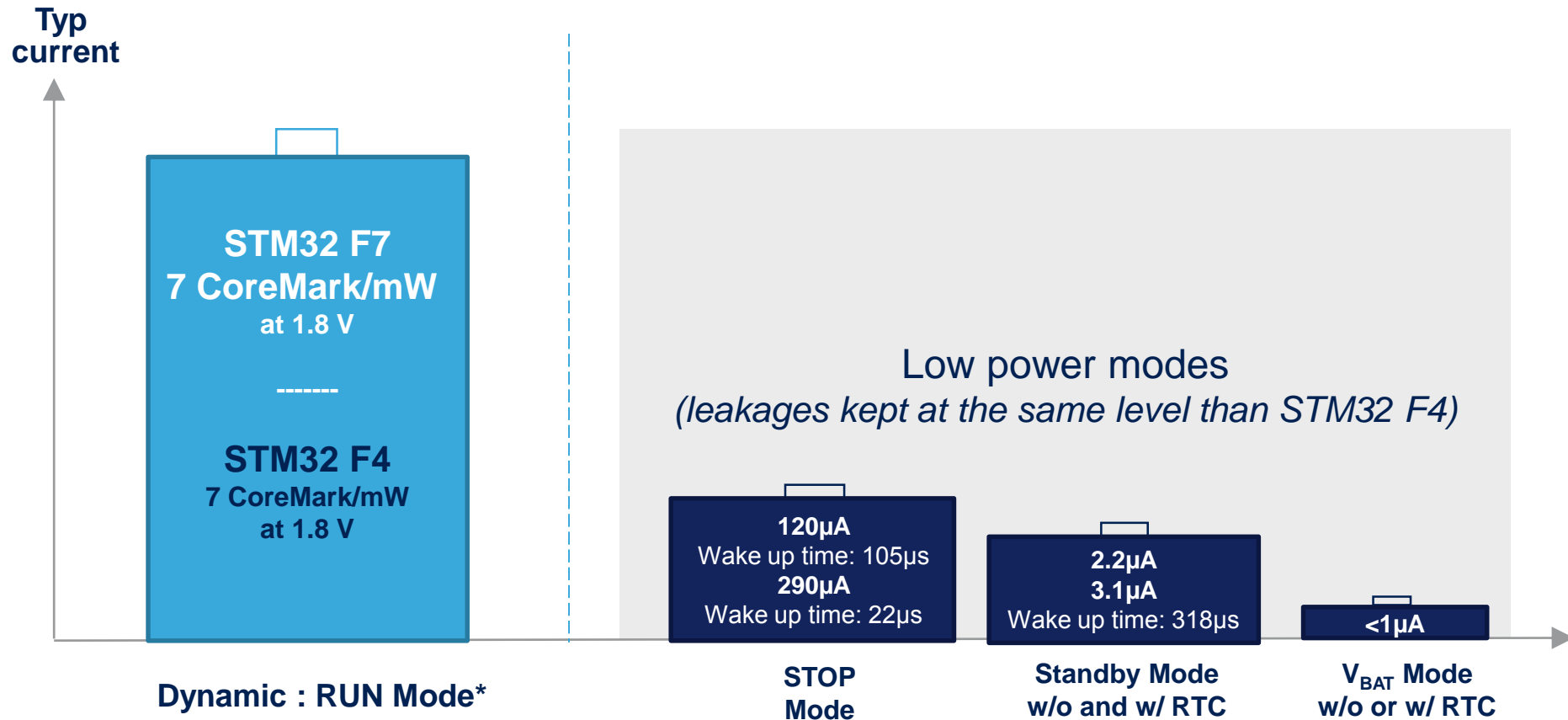
Ray tracing
algorithms are
perfect for
benchmarking
CPU computation
efficiency



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STM32 F7 power efficiency = STM32 F4 power efficiency
STM32 F7 Boosts performance, but does not compromise on power efficiency



Legend: Measurements conditions depend on Room temperature

*Run mode Conditions: CoreMark executed from Flash, peripherals OFF

Right balance of innovation and time-to-market

- Our priority: deliver innovative, upward compatible, scalable STM32s on-time!
- STM32 F7 is designed around ST's **mass-production-ready 90nm embedded Flash platform**, best in class:
 - This 90nm e-Flash platform has enabled our STM32 F4 series to be world's highest performance Cortex-M based MCU (currently 608 CoreMark at 180 MHz). Refer to coremark.org
- Everyday MCU developers need to **accelerate their innovation pace**.
Developers have no time to optimize. All their skills must be devoted to innovation, differentiation, and creativity.
 - Computing, data/signal transfer and processing
 - Large embedded and external memory resources with fast access time, all packed inside a small single MCU.



Enjoy **1000 CoreMark** now!

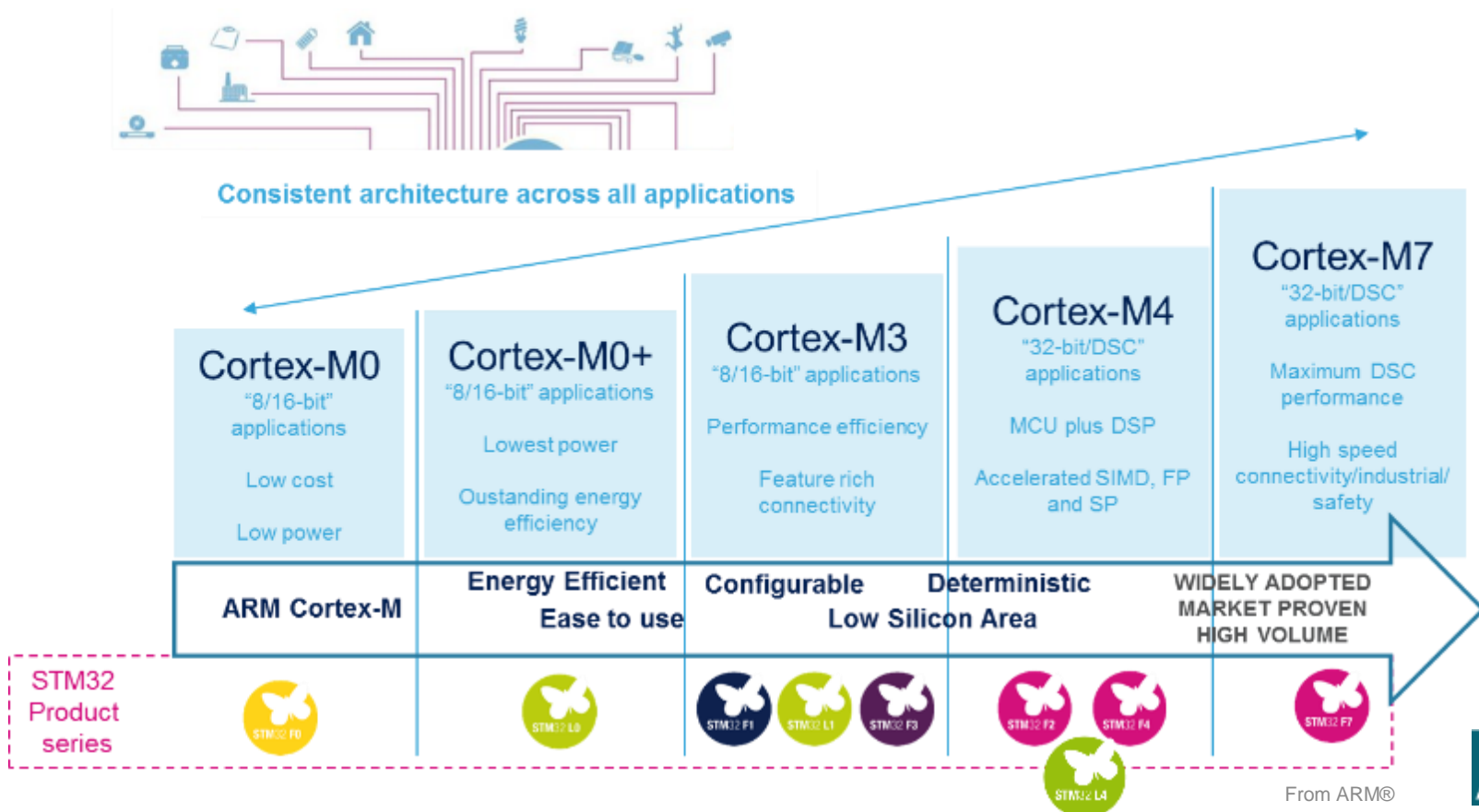
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- From ARM®

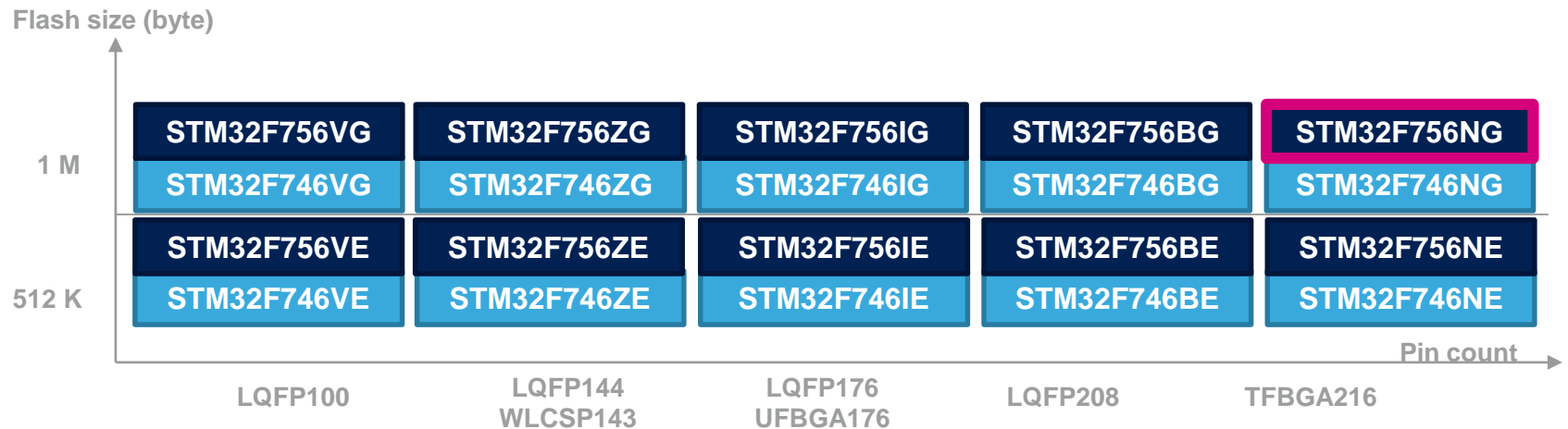
Cortex-M7 Microcontroller positioning

93



STM32 F7 portfolio

94



Legend:



without HW crypto/Hash coprocessor



with HW crypto/Hash coprocessor



STM32 F7 block diagram

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- NEW core: ARM Cortex-M7
- Up to 200 MHz, 428 DMIPS/1000 CoreMark
- Twice the DSP performance vs Cortex-M4 core
- New generation of Peripherals
- 2xSAI, 3xI2S half duplex, USB dedicated supply for 1.8 V operation, CEC, Quad SPI, SPDIF input, 4xI2C.
- Same packages as F429
 - WLCSP143
 - LQFP100,144,176,208
 - BGA 176, 216



Notes:
1. Crypto/Hash processor on dedicated devices



Thank you for your attention