STM32F4xx Introduction

Silica Tour

Autumn 2011

V1.0

Presentation highlights

The STM32 F4 series brings to the market the **world's highest performance** Cortex™-M microcontrollers
168 MHz F_{CPU}/210 DMIPS
363 Coremark score

The STM32 F4 series extends the STM32 portfolio **250+ compatible devices** already in production, including the F1 series, F2 series and ultra-low-power L1 series

The STM32 F4 series reinforces ST's current leadership in Cortex-M microcontrollers, **with 45% world market share** by units in (2010 or cumulated 2007 to Q1/11) according to ARM reporting

STM32 F4 series
High-performance digital signal controller

ARM

Cortex
Low-Power Leadership from ARM

FPU

Single precision
Ease of use
Better code efficiency
Faster time to market
Eliminate scaling and saturation
Easier support for meta-language tools (Matlab…)

STM32 F4

What is Cortex-M4?

MCU

Ease of use of C programming
Interrupt handling
Ultra-low power

DSP

Harvard architecture
Single-cycle MAC
Barrel shifter

STM32F4 Series highlights 1/3

- Based on Cortex M4 core
  - The **new DSP and FPU instructions** combined to 168MHz
- Over 30 new part numbers **pin-to-pin and software compatible** with existing STM32 F2 Series.

Advanced technology and process from ST:

- **Memory accelerator**: ART Accelerator™
- Multi AHB Bus Matrix
- 90nm process

Outstanding results:

- **210DMIPS** at 168MHz.
- Execution from Flash equivalent to **0-wait state** performance up to 168MHz thanks to ST ART Accelerator

STM32F4 Series highlights 2/3

More Memory

- Up to **1MB Flash** with option to permanent readout protection (**JTAG fuse**),
- **192kB SRAM**: 128kB on bus matrix + 64kB (Core Coupled Memory) on data bus dedicated to the CPU usage

Advanced peripherals

- **USB OTG High speed** 480Mbit/s
- **Ethernet MAC** 10/100 with IEEE1588
- PWM **High speed timers**: 168MHz max frequency
- **Crypto/Hash processor**, 32-bit random number generator (**RNG**)
- 32-bit RTC with calendar: with sub 1 second accuracy, and <1uA

STM32F4 Series highlights 3/3

Further improvements

- Low voltage: 1.8V to 3.6V VDD , down to 1.7*V on most packages
- **Full duplex I²S** peripherals
- **12-bit ADC**: 0.41µs conversion/2.4Msps (**7.2Msps** in interleaved mode)
- High speed **USART** up to **10.5Mbits/s**
- High speed **SPI** up to **37.5Mbits/s**
- **Camera interface** up to **54MBytes/s**

*external reset circuitry required to support 1.7V

STM32 F4 series – applications served

- Points of sale/inventory management

- Industrial automation and solar panels

- Transportation

- Medical

- Building

- Security/fire/HVAC

- Test and measurement

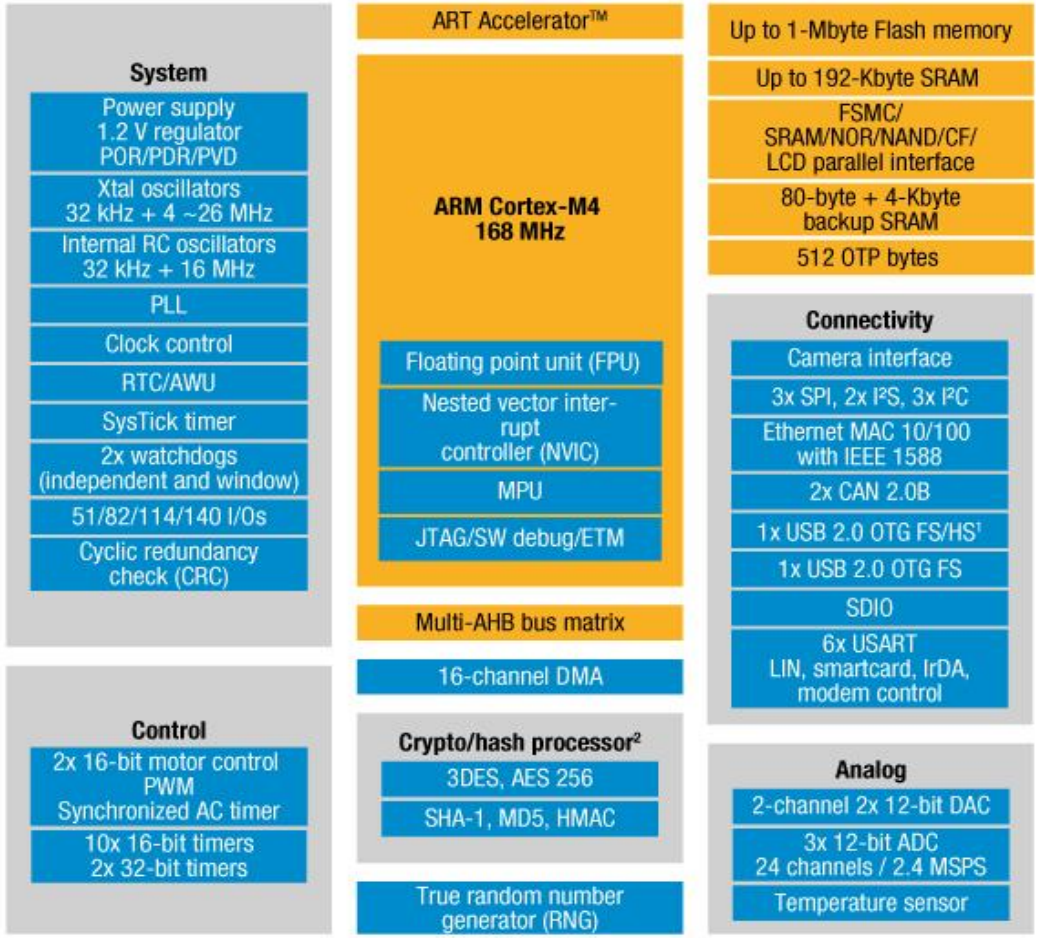
- Consumer

- Communication

STM32 F4 block diagram

Feature highlight

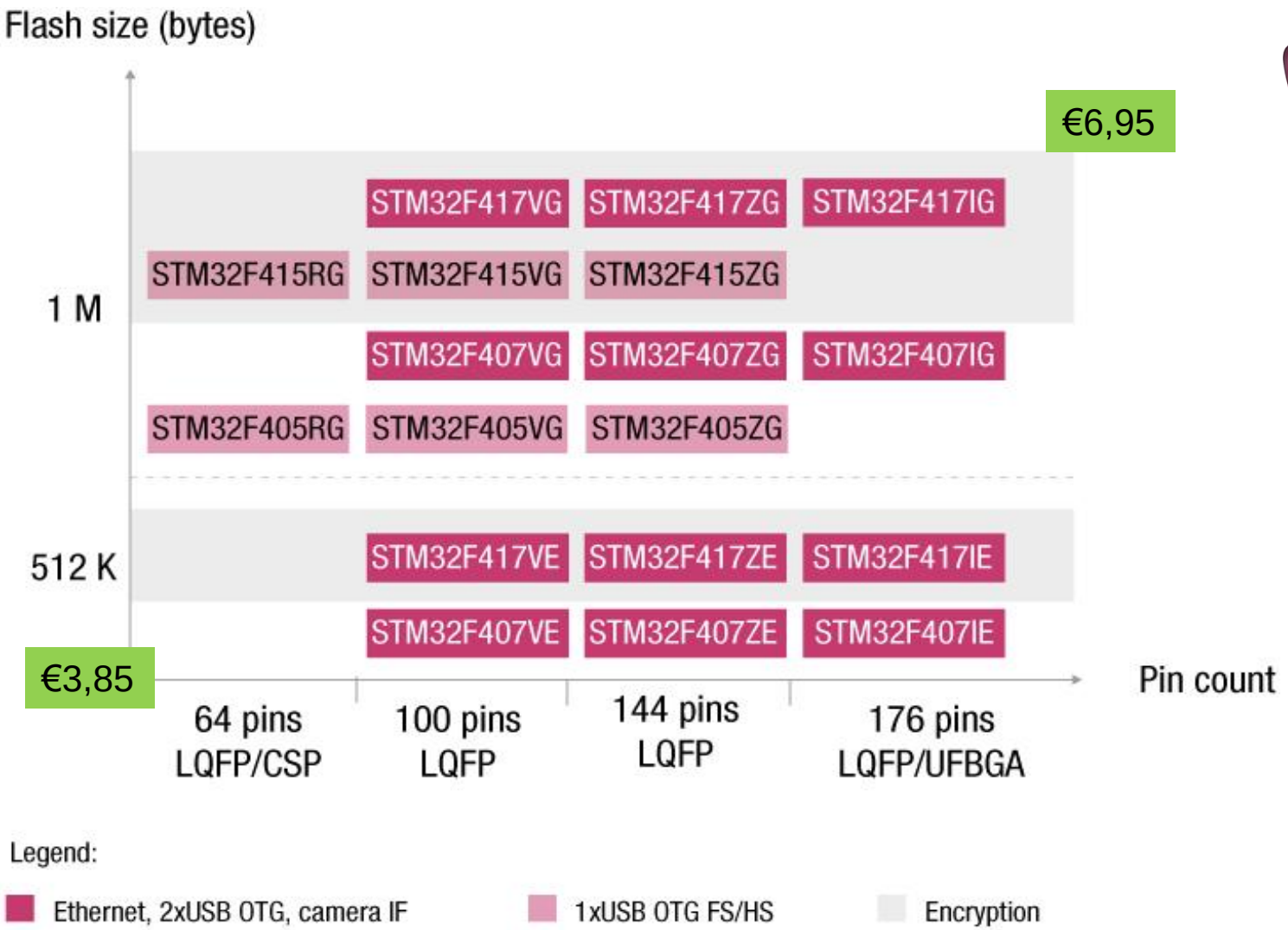
- 168 MHz Cortex-M4 CPU
  - Floating point unit (FPU)
  - ART Accelerator ™
  - Multi-level AHB bus matrix
- 1-Mbyte Flash, 192-Kbyte SRAM
- 1.7 to 3.6 V supply
- RTC: <1 µA typ, sub second accuracy
- 2x full duplex I²S
- 3x 12-bit ADC 0.41 µs/2.4 MSPS
- 168 MHz timers



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

STM32 F4 portfolio

5Ku to 10Ku avg. resale price in Eur/pc



STM32 product series

4 product series

Common core peripherals and architecture:

- Communication peripherals: USART, SPI, I²C
- Multiple general-purpose timers
- Integrated reset and brown-out warning
- Multiple DMA
- 2x watchdogs Real-time clock
- Integrated regulator PLL and clock circuit
- External memory interface (FSMC)
- Dual 12-bit DAC
- Up to 3x 12-bit ADC (up to 0.41 µs)
- Main oscillator and 32 kHz oscillator
- Low-speed and high-speed internal RC oscillators
- -40 to +85 °C and up to 105 °C operating temperature range
- Low voltage 2.0 to 3.6 V or 1.65/1.7 to 3.6 V (depending on series) 5.0 V tolerant I/Os
- Temperature sensor

STM32 F4 series - High performance with DSP (STM32F405/415/407/417)

168 MHz Cortex-M4 with DSP and FPU	Up to 192-Kbyte SRAM	Up to 1-Mbyte Flash	2x USB 2.0 OTG FS/HS	3-phase MC timer	2x CAN 2.0B	SDIO 2x I²S audio Camera IF	Ethernet IEEE 1588	Crypto/hash processor and RNG

STM32 F2 series - High performance (STM32F205/215/207/217)

120 MHz Cortex-M3 CPU	Up to 128-Kbyte SRAM	Up to 1-Mbyte Flash	2x USB 2.0 OTG FS/HS	3-phase MC timer	2x CAN 2.0B	SDIO 2x I²S audio Camera IF	Ethernet IEEE 1588	Crypto/hash processor and RNG

STM32 F1 series - Connectivity line (STM32F105/107)

72 MHz Cortex-M3 CPU	Up to 64-Kbyte SRAM	Up to 256-Kbyte Flash	USB 2.0 OTG FS	3-phase MC timer	2x CAN 2.0B	2x I²S audio	Ethernet IEEE 1588

STM32 F1 series - Performance line (STM32F103)

72 MHz Cortex-M3 CPU	Up to 96-Kbyte SRAM	Up to 1-Mbyte Flash	USB FS device	3-phase MC timer	CAN 2.0B	SDIO 2x I²S

STM32 F1 series - USB Access line (STM32F102)

+

48 MHz Cortex-M3 CPU	Up to 16-Kbyte SRAM	Up to 128-Kbyte Flash	USB FS device

STM32 F1 series - Access line (STM32F101)

36 MHz Cortex-M3 CPU	Up to 80-Kbyte SRAM	Up to 1-Mbyte Flash

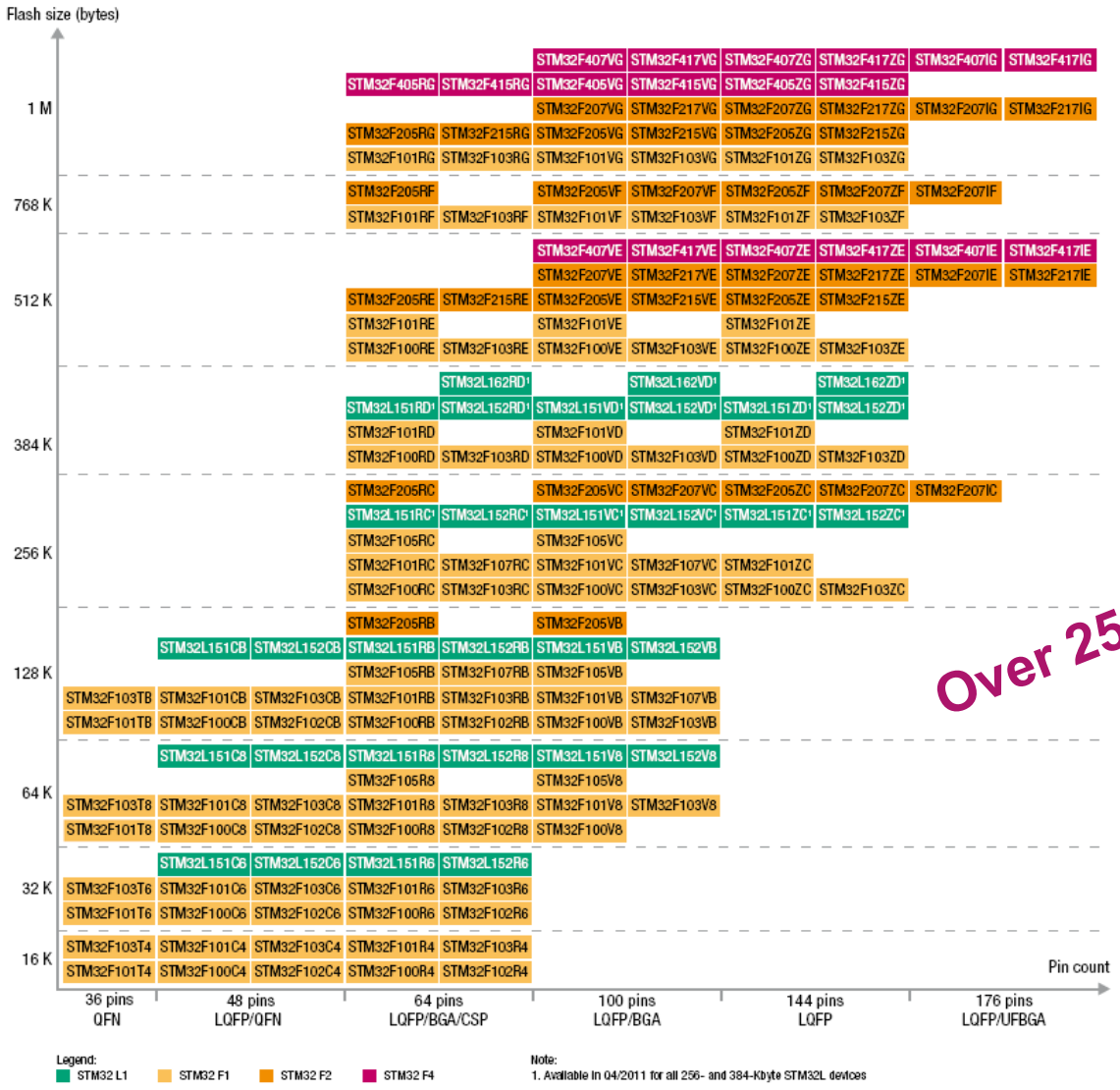
STM32 F1 series - Value line (STM32F100)

24 MHz Cortex-M3 CPU	Up to 32-Kbyte SRAM	Up to 512-Kbyte Flash	3-phase MC timer	CEC

STM32 L1 series - Ultra-low-power (STM32F151/152)

32 MHz Cortex-M3 CPU	Up to 48-Kbyte SRAM	Up to 384-Kbyte Flash	USB FS device	Data EEPROM up to 12 Kbytes	LCD 8x40 4x44	Comparator	BOR MSI VScal	AES 128-bit

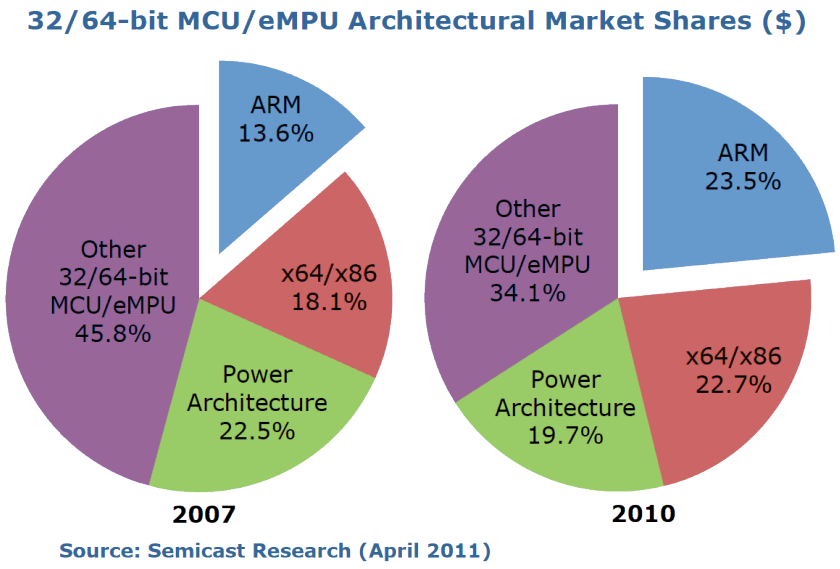
STM32 – leading Cortex-M portfolio

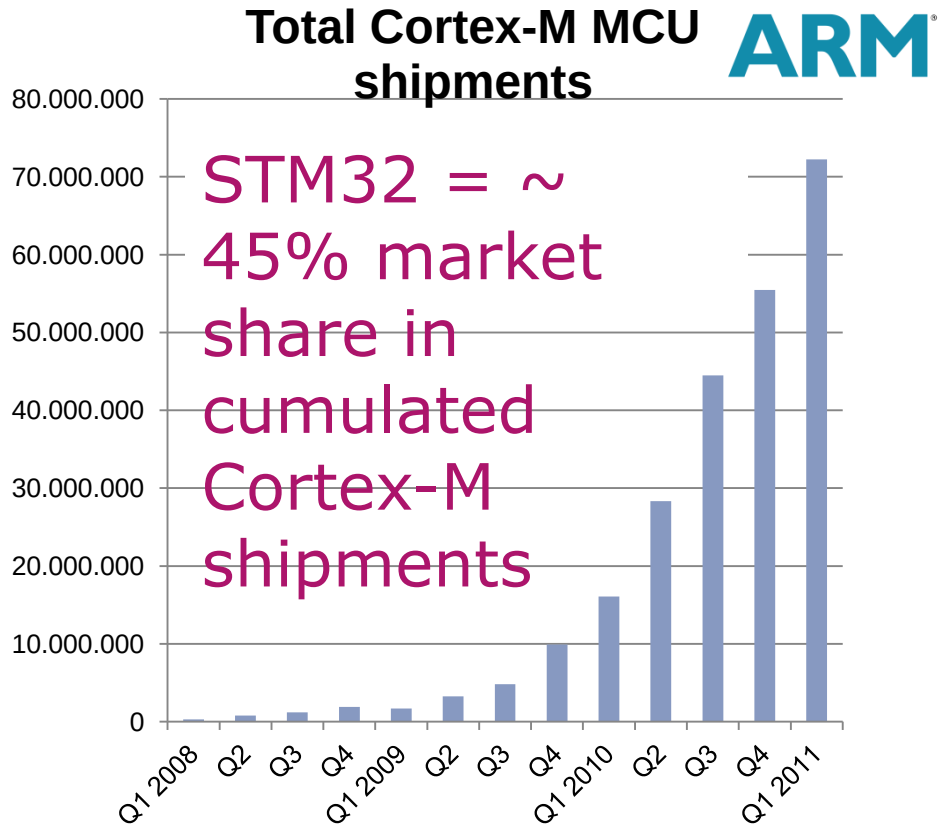


Over 250 pin-to-pin compatible part numbers

Market update

- Final Cortex-M MCU volume in shipped by ARM in 2010: 144 M units
- Growth into 2011 continues to be strong and healthy
- Strong ARM growth also acknowledged by Semicast





STM32 F4 key features

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Real-time performance

Cortex

Cortex-M4 with F_{CPU}
168 MHz/210 DMIPS

Outstanding power efficiency

< 1 µA V_{BAT} RTC,
Ultra low dynamic consumption,
1.7 to 3.6 V V_{DD}

Superior and innovative peripherals

Faster peripherals,
2 full duplex I²S,
RTC with
sub second accuracy…

Maximum integration

1 MByte Flash,
192-Kbyte SRAM…

Extensive tools and software

CMSIS DSP library,
Matlab support,
various IDE starter kits,
RTOS,and stacks

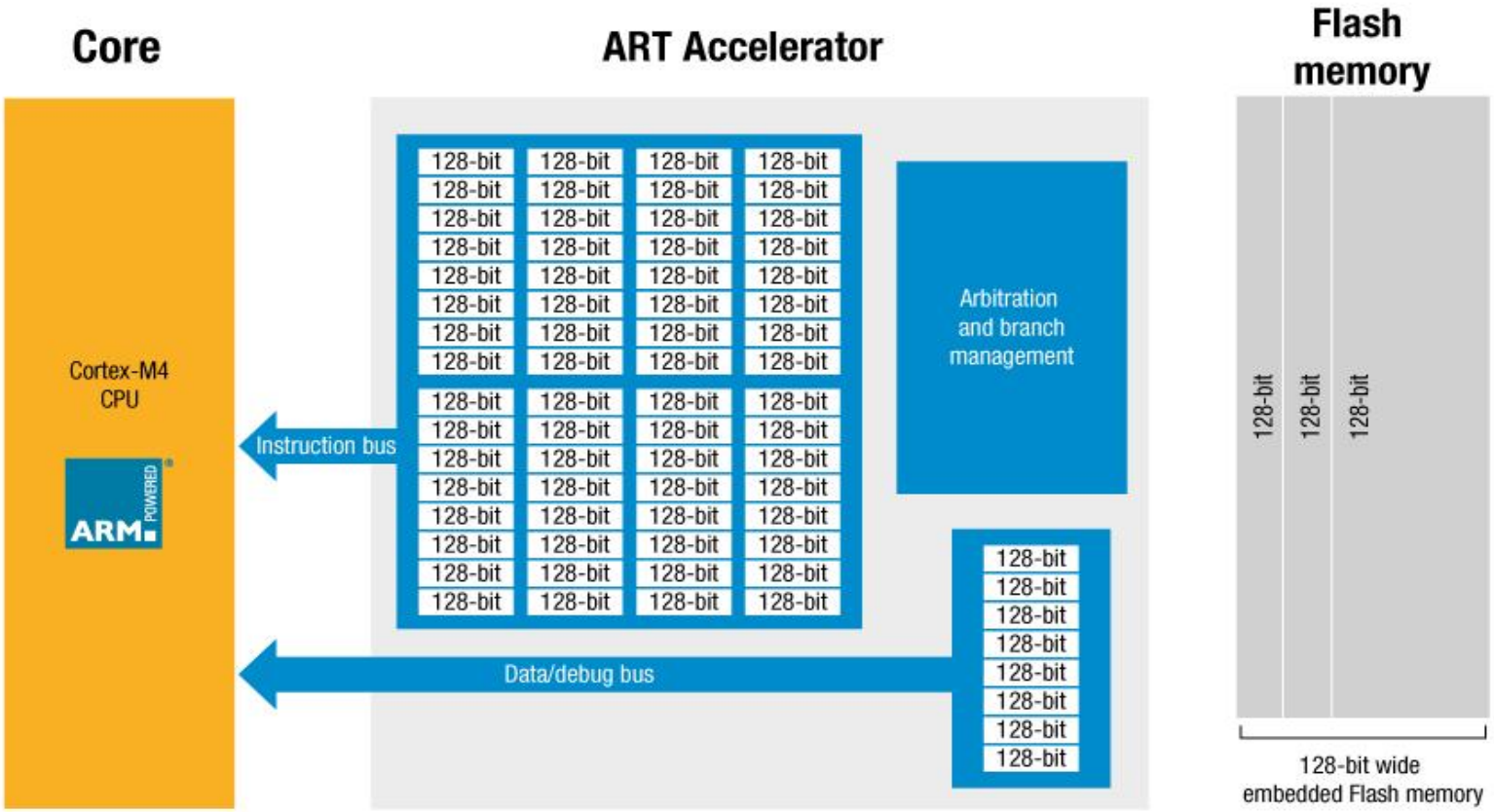
STM32 F4 series, over 30 part #s

L1, F1, F2, F4 series: seamless migration amongst 250 pin-to-pin compatible part #s

Real time performance

ST's ART Accelerator™

The adaptive real-time memory accelerator unleashes the Cortex-M4 core's maximum processing performance equivalent to 0-wait state execution Flash up to 168 MHz

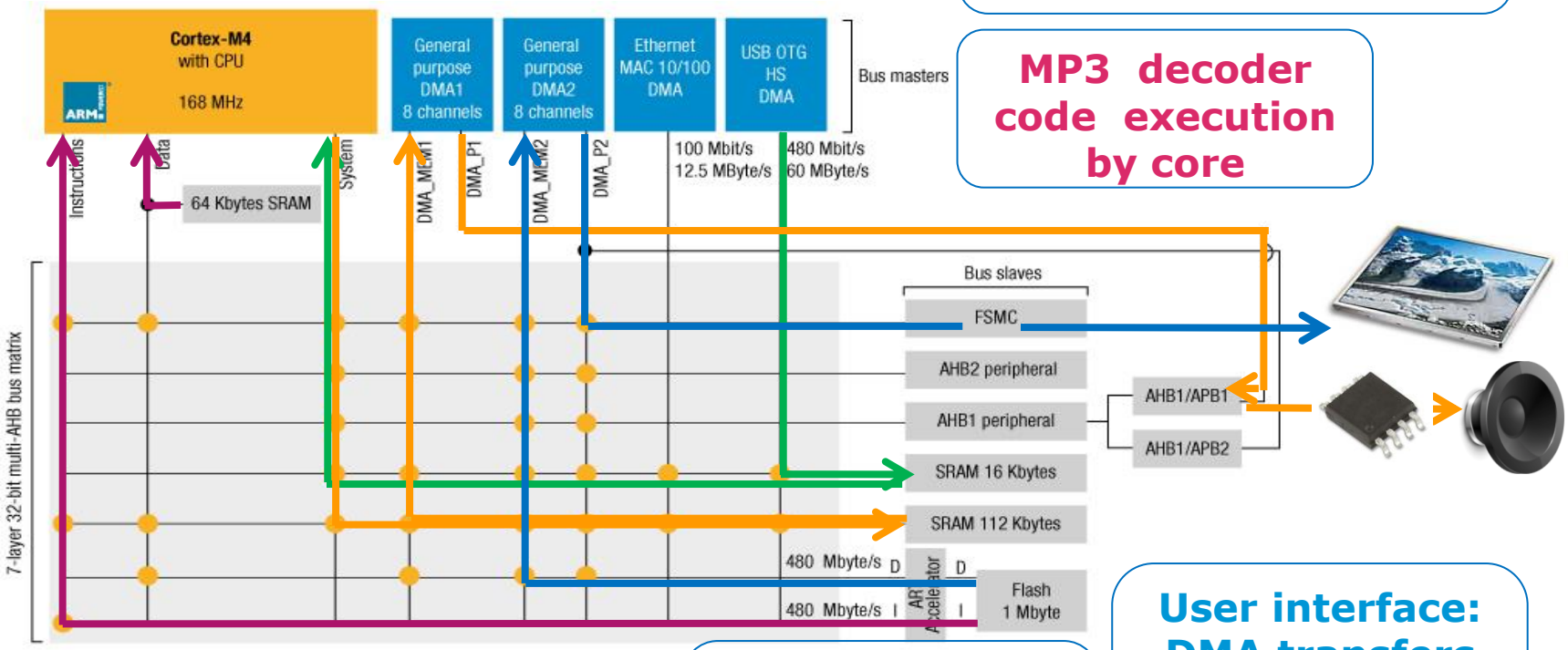


Real-time performance

32-bit multi-AHB bus matrix

Compressed audio stream (MP3) to 16kByte SRAM block

MP3 decoder code execution by core



Access to the MP3 data for decompression

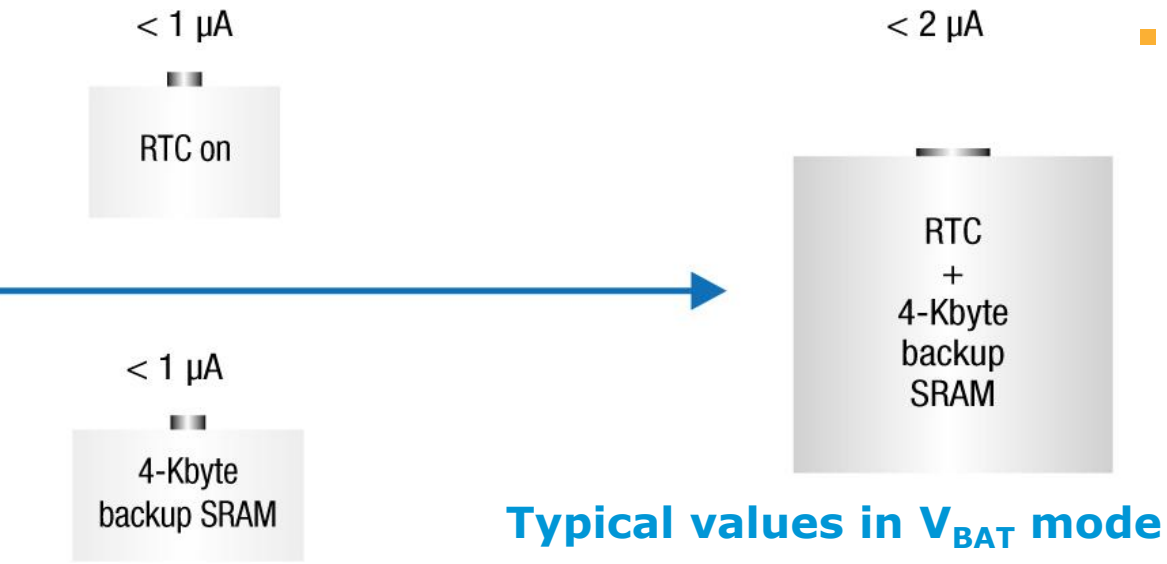
DMA transfer to audio output stage (I2S)

Decompressed audio stream to 112kByte SRAM block

User interface: DMA transfers of the graphical icons from Flash to display

Outstanding power efficiency

Outstanding power efficiency

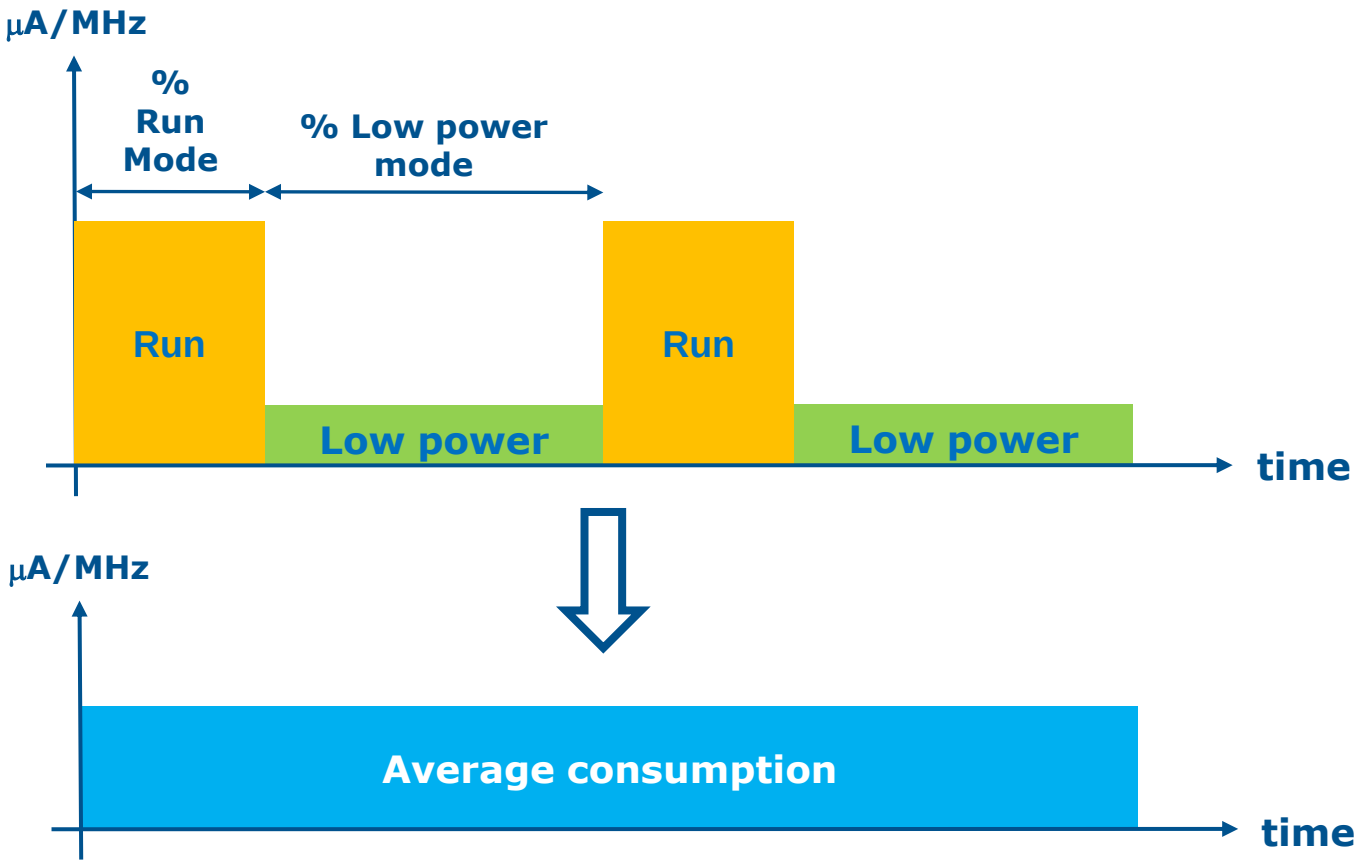


Typical values in V_{BAT} mode

- 230 µA/MHz, 38.6 mA at 168 MHz executing Coremark benchmark from Flash memory (with peripherals off), made possible with:
  - ST's 90 nm process allowing the CPU core to run at only 1.2 V
  - ART Accelerator™ reducing the number of accesses to Flash
  - Voltage scaling to optimize performance/power consumption
- V_{DD} min down to 1.7 V
- Low-power modes with backup SRAM and RTC support

Low power and real life applications

- Low power in real life applications is **not just Low-power mode**
- Need to consider the % of time spend in LP mode **and** in Run mode



Superior and innovative peripherals

Superior and innovative peripherals

Ethernet with IEEE 1588v2

HW crypto/hash coprocessor and <1 µA RTC

PWMs @ 168 MHz and ADC 2.4 MSPS

Audio architecture 2 USB OTG 2 full duplex I²S

Extensive tools and SW

Extensive tools and SW

- Evaluation board for full product feature evaluation
  - Hardware evaluation platform for all interfaces
  - Possible connection to all I/Os and all peripherals
- Discovery kit for cost-effective evaluation and prototyping
- Starter kits from 3rd parties available soon
- Large choice of development IDE solutions from the STM32 and ARM ecosystem

STM3240G-EVAL

$349

STM32F4DISCOVERY

$14.90

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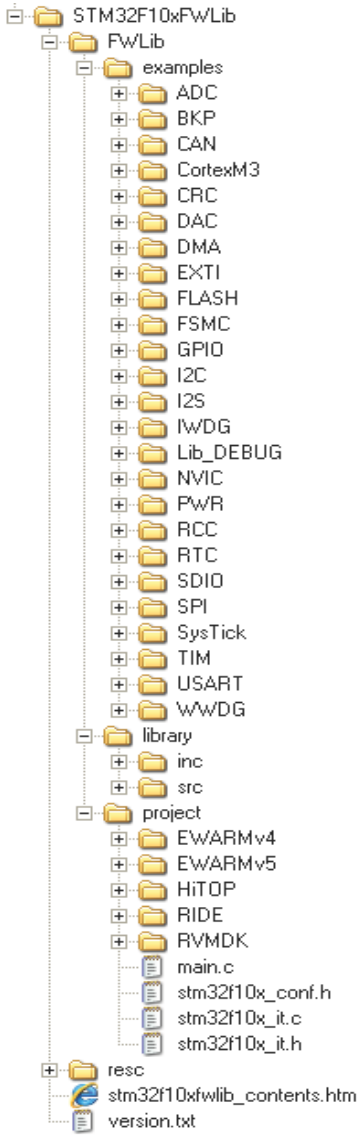
Software Libraries

- ST software libraries free is here
  C source code for easy implementation of all STM32 peripherals in any application
  - Standard library – source code for implementation of all standard peripherals. Code implemented in demos for STM32 evaluation board
  - Motor Control library – Sensorless Vector Control for 3-phase brushless motors
- ARM CMSIS DSP library – (free with license agreement)
- Audio library – MP3/WMA decoder, volume control, equalizer
  (free with license agreement).

For more software info see here:
http://www.emcu.it/STM32.html#STM_Firmware_Libraries



Key messages to remember

- STM32 F4 series
  - **World's highest performance**
  - **Extends the STM32 portfolio to over 250+ compatible devices**
  - **One-in-two Cortex-M MCUs shipped worldwide is an STM32**

Discovery kits available now

STM32F4DISCOVERY

More STM32F4 details and practical Hands-On with STM32F4 discovery kits will come just today in the afternoon!
or see here:

http://www.emcu.it/STM32F4xx/STM32F4xx.html