

# STM32 ARM® Cortex™ M3 Based Product Introduction



Sept 2007



# What is the STM32?

- ▣ STM32 **reshapes** the Microcontroller Market
  - ▣ **First** MCU family combining 32bit performance and features with the integration and end-user cost of today's 16bit MCU
  - ▣ **First** ARM® Cortex™-M3 MCU family from a leading semiconductor supplier
  
- ▣ The STM32 family brings **new degrees of freedom** to MCU users.
  - ▣ Eases migration from the 16-bit world
  - ▣ STM32 removes the last obstacles to 32bit wide usage that are
    - ▣ Integration,
    - ▣ Ease of use,
    - ▣ Low power,
    - ▣ Cost

STM32 

# ARM® Core

## World-leading 32-bit core

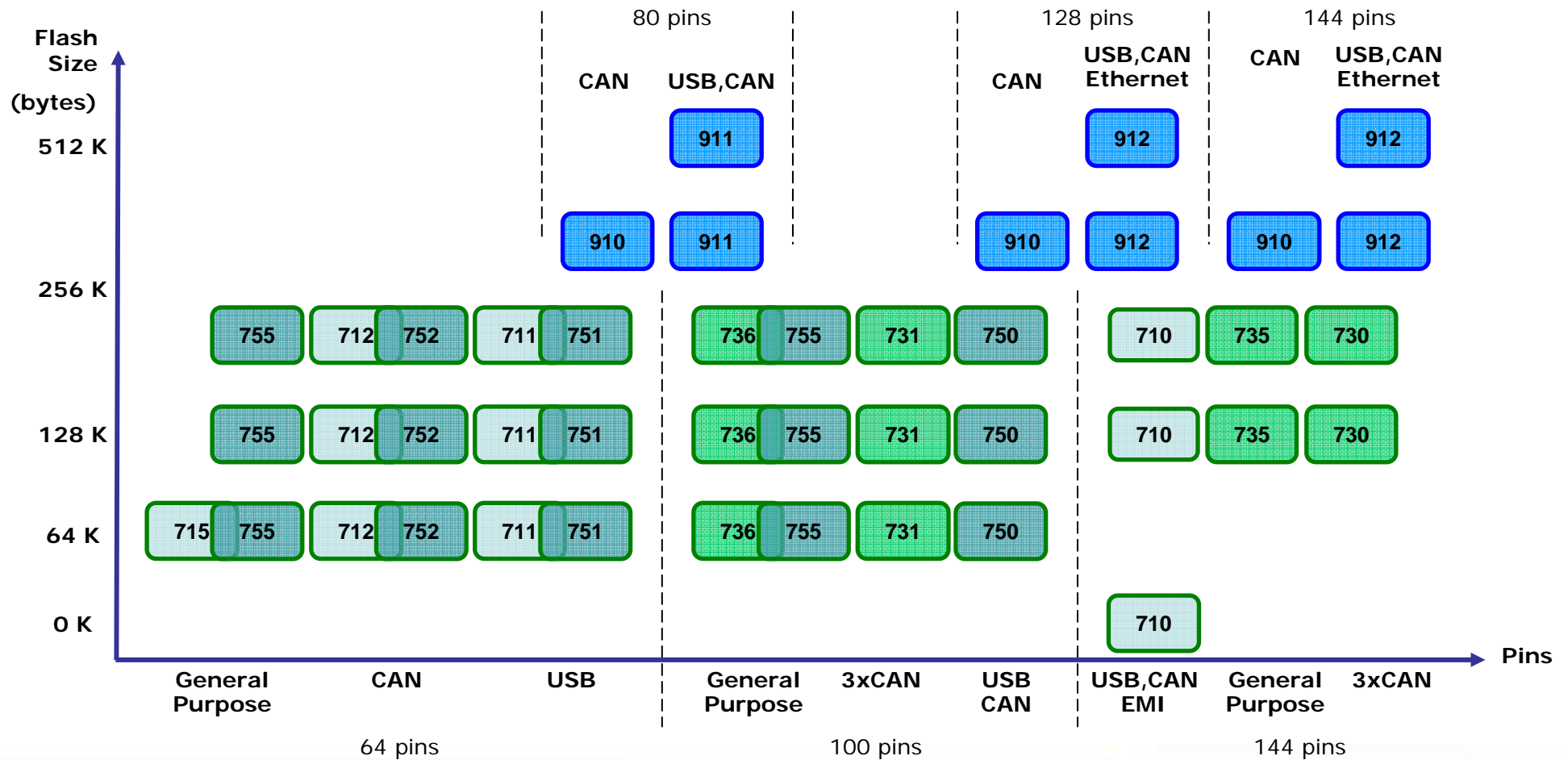
- ARM® is a UK company that designs **innovative** 32-bit cores, licensing them to the world's leading electronics companies
- ARM® is rapidly becoming a **global standard**
- Leading edge core scalable roadmap
  - ARM7 – ARM9 – ARM11 – New Cortex

## Benefits

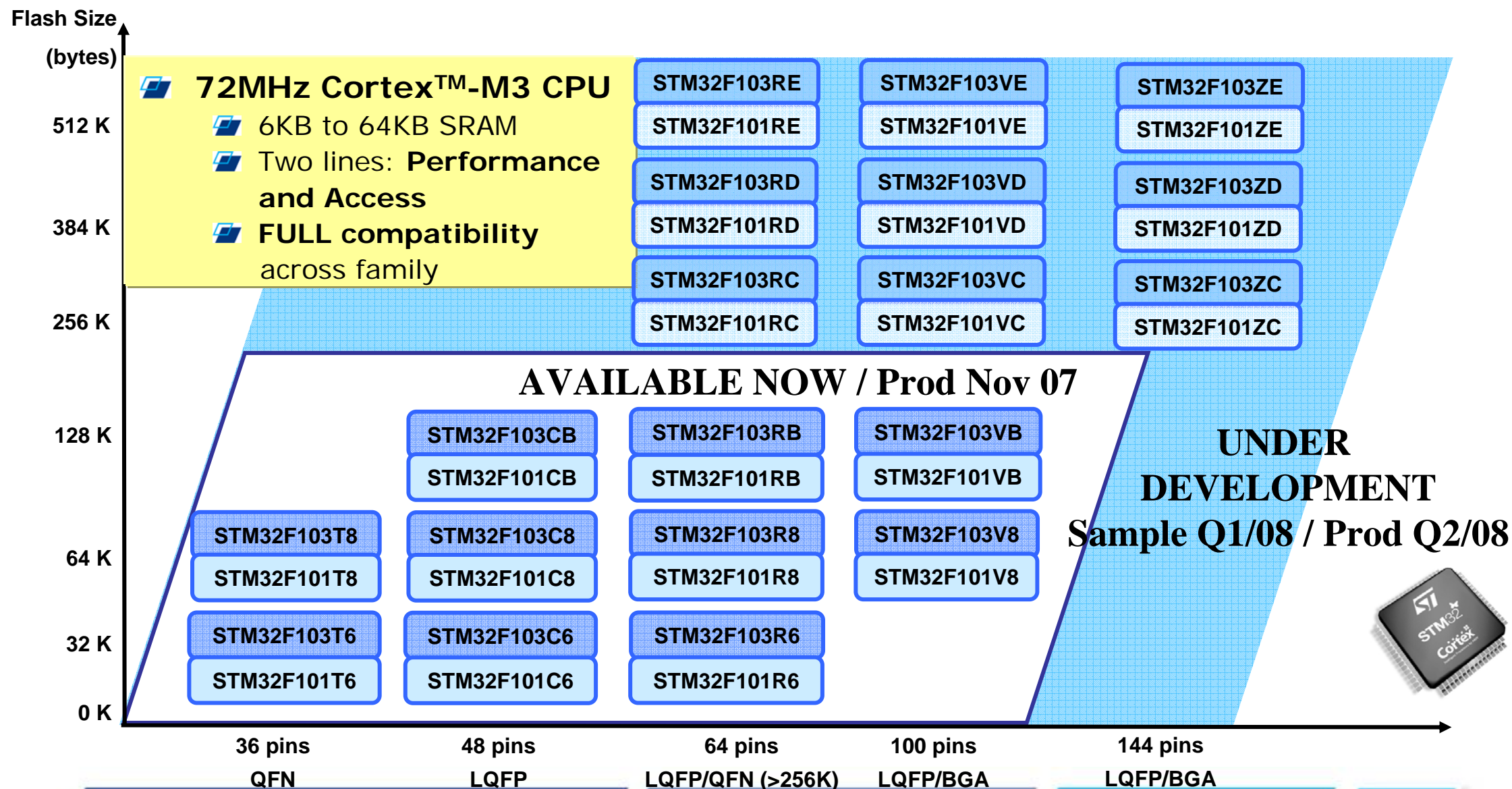
- Low power, High performance, Scalable**
- Many ARM® trained engineers
- Hardware and software tools
  - Rapid time to market using 3<sup>rd</sup>-party SW
  - ARM® has the widest range of hardware and software tools support of any 32-bit architecture
  - Designed to support RTOS and OS



# Existing STR7 / STR9 Portfolio



# Introducing STM32 Family



32-bit Microcontrollers

MMS/MCD 32-bit Marketing team





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# STM32F10x : 2 first product lines

## STM32F103 Performance Line

-  **Best in class 32-bit flash MCU**
-  **Ability to outperform integer DSP solutions**
-  **Superior control & connectivity**
-  **Excellent fit for low voltage/low power applications**

## STM32F101 Access Line

-  **32-bit performance at 16-bit Prices**
-  **Entry point to STM32 world**
-  **Excellent fit for low voltage/low power applications**



# STM32F10x : 2 first product lines

Both lines include up to:

- Up to 128KB FLASH
- 3 x USART
- 2 x SPI
- 2 x I<sup>2</sup>C
- 3 x 16-bit TIMERS
- Main Osc 4-16MHz
- Internal 8 MHz RC and 40 kHz RC
- Real Time Clock
- 2 x Watchdogs
- Reset circuitry
- Power on / down reset
- Voltage detector
- 7 channels DMA
- 80% GPIO ratio



## Performance Line STM32F103\*

72MHz CPU	Up to 20KB SRAM	2x12-bit ADC (1µs) Temp sensor	USB 2.0 FS	CAN 2.0B	PWM timer
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## Access Line STM32F101\*

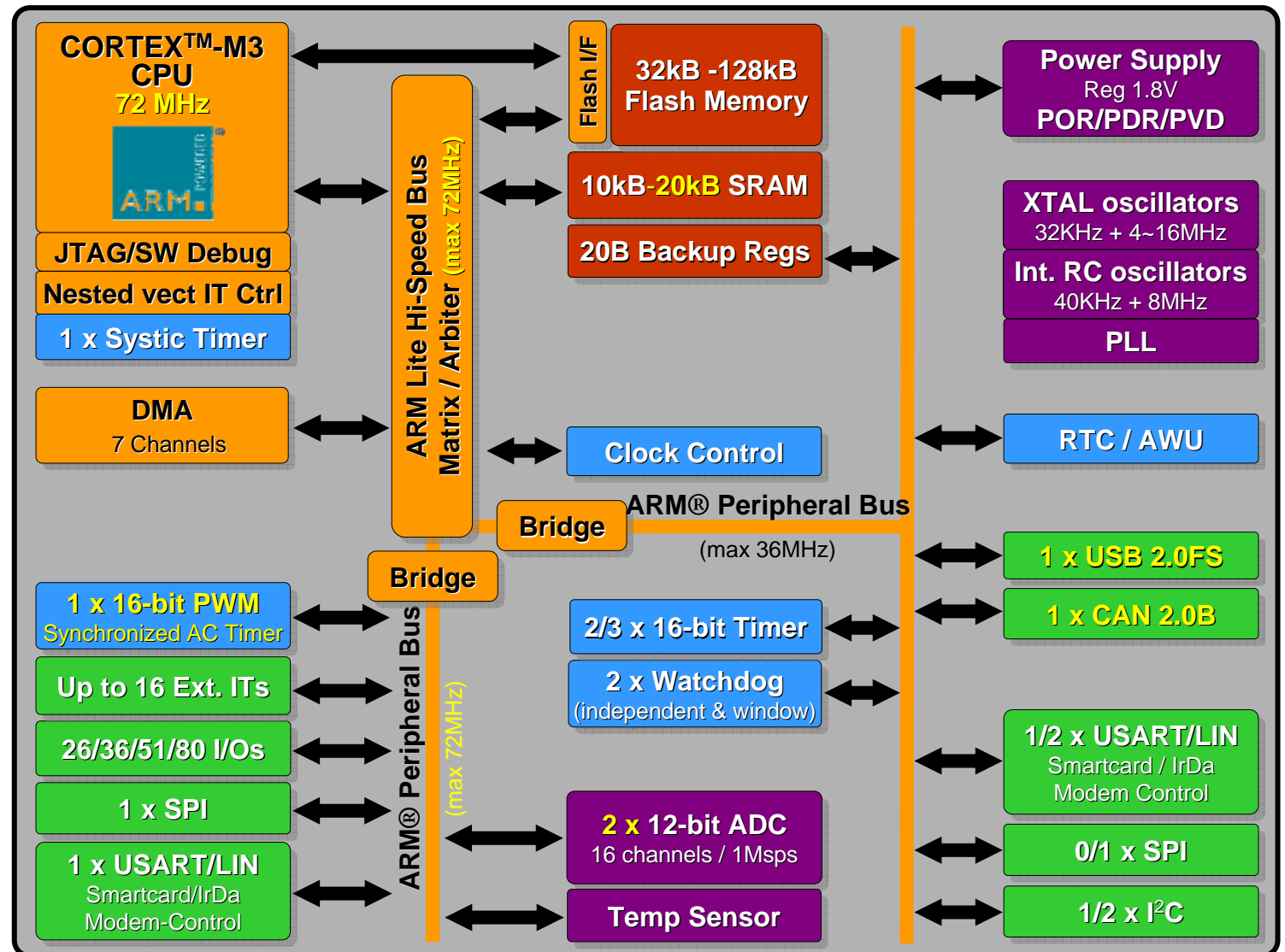
36MHz CPU	Up to 16KB SRAM	1x12-bit ADC (1µs) Temp sensor			
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\*DAC, FSMC, I2S, SDIO, additional PWM timer and 3xADC for some sales types starting at 256kB Flash







# STM32F103 Performance Line (up to 128K)

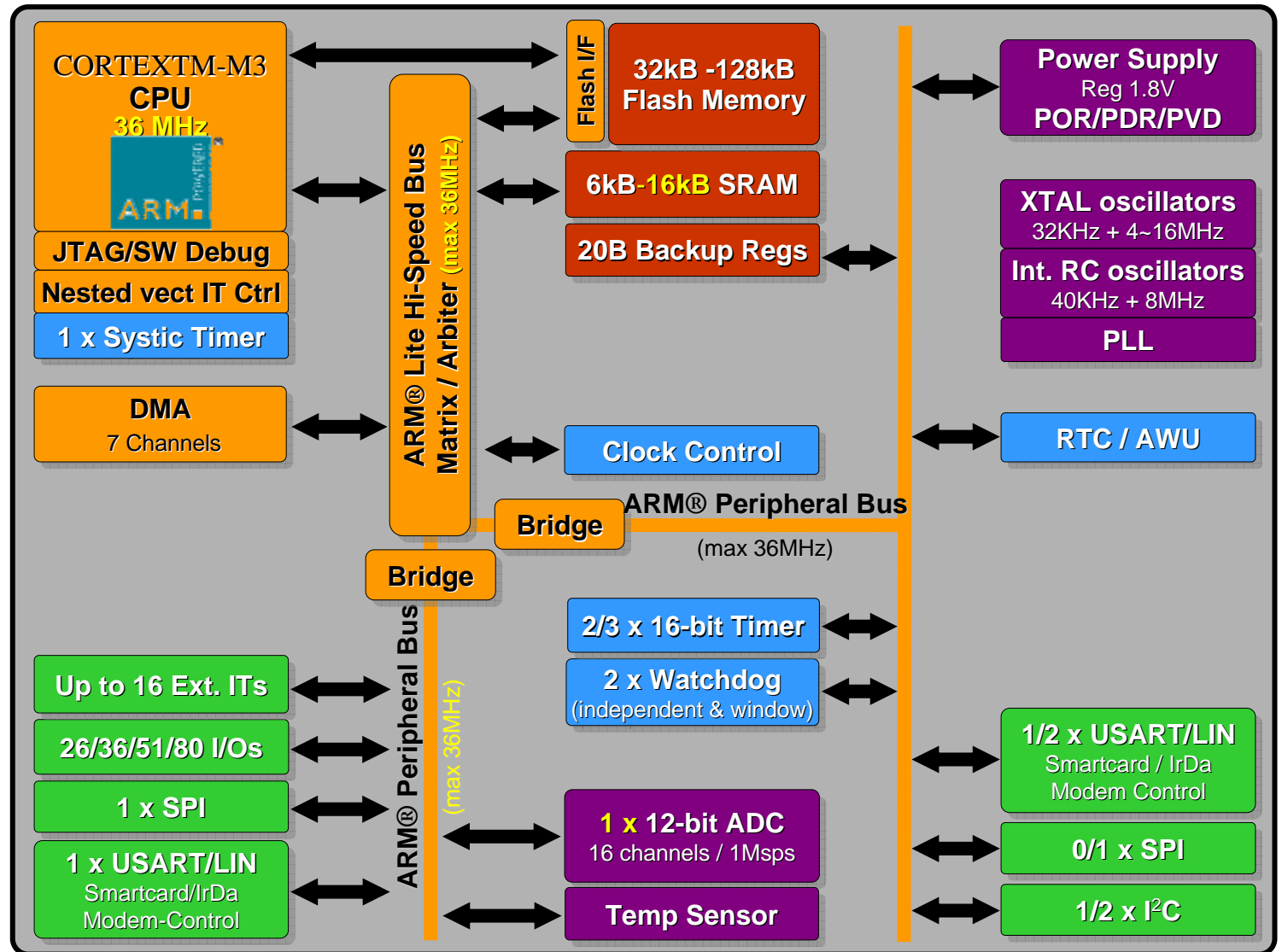
- 2V-3.6V Supply
- 5V tolerant I/Os
- Excellent safe clock modes
- Low-power modes with wake-up
- Internal RC
- Embedded reset
- 40/+105°C





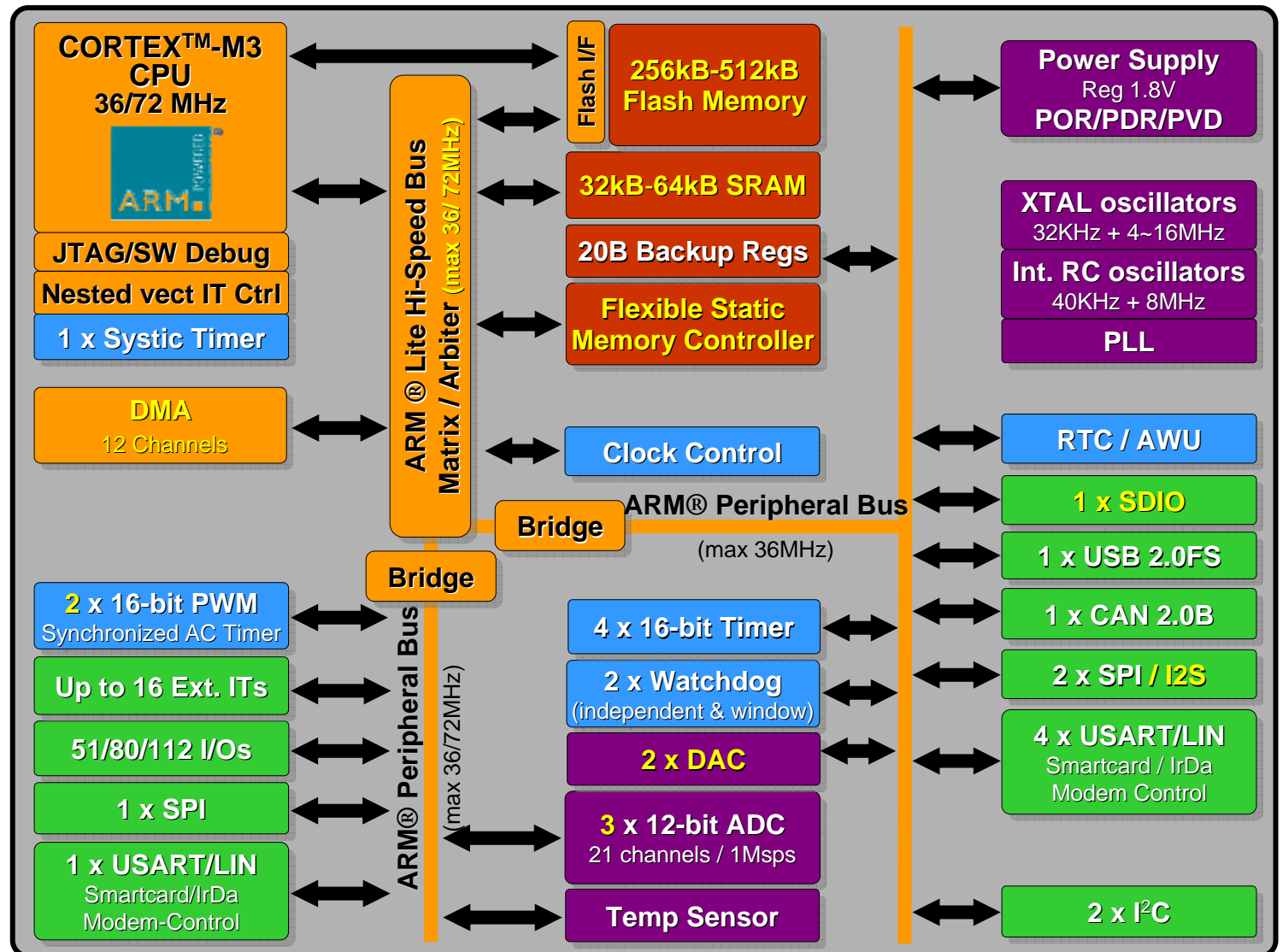
# STM32F101 Access Line (Up to 128K)

-  No USB/CAN/PWM TIMER
-  1xADC
-  SRAM up to 16K
-  -40/+85°C



# STM32F10x 256-512Kb Flash

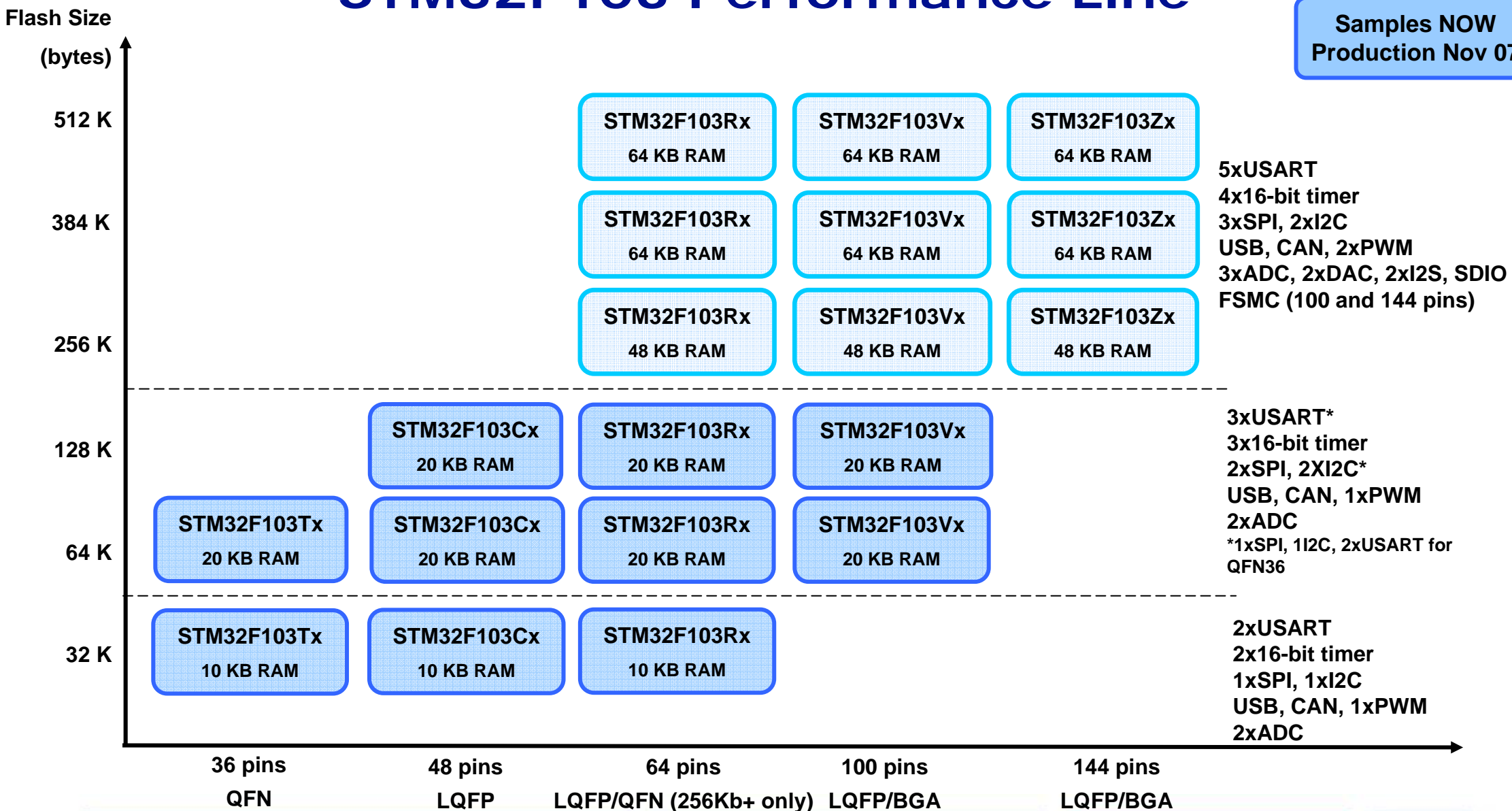
- 2x 12-bit DAC
- FSMC
- SDIO
- I2S
- 12 channels DMA
- 2xPWM timers
- 3xADCs
- Up to 112 I/Os (144 pins package)



Samples Q1 08  
Production Q2 08

Samples NOW  
Production Nov 07

# STM32F103 Performance Line



32-bit Microcontrollers

MMS/MCD 32-bit Marketing team

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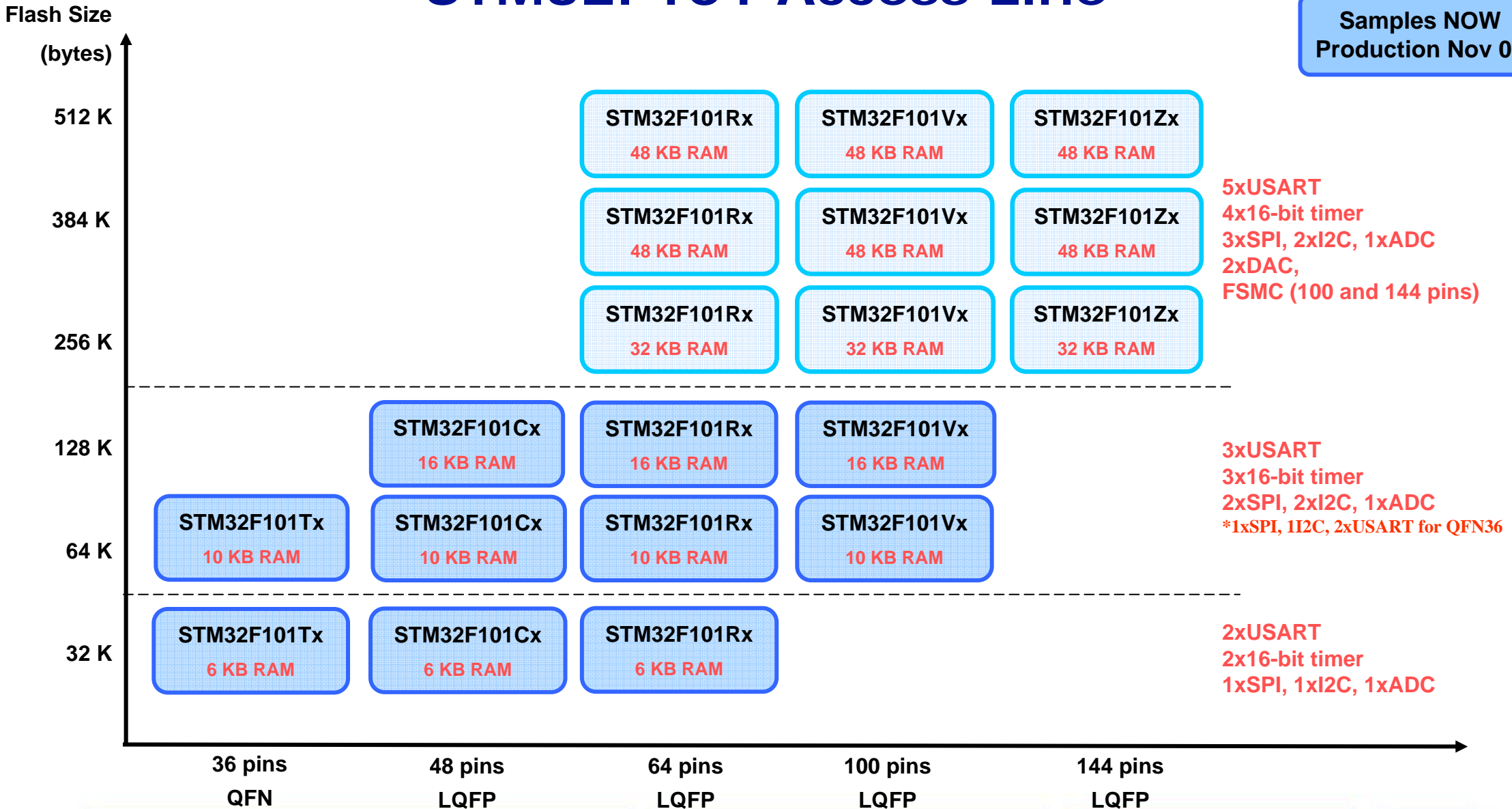
STM32 Releasing your creativity

[www.st.com/stm32](http://www.st.com/stm32)

# STM32F101 Access Line

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# STM32 family extensions

- ▣ Smaller packages (less than 5x5) under evaluation
- ▣ Die delivery
  - ▣ Under qualification for volume applications

# STM32: What else?

Click on the topic you want to develop

## Leading-edge architecture

- Cortex™-M3 core
- Low power
- Rich peripheral set
- Security and safety



## Ease of Use

- Tools and software support



**STM32** 

## Cost saving

- Minimal external components needed
- High level of integration



## Rationalize development

- Standard architecture
- Complete family and compatibility
- Multi application fit
- Fast migration path





# Conclusion



## STM32 brings ...

- ▣ Everything you have been expecting
  - ▣ Leading edge 32bit ARM® MCU, Cortex™-M3
  - ▣ Excellent low-power capabilities
  - ▣ First class peripherals
  - ▣ Maximum integration
  - ▣ Simple architecture and easy to use tools
  
- ▣ At a cost that makes it accessible for all

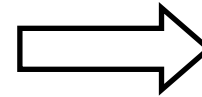
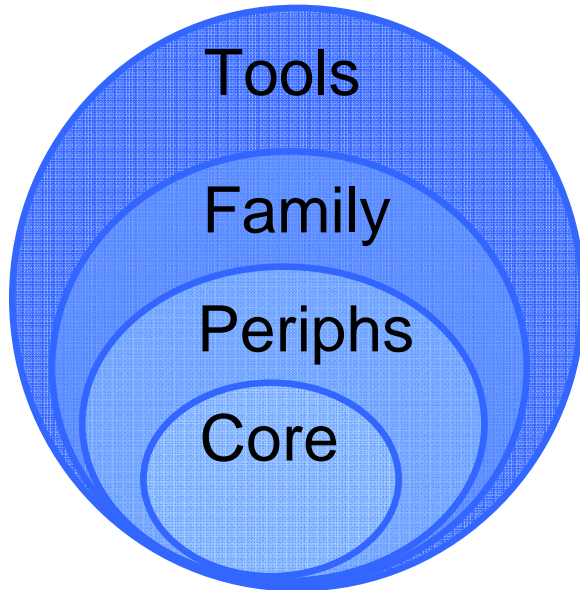


# STM32 platform choice

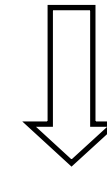


## STM32 Concept

- Standard ARM® Cortex™-M3
- Core
- High performance peripherals
- 2 Complete families offer
- Tools and Software support



**Full compatibility  
across the  
Families**



## Benefits

1. Scalable architecture
2. Set the cursor for your application
3. Same “look and feel” for the user
4. Unique Software and development investment



# STM32: Driving Convergence

## The old Dilemma

16 bit

- Proprietary architecture
- Code constraints
- Limited performance
- Limited software and tools

Vs

32 bit

- Higher cost
- Higher power consumption
- Less integration
- Perceived complexity

## The STM32 way !

STM32

- Standard ARM® 32bit architecture
- Leading edge performance and low power capability
- Best code compactness, wide memory range
- ARM® Tools and Software Ecosystem
- Maximum integration and Accessible cost

# Ease Of Use

## Single architecture – Multi applications

### Point of Sales

- Bank card readers
- Cash registers, thermal printers
- Bill validation, package tracking
- Vending
- Scanner



### USB devices

- Security and biometrics
- Card readers



### Industrial Automation

- Circuit breakers
- Programmable logic contr
- Industrial networking



### Consumer

- PC Peripherals, Gaming
- Digital Cameral, GPS platform
- Remotes, Satellite radio

### Building Security/Fire/HVAC

- Alarm systems
- Control panel



### Medical

- Cardio monitors
- Portable test equipment
- Glucosemeter



### Appliances

- Major appliances
- User interfaces and Vector Control drive



### Other

- Metering, battery operated applications...



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# Why Cortex™-M3?

- ▣ **Latest Standard Core** from ARM®
- ▣ **High-performance with low dynamic power**
  - ▣ 1.25DMIPS/MHz with Harvard Architecture, delivers .19mW/MHz
    - ▣ 30% improvement over ARM7
  - ▣ Single cycle multiply and hardware division
  - ▣ Atomic Bit manipulation allows optimized access to RAM, I/Os and registers
- ▣ **Best code density**
  - ▣ Thumb-2 instruction set brings 32-bit instruction set performance with 16-bit code density (30 to 45% code size reduction)
- ▣ **Deterministic – Real Time behaviour**
  - ▣ Interrupt controller inside the Core, inter-interrupt latency down to 6 CPU cycles
  - ▣ 6 CPU cycles wake up time from Low Power Mode
- ▣ **Improved Debug Features**
  - ▣ Serial Wire debug and JTAG
  - ▣ 2 data watch points, 8 hardware breakpoints



**Cortex™**  
Intelligent Processors by ARM®

# Power management

## Core efficiency

- Core efficiency
  - Cortex™-M3 delivers .19mW/MHz vs .39mW/MHz for ARM7TDMI™
  - For the same processing power, Cortex™-M3 runs with about **30% less speed and consumes ¼** of the power vs ARM7TDMI™

## Low power design

- Low power design
  - Automatic **clock gating**
  - Low power **Flash** with **Auto-off**
  - Internal automatic switch from Vbat to Vdd with **NO consumption** on Vbat when Vdd supplied

## Low power modes

- Low power modes
  - SLEEP (WFE,WFI), STOP and STANDBY modes
  - Ultra fast startup from low power modes / 8MHz internal RC enables **<7us from STOP mode**

## Low power RTC

- Low power RTC
  - Vbat** Independent power supply for battery operation
  - Clocked from 32.768KHz dedicated oscillator or **Low Power internal RC**



# Low power figures

Feature	STM32F10x typ @3.3V
Conso in run mode (typical configuration)	36mA @ 72MHz
Conso in RUN Mode (peripherals OFF)	27mA @ 72MHz
<b>STOP</b> All clocks stopped but MCU status, RAM and registers are preserved (no reset)	14µA
<b>STANDBY</b> Main Voltage Regulator switched off, kernel of device is powered off, RTC OFF	2µA
<b>Startup time</b> From STOP	7µs
<b>Startup time</b> From STANDBY/Reset	55µs
<b>Voltage range</b>	2.0V – 3.6V
<b>RTC on VBAT</b> RTC powered by a battery, no power on the rest of the chip	1.4µA @ 3.3V

# STM3210x Low Power diagram

## STM32F10x: Low power

$V_{dd}$ : 3.3 V

$\mu$ A typical

@ 25°C

14  $\mu$ A

3.4  $\mu$ A

2  $\mu$ A

1.4  $\mu$ A

+

Stop

-

+

Standby  
RTC on

-

+

Standby  
RTC off

-

+

RTC  $V_{bat}$

-

**RESET CIRCUITRY IS ALWAYS ACTIVE**

# Connectivity



## Communication:

- ▣ USB-FS 2.0 device : USB Certified
- ▣ CAN 2.0B
- ▣ USART, LIN Master/Slave, ISO7816 (SmartCard), IrDA, Modem Control,
- ▣ SPI with SD/MMC support
- ▣ I2C with SMBus/PMBus support

## ▣ Increase Peripherals Speed for better performance

- ▣ **Dual Advanced Peripheral buses** (APB) architecture w/ High Speed APB (APB2) allows to optimize use of peripherals (**18MHz SPI, 4.5Mbps USART, 72MHz PWM Timer, 18MHz toggling I/Os**)

- ▣ 80% I/O ratio (5V tolerant, 20mA drive)

Excellent for communication gateways

### Need for Speed

**USB:** 12 Mbps

**UART:** 4.5 Mbps

**SPI:** 18 MHz  
master and slave

**I2C:** 400 kHz

**GPIO:** 18 MHz max  
toggle

# Control

## ❏ Multiply the control capabilities

- ❏ 16-bit Timers each offer 4 Input Capture / 4 Output Compare or 4 PWM signals
- ❏ Advance Control timer can be used with complementary signals and dead times embedded OR in General Purpose timer with up to 4 IC / 4 OC or 6PWMs (13.9ns resolution)
- ❏ Timer Link system to cascade and synchronize timers

Total of up to 18 PWMs or 16 IC / 16 OC on LQFP100 package

## ❏ Save time entering the External Interrupt routine

- ❏ External Interrupt Controller improved to **decrease** interrupt **latency**
- ❏ Detection on rising, falling or both edges (< **1 CPU cycle** signal for detection).

## ❏ Get the best of external signals

- ❏ Up to 2x12 bit ADC (1µs) with Dual sample and Hold capability and synchronized with the Timers; Down **to 500ns** when both ADC combined on same channel

## ❏ Alternate functions remapping allows optimization of the pin out

- ❏ Timers, USART, CAN, SPI, I2C pins can be remapped
- ❏ Test your hardware / Boundary scan

# Security and Safety

## Reset circuitry

Back-up clock

Dual watchdog

Flash protection

Anti-tamper

Back-up registers

Emergency stop

I/O locking

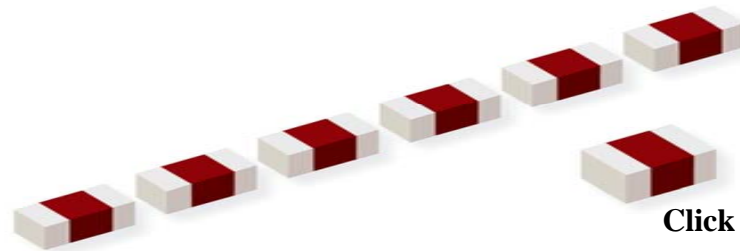
Deterministic mapping

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# Minimal External Components

- ▣ **Built-in Supervisor reduces need for external components**
  - ▣ Filtered reset input, Power-On reset, Low-Voltage Detect, Brown-Out Detect, Watchdog Timer with independent clock
- ▣ **One main crystal drives entire system (with help from PLL)**
  - ▣ Inexpensive 4-16 MHz crystal drives CPU, USB, all peripherals
- ▣ **Embedded 8 MHz RC can be used as main clock**
  - ▣ Optional 32 kHz crystal needed additionally for RTC, can run on internal 40 kHz RC
- ▣ **Only 7 external passive components for base system on LQFP100 package!!**



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# Extensive Tools and Firmware Library Support

Dramatically Reduce your Design Time

- ▣ Standard ARM<sup>®</sup> Architecture
  - ▣ **Spend the development effort once**
- ▣ Support from many third-parties worldwide
  - ▣ **Many development and starter kits to choose from (Keil, IAR, Raisonance, Hitex) to start the design**
- ▣ Many engineers trained worldwide
- ▣ Using free STM32 firmware library from ST

Get everything you need to start, right out-of-the-box

# Easy-to-Use Tools

## Compilers and IDE

IAR SYSTEMS  
KEIL™  
An ARM® Company  
Green Hills SOFTWARE, INC.  
GNU

## Device Programming

SYSTEM GENERAL  
SEGGER  
Data I/O  
BP MICROSYSTEMS  
pls Development Tools  
RAISONANCE

hitex DEVELOPMENT TOOLS  
mbest  
RA  
Z SYSTEM  
LAUTERBACH

## IDE and debuggers, GNU compilers

# Royalty free RTOS

Supplier	Product	ARM7 footprint (bytes)	STM32 footprint (bytes)
CMX	CMX-RTX	ROM: <10 K RAM: <1 K	ROM: <5 K RAM: <1 K
	CMX-TCP/IP	ROM: <10 K RAM: 1 K + buffer	Not applicable
freeRTOS.org (open source)	freeRTOS	ROM: 4.2 K RAM: 1 K	ROM: 2.7-3.6 K RAM: 0.2 K
IAR	PowerPac	ROM: 2-4 K RAM: 51 bytes	ROM: 2-4 K RAM: 51 bytes
Keil	ARTX-ARM	ROM: 6K RAM: 0.5K bytes	ROM: 1.5-3 K RAM: 0.5 K
Micrium	uC/OSII	ROM: <20 K RAM: <2 K	ROM: 16 K RAM: 2K
Segger	embOS	ROM: 3 K RAM: 51 bytes	ROM: 1.7 K RAM: 51 bytes
	emWin	– –	ROM: 2 K RAM: 20 bytes/window



# USB Developer's Kit

- ❏ Complete source file with documented, thoroughly tested C source code, compatible with major IDE toolsets for ARM®
- ❏ Supports any flavor of USB firmware with:
  - ❏ **Control transfer** for generic device management tasks
  - ❏ **Interrupt transfer** with **HID Mouse/Joystick**
  - ❏ **Bulk transfer** with **mass storage**
  - ❏ **Isochronous transfer** with **Voice Speaker/micro**
  - ❏ **DFU** for firmware updates on USB
  - ❏ **Virtual COM** (CDC class) for emulation of RS232



# Standard Firmware Library

- ❏ Complete Firmware Library in C (MISRA compliant)
  - ❏ Collection of C functions written, tested, and documented professionally by ST
  - ❏ Standard **ANSI-C**, compatible with Third Party compilers
  - ❏ Free distribution to customers from ST ([www.st.com/mcu](http://www.st.com/mcu))
  - ❏ Insulates from having to deal with low-level registers and bits of peripherals and functions
- ❏ Consistent **API** covering all family devices
- ❏ Drivers for each peripheral including USB
- ❏ Dramatically reduces design time chance for error
  - ❏ Requires less in depth study of datasheet
  - ❏ Easy migration from one device to another

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