Introducing STM32 L0x Series
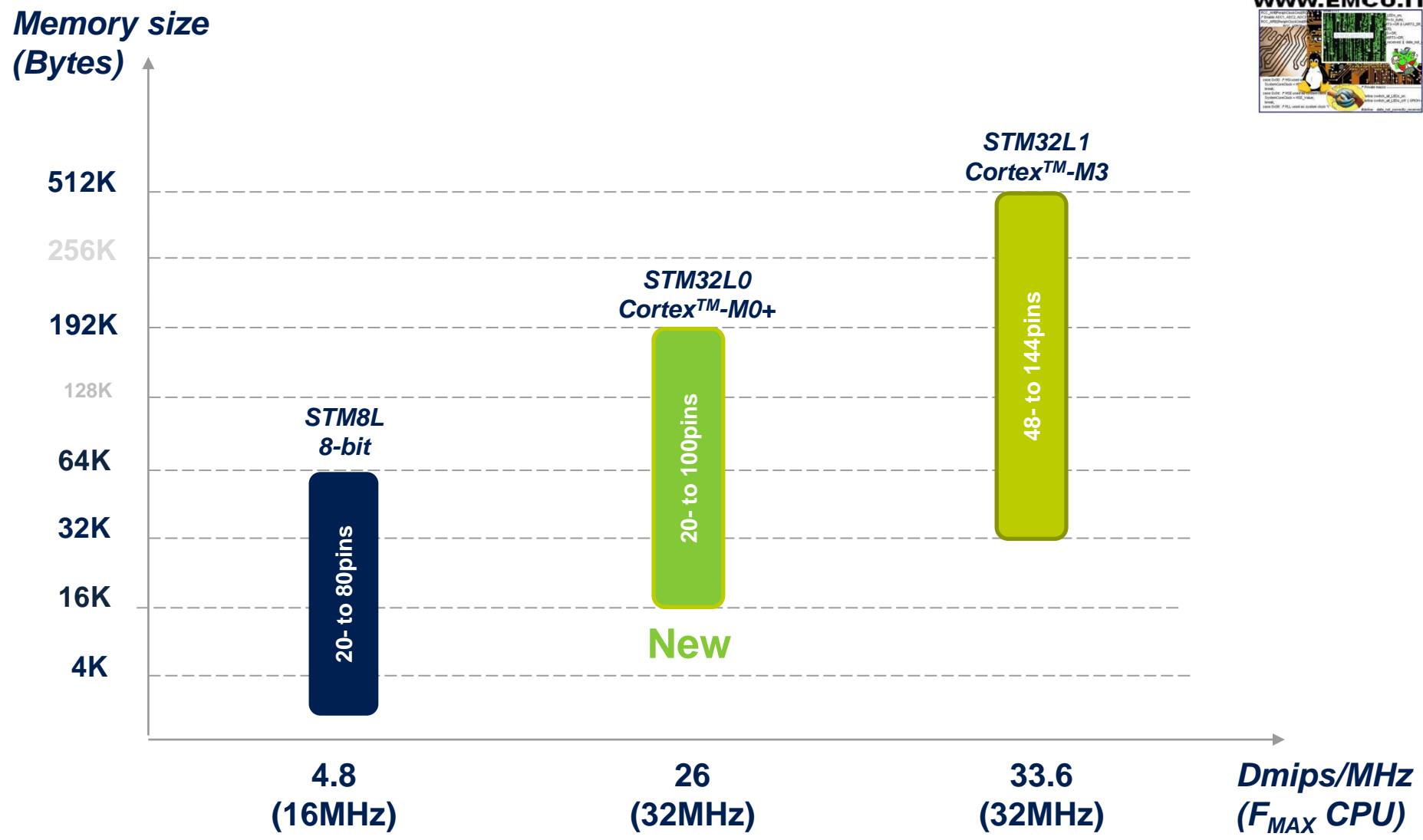
April 2014

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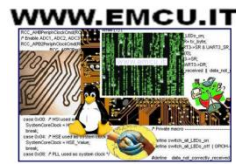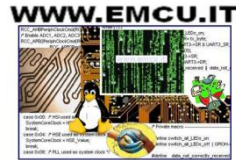
STM32 L0

ST's Ultra-low-power Continuum (1/2)

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Memory size (Bytes)

512K

256K

192K

128K

64K

32K

16K

4K

STM8L 8-bit

20- to 80pins

STM32L0 Cortex™-M0+

20- to 100pins

New

STM32L1 Cortex™-M3

48- to 144pins

| 4.8 (16MHz) | 26 (32MHz) | 33.6 (32MHz) |

Dmips/MHz (F_{MAX} CPU)

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ST's Ultra-low-power Continuum (2/2)

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Memory size (Bytes)

STM32L0 Cortex™-M0+

Phase2
H2-2014
64- to 192KB Flash

STM32L1 Cortex™-M3

512K

256K

STM3...
Cortex™...

Phase1
Feb-2014
32- to 64KB Flash

192K

48- to 144pins

128K

STM8L 8-bit

64K

32K

16K

4K

20- to 100pins

Phase3
H2-2014
16- to 32KB Flash

20- to 80pins

New

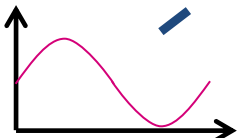| 4.8 (16MHz)	26 (32MHz)	33.6 (32MHz)	**Dmips/MHz (F$_{MAX}$ CPU)**

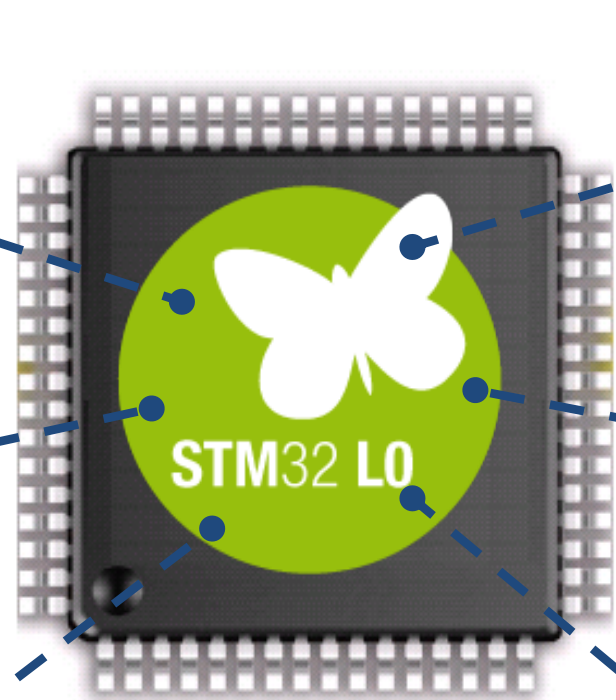SILICA
An Avnet Company

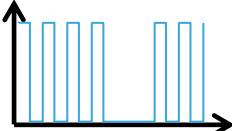life.augmented

Meet with STM32L0x Series

- **STM32® ultra-low-power DNA is now built with ARM Cortex-M0+**

- **1.71V to 3.6V 32MHz** operation
- 139µA/MHz (Run 32MHz)
- **87µA/MH**z (Run Optimized)
- **400nA Stop mode + Full Ram**
- **3.5 µs wakeup** to Run
- -40°C to +125°C range

Ultra-low-power time counter
with 16-bit low-power timer

- **Sector Flash Lock**
- **Hardware encryption - AES**
- **True RNG**[2]
- **Unique ID (96-bit)**

USB 2.0 FS Certified
Crystal-less / BCD[1]

Cortex™-M0+

Ultra-low-power ADC
12/16-bit resolution

life.augmented
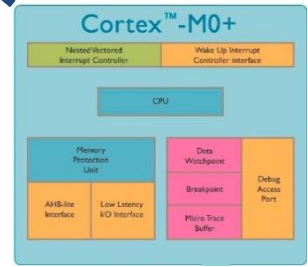
1. Battery Charger Detection
2. True Random Number Generator

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Industrial

Gas/water meter
Industrial sensors
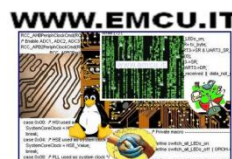Door lock

**High temperature range
Accurate time count
Field firmware upgrade
Data-log and Display**

- -40°/+125°C range
- RTC @ 0.95ppm (<1µs)
- Dual bank flash with RWW[1]
- True internal EEPROM
- LCD driver 8x48
- AES, JTAG fuse, ECC

Healthcare

Fitness trackers
Blood pressure
Glucose meter

**Extend battery life
High resolution ADC
Rich analog
Connectivity and Display**

- ADC 12/16-bit - 240µA
- DAC 12-bit
- 2xCompartors
- Low-power 16-bit timer
- I2C and SPI
- USB 2.0 – BCD[2]

Consumer

Audio Accessories
Controllers
3D glasses

**BOM cost constraint
Foot print constraint
Rich connectivity
2years + battery life**

- USB 2.0 FS Crystal-less, BCD[2], LPM[3]
- 3x3mm package and WLCSP
- I2C, I2S, SPI, UA(S)RT, Touch-sense
- 87µA/MHz optimized Active mode
- Down to 250nA with backup registers
- LP-Run mode down to 6µA

RF

Sub GHz
2.4 GHz
Remote
Sensors
Meters

**Encryption
Ultra-low-power mode
Fast wakeup
Communication peripherals**

- HW AES-128-bit
- 400nA Stop / 3.5µs wakeup
- 16 wakeup lines from stop
- I2C FM+ (1MHz)
- SPI 16Mbit/s
- Low-power UART

1. Read While Write operation (Execute code from Flash while writing in the EEPROM
2. Battery Charger Detection
3. Link Power Management

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A Genuine ultra-low-power platform

- **STM32L0 is simply …**

  - **BETTER**

    - **139 µA/MHz** (at 32MHz) down to **87 µA/MHz** (optimized mode) in Run
    - **440nA** in **Stop** mode with **Full RAM** retention and **Low-power Timer Counter** (LTC)
    - **3.5 µs** wakeup time
    - **1.71V** to 3.6V **32MHz** range

  - **SMARTER**

    - Independent clock domain for communication peripheral
    - **ADC 12/16-bit** resolution with only 48µA in 12-bit 100ksps mode (200µA at 1,14Msps)
    - USB 2.0 **Crystal-less**, BCD, LPM
    - Build-in LCD driver
    - **True EEPROM** embedded
    - **Pulse counter** and low-power UART

  - **SMALLER**

    - **3x3mm 20pins** package down the road
    - CSP package below 5mm²

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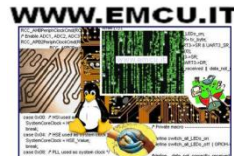
STM32 L0x – Product lines

Common features

- Cortex™-M0+ 32 MHz speed with MPU and MUL
- AES 128-bit
- Firewall protection[2] (Flash and RAM)
- Built-in 16 MHz, 4,2MHz and 38 kHz RC oscillators
- Multiple USART, SPI, I2C Low-power UART
- Multiple 16-bit timers Low-power 16-bit timer
- 2x watchdogs
- Reset circuitry POR/PDR
- Brown Out Reset Program Voltage Detector
- 2x comparators
- Dynamic Voltage Scaling

STM32L0x3 – USB & LCD line – 32-K to 192-Kbyte Flash

Up to 192-KB Flash[1]	16-KB SRAM	Up to 6-KB EEPROM	Main osc. input 1-24 MHz	RTC with 32 kHz osc.	7 ch DMA	ADC 12-bit 1Msps 12-ch	DAC 2x 12-bit	USB2.0 Crystal Less, LPM, BCD	Touch Sense	True RNG	LCD 8x48 4x52

STM32L0x2 – USB line - 32 to 192-Kbyte Flash

| Up to 192-KB Flash[1]	16-KB SRAM	Up to 6-KB EEPROM	Main osc. input 1-24 MHz	RTC with 32 kHz osc.	7 ch DMA	12-bit ADC 1Msps 12-ch	DAC 2x 12-bit	USB2.0 Crystal Less, LPM, BCD	Touch Sense	True RNG

STM32L0x1 – Access line - 16-K to 192-Kbyte Flash

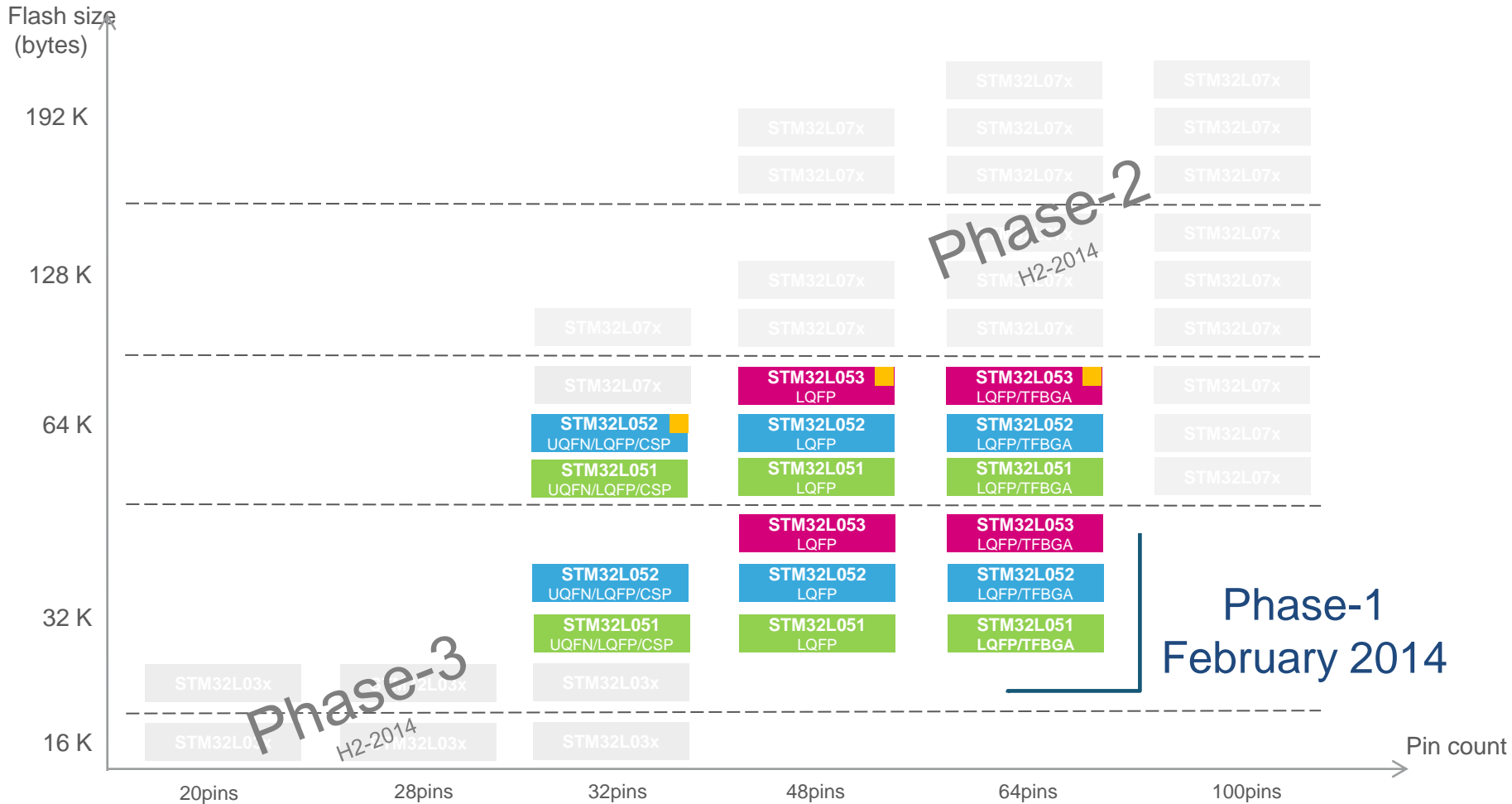| Up to 192-KB Flash[1]	16-KB SRAM	Up to 6-KB EEPROM	Main osc. input 1-24 MHz	RTC with 32 kHz osc.	4 ch DMA	12-bit ADC 1Msps 12-ch

1. Dual bank flash with Rww feature from Flash to EEPROM (on part number > 128KB Flash)
2. Only on STM32L0x2 and L0x3 line
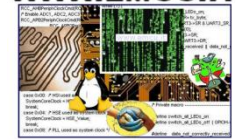
STM32L0x – portfolio
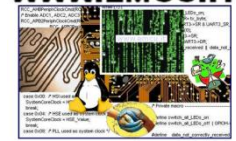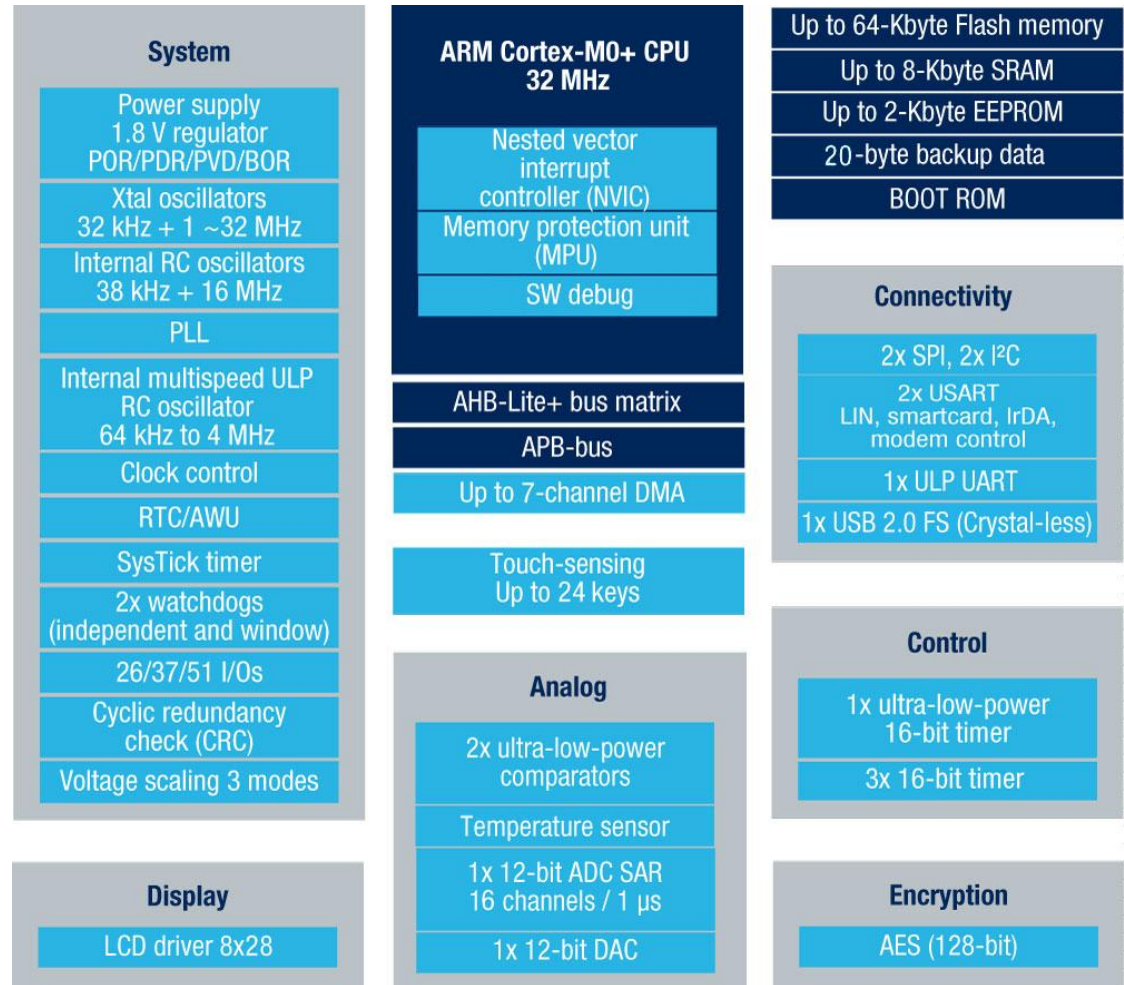*Cortex™-M0+ @ 32MHz – 100+ P/N*

STM32L05x block diagram

- **Key features**
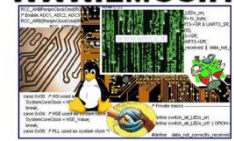 - ARM Cortex-M0+ at 32MHz
    - Single-cycle I/O access
    - Single-cycle multiplier (MUL)
    - 0.97 DMIPS/MHz
  - 1.71V to 3.6V, 32MHz full functional
  - Digital down to 1.65V
  - -40°C to +125°C temperature range
  - ADC with build-in HW oversampling
  - Flash + Ram code sector lock
  - USB 2,0 FS certified
    - Build-in 48MHz oscillator
    - Battery Charger Detection
    - Link Power Management
  - Independent clock domain
    - I2C, USART/UART
    - USB
  - **3x** timers
    - 1x 16-bit (4ch)
    - 2x 16-bit(2ch)
    - 1x 16-bit LP[1] available in stop

System
- Power supply 1.8 V regulator POR/PDR/PVD/BOR
- Xtal oscillators 32 kHz + 1 ~32 MHz
- Internal RC oscillators 38 kHz + 16 MHz
- PLL
- Internal multispeed ULP RC oscillator 64 kHz to 4 MHz
- Clock control
- RTC/AWU
- SysTick timer
- 2x watchdogs (independent and window)
- 26/37/51 I/Os
- Cyclic redundancy check (CRC)
- Voltage scaling 3 modes

ARM Cortex-M0+ CPU 32 MHz
- Nested vector interrupt controller (NVIC)
- Memory protection unit (MPU)
- SW debug

- AHB-Lite+ bus matrix
- APB-bus
- Up to 7-channel DMA

- Touch-sensing Up to 24 keys

- Up to 64-Kbyte Flash memory
- Up to 8-Kbyte SRAM
- Up to 2-Kbyte EEPROM
- 20-byte backup data
- BOOT ROM

Connectivity
- 2x SPI, 2x I²C
- 2x USART LIN, smartcard, IrDA, modem control
- 1x ULP UART
- 1x USB 2.0 FS (Crystal-less)

Control
- 1x ultra-low-power 16-bit timer
- 3x 16-bit timer

Analog
- 2x ultra-low-power comparators
- Temperature sensor
- 1x 12-bit ADC SAR 16 channels / 1 µs
- 1x 12-bit DAC

Display
- LCD driver 8x28

Encryption
- AES (128-bit)

1. Low Power

STM32L05x - power consumption

Typ current

210μA/MHz — Typ 105°C

Typ 25°C

139μA/MHz[1]
Dhrystone (32MHz)

87μA/MHz
While{1} (4MHz)

Dynamic Run
From Flash

8μA

6 μA

Low-Power Run
@ 32kHz

4.2 μA

3.2 μA

Low-Power Sleep
@ 32kHz

1 μA

800[2] nA
440[3] nA
400 nA

Stop
(Full RAM)

290 nA

650 nA
270 nA

Standby RTC
Standby
20bytes backup register
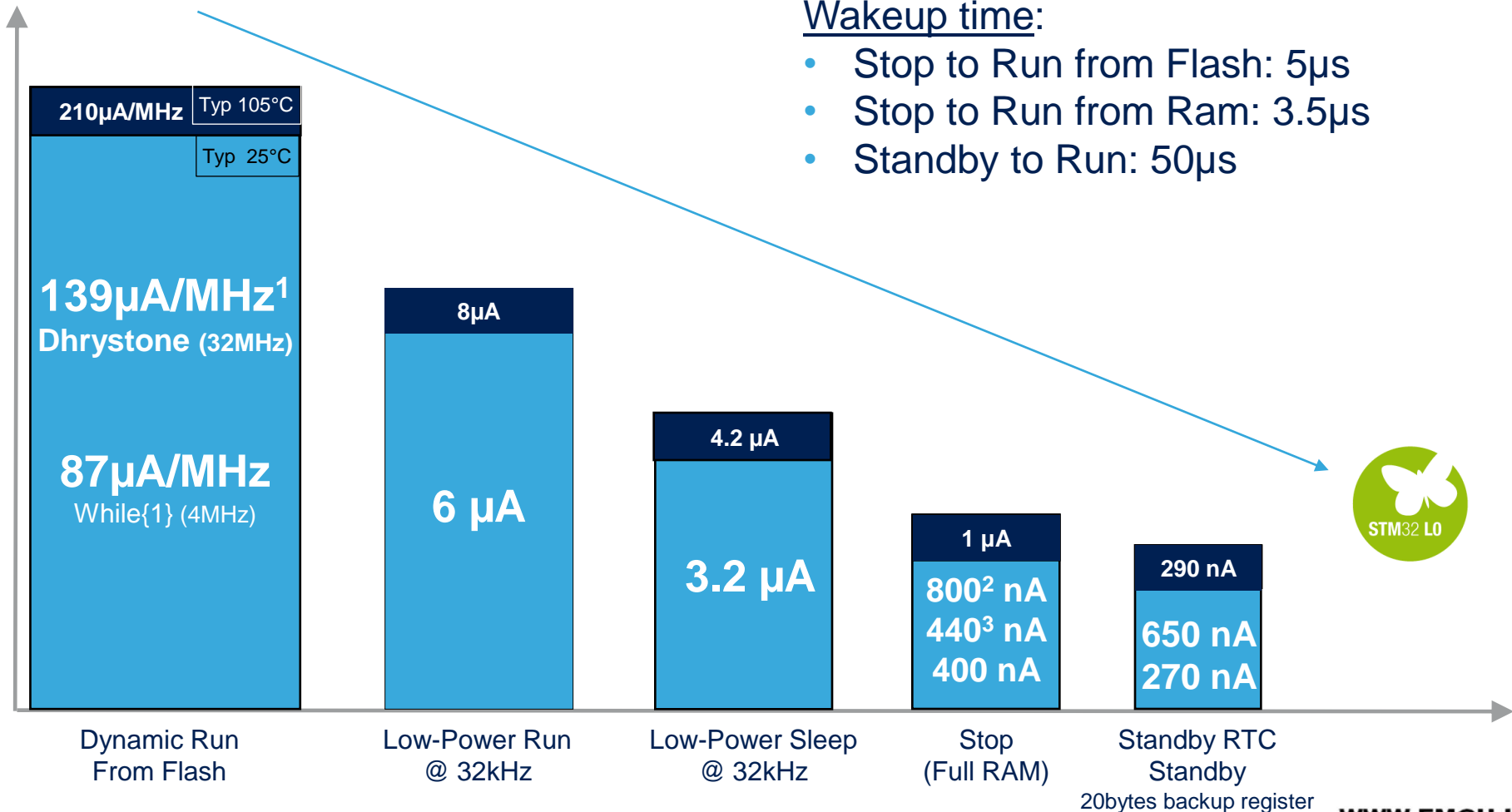
Wakeup time:
- Stop to Run from Flash: 5μs
- Stop to Run from Ram: 3.5μs
- Standby to Run: 50μs

1. Dhrystone power consumption value executed from Flash with VDD=3.3V
2. STOP mode consumption with : **Full Ram retention + RTC** (32,768kHz)
3. STOP mode consumption with : **Full Ram retention + LTC** (Low-power Time Counter)

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- Max. current value at lowest power mode vs. temperature capability

IDD (µA)
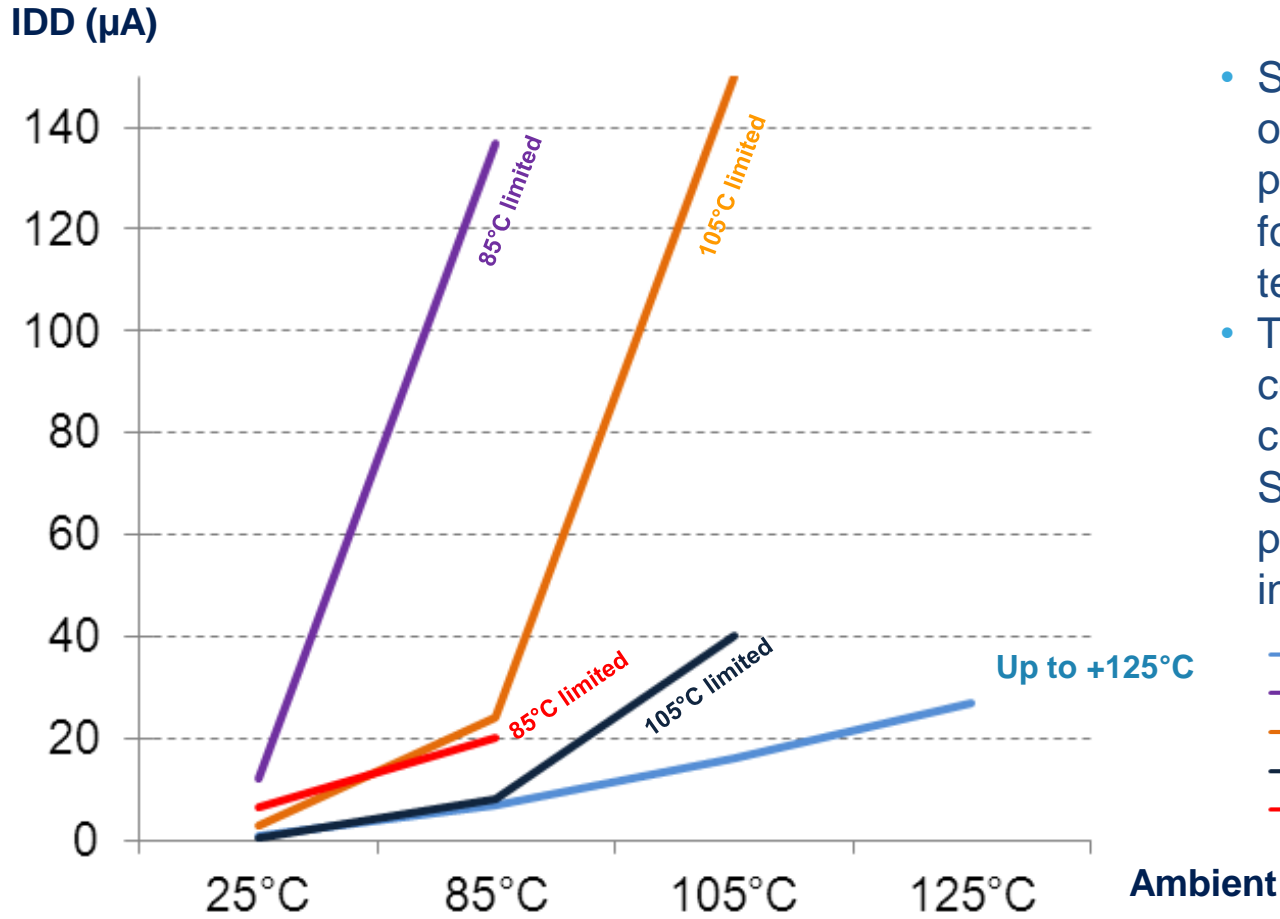
- STM32L0 platform offers the lowest power consumption for the highest temperature range.
- This capability to control leakage current makes STM32L0 the premium choice for industrial application,

Note: Value based on competition datasheet, looking at lowest power mode with full RAM retention at VDD 3.0V. All datasheet give same value for -40°C/+25°C temperature range.

STM32L0x – Technical features (1/3)

Analog peripheral set

- ## Why is STM32L0 SMARTER ?

  - ### ADC: The lowest current consuming of the Industry
    - **48 µA** only at **100Ksps** with 12-bit resolution (max speed: 1.14Msps - 200 µA)
    - **16-bit** resolution capable thanks to **built-in hardware oversampling** feature
    - DMA capability

  - ### DAC:
    - 12-bit DAC with output buffer
    - External triggers and input reference voltage capable
    - DMA capability (with underrun interrupt)

  - ### Comparator
    - 2x built-in comparator ext./int. ref. voltage capable
    - Stop mode wake up capable
    - Window comparator mode capable

- ## For which application ?

Blood pressure

Gas/Water meter

Door lock

Communication peripheral set

- ## Why is STM32L0 SMARTER ?

  - ### USB 2.0 FS Crystal-less: with **Integrated 48 MHz** oscillator

    - BCD (Battery Charging Detection) with 1.5A max and LPM (Link Power Management) capable
    - USB device library and USB VIP/PID sublicensing service for free

  - ### I2C: Independent clock domain + wakeup from stop

    - Multi-master or Slave modes capable (7 and 10-bit addressing)
    - Support Fast mode + (up 1 Mbits/s) and SMBus/PMBus

  - ### USART: Independent clock domain + wakeup from stop

    - Support ISO7816, IrDA SIR ENDEC, LIN Master/slave and auto baud rate feature
    - Low-power UART: com. available in stop mode
      - Snooze wakeup mode capable

  - ### SPI: Full duplex, half duplex up to 16 Mbits/s

    - Support basic SD Card/MMC modes
    - Built-in I2S with audio sampling freq. fro 8 kHz to 192 kHz.

- ## For which application ?

IoT/USB connected object

Mouse/keyboard

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STM32L0x – Technical features (3/3)

Other peripheral set

- ## Why is STM32L0 SMARTER ?

  - ### Timers:

    - Up to 8 timers with 5x 16-bit
    - Low-power **16-bit asynchronous timer** available in stop mode
      - 16bit up counter, 16-bit compare register, software or hardware trigger
      - Output: pulse, PWM
      - Encoder mode, and programmable glitch filter
      - Pulse counter mode

  - ### System safety and security

    - Independent Watchdog (clocked from internal 37kHz osc.) and Window watchdog
    - CSS (Clock Security System)
      - Dynamic switch to MSI(Multi Speed Internal clock) in case of HSE clock failure
      - Wakeup event or interrupt generated in case of LSE(Low Speed External clock) clock failure
    - Built-in HW encryption with AES 128-bit (AES 256-bit available with free crypto lib)
    - CRC and Unique ID (96-bit)
    - JTAG fuse option and Readout code sector protection
    - Error Correction Code (ECC) available for both Flash and EEPROM
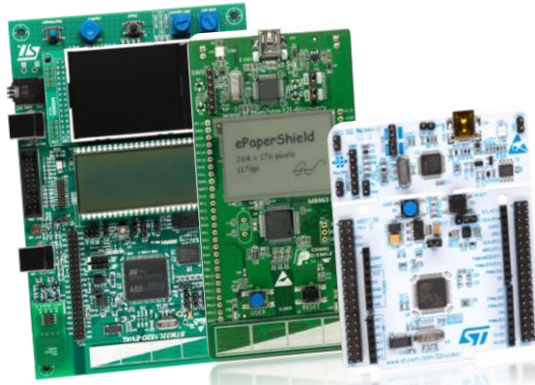
- ## For which application ?

Industrial sensors

**Wireless solution
< 1GHz or 2.4GHz**

Display card
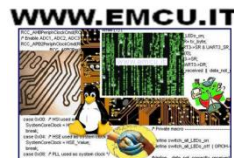
STM32L0x – Ecosystem

- ## Evaluate, Discover and Play

Evaluation   Discovery   Nucleo
Available in Q2/H2 - 2014

- ## Feel free to choose your IDE

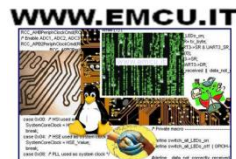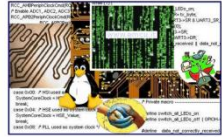GCC based toolchains

- ## Software offer

STM32Cube™

- STM32CubeMX Software: Optimize you design layout, configure your microcontroller usage, and estimate your power consumption

- Embedded Software, from Hardware Abstraction Layer (HAL) easing migration from one STM32 to another, and middleware offer for STM32L0 like FreeRTOS and USB library

Thank you

For more info contact:
enrico.marinoni@silica.com FAE
roberto.rossetti@silica.com BDM