STM32L5 MCU series excellence in ultra-low-power with more security
Main concerns for embedded design

- **Security**
  - Protection from hackers

- **Low power consumption**
  - Long life time, small battery size

- **Integration, size, performance**
  - Best fit versus the application requirements
First STM32 based on Cortex-M33

STM32L5 is the answer

- More security with TrustZone and ST security implementation
  - Hardware to resist logical and board-level attacks
- Lower Power consumption
  - STM32 ultra-low-power technology
- Integration, size, and performance
  - More performance, high memory size and wide portfolio
Security: type of attacks

- **Logical attack**
  - Malicious code injection
  - Malware replacing the genuine program
  - Man-in-the-middle attack

- **Board-level attack**
  - Cloning attack
  - Fault injection
  - Side channel attack

- **Hardware Isolation**
- **Secure Key storage**
- **Encryption**
- **Authentication**
- **IP Protection**
- **Read-out Protection**
- **Active tampering**
- **Certified Crypto library**
Security: TrustZone for isolation

ST implementation provides a high granularity of isolation

- Each GPIO or peripheral, DMA channel, clock configuration register, ART or small part of Flash memory or SRAM can be configured as Trusted or un-Trusted

- Full isolation of trusted and non-trusted worlds
Security: TrustZone for isolation

TrustZone provides full isolation

Example of IoT application implementation
Security: TrustZone and privileged zones

- More partitioning

- Possibility to separate the trusted and un-trusted area with privileged and un-privileged zone

- Strong granularity to define each part of memory or each peripheral, DMA channel as privileged or un-privileged
TrustZone: example

STM32L5

Un-Trusted

Privileged

Un-Trusted & Privileged

RTOS

Trusted

Trusted & Privileged

Secured Keys

Secured Boot

Un-Trusted & Un-Privileged

RF Stack

Un-Privileged

Sensor IP

Secured data

Sensors
A full set of security

Encryption
- AES-128/256 Encryption
- SHA-256 Authentication
- Public Key Acceleration (PKA): for RSA, Diffie-Hellmann or ECC (Elliptic Curve Cryptography)
- Certified Crypto library
- True Random Number Generator
- Unique ID
- OTP Zone

Decryption

Authentication

STM32L5

Memory & IP Protection
- Active and static Anti-tamper detection
- Memory Protection Unit (MPU)
- Secure Boot
- Read and Write Protection
- HDP (Hide Protect)
- OTFDEC (On-the-fly decryption) on Octo SPI to protect external memory
- JTAG fuse
- TrustZone
- Unique Boot Entry
Extends battery lifetime

- STM32L5 reuses the STM32L4/L4+ technology achieving best-in-class power consumption.

- STM32L5 integrates an optional SMPS (DC/DC buck voltage regulator) which can be enabled/disabled on the fly to optimize the energy.

- Proven by EEMBC test results:
  - 402 ULPMark-CP
  - 60 ULPMark-PP
## Ultra-low-power modes

### Best power consumption numbers with full flexibility

<table>
<thead>
<tr>
<th>Wake-up time</th>
<th>( V_{\text{BAT}} )</th>
<th>Tamper detection: 3 I/Os, RTC</th>
</tr>
</thead>
<tbody>
<tr>
<td>250 µs</td>
<td>3 nA / 225 nA*</td>
<td></td>
</tr>
<tr>
<td>14 µs</td>
<td>33 nA / 300 nA*</td>
<td>Wake-up sources: reset pin, 5 I/Os, RTC</td>
</tr>
<tr>
<td>14 µs</td>
<td>110 nA / 385 nA*</td>
<td>Wake-up sources: + BOR, IWDG</td>
</tr>
<tr>
<td>5 µs</td>
<td>190 nA / 465 nA*</td>
<td>Wake-up sources: + all I/Os, PVD, COMPs, I²C, LPUART, LPTIM</td>
</tr>
<tr>
<td>6 cycles</td>
<td>3.3 µA / 3.6 µA*</td>
<td></td>
</tr>
<tr>
<td>5 µs</td>
<td>38 µA / MHz</td>
<td>Wake-up sources: any interrupt or event</td>
</tr>
<tr>
<td>6 cycles</td>
<td>Down to 60 µA / MHz</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** * without RTC / with RTC
More performance

Better responsiveness of the application

• **New** Arm® Cortex®-M33 performance: +20% versus Cortex-M4

  1.5 DMIPS/MHz
  3.88 CoreMark/MHz

  165 DMIPS
  427 CoreMark

• **New** ST ART Accelerator™: working both on internal and **external** Flash
  • 8 Kbytes of instruction cache
High integration and innovation

Large memory, USB Type-C™ w/ power delivery controller, CAN FD

<table>
<thead>
<tr>
<th>Parallel interface</th>
<th>Connectivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSMC 8-/16-bit (TFT-LCD, SRAM, NOR, NAND)</td>
<td>USB Device Crystal-less, USB Type-C and PD, 1x SD/SDIO/MMC, 3x SPI, 4x PC, 1x CAN FD, 1x Octo-SPI, 5x USART + 1x LPUART</td>
</tr>
<tr>
<td>Digital</td>
<td>Encryption</td>
</tr>
<tr>
<td>2x SAI, DFSDM (4 channels)</td>
<td>AES (256-bit), PKA, SHA-1, SHA-256, TRNG, CRC, OTFDEC</td>
</tr>
<tr>
<td>Timers</td>
<td>Analog</td>
</tr>
<tr>
<td>14 timers including: 2x 16-bit advanced motor control timers 2x LPUART timers 3x 16-bit-timers 2x 32-bit timers</td>
<td>2x 12-bit ADC 12/16 bits 5 MSPS, 2x DAC, 2x comparators, 2x op amps 1x temperature sensor</td>
</tr>
<tr>
<td>I/Os</td>
<td></td>
</tr>
<tr>
<td>Up to 115 I/Os Touch-sensing controller</td>
<td></td>
</tr>
</tbody>
</table>

Arm® Cortex®-M33 CPU
- 110 MHz
- TrustZone®
- FPU
- MPU
- ETM

DMA

ART Accelerator™

512-Kbyte memory
- Flash
- Dual Bank

256-Kbyte RAM
Large portfolio

7 packages, several options
# STM32L ULP portfolio

STM32L5 completes the ultra-low-power subclass

<table>
<thead>
<tr>
<th>Cost-smart ULP champion</th>
<th>Broad-range foundation</th>
<th>ULP With performance</th>
<th>ULP with more performance</th>
<th>Advanced security</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STM32L0</strong></td>
<td><strong>STM32L1</strong></td>
<td><strong>STM32L4</strong></td>
<td><strong>STM32L4+</strong></td>
<td><strong>STM32L5</strong></td>
</tr>
<tr>
<td>Cortex-M0+ at 32 MHz</td>
<td>Cortex-M3 at 32 MHz</td>
<td>Cortex-M4 w/ FPU at 80 MHz</td>
<td>Cortex-M4 w/ FPU at 120 MHz</td>
<td>Cortex-M33 w/ FPU at 110 MHz</td>
</tr>
<tr>
<td>1.65 to 3.6V</td>
<td>1.65 to 3.6V</td>
<td>1.71 to 3.6V</td>
<td>1.71 to 3.6V</td>
<td></td>
</tr>
<tr>
<td>8-/16-bit applications</td>
<td>Wide choice of memory sizes</td>
<td>High-performance, advanced analog circuits</td>
<td>Wide choice of memory sizes</td>
<td></td>
</tr>
<tr>
<td>Wide range of pin-counts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 product lines, Cost-effective, Smaller packages, USB, LCD, Analog 8 to 192 Kbytes of Flash, Up to 20 Kbytes of SRAM</td>
<td>3 product lines, USB, LCD, AES, Rich Analog True EEPROM, Dual-bank Flash memory (RWW), 32 to 512 Kbytes of Flash, Up to 80 Kbytes of SRAM</td>
<td>5 product lines, 5-MSPS ADC, PGA, Compar., DAC, Op Amp, USB OTG, LCD, AES 64 Kbytes to 1 Mbyte Up to 320 Kbytes of SRAM</td>
<td>3 product lines, 5-MSPS ADC, PGA, Compar., DAC, Op Amp, USB OTG, LCD, AES 1 to 2 Mbytes of Flash, Up to 640 Kbytes of SRAM</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 product line, 5-MSPS ADC, PGA, Compar., DAC, Op Amp, USB Type C, AES 256 to 512 Kbytes of Flash, Up to 256 Kbytes of SRAM</td>
<td></td>
</tr>
</tbody>
</table>

STM32L0:
- Cortex-M0+ at 32 MHz
- 1.65 to 3.6V
- 8-/16-bit applications
- Wide range of pin-counts
- 3 product lines, Cost-effective, Smaller packages, USB, LCD, Analog
- 8 to 192 Kbytes of Flash
- Up to 20 Kbytes of SRAM

STM32L1:
- Cortex-M3 at 32 MHz
- 1.65 to 3.6V
- Wide choice of memory sizes
- 3 product lines, USB, LCD, AES, Rich Analog True EEPROM, Dual-bank Flash memory (RWW), 32 to 512 Kbytes of Flash, Up to 80 Kbytes of SRAM

STM32L4:
- Cortex-M4 w/ FPU at 80 MHz
- 1.71 to 3.6V
- High-performance, advanced analog circuits
- 5 product lines, 5-MSPS ADC, PGA, Compar., DAC, Op Amp, USB OTG, LCD, AES
- 64 Kbytes to 1 Mbyte
- Up to 320 Kbytes of SRAM

STM32L4+:
- Cortex-M4 w/ FPU at 120 MHz
- 1.71 to 3.6V
- Wide choice of memory sizes
- 3 product lines, 5-MSPS ADC, PGA, Compar., DAC, Op Amp, USB OTG, LCD, AES
- 1 to 2 Mbytes of Flash
- Up to 640 Kbytes of SRAM

STM32L5:
- Cortex-M33 w/ FPU at 110 MHz
- 1.71 to 3.6V
- Wide choice of memory sizes
- 1 product line, 5-MSPS ADC, PGA, Compar., DAC, Op Amp, USB Type C, AES
- 256 to 512 Kbytes of Flash
- Up to 256 Kbytes of SRAM
STM32L5 helps designers to answer IoT challenges

• More security
• Lower power consumption
• Integration, size, and performance
Releasing your creativity

/STM32
@ST_World
community.st.com
www.st.com/STM32L5
Thank you