



**POLITECNICO**  
MILANO 1863

# Embedded Systems: Hardware Projects

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**Andrea Galimberti** ([andrea.galimberti@polimi.it](mailto:andrea.galimberti@polimi.it))

**Davide Zoni** ([davide.zoni@polimi.it](mailto:davide.zoni@polimi.it))

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# Arm Cortex-M processor family

Optimized for cost and energy-efficient microcontrollers

Found in a variety of applications (IoT, industrial and everyday consumer devices)

## **Cortex M1**

Small, low-power processor for FPGA devices

Optimized for FPGA development

## **Cortex M3**

High 32-bit performance with low power consumption

**Both Cortex-M1 and Cortex-M3 are freely available through Arm DesignStart**



# Arm Cortex-M1 and Cortex-M3 processors

## arm CORTEX<sup>®</sup>-M1

Nested vectored interrupt controller

CPU  
Armv6-M

AHB-Lite

JTAG/Serial  
Wire Debug

I-TCM

Breakpoint  
unit

D-TCM

Data  
watchpoint

## arm CORTEX<sup>®</sup>-M3

Nested vectored  
interrupt controller

Wake-up interrupt  
controller

CPU  
Armv7-M

Memory protection unit

3x  
AHB-Lite

ITM trace

Data  
watchpoint

JTAG

ETM trace

Breakpoint  
unit

Serial wire

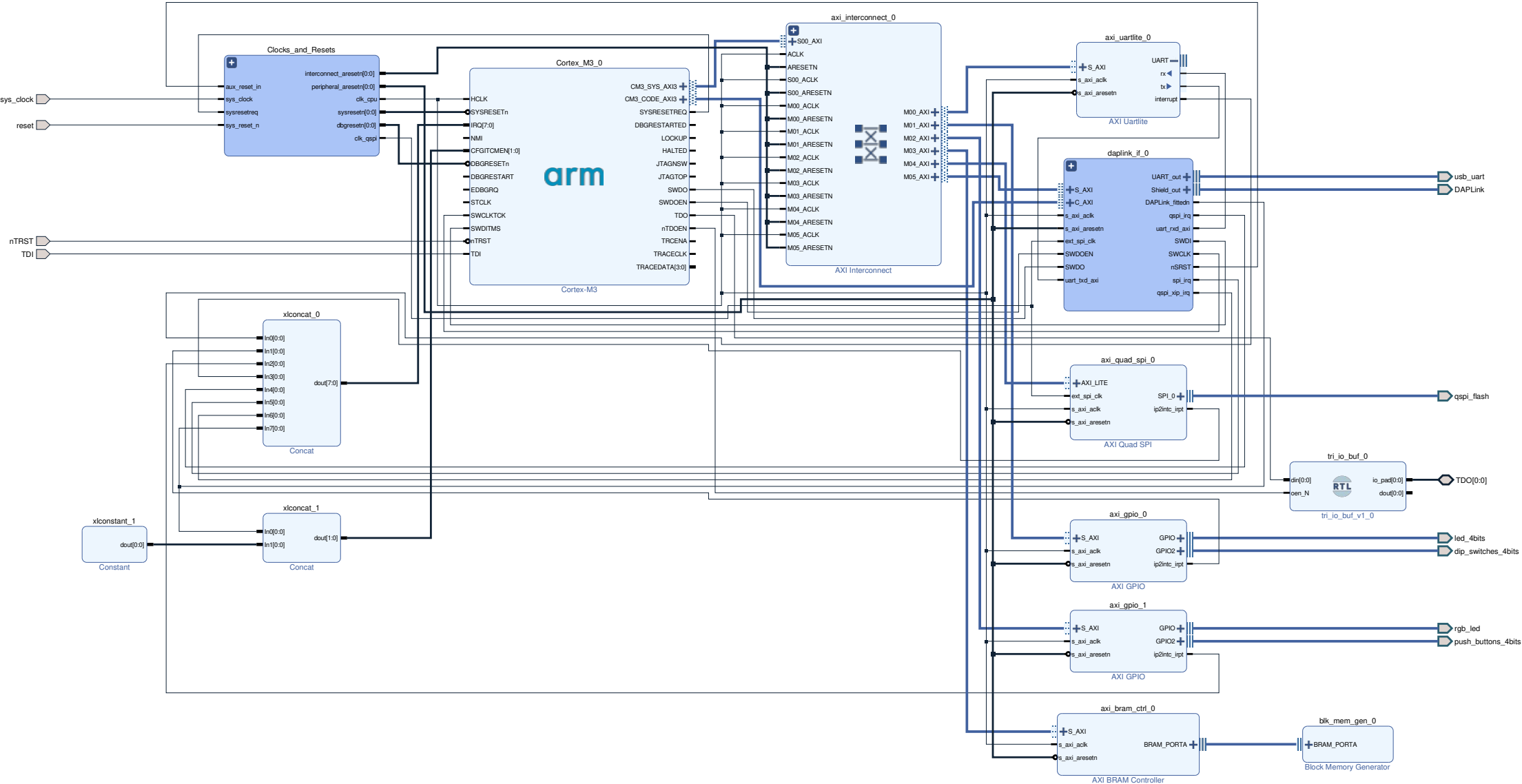
Download Cortex-M1 and Cortex-M3 soft IP for FPGA design at no cost

Integration with Xilinx Vivado Design Suite and support for Xilinx FPGAs and boards

## Advantages

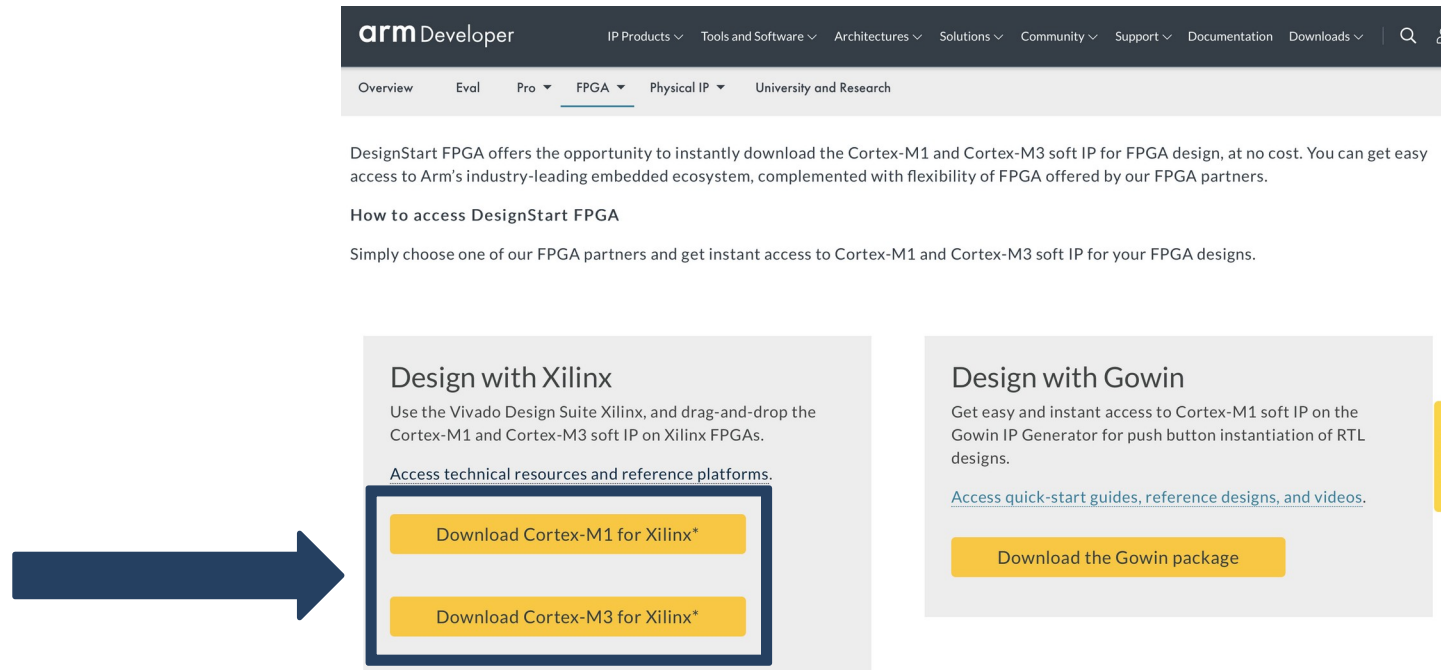
- Easy access to Arm embedded ecosystem
- Flexibility of FPGA development

Project examples available for Digilent Arty A7 board



# Download and setup

Download one of Cortex-M1 and Cortex-M3 soft IPs for Xilinx FPGAs at <https://developer.arm.com/ip-products/designstart/fpga>



Follow instructions in *Arm Cortex-[M1/M3] DesignStart FPGA-Xilinx edition User Guide* (see /docs in downloaded compressed folder)

## Xilinx Vivado

v2018.2 for Cortex-M1 (DO NOT use other versions of Vivado)

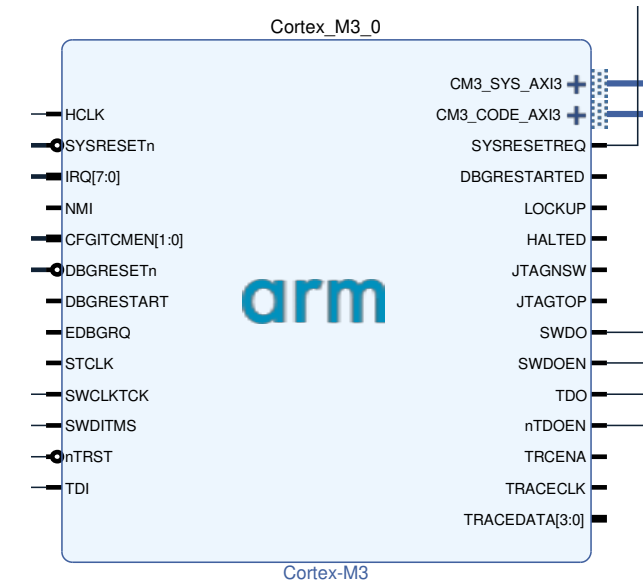
v2019.1 for Cortex-M3 (DO NOT use other versions of Vivado)

## Arm Keil $\mu$ Vision Microcontroller Development Kit (MDK)

*Windows-only, available at <https://www.keil.com/demo/eval/arm.htm>*

## Windows 10

- Explore AXI interconnect to Cortex-M microcontrollers
- Load, execute and test new application on arm Cortex-M microcontrollers (in behavioral/post-synthesis/post-implementation simulation)



If interested email to: [Andrea.galimberti@polimi.it](mailto:Andrea.galimberti@polimi.it) (CCed [davide.zoni@polimi.it](mailto:davide.zoni@polimi.it)) describing the preferred project type



# Extra tips

In order to simulate projects provided by Arm DesignStart, apply this fix to *tb\_m1\_for\_arty.v* or *tb\_m3\_for\_arty.v* files (respectively, for Cortex-M1 or -M3 for Arty A7 designs).

Rows 220/221 of *tb\_m1\_for\_arty.v* and *tb\_m3\_for\_arty.v*:

```
219          // LEDs
220          .led_4bits_tri_io      (led_4bits_tri_io),
221          .rgb_led_tri_io       (rgb_led_tri_io),
```

must be modified to:

```
219          // LEDs
220          .led_4bits_tri_o      (led_4bits_tri_io),
221          .rgb_led_tri_o       (rgb_led_tri_io),
```