Introduction to embedded programming on STM32

Intro to the world of embedded programming

Skoltech, 2019

A few words about policy

- 7 lectures + 1 project defense session
- Each lecture is supplemented with seminar at the end to reinforce given knowledge
- Each pair of students will be provided with a development board, a USB cable and a USB<->RS232 converter
- 80% attendance is highly recommended
- STM32 is cool, Arduino is not

Any questions?

The goal of the course

- To spill the beans of non-Arduino world
- Gain some knowledge in basics of ARM
- To understand the ecosystem of embedded programming
- Etc etc

Microcontrollers are everywhere

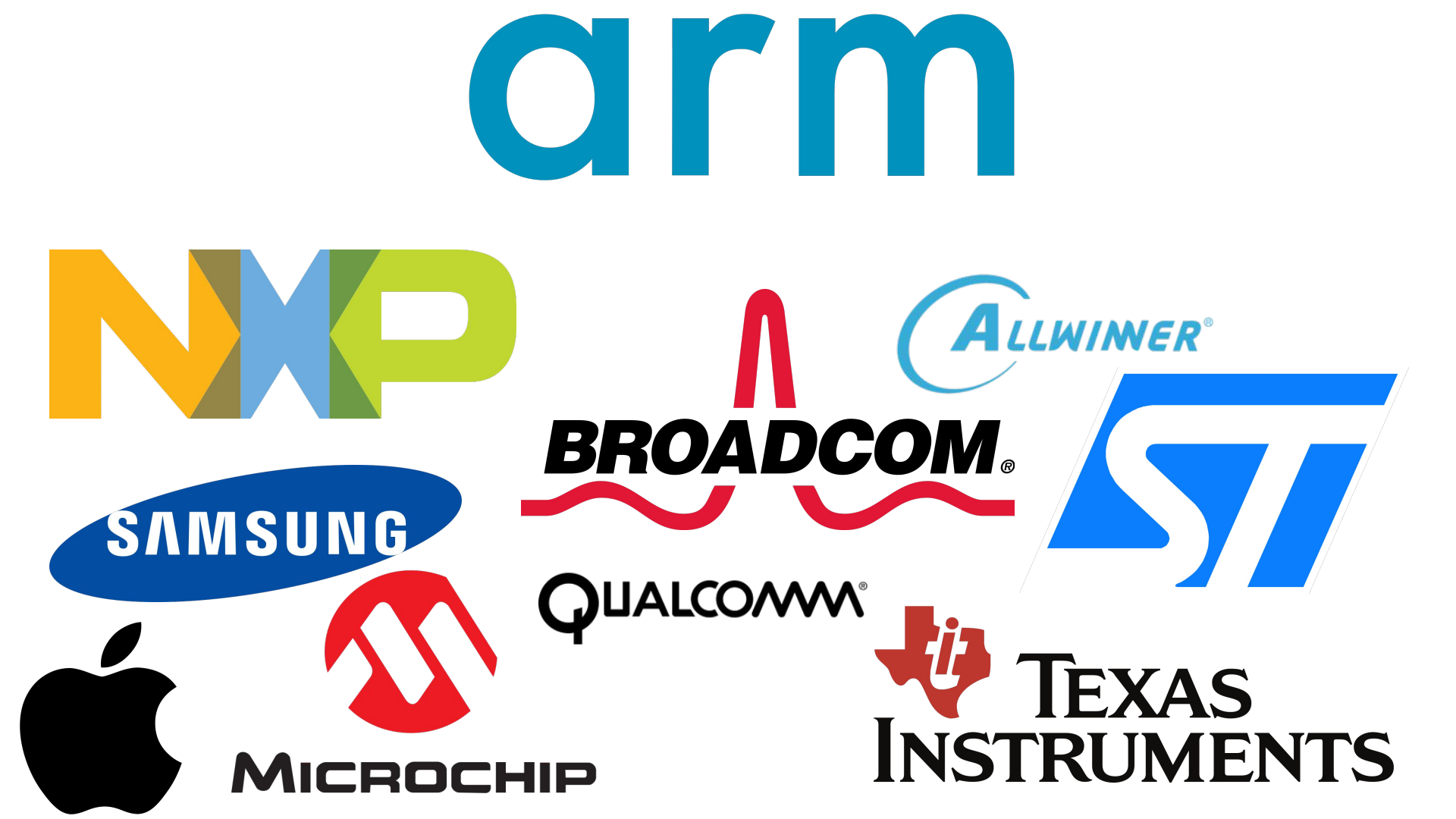
Applications

- Household appliances: microwave ovens, washing machines, dishwashers etc
- Home automation: climate control, light control, smart houses, security, surveillance etc
- Avionics: inertial guidance systems and GPS receivers
- Medical equipment: vital signs monitoring, various medical imaging (PET, SPECT, CT, and MRI) for non-invasive internal inspections
- Internet Of Things

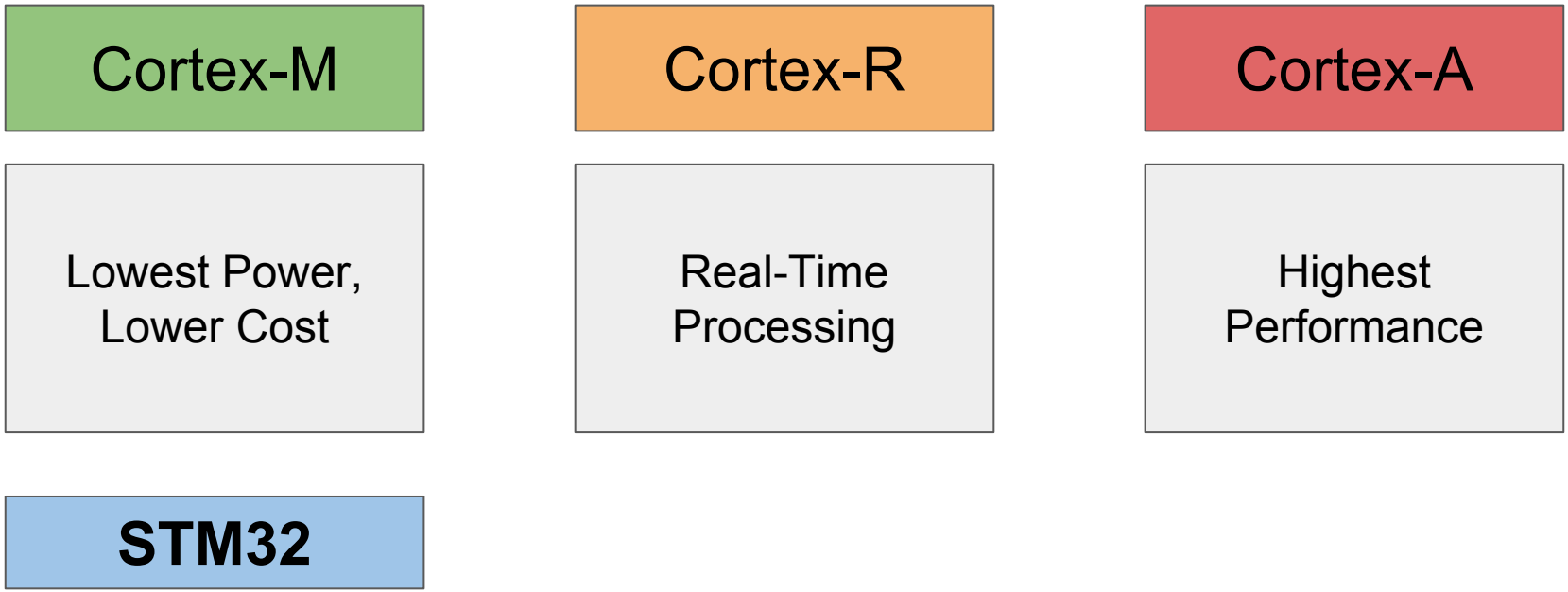
And more and more!


42.9C
17
CMP 06
RFG 27
DSP 04
+0
MIC 11
S 1 3 5 7 9 20 40 60 dB
P 0 2 4 6 8 10 W
ALC -16 -12 -8 -4 0 4 8 12
USB
100Hz
18.157.500
18.157.500
17m
DSP
OFF
FULL
FIL
2.3k
VCC
14.05V
SPECTRUM SCOPE
40 46 52 18158 64 70 76 82 88
MENU
METER
TUNE

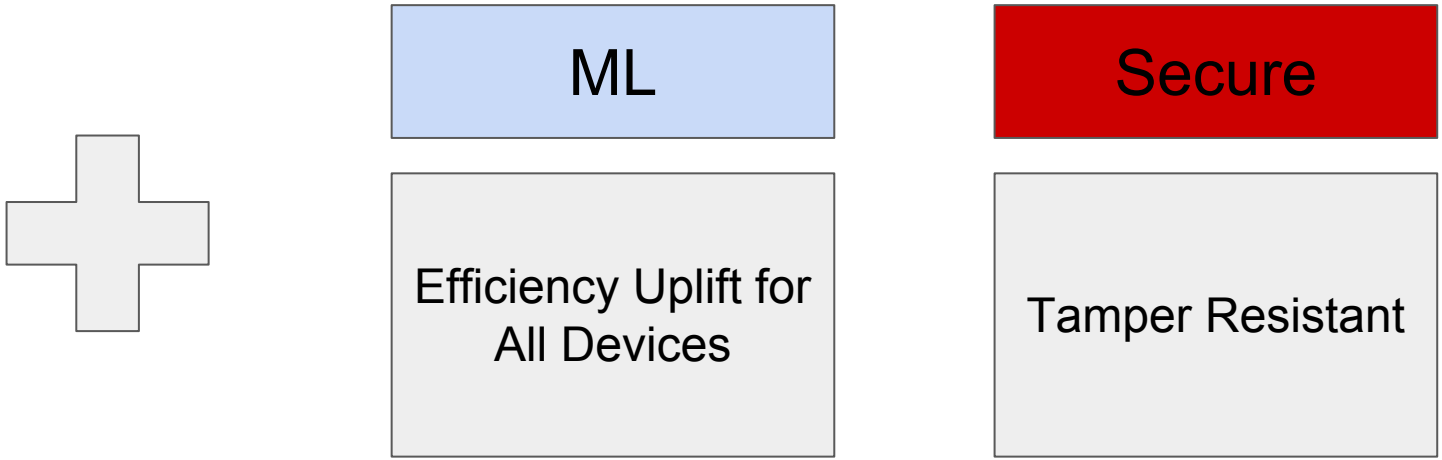

Instrument Oscillator 0-63
Drum Oscillator 0-15
Each Drum Oscillator have a
up to 3 stage Envelop Generator
and a soft retrigger on-run mode


arm
NXP
ALLWINNER
BROADCOM
SAMSUNG
QUALCOMM
MICROCHIP
TEXAS INSTRUMENTS

Taxonomy of ARM MCUs



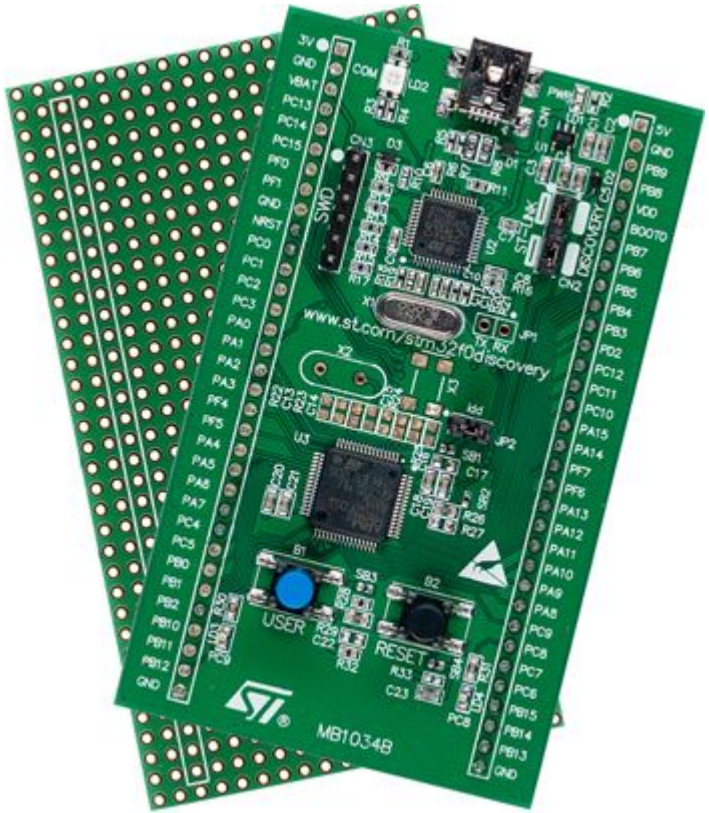
Taxonomy of ARM MCUs. Extra series



Please refer to https://www.arm.com/products/silicon-ip-cpu for further details

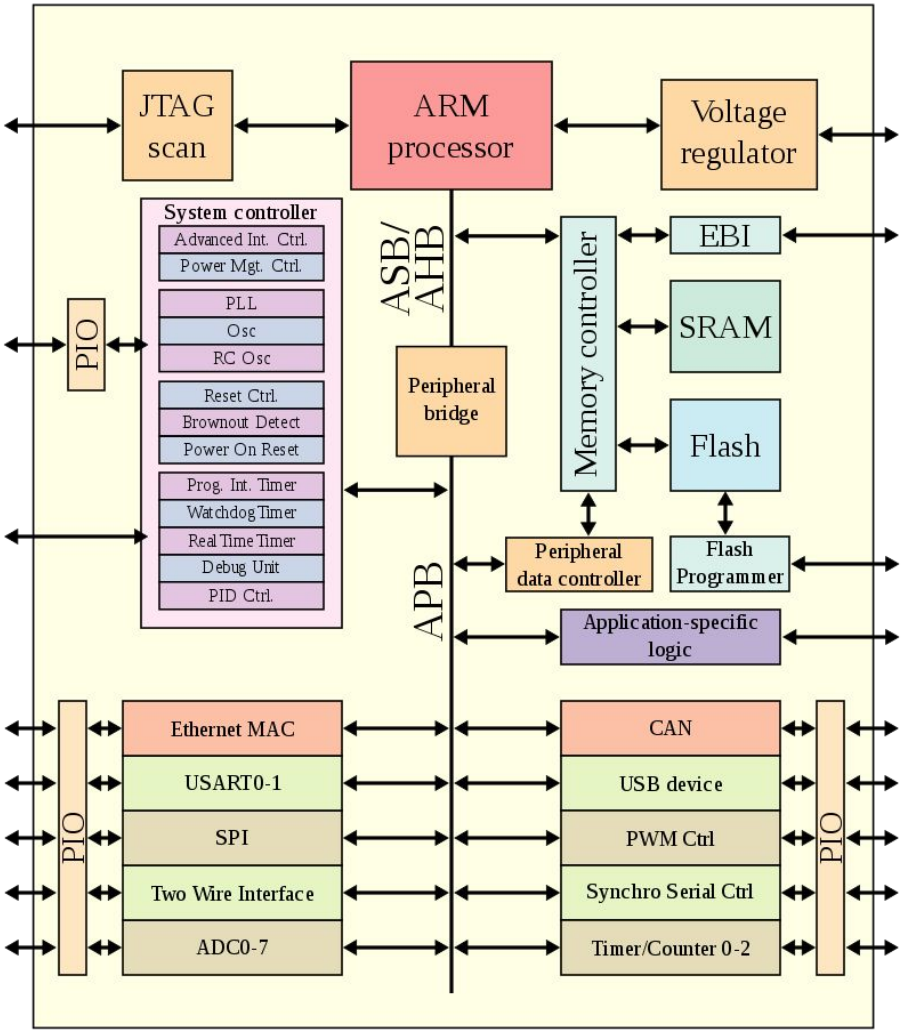

High-performance
Mainstream
Ultra-low-power
STM32 F2
398 CoreMark
120 MHz
150 DMIPS
STM32 F4
608 CoreMark
180 MHz
225 DMIPS
STM32 F7
1 082 CoreMark
216 MHz
462 DMIPS
STM32 F0
106 CoreMark
48 MHz
38 DMIPS
STM32 F1
177 CoreMark
72 MHz
61 DMIPS
STM32 F3
245 CoreMark*
72 MHz
90 DMIPS*
STM32 L0
75 CoreMark
32 MHz
26 DMIPS
STM32 L1
93 CoreMark
32 MHz
33 DMIPS
STM32 L4
273 CoreMark
80 MHz
100 DMIPS
Cortex-M0 / -M0+
Cortex-M3
Cortex-M4
Cortex-M7

STM32F0DISCOVERY

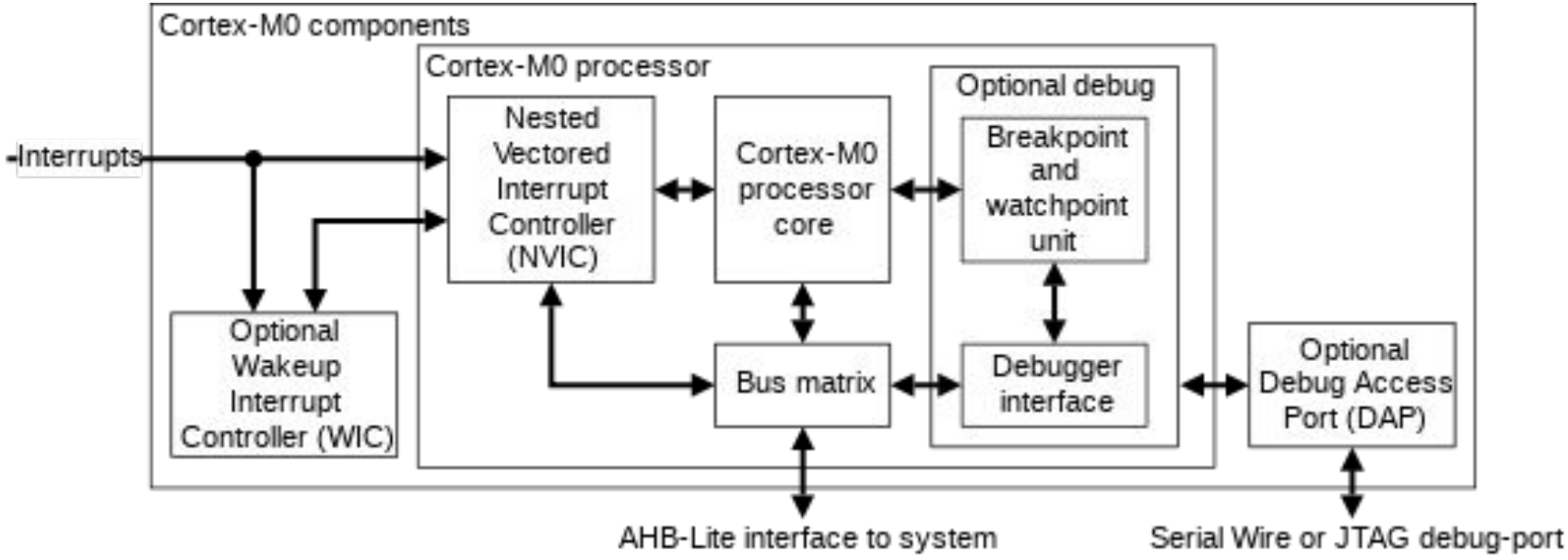


- 64 KB Flash memory, 8 KB RAM
- On-board ST-LINK/V2
- Four LEDs
- Two push buttons

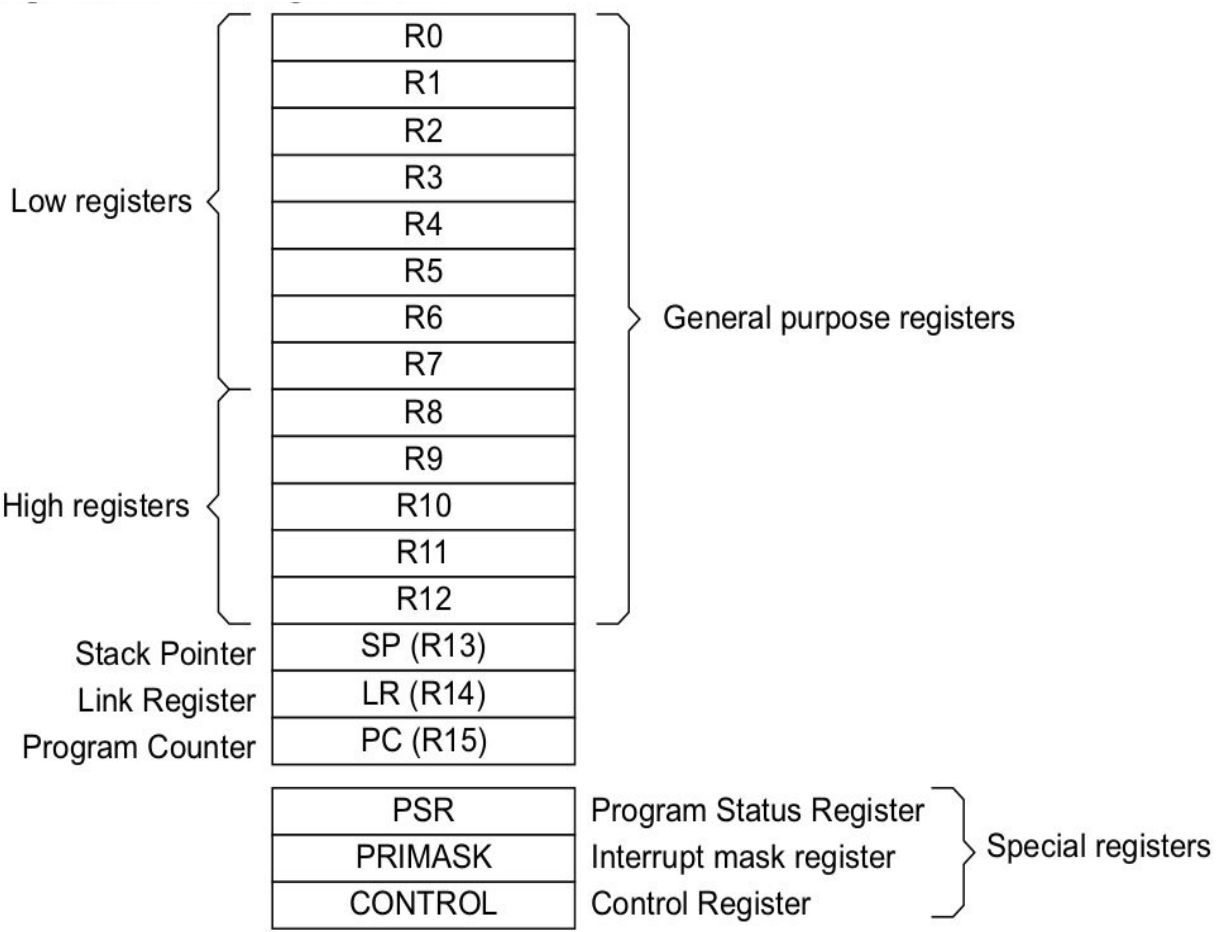
The concept of System On a Chip (SoC)



Cortex-M0 architecture

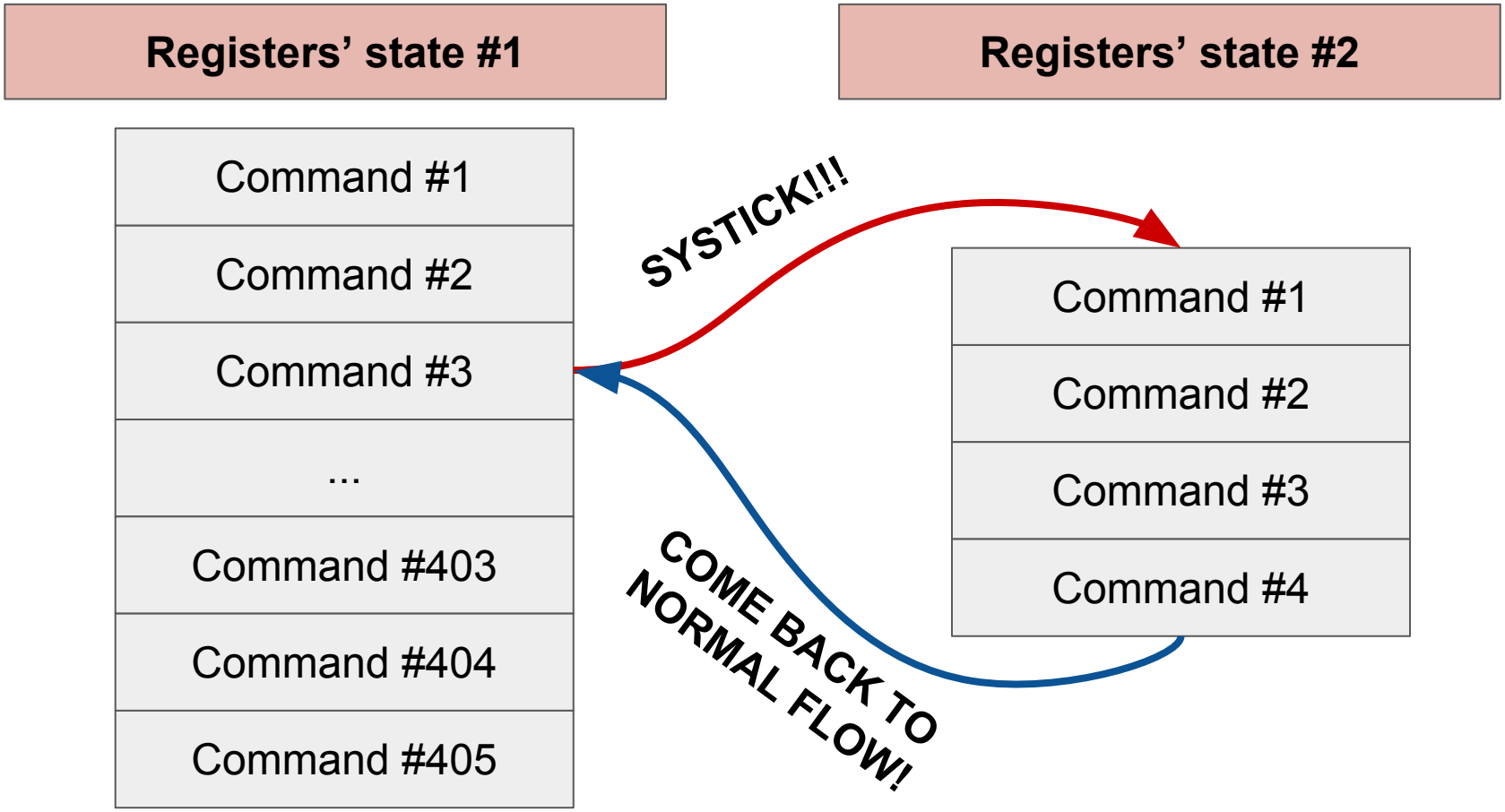


Cortex-M0. Registers

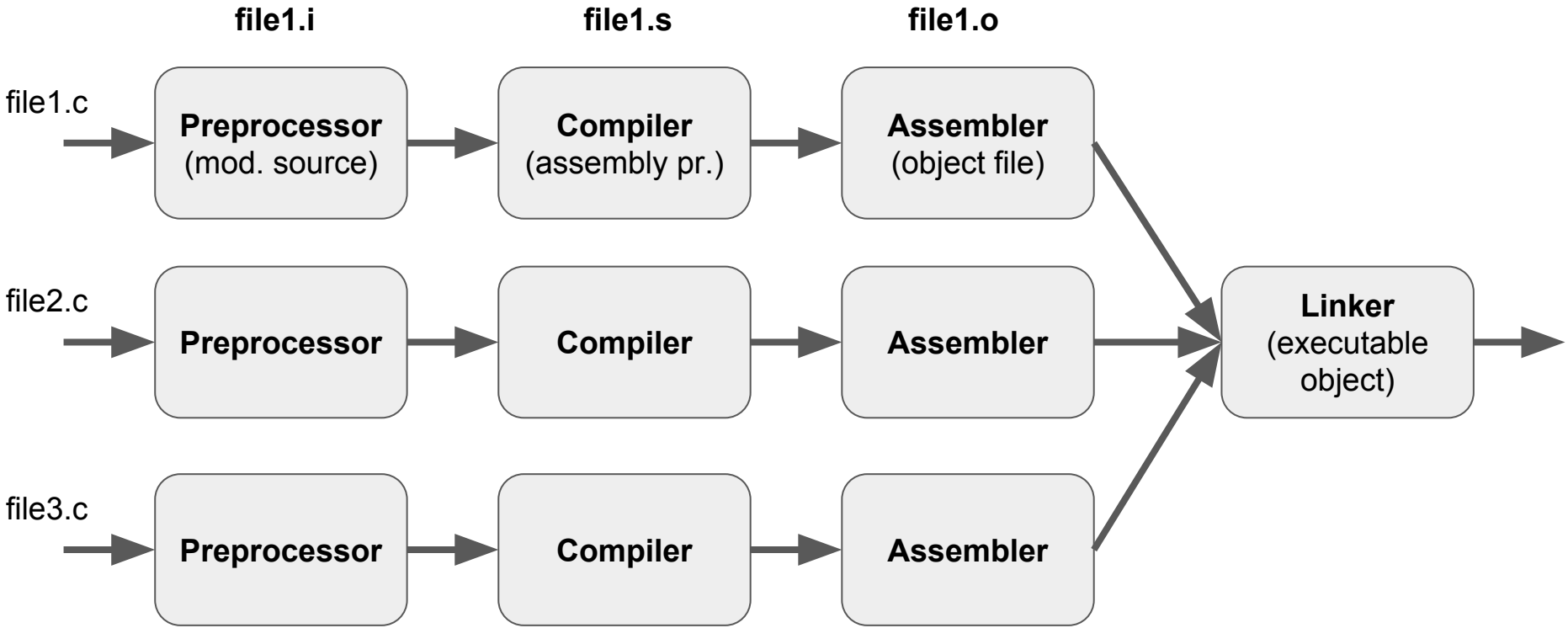


Cortex-M0. System timer.

Timer events (counter overflow)
In Cortex-M0 core those events are called SysTick interrupts


Registers' state #1
Registers' state #2
Command #1
Command #2
Command #3
...
Command #403
Command #404
Command #405
SYSTICK!!!
Command #1
Command #2
Command #3
Command #4
COME BACK TO NORMAL FLOW!

Toolchain. Compiler



Toolchain. Compiler

- Binaries can be built from sources (not recommended for newbies)
- Binaries can be downloaded from official website
  https://developer.arm.com/open-source/gnu-toolchain/gnu-rm/downloads
- Binaries might be installed from repository
  sudo apt-get install arm-none-eabi-gcc

If you have any problems with installing ask instructors for help

Toolchain. Repository

https://github.com/edosedgar/stm32f0_ARM

https://github.com/edosedgar/skoltech_stm32_course