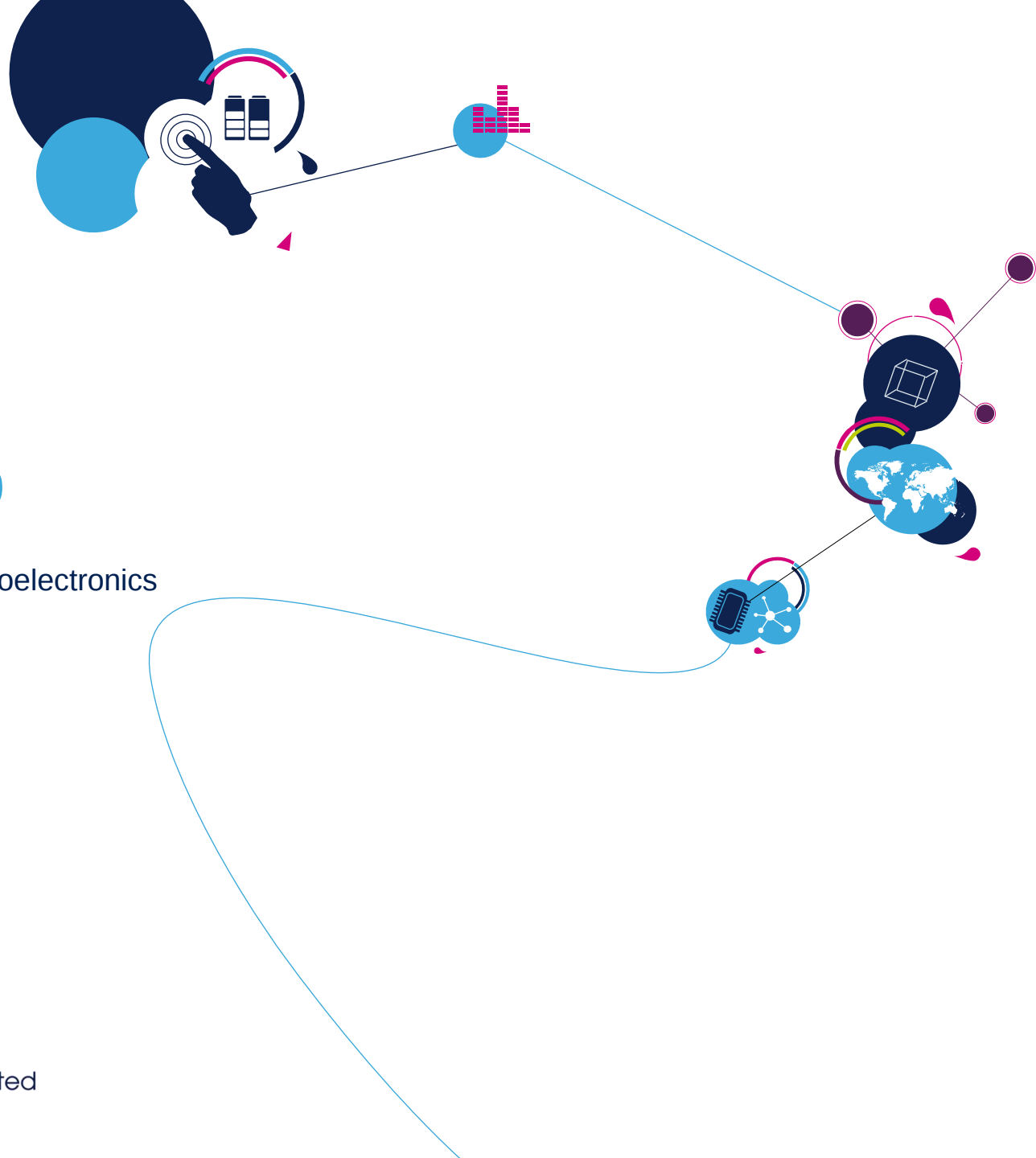
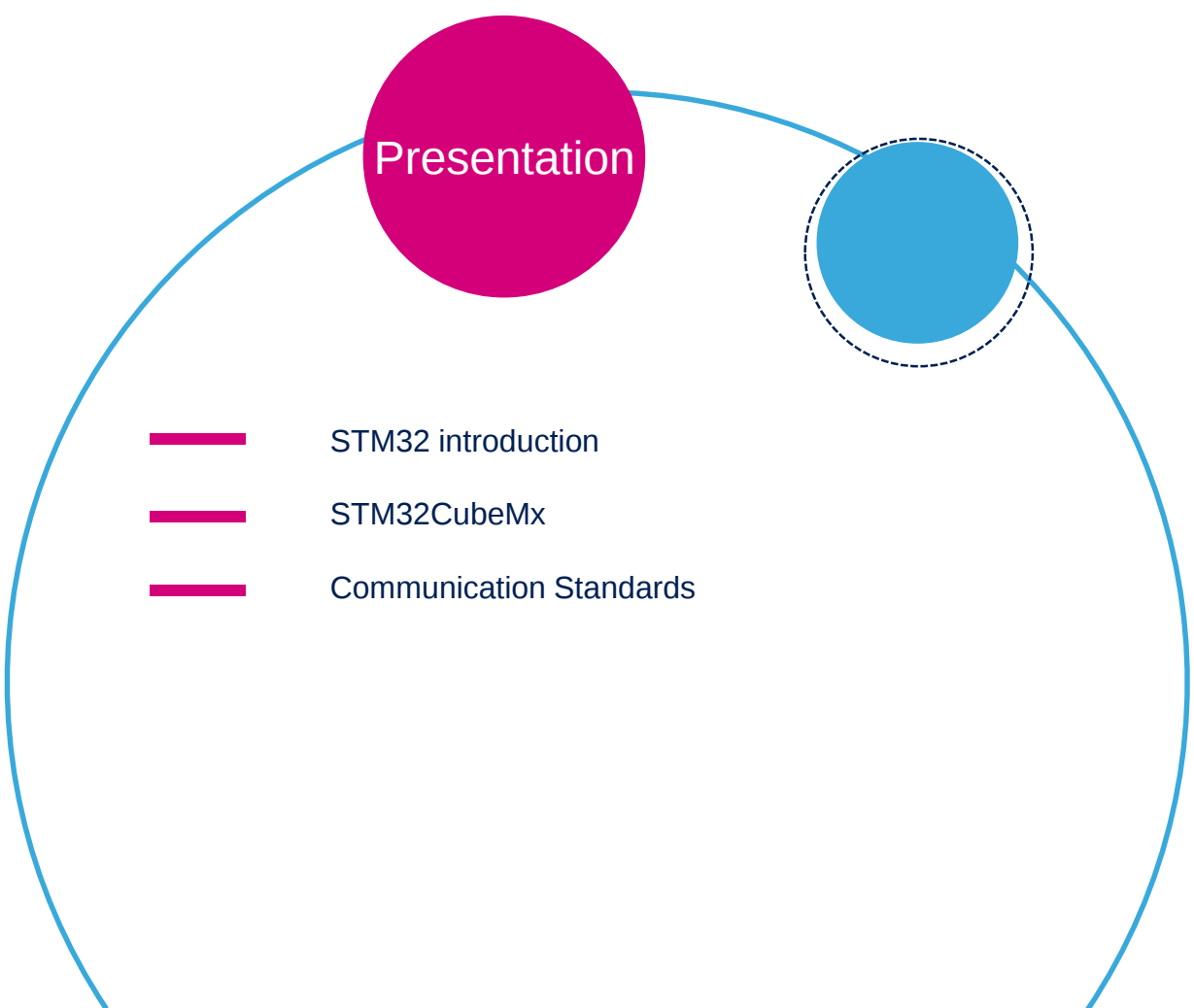


Seminario

Ing. Davide Giacalone, STMicroelectronics





Presentation

— STM32 introduction

— STM32CubeMx

— Communication Standards



STM32 Introduction

The needs of developers

4

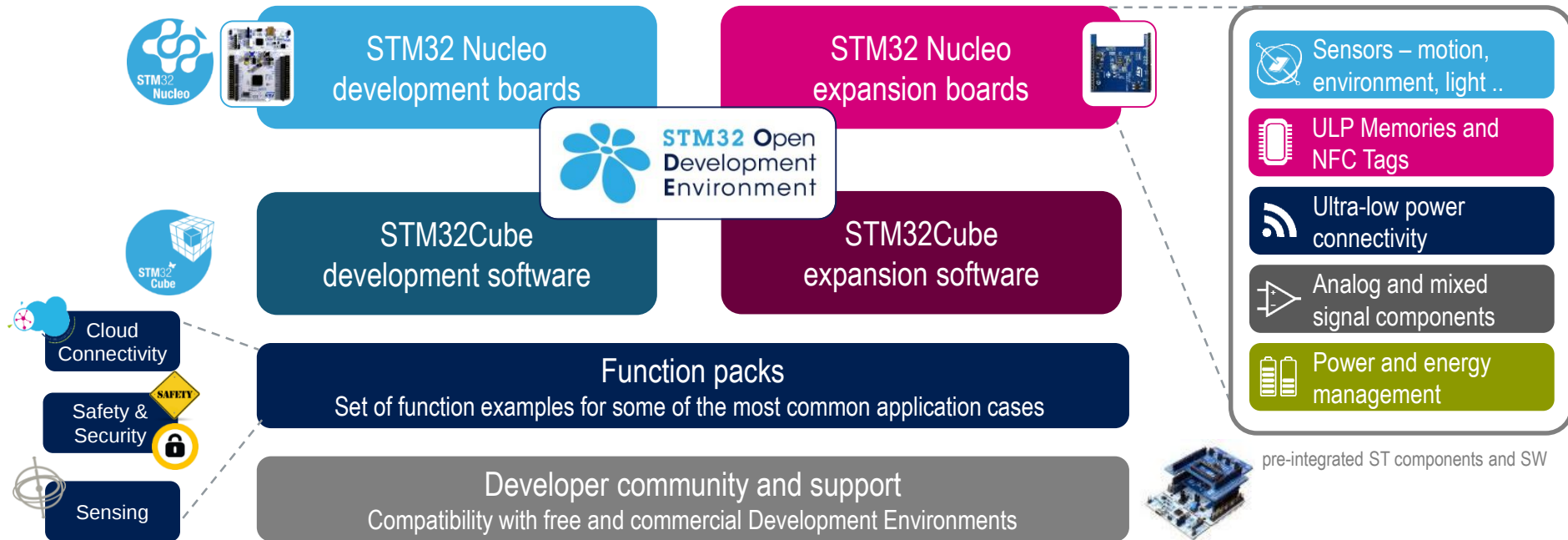
- A microcontroller is usually the first choice of developers when designing a new application
 - Need to pick from low power to high performance microcontroller based on application needs
- A set of extra functions are keys to implement the system
 - Sensing, data conversion, processing, connectivity, power management, ...
- Easy to use Integrated Development Environment to allow fast development and production
 - Support of multiple IDE
 - Free of charge tools and embedded software to enable fast and easy development



STM32 Open Development Environment

5

Fast, affordable prototyping & development



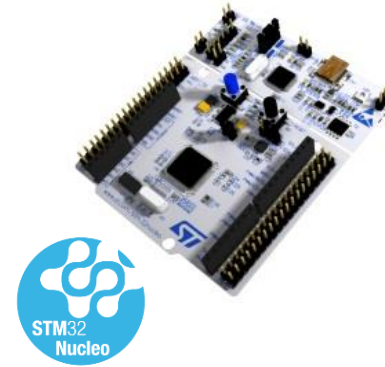
STM32 Open Development Environment

Hardware Components

6

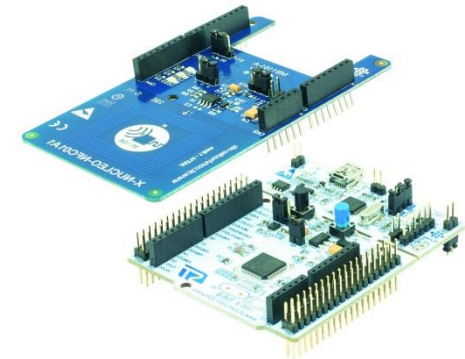
STM32 Nucleo Development Boards

- Based on ST's 32-bit ARM Cortex-M based STM32 microprocessors
- Development boards for all STM32 families available or planned



STM32 Nucleo Expansion Boards

- Boards with additional functionality: sensing, connectivity, power, analog
- Plugged on top of the STM32 Nucleo developer board or stacked on top of other expansion boards
- Leverage ST wide product portfolio



Going beyond with the STM32 Open Development Environment

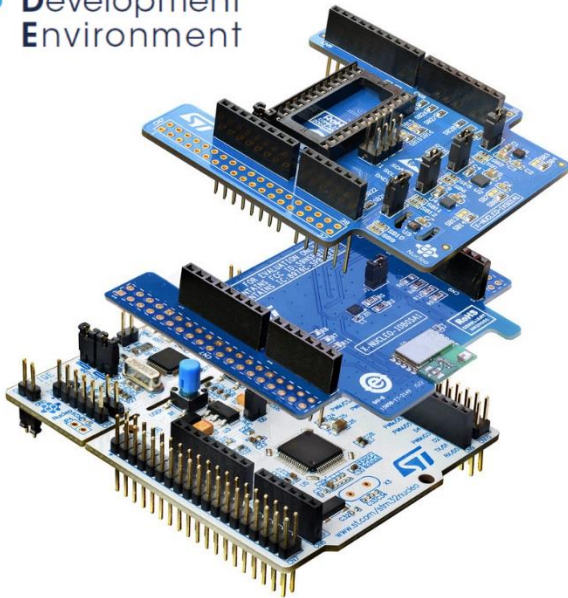
7



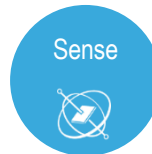
www.st.com/stm32ode
www.st.com/stm32ode-fp



STM32 Open
Development
Environment



Several expansion boards covering all the key functions



Motion &
environmental sensors
Proximity sensor
Microphone



BLE
Wi-Fi
Sub-GHz
NFC



Power management
LED Boost



Motor drive
Actuator

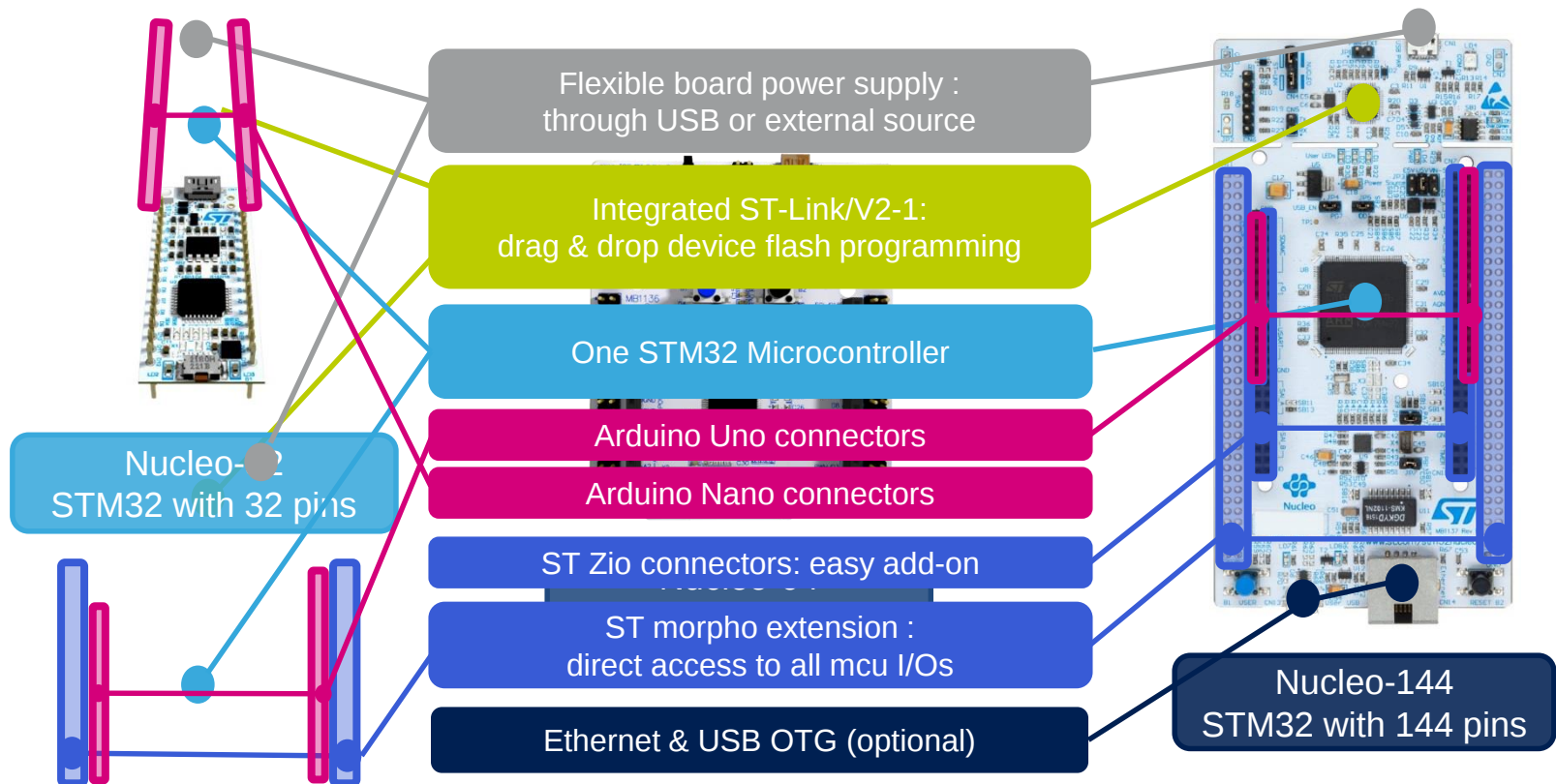


Audio
OpAmp

12 processor boards from 9 families



Enlarging the STM32Nucleo family to cover whole STM32 portfolio

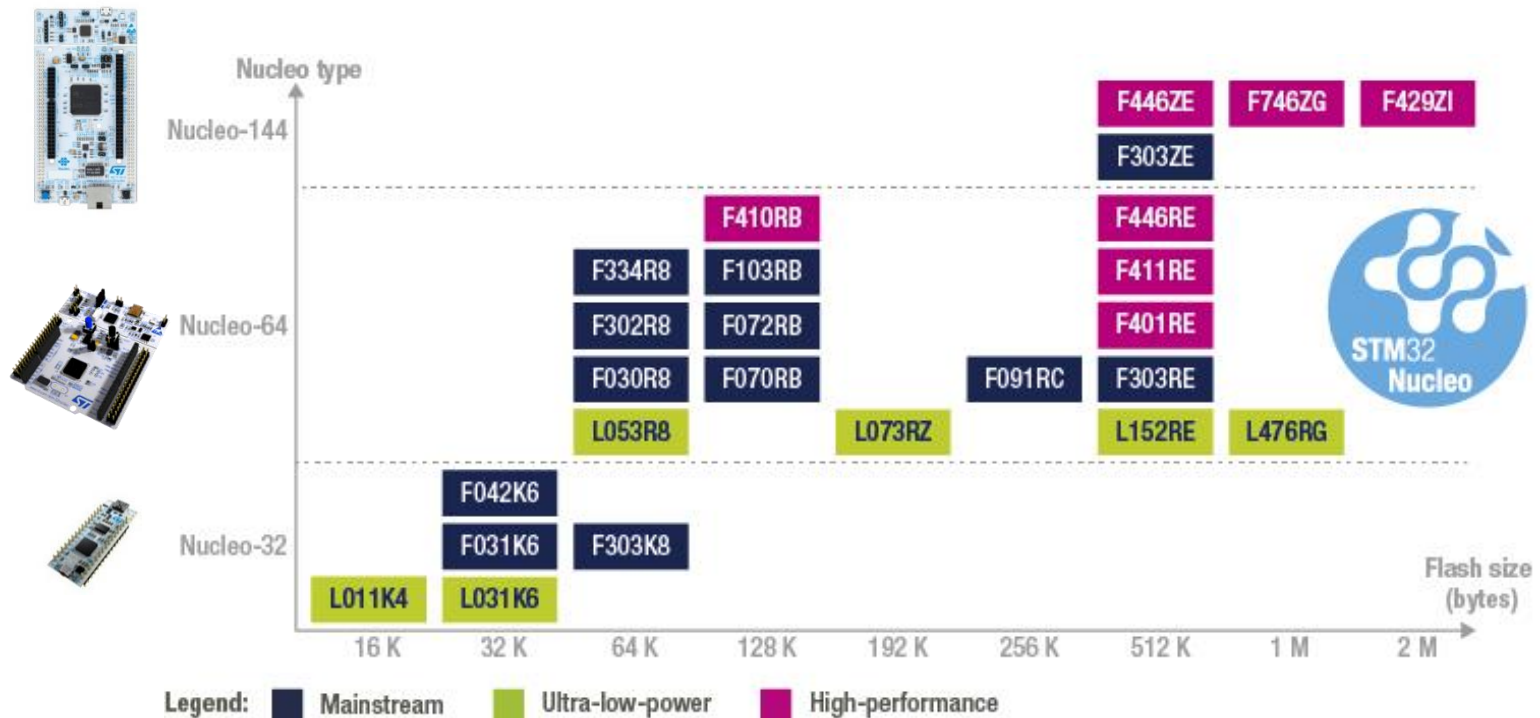


STM32Nucleo Boards

9



Enlarging the STM32Nucleo family to cover whole STM32 portfolio



STM32 Open Development Environment Software Components

10

- **STM32Cube**

- A set of free of charge tools and embedded Software bricks to enable fast and easy development on the STM32
 - PC-based STM32CubeMX for graphical configuration of the STM32
 - Hardware Abstraction Layer for easy porting from one STM32 device to another
 - Middleware bricks for the most common functions
 - Hundreds of code use examples are also included.



- **STM32Cube Expansion software**

- Free of charge for every STM32 Nucleo expansion boards

- **Multiple Development Environments**

- Compatible with a number of Development Environments including IAR EWARM, Keil MDK, mbed and GCC-based IDEs



Software Development Tools

C/C++ Focus

11

A complete flow, from configuration up to monitoring



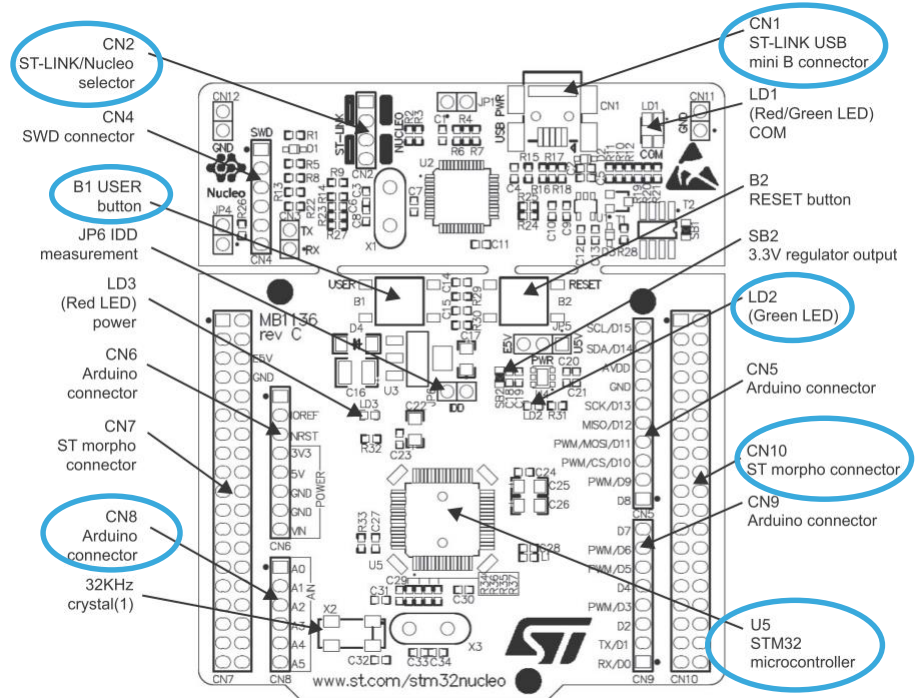
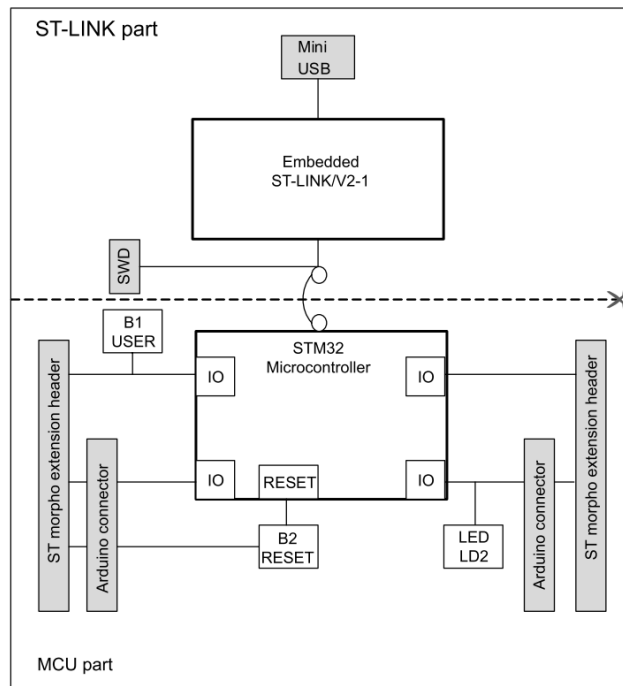
STM32CubeMX
Configure & Generate Code

Partners IDEs
Compile and Debug

STMStudio
Monitor

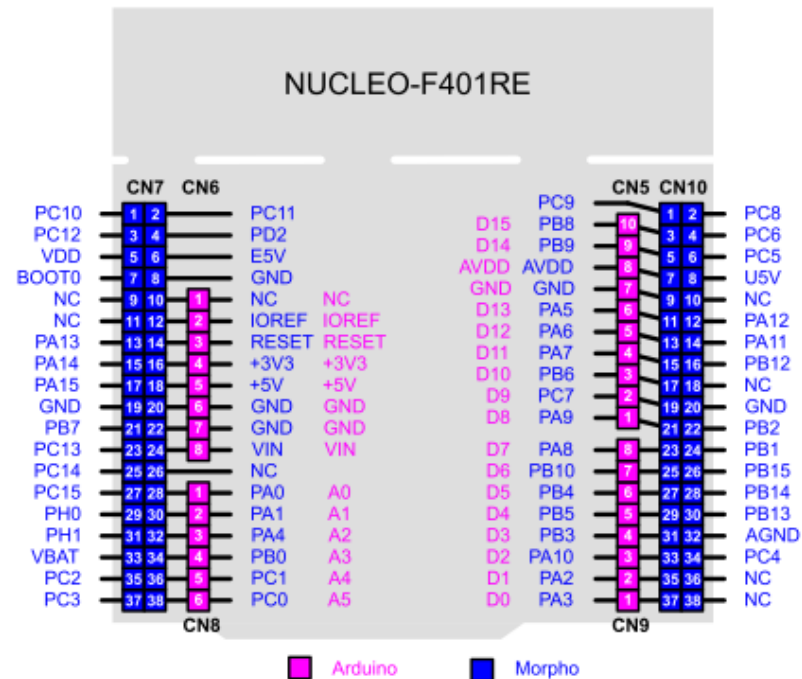
Hardware Block Diagram

12



Hardware Layout and Configuration

13

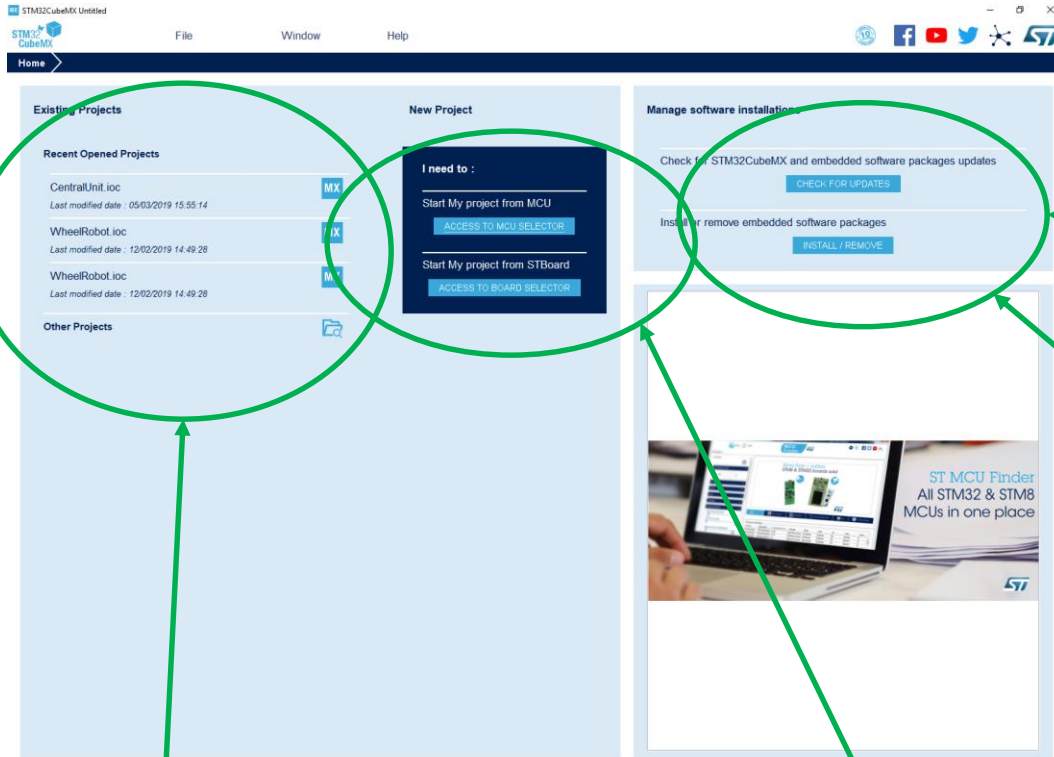




STM32CubeMX

STM32CubeMX – Main Page

15



SW updater

Additional packages
(MCU, AI, BLE, MEMS, etc)

Last projects

MCU or
board selector

STM32CubeMX – MCU/Board selector

16

MX New Project from a Board

MCU Selector Board Selector

MCU Filters

★

Part Number Search

Core

Series

Line

Package

Other

Advanced Graphic

Artificial Intelligence

Peripheral

ADC 12-bit 0 40

ADC 16-bit 0 36

AES 0 2

CAN 0 3

Features Block Diagram Docs & Resources Datasheet Buy Start Project

New multicore STM32MP1 Series for Industrial and IoT applications

MCUs List: 1272 items

Display similar items

*	Part No	Reference	Marketing	Unit Price for 1...	Board	Package	Flash	RAM	IO	Freq.	GFX S...	DDR	DEBUG	HDP	PKA	PWR	RF	TAMP
☆	STM32F0...	STM32F03...	Active	0.97		LQFP48	16 kB...	4 kBytes	39	48 M...	0.0	0	0	0	0	0	0	0
☆	STM32F0...	STM32F03...	Active	1.013		LQFP48	32 kB...	4 kBytes	39	48 M...	0.0	0	0	0	0	0	0	0
☆	STM32F0...	STM32F03...	Active	0.776		WLCS...	32 kB...	4 kBytes	20	48 M...	0.0	0	0	0	0	0	0	0
☆	STM32F0...	STM32F03...	Active	0.711		TSSO...	16 kB...	4 kBytes	15	48 M...	0.0	0	0	0	0	0	0	0
☆	STM32F0...	STM32F03...	Active	0.755		TSSO...	32 kB...	4 kBytes	15	48 M...	0.0	0	0	0	0	0	0	0
☆	STM32F0...	STM32F03...	Active	0.733		UFQF...	16 kB...	4 kBytes	23	48 M...	0.0	0	0	0	0	0	0	0
☆	STM32F0...	STM32F03...	Active	0.776		UFQF...	32 kB...	4 kBytes	23	48 M...	0.0	0	0	0	0	0	0	0
☆	STM32F0...	STM32F03...	Active	0.862		UFQF...	16 kB...	4 kBytes	27	48 M...	0.0	0	0	0	0	0	0	0
☆	STM32F0...	STM32F03...	Active	0.906	NUCLEO-F031K6	LQFP32	32 kB...	4 kBytes	25	48 M...	0.0	0	0	0	0	0	0	0
☆	STM32F0...	STM32F03...	Active	0.906		UFQF...	32 kB...	4 kBytes	27	48 M...	0.0	0	0	0	0	0	0	0
☆	STM32F0...	STM32F03...	Active	1.013		LQFP48	32 kB...	4 kBytes	38	48 M...	0.0	0	0	0	0	0	0	0
☆	STM32F0...	STM32F03...	Active	0.776		WLCS...	32 kB...	4 kBytes	20	48 M...	0.0	0	0	0	0	0	0	0
☆	STM32F0...	STM32F03...	Active	0.755		TSSO...	32 kB...	4 kBytes	14	48 M...	0.0	0	0	0	0	0	0	0
☆	STM32F0...	STM32F03...	Active	0.776		UFQF...	32 kB...	4 kBytes	22	48 M...	0.0	0	0	0	0	0	0	0
☆	STM32F0...	STM32F03...	Active	0.906		UFQF...	32 kB...	4 kBytes	26	48 M...	0.0	0	0	0	0	0	0	0
☆	STM32F0...	STM32F04...	Active	1.057		LQFP48	16 kB...	6 kBytes	38	48 M...	0.0	0	0	0	0	0	0	0
☆	STM32F0...	STM32F04...	Active	1.057		UFQF...	16 kB...	6 kBytes	38	48 M...	0.0	0	0	0	0	0	0	0
☆	STM32F0...	STM32F04...	Active	1.1		LQFP48	32 kB...	6 kBytes	38	48 M...	0.0	0	0	0	0	0	0	0

- User can filter results by part number, Core, Series, Peripherals, etc
- Choice can be performed on several ST boards, too

STM32CubeMX – Pinout & Configuration

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STM32CubeMX Untitled: STM32F401RETx NUCLEO-F401RE

File Window Help

Home > STM32F401RETx - NUCLEO-F401RE > Untitled - Pinout & Configuration > GENERATE CODE

Pinout & Configuration Clock Configuration Project Manager Tools

Additional Softwares Pinout

Options Pinout view System view

Categories A->Z

- System Core >
- Analog >
- Timers >
- Connectivity >
- Multimedia >
- Computing >
- Middleware >

STM32F401RETx LQFP64

USART_RX

USART_TX

LD2 [Green Led]

SWO

TMS

18



STM32CubeMX – Project Manager

19

STM32CubeMX Untitled: STM32F401RETx NUCLEO-F401RE

STM32CubeMX File Window Help

Home > STM32F401RETx - NUCLEO-F401RE > Untitled - Project Manager >

Pinout & Configuration Clock Configuration Project Manager

Project

Code Generator

Advanced Settings

Project Settings

Project Name

Project Location
C:\Users\davide.giacalone\Desktop\ Browse

Application Structure
Basic ☐ Do not generate the main()

Toolchain Folder Location
C:\Users\davide.giacalone\Desktop\

Toolchain / IDE
EWARM V8 ☐ Generate Under Root

Linker Settings

Minimum Heap Size 0x200

Minimum Stack Size 0x400

Mcu and Firmware Package

Mcu Reference
STM32F401RETx

Firmware Package Name and Version
STM32Cube FW_F4 V1.24.0

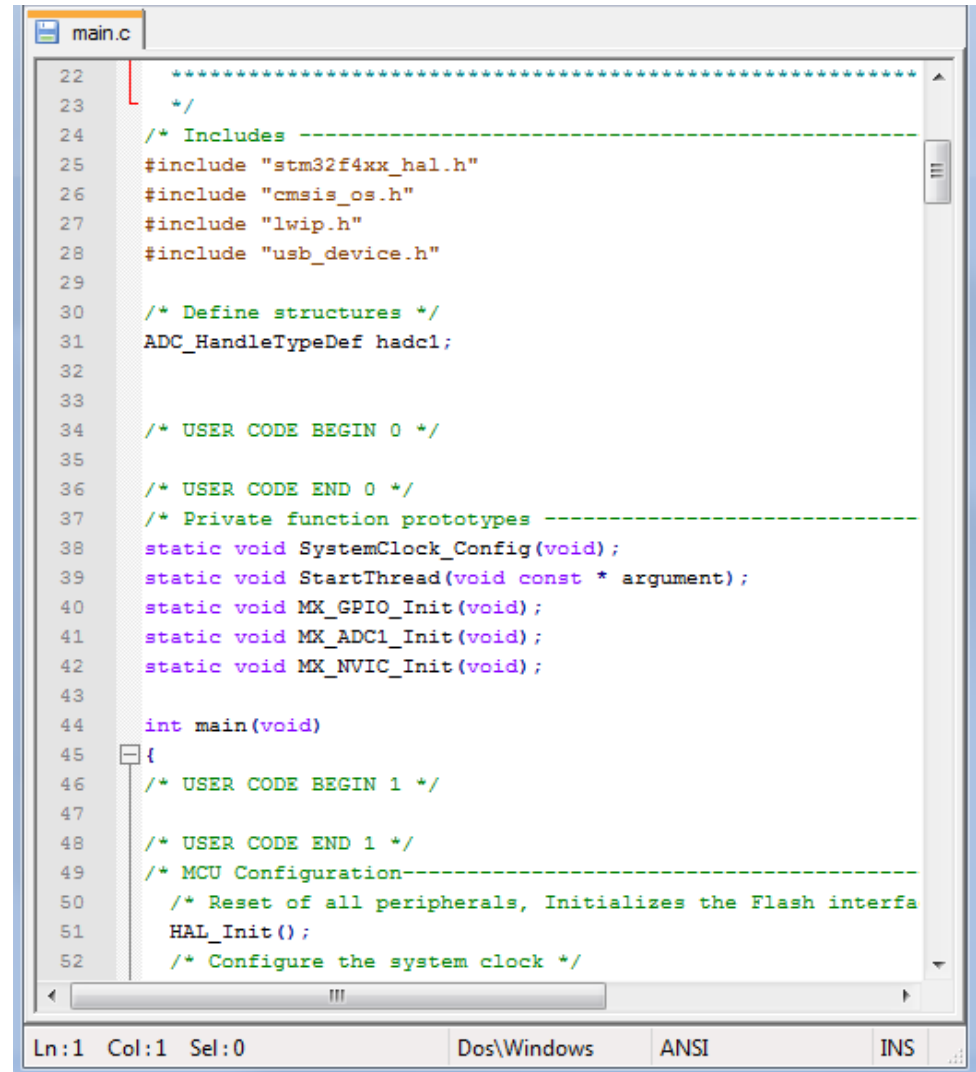
☒ Use Default Firmware Location
rs/davide.giacalone/STM32Cube/Repository/STM32Cube_FW_F4_V1.24.0 Browse

- Set the Project name
- Compiler (Ewarm, TrueStudio Sw4stm32, ..)
- Heap and Stack Size
- HAL library version
- ..

STM32CubeMX: Code generation

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- Generation of all the C initialization code
- Automatic integration with partners toolchains
- User code can be added in dedicated sections and will be kept upon regeneration
- Required library code is automatically copied or referenced in the project (updater)

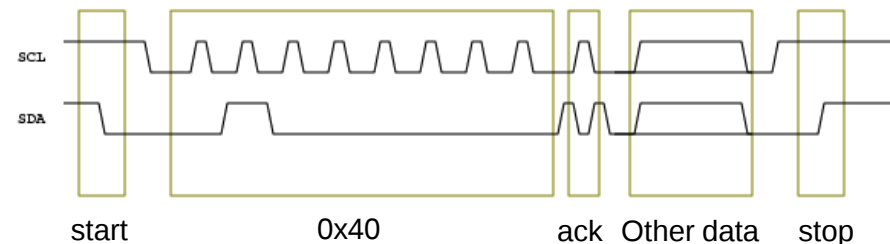
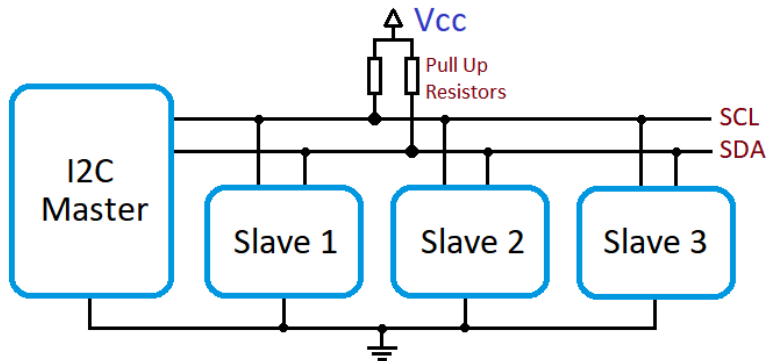


```
main.c
22  /*
23  */
24  /* Includes -----
25  #include "stm32f4xx_hal.h"
26  #include "cmsis_os.h"
27  #include "lwip.h"
28  #include "usb_device.h"
29
30  /* Define structures */
31  ADC_HandleTypeDef hadc1;
32
33
34  /* USER CODE BEGIN 0 */
35
36  /* USER CODE END 0 */
37  /* Private function prototypes -----
38  static void SystemClock_Config(void);
39  static void StartThread(void const * argument);
40  static void MX_GPIO_Init(void);
41  static void MX_ADC1_Init(void);
42  static void MX_NVIC_Init(void);
43
44  int main(void)
45  {
46  /* USER CODE BEGIN 1 */
47
48  /* USER CODE END 1 */
49  /* MCU Configuration-----
50  /* Reset of all peripherals, Initializes the Flash interface
51  HAL_Init();
52  /* Configure the system clock */
```

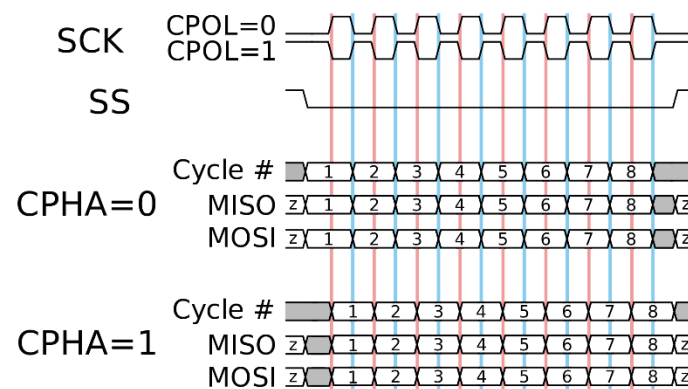
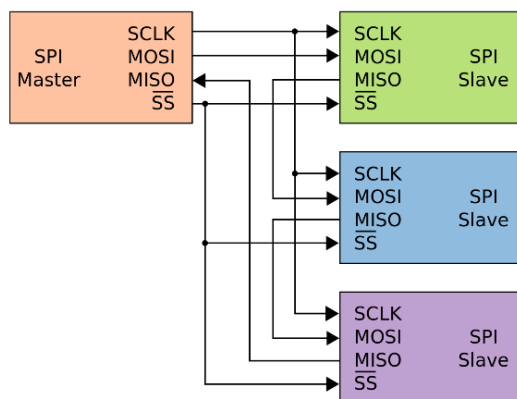


Communication Standards

- **I²C** (Inter-Integrated Circuit) is a synchronous, multi-master, multi-slave, serial computer bus invented in 1982 by Philips Semiconductor
- It is widely used for attaching lower-speed peripheral ICs to processors and microcontrollers in short-distance, intra-board communication
- I²C uses Serial Data Line (**SDA**) and Serial Clock Line (**SCL**), pulled up with resistors.
- Typically 7-bit address space, rarely-used 10-bit extension.
- Common I²C bus speeds:
 - 100 kbit/s (Standard mode)
 - 400 kbit/s (Fast mode)
- The bus has two roles for nodes: master and slave
 - Master node – node that generates the clock and initiates communication with slaves.
 - Slave node – node that receives the clock and responds when addressed by the master.



- The Serial Peripheral Interface is a synchronous serial communication interface specification used for short-distance communication, developed by Motorola in the mid-1980s.
- Typical applications include Secure Digital cards and liquid crystal displays.
- SPI devices communicate in full duplex mode using a **master-slave** architecture with a single master. The master device originates the frame for reading and writing. Multiple slave-devices are supported through selection with individual slave select (SS) lines.
- The SPI bus specifies four logic signals:
 - SCLK**: Serial Clock (output from master)
 - MOSI**: Master Output Slave Input, or Master Out Slave In (data output from master)
 - MISO**: Master Input Slave Output, or Master In Slave Out (data output from slave)
 - SS**: Slave Select (often active low, output from master)
- The master must configure clock speed, polarity (**CPOL**) and phase (**CPHA**) with respect to the data.





Thank you