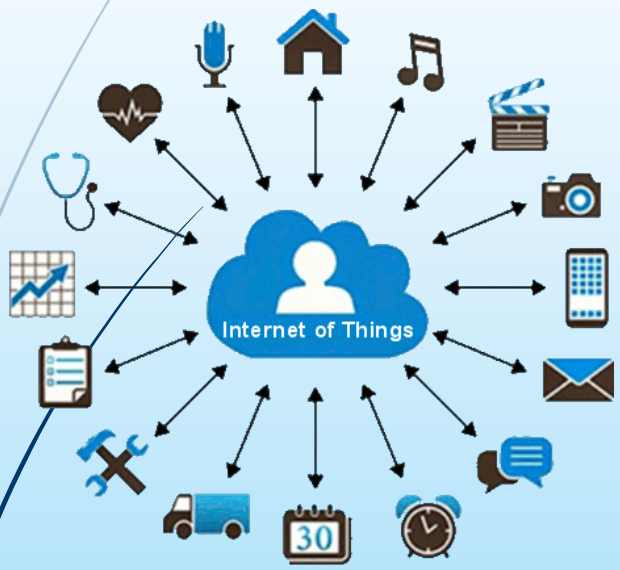
EPC for IoT – B-L072Z-LRWAN1 platform



- Architecture of the platform
  - Requirements of our use case
  - Platform details
  - Support, community…

Use-Case Analysis

- What do I need to control or measure?
  - Soil humidity
  - Ambience humidity
  - Soil temperature
  - Ambience temperature
  - Brightness
  - Growing ratio
  - Plant aspect (leaves color)
  - Location
  - Irrigation

Analysing our use case

- What do I need to control or measure?
  - Soil humidity
  - Ambience humidity
  - Soil temperature
  - Ambience temperature
  - Brightness
  - Growing ratio
  - Plant aspect (leaves color)
  - Location
  - Irrigation system
- How?
  - Soil humidity sensor
  - Ambience humidity sensor
  - Soil temperature sensor
  - Ambience temperature sensor
  - Brightness control
  - Distance sensor
  - Color cell
  - GPS/Galileo receiver
  - Water valves, motors

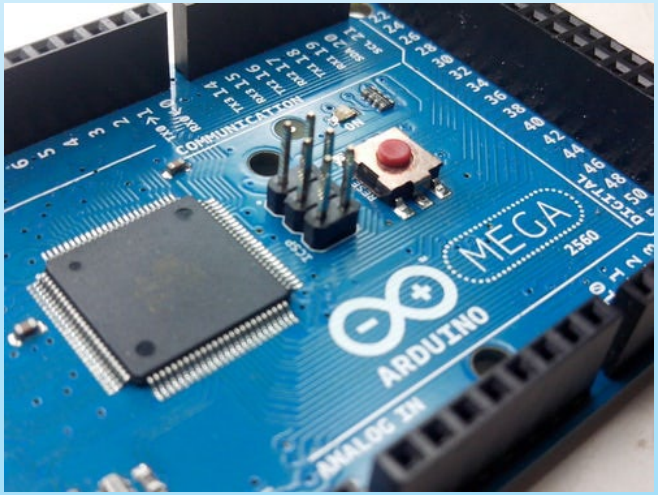
Use-Case Analysis

- How?
  - Soil humidity sensor
  - Soil temperature sensor
    - One or two?
  - Ambience humidity sensor
  - Ambience temperature sensor
    - One or two?
  - Brightness control
  - Camera, distance sensor
  - Camera, colour cell
    - One, two or three?
  - GPS/Galileo receiver
  - Water valves, motors

Budget, accuracy, connections, production, documentation, already-done code…

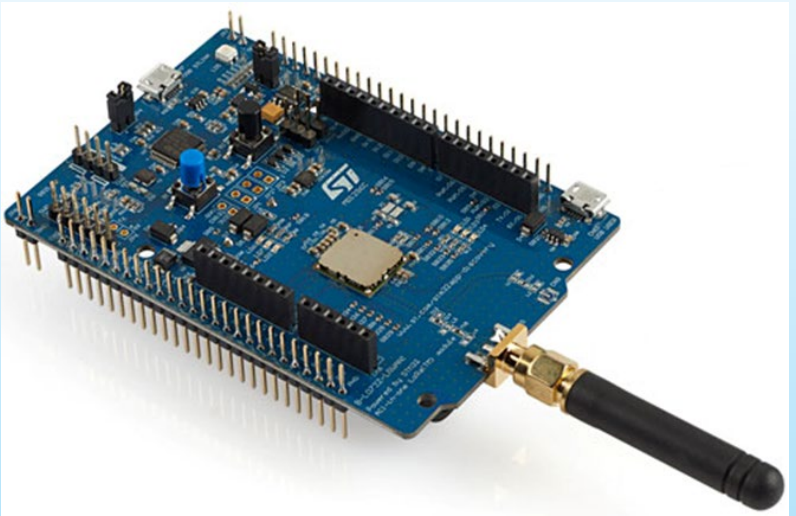
Use-Case Analysis

Don’t use a sledgehammer to crack a nut!



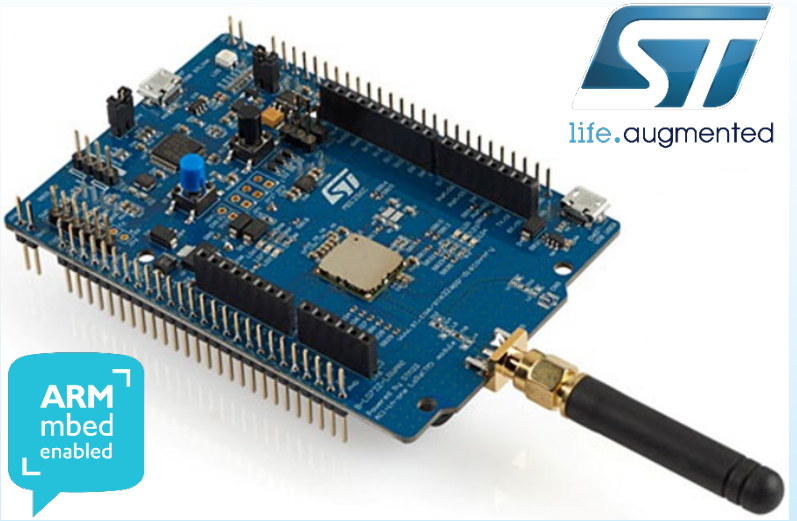
The B-L072Z-LRWAN1

- Our platform: B-L072Z-LRWAN1
  - Core: STM32L072CZ
    - ARM Cortex M0+
    - Ultra-low-power
  - Peripherals
    - ADC, DAC, timers
  - Serial connections
    - I2C, UART, SPI
  - LoRa module
  - User LEDs and buttons
  - Arduino connectors
  - *Much more…*



The B-L072Z-LRWAN1

- Our platform: B-L072Z-LRWAN1
  - Manufacturer: STMicroelectronics
  - ARM processor
  - Price: ~45 USD



  - Support & Community:
    - STMicroelectronics web site

    https://www.st.com/content/st_com/en.html
    - arm MBED OS web site

    https://www.mbed.com/en/
    - *Much more…*

Use-Case Analysis

GPS

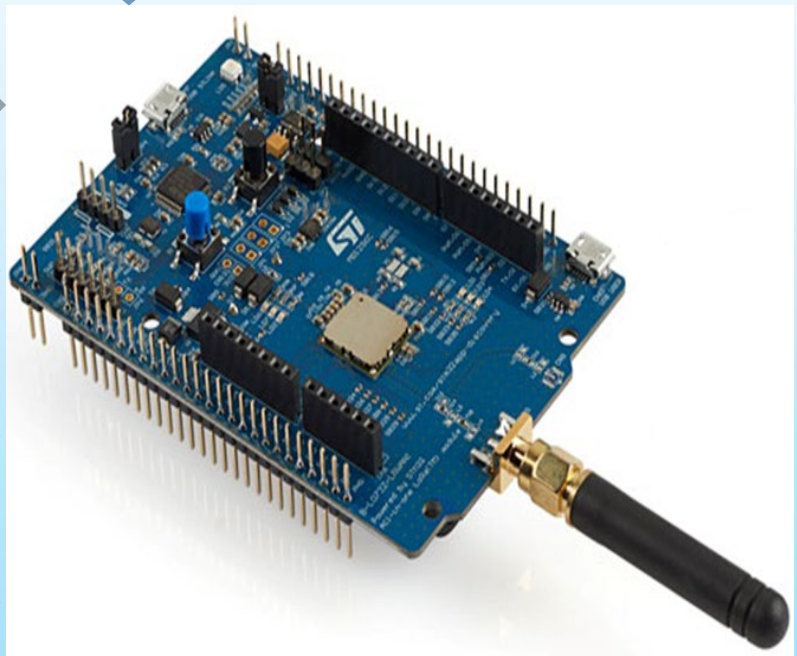
LoRa

Temp. sensor

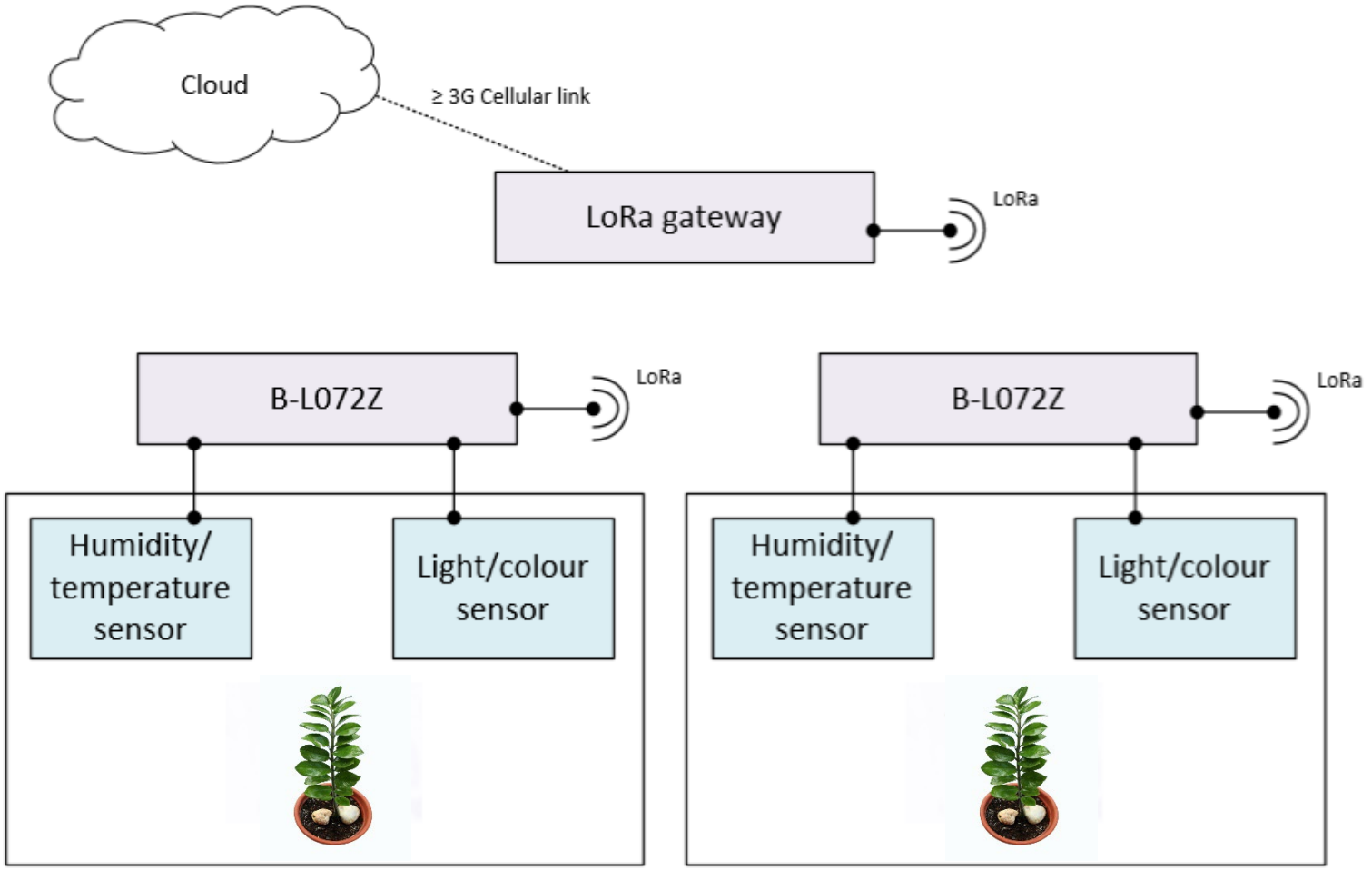
Humidity sensor

Brigthness sensor

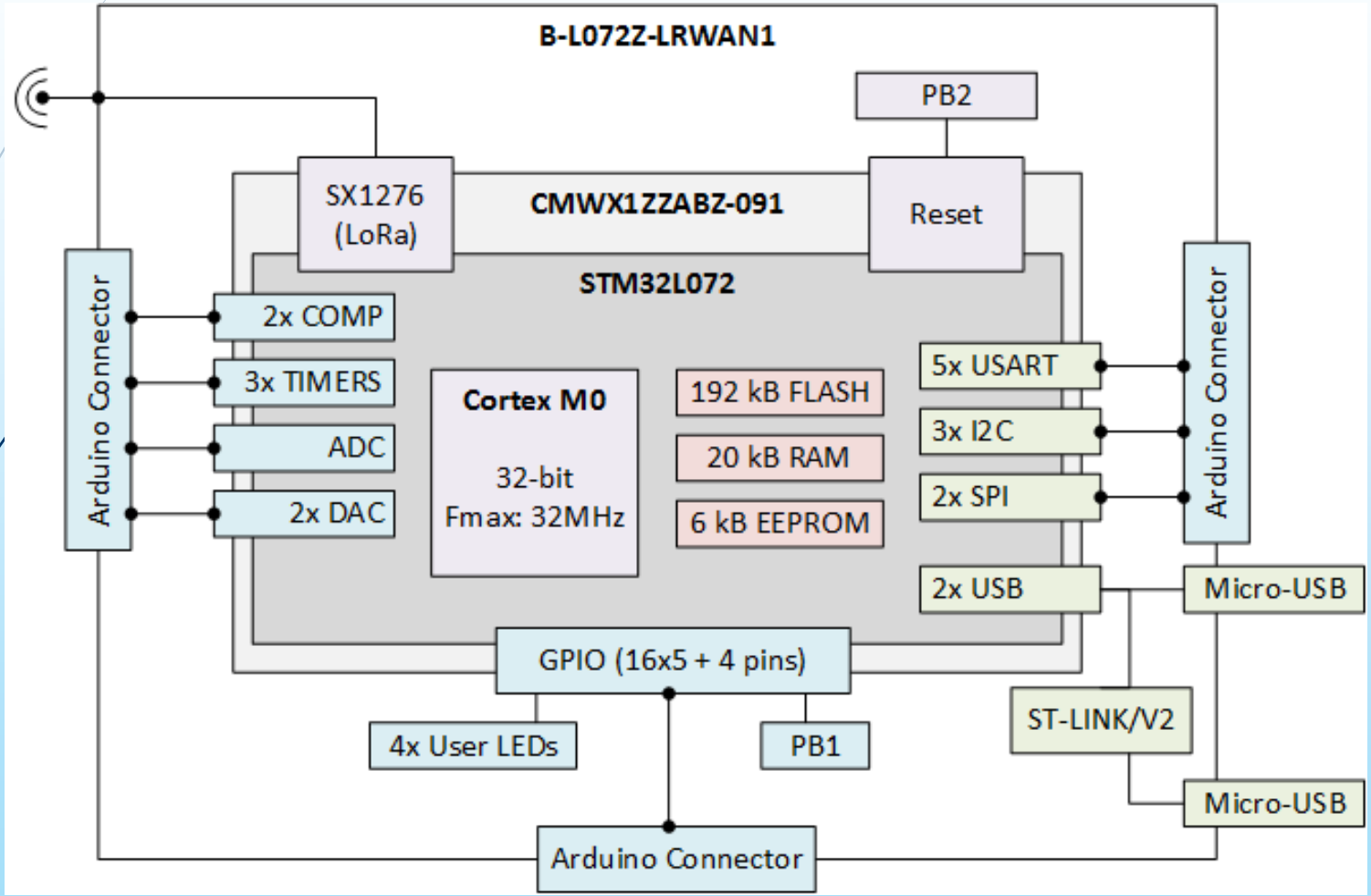
Colour sensor



Use-Case Analysis



General diagram of the B-L072Z-LRWAN

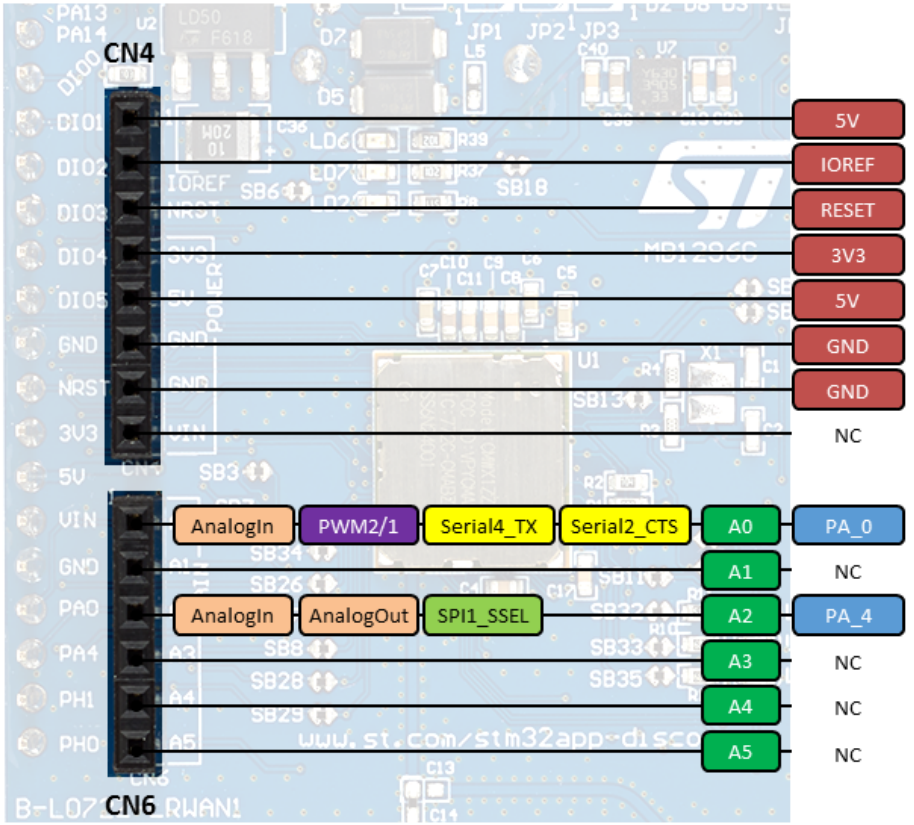


B-L072Z-LRWAN - I/O Pins

life.augmented

DISCO-L072CZ-LRWAN1

ARDUINO HEADER
(top left side)



Labels usable in code

- PX_Y — MCU pin without conflict
- PX_Y — MCU pin connected to other components
  See **PeripheralPins.c** (link below) for more information

Labels not usable in code (for information only)

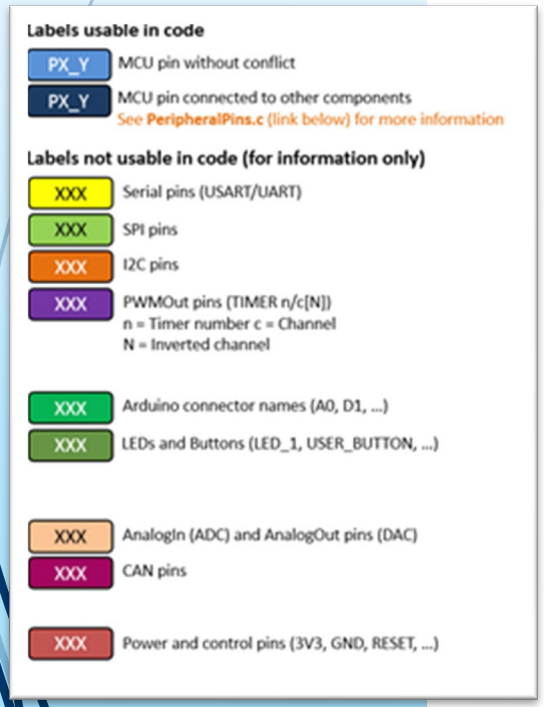
- XXX — Serial pins (USART/UART)
- XXX — SPI pins
- XXX — I2C pins
- XXX — PWMOut pins (TIMER n/c[N])
  n = Timer number c = Channel
  N = Inverted channel
- XXX — Arduino connector names (A0, D1, ...)
- XXX — LEDs and Buttons (LED_1, USER_BUTTON, ...)
- XXX — AnalogIn (ADC) and AnalogOut pins (DAC)
- XXX — CAN pins
- XXX — Power and control pins (3V3, GND, RESET, ...)

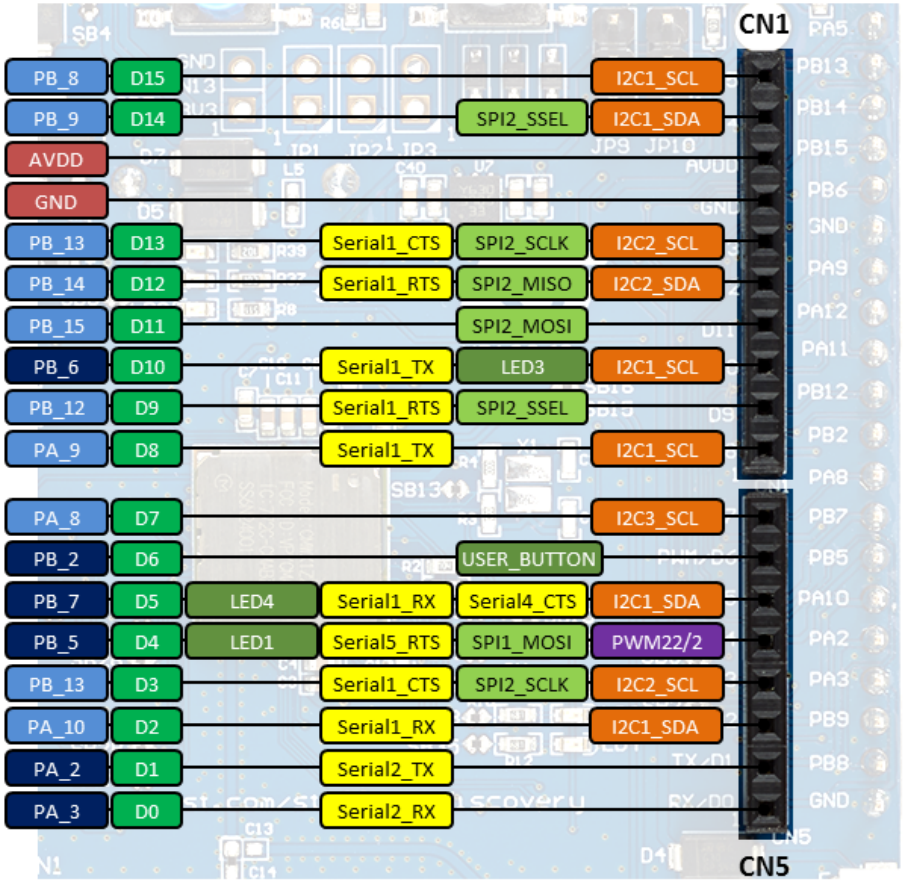
B-L072Z-LRWAN - I/O Pins

life.augmented

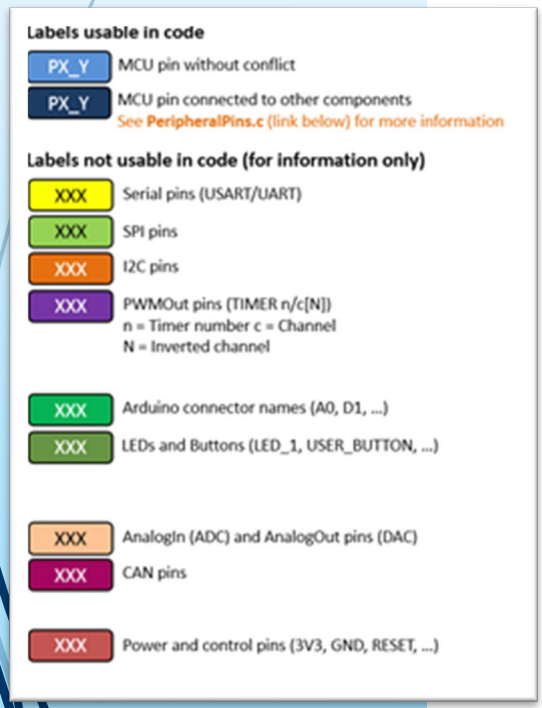
DISCO-L072CZ-LRWAN1

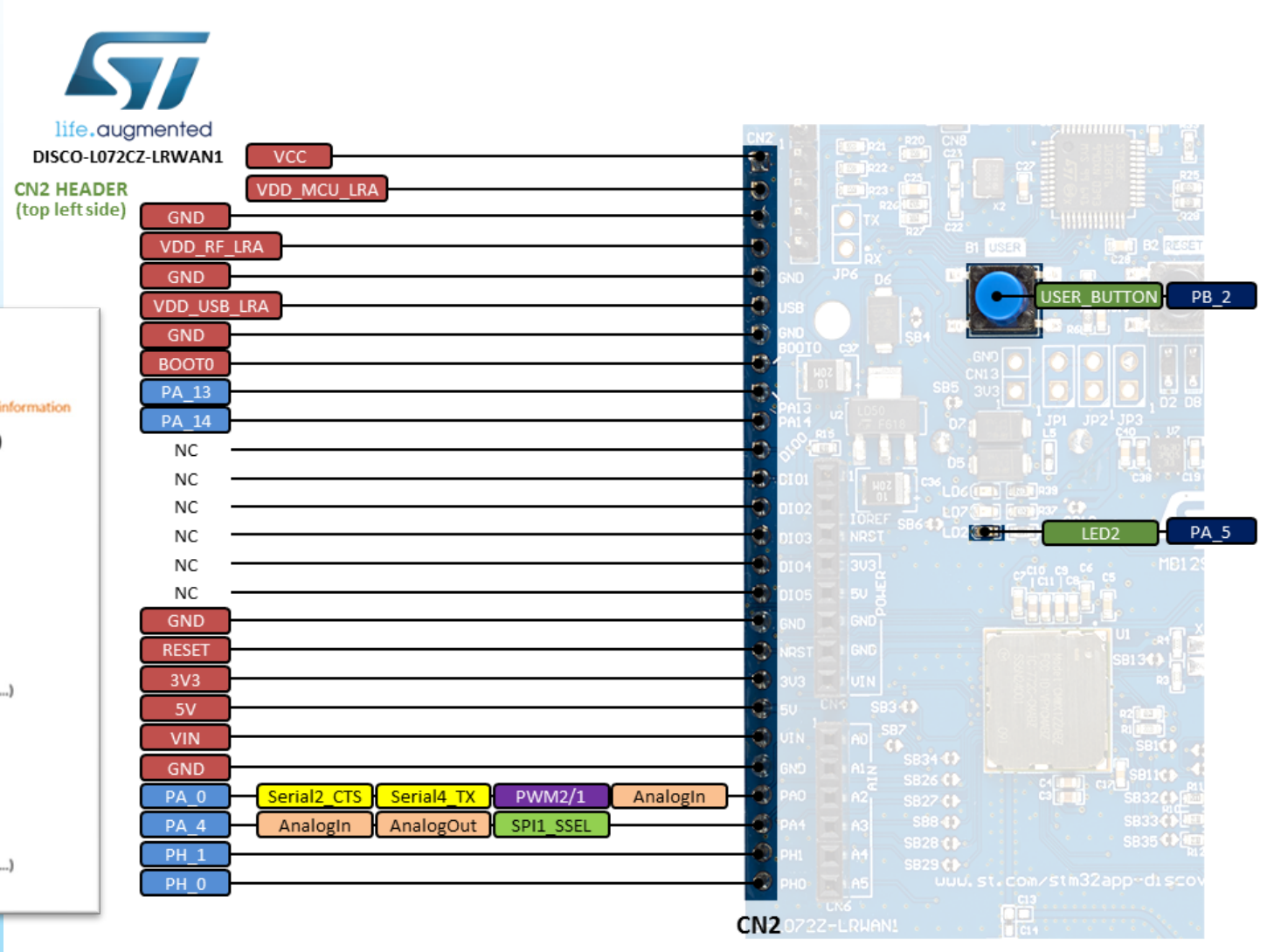
ARDUINO HEADER
(top right side)





B-L072Z-LRWAN - I/O Pins



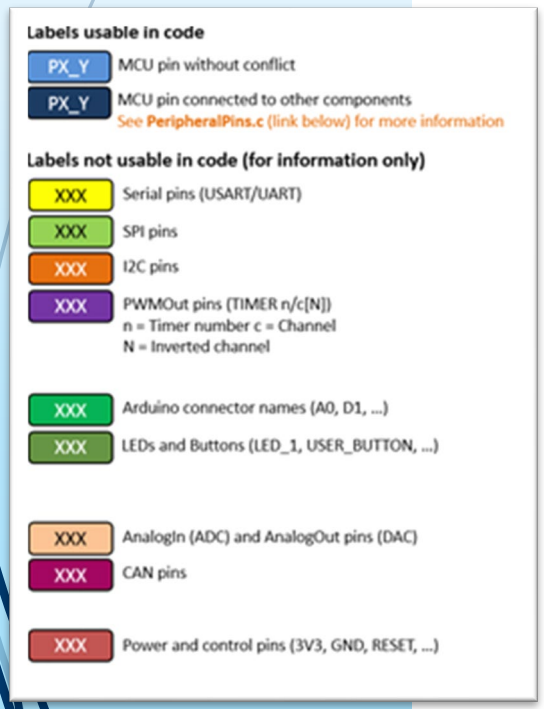


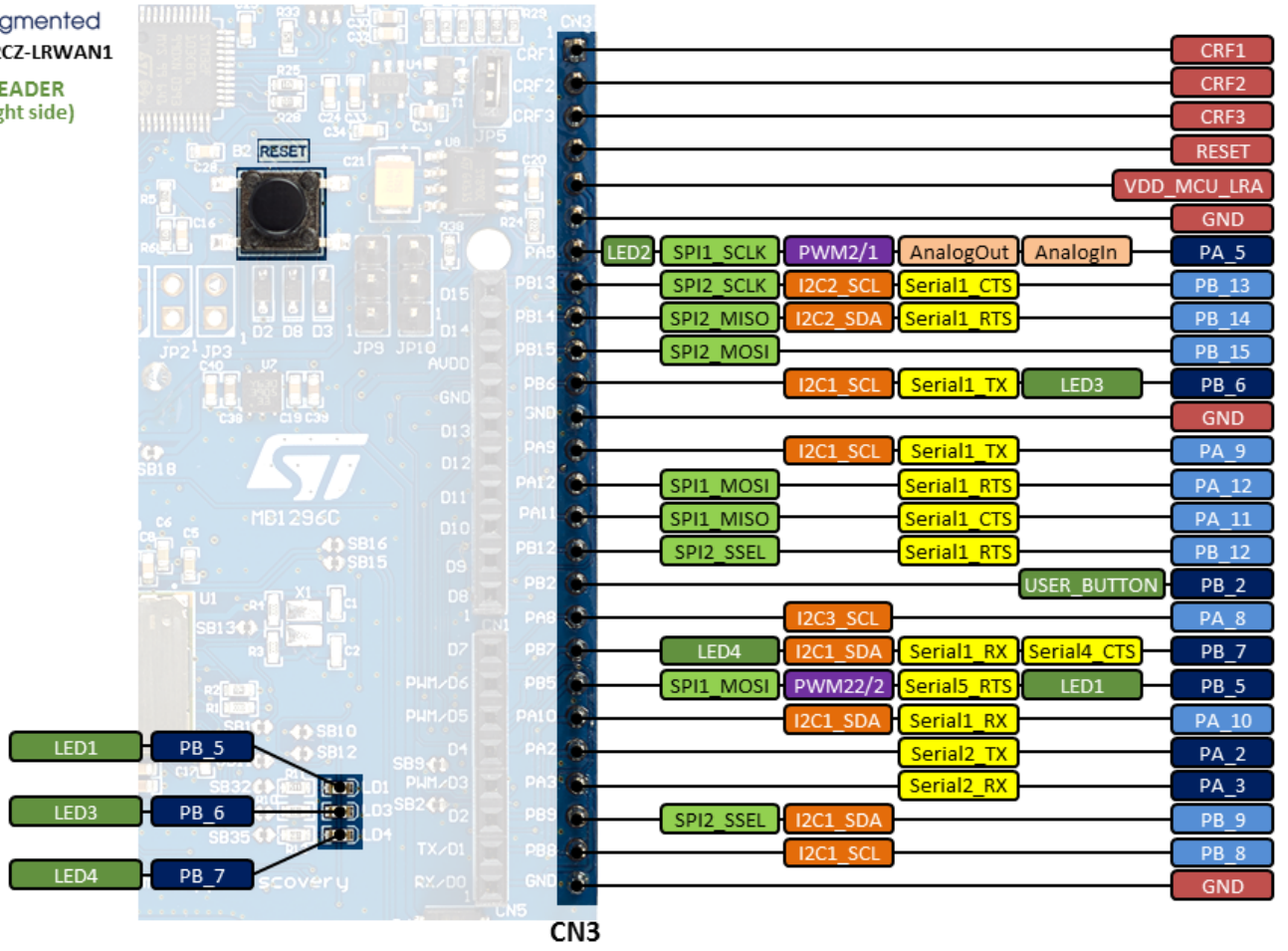
B-L072Z-LRWAN - I/O Pins

life.augmented

DISCO-L072CZ-LRWAN1

CN3 HEADER
(top right side)





Use-Case Goal

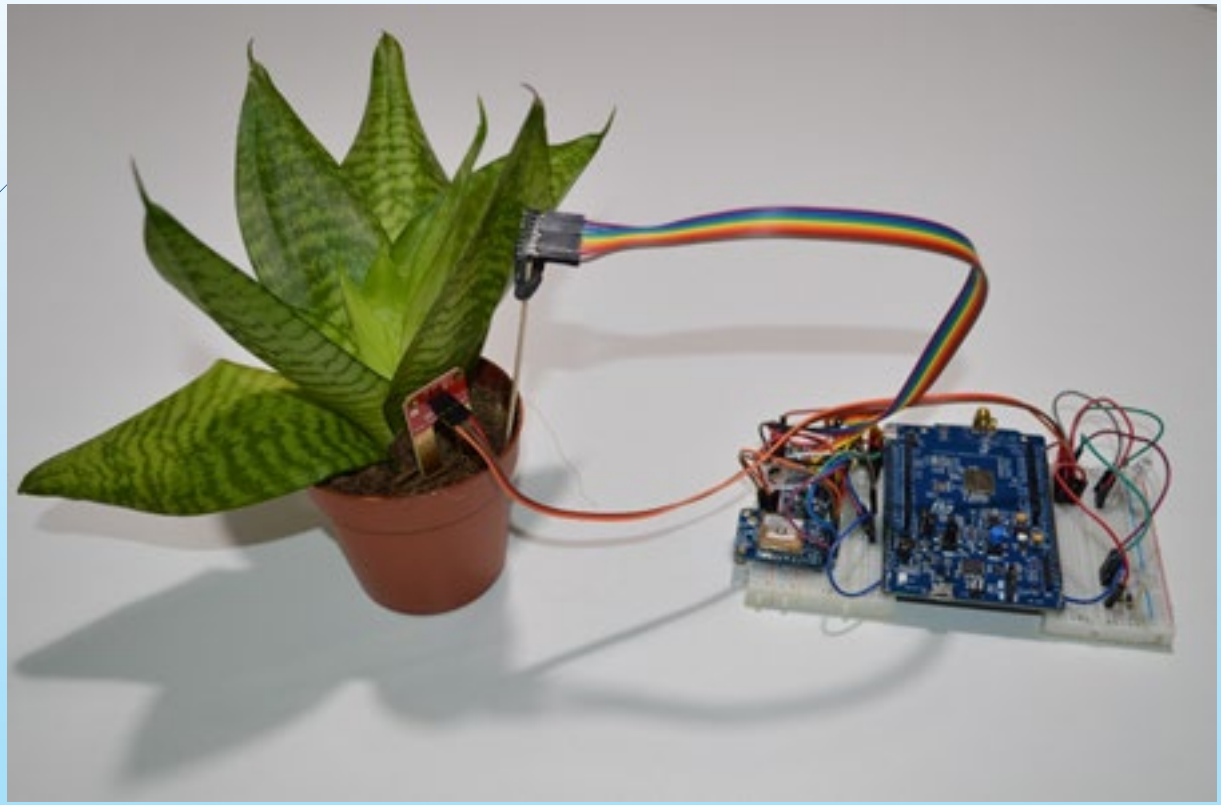
- To develop an IoT System …
  - To monitor environmental / health conditions of a plant along its life
- Potential Applications
  - To adjust plant selling prices at flower shops
    - Actual price is displayed via an Smart pone app when walking through
  - Monitoring system in greenhouses
  - Precision Agriculture
  - …
- Divided in two stages
  - Hw + Sensoring Sw (this course)
  - Wireless Communications (Sensor Networks course)

Use-Case Monitoring Goals

- Continuously monitoring basic plant environmental / health parameters
  - Temperature
  - Air relative humidity
  - Ambient light intensity
  - Soil moisture
  - Storage / transport issues
    - Falls, hits, overturns, …
- Continously monitoring the evolution along time
  - Plant leaves color
  - Plant global position

Use-Case Prototype

- B-L072Z-LRWAN + several sensors



Available Material for the Use-Case

- What you would have ….

Suggested Sensors

- Temperature and relative humidity
  - AdaFruit Si7021 Temperature & Humidity Sensor

- Ambient light
  - Photo Transistor Light Sensor HWSP-1

Suggested Sensors

- Soil moisture
  - Sparkful soil moisture sensor

- Leaves color
  - AdaFruit TCS34725 RGB color sensor with IR filter and white LED

Suggested Sensors

- Storage / Transport issue
  - AdaFruit Triple-axes accelerometer MMA8451

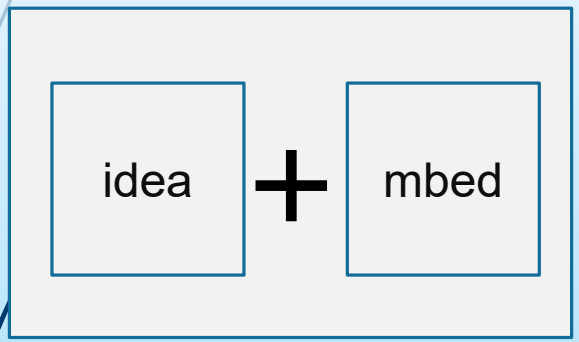
- Global Position
  - AdaFruit GPS

Suggested Status Information

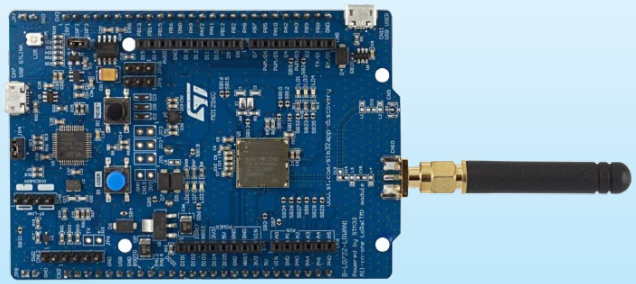
- RGB LED
  - … controlled with Pulse Width Modulation (PWM) to produce any color combination in the RGB LED

Workflow with embedded platforms

IDE*



USB (ST-Link v2)



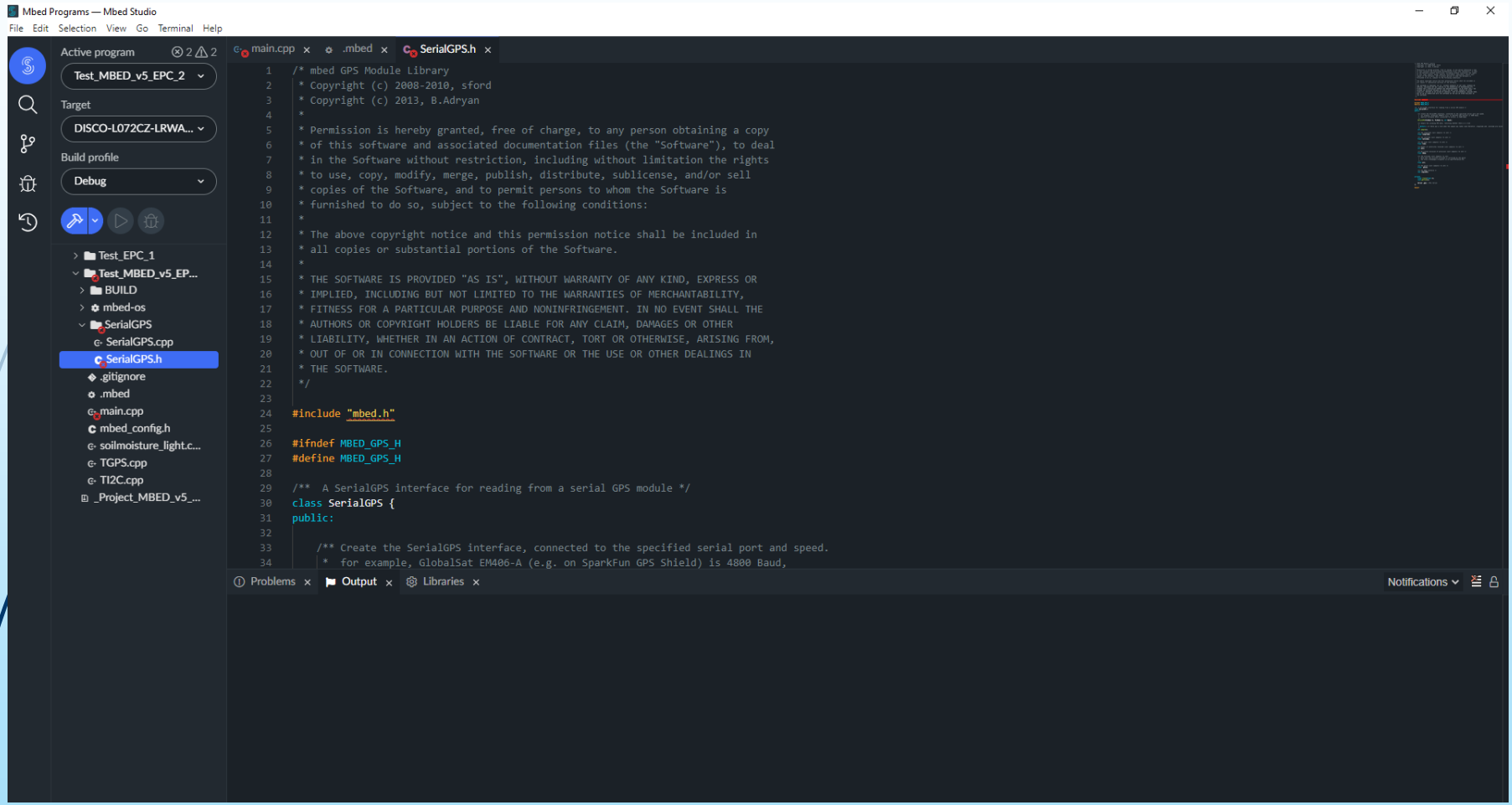
B-L072Z-LRWAN1

*IDE: Integrated Development Enviroment

Integrated development environments

- Four IDEs available in this course:
  1. mbed Studio:
     https://os.mbed.com/studio/
  2. Keil µVision:
     https://www2.keil.com/mdk5/uvision/
  3. Keil Studio (online):
     https://studio.keil.arm.com/
  4. mbed compiler (online):
     https://os.mbed.com/accounts/login/?next=%2Fide%2F

Mbed studio & Keil studio (online)



Hands-on lab

- **Blinking LEDs exercise. Steps:**
  1) Download/Import mbed blinky, compile and test it
     - Check debugging functionality!
     - Get familiar with the code
  2) Add a new –independent– LED blinking @ 1/3 s
     - Tip: use a Ticker
     - https://os.mbed.com/docs/mbed-os/v6.15/apis/ticker.html