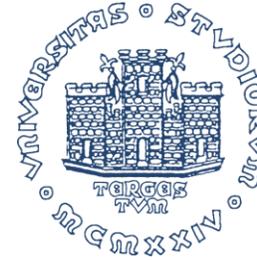




**Orama** group



**UNIVERSITY  
OF TRIESTE**

# **Argus Security Meets UNITS**

**Trieste, 28 April 2025**

---

# STM32WL55 Hands-on

- Hands on 1: SubGHz\_Phy\_AT\_Slave
  - Intro: AT commands (2 minutes)
  - Example selection from Cube MX
  - Code generation
  - AT commands via UART (Teraterm)
  - Waterfall visual on master screen
  - Breakpointing, dynamic registers manipulation, variables inspection
  
- Hands on 2: LoRa Slave device
  - Example selection from Cube MX
  - Code generation
  - Device comissioning

---

# Hands on 1: SubGHz\_Phy\_AT\_Slave

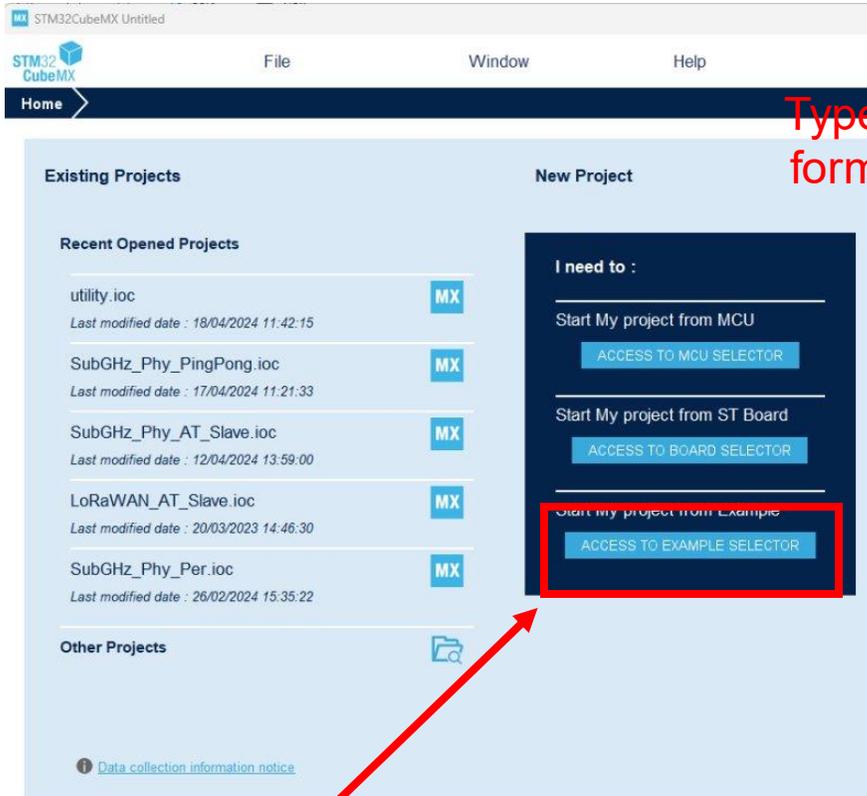
Project setup (Cube MX)



# Project selection

## SUGHz Phy AT Slave

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MX New Project from Example

MCU/MPU Selector | Board Selector | Example Selector | Cross Selector

Example Filters

Label

Keyword

Vendor

**Board**

Name: wl55jc1

Type

MCU / MPU

Type WL55JC1 in the board form. The board SHALL BE JC1 version

Example Filters

Name

OSPI

OTFDEC

PCCARD

PCD

PKA

PSSI

PWR

QSPI

RADIO

RAMCFG

RAMECC

RCC

RIF

RNG

RTC

SAI

SD

SDMMC

SDRAM

SMARTCARD

SMBUS

SPDIFRX

SPI

SRAM

**SUBGHZ**

SWPMI

TIM

TIMEBASE

TSC

UART

UCPD

USART

USB

UTILS

Check SUBGHZ in the example filter

1  
Open Example Selector

# Project selection

## SUGHz Phy AT Slave

Example Filters

Name

- OSPI
- OTFDEC
- PCCARD
- PCD
- PKA
- PSSI
- PWR
- QSPI
- RADIO
- RAMCFG
- RAMECC
- RCC
- RIF
- RNG
- RTC
- SAI
- SD
- SDMMC
- SDRAM
- SMARTCARD
- SMBUS
- SPDIFRX
- SPI
- SRAM
- SUBGHZ
- SWPMI
- TIM
- TIMEBASE
- TSC
- UART
- UCPD
- USART
- USB
- UTILS

Examples List: 15 items

*	Name	Board
☆	LocalNetwork_Concentrator	NUCLEO-WL55JC1
☆	LocalNetwork_Sensor	NUCLEO-WL55JC1
☆	LoRaWAN_AT_Slave	NUCLEO-WL55JC1
☆	LoRaWAN_End_Node	NUCLEO-WL55JC1
☆	LoRaWAN_End_Node_FreeRTOS	NUCLEO-WL55JC1
☆	PWR_SMPS	NUCLEO-WL55JC1
☆	Sigfox_AT_Slave	NUCLEO-WL55JC1
☆	Sigfox_PushButton	NUCLEO-WL55JC1
☆	Sigfox_PushButton_DualCore	NUCLEO-WL55JC1
☆	Sigfox_QSPI_1_Slot_DualCore	NUCLEO-WL55JC1
☆	SubGHZ_Phys_AT_Slave	NUCLEO-WL55JC1
☆	SubGHZ_Phys_LrFhss	NUCLEO-WL55JC1
☆	SubGHZ_Phys_Per	NUCLEO-WL55JC1
☆	SubGHZ_Phys_PingPong	NUCLEO-WL55JC1
☆	SUBGHZ_Tx_Mode	NUCLEO-WL55JC1

4  
Double click on  
SubGHZ\_Phys\_AT\_Slave

MX Start Project from Example

**i** Status: Active

Name: SubGHZ\_Phys\_AT\_Slave

Board: NUCLEO-WL55JC1

Required Software Package: STM32Cube\_FW\_WL\_V1.3.1

Install Project Directory: C:/Users/Luca/STM32Cube/Example

Open with: STM32CubeMX

Install Cancel

5  
Select STM32CubeMX as  
"Open with"

---

# Hands on: SubGHz\_Phy\_AT\_Slave

Device Configuration (Cube MX)



Pinout & Configuration

Clock Configuration

Project Manager

Project

Project Settings

Project Name:

Project Location:

Application Structure:   Do not generate the main()

Toolchain Folder Location:

Code Generator

Toolchain / IDE:     Generate Under Root

- EWARM
- EWARM
- MDK-ARM
- STM32CubeIDE**
- Makefile
- CMake

Choose STM32CubeIDE...

...then be sure the check generate Under Root!

Advanced Settings

Linker Settings

Minimum Heap Size:

Minimum Stack Size:

Generate Under Root

```
translite - SubGHz_Phys_AT_Slave/Core/Inc/sys_conf.h - STM32CubeIDE
File Edit Source Refactor Navigate Search Project Run Window Help
Project Explorer sys_conf.h
SubGHz_Phys_AT_Slave
  Binaries
  Includes
  Core
    Inc
      dma.h
      gpio.h
      main.h
      platform.h
      rtc.h
      stm32_lpm_if.h
      stm32wlxx_hal_conf.h
      stm32wlxx_it.h
      stm32wlxx_nucleo_conf.h
      subghz.h
      sys_app.h
      sys_conf.h
      sys_debug.h
      timer_if.h
      usart_if.h
      usart.h
      utilities_conf.h
      utilities_def.h
    Src
    Startup
    Drivers
    Middlewares
    SubGHz_Phys
    Utilities
```

```
46 /**
47  * @brief Enable trace logs
48  */
49 #define APP_LOG_ENABLED 1
50
51 /**
52  * @brief Activate monitoring (probes) of some int
53  */
54 #define DEBUG_SUBGHZSPI_MONITORING_ENABLED 0
55
56 #define DEBUG_RF_NRESET_ENABLED 0
57
58 #define DEBUG_RF_HSE32RDY_ENABLED 0
59
60 #define DEBUG_RF_SMPSRDY_ENABLED 0
61
62 #define DEBUG_RF_LDORDY_ENABLED 0
63
64 #define DEBUG_RF_DTRDY_ENABLED 0
65
66 #define DEBUG_RF_BUSY_ENABLED 0
67
68 /**
69  * @brief Enable/Disable MCU Debugger pins (dbg se
70  * @note by HW serial wires are ON by default, ne
71  */
72 #define DEBUGGER_ENABLED 1
73
74 /**
75  * @brief Disable Low Power mode
76  * @note 0: LowPowerMode enabled. MCU enters stop
77  */
78 #define LOW_POWER_DISABLE 1
79
```

Activate debug and disable low power in sys\_conf.h

# Rund and debug



Right click on the project, select debug as STM32 c/c++ application.

On the serial console the mcu will signal that is ready to receive AT commands.

IDE translite - SubGHZ\_Phys\_AT\_Slave/Core/Inc/sys\_conf.h - STM32CubeIDE

File Edit Source Refactor Navigate Search Project Run Window Help

Project Explorer SubGHZ\_Phys\_AT\_Slave

- Binaries
- Includes
- Core
  - Inc
    - dma.h
    - gpio.h
    - main.h
    - platform
    - rtc.h
    - stm32\_I
    - stm32w
    - stm32w
    - stm32w
    - subghz
    - sys\_app
    - sys\_con
    - sys\_deb
    - timer\_if
    - usart\_if
    - usart.h
    - utilities
    - utilities
  - Src
  - Startup
  - Drivers
  - Middlewares
  - SubGHZ\_Phys
  - Utilities
  - Debug
  - EWARM
  - MDK-ARM
  - readme.txt
  - STM32WL55
  - SubGHZ\_Phys
  - SubGHZ\_Phys
  - Translite\_v1 (in tr
  - Translite\_v1\_C
  - Translite\_v1\_C

Context Menu:

- New
- Go Into
- Open in New Window
- Show In Alt+Shift+W
- Copy Ctrl+C
- Paste Ctrl+V
- Delete
- Source
- Move...
- Rename... F2
- Import...
- Export...
- Build Project
- Clean Project
- Refresh F5
- Close Project
- Close Unrelated Project
- Build Configurations
- Build Targets
- Index
- Run As
- Debug As**
  - IDE 1 STM32 C/C++ Application
  - Debug Configurations...
- Team
- Compare With
- Restore from Local History...
- Generate Code
- Convert to C++
- Run C/C++ Code Analysis
- Configure
- Properties Alt+Enter

Termite 3.4 (by CompuPhase)

COM9 9600 bps, 8N1, no handshake

```
APPLICATION_VERSION: V1.3.1
MW_RADIO_VERSION: V1.3.1
AT? to list all available functions
```

---

# Hands on 2: Lora Slave (single core)

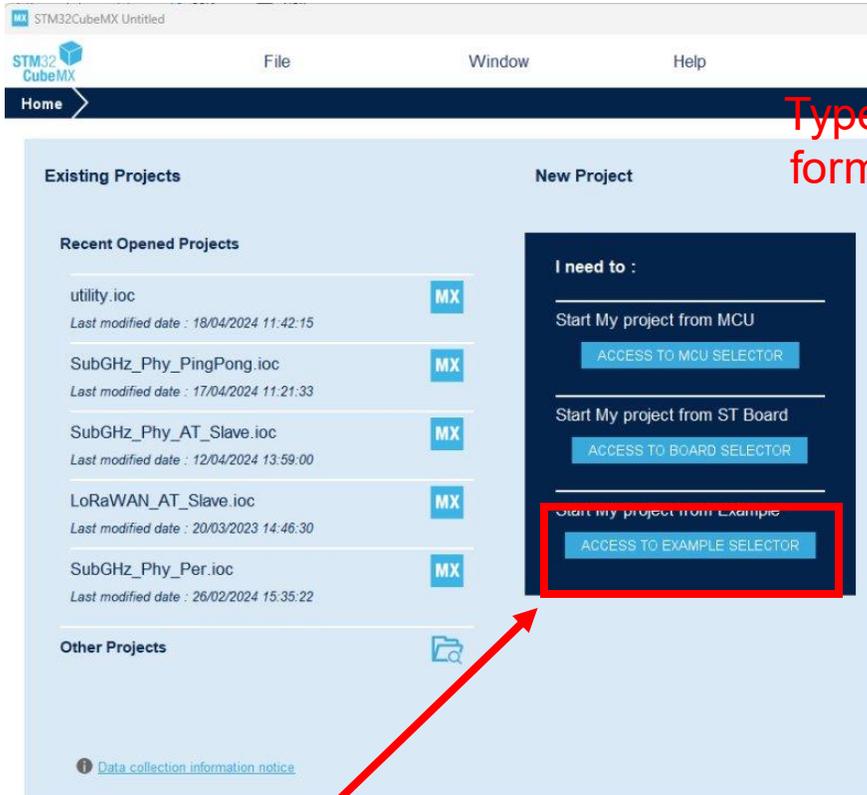
Project setup (Cube MX)



# Project selection

## LoRa WAN End Node

Orama group



MX New Project from Example

MCU/MPU Selector | Board Selector | Example Selector | Cross Selector

Example Filters

Label:

Keyword:

Vendor:

**Board**

Name:

Type:

MCU / MPU:

Type WL55JC1 in the board form. The board SHALL BE JC1 version

Example Filters

Name:

OSPI

OTFDEC

PCCARD

PCD

PKA

PSSI

PWR

QSPI

RADIO

RAMCFG

RAMECC

RCC

RIF

RNG

RTC

SAI

SD

SDMMC

SDRAM

SMARTCARD

SMBUS

SPDIFRX

SPI

SRAM

**SUBGHZ**

SWPMI

TIM

TIMEBASE

TSC

UART

UCPD

USART

USB

UTILS

Check SUBGHZ in the example filter

1

Open Example Selector

2

3

# Project selection

## LoRa WAN End Node

Example Filters

Name

+ -

- OSPI
- OTFDEC
- PCCARD
- PCD
- PKA
- PSSI
- PWR
- QSPI
- RADIO
- RAMCFG
- RAMECC
- RCC
- RIF
- RNG
- RTC
- SAI
- SD
- SDMMC
- SDRAM
- SMARTCARD
- SMBUS
- SPDIFRX
- SPI
- SRAM
- SUBGHZ
- SWPMI
- TIM
- TIMEBASE
- TSC
- UART
- UCPD
- USART
- USB
- UTILS

Examples List: 15 items

*	Name	Board
☆	LocalNetwork_Concentrator	<a href="#">NUCLEO-WL55JC1</a>
☆	LocalNetwork_Sensor	<a href="#">NUCLEO-WL55JC1</a>
☆	LoRaWAN_AT_Slave	<a href="#">NUCLEO-WL55JC1</a>
☆	LoRaWAN_End_Node	<a href="#">NUCLEO-WL55JC1</a>
☆	LoRaWAN_End_Node_FreeRTOS	<a href="#">NUCLEO-WL55JC1</a>
☆	PWR_SMPS	<a href="#">NUCLEO-WL55JC1</a>
☆	Sigfox_AT_Slave	<a href="#">NUCLEO-WL55JC1</a>
☆	Sigfox_PushButton	<a href="#">NUCLEO-WL55JC1</a>
☆	Sigfox_PushButton_DualCore	<a href="#">NUCLEO-WL55JC1</a>
☆	Sigfox_SBSFU_1_Slot_DualCore	<a href="#">NUCLEO-WL55JC1</a>
☆	SubGHz_Phys_AT_Slave	<a href="#">NUCLEO-WL55JC1</a>
☆	SubGHz_Phys_LrFhss	<a href="#">NUCLEO-WL55JC1</a>
☆	SubGHz_Phys_Per	<a href="#">NUCLEO-WL55JC1</a>
☆	SubGHz_Phys_PingPong	<a href="#">NUCLEO-WL55JC1</a>
☆	SUBGHZ_Tx_Mode	<a href="#">NUCLEO-WL55JC1</a>

4  
Double click on  
LoRaWAN\_End\_Node

MX Start Project from Example

**i** Status: Active

Name: SubGHz\_Phys\_AT\_Slave

Board: NUCLEO-WL55JC1

Required Software Package: STM32Cube\_FW\_WL\_V1.3.1

Install Project Directory: C:/Users/Luca/STM32Cube/Example

Open with: **STM32CubeMX**

Install Cancel

5  
Select STM32CubeMX as  
"Open with"

Pinout & Configuration | Clock Configuration | Project Manager

Software Packs | Pinout

LORAWAN Mode and Configuration

Mode

Enabled

Configuration

Reset Configuration

LoRaWAN application | LoRaWAN commissioning | LoRaWAN middleware | User Constants | Platform Settings

Configure the below parameters :

Search (Ctrl+F)

Application selection

Application configuration recommendations

board settings

- Send Tx on Timer or Button Evt
- Probes Lines in Platform Settings

lora\_app

- Active region
- Transmission duty cycle
- Application user port
- Switch class port
- Default class
- Default handler message state
- Handler Adaptive Data Rate
- Default activation type
- Force rejoin at each reboot
- Default data rate
- Default Tx output power
- Default Unicast ping slots periodicity
- Default reponse timeout for class b and class c confirmed downlink frames in milli seconds.

sys\_conf

- Trace verbose level
- Enable Application Logging
- Disable Low Power Mode
- Enable Sensor

End Node skeleton  
!! Please read carefully Information panel below!!

TX\_ON\_EVENT

LORAMAC\_REGION\_EU868

10000

2

3

CLASS\_A

Unconfirmed message

Off

OTAA

DR\_0

TX\_POWER\_14

4

8000

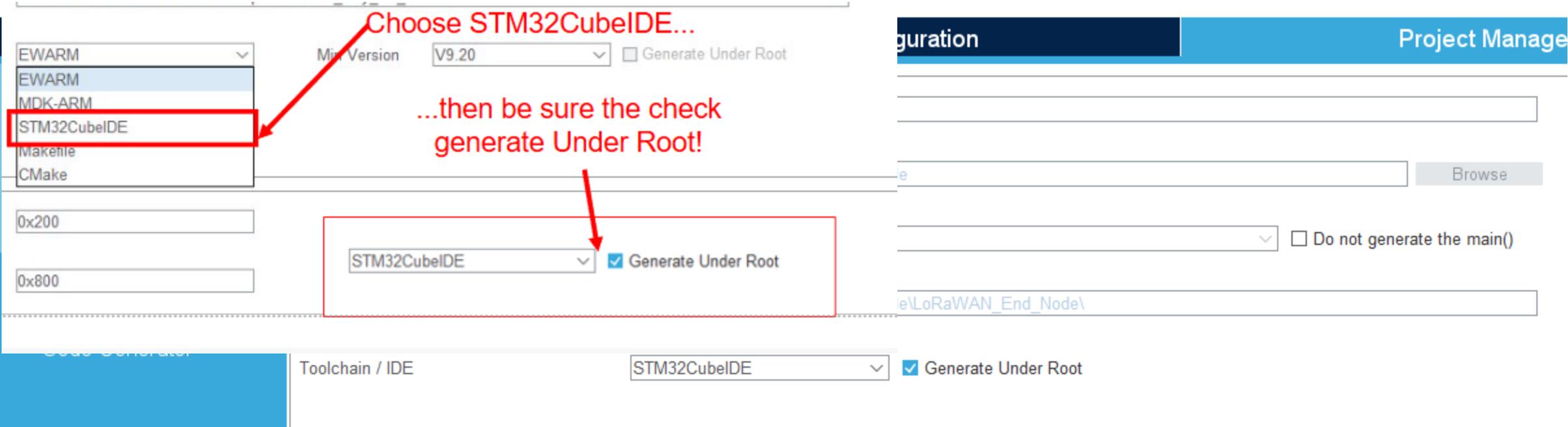
VLEVEL\_M

**6**  
Edits to the configuration:  
**TX\_ON\_EVENT**  
Adaptive Data Rate OFF,  
Disable LOW POWER  
MODE, enable app logging

# Project selection

## LoRa WAN End Node

**Orama** group



**Choose STM32CubeIDE...**

...then be sure the check generate Under Root!

EWARM  
EWARM  
MDK-ARM  
**STM32CubeIDE**  
Makefile  
CMake

Min Version V9.20  Generate Under Root

0x200

0x800

STM32CubeIDE  Generate Under Root

Do not generate the main()

Toolchain / IDE STM32CubeIDE  Generate Under Root

**Then Open Project (STM32 Cube IDE shall start or already be opened)**



# Project selection

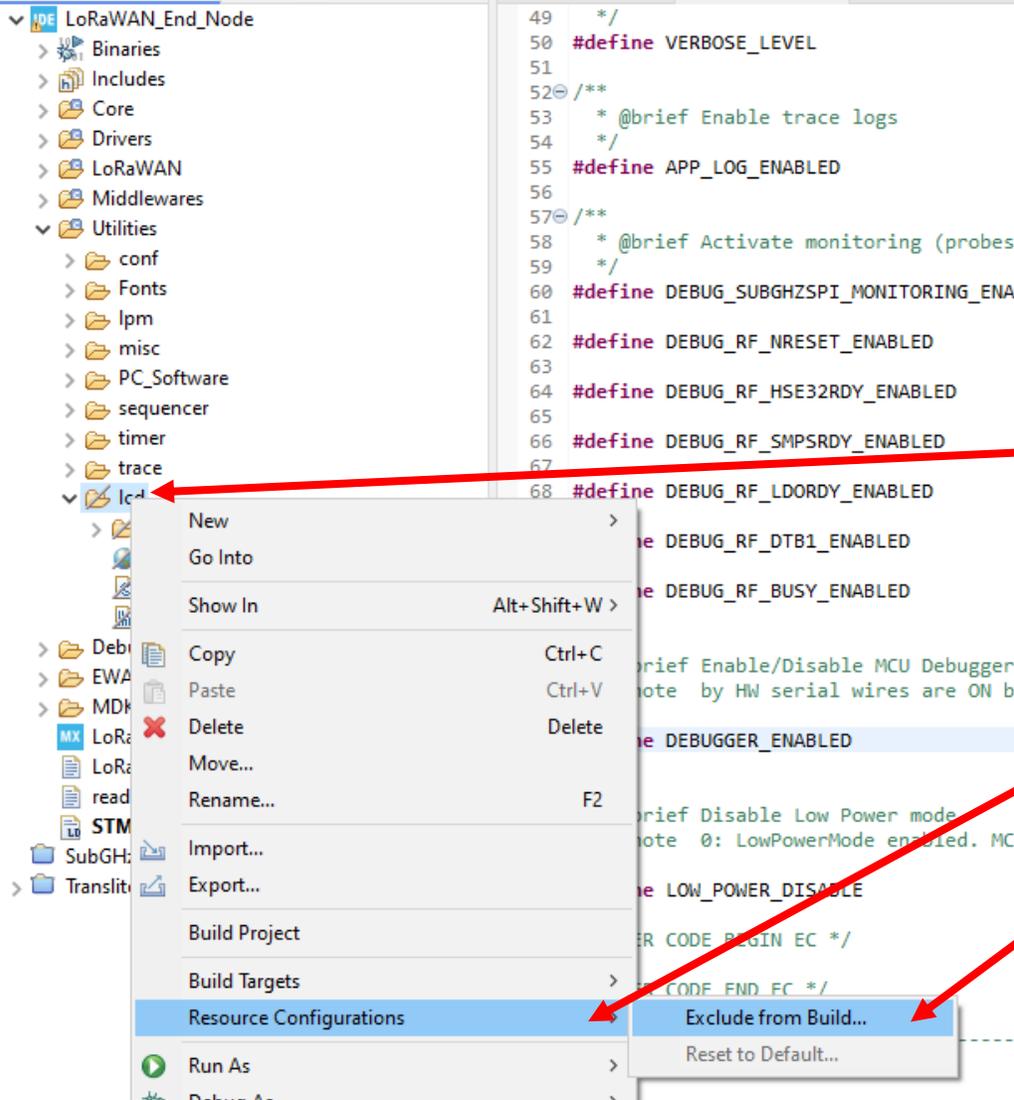


```
49  */
50  #define VERBOSE_LEVEL          VLEVEL_M
51
52  /**
53   * @brief Enable trace logs
54   */
55  #define APP_LOG_ENABLED        1
56
57  /**
58   * @brief Activate monitoring (probes) of some interna
59   */
60  #define DEBUG_SUBGHZSPI_MONITORING_ENABLED  0
61
62  #define DEBUG_RF_NRESET_ENABLED            0
63
64  #define DEBUG_RF_HSE32RDY_ENABLED         0
65
66  #define DEBUG_RF_SMPSRDY_ENABLED         0
67
68  #define DEBUG_RF_LDORDY_ENABLED          0
69
70  #define DEBUG_RF_DTBL_ENABLED            0
71
72  #define DEBUG_RF_BUSY_ENABLED            0
73
74  /**
75   * @brief Enable/Disable MCU Debugger pins (dbg serial
76   * @note  by HW serial wires are ON by default, need t
77   */
78  #define DEBUGGER_ENABLED                 1
79
80  /**
81   * @brief Disable Low Power mode
82   * @note  0: LowPowerMode enabled. MCU enters stop2 mo
83   */
84  #define LOW_POWER_DISABLE                 1
85
86  /* USER CODE BEGIN EC */
```

Activate debug and disable low power in sys\_conf.h

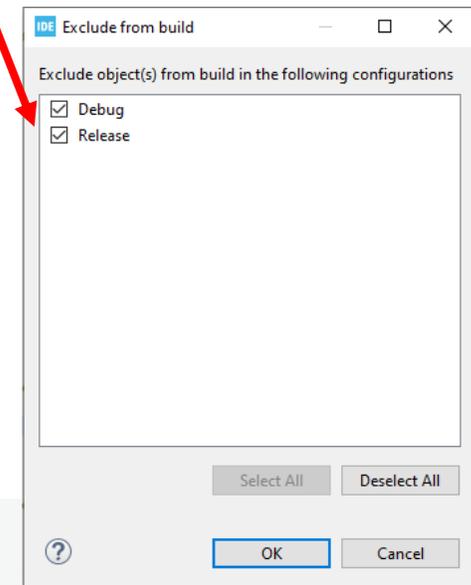
# Project selection

## LoRa WAN End Node



```
49  */
50  #define VERBOSE_LEVEL
51
52  /**
53   * @brief Enable trace logs
54   */
55  #define APP_LOG_ENABLED
56
57  /**
58   * @brief Activate monitoring (probes)
59   */
60  #define DEBUG_SUBGHZSPI_MONITORING_ENA
61
62  #define DEBUG_RF_NRESET_ENABLED
63
64  #define DEBUG_RF_HSE32RDY_ENABLED
65
66  #define DEBUG_RF_SMPSRDY_ENABLED
67
68  #define DEBUG_RF_LDORDY_ENABLED
69
70  #define DEBUG_RF_DTDB1_ENABLED
71
72  #define DEBUG_RF_BUSY_ENABLED
73
74  @brief Enable/Disable MCU Debugger
75  Note by HW serial wires are ON by
76
77  #define DEBUGGER_ENABLED
78
79  @brief Disable Low Power mode
80  Note 0: LowPowerMode enabled. MCI
81
82  #define LOW_POWER_DISABLE
83
84  ER CODE BEGIN EC */
85
86  ER CODE END EC */
```

Exclude from build Utilities/lcd  
(right click on the folder, check Debug and Release)



IDE Exclude from build

Exclude object(s) from build in the following configurations

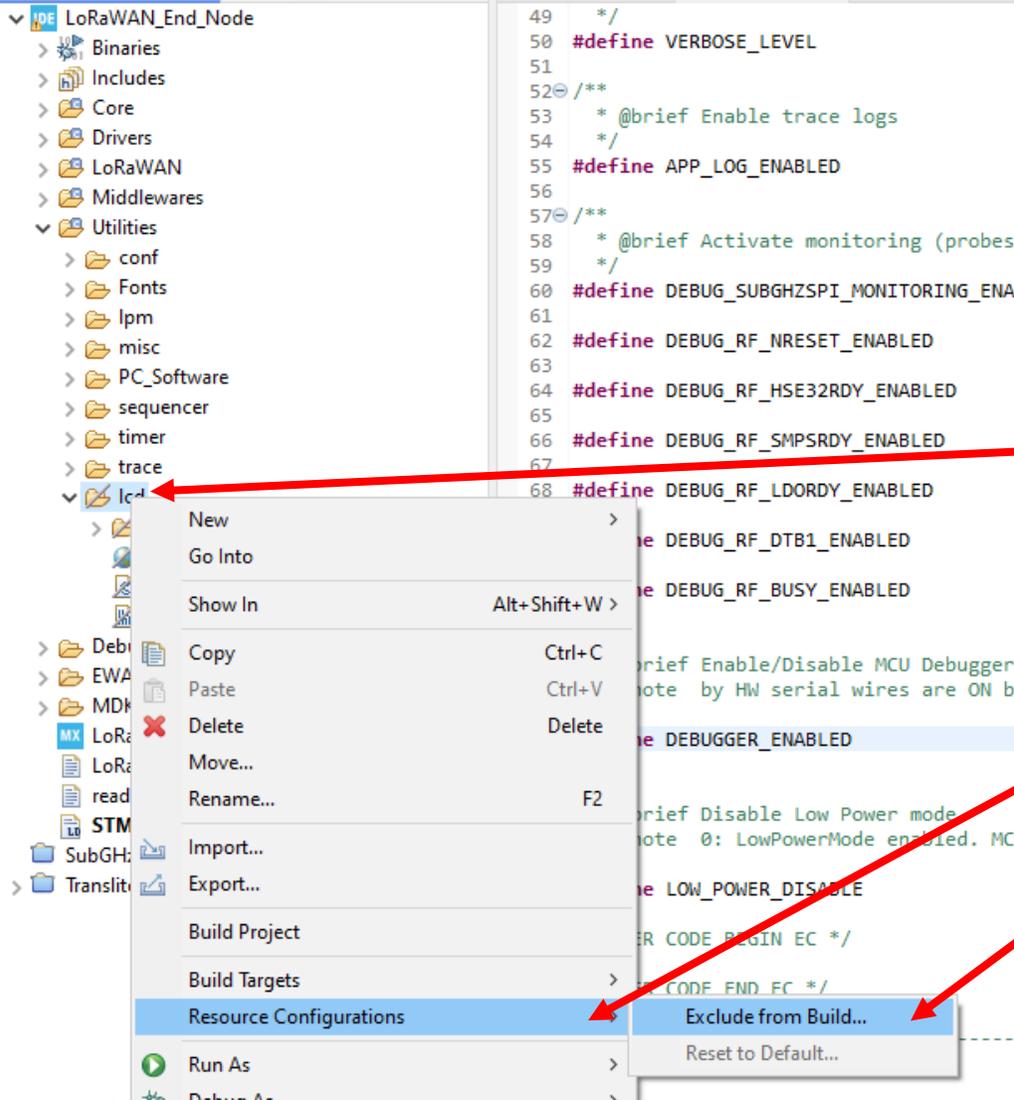
- Debug
- Release

Select All Deselect All

OK Cancel

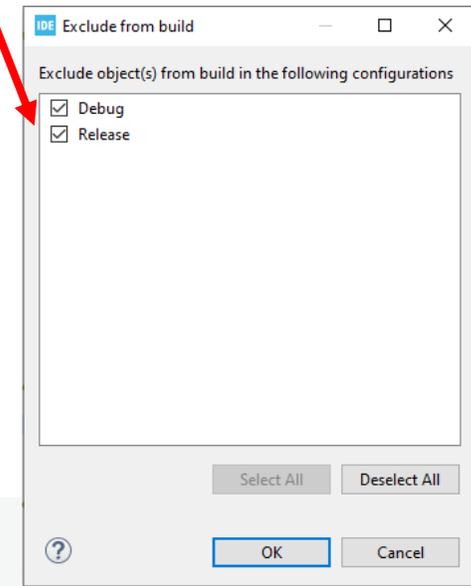
# Project selection

## LoRa WAN End Node



```
49  */
50  #define VERBOSE_LEVEL
51
52  /**
53   * @brief Enable trace logs
54   */
55  #define APP_LOG_ENABLED
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57  /**
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65
66  #define DEBUG_RF_SMPSRDY_ENABLED
67
68  #define DEBUG_RF_LDORDY_ENABLED
69
70  #define DEBUG_RF_DTB1_ENABLED
71
72  #define DEBUG_RF_BUSY_ENABLED
73
74  @brief Enable/Disable MCU Debugger
75  Note by HW serial wires are ON by
76
77  #define DEBUGGER_ENABLED
78
79  @brief Disable Low Power mode
80  Note 0: LowPowerMode enabled. MCI
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83
84  ER CODE BEGIN EC */
85
86  ER CODE END EC */
```

Exclude from build Utilities/lcd  
(right click on the folder, check Debug and Release)



IDE Exclude from build

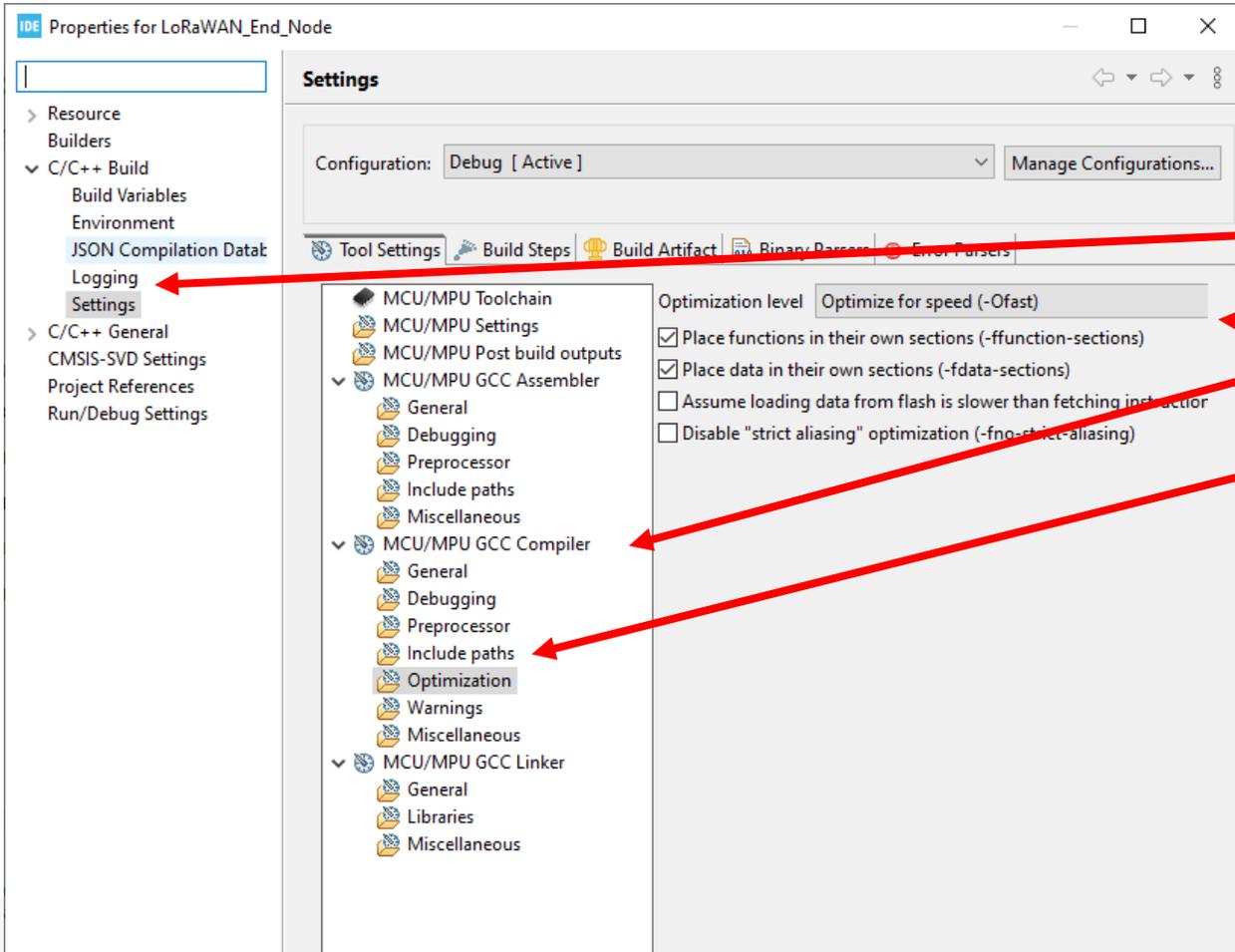
Exclude object(s) from build in the following configurations

- Debug
- Release

Select All Deselect All

OK Cancel

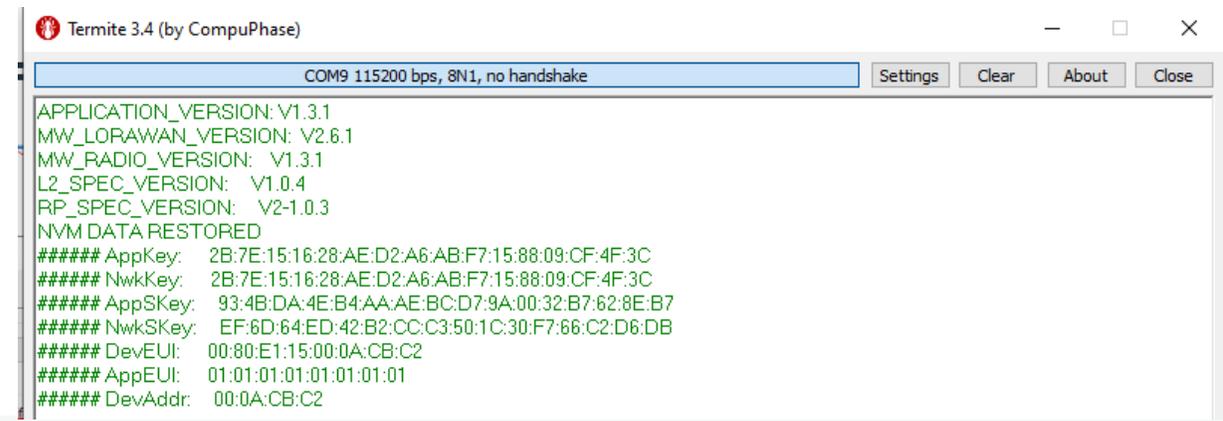
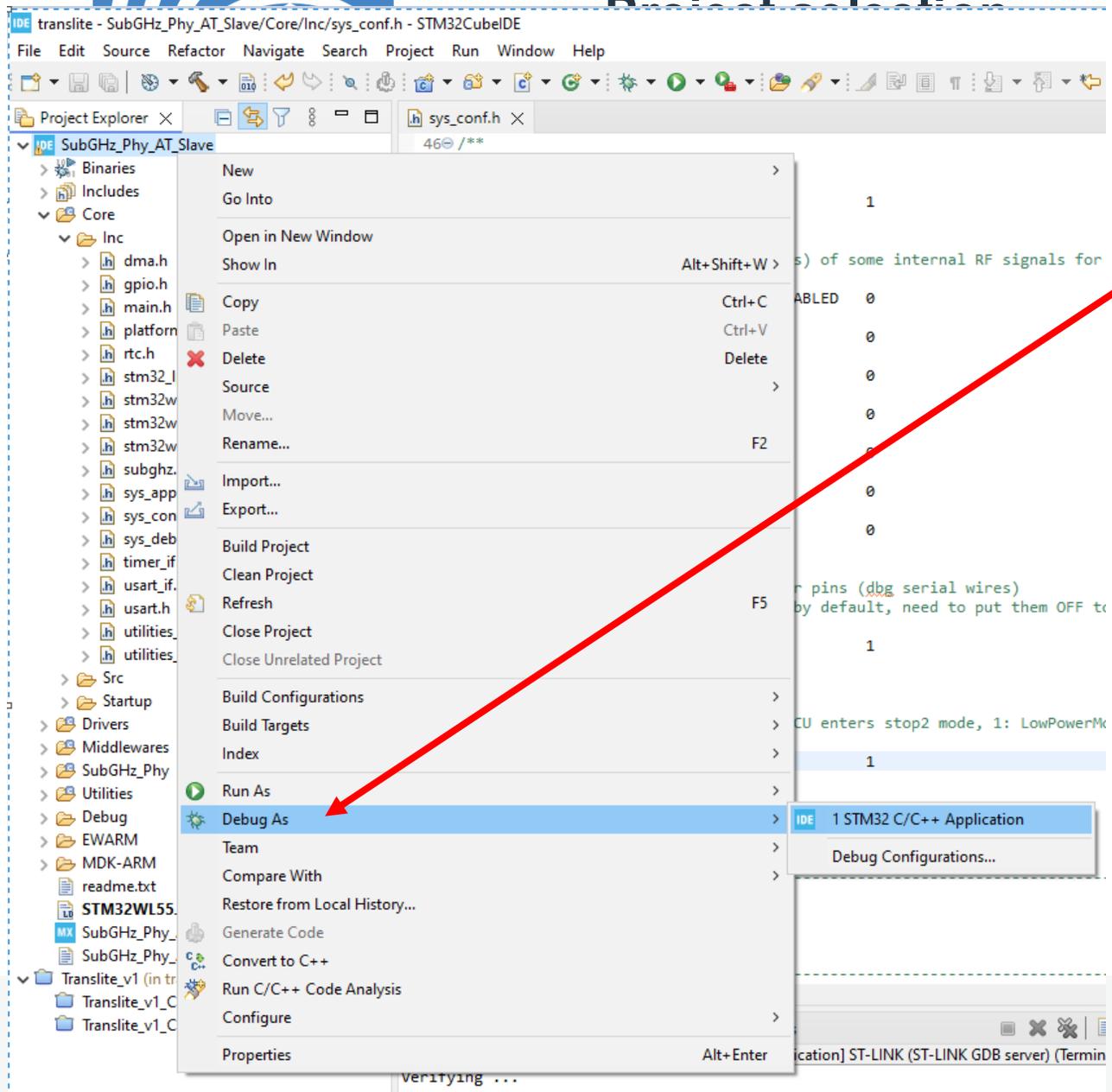
### Orama group



Right click on the project folder, select Settings and in MCU/MPU GCC Compiler select (-Ofast)

Right click on the project, select debug as STM32 c/c++ application.

! The serial console shall be configured as 115200, 81N). Data for LoRa WAN comissioning will appear



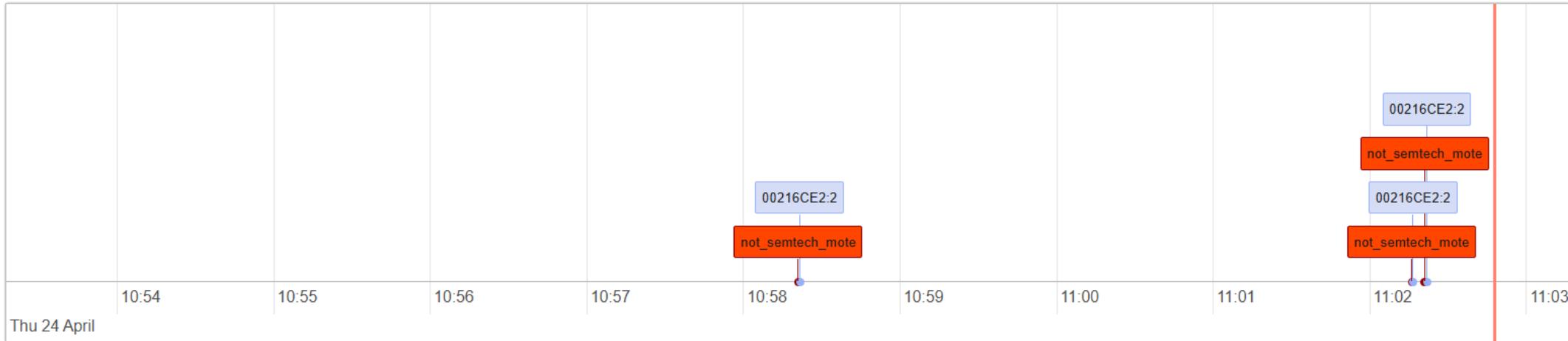




localhost:8080/admin#/dashboard

- Infrastructure
- Areas
- Gateways
- Networks
- Multicast Channels
- Devices
- Groups
- Profiles
- Commissioned
- Activated (Nodes)
- Ignored
- Backends
- Frames

## Dashboard



Servers				
Name	Version	Memory	Disk	Status
lorawan@NB004-24	0.6.7	6 GB (38%)		⚠

Gateways				
MAC	IP Address	Dwell [%]	Last Alive	Status
0080E1FFFFF015F17	10.65.8.234	0.000	2025-02-12 16:34:54	❌
080027FFFFF0D2338	10.65.8.200	0.038	2025-04-24 09:52:58	✅

Events				
Last Occurred	Entity	Eid	Text	Args
2025-04-24 09:51:35	device	0080E115000ACBC2	join	<<"00216CE2">>

Nodes					
DevAddr	Profile	Battery	D/L SNR	Last RX	Status
00216CE2	TestProfile				
00F1EE6B	TestProfile			2025-02-12 16:33:01	

---

# Q&A





**THANK YOU!**

**Orama** group

