

Getting Started in LoRaWAN Hands On

Class 3: The Design Of A LoRaWAN Node, Hands-on

November 29, 2017

Charles J. Lord, PE
President, Consultant, Trainer
Blue Ridge Advanced Design and Automation

This Week's Agenda

11/27 An Overview of Low-Power IoT Technologies

11/28 Introduction to LoRa and LoRaWAN

11/29 The design of a LoRaWAN node, hands-on

11/30 No Service? No Problem!

Building your own LoRaWAN server

12/1 Testing Our LoRaWAN design

This Week's Agenda

11/27 An Overview of Low-Power IoT Technologies

11/28 Introduction to LoRa and LoRaWAN

11/29 **The design of a LoRaWAN node, hands-on**

11/30 No Service? No Problem!

Building your own LoRaWAN server

12/1 Testing Our LoRaWAN design

First, let's get some Things for our IoT

- If you already have a gateway locally or through a carrier, you are ready for this step
- If you are building your own gateway (recommended anyway for development), this usually comes after (or parallel) with tomorrow's gateway build
- Let's look at some boards from STMicro

Question 1 - Will you be building end nodes?

STM B-L072Z-LRWAN1



- Uses Murata Open LoRa module
- STM32L072 Cortex M0+
- mbed
- ST-Link
- Arduino pins
- Comes loaded with ping/pong board to board

P-NUCLEO-LRWAN1 Pack



- Nucleo L073 board mated to SEMTECH SX1272 shield
- L073 is Cortex M0+
- SEMTECH shield includes an assortment of grove connectors for sensors / actuators

If you already have an mbed



Presented by:

Optional but handy

STM32CubeMX ACTIVE Save to MyST Share Print

STM32Cube initialization code generator

[Download Databrief](#)

[QUICK VIEW](#) [RESOURCES](#) [TOOLS AND SOFTWARE](#) [GET SOFTWARE](#) [Support & Community](#)

STM32CubeMX is part of STMicroelectronics STMCube™ original initiative to make developers' lives easier by reducing development effort, time and cost. STM32Cube covers the whole STM32 portfolio.

STM32Cube includes STM32CubeMX, a graphical software configuration tool that allows the generation of C initialization code using graphical wizards.

It also embeds comprehensive STM32Cube MCU Packages, delivered per STM32 microcontroller Series (such as STM32CubeF4 for STM32F4 Series). These packages include the STM32Cube HAL (an STM32 abstraction layer embedded software ensuring maximized portability across the STM32 portfolio), the STM32Cube LL (low-layer APIs, a fast, light-weight, expert-oriented layer), plus a consistent set of middleware components such as RTOS, USB, TCP/IP and graphics. All the embedded software utilities are delivered with a full set of examples.

STM32CubeMX is a graphical tool that allows a very easy configuration of STM32 microcontrollers and the generation of the corresponding initialization C code through a step-by-step process.

Step one consists in selecting the STMicroelectronics STM32 microcontroller that matches the required set of peripherals.

The next step is to configure each peripheral, such as I2C, SPI, UART, ADC, DAC, EXTI, TIM, etc. This is done through a graphical wizard that allows the user to select the required peripheral and its configuration parameters. The user can also select the required peripheral and its configuration parameters through a graphical wizard.

FEATURED VIDEOS [See All](#)





STM32Cube Making development easier

STM32CubeMX in 5 points

- 1. STM32CubeMX software installation
- 2. MCU selection
- 3. Configuration
- 4. Selection of peripherals
- 5. Setup peripherals
- 6. Software
- 7. C code generation
- 8. Final user code with STM32 communication example

Presented by:

Installing CubeMX

Name	Date modified	Type	Size
 SetupSTM32CubeMX-4.23.0.app	11/28/2017 11:48 ...	File folder	
 Readme.html	11/28/2017 11:48 ...	Firefox HTML Doc...	5 KB
 SetupSTM32CubeMX-4.23.0.exe	11/28/2017 11:48 ...	Application	379,164 KB
 SetupSTM32CubeMX-4.23.0.linux	11/28/2017 11:48 ...	LINUX File	12 KB

Installing and running STM32CubeMX 4.23.0

Supported operating systems and architectures

- Windows® 7: 32-bit (x86), 64-bit (x64)
- Windows® 8: 32-bit (x86), 64-bit (x64)
- Windows® 10: 32-bit (x86), 64-bit (x64)
- Linux®: 32-bit (x86) and 64-bit (x64) (tested on RedHat, Ubuntu and Fedora)
Since STM32CubeMX is a 32-bit application, some versions of Linux 64-bit distributions require to install 32-bit compliant packages such as ia32-libs.
- MacOS: 64-bit (x64) (tested on OS X Yosemite)

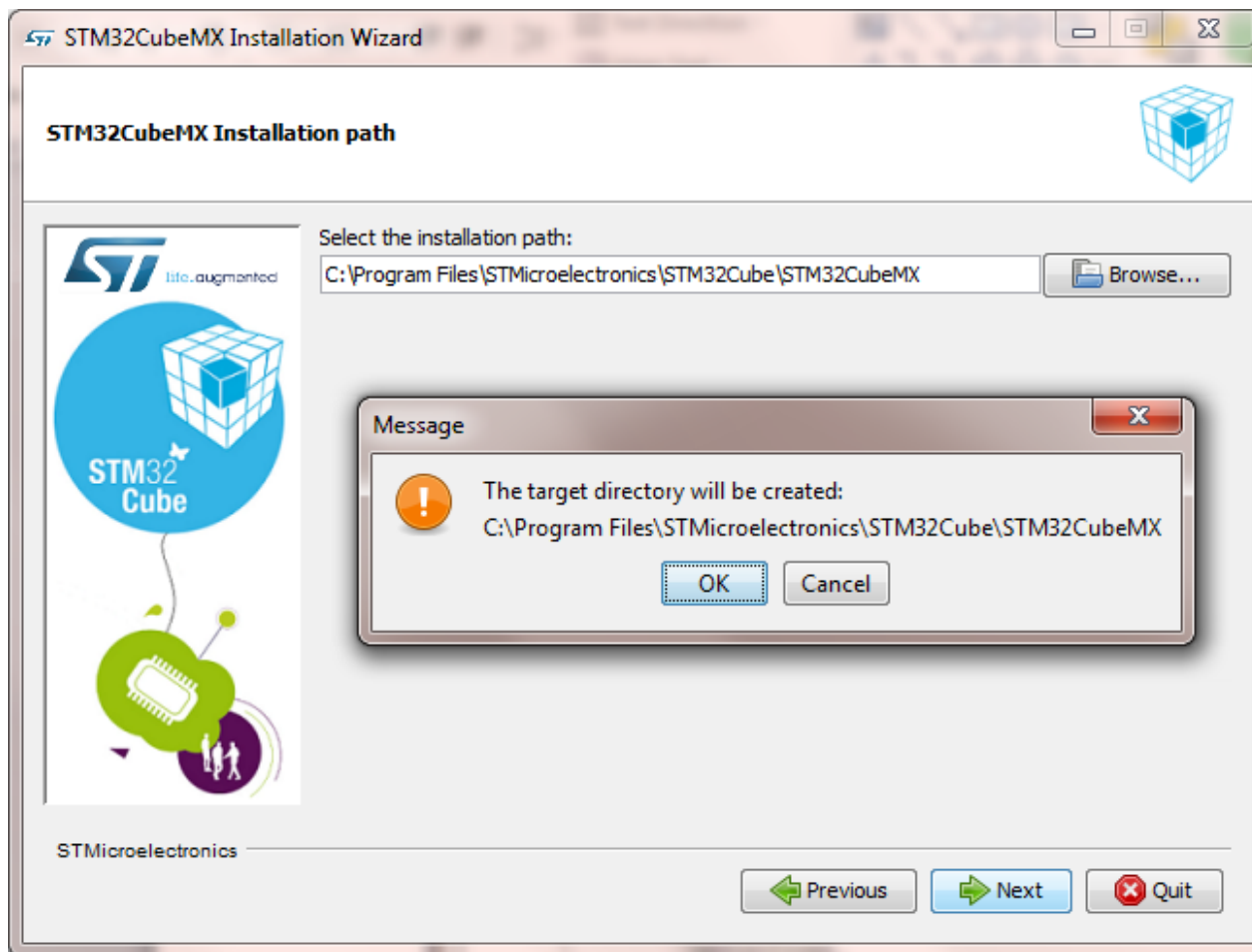
Software requirements

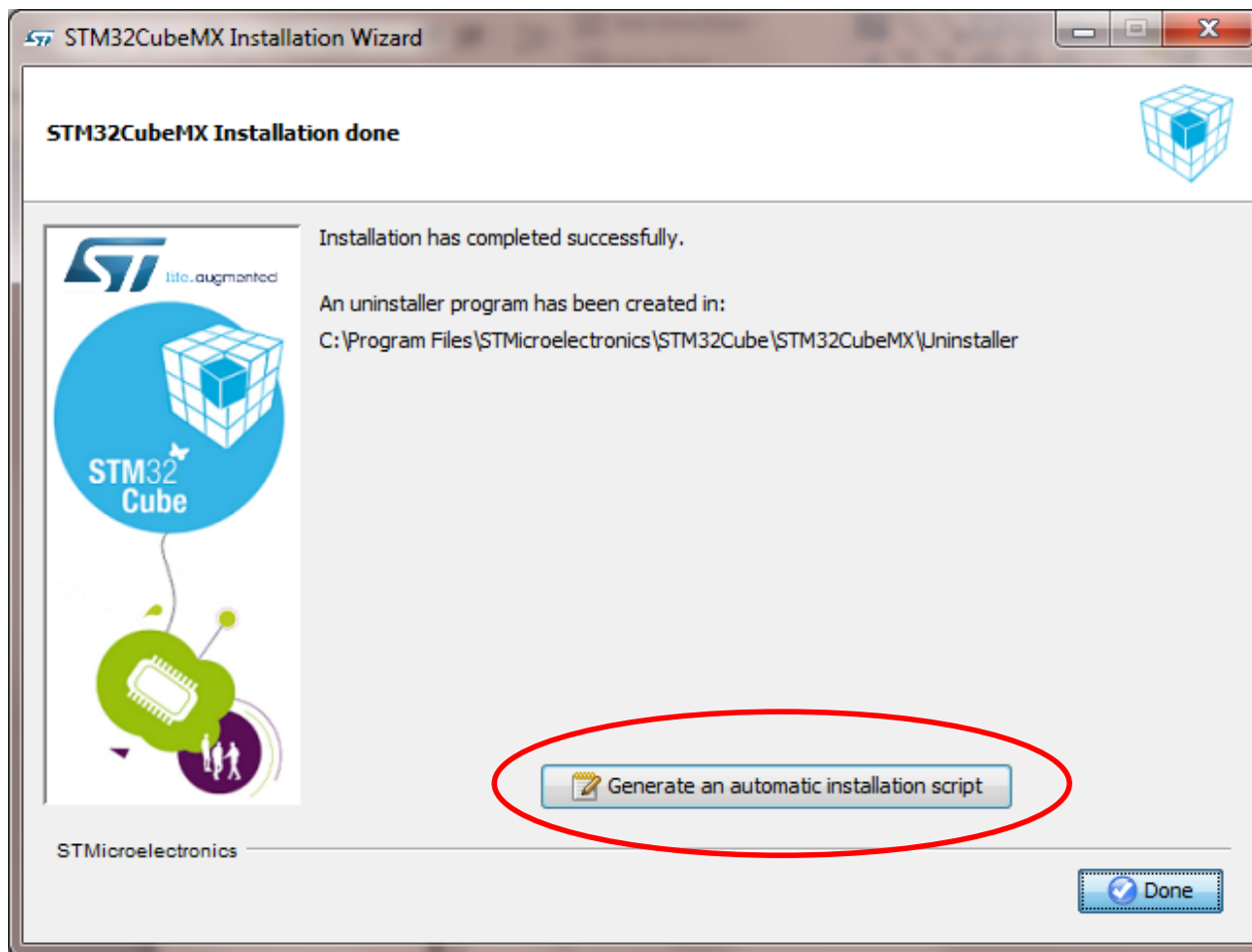
On Windows and Linux: Java Run Time Environment (minimum version 1.7.0_45)
On MacOS: Java Development Kit (minimum version 1.7.0_45)

Installing STM32CubeMX

To install STM32CubeMX, follow the steps below:

- Extract (unzip) the whole content of the the latest STM32CubeMX installation package from <http://www.st.com/stm32cubemx> into the same directory
- on Windows
 - Make sure you have administrators rights
 - Double click on the SetupSTM32CubeMX-4.23.0.exe file
- On Linux
 - Make sure you have access rights to the target installation directory, you can run the installation as root (or sudo) to install STM32CubeMX on shared directories
 - Double click (or launch from the console window) on the SetupSTM32CubeMX-4.23.0.linux file
- On MacOS
 - Make sure you have access rights to the target installation directory, you can run the installation as root (or sudo) to install STM32CubeMX on shared directories
 - Double click (or launch from the console window) on the SetupSTM32CubeMX-4.23.0 application
- After the installation you can safely remove the content of the zip from your disk.
- Please refer to the STM32CubeMX user manual for more details on System requirements or other possible installations.





st.com, search for LoRa

History / Bookmark

- All site
- Products
- Solutions
- Applications
- Resources (35)
- Tools & Software (5)
- X-Reference
- Videos (4)

LoRaWAN Technology Recommended Link

Tools & Software (5): lora

Show / hide columns

Part Number	Type	Category	Description
B-L072Z-LRWAN1	Evaluation Tools	Product Evaluation Tools	STM32L0 Discovery kit LoRa, low-power wireless
I-CUBE-LRWAN	Embedded Software	MCUs Embedded Software	LoRaWAN software expansion for STM32Cube (UM2073)
I-NUCLEO-LRWAN1	Evaluation Tools	Product Evaluation Tools	USI® STM32™ Nucleo expansion board for LoRa™
I-NUCLEO-SX1272D	Evaluation Tools	Product Evaluation Tools	High-performance RF transceiver expansion board featuring FSK, OOK and the LoRa long range modem for STM32 Nucleo-64
P-NUCLEO-LRWAN1	Evaluation Tools	Product Evaluation Tools	Low-power wireless Nucleo pack with Nucleo-L073RZ and LoRa expansion board

Search results (59): lora

LoRaWAN Technology

http://www.st.com/content/st_com/en/.../lorawan-technology.html

encryption of data Geolocation: enables indoor/outdoor tracking without GPS **LoRaWAN™** is a global LPWAN specification created by the **LoRa Alliance™** to drive a single standard for seamless interoperability across the

STM32Cube for LoRaWAN



Menu



Product Catalog



English



Login

Home > Embedded Software > MCUs Embedded Software > STM32 Embedded Software > STM32Cube Expansion Packages > I-CUBE-LRWAN

I-CUBE-LRWAN ACTIVE

Save to MyST

Share

Print

LoRaWAN software expansion for STM32Cube (UM2073)

Download Databrief

QUICK VIEW

RESOURCES

TOOLS AND SOFTWARE

GET SOFTWARE

Support & Community



LoRa[®] is a long range wireless area network allowing low-power sensors to report over ranges of up to a dozen kilometers.

The I-CUBE-LRWAN software expansion package consists of a set of libraries and application examples for STM32L0, STM32L1 and STM32L4 Series microcontrollers acting as end-devices.

This package supports the SX1276MB1MAS, SX1276MB1LAS and SX1272MB2DAS LoRa[®] radio expansion boards provided by SEMTECH.

This package includes an application running on NUCLEO-L053R8, NUCLEO-L152RE, NUCLEO-L476RG and B-L072Z-LRWAN1 Discovery kits embedding the CMWX1ZZABZ-091 LoRa[®] module from Murata. It also supports a US1[®] LoRaWAN[™] technology module through the I-NUCLEO-LRWAN1 expansion board. The application reads sensor data from the X-NUCLEO-IKS01A1 expansion board and sends the sensor data to the LoRa[®] network in class A. For further details about the components of the LoRa middleware library, refer to the "STM32 LoRa[®] software expansion for STM32Cube" User manual (UM2073).

FEATURED VIDEOS

[See All](#)



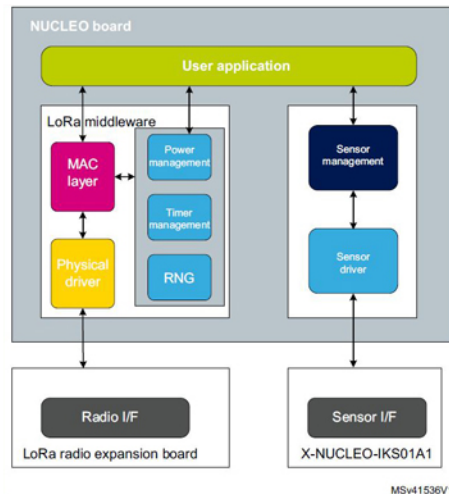
Presented by:

Features and Structure

Key Features




- Compliant with the LoRa Alliance™ specification protocol, named LoRaWAN™ version V1.0.2 July 2016
- Bidirectional end-devices with class A and class C protocol support
- EU 868 MHz ISM band ETSI (European telecommunications standards institute) compliant
- EU 433 MHz ISM band ETSI compliant
- US 915 MHz ISM band FCC (federal communications commission) compliant
- End-device activation either through OTAA (over-the-air activation) or ABP (activation-by-personalization)
- Adaptive data rate support
- LoRaWAN™ test application for certification tests included
- Low-power optimized
- Full STM32 portfolio compatibility
- Compliant with the CMWX1ZZABZ-091 LoRa® module from Murata
- Compliant with the WM-SG-SM-42 LoRa® module from USI

IMAGE




Question 2 - Why might we need CubeMX here?

You will need these

User Manuals			
	Description	Version	Size
	UM2312: Development checklist for STM32Cube Expansion Packages	1.0	283 KB
	UM2285: Development guidelines for STM32Cube Expansion Packages	1.0	485 KB
	UM2073: STM32 LoRa® software expansion for STM32Cube	5.0	849 KB

Go to Board Webpage



life.augmented

Menu


Search

Product

Home > Evaluation Tools > Product Evaluation Tools > MCU Eval Tools > STM32 MCU Eval Tools > STM32 MCU Discovery Kits > **B-L072Z-LRWAN1**

B-L072Z-LRWAN1 ACTIVE

STM32L0 Discovery kit LoRa, low-power wireless

 Download Databrief

QUICK VIEW	RESOURCES	TOOLS AND SOFTWARE	SAMPLE & BUY	QUALITY & RELIABILITY
------------	-----------	--------------------	--------------	-----------------------

The B-L072Z-LRWAN1 LoRa[®]Discovery kit is a development tool to learn and develop solutions based on LoRa[®]and FSK/OOK technologies. This Discovery kit features an all-in-one open module CMWX1ZZABZ-091 (by Murata). The module is powered by an STM32L072CZ and an SX1276 transceiver. The transceiver features the LoRa[®]long-range modem, providing ultra-long-range spread spectrum communication and high interference immunity, minimizing current consumption. Since CMWX1ZZABZ-091 is an open module, user has access to all STM32L072 peripherals such as ADC, 16-bit timer, LP-UART, I²C, SPI and USB 2.0 FS (supporting BCD and LPM).

The B-L072Z-LRWAN1 Discovery kit includes an ST-LINK/V2-1 embedded debug tool interface, LEDs, push-buttons, antenna, Arduino[™] Uno V3 connectors and USB OTG connector in Micro-B format.

The LoRaWAN[™] stack is certified class A and C compliant. It is available in i-CUBE-LRWAN firmware package. Several examples, as an AT-command stack, are available to help users setting up a complete LoRaWAN[™] node.

Download drivers!

TOOLS AND SOFTWARE

Development Tools

SOFTWARE DEVELOPMENT TOOLS

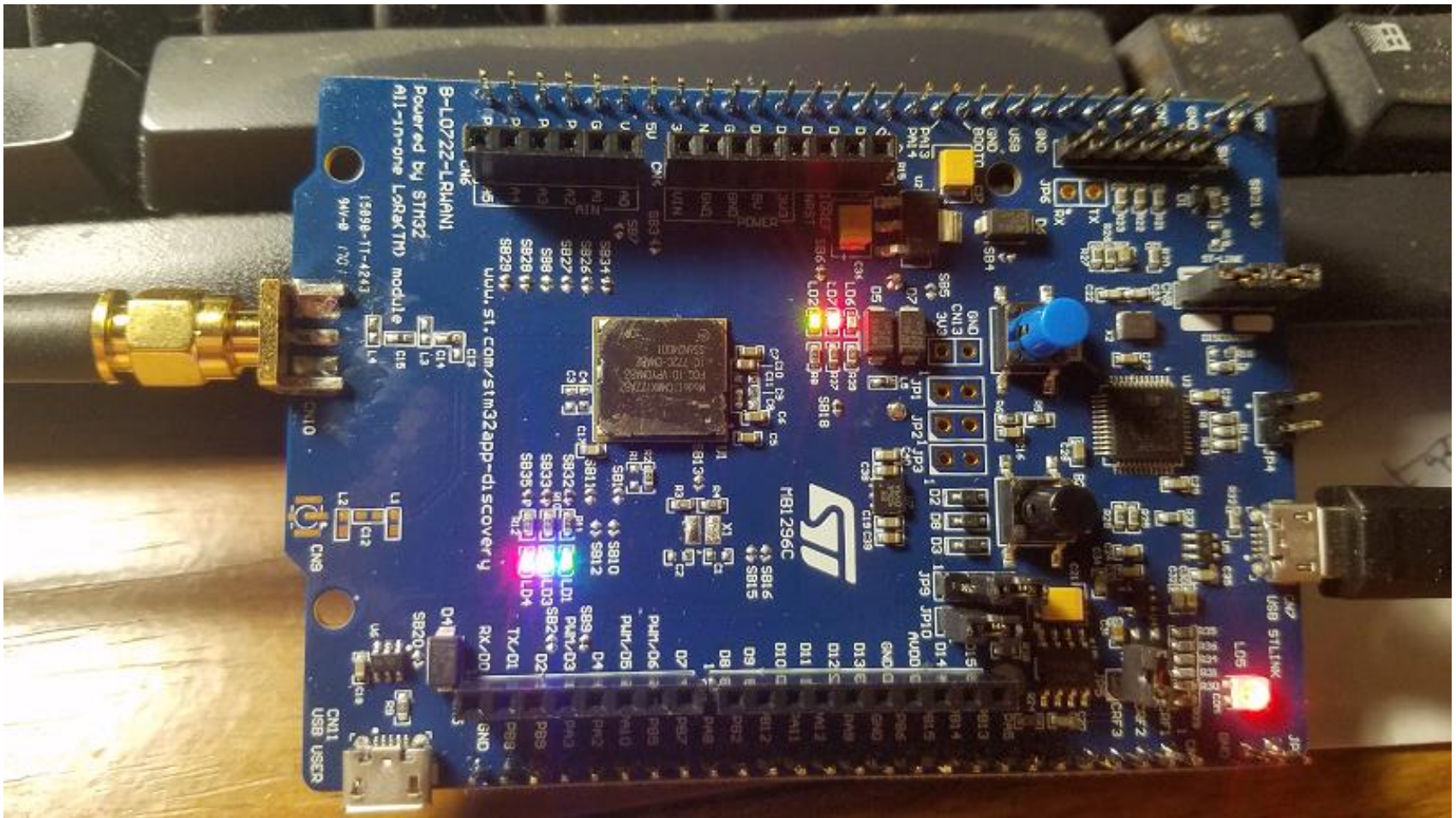
Part Number	Manufacturer	Description	Action
ST-LINK-SERVER	ST	ST-LINK server software module	Get Software
STSW-LINK007	ST	ST-LINK, ST-LINK/V2, ST-LINK/V2-1 firmware upgrade	Get Software
STSW-LINK009	ST	ST-LINK, ST-LINK/V2, ST-LINK/V2-1 USB driver, signed for Windows7, Windows8, Windows10	Get Software

Embedded Software

MCUS EMBEDDED SOFTWARE

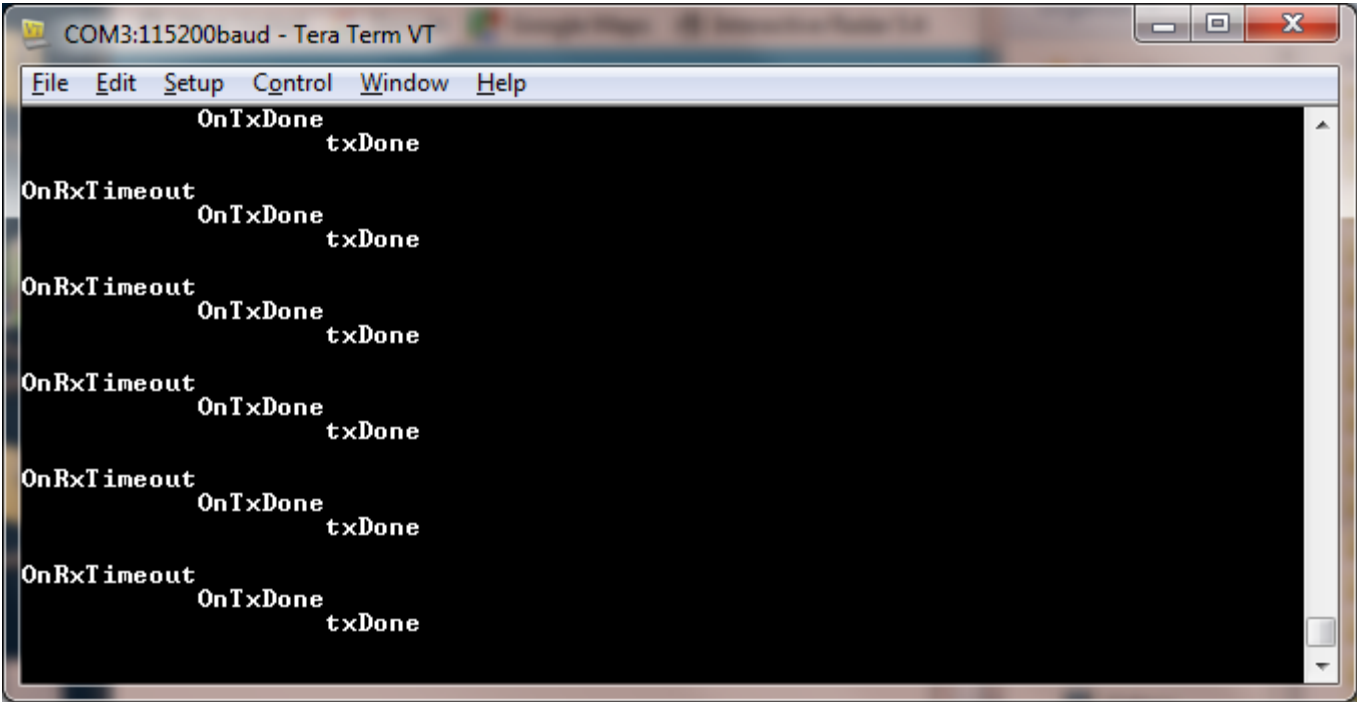
Part Number	Manufacturer	Description	Action
I-CUBE-LRWAN	ST	LoRaWAN software expansion for STM32Cube (UM2073)	Get Software

Install drivers, plug in a board

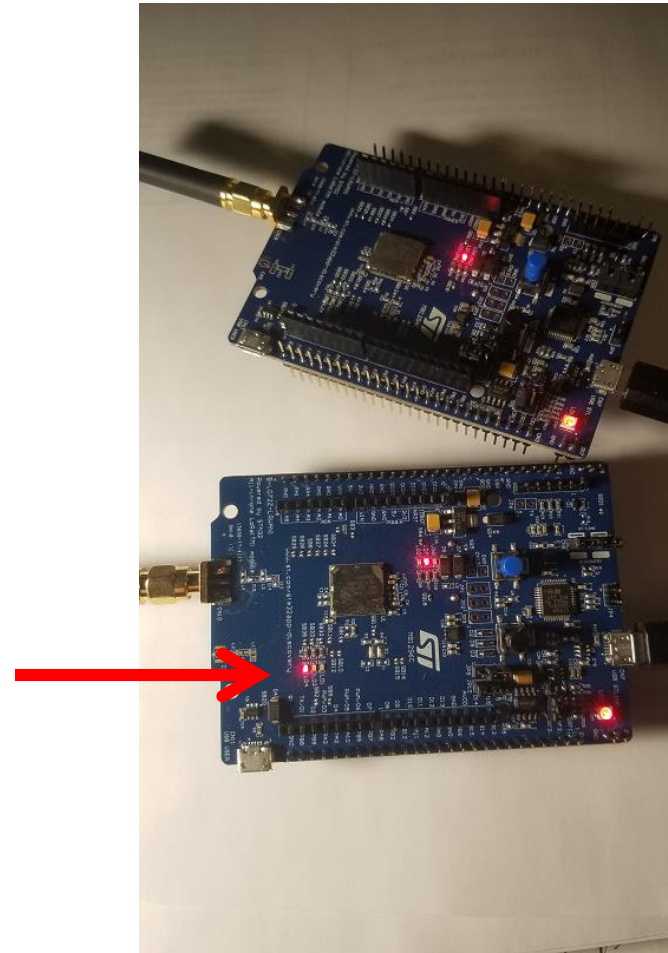
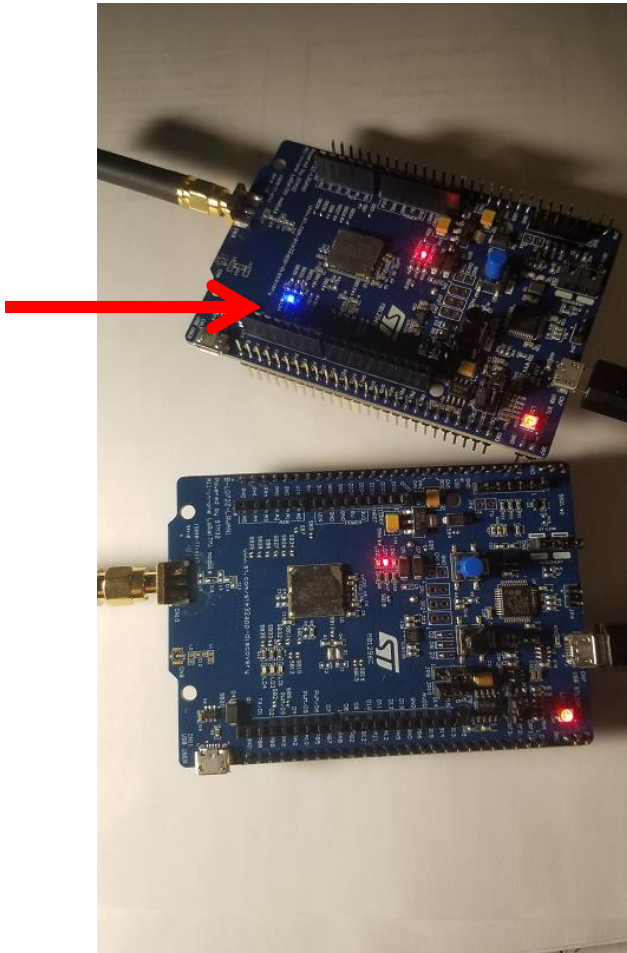


Presented by:

Open Tera Term (or puTTY, etc)



Power Up a Second Board



We Have Ping-Pong

```
COM3:115200baud - Tera Term VT
File Edit Setup Control Window Help
OnRxTimeout
  OnTxDone
    txDone
OnRxTimeout
  OnTxDone
    txDone
OnRxDone
  RssiValue=-14 dBm, SnrValue=25
    rxDone
...PING
  OnTxDone
    txDone
OnRxDone
  RssiValue=-14 dBm, SnrValue=25
    rxDone
...PING
  OnTxDone
    txDone
```

Program is Explained in Cube Manual

5.5 PingPong application description

This application is a simple Rx/Tx RF link between two LoRa end-devices. By default, each LoRa end-device starts as a master and transmits a "Ping" message and wait for an answer. The first LoRa end-device receiving a "Ping" message becomes a slave and answers the master with a "Pong" message. The PingPong is then started.

In order to launch the PingPong project, the user must go to the "%Projects\Multi\Applications\LoRa\PingPong" folder and follow the same procedure as for the LoRa End_Node project to launch the preferred toolchain.

Hardware and software set-up environment

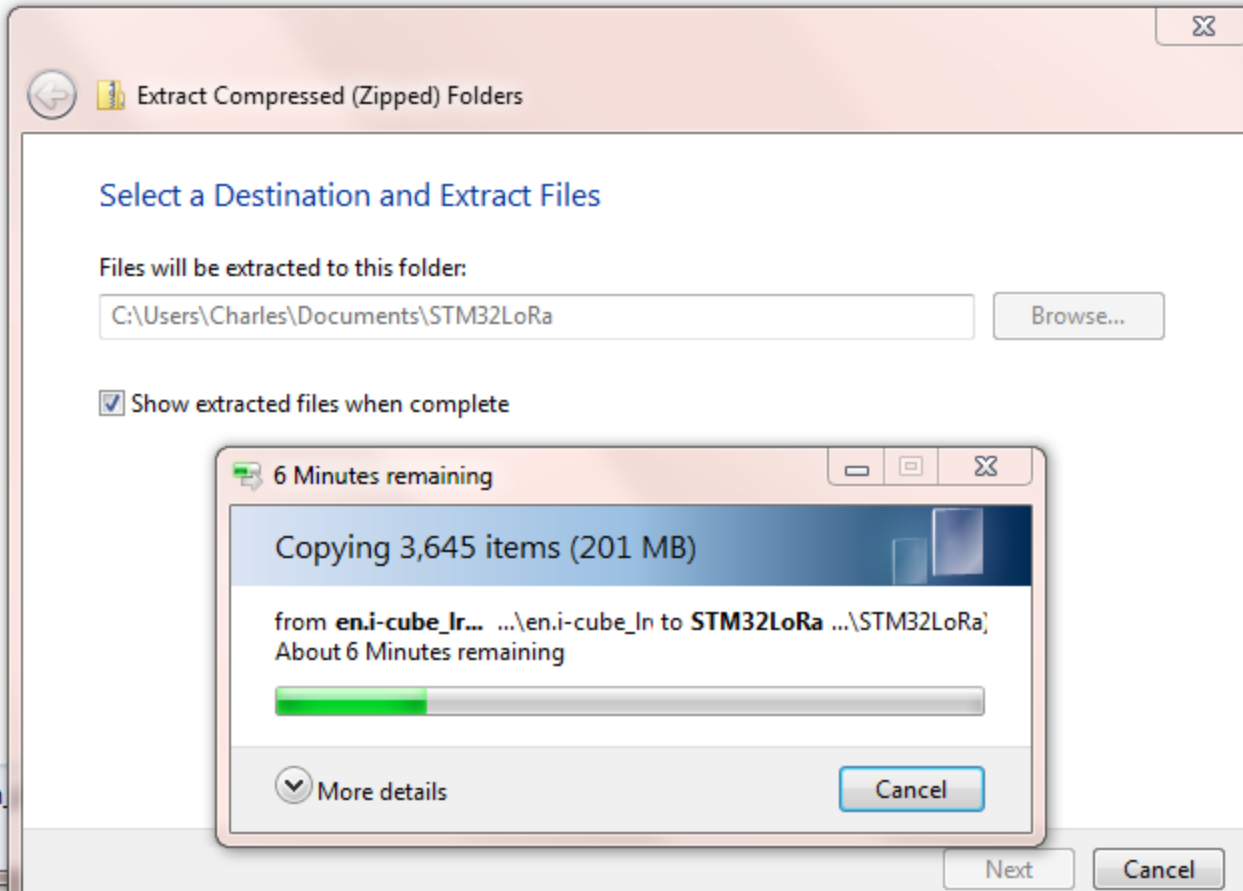
To setup the STM32Lxxx-NUCLEO, connect the NUCLEO (or the B-L072Z-LRWAN1) board to the computer with a USB cable type A to mini B to the ST-LINK connector (CN1). Ensure that the CN2 ST-LINK connector jumpers are fitted. See [Figure 16](#) for a representation of the PingPong setup.

But We Want a LoRaWAN End Node

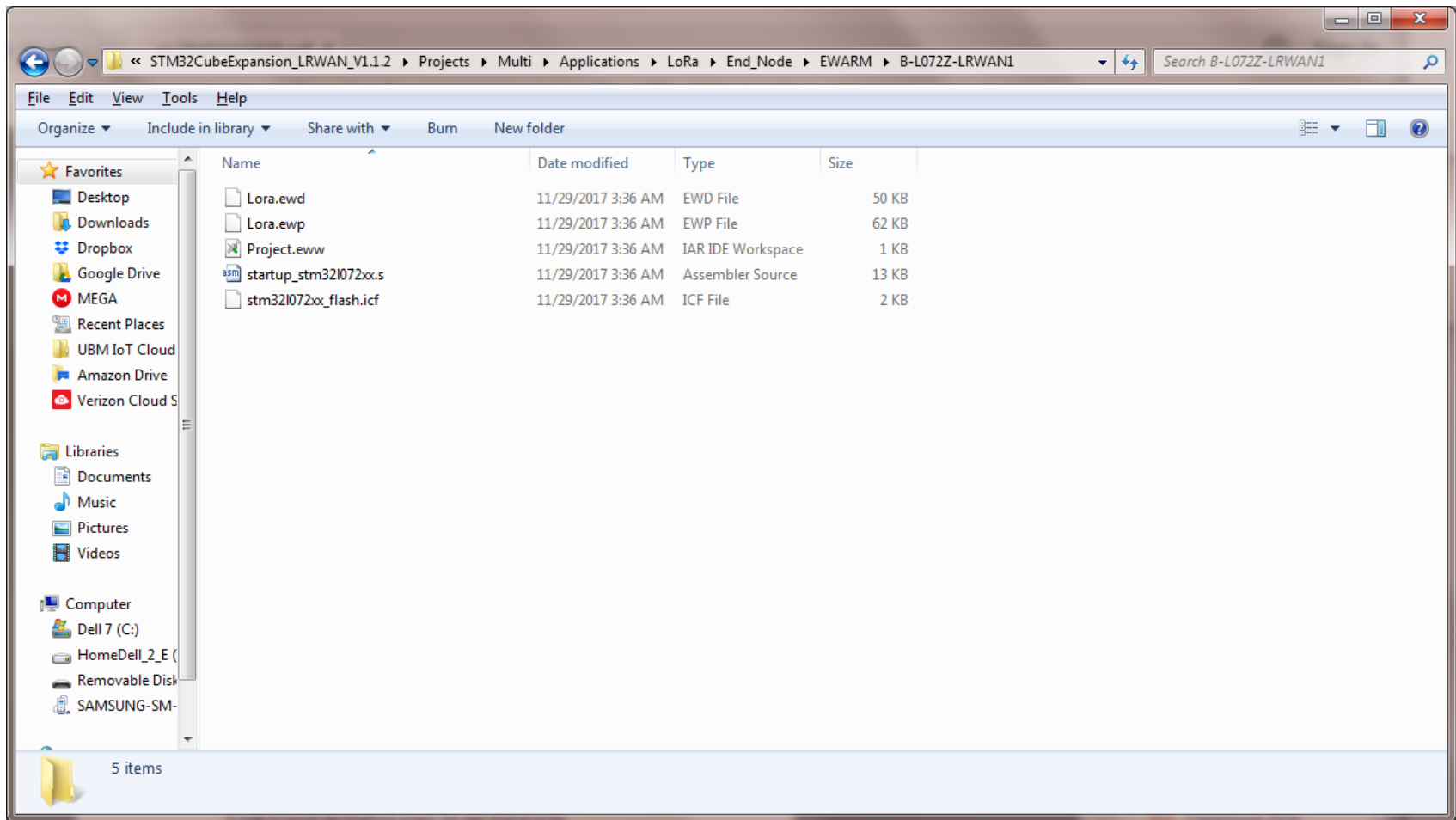
- We will now unzip and 'install' the I-CUBE-LRWAN.
- The end node is an example in the projects area. We will need to set it up in our favorite IDE (supports IAR, Keil, gcc)
- We will need the user manual

Unzip Cube in a handy location

Name	Type	Compressed size	Password ...	Size	Ratio	Date modified
STM32CubeExpansion_LRWAN_V1....	File folder					9/11/2017 3:59 PM



Note the Path (using IAR here)



Presented by:

Requires Current EWARM



Download a free trial

Complete, powerful compiler and debugger tools in a user-friendly IDE—try for yourself!



Download Software

(Version 8.20,
1290.03 MB)

The evaluation license is completely free of charge and allows you to try the integrated development environment and evaluate its efficiency and ease of use. When you start the product for the first time, you will be asked to register to get your evaluation license.

After installation, you have the following evaluation options to choose from:

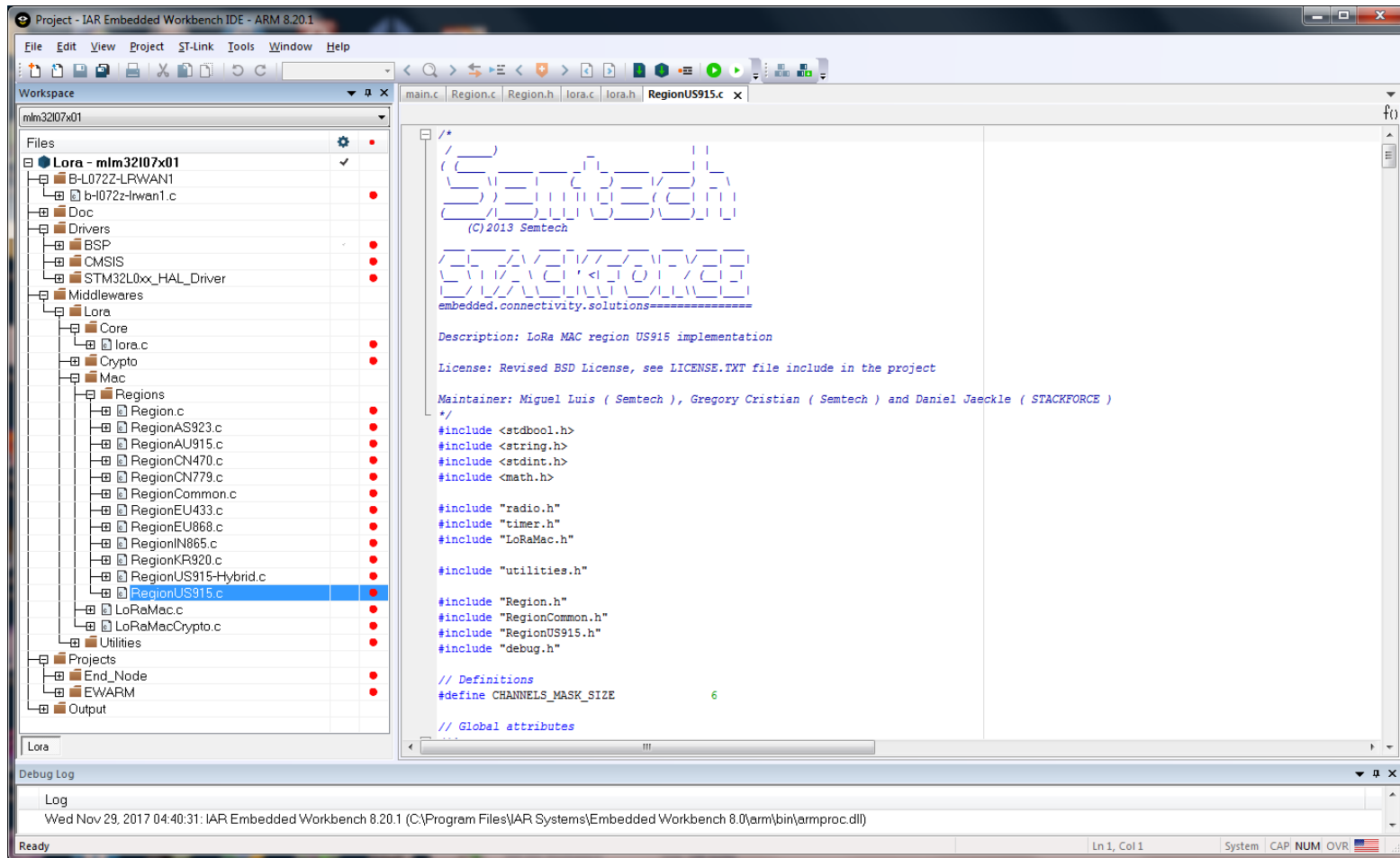
- a 30-day time-limited but fully functional license
- a size-limited Kickstart license without any time limit

Restrictions to the 30-day time-limited evaluation

- A 30-day time limitation.
- Source code for runtime libraries is not included.
- No support for MISRA C.
- C-RUN is size-limited to 12 Kbytes of code, excluding constant data.
- Limited technical support.
- Must not be used for product development or any other kind of commercial use.

Presented by:

Now Loaded in EWARM



Presented by:

We will need to set some defines

Table 27. Switch options for the application's configuration

Project	Switch option	Definition	Location
LoRa stack	OVER_THE_AIR_ACTIVATION	Application uses over-the-air activation procedure	Commissioning
	STATIC_DEVICE_EUI	Static or dynamic end-device identification	Commissioning
	STATIC_DEVICE_ADDRESS	Static or dynamic end-device address	Commissioning
	REGION_EU868	Enable the EU band selection	Compiler option setting
	REGION_EU433		
	REGION_US915		
	REGION_AS923		
	REGION_AU915		
	REGION_CN470		
	REGION_CN779		
REGION_IN865			
REGION_KR920			
Sensor	DEBUG	Enable "Led on/off"	hw_conf.h
	TRACE	Enable "printf".	hw_conf.h
	SENSOR_ENABLED	Enable the call to the sensor board	hw_conf.h

Question 3 - What are some good reasons for turning off the DEBUG and TRACE defines?

This Week's Agenda

11/27 An Overview of Low-Power IoT Technologies

11/28 Introduction to LoRa and LoRaWAN

11/29 The design of a LoRaWAN node, hands-on

11/30 No Service? No Problem!

Building your own LoRaWAN server

12/1 Testing Our LoRaWAN design

Please stick around as I answer your questions!

- Please give me a moment to scroll back through the chat window to find your questions
- I will stay on chat as long as it takes to answer!
- I am available to answer simple questions or to consult (or offer in-house training for your company)

c.j.lord@ieee.org

<http://www.blueridgetechnc.com>

<http://www.linkedin.com/in/charleslord>

Twitter: @charleslord

<https://www.github.com/bradatrainng>