Catena 4617 User Manual

Engineering Report 234001226
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Document Release History

Rev A	2019-07-04	Initial Release
Rev B	2020-02-18	Updated the Pinout

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1   Introduction

The MCCI Catena® 4617 is a complete single-board IoT device for LoRaWAN™ technology projects.

Based on the Murata CMWX1ZZABZ-078, and designed to be compatible with the Adafruit Feather family of development boards and accessories, the Catena 4617 is a great platform for LoRaWAN investigation and deployment. It works well with The Things Network, or any LoRaWAN 1.0 or 1.1 network in the 865 to 923 MHz range.

Lightweight and small (roughly 2" by 0.9"), the 4617 needs no external components to measure and send temperature, pressure, humidity, and Lux, powered from USB or two AAA cells.

Because of the embedded FRAM, the Catena 4617 fully meets the requirements of LoRaWAN 1.1, without worrying about EEPROM wear out or wear-leveling, both for ABP and OTAA.

Figure 1 Catena 4617
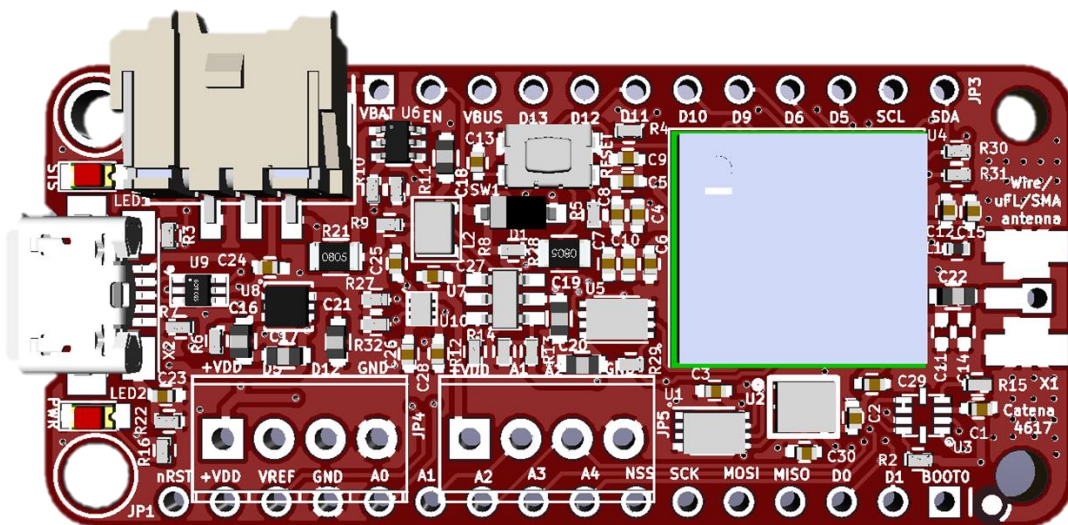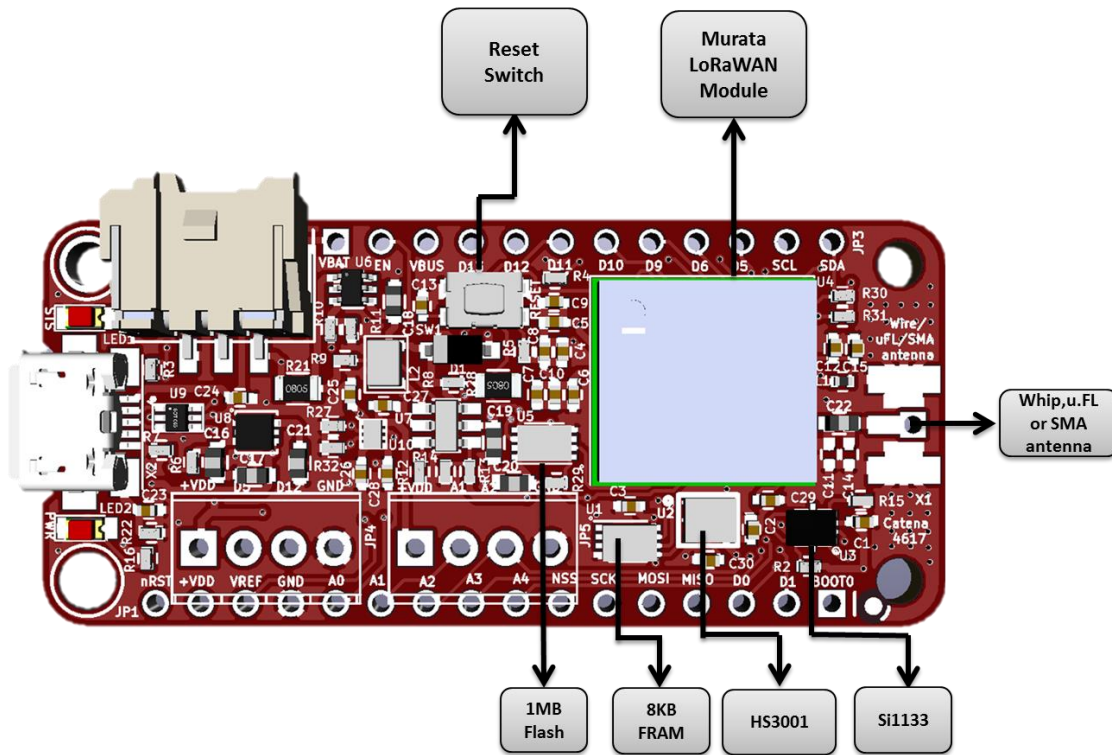

2   Specifications and Features

The specifications and features of Catena 4617 are given below:

Murata LoRaWAN module

- Semtech SX1276 LoRa radio
- STM32L082 CPU (Cortex M0+, 32 MHz, 192K flash, 20K RAM)

- High quality RF engineering
- Certified for US and EU
- Compatible with IN866, AS923, AU921 bands

Figure 2 Catena 4617 Description

Integrated sensors

- Temperature
- Humidity
- Lux

2.1 Additional Features

- Powered from primary (disposable) batteries (such as 2x AAA cells)
- 30uA current draw in standby
- 8K bytes FRAM for LoRaWAN provisioning info and frame counters -- power can be removed completely without requiring a new join to the network, and without losing uplink and downlink count values (required for LoRaWAN 1.1)
- 1M byte SPI Flash for bulk data storage, future FUOTA firmware storage, etc.
- Software-controlled boost converter allows dynamically raising voltage to 3.3V for analog measurement and powering internal sensors
- USB or SWD for download and debug

- Pin-compatible with Adafruit Feather M0 family of boards (some limitations because the of functional differences between the Murata module and the Atmel SAMD21 CPU used in the Feather M0)
- Arduino-compatible
- Provisions for screw terminals for pulse, analog or digital I/O
- Whip, u.FL, or SMA antenna
- Open source hardware and software (https://github.com/mcci-catena)
- MCCI provides a full Arduino board-support package, available here.
- MCCI also provides libraries to allow rapid prototyping and experimenting, including an open-source LoRaWAN stack that supports the EU868, US915, AS923, AU921 and IN866 regional plans.
- ST Micro tools may also be used.
- The Catena 4617 works well with and is tested with The Things Network (an open-source, user-owned IoT network based on LoRaWAN); but can be used with any LoRaWAN-compatible network.

3   Catena 4617 Pinouts

Catena 4617 Pinout is given below:
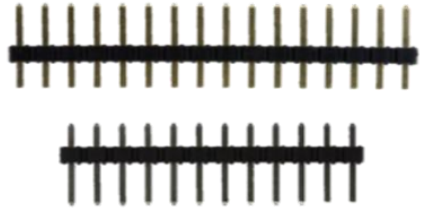

Figure 3 Catena 4617 pinouts
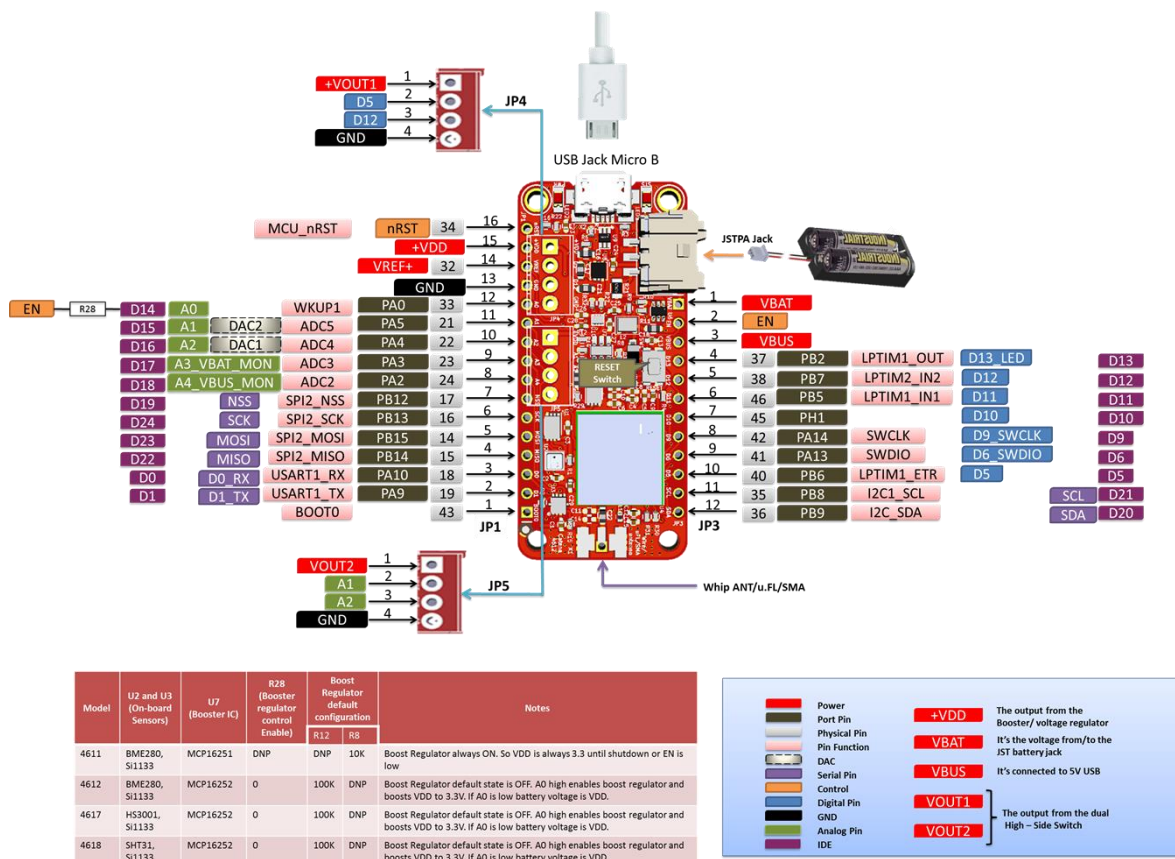
4   Requirements

4.1   Hardware Requirements

4.1.1   PinHeaders

12-pin & 16-pin male headers (123001009 & 12301011) have a pitch of 0.1" (2.54mm).

Figure 4 12-pin & 16-pin Male Headers

4.1.2   1x04 Screw Terminals

The 1x4 screw terminal blocks (123001012) has a pitch of 0.1" (2.54mm), and can be used as an alternative to standard male or female headers of 0.1". They help in connecting external sensors to the 4612.

Figure 5 1x04 Screw Terminals

4.1.3   Antenna

Whip Antenna, u.FL and SMA Antennas can be used. The antenna specifications are shown in
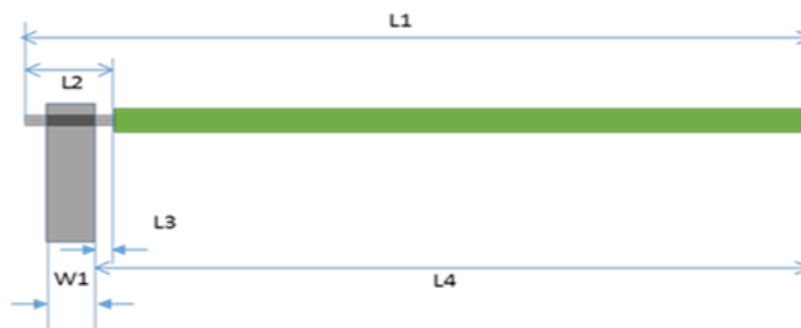
Table 1

Figure 6 Whip Antenna

Table 1 Antenna Specification

Parameters	Reference	US Version	EU Version	IN Version	AU Version	AS Version
Wire Color		Yellow	Green	Blue	Yellow	Yellow
Reference Number		123001007	123001069	123001070	123001007	123001007
Wire length	L1	88.6	84.2	88.9	82	82
Tolerance	-	+/- 0.3 mm	+/- 0.3 mm	+/- 0.3 mm	+/- 0.3 mm	+/- 0.3 mm
Board thickness	W1	1.5748	1.5748	1.5748	1.5748	1.5748
Tin length	L2	3 mm	3 mm	3 mm	3 mm	3 mm
Tin tolerance	-	+/- 0.03 mm	+/- 0.03 mm	+/- 0.03 mm	+/- 0.03 mm	+/- 0.03 mm
Slop from soldering	L3	1.5 mm	1.5 mm	1.5 mm	1.5 mm	1.5 mm
Minimum length	-	80.9	80.9	85.6	80.9	80.9
Maximum length	-	82.9	82.9	86.6	82.9	82.9
Typical length	L4	81.9	81.9	87.6	81.9	81.9
Minimum f	-	903.83 MHz	903.83 MHz	855.33 MHz	915 MHz	920 MHz
Maximum f	-	928.80 MHz	928.80 MHz	875.87 MHz	928 MHz	925 MHz
Typical f	-	915 MHz	915 MHz	866 MHz	921 MHz	923 MHz

4.2 Programming Requirements

4.2.1 ST-LINK/V2 in-circuit debugger/programmer

The ST-LINK/V2 (123001120) is an in-circuit debugger and programmer for the STM8 and STM32 microcontroller families. The single wire interface module (SWIM) and JTAG/serial wire debugging (SWD) interfaces are used to communicate with any STM8 or STM32 microcontroller located on an application board.

Figure 7 ST Link Programmer

4.2.2 USB to Serial Cable

USB to Serial Cable (123001121) is used for Configuring the device with TTN and also for monitoring the device performance on the Serial Monitor.

Figure 8 USB to Serial Cable

Note: The Serial cable configurations are mentioned in the Table 2

4.3 Software Requirements

To proceed with Catena 4617 setup and test procedure, the below software tools are required.

- **Arduino IDE** for windows can be downloaded from below link:

  - https://www.arduino.cc/en/Main/Software

- **ST-Link Debugger driver** for windows can be downloaded from the link below:

  - https://www.st.com/en/development-tools/st-link-v2.html

- **USB to Serial converter** for windows
- **Zadig** tool is required for programming Catena 4617 the tool can be downloaded from the link below:
  - https://zadig.akeo.ie
- **Basic libraries required**

  - Catena-Arduino-Platform
  - Catena-mcciadk
  - arduino-lorawan
  - arduino-lmic
  - MCCI-Catena-HS300x
  - Adafruit_FRAM_I2C
  - Adafruit_Sensor

5   Assembly Instructions

1) Catena 4617 board assembling procedures are listed below:
   a. Attach the 12-pin & 16-pin Male Headers on JP1 and JP2 of Catena 4617 board respectively.
      i. Solder one or two posts on each strip, to tack the header in place
      ii. Adjust the vertical and horizontal alignment
      iii. Solder the remaining posts for reliable electrical contact
   b. Trim excess length of the 16-pin header in the area of screw terminals.

c. Solder the Whip antenna as per the Antenna Specification mentioned in **Error! eference source not found.**

d. Attach the 1x04 Screw Terminals on JP3 and JP4 respectively.

    i. Solder one post

    ii. Adjust for proper alignment and good cosmetics
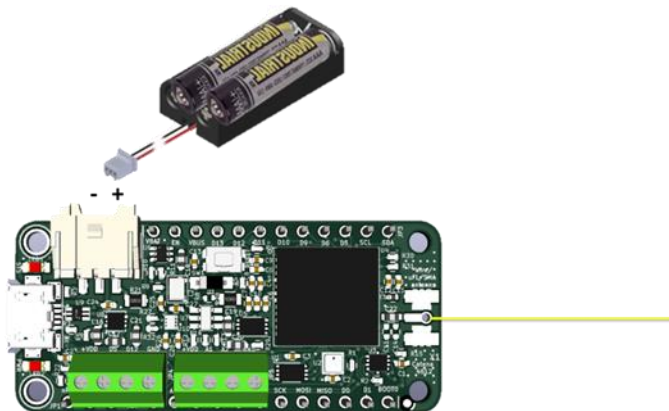
    iii. Solder the remaining posts

NOTE: Catena 4617 Base do not require male pin headers and screw terminals to be soldered (only whip antenna is sufficient for base board). However, user can solder them based on their setup requirement.

Figure 9 Catena 4617 after soldering components
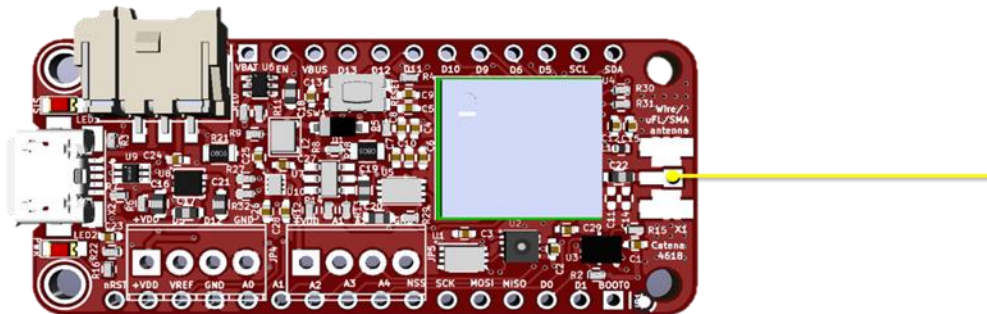
e. Connect the Battery to the X3 of the board.

Figure 10 Catena 4617 with Battery

(Note: The orange plastic seal from the HS3001 (U1) should be removed for proper operation. This seal is intended for protection during manufacturing)

6   Catena 4617 Serial connection.

User can prefer **Generic Serial** for **Serial Interface** when USB cable is not used in the setup. MCCI preferred using USB to Serial Cable TTL-232R-RPI and it has been used for Serial monitor. The color code and the pin configuration detail are listed in the Table 2 USB to Serial Connection

Figure 11 Catena 4617 Serial Configuration
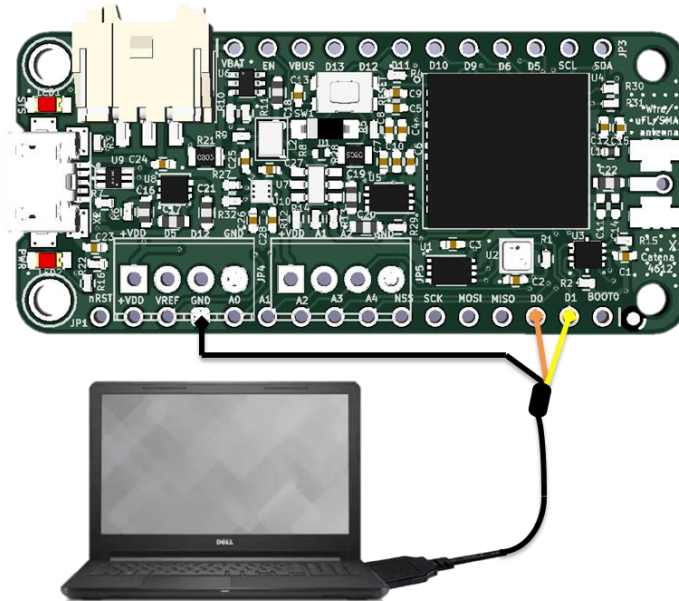
Table 2 USB to Serial Connection

Catena4617 (JP1)	USB - Serial cable (color)
GND	Black
D0_RX	Orange
D1_TX	Yellow

7   Configurations of Catena 4617

7.1   Library Installation

Catena 4617 simple sketch requires the following libraries:
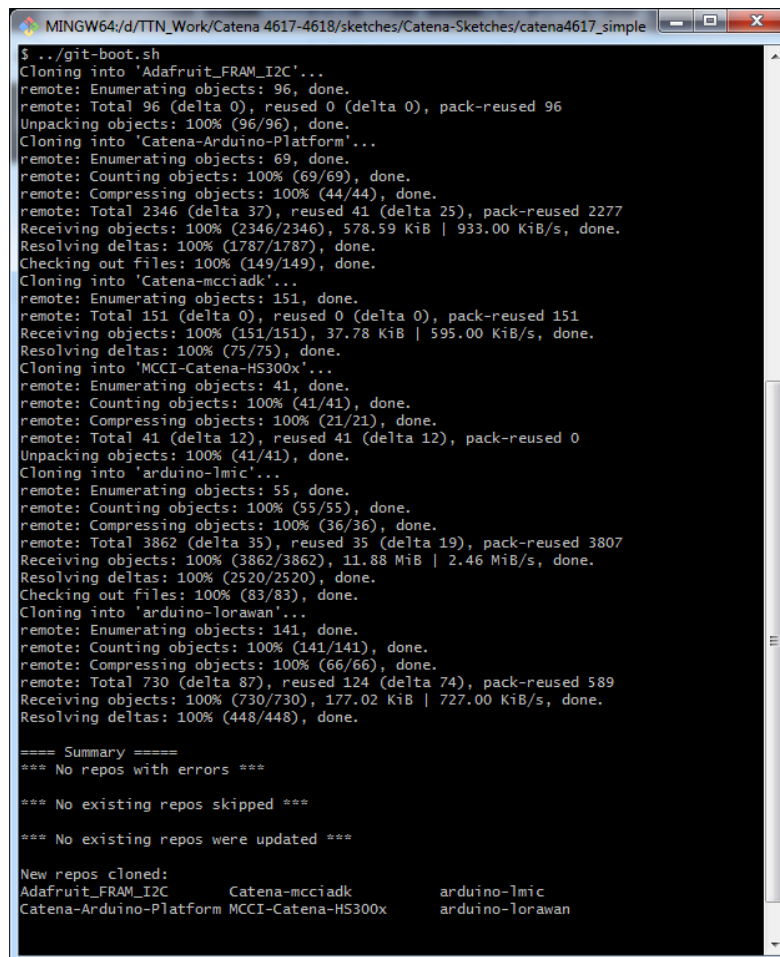
- Catena-Arduino-Platform
- Catena-mcciadk
- arduino-lorawan

- arduino-lmic
- MCCI-Catena-HS300x
- Adafruit_FRAM_I2C
- Adafruit_Sensor

The above libraries can be cloned from https://github.com/mcci-catena or by executing the shell script *"git-boot.sh"* in the directory.

It's easy to run, provided you're on Windows, macOS, or Linux, and provided you have git installed. We tested on Windows with git bash from https://git-scm.org, on macOS 10.11.3 with the git and bash shipped by Apple, and on Ubuntu 16.0.4 LTS (64-bit) with the built-in bash and git from apt-get install git. Refer the Figure 12 to clone using the script git-boot.sh.

Figure 12 Cloning libraries using the script

7.2 Arduino IDE Setup

Now follow the below steps to upload the test sketch using Arduino IDE:

1. Open the Arduino IDE. Go to File>Preferences>Settings. Add

"https://github.com/mcci-catena/arduino-boards/raw/master/BoardManagerFiles/package_mcci_index.json"
to the list in Additional Boards Manager URLs.

2. If you already have entries in that list, use a comma (,) to separate the entry you're adding from the entries that are already there.
3. Next, open the board manager. Tools>Board:...Search for MCCI's BSPs
4. Install the latest BSP for MCCI Catena STM32 to add support for Catena 4617 in Arduino IDE.
5. **MCCI Catena STM32 Boards** should be installed from the Boards Manager.
6. Once the board has been installed, **Catena 4617** board has to be selected under **MCCI Catena STM32 Boards**.
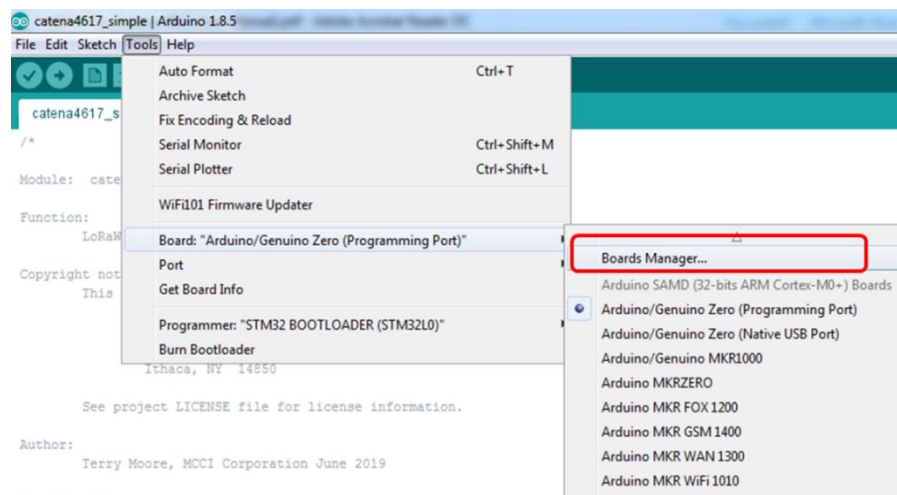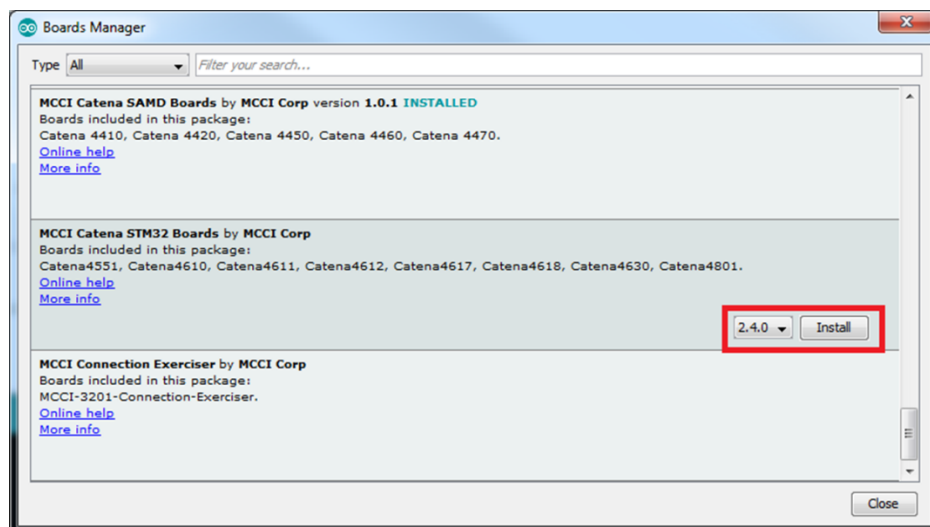
Figure 13 BSP Search

Figure 14 BSP Installation

7. Enable USB Serial in the serial interface menu from the Tools tab.

8. Choose your desired system clock and LoRaWAN region

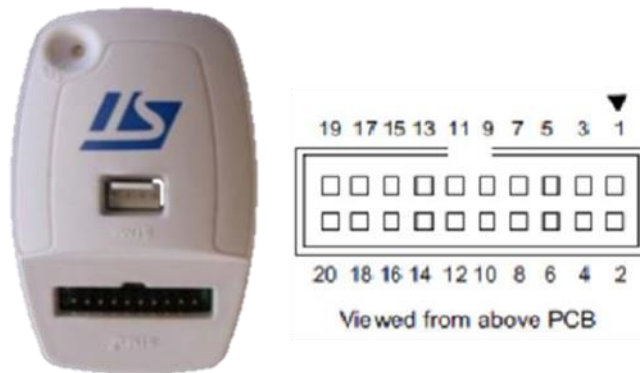9. Compile and Upload your sketch

7.3 Programming Methods

Catena 4617 programming includes two methods

    I.   DFU

   II.   ST-Link

7.3.1 ST-LinK

Catena 4617 uses ST-Link V2 programmer for programming the firmware. Below is the connection between 4617 and ST-Link programmer

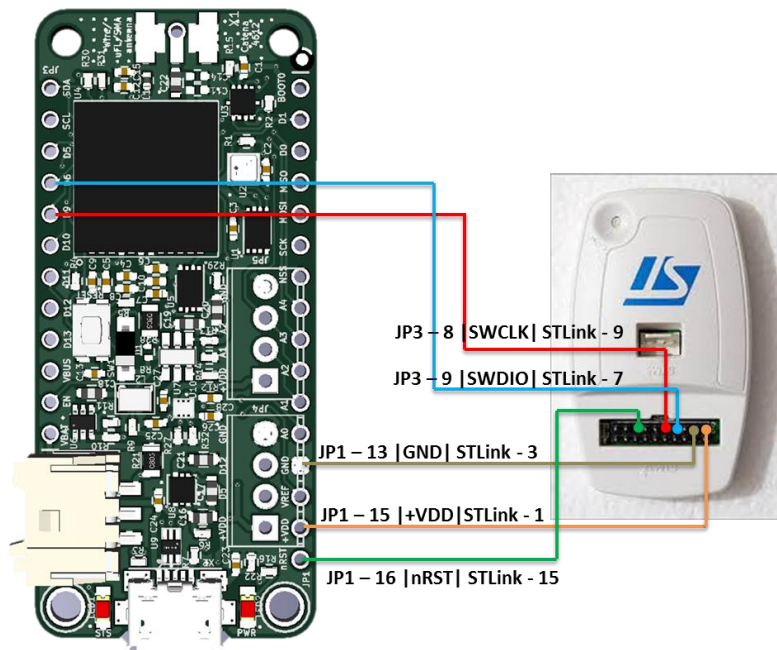**Figure 15 Catena 4617 connection with PC using STLink Debugger**

Pin configurations of the ST-Link debugger with Catena 4617 are mentioned in Table 3

Table 3 Catena 4617 to STLink connection

Catena 4617 ST-Link connection		
Pin Names	**ST-Link** **Pin Numbers**	**4617** **Pin Numbers**
+VDD	Pin 1	JP1 - 15
GND	Pin 3	JP1 - 13
SWDIO	Pin 7	JP3 - 9
SWCLK	Pin 9	JP3 - 8
nRST	Pin 15	JP1 - 16

Figure 16 Catena 4617 connection with ST Link programmer

JP3 – 8 |SWCLK| STLink - 9

JP3 – 9 |SWDIO| STLink - 7

JP1 – 13 |GND| STLink - 3

JP1 – 15 |+VDD|STLink - 1

JP1 – 16 |nRST| STLink - 15

Before uploading the code select the following options from Arduino IDE.

TOOLS --> UPLOAD METHOD - STLink" && PROGRAMMER - "STLink (STM32L0)"

Figure 17 Configuration for upload using STLink programmer
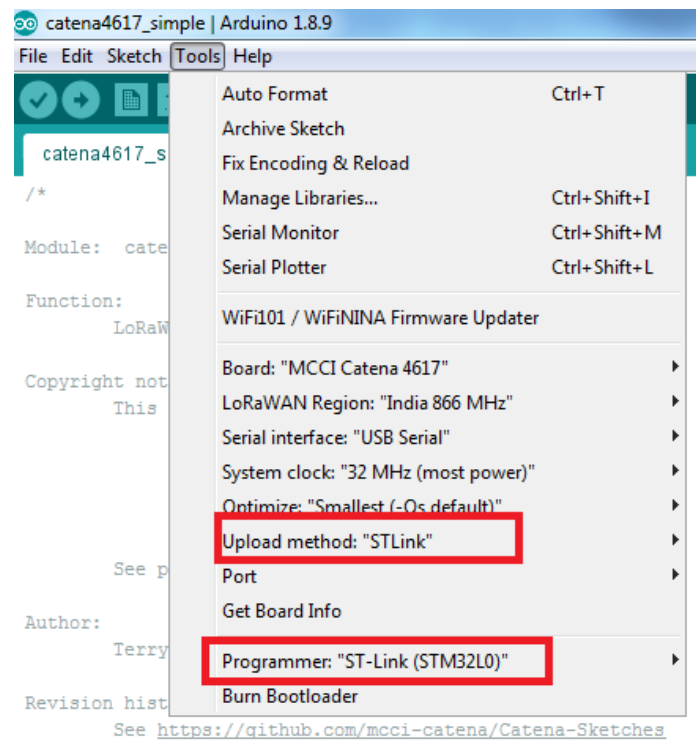
7.3.2   DFU

1. Program the Catena 4617 using DFU mode, this mode requires Zadig tool the download link is mentioned above.
2. Once the tool is downloaded, BOOT0 and +VDD pins should be Shorted using the jumper wire
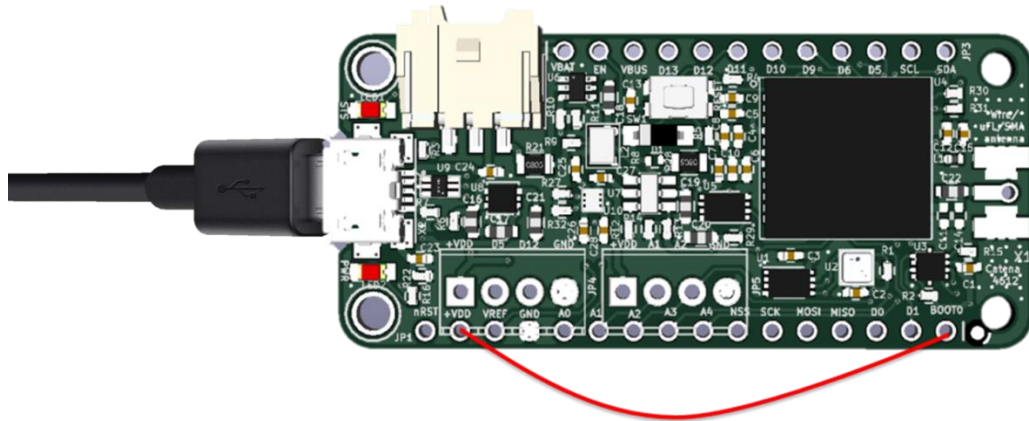
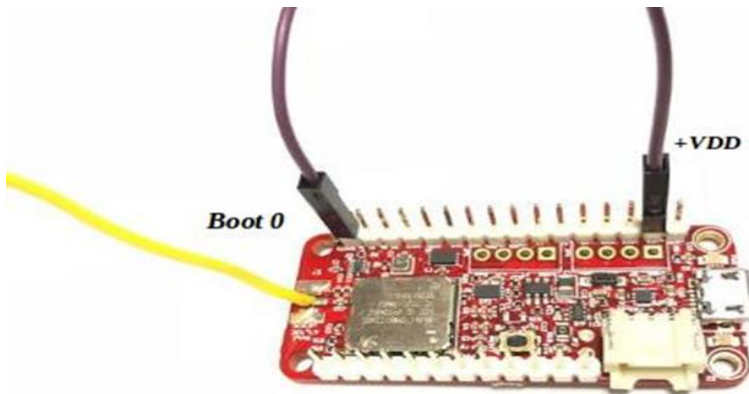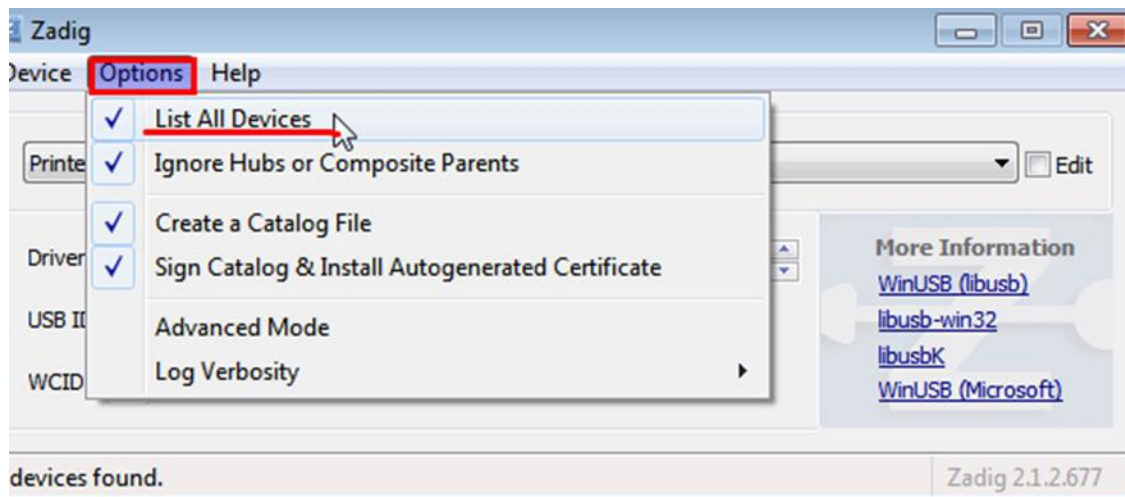Figure 18 Catena 4617 DFU Mode Connection
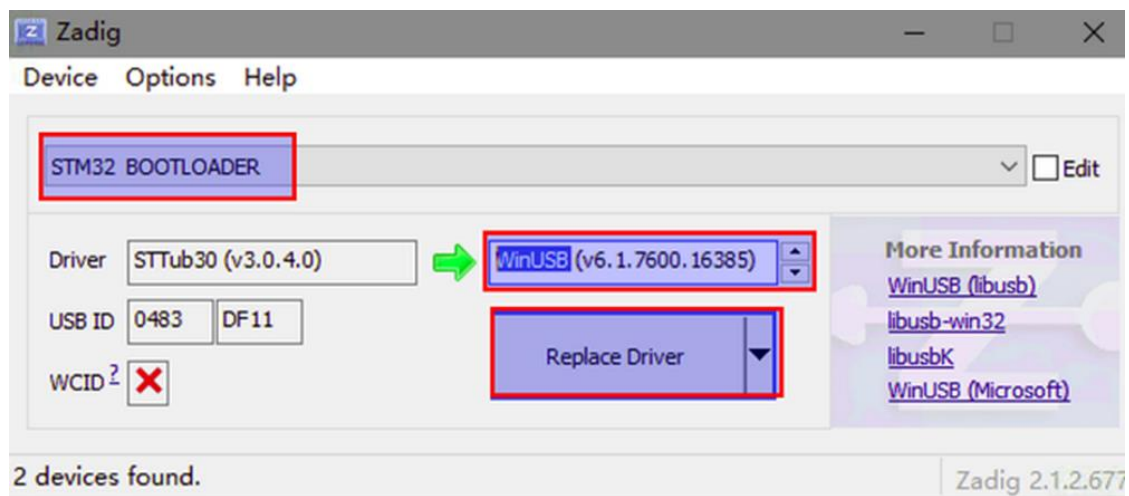

Figure 19 DFU mode Example

3. Now reboot Catena 4617 using USB cable.
4. On the Zadig terminal - Select **Options -> List All devices as shown**

Figure 20 Zadig Device Selection

5. Select STM32 BOOTLOADER from the device dropdown
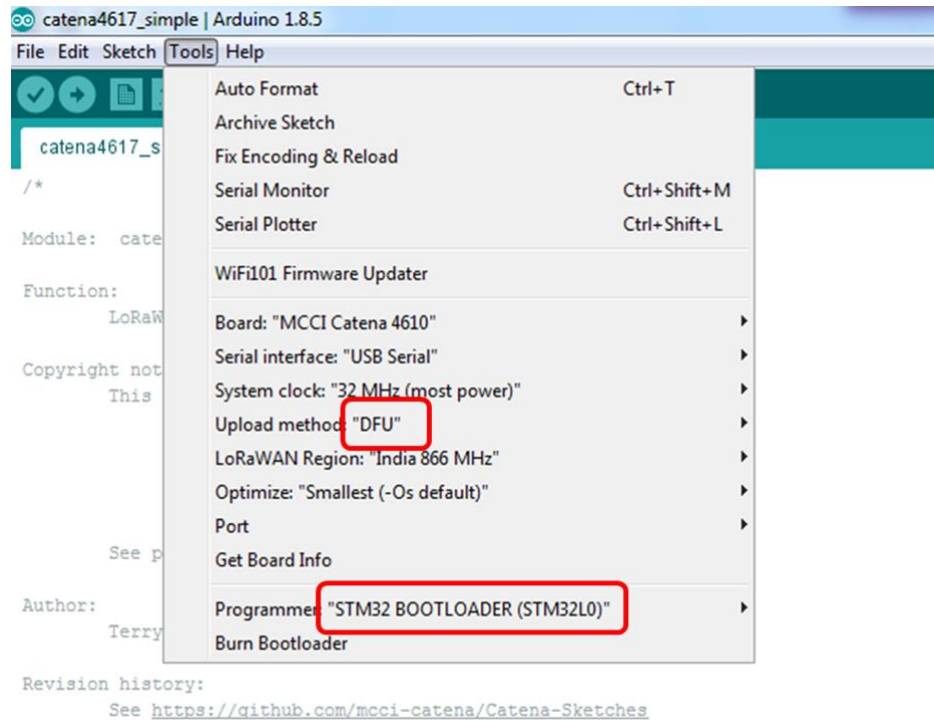6. Select WinUSB (v6.1.7600.16385) as new driver
7. Click Replace Driver

Figure 21 Zadig driver replacement

8. Before uploading the code select the following options from Arduino IDE.

TOOLS --> UPLOAD METHOD - DFU" && PROGRAMMER - "STM 32 BOOTLOADER"

Figure 22 Configuration for upload using DFU mode

Now the Sketch can be compiled and uploaded using DFU mode.

7.4   Provisioning Steps

After upload the sketch.
Please follow the provisioning steps mentioned in the below link

https://github.com/mcci-catena/Catena-Sketches/tree/master/catena4450m101_sensor#provision-your-catena-4450

Note: use platformguid "915decfa-d156-4d4f-bac5-70e7724726d8"

7.5   TTN Registration Steps

Please follow the steps mentioned in the below link to create an application in The Things Network

https://github.com/mcci-catena/Catena-Sketches/tree/master/catena4450m101_sensor#getting-started-with-the-things-network