SEMTECH

WIRELESS, SENSING & TIMING PRODUCTS

Single Channel Gateway
User Manual

1   Introduction

Single channel gateway design using one channel to communicate with end device. It can forward RF packets received by the gateway to a server through an IP/UDP link, and emit RF packets sent by the server.

Note: This single channel gateway design is not fully validated. Customer should validate the necessary items as they require and bear the risk if wants to apply to their own project.

1.1   Hardware Overview

Single channel gateway is built up with ST NucleoF429 and SX1268 radio chip. NucleoF429 board works as the master board, which runs control code. Semtech's low cost LoRa radio chip – SX1268 works as an RF front end, which transmits and receives LoRa message.
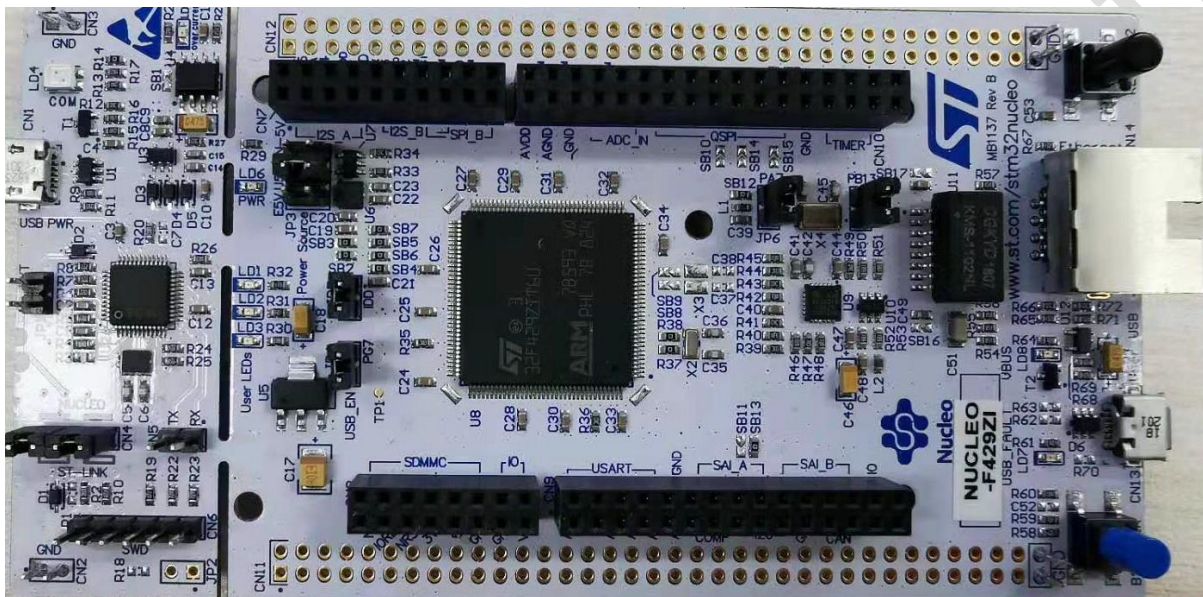

Fig 1 Single Channel Gateway Component – NucleoF429 Master Board

Note: For NucleoF429 board, there is a pin conflict for Ethernet and SPI, so the board need to be modified. Please refer to https://os.mbed.com/teams/ST/wiki/Nucleo-144pins-ethernet-spi-conflict.

Fig 2 Single Channel Gateway Component – SX1268 Shield RF Front End

1.2 Software Overview

Single channel gateway software is built based on MBED OS, and mainly implemented Semtech packet forwarder protocol with UDP link. The application is designed based on MBED_OS, which use module libraries provided by MBED_OS.

Ethernet: Since single channel gateway implementation is based on UDP link, and we directly utilize this module to drive the NucleoF429 Ethernet and do UDP bi-direction communication.

Jsmn: This library is used to format between raw buffer and json object.

Base64: This library is used to do base64 decode for the downlink message from network server.

SX1268 HAL and driver: This library is provided by Semtech and used by application to receive and transmit LoRa packet.
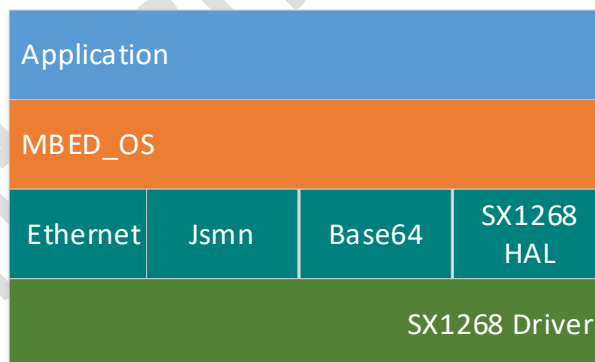

Fig 3 Single channel gateway software overview

1.3 Software configuration

For the software, we define several configurable parameters in **userconf.h**. And customer can find the initial configuration for gateway from structure "gw_conf".

```
static gateway_conf_t gw_conf = {
    .channel_freq                = CHANNEL_FREQ,
    .sf                          = LORA_SF7,
    .bw                          = LORA_BW_125,
    .tx_power                    = 15,
    .server_address              = "192.168.1.1",
    .server_port                 = 1700,
    .antenna_switch_alternate    = false
};
```

The meaning of these parameters are as follows.

1. channel_freq

Value for this section defines the frequency for uplink message for gateway to listen at.

2. sf

Value for this section defines the SF for message that gateway is listening to.

3. tx_power

Value for this section defines the transmission power for gateway.

4. server_address

Value for this section defines the IP address of network server. **Make sure to change it to the right value**.

5. server_port

Value for this section defines the IP port of network server.

Note: Customers should modify these parameters according to end device's parameters and network server. Then need to recompile project and flash the gateway firmware to make effective.

2   Setup Single Channel Gateway

2.1   Hardware Setup

1. Connect the SX1268 shield with NucleoF2429 master board and connect a CN470 antenna to SX1268 shield. Connect the board with a network cable. It likes Fig 4.
2. Connect the board to your PC. On your PC it will be recognised as a disk ("NODE_F429ZI"), like Fig 5.
3. Drag the single channel gateway firmware image (.bin file) into the disk ("NODE_F429ZI").
4. Wait until the "burn" is done then press the "RESET" button to start the firmware.
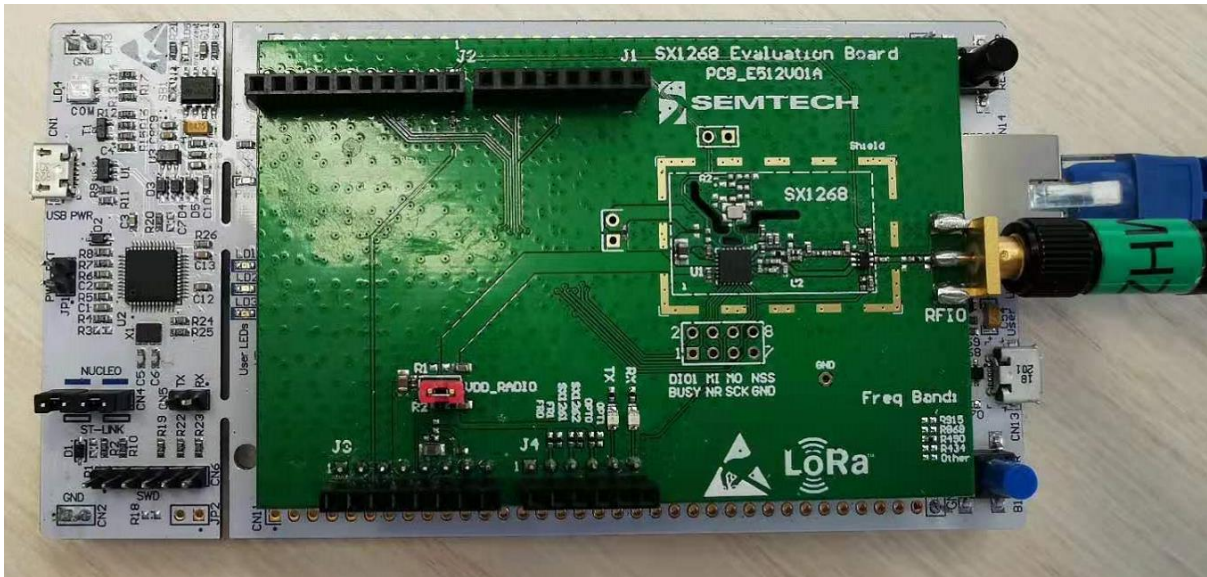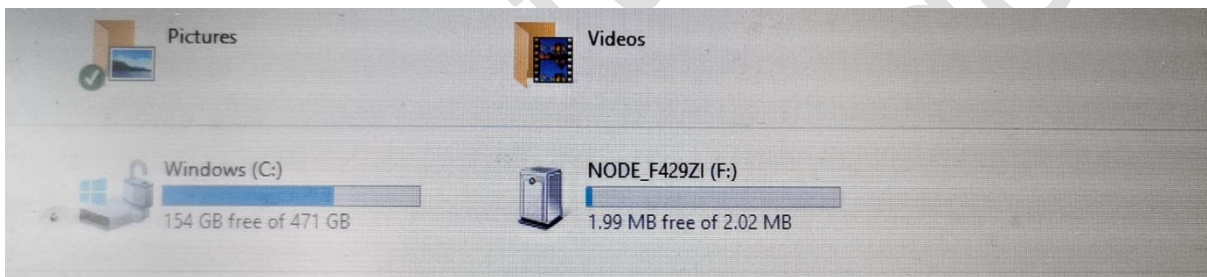
Fig 4 Single Channel Gateway

Fig 5 Hard drive recognised for the board

2.2 Compile Software

Customers should follow below steps to compile the firmware. Here we use Linux to compile it, but below steps should also work under Windows or Mac OS X.

1. Download the code base by 'git clone' or "Download" from below repository and go to the right subfolder, such as:
    git clone https://github.com/lorabasics/lorabasicsmodem/
    cd tools/single_channel_gateway

2. Configure mbed environment. Follow this link:
    https://os.mbed.com/docs/mbed-os/v6.9/build-tools/install-and-set-up.html

3. Download `mbed-os-5.7.4` from:
    https://github.com/ARMmbed/mbed-os/archive/refs/tags/mbed-os-5.7.4.zip.

4. Unzip the downloaded file and rename it to be just **mbed-os**, so the folder
    "**single_channel_gateway**" should contain folders and files as below:
    *jsmn **mbed-os** PROTOCOL.md readme.md src sx126x-driver user_manual.pdf*

5. Open file `**mbed-os/targets/targets.json**` and change **PA_7** to **PB_5** at line **1166**.

6. Compile the project to get the .bin file with following command.
    mbed compile -c -t GCC_ARM -m NUCLEO_F429ZI --source src --source sx126x-driver --source mbed-os --source jsmn

Final gateway firmware is **src.bin** under folder *./BUILD/NUCLEO_F429ZI/GCC_ARM*. Below shows the output of the compile process.

```
| rtos/EventFlags.o              |     210 |      0 |      0 |
| rtos/Mutex.o                   |     186 |      0 |      0 |
| rtos/TARGET_CORTEX             |   11149 |    168 |   5985 |
| rtos/Thread.o                  |      20 |      0 |      4 |
| sx126x-hal.o                   |    1922 |      0 |      0 |
| sx126x.o                       |    2279 |      0 |      5 |
| targets/TARGET_STM             |   17431 |      4 |   1236 |
| Subtotals                      |  143412 |   2932 |  59584 |
+-------------------------------+--------+-------+-------+

Total Static RAM memory (data + bss): 62516 bytes
Total Flash memory (text + data): 146344 bytes

Image: ./BUILD/NUCLEO_F429ZI/GCC_ARM/src.bin
```

2.3 Work with Server

After you set up gateway and end device correctly, you can check the data traffic on the network server. It should works with any general NS following LoRaWAN protocol, or users can provide their own NS adopted for this gateway.

3 Version History

Date	Version	Detail
20210127	0.1	Initial draft
20210425	1.0	Release version

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