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WIRELESS, SENSING & TIMING PRODUCTS

LoRa IOT Starter Kits

User's Guide

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1. Goal of this Kit

This kit is designed to offer a self-contained Plug'n Play local loop for all IOT object designers, allowing them to verify that their design is able to connect to a public IOT network following the LoRaWAN specification.

No connection to an Ethernet network is required, simplifying the setup. A simple cross over Ethernet cable can be used to access the kit.

2. Contents of the development kit

- ❖ RaspberryPi B+ with its LoRa IOT shield unit and pre-installed micro SD card
- ❖ SX1301-based concentrator reference design
- ❖ Active GPS antenna
- ❖ USB cables
- ❖ Power adapter
- ❖ Example end-point: LoRaMote or MBED shield unit. It is provided as a reference to confirm the functionality of this setup.

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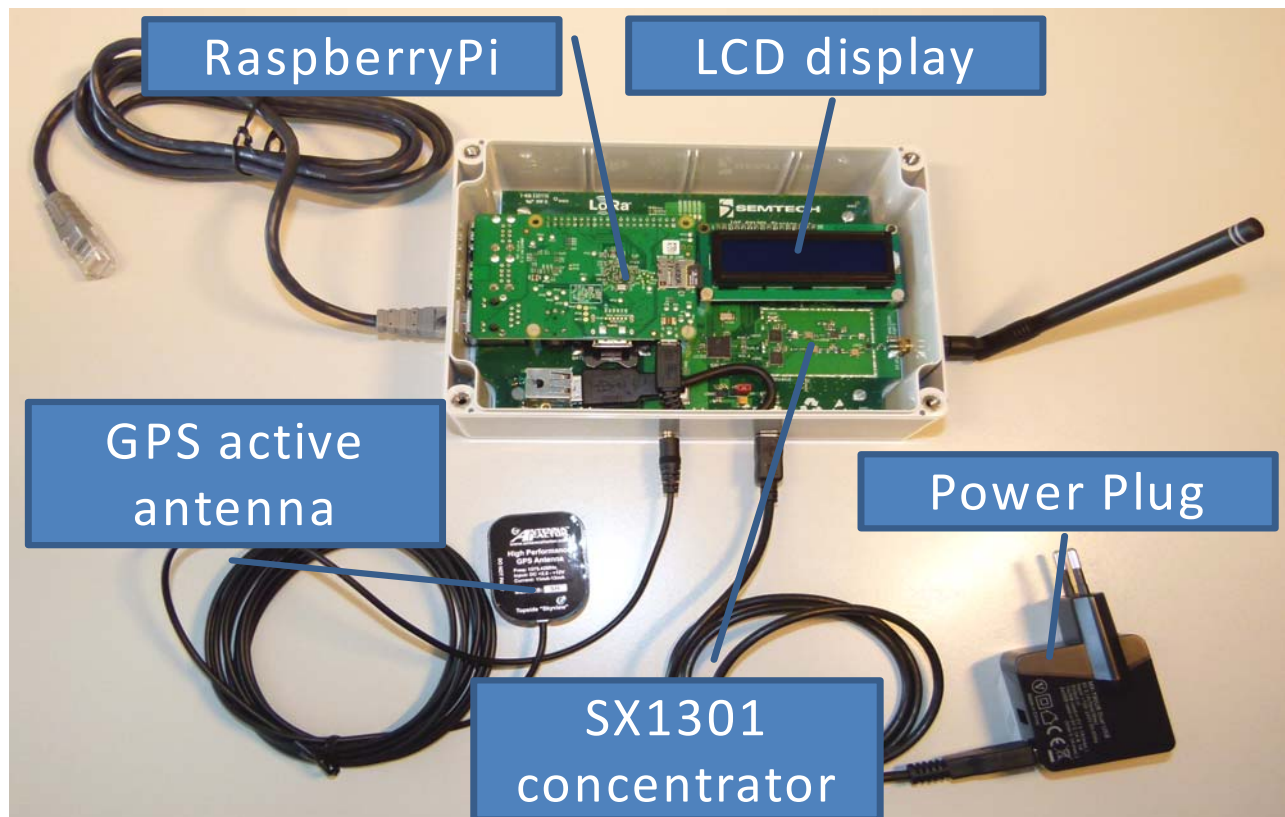
3. Getting Started

Two ways to get connected to the starter kit are possible.

- ◆ Connection to an Ethernet network composed of a router and a DHCP server.
- ◆ Connection using an Ethernet cable connected between the development PC and the starter kit.

3.1. Connection to an Ethernet Network

1) Plug the simplified network setup as per the picture below. It must be connected to the same network as the one your development PC is connected to.
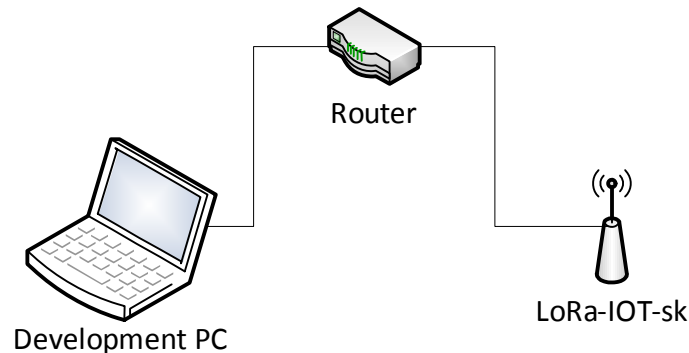
2) When all ready, power it up and wait about 2mn for the device to boot-up.

3) Look-up the LCD screen to see the IP address that the RaspberryPi was given by the DHCP server.

4) On your PC, launch a web browser session and type this IP address into the web browser address bar.

5) The following page will appear:

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6) Click on "Demonstration" link

7) Click on the "RecentActivity" link:


8) Power up the provided end-point device.

9) Its packets should start flowing in the database and will be displayed on the screen (hit F5 to refresh).

A local network has been successfully deployed on your bench. Any proprietary end-point design can now try and connect to the network.
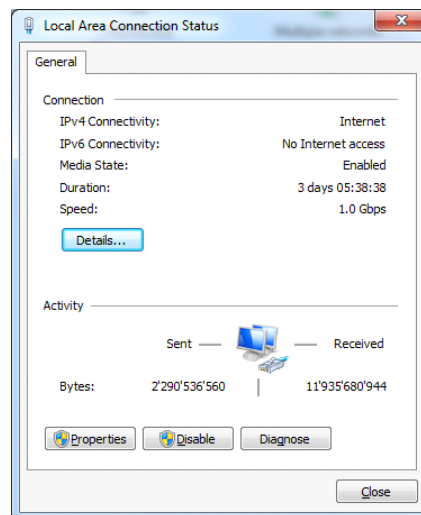
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3.2. Connection using an Ethernet Cable

1) Connect the RaspberryPi to your PC using an Ethernet cable.

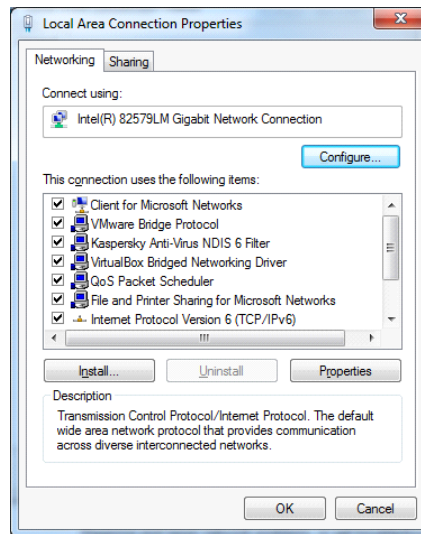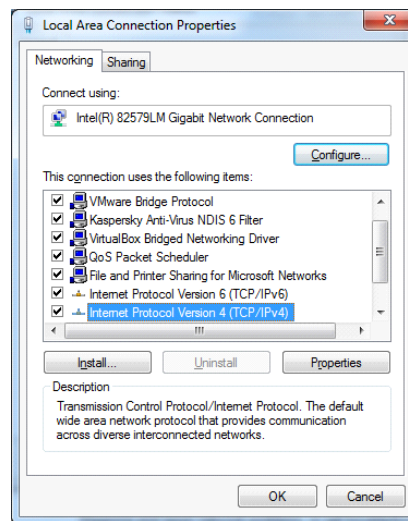2) On the PC, go to Network settings.
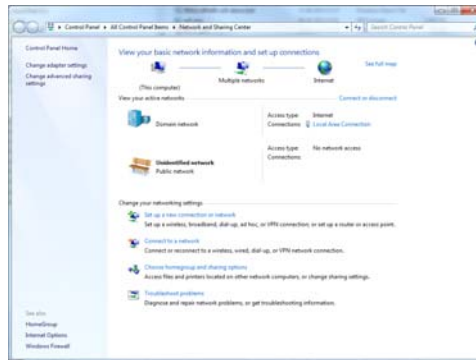
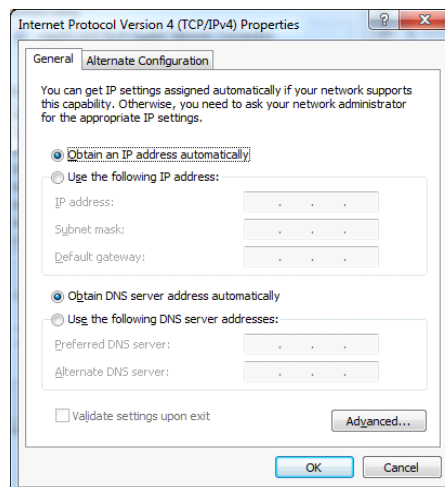3) Click on "Local Area Connection"

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4) Click on "Properties"

5) Select "Internet Protocol Version 4 (TCP/IPv4)

6) Click "Properties" button

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7) Select "Use the following IP address:"
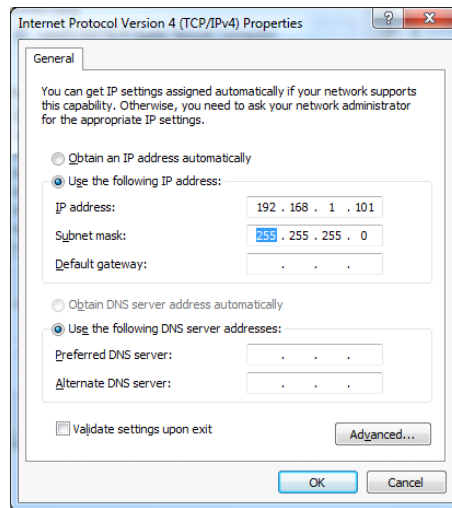
8) Enter the IP address like 192.168.1.XXX where XXX is different from 100 as it is the Raspberry static IP address.

9) Click the "OK" button.

10) Click the "OK" button on "Local Area Connection Properties" window.

11) Close "Local Area Connection Status".

12) Please follow the same steps as on previous chapter starting from step 4.
REMARK: Don't forget to replace the IP address for 192.168.1.100 instead of the one assigned by DHCP

A local network has been successfully deployed on your bench. Any proprietary end-point design can now try and connect to the network.

4. RaspberryPI Software

The LoRaWAN server and gateway software run on the RaspberryPI.

Once the RaspberryPI has boot up the LCD screen will show information about the LoRaWAN server and gateway applications status, the percentage of used disk space on the SD card as well as the DHCP and static IP addresses.

The indications meaning of the LCD first line are:

- ◆ G: Indicates if the gateway application is running or not
- ◆ S: Indicates if the LoRaWAN server application is running or not
- ◆ D: Used disk space in percent

The second line displays the DHCP assigned IP address as well as the static IP address. Each one is displayed every 5 seconds when both are available.
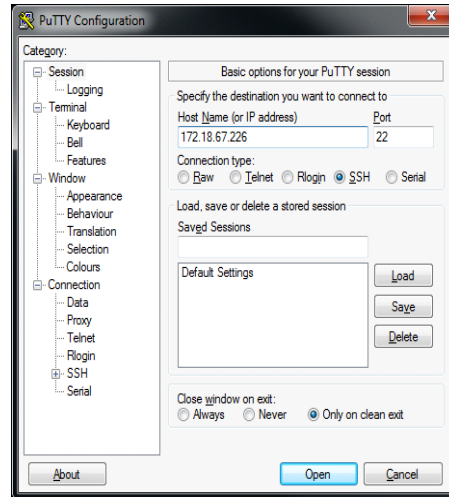
4.1. RaspberryPI Command Line Access

To access the RaspberryPI one must use an SSH client such PuTTY on Windows platforms or a terminal console on UNIX based systems.

The RaspberryPI user name is `lora` and the password `lora`.
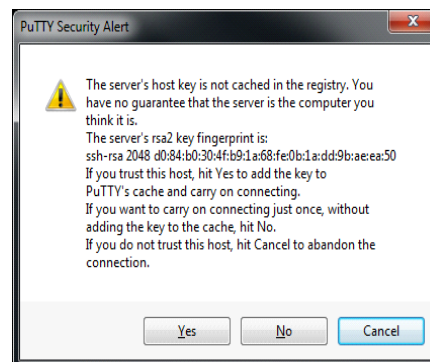
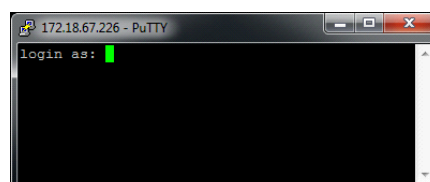## 4.2. Access Using PuTTY

1) Launch PuTTY

2) Enter the IP address displayed on the RaspberryPI LCD display

3) Click the "Open" button

4) If a security alert window is displayed Please click on "Yes" button.
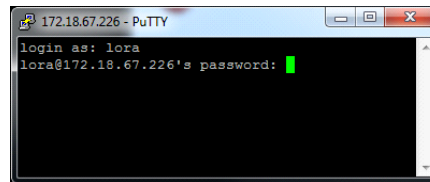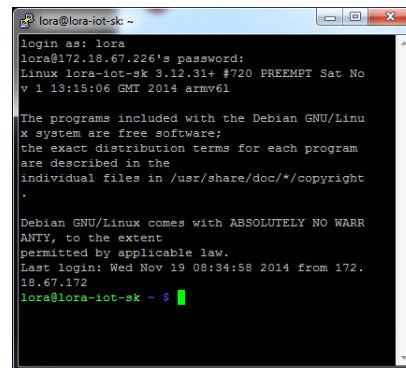
5) The login prompt is then displayed

6) Please enter `lora` as username
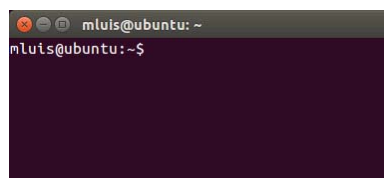

7) Please enter `lora` as password

8) You are now logged on

4.3. Access Using UNIX Terminal Console

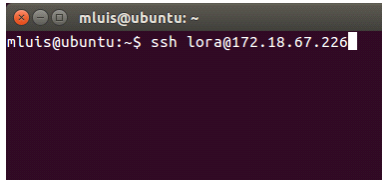1) Launch a terminal console
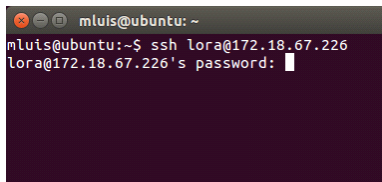
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2) Please enter the following command in the terminal window
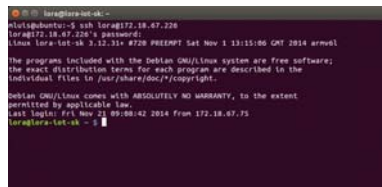
```
$ ssh lora@RaspberryPi-IP-address
```


3) After pressing the Enter key, enter the password `Lora`

4) You are now logged on

5. Application Software Locations

All the software applications used by the RaspberryPI to run the IOT starter kit are located under `/opt/lora-net`.

This directory contains 4 directories:

- ◆ gateway, this directory contains the
  1) lora_gateway, SX1301 control library source code
     https://github.com/Lora-net/lora_gateway.git
     This source code has been adapted to use the RaspberryPI hardware SPI as well as the control of the SX1301 board reset pin.
  2) packet_forwarder, gateway application source code
     https://github.com/Lora-net/packet_forwarder.git
     The configuration JSON files have been modified in order to use the GPS module as well as the network server connection parameters.
  3) lr-nwk-gw, gateway script to start/stop/restart the daemon.
- ◆ misc, contains the Python and shell scripts need for the LCD management.
- ◆ server, contains the precompiled LoRaWAN network server as well as the script to start/stop/restart the daemon
- ◆ www, contains the web server pages

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6. Starting / Stopping the Demon Scripts

To control the server and gateway daemons the following commands must be issued:

- Starting
  The server: `sudo /etc/init.d/lr-nwk-srv start`
  The gateway: `sudo /etc/init.d/lr-nwk-gw start`

- Stopping
  The server: `sudo /etc/init.d/lr-nwk-srv stop`
  The gateway: `sudo /etc/init.d/lr-nwk-gw stop`

- Restarting
  The server: `sudo /etc/init.d/lr-nwk-srv restart`
  The gateway: `sudo /etc/init.d/lr-nwk-gw restart`

- Getting the demon status
  The server: `sudo /etc/init.d/lr-nwk-srv status`
  The gateway: `sudo /etc/init.d/lr-nwk-gw satus`

The 2 daemons output their logs to files located in the /tmp directory.

The LCD "G:" and "S:" indicate the 2 daemons status

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7. Server MySQL Database

The RaspberryPI disk usage will increase over the time by recording all the end-devices frames onto the MySQL database.

It is advisable that once the disk usage displayed on the RaspberryPI LCD screen is getting close to 90% of disk usage that the database is cleaned up.

7.1. Cleanup

It is possible to clean-up the database for a fresh-start.

1) Please stop the server application as described in chapter "Starting / Stopping the demon scripts"

2) Open a web browser

3) Type the IOT Starter Kit IP address followed by the following text "/phpmyadmin" to the web browser address bar.
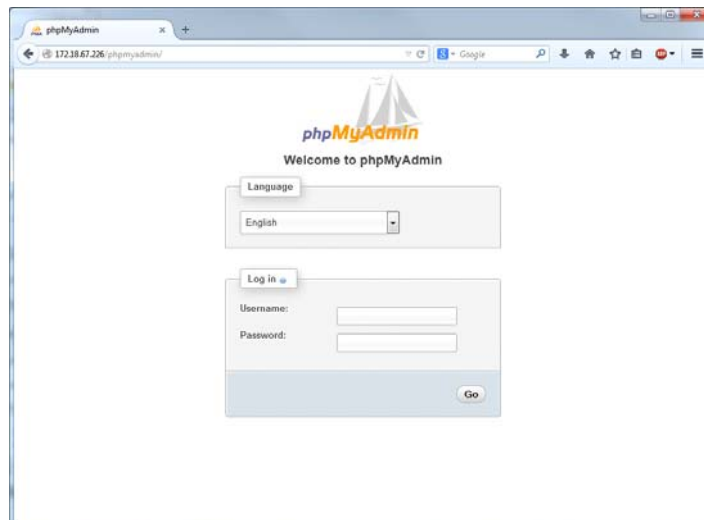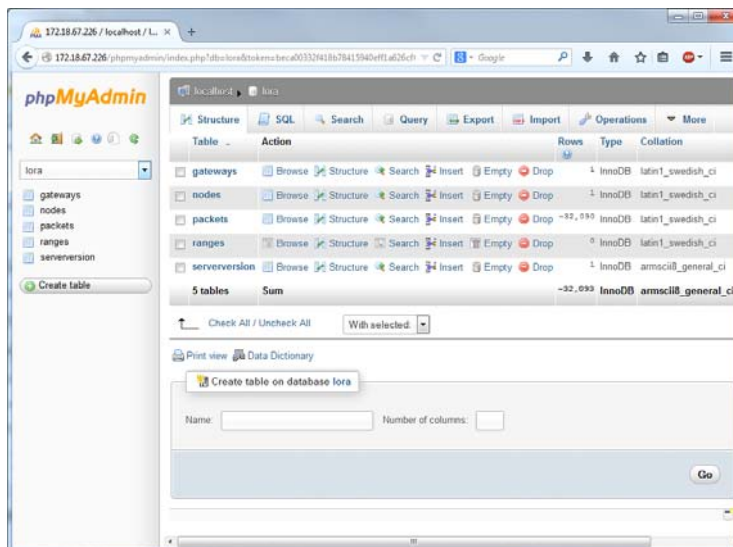

4) The user name is `root` and password is also `root`

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5) Click "Go" button
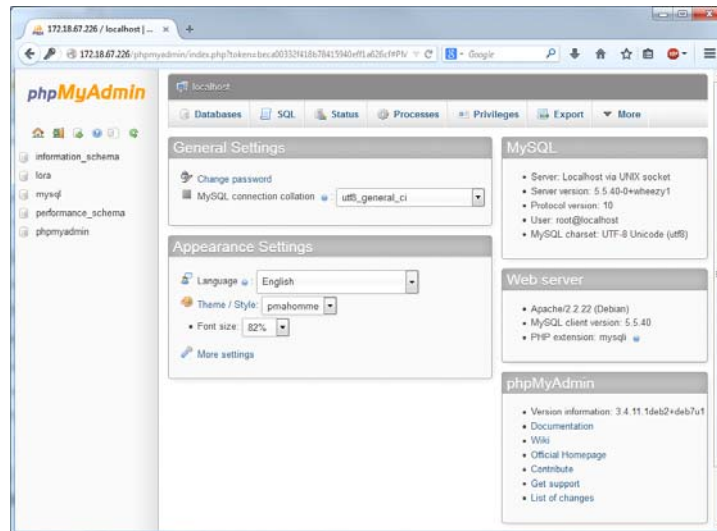
6. Click "lora" database on the left of the window

7) Click on "Empty" (trash can icon) link for each table

7.2. MySQL Server Users

Three more users have been defined (in addition to the `root` user) to access the database:

- ◆ `loraadmin`, has full access to the database (password: `loraadmin`)
- ◆ `lorarw`, has the right to read and update the tables (password: `lorarw`). The server uses this user to access the database.
- ◆ `loraro`, has the right to only read the tables (password: `loraro`). Used by the web server to access the tables.

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8. Updates and Upgrades

Semtech will issue some releases of the network software under the form of a new RaspberryPi image file to be programmed onto a SD card. Please ask your Semtech representative for an update.

The current delivery of the IOT kits contains the following versions of the different components:

- ◆ LoRaWAN specification R3.0 (production)
- ◆ Server release v1.4.2 (Semtech's example network server implementation)
- ◆ LoRaMote end-point firmware v3.0
- ◆ mbed platform end-point firmware (not yet available)

9. End-devices Firmware

9.1. LoRaMote

LoRaWAN firmware projects are available as source code in GitHub at the following address:

https://github.com/Lora-net/LoRaMac-node.git

The firmware must be configured to use activation by personalization and the NwkSKey and AppSKey must be modified to:

- ◆ NwkSKey:
  ```
  {0x11,0x22,0x33,0x44,0x55,0x66,0x77,0x88,0x99,0xAA,0xBB,0xCC,0xDD,0xEE,0xFF,0
  x00}
  ```
- ◆ AppSKey:
  ```
  {0x11,0x22,0x33,0x44,0x55,0x66,0x77,0x88,0x99,0xAA,0xBB,0xCC,0xDD,0xEE,0xFF,0
  x00}
  ```

These keys correspond to the application server implemented in this demo. They are hardcoded and compiled in the LoRaWAN server and can't be changed in this release.

9.2. mbed

LoRaWAN firmware projects aren't yet available at the time of this document release. Please check:

http://www.mbed.org

as sources will be provided by Semtech soon.

9.3. How-to Upgrade the RaspberryPi SD Card

To upgrade the SD card you can follow the instructions described in the following link:

http://www.raspberrypi.org/documentation/installation/installing-images/

The image to be used is the one that you get from Semtech.

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10. Ordering Information

Option 1: LoRaMote with integrated antenna

- ◆ A variety of sensors to select from
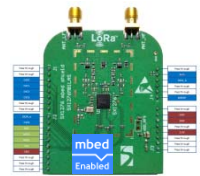- ◆ GPS is built-in
- ◆ Download sources for Keil and Ride on:
  https://github.com/Lora-net/LoRaMac-node

  Ordering Code: IOT868STKLM1

Option 2: MBED shield unit plugged onto MBED Freedom platform

- ◆ MBED-enabled, with online development environment
- ◆ Multiple ARM vendors to select from
- ◆ Download sources on:
  http://mbed.org/components/SX1276MB1xAS/

  Ordering Code: IOT868STKMB1

11. Troubleshooting

Q: The IP address I type doesn't lead me to the corresponding landing page.

A: It is probably because the Raspberry Pi device did not get a DHCP lease from the network router (this depends of companies' network policies, please talk to your IT manager). If it is not possible to whitelist this device, the fall back solution is to use the second connection option described in "Connection using an Ethernet cable connected between the development PC and the starter kit." chapter.

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