

WiMOD Lite Gateway

QuickStartGuide

Document ID: 4000/40140/0116

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Document Information

File name	WiMOD_LiteGateway_QuickStartGuide.docx
Created	2016-11-25
Total pages	14

Document History

Date	Version	Chapter	Change
2016-11-25	1.0	All	Released version.
2017-06-09	1.1	All	Update
			-

Aim of this Document

Aim of this document is to give some quick start instructions how to start working with the WiMOD Lite Gateway (LGW) for LoRa™. This document only applies to LGWs with aluminum case, delivered after May 2017.

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2 Introduction

Purpose of this documentation is to give some useful information how to get started with the Lite Gateway.

It is not meant to be a complete instruction guide explaining all steps and configuration options available for LoRa and Linux based systems.

The intended reader should (at least) know the basics of the Linux command line and the basics of the LoRa technology in general. This document does not explain the very basic system concepts.

The Lite Gateway is meant to be used as demonstration system for the LoRaWAN network system. It is not designed to be a full featured outdoor gateway.

3 Overview

The Lite Gateway is a device that consists of a Raspberry-Pi B+ and an iC880A LoRa Concentrator. Both parts form a LoRaWAN Gateway can be connected to a LoRaWAN server.



Figure 3-1: Lite Gateway

3.1 Basic System Concept

Figure 3-2 shows the basic system concept for the LoRaWAN system. The Lite Gateway is the central hardware solution for all LoRa based radio communication. It receives and transmits radio messages. Processing of the radio messages as well as the protocol related tasks is done by the embedded host system (Raspberry Pi). Received and processed radio messages are being sent to a LoRaWAN server. The concrete segmentation of the protocol related tasks is outside the scope of this document.

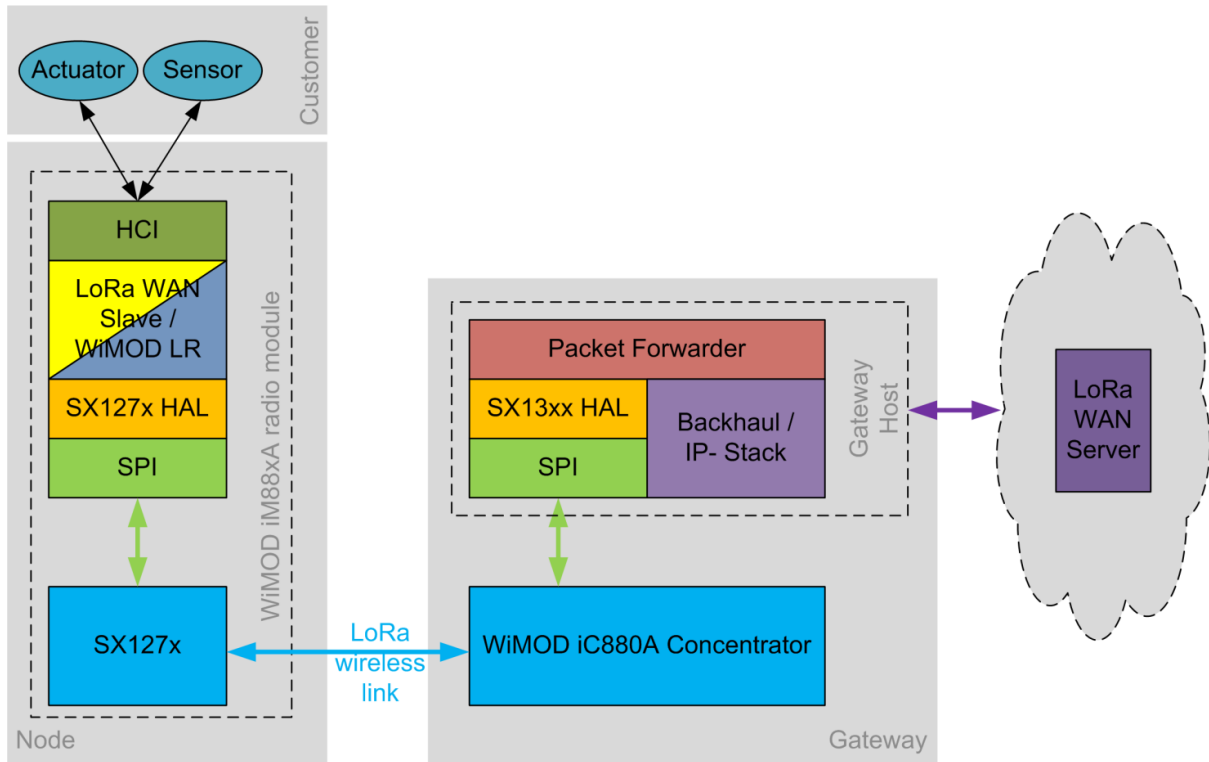


Figure 3-2: Basic System Concept

4 Getting Started

4.1 Update June 2017

The SD-Card image has been updated in June 2017. The main difference to the original system image is that the root file system is now mounted in ReadOnly (RO) mode. That means that the user has to enable write access to the SD card before accomplishing (permanent) modifications to the system.

The following steps will apply only to RO-Systems:

In order to enable write access to the file system a script called “**enableWriteAccess.sh**” has been placed in the user’s home folder. If this script is executed the system is in ReadWrite (RW) mode. Modifications can now be permanently stored on the SD card.

After all modifications are done the user can switch back to ReadOnly (RO) mode by executing the “**disableWriteAccess.sh**” script that is placed in the home folder, too.

Hint: The following chapters will not mention the additional step of activating the RW mode before modifying the system. This knowledge is implied.

4.2 Basic Setup

Before connecting the power cord to the Lite Gateway, the antenna must be connected to the 50 ohm SMA connector and an Ethernet cable must be connected to the box.

- After powering up, the Lite Gateway tries to obtain an IP-address by using a DHCP discovery procedure.
- If the network does not support DHCP, the Lite Gateway will use a fallback address of **169.254.125.124**.
- The box tries to register the name “**LoRaGateway.local**” for its current (IP) address via zeroconf protocol, so PCs running a zeroconf / bonjour client¹ are able to access the Lite Gateway via the convenient name.

For restricted DHCP servers the MAC address of the box must be added to the DHCP server service. For detailed instructions the local network administrator / the handbook of the DHCP server / router should be consulted.

¹ MacOS and most Linux distributions offer an appropriate service as part of the standard installation. Windows needs an additional client in order to support this.

4.2.1.1 (Optional) Setting Up a Customized IP Configuration

An easy way to change the IP related settings of the Lite Gateway is to use a cross link Ethernet cable to establish a direct one to one connection between the Lite Gateway and a PC. If the PC is setup to use the DHCP service, it will also use fallback IP within the 169.254.x.x range. A SSH session can be opened via the default fallback address. By editing the file `/etc/dhcpd.conf` a customized IP configuration can be setup. A customized setup may look like this:

```
# Custom static IP address for eth0.  
interface eth0  
static ip_address=192.168.0.200/24  
static routers=192.168.0.1  
static domain_name_servers=192.168.0.1
```

Note: Any change will require a reboot in order to activate the new settings. Using the command

```
sudo reboot
```

is highly recommended. (See also chapter 5)

4.2.2 Firewall Settings:

If a firewall is involved the following connections / ports must be allowed since the Lite Gateway needs to have internet access for working with external LoRaWAN server services:

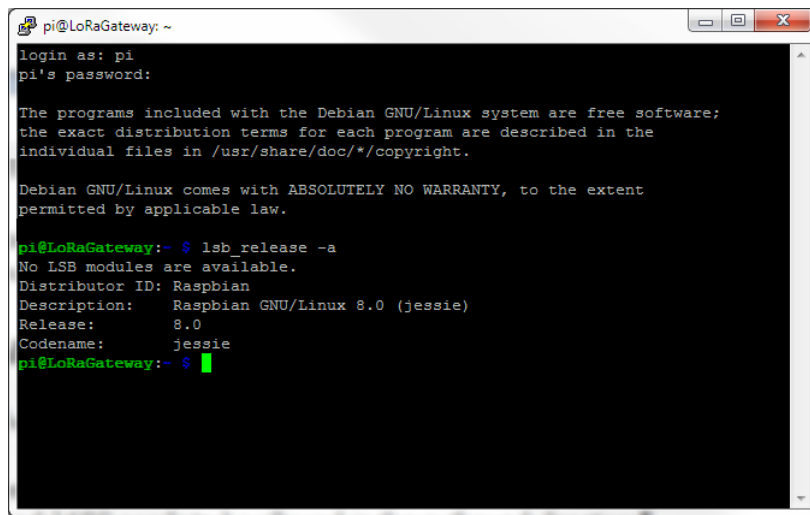
- Ports 123, 443, 1680 and 1780 needs to be allowed in the outbound direction.
- Optional: For SSH access from outside of the local LAN port 22 needs to be accessible.

4.2.3 Obtaining Access to the Lite Gateway

Since this system is headless, the main interface to the box is the Ethernet interface. (This documents assumes that the user as already got a SSH client (e.g. PuTTY) installed.)

In order to login to the box the following credentials for a SSH based console can be used:

- User: `pi`
- Password: `raspberry`



```
pi@LoRaGateway: ~
login as: pi
pi's password:

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

pi@LoRaGateway:~$ lsb_release -a
No LSB modules are available.
Distributor ID: Raspbian
Description:   Raspbian GNU/Linux 8.0 (jessie)
Release:      8.0
Codename:     jessie
pi@LoRaGateway:~$
```

Figure 4-1: SSH terminal window

4.2.3.1 (Optional) Expanding the file system

By default a generic image has been copied to the SD card that is not configured to use the full space of the SD card.

In order to expand the file system to the full size of the SD card, the tool “**raspi-config**” can be used.

4.2.3.2 Getting the MAC-Address of the Box

The LoRaWAN network server services use the unique MAC-address of the box to identify it in the list of gateways. In order to find out the MAC address of the hardware the following command can be executed on the command line:

```
ifconfig | grep HWaddr
```

The box will output an address in the form of “**HWaddr: aa:bb:cc:dd:ee:ff**”². This is the 48 bit unique MAC address of the concrete hardware. Since the LoraWAN servers us a 64 bit unique address the 48bit address must be extended by adding a “**:FF:FE:**” in the middle of the address.

For example a 48 bit address of **aa:bb:cc:dd:ee:ff** will transformed in the 64 bit address of **aa:bb:cc:FF:FE:dd:ee:ff**.

This address will be used as identification address for the Lite Gateway within the LoRaWAN server.

The Lite Gateway needs to be configured before it can be used.

² Note: The string “aa:bb:cc:dd:ee:ff” is only a place holder for individual hexadecimal numbers.

4.3 Pre Installed LoRa Software

4.3.1 Update June 2017

The pre-installed LoRa clients need write access to the file system in order to make changes to the default configuration files. Since the file system is mounted in ReadOnly (RO) mode, the folders containing the tools will be copied to the `/tmp` folder of the system. The `/tmp` folder is mounted as a RAM file system and allows full Read/Write (RW) access. Please note that all changes to the `/tmp` folder are volatile and lost after a power cycle / re-boot.

On delivery there is the LoRa HAL software pre-installed on the SD card:

4.3.2 Github Repositories

The pre-installed github repositories are:

- "lora_gateway" (V4.1) (https://github.com/Lora-net/lora_gateway)
- "packet_forwarder" (V3.1) (https://github.com/Lora-net/packet_forwarder)

Both repositories have been installed on the folder `/home/pi/github`.

In general the code base has been untouched. There are only some adoptions to the current hardware connections. Especially the `reset_lgw.sh` script has been fitted to the used PCB.

Additionally a `systemd3.service` file has been installed in order to simplify to start of the lora packet forwarder. The file is named "IoTsemtech.service".

4.3.3 Loriot.io Client

Additionally to the gitub code base a loriot.io client binary has been installed on the SD card. It has been installed on the folder `/home/pi/loriot`.

Note: In order to use the loriot client an account on the <http://loriot.io> website has to be created.

Note 2: The loriot client uses an encrypted communication path to the loriot.io servers. This requires that the local system time setup correctly. Since the used Raspberry-Pi has no build-in RTC, an update of the system time has to be done at boot-up. Please make sure that the system as access to public time servers.

³ systemd is an init system used in several Linux distributions to manage bootstrapping user space processes.

4.3.4 Automatic Software Start

4.3.4.1 Packet_forwarder (github)

For demonstration purposes the system can be configured to start the LoRa client software “packet_forwarder” which is part of the github repository.

The Lite Gateway will try to connect to the iot.semtech.com server by using its individual 64 bit address. (see chapter 4.2.3.1).

The user can browse to the website <http://iot.semtech.com> and search for the gateway in the list of gateways presented there.

The usage of the iot.semtech.com service is out of the scope of this document.

In order to use the packet_forwarder, the following instructions have to be executed in the ssh command shell:

- Disable the packet_forwarder:
 - `sudo systemctl stop loriot`
 - `sudo systemctl disable loriot`
- Enable the loriot.io client
 - `sudo systemctl enable IoTSemtech`
 - `sudo systemctl start IoTSemtech`

The first two commands try to stop a running loriot application and try to remove this service from the list of services that should be started automatically during the boot process. The next two commands try to activate the automatic start of the IoTSemtech service at (next) boot time and try to start the service for the current session. If no change of the automatic start procedure is intended, commands two and three can be left out.

4.3.4.1.1 Update June 2017

Since the iot.semtech.com website does not allow new users to register themselves for this service, the loriot client has been activated as default client on delivery of the system.

4.3.4.2 Local Tests (github)

Next to the “packet_forwarder” there are other tools included within the github repositories that allow local tests with the hardware (e.g. logging each received LoRa packet in a .csv file).

In order to use these tools the “packet_forwarder” needs to be stopped via the command:

```
sudo systemctl stop IoTSemtech
```

4.3.4.3 Loriot Client:

Additionally there is a loriot.io client installed on the system. In order to use this service following instructions must be executed in the ssh command shell:

- Disable the packet_forwarder:
 - `sudo systemctl stop IoTSemtech`
 - `sudo systemctl disable IoTSemtech`
- Enable the loriot.io client
 - `sudo systemctl enable loriot`
 - `sudo systemctl start loriot`

Next the Lite Gateway has to be registered at the loriot.io service following the instructions given on the website.

The usage of the loriot.io service is out of the scope of this document.

5 Important Information / Shutdown Instructions

The system image of the SD-card is mounted with full read/write (rw) options by default. This allows the user to install and configure the system to individual needs.

On the other hand this means that the system has to be shutdown in an ordered way. **The user must not unplug the power supply without having issued the command:**

```
sudo halt
```

5.1 Update June 2017

Since the system is mounted in ReadOnly (RO) mode, the user is no longer required to issue a shutdown command to prevent data loss. However it is still recommended to shutdown the system in an ordered way.

6 Troubleshooting

If the (automatic) start of the LoRa clients does not work as expected a manual investigation on the problem can be started.

6.1 Only one Software at a Time

Only one piece of software can access the RF-hardware (iC880A) at the same time. Unfortunately there is no low level lock mechanism implemented that manages access trials. In case of unpredictable behavior it is a good practice to check if there is already another LoRa

software running.

6.2 Gateway does not show up on the LoRa server website

This situation may have several reasons. The remote server may be down, or the gateway has not been registered correctly.

In order to check the local setting some status information can be checked via the command:

```
sudo systemctl status IoTSemtech
```

or:

```
sudo systemctl status loriot
```

If there is a network related problem shown the user should check the network connection / setup. In some constellations the network service has not been setup completely before the automatic start of the LoRa client software is being triggered during the boot process. The user should consult the network administrator to solve the reason for the delayed setup.

6.3 No automatic Start at Boot Time

Some LoRaWAN clients need to have the correct time in order to start. Please check that the system has acquired a valid time from public time servers.

6.4 Disk Space

The Lite Gateway runs a normal Debian based Linux system that has full write access to the SD-Card. This means that the system will use the disk space to write various log information to disk. Since the limited size of the SD-Card it is recommended to clean up the log files from time to time in order to prevent system errors based on short disk space.

6.4.1 Update June 2017

In default mode the system starts in ReadOnly (RO) mode. That means that there will be no write operations to the SD card. Therefore there is no storage of various log information that persist a power cycle.

6.5 Important Notice

6.5.1 Disclaimer

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