LORIX*One*

Low cost LoRa IP43/IP65 gateway

User manual

Waterproof N connector

10/100Mbps ethernet Passive PoE 24V

Config/factory reset

Status LED

USB debug serial

Storage extension SD-CARD
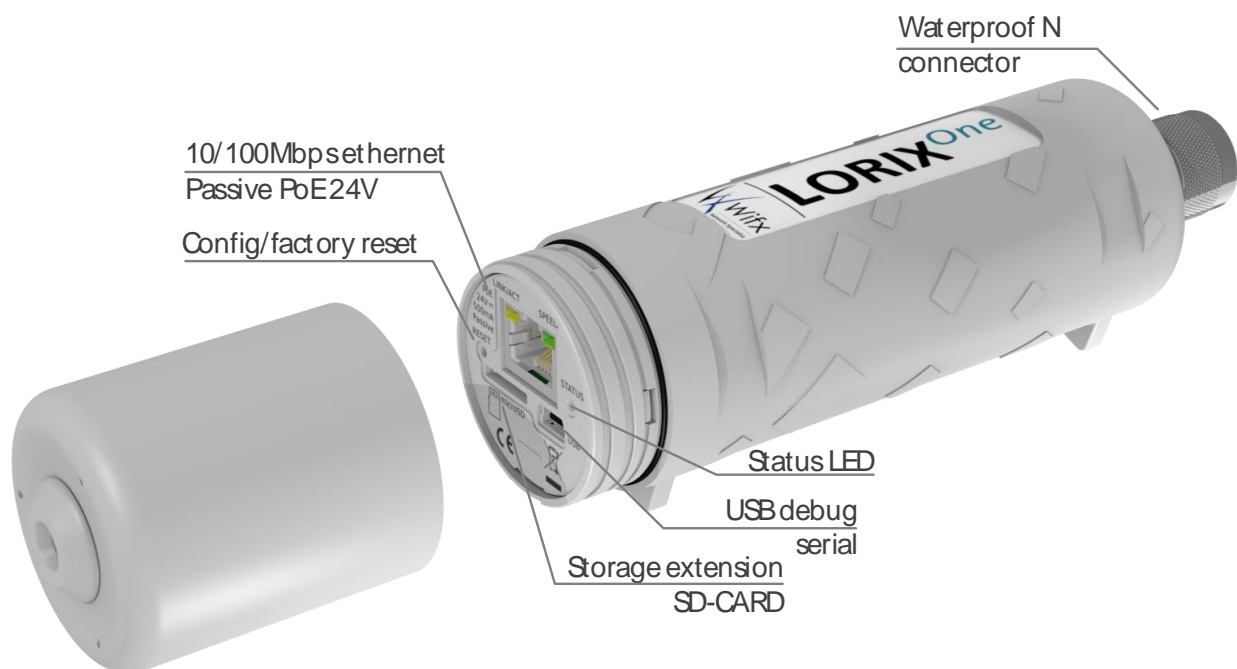
Versions:

Revision	Note	Date
0.1	Initial creation	08/14/2016
0.2	Modified	09/08/2016
0.9	Product release pre-revision	04/21/2017
1.0	Added TTN cloud application Added system update	05/03/2017
1.1	Updated operating temperature and power supply following safety certification requirements	07/30/2017

1 Summary

2 PRODUCT SPECIFICATIONS

| Version	IP43 (Semi-waterproof)		IP64 (Waterproof)
Physical specifications			
Dimensions	See 11.1 IP43 (Semi-waterproof)		See 11.2 IP65 (Waterproof)
Weight	< 230 grams		
Connectors			
	1 RJ45 Ethernet 10/100Mbps port Max 100m. length, use shielded cable for outdoor use		
	1 USB micro-B service connector (service access only)		
	1 N type RF antenna connector		
	1 microSD SD Memory Card Specification v2.0 slot		
Power specifications			
Input supply	24VDC 500mA (through passive PoE)		
Power supply	See 6.1 Power through passive PoE		
Consumption	See 10.1 Power consumption		
Climatic specifications			
Operating temperature	-30°C to +55°C -5°C to +40°C for the power supply HNP12-240L6, indoor use only		
Storage temperature	-20°C to +70°C		
Operating humidity	10% to 90% RH Non-condensing		
Storage humidity	5% to 90% RH Non-condensing		
Certifications compliance			
Radio & EMC	RED 2014/53/EU (European Radio Equipment Directive)		
	ETSI EN 300 220-2		
	EN 61000-6-1:2007 IEC 61000-6-1:2005 (ed2.0)		
	ETSI EN 301 489-3 V1.6.1:2013		
Human safety	EN 62209-2 IEC/EN 62479-1		
Electrical safety	EN 60950		
System			
CPU	ARM® Cortex™-A5 @ 600MHz		
RAM	128 MBytes DDR2 @ 200MHz		
Internal memory	256 MBytes NAND FLASH with 4bit hardware ECC		
External memory	microSD card slot, SDHC compatible, can be used as boot source		

TABLE 1 PRODUCT SPECIFICATION

3   GENERAL INFORMATION

3.1   WIKI

The LORIX One wiki is accessible at www.lorixone.io/wiki and contains information about technical use of the product. It contains for example explanation on how to use the toolchain to create custom binaries or to flash the internal NAND memory.

4   CONNECTIVITY/INTERFACE
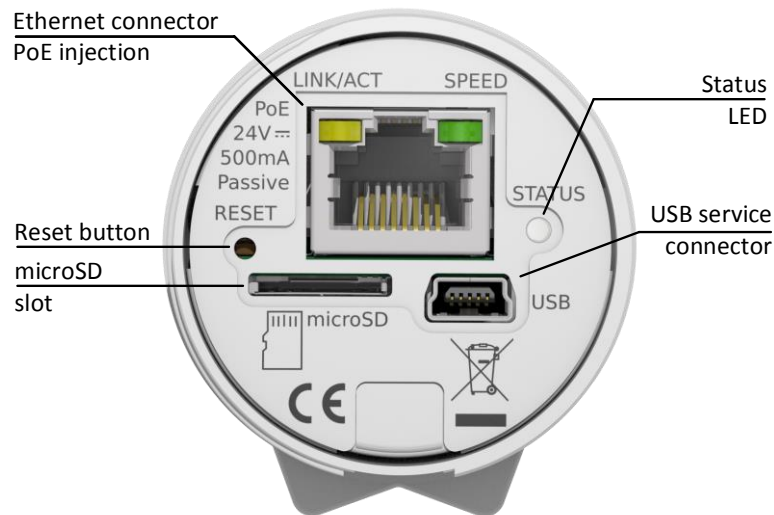
5   START/RESET

The gateway automatically boots when connected to passive PoE through the Ethernet cable. On boot, the status LED blinks shortly then goes off to signal the power up status. Once the Linux OS started, the status LED starts blinking in "heartbeat" mode.

The reset button can be used to reset the gateway, to enter in factory reset mode or to enter in debug programming mode. For a simple reset, just press the reset button with a thin tool like a paper clip shortly. On release, the status LED will flash shortly and then goes off to signal the reset action.

5.1   PROCEDURES

Short-press

Pressure during less than 1 second. The blue LED blinks shortly on release.

Long-press

Pressure for long time. The blue LED blinks shortly after the delay.

Status LED

A short flash from the blue LED

Normal reset procedure

1. Short-press
2. The status LED flashes on release and the gateway reboots.

Factory reset procedure

The factory reset procedure is used to put back the default parameters. It's useful in case of network misconfiguration for example or if in case of a forgotten password which would be reset.

1. Wait at least one second from another reset pressure
2. Long-press for at least 10 seconds
3. After the blue LED flashes, release the reset button
4. The gateway boot in factory reset mode

> 10sec
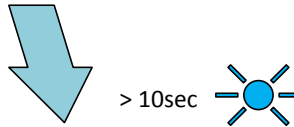
Programming mode procedure

This mode is used to enter in programming mode. Useful to reprogram the gateway using the Atmel SAM-BA programming tool by USB as explained in the wiki.

1. Remove an eventual microSD card
2. Wait at least one second from another reset pressure
3. 2 shorts press with less than 1 second between each
4. Third long press for more than 3 seconds (and less than 5 seconds)

< 1sec   < 1sec

> 3sec
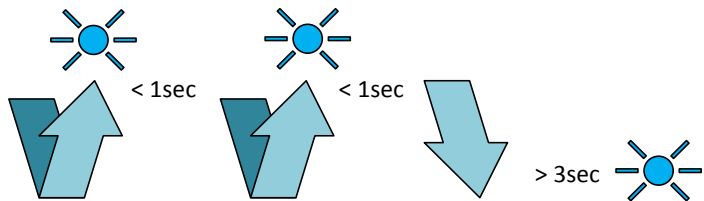
6 ETHERNET/PoE

Connector details:

RJ45 Pin number	Color wire	Function	
1	Green	TX+	
2	Green/white	TX-	
3	Orange	RX+	
4	Blue	VPOE1	Voltage 1 for PoE powering (must be connected with terminal 5)
5	Blue/white	VPOE1	Voltage 1 for PoE powering (must be connected with terminal 4)
6	Orange/white	RX-	
7	Brown	VPOE2	Voltage 2 for PoE powering (must be connected with terminal 8)
8	Brown/white	VPOE2	Voltage 2 for PoE powering (must be connected with terminal 7)

TABLE 2 ETHERNET/POE CONNECTION

The yellow LED shows the LINK and the ACTIVITY on the Ethernet connection:

OFF   No link
ON   Link
Blink   Link and activity

The green LED shows the actual SPEED of the Ethernet connection:

OFF   10Base-T
ON   100Base-TX

6.1 POWER THROUGH PASSIVE PoE

The LORIX One gateway is exclusively powered through passive PoE using the Ethernet connector. The power is injected through a PoE injector as shown:
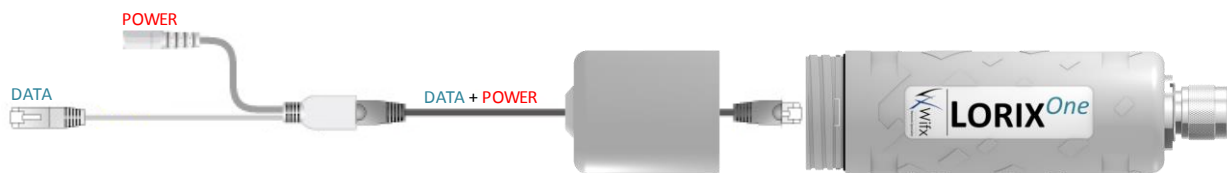
V_{POE1} and V_{POE2} (in Table 2) represent the two power lines of the gateway. Power must be injected in the power input connector using only the switching power supply provided with the LORIX One:

Reference   HNP12-240L6
Output voltage   24VDC
Output courant   500mA

7 ADMINISTRATION TERMINAL ACCESS

The embedded Linux can be accessed through either the USB connector or through SSH with a working Ethernet connection.

7.1 USB

The LORIX One gateway has an USB micro-B type connector which provides virtual COM port. Accessing the gateway this way allows you to debug and configure the software. This is the only way to access the terminal when the network isn't accessible (without SSH access).

> **USB Connection consideration**
>
> Please note that the gateway can't be powered through the USB and needs to be powered with the passive PoE through the Ethernet cable.
>
> In addition, the USB connection is only intended to be used for administration/configuration and should not be left connected during normal use. In addition, the IPxx level is not guarantee during USB service connector use.

To access the gateway with USB:

1. Power up the gateway with passive PoE through the Ethernet cable
2. Connect a PC to the gateway with a A ⇔ mini-B cable
3. The virtual COM port is automatically detected by the PC

a. On Windows a new virtual COM port appears in the device manager with the name **COMxx**
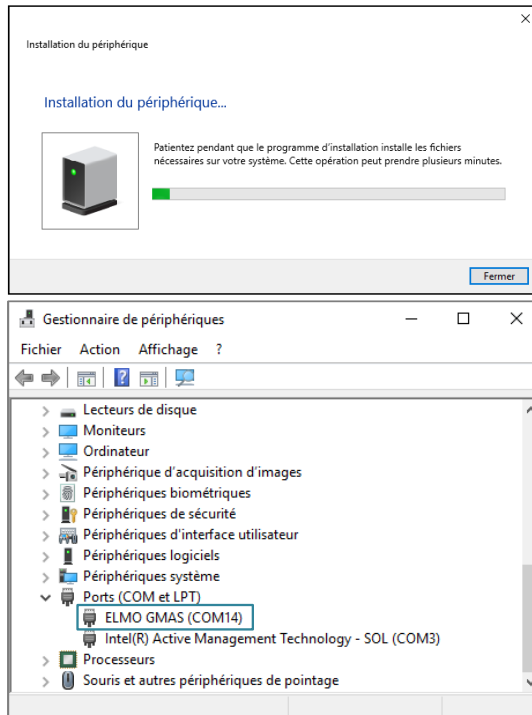
b. On Linux a new virtual COM port appears in **/dev/ttyACMxx**

4. A terminal program like PuTTY or minicom can be used with the following parameters:

baudrate   **115200**
data bits   **8**
stop bits   **1**
parity   **none**
flow control   **none**

7.2   SSH

The LORIX One gateway provides a SSH server and can be accessed through SSH as soon as connected to a working network using a SSH client program like PuTTY or ssh on Linux.

You need to know its IP address in order to access the gateway through SSH.

To access the gateway with SSH:

1. Power up the gateway with passive PoE through the Ethernet cable
2. A terminal program like PuTTY or ssh can be used with the following parameters:
    address   **depending on your config**
    port   **22**
3. Accept the RSA key fingerprint as asked

8   SYSTEM ACCESS & CONFIGURATION

8.1   LOGIN

When the connection is made by USB, the following text appears:

```
Poky (Yocto Project Reference Distro) 2.1.2 sama5d4-lorix-one /dev/ttyGS0

sama5d4-lorix-one login:
```

With SSH:

```
Login as:
```

The login by default is **admin** and password **lorix4u**. It strongly recommended to change the password as soon as possible and as explained in the user/access chapter.

Enter the login admin and validate with ENTER to be prompted for the password:

```
login as: admin
admin@root's password:
 _     ___  ____  _____  __   ___
| |   / _ \|  _ \|_ _\ \/ /  / _ \ _ __   ___
| |  | | | | |_) || | \  /  | | | | '_ \ / _ \
| |__| |_| |  _ < | | /  \  | |_| | | | |  __/
|_____/|_| \_\___/_/\_\  \___/|_| |_|\___|
--------------------------------------------------
LoRa gateway                            www.lorixone.io

sama5d4-lorix-one:~$
```

8.2   USER/PASSWORD

> **Security issue with the default password**
>
> By default, all the gateways have the same password and user should change it before any "production" use. As usual, complex password with lower and uppercase, number and special character is preferable to increase the security of the access.

8.2.1   DEFINE OR CHANGE A PASSWORD
To define a new password, use the **passwd** command as follow:

```
sama5d4-lorix-one:~$ passwd
Changing password for admin
Enter the new password (minimum of 5 characters)
Please use a combination of upper and lower case letters and numbers.
New password: <new password>
Re-enter new password: <new password>
passwd: password changed.
```

8.3   ROOT PRIVILEGES
Most of the files or executables are limited to root access on the gateway. The main goal is to protect and avoid wrong manipulation. Depending on the rights of these files, to read, write or execute them unless being root user.

8.3.1   SUDO COMMAND
Given that terminal access isn't possible with root user (for security reasons), the command **sudo** can be used to temporarily execute a command as root user:

```
sama5d4-lorix-one:~$ sudo reboot
Password:
```

The command reboot is executed as root user after the password has been entered which is not possible as admin user. The sudo command is valid once a time and must be applied for each command needed to be executed as root. Once the password is entered, it's cached for 15min.

8.3.2   SU COMMAND
It's sometime useful to manipulate multiple files with root access without using the sudo command for each action. This can be done by using the **su** command (stands for substitute user) which permits to change the session's owner and can, for example, be used to become the root user.

```
sama5d4-lorix-one:~$ whoami
admin
```

The actual user is **admin**.

```
sama5d4-lorix-one:~$ sudo su
Password:
sama5d4-lorix-one:/home/admin# whoami
root
```

The command **sudo su** allows becoming root (su command without argument is a shortcut for su root).

```
sama5d4-lorix-one:/home/admin# su admin
sama5d4-lorix-one:~$ whoami
admin
```

As root user, the sudo command isn't necessary to use the command su.

> **Security issue or error using su command**
>
> The commands sudo and su are powerful and allow user to modify/corrupt important files or (mis)use critical command. su command is particularly dangerous since user may forget its privileges over the time.

8.4   EDIT A FILE

You can edit a file with two different program, Vi or Nano. They are both very simple but very different in term of use.

8.4.1   USING VI

Vi is less intuitive but very efficient when you master it. You can edit a text file, existing or not using the following command:

```
sama5d4-lorix-one:~$ vi file.txt
```

Or prefixed with sudo if the file is root access protected.

Once opened, there is two main mode, insert or command in which we begin.

Basically, you pass from the command mode to the insert mode by typing "i" or "a".

"i" for insert will begin insertion where the cursor is.

"a" for append will begin insertion at the next character.

In the insert mode, you can modify the file as any text editor and you can quit the insert mode by simply typing ESC.

In the command mode, you can type ":" followed by one or many command:

":w" for writing the modifications

":q" to quit the program

":q!" to force quitting if modification has been made but not saved

":wq" to write and quit

There are other options which will not be described here but many tutorial can be found on the web.

8.4.2   USING NANO

Nano is less efficient but far more intuitive and user friendly. This is the one you would choose if you are not familiar with terminal. You can edit a text file, existing or not using the following command:

```
sama5d4-lorix-one:~$ nano file.txt
```

Or prefixed with sudo if the file is root access protected.

Once opened, you can navigate in the file with the arrow key, modify, add or delete text like a standard file editor.

Nano use the CTRL key to accept command and is easy to use since all the command are detailed at the bottom. The "^" character represent the CTRL key. For example, you can quit nano using CTRL+X.

8.5   CONFIGURING LAN CONNECTION PARAMETERS

The network parameters are in the file **/etc/network/interfaces**. You can use your favourite edit program to modify it:

```
sama5d4-lorix-one:~$ sudo vi /etc/network/interfaces
```

And the content by default:

```
# /etc/network/interfaces -- configuration file for ifup(8), ifdown(8)

# The loopback interface
auto lo
iface lo inet loopback

# Wired or wireless interfaces
auto eth0
iface eth0 inet static
    address 192.168.1.50
    netmask 255.255.255.0
    gateway 192.168.1.1
    dns-nameservers 192.168.1.1
```

The first group defines the local network loop and should not be modified unless you know what you are doing. The second group defines the main Ethernet port of the gateway (namely eth0). It's configured with a static IP address by default (192.168.1.50).

8.5.1   STATIC CONFIGURATION
It possible to configure a static configuration with parameters as follow:

```
auto eth0
iface eth0 inet static
    address <IP address>
    netmask <Network mask>
    gateway <Gateway IP address>
    dns-nameservers <DNS1 address> [<DNS2 address>] [<DNS3 address>]
```

8.5.2   DHCP CONFIGURATION
It possible to configure a DHCP configuration with parameters as follow:

```
auto eth0
iface eth0 inet dhcp
```

8.5.3   NETWORK RESTARTING
Once the parameters are saved, you can restart (or simply stop) the networking system by using the networking script file:

```
sama5d4-lorix-one:~$ sudo /etc/init.d/networking {start|stop|restart}
```

> **Warning concerning network modification and SSH**
>
> If you access the gateway with SSH, keep in mind that modification in the network interface could stop your connection with the gateway.

8.6   SYSTEM UPDATE

The product has the possibility to be updated manually using the package manager **opkg** which is similar to the Debian package manager dpkg in a lighter version.

8.6.1   MAIN SERVERS

The main server containing the packages is located at http://lorixone.io/yocto/feeds/2.1.2/. This information is written in the file **/etc/opkg/base-feeds.conf** of the gateway and can be modified to handle more server addresses for example.

More information about opkg can be found at https://code.google.com/archive/p/opkg/ or in the Yocto documentation which can generate directly all the packages for the product.

8.6.2   MANUAL UPDATE

To update the list of available package (without updating the packages), the following command must be done prior to any update (it will not affect the system at this point):

```
sama5d4-lorix-one:~$ sudo opkg update
Downloading http://lorixone.io/yocto/feeds/2.1.2/all/Packages.gz.
Updated source 'all'.
Downloading http://lorixone.io/yocto/feeds/2.1.2/cortexa5hf-neon/Packages.gz.
Updated source 'cortexa5hf-neon'.
Downloading http://lorixone.io/yocto/feeds/2.1.2/sama5d4_lorix_one/Packages.gz.
Updated source 'sama5d4_lorix_one'.
Downloading http://lorixone.io/yocto/feeds/2.1.2/sama5d4_lorix_one/Packages.gz.
Updated source 'sama5d4_lorix_one_sd'.
```

Once the list of packages updated, you can start the update by running:

```
sama5d4-lorix-one:~$ sudo opkg upgrade
```

This command will update every packages already installed and which are not up to date.

> **Services stop during updates**
>
> If updates are available, some services which are concerning could be stopped during the update and then restarted afterwards, for example, LoRa cloud applications.

8.6.3   PACKAGE INSTALL

Some packages which are not installed by default can be installed using the following command:

```
sama5d4-lorix-one:~$ sudo opkg install <pkgs>
```

Packages availability can be consulted at the address http://lorixone.io/yocto/feeds/2.1.2/ and under each subdirectories in the files **Packages**.

8.7   CLOUD APPLICATIONS

8.7.1   LORIOT

The LORIX One gateway is preinstalled with the LORIOT cloud application. The application is available under the directory **/opt/lorix/clouds/loriot**.

To test the LORIOT cloud, create an account for free at loriot.io and add a new gateway using the MAC address of your LORIX gateway (under the form XX:XX:XX:XX:XX:XX) which you can find on the back label or using the command ifconfig under Linux (SSH or USB):

```
sama5d4-lorix-one:~$ ifconfig
eth0       Link encap:Ethernet HWaddr XX:XX:XX:XX:XX:XX
           […]
lo         Link encap:Local Loopback
           […]
```

8.7.2   PACKET-FORWARDER

Semtech provides as well a packet forwarder (https://github.com/Lora-net/packet_forwarder). The related program and some other utilities related to it are available in the directory **/opt/lorix/clouds/packet_forwarder**.

The main configuration file is global_conf.json and contains with other parameters the TX lookup table of the gateway. The file global_conf_2dBi_indoor.json and global_conf_4dBi_outdoor.json contain respectively the power for indoor and outdoor antenna.

To modify the power table and use the 2dBi antenna:

```
sama5d4-lorix-one:~# cd /opt/lorix/clouds/packet-forwarder/
sama5d4-lorix-one:/opt/lorix/clouds/packet-forwarder# sudo cp global_conf_2dBi_indoor.json
global_conf.json
```

The file local_conf.json contains more gateway specific parameters and can be customized according to source code.

8.7.3   TTN PACKET-FORWARDER

The Things Network is a free and collaborative LoRa network. The cloud application is based on the Semtech packet-forwarder and is available under the directory **/opt/lorix/clouds/ttn**.

The main configuration file is global_conf.json and contains with other parameters the TX lookup table of the gateway as the standard packet-forwarder. The file EU_global_2dBi_indoor.json and EU_global_4dBi_outdoor.json contain respectively the power for indoor and outdoor antenna.

To modify the power table and use the 2dBi antenna:

```
sama5d4-lorix-one:~# cd /opt/lorix/clouds/ttn/
sama5d4-lorix-one:/opt/lorix/clouds/ttn# sudo cp EU_global_conf_2dBi_indoor.json global_conf.json
```

The file local_conf.json contains (and can be updated) latitude, longitude, altitude, description and administrator e-mail.

8.7.4   WIFX CLOUDS-MANAGER

The desired clouds can be easily configured by SSH or USB using the following command:

```
sama5d4-lorix-one:~$ /etc/init.d/clouds-manager.sh {start|stop|restart|force-reload|status|configure}
```

It permits to see the actual status of the running cloud if any without special permission but needs to be root to modify configuration, start, stop or restart.

8.7.4.1   CONFIGURATION

Before running the configuration, you need to stop eventual running cloud:

```
sama5d4-lorix-one:~$ /etc/init.d/clouds-manager.sh stop
Password:
Stopping cloud loriot... done.
```

Once stopped, you can modify the configuration:

```
sama5d4-lorix-one:~$ /etc/init.d/clouds-manager.sh configure
=======================================
| LORIX One clouds manager configuration |
=======================================
```

```
Actual configuration:
  autostart=true
      cloud=loriot

Do you want to enable autostart at boot time?
[Yes|No]
 > no

Which cloud app. do you want to use ?
[loriot|packet-forwarder|ttn]
 > loriot

New configuration:
  autostart=false
      cloud=loriot
```

It allows two parameters, the first one is the "autostart" option which defines if either or not the cloud will start automatically during boot time (default=yes).

The second option which is asked for is the cloud itself and let you decide now between LORIOT, the Semtech packet-forwarder or the TTN (The Things Network) packet-forwarder.

8.8   LoRa concentrator utilities

> **Clouds-manager incompatibility**
>
> Please note that the clouds-manager and its sub application cloud can't run during usage of tests and util applications. Prior to use tools, the clouds-manager should be stopped as explained at the point 8.7.4 Wifx clouds-manager

Semtech provides utilities to test the SX1301 LoRa concentrator chip and to perform RX/TX performance tests as well. All the binaries relative to gateway are located under the **/opt/lorix/utils** directory ordered into subdirectory.

8.8.1   SX1301 reset pin control
The reset pin of the SX1301 LoRa concentrator chip is accessible through the script **/etc/init.d/reset_lgw**.

```
sama5d4-lorix-one:~$ sudo /etc/init.d/reset_lgw {start|stop|restart}
```

The **start** argument will disable the reset signal and activates the SX1301.
The **stop** argument will enable the reset signal and deactivates the SX1301.
The **restart** will perform a pulse on the reset signal then activates the SX1301.

This script is automatically called with **start** during system start and with **stop** during system shutdown.

8.8.2   Test binaries
All the test binaries related to the **libloragw** (https://github.com/Lora-net/lora_gateway) are located into the **/opt/lorix/tests** folder.

The following tests are available:

```
test_loragw_cal
test_loragw_hal
test_loragw_spi
test_loragw_gps
test_loragw_reg
```

The related Git repository gives more information.

8.8.3   Util binaries
On the top of the **libloragw** library, the **lora_gateway** repository provides utilities to test RX/TX functionalities of the SX1301 LoRa concentrator.

The following utils are available under the directory **/opt/lorix/utils**:

```
util_lbt_test
util_pkt_logger
util_spectral_scan
util_spi_stress
util_tx_continuous
util_tx_test
```

In addition, the configuration files **global_conf.json** and **local_conf.json** are used by the program **util_pkt_logger**. They provide parameters for channels configuration, etc.

9 SD CARD

The LORIX One gateway has a microSD slot and is compatible with microSD cards following the SD Memory Card Specification Version 2.0 including SDHC.

A microSD card can be used to extend the internal FLASH memory (256MB), alternatively, the gateway can boot from the SD card if a bootable file is found.

9.1.1 INSERTION/REMOVAL

To insert the SD card, simply push it into the hole until it makes a "click" sound. To remove it, push it again until the "click" sound, the SD card will stand out on release.
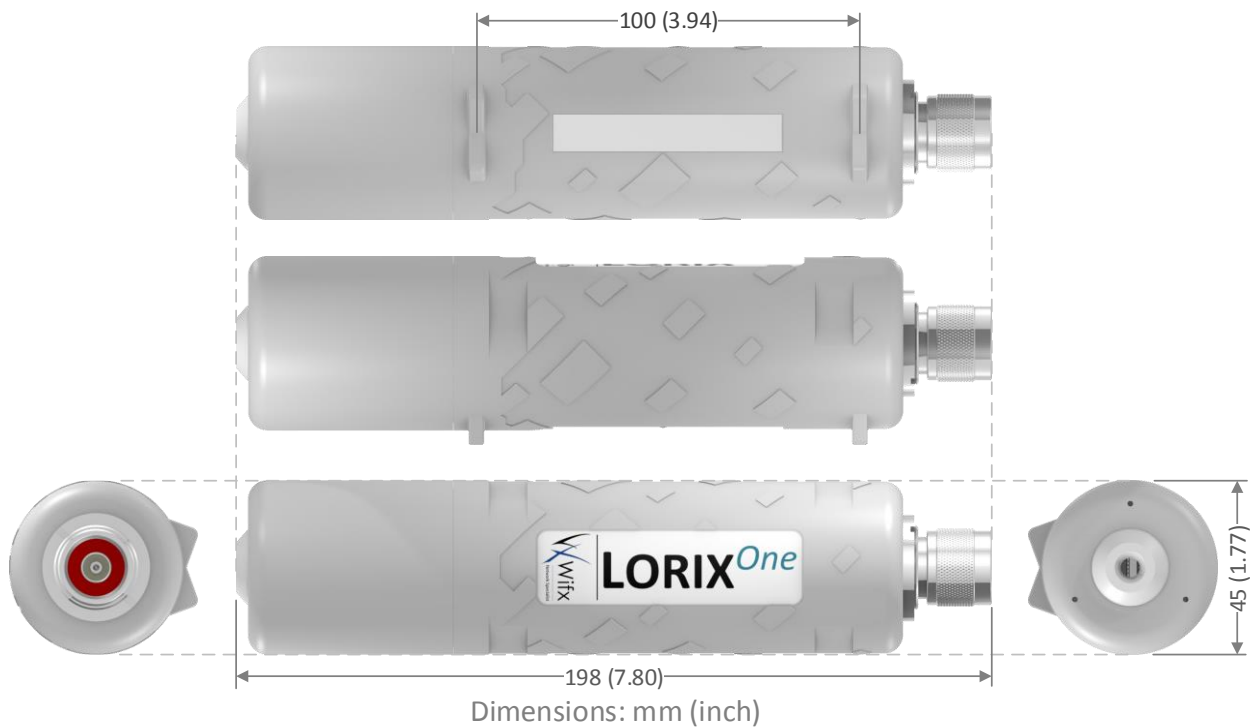
10 ELECTRICAL

10.1 POWER CONSUMPTION

Task (@ 20°C ambient)	Voltage [V]	Current [mA]	Power [W]
Linux only running RF part disable	24	42	1,01
LoRa gateway with util_pkt_logger 6 channels for RX	24	105	2,52
LoRa gateway with util_pkt_logger 8 channels for RX	24	117	2,81

11 MECHANICAL

11.1 IP43 (SEMI-WATERPROOF)

Dimensions: mm (inch)

11.2 IP65 (WATERPROOF)

Dimensions: mm (inch)

11.3 FIXATION

The LORIX One gateway is designed to be placed **vertically** with antenna **upwards**.
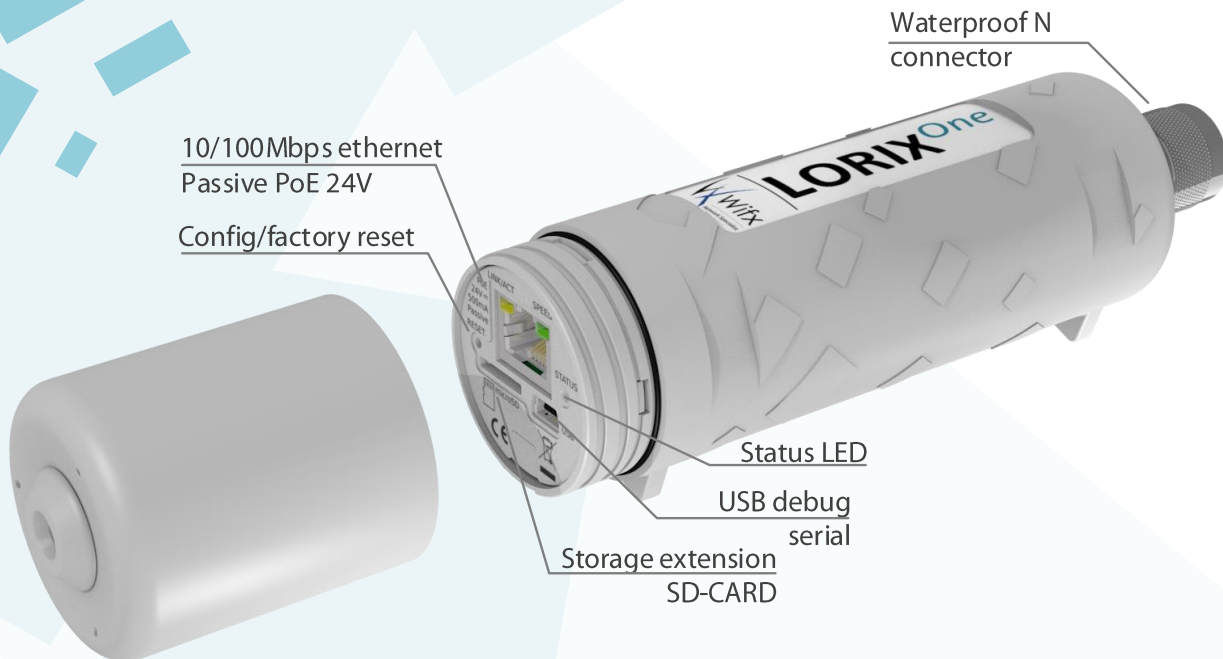
If you wish to tighten the LORIX One to a pole, you can do it with the provided mounting loops. The LORIX One comes bundled with two mounting loops - guide the loops around the LORIX One though the provided edge markings, and around the pole where it will be mounted.

You should avoid connecting a loose Ethernet cable to the Ethernet port, secure the cable to a wall or the pole, so that the cable weight is not pulling the port. It's recommended to secure the Ethernet cable less than 2m. from the gateway device. This is to ensure that the cable doesn't damage the port by its weight or doesn't fall out.

LORIX *One*

EXCELLENT PRICE/QUALITY RATIO LORAWAN™ GATEWAY

– Passive PoE 24VDC
– IP43 and IP65 versions
– Quick and easy to deploy
– -30 to +55°C

Waterproof N connector

10/100Mbps ethernet
Passive PoE 24V

Config/factory reset

Status LED

USB debug serial

Storage extension SD-CARD

MAIN SYSTEM

CPU	ARM® Cortex™-A5 600MHz
RAM	128MBytes DDR2 200MHz
NAND	256MBytes flash with PMECC

OS/SOFTWARE

- Linux Yocto 4.4
- Base configuration and factory reset
- Prebuilt with:
    - SSH server
    - Python
    - LORIOT cloud app
    - The Thing Network cloud app
    - Semtech packet-forwarder
- Toolchain/sources completely open

WORKS WITH

Indoor 20cm inclinable antenna @ 2dBi

Outdoor IP65 50cm antenna @ 4.15dBi

CONNECTIVITY

Ethernet 10/100Mbps with passive PoE 24VDC
Permits to bring power and data with only one cable
SD-CARD Slot to extend/replace the internal flash
USB connector providing serial interface to
manage/update the gateway

LORA/RF SYSTEM

SX1301 gateway chip SPI based
8 channels, 49 demodulators @ 868MHz
RX sensitivity: -140dBm (LoRa) / -110dBm (FSK)
TX power: 27dBm

DIMENSIONS

IP43

IP65

45 (1.77)

45 (1.77)

198 (7.80)

Dimensions: mm (inch)

LORIX *One*

made by

Wifx
Network Specialist

in collaboration for the software with

LORIO T