LORIX One
Low cost LoRa IP43/IP65 gateway
User manual

Versions:

<table>
<thead>
<tr>
<th>Revision</th>
<th>Note</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Added TTN cloud application</td>
<td>05/03/2017</td>
</tr>
<tr>
<td></td>
<td>Added system update</td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Updated operating temperature and power supply following safety certification requirements</td>
<td>07/30/2017</td>
</tr>
<tr>
<td>1.2</td>
<td>Added Kersing packet-forwarder and updated others packet-forwarders and clouds-manager with manual forwarder option</td>
<td>21/04/2018</td>
</tr>
<tr>
<td>1.3</td>
<td>Added US version</td>
<td>08/05/2018</td>
</tr>
<tr>
<td>1.4</td>
<td>Updated FCC and IC legal texts and added installation description</td>
<td>06/07/2018</td>
</tr>
<tr>
<td>1.5</td>
<td>Updated NAND memory based on HW version</td>
<td>03/09/2018</td>
</tr>
<tr>
<td>1.6</td>
<td>Updated graphics with latest Wifx logo and added RF specifications table</td>
<td>02/14/2019</td>
</tr>
</tbody>
</table>
1 SUMMARY

1 Summary .................................................................................................................................................. 2
2 Product Specifications .............................................................................................................................. 4
3 Regulations ............................................................................................................................................... 6
  3.1 Version 868MHz band ......................................................................................................................... 6
    3.1.1 Europe / CE ..................................................................................................................................... 6
  3.2 Version 915MHz band ......................................................................................................................... 7
    3.2.1 USA / FCC ...................................................................................................................................... 7
    3.2.2 Canada / IC .................................................................................................................................... 7
    3.2.3 Australia/New Zealand ................................................................................................................... 8
4 General information .................................................................................................................................. 9
  4.1 Wiki ...................................................................................................................................................... 9
    4.1.1 Update information ........................................................................................................................... 9
    4.1.2 Troubleshooting ................................................................................................................................ 9
    4.1.3 Open source licenses ...................................................................................................................... 9
  4.2 Connectivity/Interface ......................................................................................................................... 9
  4.3 Start/Reset ........................................................................................................................................... 10
    4.3.1 Procedures ....................................................................................................................................... 10
5 Ethernet/PoE .......................................................................................................................................... 12
  5.1 Power through passive PoE .................................................................................................................. 12
6 Administration terminal access .............................................................................................................. 13
  6.1 USB ...................................................................................................................................................... 13
  6.2 SSH ...................................................................................................................................................... 14
7 System access & configuration .............................................................................................................. 15
  7.1 Login .................................................................................................................................................. 15
  7.2 User/Password ..................................................................................................................................... 15
    7.2.1 Define or change a password ........................................................................................................... 15
  7.3 Root privileges ..................................................................................................................................... 15
    7.3.1 Sudo command ............................................................................................................................... 15
    7.3.2 Su command ................................................................................................................................... 16
  7.4 Edit a file ............................................................................................................................................. 16
    7.4.1 Using Vi ........................................................................................................................................... 16
    7.4.2 Using Nano ..................................................................................................................................... 17
  7.5 Configuring LAN connection parameters .......................................................................................... 17
    7.5.1 Static configuration ......................................................................................................................... 17
    7.5.2 DHCP configuration ...................................................................................................................... 18
    7.5.3 Network restarting ......................................................................................................................... 18
  7.6 System update .................................................................................................................................... 18
    7.6.1 Main server ..................................................................................................................................... 18
    7.6.2 Manual update ................................................................................................................................. 18
7.6.3 Package installation ........................................................................................................... 19
7.7 Cloud applications .................................................................................................................. 20
  7.7.1 LORIOT .......................................................................................................................... 20
  7.7.2 Semtech packet-forwarder .............................................................................................. 22
  7.7.3 TTN Packet-forwarder ..................................................................................................... 24
  7.7.4 Kersing mp-packet-forwarder ......................................................................................... 26
  7.7.5 Wifx clouds-manager ...................................................................................................... 28
7.8 LoRa concentrator utilities .................................................................................................... 29
  7.8.1 Gateway ID update script ............................................................................................... 29
  7.8.2 SX1301 reset pin control ................................................................................................. 29
  7.8.3 Test binaries ..................................................................................................................... 30
  7.8.4 Util binaries ...................................................................................................................... 30
8 SD Card ................................................................................................................................... 31
  8.1.1 Insertion/Removal .......................................................................................................... 31
  8.1.2 SD card detection ............................................................................................................ 31
  8.1.3 SD card (un)mounting .................................................................................................... 31
9 Electrical .................................................................................................................................. 32
  9.1 Power consumption ............................................................................................................. 32
10 Mechanical ............................................................................................................................. 33
  10.1 LORIX One ......................................................................................................................... 33
    10.1.1 IP43 (Semi-waterproof) ............................................................................................... 33
    10.1.2 IP65 (Waterproof) ....................................................................................................... 33
  10.2 Antenna 4dbi (868 & 915 versions) ................................................................................... 33
  10.3 Antenna 2.15dbi (868 versions) ......................................................................................... 34
11 Setup guide ............................................................................................................................. 35
  11.1 General recommendations ................................................................................................. 35
  11.2 Standard mounting using a pole......................................................................................... 35
## 2 PRODUCT SPECIFICATIONS

<table>
<thead>
<tr>
<th>Version</th>
<th>IP43 (Semi-waterproof)</th>
<th>IP64 (Waterproof)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical specifications</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimensions</td>
<td>See <strong>10.1.1 IP43 (Semi-waterproof)</strong></td>
<td>See <strong>10.1.2 IP65 (Waterproof)</strong></td>
</tr>
<tr>
<td>Weight</td>
<td>&lt; 230 grams</td>
<td></td>
</tr>
<tr>
<td><strong>Connectors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 RJ45 Ethernet 10/100Mbps port</td>
<td>Max 100m. length, use shielded cable for outdoor use</td>
<td></td>
</tr>
<tr>
<td>1 USB micro-B service connector (service access only)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 N type RF antenna connector</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 microSD SD Memory Card Specification v2.0 slot</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Power specifications</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input supply</td>
<td>24VDC 500mA (through passive PoE)</td>
<td></td>
</tr>
<tr>
<td>Power supply</td>
<td>See <strong>5.1 Power through passive PoE</strong></td>
<td></td>
</tr>
<tr>
<td>Consumption</td>
<td>See <strong>9.1 Power consumption</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Climatic specifications</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating temperature</td>
<td>-30°C to +55°C</td>
<td>-5°C to +40°C for the power supply (S-)HNP12-240L6, indoor use only</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-20°C to +70°C</td>
<td></td>
</tr>
<tr>
<td>Operating humidity</td>
<td>10% to 90% RH Non-condensing</td>
<td></td>
</tr>
<tr>
<td>Storage humidity</td>
<td>5% to 90% RH Non-condensing</td>
<td></td>
</tr>
<tr>
<td><strong>System</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPU</td>
<td>ARM® Cortex™-A5 @ 600MHz</td>
<td></td>
</tr>
<tr>
<td>RAM</td>
<td>128 MBytes DDR2 @ 200MHz</td>
<td></td>
</tr>
<tr>
<td>Internal memory</td>
<td>Up to <strong>1.0d</strong> HW version: 256 MBytes NAND FLASH with 4bits hardware ECC (Micron MT29F2G08ABAEAH4)</td>
<td>From <strong>1.0d2</strong> HW version: 512 MBytes NAND FLASH with 8bits hardware ECC (Micron MT29F4G08ABAEAH4)</td>
</tr>
<tr>
<td>External memory</td>
<td>microSD card slot, SDHC compatible, can be used as boot source</td>
<td></td>
</tr>
</tbody>
</table>

**TABLE 1 PRODUCTS SPECIFICATIONS**
<table>
<thead>
<tr>
<th>Version</th>
<th>EU868</th>
<th>US915</th>
<th>AU915</th>
</tr>
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<tbody>
<tr>
<td>RF specification</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LoRa modulation</td>
<td>863-873MHz</td>
<td>902-928MHz</td>
<td>915-928MHz</td>
</tr>
<tr>
<td>Following Table 3: Certification compliance version 868MHz for Europe</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FSK Modulation</td>
<td>863-873MHz</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Following Table 3: Certification compliance version 868MHz for Europe</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TABLE 2 PRODUCTS RF SPECIFICATIONS
3 REGULATIONS

3.1 VERSION 868MHZ BAND

3.1.1 EUROPE / CE

The LORIX One (IP43 & IP65) 868MHz version complies with requirements listed in article 3 of the RED 2014/53/EU directive:

<table>
<thead>
<tr>
<th>Certification compliance</th>
<th>RED 2014/53/EU (European Radio Equipment Directive)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ETSI EN 300 220-2</td>
</tr>
<tr>
<td></td>
<td>EN 61000-6-1:2007</td>
</tr>
<tr>
<td></td>
<td>IEC 61000-6-1:2005 (ed2.0)</td>
</tr>
<tr>
<td></td>
<td>ETSI EN 301 489-3 V1.6.1:2013</td>
</tr>
<tr>
<td>Human safety</td>
<td>EN 62209-2</td>
</tr>
<tr>
<td></td>
<td>IEC/EN 62479-1</td>
</tr>
<tr>
<td>Electrical safety</td>
<td>IEC/EN 62368-1</td>
</tr>
</tbody>
</table>

TABLE 3: CERTIFICATION COMPLIANCE VERSION 868MHZ FOR EUROPE

For use in Europe, the LORIX One must comply with the ERC 70-3 requirements regarding duty cycle and maximum EIRP. These parameters are summarized in the following table:

<table>
<thead>
<tr>
<th>ERC 70-3 Band</th>
<th>Frequency (MHz)</th>
<th>Power</th>
<th>Duty cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>h1.3</td>
<td>863 – 865</td>
<td>14dBm ERP</td>
<td>0.1%</td>
</tr>
<tr>
<td>h1.3</td>
<td>865 – 868</td>
<td>14dBm ERP</td>
<td>1%</td>
</tr>
<tr>
<td>h1.4</td>
<td>868 – 868.6</td>
<td>14dBm ERP</td>
<td>1%</td>
</tr>
<tr>
<td>h1.5</td>
<td>868.7 – 869.2</td>
<td>14dBm ERP</td>
<td>0.1%</td>
</tr>
<tr>
<td>h1.6</td>
<td>869.4 – 869.65</td>
<td>27dBm ERP</td>
<td>10%</td>
</tr>
<tr>
<td>h1.7</td>
<td>869.7 – 870</td>
<td>14dBm ERP</td>
<td>1%</td>
</tr>
<tr>
<td>h2</td>
<td>870 – 873</td>
<td>14dBm ERP</td>
<td>1%</td>
</tr>
</tbody>
</table>

TABLE 4: DUTY CYCLES AND MAXIMUM EIRP VERSION 868MHZ FOR EUROPE

If the antenna is changed, the output power must be adjusted to take into account the antenna gain to avoid exceeding the values defined by the ERC 70-3 regulation.

Warning: some countries in Europe may have a specific frequency range, a maximum EIRP and duty cycle regulation. Please check the local regulations before installing and using the LORIX One 868MHz version.

For countries outside Europe, please check that the frequency range, the maximum allowed EIRP and duty cycle are authorized.
3.2 VERSION 915MHz BAND

The LORIX One (IP43 & IP65) 915MHz version complies with both FCC and IC regulation:

<table>
<thead>
<tr>
<th>Certification compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSS 247</td>
</tr>
</tbody>
</table>

**TABLE 5: CERTIFICATION COMPLIANCE VERSION 915MHz FOR US/CANADA**

The associated FCC and IC identifiers of the LORIX One 915MHz version are:

FCC ID: 2APAZ-LORIXONE
IC: 23715-LORIXONE
Model: LORIX One

Some conditions must be met to maintain the FCC and IC compliance of the devices in the USA and Canada. These conditions are detailed in the following paragraphs. For other countries, please check the specific regulations regarding maximum allowed EIRP and duty cycle.

3.2.1 USA / FCC

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference which case the user will be required to correct the interference at personal expense.

This device must be professionally installed.

Also, some specific recommendations for exposure to magnetic fields must be followed: This equipment complies with FCC’s radiation exposure limits set forth for an uncontrolled environment under the following conditions:

1. This equipment should be installed and operated such that a minimum separation distance of 20 cm is maintained between the radiator (antenna) and user’s/nearby person’s body at all times.
2. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

3.2.2 CANADA / IC

This device complies with Industry Canada’s license-exempt RSS standards. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:
1. L’appareil ne doit pas produire de brouillage;
2. l’utilisateur de l’appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d’en compromettre le fonctionnement.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, that antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that necessary for successful communication.

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed as accessories with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with the device.

This equipment should be installed and operated such that a minimum separation distance of 20 cm is maintained between the radiator (antenna) and user’s/nearby person’s body at all times.

3.2.3 AUSTRALIA/NEW ZEALAND

This device complies with the section 134 (1) (g) of the New Zealand Radiocommunication Act 1989 and belongs on the following applicable standards:

<table>
<thead>
<tr>
<th>Certification compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety</td>
</tr>
<tr>
<td>EMC</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

This device must be professionally installed and used only in industrial context.
4 GENERAL INFORMATION

4.1 WIKI

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

4.1.1 UPDATE INFORMATION

The modifications made between each new release of the Yocto Linux are described under the Wiki changelog page www.lorixone.io/wiki/Changelog

4.1.2 TROUBLESHOOTING

Frequent encountered problems are summarized under the Wiki troubleshooting page, with suggested solutions: www.lorixone.io/wiki/Troubleshooting

4.1.3 OPEN SOURCE LICENSES

All the licenses of the open source software used or available in the package repository of the LORIX One are available at the following address: www.lorixone.io/yocto/licenses/2.1.2

4.2 CONNECTIVITY/INTERFACE

4.3 START/RESET

The gateway automatically boots when connected to a power supply through passive PoE on the Ethernet cable. After start-up, the status LED should blink briefly and turn off. Once the Linux OS starts, the status LED will start blinking in “heartbeat” mode.

The reset button can be used to:

▪ reset normally the gateway and start in normal operating mode
▪ restore the gateway close to its original factory settings
▪ enter in programming mode.

To press the button, use a thin tool such as a paper clip. Upon release, the status LED will briefly flash and then stop to signal the reset action.
4.3.1 PROCEDURES

**Short-press**
Press briefly, for less than 1 second. The blue LED will briefly blink upon release

**Long-press**
Press and hold for several seconds. The blue LED will briefly blink after the delay specified below

**Status LED**
A short flash of the blue LED

**Normal reset procedure**
1. Short-press
2. The status LED will flash upon release and the gateway will reboot

**Factory reset procedure**
The factory reset procedure can be used to reset the initial default configuration and thus restore the device to its original settings. This procedure is useful to solve a network misconfiguration or to recover a forgotten password.

**Scope of the factory reset**
The factory reset does not reset the device to its original factory settings. It does not perform a complete restoration and some issues cannot be solved. A complete factory reset can be done following the procedure described on the NAND Programming page of the wiki.

1. Wait at least 1 second after another reset pressure.
2. Long-press for at least 10 seconds
3. After the LED starts blinking, release the reset button.
4. The gateway will boot in factory reset mode. When Linux has started, a script will copy the default files.

**Programming mode procedure**
This procedure is used to enter in programming mode. It enables the possibility to reprogram the gateway using the Atmel SAM-BA programming tool through the USB port as summarized on the NAND Programming page of the wiki.
1. Remove the microSD card from the device
2. Wait at least 1 second for another reset pressure
3. Perform 2 short presses with less than 1 second between each press
4. Perform a third long press for more than 3 seconds (but less than 5 seconds)
5 Ethernet/POE

Connector details:

<table>
<thead>
<tr>
<th>RJ45 Pin number</th>
<th>Wire color</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Green</td>
<td>TX+</td>
</tr>
<tr>
<td>2</td>
<td>Green/white</td>
<td>TX-</td>
</tr>
<tr>
<td>3</td>
<td>Orange</td>
<td>RX+</td>
</tr>
<tr>
<td>4</td>
<td>Blue</td>
<td>VPOE1 Voltage 1 for PoE powering (must be connected with pin 5)</td>
</tr>
<tr>
<td>5</td>
<td>Blue/white</td>
<td>VPOE1 Voltage 1 for PoE powering (must be connected with pin 4)</td>
</tr>
<tr>
<td>6</td>
<td>Orange/white</td>
<td>RX-</td>
</tr>
<tr>
<td>7</td>
<td>Brown</td>
<td>VPOE2 Voltage 2 for PoE powering (must be connected with pin 8)</td>
</tr>
<tr>
<td>8</td>
<td>Brown/white</td>
<td>VPOE2 Voltage 2 for PoE powering (must be connected with pin 7)</td>
</tr>
</tbody>
</table>

**TABLE 6 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

5.1 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 below:

$V_{P0E1}$ and $V_{P0E2}$ (in Table 6) represent both power lines of the gateway. Power must be injected in the power input connector using the switching power supply provided with the LORIX One only:

- **Reference**  HNP12-240L6
- **Output voltage**  24VDC
- **Output current**  500mA
6 ADMINISTRATION TERMINAL ACCESS

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

6.1 USB

The gateway has a 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 is not accessible (without SSH access).

**USB Connection consideration**

Please note that the gateway cannot be powered through the USB port and needs to be powered with the passive PoE through the Ethernet connector.

The USB connection should exclusively be used for administration/configuration and should not be left connected during normal use. The IPxx level is also not guaranteed during USB service connector use.

To access the gateway through USB:

1. Power up the gateway with passive PoE through the Ethernet connector
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 will appear in the device manager under the name **ELMO GMAS (COMxx)**
   b. On Linux a new virtual COM port will appear in the folder */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
6.2 SSH

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

You need to know the 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 connector
2. A terminal program like PuTTY or ssh can be used with the following parameters:
   - address depending on your configuration
   - port 22
3. Accept the RSA key fingerprint if asked
7 SYSTEM ACCESS & CONFIGURATION

7.1 LOGIN

When the connection is made via USB, the following text will appear:

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

If the prompt does not appear, press on the ENTER key to restart the login query.

With SSH:

```
Login as:
```

The default login user name is **admin** and the password is **lorix4u**. It is strongly recommended to change the password as soon as possible. The procedure to change the password is found in the chapter user/password.

Enter the login and validate with ENTER, the password will then be asked:

```
login as: admin
admin@root's password:
```

7.2 USER/PASSWORD

Security issue with the default password

By default, all the LORIX One gateways have the same password and users should change it before any “production” use. It is recommended to create a strong password which consists of numerals, special characters, upper- and lower-case letters to increase the security of the access.

7.2.1 DEFINE OR CHANGE A PASSWORD

To define a new password, use the **passwd** command as follows:

```
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>
pwd: password changed.
```

7.3 ROOT PRIVILEGES

Most of the files or executables are limited to root access on the gateway to protect from any mishandling. Depending on the rights of these files, only the root user can read, write or execute them.

7.3.1 SUDO COMMAND

For security reasons, the root user does not have access to the terminal. However, the root user can temporarily use the **sudo** command to execute a command:
The reboot command will be executed by the root user after entering the password. This action is not possible for the admin user. The sudo command is valid only once and must be applied for each command. Once the password is entered, the command is available for 15 minutes.

### 7.3.2 SU COMMAND

It is sometimes useful to manipulate multiple files with a root access without using the sudo command for each action. This can be done by using the su command (short for substitute user) which allows you to change the current session’s owner. This action can allow you to become a root user and to benefit from its privileges.

The whoami (Who Am I) command will allow you to see which user you are currently:

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

The current user is **admin**.

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

The **sudo su** command allows you to become the root (su command without argument is a shortcut for su root).

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

As the root user, the sudo command is not necessary to use the su command.

---

**Security issue or error using the su command**

The sudo and su commands are powerful and allow users to modify/corrupt important files or (mis)use critical commands. Su command is particularly dangerous since users may forget its privileges over time.

### 7.4 EDIT A FILE

There are two different programs to edit files on the gateway, namely **Vi** or **Nano**. They are both very simple but very different in terms of use.

#### 7.4.1 USING Vi

Vi is less intuitive but very efficient when it is mastered. It allows you to 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 the file is open, there are two main modes: insert or command. The insert mode is indicated by an I in the bottom left corner of the terminal.

You can switch from command mode to insert mode by typing "i" or "a".

- "i" for insert – the insertion will begin where the cursor is positioned
- "a" for append – the insertion will begin from the following character.

In the insert mode, you can modify the file as in any text editor and you can simply quit the insert mode with the **ESC** key.
In command mode, you can type ":w" followed by one or several commands:

- ":w" for writing – to write the modifications
- ":q" for quitting – to quit the program
- ":q!" to force quit the program even if the modifications have not been saved
- ":wq" or ":x" to write and quit

There are other possible options which are not provided here but many tutorials can be found on the internet.

### 7.4.2 Using Nano

Nano is less efficient but far more intuitive and user friendly. This program is recommended if you are not familiar with a terminal or Vi. 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 through the file with the arrow keys and modify, add or delete text like any standard file editor.

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

### 7.5 Configuring LAN Connection Parameters

The network parameters are in the file `/etc/network/interfaces`. You can use your favorite editing program to modify it:

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

And the default content:

```bash
# /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 (named eth0). It is configured with a default static IP address (192.168.1.50).

#### 7.5.1 Static Configuration

It possible to configure a static configuration the following parameters:

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

It is possible to configure a DHCP configuration with the following parameters:

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

7.5.3 NETWORK RESTARTING

Once the new 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}
```

This step is required to apply the new parameters.

**Warning concerning network modification and SSH**

If you access the gateway with SSH, keep in mind that any modification in the network interface could stop your connection with the gateway and it could be impossible to access the gateway if you cannot use the service USB port.

7.6 SYSTEM UPDATE

The gateway 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.

7.6.1 MAIN SERVER

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

7.6.2 MANUAL UPDATE

To update the list of available packages (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'.
```

```
Download http://lorixone.io/yocto/feeds/2.1.2/cortexa5hf-neon/Packages.gz.
Updated source 'cortexa5hf-neon'.
```

```
Download http://lorixone.io/yocto/feeds/2.1.2/sama5d4_lorix_one/Packages.gz.
Updated source 'sama5d4_lorix_one'.
```

```
Download http://lorixone.io/yocto/feeds/2.1.2/sama5d4_lorix_one_sd/Packages.gz.
Updated source 'sama5d4_lorix_one_sd'.
```
Once the list of packages updated, you can start the update by running:

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

This command will update every package already installed and which is not up to date.

### Services stop during updates

If any updates are available, some services such as LoRa cloud applications could be stopped during the update and restarted afterwards.

### Errors during updates

If any error appears during the update, do not hesitate to read the trouble section of the wiki under 4.1.2 Troubleshooting.

#### 7.6.3 PACKAGE INSTALLATION

Packages that are not installed by default can be added using the following command:

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

Package availability can be consulted at the following address: www.lorixone.io/yocto/feeds/2.1.2/ under each subdirectories in the file Packages.

### Installation of new packages

If you have an older version of the software, the recently added packages are available on the packages server. However, the `opkg upgrade` command will not install these packages and you will need to install them manually using the `opkg install` command followed by the package’s name.

Example: opkg install kersing-packet-forwarder
7.7 CLOUD APPLICATIONS

7.7.1 LORIOT

7.7.1.1 SUMMARY
Website: https://loriot.io
Yocto package name: loriot
Rootfs location: /opt/lorix/clouds/loriot
Init script: /etc/init.d/loriot-gw
Status: STABLE
The LORIX One gateway is preinstalled with the LORIOT cloud application.

7.7.1.2 CONFIGURATION
To test the LORIOT cloud, create a free account on loriot.io and add the new gateway using the MAC address of your LORIX One (under the XX:XX:XX:XX:XX:XX form) 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
        [...]```

7.7.1.3 MANUAL TEST
Before conducting any manual test, make sure you do not have any other packet-forwarder already running and launched with the clouds-manager script using the following command:

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

Once stopped, the LORIOT packet-forwarder can be launched manually by using the following command:
In manual mode, the terminal on which the packet-forwarder has been launched must be kept open during the whole time of use.

Once started, the application displays its log output and allows easy debugging before passing in production mode. It can be stopped using the CTRL+C keyboard shortcut.

7.7.1.4  Production mode

Once the configuration has been manually tested (optional), the LORIOT packet-forwarder can be automatically started at boot or on command (without the need of keeping the terminal open) using the `Wifx clouds-manager`. 

```bash
sama5d4-lorix-one:~$ cd /opt/lorix/clouds/loriot/
sama5d4-lorix-one:~/opt/lorix/clouds/loriot$ sudo /loriot-gw -f
Password: 
```

In manual mode, the terminal on which the packet-forwarder has been launched must be kept open during the whole time of use.

Once started, the application displays its log output and allows easy debugging before passing in production mode. It can be stopped using the CTRL+C keyboard shortcut.

7.7.1.4  Production mode

Once the configuration has been manually tested (optional), the LORIOT packet-forwarder can be automatically started at boot or on command (without the need of keeping the terminal open) using the `Wifx clouds-manager`. 

```bash
sama5d4-lorix-one:~$ cd /opt/lorix/clouds/loriot/
sama5d4-lorix-one:~/opt/lorix/clouds/loriot$ sudo /loriot-gw -f
Password: 
```
7.7.2 SEMTECH PACKET-FORWARDER

7.7.2.1 SUMMARY

Sources page: https://github.com/Wifx/packet_forwarder
Forked from: https://github.com/Lora-net/packet_forwarder
License: https://github.com/Lora-net/packet_forwarder/blob/master/LICENSE
Yocto package name: packet-forwarder
Rootfs location: /opt/lorix/clouds/packet-forwarder
Init script: /etc/init.d/packet-forwarder-gw
Status: STABLE

7.7.2.2 CONFIGURATION

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

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.

Do not forget to update the gateway ID in the global_conf.json and/or local_conf.json files as explained in chapter 7.8.1 Gateway ID update script if you do not use the initial *.json files supplied with the LORIX One.

7.7.2.3 MANUAL TEST

Before conducting any manual test, make sure you do not have any other packet-forwarder already running and launched with the clouds-manager script using the following command:

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

Once stopped, the Semtech packet-forwarder can be launched manually by using the following command:
In manual mode, the terminal on which the packet-forwarder has been launched must be kept open during the whole time of use.

Once started, the applications displays its log output and allows easy debugging before passing in production mode. It can be stopped using the CTRL+C keyboard shortcut.

7.7.2.4 PRODUCTION MODE

Once the configuration has been manually tested (optional), the Semtech packet-forwarder can be automatically started at boot or temporarily (without the need of keeping the terminal open) using the Wifx clouds-manager.
7.7.3 TTN Packet-forwarder

7.7.3.1 Summary

Sources page: https://github.com/Wifx/ttn_packet_forwarder
Forked from: https://github.com/TheThingsNetwork/packet_forwarder/tree/legacy
License: https://github.com/TheThingsNetwork/packet_forwarder/blob/legacy/LICENSE
Yocto package name: ttn-packet-forwarder
Rootfs location: /opt/lorix/clouds/ttn
Init script: /etc/init.d/ttn-gw
Status: STABLE

The Things Network is a free and collaborative LoRa network.

7.7.3.2 Configuration

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

EDIT: From the version 2.1.0r5, the file EU_global_<antenna version>.json has been replaced by the file global_<antenna version>.json.

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
or from the version 2.1.0r5
sama5d4-lorix-one:/opt/lorix/clouds/ttn# sudo cp global_conf_2dBi_indoor.json global_conf.json
```

The file local_conf.json contains information about latitude, longitude, altitude, description and administrator e-mail. This file can be updated:

**Gateway EUI update in configuration files**

Do not forget to update the gateway ID in the global_conf.json and/or local_conf.json files as explained in chapter 7.8.1 Gateway ID update script if you do not use the initial *.json files supplied with the LORIX One.

7.7.3.3 Manual Test

Before conducting any manual test, make sure you do not have any other packet-forwarder already running and launched with the clouds-manager script using the following command:

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

Once stopped, the TTN packet-forwarder can be launched manually by using the following command:
In manual mode, the terminal on which the packet-forwarder has been launched must be kept open during the whole time of use.

Once started, the application displays its log output and allows easy debugging before passing in production mode. It can be stopped using the CTRL+C keyboard shortcut.

### 7.7.3.4 Production Mode

Once the configuration has been manually tested (optional), the TTN packet-forwarder can be automatically started at boot or temporarily (without the need of keeping the terminal open) using the Wifx clouds-manager.
7.7.4 KERSING MP-PACKET-FORWARDER

7.7.4.1 SUMMARY

Sources page: https://github.com/Wifx/mp_packet_forwarder
Forked from: https://github.com/kersing/packet_forwarder
License: https://github.com/kersing/packet_forwarder/blob/master/LICENSE
Yocto package name: kersing-packet-forwarder
Rootfs location: /opt/lorix/clouds/mp-pkt-fwd
Init script: /etc/init.d/mp-pkt-fwd-gw
Status: UNSTABLE

The Kersing packet-forwarder is a great improvement of the standard Semtech packet-forwarder version. It brings more interesting features such as MQTT support. However, it is still under development and could work in an unexpected manner. If the gateway is not connected to internet when launched, it will stop.

7.7.4.2 CONFIGURATION

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

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

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

The file local_conf.json contains information about latitude, longitude, altitude, description and administrator email. This file can be updated.

**Gateway EUI update in configuration files**

Do not forget to update the gateway ID in the global_conf.json and/or local_conf.json as explained in chapter 7.8.1 Gateway ID update script if you do not use the initial *.json files supplied with the LORIX One.

7.7.4.3 MANUAL TEST

Before conducting any manual test, make sure you do not have any other packet-forwarder already running and launched with the clouds-manager script using the following command:

```
sama5d4-lorix-one:~$ /etc/init.d/clouds-manager.sh stop
Password: [omitted]
Stopping cloud <running cloud>... done.
```

Once stopped, the TTN packet-forwarder can be launched manually by using the following command:
In manual mode, the terminal on which the packet-forwarder has been launched must be kept open during the whole time of use.

Once started, the applications displays its log output and allows easy debugging before passing in production mode. It can be stopped using the CTRL+C keyboard shortcut.

7.7.4.4 Production Mode

Once the configuration has been manually tested (optional), the Kersing packet-forwarder can be automatically started at boot or temporarily (without the need of keeping the terminal open) using the Wifx clouds-manager with the manual option.

To use the manual, follow the description in the chapter about manual configuration of the clouds-manager script using the following values:

```bash
# Manual cloud client
# Replace this path by your customized cloud application start script
MANUAL_INIT_FILE="/etc/init.d/mp-pkt-fwd-gw"
MANUAL_CLOUD_NAME="kersing"
```

Then, select the manual packet-forwarder using the configure command of the clouds-manager as described in the following chapters.
7.7.5 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 allows to see the current status of the running cloud without any special permission. However, you need special permission (root access) to be able to modify configurations, or to start, stop and restart it.

7.7.5.1 CONFIGURATION

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

```
sama5d4-lorix-one:$ /etc/init.d/clouds-manager.sh stop
Password: Stopping cloud <running cloud>... 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|manual]
> loriot

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

It allows to modify two parameters, the first one is “autostart” which defines whether the cloud will be started automatically at boot time or not (default=yes).

The second option which is asked for is the cloud itself and will let you decide between LORIOT, the Semtech packet-forwarder, the TTN (The Things Network) packet-forwarder or manual to use another packet-forwarder as explained in the following chapter.

7.7.5.2 MANUAL CONFIGURATION

Since the version 1.1.0-r0, the LORIX One clouds-manager package supports a new packet-forwarder mode, namely manual. It does not belong to a particular packet-forwarder but instead, it allows you to choose any application to be started at boot time. It permits to virtually support any new packet-forwarder like the Kersing packet-forwarder for instance.

To configure the manual packet-forwarder, you must stop any running packet-forwarder:

```
sama5d4-lorix-one:$ sudo /etc/init.d/clouds-manager.sh stop
Password: Stopping cloud <running cloud>... done.
```

Once stopped, you can edit the script (using sudo) `/etc/init.d/clouds-manager.sh` with Vi or Nano and define the variable `MANUAL_INIT_FILE` to point towards the initiation script located in the folder `/etc/init.d` and normally following the convention name `<cloud name>-gw`.

Optionally, you can also define the variable `MANUAL_CLOUD_NAME` with a customized name which is only used to give more information when using the clouds-manager.sh script.

An example is available in the Kersing packet-forwarder chapter.
7.8  **LoRa Concentrator Utilities**

**Clouds-manager incompatibility**

Please note that the clouds-manager and its sub applications cannot be running during the use of test and utility applications (LoRa). Before using these tools, the clouds-manager must be stopped as explained in point 7.7.5.

Wixem clouds-manager.

Semtech provides utilities to test the SX1301 LoRa concentrator chip and to perform RX/TX performance tests. All the binaries relative to the gateway are located in the file `/opt/lorix/utils` and arranged into subfiles.

### 7.8.1 Gateway ID Update Script

The Semtech **packet-forwarder** package provides also a script which allows to update any packet-forwarder configuration `*.json` file by modifying the `gateway_ID` field with the correct gateway ID (or EUI) according to the unique MAC address number as described in the next chapter.

**7.8.1.1 GWID Format**

The gateway ID is a 64 bits unique ID based on the 48 bits unique MAC address. The extended 64 bits address is simply created by removing the “:” of the MAC address and by adding the 2 Bytes 0xFF and 0xFE between the 3rd and 4th Bytes.

The format of the gateway ID (GWID) is the following:

```
MAC: 48-bits
XX:XX:XX:XX:XX:XX

GWID: EUI-64 Address
XX XX XX FF FE XX XX XX
```

Following this process, the MAC address `01:00:5E:22:BB:33` becomes the gateway ID `01005EFFFE22BB33`.

The gateway ID is also, on some clouds, under the form `eui-gateway ID`. In this case `eui-01005efffe22bb33`.

**7.8.1.2 Gateway ID Update**

You can either modify the `gateway_ID` field in the `global_conf.json` and `local_conf.json` files manually using Vi or Nano; or use the `update_gwid.sh` script located in the file `/opt/lorix/utils` with the following commands:

```bash
sama5d4-lorix-one:~$ cd /opt/lorix/utils/
sama5d4-lorix-one:/opt/lorix/utils$ sudo ./update_gwid.sh /opt/lorix/clouds/ttn/global_conf.json

Password:
Gateway_ID set to <gateway ID> in file /opt/lorix/clouds/ttn/global_conf.json
```

The script takes the `*.json` file to update as first argument.

### 7.8.2 SX1301 Reset Pin Control

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

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

The `start` argument will disable the reset signal and activate the SX1301.

The `stop` argument will enable the reset signal and deactivate the SX1301.

The `restart` will perform a pulse on the reset signal to restart the SX1301.

This script is automatically called with `start` during system startup and with `stop` during system shutdown.
7.8.3 Test binaries

All the test binaries related to the libloragw (https://github.com/Lora-net/lora_gateway) are located in the file /opt/lorix/tests.

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 about their use.

7.8.4 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 utilis are available in the file /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 channel configuration, etc.
8 SD CARD

The gateway has a microSD slot and is compatible with all microSD cards according to the SD Memory Card Specification Version 2.0 including the SDHC standard.

A microSD card can be used to extend the internal FLASH memory (256MB), alternatively, the gateway can boot from the SD card if startup files are detected at startup.

8.1.1 INSERTION/REMOVAL

To insert an SD card, simply push it into the hole until it makes a “click” sound. To remove the card, simply push it back until you hear the “click” sound. The SD card will come out on release.

8.1.2 SD CARD DETECTION

Once inserted, you can verify that the SD Card is correctly detected by the Linux system using the command dmesg (“display message”) which will display important system information:

```
sama5d4-lorix-one:~$ dmesg
[-]
[ 24.710000] mmc0: host does not support reading read-only switch, assuming write-enable
[ 24.720000] mmc0: new high speed SDHC card at address 59b4
[ 24.730000] mmcblk0: mmc0:59b4 BB2MW 29.8 GiB
[ 24.740000] mmcb1k0: p1
```

8.1.3 SD CARD (UN)MOUNTING

It is possible to mount the SD card in the Linux system using the following command:

```
sama5d4-lorix-one:~$ sudo mount -t <filesystem type> /dev/mmcblk0p1 /mnt
```

The -t parameter is used to specify the filesystem of the SD card to be mounted. Currently, the gateway only supports ext2, 3, 4 filesystem types. It can however be extended by adding another filesystem supports in the Linux kernel.

To unmount a mounted SD card, use the sync command to synchronize any eventual files that are not yet written in the SD card and unmount the card from the Linux filesystem:

```
sama5d4-lorix-one:~$ sync /mnt
sama5d4-lorix-one:~$ sudo umount /mnt
```
## 9 ELECTRICAL

### 9.1 POWER CONSUMPTION

<table>
<thead>
<tr>
<th>Task (@ 20°C ambient)</th>
<th>Voltage [V]</th>
<th>Current [mA]</th>
<th>Power [W]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linux only running</td>
<td>24</td>
<td>42</td>
<td>1,01</td>
</tr>
<tr>
<td>RF part disabled</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LoRa gateway with util_pkt_logger</td>
<td>24</td>
<td>105</td>
<td>2,52</td>
</tr>
<tr>
<td>6 channels for RX</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LoRa gateway with util_pkt_logger</td>
<td>24</td>
<td>117</td>
<td>2,81</td>
</tr>
<tr>
<td>8 channels for RX</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
10 Mechanical

10.1 LORIX One

10.1.1 IP43 (Semi-Waterproof)

10.1.2 IP65 (Waterproof)

10.2 Antenna 4DBI (868 & 915 Versions)
10.3 **Antenna 2.15dBi (868 Versions)**

Dimensions: mm (inch)
11 SETUP GUIDE

11.1 GENERAL RECOMMENDATIONS

The LORIX One gateway is designed to be placed vertically with the antenna pointing upwards.

If you wish to attach the LORIX One to a pole, it is strongly recommended to use the plastic mounting loops provided with the gateway which are UV-resistant. Guide the loops around the LORIX One through the edge markings, and attach the gateway around the pole where it will be mounted.

It is strongly recommended to not connect a loose Ethernet cable to the Ethernet port while attaching the gateway to a pole, to avoid adding weight to the port. Ideally, the Ethernet cable should be attached within 2 meters from the gateway device.

11.2 STANDARD MOUNTING USING A POLE

Remove the wire grommet from the cap.
Once the Ethernet cable passed through the cap hole, open the silicon grommet and put it around the cable as showed on the picture.

**Be careful with the orientation of the grommet**

Press the grommet with your finger from inside the cap (left picture) until take it final position (right picture).

Connect the Ethernet cable.

Move the cap in direction of the body while maintaining the cable with the other hand to keep the cable as straight as possible.
Screw the cap on the body to guarantee as good as possible water and dust protection.
Once fixed, be sure the cable is well placed and verify that the grommet is correctly positioned.

Use only appropriate antenna provided as accessory for the LORIX One.

Engage the antenna connector into the LORIX One RF connector as showed on the picture.
While maintaining the antenna into the LORIX One, start screwing with the other hand the RF LORIX One connector tightening ring.
Never turn or use directly the antenna body to screw it on the LORIX One, it could damage or break the antenna.

Once the cable and the antenna correctly connected and the LORIX One correctly closed, you can install it on a pole using the 2 provided cable tie.

The provided cable tie are black because they are specifically made to support UV.

You should use always the provided one or UV protected specifically.
Once the LORIX One well oriented and the cable tie well tight, use a cutting pliers to cut the exceeding plastic part of the cable tie.
The LORIX One is now installed on a pole using the provided elements (excluding Ethernet cable).

It is strongly recommended to not connect a loose Ethernet cable to the Ethernet port while attaching the gateway to a pole, to avoid adding weight to the port. Ideally, the Ethernet cable should be attached within 2 meters from the gateway device.

On the other side of the cable, use the PoE passive injector provided with the LORIX One as explained in the chapter **5.1 Power through passive PoE**.

The LORIX One is running by default with the LORIOT Cloud application and is ready to use as soon as it has internet connection and a registered MAC Address in the LORIOT web user space.

Please refer to the chapter **7.7 Cloud applications** for more information about how to use and configure others cloud applications.