



# LoRaWAN gateways installation recommendations

Application Note AN-KLK03357

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# LoRaWAN gateways installation recommendations

	Redaction	Validation	Approbation
Trigram	MGI	SNI	LGE
Date	2019-10-11		
Signature			

Version	Edits
V0.1	First draft
V0.2	Minor updates after internal review
V0.3	Minor updates after 2 <sup>nd</sup> internal review Updated cavity filter list
V0.4	Added different use case in Cavity Filter paragraph. Defined when cavity filter is required and when it is not.
V0.5	Minor typo corrections
V0.6	Added details in case of colocalization with LTE BS
V0.7	Detailed connection of antennas and surge protections for Wirnet iStation
V0.8	Wording modifications about connection of antennas for Wirnet iStation
V0.9	Changed recommended cavity filter for Sri Lanka
V0.10	Added 915MHz / 9dBi omnidirectional antenna (KLK03456)
V0.11	Added details about position of surge protections

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## 1 Introduction

Industry is increasingly using the Internet of Things (IoT) to reduce costs and improve operational efficiencies. The IoT market has vastly grown with an increasing number of practical applications in many fields including utilities and smart metering, asset tracking, agriculture, smart cities, smart homes, etc. IoT applications have a range of requirements with many enterprise applications relying on long-range, low data rate, low energy consumption, and cost-effective connectivity.

Therefore, the requirements of IoT applications have driven the emergence of a new wireless communication technology: Low Power Wide Area Network (LPWAN). These comprise a range of technologies which offer large coverage and low energy consumption, often using unlicensed spectrum. Among them, SigFox, LoRaWAN, and NB-IoT are today's leading emergent technologies that involve many technical differences.

The choice of a LPWAN technology is driven by the following criteria

- Quality of service (QoS)
- Scalability i.e. support of the massive number of increasing number and density of connected devices.
- Network coverage and range
- Deployment model i.e. private networks or public nation-wide networks
- Cost - including spectrum cost (license), network/deployment cost, and device cost.

One significant advantage of LoRaWAN ecosystem is its flexibility. Unlike SigFox and NB-IoT, LoRaWAN offers local network deployment as well as public network operation. In the industrial field, a hybrid operating model could be used to deploy a local LoRaWAN network in factory areas and uses the public LoRaWAN network to cover the outside areas.

LoRaWAN is moreover considered as a low-cost solution compared to other LPWAN technologies. As it operates in unlicensed band the spectrum cost is significantly lower compared to NB-IoT operating in licensed band. Deployments costs are significantly lower compared to SigFox due to lower price of the gateways.

A successful deployment of a LoRaWAN network shall ensure that all the above criteria (QoS, scalability, network coverage, deployment cost) are properly monitored during the whole lifecycle of the project. Installation of the gateways is a critical phase to achieve successful deployment of LoRaWAN network and meet customer expectations. Preparation of the installation shall be carefully considered to avoid future critical issues compromising QoS.

This application note provides guidelines to anticipate the gateways installation. It could be considered as a check list, before installing the gateways, to make sure all critical parameters are identified and will be properly addressed during the installation.

## 2 Preparing the installation

Installation of a LoRaWAN gateway shall be carefully prepared in advance to anticipate the future coverage area, QoS and make sure that all needed equipment's are listed and are available the D-day. Intervention costs per day are very expensive on an installation site, so the installation procedure shall be fully detailed and prepared to avoid any later intervention to fix issues that could have been anticipated.

This chapter details all the parameters to be considered before the installation i.e.:

- Selection of the installation site
- Selection of the right gateway depending on the application, installation site, etc.
- Selection of the backhaul
- Selection of accessories (antenna, cavity filter, lightning surge protection, cables, etc.)

### 2.1 Installation site

Installation site is a key factor which determines the coverage area but also the QoS of the LoRaWAN network. The choice of the installation site shall be carefully made considering:

- The targeted coverage area
- The power supply options (Mains, DC supply, Photovoltaic, etc.)
- The backhauling options (Ethernet, Cellular, Wi-Fi, etc.)

The choice of the installation site also determines installation constraints such as:

- The type of gateways to be used (indoor/outdoor).
- Usage of cavity filters in case of colocalized installation.
- The mounting type (wall, mast, tower, roof top, etc.).
- The antennas and brackets to be used.
- The lightning protections to be used.
- The cables (Supply, Ethernet, RF coaxial cables, etc.) to be installed.

See also § 2.1.3 and §2.1.9.

For additional information see also:

- [1] AN-KLK03355 - Improving radio coexistence performance of LoRaWAN gateways
- [2] AN-KLK03356 - LoRaWAN gateways coverage optimization
- [3] AN-KLK03358 - LoRaWAN gateways lightning protection

## 2.1 Characteristics of the gateway

### 2.1.1 LoRaWAN gateways portfolio

The Kerlink portfolio of LoRaWAN gateways is composed of:



Each version is derived into several references to address different LPWAN unlicensed bands but also supporting different features. They are summarized in the following table:

Gateway designation	Gateway Reference	Backhaul	GNSS receiver	LoRaWAN channels	Space diversity	Geo location	Msg/day
<b>Wirnet Station 868</b>	PDTIOT-ISS00 PDTKLK-ISS0005	Eth, 3G Eth, 3G	Yes Yes	8	No No	No No	>0.7M >0.7M
<b>Wirnet Station 915</b>	PDTIOT-ISS01	Eth, 3G	Yes	8	No	No	>0.7M

<b>Wirnet Station 923</b>	PDTIOT-ISS02	Eth, 3G	Yes	8	No	No	>0.7M
<b>Wirnet iStation 868</b>	PDTIOT-ISS04	Eth, 4G	Yes	8	No	No	>0.7M
<b>Wirnet iStation 915</b>	PDTIOT-ISS05	Eth, 4G	Yes	8	No	No	>0.7M
<b>Wirnet iStation 923</b>	PDTIOT-ISS06	Eth, 4G	Yes	8	No	No	>0.7M
<b>Wirnet iBTS Compact 868</b>	PDTIOT-MCS01 PDTIOT-MCS02 PDTIOT-MCS18	Eth Eth, 4G Eth, 2x4G	Yes Yes Yes	16 16 16	Option Option Option	Yes Yes Yes	>1.4M >1.4M >1.4M
<b>Wirnet iBTS Compact 915</b>	PDTIOT-MCS11 PDTIOT-MCS12	Eth Eth, 4G	Yes Yes	16 16	Option Option	Yes Yes	>1.4M >1.4M
<b>Wirnet iBTS Compact 923</b>	PDTIOT-MCS09 PDTIOT-MCS10 PDTIOT-MCS15 PDTIOT-MCS19	Eth Eth, 4G Eth, 4G Eth, 4G	Yes Yes Yes Yes	16 16 16 16	Option Option Option Option	Yes Yes Yes Yes	>1.4M >1.4M >1.4M >1.4M
<b>Wirnet iBTS 868</b>	PDTIOT-MSS01 PDTIOT-MSS02 PDTIOT-MSS03 PDTIOT-MSS04	Eth Eth, 4G Eth Eth, 4G	Yes Yes Yes Yes	16 16 48 48	Yes Yes Yes Yes	Yes Yes Yes Yes	>1.4M >1.4M >4.2M >4.2M
<b>Wirnet iBTS 915</b>	PDTIOT-MSS05 PDTIOT-MSS06	Eth Eth, 4G	Yes Yes	64 64	Yes Yes	Yes Yes	>5.6M >5.6M
<b>Wirnet iBTS 923</b>	PDTIOT-MSS07 PDTIOT-MSS08 PDTIOT-MSS11 PDTIOT-MSS12 PDTIOT-MSS13 PDTIOT-MSS14 PDTIOT-MSS16 PDTIOT-MSS17	Eth Eth, 4G Eth Eth, 4G Eth Eth, 4G Eth, 4G Eth, 4G	Yes Yes Yes Yes Yes Yes Yes Yes	64 64 48 48 16 16 16 48	Yes Yes Yes Yes Yes Yes Yes Yes	Yes Yes Yes Yes Yes Yes Yes Yes	>5.6M >5.6M >4.2M >4.2M >1.4M >1.4M >1.4M >4.2M
<b>Wirnet iBTS 64 Highway</b>	PDTIOT-MSS20 PDTIOT-MSS21 PDTIOT-MSS22 PDTIOT-MSS23	Eth Eth Eth, 4G Eth, 4G	Yes Yes Yes Yes	64 64 64 64	No Yes No Yes	Yes Yes Yes Yes	>5.6M >5.6M >5.6M >5.6M
<b>Wirnet iFemtoCell 868</b>	PDTIOT-IFE00	Eth, Wi-Fi	No	8	No	No	>0.7M
<b>Wirnet iFemtoCell 915</b>	PDTIOT-IFE01	Eth, Wi-Fi	No	8	No	No	>0.7M
<b>Wirnet iFemtoCell 923</b>	PDTIOT-IFE02	Eth, Wi-Fi	No	8	No	No	>0.7M
<b>Wirnet iFemtoCell-evolution 868</b>	PDTIOT-IFE03	Eth, 4G	No	8	No	No	>0.7M
<b>Wirnet iFemtoCell-evolution 915</b>	PDTIOT-IFE04	Eth, 4G	No	8	No	No	>0.7M
<b>Wirnet iFemtoCell-evolution 923</b>	PDTIOT-IFE05	Eth, 4G	No	8	No	No	>0.7M

The features are detailed in the following paragraphs.

### 2.1.2 Gateway vs. IoT application

Depending of the customer application, the following LoRaWAN gateways are recommended:

Gateway designation	Typical use case	Smart Metering	Smart City	Smart Agriculture	Smart Energy	Smart Industry	Smart Building
Wirnet Station	Private Network Edge Networking	O	O	✓	O	O	O
Wirnet iStation	Private Network Edge Networking	O	O	✓	O	O	O
Wirnet iBTS Compact	Public Network	✓	✓				
Wirnet iBTS	Public Network	✓	✓				
Wirnet iBTS 64 Highway	Public Network	✓	✓				
Wirnet iFemtoCell	Private Network, Edge Networking				✓	✓	✓
Wirnet iFemtoCell-evolution	Private Network, Edge Networking				✓	✓	✓

✓ : typical usage (recommended)

O: possible usage

### 2.1.3 Gateway vs. installation site

Because of their targeted application, their robustness and ingress protection, the LoRaWAN gateways are particularly dedicated to the following environments:

Gateway designation	Outdoor / Colocalized	Outdoor	Indoor
Wirnet Station	O	✓	O
Wirnet iStation	O	✓	✓
Wirnet iBTS Compact	✓	✓	
Wirnet iBTS	✓	✓	
Wirnet iBTS 64 Highway	✓	✓	
Wirnet iFemtoCell			✓
Wirnet iFemtoCell-evolution			✓

✓ : typical usage (recommended)

O: possible usage

### 2.1.4 Scalability of the gateway

Kerlink LoRaWAN gateways are designed to provide Firmware Upgrade capabilities.

The Wirnet iBTS family has, moreover, a modular architecture allowing to configure the backhaul and capacity of the LoRaWAN receiver.

The scalability features are summarized in the following table:

Gateway designation	Firmware upgrade	Modularity
Wirnet Station	Eth, 3G FOTA USB	No

<b>Wirnet iStation</b>	Eth, 4G FOTA USB	No
<b>Wirnet iBTS Compact</b>	Eth, 4G FOTA USB	Yes
<b>Wirnet iBTS</b>	Eth, 4G FOTA USB	Yes
<b>Wirnet iBTS 64 Highway</b>	Eth, 4G FOTA USB	Yes
<b>Wirnet iFemtoCell</b>	Eth, Wi-Fi FOTA USB	No
<b>Wirnet iFemtoCell-evolution</b>	Eth, 4G FOTA USB	No

### 2.1.5 LoRaWAN unlicensed bands

LoRaWAN end-devices and gateways communicates in license free frequency bands. This is a benefit for the operator or customer that do not need license from government or state, to transmit on these frequencies. The most common LPWAN frequency bands used worldwide are the following:

- 433MHz (EMEA)
- 868-870MHz (EMEA)
- 902-915MHz (North America)
- 915-928MHz (LATAM, APAC)

However, it is important to note that unlicensed frequencies are country specific. Although some continents share similar frequency bands, some countries may have specific usage. This could relate to the allowed frequencies but also time on air, duty cycle, EIRP, etc.

The following table details the frequency range (both UL and DL) of Kerlink LoRaWAN outdoor gateways and the corresponding LoRaWAN Regional Parameters:

Gateway designation	TX band (DL)	RX band (UL)	LoRaWAN Regional Parameters
<b>Wirnet Station 868</b>	863-873MHz	863-873MHz	<b>EU868</b> <b>IN865</b> <b>RU864</b>
<b>Wirnet Station 915</b>	902-928MHz	902-928MHz	<b>AS923-1</b> <b>AS923-2</b> <b>AS923-3</b> <b>KR920</b> <b>AU915</b> <b>US915</b>
<b>Wirnet Station 923</b>	920-928MHz	915-928MHz	<b>AS923-1</b> <b>AS923-2</b> <b>KR920</b> <b>AU915</b>

<b>Wirnet iStation 868</b>	863-873MHz	863-873MH	<b>EU868 IN865 RU864</b>
<b>Wirnet iStation 915</b>	923-928MHz	902-915MHz	<b>US915</b>
<b>Wirnet iStation 923</b>	915-928MHz	915-928MHz	<b>AS923-1 AS923-2 AS923-3 KR920 AU915</b>
<b>Wirnet iBTS Compact 868</b>	863-873MHz	863-873MH	<b>EU868 IN865 RU864</b>
<b>Wirnet iBTS Compact 915</b>	902-928MHz	902-928MHz	<b>AS923-1 AS923-2 AS923-3 KR920 AU915 US915</b>
<b>Wirnet iBTS Compact 923</b>	920-928MHz	915-928MHz	<b>AS923-1 AS923-2 KR920 AU915</b>
<b>Wirnet iBTS 868</b>	863-873MHz	863-873MH	<b>EU868 IN865 RU864</b>
<b>Wirnet iBTS 915</b>	902-928MHz	902-928MHz	<b>AS923-1 AS923-2 AS923-3 KR920 AU915 US915</b>
<b>Wirnet iBTS 923</b>	920-928MHz	915-928MHz	<b>AS923-1 AS923-2 KR920 AU915</b>
<b>Wirnet iBTS 64 Highway</b>	923-928MHz	902-915MHz	<b>US915</b>
<b>Wirnet iFemtoCell 868</b>	863-873MHz	863-873MHz	<b>EU868 IN865 RU864</b>
<b>Wirnet iFemtoCell 915</b>	902-928MHz	902-928MHz	<b>AS923-1 AS923-2 AS923-3 KR920 AU915 US915</b>
<b>Wirnet iFemtoCell 923</b>	920-928MHz	915-928MHz	<b>AS923-1 AS923-2 KR920 AU915</b>
<b>Wirnet iFemtoCell-evolution 868</b>	863-874.4MHz	863-874.4MH	<b>EU868 IN865 RU864</b>

<b>Wirnet iFemtoCell-evolution 915</b>	923-928MHz	902-915MHz	<b>US915</b>
<b>Wirnet iFemtoCell-evolution 923</b>	915-928MHz	915-928MHz	<b>AS923-1</b> <b>AS923-2</b> <b>AS923-3</b> <b>KR920</b> <b>AU915</b>

**Note:** Regional Parameters in bold are the one initially intended to be supported by the gateway. Regional Parameters in italics can be supported but are not recommended.

## 2.1.6 Backhaul

### 2.1.6.1 Backhauling options

Kerlink LoRaWAN gateways support different backhauling options to cover customer needs. They are summarized in the following table:

Gateway designation	Ethernet	Cellular	Wi-Fi
<b>Wirnet Station</b>	100Base-T	2G, 3G	No
<b>Wirnet iStation</b>	100Base-T	2G, 3G, 4G	No
<b>Wirnet iBTS Compact</b>	100Base-T	2G, 3G, 4G	Option
<b>Wirnet iBTS</b>	100Base-T	2G, 3G, 4G	Option
<b>Wirnet iBTS 64 Highway</b>	100Base-T	2G, 3G, 4G	Option
<b>Wirnet iFemtoCell</b>	100Base-T	External 2G, 3G, 4G USB stick (option)	Yes (2.4GHz)
<b>Wirnet iFemtoCell-evolution</b>	100Base-T	2G, 3G, 4G	No

Cellular technologies listed above shall be understood as follows:

- 2G: GPRS / EGPRS
- 3G: UMTS, HSPA
- 4G: LTE FDD and LTE TDD

The list of supported cellular bands is fully detailed in the “Product Description” document of the corresponding LoRaWAN gateway.

Other backhaul options (satellite) could be considered upon demand.

### 2.1.6.2 Single gateway installation topology

If a single LoRaWAN gateway is installed on a site, two configurations are possible regarding the WAN technology used:

- 4G/3G/2G connection
- Ethernet connection

The 4G/3G/2G connection requires a USIM subscription.

The Ethernet connection requires an Ethernet access through a dedicated RJ45 cable.

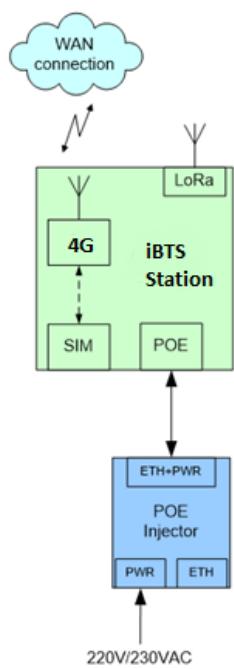


Figure 1 : Single gateway installation (with USIM)

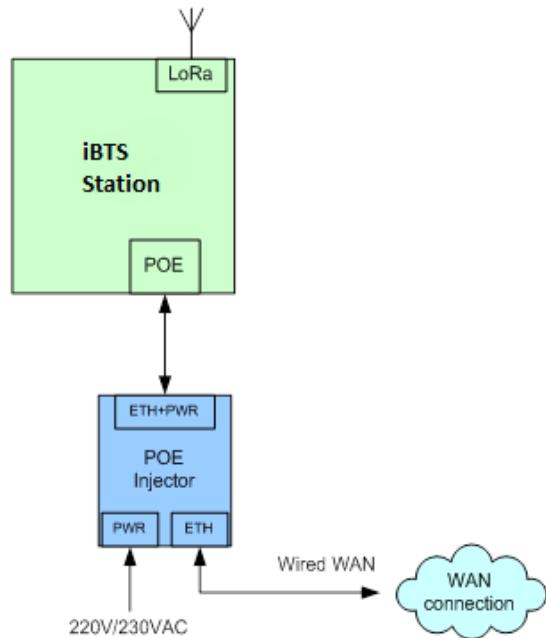


Figure 2 : Single gateway installation (No USIM)

#### 2.1.6.3 Multi gateways installation topology

In rare use cases, multiple LoRaWAN gateways can be installed on one site. The recommended WAN connection is then Ethernet. An Ethernet switch (not provided by Kerlink) is used to interface all the gateways.

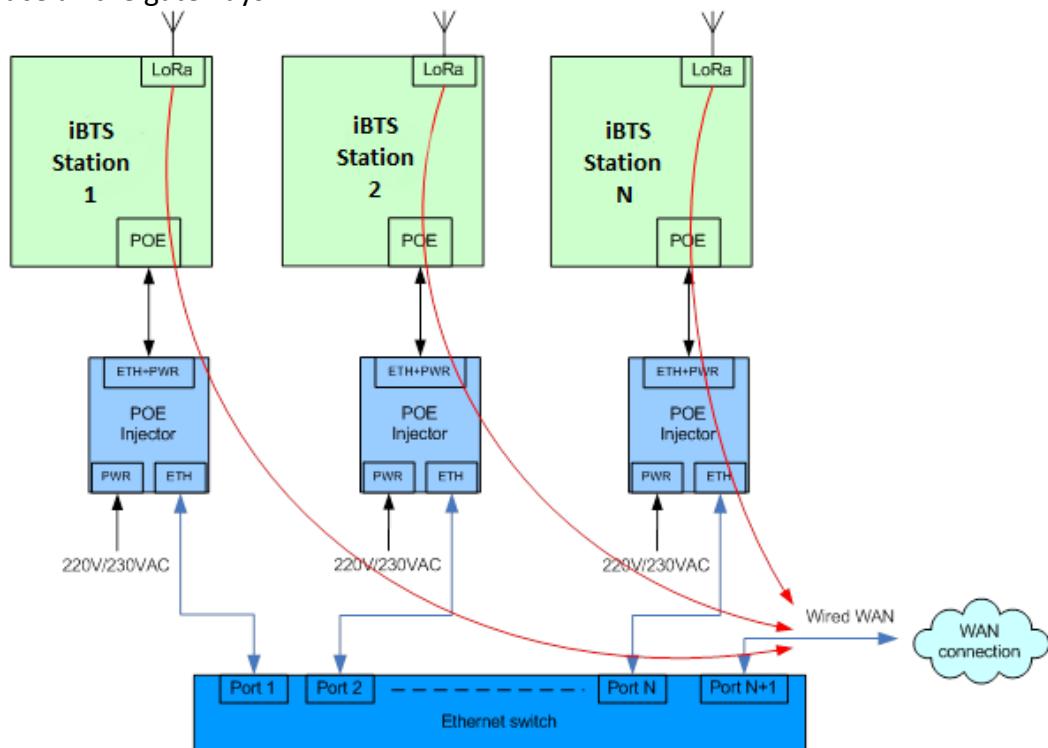


Figure 3 : Multi-station installation (No USIM)

#### 2.1.6.4 USIM card

The USIM card is mandatory to establish the 4G/3G/2G communications.

The USIM card to be used with the Wirnet gateways shall be a 2FF format (Mini-SIM).

KERLINK recommends the usage of a M2M UICC compliant with 3GPP TS 102.671. It offers then a better temperature operating range, improved data retention and increased number of UPDATE commands.

#### 2.1.6.5 Preparing the configuration of the backhaul

The Wirnet gateways are configured through a web interface, in addition to the command-line interface which is used through the serial port or SSH connection.

To access the web interface, consult the [Kerlink Wiki](#) and contact [KERLINK support](#) for more information and to get the credentials.

The easiest way to connect the Wirnet gateway is to address it by host name. The host name includes six (or eight for Wirnet Station) hexadecimal digits from the serial number of the gateways (identified as XXXXXX or YYYYYYYY below). Therefore, it is essential to have the serial number of the gateway to configure it.

The host names of the connections for the different gateways are detailed in the following table:

Gateway designation	Connection host name	Serial number to be used
<b>Wirnet Station</b>	wirgrid_YYYYYYYY (up to firmware V3.1) wirnet_YYYYYYYY (from firmware V3.2)	Gateway ID
<b>Wirnet iStation</b>	klk-wiis-XXXXXX	Board ID
<b>Wirnet iBTS Compact</b>	klk-lpbs-XXXXXX	CPU module ID
<b>Wirnet iBTS</b>	klk-lpbs-XXXXXX	CPU module ID
<b>Wirnet iBTS 64 Highway</b>	klk-lpbs-XXXXXX	CPU module ID
<b>Wirnet iFemtoCell</b>	klk-wifc-XXXXXX	Board ID
<b>Wirnet iFemtoCell-evolution</b>	klk-fevo-XXXXXX	Board ID

The serial numbers are located on the sticker of the gateways.

For example, the host name of the Wirnet™ iFemtoCell is “klk-wifc-xxxxxx” where xxxxxx is the end of the board ID. The board ID is located on the sticker placed on the rear side of the product. Here, board ID is 704BEc030178, so xxxxxx is 030178.



Figure 4: Wirnet iFemtoCell Board ID

For Wirnet iBTS family, the host name of the gateway is “klk-lpbs-xxxxxx” where xxxxxx is the end of the CPU module ID. The CPU module ID is located on the sticker placed on the top side of the CPU module, inside the enclosure. Here, CPU module ID is 623ATd04011F, so xxxxxx is 04011F.



Figure 5: Wirnet iBTS Board ID

For the Wirnet Station, the host name of the gateway is “wirnet\_YYYYYYYY” or “wirgrid\_YYYYYYYY” where YYYYYYYY is the end of the gateway ID. The gateway ID is located on the sticker placed inside the enclosure. Here, gateway ID is 0x80604A1, so YYYYYYYY is 080604A1.

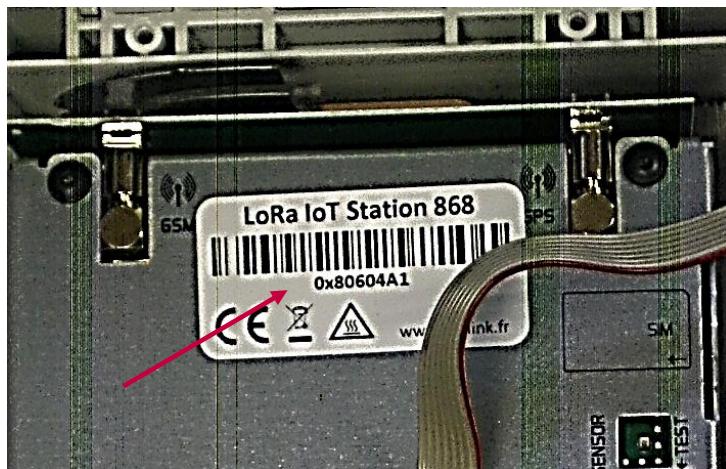


Figure 6: Wirnet Station Board ID

The network bearer can be chosen among Ethernet, 2G/3G/4G and Wi-Fi, according to the available backhauling options of the LoRaWAN gateway. The configuration parameters are:

- Ethernet:
  - IPv4 mode: Automatic (DHCP) or Manual (static) or OFF (disabled)
  - IPv4 address (if static mode)
  - IPv4 Gateway address & network mask
  - IPv4 DNS resolver
- 2G/3G/4G:
  - USIM pin code
  - APN

- Login
- Password
- Wi-Fi:
  - SSID
  - Password
  - Scanning (SSID, RSSI)

### 2.1.7 Power Supply

Depending on the LoRaWAN gateways, several power supply options are available:

Gateway designation	DC supply	PoE Supply	Internal battery
<b>Wirnet Station</b>	11V-30V	Yes	Yes
<b>Wirnet iStation</b>	No	Yes	Yes
<b>Wirnet iBTS Compact</b>	11V-56V	Yes	Yes
<b>Wirnet iBTS</b>	11V-56V	Yes	Yes
<b>Wirnet iBTS 64 Highway</b>	11V-56V	Yes	Yes
<b>Wirnet iFemtoCell</b>	5.5V-17V / 12V nominal	No	No
<b>Wirnet iFemtoCell-evolution</b>	5.5V-17V / 12V nominal 5V nominal (USB-C)	No	No

The internal backup batteries provide about 1-minute autonomy allowing safe power down.

#### 2.1.7.1 POE injectors

Several PoE injectors are available for the LoRaWAN gateways. The choice of the PoE injectors depends mainly on the output power (15W, 30W or 60W), the environment (indoor/outdoor) and the input voltage (DC or mains supply).

The different PoE injectors are listed below:

PoE designation	POE standard	Input supply	PoE output power	Indoor / Outdoor	Kerlink PN
<b>PoE injector 15W indoor – EU version</b>	IEEE 802.3af	100-240V AC	15W	Indoor	KLK02109
<b>PoE injector 15W indoor – US version</b>	IEEE 802.3af	100-240V AC	15W	Indoor	KLK02524
<b>PoE injector 30W indoor – EU version</b>	IEEE 802.3at IEEE 802.3af	100-240V AC	30W	Indoor	KLK02681
<b>PoE injector 30W indoor – US version</b>	IEEE 802.3at IEEE 802.3af	100-240V AC	30W	Indoor	KLK02765
<b>PoE injector 30W indoor</b>	IEEE 802.3at	36V-72V DC 48V DC nom.	30W	Indoor	KLK02855
<b>PoE injector 30W outdoor</b>	IEEE 802.3at IEEE 802.3af	100-240V AC	30W	Outdoor	KLK02953
<b>PoE injector 60W indoor – EU version</b>	IEEE 802.3at IEEE 802.3af	100-240V AC	60W	Indoor	KLK02744
<b>PoE injector 60W indoor – US version</b>	IEEE 802.3at IEEE 802.3af	100-240V AC	60W	Indoor	KLK02766
<b>PoE injector 60W indoor</b>	IEEE 802.3at IEEE 802.3af	36V-60V DC 48V DC nom.	60W	Indoor	KLK02863

PoE injector 60W outdoor	IEEE 802.3at IEEE 802.3af	100-240V AC	60W	Outdoor	KLK02954
PoE injector 60W outdoor	IEEE 802.3at IEEE 802.3af	36V-60V DC 48V DC nom.	60W	Outdoor	KLK02879

The recommended PoE injectors depending on the LoRaWAN gateways are detailed below:

Gateway designation	Recommended indoor PoE supply	Recommended outdoor PoE supply
Wirnet Station 868 Wirnet Station 923	KLK02109 KLK02855	KLK02953
Wirnet Station 915	KLK02524 KLK02855	KLK02953
Wirnet iStation 868 Wirnet iStation 923	KLK02109 KLK02855	KLK02953
Wirnet iStation 915	KLK02524 KLK02855	KLK02953
Wirnet iBTS Compact 868 Wirnet iBTS Compact 923	KLK02681 KLK02855	KLK02953
Wirnet iBTS Compact 915	KLK02765 KLK02855	KLK02953
Wirnet iBTS 868 Wirnet iBTS 923	KLK02744 KLK02863	KLK02954 KLK02879
Wirnet iBTS 915	KLK02766 KLK02863	KLK02954 KLK02879
Wirnet iBTS 64 Highway	KLK02766 KLK02863	KLK02954 KLK02879
Wirnet iFemtoCell	N/A	N/A
Wirnet iFemtoCell-evolution	N/A	N/A

#### 2.1.7.2 Isolated DC/DC supply

Isolated DC/DC supplies are required when the gateway is supplied by external -48V DC supply for instance. The isolated DC/DC supplied shall be inserted between the -48V supply and the DC input of the gateway. Two references are available depending on the output power:

Isolated DC/DC supply designation	Input Voltage	Output Voltage	Power	Indoor / Outdoor	Kerlink PN
Isolated 48V DC/DC 40W	48V	48V	40W	Indoor	KLK02898
Isolated 48V DC/DC 60W	48V	48V	60W	Indoor	KLK02882

The recommended isolated DC/DC supplies, depending on the LoRaWAN gateways are detailed below:

Gateway designation	Recommended DC/DC supply
Wirnet Station	KLK02898
Wirnet iStation	N/A
Wirnet iBTS Compact	KLK02898
Wirnet iBTS	KLK02882
Wirnet iBTS 64 Highway	KLK02882
Wirnet iFemtoCell	N/A
Wirnet iFemtoCell-evolution	N/A

### 2.1.7.3 AC/DC power supplies

AC/DC power supplies are provided with the indoor LoRaWAN gateways. Several versions are available depending on the targeted countries:

AC/DC supply designation	Input Voltage	Input plug	Output Voltage	Output plug	Power	Color	Kerlink PN
<b>Switching AC/DC power supply – EU version</b>	90-264V AC	EU	12V DC	2.5x5.5mm	6W	Black	KLK02889
<b>Switching AC/DC power supply – US version</b>	90-264V AC	US	12V DC	2.5x5.5mm	6W	Black	KLK02890
<b>Switching AC/DC power supply with interchangeable plugs</b>	90-264V AC	Multi-blades	12V DC	2.5x5.5mm	6W	White	KLK02942

The recommended AC/DC supplies, depending on the LoRaWAN gateways are detailed below:

Gateway designation	Recommended AC/DC supply
<b>Wirnet iFemtoCell 868</b>	KLK02889
<b>Wirnet iFemtoCell 915</b>	KLK02890
<b>Wirnet iFemtoCell 923</b>	KLK02942
<b>Wirnet iFemtoCell-evolution 868</b>	KLK02942
<b>Wirnet iFemtoCell-evolution 915</b>	KLK02942
<b>Wirnet iFemtoCell-evolution 923</b>	KLK02942

### 2.1.7.4 Photovoltaic system

A photovoltaic system, including a solar panel, a solar converter or UPS, and a battery, can be interfaced to the external DC input of the LoRaWAN gateways.

The dimensioning of the PV system shall consider the recommended DC input voltages and nominal power consumption of the gateways, according to the table below:

Gateway designation	DC supply input	Solar system voltage	Nominal power
<b>Wirnet Station</b>	11V-30V	24V (12V)	4W
<b>Wirnet iStation</b>	No	24V (12V)	5W
<b>Wirnet iBTS Compact</b>	11V-56V	24V (12V)	10W
<b>Wirnet iBTS</b>	11V-56V	24V (12V)	10W (1 LoRa Module) 18W (2 LoRa Modules) 24W (3 LoRa Modules) 30W (4 LoRa Modules)
<b>Wirnet iBTS 64 Highway</b>	11V-56V	24V (12V)	28W
<b>Wirnet iFemtoCell</b>	5.5V-17V	12V	4W
<b>Wirnet iFemtoCell-evolution</b>	5.5V-17V	12V	3W

### 2.1.7.5 UPS

Uninterrupted Power Supplies are available for indoor LoRaWAN gateways. Two versions can be provided depending on the targeted autonomy:

Characteristics	Nano UPS	Mini UPS
<b>Input voltage</b>	100-240 VAC	230VAC +/-15%
<b>Input plug</b>	Europlug CEE 7/16	Europlug CEE 7/7
<b>Output voltage</b>	12V DC	13.6V DC
<b>Output plug</b>	5.5x2.5mm	5.5x2.5mm
<b>Battery capacity</b>	6Ah (3.6V)	7Ah (12V)
<b>Kerlink PN</b>	KLK03374	ACCIOT-UPS01 (KLK03375)

The corresponding autonomy, depending on the LoRaWAN gateways are detailed below:

Gateway designation	Nano UPS (KLK03374)	Mini UPS (ACCIOT-UPS01 / KLK03375)
Wirnet iFemtoCell	4-5 hours	20-24 hours
Wirnet iFemtoCell-evolution	4-5 hours	20-24 hours

### 2.1.8 Antennas

#### 2.1.8.1 GNSS antennas

Kerlink can provide the following GNSS antennas for the LoRaWAN gateways:

GNSS antenna type	Mounting type	Kerlink PN	Kerlink antenna bracket PN
Active GNSS dome antenna 5meters RG58 coaxial cable N male connector	Deported Bracket for dome antenna	KLK02659	KLK02692
Combo dome antenna Active GNSS and LTE 700-2700MHz 5meters RG58 coaxial cables N male connectors	Deported Bracket for dome antenna	KLK02735	KLK02692
Active GPS dome antenna High immunity to interferences N female connector	Deported Bracket for dome antenna	KLK03044	KLK02692
Passive GNSS mushroom antenna N male connector	Mounted on gateway N connector	KLK03204	N/A
Passive GNSS dome antenna 5meters RG58 coaxial cable N male connector	Deported Bracket for dome antenna	KLK03217	KLK02692

The recommended external GNSS antennas depending on the LoRaWAN gateways are detailed below:

Gateway designation	GNSS antenna	Recommended external GNSS antenna
Wirnet Station	Internal / Passive	N/A
Wirnet iStation	Internal / Passive	N/A
Wirnet iBTS Compact	Internal / Passive	N/A

Wirnet iBTS	External	KLK02659 KLK03217
Wirnet iBTS 64 Highway	External	KLK02659 KLK03217
Wirnet iFemtoCell	N/A	N/A
Wirnet iFemtoCell-evolution	N/A	N/A

### 2.1.8.2 LTE antennas

Kerlink can provide the following LTE antennas for the LoRaWAN gateways:

LTE antenna type	Mounting type	Kerlink PN	Kerlink antenna bracket PN
Combo dome antenna Active GNSS and LTE 700-2700MHz 5meters RG58 coaxial cables N male connectors	Deported Bracket for dome antenna	KLK02735	KLK02692
Dome antenna LTE 700-2700MHz 5meters RG58 coaxial cable N male connector	Deported Bracket for dome antenna	KLK02734	KLK02692
Dome antenna LTE 700-2700MHz 5meters CS29 coaxial cable N male connector	Deported Bracket for dome antenna	KLK02810	KLK02692
Mushroom antenna LTE 700-2700MHz N male connector	Mounted on gateway N connector	KLK03202	N/A
Candle antenna LTE 700-2700MHz N male connector	Mounted on gateway N connector	KLK03285	N/A

The recommended external LTE antennas depending on the LoRaWAN gateways are detailed below:

Gateway designation	LTE antenna	Recommended external LTE antenna
Wirnet Station	Internal	N/A
Wirnet iStation	Internal	N/A
Wirnet iBTS Compact	Internal	N/A
Wirnet iBTS	External	KLK02810 KLK03285
Wirnet iBTS 64 Highway	External	KLK02810 KLK03285
Wirnet iFemtoCell	N/A	N/A
Wirnet iFemtoCell-evolution	Internal	N/A

### 2.1.8.3 LoRa antennas

Kerlink can provide the following LoRa external antennas for the LoRaWAN gateways:

LoRa antenna type	Mounting type	Kerlink PN	Kerlink coaxial cable PN	Kerlink antenna bracket PN
868MHz, 3dBi Omnidirectional dipole antenna N female connector	Deported Kerlink Universal Bracket	KLK02124	KLK02460	KLK02453
868MHz, 3dBi Omnidirectional dipole antenna N male connector	Mounted on gateway N connector	KLK03198	N/A	N/A
868MHz, 6dBi Omnidirectional dipole array antenna N female connector	Deported Kerlink Universal Bracket	KLK02947	KLK02460	KLK02453
868MHz, 6dBi Omnidirectional dipole array antenna N female connector	Deported Bracket for pole mount	KLK02373	KLK02460	N/A
868MHz, 9dBi Omnidirectional dipole array antenna N female connector	Deported Bracket for pole mount	KLK02374	KLK02460	N/A
868MHz, 6dBi Panel antenna N female connector	Deported Bracket for pole mount	KLK02382	KLK02460	N/A
868MHz, 9dBi Panel antenna N female connector	Deported Bracket for pole mount	KLK02383	KLK02460	N/A
868MHz, 12dBi Panel antenna N female connector	Deported Bracket for pole mount	KLK02375	KLK02460	N/A
915MHz, 3dBi Omnidirectional dipole antenna N female connector	Deported Kerlink Universal Bracket	KLK02658	KLK02460	KLK02453
915MHz, 3dBi Omnidirectional dipole antenna N male connector	Mounted on gateway N connector	KLK03199	N/A	N/A
915MHz, 6dBi Omnidirectional dipole array antenna N female connector	Deported Kerlink Universal Bracket	KLK02648	KLK02460	KLK02453
915MHz, 6dBi Omnidirectional dipole array antenna N female connector	Deported Bracket for pole mount	KLK02518	KLK02460	N/A
915MHz, 9dBi Omnidirectional dipole array antenna N female connector	Deported Bracket for pole mount	KLK03456	KLK02460	N/A
Dual band 868/915MHz, 3dBi Omnidirectional dipole antenna N female connector	Deported Kerlink Universal Bracket	KLK03196	KLK02460	KLK02453
Dual band 868/915MHz, 3dBi Omnidirectional dipole antenna N male connector	Mounted on gateway N connector	KLK03197	N/A	N/A
Dual band 868/915MHz, 6dBi Omnidirectional dipole array antenna N female connector	Deported Kerlink Universal Bracket	KLK03195	KLK02460	KLK02453

Dual band 868/915MHz, 3dBi Omnidirectional swivel antenna SMA male connector	Mounted on gateway SMA connector	KLK02843	N/A	N/A
Dual band 868/915MHz, 3dBi Omnidirectional swivel antenna RP-SMA male connector	Mounted on gateway RP-SMA connector	KLK02887	N/A	N/A

The recommended LoRa antenna depending on the LoRaWAN gateways are detailed below:

Gateway designation	LoRa antenna	Recommended external LoRa antenna
Wirnet Station 868	External	KLK02124 KLK02947 KLK02373 KLK02374
Wirnet Station 915	External	KLK02658 KLK02648 KLK02518 KLK03456
Wirnet Station 923	External	KLK02658 KLK02648 KLK02518 KLK03456
Wirnet iStation 868	Internal <sup>1</sup> / External	KLK03198 KLK02124 KLK02947 KLK02373 KLK02374
Wirnet iStation 915	Internal <sup>2</sup> / External	KLK03199 KLK02658 KLK02648 KLK02518 KLK03456
Wirnet iStation 923	Internal <sup>3</sup> / External	KLK03199 KLK02658 KLK02648 KLK02518 KLK03456
Wirnet iBTS Compact 868	External	KLK02124 KLK02947 KLK02373 KLK02374
Wirnet iBTS Compact 915	External	KLK02648 KLK02518 KLK03456
Wirnet iBTS Compact 923	External	KLK02658 KLK02648 KLK02518 KLK03456

<sup>1</sup> Internal antenna gain is 2.5dBi max, 0dBi mean

<sup>2</sup> Internal antenna gain is 2.5dBi max, 0dBi mean

<sup>3</sup> Internal antenna gain is 2.5dBi max, 0dBi mean

Wirnet iBTS 868	External	KLK02947 KLK02373 KLK02374 KLK02382 KLK02383 KLK02375
Wirnet iBTS 915	External	KLK02648 KLK02518 KLK03456
Wirnet iBTS 923	External	KLK02648 KLK02518 KLK03456
Wirnet iBTS 64 Highway	External	KLK02648 KLK02518 KLK03456
Wirnet iFemtoCell 868	External	KLK02843
Wirnet iFemtoCell 915	External	KLK02887
Wirnet iFemtoCell 923	External	KLK02887
Wirnet iFemtoCell-evolution 868	External	KLK02843
Wirnet iFemtoCell-evolution 915	External	KLK02887
Wirnet iFemtoCell-evolution 923	External	KLK02887

Connection between the LoRa antenna and the gateway requires coaxial cable KLK02460 (LMR195, 1meter, N male connectors).

**Beware:** connection of external antennas KLK03198 and KLK03199 to Wirnet iStation 868, 915 or 923 requires an N male - N female adapter (KLK03443).

As detailed in “[2] AN-KLK03356 - LoRaWAN gateways coverage optimization”, the gateway antenna gain shall be therefore adjusted depending on:

- The gateway maximum conducted power.
- The feeder losses including coaxial cable, lightning surge insertion losses and cavity filter losses.
- The maximum allowed EIRP, according to the local regulation.

The following antenna gain are then recommended for different use cases:

Gateway max conducted power	Max EIRP (local regulation)	Feeder losses	Recommended antenna gain
≤27dBm	≤30dBm	≤1dB	3dBi (6dBi)
≤27dBm	≤30dBm	≥3dB	6dBi
≤27dBm	≥36dBm	≤1dB	9dBi
≤27dBm	≥36dBm	≥3 dB	12dBi
≤30dBm	≤30dBm	≤1dB	3dBi (6dBi)
≤30dBm	≤30dBm	≥3dB	6dBi
≤30dBm	≥36dBm	≤1dB	6dBi
≤30dBm	≥36dBm	≥3 dB	9dBi

Also, when choosing the antenna, the following criteria shall be considered:

- Size, weight and easy installation:  
A 3dBi antenna is about 0.3m length and 0.3Kg weight.  
A 12dBi antenna is about 3m length and 2Kg weight.  
Installation constraints are obviously very different considering the two antennas.
- Cost:  
A 3dBi antenna is a low-cost antenna (< 50 euros).  
A 12dBi antenna cost could reach up to 200 euros.  
Sometimes the rental cost of the installation site is linked to the size of the gateway and therefore the size of the antenna. Increasing the size of the antenna would have a huge impact on operational costs.
- Location of the end-devices:  
Increasing the antenna gain helps to increase the coverage area, so the gateway can receive end-devices located at long distances. However, the gain is maximized in the horizon plan but gain at 220° elevation could be very low. A 3dBi gain antenna may have a higher gain at 220° elevation compared to a 9dBi gain antenna. About 10 to 20dB gain difference could be obtained for specific directions or angles. This means, for example, that a gateway would not be able to receive water meters in a 1m depth pit, just below the tower, with a 9dBi gain antenna whereas it could be possible with a 3dBi antenna gain. At the same time, the gateway with 9dBi gain antenna would be able to receive water meters at 10km distance whereas it would be impossible with the 3dBi gain antenna.

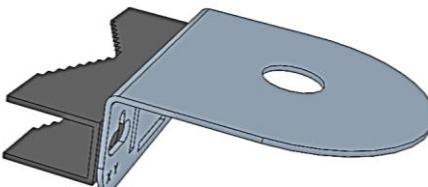
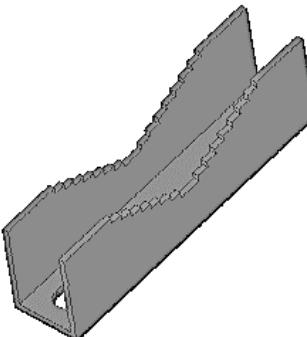
#### 2.1.8.4 Brackets

As detailed in the previous paragraphs, the listed antennas require a bracket for mounting. Some antennas are provided with their own mounting kit whereas others require an additional bracket. Two types of brackets are available depending on the antenna format: one for dome antennas (GNSS, LTE) and one for candle antennas (LoRa).

A notched V-shaped pole mounting kit including a notched V shaped plate and a U bolt with 2 nuts can be used in conjunction with the dome antenna bracket for pole mounting. The maximum diameter of the pole is 60mm.

The antenna brackets are presented below with the corresponding antennas:

Antenna bracket description	Picture	Mounting type	Kerlink PN	Kerlink antenna PN
Universal bracket for omnidirectional antenna		Wall Pole Strapping	KLK02453	KLK02124 KLK02947 KLK02658 KLK02648 KLK03196 KLK03195

Dome antenna bracket		Wall Pole Strapping	KLK02692	KLK02659 KLK02735 KLK03044 KLK03217 KLK02735 KLK02734 KLK02810
Notched V shaped pole mounting kit		Pole (60mm max)	KLK02168	KLK02692

### 2.1.9 Cavity filters

In case of colocalization with other transmitters (LTE BS, etc.) a cavity filter may be required to avoid desensitization. Kerlink has a complete portfolio of cavity filters to address worldwide countries specificities, depending on:

- The cellular (LTE) bands colocalized with LoRaWAN gateway,
- The usable unlicensed band for LoRaWAN,
- The Regional Parameters to be used for LoRaWAN,
- Outdoor or indoor (embedded) versions depending on the gateways.

Usage of cavity filter, or no usage of cavity filter, depends on the configuration of the installation, and also on the gateway RF filtering performance, mainly due to the guard band between LTE band and LoRaWAN band.

The following table summarizes the different configurations that may be encountered:

Gateway designation	Outdoor colocalized	Outdoor urban	Outdoor suburban / rural	Indoor
	Public network	Private network	Private network	Private network
		Public network extension	Public network extension	Public network extension
Wirnet Station	O	✓	✓	✓
Wirnet iStation	O	✓	✓	✓
Wirnet iBTS Compact	✓	O	O	
Wirnet iBTS	✓	O	O	
Wirnet iBTS 64 Highway	✓	O	O	
Wirnet iFemtoCell				✓
Wirnet iFemtoCell-evolution				✓

✓ : typical usage (recommended)

O: possible usage

Usage of cavity filter, or no usage of cavity filter, depends also on the emitters in the vicinity of the gateway. Several types of LTE Base Station can be considered, depending on their radiated output power:

- **Wide Area Base Stations** are characterized by requirements derived from Macro Cell scenarios.  
Wide Area BS are typically deployed in rural or suburban environments, with large cell deployment. They are installed on high towers or above rooftops.  
Output power may reach up to +48dBm and EIRP up to +68dBm.
- **Medium Range Base Stations** are characterized by requirements derived from Micro Cell scenarios.  
Medium range BS are typically deployed in urban or rural outdoor environments. They are often installed on rooftops or embedded in street furniture such as lighting fixtures, advertisement panels, bus shelters or street signs. They can also be deployed to extend the mobile network coverage and capacity on a localized area, such as isolated villages, industrial sites or emergency situations.  
Output power is limited to +38dBm and EIRP may reach up to +58dBm.  
In street furniture, the EIRP is limited to reduce Electromagnetic Fields for public health purpose. We are going to consider for instance 43dm EIRP in this case. The BS are considered as **Small Range Base Stations** in the following paragraphs.
- **Local Area Base Stations** are characterized by requirements derived from Pico Cell scenarios.  
Local Areas BS are typically deployed in indoor environments accessible to the general public such as stations, airports, commercial centers.  
Output power may reach up to +24dBm. The antenna gain is usually limited to 5dBi for instance so EIRP may reach up to 30dBm.  
Local Areas BS may not cause any interferences issues with LoRaWAN gateways. A few meters separation distance would ensure no

The different types of installations and also the several LTE BS are detailed in the following paragraphs. For each use case, a minimum separation distance is recommended to avoid desensitization of the LoRaWAN gateway. Cavity filter usage is also detailed when necessary.

See “[1] AN-KLK03355 - Improving radio coexistence performance of LoRaWAN gateways” for further details.

#### 2.1.9.1 First use case: outdoor / colocalized

This use case applies for:

- Public networks
- Installation on tower or mast
- Installation on roof top in urban or suburban areas
- Site is shared with other emitters (LTE BS, DVB-T, etc....)
- Other emitters in the vicinity (close roof top, other mast, ...)
- Gateway is installed at height greater than 10 meters
- Quasi direct Line of Sight between LTE BS and LoRaWAN gateway

Gateway designation	Min Vertical separation for Wide Area BS	Min Vertical separation for Medium Range BS	Min Horizontal separation for Wide Area BS	Min Horizontal separation for Medium Range	Recommendation
Wirnet Station 868	2m	2m	300m	300m	Cavity filter
Wirnet Station 915	1m	1m	150m	40m	Cavity filter
Wirnet Station 923 Guard band <2MHz	100m	40m	10km	7km	Cavity filter + increase guard band
Wirnet Station 923 Guard band <5MHz	7m	2.5m	1500m	400m	Cavity filter + increase guard band t
Wirnet Station 923 Guard band <10MHz	2m	2m	300m	300m	Cavity filter
Wirnet iStation 868	2m	2m	300m	300m	Cavity filter
Wirnet iStation 915	1m	1m	150m	40m	Cavity filter
Wirnet iStation 923 Guard band <2MHz	100m	40m	10km	7km	Cavity filter + increase guard band
Wirnet iStation 923 Guard band <5MHz	7m	2.5m	1500m	400m	Cavity filter + increase guard band
Wirnet iStation 923 Guard band <10MHz	2m	2m	300m	300m	Cavity filter
Wirnet iBTS Compact 868	1m	1m	150m	150m	Cavity filter
Wirnet iBTS Compact 915	1m	1m	150m	40m	Cavity filter
Wirnet iBTS Compact 923 Guard band <2MHz	100m	40m	10km	7km	Cavity filter + increase guard band
Wirnet iBTS Compact 923 Guard band <5MHz	7m	2.5m	1500m	400m	Cavity filter + increase guard band
Wirnet iBTS Compact 923 Guard band <10MHz	1.5m	1m	200m	150m	Cavity filter
Wirnet iBTS 868	1m	1m	150m	150m	Cavity filter
Wirnet iBTS 915	1m	1m	150m	40m	Cavity filter
Wirnet iBTS 923 Guard band <2MHz	100m	40m	10km	7km	Cavity filter + increase guard band
Wirnet iBTS 923 Guard band <5MHz	7m	2.5m	1500m	400m	Cavity filter + increase guard band
Wirnet iBTS 923 Guard band <10MHz	1.5m	1m	200m	150m	Cavity filter
Wirnet iBTS 64 Highway	1m	1m	150m	40m	N/A

In all above uses cases, a cavity filter is required.

In APAC zone, a guard band of 2MHz min is required between LoRaWAN band and LTE DL band.

**Note:** values in red are driven by out-of-band emissions of LTE BS. This means that performance cannot be improved through a cavity filter, although the cavity filter is required to address other issues. The minimum separation distance shall be met unless desensitization of the LoRaWAN gateway. Out-of-band emissions of the LTE BS are driven by the performance of their own cavity filter. This performance may vary depending on the LTE BS and is specific to each site. Beware of the LTE BS installation characteristics and RF filters performance.

**Note:** usually Wide Area BS are not deployed in urban areas. Medium Range BS should be considered instead. Wide Area BS column is applicable for suburban or rural areas only.

### 2.1.9.2 Second use case: outdoor / urban

This use case applies for:

- Private networks
- Public networks extension
- Installation in manufactory plant, warehouse, stores, ...
- Installation on wall, balcony, ...
- Installation in urban areas
- Site is not shared with other emitters (LTE BS, ...)
- Gateway is installed at height less than 10 meters
- No direct Line of Sight between LTE BS and LoRaWAN gateway (obstacles)

Gateway designation	Min separation for Wide Area BS	Min separation for Medium Range BS	Min separation for Small Range BS	Recommendation
Wirnet Station 868	250m	100m	35m	
Wirnet Station 915	400m	180m	75m	
Wirnet Station 923 Guard band <2MHz	1000m	400m	100m	Cavity filter + increase guard band
Wirnet Station 923 Guard band <5MHz	250m	100m	25m	Cavity filter
Wirnet Station 923 Guard band <10MHz	250m	100m	35m	
Wirnet iStation 868	250m	100m	35m	
Wirnet iStation 915	200m	100m	40m	
Wirnet iStation 923 Guard band <2MHz	1000m	400m	100m	Cavity filter + increase guard band
Wirnet iStation 923 Guard band <5MHz	250m	100m	25m	Cavity filter
Wirnet iStation 923 Guard band <10MHz	250m	100m	35m	
Wirnet iBTS Compact 868	150m	60m	25m	
Wirnet iBTS Compact 915	400m	180m	75m	
Wirnet iBTS Compact 923 Guard band <2MHz	1000m	400m	100m	Cavity filter + increase guard band
Wirnet iBTS Compact 923 Guard band <5MHz	250m	100m	25m	Cavity filter
Wirnet iBTS Compact 923 Guard band <10MHz	150m	60m	25m	
Wirnet iBTS 868	150m	60m	25m	
Wirnet iBTS 915	400m	180m	75m	
Wirnet iBTS 923 Guard band <2MHz	1000m	400m	100m	Cavity filter + increase guard band
Wirnet iBTS 923 Guard band <5MHz	250m	100m	25m	Cavity filter
Wirnet iBTS 923 Guard band <10MHz	150m	60m	25m	
Wirnet iBTS 64 Highway	70m	40m	7m	

A cavity filter is required for “923MHz” versions when the guard band between LoRaWAN band and LTE DL band 8 is less than 5MHz.

In APAC zone, for “923MHz” versions, a guard band of 2MHz min is required between LoRaWAN band and LTE DL band 8.

When the minimum separation distance cannot be guaranteed, then a cavity filter shall be added.

**Note:** values in red are driven by out-of-band emissions of LTE BS. This means that performance cannot be improved through a cavity filter, although the cavity filter is required to address other issues. The minimum separation distance shall be met unless desensitization of the LoRaWAN gateway. Out-of-band emissions of the LTE BS are driven by the performance of their own cavity filter. This performance may vary depending on the LTE BS and is specific to each site. Beware of the LTE BS installation characteristics and RF filters performance.

**Note:** usually Wide Area BS are not deployed in urban areas. The column is therefore mostly for information here, except for specific use cases! Medium Range BS should be considered instead.

#### 2.1.9.3 Third use case: outdoor / suburban / rural

This use case applies for:

- Installation in suburban (not dense) or rural areas
- Private networks
- Public networks extension (suburban mainly)
- Installation in manufactory plant, warehouse, stores, farms, ...
- Installation on wall, balcony, ...
- Site is not shared with other emitters (LTE BS, ...)
- Gateway is installed at height less than 10 meters
- Quasi direct Line of Sight between LTE BS and LoRaWAN gateway (few obstacles)

Gateway designation	Min separation for Wide Area BS	Min separation for Medium Range BS	Min separation for Small Range BS	Recommendation
Wirnet Station 868	900m	300m	60m	
Wirnet Station 915 Rural installation	2500m	700m	200m	
Wirnet Station 915 Suburban installation	150m	40m	7m	Cavity filter
Wirnet Station 923 Guard band <2MHz	4500m	1700m	150m	Cavity filter + increase guard band
Wirnet Station 923 Guard band <5MHz	1200m	400m	35m	Cavity filter
Wirnet Station 923 Guard band <10MHz	250m	100m	35m	
Wirnet iStation 868	900m	300m	60m	
Wirnet iStation 915 Rural installation	1000m	300m	60m	
Wirnet iStation 915 Suburban installation	150m	40m	7m	Cavity filter

Wirnet iStation 923 Guard band <2MHz	4500m	1700m	150m	Cavity filter + increase guard band
Wirnet iStation 923 Guard band <5MHz	1200m	400m	35m	Cavity filter
Wirnet iStation 923 Guard band <10MHz	900m	300m	60m	
Wirnet iBTS Compact 868	300m	160m	35m	
Wirnet iBTS Compact 915 Rural installation	2500m	700m	200m	
Wirnet iBTS Compact 915 Suburban installation	150m	40m	7m	Cavity filter
Wirnet iBTS Compact 923 Guard band <2MHz	4500m	1700m	150m	Cavity filter + increase guard band
Wirnet iBTS Compact 923 Guard band <5MHz	1200m	400m	35m	Cavity filter
Wirnet iBTS Compact 923 Guard band <10MHz	300m	160m	35m	
Wirnet iBTS 868	300m	160m	35m	
Wirnet iBTS 915 Rural installation	2500m	700m	200m	
Wirnet iBTS 915 Suburban installation	150m	40m	7m	Cavity filter
Wirnet iBTS 923 Guard band <2MHz	4500m	1700m	150m	Cavity filter + increase guard band
Wirnet iBTS 923 Guard band <5MHz	1200m	400m	35m	Cavity filter
Wirnet iBTS 923 Guard band <10MHz	300m	160m	35m	
Wirnet iBTS 64 Highway	100m	40m	7m	

For “915MHz” versions, a cavity filter is recommended in suburban environments as the minimum separation distance could be hardy achieved. In rural environments separation distance could be easier to achieve, so the cavity filter could be omitted.

For “923MHz” versions, a cavity filter is required when the guard band between LoRaWAN band and LTE DL band 8 is less than 5MHz. A guard band of less than 2MHz shall be avoided. These use cases typically apply in APAC zone.

When the minimum separation distance cannot be guaranteed, then a cavity filter shall be added.

**Note:** values in red are driven by out-of-band emissions of LTE BS. This means that performance cannot be improved through a cavity filter, although the cavity filter is required to address other issues. The minimum separation distance shall be met unless desensitization of the LoRaWAN gateway. Out-of-band emissions of the LTE BS are driven by the performance of their own cavity filter. This performance may vary depending on the LTE BS and is specific to each site. Beware of the LTE BS installation characteristics and RF filters performance.

#### 2.1.9.4 Fourth use case: indoor

For indoor configurations, no cavity filter is recommended.

In APAC zone, for “923MHz” versions, a guard band of 2MHz min is required between LoRaWAN band and LTE DL band.

#### 2.1.9.5 Outdoor cavity filters

The main characteristics of the outdoor cavity filters are the following:

Part Number	Band pass (MHz)	Insertion Losses (dB)	Targeted rejected band (MHz)	Targeted countries	LoRaWAN Regional Parameters
KLK02522	920–925MHz	2.0	885–915MHz 930–960MHz	Bangladesh Hong-Kong Laos, Singapore Taiwan, Thailand	AS923-1 AS923-2 KR920
KLK02523	865–867MHz	3.0	869–880MHz	India	IN865
KLK02905	918–923.5MHz	2.5	880–915MHz 925–960MHz	Indonesia Malaysia Myanmar South Korea Sri Lanka Vietnam	AS923-1 AS923-2 KR920
KLK02906	915–920MHz	2.0	925–960MHz	Cuba Israel Europe Philippines	AS923-3
KLK02909	920–928MHz	2.0	890–915MHz 935–960MHz	Costa Rica Japan New-Zealand Venezuela	AS923-1 AS923-2 KR920 AU915
KLK03410	865–870MHz	0.8	880–960MHz 832–862MHz	Europe Middle East Africa	EU868 IN865
KLK02916	863–874.4MHz	0.8	791–821MHz 925–960MHz	Europe Russia Middle East Africa	EU868 IN865 RU864
KLK02973	902–928MHz	1.2	869–894MHz	North America Central America	US915 AS923-1 AS923-2 AS923-3 KR920 AU915
KLK03306	915–928MHz	2.0	935–960MHz	Australia New-Zealand LATAM	AS923-1 AS923-2 AS923-3 KR920 AU915

The different outdoor cavity filters can be used in the Kerlink LoRaWAN gateways as follows:

Gateway designation	Gateway Reference	Outdoor cavity filter compatibility
<b>Wirnet Station 868</b>	PDTIOT-ISS00 PDTKLK-ISS0005	KLK02523 KLK03410 KLK02916
<b>Wirnet Station 915</b>	PDTIOT-ISS01	KLK02522 KLK02905 KLK02906 KLK02909 KLK02973 KLK03306
<b>Wirnet Station 923</b>	PDTIOT-ISS02	KLK02522 KLK02905 KLK02909 KLK03306
<b>Wirnet iStation 868</b>	PDTIOT-ISS04	KLK02523 KLK03410 KLK02916
<b>Wirnet iStation 915</b>	PDTIOT-ISS05	KLK02973
<b>Wirnet iStation 923</b>	PDTIOT-ISS06	KLK02522 KLK02905 KLK02906 KLK02909 KLK03306
<b>Wirnet iBTS Compact 868</b>	PDTIOT-MCS01 PDTIOT-MCS02 PDTIOT-MCS18	KLK02523 KLK03410 KLK02916
<b>Wirnet iBTS Compact 915</b>	PDTIOT-MCS11 PDTIOT-MCS12	KLK02522 KLK02905 KLK02906 KLK02909 KLK02973 KLK03306
<b>Wirnet iBTS Compact 923</b>	PDTIOT-MCS09 PDTIOT-MCS10 PDTIOT-MCS15 PDTIOT-MCS19	KLK02522 KLK02905 KLK02909 KLK03306
<b>Wirnet iBTS 868</b>	PDTIOT-MSS01 PDTIOT-MSS02 PDTIOT-MSS03 PDTIOT-MSS04	KLK02523 KLK03410 KLK02916
<b>Wirnet iBTS 915</b>	PDTIOT-MSS05 PDTIOT-MSS06	KLK02522 KLK02905 KLK02906 KLK02909 KLK02973 KLK03306

<b>Wirnet iBTS 923</b>	PDTIOT-MSS07 PDTIOT-MSS08 PDTIOT-MSS11 PDTIOT-MSS12 PDTIOT-MSS13 PDTIOT-MSS14 PDTIOT-MSS16 PDTIOT-MSS17	KLK02522 KLK02905 KLK02909 KLK03306
<b>Wirnet iBTS 64 Highway</b>	PDTIOT-MSS20 PDTIOT-MSS21 PDTIOT-MSS22 PDTIOT-MSS23	N/A
<b>Wirnet iFemtoCell</b>	PDTIOT-IFE00 PDTIOT-IFE01 PDTIOT-IFE02	N/A
<b>Wirnet iFemtoCell-evolution</b>	PDTIOT-IFE03 PDTIOT-IFE04 PDTIOT-IFE05	N/A

#### 2.1.9.6 Embedded cavity filters

Embedded cavity filters can be inserted in the LoRaWAN gateways. Two types of embedded cavity filters are available:

- Band pass filters for half-duplex, single band gateways
- Duplexers for full-duplex or dual-band gateways

The specific characteristics of the embedded band-pass cavity filters are the following:

Part Number	Band pass (MHz)	Insertion Losses (dB)	Targeted rejected band (MHz)	Targeted countries	LoRaWAN Regional Parameters
KLK03133	915–928MHz	2.2	935–960MHz	Australia New-Zealand LATAM	AS923-1 AS923-2 AS923-3 KR920 AU915
KLK03134	920–925MHz	2.2	885–915MHz 930–960MHz	Bangladesh Hong-Kong Laos, Sri Lanka Singapore Taiwan, Thailand	AS923-1 AS923-2 KR920
KLK03135	920–928MHz	2.2	890–915MHz 935–960MHz	Costa Rica Japan New-Zealand Venezuela	AS923-1 AS923-2 KR920 AU915
KLK03136	918–923.5MHz	3.0	880–915MHz 925–960MHz	Indonesia Malaysia Myanmar South Korea Vietnam	AS923-1 AS923-2 KR920

KLK03137	915–921MHz	2.5	925–960MHz	Cuba Israel Europe Philippines	AS923-3
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The specific characteristics of the embedded cavity duplexers are the following:

Part Number	Band pass (MHz)	Insertion Losses (dB)	Targeted rejected band (MHz)	Targeted countries	LoRaWAN Regional Parameters
KLK03042 (dual)	902–915MHz 923–928MHz	1.5 1.7	869–894MHz	North America Central America	US915
KLK03078	902–915MHz 923–928MHz	1.5 1.7	869–894MHz	North America Central America	US915
KLK03106	902–915MHz 923–928MHz	1.5 1.7	869–894MHz	North America Central America	US915
KLK03107	863–874.4MHz 915–919.4MHz	1.5 2.0	791–821MHz 925–960MHz	Europe Russia Middle East Africa	EU868 RU864 AS923-3
KLK03132	865–867MHz 915–920MHz	4.0 3.5	869–880MHz 925–960MHz	India	IN865 AS923-3

The different embedded cavity filters (band-pass and duplexers) can be used in the Kerlink LoRaWAN gateways as follows:

Gateway designation	Gateway Reference	Embedded cavity filter compatibility
Wirnet Station	PDTIOT-ISS00 PDTIOT-ISS01 PDTIOT-ISS02 PDTKLK-ISS0005	N/A
Wirnet iStation	PDTIOT-ISS04 PDTIOT-ISS05 PDTIOT-ISS06	N/A
Wirnet iBTS Compact	PDTIOT-MCS01 PDTIOT-MCS02 PDTIOT-MCS09 PDTIOT-MCS10 PDTIOT-MCS11 PDTIOT-MCS12 PDTIOT-MCS15 PDTIOT-MCS18 PDTIOT-MCS19	N/A
Wirnet iBTS 868	PDTIOT-MSS01 PDTIOT-MSS02 PDTIOT-MSS03 PDTIOT-MSS04	KLK03107 KLK03132
Wirnet iBTS 915	PDTIOT-MSS05 PDTIOT-MSS06	KLK03106

<b>Wirnet iBTS 923</b>	PDTIOT-MSS07 PDTIOT-MSS08 PDTIOT-MSS11 PDTIOT-MSS12 PDTIOT-MSS13 PDTIOT-MSS14 PDTIOT-MSS16 PDTIOT-MSS17	KLK03133 KLK03134 KLK03135 KLK03136 KLK03137
<b>Wirnet iBTS 64 Highway</b>	PDTIOT-MSS20 PDTIOT-MSS22	KLK03078
<b>Wirnet iBTS 64 Highway (dual)</b>	PDTIOT-MSS21 PDTIOT-MSS23	KLK03042
<b>Wirnet iFemtoCell</b>	PDTIOT-IFE00 PDTIOT-IFE01 PDTIOT-IFE02	N/A
<b>Wirnet iFemtoCell-evolution</b>	PDTIOT-IFE03 PDTIOT-IFE04 PDTIOT-IFE05	N/A

### 2.1.10 Lightning protections

In their standard configuration, the Kerlink gateways are provided with optimal internal surge protections. In harsh environment, additional protections may be used to improve lightning immunity. The gateways are not warranted by KERLINK in case of deterioration due to lightning. KERLINK recommends adding surge protections in high keraunic levels areas and on high points.

The lightning surge protections shall be completed on three interfaces to be efficient:

- Mains supply (or DC supply)
- Ethernet (PoE) cable
- RF coaxial cable (antenna interfaces)

A lightning rod, or LPS system, with a down conductor to earth is strongly recommended for this kind of applications, to avoid direct impacts on the aerials (antennas and gateway).

See “[3] AN-KLK03358 - LoRaWAN gateways lightning protection” for further details.

The list of recommended lightning surge protections is summarized in the following table:

Lightning surge protection type	Reference	Supplier	Kerlink PN
RF coaxial for GNSS, LTE antenna port	<a href="#">P8AX09-6G-N/MF</a>	CITEL	KLK02819
RF coaxial for LoRaWAN antenna port	<a href="#">PRC822S-N/MF</a>	CITEL	KLK02900
Indoor PoE	<a href="#">MJ8-POE-A</a>	CITEL	KLK02818
Outdoor PoE	<a href="#">PD-OUT/SP11</a>	Microsemi	KLK02817
DC 1 pole	<a href="#">DS71R-48DC</a>	CITEL	KLK02881
DC 2 poles	<a href="#">DS72R-48DC</a>	CITEL	KLK02880

The following table indicates the compatibility of the different lightning surge protection versus the Kerlink gateways:

Gateway designation	Gateway Reference	KLK02819	KLK02900	KLK02818	KLK02817	KLK02881	KLK02880
<b>Wirnet Station</b>	PDTIOT-ISS00 PDTIOT-ISS01 PDTIOT-ISS02 PDTKLK-ISS0005	No	LoRa RF port	Yes	Yes	External	External
<b>Wirnet iStation</b>	PDTIOT-ISS04 PDTIOT-ISS05 PDTIOT-ISS06	No	LoRa RF port	Yes	Yes	N/A	N/A
<b>Wirnet iBTS Compact</b>	PDTIOT-MCS01 PDTIOT-MCS02 PDTIOT-MCS09 PDTIOT-MCS10 PDTIOT-MCS11 PDTIOT-MCS12 PDTIOT-MCS15 PDTIOT-MCS18 PDTIOT-MCS19	No	LoRa RF port(s)	Yes	Yes	Internal	External
<b>Wirnet iBTS</b>	PDTIOT-MSS01 PDTIOT-MSS02 PDTIOT-MSS03 PDTIOT-MSS04 PDTIOT-MSS05 PDTIOT-MSS06 PDTIOT-MSS07 PDTIOT-MSS08 PDTIOT-MSS11 PDTIOT-MSS12 PDTIOT-MSS13 PDTIOT-MSS14 PDTIOT-MSS16 PDTIOT-MSS17	LTE RF port GNSS RF port	LoRa RF port(s)	Yes	Yes	Internal	Internal Internal Internal Internal Internal Internal External Internal External Internal Internal Internal Internal Internal Internal Internal Internal
<b>Wirnet iBTS 64 Highway</b>	PDTIOT-MSS20 PDTIOT-MSS21 PDTIOT-MSS22 PDTIOT-MSS23	LTE RF port GNSS RF port	LoRa RF port(s)	Yes	Yes	Internal	Internal Internal External External
<b>Wirnet iFemtoCell</b>	PDTIOT-IFE00 PDTIOT-IFE01 PDTIOT-IFE02	N/A	LoRa RF port	Yes	N/A	N/A	N/A
<b>Wirnet iFemtoCell-evolution</b>	PDTIOT-IFE03 PDTIOT-IFE04 PDTIOT-IFE05	N/A	LoRa RF port	Yes	N/A	N/A	N/A

For indoor gateways, the lightning surge protections are required only if the antenna or Ethernet cable are deported outdoor. In a "full" indoor configuration, the lightning surge protections are not required.

**Beware:** connection of coaxial lightning protection KLK02900 onto Wirnet iStation requires an N male - N female adapter (KLK03443).

## 2.1.11 Cables

### 2.1.11.1 RF coaxial cables

Kerlink outdoor gateways are provided with a KLK02460 coaxial cable. This a 1m length LMR195 coaxial cable equipped with 2 x N male IP68 connectors. The insertion losses are less than 0.5dB at 900MHz.

If longer coaxial cables are required, low insertion losses references shall be used. Kerlink recommend using LMR400 cables in this case. These cables are designed for 20-year service outdoor use and has low insertion losses as shown below:

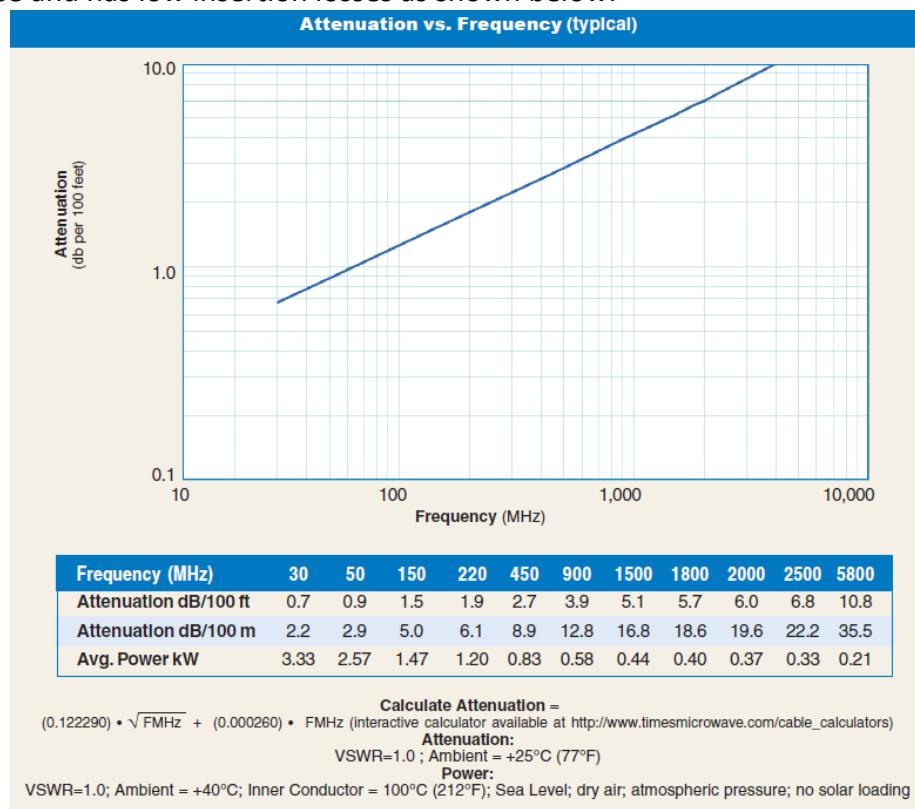


Figure 7 : LMR400 coaxial cable - attenuation vs. frequency

### 2.1.11.2 Ethernet cable

Ethernet cable is not provided with the Kerlink LoRaWAN gateways.

KERLINK recommends using an Ethernet cable with the following characteristics:

Characteristics	Specification
<b>Category</b>	6A
<b>Shielding</b>	STP (U/FTP) or SSTP (S/FTP)
<b>Section conductors</b>	AWG26 or bigger
<b>External jacket</b>	LSZH or PUR
<b>Maximum length</b>	100 meters
<b>Operating temperature range</b>	-20°C to +60°C

KERLINK recommends the following reference:

TELEGARTNER AMJ 500 U/FTP 4x2x0.55 LSZH Cat. 6A IEC 600332-1

The Ethernet cable shall be provided with two RJ45 T 568A (or 568B) plugs on each side.

#### 2.1.11.3 Earthing cables

In case of outdoor gateways, several earthing cables, wires or tapes are required to connect the installation and the materials to earth for lightning immunity and electrical security. The earthing cables are not provided by KERLINK.

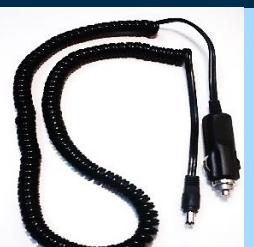
The earthing cables are detailed hereafter with recommended wires and sections:

Cable description	Technical characteristics
Earthing of the Gateway mounting kit	25mm <sup>2</sup> , copper
Earthing of the antenna brackets (LoRa antenna, GNSS antenna, LTE antenna)	25mm <sup>2</sup> , copper
Earthing of the RF coaxial surge protection	16mm <sup>2</sup> , copper
Earthing of the Ethernet surge protection	16mm <sup>2</sup> , copper
Earthing of the DC surge protection	16mm <sup>2</sup> , copper
Earthing of the outdoor PoE injector	16mm <sup>2</sup> , copper

#### 2.1.11.4 Cigarette lighter cord

An auto cigarette coil cord can be provided for installation of indoor gateways in vehicles. The gateway can be then supplied by the auto power outlet.

The main characteristics of the cord are:

Characteristics	Cigarette Lighter cord	Pictures
Voltage	12V DC	
Connector #1	Auto cigarette plug	
Connector #2	5.5 x 2.5 mm plug	
Output plug	5.5x2.5mm	
Length	3.65m (12')	
Kerlink PN	KLK03371	
Gateways compatibility	Wirnet iFemtoCell Wirnet iFemtoCell-evolution	

#### 2.1.12 Debug probes

Debug probes are available for debug purpose and / or firmware upgrade. Several versions are available depending on the LoRaWAN gateway:

Debug probe designation	Kerlink PN	Gateways compatibility
Wirgrid Debug Probe	ACCIOT-SDE00	Wirnet Station Wirnet iFemtoCell
Wirnet Debug Probe	ACCIOT-SDE01	Wirnet iStation Wirnet iFemtoCell-evolution

Wirma Debug Probe	ACCWM2-SDE00	Wirnet iBTS Compact Wirnet iBTS Wirnet iBTS 64 Highway
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Wirnet Debug Probe (ACCIOT-SDE01) is the last version of debug probe to be used on the new gateways and future gateways.

### 2.1.13 Gateway management

In order to operate the LoRaWAN gateways, but also to enable the deployment and the management of a private LoRaWAN networks at scale, a secure and scalable management tool is required. Kerlink provides two solutions for our customers to operate their LoRaWAN network according to their needs.

#### WANESY MANAGEMENT CENTER (WMC)

Wanesy Management Center is a very modular and complete solution providing you Operating Support System (OSS), Base Station Controller (BSC), Radio Network Controller (RNC), and LoRaWAN Network Server (LNS) features to run, monitor and manage your entire IoT network. This solution is available in SaaS, “On premises” and even in NaaS mode.

Wanesy Management Center will allow you to speed-up deployments, to optimize operations and maintenance in order to increase the QoS of your IoT network, and quickly monetize your IoT services.

Based on the latest SW technology (docker, Kubernetes ...) and on a very intuitive GUI (Graphic User Interface), Wanesy Management Center will deliver powerful instant features and dashboards to permanently monitor, analyze, manage and optimize your network infrastructure (gateways) and radio performances.

#### WANESY SMALL PRIVATE NETWORK (SPN)

Based on its highly intuitive graphical user interface (GUI), Wanesy SPN allows users to speed-up deployment, optimize network operation and maintenance, and quickly put their data to work. As Wanesy SPN is fully integrated in the Wirnet gateways firmware, this eliminates the need for cloud storage and a more complex network design.

The platform can support up to 20 Kerlink LoRaWAN Wirnet gateways.

Easy to configure, Wanesy SPN offers multiple options for backhaul, including Ethernet, Wi-Fi or cellular.

Gateway designation	WMC compatibility	SPN compatibility
Wirnet Station	✓	✓
Wirnet iStation	✓	✓
Wirnet iBTS Compact	✓	
Wirnet iBTS	✓	
Wirnet iBTS 64 Highway	✓	
Wirnet iFemtoCell	✓	✓
Wirnet iFemtoCell-evolution	✓	✓

### 3 Outdoor gateways

The gateways shall be professionally installed.

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

Read carefully the "User Manual – Quick Start Guide" of every LoRaWAN gateway for any specificities.

#### 3.1 Opening the enclosure

Before proceeding to the installation of the outdoor gateway, opening of the enclosure is required for:

- insertion of the USIM card
- connection of the Ethernet cable (or PoE cable)
- connection of the DC power supply wires (if PoE injector not used)

The following table details the gateways that requires opening and those not requiring opening:

Gateway designation	Opening required
Wirnet Station	Yes / USIM, Ethernet, Supply
Wirnet iStation	No
Wirnet iBTS Compact	Yes / USIM, Ethernet, Supply
Wirnet iBTS	Yes / USIM, Ethernet, Supply
Wirnet iBTS 64 Highway	Yes / USIM, Ethernet, Supply

The gateways that do not require opening have an enclosure embedding caps, cable glands or covers allowing the connections from the exterior.

The connections setting (Ethernet, DC supply) and USIM insertion shall be completed, as far as possible, in indoor conditions to avoid any ingress of water, dust, etc. This shall be prohibited in outdoor conditions especially in presence of rain.

The lid of the enclosure shall be closed once the connection settings are completed.

##### 3.1.1 Wirnet iBTS and Wirnet iBTS 64 Highway opening

The lid tightens to the frame with 4 x M5 screws, hidden by two plastic clip-on design covers. First, remove the two plastic clips. This can be done manually, without any particular tool:



Figure 8: Wirnet iBTS – plastic clips on the lid

The 4 x M5 screws are now accessible.

Unlock the screw with a big flat blade screw driver (65-098 5,5x100 Stanley for instance).



Figure 9: Wirnet iBTS – 4x M5 screws

Remove the lid.

### 3.1.2 Wirnet iBTS Compact and Wirnet Station opening

Opening of the Wirnet iBTS Compact or Wirnet Station casing is very simple as the cover of the enclosure is just clipped on the frame.

There are 2 door hinges that lock the cover. You just have to open one to open the cover like a door. Due to the 2 hinges, there are then two open points that are noted as "A" and "B" on the picture below:

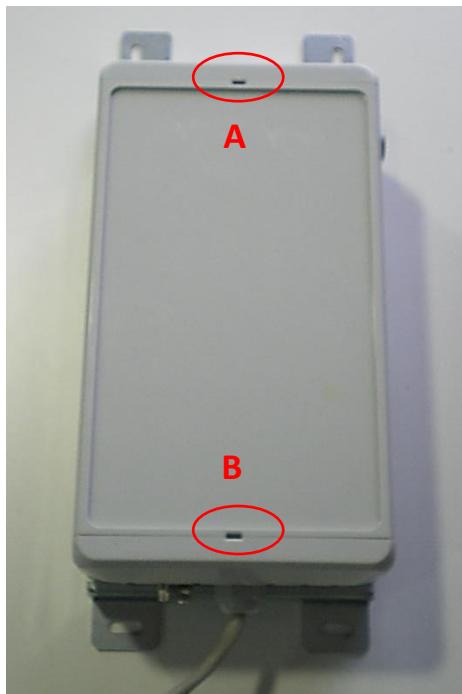


Figure 10 : Open points of the compact enclosure

To open the cover, you need to use a screwdriver that shall be inserted in the slots A or B. The screwdriver can be a small one or a bigger one.

Small flat-blade screwdriver:

Example: 64-978 3x50 Stanley

Push the screwdriver into the slot A, and lift up and down, down and up, with progressive strength and going deeper. It will clip. Don't be afraid to break it, if will be opened before, if you do it step by step (progressive, to feel the point of opening).

Big flat-blade screwdriver:

Example: 65-098 5,5x100 Stanley

Push the screwdriver into the slot, (it won't enter completely) and lift up in turning the screwdriver into the slot (like to drive screws into the slot). Here you have to use more strength because the lever arm is smaller.



Figure 11 : Opening of the compact enclosure with screwdriver

### 3.2 Inserting an additional module inside the Wirnet iBTS enclosure

The Wirnet iBTS family has a modular architecture allowing scalability as detailed in §2.1.4. It is then possible to add modules (LoRa module or WAN module) to increase the capacity or add a backhaul option.

This operation shall be completed in an indoor environment, before the installation of the gateway on the mast or tower. If already installed, it is recommended to des-install it before proceeding to the addition of the module.

To add a LoRa module in the Wirnet iBTS enclosure, follow the procedure below:

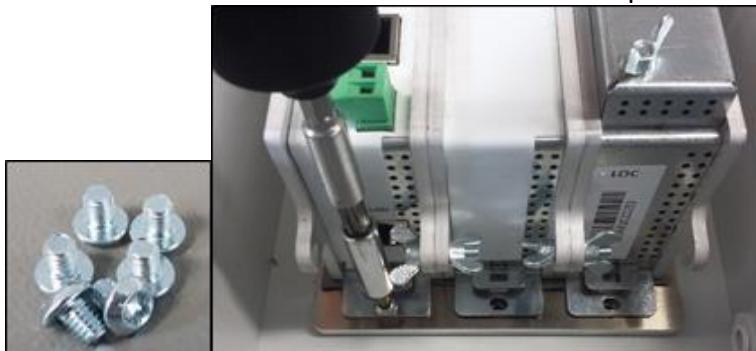
- Place thermal paste on the bottom side of the radiators.



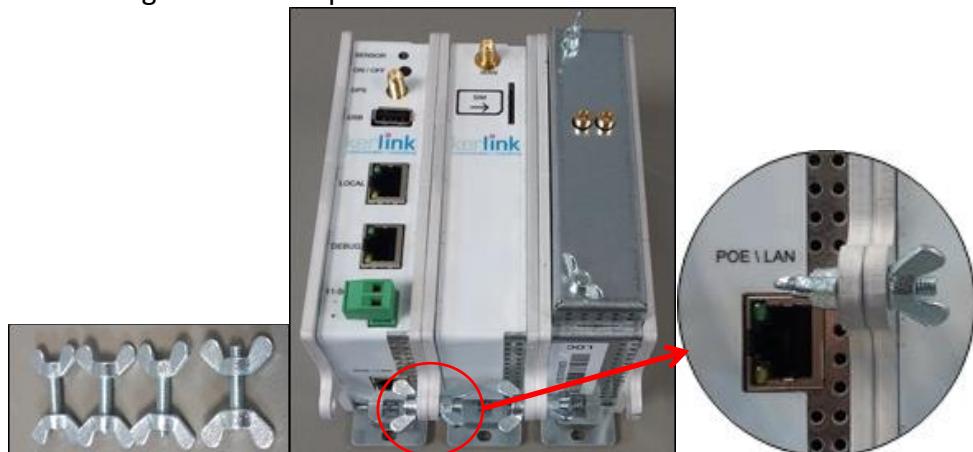
- Insert the LoRa module into the enclosure. Place it close to the available blind threaded standoffs on the back of the enclosure.
- Slide the new LoRa module on the left, close to the previous installed module:
  - Ensure the back-panel connector is properly inserted into the previous module
  - Ensure the radiator of the new module get in contact with the radiator of the previous module



- Screw the module on the blind threaded standoffs with the provided M4 screws



- Screw the wing screws on top and on the bottom of the radiators

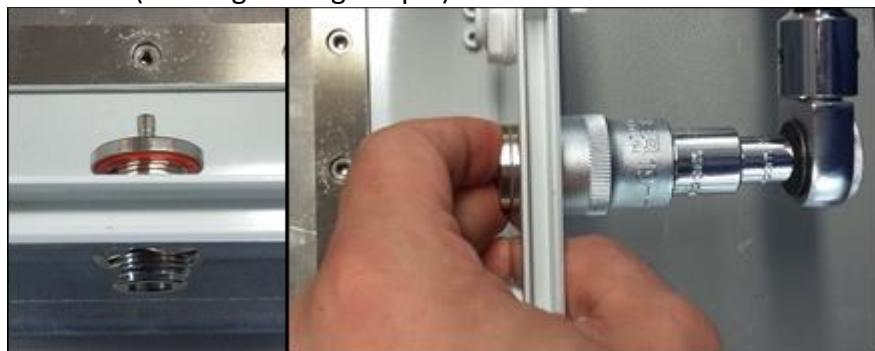


**Note:** to remove a LoRa module, use the same procedure.

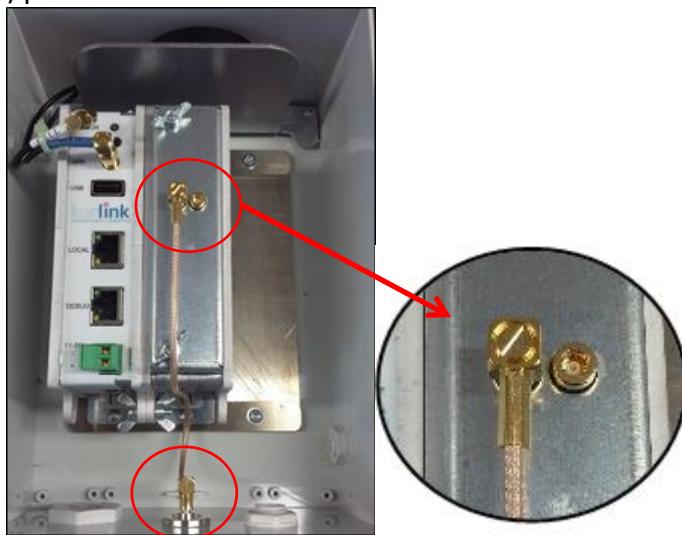
- Once the module is properly installed, then one or two N-SMB adapters are required for the antenna's connections, depending on the chosen configuration.



- To add a N-SMB adapter, follow the procedure below:
  - Unscrew the M16 blind stop
  - Screw the N-SMB adapter on the bottom side of the enclosure with M19 wrench (3Nm tightening torque)



- Connect the SMB-SMB coaxial cable between the N-SMB adapter and the RF1 (and RF2) port of the LoRa module



### 3.3 USIM card

#### 3.3.1 Wirnet iBTS family

Before inserting the USIM card, pay attention that the Wirnet iBTS is unpowered by checking that all LEDs of the CPU module are OFF.

USIM card insertion is based on a push-push mechanism.

Then, to insert a USIM card in the WAN module, follow the procedure:

- Open the enclosure (see §3.1)
- Insert carefully the USIM card in the WAN module respecting the USIM orientation drawn besides the connector and as shown below
- Push the USIM card and released pressure until a “click” can be heard.



Figure 12 : USIM Card – Wirnet iBTS

In case of replacement of the USIM card, the power supply shall be firstly switched off by disconnecting Ethernet wires or disconnecting the POE injector. For few seconds, the Wirnet iBTS is still powered-on due to the internal backup battery. Wait and check the LEDs are switched off before extracting the USIM card.

Simply push the USIM card to extract it from the WAN module.

After inserting the new USIM card as described above, the Wirnet iBTS can be re-powered on again.

In case of change of mobile operator, APN and login/password shall be updated. This can be done through USB update or through the local maintenance Web interface.

### 3.3.2 Wirnet Station

Before inserting the USIM card, pay attention that the Wirnet Station is unpowered by checking the 2 LEDs PWR are OFF, after pressing the TEST button.

Then, to insert a USIM card in the gateway:

- Open the Wirnet Station casing as detailed in §3.1
- Then, you can remove the USIM card holder of the Wirnet Station by pressing with a little screwdriver, the extraction button (as shown below)
- Place the USIM card in the USIM card holder
- Insert carefully the USIM card holder with the USIM card in the Wirnet Station

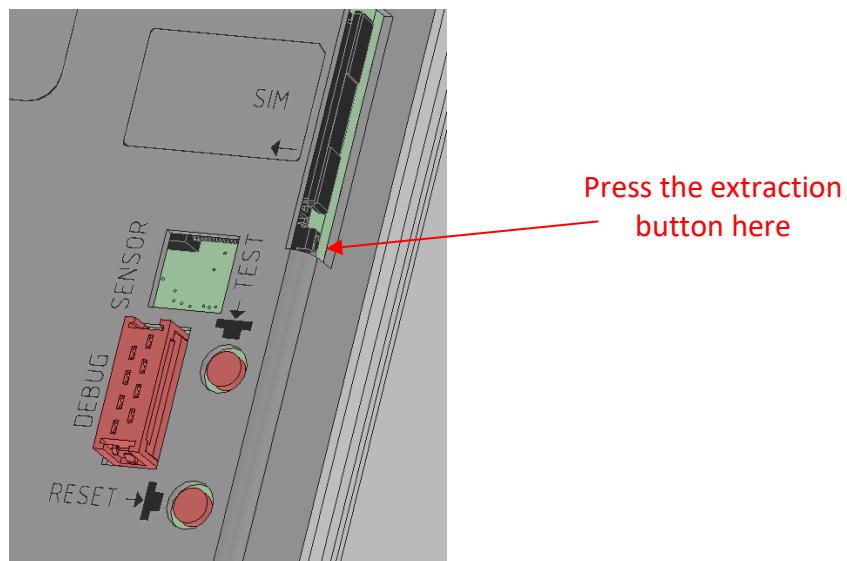


Figure 13 : USIM Card – Wirnet Station

In case of replacement of the USIM card, the power supply shall be firstly switched off by disconnecting Ethernet wires or disconnecting the POE injector. For few seconds, the Wirnet Station is still powered-on due to the internal backup battery. Wait and check the 2 LEDs PWR are switched off, after pressing the TEST button, before extracting the USIM card.

After inserting the new USIM card as described above, the Wirnet Station can be re-powered on.

In case of change of mobile operator, APN and login/password shall be updated.

### 3.3.3 Wirnet iStation

Before inserting the USIM card, pay attention that the Wirnet iStation is unpowered by checking the 2 LEDs are OFF on the bottom side of the gateway enclosure.

Then, to insert a USIM card in the gateway:

- Remove the M25 black cap on the right side of the enclosure
- Insert carefully the USIM card in the connector respecting the USIM orientation drawn besides the connector and as shown below
- Push the USIM card and released pressure until a “click” can be heard.
- Replace the M25 black cap

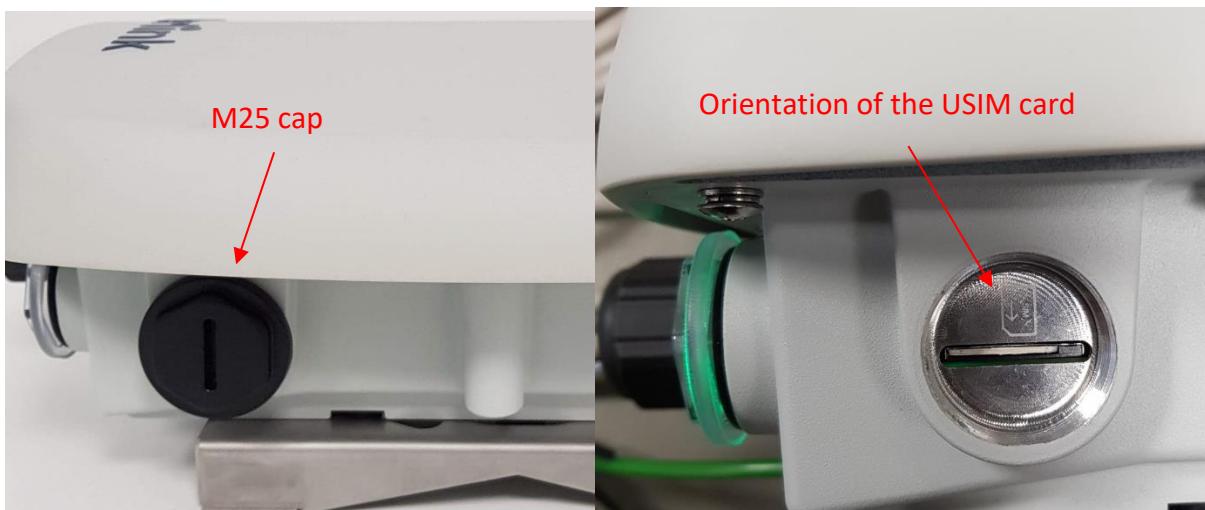


Figure 14 : USIM Card insertion – Wirnet iStation

In case of replacement of the USIM card, the power supply shall be firstly switched off by disconnecting Ethernet wires or disconnecting the POE injector. For few seconds, the Wirnet iStation is still powered-on due to the internal backup battery. Wait and check the 2 LEDs are switched off, before extracting the USIM card.

After inserting the new USIM card as described above, the Wirnet iStation can be re-powered on.

In case of change of mobile operator, APN and login/password shall be updated.

### 3.4 Electric distribution to the outdoor gateway

#### 3.4.1 Safety

The installation shall comply with IEC/EN 60728-11 (Cable Networks - Safety).

Earthing is a key parameter for a secure installation.

Earthing of the installation is mandatory for:

- Indoor installation parts: mains supply, PoE injector
- Outdoor installation parts: tower, pole, gateway enclosure, mounting kit, antennas.

A second key parameter for a secure installation is the lightning protection.

In its standard configuration, the LoRaWAN gateway is provided with nominal internal surge protections. The LoRaWAN gateways are not warranted by KERLINK in case of deterioration due to lightning. Additional surge protections are recommended in harsh environments.

A lightning rod with a down conductor to earth is strongly recommended in most of the applications to avoid direct impacts on the aerials (antennas and gateway).

See “[3] AN-KLK03358 - LoRaWAN gateways lightning protection” for further details.

The following picture describes all the required cables connections required for the installation, including power supply cables, data cables, RF coaxial cables and earthing connections.

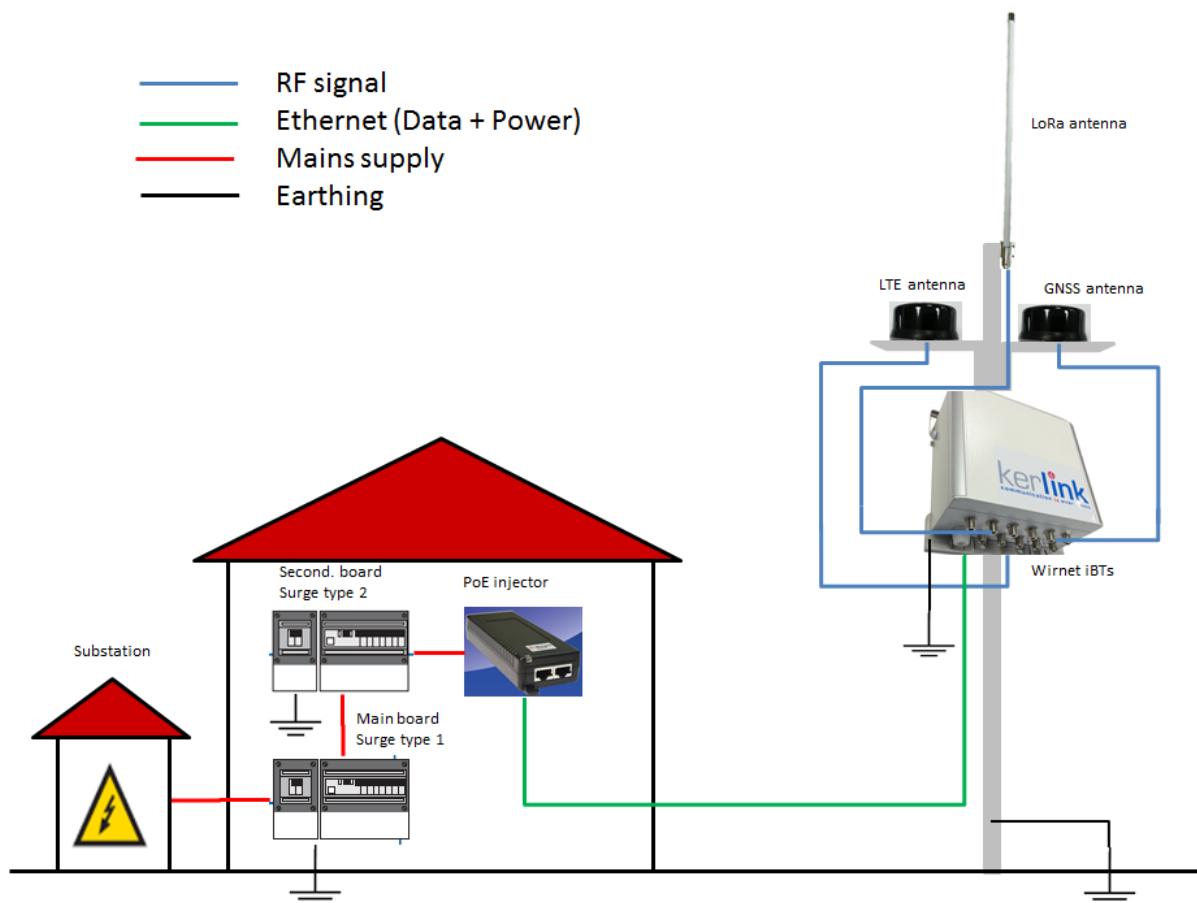


Figure 15 : Power distribution in the installation

### 3.4.2 Mains supply

The mains supply is not injected directly into the gateway but through a PoE injector or AC/DC supply.

The mains supply shall be an indoor installation composed of:

- A main electrical board including:
  - a circuit breaker
  - a surge protection type 1
  - a connection to “earth”
- A secondary electrical board including:
  - a circuit breaker
  - a surge protection type 2
  - a connection to “earth”

Surge protections type 1 and 2 are required to protect the PoE injector or AC/DC supply.

In case surge protections type 1 and 2 are not available, specific PoE injectors for outdoor applications are required.

### 3.4.3 POE supply

The Wirnet gateway is supplied by a PoE injector through an Ethernet cable.

The recommended PoE injectors are detailed in §2.1.7.1.

The recommended Ethernet cable is detailed in §2.1.11.2.

**Note 1:** The Ethernet cable is not provided by Kerlink.

**Note 2:** The maximum Ethernet cable length is 100m.

**Note 3:** The PoE injectors are considered as limited power sources

### 3.4.4 Auxiliary power supply

The Wirnet gateways can be also supplied with an auxiliary DC power supply as detailed in §2.1.7.2 and §2.1.7.4.

The installation of the DC supply cable is detailed in §3.7.5.

### 3.5 Lightning protections

In their standard configuration, the Wirnet gateways are provided with optimal internal surge protections. In harsh environment, additional protections may be used to improve lightning immunity. The Wirnet gateways are not warranted by KERLINK in case of deterioration due to lightning. KERLINK recommends adding surge protections in high keraunic levels areas and on high points.

The lightning surge protection shall be completed on three interfaces to be efficient:

- Mains supply (or DC supply)
- Ethernet (PoE) cable
- RF coaxial cable (antenna interfaces)

A lightning rod, or LPS system, with a down conductor to earth is strongly recommended for this kind of applications. The lightning rod avoids direct impacts on the aerials (antennas and gateway).

Another key parameter for an efficient lightning surge protection is “earthing”. The earthing connection ensure that the lightning surge is driven to the ground properly as detailed in §3.7.1. Earthing of the installation is mandatory for:

- indoor installation (mains supply, PoE injector)
- outdoor installation (tower, pole, ...)

See “[3] AN-KLK03358 - LoRaWAN gateways lightning protection” for further details.

### 3.6 Mounting of the enclosure

#### 3.6.1 General considerations

The Wirnet gateways enclosures shall be mounted on any concrete pedestal, concrete wall or any non-flammable surface (UL94-V0). It shall not be mounted on a flammable surface.

The mounting kits delivered with the Wirnet gateways allow tightening the product in different ways:

- Wall mount
- Pole mount by U-bolt
- Pole mount by metallic strapping

Universal antenna brackets (see §2.1.8.4) or specific antenna brackets are provided with the LoRa antennas. Universal antenna brackets can be directly mounted on the Wirnet Station and Wirnet iBTS Compact mounting kit.

Dome antenna brackets (see §2.1.6.4) are provided with the LTE antennas and GNSS antennas. All these kits are detailed in the following paragraphs.

### 3.6.2 Antennas mountings kits

#### 3.6.2.1 GNSS, LTE and LoRa antenna considerations

The Wirnet gateways integrates GNSS, LTE and LoRa antennas. GNSS and LTE antennas can be integrated inside the enclosure or are external to the enclosure (see §2.1.8). The LoRa antennas are always external to the enclosure, except Wirnet iStation.

The position of these antennas, in an open environment, is important and could determine the overall performance of the Wirnet gateways.

The GNSS antenna requires an open sky view to be able to receive a maximum number of satellites. This determines the PPS clock accuracy and finally the TDOA / geolocalization accuracy. The recommended antennas (see §2.1.8.1) are provided with a 5m coaxial cable. Extension coaxial cables could be used to reach the optimum sky view but are not provided by KERLINK.

The LTE antenna requires an open environment to optimize the link with the LTE BS in the area. The benefits are less multipath fading and better data throughput.

One recommended antenna (KLK02810) is provided with a 5m coaxial cable (see §2.1.8.2). Extension coaxial cables could be used to reach a better position but are not provided by KERLINK. However, beware of the insertion losses! A candle antenna (KLK03285) could be directly mounted on the gateway enclosure in case of proximity of the LTE BS (colocalization site for example).

The LoRa antenna requires an open environment to optimize the link with the end-devices. The benefits are less multipath fading and optimized coverage area.

The antenna is provided with a 1m coaxial cable. Extension coaxial cables could be used to reach a better position but are not provided by KERLINK. However, beware of the insertion losses! Recommended coaxial cable in this case is LRM400 as detailed in §2.1.11.1.

#### 3.6.2.2 Distance between antennas

##### 3.6.2.2.1 LoRa antenna vs. LTE antennas

To avoid or minimize the intermodulation between the LoRa transmitter and the LTE transmitter, a minimum distance is required between the LoRa antenna and the LTE antenna. This minimum distance is also recommended to avoid mutual desensitization of the receivers. To optimize the colocalization between the LTE antenna and the external LoRa antenna, a distance of 20 cm min is required between both radiated parts.

Therefore, when possible KERLINK strongly recommend dissociating the universal antenna bracket away from the gateway enclosure support. This is the best way to guarantee the 20 cm min distance between LTE antenna and LoRa antenna. When the dissociation is not possible, the LoRa antenna shall be placed on the right side of the enclosure as described on Figure 16.

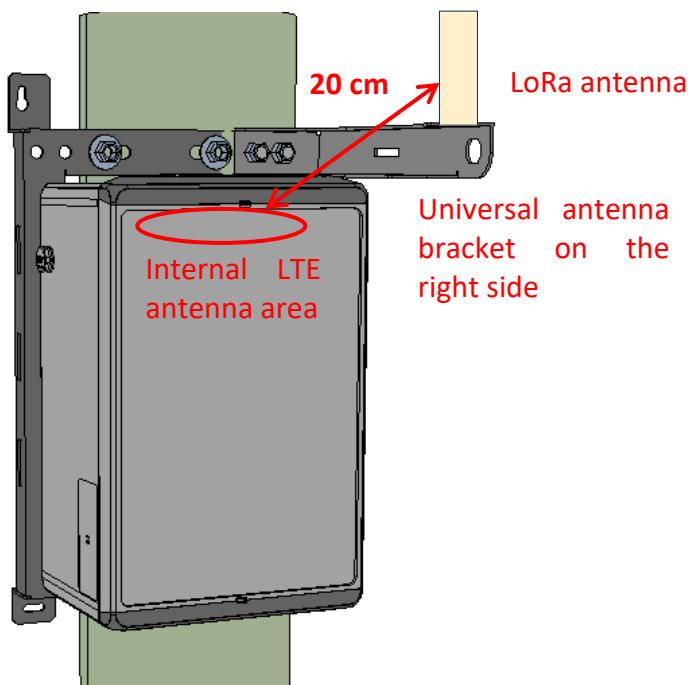


Figure 16 : Position of the universal antenna support when mounted on the compact enclosure support

### 3.6.2.2.2 LoRa space diversity

Space diversity is supported by the Wirnet iBTS family as detailed in §2.1.1.

Distance between antennas to optimize the spacing diversity performance is always a subject of discussion. There are no miracle formulas helping to determine the distance because each use case is a particular use case.

However, there are some rules to be followed:

- The minimum distance between antenna shall be the half wavelength i.e.:
  - 18 cm at 868MHz
  - 17 cm at 915MHz
- To have uncorrelated antennas it is better to have a minimum distance of  $13\lambda/8$  between antennas i.e.:
  - 56 cm at 868MHz
  - 53 cm at 915MHz
- The distances can be increased to improve the performance, ideally by steps of a wavelength. The recommended distances are then:
  - 868MHz: 56 cm, 91 cm, 125 cm, 160 cm, etc...
  - 915MHz: 53 cm, 86 cm, 119 cm, 151 cm, etc...

**Note 1:** the distance between the two universal antenna brackets installed on the Wirnet iBTS Compact mounting kit is 20cm. This meets the 18cm minimum distance for space diversity although the performance is not optimum.

**Note 2:** the universal bracket length is about 20cm. In a 120mm pole mount configuration, the maximum distance between antennas can be the  $20+20+12=52$ cm which is close to the optimum distance listed above.

### 3.6.2.3 Universal antenna bracket

The universal antenna bracket (KLK02453) is recommended for the omnidirectional LoRa antennas detailed in §2.1.8.4.

The universal antenna bracket is presented hereafter:

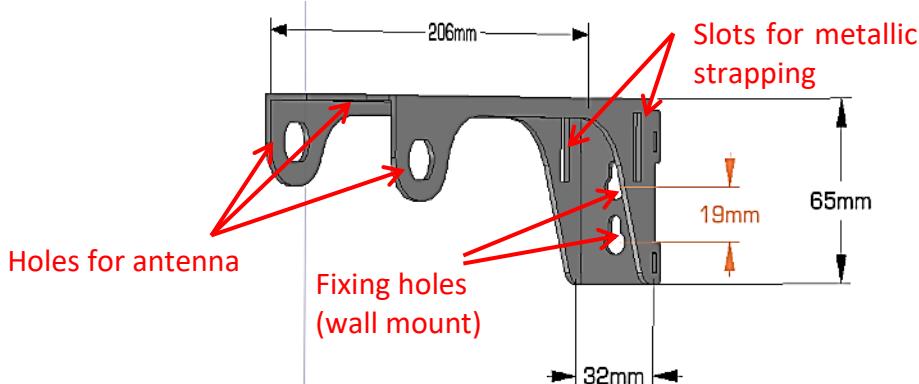


Figure 17 : Universal antenna bracket dimensions

The universal antenna bracket has 3 holes dedicated to the LoRa antenna N connector. The bracket can be then oriented in 3 different positions without compromising the antenna position.

The universal antenna bracket can be mounted:

- On a wall: use in this case two M4 screws separated by 19mm.
- On a pole: use metallic strapping through the two 5mm x 25mm slots.
- On the Wirnet iBTS Compact or Wirnet Station mounting kit, with 2 x M8 bolts and screws as follows.

It is preferred to have the universal antenna bracket installed on the right side of the compact casing mounting kit (as follow) to have a better isolation between the LoRa antenna and the GPS/LTE internal antennas.

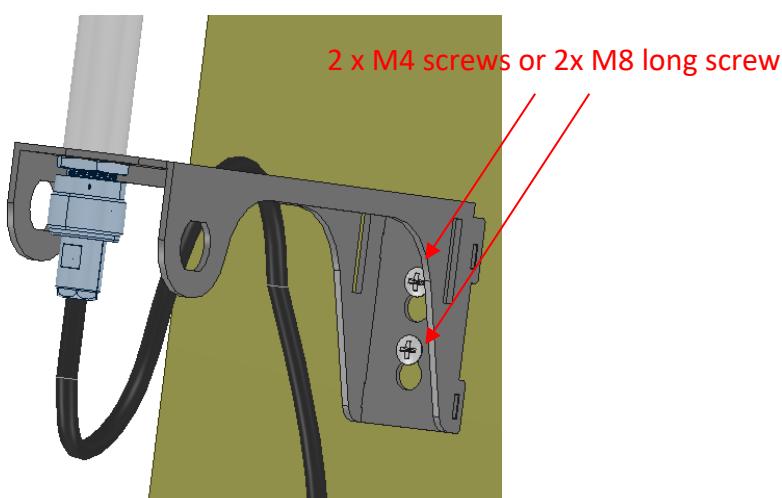


Figure 18 : Wall mount of the universal antenna bracket

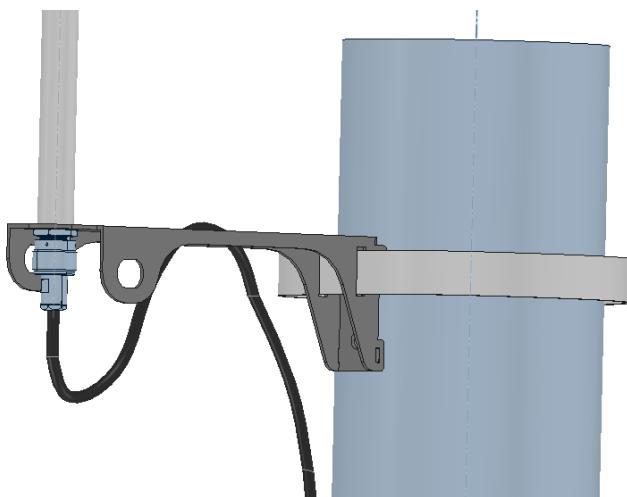


Figure 19 : Pole mounting of the universal antenna bracket using strapping

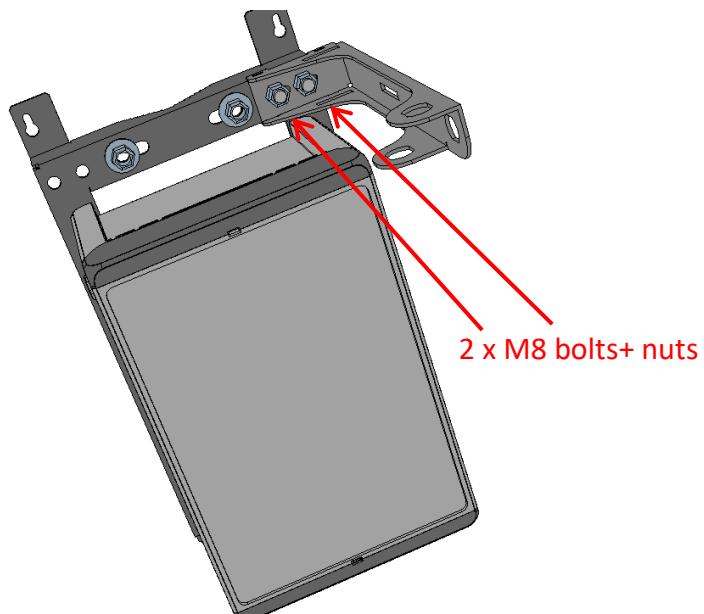


Figure 20 : Universal antenna bracket with Wirnet Gateway mounting kit

**Note 1:** the M4 screws and the metallic strapping are not provided by KERLINK.

**Note 2:** the M8 bolts and nuts are provided by KERLINK.

Once the universal antenna bracket is installed, then the LoRa antenna can be mounted on the bracket. The LoRa antenna is provided with a N female connector, a washer and a M19 nut.

Follow the following procedure:

- Unscrew the M19 nut
- Remove the washer
- Introduce the N connector into the hole of the universal antenna bracket
- Place the washer
- Screw the M19 nut



Figure 21 : LoRa antenna mounted on universal antenna bracket

### 3.6.2.4 Dome antenna bracket

The dome antenna bracket (KLK02692) is recommended for the GNSS and LTE antennas detailed in §2.1.8.4.

The dome antenna bracket is presented hereafter:

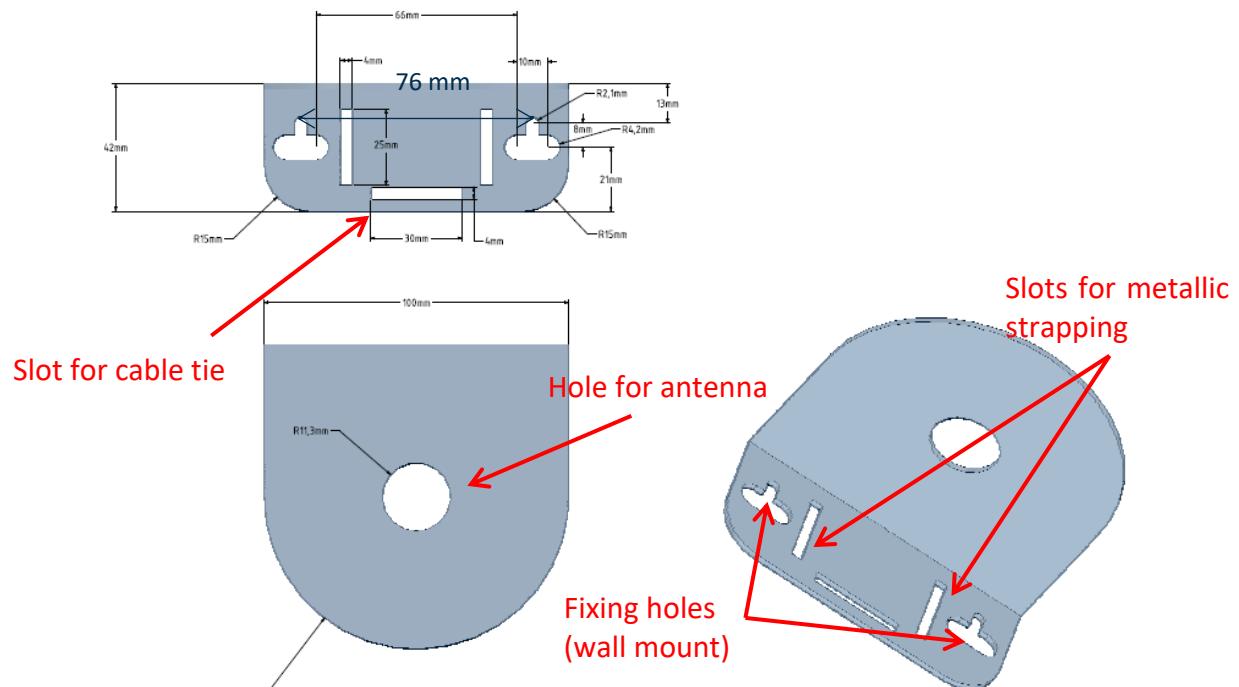


Figure 22 : Dome antenna bracket dimensions

The dome antenna bracket has a single hole dedicated to the LTE and / or GNSS M22 screw.

The dome antenna bracket can be mounted:

- On a wall: use in this case 2 x M4 screws separated by 76mm.
- On a pole: use metallic strapping through the two 4mm x 25mm slots.
- On a pole: using the “notched V shaped plate” (KLK02168) and a U-bolt. The maximum diameter of the pole is 60mm.

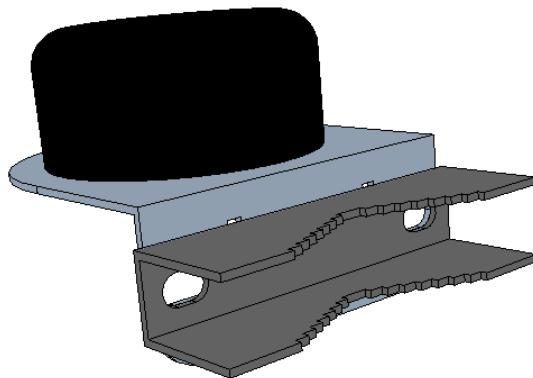


Figure 23 : Dome antenna bracket with notched V shaped bolt

Another slot is available. It can be used for cable ties to tighten the RF coaxial cable to the antenna bracket.

**Note 1:** the M4 screws and the metallic strapping are not provided by KERLINK.

**Note 2:** the cables ties are not provided by KERLINK.

Once the dome antenna bracket is installed, then the GNSS antenna, or LTE, or GNSS/LTE combo antenna can be mounted on the bracket. These antennas are provided with N female connector(s) and a M22 nut.

Follow the following procedure:

- Introduce the N connector(s) into the hole of the bracket
- Pass all the coaxial cable length through the hole until the antenna is in contact with the bracket
- Unscrew the M22 nut
- Introduce the antenna M22 screw into the hole
- Beware the position of the gasket to insure waterproof installation. There shall be no aperture between the antenna casing and the gasket.
- Screw the M22 nut

Repeat the operation for GNSS antenna, LTE antenna (or GNSS/LTE combo antenna).



Figure 24 : N connector introduced in the hole of the dome antenna bracket / Figure 25 : Antenna installed on the dome antenna bracket

### 3.6.3 Mounting of the Wirnet iBTS Compact and Wirnet Station enclosures

Both Wirnet iBTS Compact and Wirnet Station are delivered with a mounting kit already screwed on the gateway enclosure. Their mounting kit share a similar mechanical design although the dimensions are different. The mounting procedure is therefore similar for both gateways.

#### 3.6.3.1 Wirnet Station mounting kit

The Wirnet Station mounting kit is composed of a single mechanical part as shown below:

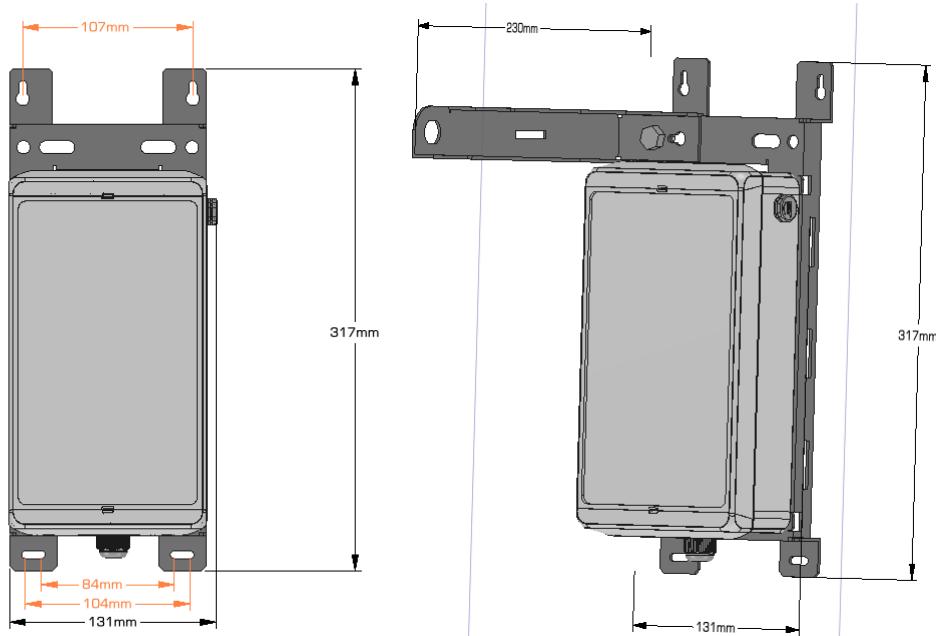


Figure 26 : Compact casing mounting kit dimensions

The Wirnet Station is delivered with the mounting kit already installed on the rear side.

#### 3.6.3.2 Wirnet iBTS Compact mounting kit

The Wirnet iBTS Compact mounting kit is composed of a single mechanical part as shown below:

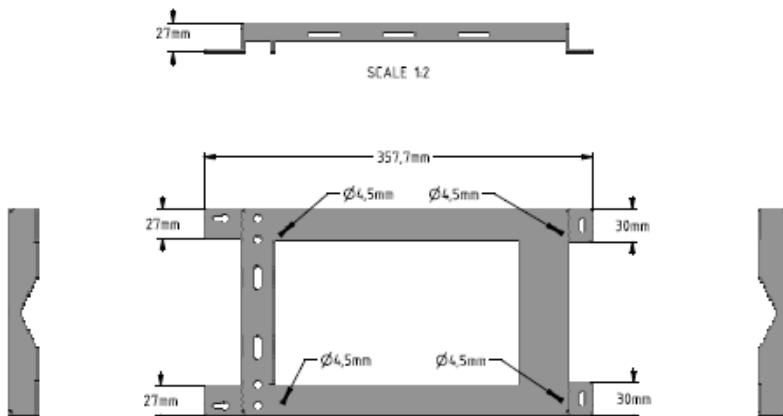


Figure 27 : Compact casing mounting kit dimensions

The Wirnet iBTS Compact is delivered with the mounting kit already installed on the rear side.

### 3.6.3.3 Wall mounting

The Wirnet iBTS Compact and Wirnet Station can be also mounted on a wall with 4 x M4 screws.

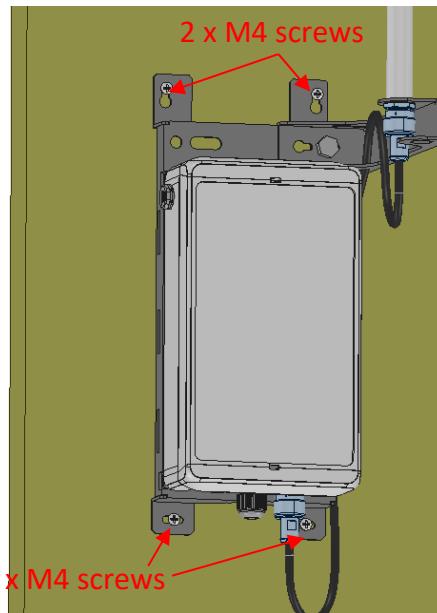


Figure 28 : Compact casing - Wall mount

**Note:** M4 screws are not delivered with the mounting kit.

For safety reason, the metallic mounting kit shall own a good earth connection. This is ensured by adding an earth connection through the M8 bolt and nut (see §3.7.1.2).

### 3.6.3.4 Pole mounting by U-bolt

The Wirnet iBTS Compact or Wirnet Station is delivered with a U-bolt to be mounted on a pole with a maximum diameter of 60mm.

To screw the U-bolt, it is recommended to use the nuts provided in the mounting kit.

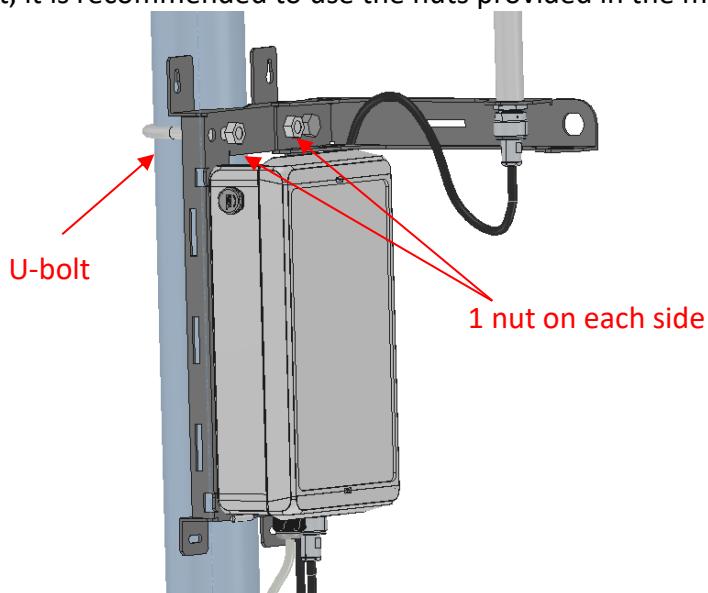


Figure 29 : Wirnet iBTS Compact / Wirnet Station - Pole mount using U-bolt

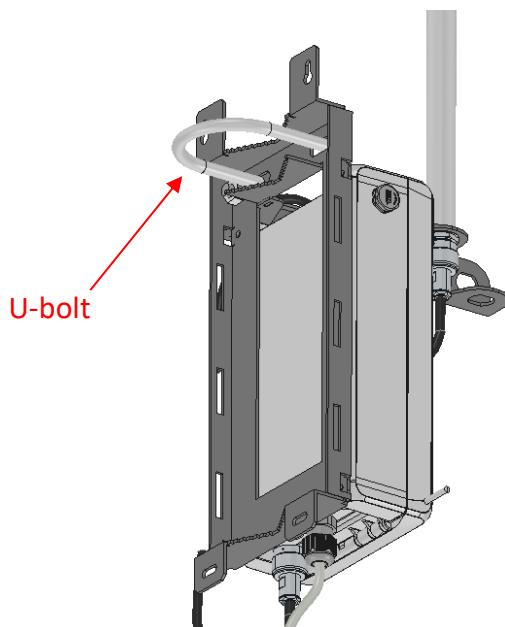


Figure 30 : Wirnet iBTS Compact / Wirnet Station - rear view of the pole mounting using U-bolt (no pole represented)

For safety reason, the metallic mounting kit shall own a good earth connection. This is ensured by adding an earth connection on the U bolt nut or the M8 nut (see §3.7.1.2).

### 3.6.3.5 Metallic strapping mounting

The Wirnet iBTS Compact or Wirnet Station can be also mounted on a pole by strapping. The maximum acceptable width of the strapping is 25mm. It is recommended to use 2 metallic strappings as described on the figure below:

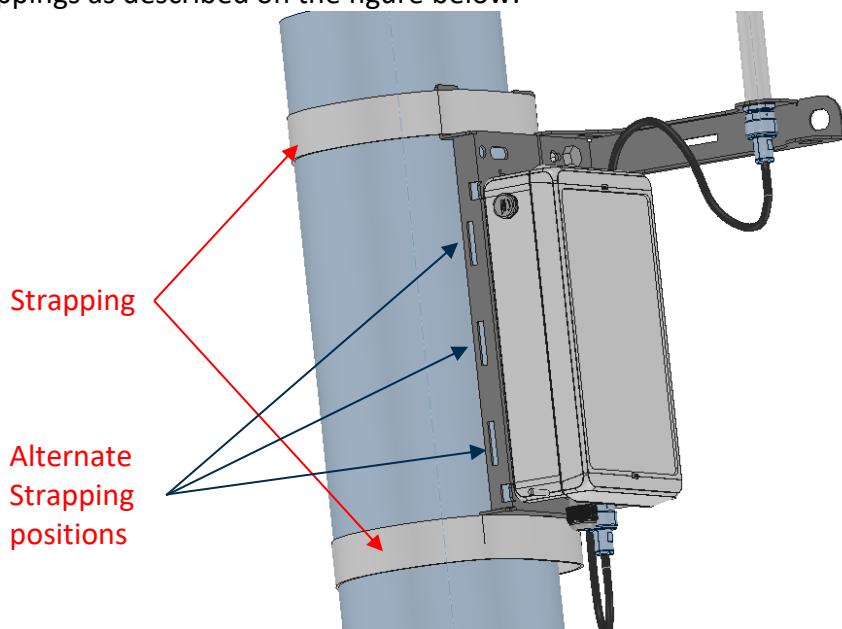


Figure 31 : Wirnet iBTS Compact / Wirnet Station - Pole mount using strapping

For safety reason, the metallic mounting kit shall own a good earth connection. This is ensured by adding an earth connection on the M8 nut (see §3.7.1.2).

### 3.6.4 Mounting of the Wirnet iBTS and Wirnet iBTS 64 Highway enclosures

#### 3.6.4.1 Wirnet iBTS and Wirnet iBTS 64 Highway mounting kit

The Wirnet iBTS and Wirnet iBTS 64 Highway mounting kit is composed of two identical parts as shown below:

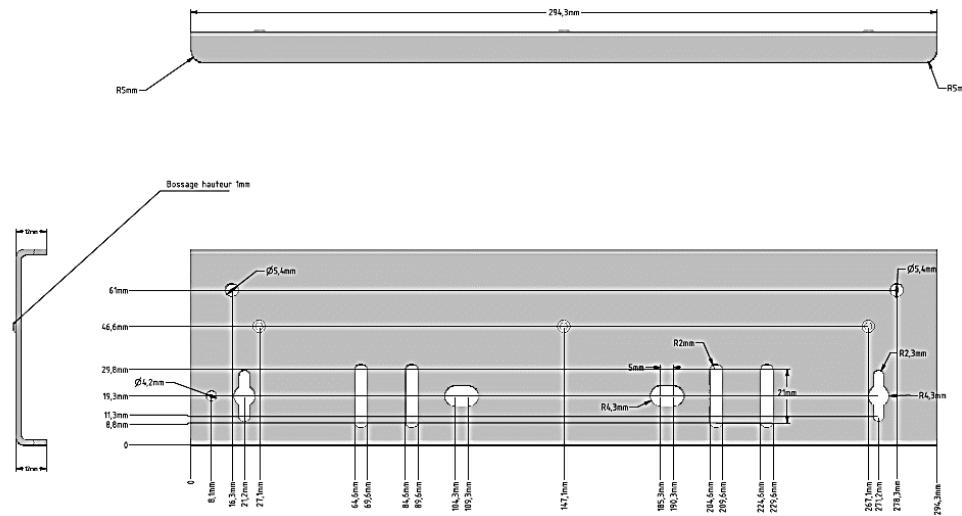


Figure 32 : Wirnet iBTS and Wirnet iBTS 64 Highway mounting kit dimensions

One part is mounted on the top of the enclosure and the second one on the bottom of the enclosure. The parts include several holes and slots dedicated to wall mount screwing and strapping. The holes are also used for earthing through a M8 bolt and nut (see §3.7.1.1). The Wirnet iBTS or Wirnet iBTS 64 Highway is delivered with the standard casing mounting kit already installed on the rear side:

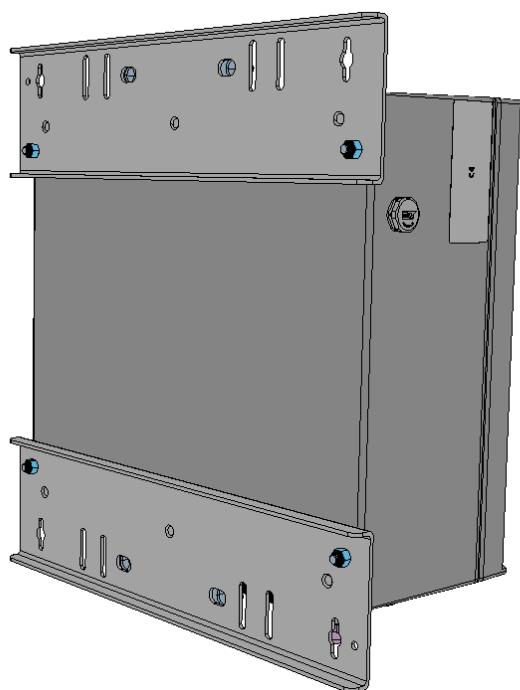


Figure 33 : Rear view of the Wirnet iBTS / Wirnet iBTS 64 Highway with mounting kit

### 3.6.4.2 Wall mounting

The Wirnet iBTS or Wirnet iBTS 64 Highway can be also mounted on a wall with 4 x M4 screws.

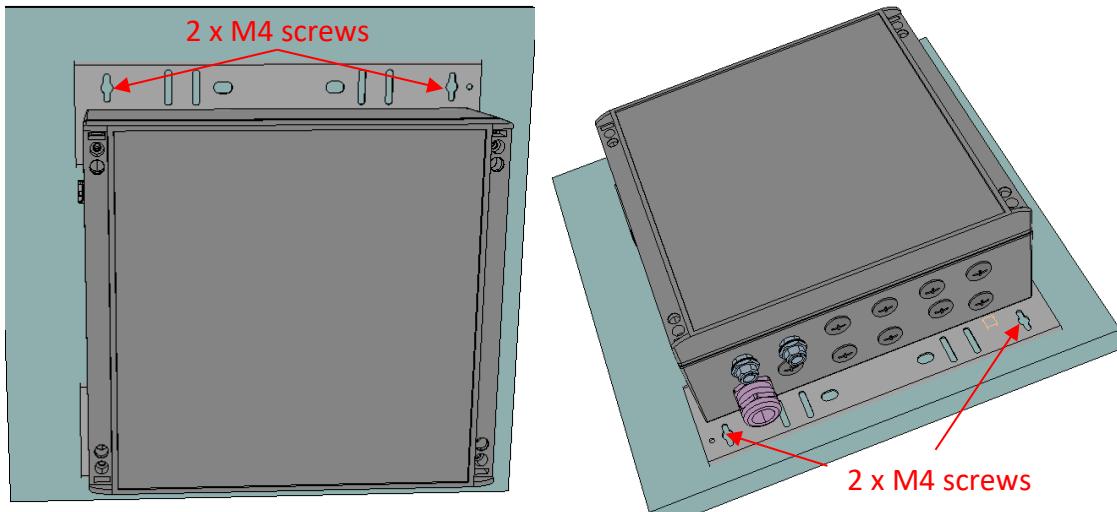


Figure 34 : Compact casing - Wall mount

**Note:** M4 screws are not delivered with the mounting kit.

For safety reason, the metallic mounting kit shall own a good earth connection. This is ensured by adding an earth connection on the dedicated hole (see §3.7.1.1).

### 3.6.4.3 Pole mounting by U-bolt

The Wirnet iBTS or Wirnet iBTS 64 Highway is delivered with two notched V-shaped plates and two U-bolts to be mounted on a pole with a maximum diameter of 60mm.

To screw the U-bolts, it is recommended to use the four nuts provided in the mounting kit.

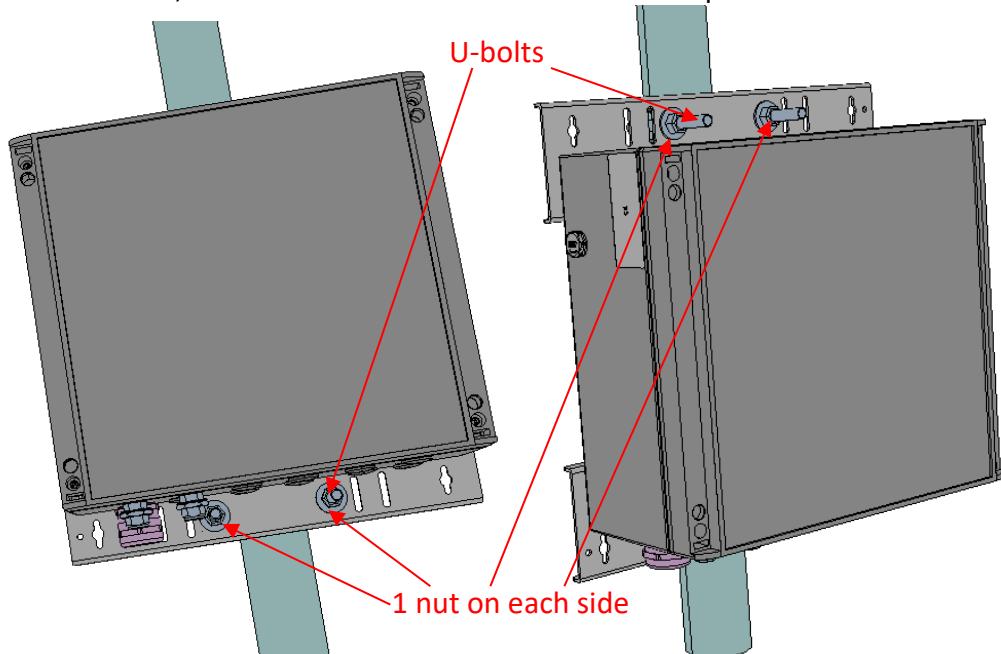


Figure 35 : Standard casing - Pole mount using U-bolts

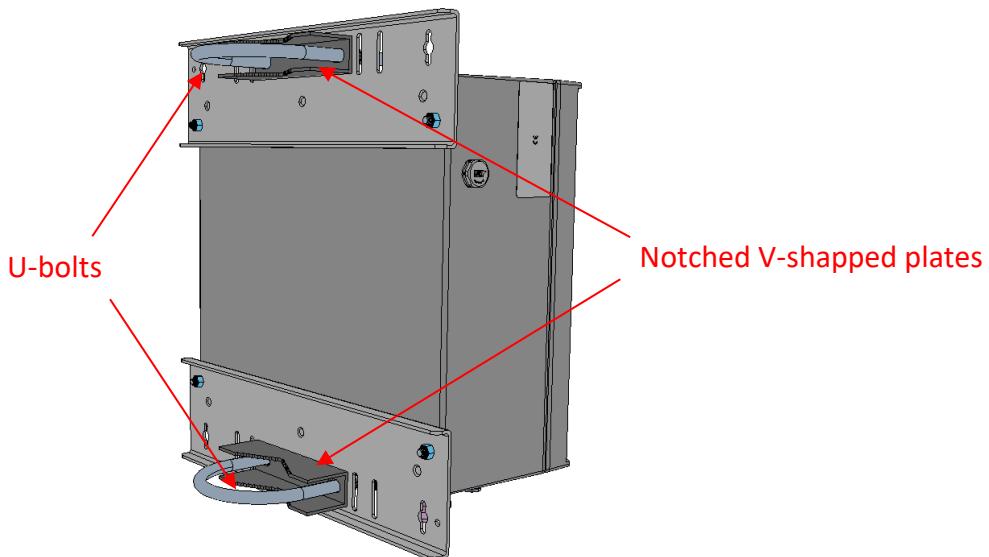


Figure 36 : Wirnet iBTS or Wirnet iBTS 64 Highway - rear view of the pole mounting using U-bolt (no pole represented)

For safety reason, the metallic mounting kit shall own a good earth connection. This is ensured by adding an earth connection on the dedicated hole (see §3.7.1.1).

#### 3.6.4.4 Metallic strapping mounting

The Wirnet iBTS or Wirnet iBTS 64 Highway can be also mounted on a pole by strapping. The maximum acceptable width of the strapping is 25mm. Several slots are available allowing adapting different diameters of poles. It is recommended to use 2 metallic strappings as described on the figure below:

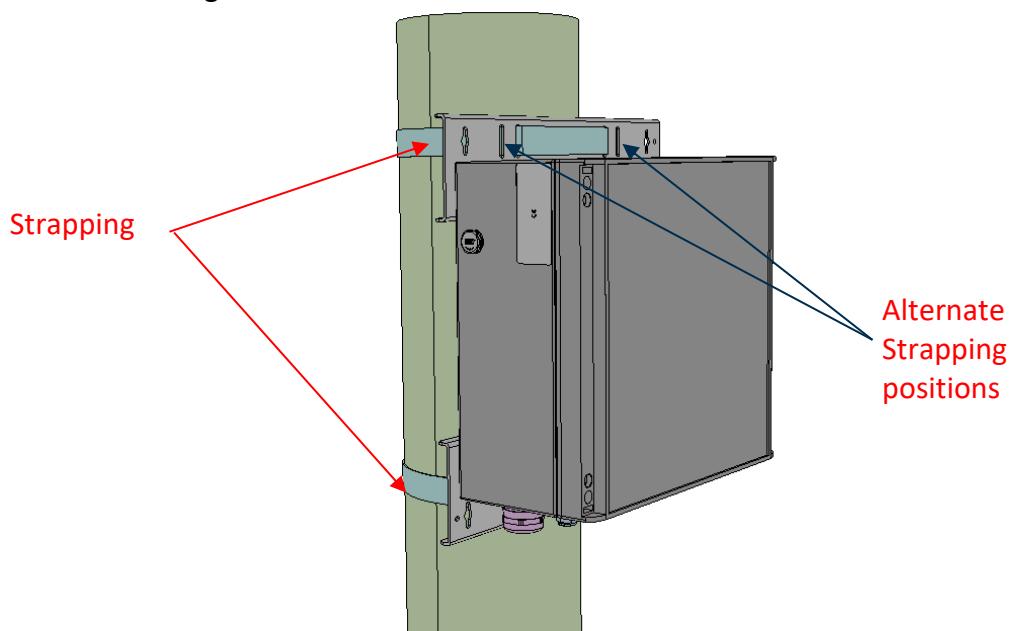


Figure 37 : Standard casing - Pole mount using strapping

For safety reason, the metallic mounting kit shall own a good earth connection. This is ensured by adding an earth connection on the dedicated hole (see §3.7.1.1).

### 3.6.5 Mounting of the Wirnet iStation enclosure

Wirnet iStation is delivered with a mounting kit already installed on the gateway enclosure. The mounting kit is easily detachable allowing easy installation of the gateway. The mounting kit shall be first detached from the enclosure and installed separately. The enclosure can be installed on the mounting kit, once the mounting kit is already installed.

#### 3.6.5.1 Wirnet iStation mounting kit

The Wirnet iStation mounting kit is composed of a single mechanical part as shown below:

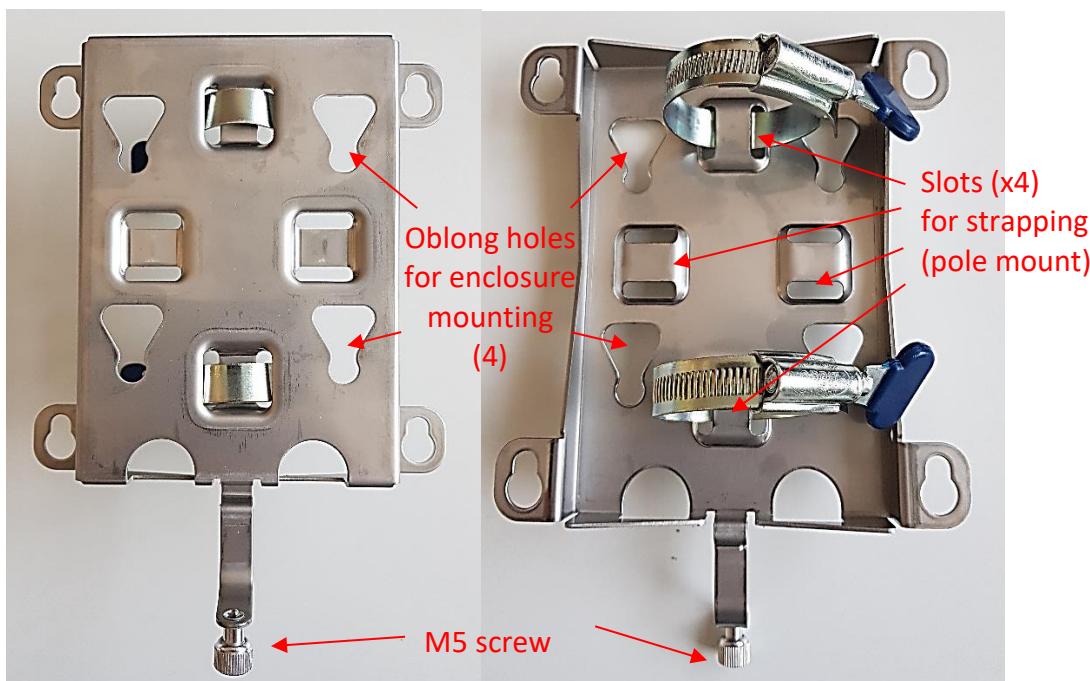


Figure 38 : Wirnet iStation mounting kit dimensions

The mounting kit is composed of:

- 4 oblong holes to insert the positioning screws of the enclosure
- 4 double slots to insert the strapping for pole mount
- 1 M5 screw used to tighten the mounting kit to the enclosure

The Wirnet Station is delivered with the mounting kit already installed on the rear side.

#### 3.6.5.2 Insertion of the Wirnet iStation enclosure on its mounting kit

To install the Wirnet iStation enclosure on its mounting kit:

- Place the 4 positioning screws at the rear of the enclose inside the 4 oblong holes of the mounting kit
- Slide the mounting kit to place the 4 positioning screws as follows:

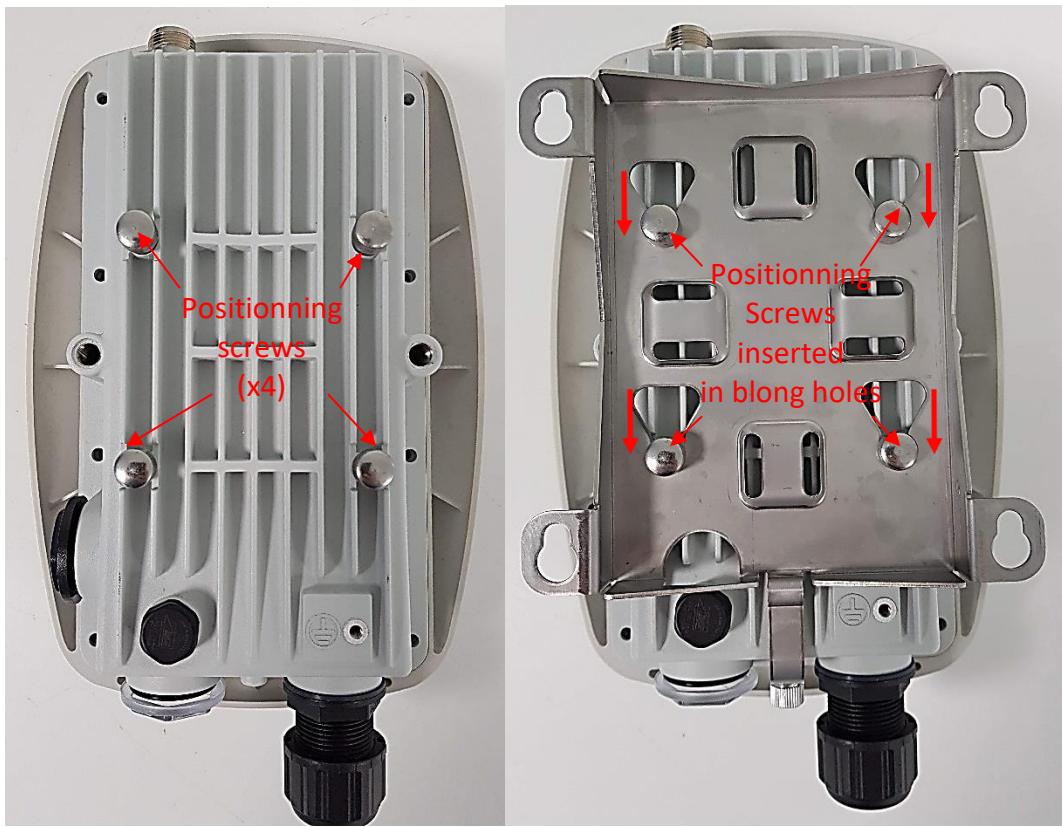


Figure 39 : Rear view of Wirnet iStation without and with mounting kit

- Screw the M5 screw to maintain the mounting kit on the enclosure:

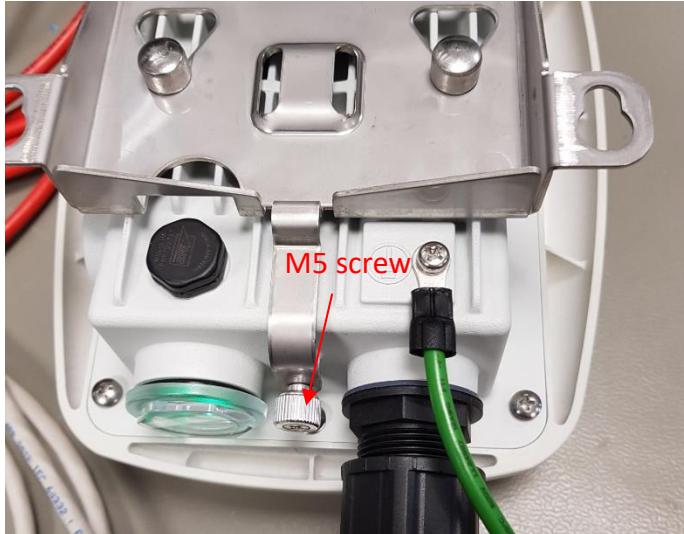


Figure 40 : Detail of M5 screw

To remove the mounting kit, the same procedure applies.

### 3.6.5.3 Wall mounting

The Wirnet iStation can be also mounted on a wall with 4 x M4 screws.

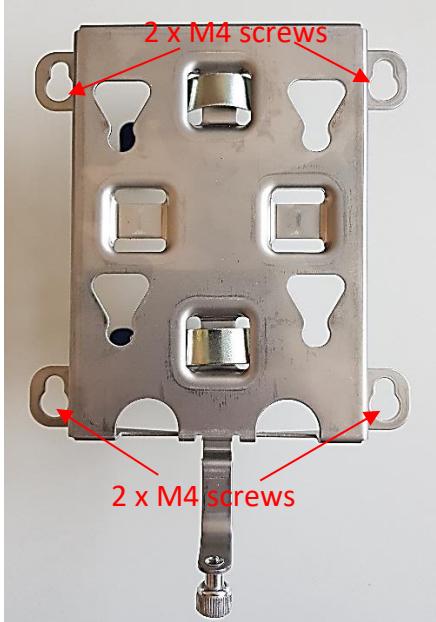


Figure 41 : Compact casing - Wall mount

**Note:** M4 screws are not delivered with the mounting kit.

### 3.6.5.4 Metallic strapping mounting

The Wirnet iStation can be also mounted on a pole by strapping. The maximum acceptable width of the strapping is 25mm. It is recommended to use 2 metallic strappings as described on the figure below:

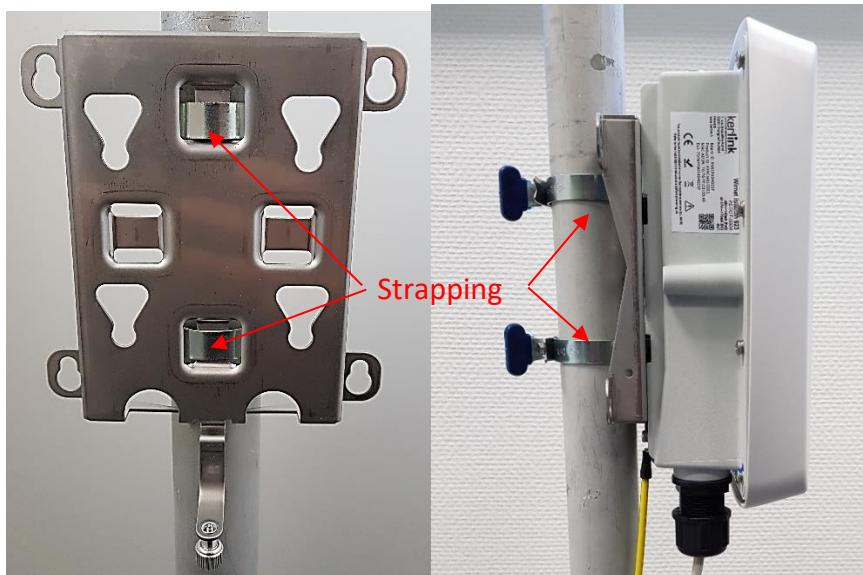


Figure 42 : Wirnet iStation - Pole mount using strapping

For safety reason, the metallic mounting kit shall own a good earth connection. This is ensured through the ground connection of the enclosure (see §3.7.1.3).

### 3.6.6 Mounting of the accessories

#### 3.6.6.1 Indoor PoE injectors

Indoor PoE injectors listed in §2.1.7.1 can be wall mounted with 2 x M3 screws.



Figure 43 : Screws for indoor POE injectors mounting

#### 3.6.6.2 Outdoor PoE injectors

Outdoor PoE injectors listed in §2.1.7.1 can be wall mounted using 3 x M3 screws (positions 1, 2 and 3 below):

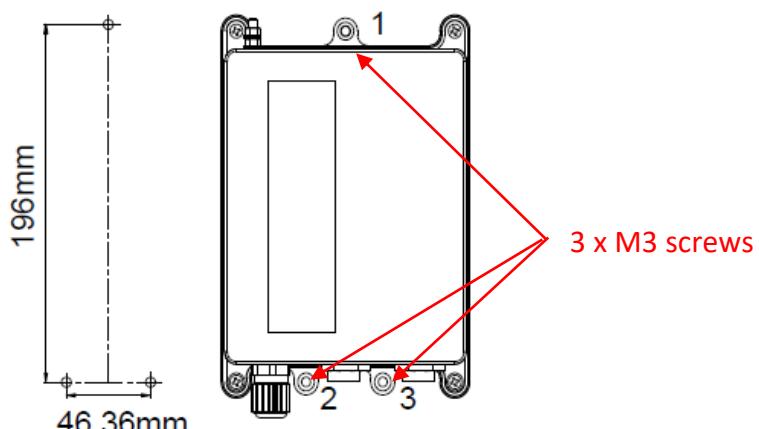


Figure 44 : Screws for outdoor POE injectors mounting

A mounting bracket kit is also available:

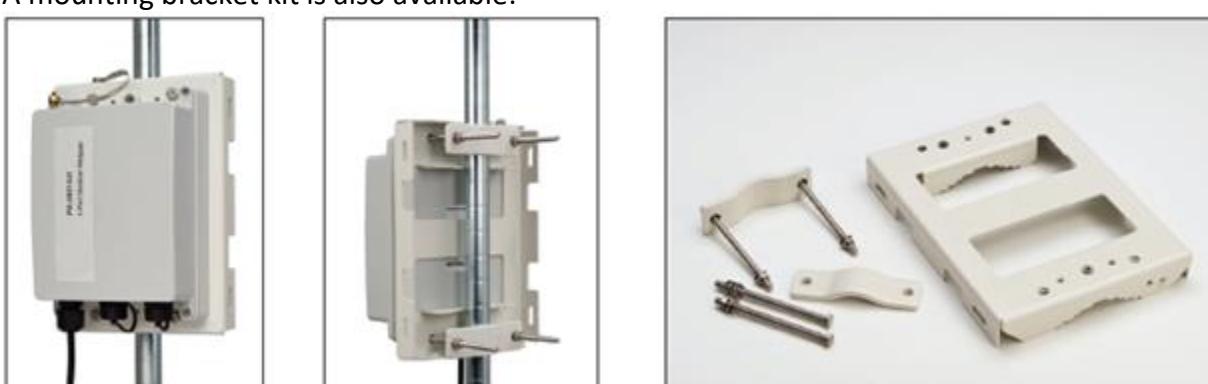


Figure 45 : Mounting bracket for outdoor POE injectors

### 3.6.6.3 Indoor Ethernet surge protection

The indoor Ethernet surge protection (see §2.1.10) is provided with a clip dedicated to DIN rail mounting. The DIN rail clip can be removed by unscrewing the nut:

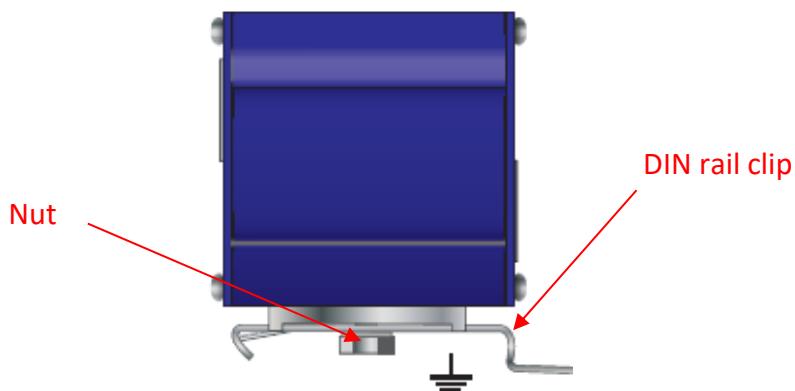


Figure 46 : Indoor Ethernet surge protection – DIN rail clip

The indoor Ethernet surge protector shall be placed at the entrance of the shelter or building.

### 3.6.6.4 Outdoor Ethernet surge protection

The outdoor Ethernet surge protection (see §2.1.10) is provided with an “omega” bracket dedicated to wall mounting. Use 2 x M4 screws to fix to bracket on the wall:

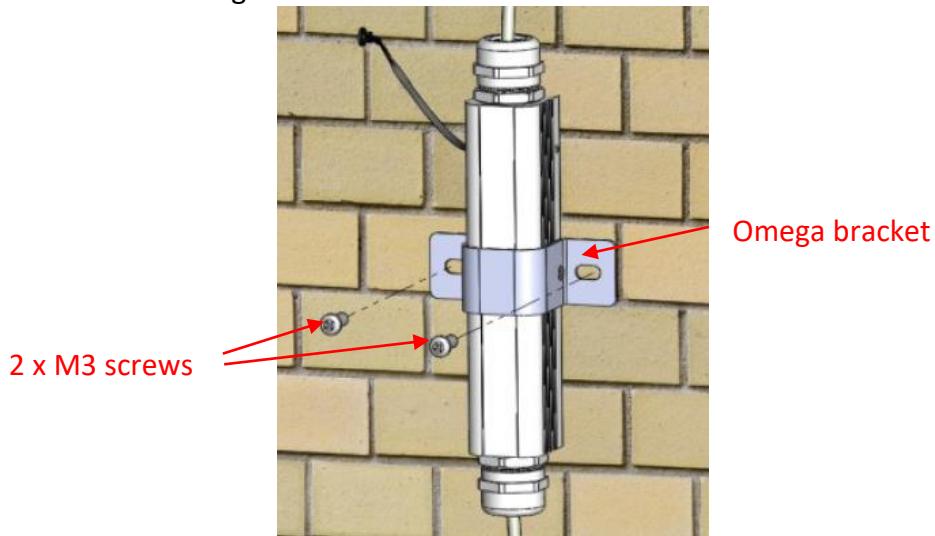


Figure 47 : Outdoor Ethernet Surge protection – wall mounting

The outdoor PoE surge protector shall be placed close to the gateway to ensure adequate protection. A distance of 0.5m max is recommended.

The outdoor Ethernet surge protection can be also pole mounted with strapping:

- Disassemble the “omega” bracket by unscrewing both of its screws.
- Mount the surge protection on the pole and use a metallic strapping or worm gear clam to fix it:

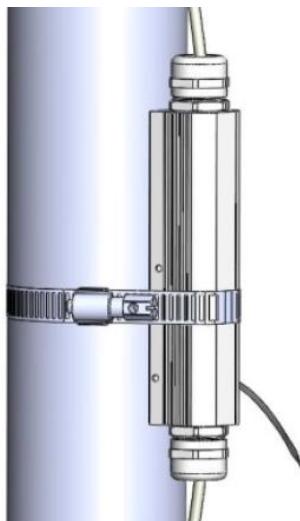


Figure 48 : Outdoor Ethernet Surge protection – pole mounting with strapping

### 3.6.6.5 RF coaxial lightning protections (general use case)

The RF coaxial surge protections are directly mounted (screwed) on the N connectors of the Wirnet gateways as shown below:



Figure 49 : Coaxial surge lightning protection mounting on Wirnet iBTS gateway LTE port

To improve the durability of the RF connections against environmental aggression (moisture, pollution, etc.), KERLINK recommends protecting connectors of coaxial lightning protection with an insulating tape like the reference 130C from 3M.

An example of insulating protection is presented below:



Figure 50 : Example of insulating tape protection on Wirnet iBTS gateway RF port with coaxial lightning protection

### 3.6.6.6 RF coaxial lightning protection on Wirnet iStation

Kerlink found disparity in the length of the pins of the market accessories that could be connected to the Wirnet iStation: if these pins are too long, they can mechanically permanently damage the Wirnet iStation connector internal mechanical switch that selects the internal or external antenna, thus potentially generating loss of performance and preventing the later use of the internal antenna.

Direct mounting of the surge protection onto the gateway RF port shall be avoided:

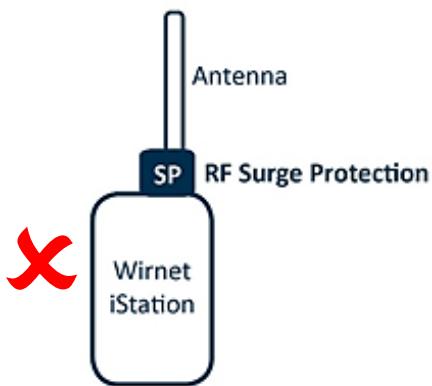


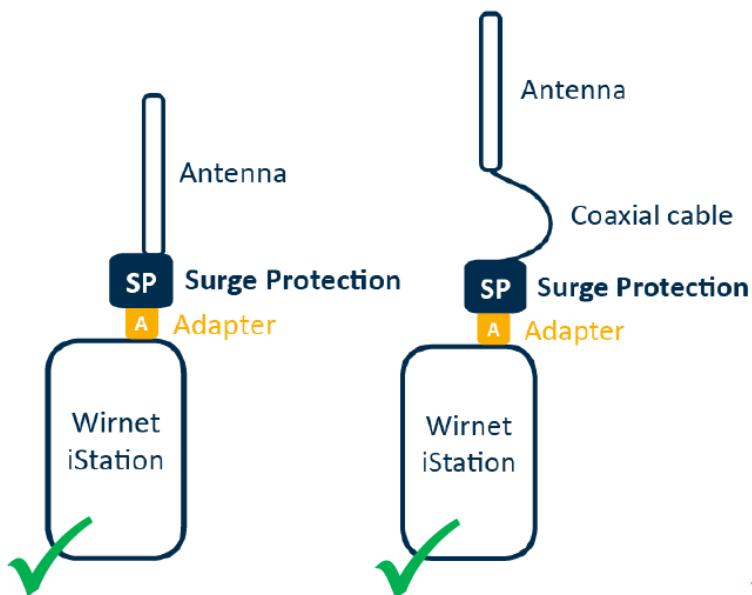
Figure 51 : Prohibited coaxial lightning protection mounting on Wirnet iStation

**Beware:** connection of coaxial lightning protection KLK02900 onto Wirnet iStation requires an N male - N female adapter (KLK03443).

The N adapter, provided by Kerlink, ensures a controlled pin length of the N connector and no damages of the gateway connector. This adapter shall not be substituted by another reference.

Surge protection N connector and N adapter are designed for manual clamping so as not to damage the connectors.

The following installations are recommended:



*Figure 52 : Recommended coaxial surge lightning protection mounting on Wirnet iStation*

### 3.6.6.7 Cavity filters

The cavity filters are directly mounted (screwed) on the N connectors of the LoRa antennas or of the Wirnet gateways as follows:

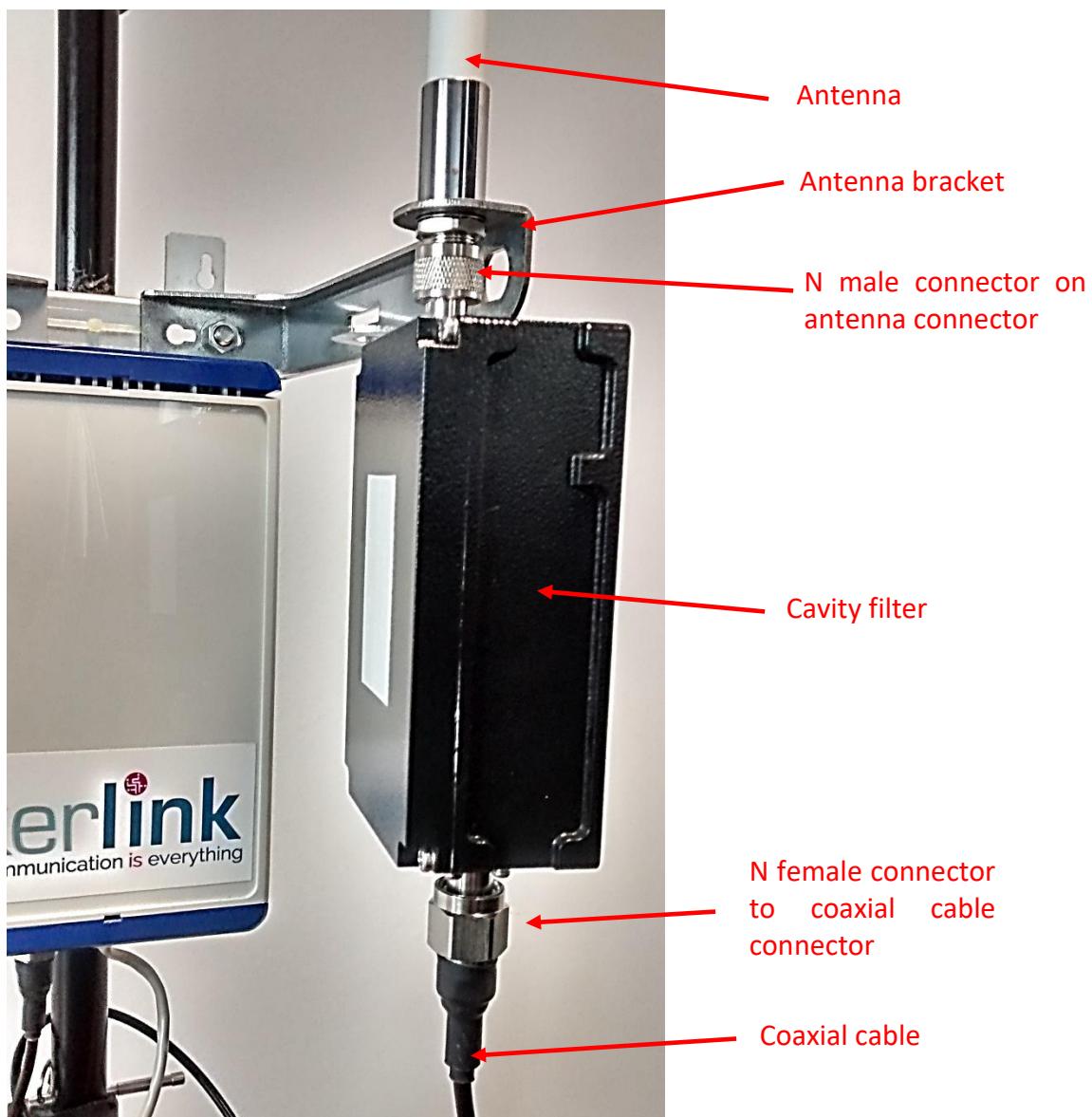


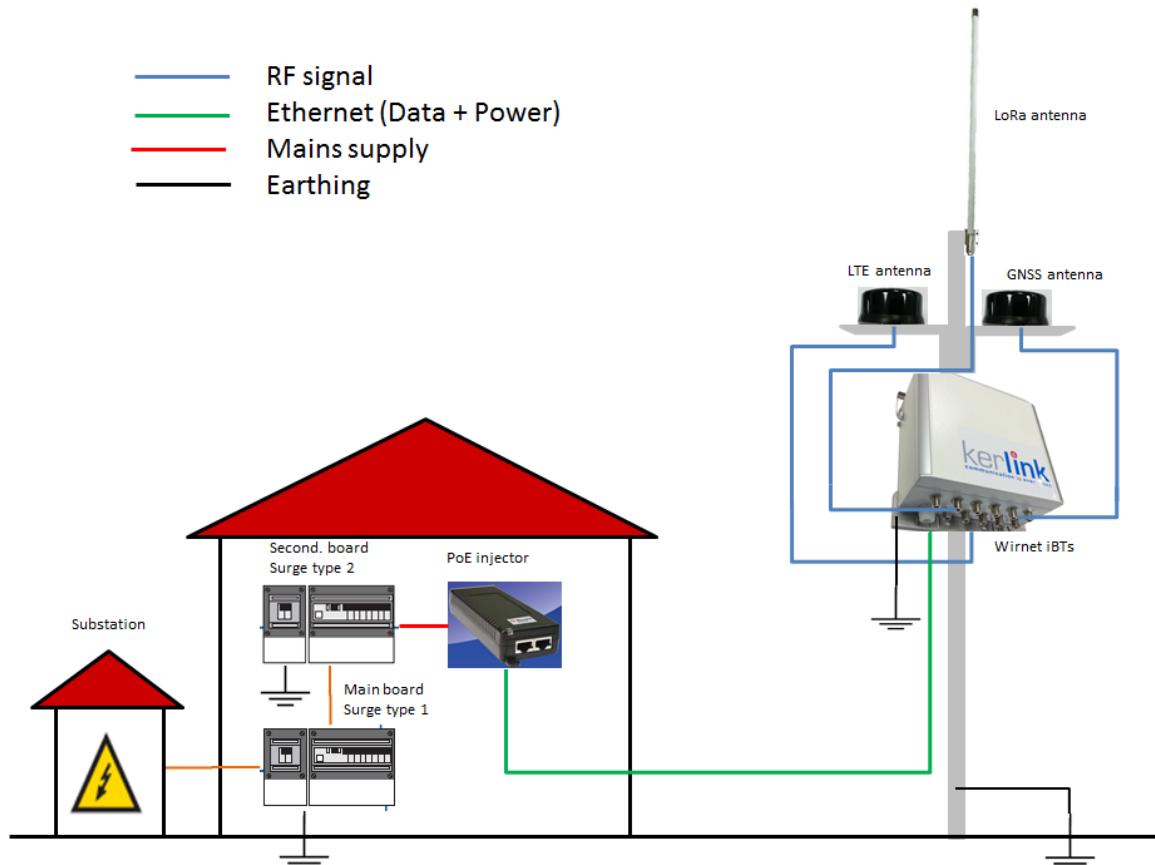
Figure 53 : Cavity filter mounted on antenna N port

To improve the durability of the RF connections against environmental aggression (moisture, pollution ...), KERLINK recommends protecting connectors of cavity filters with an insulating tape like the reference 130C from 3M.

### 3.7 Setting connections

Before setting all connections, ensure that the gateway is not supplied either via the PoE injector or via the auxiliary DC supply.

The following pictures details all the outdoor gateway required connections, including power supply cables, data cables, RF coaxial cables and earthing connections:



#### 3.7.1 Earthing

Several earthing cables, wires, tapes or ring tongue terminals are required to connect the installation and the materials to earth for lightning immunity and electrical security:

- Earthing of the gateway enclosure / mounting kit
- Earthing of the antenna brackets
- Earthing of the RF coaxial surge protection
- Earthing of the DC surge protection
- Earthing of the Ethernet surge protection
- Earthing of the outdoor PoE injector

The required earthing cables are detailed in §2.1.11.3.

**Note:** the earthing cables are not provided by KERLINK.

### 3.7.1.1 Earthing of the Wirnet iBTS and Wirnet iBTS 64 Highway

Earthing of the Wirnet iBTS and Wirnet iBTS 64 Highway is completed through the mounting kit, by using the 2 holes dedicated to the M8 U Bolt used for pole mount. The earthing symbol  $\ominus$  is placed close to dedicated holes. Two different configurations are then possible, depending on the usage of the U bolt:

1. The M8 U bolt is used (pole mount by U-bolt configuration):  
The U-bolt and the M8 nut are used to connect the ring tongue terminal
2. The M8 U bolt is not used (wall mount configuration or metallic strapping configuration):  
A M8 bolt and nut is used to connect the ring tongue terminal

The different configurations are presented below:

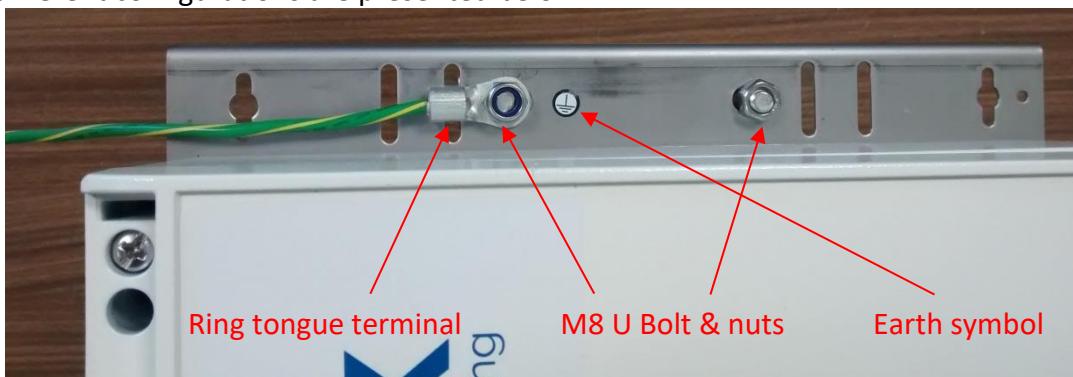


Figure 55 : Wirnet iBTS and Wirnet iBTS 64 Highway – earthing with U bolt configuration

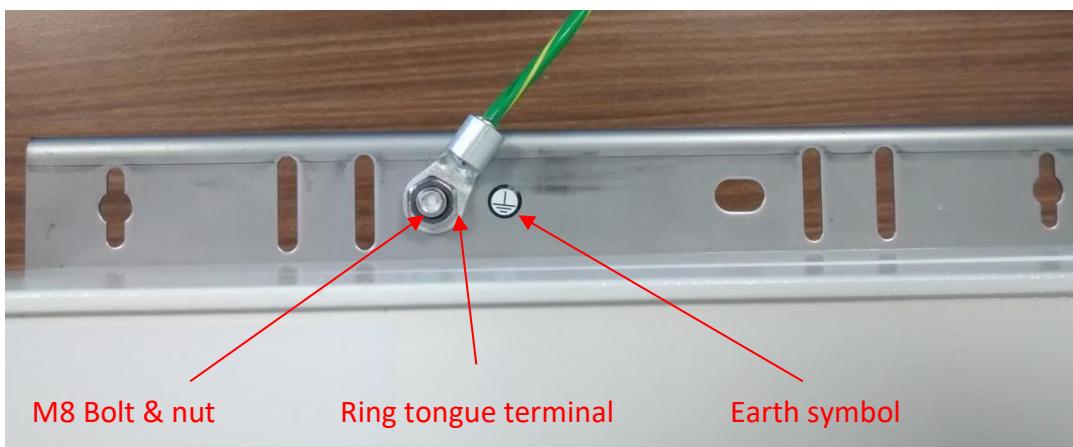


Figure 56 : Wirnet iBTS and Wirnet iBTS 64 Highway – earthing without U bolt configuration

- Crimp the ring tongue terminal to earthing cable with the crimping tool
- Connect the ring tongue to the mounting kit with M8 bolt and nut.
- Connect the other side of the earthing cable to the earthing system or lightning protection system of the of the pole, mast, ... of the installation.

**Note 1:** the earthing cable is not provided by KERLINK

**Note 2:** the earthing cable characteristics are detailed in §2.1.11.3.

**Note 3:** use a crimping tool to crimp the ring tongue terminal with earthing cable.

### 3.7.1.2 Earthing of the Wirnet iBTS Compact and Wirnet Station

Earthing of the Wirnet iBTS Compact and Wirnet Station is completed through the mounting kit, by using the holes dedicated to the M8 U Bolt used for pole mount or the holes dedicated to the universal antenna bracket. The earthing symbol  $\ominus$  is placed close to dedicated holes. Two different configurations are then possible, depending on the usage of the U bolt:

1. The M8 U bolt is used (pole mount by U-bolt configuration):  
The U-bolt and the M8 nut are used to connect the ring tongue terminal
2. The M8 U bolt is not used (wall mount configuration or metallic strapping configuration):  
The M8 bolt and nut dedicated to the universal antenna bracket is used to connect the ring tongue terminal. It can be used whatever the universal antenna bracket is installed or not on the mounting kit.

The different configurations are presented below:

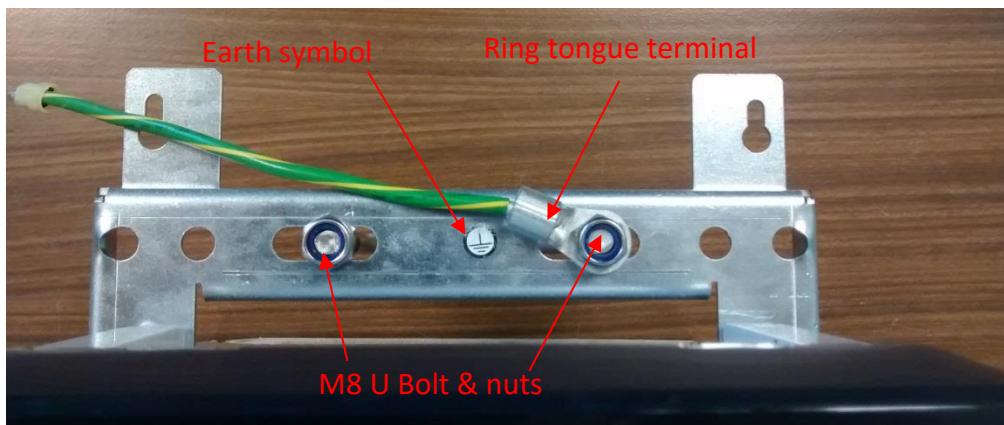


Figure 57 : Wirnet iBTS Compact and Wirnet Station – earthing with U bolt configuration

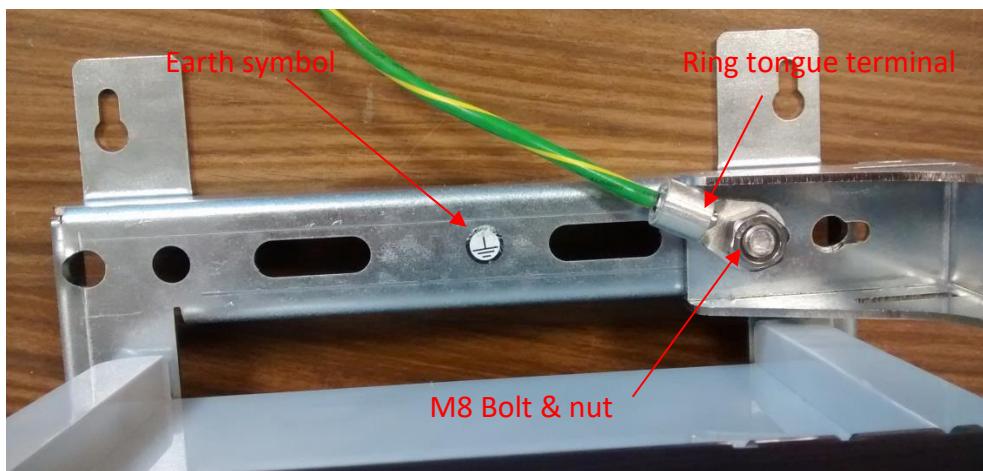


Figure 58 : Wirnet iBTS Compact and Wirnet Station – earthing without U bolt configuration

- Crimp the ring tongue terminal to earthing cable with the crimping tool
- Connect the ring tongue to the mounting kit with M8 bolt (or U-bolt) and nut.
- Connect the other side of the earthing cable to the earthing system or lightning protection system of the of the pole, mast, ... of the installation.

**Note 1:** the earthing cable is not provided by KERLINK

**Note 2:** the earthing cable characteristics are detailed in §2.1.11.3.

**Note 3:** use a crimping tool to crimp the ring tongue terminal with earthing cable.

### 3.7.1.3 Earthing of the Wirnet iStation

Earthing of the Wirnet iStation is completed through an earthing cable to be connected at the rear side of the enclosure. The earthing symbol  is placed close to the dedicated hole.

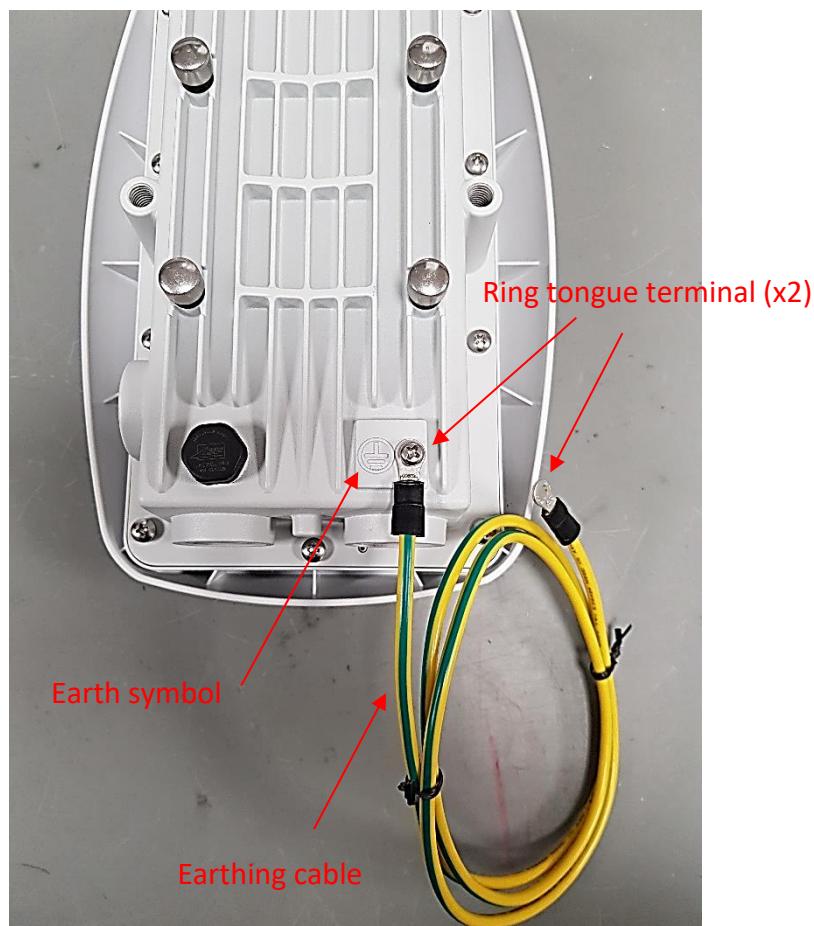


Figure 59 : Wirnet iStation – earthing cable

- Connect the ring tongue to the enclosure with the dedicated screw.
- Connect the other side of the earthing cable to the earthing system or lightning protection system of the pole, mast, ... of the installation.

**Note 1:** the earthing cable and screw are provided by KERLINK

**Note 2:** use a crimping tool to crimp the ring tongue terminal with earthing cable.

### 3.7.1.4 Earthing of the RF coaxial surge protection

On the RF coaxial surge protection side, the earthing connection is completed through a ring tongue terminal. The earthing cable shall be crimped inside this ring tongue terminal. A specific crimping tool is required to perform the operation.

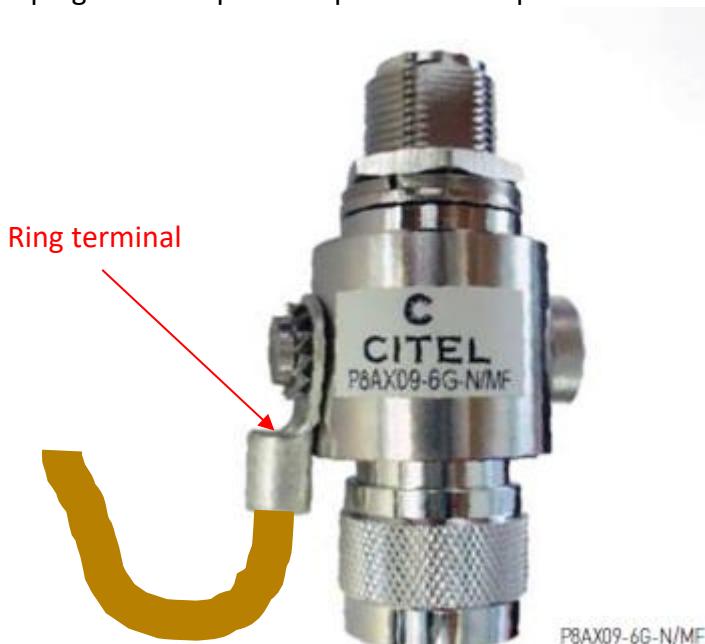


Figure 60 : Earthing of the RF coaxial surge protection

**Note 1:** the earthing cable is not provided by KERLINK

**Note 2:** the earthing cable characteristics are detailed in §§2.1.11.3.

**Note 3:** use a crimping tool to crimp the ring tongue terminal with earthing cable.

### 3.7.1.5 Earthing of the DC surge protection

On the DC surge protection side, the earthing connection is completed through a stripped wire. The other side of the cable could be connected through a ring tongue terminal.

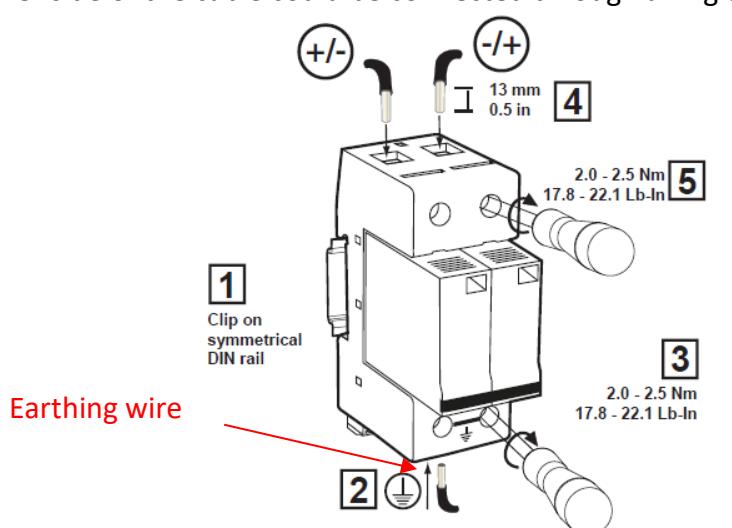


Figure 61 : Earthing of the RF coaxial surge protection

**Note 1:** the earthing cable is not provided by KERLINK

**Note 2:** the earthing cable characteristics are detailed in §2.1.11.3.

### 3.7.1.6 Earthing of the Ethernet surge protection

On the indoor Ethernet surge protection side, the earthing connection is completed through the DIN rail clip. Therefore, the earthing cable can be connected to the DIN rail itself or using the nut of the DIN rail clip.

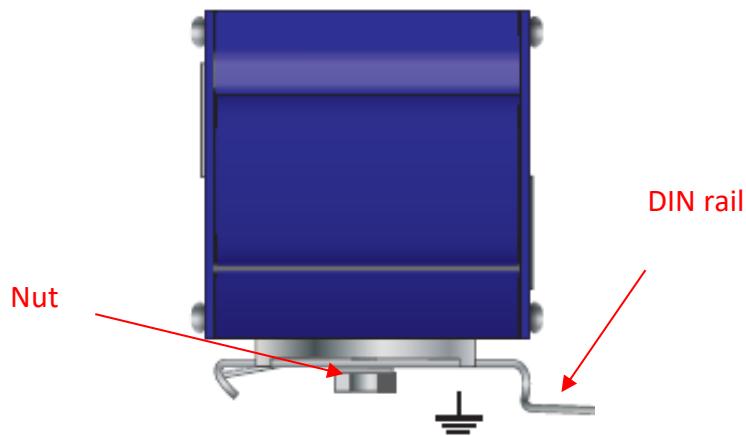


Figure 62 : Earthing of the indoor Ethernet surge protection

On the outdoor Ethernet surge protection side, the earthing connection is completed through a dedicated earthing screw. The earthing connection is completed through a ring terminal. The earthing cable shall be crimped inside this ring terminal.

A specific crimping tool is required to perform the operation.

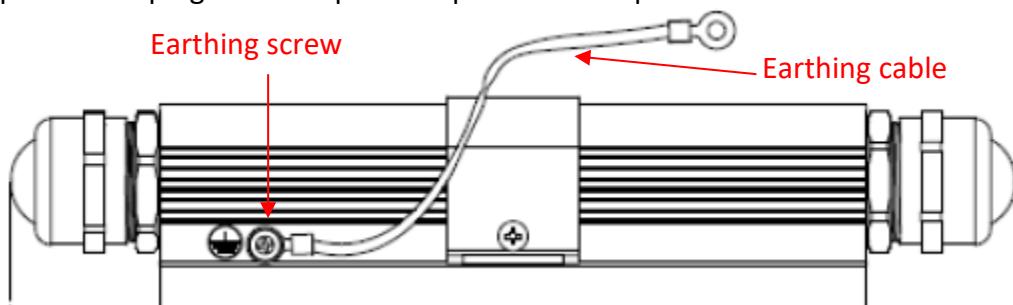


Figure 63 : Earthing of the outdoor Ethernet surge protection

**Note 1:** the earthing cables are not provided by KERLINK

**Note 2:** the earthing cables characteristics are detailed in §2.1.11.3.

**Note 3:** A cable is provided by Microsemi for the outdoor PoE surge protector

### 3.7.1.7 Earthing of the outdoor PoE injector

On the outdoor PoE injector, the earthing connection is completed through a dedicated earthing bolt and two nuts. The earthing connection on the cable is completed through a ring terminal. A specific crimping tool is required to perform the operation. The earthing cable shall be crimped inside this ring terminal.

The ring terminal is inserted between the two nuts as follows:

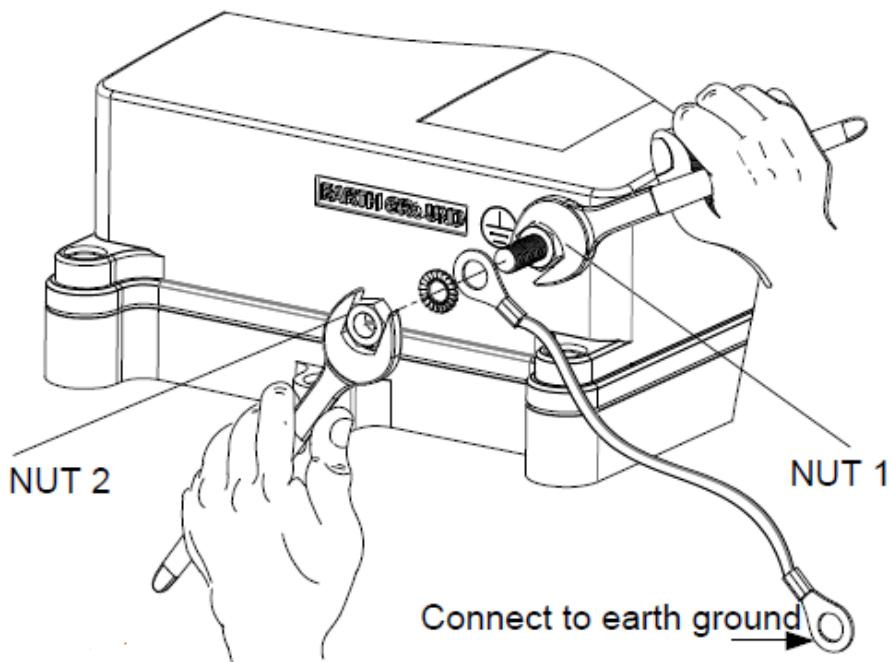


Figure 64 : Earthing of the outdoor PoE injector

**Note 1:** the earthing cables are not provided by KERLINK

**Note 2:** the earthing cables characteristics are detailed in §2.1.11.3.

### 3.7.1.8 Earthing Ethernet cable

In many use cases, the Ethernet cable has a significant length (up to 100m) from the Ethernet switch to the gateway. The long Ethernet cable shall be properly guided, and grounding of the cable is recommended to offer better surge protection. Cable grounding clamp can be used for this purpose as shown below:



Figure 65 : Earthing of the Ethernet cable

The sheath of the cable shall be obviously removed to ensure good connection to the clamp and therefore good ground connection. Removing the sheath may compromise sealing of the Ethernet cable so a waterproof tape is recommended in this case.

### 3.7.1.9 Earthing RF coaxial cables

In some use cases, antennas may be deported using long RF coaxial cables (>5m). The long coaxial cable shall be properly guided, and grounding of the coaxial cable is recommended to offer better surge protection. Cable grounding clamp can be used for this purpose (see also §3.7.1.8).

The sheath of the cable shall be obviously removed to ensure good connection to the clamp and therefore good ground connection. Removing the sheath may compromise sealing of the Ethernet cable so a waterproof tape is recommended in this case.

In most of the use case, short RF coaxial cables are used (1m), so earthing is not required.

### 3.7.1.10 Earthing antenna brackets

Antenna brackets can be provided with the gateways as accessories. This could be LoRa, GNSS or LTE antenna brackets. The brackets are metal parts and they shall be also connected to earth to prevent surges to be driven to the gateway RF ports.

Earthing of the antenna brackets can be completed by:

- Pole mounting: by using the metallic strapping.
- Wall mounting: by using M4 screws provided with the bracket

The earthing connection is completed through a ring terminal in this case. A specific crimping tool is required to perform the operation. The earthing cable shall be crimped inside this ring terminal.

**Note 1:** the earthing cables are not provided by KERLINK.

**Note 2:** the earthing cables characteristics are detailed in §2.1.11.3.

### 3.7.2 RF antennas

#### 3.7.2.1 Wirnet iBTS family

RF antennas (GNSS, LTE and LoRa) are connected to the Wirnet iBTS gateways through the N connectors on the bottom side of the enclosure.

In its default configuration, the gateway features only 3 N-SMB adapters used as RF interfaces for the antennas:

- 1 for GNSS antenna (GPS)
- 1 for WAN antenna (GSM/HSDPA/LTE)
- 1 for LoRa antenna.

The N connectors are connected to the modules (CPU, WAN and Lora) through SMB-SMB or SMB-SMA coaxial cables. The coaxial cables shall be carefully checked to make sure the right RF interface of each module is connected to the right N connector and therefore to the right antenna.

The N connectors are located as follows:

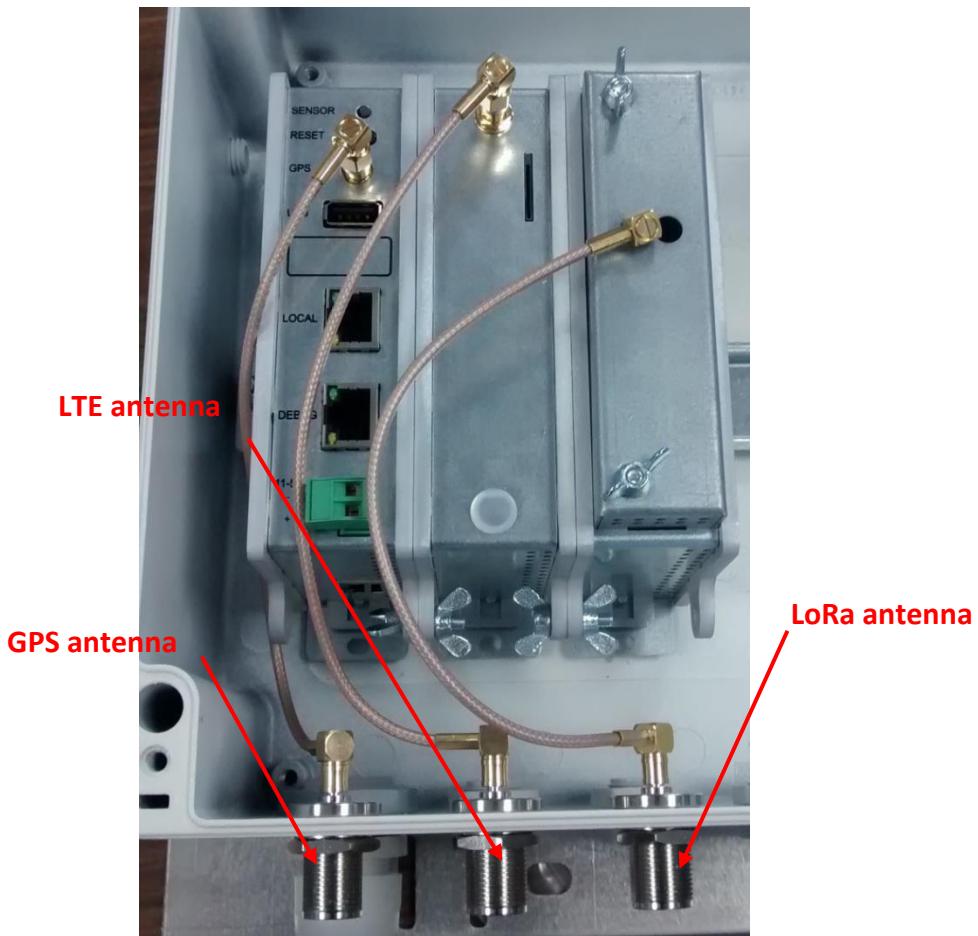


Figure 66 : nominal configuration of N connectors – Wirnet iBTS

Therefore, in its nominal configuration, only one N connector is available for a single antenna. If antenna diversity is required, or additional LoRa modules are required, then the installer has to add the missing modules inside the enclosure and mount the required N-SMB adapters on the bottom side of the enclosure. 8 x M16 blind stops are available for that purpose (see §3.2).

In order, to facilitate the installation, KERLINK recommends the following allocation of the M16 blind stops for the additional N-SMB connectors:

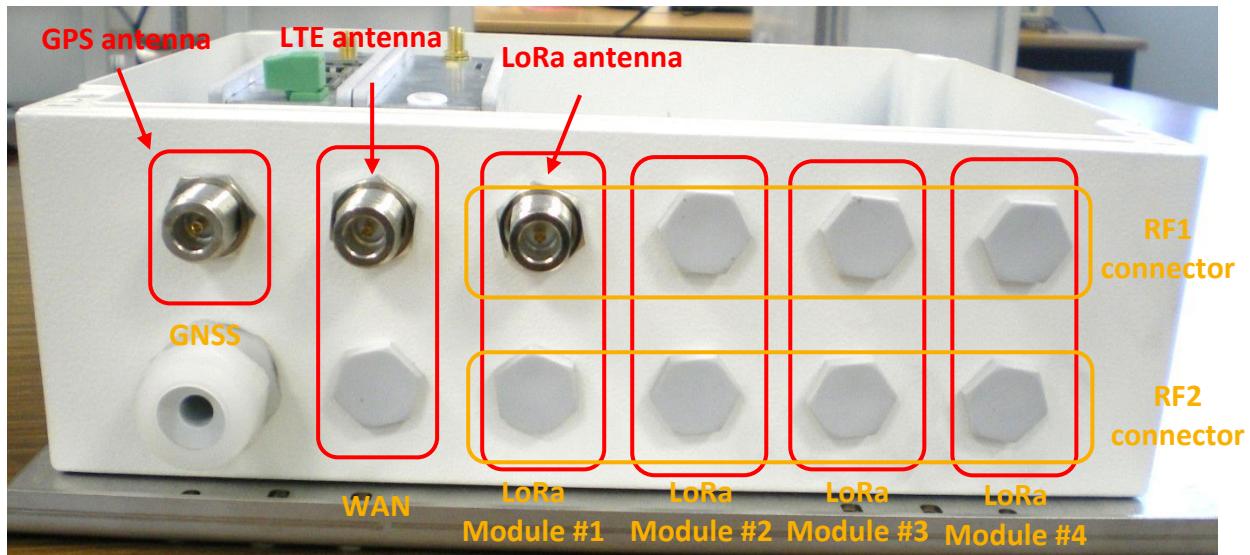


Figure 67 : Recommended allocation of the N connectors – Wirnet iBTS

**Note:** the bottom side of the enclosure does not include any label or any serigraphy to differentiate the N connectors. This is because of the full modularity of the Wirnet iBTS. We strongly recommend to the installer following KERLINK recommendations regarding the placement of the connectors to facilitate the installation. The installer shall ensure that the right N connector is connected to the right SMB connector of the LoRa module and therefore to the right antenna!

In its default configuration, the Wirnet iBTS Compact features only one N-SMB adapters used as RF interfaces for the LoRa antenna:

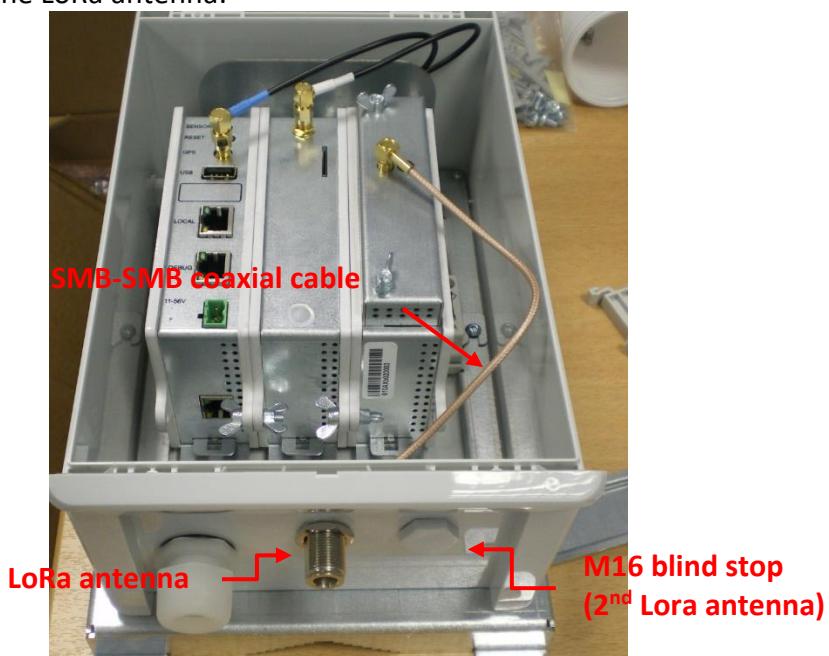


Figure 68 : Nominal configuration of N connectors - compact casing

If antenna diversity is required, then the installer has to mount an additional N-SMB adapter on the bottom side of the enclosure. The M16 blind stop is available for that purpose.

#### 3.7.2.1.1 GNSS antenna

Connect the N male connector of the GNSS antenna onto the dedicated N female connector as indicated below:

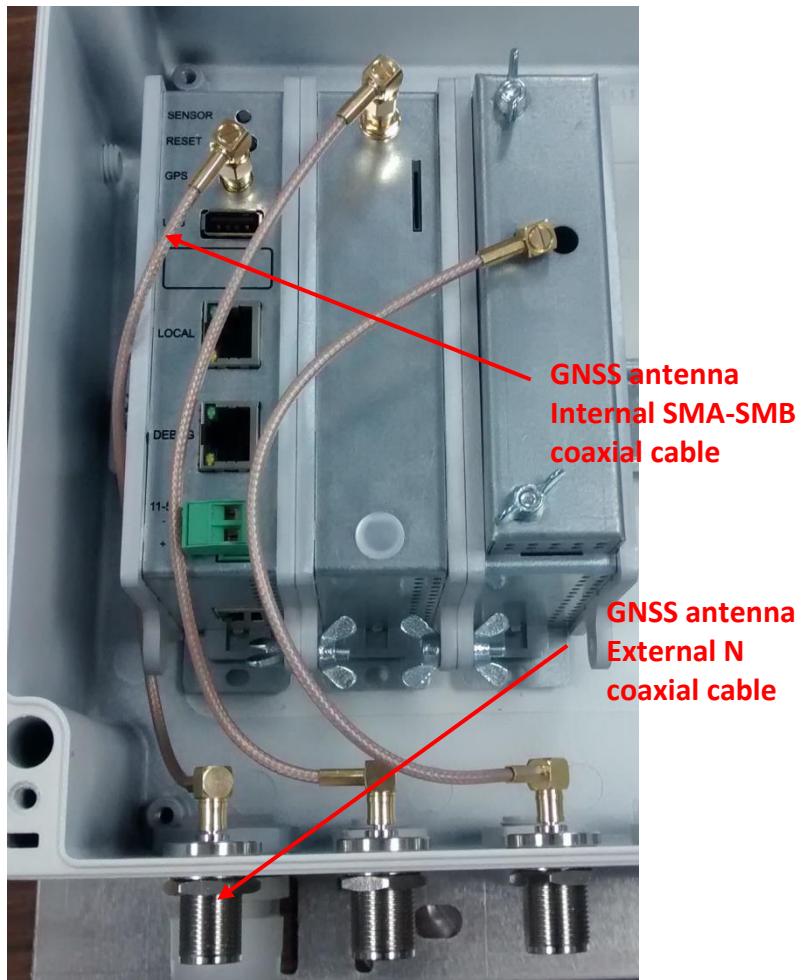


Figure 69 : GNSS antenna cabling, internal and external

Make sure the SMA-SMB cable inside the enclosure is properly connected to the CPU module.

### 3.7.2.1.2 LTE antenna

Connect the N male connector of the LTE antenna onto the dedicated N female connector as indicated below:

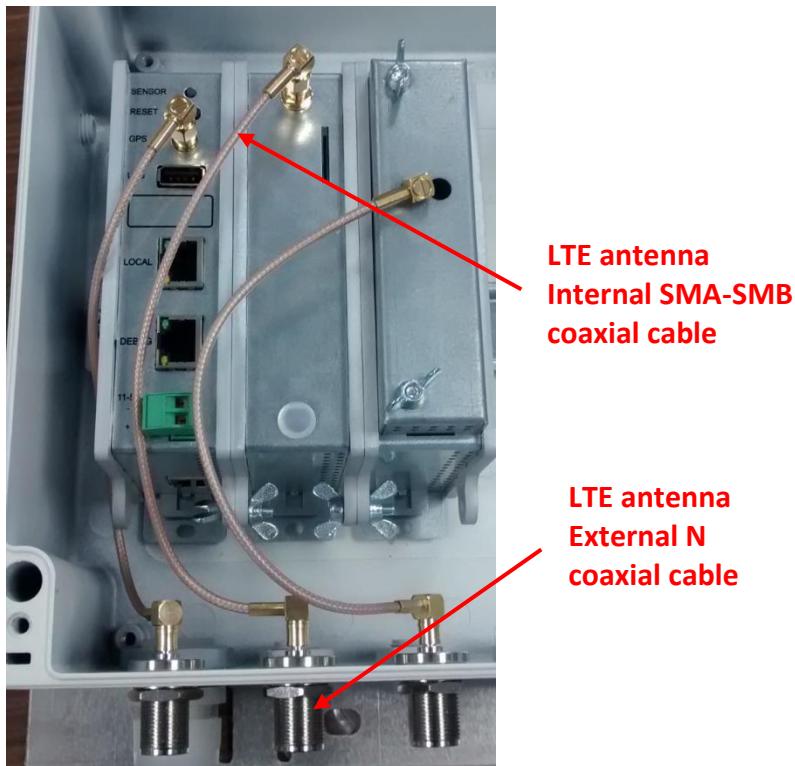


Figure 70 : LTE antenna cabling, internal and external

Make sure the SMA-SMB cable inside the enclosure is properly connected to the WAN module.

### 3.7.2.1.3 GNSS / LTE combo antenna

The Wirnet iBTS Compact is delivered with an internal GNSS/LTE combo antenna mounted on the internal bracket. Check the antenna is well mounted on the bracket and the SMA connectors are properly screwed on the modules, as described below:

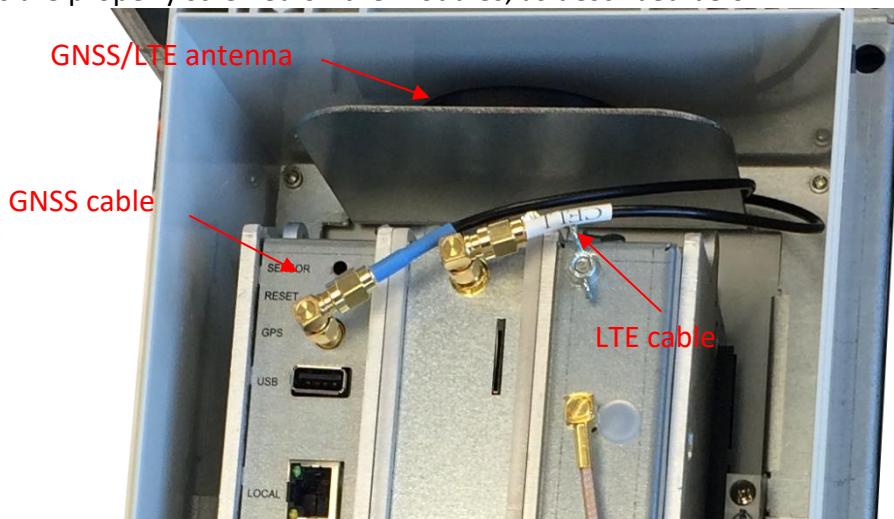


Figure 71 : GPS and LTE cabling within Wirnet iBTS Compact

The GNSS cable is the blue one, referenced as “GPS”, and connected to the CPU module.  
The LTE cable is the white one, referenced as “CELL”, and connected to the WAN module.

#### 3.7.2.1.4 Internal LTE antenna

The Wirnet iBTS Compact may be delivered with a dual WAN module. In this case, an internal LTE antenna and an internal GNSS/LTE combo antenna are embedded in the casing.

The internal LTE antenna shall be screwed on the dual WAN module and oriented to the bottom side of the enclosure, in order to optimize the WAN reception.

Check the internal LTE antenna is well mounted on the SMA connector and properly screwed on the module, as described below:

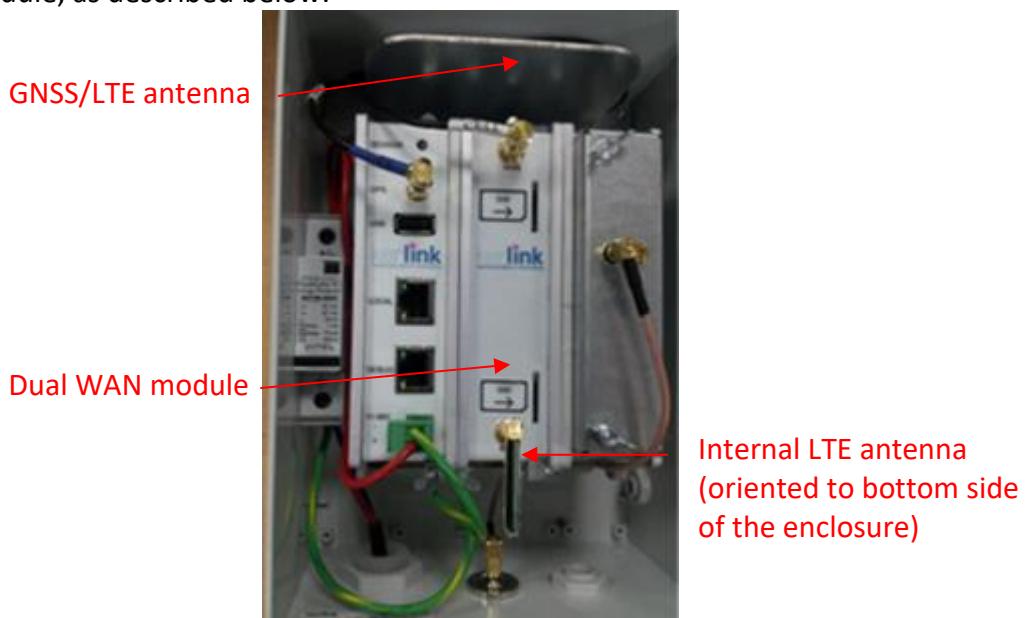


Figure 72 :Internal LTE antenna within Wirnet iBTS Compact

#### 3.7.2.1.5 LoRa RF Antenna

Once the antennas are mounted, a RF coaxial cable shall be used to connect the antenna to the Wirnet iBTS.

The RF coaxial cable delivered by default is only 1m length. This is suitable for many installations, but extension coaxial cables can be used when the distance between the LoRa antenna and the Wirnet iBTS is greater than 1 meter.

The RF coaxial cables have two N male connectors on each side. One side is screwed on the antenna N female connector and the other side is screwed on the N female connector on the bottom side of the Wirnet iBTS as follows:

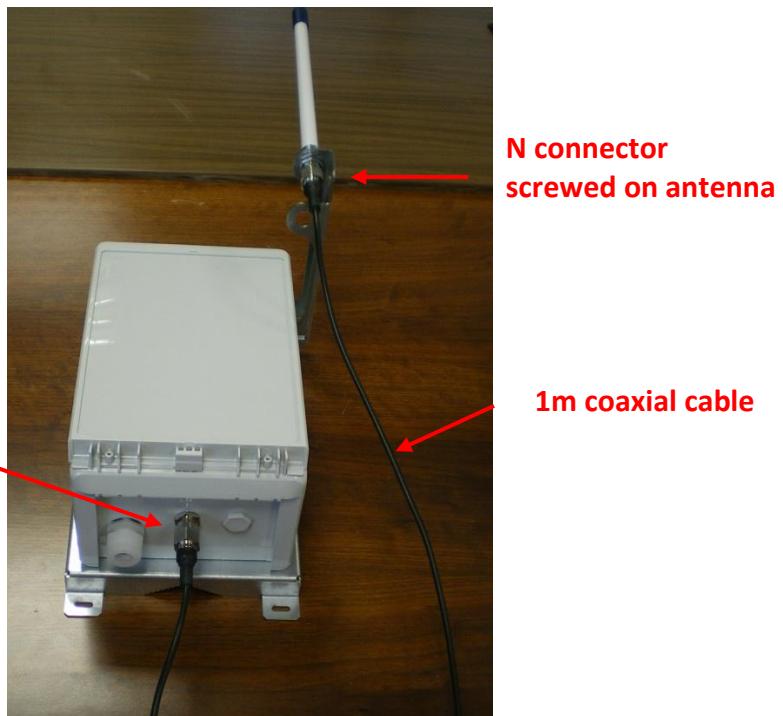


Figure 73 : Connection of the RF coaxial cable

To improve the durability of the RF connections against environmental aggression (moisture, pollution ...), KERLINK recommends protecting connectors with an insulating tape like the reference 130C from 3M.

To tighten the coaxial cable of the Wirnet iBTS Compact, the installer can use cable clamps inserted in the dedicated slots of the mounting kit:

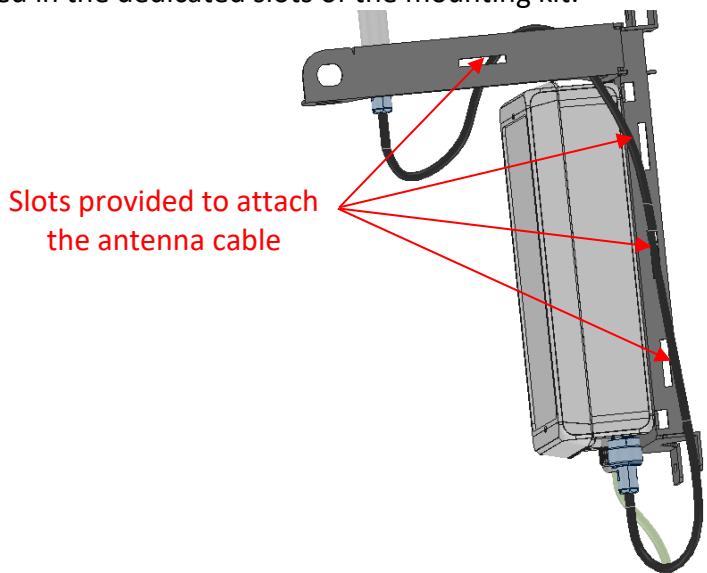


Figure 74 : attachment of the RF antenna coaxial cable

### 3.7.2.2 Wirnet Station

GNSS and LTE antennas are internal and do not require any intervention.

Only LoRa antenna requires a coaxial connection.

Once the LoRa RF antenna is installed on its bracket, connect the N connector of the 1m coaxial cable on the N female connector of the antenna as described on the figure below.

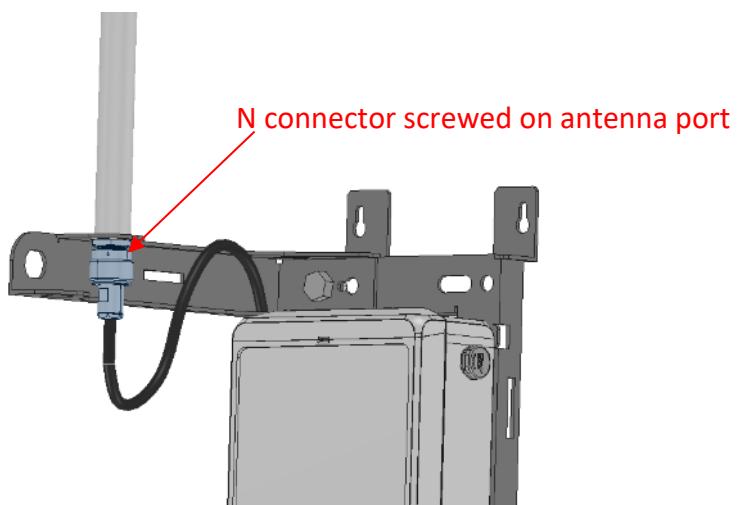


Figure 75 : attachment of the antenna on the mounting set

Once the other side, connect the N connector of the antenna cable on the connector based on the bottom of the enclosure as described on the figure below.

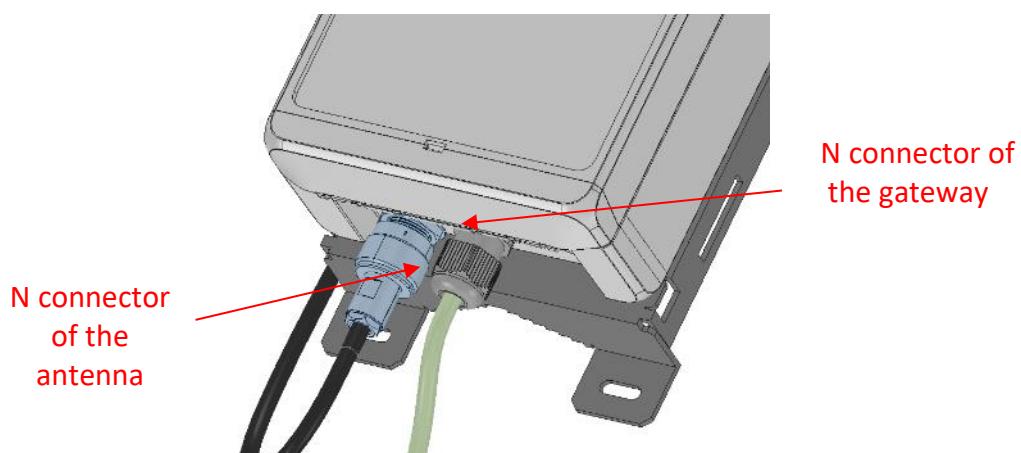


Figure 76 : connection of LoRa RF antenna (bottom view)

For safety reason, the power supply of the product shall be disconnected before plugging the N connector.

To improve the durability of the RF connections against environmental aggression (moisture, pollution, ...), KERLINK recommends protecting connectors with an insulating tape like the reference 130C from 3M.

To tighten the antenna cable, it is possible to tighten it with cable clamp, using spaces provided for this purpose:

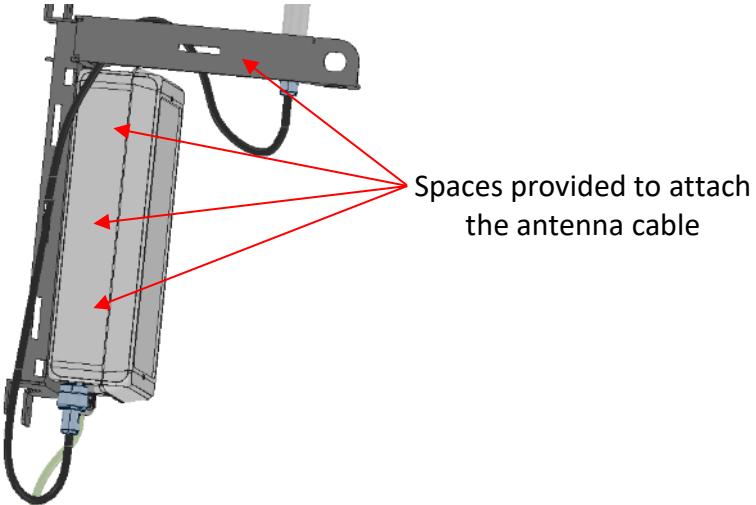


Figure 77 : attachment of the RF antenna cable

### 3.7.2.3 Wirnet iStation

GNSS and LTE antennas are internal and do not require any intervention.

Only LoRa antenna may require a coaxial connection. It is however possible to use the internal LoRa antenna.

If internal LoRa antenna is intended to be used, then keep the N connector cap on the top of the enclosure as follows:



Figure 78 : LoRa antenna port with N cap

If external LoRa antenna is required, to maximize the coverage area, then the N cap shall be removed. A LoRa antenna can be then connected on the N connector of the enclosure through a N adapter provided by Kerlink.

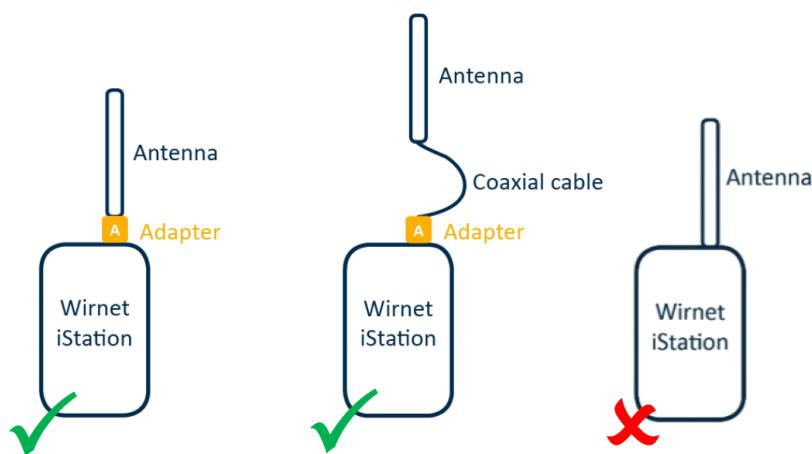
**Beware:** connection of external antennas KLK03198 and KLK03199 to Wirnet iStation 868, 915 or 923 requires an N male - N female adapter (KLK03443).

Kerlink found disparity in the length of the pins of the market accessories that could be connected to the Wirnet iStation: if these pins are too long, they can mechanically permanently damage the Wirnet iStation connector internal mechanical switch that selects the internal or external antenna, thus potentially generating loss of performance and preventing the later use of the internal antenna.

Direct mounting of the RF antennas onto the gateway RF port shall be avoided and the N adapter shall be inserted in-between.

The N adapter, provided by Kerlink, ensures a controlled pin length of the N connector and no damages of the gateway connector. This adapter shall not be substituted by another reference.

Antenna connector and N adapter are designed for manual clamping so as not to damage the connectors.



*Figure 79 : Recommended LoRa antenna configurations for Wirnet iStation*

If RF coaxial lightning protections are used, then see installation recommendations in §3.6.6.6,

Considering the LoRa antennas detailed in §2.1.8.3:

- Only 3dBi antennas KLK03198 and KLK03199 can be mounted directly on the N connector, via the N adapter
- Other antennas shall be deported using a coaxial cable

In case of LoRa antenna deported on universal bracket, use same procedure as for Wirnet Station (§3.7.2.2) or Wirnet iBTS.

If alternate N male antennas (not listed in §2.1.8.3) are considered to be mounted directly on the N connector, they shall have limited size and weight to avoid damage to N connector, especially in windy conditions. Use the N adapter in this case. High gain antennas should, therefore, not be direct mounted on the N connector but should be deported.

### 3.7.3 Ethernet connection

#### 3.7.3.1 Wirnet iBTS family

The Wirnet iBTS gateway is supplied by a PoE injector through an Ethernet cable.

The PoE injectors are detailed in §2.1.7.1.

The recommended Ethernet cable is detailed in §2.1.11.2. It includes two RJ45 T 568A plugs on each side

**Note 1:** The Ethernet cable is not provided with the Wirnet iBTS.

**Note 2:** The maximum Ethernet cable length is 100m.

On Wirnet iBTS side, the Ethernet RJ45 connector shall be firstly inserted through the M25 cable gland as shown on the Figure 80.

To introduce the RJ45 cable into the cable gland, follow the procedure below:

- Unscrew the external nut
- Remove the seal
- Introduce the RJ45 cable into the external nut
- Place the seal around the RJ45 cable
- Introduce the RJ45 cable into the cable gland body
- Connect the RJ45 connector in to the PoE/LAN port of the CPU module
- Replace the seal in the cable gland body
- Screw the external nut

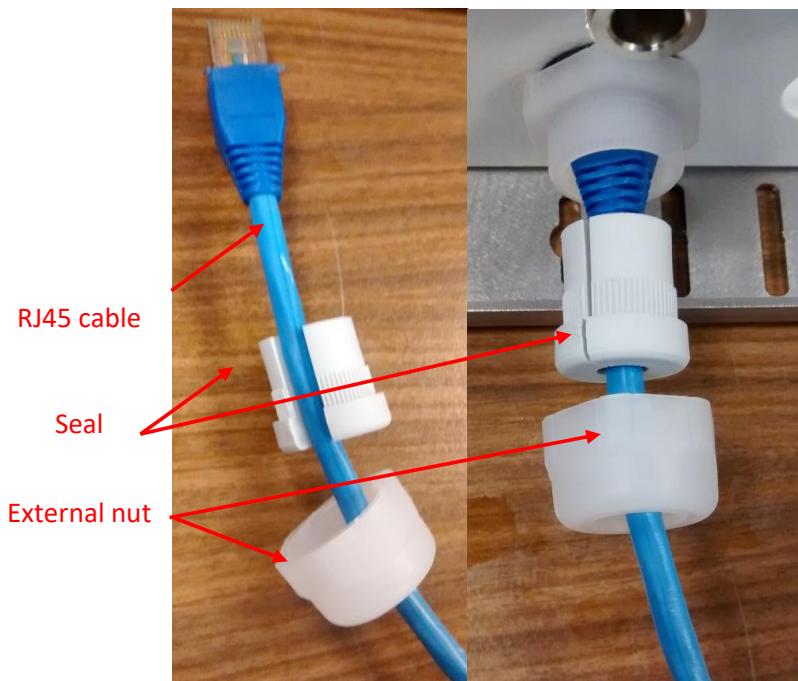


Figure 80 : Ethernet connection on Wirnet iBTS side / cable gland

**Note 3:** The cable gland allows external cable diameter (cable and RJ45 connector) from 5mm to 8 mm.

An example of RJ45 connector inserted to the PoE/LAN port of the CPU module is shown below:

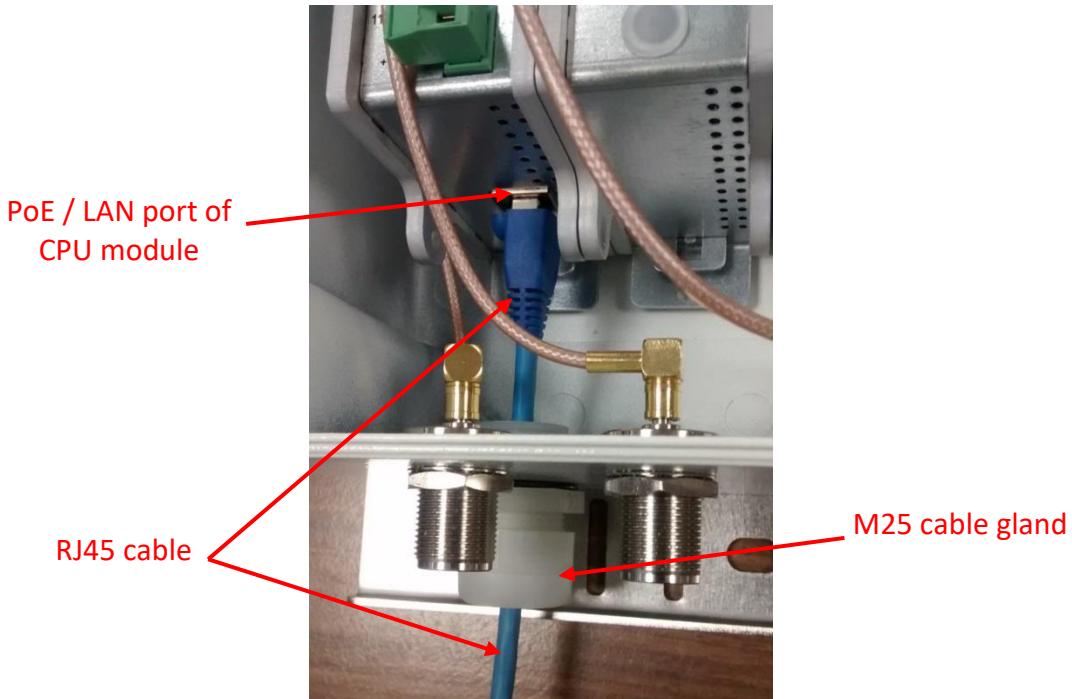


Figure 81 : Ethernet connection on Wirnet iBTS side

On the other side of the Ethernet cable, the RJ45 connector shall be inserted into the RJ45 “Data + Power” port of the POE injector. This POE injector is connected to 230VAC mains supply as detailed in §3.4.2.

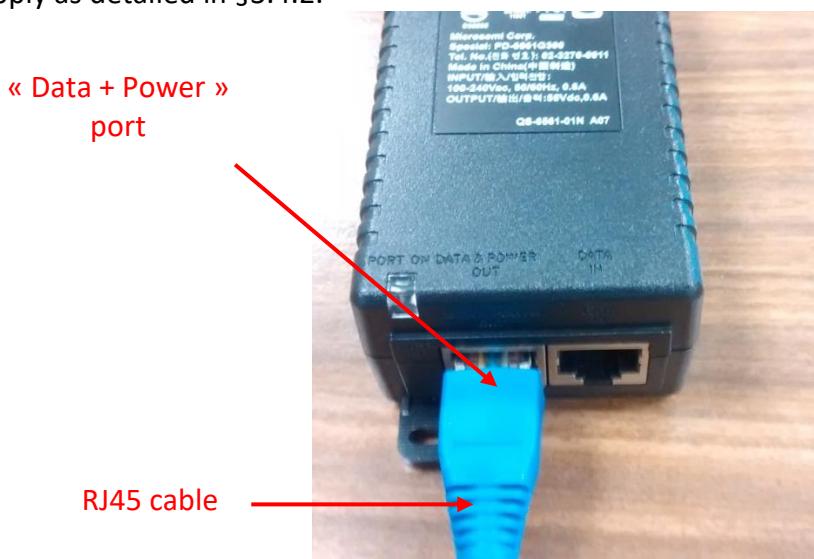


Figure 82 : Ethernet connection on PoE injector side

Before connecting the Ethernet wires, ensure that the POE injector is not connected to 230VAC.

### 3.7.3.1 Wirnet Station

The Wirnet Station is supplied by a PoE injector through an Ethernet cable.

The PoE injectors are detailed in §2.1.7.1.

The recommended Ethernet cable is detailed in §2.1.11.2. It includes two RJ45 T 568A plugs on each side

**Note 1:** The Ethernet cable is not provided with the Wirnet Station.

**Note 2:** The maximum Ethernet cable length is 100m.

**Note 3:** The cable gland allows external cable diameter (cable and RJ45 connector) from 4mm to 8 mm.

On Wirnet Station side, the Ethernet cable shall be firstly inserted through the cable gland. Then, the shield of the cable shall be clamp in the “earthing clip” like in the following picture to get a good earth shielding.

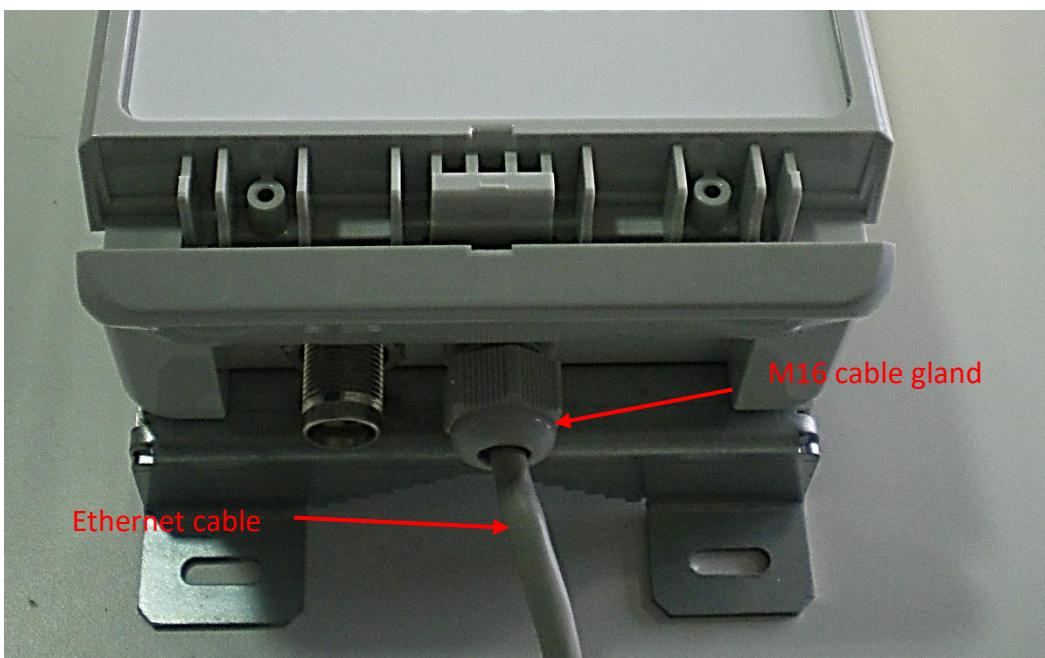


Figure 83 : Ethernet connection on Wirnet Station side / cable gland

**Note 4:** the earthing clip is screwed on the cover shield with a M3x12; head button, hexagon socket screw (B3X12/BN11252 Bossard). Use screwdriver or Allen hexagon key, 2.0mm for this screw.

The internal wires shall be connected to the terminal block, respecting the color codes of the wires, as described on the picture below:

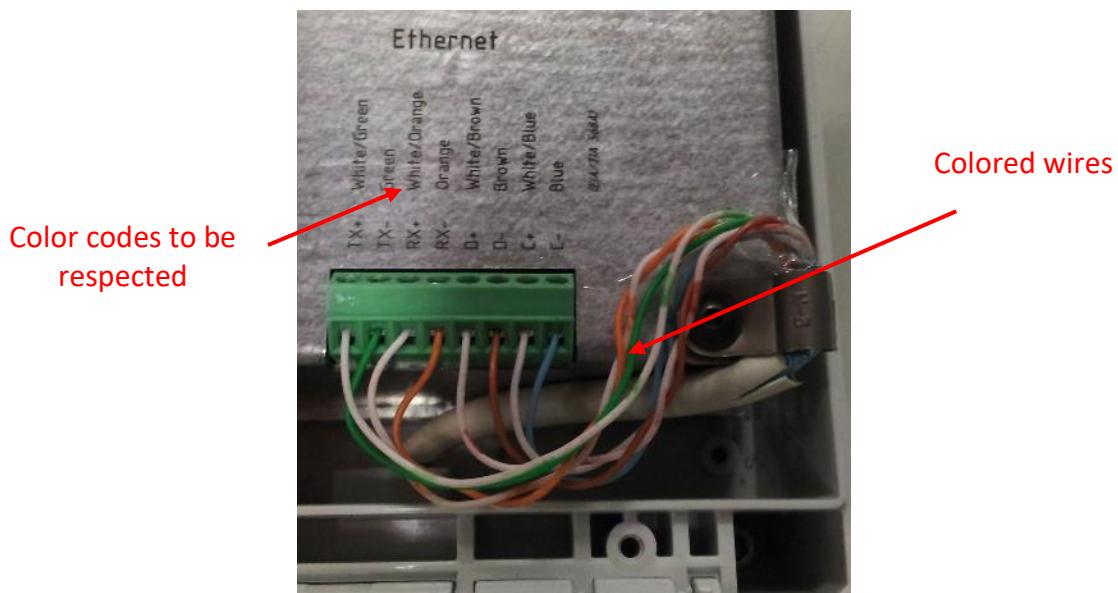


Figure 84 : Ethernet connection

On the other side of the Ethernet cable, the RJ45 connector shall be inserted into the RJ45 “Data + Power” port of the PoE injector.

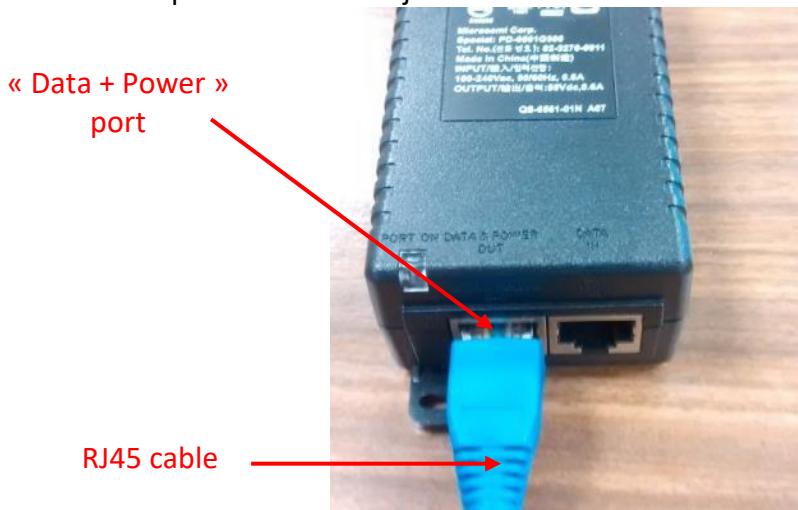


Figure 85 : Ethernet connection on PoE injector side

Before connecting the Ethernet wires, ensure that the PoE injector is not connected to 230VAC.

### 3.7.3.1 Wirnet iStation

The Wirnet iStation is supplied by a PoE injector through an Ethernet cable.

The PoE injectors are detailed in §2.1.7.1.

The recommended Ethernet cable is detailed in §2.1.11.2. It includes two RJ45 T 568A plugs on each side

**Note 1:** The Ethernet cable is not provided with the Wirnet iStation.

**Note 2:** The maximum Ethernet cable length is 100m.

**Note 3:** The cable gland allows external cable diameter (cable and RJ45 connector) from 4mm to 8 mm.

On Wirnet Station side, the Ethernet cable shall be firstly inserted through the M25 cable gland at the bottom side of the enclosure:

- Unscrew the external nut
- Remove the seal
- Introduce the RJ45 cable into the external nut
- Place the seal around the RJ45 cable
- Introduce the RJ45 cable into the cable gland body
- Connect the RJ45 connector in to the PoE/LAN port of the CPU module
- Replace the seal in the cable gland body
- Screw the external nut



Figure 86 : Wirnet iStation Ethernet connection

On the other side of the Ethernet cable, the RJ45 connector shall be inserted into the RJ45 “Data + Power” port of the POE injector.

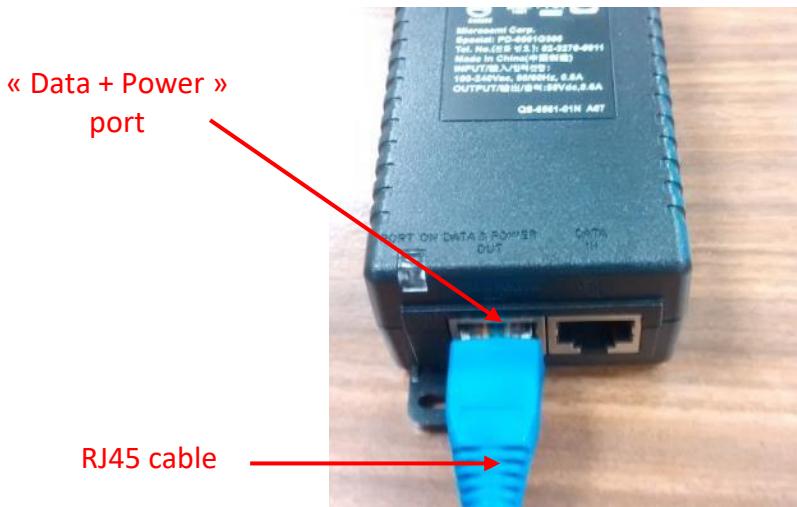


Figure 87 : Ethernet connection on PoE injector side

Before connecting the Ethernet wires, ensure that the PoE injector is not connected to 230VAC.

### 3.7.4 Mains supply

The AC/DC PoE injectors detailed in § are provided with E/F type cable (Europe) or B type cable (USA).

Insert the plugs to the mains receptacle of the electrical installation.

**Note:** the E/F type or B type plugs shall be inserted into the mains receptacle only once all other connections are settled and USIM card inserted (see §4.4).

### 3.7.5 Auxiliary power supply

#### 3.7.5.1 Wirnet iBTS family

The Wirnet iBTS can be supplied with an auxiliary DC power supply as a solar panel for instance. A two-wire cable is required to interconnect the auxiliary power supply connector. The recommended cable section is 1.5 sq. mm.

The auxiliary power supply connector is a Euroblock plug, which is located on the front side of the CPU module. The polarity of the power signals is indicated besides the connector, as shown below:

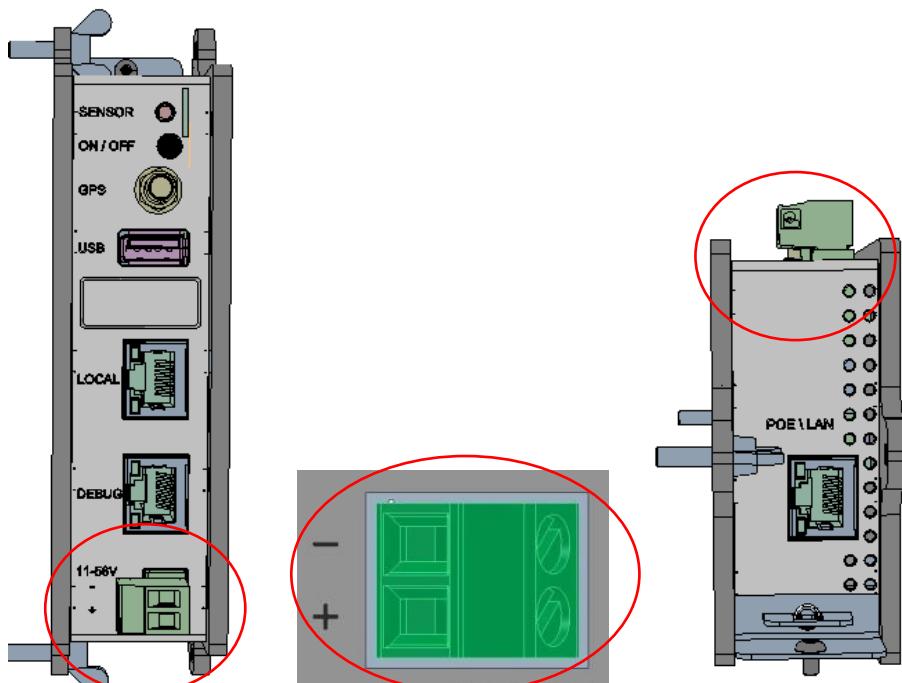


Figure 88 : Auxiliary DC power supply connector

First, the auxiliary power supply cable shall be introduced into the enclosure through a cable gland. The operator needs to determine which cable gland can be used for this operation:

- M25 cable gland can be used for that purpose if the Ethernet cable is no longer required (LTE backhaul only).
- If the Ethernet cable is required, then a M16 cable gland shall be used. One M16 blind stops shall be removed and replaced by the M16 cable gland.

**Note 1:** The M16 cable glands are not provided by KERLINK.

The M25 cable gland allows external cable diameter from 5mm to 8 mm.

The M16 cable glands allow external cable diameter from 4mm to 8 mm.

After insertion through the cable gland, the 2-wire cable can be screwed to the dedicated Euroblock plug as described on the Figure 88, according to the defined polarity.

**Note 2:** the Euroblock plug shall be inserted into the Euroblock receptacle only once all other connections are settled and USIM card inserted (see §4.4).

**Note 3:** the external power supply shall be a limited power source.

### 3.7.5.1 Wirnet Station

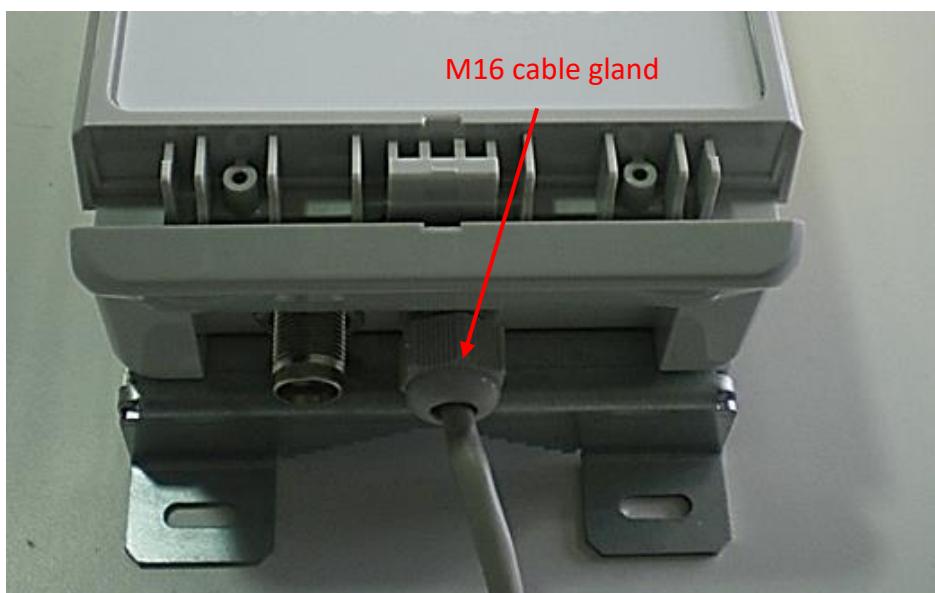
The Wirnet Station can be supplied with a DC power supply as a solar panel.

The power supply shall be qualified as a limited power source.

A two-wire cable is required to interconnect the auxiliary power supply connector.

The recommended cable section is 1.5 sq. mm.

The cable shall be introduced into the gateway enclosure via the cable gland usually used for Ethernet cable. This means that auxiliary external DC supply and Ethernet backhaul cannot be used simultaneously.



After insertion through the cable gland, a 2-wire cable can be connected (screwed) to the dedicated terminal block as described on the figure below:

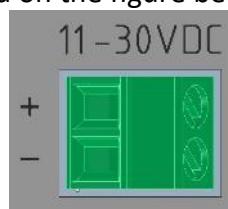


Figure 89 : DC power supply connection

The cable gland allows external cable diameter from 4mm to 8 mm.

The nominal section of the wires is 1 mm<sup>2</sup>.

Considering 1mm<sup>2</sup> sections copper wires, the maximum recommended length of the cable is:

- 20m for a 12V DC solar system
- 50m for a 24V DC solar system

**Note 1:** Beware of the polarity.

**Note 2:** the wires shall be inserted into the terminal block only once all other connections are settled and USIM card inserted).

### 3.8 Commissioning

Once the RF antenna(s) and the Ethernet cable are connected and the USIM card is inserted, the gateway can be powered ON.

To POWER ON the gateway, connect the PoE injector onto the 230VAC mains supply.

#### 3.8.1 Wirnet iBTS family

To ensure the Wirnet iBTS is started up, check the behavior of the LED indicators on the CPU module:

Connector	LED	Description
LOCAL	Green	Ethernet data activity
LOCAL	Orange	Ethernet Link
PoE/LAN	Green	Ethernet data activity
PoE/LAN	Orange	Ethernet Link
DEBUG	Green	Power status
DEBUG	Orange	Software status/ activity

When the Wirnet iBTS is powered ON then, all the LED are switched ON for seven seconds. Then the DEBUG green LED shall be ON to indicate the power supplies are OK.

The DEBUG orange LED is blinking very fast during two seconds at the end of the boot.

Once the boot is completed and the Wirnet iBTS is in nominal configuration, then the DEBUG orange LED is blinking every 5 seconds.

Then, to check and analyze the status of the Wirnet iBTS, a standard laptop can be connected to the LOCAL RJ45 connector of the CPU module or the RJ45 connector of the PoE injector. Once connected, run the maintenance Web interface as explained in next section.

#### 3.8.2 Wirnet Station

To ensure the Wirnet Station is started up, check the 2 PWR LEDs, after pressing the TEST button: they should be switched ON. After some seconds, the LEDs switch off.

Then, to check and analyze the status of the Wirnet Station, the TEST button shall be pressed briefly in order to activate the LEDs functionality for 1 minute. This operation can be repeated indefinitely.

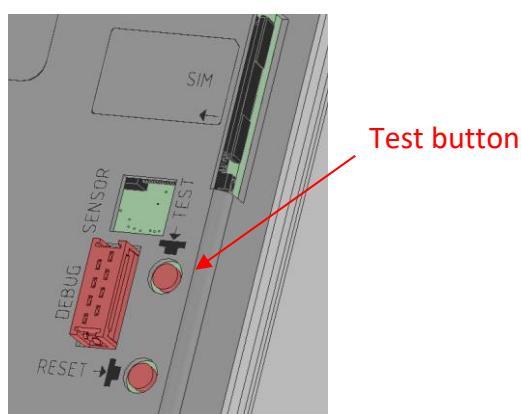


Figure 90 : Test button

### Status of the Wirnet Station:

Name	Color	Mode	Details
PWR (Station)	Green	Continuous	Station power indicator
PWR (Modem)	Green	Continuous	Modem power indicator
GSM1	Green	Continuous	GSM quality level Most Significant Bit
GSM2	Green	Continuous	GSM quality level Least Significant Bit

### WAN quality level:

GSM1	GSM2	Status
0	0	SIM Card error
0	1	No network connection
1	0	RSSI Level < 17
1	1	RSSI Level >18

The behavior of the other LEDs depends on the application software downloaded in the Wirnet Station. Only Station LEDS (WAN, MOD1 and MOD2) can be controlled by the application.



Figure 91 : LEDs indicators – Wirnet Station

### 3.8.3 Wirnet iStation

To ensure the Wirnet iStation is started up, check the 2 LEDS, on the bottom side of the enclosure. The LED can be observed through the transparent M25 cap:

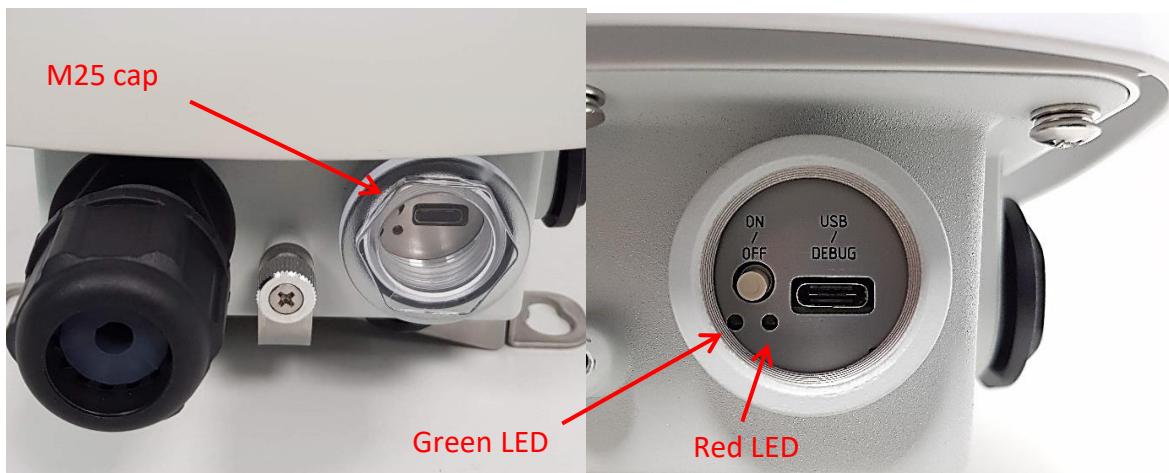


Figure 92: LEDs on bottom side – Wirnet iStation

The behavior of the two LED indicators are as follows:

Item	Specification
LED 1: Power	Green if power supply is present otherwise light off
LED 2: Status	Red blinking during kernel boot & system boot Light off when boot is finished

### 3.9 Interfaces for maintenance

#### 3.9.1 USB interface

##### 3.9.1.1 Wirnet iBTS family

Firmware upgrade can be performed with a USB stick via the USB type A connector. The connector is located on the CPU module as described below:

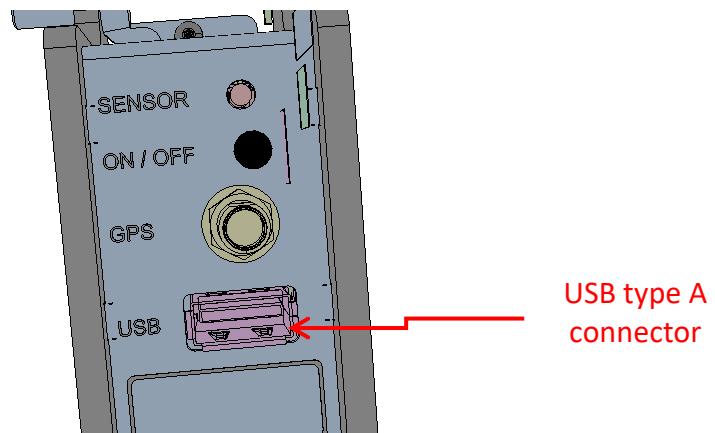


Figure 93 : USB connector of the Wirnet iBTS

##### 3.9.1.1 Wirnet Station

Firmware update can be performed with a USB key via the USB type A connector below:

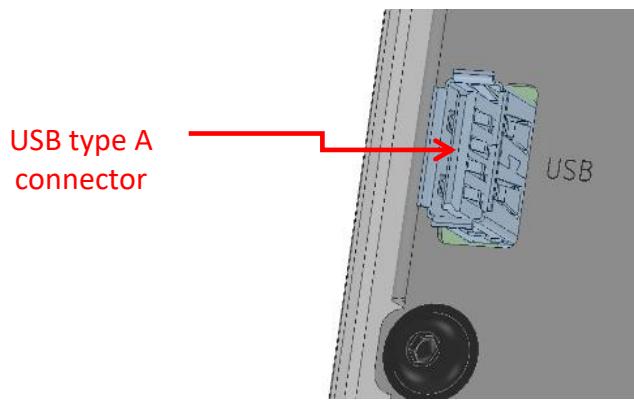


Figure 94 : USB connector of the Wirnet Station

### 3.9.1.2 Wirnet iStation

A USB-C connector, at the bottom side of the enclosure, allows to connect:

- Wirnet debug probe to use debug mode
- a USB mass-storage stick to upgrade gateway



Figure 95: USB interface on bottom side – Wirnet iStation

### 3.9.2 ON/OFF button

#### 3.9.2.1 Wirnet iBTS family

An ON/OFF button is located on the front side of the CPU module:

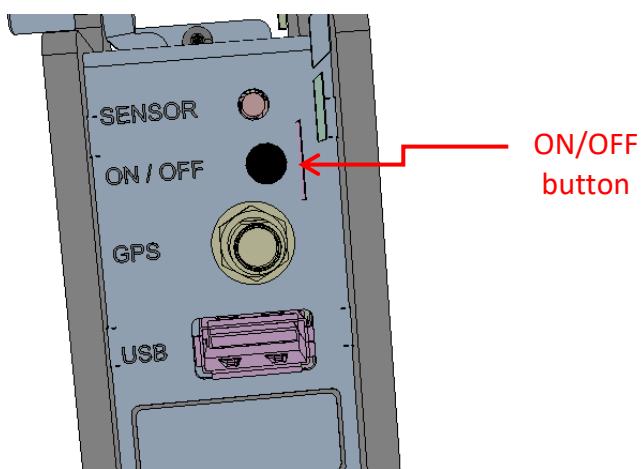


Figure 96 : ON/OFF button of the Wirnet iBTS

This button is intended to perform a hard reboot, soft halt, power down (hard halt) and power on of the Wirnet iBTS:

- Press the button once (<1s) to complete the hard reboot of the Wirnet iBTS
- Press the button during 1s to 5s to perform a soft halt. The Wirnet iBTS closes the SW applications and reboots within the next 2minutes.

- Long press the button for 5 seconds min to power down the Wirnet iBTS (hard halt). Wait the shutdown of the Wirnet iBTS i.e. until the LEDs are switched off. The shutdown may take up to 30s depending on the current software activity.
- Press the button once again to power on the Wirnet iBTS when powered off.

If the shutdown is not completed properly or may take longer than expected or if the Wirnet iBTS is under fault for any expected reason, then a hard halt can be performed.

### 3.9.2.1 Wirnet Station

RESET button is a small button located on the top side as shown below.

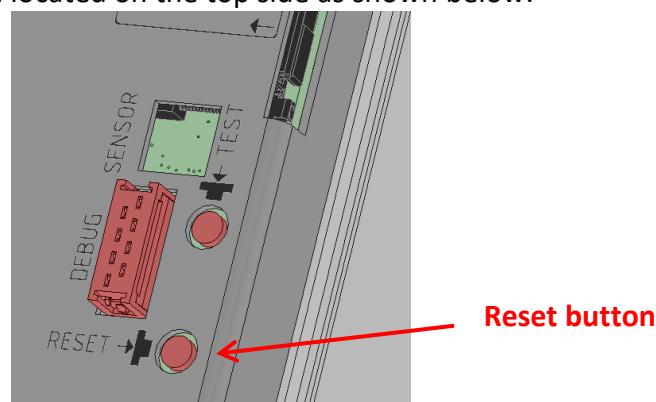


Figure 97 : Reset button of the Wirnet Station

RESET button is intended to reboot and reinitialize the Wirnet Station in its factory configuration.

### 3.9.2.2 Wirnet iStation

A push-button is available on the bottom of enclosure.

The ON/OFF/RST button shall be pressed during 1s to generate a SW reset of the product. A long press for 5s turns off the gateway.

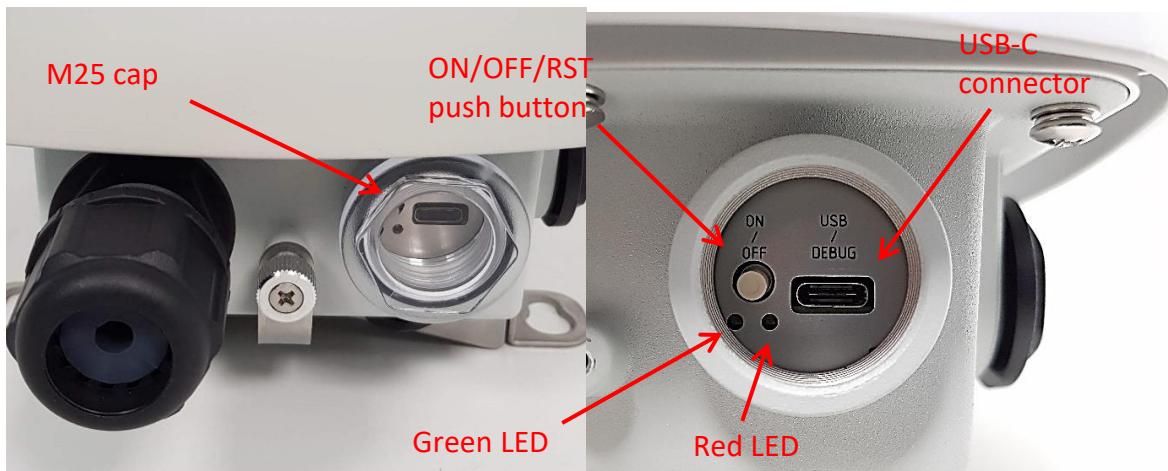
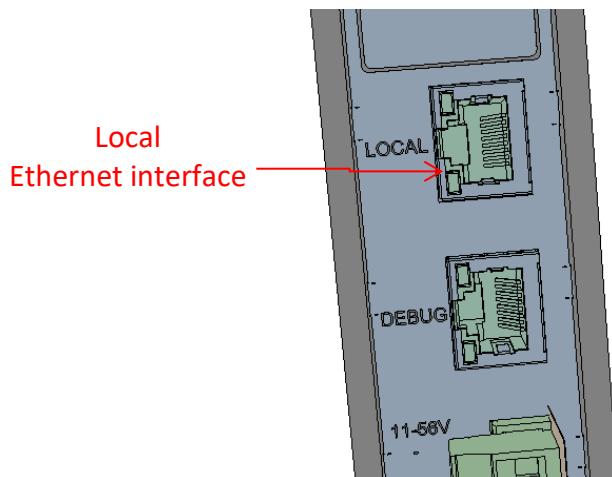


Figure 98: ON/OFF/RST button on bottom side – Wirnet iStation

### 3.9.3 Local interface

Local interface is available only for Wirnet iBTS family gateways.

A LOCAL Ethernet RJ45 connector is located on the front side of the CPU module:



*Figure 99 : Local Ethernet interface of the Wirnet iBTS*

This RJ45 Ethernet connector is dedicated to the maintenance of the Wirnet iBTS through a Linux SSH console session, or through the Web interface (see §3.8.2).

## 4 Indoor gateways

### 4.1 USIM card

#### 4.1.1 Wirnet iFemtoCell-evolution

A USIM card is mandatory to establish the LTE/3G/GPRS communications.

The USIM connector is located on the bottom side of the Wirnet™ iFemtoCell-evolution.  
It is a push-push connector with card detection.



Figure 100: Views of the USIM connector

Before inserting the USIM card, pay attention that the Wirnet™ iFemtoCell-evolution is unpowered by checking that all LEDs are OFF.

Then, insert the USIM card in the Wirnet™ iFemtoCell-evolution into the USIM connector.  
Beware on the side of the USIM before insertion:



Figure 101: Position of the USIM card before insertion into the USIM connector

Once introduced into the connector, push the USIM card until locking.  
To remove the USIM card, push it again.

In case of replacement of the USIM card, the power supply shall be firstly switched off by disconnecting the power supply. Wait and check the LEDs are switched off before extracting the USIM card.

#### 4.1.2 Wirnet iFemtoCell

Wirnet iFemtoCell does not embed an LTE modem. However, a USB dongle can be connected into the USB-A connector to provide cellular backhauling.

In this case, the LTE/HSPA/GPRS connection requires a USIM subscription for this optional USB dongle. Kerlink recommends using the Kerlink validated USB dongles. Alternative dongle may require additional drivers and firmware update to be used.

Before inserting the USIM card, pay attention that the Wirnet™ iFemtoCell is unpowered by checking that all LEDs are OFF.

Then, insert a USIM card in the USB WAN dongle.

In case of replacement of the USIM card, the power supply shall be firstly switched off by disconnecting the power supply. Wait and check the LEDs are switched off before extracting the USIM card.

After inserting the new USIM card as described above, the Wirnet™ iFemtoCell can be re-powered on again.

In case of change of mobile operator, APN and login/password shall be updated. This can be done through USB update.

## 4.2 Mounting of the enclosure

### 4.2.1 General considerations

This device shall be professionally installed.

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

The Wirnet™ gateways shall be mounted on any concrete pedestal, concrete wall or any non-flammable surface (UL94-V0). It shall not be mounted on a flammable surface.

### 4.2.2 Wirnet™ iFemtoCell and Wirnet™ iFemtoCell-evolution Wall Mounting

The Wirnet™ iFemtoCell may be mounted on a wall using the two oblong holes:

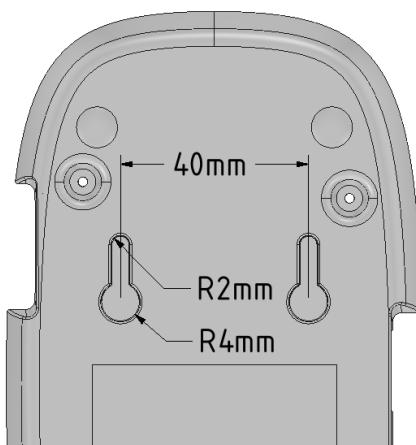


Figure 102: Wall mounting dimensions



*Figure 103: Wall mounting*

Only two screws are then needed to wall mount the gateway.

### 4.3 Setting connections

Before setting all connections, ensure that the power supply is not connected to the mains supply.

#### 4.3.1 LoRa antenna

##### 4.3.1.1 Wirnet iFemtoCell and Wirnet iFemtoCell-evolution

The LoRa® antenna interface of Wirnet™ iFemtoCell and Wirnet™ iFemtoCell-evolution is a SMA female or RP-SMA female connector.

SMA is provided on versions 868 whereas RP-SMA is provided on versions 915 and 923.

The difference between RP-SMA and SMA are detailed below:



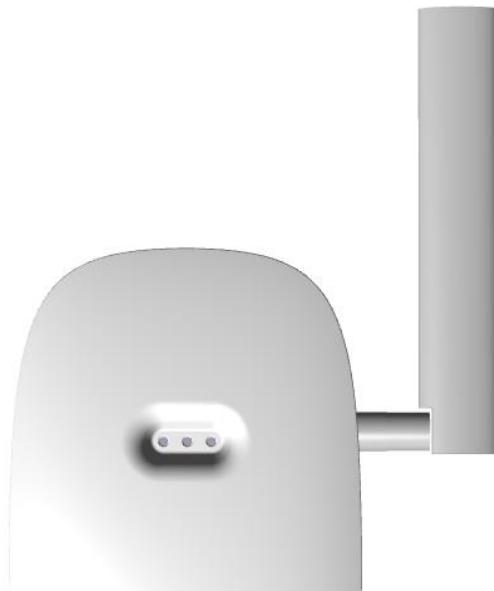
*Figure 104: Differences between RP-SMA female and SMA female connectors*

The connector is located on the right side of the gateways:



*Figure 105: View of the LoRa® RF connector*

A dual band swivel antenna is provided with Wirnet™ iFemtoCell-evolution. Depending on the version, this external antenna is equipped with SMA or RP-SMA connector.



*Figure 106: LoRa® swivel antenna*

#### 4.3.1.2 Distance between LoRa antenna and LTE USB dongle of Wirnet iFemtoCell

To avoid or minimize the intermodulation between the LoRa transmitter and the LTE transmitter of Wirnet iFemtoCell, a minimum distance is required between the LoRa antenna and the LTE USB dongle. This minimum distance is also recommended to avoid mutual desensitization of the receivers.

To optimize the colocalization between the internal LTE USB dongle and the external LoRa antenna, a distance of 1m is required between both radiated parts.

Therefore, when possible, Kerlink strongly recommends dissociating the LTE USB dongle away from the enclosure and the LoRa antenna by using a 1-meter extension cable.

### 4.3.2 Ethernet

#### 4.3.2.1 Wirnet iFemtoCell and Wirnet iFemtoCell-evolution

The Wirnet iFemtoCell and Wirnet™ iFemtoCell-evolution embeds a RJ45 Ethernet connector, an Ethernet transformer and an Ethernet 10BASE-T/100BASE-TX physical layer (PHY) transceiver connected to the CPU core through an RMII interface.

The transceiver implements auto negotiation to automatically determine the best possible speed and duplex mode of operation.

The device is configured to operate on a single 3.3V supply.

No synchronization via Ethernet (PTP or other) is required.

The RJ45 Ethernet socket is located on the left side of the Wirnet™ iFemtoCell-evolution:

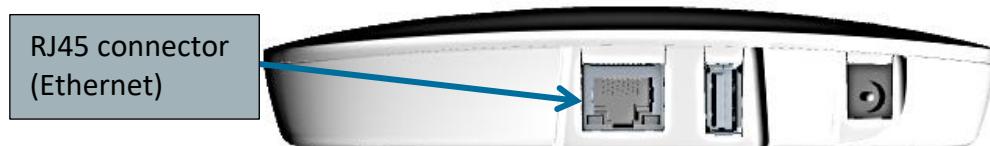


Figure 107: Views of the Ethernet RJ45 connector

The RJ45 connectors also integrates two LEDs:

- Green LED on the left side for Ethernet Data Activity
- Orange LED on the right side for Ethernet Link

**Note 1:** The Ethernet cable is not provided with the Wirnet™ iFemtoCell.

**Note 2:** The maximum Ethernet cable length is 100m.

### 4.3.3 DC supply

#### 4.3.3.1 Wirnet iFemtoCell and Wirnet iFemtoCell-evolution

The Wirnet™ iFemtoCell and Wirnet™ iFemtoCell-evolution, in nominal configuration, are supplied with 12VDC voltage via a 5.5mmx2.5mm socket located on the left side of the gateway.

This interface is the preferred supply interface due to the robustness of the sockets and plugs, which shall be considered, especially in industrial or harsh environments.



Figure 108: View of the 5.5x2.5mm socket

An AC/DC supply voltage is provided to interface this socket, but additional accessories could be also eventually used.

The AC/DC switching power supply may have interchangeable AC plugs such as US, EU, KC, UK, AU, CN:

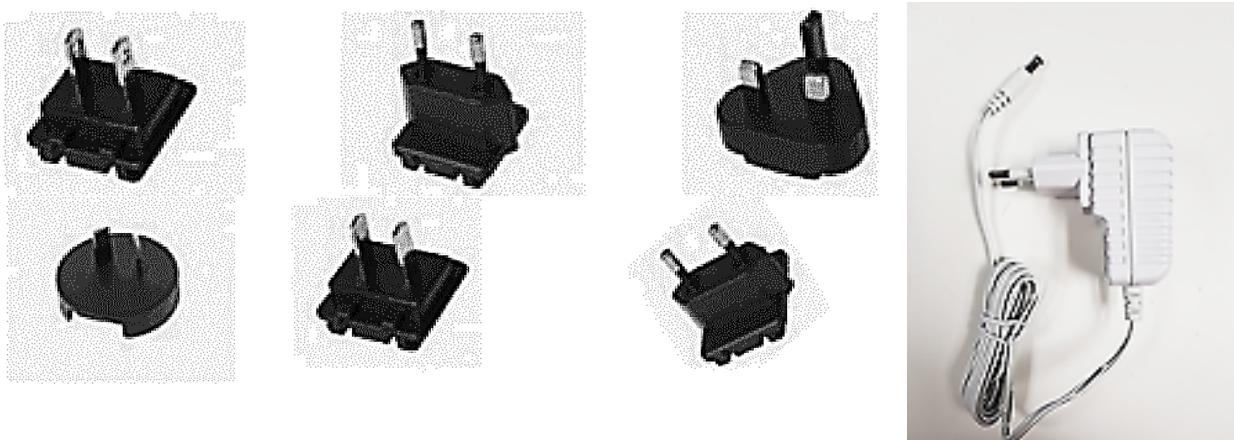


Figure 109: AC/DC and interchangeable plugs

#### 4.3.3.1 Wirnet iFemtoCell-evolution

The Wirnet™ iFemtoCell-evolution integrates an autonomous USB Type-C Port controller providing logic detection for Source Port role, Sink Port role, DRP and accessory detection support and Dead Battery support as defined in USB-C specifications.

Therefore, the USB-C port can be used either to supply OTG devices (source port role), either to supply the Wirnet™ iFemtoCell-evolution itself (sink port role).

The USB-C connector is located at the bottom side of the gateway as shown below:

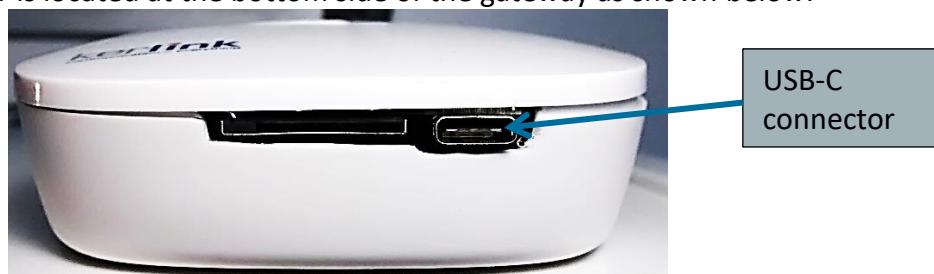


Figure 110: View of USB-C connector

**Note:** In order to supply the Wirnet™ iFemtoCell-evolution through the USB-C connector, a specific cable including USB-C male plug is required. This cable is not provided with the Wirnet™ iFemtoCell-evolution.

## 4.4 Commissioning

### 4.4.1 Wirnet iFemtoCell and Wirnet iFemtoCell-evolution

Once the LoRa antenna, the Ethernet cable and the power supply jack connector are connected and the USIM card is inserted, the Wirnet™ iFemtoCell or Wirnet™ iFemtoCell-evolution can be powered ON.

To POWER ON the gateway, connect the AC/DC power supply onto the 230VAC mains supply.

To ensure the Wirnet gateway is started up, check the behavior of the LED indicators: Wirnet™ iFemtoCell and Wirnet™ iFemtoCell-evolution has three bicolor LEDs located on the front side of the gateway as described below:

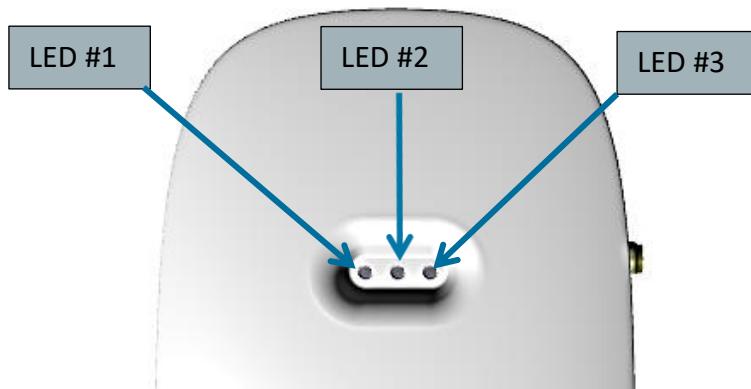


Figure 111: View of LEDs

The LEDs are used to indicate the behavior of the gateway as follows:

Item	Specification
<b>LED 1: Power</b>	A solid Green for Power LED A Status Red LED <ul style="list-style-type: none"> <li>• Boot part 1 -&gt; Fix on</li> <li>• Boot part 2 -&gt; Heartbeat</li> <li>• Boot part 3 -&gt; Blink every second</li> <li>• Run time -&gt; Off</li> <li>• Power down sequence -&gt; Heartbeat</li> <li>• Update -&gt; Blink / 0.4 second</li> <li>• Restore backup -&gt; Blink / 2 seconds</li> <li>• Restore stock -&gt; Blink / 4 seconds</li> </ul>
<b>LED 2: Backhaul</b>	RED during boot If the applicative software provided by Kerlink is installed: <ul style="list-style-type: none"> <li>• RED if applicative software is disconnected</li> <li>• GREEN blinking during applicative software connection</li> <li>• GREEN fix if applicative software is connected</li> </ul>
<b>LED 3: LoRa® traffic</b>	RED during boot If the applicative software provided by Kerlink is installed: <ul style="list-style-type: none"> <li>• Applicative software management</li> <li>• Rx: GREEN blinking</li> <li>• Tx: RED blinking</li> </ul>

#### 4.4.2 Wi-Fi connection of Wirnet iFemtoCell

If you have a WPS-compatible (Wi-Fi Protected Setup) Wi-Fi Access Point, press the WPS button on the Wirnet™ iFemtoCell and then press the WPS button on the Wi-Fi Access Point of the installation.



*Figure 112: WPS button*

The connection will be established automatically.

Alternatively, if you do not have a WPS-compatible Wi-Fi Access Point, you can connect directly to the Wirnet™ iFemtoCell through Wi-Fi.

## 4.5 Interfaces for maintenance

### 4.5.1 Wirnet™ iFemtoCell

#### 4.5.1.1 Reset button

The Reset push button is located on the right side flounce of the Wirnet™ iFemtoCell. The Reset button is identified with the silkscreen “Reset” marking placed on the top side of the gateway to clearly identify the placement.

The Reset button shall be pressed during 1s to generate a SW reset of the product.

To press the button, a tool with a 1mm diameter shall be used:



Figure 113: Reset buttons

To press the buttons, a tool with a 1mm diameter shall be used:



Figure 114: Push button tool

## 4.5.2 Wirnet™ iFemtoCell-evolution

### 4.5.2.1 USB-C Connector

The Wirnet™ iFemtoCell-evolution integrates an autonomous USB Type-C Port controller providing logic detection for Source Port role, Sink Port role, DRP and accessory detection support and Dead Battery support as defined in USB-C specifications.

The USB Type-C Port controller is connected to a dedicated USB PHY of the CPU (OTG1).

The USB-C connector allows then to connect:

- A 5V DC supply as detailed in §4.3.3.1.
- A Wirnet™ Debug Probe, from Kerlink, to use debug mode
- A USB mass-storage stick to upgrade the gateway

The USB-C connector is located at the bottom side of the gateway as shown below:

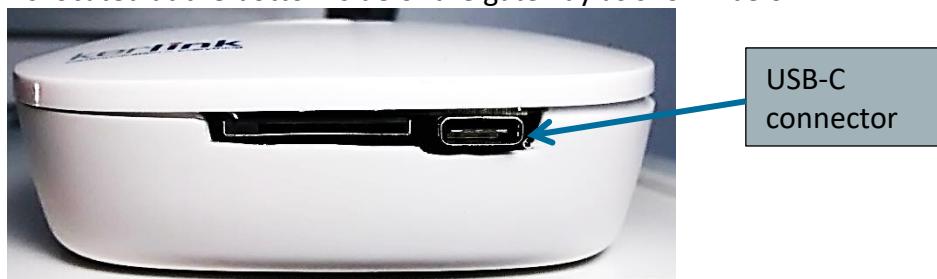


Figure 115: View of USB-C connector

The different pins of the USB-C connector as used to both comply USB type C specification and allow usage of the Wirnet™ Debug Probe.

**Note:** In order to connect the Wirnet™ iFemtoCell-evolution through the USB-C connector, a specific cable including USB-C male plug is required. No such cable is provided with the Wirnet™ iFemtoCell-evolution. The necessary USB-C cables are however provided with Wirnet™ Debug Probe.

#### 4.5.2.2 Reset On/Off Push-button

The Reset On / Off push button is located on the right side flounce of the Wirnet™ iFemtoCell-evolution. The Reset On / Off button is identified with the silkscreen “Reset On / Off” marking placed on the top side of the gateway to clearly identify the placement.

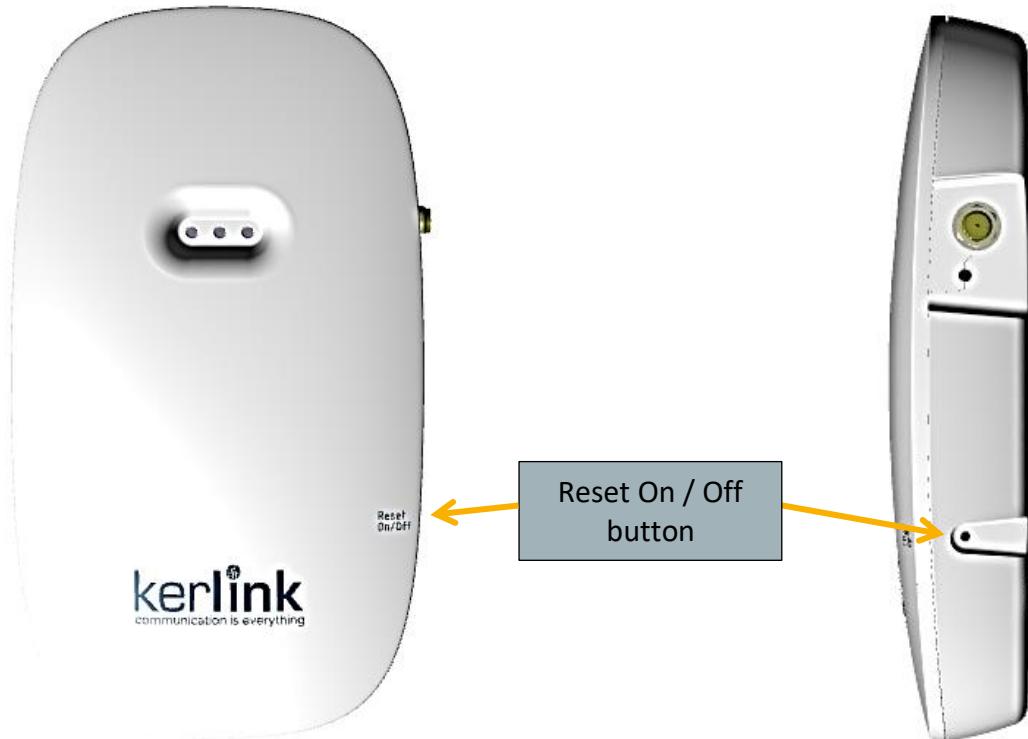


Figure 116: Push buttons

The Reset On / Off button shall be pressed during 1s to generate a SW reset of the product. A long press for 5s turns off the gateway. Another short press turns on the gateway. To press the buttons, a tool with a 1mm diameter shall be used:



Figure 117: Push button tool

## 5 References

- [1] AN-KLK03355 - Improving radio coexistence performance of LoRaWAN gateways
- [2] AN-KLK03356 - LoRaWAN gateways coverage optimization
- [3] AN-KLK03358 - LoRaWAN gateways lightning protection
- [4] IEC / EN 60728-11:2016 - Cable networks for television signals, sound signals and interactive services - Part 11: Safety

**End of Document**