The following picture describes the Wirma2 debug tool connected to the CPU module:

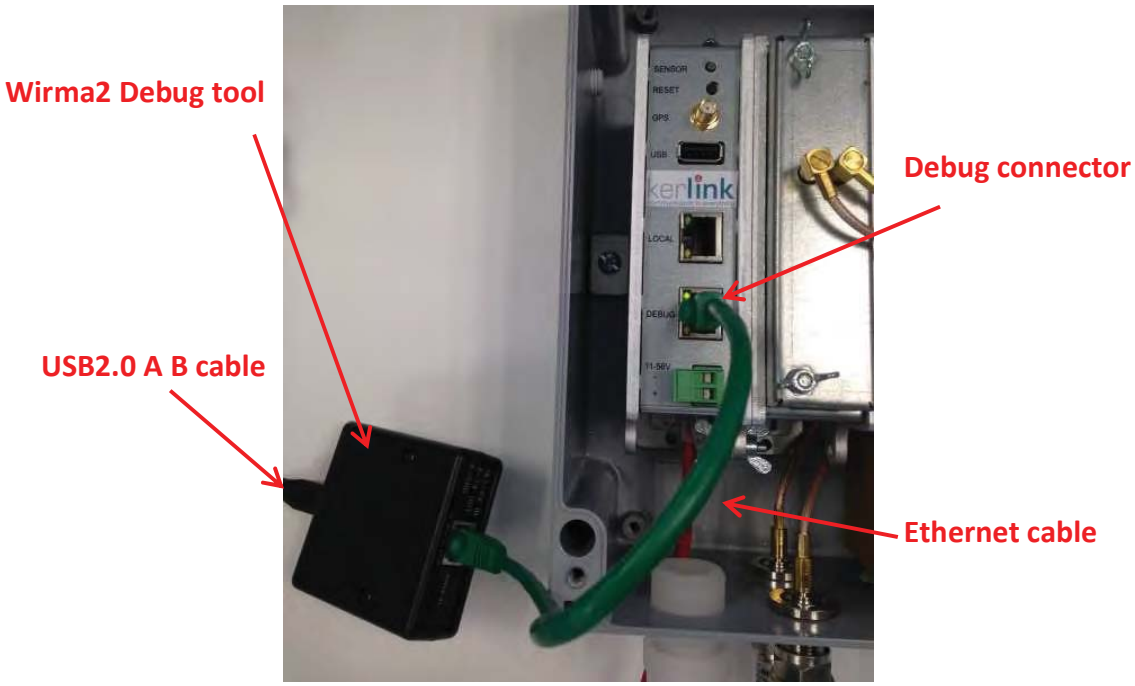


Figure 82 : WIRMA2 Debug Tool connected to the CPU module

2. Regulations

2.1 Wirnet iBTS 868

2.1.1 Europe / CE

Wirnet iBTS 868 complies with requirements listed in:

- RED Directive 2014/53/EU
- Low Voltage Directive 2014/35/EU
- Electromagnetic Compatibility Directive 2014/30/EU
- The limitation of exposure of the general public to electromagnetic fields specified in the Council Recommendation 1999/519/EC:

The power supply of the Wirnet iBTS 868 must be a limited power source.
The Wirnet iBTS 868 is considered as a category 1.5 receiver according to the EN 300 220-1.
The Wirnet iBTS 868 has CE marking.

In Europe, the Wirnet iBTS 868 station must comply with the ERC 70-3 requirements regarding duty cycle and maximum EIRP. They are summarized in the following table:

ERC 70-03 Band	Frequency (MHz)	Power	Duty cycle
h1.2	865-868	14dBm ERP	1%
h1.4	868-868,6	14dBm ERP	1%
h1.5	868,7-869,2	14dBm ERP	0,1%
h1.6	869,4-869,65	27dBm ERP	10%
h1.7	869,7-870	14dBm ERP	1%
h2.1	870-873	14dBm ERP	1%

The frequency channels arrangement must be compliant to the LoRaWAN specification and the regional parameters (EU 863-870 MHz) as defined in [1] and [2].

If the LoRa antenna is changed, the output power must be adjusted to take into account the gain of the antenna to not overrule the ERC 70-3 regulation.
Be careful, some countries in Europe may have specific frequency range, EIRP and duty cycles regulations:

- Greece, Sweden: bands h1.2 and h2.1 must not be used
- Andorra, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, France, Germany, Spain, Netherlands, Italy, Liechtenstein, Lithuania, Latvia, Macedonia, Malta, Montenegro, Potugal, Romania, Switzerland, Serbia, Turkey: band h2.1 must not be used

Check the local regulations before installing and commissioning the gateway.
For other countries, outside Europe, check the frequency range, the maximum EIRP and duty cycle allowed.

2.1.2 India

The Type Approvals No NR-ETA/5251-RLO(NR), NR-ETA/6064-RLO(NR) and NR-ETA 354/2017-RLO(SR) were granted by WPC to the Wirnet iBTS Compact 868.
However:

- Separate Import license is required to be obtained for each import as per WPC procedures,
- Record of all the equipments imported needs to be maintained and submitted to the Ministry as and when required.

In India, the Wirnet iBTS Compact 868 can be used with the following limitations:

Item	Specification
Frequency range	865-867MHz
Max EIRP	4W
Max conducted power with 6dBi antenna	1W
Channelization	200KHz

The frequency channels arrangement must be compliant to the LoRaWAN specification and the regional parameters (India 865-867 MHz) as defined in [1] and [2].

Note: A 865-867MHz cavity filter may be required in India to avoid saturation and desensitization of the LoRa receiver due to co-located LTE850 or CDMA800 base stations. This cavity filter is described in §1.8.3.1.

2.1.3 South Africa

-ICASA Type approval required-

The Wirnet iBTS 868 is compliant to:

- Radio Frequency Spectrum Regulations, 2015
- SANS 301489-1: Electromagnetic compatibility and Radio spectrum Matters (ERM) - ElectroMagnetic Compatibility (EMC) standard for radio equipment and services Part 1: Common technical requirements
- SANS 301489-3: Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services Part 3: Specific conditions for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 246 GHz
- SANS 60950-1: Information technology equipment - Safety Part 1: General requirements

In South-Africa, the Wirnet iBTS 868 can be used with the following limitations:

Frequency (MHz)	Power	Duty cycle
868-868,6	14dBm ERP	1%
868,7-869,2	14dBm ERP	0,1%
869,4-869,65	27dBm ERP	10%
869,7-870	7dBm ERP	100%

The frequency channels arrangement is the same as in Europe i.e. must be compliant to the LoRaWAN specification and the regional parameters (EU 863-870 MHz) as defined in [1] and [2].

2.1.4 Saudi Arabia

-CITC approval required-

The Wirnet iBTS 868 is compliant to:

- RI054 – Specifications for Non-specific Short Range Devices and Ancillary Equipment
- National Guideline for Human Exposure to Radiofrequency Electromagnetic Fields, 2009
- GEN001 – Technical Specification – General Requirements
- IEC 60950-1: 2005 + A1: 2009 + A2: 2013 - Information technology equipment - Safety - Part 1: General requirements

In Saudi-Arabia, the Wirnet iBTS 868 can be used with the following limitations:

Frequency (MHz)	Power
865-868	14dBm ERP
868-868,6	14dBm ERP
868,7-869,2	14dBm ERP
869,4-869,65	27dBm ERP
869,7-870	7dBm ERP

The frequency channels arrangement is the same as in Europe i.e. must be compliant to the LoRaWAN specification and the regional parameters (EU 863-870 MHz) as defined in [1] and [2].

2.1.5 United Arab Emirates

-TRA Type approval required-

The Wirnet iBTS 868 is compliant to:

- TS031 – Non Specific Short range Devices
- TS001 – EMC and Safety Requirements

- UAE.S GSO 1799: Safety Levels With Respect To Human Exposure To Radio Frequency Electromagnetic Fields, 3 kHz To 300 GHz

In United Arab Emirates, the Wirnet iBTS 868 can be used with the following limitations:

Frequency (MHz)	Power
865-870	17dBm EIRP*
870-873	10dBm EIRP

*: can be increased to 20dBm EIRP with authorization of the TRA.

The frequency channels arrangement is the same as in Europe i.e. must be compliant to the LoRaWAN specification and the regional parameters (EU 863-870MHz) as defined in [1] and [2].

2.1.6 Russia

-Minsvyaz approval and EAC marking required-

The Wirnet iBTS 868 is compliant to:

- CU TR 020/2011 : Electromagnetic Compatibility of Technical Products
- CU TR 004/2011 : Safety of Low Voltage Equipment
- GOST R IEC 60950-1 - Information technology equipment. Safety. Part 1. General requirements.

In Russia, the Wirnet iBTS 868 can be used with the following limitations:

Frequency (MHz)	Power	Duty cycle
864-865	14dBm ERP	1%
868.7-869.2	14dBm ERP	N/A

The frequency channels arrangement is defined in the LoRaWAN specification and the regional parameters (RU 864) as defined in [1] and [2].

2.2 Wirnet iBTS 915

2.2.1 USA / FCC

The Wirnet iBTS 915 is compliant to:

- UL 60950 -1 : 2007, Amendment A1:2011, Amendment A2:2014

The power supply of the Wirnet iBTS 915 must be a limited power source.

The Wirnet iBTS 915 is also compliant to CFR 47 FCC Part 15 regulations:

- FCC 47 CFR Part 15 : 2014 - Part 15- Radio frequency devices
- FCC PART 15.247 - Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz (frequency hopping and digitally modulated)
    - FCC Part 15.207 conducted emissions on AC mains in the band 150kHz – 30MHz
    - FCC Part 15.247 intentional radiated emissions
    - FCC Part 15.215 Additional provisions to the general radiated emissions limitations

The associated FCC identifiers of the Wirnet iBTS 915 are:

FCC ID : 2AFYS-KLK915IBTS
Model : WIRNET iBTS 915
Contains FCCID : N7NMC7355
Model : MC7355

The associated FCC identifiers of the Wirnet iBTS Compact 915 are:

FCC ID : 2AFYS-KLK915IBTSC
Model : WIRNET iBTS Compact 915
Contains FCCID : N7NMC7355
Model : MC7355

As stated by the external sticker on the enclosure, “This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.”
Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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

This device must be professionally installed.

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

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

2.2.2 Canada / IC

The Wirnet iBTS 915 is compliant to:

- CAN/CSA-C22.2 NO. 60950-1-07 / A1: 2011 / A2: 2014

The power supply of the Wirnet iBTS 915 must be a limited power source.

The Wirnet iBTS 915 is also compliant to IC - RSS 247 regulations:

- RSS-Gen – Issue 4, November 2014- General requirements and Information for the Certification of radio Apparatus
- RSS-247 Issue 1, May 2015 - Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSS) and License-Exempt Local Area Network (LE-LAN) Devices

The associated IC identifiers of the Wirnet iBTS 915 are:

IC : 20637-KLK915IBTS
Model : WIRNET iBTS 915
Contains / Contient IC : 2417C-MC7355
Model : MC7355

The associated IC identifiers of the Wirnet iBTS Compact 915 are:

IC : 20637-KLK915IBTSC
Model : WIRNET iBTS Compact 915
Contains / Contient IC : 2417C-MC7355
Model : MC7355

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

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

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence.
L'exploitation est autorisée aux deux conditions suivantes:

1. *L'appareil ne doit pas produire de brouillage;*
2. *l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.*

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

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

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

The radio transmitter has been approved by Industry Canada to operate with a maximum duty cycle of 40% to not overrule the 2.784 W/m2 RF Field Strength Limits for Devices. The duty cycle, in normal conditions, is far below this limit. Do not operate the Wirnet iBTS 915 out of the 40% duty cycle limit.

2.2.3 Mexico

-IFETEL certification required-

The Wirnet iBTS 915 is compliant to "IFT-008-2015 (PROLAB-89) – Telecomunicaciones – Radiocomunicación - Sistemas de radiocomunicación que emplean la técnica de espectro disperso - Equipos de radiocomunicación por salto de frecuencia y por modulación digital a operar en las bandas 902-928 MHz, 2400-2483.5 MHz y 5725-5850 MHz - Especificaciones, límites y métodos de prueba".

"La operación de este equipo está sujeta a las siguientes dos condiciones: (1) es posible que este equipo o dispositivo no cause interferencia perjudicial y (2) este equipo o dispositivo debe aceptar cualquier interferencia, incluyendo la que pueda causar su operación no deseada."

The frequency channels arrangement must be compliant to the LoRaWAN specification and the regional parameters (US 902-928 MHz) as defined in [1] and [2].

2.2.4 Philippines

-NTC Type Approval required-

The Wirnet iBTS 915 is compliant to:

- Memorandum Circular MC 03-08-2013 amending MC 09-09-20003 for Wireless data Networks and Devices
- Memorandum Circular n°20-12-92 : Implementing guidelines for Cellular Mobile Telephone System (CMTS) operations in the Philippines
- Memorandum Circular n°07-08-2005 : Rules and regulations on the Allocation and Assignment of 3G Radio Frequency bands
- Memorandum Circular n°01-03-2010 : Rules on the Assignment of the Remaining Allocated 3G Radio Frequency Band
- PNS –IEC 60950-1 - Information Technology Equipment – Safety – Part 1: General requirements.

In Philippines, the Wirnet iBTS 915 can be used with the following limitations:

Item	Specification
Frequency range	915-918MHz
Max ERP	250mW
Max conducted power with 3dBi antenna	+23dBm (200mW)
Max conducted power with 6dBi antenna	+20dBm (100mW)
Channelization	200KHz
Number of channels	14
Channels center frequency	915.2 MHz +n*0.2MHz (0<=n<=13)

No frequency channels arrangement defined in LoRaWAN specification and the regional parameters as defined in [1] and [2] can be applicable to Philippines. Alternate JointReq channels must be then defined.

Note: A 915-920MHz cavity filter may be required in Philippines to avoid saturation and desensitization of the LoRa receiver due to co-located EGSM900 base stations. This cavity filter is described in §1.8.3.4.

2.3 Wirnet iBTS 923

The Wirnet iBTS 923 is compliant to:

- IEC 60950-1:2005/A1:2009/A2:2013
- CENELEC EN 60 950-1 (Ed. 2006/A11 : 2009/A1 : 2010/A12:2011/A2:2013)
- AS/NZS 60950.1 : 2011
- GB4943-2011
- K60950-1
- J60950-1

The Wirnet iBTS 923 is also compliant to both FCC and CE regulations.
Applicable documents:

- CFR 47 FCC Part 15 :
  - FCC 47 CFR Part 15 : 2014 - Part 15- Radio frequency devices
  - FCC PART 15.247 - Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz (frequency hopping and digitally modulated)
    - FCC Part 15.207 conducted emissions on AC mains in the band 150kHz – 30MHz
    - FCC Part 15.247 intentional radiated emissions
    - FCC Part 15.215 Additional provisions to the general radiated emissions limitations
- Article 3.2 of the R&TTE Directive :
  - EN 300 220-1, issue 3.3.1
  - EN 300 220-2, issue 3.3.1

  The Wirnet iBTS 923 is considered as a category 1.5 receiver according to the EN 300 220-1.

Note 1:
The power supply of the Wirnet iBTS 923 must be a limited power source.

Note 2:
Depending on the countries, check the specific regulations applying, especially regarding frequency range, maximum EIRP, duty cycle allowed, maximum transmit duration, carrier sense mandatory or not, etc …
Some specific rules are detailed hereafter for specific countries.

2.3.1 Australia

M2M Connectivity is the only Responsible Supplier of the Wirnet iBTS 923 and Wirnet iBTS Compact 923 under the ACMA registration process. The company acts as importer of the Wirnet Station 923 and agreed to let Kerlink affix the product with the RCM mark.

The Wirnet iBTS 923 complies with the requirements of the relevant ACMA Standards made under the Radiocommunications Act 1992 and the Telecommunications Act 1997. These Standards are referenced in notices made under section 182 of the Radiocommunications Act and 407 of the Telecommunications Act.
The applicable Standard are:

- Radiocommunications (Short Range Devices) Standard 2014
  AS/NZS 4268: 2017: Radio equipment and systems – Short range devices – Limits and methods of measurement

- AS/CA S042.1: 2015 - Requirements for connection to an air interface of a Telecommunications Network - Part 1: General
- AS/ACIF S042.3: 2005 - Requirements for connection to an air interface of a Telecommunications Network - Part 3: GSM Customer Equipment
- AS/CA S042.4: 2015 - Requirements for connection to an air interface of a Telecommunications Network—Part 4: IMT Customer Equipment
- AS/NZS 60950.1: 2015 - Information technology equipment - Safety - General requirements

In Australia, the Wirnet iBTS 923 can be used with the following limitations:

Item	Specification
Frequency range	915-928MHz
Max EIRP	1W (30dBm)
Max conducted power with 6dBi antenna	24dBm
Max conducted power with 3dBi antenna	27dBm

The frequency channels arrangement must be compliant to the LoRaWAN specification and the regional parameters (AU 915-928MHz) as defined in [1] and [2].

2.3.2 Hong-Kong

The Wirnet iBTS 923 can be used in Hong-Kong, based on a Voluntary Certification Scheme.
The Wirnet iBTS 923 is compliant to:

- Hong Kong Telecommunications Equipment Evaluation and Certification (HKTEC) Scheme OFCA I 421, Issue 6, 2012, based on a Voluntary Certification Scheme.
- HKCA 1035 – Issue 7, 2016: Performance specification for radio equipment exempted from licensing
- HKCA 1078 – Issue 1, 2017: Performance specification for Radio Equipment operating in the 920-925 MHz band for the provision of public telecommunications services.
- HKCA 1049 – Issue 1, 2005: Performance specification for RFID Equipment operating in the 865-868 MHz and/or 920-925 MHz bands.
- HKCA 1033 – Issue 7, 2012: Performance Specification for Mobile Stations and Portable Equipment for use in the Global System for Mobile Communications (GSM) 900 and 1800 MHz Bands.
- HKCA 1048 – Issue 2, 2008: Performance specification for user equipment for use in the third generation (3G) mobile communication services employing CDMA Direct Spread (UTRA FDD).
- HKCA 1057 – Issue 1, 2011: Performance Specification for User Equipment for Use in Public Mobile Communications Services based on Evolved Universal Terrestrial Radio Access (E-UTRA) Frequency Division Duplex (FDD).
- HKCA 2001 – Issue 12, 2012: Compliance test specification – Safety and Electrical Protection requirements for subscriber Telecommunications Equipment.

In Hong-Kong, the Wirnet iBTS 923 can be then used with the following limitations:

Item	Specification
Frequency range	920-925MHz
Max EIRP	36dBm
Max conducted power with 6dBi antenna	30dBm
Channelization	200KHz
Number of channels	24
Channels center frequency	920.2 MHz +n*0.2MHz (0<=n<=23)

The frequency channels arrangement may be compliant to the LoRaWAN specification and the regional parameters (AS 923MHz) as defined in [1] and [2].

Note: A 920-925MHz cavity filter may be required in Hong-Kong to avoid saturation and desensitization of the LoRa receiver due to co-located EGSM900 base stations. This cavity filter is described in §1.8.3.6.

2.3.3 Indonesia

-SDDPI Certification required-

The Wirnet iBTS 923 is compliant to:

- PERSYARATAN TEKNIS ALAT DAN PERANGKAT TELEKOMUNIKASI JARAK DEKAT (SHORT RANGE DEVICE) – 22 November 2012
- KEPDIRJEN No. 370 / DIRJEN / 2010 for 2G WAN part
- KEPDIRJEN No. 173 / DIRJEN / 2009 for 3G WAN part

In Indonesia, the Wirnet iBTS 923 can be used with the following limitations:

Item	Specification
Frequency range	923-925MHz
Max ERP	500mW (27dBm)
Max EIRP	29dBm
Max conducted power with 6dBi antenna	23dBm
Max conducted power with 3dBi antenna	26dBm
Channelization	200KHz
Number of channels	9
Channels center frequency	923.2 MHz +n*0.2MHz (0<=n<=8)

The frequency channels arrangement must be compliant to the LoRaWAN specification and the regional parameters (AS 923MHz) as defined in [1] and [2].

Note: A 920-925MHz cavity filter may be required in Indonesia to avoid saturation and desensitization of the LoRa receiver due to co-located EGSM900 base stations. This cavity filter is described in §1.8.3.6.

2.3.4 Korea (Republic of)

-RRA Certification and KC label required-

The Wirnet iBTS 923 is compliant to:

- Regulations on Radio Equipment (KCC Public Notification 2013-01, Jan 3, 2013)
- Unlicensed Radio Equipment Established Without Notice (KCC Public Notification 2012-102, Dec 5, 2012)
- Technical Requirements of Radio Wave Application (RRA Public Notification 2012-29, Dec 28, 2012)
- Measurements of the high-frequency output of radio wave application equipment and antenna power calculation methods (RRA Announce 2012-30, Dec 28, 2012)

- Technical Requirements for Radio Equipment of Standard of Safety Facility (RRA Public Notification 2012-31, Dec 28, 2012)
- Technical Requirements for the Human Protection against Electromagnetic Waves (KCC Public Notification 2012-2, Jan 5, 2012)
- Technical Requirements for Measurement and Test Procedure of Specific Absorption Rate (RRA Public Notification 2012-23, Dec 6, 2012)
- Technical Requirements for Measurement of Electromagnetic Field Strength (RRA Public Notification 2012-21, Nov 6, 2012)
- Equipment to be subject of Test Procedure for Electromagnetic Field Strength and Specific Absorption Rate (KCC Public Notification 2012-1, Jan 5, 2012)
- Conformity Assessment Procedure of Radio Equipment (RRA Announce 2011- 32, Dec 27, 2011)
- KN 301489-1: 2012-06 – test method of common technical EMC for radio equipment
- KN 301489-3 – Test method of EMC for radio equipments of short-range.
- KN 301489-7: 2008-5 – Test method of EMC for mobile and portable radio telecommunications systems.
- KN 301489-24: 2008-5 – test method for EMC for mobile and portable radio and ancillary equipment
- K60950-1 (2.0) - Information technology equipment – Safety – Part 1: General requirements

In Republic of Korea, the Wirnet iBTS 923 can be used with the following limitations:

Item	Specification
Frequency range	920.9-923.3MHz
Max EIRP	200mW (23dBm)
Max conducted power with 6dBi antenna	17dBm
Max conducted power with 3dBi antenna	20dBm
Carrier sense (LBT)	5ms / -65dBm
Transmit duration	< 4s
Pause duration	> 50 ms
Duty cycle	<2% in 20 s duration

The frequency channels arrangement must be compliant to the LoRaWAN specification and the regional parameters (KR 920-923MHz) as defined in [1] and [2].

2.3.5 New-Zealand

Due to mutual Recognition with Australia, the Wirnet iBTS 923 is exempted from the requirement to be the subject of a New Zealand declaration of conformity and to comply with New Zealand labelling requirements, provided the product is declared, labelled and supplied in accordance with the Radiocommunications (Compliance Labelling) Notice 2003,

or a notice in replacement thereof, issued by the ACMA under section 182 of the Radiocommunications Act 1992 (Australia). See §2.3.1.

The Wirnet iBTS 923 is compliant to General User Radio License (GURL) for Short Range Devices (SRD) and all the applicable deviations such as item 23:
Transmissions must not exceed the following unwanted emission limits: –79 dBW (–49 dBm) e.i.r.p. within 800 – 915 MHz and –63 dBW (–33 dBm) e.i.r.p. within 928 MHz – 1 GHz. The reference bandwidth for emissions is 100 kHz. Outside the band 800 MHz – 1 GHz, the limits prescribed in applicable standards prescribed in the Radiocommunications (Radio Standards) Notice 2016 apply. In the absence of applicable standards, the limits prescribed in Table 2 of the notice apply.*

In New-Zealand, the Wirnet iBTS 923 can be used with the following limitations:

Item	Specification
Frequency range	920-928 MHz
Max EIRP	4W (36dBm)
Max conducted power with 6dBi antenna	30dBm
Upstream channels	8 channels 915.9 MHz to 927.1 MHz Steps of 1.6 MHz 500 kHz BW LoRa modulation SF7 to SF12
Upstream channels	64 channels 915.2 MHz to 927.8 MHz Steps of 200 kHz 125 kHz BW LoRa modulation SF7 to SF12
Downstream channels	8 channels 923.3 MHz to 927.5 MHz Steps of 600 kHz 500 kHz BW LoRa modulation SF7 to SF12

Or:

Item	Specification
Frequency range	915-928 MHz
Max EIRP	1W (30dBm)
Max conducted power with 6dBi antenna	24dBm
Max conducted power with 3dBi antenna	27dBm
Upstream channels	64 channels 915.2 MHz to 927.8 MHz Steps of 200 kHz

	125 kHz BW LoRa modulation SF7 to SF12
Downstream channels	64 channels 915.2 MHz to 927.8 MHz Steps of 200 kHz 125 kHz BW LoRa modulation SF7 to SF12

Therefore, two different frequency plans can be used:

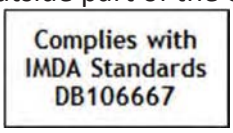
- Frequency plan and channel arrangement similar to Australia, according to the LoRaWAN specification and the regional parameters (AU 915-928MHz) as defined in [1] and [2].
- Frequency plan compliant to the LoRaWAN specification and the regional parameters (AS 923MHz) as defined in [1] and [2].

Note: A 920-928MHz cavity filter may be required in New-Zealand to avoid saturation and desensitization of the LoRa receiver due to co-located GSM900 base stations in harsh environments. This cavity filter is described in §1.8.3.7.

2.3.6 Singapore

The equipments are registered by IMDA under telecommunications (dealers) regulations. The Registration Numbers are N4572-17 and N4573-17, expiring on 30/11/2022. A dealer license is required to operate the gateways in Singapore. Kerlink Singapore Dealer License is DB106667.

The following label is placed on the outside part of the enclosure:



The Wirnet iBTS 923 is compliant to:

- IMDA Technical Specifications for Short Range Devices (IMDA TS SRD) – Issue 1, 1 October 2016
- IDA Technical Specifications for Cellular Mobile Terminal (IMDA TS CMT) – Issue 1, 1 October 2016
- IEC 60950-1: 2005 + A1: 2009 + A2: 2013 - Information technology equipment - Safety - Part 1: General requirements

In Singapore, the Wirnet iBTS 923 can be used with the following limitations:

Item	Specification
Frequency range	920-925MHz

Max ERP	500mW
Max EIRP	29dBm
Max conducted power with 6dBi antenna	23dBm
Channelization	200KHz
Number of channels	24
Channels center frequency	920.2 MHz +n*0.2MHz (0<=n<=23)

The frequency channels arrangement must be compliant to the LoRaWAN specification and the regional parameters (AS 923MHz) as defined in [1] and [2].

Note: A 920-925MHz cavity filter may be required in Singapore to avoid saturation and desensitization of the LoRa receiver due to co-located EGSM900 base stations. This cavity filter is described in §1.8.3.6.

2.3.7 Japan

The Wirnet iBTS 923 is certified by C&S in Japan and registered with number CSRT170147.
The specified Radio Equipment marking is visible on the external sticker on the enclosure:

The Wirnet iBTS Compact 923 is also certified by C&S in Japan and registered with number CSRT170148.
The specified Radio Equipment marking is visible on the external sticker on the enclosure:

The Wirnet iBTS 923 is compliant to “ARIB STD-T108 - 920MHz-Band Telemeter, Telecontrol and Data Transmission Radio Equipment”.

The certifications are valid for 3dBi, 6dBi and 8dBi referenced antennas from KERLINK:

- SCOUT KER-915-3 (3dBi) – KLK02658
- FT-RF OA-915M06-NF (6dBi) – KLK02518
- Terrawave T09080O100061 (8dBi)

Contact Kerlink for more information.

In Japan, the Wirnet iBTS 923 can be used with the following limitations:

Item	Specification
Frequency range	920.5-928.0MHz

Channelization	200KHz
Max EIRP (920.6-923.4MHz)**	500mW (27dBm)
Max conducted power (920.6-923.4MHz)**	250mW (24dBm)
Max EIRP (923.6-928MHz)*	40mW (16dBm)
Max conducted power (923.6-928.0MHz)*	20mW (13dBm)
Carrier sense (LBT) 920.6-922.2MHz**	5ms / -80dBm
Carrier sense (LBT) 922.4-923.4MHz**	128uS / -80dBm
Carrier sense (LBT) 923.6-928.0MHz*	128uS / -80dBm
Transmit duration (920.6-922.2MHz)**	< 4s
Transmit duration (922.4-923.4MHz)**	<400ms
Transmit duration (923.6-928.0MHz)*	<400ms
Pause duration (920.4-922.2MHz)	> 50 ms
Pause duration (922.4-923.4MHz)	> 10*Tx duration
Pause duration (923.6-928.0MHz)	> 10*Tx duration

*: ARIB STD-T108 Convenience Radio Station
**: ARIB STD-T108 Specified low power radio station

The frequency plan and channel allocation is defined for Japan in the LoRaWAN specification and the regional parameters as defined in [1] and [2], according to “AS 923MHz” plan.

The full frequency plan proposed by Kerlink is the following:

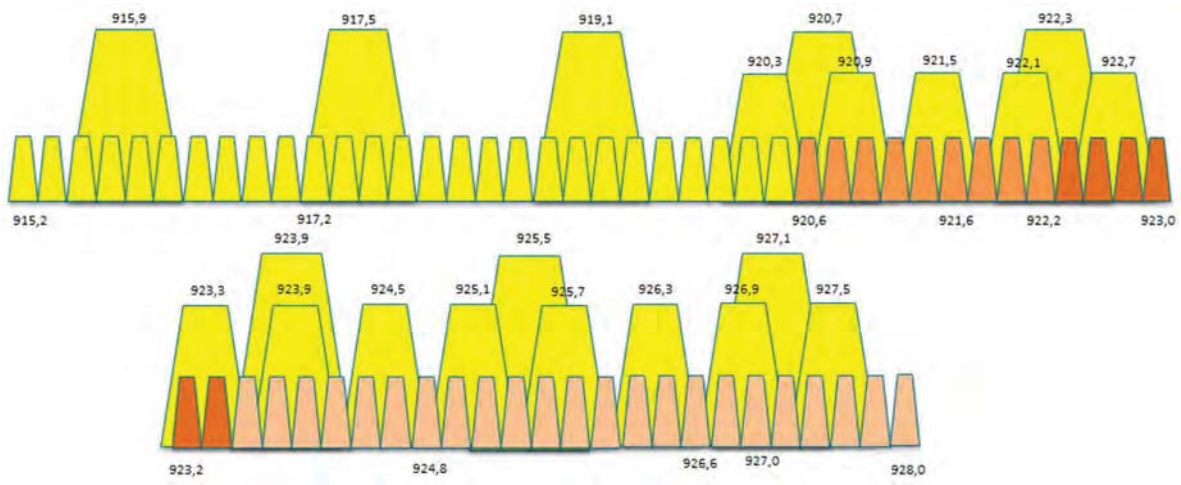


Figure 83 : Channels allocation proposal in Japan

Note:
In the above figure:

- Upstream and downstream channels are in orange: 38 channels, 200KHz spacing, 125KHz BW
- Upstream channels in medium orange:

- 9 channels (920.6MHz to 922.2MHz)
- SF7 to SF12
- Max frame length=4s
- 50 ms between frames
- 500mW EIRP
- 5ms min carrier sense

- Upstream channels in dark orange:
  - 6 channels (922.4MHz to 923.4MHz)
  - SF7 to SF10
  - Max frame length=400ms
  - 10% duty cycle max
  - 500mW EIRP
  - 128us min carrier sense
- Upstream channels in light orange:
  - 23 channels (923.6MHz to 928.0MHz)
  - SF7 to SF10
  - Max frame length=400ms
  - 10% duty cycle max
  - 40mW EIRP
  - 128us min carrier sense
- Unused channels are in yellow

The channels allocation can be organized differently if needed.

2.3.8 Taiwan

-NCC Certification required-

In Taiwan, the Wirnet iBTS 923 can be used be used as a « digitally modulated techniques systems" according to item 1, chapter 4.8.1 of the "Low Power 0002 (LP0002)" specifications.

Item	Specification
Frequency range	920-925MHz
Max EIRP	0.5W
Max conducted power with 6dBi antenna	125mW (21dBm)

For Reducing RF Influence, Use Properly.
'減少電池波影響，請妥適使用。

注意！
依據 低功率電波輻射性電機管理辦法
第十二條 經型式認證合格之低功率射頻電機，非經許可，
公司、商號或使用者均不得擅自變更頻率、加大功率或變更原設計
之特性及功能。

第十四條 低功率射頻電機之使用不得影響飛航安全及干擾合法通信；
經發現有干擾現象時，應立即停用，並改善至無干擾時方得繼續使用。
前項合法通信，指依電信規定作業之無線電信。
低功率射頻電機須忍受合法通信或工業、科學及醫療用電波輻射性
電機設備之干擾。

The Wirnet iBTS 923 is also compliant to:

- PLMN01: GSM900 and DCS1800 Mobile Equipment Technical Specifications, rev 09-05-2012
- PLMN08: the Third Generation Mobile Telecommunication Terminal Equipment Technical Specifications
- CNS 13438: 2006 - Information technology equipment – Radio disturbance Characteristics – limits and methods of measurement.
- CNS 14336-1: 2010 - Information Technology Equipment – Safety – Part 1: General requirements.

The LoRa frequency plan and channel allocation for Taiwan is defined in the LoRaWAN specification and the regional parameters, as defined in [1] and [2], according to “AS 923MHz”.

2.3.9 Malaysia

The Wirnet iBTS 923 and Wirnet iBTS Compact 923 own a MCMC Type Approval with the identification number RFFT/01A/1117/S(17-3593) and RFFT/02A/1117/S(17-3594) respectively. The expiry date is 23/11/2022.
The following SLP certification mark is available on the external label:

No CID is available so far. It will be provided later on.

In Malaysia, the Wirnet iBTS 923 is considered as a Short Range Device (SRD) according to “MCMC MTSFB TC T007: 2014, 1st Rev”.
The Wirnet iBTS 923 uses the 919-924MHz band with a maximum 500mW EIRP, according to “CLASS ASSIGNMENT NO. 1 OF 2017”.

Item	Specification
Frequency range	919-923MHz
	923-924MHz (1% duty cycle)
Max EIRP	0.5W
Max conducted power with 3dBi antenna	250mW (24dBm)
Max conducted power with 6dBi antenna	125mW (21dBm)

Channelization	200KHz
Number of channels	19
Channels center frequency	919.2 MHz +n*0.2MHz (0<=n<=18)

The Wirnet iBTS 923 is also compliant to:

- SKMM WTS GSM-MT Rev. 1.01:2007 for the WAN / GSMpart
- SKMM WTS IMT-MT Rev. 1.01:2007 for the WAN /3G part
- MS IEC 60950-1:2007 - Information Technology Equipment – Safety – part 1: General Requirements

The LoRa frequency plan and channel allocation for Malaysia is defined in the LoRaWAN specification and the regional parameters as defined in [1] and [2], according to "AS 923" plan.

Note: A 918-923MHz cavity filter may be required in Malaysia to avoid saturation and desensitization of the LoRa receiver due to co-located EGSM900 base stations. This cavity filter is described in §1.8.3.5.

2.3.10 Thailand

The Wirnet iBTS 923 is compliant to "NTC TS 1033-2560 – Technical Standard for non-RFID Radio Communication Equipment 920-925 MHz.

The Wirnet iBTS 923 is NBTC certified as a Class B equipment. The certification number are B69006-18 (Wirnet iBTS 923) and B69007-18 (Wirnet iBTS 923 Compact)
The following labels are placed on the outside part of the enclosures:

The Wirnet iBTS 923 is also compliant to:

- NTC TS 1004-2553 – User Equipment of Cellular land Mobile Service using GSM Technology
- NTC TS 1015-2549 - User equipment operating in cellular land mobile service using IMT-2000 CDMA Direct Spread (WCDMA) technology
- NTC TS 5001-2550 : Radiocommunication Equipment (Radio Frequency Radiation Exposure in 9 kHz-300 GHz)
- TISI 1956-2548 : Information Technology Equipment – Radio Disturbance Limits
- NTC TS 4001-2550: Electrical Safety of Telecom Terminal Equipment

In Thailand, the Wirnet iBTS 923 can be then used with the following limitations:

Item	Specification
Frequency range	920-925MHz
Max EIRP	33dBm (2W)
Max conducted power with 6dBi antenna	27dBm (500mW)
Duty cycle	<10%
Channelization	200KHz
Number of channels	24
Channels center frequency	920.2 MHz +n*0.2MHz (0<=n<=23)

The frequency channels arrangement in Thailand must be compliant to the LoRaWAN specification and the regional parameters (AS 923MHz) as defined in [1] and [2].

2.3.11 Brazil

In Brazil, the Wirnet iBTS 923 can be used according to « Resolução n°680 de 27 de junho de 2017– Regulamento Sobre Equipementos de Radiocomunicaçao de radiaçao Restrita.”

Item	Specification
Frequency range	915-928MHz
Max conducted power	1W (30dBm)
Max EIRP (6dBi max antenna)	4W (36dBm)
System type	DSSS / DTS

The Wirnet™ iBTS 923 and Wirnet™ iBTS Compact 923 are compliant to Anatel regulation.

The following label respects the resolution 680:

The following label is placed on the outside part of the enclosure:

Be careful:

"Este equipamento não tem direito à proteção contra interferência prejudicial e não pode causar interferência em sistemas devidamente autorizados".

"This equipment has no right to protection against harmful interference and cannot cause interference in duly authorized systems".

The frequency channels arrangement is not defined for Brazil in the LoRaWAN specification and the regional parameters as defined in [1] and [2], but Kerlink recommends following the Australian plan (AU 915-928MHz).

2.4 Wirnet iBTS 64 Highway

2.4.1 USA / FCC

The Wirnet iBTS 64 Highway is compliant to:

- UL 60950 -1 : 2007, Amendment A1:2011, Amendment A2:2014

The power supply of the Wirnet iBTS 64 Highway must be a limited power source.

The Wirnet iBTS 64 Highway is also compliant to CFR 47 FCC Part 15 regulations:

- FCC 47 CFR Part 15 : 2014 - Part 15- Radio frequency devices
- FCC PART 15.247 - Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz (frequency hopping and digitally modulated)
    - FCC Part 15.207 conducted emissions on AC mains in the band 150kHz – 30MHz
    - FCC Part 15.247 intentional radiated emissions
    - FCC Part 15.215 Additional provisions to the general radiated emissions limitations

The associated FCC identifiers of the Wirnet iBTS 64 Highway are:

FCC ID : 2AFYS-KLK64HIGHWAY
Model : WIRNET iBTS 64 HIGHWAY
Contains FCCID : N7NMC7355
Model : MC7355

Any changes or modifications to this equipment not expressly approved by KERLINK may cause, harmful interference and void the FCC authorization to operate this equipment

As stated by the external sticker on the enclosure, “This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.”
Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

—Reorient or relocate the receiving antenna.
—Increase the separation between the equipment and receiver.
—Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
—Consult the dealer or an experienced radio/TV technician for help.

This device must be professionally installed.

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

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

2.4.2 Canada / IC

The Wirnet iBTS 64 Highway is compliant to:

- CAN/CSA-C22.2 NO. 60950-1-07 / A1: 2011 / A2: 2014

The power supply of the Wirnet iBTS 915 must be a limited power source.

The Wirnet iBTS 64 Highway is also compliant to IC - RSS 247 regulations:

- RSS-Gen – Issue 4, November 2014- General requirements and Information for the Certification of radio Apparatus
- RSS-247 Issue 1, May 2015 - Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSS) and License-Exempt Local Area Network (LE-LAN) Devices

The associated IC identifiers of the Wirnet iBTS 64 Highway are:

IC : 20637-KLK64HIGHWAY
Model : WIRNET iBTS 64 HIGHWAY
Contains / Contient IC : 2417C-MC7355
Model : MC7355

This equipment complies with RSS102's radiation exposure limits set forth for an uncontrolled environment under the following conditions:

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

Cet équipement est conforme aux limites d'expositions de la CNR102 applicables pour un environnement non contrôlé aux conditions suivantes:

1. Cet équipement devra être installé et fonctionner de telle manière qu'une distance minimale de séparation de 20 cm soit maintenue entre la partie rayonnante (l'antenne) et l'utilisateur / les personnes à proximité à tout moment.
2 Cet émetteur ne doit pas être co-localisé ou opérer en conjonction avec toute autre antenne ou émetteur..

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

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

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

1. L'appareil ne doit pas produire de brouillage;
2. L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

The radio transmitter has been approved by Industry Canada to operate with a maximum duty cycle of 40% to not overrule the 2.784 W/m2 RF Field Strength Limits for Devices. The duty cycle, in normal conditions, is far below this limit. Do not operate the Wirnet iBTS 64 Highway out of the 40% duty cycle limit.

3. Key parameters to optimize the radio performance

The installation site is very important and can determinate the coverage area of the Wirnet iBTS. Some keys points are detailed hereafter. They are general rules that must be considered in every installation.
However, each individual installation is a particular case with specific constraints and sometimes with unexpected interferers. The proximity of other emitters, bad electrical installations may cause desensitization of the LoRa receiver.
KERLINK recommends performing spectrum analysis to validate the choice of the installation site. This analysis can be completed with a portable spectrum analyzer for instance.
The Wirnet iBTS has also the optional ability to perform spectrum analysis through the Wanesy Management Center (WMC), if the customer has subscribed to this service. This analysis is however only possible once the installation is completed. Please contact Kerlink for more information on this service.

3.1 Height of the site

A key factor to have an optimized Wirnet iBTS reception is the height of installation site and moreover the height of the LoRa antenna. The Wirnet iBTS gateway must be installed as high as possible to have the better reception and wider coverage area.
The figure below shows the RSSI of the signal (dBm) vs. the distance to the end point (meters) vs. the height of the Wirnet iBTS (4m, 8m, 12m and 30m). Two uses cases are presented: one for a small city configuration (urban area) and one for countryside area.
The propagation model used is based on Hata model.
The frequency is 868MHz in this case but performance and conclusions at 915MHz would be almost identical. The RSSI is the received signal by the Wirnet iBTS. The end point EIRP is assumed to be 25mW. The height of the end point is 1m.

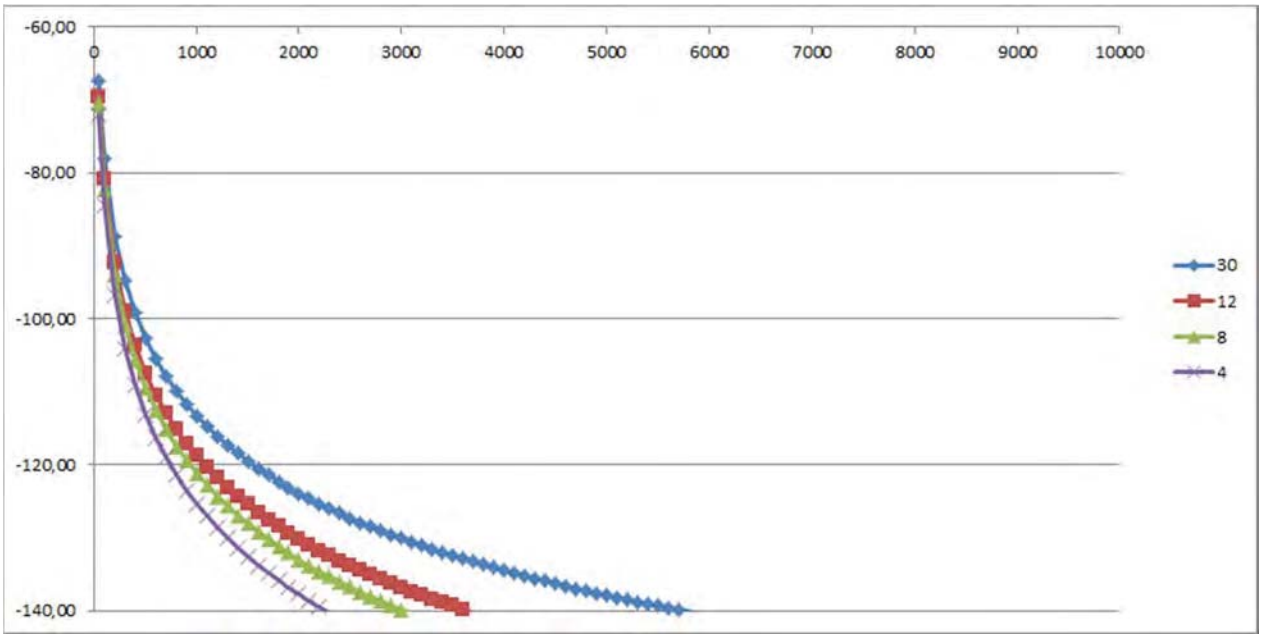


Figure 84 : Urban (small city) Hata propagation model – RSSI (dBm) vs distance (meters) vs height of the antenna

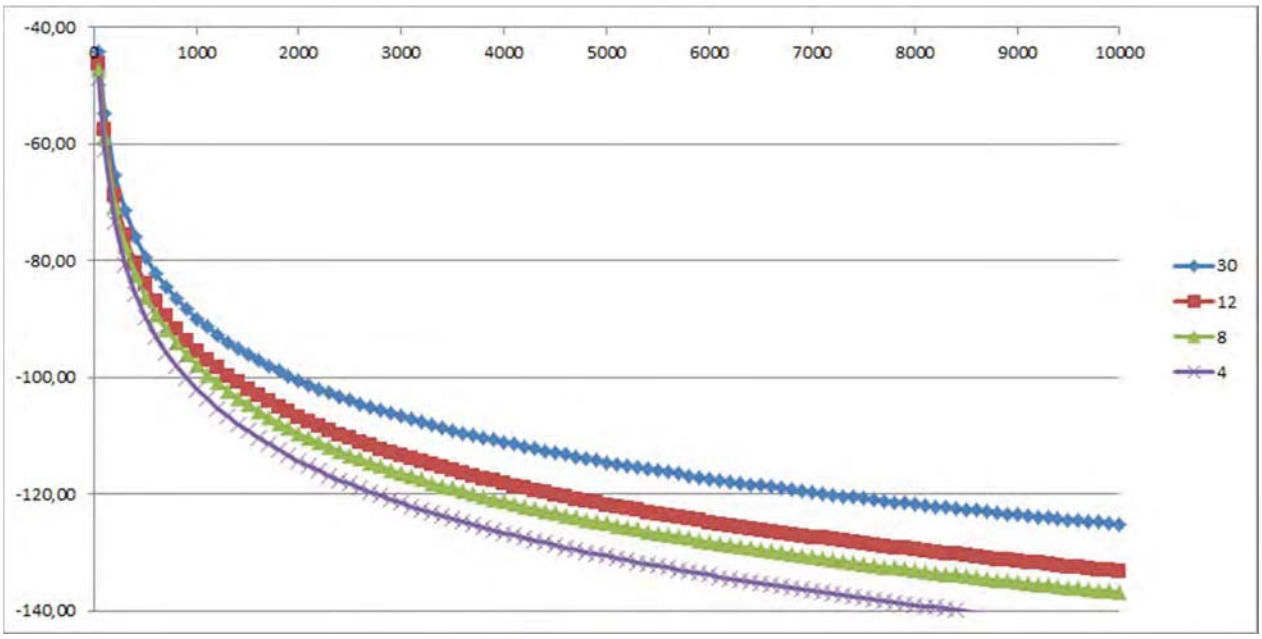


Figure 85 : Rural countryside Hata propagation model - RSSI (dBm) vs distance (meters) vs height of the antenna

What is noticeable is that the coverage distance at a fixed RSSI is doubled depending on the height of the antenna.

3.2 Propagation model vs area type

Predicting the RSSI and more generally the coverage of the Wirnet iBTS depends on many factors. The propagation channel must be well defined and known to have an efficient prediction.
Radio coverage simulations are recommended before the installation of the Wirnet iBTS to make sure the gateway would cover the expected area. Contact KERLINK for more information.
In a first approach, the figures below show the RSSI of the signal (dBm) vs. the distance to the end point (meters) vs. the type of area (urban, suburban, countryside, desert). The height of the LoRa antenna is assumed to be 12 meters and 30 meters.

The propagation model used is based on Hata model.
The frequency is 868MHz in this case but performance and conclusions at 915MHz would be almost identical. The RSSI is the received signal by the Wirnet iBTS. The end point EIRP is assumed to be 25mW. The height of the end point is 1m.

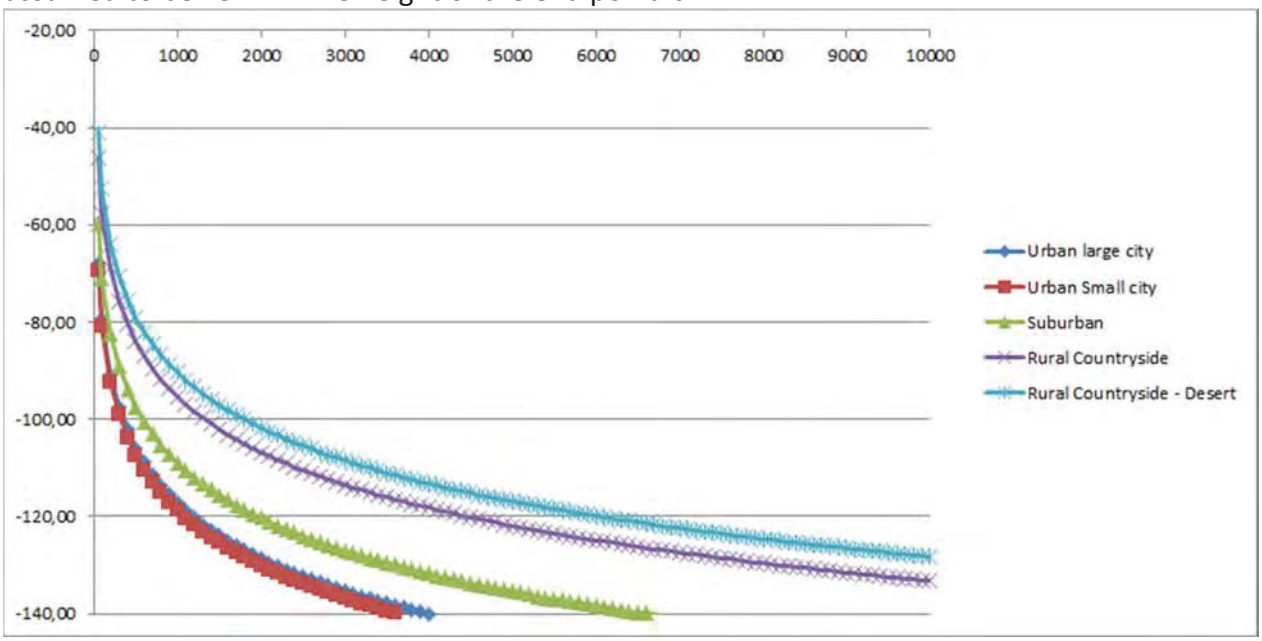


Figure 86 : Hata propagation model vs area configuration (Height = 12m) – RSSI (dBm) vs distance (m)

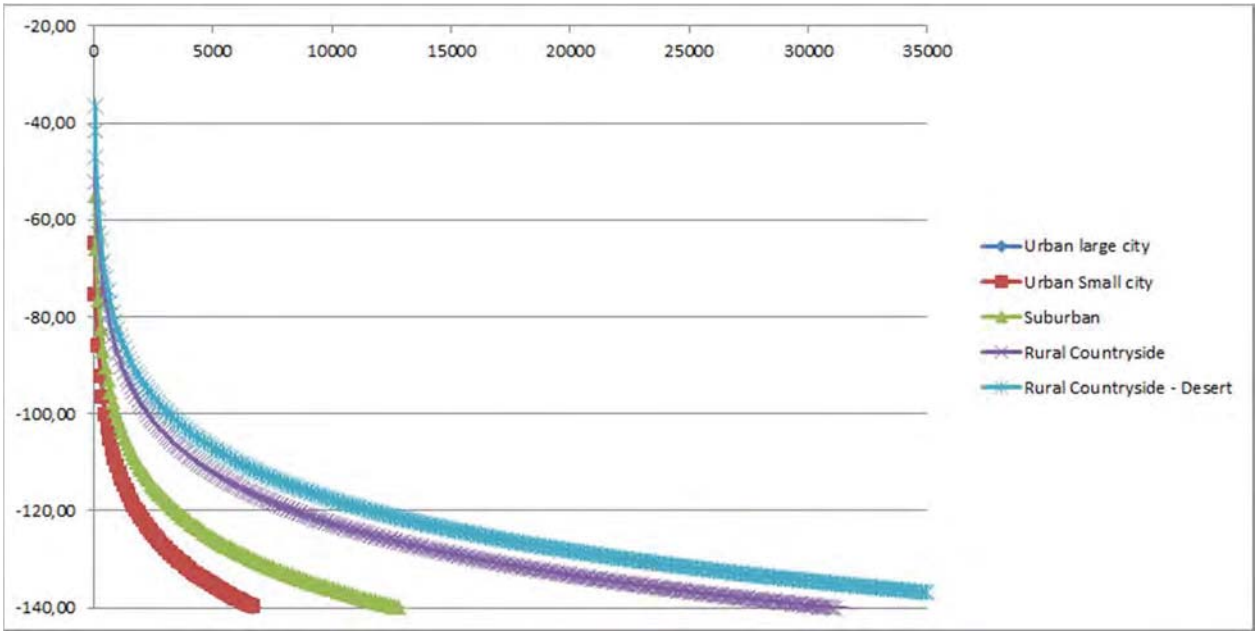


Figure 87 : Hata propagation model vs area configuration (Height = 30m) – RSSI (dBm) vs distance (m)

The coverage radius of the Wirnet iBTS, depending on the area type can vary from 2 km (urban areas, low height of the LoRa antenna), up to 40 km (countryside, very high sites).

3.3 Fresnel ellipsoid

Radio waves generally travel in a straight line from the emitter to the receiver. This is obviously true when there are no obstacles between the transmitter and the receiver. However, there are, most of the time, some obstacles between the transmitter and the receiver. Then, the radio waves bump into the obstacles and are reflected or diffracted with dephasing. These diffracted waves when arriving on the receiver can cause phase cancelling with the straight line signals reducing the received power (fading). The fading effect depends on the distance between the receiver and the emitter, the nature of the obstacles and the associated out of phase.

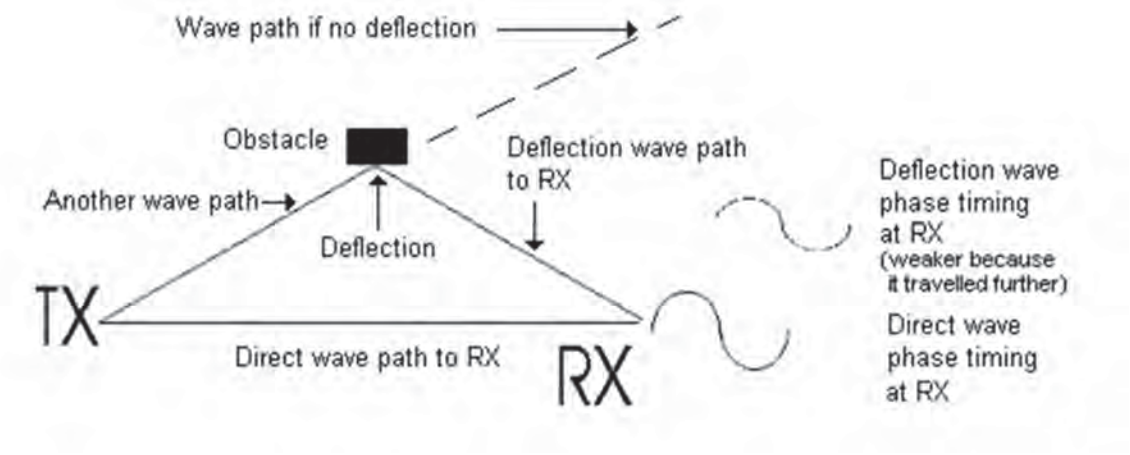


Figure 88 : Fading effects due to obstacles

To minimize the fading effects, obstacles in a “Fresnel ellipsoid” must be avoided.
The Fresnel ellipsoid is a theoretical ellipsoid located between the transmitter and the receiver.
The radius of the ellipsoid is defined as follows:

$$r1 = \sqrt{\frac{d1 * d2 * c}{f * (d1 + d2)}}$$

Where:

- d1 = distance from Tx antenna
- d2 = distance from Rx antenna
- f = frequency
- c = celerity (3E8 m/s)
- r1 = radius at the distance d1

A global rule is that 60% of the Fresnel ellipsoid must be clear of obstacles.
In case of buildings between the end point and the Wirnet iBTS, the antenna height must be adjusted to make sure the building is not close to 60% of r1.

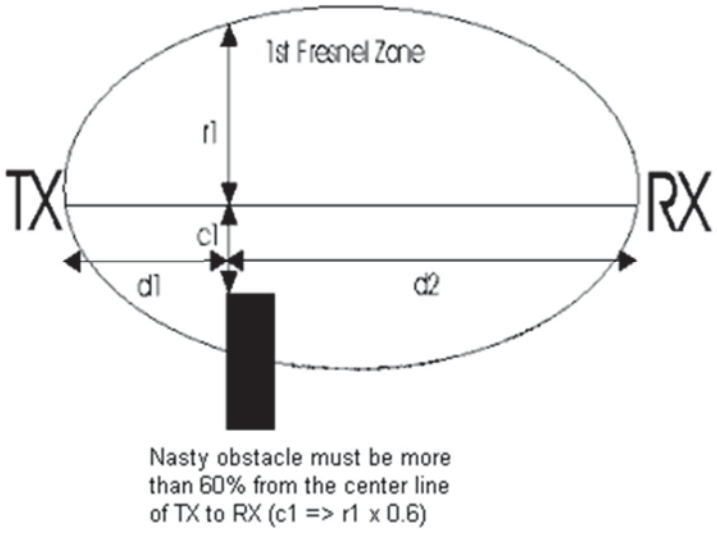


Figure 89 : Fresnel ellipsoid clearance

Be careful, if the antennas heights are not sufficient, then the ground (earth curve) can get inside the Fresnel ellipsoid and overrule the 60% criteria.

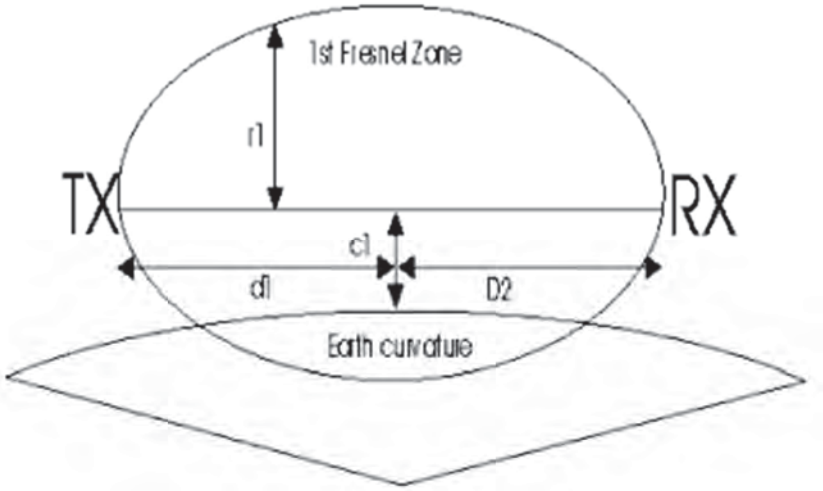


Figure 90 : Fresnel ellipsoid and earth curvature

Example:

An end point is located at 3500m from the Wirnet iBTS.
The Wirnet iBTS is installed on the roof of a building. The building roof is 30 meters long vs 20m large.
What is the required height of the LoRa antenna for have an optimized reception?

Answer:

If we want to receive end points i.e. 360° area coverage, it should be better to have the antenna located in the mid of the building roof.
The antenna is therefore at 15m from the edge of the roof.

Then we have:

- d1 = 15m
- d2 = 3600 -15 = 3585m
- f = 868MHz
- c = 3E8 m/s

So, r1 = 2.3m
The antenna must be installed at a minimum height of 2.3m from the roof top, on a mast for instance.

3.4 Co-localization with GSM/UMTS/LTE transmitters

The design of the Wirnet iBTS gateway insures good co-localization with other transmitters on the same site, and especially with BTS, in two ways:

- Limited spurious and noise generated in the BTS receiver bands
- Immunity to BTS transmitter

The Wirnet iBTS is obviously compliant to all EMC emissions and immunity regulations specific to each country. However, meeting these regulations is not sufficient to insure good coexistence with BTS when sharing the same site.
This is why KERLINK has reinforced these specifications to allow the coexistence.

KERLINK has designed the transmitter (LoRa-LOC module) to reduce the spurious and the noise generated in the BTS RX bands below -80dBm in a 100KHz resolution bandwidth. This is then pretty much in line with BTS specifications to insure co-localization between BTS.
The measurements made on the iBTS station show typical values of -85dBm/100KHz.

The receiver offers also high attenuation outside the receive band.
High attenuation of out of band blockers is obtained:

- >105dB at +/-10MHz
- >150dB in BTS downlink bands

This means that the blockers levels, due to the BTS, could be up to +10dBm causing no interference with the gateway.

Based on this performance, this means that about 50dB isolation is required between the Lora antenna of the Wirnet iBTS and the base station antenna to avoid desensitization of the BTS. Specifying a minimum distance between antennas may not guarantee the 50dB isolation, unless over specifying the required distance. This is mainly due to the fact that both LoRa antenna and BTS antennas are directive antennas. This means that the antenna gain is not omnidirectional in both cases.
BTS antenna have about 10 to 15dB antenna maximum gain but the gain above or below the antenna is reduced by 20dB to 30dB as described below:

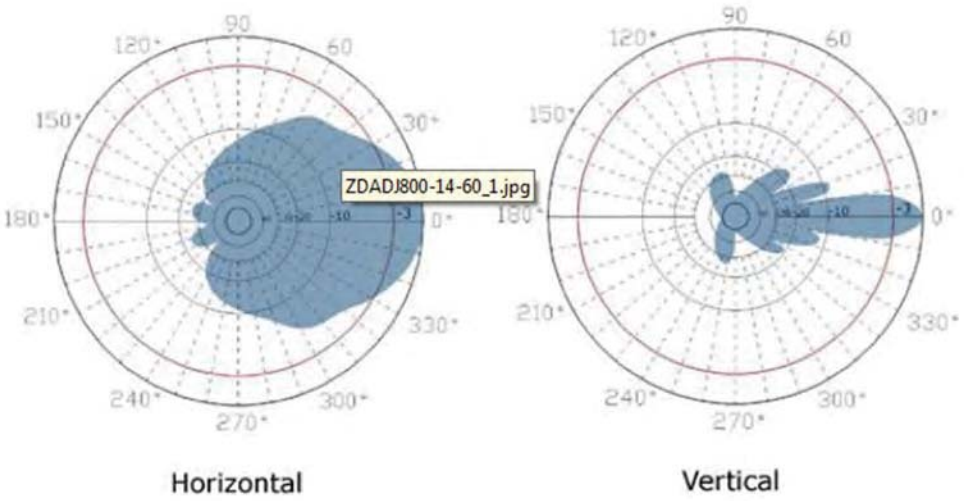


Figure 91 : Typical antenna gain pattern of a GSM BTS

Mounting the LoRa antenna just above or below the 4G antenna allows then to get 20 to 30dB isolation among the 50dB required.

The LoRa antenna can be an omnidirectional antenna. The worst case would be a 3dBi antenna which has the “less directive” antenna pattern. An example is presented below:

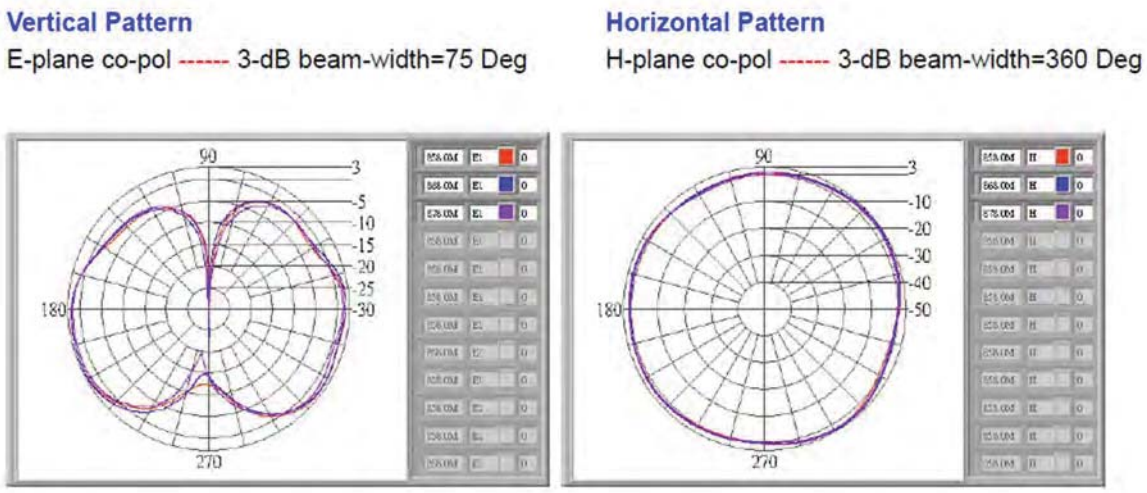


Figure 92 : Typical gain of 3dBi omnidirectional antenna

We can see that the gain on the top of the antenna or below the antenna is about -15dBi to -20dBi.

In case of sectorial antenna, the antenna gain above or below the antenna is also significantly reduced to -10 to -15dB as shown below:

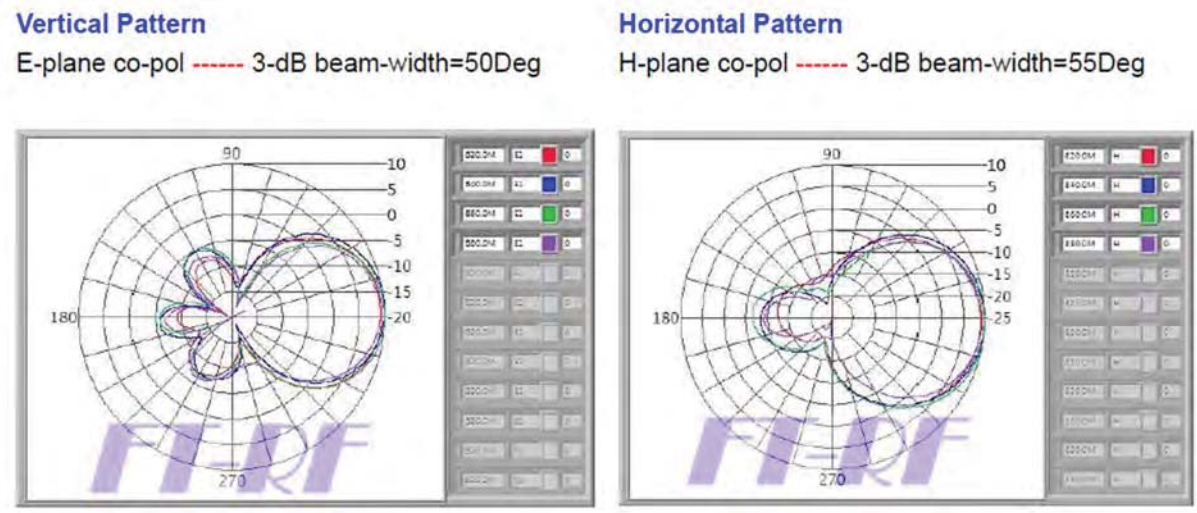


Figure 93 : Typical gain of a sectorial antenna

Then, taking into account the performance of the antenna, we need to get about 10 to 20dB more isolation to meet the 50dB isolation between antennas.
A gap of 1 meter between antennas would insure 30dB additional attenuation.

Therefore, our recommendation is to have the LoRa antenna just above the BTS antenna with 1 meter gap min.
Placing the LoRa antenna below the BTS antenna could be also possible. However, this is not recommended as reception could be impacted by metallic structures in the close area.

3.4.1 Wirnet iBTS 868

Co-localization is possible with the following BTS:

- EGSM900, GSM1800, GSM1900
- UMTS900, UMTS1900, UMTS2100
- LTE800, LTE 900, LTE 1800, LTE 2100, LTE 2300, LTE2600

The most difficult use case is the LTE 800 band that is very close to the 868MHz band. Actually, the end of the LTE 800 band is 862MHz whereas the beginning of the 868MHz band is 863MHz. Insuring -80dBm/100KHz at 862MHz while transmitting at 863MHz or even at 868MHz is not achievable with the state of the art of SAW filters. Therefore, the Wirnet iBTS gateway embeds specific SAW filters allowing the transmitter (LoRa-LOC module) to achieve the -80dBm/100KHz spurious limit in the LTE 800 band.

Co-localization is not possible with GSM850, UMTS850 and LTE850

Note 1:
In India, co-localization with CDMA800 / LTE 850 requires usage of a specific cavity filter.
See §1.8.3.1. Contact KERLINK for more information.

Note 2:
In Europe or South-Africa, if the 50dB isolation between antenna cannot be achieved, then a cavity filter is required (see § 1.8.3.2 and §1.8.3.3). Contact KERLINK for more information.

3.4.2 Wirnet iBTS 915

Co-localization is possible with the following BTS:
- GSM850, GSM1800, GSM1900
- UMTS850, UMTS1900, UMTS1700, UMTS2100
- LTE700, LTE850, LTE1700, LTE 1800, LTE1900, LTE2600

Co-localization is not possible with (E)GSM900, UMTS900 and LTE900.
In case of co-localization with GSM900, UMTS900 or LTE900, then the Wirnet iBTS 923 is a more suitable gateway. If Wirnet iBTS 915 want to be used when co-localized with GSM900, UMTS900 or LTE900, then a specific cavity filter is required. Contact KERLINK for more information.

Note:
In Philippines, co-localization with EGSM900 requires usage of a specific cavity filter (see §1.8.3.4). Contact KERLINK for more information.

3.4.3 Wirnet iBTS 64 Highway

Co-localization is possible with the following BTS:
- GSM850, GSM1800, GSM1900
- UMTS850, UMTS1900, UMTS1700, UMTS2100
- LTE700, LTE850, LTE1700, LTE 1800, LTE1900, LTE2600

Co-localization is not possible with (E)GSM900, UMTS900 and LTE900.

3.4.4 Wirnet iBTS 923

Co-localization is possible with the following BTS:
- GSM850, GSM900, GSM1800, GSM1900
- UMTS850, UMTS900, UMTS2100
- LTE700, LTE800, LTE850, LTE 900, LTE 1800, LTE 2100, LTE 2300, LTE2500, LTE2600

Co-localization is not possible with EGSM900, only GSM900.

Note 1:
In Singapore, Indonesia and Hong-Kong, co-localization with EGSM900 requires usage of a specific cavity filter. See §1.8.3.6. Contact KERLINK for more information.

Note 2:
In Malaysia co-localization with EGSM900 may require usage of a specific cavity filter (see §1.8.3.5). Contact KERLINK for more information.

Note 3:
In New-Zealand co-localization with GSM900 may require usage of a specific cavity filter in harsh environments (see §1.8.3.7). Contact KERLINK for more information.

4. Installation procedure

This device must 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.

4.1 How to open the enclosure

Before proceeding to the insertion of the USIM card and the connection of the power supply, the enclosure has to be opened.

Note: the lid of the enclosure must be kept opened during all the installation allowing setting and checking all the connections. It must be closed once the installation is completed.

4.1.1 Standard casing version

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 94: 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 95: Wirnet iBTS – 4x M5 screws

Remove the lid.

4.1.2 Compact casing version

Opening of the compact 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:

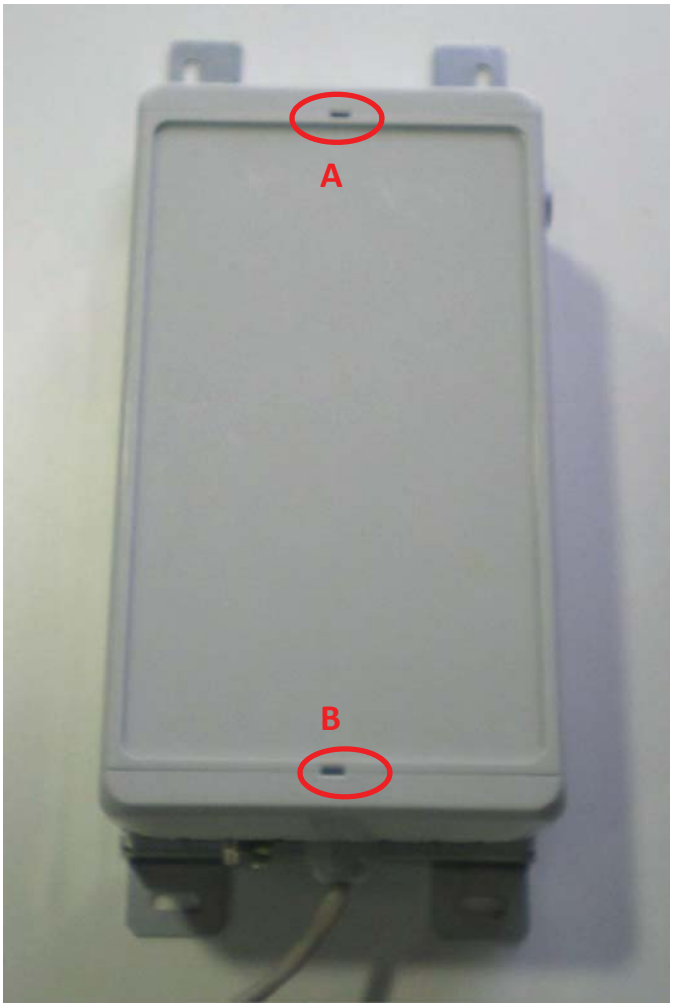


Figure 96 : Open points of the compact enclosure

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

Small flat-blade screw driver:
Example: 64-978 3x50 Stanley
Push the screw driver 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 screw driver:
Example: 65-098 5,5x100 Stanley
Push the screw driver into the slot, (it won't enter completely) and lift up in turning the screw driver into the slot (like to drive screws into the slot). Here you have to use more strength because the lever arm is smaller.

Figure 97 : Opening of the compact enclosure with screwdriver

4.2 Installation topology

4.2.1 Single Wirnet iBTS gateway installation

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

- LTE/HSPA/GPRS connection
- Ethernet connection

The LTE /HSPA/GPRS connection requires a USIM subscription.
The Ethernet connection requires an Ethernet access through a dedicated RJ45 cable.

Both configurations are detailed hereafter:

With USIM Subscription:

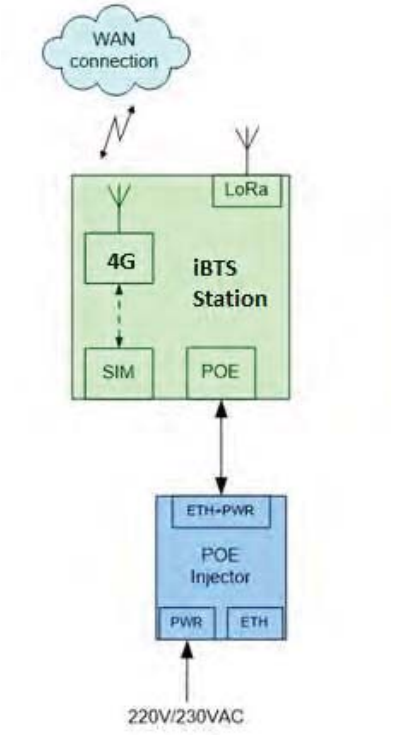


Figure 98 : Single station installation (with USIM)

Without USIM Subscription:

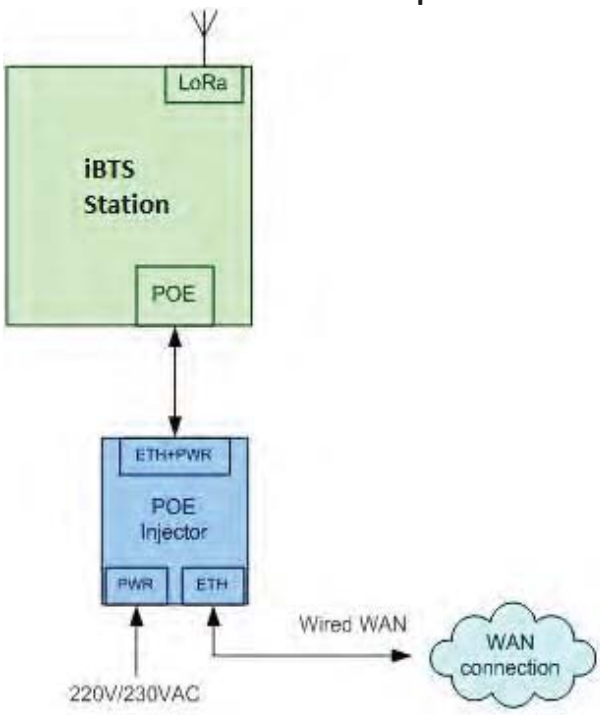


Figure 99 : Single station installation (No USIM)

4.2.2 Multi-Wirnet iBTS installation

In rare use cases, multiple Wirnet iBTS gateways can be installed on one site.
The recommended WAN connection is then Ethernet.
An Ethernet switch is used to interface all the gateways.

Note 1: the Ethernet switch is not provided by KERLINK

The configuration is detailed hereafter:

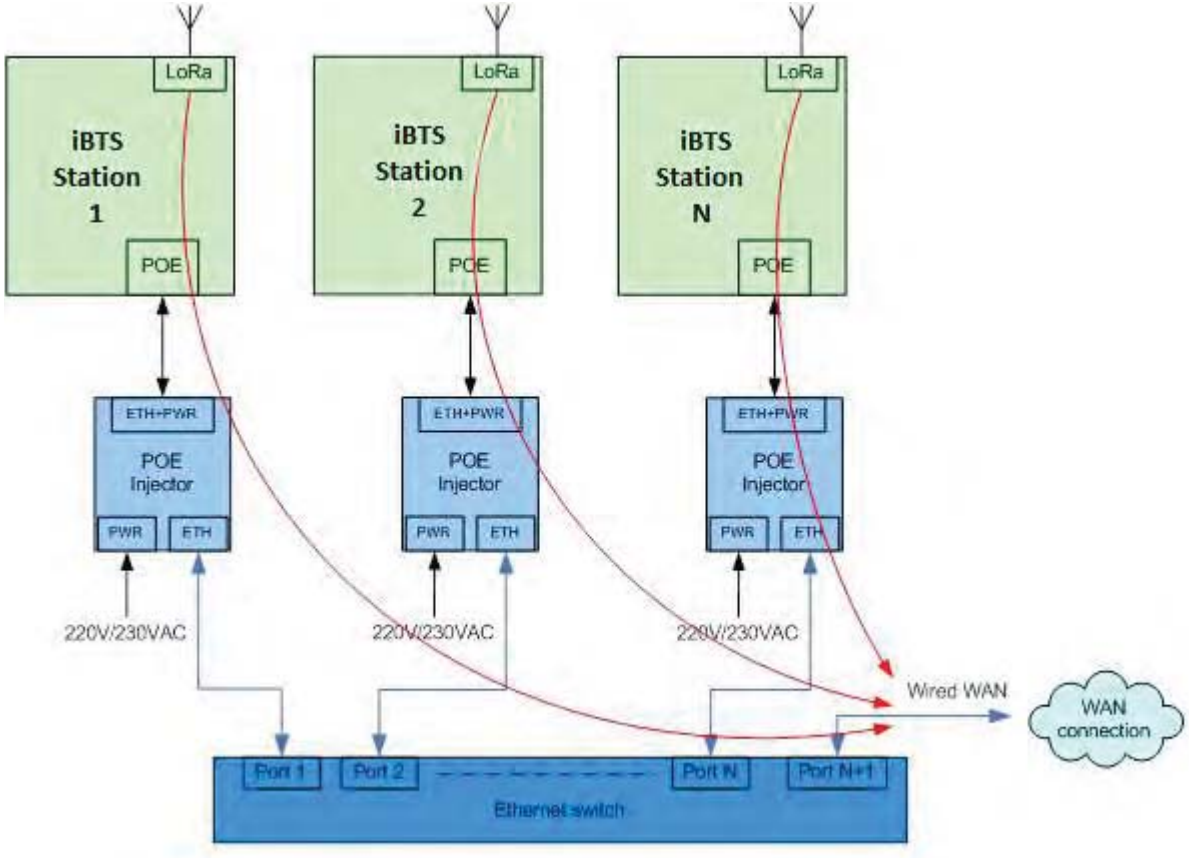


Figure 100 : Multi-station installation (No USIM)

Note 2: this configuration is no longer detailed in the present document

4.3 Electric distribution to the Wirnet iBTS

4.3.1 Safety

The installation must comply with EN 60728-11 (Cabled distribution systems standard - Security).
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, Wirnet iBTS mounting kit, antennas.

Note: none of the earthing cables required for the installation are provided by KERLINK.

A second key parameter for a secure installation is the lighting protection.
In its standard configuration, the Wirnet iBTS is provided with nominal internal surge protections. The Wirnet iBTS gateways are not warranted by KERLINK in case of deterioration due to lighting. Additional surge protections are recommended in harsh environments.
A lighting rod with a down conductor to earth is strongly recommended in most of the applications to avoid direct impacts on the aerials (antennas and Wirnet iBTS).
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.

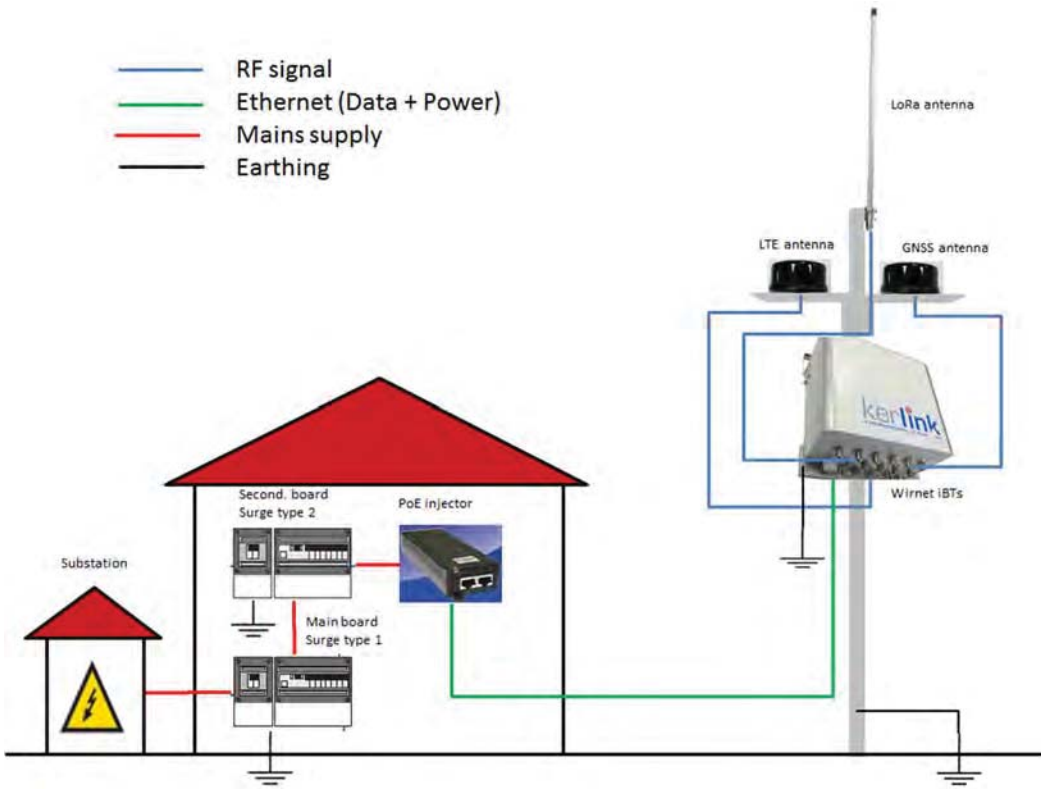


Figure 101 : Power distribution in the installation

4.3.2 Mains supply

The mains supply is not injected directly into the Wirnet iBTS but into the PoE injector.
The mains supply must 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.

Note: in case surge protections type 1 and 2 are not available, specific PoE injectors for outdoor applications are required (see § 4.3.3).

4.3.3 POE supply

The Wirnet iBTS gateway is supplied by a PoE injector through an Ethernet cable.
The PoE injectors are detailed in §1.6.1.1 and §1.6.1.3.
The recommended Ethernet cable is detailed in §1.8.4.1. 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.
Note 3: The PoE injectors are considered as limited power sources

The installation of the PoE cable is detailed in §4.6.3.

4.3.4 Auxiliary power supply

The Wirnet iBTS can be also supplied with an auxiliary DC power supply as a solar panel for instance. The input voltage range is 11 to 56VDC. A 24V DC solar system is then recommended for optimized performance.
The power supply must be qualified as a limited power source.
The maximum power is 30W.
The nominal current for a 24V power supply is about 1.2A in the following configuration:

- HSPA in a network attached mode
- 4 LoRa LOC modules / all demodulators activated
- 20% CPU load

A two-wires cable is required to interconnect the auxiliary power supply connector.
The installation of the cable is detailed in §4.6.5.

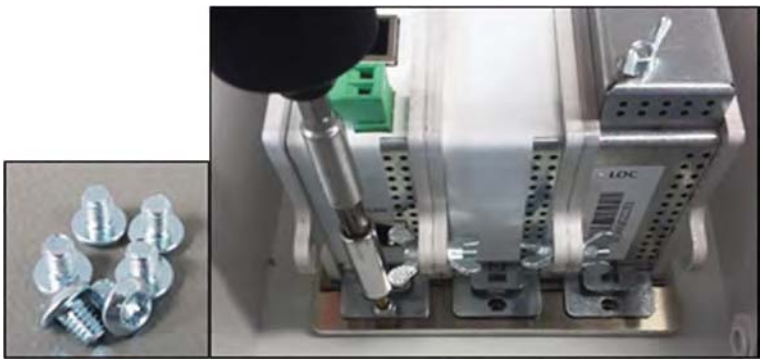
4.4 Inserting an additional module inside the enclosure

The Wirnet iBTS is provided with a single LoRa module in its default configuration.
Additional Lora modules can be added to fulfill the needs.
To add a LoRa module in the Wirnet iBTS enclosure, follow the procedure below:

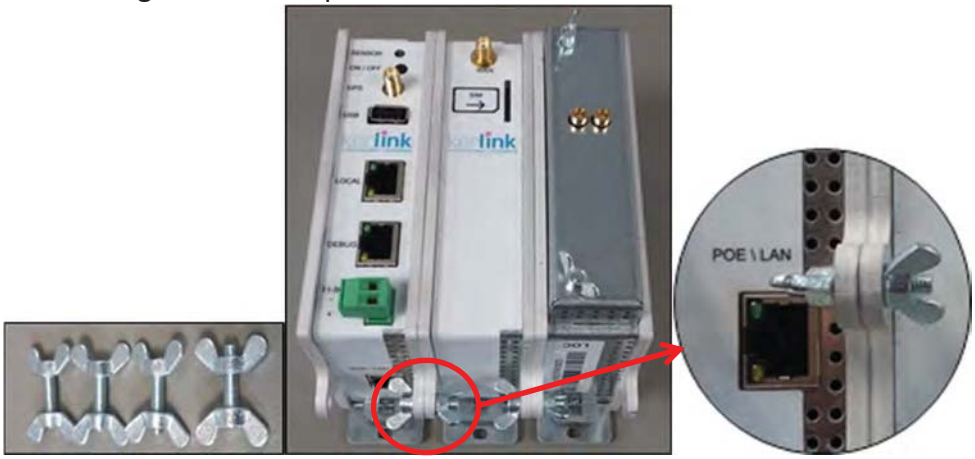
- Place thermal paste on the bottom side of the radiators.

- 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



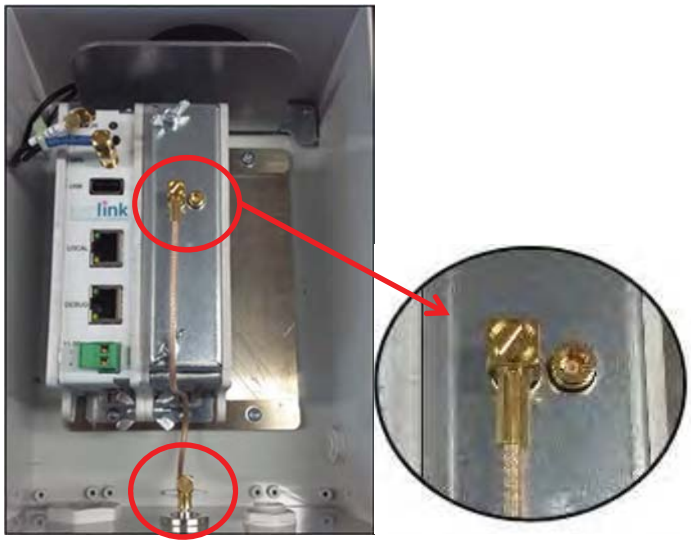
Note: to remove a LoRa module, use the same procedure.

Once the module is properly installed, then one or two N-SMB adapters are required for the antennas 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



4.5 Mounting of the enclosure

4.5.1 General considerations

The Wirnet iBTS enclosure must be mounted on any concrete pedestal, concrete wall or any non-flammable surface (UL94-V0).
It must not be mounted on a flammable surface.

The mounting kits delivered with the Wirnet iBTS stations allow fixing the product in different ways:

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

Two different mounting kits are available depending on the casing:

- One for the Standard casing
- One for the Compact casing

Universal antenna brackets or specific antenna brackets are provided with the LoRa antennas. Universal antenna brackets can be directly mounted on the Compact casing mounting kit.
Dome antenna brackets are provided with the LTE antennas and GNSS antennas.

All these several kits are detailed in the following paragraphs.

4.5.2 Antennas mountings kits

4.5.2.1 GPS, LTE and LoRa antenna considerations

The Wirnet iBTS integrates GPS, LTE and LoRa antennas. GPS and LTE antennas can be integrated inside the enclosure (compact casing) or are external to the enclosure (standard casing). The LoRa antennas are always external to the enclosure.
The position of these antennas, in an open environment, is important and could determine the overall performance of the Wirnet iBTS.

The GPS 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 antenna is 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 BTS in the area.
The benefits are less multipath fading and better data throughput.
The antenna is provided with a 5m coaxial cable. Extension coaxial cables of could be used to reach a better position but are not provided by KERLINK. However, beware of the insertion losses!

The LoRa antenna requires an open environment to optimize the link with the end-points.
The benefits are less multipath fading and optimized coverage area.
The antenna is provided with a 1m coaxial cable. Extension coaxial cables of could be used to reach a better position but are not provided by KERLINK. However, beware of the insertion losses!

4.5.2.2 Distance between antennas

4.5.2.2.1 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.
With the Wirnet iBTS standard casing, it is very simple to ensure the required distance between antennas because they have separated antenna brackets.
With the Wirnet iBTS compact casing, the separation between antennas is more complex as the LTE antenna is internal (cannot be moved apart) and the LoRa antenna could be mounted on the universal antenna bracket tightened to the compact casing mounting kit.
To optimize the colocation between the internal LTE antenna and the external LoRa antenna, a distance of 20 cm is required between both radiated parts.
Therefore, when possible we strongly recommend dissociating the universal antenna bracket away from the compact 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 must be placed on the right side of the enclosure as described on Figure 102.

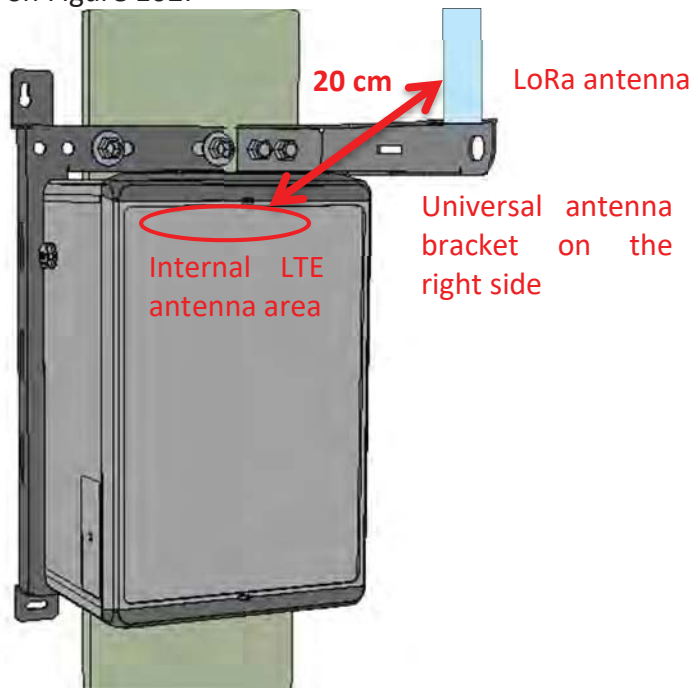


Figure 102 : Position of the universal antenna support when mounted on the compact enclosure support

4.5.2.2.2 LoRa space diversity

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 must be the half wave length i.e.:
  - 18 cm at 868MHz
  - 17 cm at 915MHz
- To have uncorrelated antennas it is better to have a minimum distance of 13*λ/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 compact casing 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=52cm which is close to the optimum distance listed above.

4.5.2.3 Universal antenna bracket

The universal antenna bracket is used with the following antennas:

- 868MHz, 3dBi omnidirectional (see §1.8.1.1).
- 915MHz, 3dBi omnidirectional (see §1.8.1.3).
- 915MHz, 6dBi omnidirectional, except FT-RF antenna (see §1.8.1.4).

The universal antenna bracket is detailed in §1.8.6.2.

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 compact casing 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.

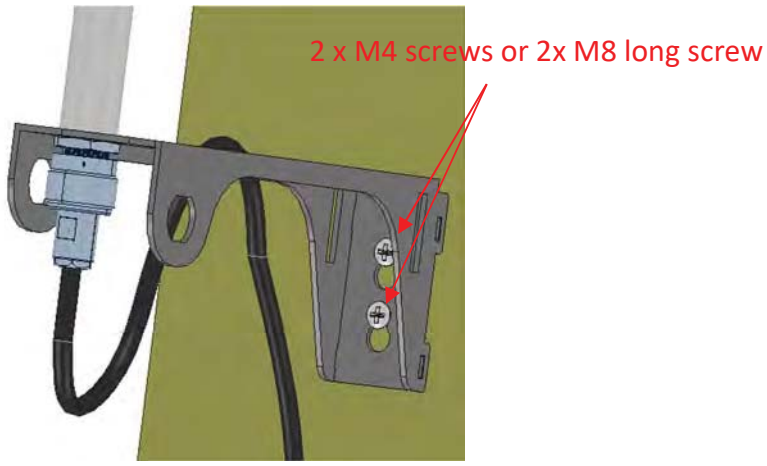


Figure 103 : Wall mount of the universal antenna bracket

Figure 104 : Pole mounting of the universal antenna bracket using strapping

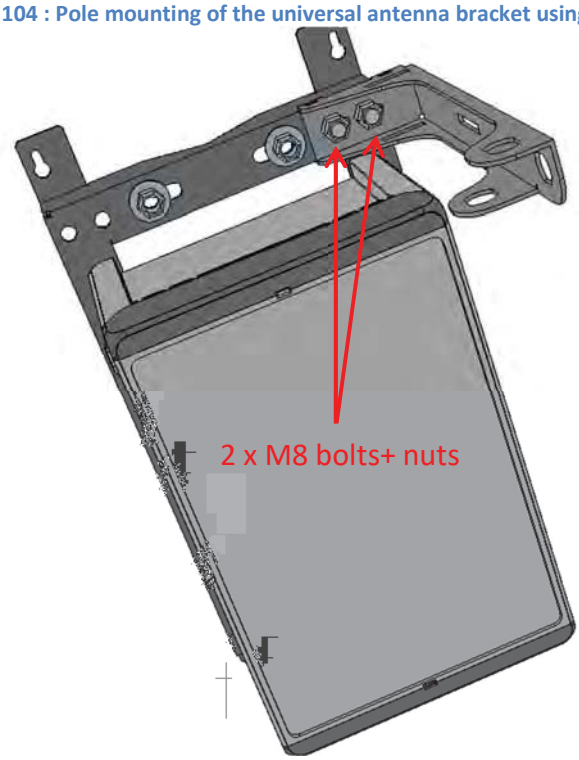


Figure 105 : Universal antenna bracket with compact casing mounting kit

Note 1: the M4 screws, 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 106 : LoRa antenna mounted on universal antenna bracket

Note 3: The LoRa 915MHz/ 6dBi omnidirectional antenna from FT-RF with its own mounting kit based on two U-bolts for pole mount. The pole must have a maximum diameter of 50mm. This antenna cannot be installed on the universal antenna bracket.

4.5.2.4 Dome antenna bracket

The dome antenna bracket is used for the following antennas:

- GNSS antenna (see §1.8.2.1)
- LTE antenna (see §1.8.2.2)

The dome antenna bracket is detailed in §1.8.6.3.

The dome antenna bracket has a single hole dedicated to the LTE and / or GPS 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: alternate option is to use the “notched V shaped plate and a U-bolt” as detailed in §1.8.6.1. The maximum diameter of the pole is 60mm.

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, the metallic strapping are not provided by KERLINK.
Note 2: the cables ties are not provided by KERLINK.
Note 3: the notched V shaped plate and a U-bolt can be provided by KERLINK as accessories (see §6).

Once the dome antenna bracket is installed, then the GPS antenna, or LTE, or GPS/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 must be no aperture between the antenna casing and the gasket.
- Screw the M22 nut

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

Figure 107 : N connector introduced in the hole of the dome antenna bracket

Figure 108 : Antenna installed on the dome antenna bracket

4.5.3 Mounting of the compact enclosure

4.5.3.1 Compact casing mounting kit

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

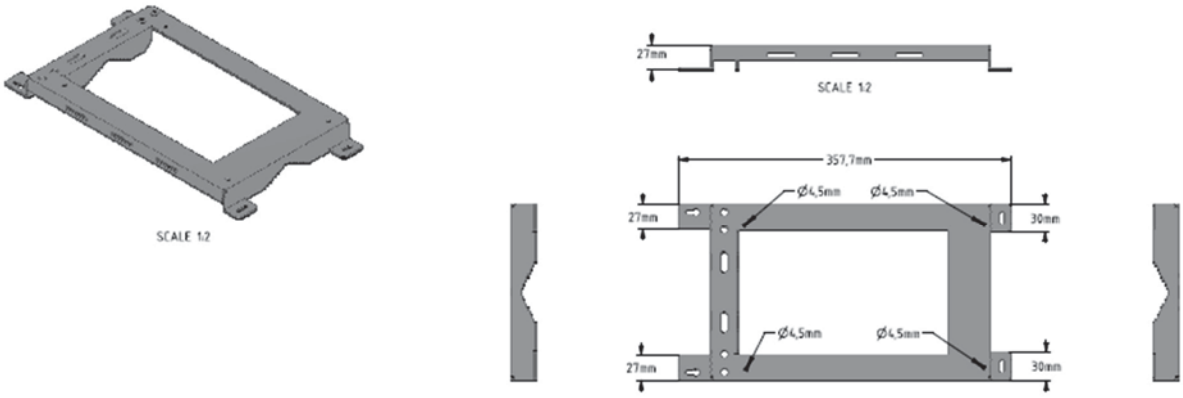


Figure 109 : Compact casing mounting kit dimensions

The Wirnet iBTS Compact is delivered with the compact casing mounting kit already installed on the back.

4.5.3.2 Wall mounting

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

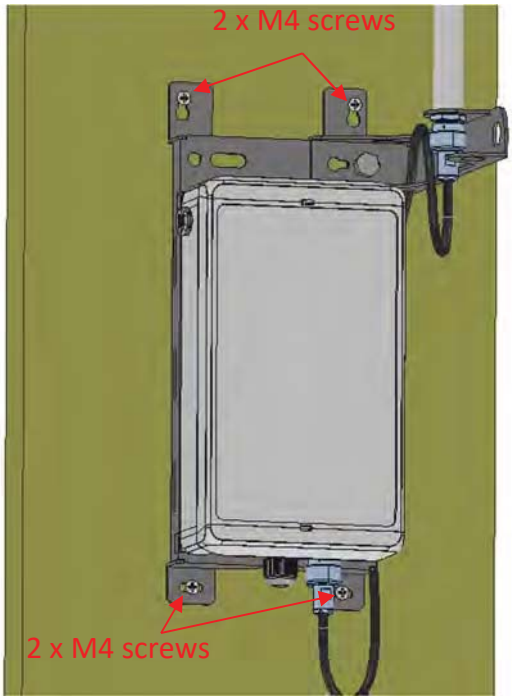


Figure 110 : Compact casing - Wall mount

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

For safety reason, the metallic mounting kit must own a good earth connection. This is ensured by adding an earth connection through the M8 bolt and nut (see §4.6.1.2).

4.5.3.3 Pole mounting by U-bolt

The Wirnet iBTS 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.

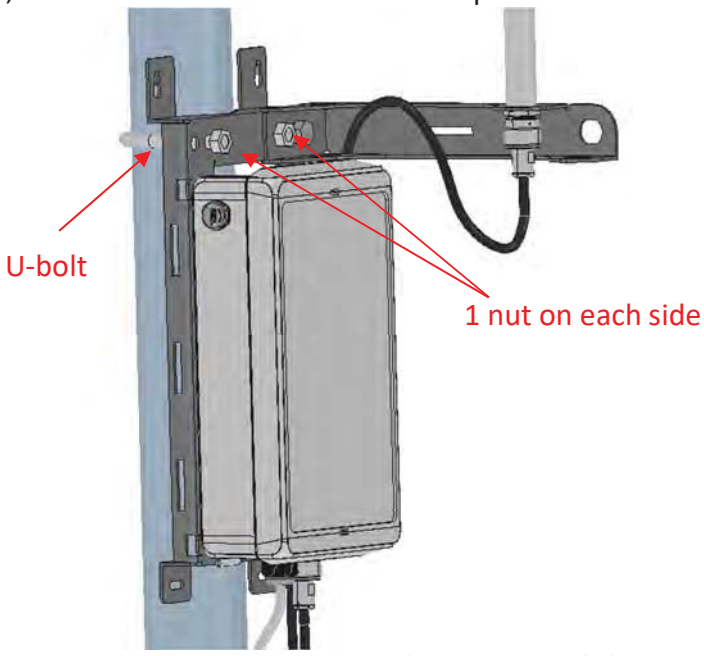


Figure 111 : Compact casing - Pole mount using U-bolt

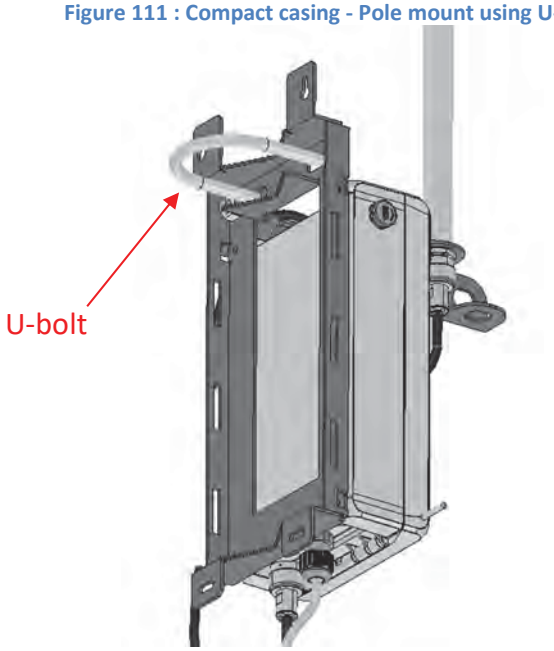


Figure 112 : Compact casing - rear view of the pole mounting using U-bolt (no pole represented)

For safety reason, the metallic mounting kit must own a good earth connection. This is ensured by adding an earth connection on the U bolt nut or the M8 nut (see §4.6.1.2).

4.5.3.4 Metallic strapping mounting

The Wirnet iBTS 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:

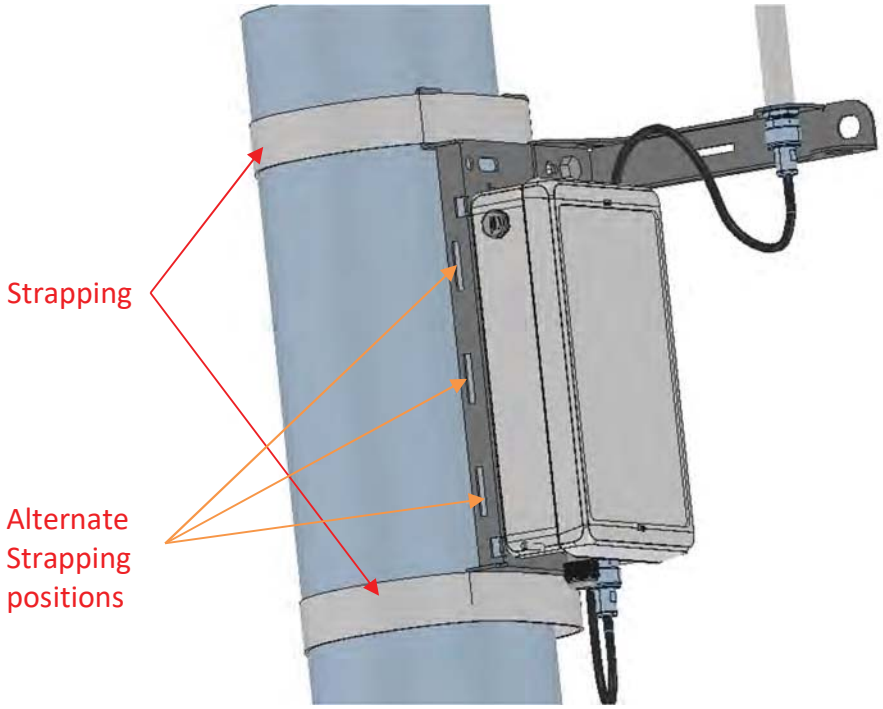


Figure 113 : Compact casing - Pole mount using strapping

For safety reason, the metallic mounting kit must own a good earth connection. This is ensured by adding an earth connection on the M8 nut (see §4.6.1.2).

4.5.4 Mounting of the standard enclosure

4.5.4.1 Standard casing mounting kit

The standard casing mounting kit is composed of two identical parts as shown below:

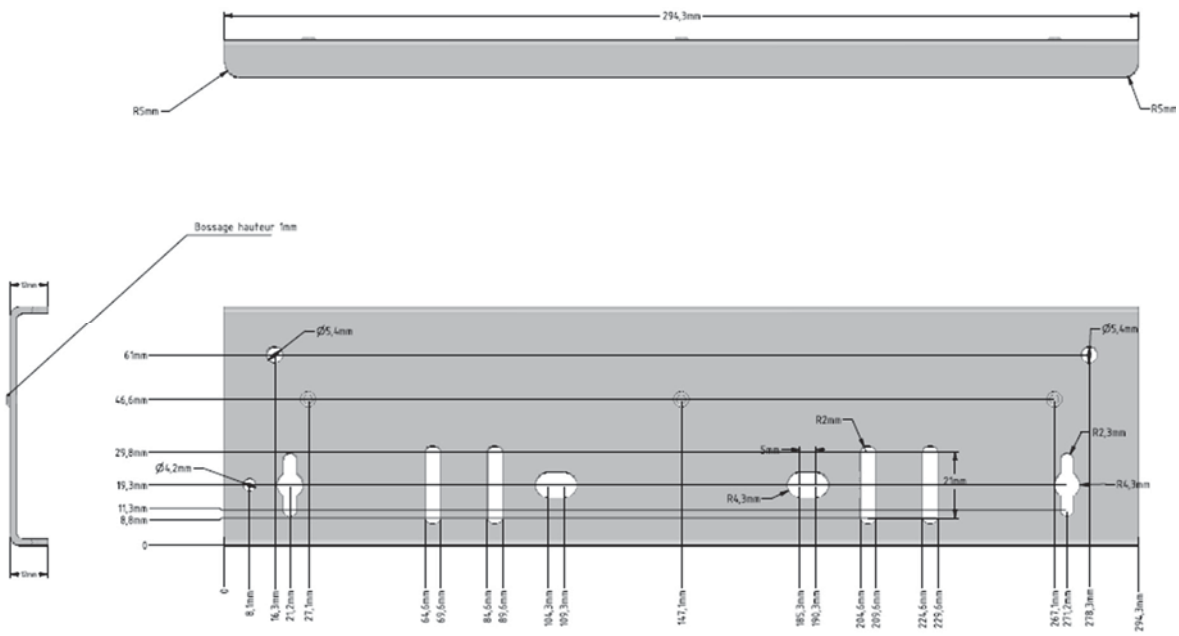


Figure 114 : Standard casing mounting kit dimensions

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 §4.6.1.1).

The Wirnet iBTS is delivered with the standard casing mounting kit already installed on the rear side:

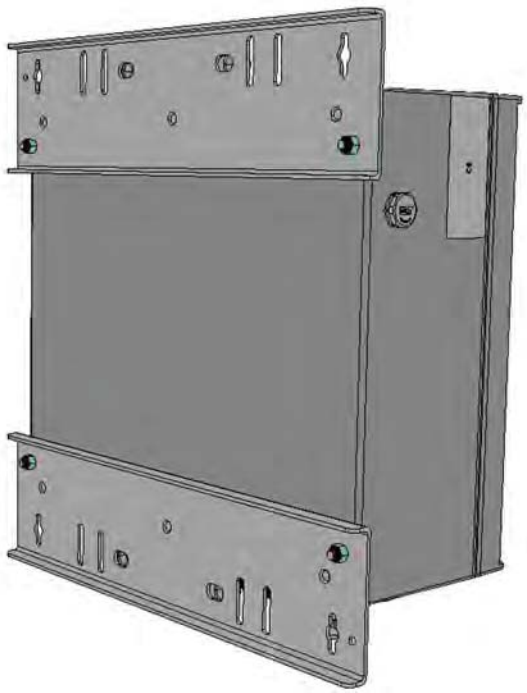


Figure 115 : Rear view of the standard casing with mounting kit

4.5.4.2 Wall mounting

The Wirnet iBTS can be also mounted on a wall with 4 x M4 screws.
Note: M4 screws are not delivered with the mounting kit.

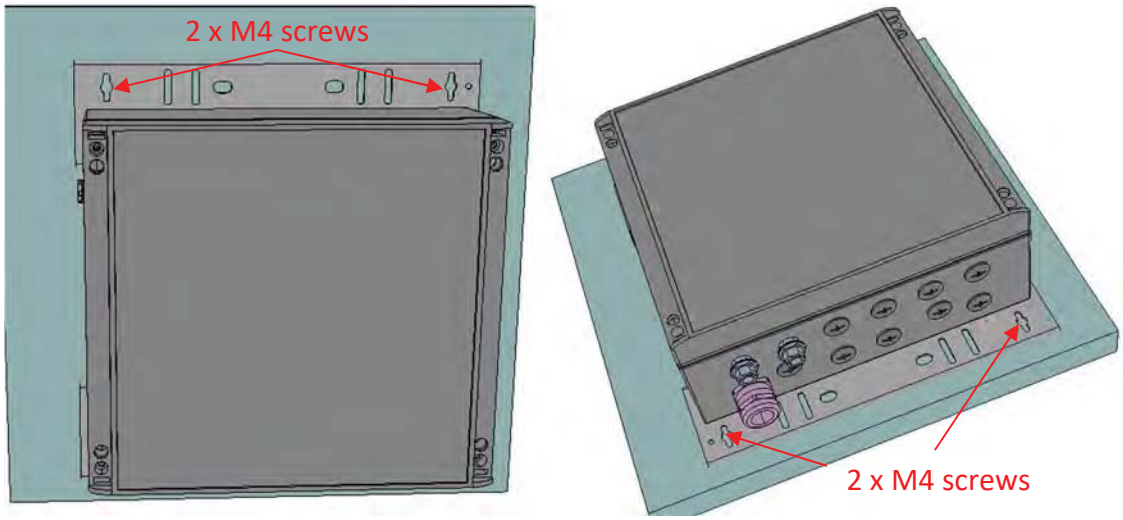


Figure 116 : Compact casing - Wall mount

For safety reason, the metallic mounting kit must own a good earth connection. This is ensured by adding an earth connection on the dedicated hole (see §4.6.1.1).

4.5.4.3 Pole mounting by U-bolt

The Wirnet iBTS 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.

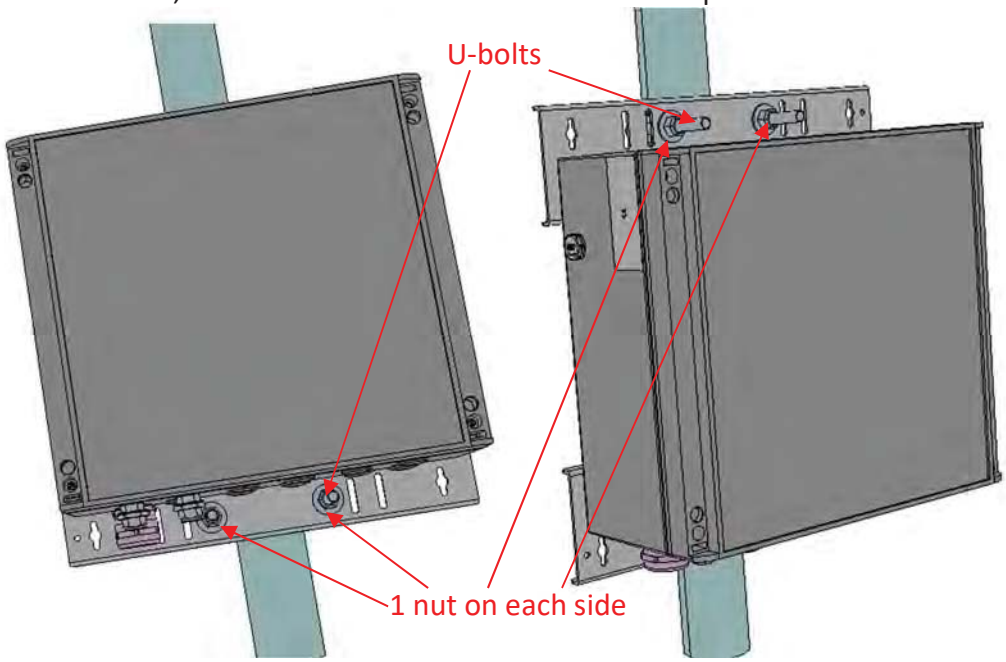


Figure 117 : Standard casing - Pole mount using U-bolts

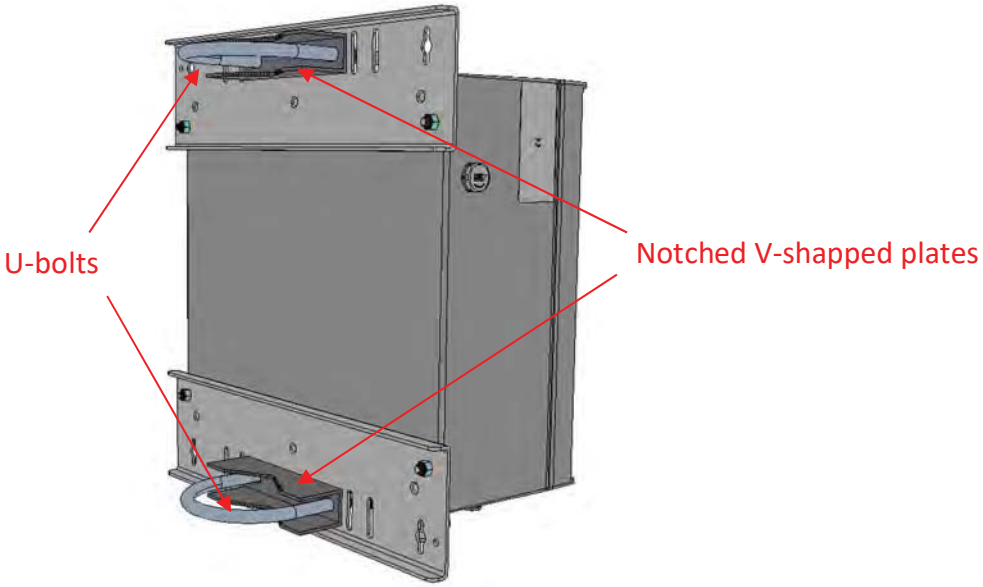


Figure 118 : Compact casing - rear view of the pole mounting using U-bolt (no pole represented)

For safety reason, the metallic mounting kit must own a good earth connection. This is ensured by adding an earth connection on the dedicated hole (see §4.6.1.1).

4.5.4.4 Metallic strapping mounting

The Wirnet iBTS 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:

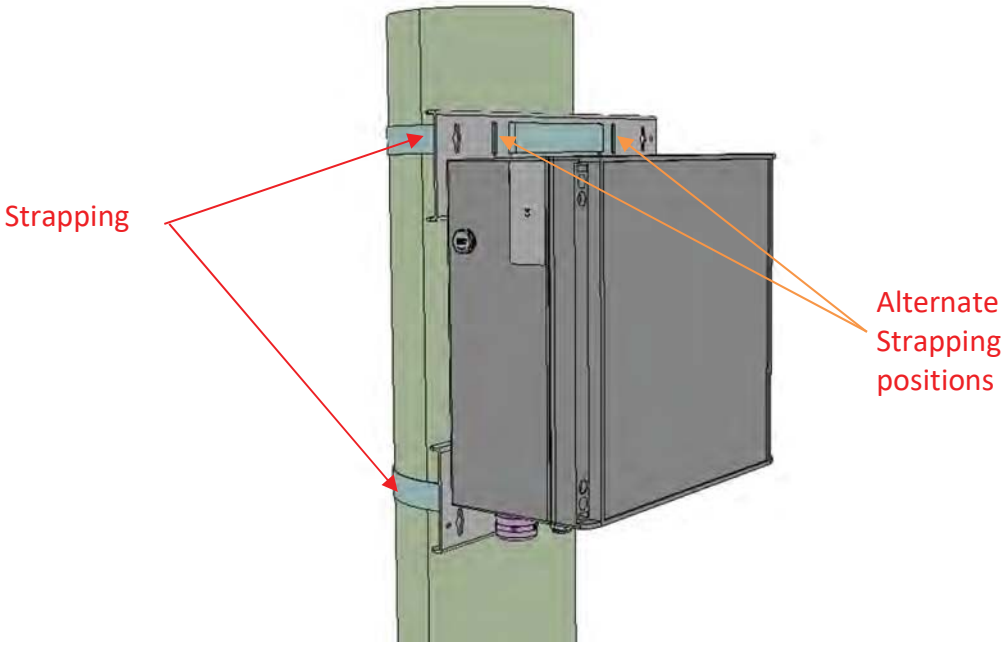


Figure 119 : Standard casing - Pole mount using strapping

For safety reason, the metallic mounting kit must own a good earth connection. This is ensured by adding an earth connection on the dedicated hole (see §4.6.1.1).

4.5.5 Mounting of the accessories

4.5.5.1 Indoor PoE injectors

Both indoor PoE injectors described in §1.6.1 can be wall mounted with 2 x M3 screws.

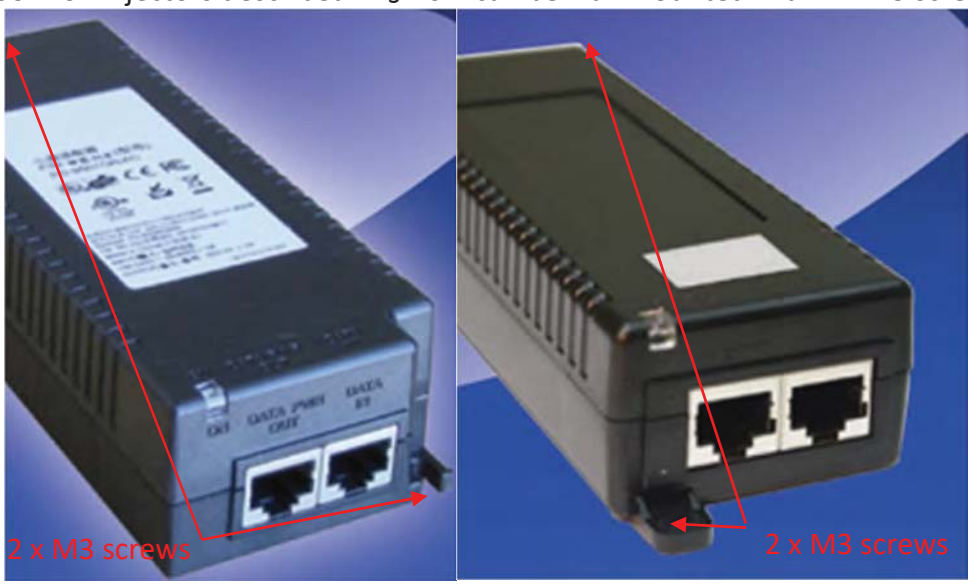


Figure 120 : Screws for indoor POE injectors mounting

4.5.5.2 Outdoor PoE injectors

Both outdoor PoE injectors described in §1.6.1 can be wall mounted using 3 x M3 screws (positions 1, 2 and 3 below):

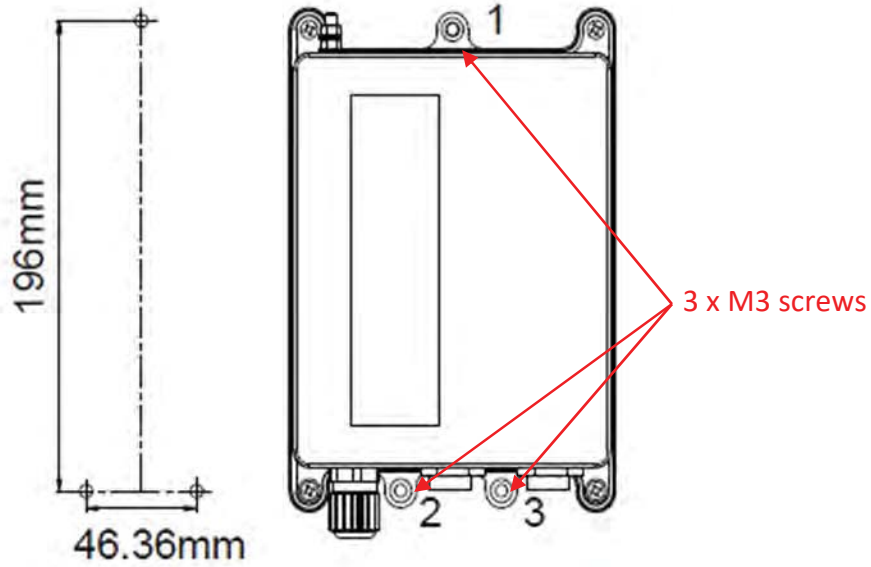


Figure 121 : Screws for outdoor POE injectors mounting

A mounting bracket kit is also available:

Figure 122 : Mounting bracket for outdoor POE injectors

4.5.5.3 Indoor Ethernet surge protection

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

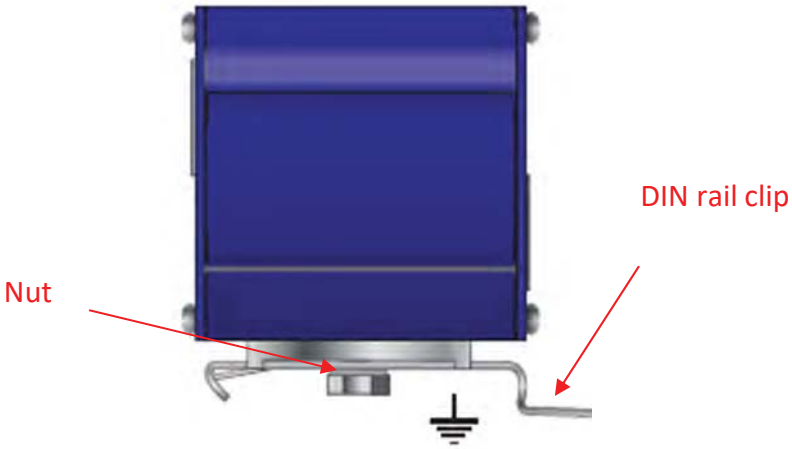


Figure 123 : Indoor Ethernet surge protection – DIN rail clip

4.5.5.4 Outdoor Ethernet surge protection

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

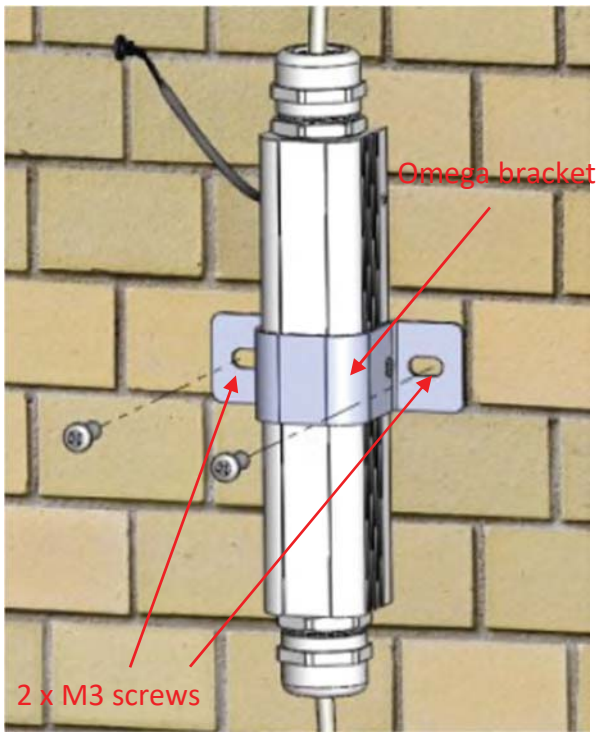


Figure 124 : Outdoor Ethernet Surge protection – wall mounting

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:

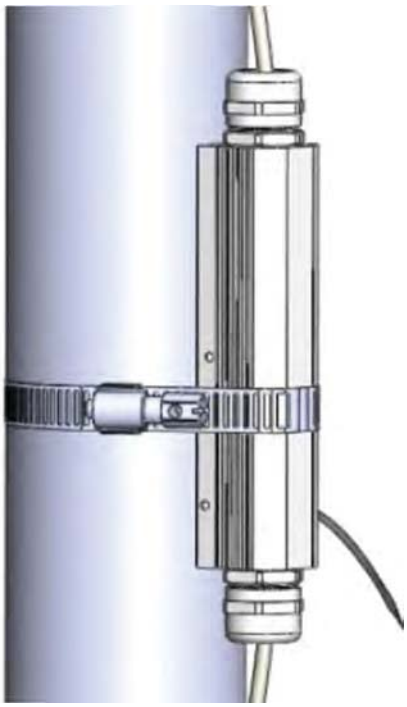


Figure 125 : Outdoor Ethernet Surge protection – pole mounting with strapping

4.5.5.5 RF coaxial surge protections

The RF coaxial surge protections are directly mounted (screwed) on the N connectors of the antennas or of the Wirnet iBTS.

4.5.5.6 Cavity filters

The cavity filters are directly mounted (screwed) on the N connectors of the LoRa antennas or of the Wirnet iBTS.
Some of them can also be wall mounted with 4 x M4 x 8 mm screws as detailed in Figure 51 and Figure 61.

4.6 Setting connections

Before setting all connections, ensure that the POE injector is not connected to the mains supply.
The following pictures details all the Wirnet iBTS required connections, including power supply cables, data cables, RF coaxial cables and earthing connections:

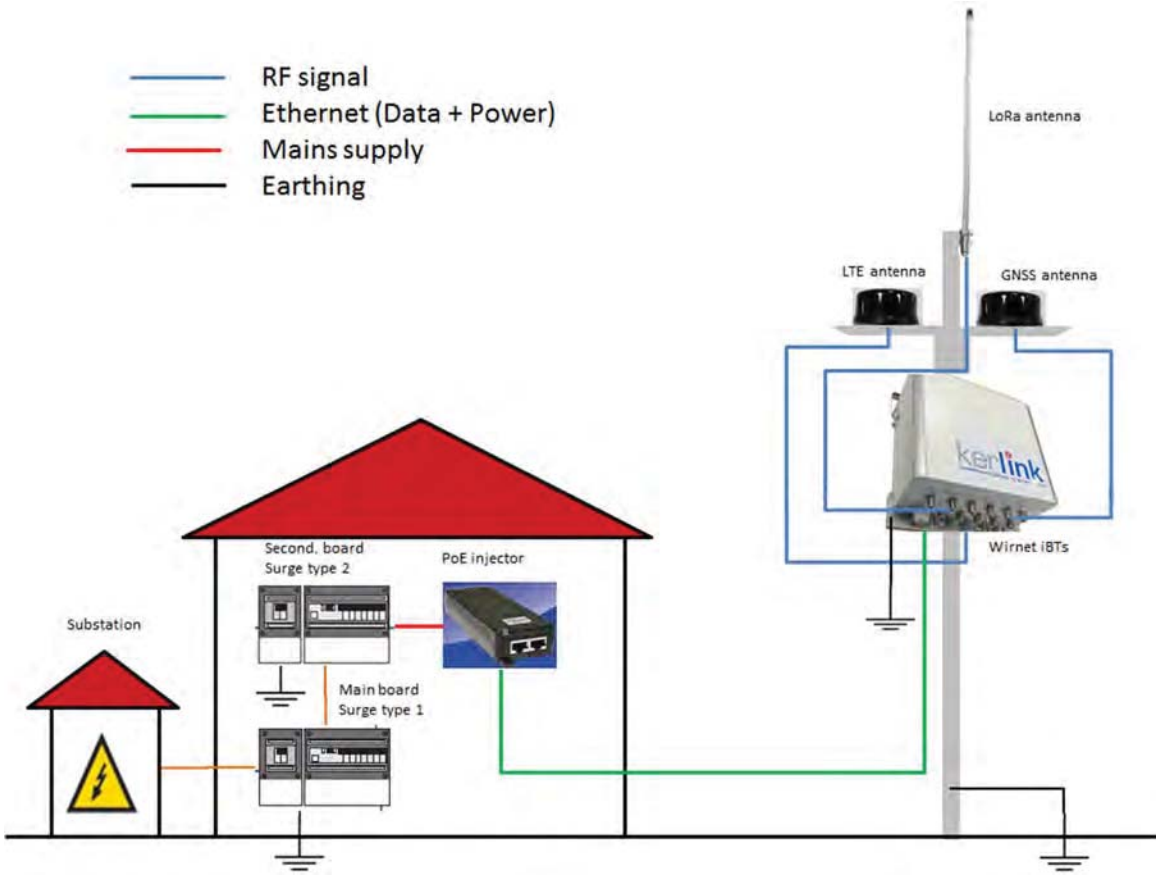


Figure 126 : connection settings of the installation

4.6.1 Earthing

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

- Earthing of the Wirnet iBTS mounting kit
- Earthing of the RF coaxial surge protection
- Earthing of the Ethernet surge protection
- Earthing of the outdoor PoE injector

A M8 ring tongue terminal is provided for earthing of the Wirnet iBTS mounting kit.
The earthing cables characteristics are detailed in §1.8.4.2.

Note: the earthing cables are not provided by KERLINK.

4.6.1.1 Earthing of the Wirnet iBTS mounting kit

Earthing of the standard casing mounting kit is completed through the 2 holes dedicated to the M8 U Bolt used for pole mount. The earthing symbol ⏚ 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:

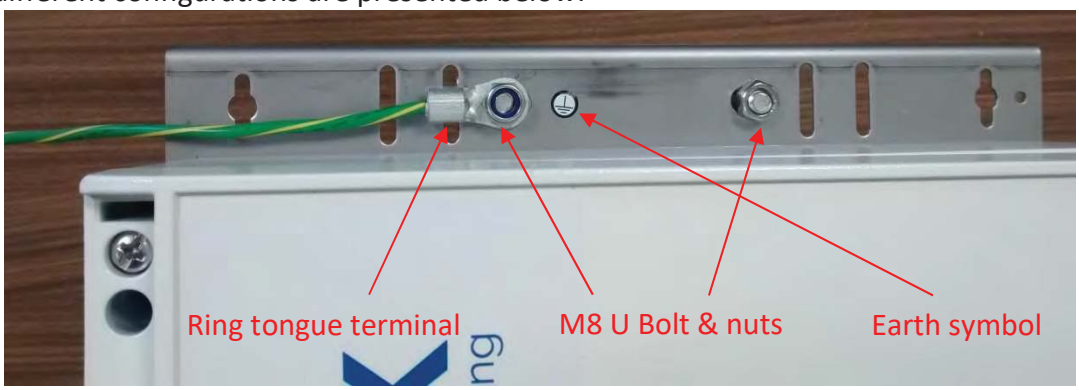


Figure 127 : Standard casing – earthing with U bolt configuration

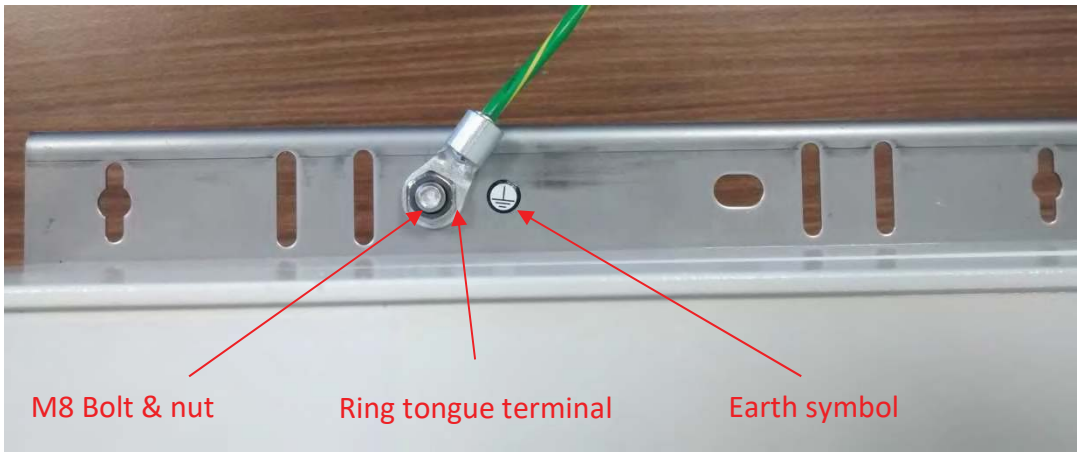


Figure 128 : Standard casing – earthing without U bolt configuration

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 lighting 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 §1.8.4.2.
Note 3: use a crimping tool to crimp the ring tongue terminal with earthing cable.

4.6.1.2 Earthing of the Wirnet iBTS Compact mounting kit

Earthing of the compact casing mounting kit is completed through the holes dedicated to the M8 U Bolt used for pole mount or the holes dedicated to the universal antenna bracket. The earthing symbol ⏚ 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:

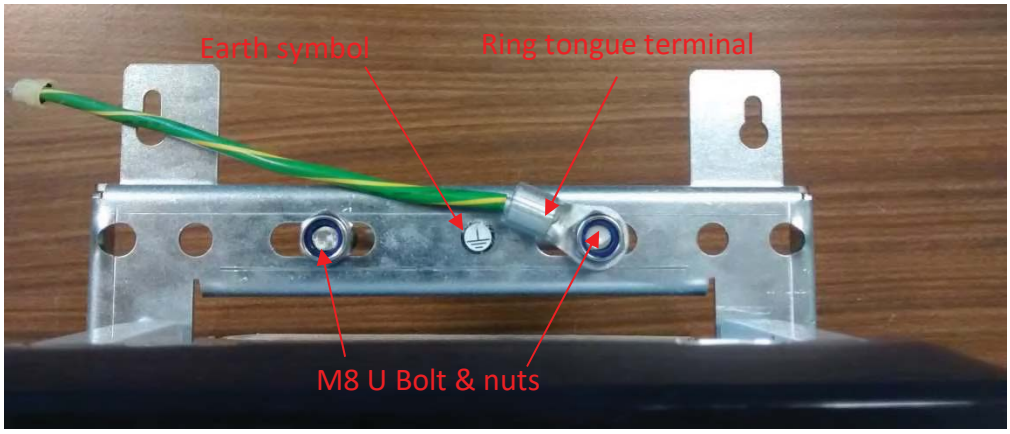


Figure 129 : Compact casing – earthing with U bolt configuration

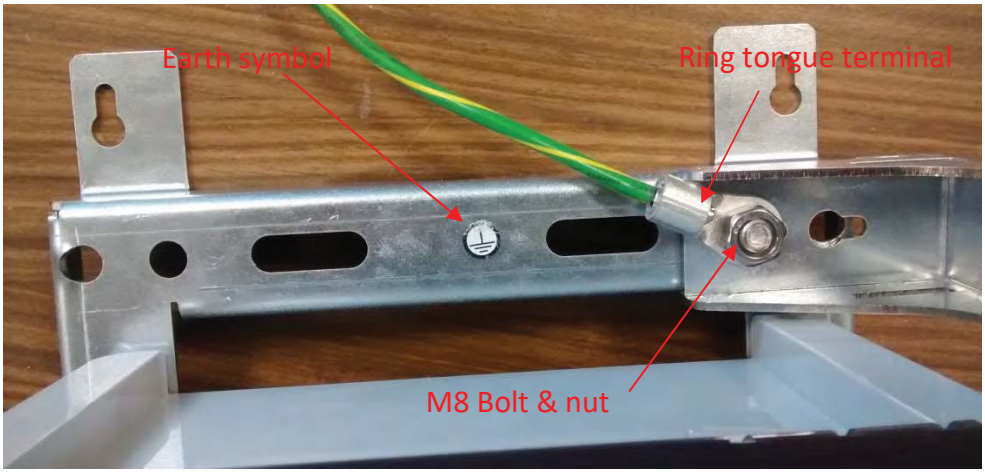


Figure 130 : Compact casing – earthing without U bolt configuration

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 lighting 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 §1.8.4.2.
Note 3: use a crimping tool to crimp the ring tongue terminal with earthing cable.

4.6.1.3 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 must be crimped inside this ring tongue terminal.
A specific crimping tool is required to perform the operation.

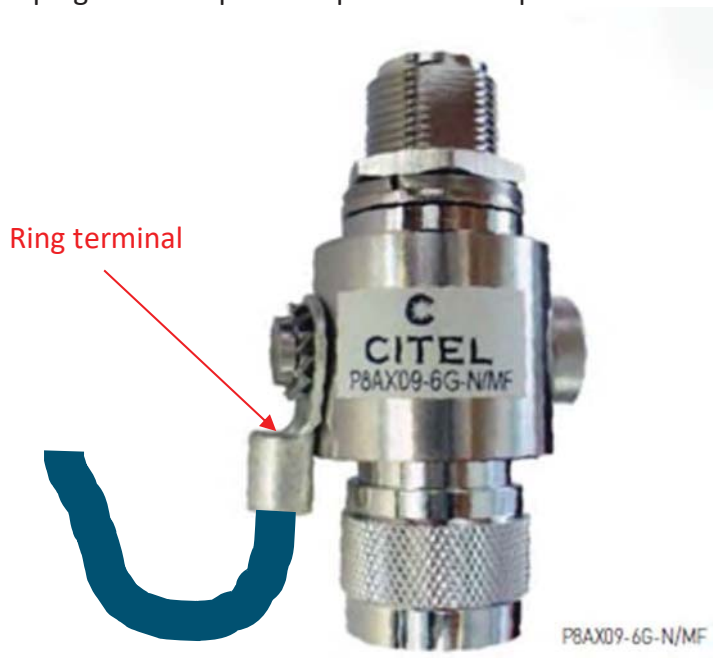


Figure 131 : Earthing of the RF coaxial surge protection

Note 1: the earthing cable is not provided by KERLINK
Note 2: the earthing cable characteristics are detailed in §1.8.4.2.
Note 3: use a crimping tool to crimp the ring tongue terminal with earthing cable.

4.6.1.4 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 theough a ring tongue terminal.
An example of cabling is described on §1.8.5.2.

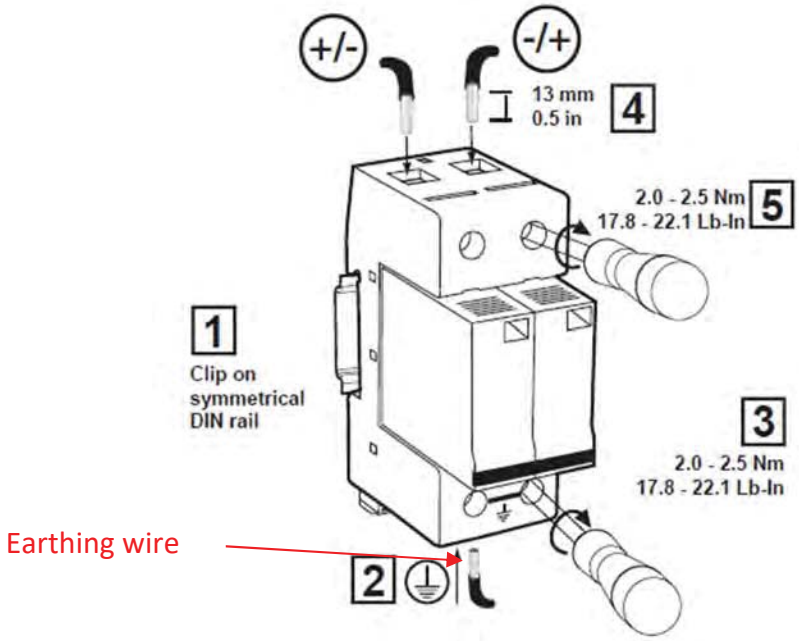


Figure 132 : Earthing of the RF coaxial surge protection

Note 1: the earthing cable is not provided by KERLINK
Note 2: the earthing cable characteristics are detailed in §1.8.4.2.

4.6.1.5 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.

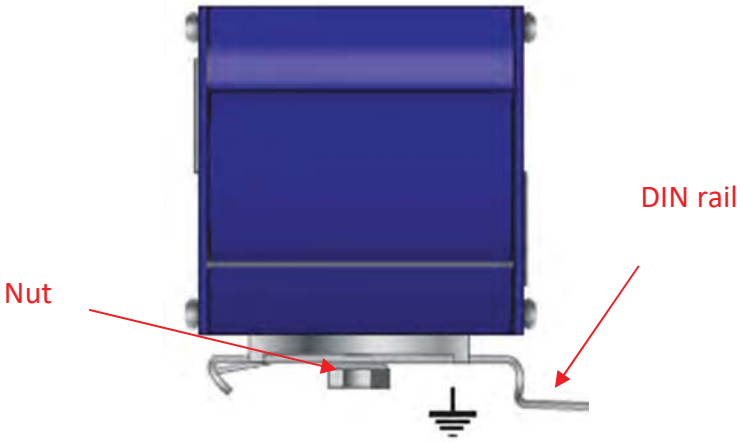


Figure 133 : Earthing of the indoor Ethernet surge protection

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 must be crimped inside this ring terminal.

A specific crimping tool is required to perform the operation.

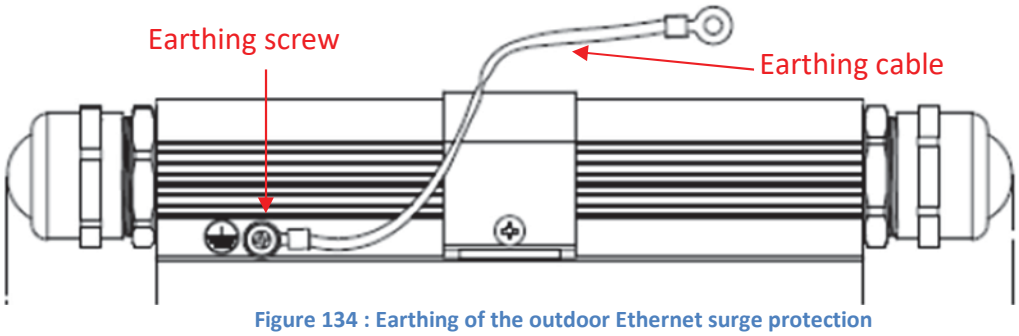


Figure 134 : Earthing of the outdoor Ethernet surge protection

Note 1: the earthing cables are not provided by KERLINK
Note 2: the earthing cables characteristics are detailed in §1.8.4.2.

4.6.1.6 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 must be crimped inside this ring terminal.
The ring terminal is inserted between the two nuts as follows:

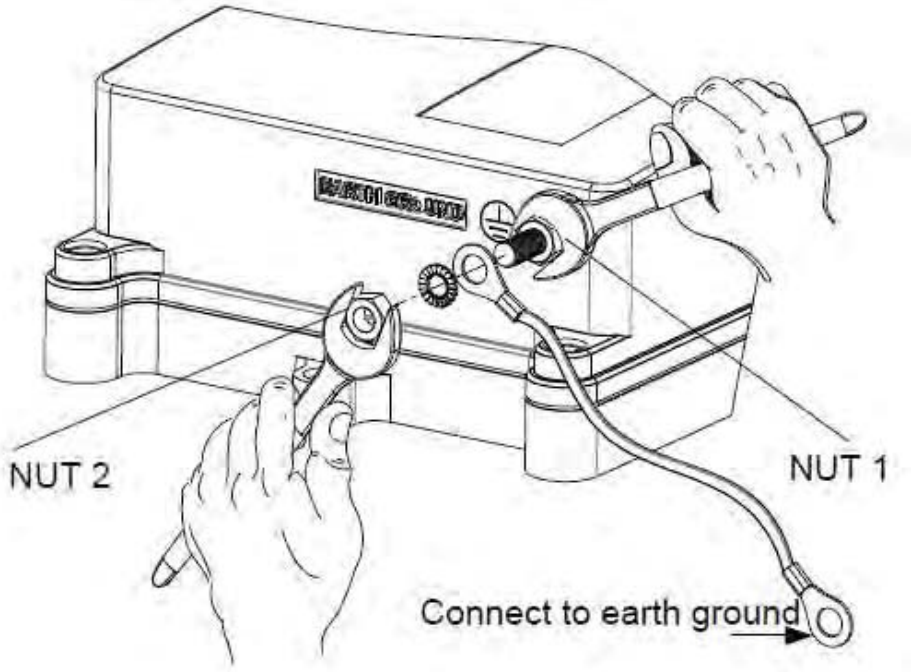


Figure 135 : Earthing of the outdoor PoE injector

Note 1: the earthing cables are not provided by KERLINK
Note 2: the earthing cables characteristics are detailed in §1.8.4.2.

4.6.2 RF antennas

RF antennas (GNSS, LTE and LoRa) are connected to the Wirnet iBTS through the N connectors on the bottom side of the enclosure.
In its default configuration, the standard casing 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 must 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:

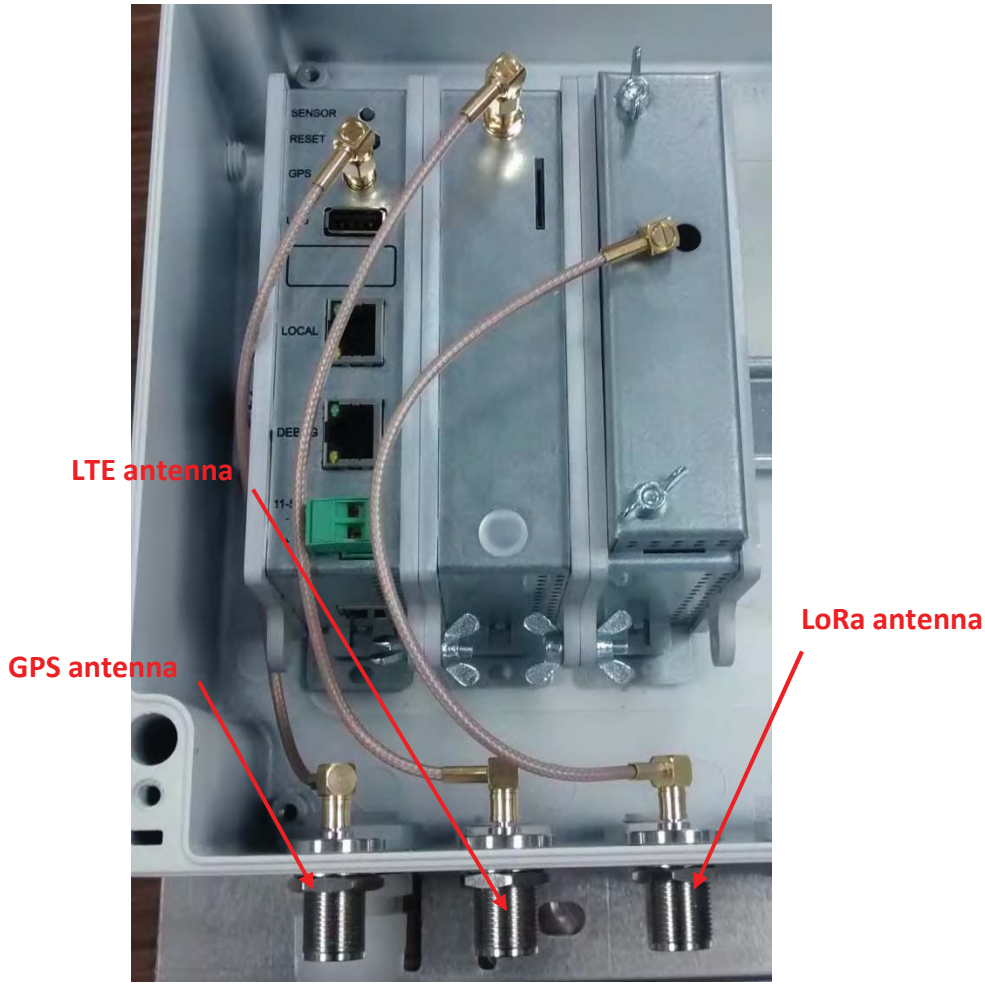


Figure 136 : nominal configuration of N connectors - standard casing

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 §4.4).
In order, to facilitate the installation, KERLINK recommends the following allocation of the M16 blind stops for the additional N-SMB connectors:

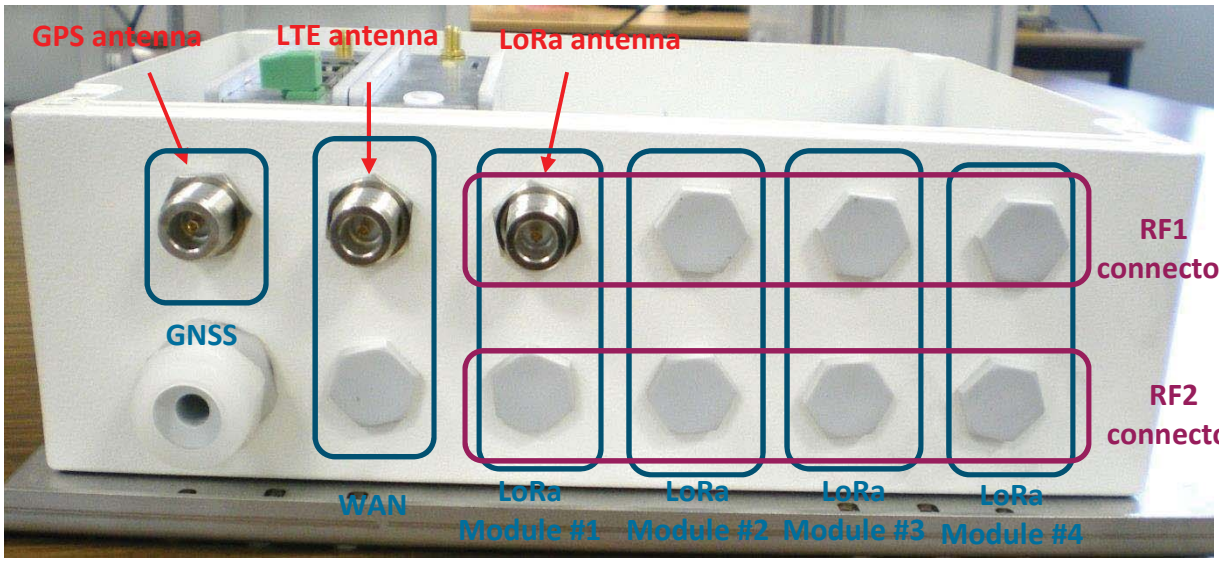


Figure 137 : Recommended allocation of the N connectors – Standard casing

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 must 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 compact casing features only one N-SMB adapters used as RF interfaces for the LoRa antenna:

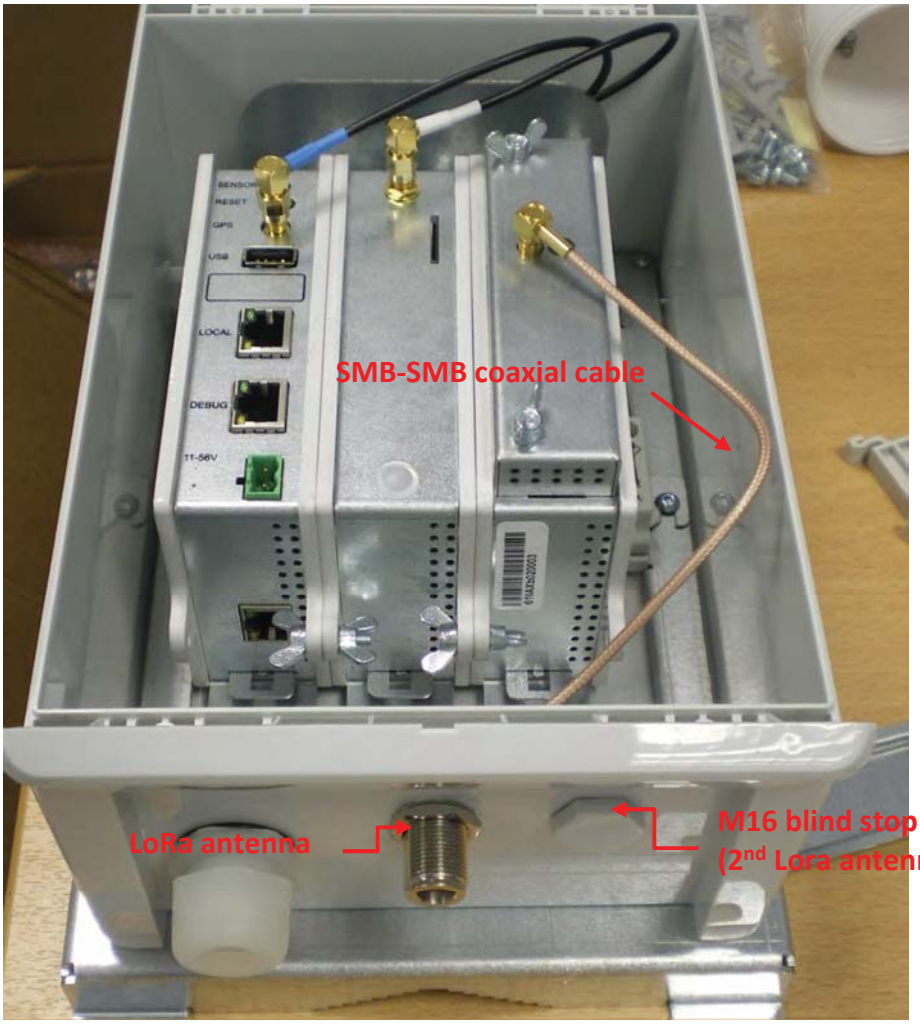


Figure 138 : Nominal configuration of N connectors - compact casing

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.

4.6.2.1 GNSS antenna

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

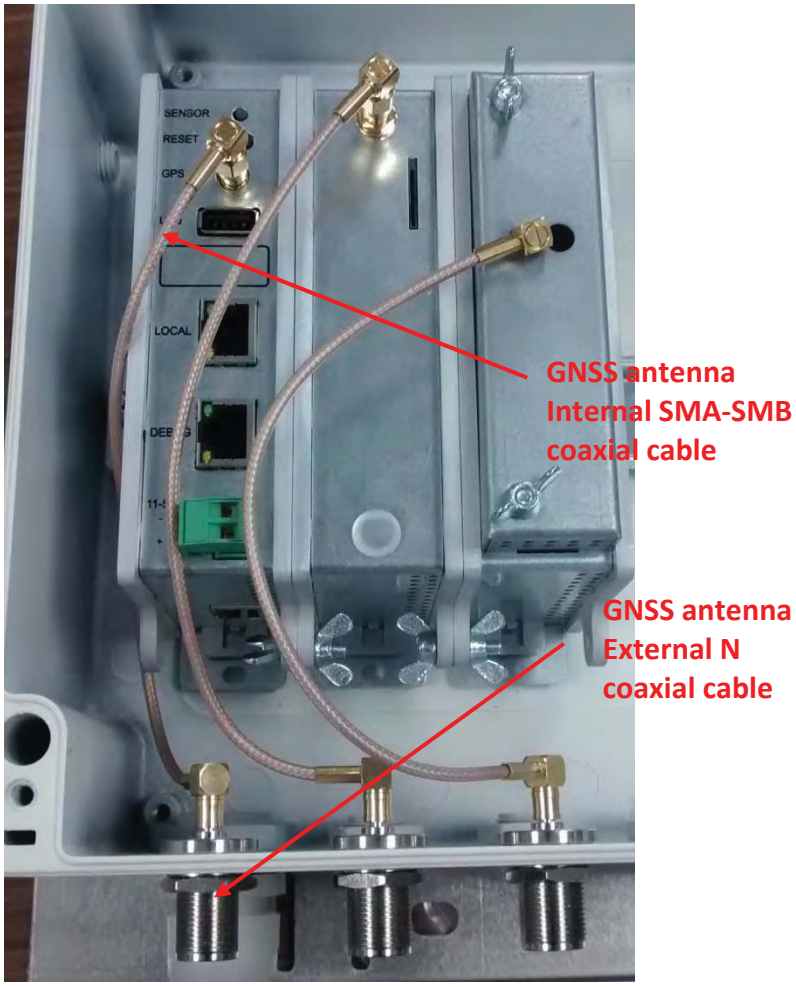


Figure 139 : GNSS antenna cabling, internal and external

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

4.6.2.2 LTE antenna

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

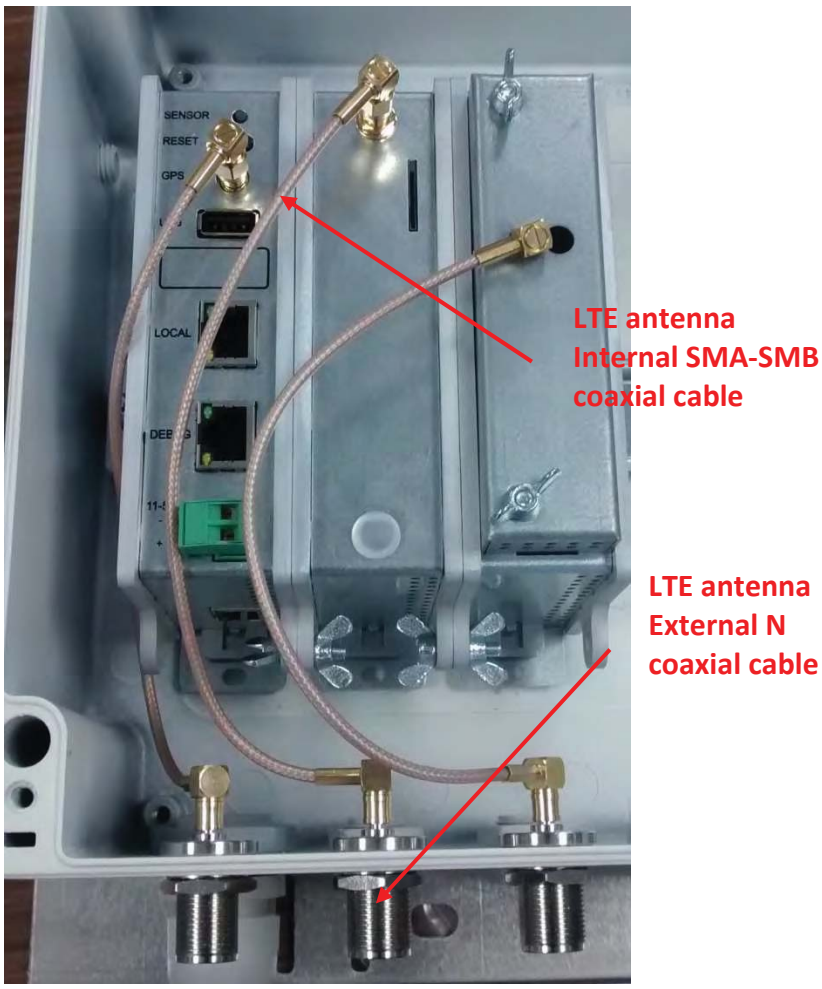


Figure 140 : LTE antenna cabling, internal and external

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

4.6.2.3 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:

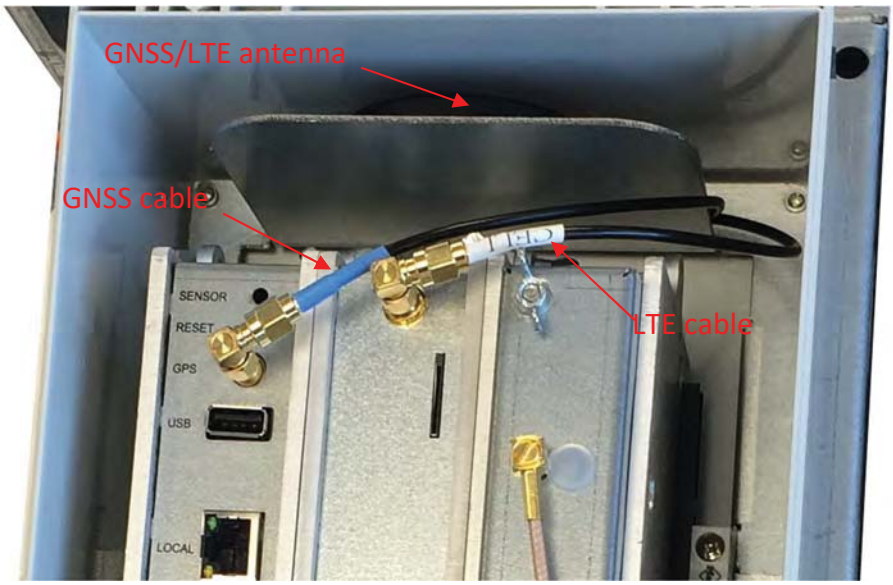


Figure 141 : GPS and LTE cabling within Wirnet iBTS Compact

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.

4.6.2.4 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 must 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 LTEantenna is well mounted on the SMA connector and properly screwed on the module, as described below:

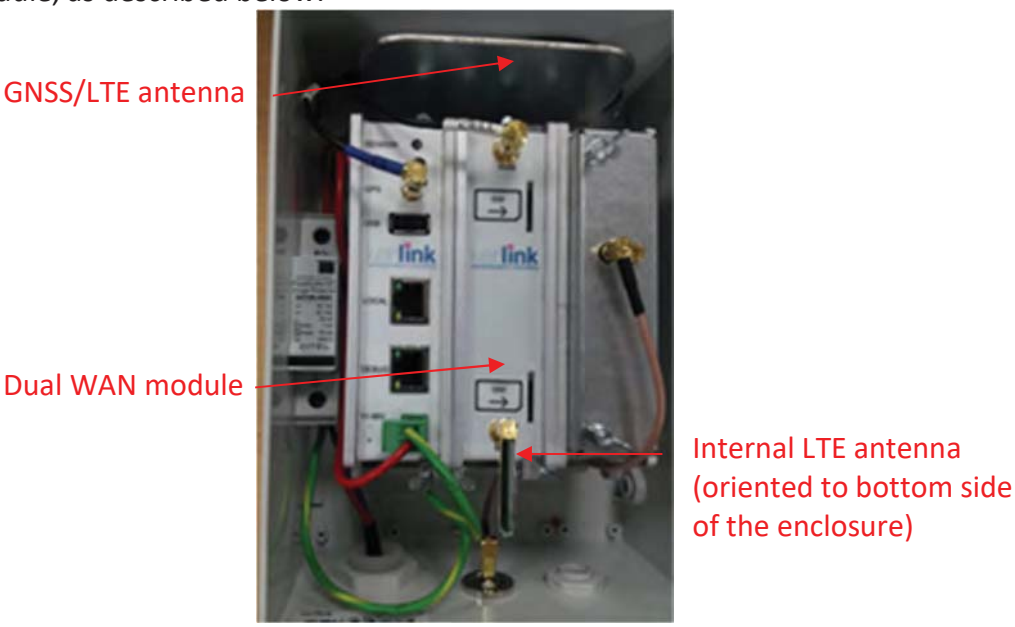


Figure 142 :Internal LTE antenna within Wirnet iBTS Compact

4.6.2.5 LoRa RF Antenna

4.6.2.5.1 Common generalities

Several LoRa antennas can be used with the Wirnet iBTS as detailed in §1.8.1.
Once the antennas are mounted (see §4.5.2), a RF coaxial cable must 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 installation 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:

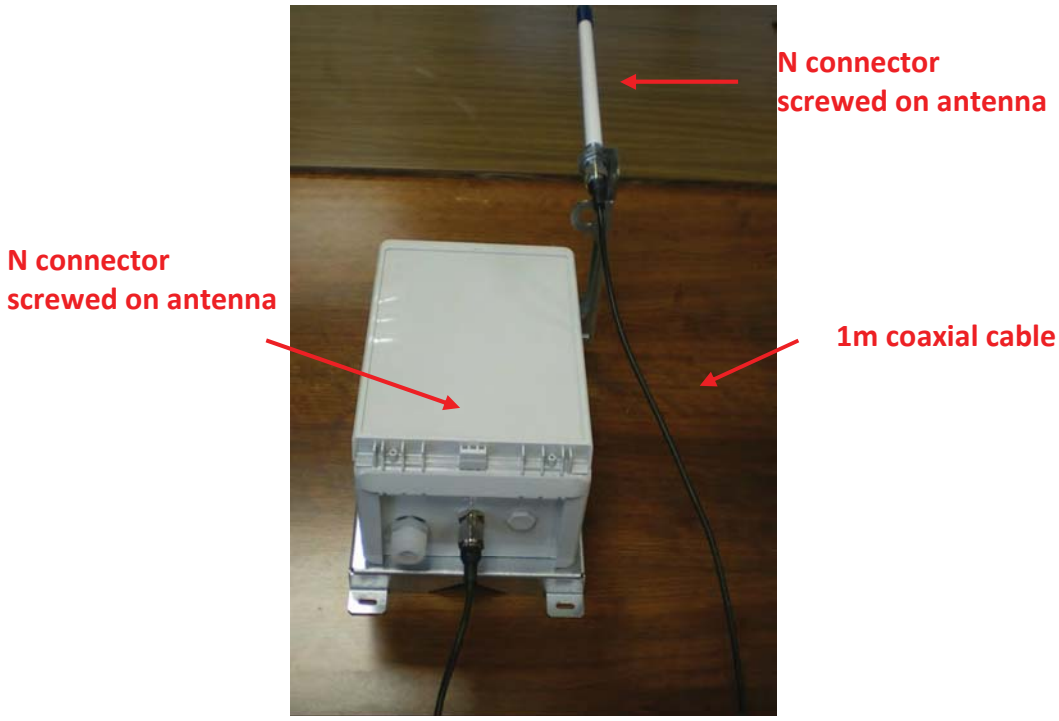


Figure 143 : Connection of the RF coaxial cable

To improve the durability of the RF connections against environmental aggression (moisture, pollution …), KERLINK recommends to protect 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:

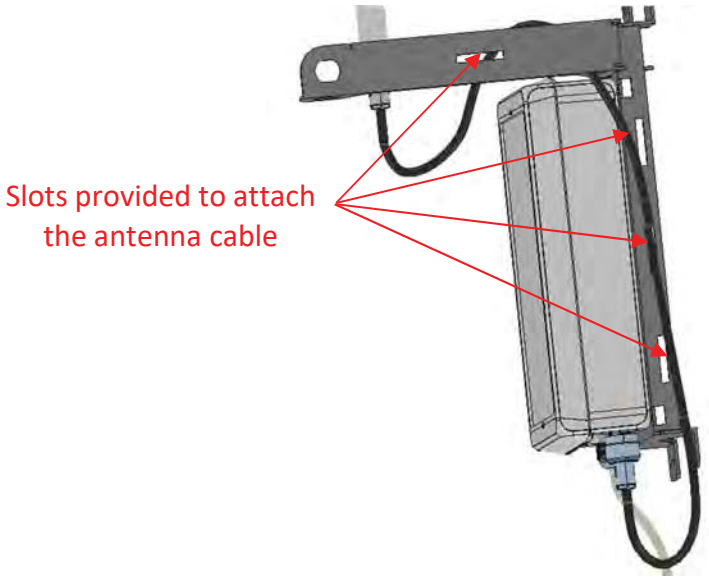


Figure 144 : attachment of the RF antenna coaxial cable

Several configurations of antennas are possible depending on the number of LoRa modules used. They are listed in the following paragraphs.

4.6.2.5.2 Single LoRa module / single omnidirectional antenna

In this configuration, the Wirnet iBTS receiver supports 16 channels.

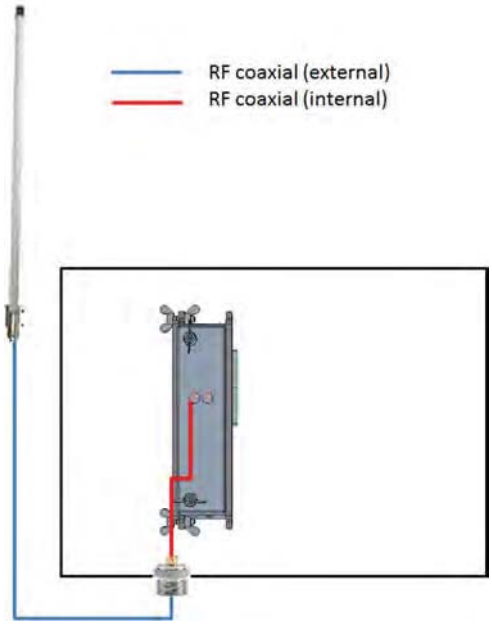


Figure 145 : Single LoRa module / single omnidirectional antenna connections

4.6.2.5.3 Single LoRa module / dual omnidirectional antennas / diversity

In this configuration, the Wirnet iBTS receiver supports 2 x 8 channels.
The distance between antennas must be optimized to offer the best reception (see §4.5.2.2.2).

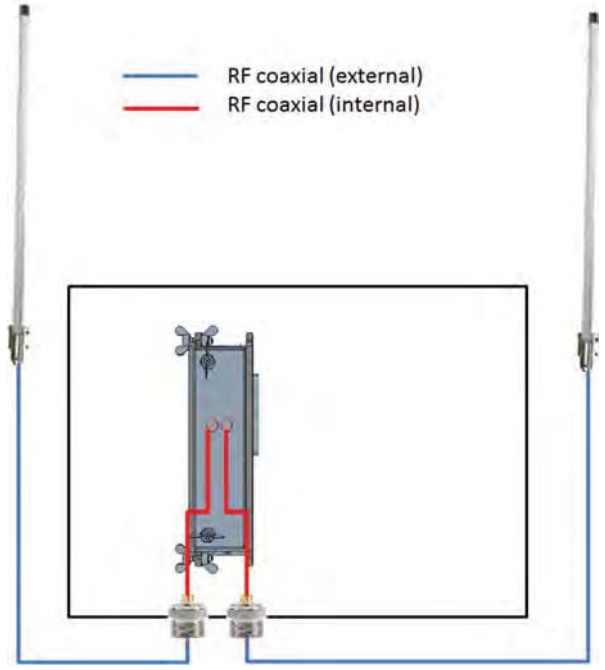


Figure 146 : Single LoRa module / dual omnidirectional antennas connections

4.6.2.5.4 Single LoRa module / single dual polarization antenna

In this configuration, the Wirnet iBTS receiver supports 2 x 8 channels.

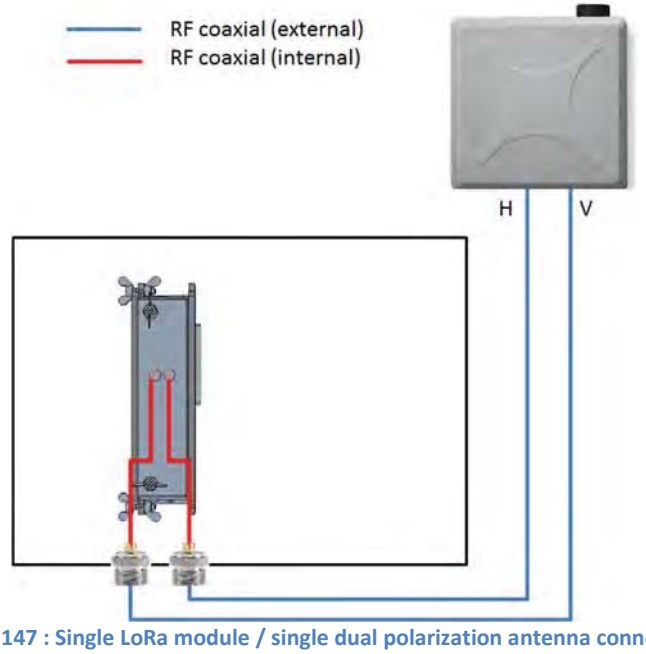


Figure 147 : Single LoRa module / single dual polarization antenna connections

4.6.2.5.5 Two LoRa modules / two omnidirectional antennas / diversity

In this configuration, the Wirnet iBTS receiver supports 2 x 16 channels.
The distance between antennas must be optimized to offer the best reception (see §4.5.2.2.2).

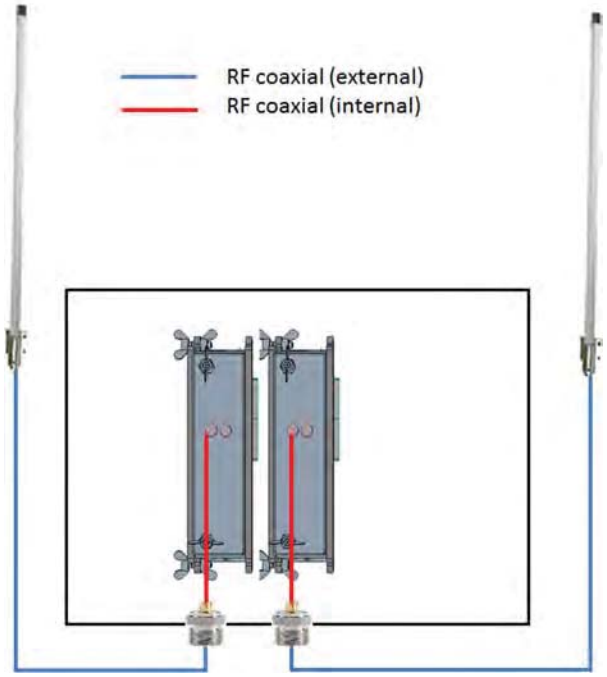


Figure 148 : Two LoRa modules / two omnidirectional antennas / diversity connections

4.6.2.5.6 Two LoRa modules / two dual polarization antennas

In this configuration, the Wirnet iBTS receiver supports 2 x 2 x 8 channels.

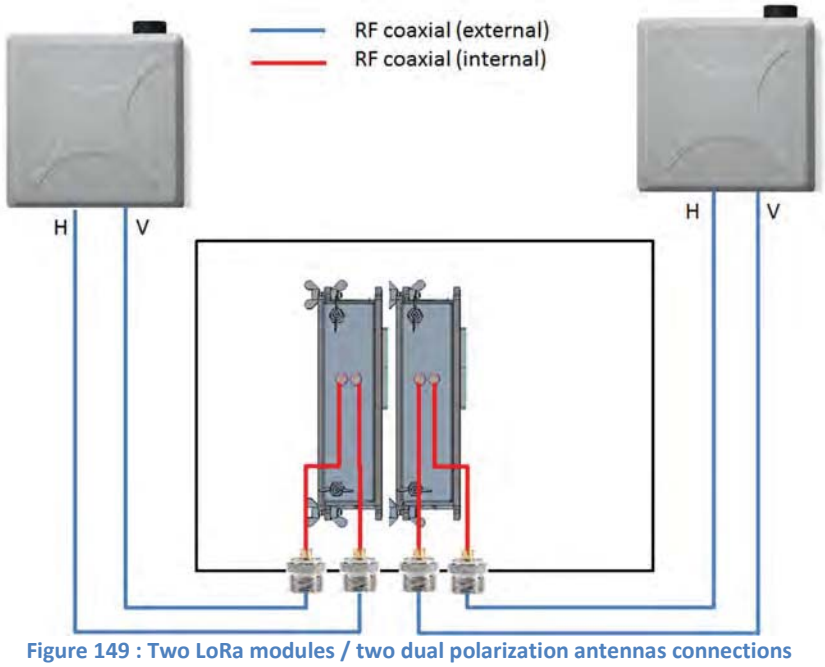


Figure 149 : Two LoRa modules / two dual polarization antennas connections

4.6.2.5.7 Three LoRa modules / three sectors antennas

In this configuration, the Wirnet iBTS receiver supports 3 x 16 channels.

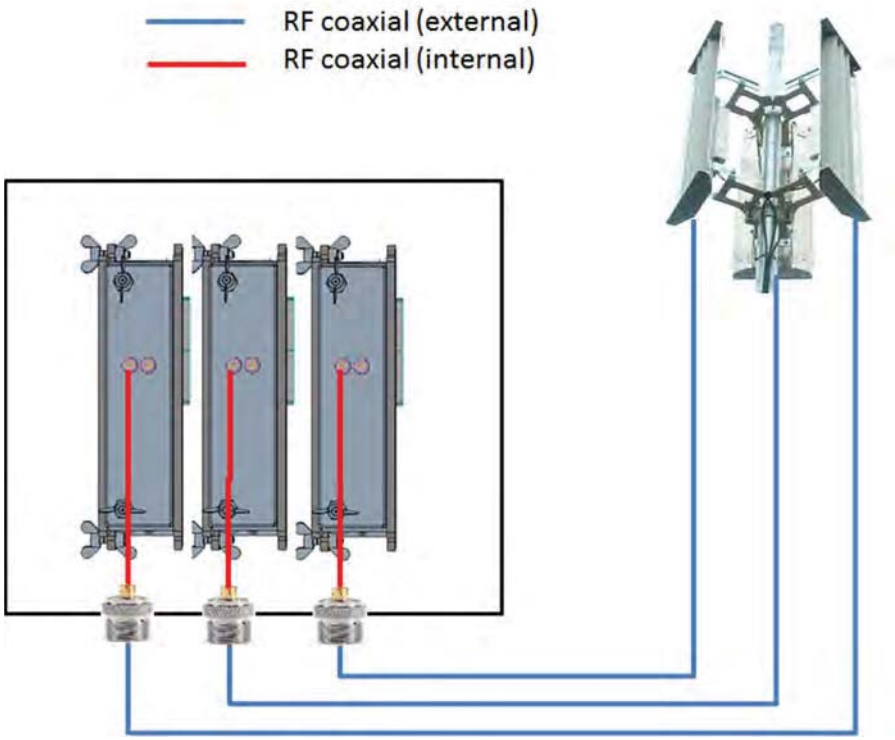


Figure 150 : Three LoRa modules / three sectors antennas connections

4.6.2.5.8 Three LoRa modules / three sectors antennas / dual polarization

In this configuration, the Wirnet iBTS receiver supports 3 x 2 x 8 channels.

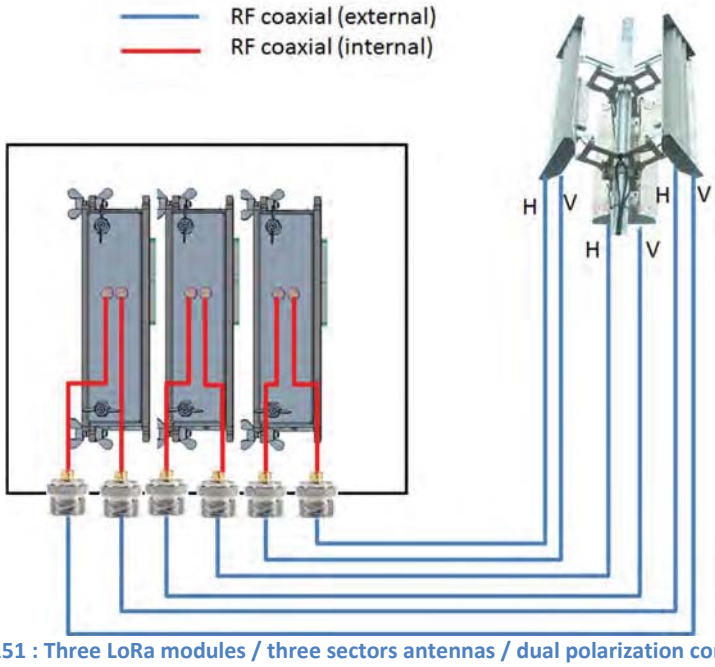


Figure 151 : Three LoRa modules / three sectors antennas / dual polarization connections

4.6.2.5.9 Four LoRa modules / single omnidirectional antenna

In this configuration, the Wirnet iBTS receiver supports 64 channels.

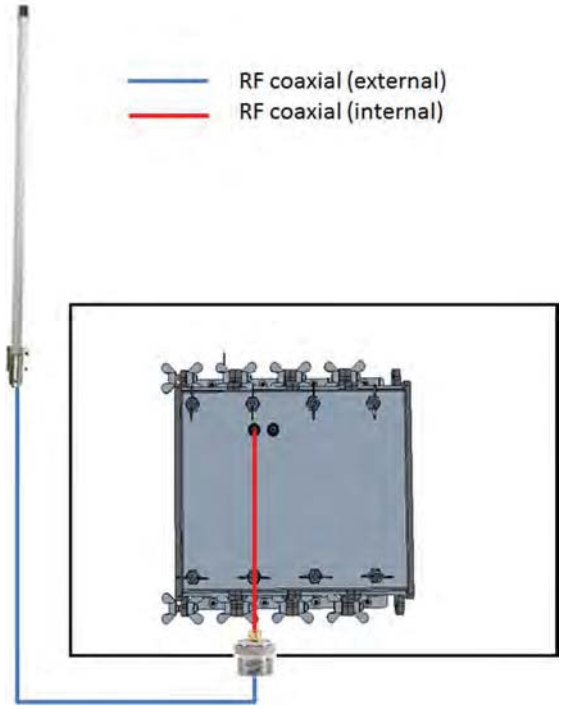


Figure 152 : Four LoRa modules / single omnidirectional antenna connections

4.6.2.5.10 Four LoRa modules / dual omnidirectional antennas / diversity

In this configuration, the Wirnet iBTS receiver supports 2 x 32 channels.

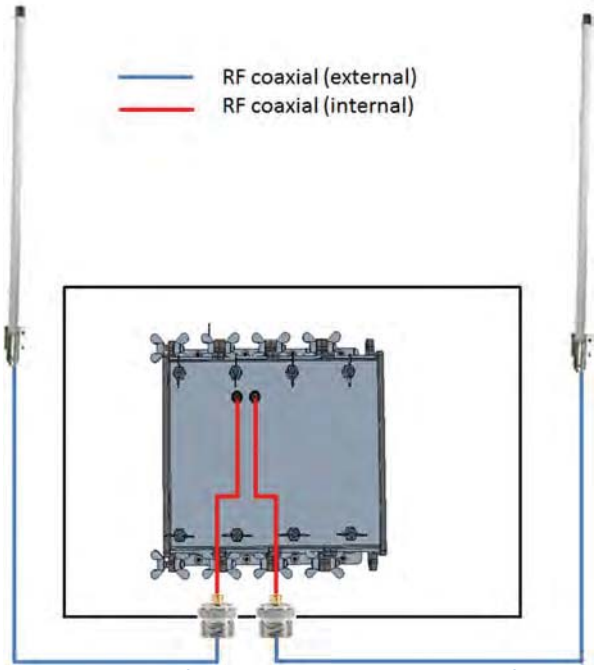


Figure 153 : Four LoRa modules / dual omnidirectional antennas / diversity connections

4.6.2.5.11 Four LoRa modules / dual polarization antenna

In this configuration, the Wirnet iBTS receiver supports 2 x 32 channels.

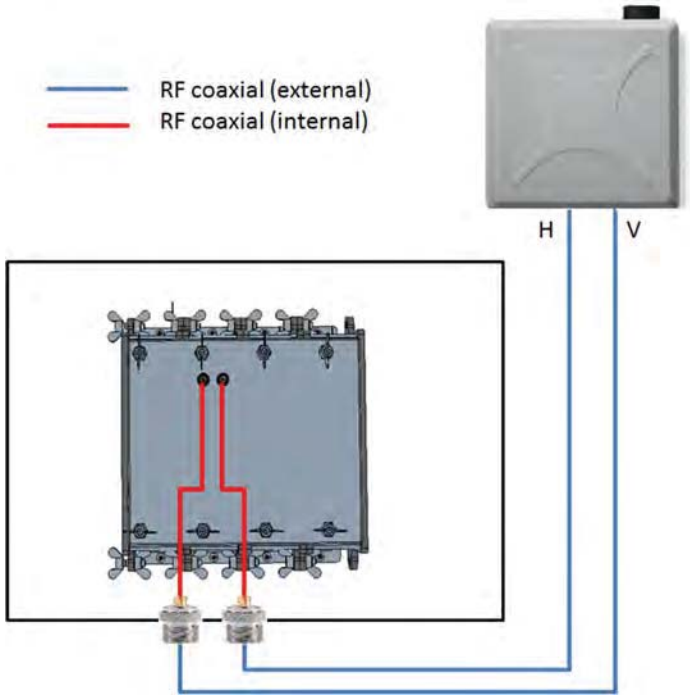


Figure 154 : Four LoRa modules / dual polarization antenna connections

4.6.3 Ethernet connection

The Wirnet iBTS gateway is supplied by a PoE injector through an Ethernet cable.
The PoE injectors are detailed in §1.6.1.
The recommended Ethernet cable is detailed in §1.8.4.1. 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 must be firstly inserted through the M25 cable gland as shown on the Figure 155.
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

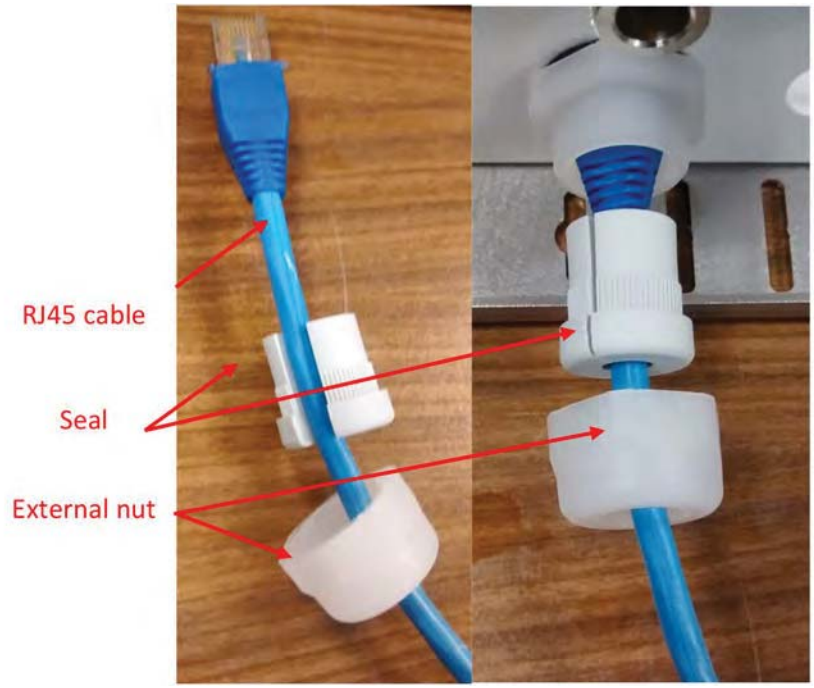


Figure 155 : Ethernet connection on Wirnet iBTS side / cable gland

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:

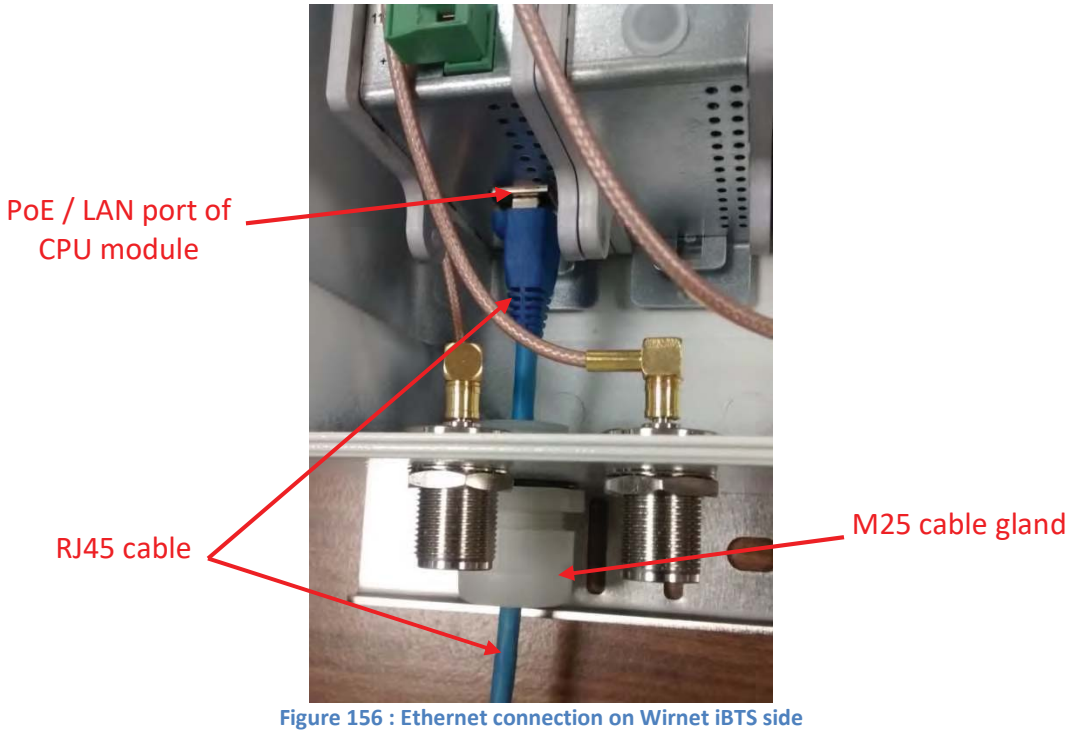


Figure 156 : Ethernet connection on Wirnet iBTS side

On the other side of the Ethernet cable, the RJ45 connector must be inserted into the RJ45 "Data + Power" port of the POE injector. This POE injector is connected to 230VAC mains supply as detailed in §4.3.2.

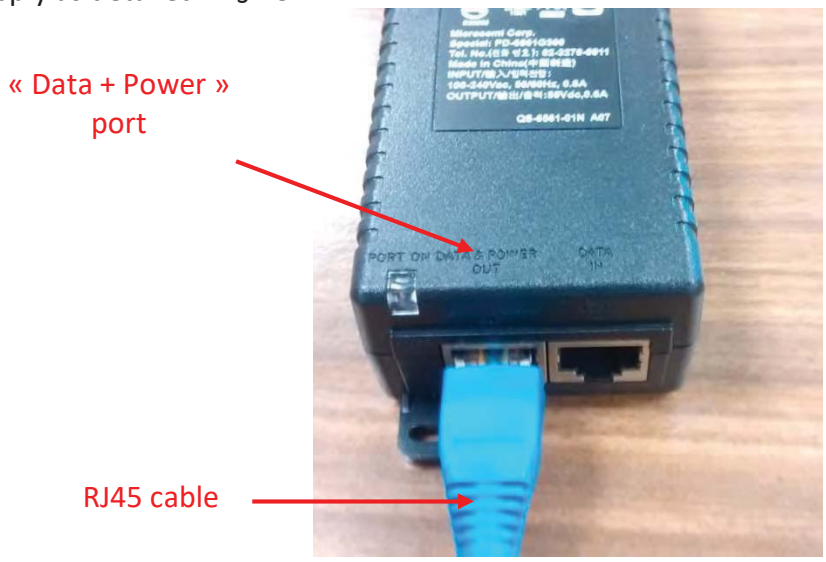


Figure 157 : Ethernet connection on PoE injector side

Note 4: the PoE injector must be connected to the mains supply through a main electrical board with surge protections type 1 and a secondary electrical board with surge protections type 2 as detailed in §4.3.2.
Note 5: the PoE injectors detailed in §1.6.1.1 and §1.6.1.3 are intended for indoor applications only.
Note 6: If the electrical installation does not include surge protections type 1 and 2, then an outdoor PoE injector featuring better surge protection is required. These outdoor PoE injector are detailed in §1.6.1.6 and § 1.6.1.7.

4.6.4 Mains supply

The AC/DC PoE injectors detailed in §1.6.1, 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 must be inserted into the mains receptacle only once all other connections are settled and USIM card inserted (see §4.7).

4.6.5 Auxiliary power supply

The Wirnet iBTS can be also supplied with an auxiliary DC power supply as a solar panel for instance. The input voltage range is 11 to 56VDC. A 24V DC solar system is then recommended for optimized performance.
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 are indicated besides the connector, as shown below:

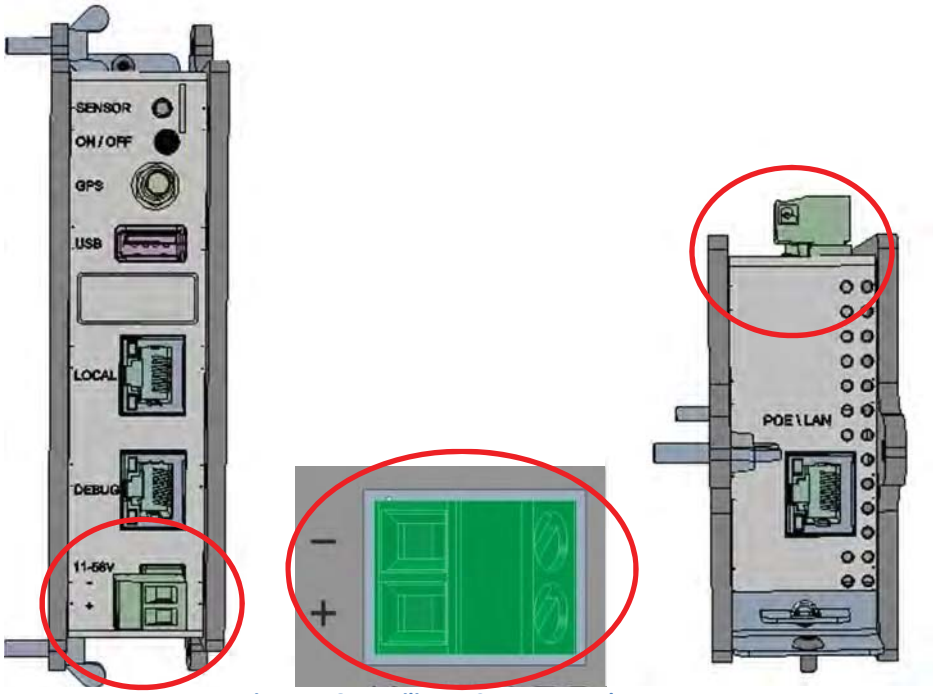


Figure 158 : Auxiliary DC power supply connector

First, the auxiliary power supply cable must 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 must be used. One M16 blind stops must 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 allows 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 158, according to the defined polarity.

Note 2: the Euroblock plug must be inserted into the Euroblock receptacle only once all other connections are settled and USIM card inserted (see §4.7).

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

4.7 Lighting protections

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

The lighting surge protection must be completed on three interfaces to be efficient:

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

Another key parameter for an efficient lighting surge protection is “earthing”. The earthing connection insures that the lighting surge is driven to the ground properly.

Earthing of the installation is mandatory for:

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

The following figure describes the lighting protections that are required in a high keraunic area configuration:

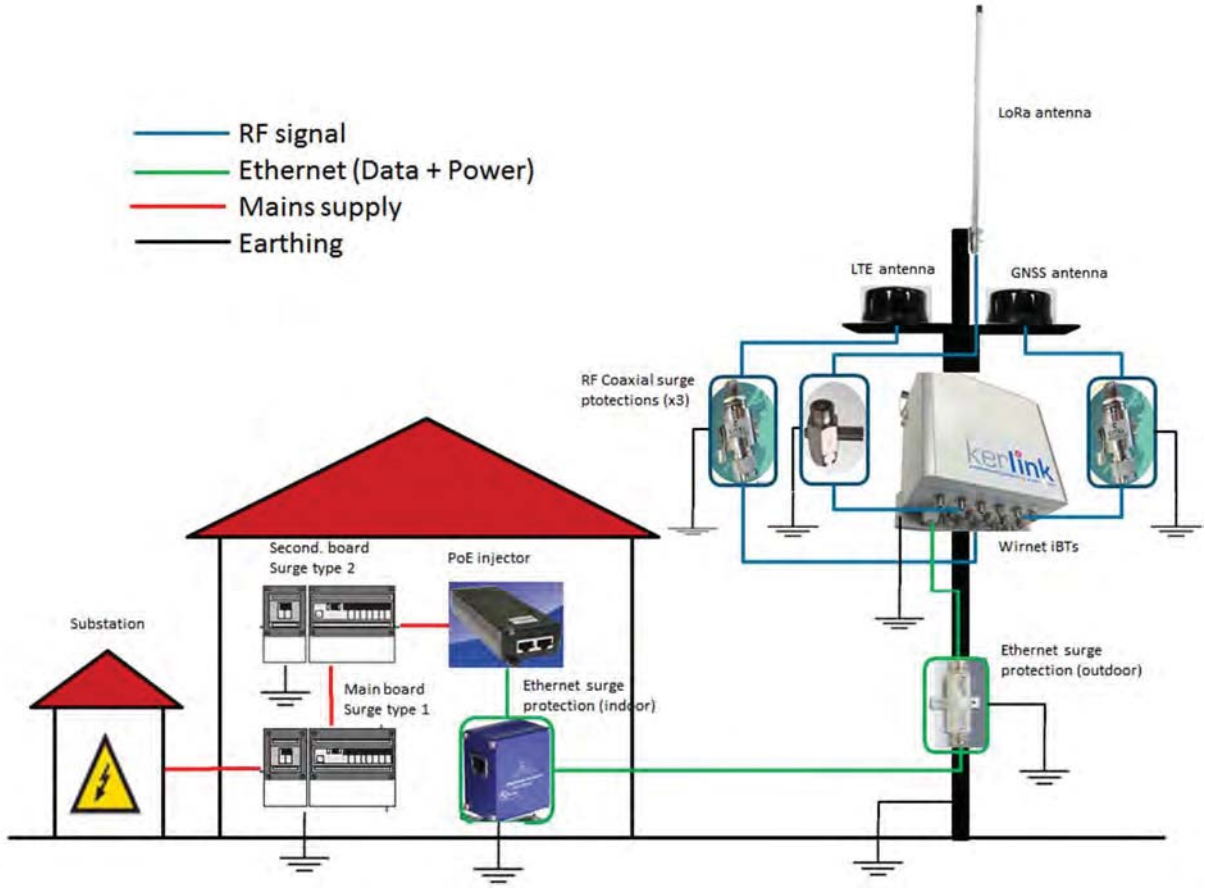


Figure 159 : Installation with recommended lighting protections

The installation is composed of two separated areas: indoor installation and outdoor installation.
The indoor installation is 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”
- The PoE injector (see §1.6.1.1 and §1.6.1.3)
- An Ethernet surge protection, connected to “earth” (see §1.8.5.2)

The outdoor installation is composed of:

- A tower, mast or pole that must be connected to “earth”.
- The Wirnet iBTS and its mounting kit.

The mounting kit must be connected to earth.

- The antennas (LoRa, LTE, GNSS) with their RF coaxial surge protections (see §1.8.5.1) connected to “earth”.

A lighting rod with a down conductor to earth is strongly recommended for this kind of applications. The lighting rod avoids direct impacts on the aerials (antennas and Wirnet iBTS).

Note 1: the PoE injector must be connected to the mains supply through a main electrical board with surge protections type 1 and a secondary electrical board with surge protections type 2. If the electrical installation does not meet those requirements, use an alternate PoE injector featuring better surge protection. Contact KERLINK for more information.

Note 2: the PoE injector is intended for indoor applications only.

Note 3: the Ethernet surge protection is intended for indoor applications only.

In some use cases the electrical installation does not have the required surge protections type 1 and type 2. Also, the PoE injector and Ethernet surge protection could not be installed indoor. Therefore, an alternate PoE injector and an Ethernet surge protection dedicated to outdoor applications are required. These are detailed in §1.6.1.6, § 1.6.1.7 and §1.8.5.5.
In this use case, the installation is still composed of two separated areas: indoor installation and outdoor installation.

The indoor installation is composed of:

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

The outdoor installation is composed of:

- A tower, mast or pole that must be connected to “earth”.
- The Wirnet iBTS and its mounting kit.

The mounting kit must be connected to earth.

- The antennas (LoRa, LTE, GNSS) with their RF coaxial surge protections (see §1.8.5.1) connected to “earth”.
- The PoE injector (see §1.6.1.6 and § 1.6.1.7)
- An Ethernet surge protection, connected to “earth” (see §1.8.5.5.)

A lighting rod with a down conductor to earth is still strongly recommended for this kind of applications to avoid direct impacts on the aerials.

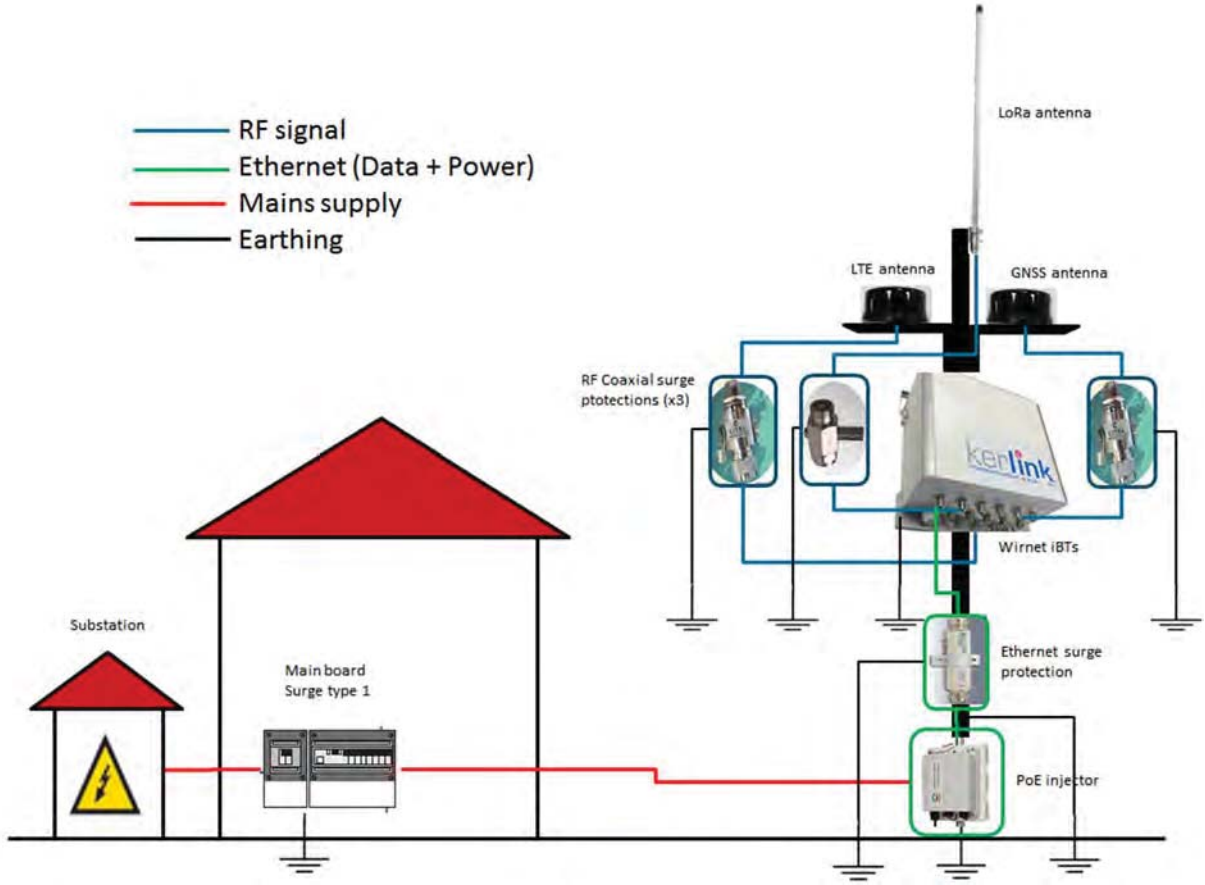


Figure 160 : Installation with recommended lighting protections / Outdoor PoE injector

Note 1: the outdoor PoE injector and Ethernet surge protectors have cable glands to insure the ingress protection. RJ45 connectors must be inserted into the POE injector through the cable glands.
Note 2: in both use cases, the earthing cables for the PoE injector, Ethernet surge protection, RF coaxial surge protection and Wirnet iBTS mounting kit are not provided by KERLINK.

4.8 Commissioning

4.8.1 USIM card

The USIM card is mandatory to establish the LTE/3G/GPRS communications.
The USIM card to be used with the Wirnet iBTS must be a 2FF format.
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.

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 §4.1)
- 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 161 : USIM Card

In case of replacement of the USIM card, the power supply must 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 must be updated. This can be done through USB update or through the local maintenance Web interface.
For more details, contact KERLINK.

4.8.2 Power ON

Once the RF antenna(s) and the Ethernet cable are connected and the USIM card is inserted, the Wirnet iBTS can be powered ON.
To POWER ON the Wirnet iBTS, connect the POE injector onto the 230VAC mains supply.

4.8.3 Functional check

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 during seven seconds.
Then the DEBUG green LED must 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.

4.8.4 Configuration

Several interfaces are available for debug and maintenance purpose. They are detailed in §5.3. Their use is detailed in the following sections.

4.8.4.1 Configuration through the web interface

The iBTS can be graphically 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, you must have a computer connected either through the local interface port directly, or to the same network as the Ethernet PoE connection. Please consult the Kerlink Wiki or contact KERLINK for more information and to get the credentials. You will be greeted with the following login screen:

4.8.4.2 Configuring network parameters

The network bearer can be chosen among Ethernet, LTE and WLAN, according to the available WAN modules plugged inside the 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
- GSM / HSPA / LTE:

- USIM pincode
- APN
- Login
- Password

Consult the Kerlink Wiki or contact KERLINK for more information.

4.8.4.3 Configuring credentials

Several security credentials have to be updated when installing the device. KERLINK recommends to:

- Change the admin password (through Web interface or command-line)
- Change the root, usbuser and support passwords (through commande-line only)

Consult the Kerlink Wiki or contact KERLINK for more information.

5. Maintenance of the Wirnet iBTS

5.1 Simple checks

5.1.1 Wirnet iBTS enclosure

Check the robustness of the installation:

- Screwing of the Wirnet iBTS station on the mounting kit
- Screwing of the mounting kit (depends on the configuration)

Check the Ingress Protection of the enclosure:

- No trace of water inside the enclosure
- Tightening of the cable gland
- Tightening / screwing of the N connectors
- Tightening of the pressure stabilizers
- Tightening / screwing of the blind stops
- Gasket on the door

5.1.2 User interface

Check the USIM is properly inserted in the USIM connector of the WAN module
Check the LED indicators on the CPU module inside the enclosure:

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

5.1.3 Cables and antennas

Check tightening and cabling of the antennas:

- The coaxial cables of LoRa, GNSS (GPS) and LTE antennas are well screwed and tightened on the Wirnet iBTS N connectors.
- The coaxial cables of LoRa, GNSS (GPS) and LTE antennas are not deteriorated.
- The LoRa, GNSS (GPS) and LTE antennas are well screwed and tightened on their brackets.
- The antenna brackets are well tightened to the wall or pole.
- RJ45/PoE cable is not deteriorated.

Check earthing of the installation:

- Antennas + mounting kit earthing cables are connected and not deteriorated.
- Wirnet iBTS + mounting kit earthing cable is connected and not deteriorated.
- Surge protectors earthing cables are connected and not deteriorated.

Check cabling inside the enclosure:

- The SMB and SMA cables are correctly connected to the modules and to the SMB/N adapters.
- RJ45/PoE connector is properly inserted in the CPU module
- Auxiliary supply wires (optional) are correctly inserted and screwed in the Euroblock connector of the CPU module

5.1.4 PoE injector

Check the RJ45 connectors of the Ethernet cables are properly inserted into the PoE injector

Check the LED indicator on the indoor 30W PoE injector:

- Yellow: AC Power OK but Channel Power KO -> defect
- Green: AC Power OK and Channel Power OK -> no defect
- None: no AC Power -> defect

Check the LED indicators on the indoor 60W PoE injectors:

- Yellow: AC Power OK but Channel Power KO -> defect
- Green: AC Power OK and Channel Power OK -> no defect
- None: no AC Power -> defect

5.2 Adding or replacing a module

To replace a module or add a module, follow the procedure detailed in §4.4.

5.3 Interfaces for debug or maintenance purposes

5.3.1 Proprietary debug interface

The Wirnet iBTS station has a proprietary serial debug interface named DEBUG located on the front side of the CPU module.
This debug interface is intended to be used by authorized and qualified personnel only.

Be careful: Only specific equipment developed by KERLINK must be connected to this interface.

The Wirma2 Debug Tool is intended to be connected to the debug interface. This tool is detailed in §1.8.7. It can be ordered to KERLINK as part of the accessories (see §6).
An Ethernet cable is required to connect the Wirma2 Debug Tool to the RJ45 DEBUG connector of the CPU module. A USB2.0 type A to type B male cable is also required to connect the Wirma2 Debug Tool to a computer. Both cables can be provided by KERLINK as accessories (see §6).

The connections of the Wirma2 Debug Tool to the CPU module and the computer are detailed on the following picture:

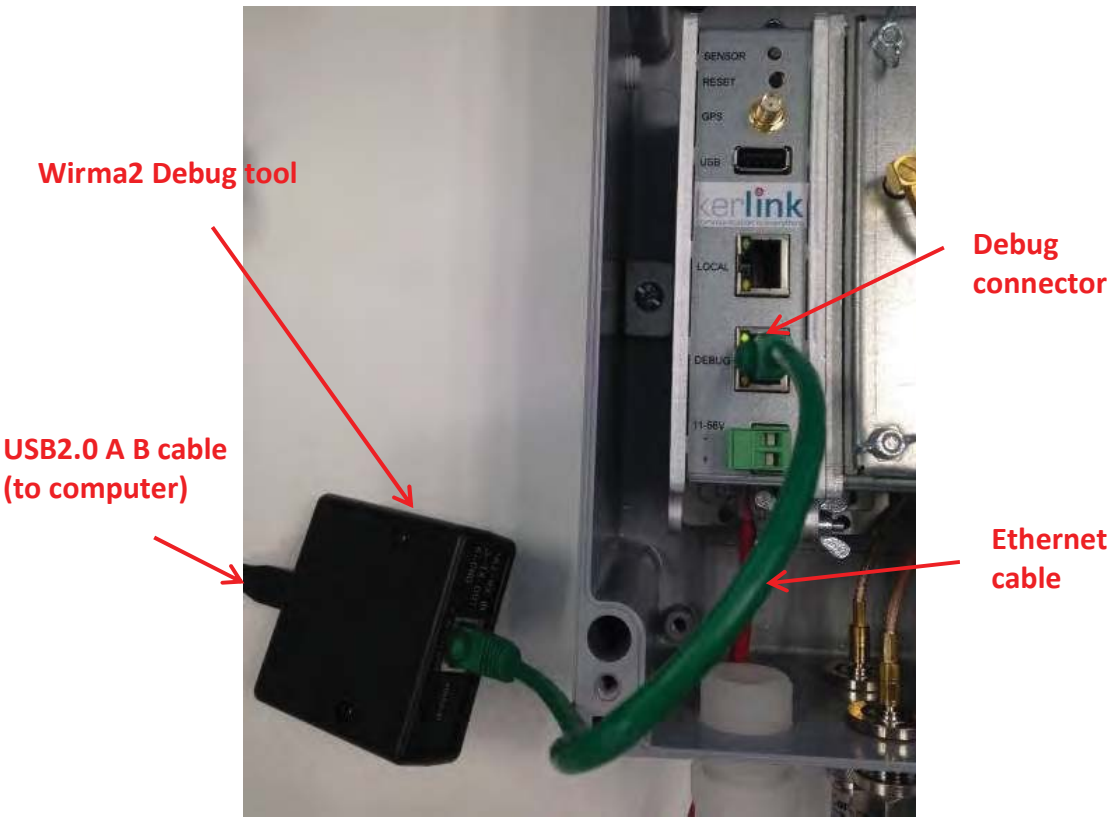


Figure 162 : Wirma2 Debug tool connected to the Wirnet iBTS

Use HyperTerminal or Teraterm on the computer to visualize the traces.

The serial port must be configured as follows:

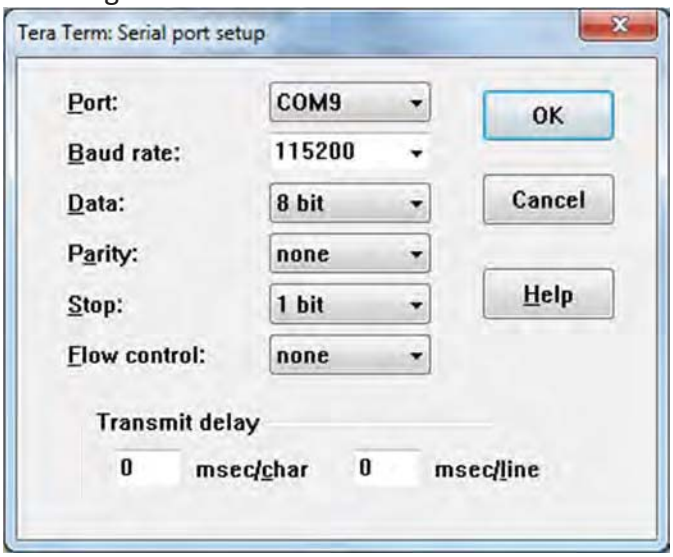


Figure 163 : Serial port configuration

Note 1: COM port number must be adjusted depending on which serial port is used on the computer.
Note 2: It is also possible to access to the debug interface by Ethernet connection by connecting directly to the POE injector or the Ethernet switch (depending on the installation topology).
Note 3: request default login/password to KERLINK.

5.3.2 USB interface

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

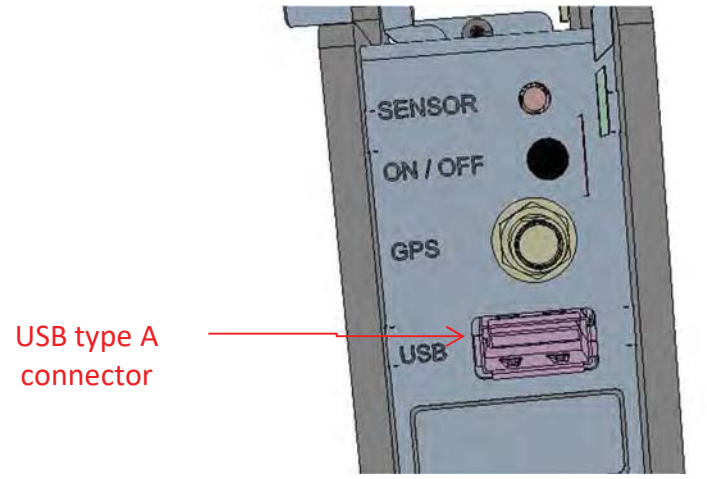


Figure 164 : USB connector of the Wirnet iBTS

5.3.3 ON/OFF button

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

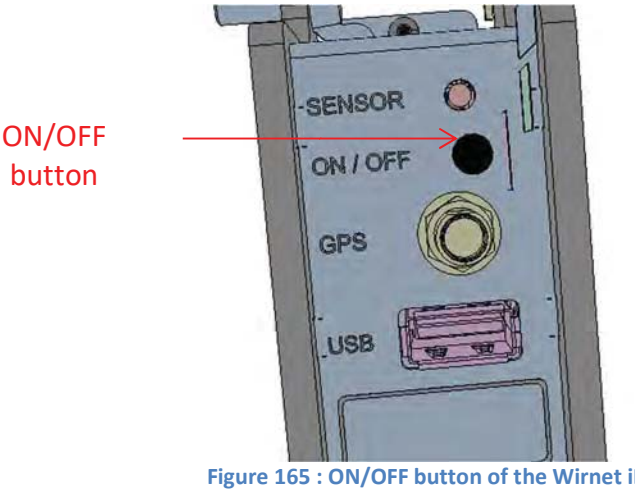


Figure 165 : ON/OFF button of the Wirnet iBTS

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 during 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.

5.3.4 Local interface

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

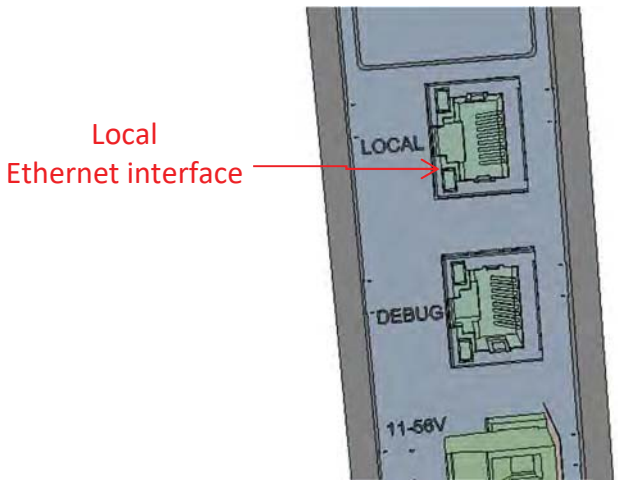


Figure 166 : Local Ethernet interface of the Wirnet iBTS

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 §4.8.4).

Consult the Kerlink Wiki or contact KERLINK for more information.

6. List of the accessories

Basic configuration:

KERLINK Reference	Designation
KLK-I0144	Wirnet iBTS enclosure, including: - 1 X Wall mount kit - 1 X U bolt mounting kit - 1 X M25 cable gland - 2 X N-SMB adapters - 2 x RF coaxial SMB/SMA cables - 9 X M16 blind stop - 1 X CPU Module
KLK-I0151	Wirnet iBTS Compact enclosure, including: - 1 X Wall mount kit - 1 X U bolt mounting kit - 1 x combo antenna LTE / GNSS - 1 X M25 cable gland - 1 X N-SMB adapters - 1 x RF coaxial SMB/SMA cables - 1 X M16 blind stop - 1 X CPU Module

LoRa modules:

KERLINK Reference	Designation
PDTIOT-ACS02 (KLK-I0181)	Single LoRa Module 868 – LoRa LOC, including: - 2 X N-SMB adapter - 2 x RF coaxial SMB/SMB cable
KLK-I0164	Single LoRa Module 915 – LoRa LOC, including: - 2 X N-SMB adapter - 2 x RF coaxial SMB/SMB cable
KLK-I0153	Quad LoRa Modules 915 – LoRa LOC – 64 channels, including: - 2 X N-SMB adapter - 2 x RF coaxial SMB/SMB cable
PDTIOT-ACS03 (KLK-I0183)	Single LoRa Module 923 – LoRa LOC, including: - 2 X N-SMB adapter - 2 x RF coaxial SMB/SMB cable
KLK-I0160	Quad LoRa Modules 923 – LoRa LOC – 64 channels, including: - 2 X N-SMB adapter - 2 x RF coaxial SMB/SMB cable

UC module:

KERLINK Reference	Designation
KLK-I0177	UC Module, including: - 1 X N-SMB adapter - 1 x RF coaxial SMB/SMA cable

WAN modules:

KERLINK Reference	Designation
ACCIOT-MWA00 (KLK-I0178)	WAN Module – LTE Europe – with backup battery, including: - 1 X 868MHz notch filter - 1 X LTE Europe / APAC Mini PCI Express module MC7304 - 1 X N-SMB adapter - 1 x RF coaxial SMB/SMA cable - 1 x backup battery
ACCIOT-MWA01 (KLK-I0179)	WAN Module – LTE Americas – with backup battery, including: - 1 X 915MHz notch filter - 1 X LTE Americas Mini PCI Express module MC7354 - 1 X N-SMB adapter - 1 x RF coaxial SMB/SMA cable - 1 x backup battery
ACCIOT-MWA02 (KLK-I0180)	WAN Module – LTE APAC – with backup battery, including: - 1 X 915MHz notch filter - 1 X LTE Europe / APAC Mini PCI Express module MC7304 - 1 X N-SMB adapter - 1 x RF coaxial SMB/SMA cable - 1 x backup battery
ACCIOT-MWA03 (KLK-I0189)	WAN Module – LTE APAC – with backup battery, including: - 1 X 915MHz notch filter - 1 X LTE Europe / APAC Mini PCI Express module MC7430 - 1 X N-SMB adapter - 1 x RF coaxial SMB/SMA cable - 1 x backup battery

Dual WAN module:

KERLINK Reference	Designation
ACCIOT-MWA04 (KLK-I0174)	Dual WAN Module – LTE Europe – with backup battery, including: - 2X 868MHz notch filter - 2 X LTE Europe / APAC Mini PCI Express module MC7304 - 2 X N-SMB adapter - 2 x RF coaxial SMB/SMA cable - 1 x backup battery

LoRa antennas:

KERLINK Reference	Designation
ACCIOT-KAN00 (KLK02124)	Omnidirectional antenna 868MHz 3dBi kit, including: - 1 X Universal antenna bracket - 1 X 1m coaxial cable
ACCIOT-KAN01 (KLK02373)	Omnidirectional antenna 868MHz 6dBi from FT-RF with its own antenna bracket
ACCIOT-KAN03 (KLK02658)	Omnidirectional antenna 915MHz 3dBi kit, including: - 1 X Universal antenna bracket - 1 X 1m coaxial cable
ACCIOT-KAN04 (KLK02648)	Omnidirectional antenna 915MHz 6dBi kit, including: - 1 X Universal antenna bracket - 1 X 1m coaxial cable
ACCIOT-KAN02 (KLK02518)	Omnidirectional antenna 915MHz 6dBi from FT-RF with its own antenna bracket

GNSS and WAN antennas:

KERLINK Reference	Designation
KLK-I0149	GNSS antenna kit, including: - 1 X 5m coaxial cable - 1 X Dome antenna bracket
KLK-I0150	LTE antenna kit, including: - 1 X 5m coaxial cable - 1 X Dome antenna bracket

Cavity filters:

KERLINK Reference	Designation
ACCIOT-CAV01 (KLK02522)	920-925MHz cavity filter, IP66, N connectors
ACCIOT-CAV02 (KLK02523)	865-867MHz cavity filter, IP66, N connectors
KLK02905	918-923MHz cavity filter, IP66, N connectors
KLK02906	915-920MHz cavity filter, IP66, N connectors
ACCIOT-CAV03 (KLK02909)	920-928MHz cavity filter, IP66, N connectors
KLK02915	865-870MHz cavity filter, IP66, N connectors
KLK02916	863-873MHz cavity filter, IP66, N connectors
KLK02973	902-928MHz cavity filter, IP66, N connectors

Cables:

KERLINK Reference	Designation
ACCIOT-CAB00	RF coaxial cable N-N 1m

(KLK02460)

PoE injectors:

KERLINK Reference	Designation
ACCIOT-INJ04 (KLK02681)	Indoor AC/DC Midspan PoE injector 30W with E/F type cable (Europe)
ACCIOT-INJ06 (KLK02765)	Indoor AC/DC Midspan PoE injector 30W with B type cable (USA)
ACCIOT-INJ05 (KLK02744)	Indoor AC/DC Midspan PoE injector 60W with E/F type cable (Europe)
ACCIOT-INJ07 (KLK02766)	Indoor AC/DC Midspan PoE injector 60W with B type cable (USA)
ACCIOT-INJ00 (KLK02815)	Outdoor AC/DC Midspan PoE injector 30W, IP66 – end of life
KLK02953	Outdoor AC/DC Midspan PoE injector 30W, IP66 – new version
ACCIOT-INJ08 (KLK02816)	Outdoor AC/DC Midspan PoE injector 60W, IP66 – end of life
KLK02954	Outdoor AC/DC Midspan PoE injector 60W, IP66 – new version
ACCIOT-INJ02 (KLK02855)	Indoor DC/DC Midspan PoE injector 30W
ACCIOT-INJ03 (KLK02863)	Indoor DC/DC Midspan PoE injector 60W
ACCIOT-INJ08 (KLK02879)	Outdoor DC/DC Midspan PoE injector 60W

48V DC/DC converter:

KERLINK Reference	Designation
ACCIOT-DCD01 (KLK02898)	40W 48V DC/DC isolated converter

Surge protections:

KERLINK Reference	Designation
ACCIOT-RSP00 (KLK02819)	RF coaxial surge protector (GNSS, GSM Link)
ACCIOT-RSP01 (KLK02900)	RF coaxial surge protector (LoRa Link)
KLK02818	PoE surge protector, indoor
KLK02817	PoE surge protector, outdoor
ACCIOT-DSP00 (KLK02881)	DC surge protection, 1 pole
KLK02880	DC surge protection, 2 poles

Debug tool:

KERLINK Reference	Designation
ACCWM2-SDE00 **KLK-I0036**	Wirma2 debug tool
KLK02314	RJ45 cable, 40cm
KLK02440	USB2.0 A type / B type cable, 2m

Mounting kits:

KERLINK Reference	Designation
KLK-I0168	Notched V-shaped pole mounting kit, including: - 1 X notched V shaped plate - 1 X U bolt
KLK02453	Universal antenna bracket
KLK02692	Dome antenna bracket

7. Customer support

The Wirnet iBTS gateway must be installed and maintained by authorized and qualified personnel only.
In case of defect or breakdown, make sure the above recommendations detailed in this document are met.
If an issue is not addressed in this document, contact your first level of support.

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