



INSTALLATION AND MAINTENANCE MANUAL

WIRNET IBTS

	Written by	Approved by	Approved by	Validated by
Name	BCA	BLT	SNI	MCH
Entity	DRD	DRD	PRG	DRD
Date	15/10/2018	15/10/2018	12/11/2018	21/11/2018



HISTORY

Date	Modification	Author	Version
03/17/2016	Preliminary version	MGI	0.1
04/06/2016	Removed specification part	MGI	0.2
06/08/2016	Updated accessories list	MGI	0.3
07/05/2016	Updates for IEC 60950-1 compliance	MGI	0.4
07/11/2016	Updates for FCC and IC certification	MGI	0.5
08/30/2016	Minor updates after internal review	MGI	0.6
09/08/2016	Updated regulation section	MGI	0.7
10/01/2017	Remove all references to DIN rail Add draft chapter for WAN module Dual SIM version	PTA	0.8
11/01/2017	New POE injector references Power supply recommendations WAN dual SIM (additional information)	SNI	0.9
20/02/2017	Update of WAN module Dual SIM version	PTA	0.10
08/03/2017	Dual WAN module adding LoRa Link lightning protection recommendations	SNI	0.11
13/03/2017	Official version	SNI	1.0
15/05/2017	Completed Dual WAN module and LoRa Link lightning protections, MC7430 and cavity filters Updated Certifications	MGI	1.1
25/07/2017	Updated certifications, cavity filters, insertion of modules and ON/OFF button	MGI	1.2
25/04/2018	Updated LoRa radio performance, certifications, accessories	MGI	1.3
25/04/2018	Added NBTC certification (Thailand) Added Wirnet iBTS Full-Duplex	MGI	1.4
15/10/2018	Amend spectrum analysis possibility (§3); adapt §4.8.4 to	BCA	1.5

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 2 / 221
Strict confidential			

	web interface configuration (with screenshot); fix web interface reference in §4.8.3 and §5.3.4		
	Updates Mechanical implementation (§1.3)	SNI	
04/12/2018	Official version	SNI	2.0

INDEX

1.	Description of the Wirnet iBTS.....	22
1.1	Modular architecture	22
1.2	Mechanical implementation for standard casing	25
1.2.1	Standard casing	25
1.2.2	Stickers	28
1.3	Mechanical implementation for compact casing.....	29
1.3.1	Compact casing	29
1.3.2	Stickers	33
1.4	Block Diagram.....	33
1.4.1	Common functionalities	33
1.4.2	Standard version of Wirnet iBTS	35
1.4.3	“Four Lora Modules” version of Wirnet iBTS	36
1.4.4	Compact version of Wirnet iBTS	37
1.4.5	Wirnet iBTS FDx.....	38
1.5	Description of the modules	39
1.5.1	CPU module.....	39
1.5.1.1	Mechanical description.....	39
1.5.1.2	Connectors and user interfaces	40
1.5.1.3	CPU module characteristics	41
1.5.2	WAN module	43
1.5.2.1	Mechanical description.....	43
1.5.2.1	Connectors and user interfaces	44
1.5.2.2	WAN module characteristics	45
1.5.2.3	Supported mini PCIe cards.....	45
1.5.2.3.1	LTE - Europe and APAC Mini PCI Express card – MC7304	45
1.5.2.3.2	LTE - Europe and APAC Mini PCI Express card – MC7430	46
1.5.2.3.1	LTE - Americas Mini PCI Express card – MC7354	47
1.5.3	Dual WAN Module.....	48
1.5.3.1	Mechanical description.....	48

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 4 / 221
Strict confidential			

- 1.5.3.2 Connectors and user interfaces 49
- 1.5.3.3 Dual WAN module characteristics 50
- 1.5.3.4 Supported Mini PCIe cards..... 50
- 1.5.4 LoRa module – LoRa LOC..... 50
 - 1.5.4.1 Mechanical description..... 50
 - 1.5.4.1.1 Single “LoRa-LOC” module 50
 - 1.5.4.1.2 Four “LoRa-LOC” modules..... 52
 - 1.5.4.1.3 Four “LoRa-LOC-FDX” modules..... 53
 - 1.5.4.2 Connectors and user interfaces 54
 - 1.5.4.2.1 Single LoRa-LOC module..... 54
 - 1.5.4.2.2 Four LORA-LOC modules 56
 - 1.5.4.2.3 Four “LoRa-LOC-FDX” modules..... 57
 - 1.5.4.3 LoRa LOC modem characteristics 58
 - 1.5.4.4 Front-end boards 60
 - 1.5.4.4.1 Front-end board - Single module 60
 - 1.5.4.4.2 Front-end board - Four modules 61
 - 1.5.4.4.3 Front-end board- Four modules Full-Duplex..... 61
 - 1.5.4.5 Modulations and data rates..... 63
 - 1.5.4.6 Frequency bands and channelization 63
 - 1.5.4.7 Output Power..... 65
 - 1.5.4.8 Out of band emissions 65
 - 1.5.4.9 Sensitivity 66
 - 1.5.4.10 RSSI and SNR 66
 - 1.5.4.11 Out of band blockers rejection 67
 - 1.5.4.11.1 868MHz 68
 - 1.5.4.11.2 915MHz 68
 - 1.5.4.11.1 915MHz full-duplex 68
 - 1.5.4.11.2 923MHz 68
- 1.5.5 Dual duplexer 69
 - 1.5.5.1 Mechanical description..... 69
 - 1.5.5.2 Connectors 70
 - 1.5.5.3 Technical performance 70

1.6 Power supply 72

1.6.1 PoE injectors 72

1.6.1.1 PoE injectors recommendations 72

1.6.1.2 Indoor AC/DC Midspan PoE injector 30W 73

1.6.1.3 Indoor AC/DC Midspan PoE injector 60W 75

1.6.1.4 Indoor DC/DC Midspan PoE injector 30W 77

1.6.1.5 Indoor DC/DC Midspan PoE injector 60W 78

1.6.1.6 Outdoor AC/DC Midspan PoE injector 30W 80

1.6.1.7 Outdoor AC/DC Midspan PoE injector 60W 81

1.6.1.8 Outdoor DC/DC Midspan PoE injector 60W 83

1.6.2 Auxiliary power supply 84

1.6.3 Isolated DC/DC converter 40W 85

1.7 Power consumption 87

1.8 Description of the accessories 88

1.8.1 LoRa antennas 88

1.8.1.1 Omnidirectional antenna 868MHz 3dBi 88

1.8.1.2 Omnidirectional antenna 868MHz 6dBi 89

1.8.1.3 Omnidirectional antenna 915MHz 3dBi 90

1.8.1.4 Omnidirectional antenna 915MHz 6dBi 91

1.8.2 GNSS and WAN antennas 92

1.8.2.1 GNSS antenna 92

1.8.2.2 LTE antenna 92

1.8.2.3 GNSS/LTE magnetic antenna 93

1.8.2.4 Internal LTE antenna 94

1.8.3 Cavity filters 95

1.8.3.1 865-867MHz cavity filter 95

1.8.3.2 865-870MHz cavity filter 96

1.8.3.3 863-873MHz cavity filter 98

1.8.3.4 915-920MHz cavity filter 99

1.8.3.5 918-923MHz cavity filter 101

1.8.3.6 920-925MHz cavity filter 102

1.8.3.7 920-928MHz cavity filter 104

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 6 / 221
Strict confidential			

- 1.8.3.8 902-928MHz cavity filter..... 105
- 1.8.4 Cables 107
 - 1.8.4.1 RJ45 PoE cable..... 108
 - 1.8.4.2 Earthing cables 108
- 1.8.5 Surge protections 109
 - 1.8.5.1 RF coaxial surge protection..... 109
 - 1.8.5.1.1 GNSS, LTE Links..... 109
 - 1.8.5.1.1 LoRa Link..... 109
 - 1.8.5.2 DC surge protection, 1 pole 110
 - 1.8.5.3 DC surge protection, 2 poles..... 113
 - 1.8.5.4 Indoor Ethernet surge protection 114
 - 1.8.5.5 Outdoor Ethernet surge protection 114
- 1.8.6 Mounting kits 116
 - 1.8.6.1 Notched V-shaped pole mounting kit..... 116
 - 1.8.6.2 Universal antenna bracket 116
 - 1.8.6.3 Dome antenna bracket 117
- 1.8.7 Debug tool..... 119
- 2. Regulations..... 121
 - 2.1 Wirnet iBTS 868..... 121
 - 2.1.1 Europe / CE..... 121
 - 2.1.2 India..... 122
 - 2.1.3 South Africa 122
 - 2.1.4 Saudi Arabia..... 123
 - 2.1.5 United Arab Emirates 123
 - 2.1.6 Russia..... 124
 - 2.2 Wirnet iBTS 915..... 124
 - 2.2.1 USA / FCC..... 124
 - 2.2.2 Canada / IC 126
 - 2.2.3 Mexico 127
 - 2.2.4 Philippines 127
 - 2.3 Wirnet iBTS 923..... 128
 - 2.3.1 Australia 129

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 7 / 221
Strict confidential			

- 2.3.2 Hong-Kong..... 131
- 2.3.3 Indonesia 132
- 2.3.4 Korea (Republic of)..... 132
- 2.3.5 New-Zealand 133
- 2.3.6 Singapore..... 135
- 2.3.7 Japan..... 136
- 2.3.8 Taiwan 138
- 2.3.9 Malaysia 139
- 2.3.10 Thailand..... 140
- 2.3.11 Brazil..... 141
- 2.4 Wirnet iBTS Full-Duplex..... 142
 - 2.4.1 USA / FCC..... 142
 - 2.4.2 Canada / IC 143
- 3. Key parameters to optimize the radio performance 145
 - 3.1 Height of the site 145
 - 3.2 Propagation model vs area type 146
 - 3.3 Fresnel ellipsoid..... 148
 - 3.4 Co-localization with GSM/UMTS/LTE transmitters..... 150
 - 3.4.1 Wirnet iBTS 868..... 152
 - 3.4.2 Wirnet iBTS 915..... 153
 - 3.4.3 Wirnet iBTS Full-Duplex..... 153
 - 3.4.4 Wirnet iBTS 923..... 153
- 4. Installation procedure 155
 - 4.1 How to open the enclosure 155
 - 4.1.1 Standard casing version 155
 - 4.1.2 Compact casing version..... 156
 - 4.2 Installation topology 159
 - 4.2.1 Single Wirnet iBTS gateway installation..... 159
 - 4.2.2 Multi-Wirnet iBTS installation 160
 - 4.3 Electric distribution to the Wirnet iBTS 161
 - 4.3.1 Safety..... 161
 - 4.3.2 Mains supply 162

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 8 / 221
Strict confidential			

- 4.3.3 POE supply..... 162
- 4.3.4 Auxiliary power supply 162
- 4.4 Inserting an additional module inside the enclosure 163
- 4.5 Mounting of the enclosure..... 166
 - 4.5.1 General considerations 166
 - 4.5.2 Antennas mountings kits..... 166
 - 4.5.2.1 GPS, LTE and LoRa antenna considerations..... 166
 - 4.5.2.2 Distance between antennas 167
 - 4.5.2.2.1 LoRa antenna vs. LTE antennas 167
 - 4.5.2.2.2 LoRa space diversity 168
 - 4.5.2.3 Universal antenna bracket..... 168
 - 4.5.2.4 Dome antenna bracket 170
 - 4.5.3 Mounting of the compact enclosure..... 172
 - 4.5.3.1 Compact casing mounting kit 172
 - 4.5.3.2 Wall mounting..... 172
 - 4.5.3.3 Pole mounting by U-bolt..... 173
 - 4.5.3.4 Metallic strapping mounting..... 174
 - 4.5.4 Mounting of the standard enclosure 174
 - 4.5.4.1 Standard casing mounting kit 174
 - 4.5.4.2 Wall mounting..... 176
 - 4.5.4.3 Pole mounting by U-bolt..... 176
 - 4.5.4.4 Metallic strapping mounting..... 177
 - 4.5.5 Mounting of the accessories 178
 - 4.5.5.1 Indoor PoE injectors..... 178
 - 4.5.5.2 Outdoor PoE injectors..... 178
 - 4.5.5.3 Indoor Ethernet surge protection 179
 - 4.5.5.4 Outdoor Ethernet surge protection 179
 - 4.5.5.5 RF coaxial surge protections 181
 - 4.5.5.6 Cavity filters 181
- 4.6 Setting connections..... 182
 - 4.6.1 Earthing 182
 - 4.6.1.1 Earthing of the Wirnet iBTS mounting kit..... 183

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 9 / 221
Strict confidential			

4.6.1.2 Earthing of the Wirnet iBTS Compact mounting kit 184

4.6.1.3 Earthing of the RF coaxial surge protection..... 185

4.6.1.4 Earthing of the DC surge protection 185

4.6.1.5 Earthing of the Ethernet surge protection 186

4.6.1.6 Earthing of the outdoor PoE injector 187

4.6.2 RF antennas 188

4.6.2.1 GNSS antenna 191

4.6.2.2 LTE antenna..... 192

4.6.2.3 GNSS / LTE combo antenna 192

4.6.2.4 Internal LTE antenna 193

4.6.2.5 LoRa RF Antenna 194

4.6.2.5.1 Common generalities 194

4.6.2.5.2 Single LoRa module / single omnidirectional antenna..... 195

4.6.2.5.3 Single LoRa module / dual omnidirectional antennas / diversity 196

4.6.2.5.4 Single LoRa module / single dual polarization antenna 196

4.6.2.5.5 Two LoRa modules / two omnidirectional antennas / diversity 197

4.6.2.5.6 Two LoRa modules / two dual polarization antennas..... 197

4.6.2.5.7 Three LoRa modules / three sectors antennas 198

4.6.2.5.8 Three LoRa modules / three sectors antennas / dual polarization..... 198

4.6.2.5.9 Four LoRa modules / single omnidirectional antenna 199

4.6.2.5.10 Four LoRa modules / dual omnidirectional antennas / diversity..... 199

4.6.2.5.11 Four LoRa modules / dual polarization antenna 200

4.6.3 Ethernet connection..... 200

4.6.4 Mains supply 202

4.6.5 Auxiliary power supply 202

4.7 Lighting protections 204

4.8 Commissioning 207

4.8.1 USIM card 207

4.8.2 Power ON 208

4.8.3 Functional check..... 208

4.8.4 Configuration..... 209

4.8.4.1 Configuration through the web interface..... 209

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 10 / 221
Strict confidential		

- 4.8.4.2 Configuring network parameters..... 209
- 4.8.4.3 Configuring credentials 210
- 5. Maintenance of the Wirnet iBTS 211
 - 5.1 Simple checks 211
 - 5.1.1 Wirnet iBTS enclosure 211
 - 5.1.2 User interface 211
 - 5.1.3 Cables and antennas 211
 - 5.1.4 PoE injector 212
 - 5.2 Adding or replacing a module 212
 - 5.3 Interfaces for debug or maintenance purposes..... 212
 - 5.3.1 Proprietary debug interface 212
 - 5.3.2 USB interface 214
 - 5.3.3 ON/OFF button 214
 - 5.3.4 Local interface 215
- 6. List of the accessories..... 216
- 7. Customer support 220

FIGURES

- Figure 1: LoRa Network topology..... 20
- Figure 2: Wirnet iBTS external view 23
- Figure 3: Wirnet iBTS internal view 23
- Figure 4: Wirnet iBTS Fdx internal view 24
- Figure 5: Enclosure internal view 26
- Figure 6: Insertion of the modules inside the enclosure..... 27
- Figure 7: Insertion of the modules inside the enclosure..... 28
- Figure 8: Wirnet iBTS Compact external view 29
- Figure 9 : Wirnet iBTS Compact internal view..... 30
- Figure 10: Insertion of the modules inside the cabinet 32
- Figure 11: Wirnet iBTS Compact internal antennas 32
- Figure 11: Common Wirnet iBTS block diagram 33
- Figure 12: Standard Wirnet iBTS block diagram..... 35
- Figure 13: Wirnet iBTS “4 LoRa modules” block diagram 36
- Figure 14: Wirnet iBTS Compact block diagram..... 37
- Figure 15: Wirnet iBTS Fdx block diagrams..... 38
- Figure 16: Mechanical description of the CPU module..... 39
- Figure 17: Connectors and user interfaces of the CPU module 41

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 11 / 221
Strict confidential			

Figure 18: Mechanical description of the WAN module 43
 Figure 19: Connectors and user interfaces of the WAN module 44
 Figure 20: Mechanical description of the Dual WAN module..... 48
 Figure 21: Connectors and user interfaces of the Dual WAN module 49
 Figure 22: Mechanical description of the LoRa – LOC module 51
 Figure 23: Mechanical description of the four LoRa LOC modules configuration 52
 Figure 24: Mechanical description of the four LoRa LOC-FDx modules configuration 53
 Figure 25: Connectors and user interfaces of the LoRa LOC module..... 55
 Figure 26: RF1 and RF2 connectors of the LoRa LOC module 55
 Figure 27: Connectors and user interfaces of the 4 LoRa LOC modules 56
 Figure 28: Connectors and user interfaces of the 4 LoRa LOC modules 57
 Figure 29: Front-end board block diagram 60
 Figure 30: Front-end 4 modules board block diagram..... 61
 Figure 31: Front-end 4 modules full-duplex board block diagram..... 62
 Figure 32: Example of SNR, RSSI and RSSI+SNR plots at 125KHz BW / SF7..... 67
 Figure 33: Dimensions of the dual duplexer 69
 Figure 34: Connectors of the dual duplexer..... 70
 Figure 35: S parameters of the dual duplexer..... 71
 Figure 36 : Required isolation on PoE injector 73
 Figure 37 : indoor 30W AC/DC POE injector 74
 Figure 38 : indoor 60W AC/DC POE injector 76
 Figure 39 : indoor 30W DC/DC POE injector 78
 Figure 40 : indoor 60W DC/DC POE injector 79
 Figure 41 : Outdoor 30W AC/DC POE injector 81
 Figure 42 : Outdoor 60W AC/DC POE injector 82
 Figure 43 : Outdoor 60W DC/DC POE injector 84
 Figure 44 : Required isolation on auxiliary power supply input..... 85
 Figure 45 : Isolated 40W DC/DC converter 87
 Figure 46 : Radiation pattern of omnidirectional 868MHz/3dBi antenna 88
 Figure 47 : Radiation pattern of omnidirectional 868MHz/6dBi antenna 89
 Figure 48 : Radiation pattern of omnidirectional 915MHz/3dBi antenna 90
 Figure 49 : Radiation pattern of omnidirectional 915MHz/6dBi antenna 91
 Figure 50 : Dimensions of the 865-867MHz cavity filter 95
 Figure 51 : Frequency response of the 865-867MHz cavity filter 96
 Figure 52 : Dimensions of the 865-870MHz cavity filter 97
 Figure 53 : Frequency response of the 865-870MHz cavity filter 97
 Figure 54 : Dimensions of the 863-873MHz cavity filter 98
 Figure 55 : Frequency response of the 863-873MHz cavity filter 99
 Figure 56 : Dimensions of the 915-920MHz cavity filter 100
 Figure 57 : Frequency response of the 915-920MHz cavity filter 100
 Figure 58 : Dimensions of the 918-923MHz cavity filter 101
 Figure 59 : Frequency response of the 918-923MHz cavity filter 102
 Figure 60 : Dimensions of the 920-925MHz cavity filter 103
 Figure 61 : Frequency response of the 920-925MHz cavity filter 103
 Figure 62 : Dimensions of the 920-928MHz cavity filter 104
 Figure 63 : Frequency response of the 920-928MHz cavity filter 105
 Figure 64 : Dimensions of the 902-928MHz cavity filter 106

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 12 / 221
Strict confidential		

Figure 65 : Frequency response of the 902-928MHz cavity filter 107
 Figure 66 :RJ45 T-568A plug 108
 Figure 67 : P8AX Citel 109
 Figure 68 : PRC822S Citel..... 110
 Figure 69 : DC surge protections (1 pole and 2 poles) 110
 Figure 70 : DC surge protection 1 pole schematic 111
 Figure 71 : Example of DC surge protection cabling 111
 Figure 72 : Tongue terminal 112
 Figure 73 : Tongue terminal assembly 112
 Figure 74 : DC surge protection 2 poles schematic..... 113
 Figure 75 : MJ8-POE-A Citel..... 114
 Figure 76 : PD-OUT/SP11 Microsemi..... 115
 Figure 77 : Dimensions of the notched V shaped plate 116
 Figure 78 : Universal antenna bracket dimensions 117
 Figure 79 : Dome antenna bracket dimensions 118
 Figure 80 : Dome antenna bracket with notched V shaped bolt 119
 Figure 81 : WIRMA2 Debug Tool connected to the CPU module..... 120
 Figure 82 : Channels allocation proposal in Japan 137
 Figure 83 : Urban (small city) Hata propagation model – RSSI (dBm) vs distance (meters) vs height of the antenna 146
 Figure 84 : Rural countryside Hata propagation model - RSSI (dBm) vs distance (meters) vs height of the antenna 146
 Figure 85 : Hata propagation model vs area configuration (Height = 12m) – RSSI (dBm) vs distance (m) 147
 Figure 86 : Hata propagation model vs area configuration (Height = 30m) – RSSI (dBm) vs distance (m) 147
 Figure 87 : Fading effects due to obstacles..... 148
 Figure 88 : Fresnel ellipsoid clearance 149
 Figure 89 : Fresnel ellipsoid and earth curvature..... 149
 Figure 90 : Typical antenna gain pattern of a GSM BTS 151
 Figure 91 : Typical gain of 3dBi omnidirectional antenna 151
 Figure 92 : Typical gain of a sectorial antenna 152
 Figure 93: Wirnet iBTS – plastic clips on the lid 155
 Figure 94: Wirnet iBTS – 4x M5 screws 156
 Figure 95 : Open points of the compact enclosure 157
 Figure 96 : Opening of the compact enclosure with screwdriver 158
 Figure 97 : Single station installation (with USIM) 159
 Figure 98 : Single station installation (No USIM)..... 159
 Figure 99 : Multi-station installation (No USIM) 160
 Figure 100 : Power distribution in the installation..... 161
 Figure 101 : Position of the universal antenna support when mounted on the compact enclosure support 167
 Figure 102 : Wall mount of the universal antenna bracket 169
 Figure 103 : Pole mounting of the universal antenna bracket using strapping 169
 Figure 104 : Universal antenna bracket with compact casing mounting kit 169
 Figure 105 : LoRa antenna mounted on universal antenna bracket..... 170
 Figure 106 : N connector introduced in the hole of the dome antenna bracket..... 171

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 13 / 221
Strict confidential		

Figure 107 : Antenna installed on the dome antenna bracket 171
 Figure 108 : Compact casing mounting kit dimensions..... 172
 Figure 109 : Compact casing - Wall mount 172
 Figure 110 : Compact casing - Pole mount using U-bolt 173
 Figure 111 : Compact casing - rear view of the pole mounting using U-bolt (no pole represented) . 173
 Figure 112 : Compact casing - Pole mount using strapping 174
 Figure 113 : Standard casing mounting kit dimensions 175
 Figure 114 : Rear view of the standard casing with mounting kit..... 175
 Figure 115 : Compact casing - Wall mount 176
 Figure 116 : Standard casing - Pole mount using U-bolts 176
 Figure 117 : Compact casing - rear view of the pole mounting using U-bolt (no pole represented) . 177
 Figure 118 : Standard casing - Pole mount using strapping 177
 Figure 119 : Screws for indoor POE injectors mounting 178
 Figure 120 : Screws for outdoor POE injectors mounting 178
 Figure 121 : Mounting bracket for outdoor POE injectors..... 179
 Figure 122 : Indoor Ethernet surge protection – DIN rail clip 179
 Figure 123 : Outdoor Ethernet Surge protection – wall mounting 180
 Figure 124 : Outdoor Ethernet Surge protection – pole mounting with strapping 180
 Figure 125 : connection settings of the installation..... 182
 Figure 126 : Standard casing – earthing with U bolt configuration 183
 Figure 127 : Standard casing – earthing without U bolt configuration 183
 Figure 128 : Compact casing – earthing with U bolt configuration..... 184
 Figure 129 : Compact casing – earthing without U bolt configuration 184
 Figure 130 : Earthing of the RF coaxial surge protection 185
 Figure 131 : Earthing of the RF coaxial surge protection 186
 Figure 132 : Earthing of the indoor Ethernet surge protection 186
 Figure 133 : Earthing of the outdoor Ethernet surge protection 187
 Figure 134 : Earthing of the outdoor PoE injector 187
 Figure 135 : nominal configuration of N connectors - standard casing 188
 Figure 136 : Recommended allocation of the N connectors – Standard casing 189
 Figure 137 : Nominal configuration of N connectors - compact casing 190
 Figure 138 : GNSS antenna cabling, internal and external..... 191
 Figure 139 : LTE antenna cabling, internal and external 192
 Figure 140 : GPS and LTE cabling within Wirnet iBTS Compact 193
 Figure 141 : Internal LTE antenna within Wirnet iBTS Compact 193
 Figure 142 : Connection of the RF coaxial cable 194
 Figure 143 : attachment of the RF antenna coaxial cable..... 195
 Figure 144 : Single LoRa module / single omnidirectional antenna connections 195
 Figure 145 : Single LoRa module / dual omnidirectional antennas connections 196
 Figure 146 : Single LoRa module / single dual polarization antenna connections..... 196
 Figure 147 : Two LoRa modules / two omnidirectional antennas / diversity connections..... 197
 Figure 148 : Two LoRa modules / two dual polarization antennas connections 197
 Figure 149 : Three LoRa modules / three sectors antennas connections..... 198
 Figure 150 : Three LoRa modules / three sectors antennas / dual polarization connections 198
 Figure 151 : Four LoRa modules / single omnidirectional antenna connections..... 199
 Figure 152 : Four LoRa modules / dual omnidirectional antennas / diversity connections 199
 Figure 153 : Four LoRa modules / dual polarization antenna connections..... 200

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 14 / 221
Strict confidential		

Figure 154 : Ethernet connection on Wirnet iBTS side / cable gland..... 201
 Figure 155 : Ethernet connection on Wirnet iBTS side 201
 Figure 156 : Ethernet connection on PoE injector side..... 202
 Figure 157 : Auxiliary DC power supply connector 203
 Figure 158 : Installation with recommended lighting protections..... 204
 Figure 159 : Installation with recommended lighting protections / Outdoor PoE injector 206
 Figure 160 : USIM Card..... 207
 Figure 161 : Wirma2 Debug tool connected to the Wirnet iBTS..... 213
 Figure 162 : Serial port configuration..... 213
 Figure 163 : USB connector of the Wirnet iBTS..... 214
 Figure 164 : ON/OFF button of the Wirnet iBTS 214
 Figure 165 : Local Ethernet interface of the Wirnet iBTS..... 215

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 15 / 221
Strict confidential		

REFERENCES

Reference	Document / link	Description
[1]	https://www.lora-alliance.org/For-Developers/LoRaWANDevelopers	LoRaWAN™ Specification V1.0.3 2018 March 19th
[2]	https://www.lora-alliance.org/For-Developers/LoRaWANDevelopers	LoRaWAN™ 1.1 Regional Parameters Revision B, 2018 January
[3]		E-CON-Product_Description_Wirnet_iBTS-V1.4.docx
[4]	https://www.lora-alliance.org/For-Developers/LoRaWANDevelopers	LoRaWAN™ Regional Regulation Summary Version 1.5 draft 8 February 12th, 2018

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 16 / 221
Strict confidential		

GLOSSARY

Abbreviation	Description
ADC	Analog to Digital Converter
AES	Advanced Encryption Standard
AGC	Automatic Gain Control
AMR	Automatic Meter Reading
ANATEL	Agência Nacional de Telecomunicações (Brazilian agency of telecommunications)
AP	Access Point
APAC	Asia PACific
APC	Automated Power Control
API	Application Programming Interface
APN	Access Point Name
ARM	Advanced RISC Machine
BER	Bit error Rate
BLER	Block Error rate
BTS	Base Transceiver Station
BW	Band Width
CAN	Control Area Network
CDMA	Code Division Multiple Access
CMOS	Complementary Metal Oxide Semiconductor
CPU	Central Processing Unit
DAC	Digital to Analog Converter
DDR	Double Data Rate
DDRAM	Double Data Rate RAM
DHCP	Dynamic Host Configuration Protocol
DIN	Deutsches Institut für Normung (German Institute for Standardization)
DOTA	Download Over The Air
DSP	Digital Signal Processor
DVFS	Dynamic Voltage and Frequency Scaling
EDGE	Enhanced Data rates for GSM Evolution
EIRP	Equivalent Isotropically Radiated Power
EMC	ElectroMagnetic Compatibility
eMMC	Embedded Multi Media Card
FCC	Federal Communications Commission
FER	Frame Error Rate
FPGA	Field Programmable Gate Array
FTP	File Transfer Protocol
GNSS	Global Navigation Satellite System

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 17 / 221
Strict confidential		

GMSK	Gaussian Minimum Shift Keying
GPIO	General Purpose Input Output
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile communication
HSPA	High Speed Packet Access
HTTP	HyperText Transfer Protocol
IC	Integrated Circuit or Industry Canada
IK	Mechanical Impact
IO	In / Out
IoT	Internet of Things
IP	Internet Protocol or Ingress Protection
IrDA	Infrared Data Association
ISM	Industrial Scientific and Medical
I2C	Inter Integrated Circuit
I2S	Inter IC Sound
KLK	KERLINK
KNET	KERLINK M2M network
LBT	Listen Before Talk
LDO	Low Drop Out
LED	Light-Emitting Diode
LNA	Low Noise Amplifier
LoRa	Long Range
LSZH	Low Smoke Zero Halogen
LTE	Long Term Evolution
LUT	Look Up table
LVDS	Low Voltage Differential Signaling
M2M	Machine to Machine
MIPS	Millions of Instructions Per Second
MFLOPS	Million Floating-point Operations Per Second
NFS	Network File System
NMEA	National Marine Electronics Association
PA	Power Amplifier
PC	Personal Computer or Polycarbonate
PCB	Printed Circuit Board
PCI	Peripheral Component Interconnect
PER	Packet Error Rate
PLL	Phase Locked loop
PoE	Power over Ethernet

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 18 / 221
Strict confidential		

PU	Polyurethane
RAM	Random Access Memory
RF	Radio Frequency
RSSI	Received Signal Strength Indicator
RTC	Real Time Clock
RX	Receive
SAW	Surface Acoustic Wave
SDIO	Secure Digital Input Output
SI	Système d'Information
SIM	Subscriber Identity Module
SMA	SubMiniature version A
SMB	SubMiniature version B
SNR	Signal to Noise Ratio
SPDT	Single Pole Double Throw
SPI	Serial Peripheral Interface bus
SSH	Secure Shell
SSTP	Screened Shielded Twisted Pair
STP	Shielded Twisted Pair
TBD	To Be Defined
TCP	Transmission Control Protocol
TDOA	Time Difference On Arrival
TPE	ThermoPlastic Elastomer
TX	Transmit
UART	Universal Asynchronous Receiver Transmitter
UFL	Miniature coaxial RF connector manufactured by Hirose Electric Group
UICC	Universal Integrated Circuit Card
UMTS	Universal Mobile Telecommunications System
USB	Universal Serial Bus
USIM	Universal Subscriber Identity Module
UV	UltraViolet
VLIW	Very Long Instruction Word
WAN	Wide Area Network
WLAN	Wireless Local Area Network
VHF	Very High Frequency
3G	Third generation of mobile telecommunications technology
3GPP	3rd Generation Partnership Project
4G	Fourth generation of mobile telecommunications technology
8PSK	Eight Phase shift Keying

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 19 / 221
Strict confidential		

INTRODUCTION

The Wirnet iBTS gateway is part of the global Long Range Radio fixed network to provide M2M connectivity link between low power end-point and Internet access. The gateway architecture is specifically designed for the needs of public networks operators.

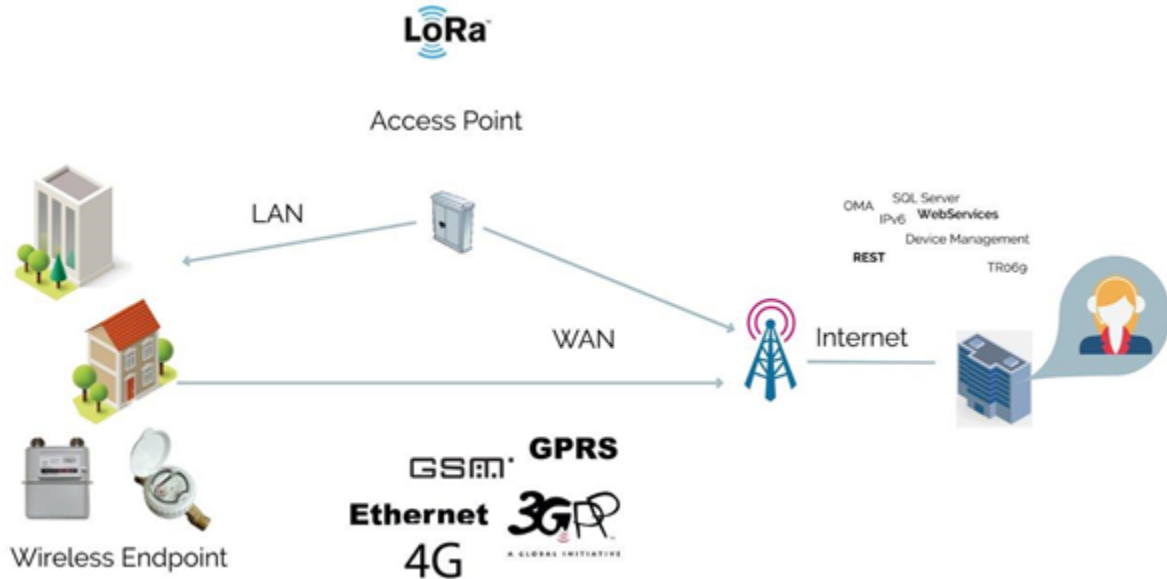


Figure 1: LoRa Network topology

The Wirnet iBTS is based on “Next Generation LoRa” technology provided by Semtech Company. It is compatible and interoperable with existing LoRa LPWAN and offers GPS-free geolocalization features compatibility.

Wirnet iBTS architecture is completely modular and upgradable to offer multiple configurations to cover different countries and areas around the world:

	Wirnet iBTS 868	Wirnet iBTS 915	Wirnet iBTS FDx	Wirnet iBTS 923
Geographical area	Europe, Russia Africa Middle East, India	North America Central America South America Philippines	North America	Asia : Indonesia, Malaysia, Korea, Japan, Taiwan, Hong Kong, Thailand, Vietnam, Papua New Guinea, Singapore Oceania : Australia, New Zealand Latin America: Brazil, Argentina, Colombia
ISM band	863 - 876 MHz	902 - 928 MHz	902 - 928 MHz	915 - 928 MHz
Downstream band	863 - 873MHz	902 - 928 MHz	923 - 928 MHz	919 - 928 MHz
Upstream band	863 - 873 MHz	902 - 928 MHz	902 - 915 MHz	915 - 928 MHz

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 20 / 221
Strict confidential			

WWAN capabilities	LTE B1, B3, B7, B8 and B20 HSPA B1, B2, B5 and B8 GSM/GPRS/EDGE 850, 900, 1800 and 1900	LTE B2, B4, B5, B13, B17 and B25 CDMA BC0, BC1 and BC10 HSPA B1, B2, B4, B5 and B8 GSM/GPRS/EDG E 850, 900, 1800 and 1900	LTE B2, B4, B5, B13, B17 and B25 CDMA BC0, BC1 and BC10 HSPA B1, B2, B4, B5 and B8 GSM/GPRS/EDGE 850, 900, 1800 and 1900	LTE B1, B3, B5, B7, B8, B18, B19, B20, B21, B28, B38, B39, B40 and B41 HSPA B1, B2, B5, B6, B8, B9 and B19 TD-SCDMA B39 GSM/GPRS/EDGE 850, 900, 1800 and 1900
Certifications	CE (Europe) WPC (India)	FCC (USA) IC (Canada) CB scheme for : Philippines, Mexico, Chile, Colombia	FCC (USA) IC (Canada)	ACMA (Australia, New-Zealand) MIC (Japan) OFCA (Hong-Kong) CB scheme for : Thailand, Korea, Singapore, Indonesia, Malaysia, Brazil, Argentina
Filters for installation already existing in telco-area	Usage in India requires a specific cavity filter for coexistence with CDMA800	Not able to share the same installation site with GSM900/HSPA900/LTE900 BTS (if necessary, use a specific cavity filter) Usage in Philippines requires a specific cavity filter.	Embedded cavity duplexer Not able to share the same installation site with GSM900/HSPA900/LTE900 BTS	Usage in Singapore, Hong-Kong and Malaysia requires a specific cavity filter.

Please check the appropriate version for the dedicated country. Contact KERLINK if required.

The present document addresses all the above Wirnet iBTS versions.

1. Description of the Wirnet iBTS

1.1 Modular architecture

The Wirnet iBTS has a modular architecture allowing the operator to configure and upgrade the gateway to fulfill its needs.

Thanks to the modularity the operator is able to choose:

- The backhaul network: Ethernet or GPRS/EDGE/HSPA/CDMA/LTE
- The unlicensed band (ISM) where to operate the LoRa LPWAN: 863-873MHz (aka 868MHz), 902-928MHz (aka 915MHz) or 915-928MHz (aka 923MHz)
- The number of channels to operate the LoRa LPWAN: 8 to 64
- The antenna interface: single (omnidirectional), dual (space diversity or dual polarization) or tri (sectorization)

Four different modules can be integrated in the Wirnet iBTS:

- CPU Module, which includes the main following features:
 - Power management of the Wirnet iBTS
 - CPU
 - Memories
 - GNSS receiver (GPS)
- WAN Module, which provides the backhaul functionality:
 - Backup battery
 - 4G modem declined in 3 versions depending on the geographical area:
 - Europe
 - Americas
 - APAC
- LoRa module – LoRa LOC, which can be also derived in 4 versions :
 - 868MHz (863-873MHz)
 - 915MHz (902-928MHz)
 - 915MHz Full-Duplex (902-915MHz uplink, 923-928MHz downlink)
 - 923MHz (915-928MHz)

The Wirnet iBTS can integrate from one to four « LoRa modules ». In this particular “4 LoRa modules” configuration, a specific “front-end” board and mechanical lid are used to combine the four “LoRa modules” together (see §1.4.3 for further details).

In its maximum size configuration, the Wirnet iBTS can then integrate six modules: one “CPU module”, one “WAN module” and four “LoRa modules”.

The Figure 2 below shows an external view of the Wirnet iBTS:

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 22 / 221
Strict confidential			



Figure 2: Wirnet iBTS external view

The Figure 3 below shows an internal view of the Wirnet iBTS, featuring three “LoRa modules”, one “CPU module” and one “WAN module”:

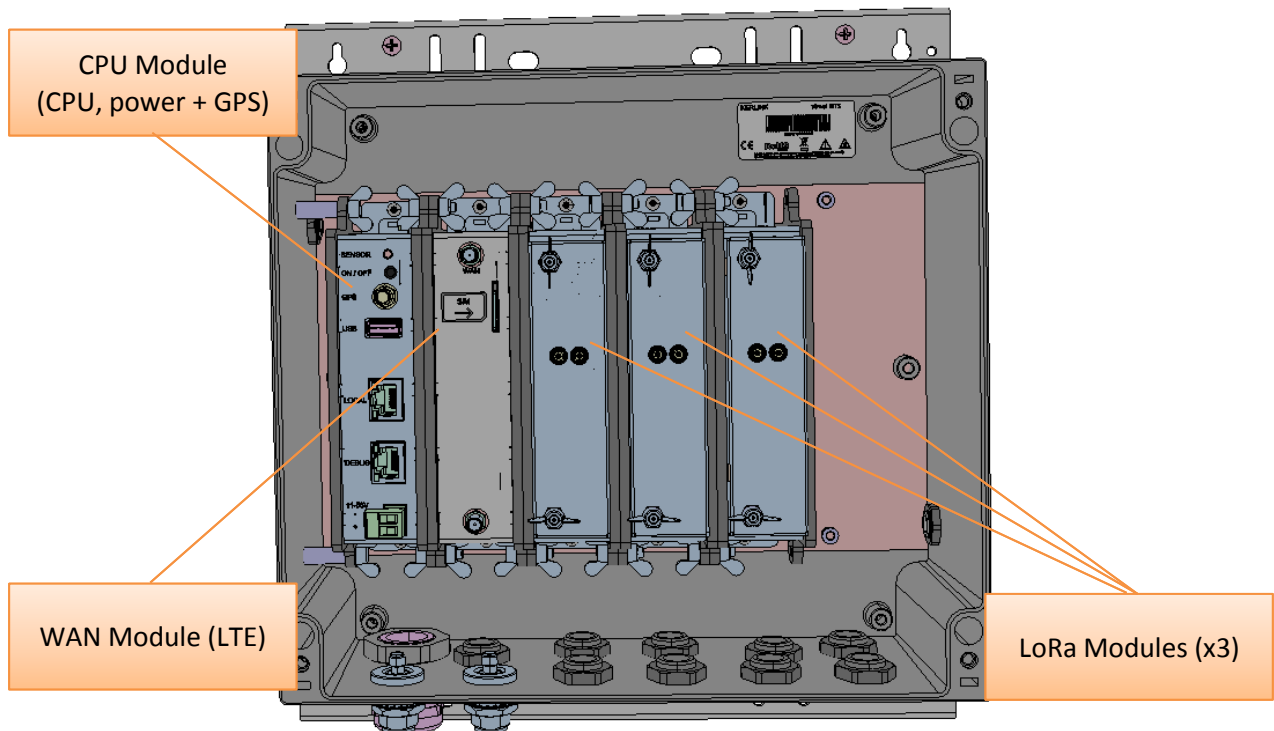


Figure 3: Wirnet iBTS internal view

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 23 / 221
Strict confidential		

A dual cavity duplexer is also embedded in the Wirnet iBTS FDx above the other modules
The Figure 4 below shows an internal view of the Wirnet iBTS FDx, featuring three “LoRa modules”, one “CPU module” one “WAN module” and the dual duplexer:

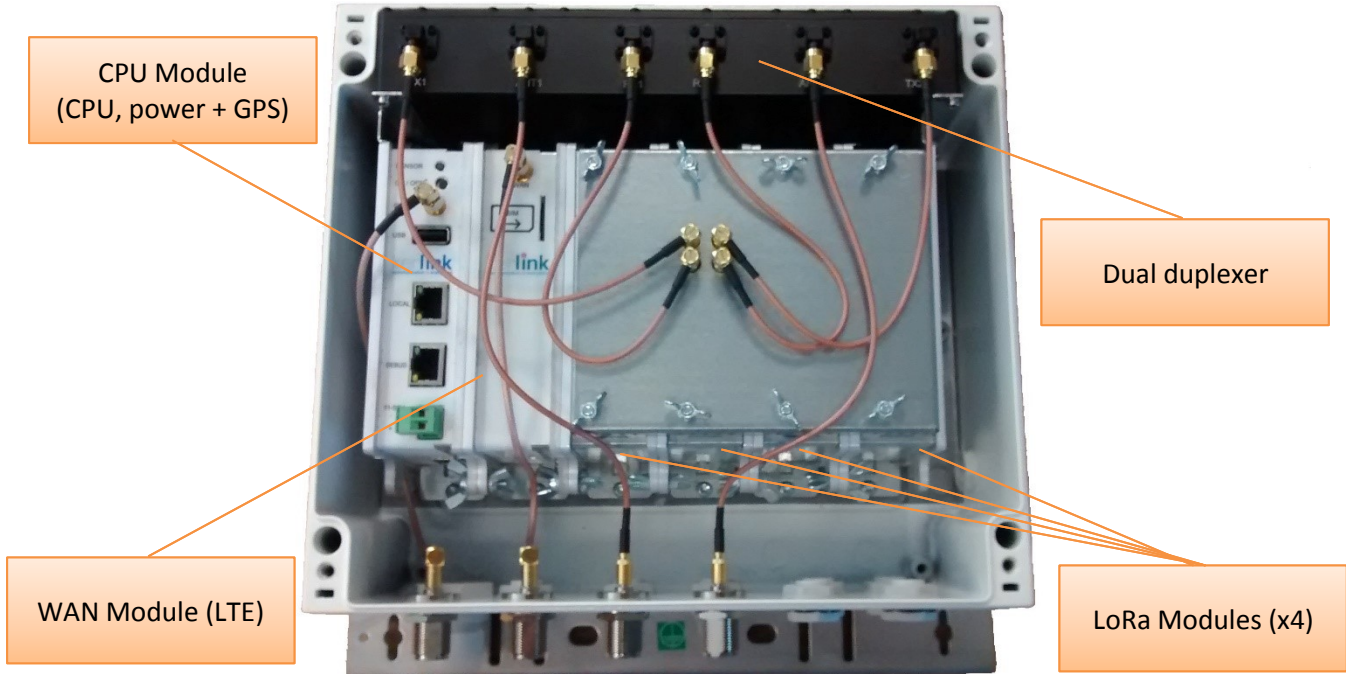


Figure 4: Wirnet iBTS FDx internal view

As part of the Wirnet iBTS modularity, many accessories can be provided for configuration purpose:

- GNSS antennas
- LTE antennas
- LoRa antennas
- RF cavity filters
- PoE injectors
- Surge protections

The full list of accessories is detailed in §1.8 and §6.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 24 / 221
Strict confidential		

1.2 Mechanical implementation for standard casing

1.2.1 Standard casing

The Wirnet iBTS station is built on a robust IP66 aluminum enclosure of 280 x 250 x 120 mm. It is composed of two separated parts: the frame and a lid. The lid tightens to the frame through M5 screws, hidden by two plastic clip-on design covers.

A mounting kit is screwed on the back of the enclosure, allowing several mounting configurations: wall mount, pole mount and metallic strapping.

The left and right sides of the enclosure integrate two waterproof screw-in vents to equalize the pressure inside and outside. This reduces condensation by allowing air to flow freely into and out of the sealed enclosure. At the same time, they provide a durable barrier to protect the internal modules from contaminants like dust, sand, water, etc ... improving reliability, safety and longer product life.

The bottom side of the enclosure is dedicated for the connectors:

- 1 x M25 cable gland used to introduce the Ethernet cable (PoE) inside the enclosure
- 3 x 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 number of LoRa antenna interfaces can be extended to 6.
- 8 x M16 blind stops. They are considered as provisions for N-SMB connectors to be used for additional antennas (LoRa or WAN) or external power supply cable gland.

Blind threaded standoffs are inserted in the rear side the enclosure. They are used to screw and maintain the modules inside the enclosure. The modules can be easily inserted and extracted for maintenance and upgradability purposes.

The Figure 5 below shows the different components inside the enclosure.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 25 / 221
Strict confidential		

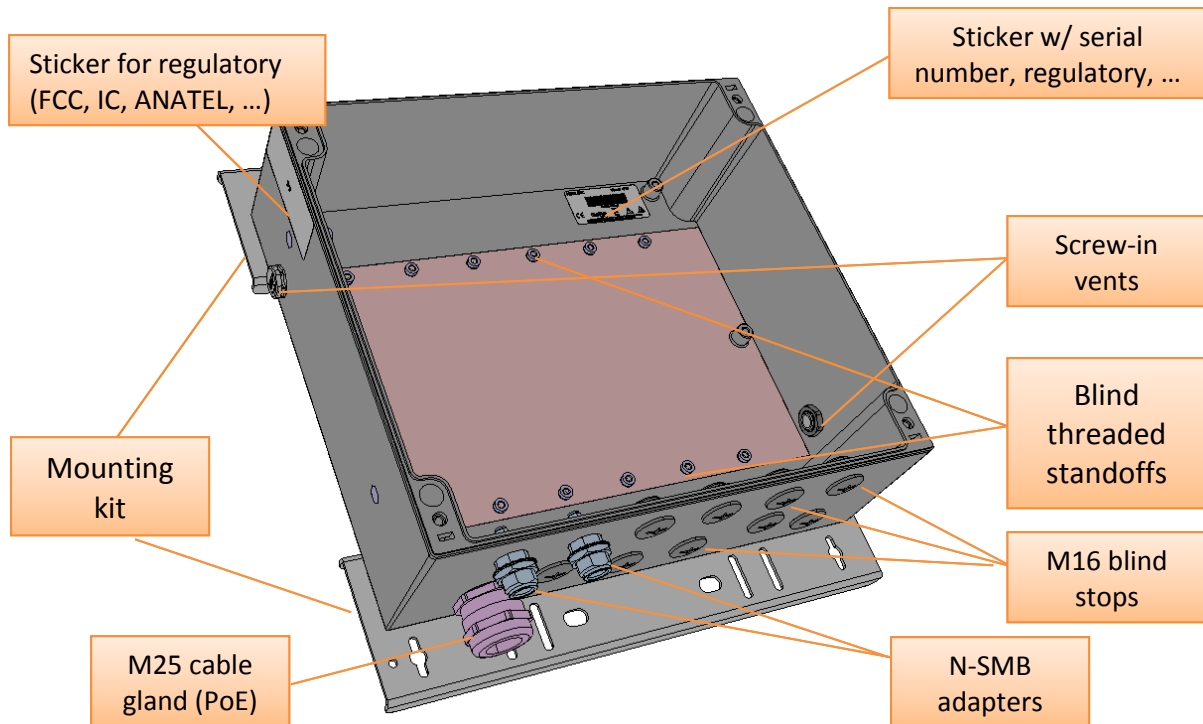


Figure 5: Enclosure internal view

The main characteristics of the enclosure are detailed hereafter:

Description	Specification
Enclosure material	Aluminum
Gasket material	TPE
Mounting kit material	Stainless steel
Color	RAL 9010
Dimensions with connectors	300 x 280 x 120 mm
Dimensions with connectors + mounting kit	300 x 320 x 125 mm
Weight – no modules	5.4 Kg
Weight – 3 modules configuration	7.2 Kg
Weight – Full-Duplex version	10Kg
Ingress protection	IP66 / EN 60529
Humidity	95% non-condensing
Impact resistance	IK08
Flammability rating	UL94-V0
Number of pressure equalizer	2
Enclosure temperature range	-40°C to +120°C
Wirnet iBTS operating temperature range	-20°C to +55°C
Connectors	1 x M25 cable gland (PoE) 3 x N-SMB adapters (extension to 11 max) 8 x M16 blind stops (provisions for N-SMB or cable gland)

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 26 / 221
Strict confidential		

The modules are screwed on the blind threaded standoffs to build the Wirnet iBTS according to customer requirements.

The modules are tightened all together with two mechanisms:

- the back panel board connectors,
- the wing screws assembling the mechanical sides (radiators) of the modules

SMB-SMB cables are provided to interconnect the RF interfaces of the modules to the SMB-N adapters, on the bottom side of the enclosure.

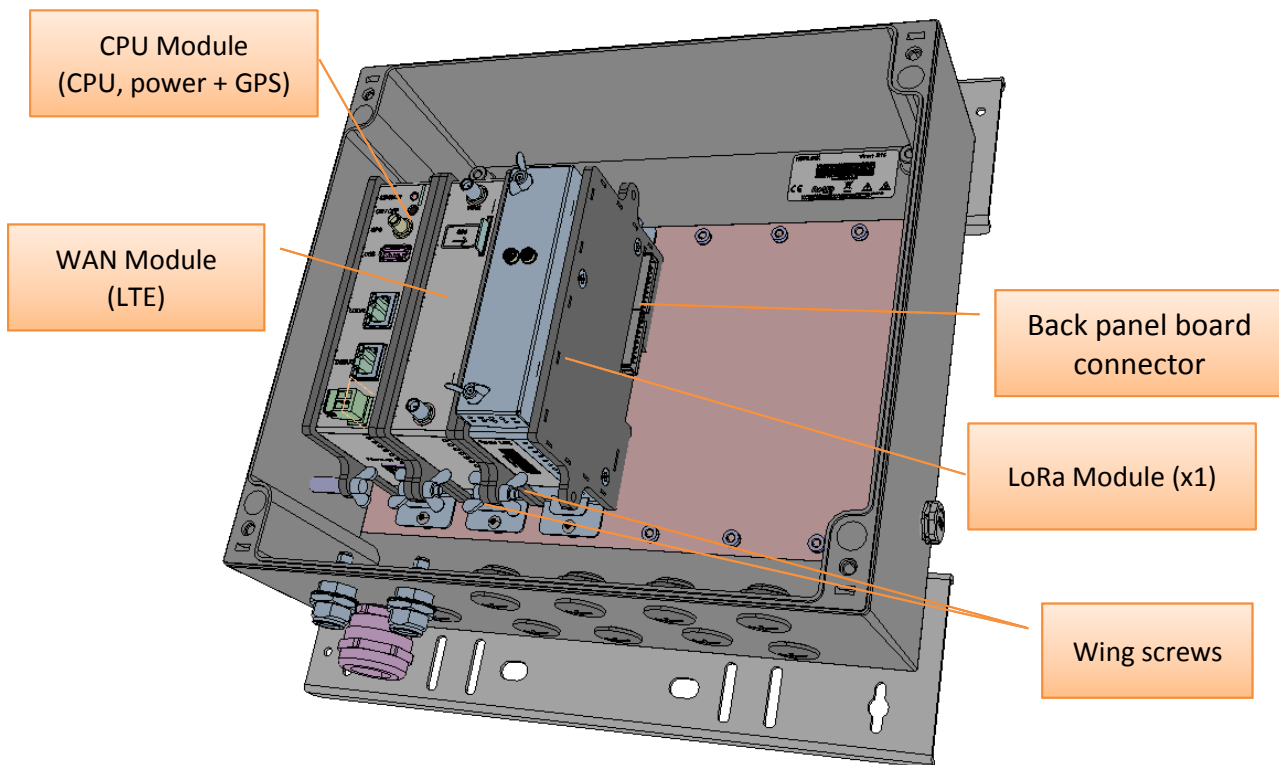


Figure 6: Insertion of the modules inside the enclosure

The modules are also screwed on the blind threaded standoffs to build the Wirnet iBTS FDx. The dual duplexer is assembled to the modules with a specific mounting kit.

SMB-SMB cables are provided to interconnect the RF interfaces of the modules to the SMB-N adapters, on the bottom side of the enclosure.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 27 / 221
Strict confidential			

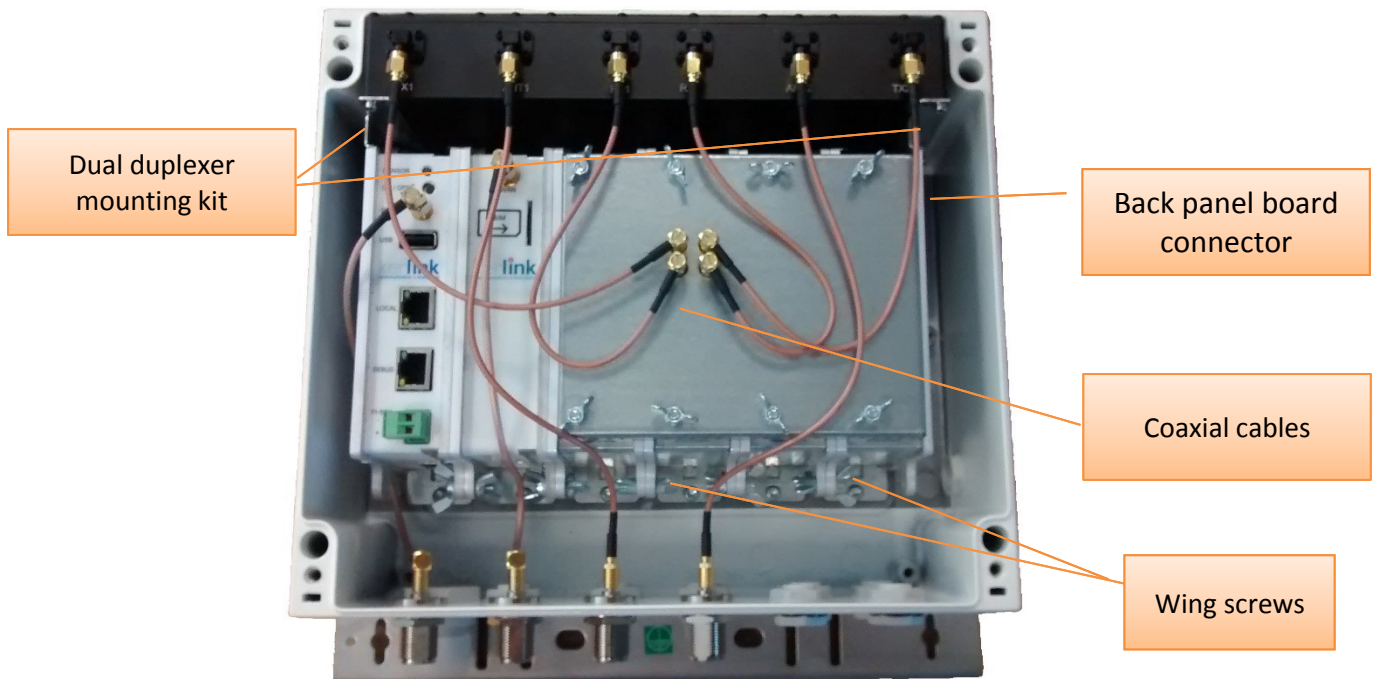


Figure 7: Insertion of the modules inside the enclosure

1.2.2 Stickers

The Wirnet iBTS has two stickers placed inside and outside the casing:

- A sticker on the rear of the Wirnet iBTS enclosure including serial number, regulatory markings and electrical information.
- A sticker outside the enclosure including regulatory marking, logo and sentences depending on the countries (FCC, IC, ANATEL, etc ...).

The placement of the stickers is described on Figure 5.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 28 / 221
Strict confidential		

1.3 Mechanical implementation for compact casing

1.3.1 Compact casing

The Wirnet iBTS Compact station is built on a high impact resistant IP67 polycarbonate wall mounting cabinet that withstands harsh industrial and outdoor environments.

It offers excellent flammability rating, good UV resistance and also good chemical resistance. The dimensions of the cabinet are 260 mm x 170 mm x 120 mm.

It is composed of two separated parts: the frame and a lid. The lid tightens to the frame through two hinges that can be opened or closed by simple clipping. No screws are required but only optional.

A mounting kit, with embedded antenna brackets, is screwed on the back of the enclosure, allowing several mounting configurations: wall mount, pole mount and metallic strapping.

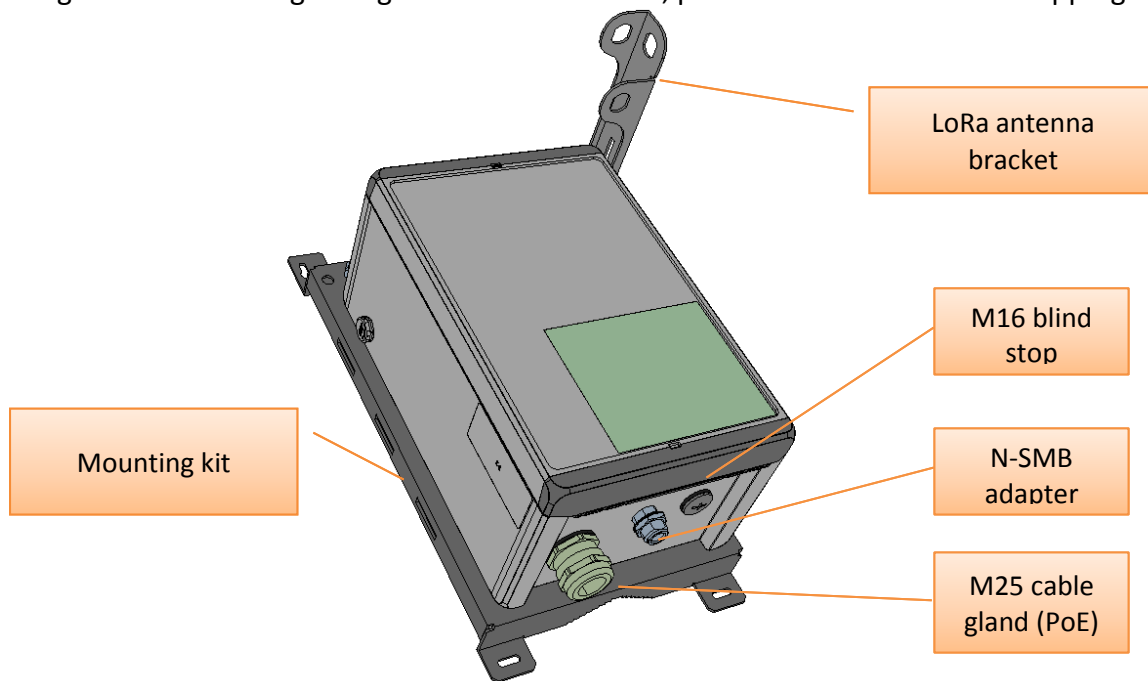


Figure 8: Wirnet iBTS Compact external view

The left and right sides of the enclosure integrate two waterproof screw-in vents to equalize the pressure inside and outside. This reduces condensation by allowing air to flow freely into and out of the sealed enclosure. At the same time, they provide a durable barrier to protect the internal modules from contaminants like dust, sand, water, etc ... improving reliability, safety and longer product life.

The bottom side of the enclosure is dedicated for the connectors:

- 1 x M25 cable gland used to introduce the Ethernet cable (PoE) inside the enclosure
- 1 x N-SMB adapters used as RF interfaces for LoRa antenna. The number of LoRa antenna interfaces can be extended to two.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 29 / 221
Strict confidential		

- 1 x M16 blind stop. It is considered as provision for an N-SMB connector to be used for additional LoRa antenna or external power supply cable gland.

An internal metal plate features a GNSS/LTE antenna bracket. An internal GNSS/LTE magnetic mount antenna is placed on this bracket.

Blind threaded standoffs are inserted in the rear side the enclosure. They are used to screw and maintain the modules inside the enclosure. The modules can be easily inserted and extracted for maintenance and upgradability purposes.

The Figure 9 below shows the different components inside the enclosure.

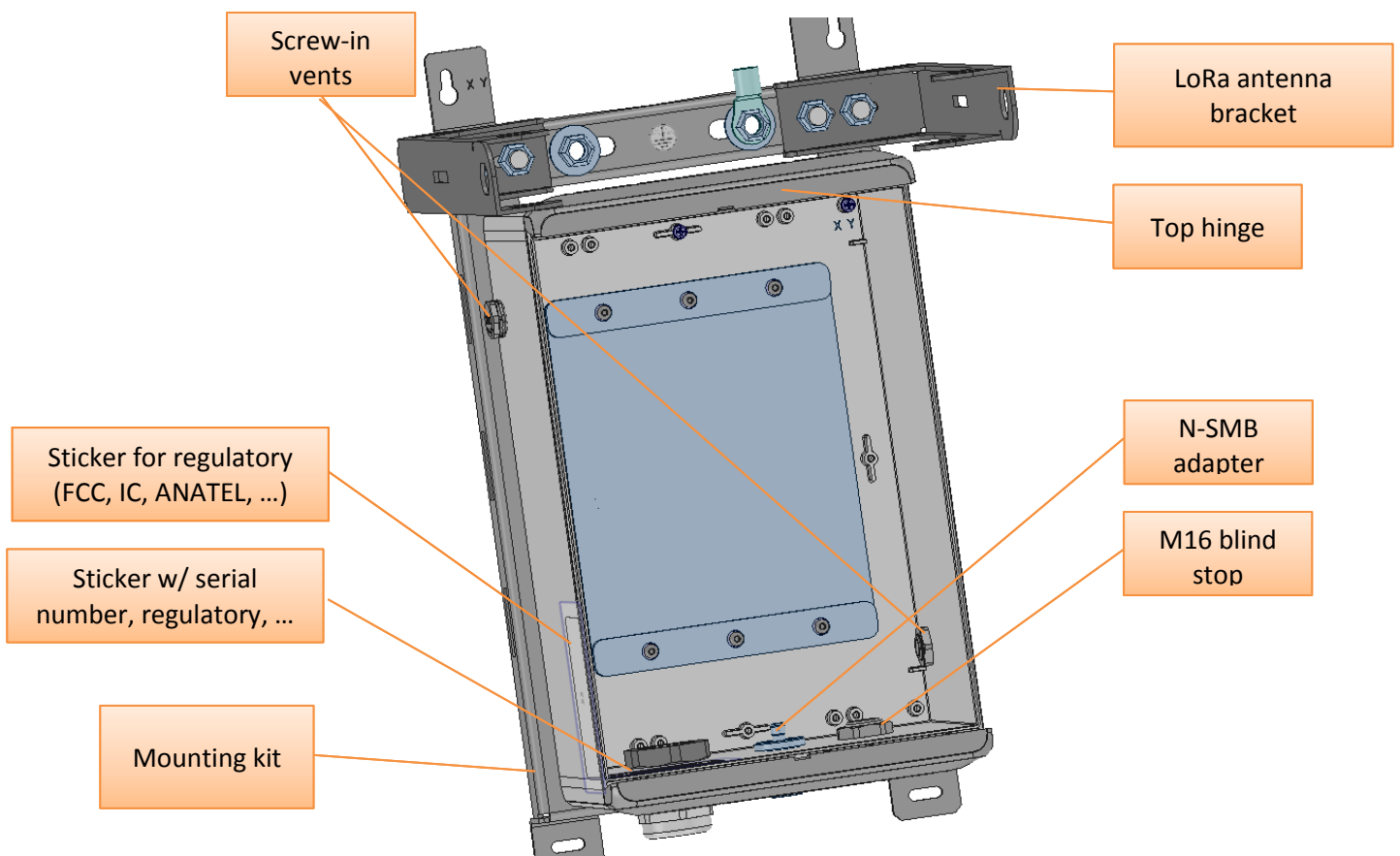


Figure 9 : Wirnet iBTS Compact internal view

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 30 / 221
Strict confidential		

The main characteristics of the cabinet are detailed hereafter:

Description	Specification
Enclosure material	Polycarbonate (PC)
Gasket material	Polyurethane (PU)
Mounting kit material	Stainless steel
Color	RAL 7035
Dimensions with connectors	280 x 170 x 120 mm
Dimensions with connectors + mounting kit	360 x 190 x 150 mm
Weight – 3 modules configuration	3 Kg
Ingress protection	IP66 / EN 60529
Humidity	95% non-condensing
Impact resistance	IK08
Flammability rating	UL94-V0
Number of pressure equalizer	2
Cabinet temperature range	-40°C to +105°C
Wirnet iBTS operating temperature range	-20°C to +55°C
Connectors	1 x M25 cable gland (PoE) 1 x N-SMB adapters (extension to 2 max) 1 x M16 blind stops (provision for N-SMB or cable gland)

The modules are screwed on the blind threaded standoffs to build the Wirnet iBTS Compact according to customer requirements.

The Wirnet iBTS Compact can embed up to 3 modules.

The modules are tightened all together with two mechanisms:

- the back panel board connectors,
- the wing screws assembling the mechanical sides (radiators) of the modules

SMB-SMB cables are provided to interconnect the RF interfaces of the modules to the SMB-N adapters, on the bottom side of the enclosure.

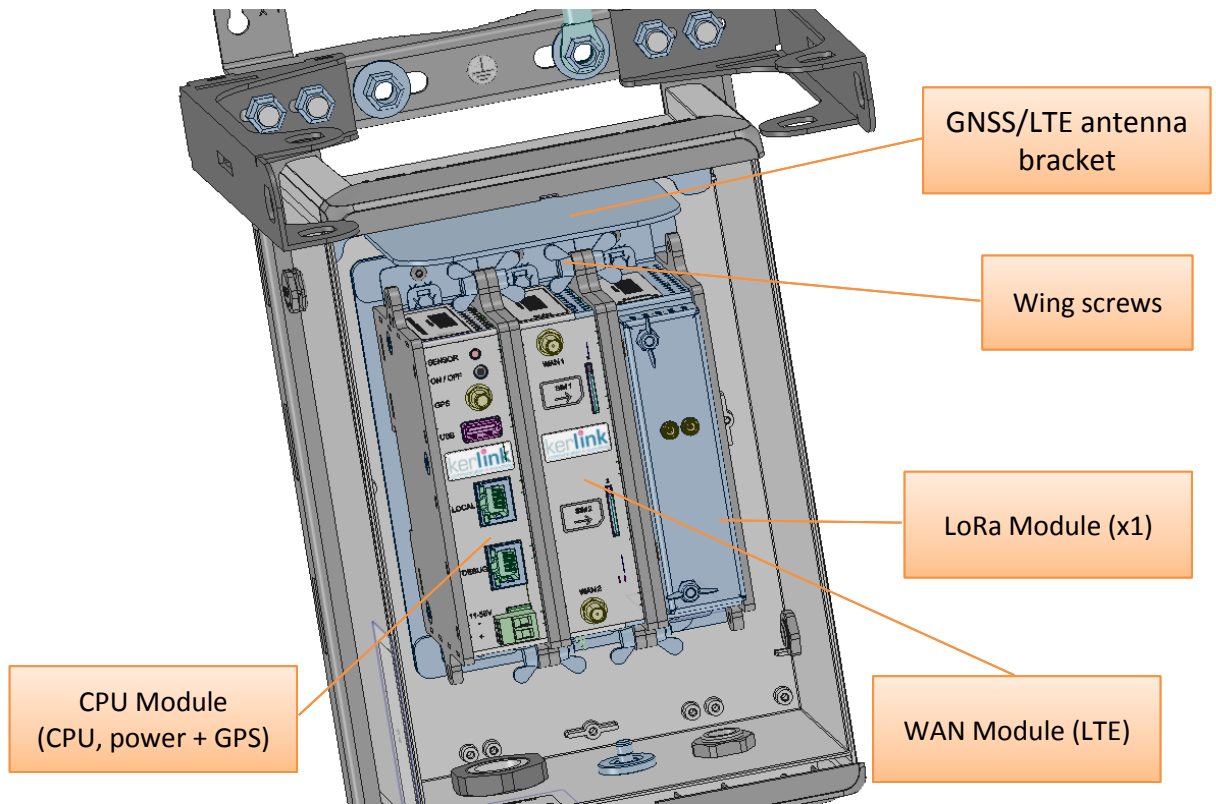


Figure 10: Insertion of the modules inside the cabinet

Depending on Wirnet IBTS compact versions, two kind of internal antennas are used:

- A combo Cellular/GPS antenna with a dedicated internal mounting bracket
- One single GPS antenna and a single cellular Antenna

Performances of both configurations are very similar.

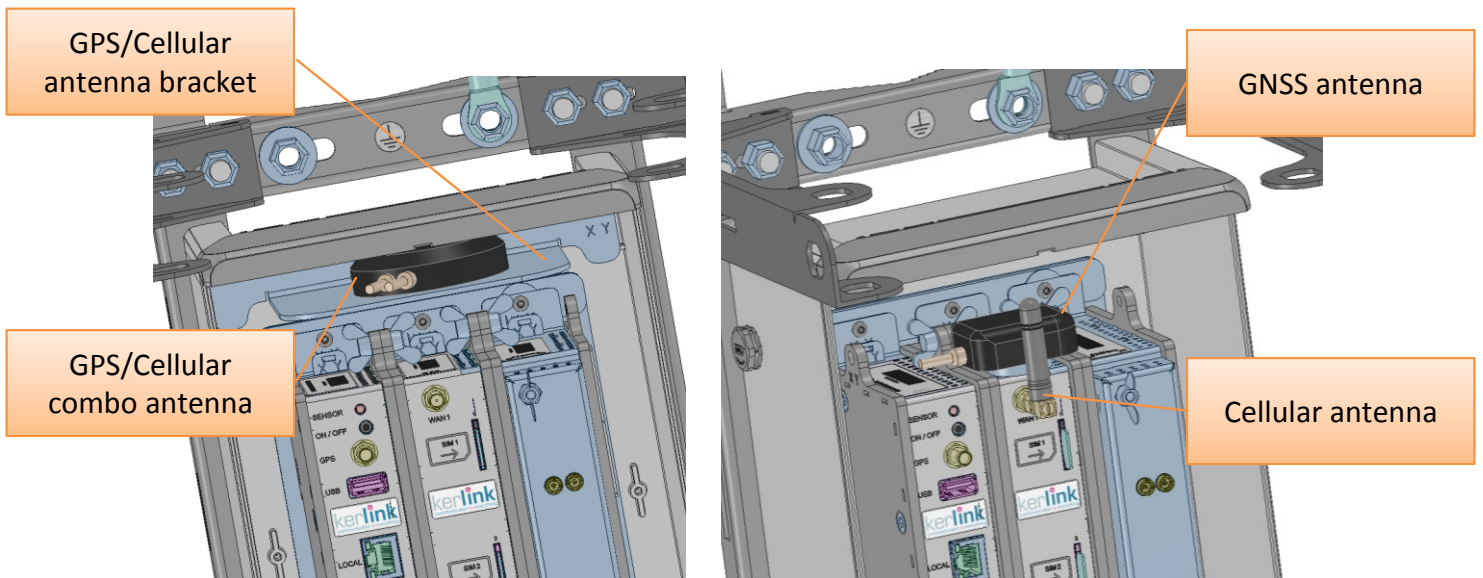


Figure 11: Wirnet iBTS Compact internal antennas

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 32 / 221
Strict confidential		

1.3.2 Stickers

The Wirnet iBTS Compact has two stickers placed inside and outside the casing:

- A sticker on the bottom of the Wirnet iBTS Compact cabinet including serial number, regulatory markings and electrical information.
- A sticker outside the cabinet including regulatory marking, logo and sentences depending on the countries (FCC, IC, ANATEL, etc ...).

The placement of the stickers is described on Figure 9.

1.4 Block Diagram

1.4.1 Common functionalities

The following figure describes the hardware architecture and basic principles that are common to the many Wirnet iBTS versions. In this particular case, we consider a configuration with one “CPU module”, one “WAN module” (or “Dual WAN module”) and one “LoRa Module”.

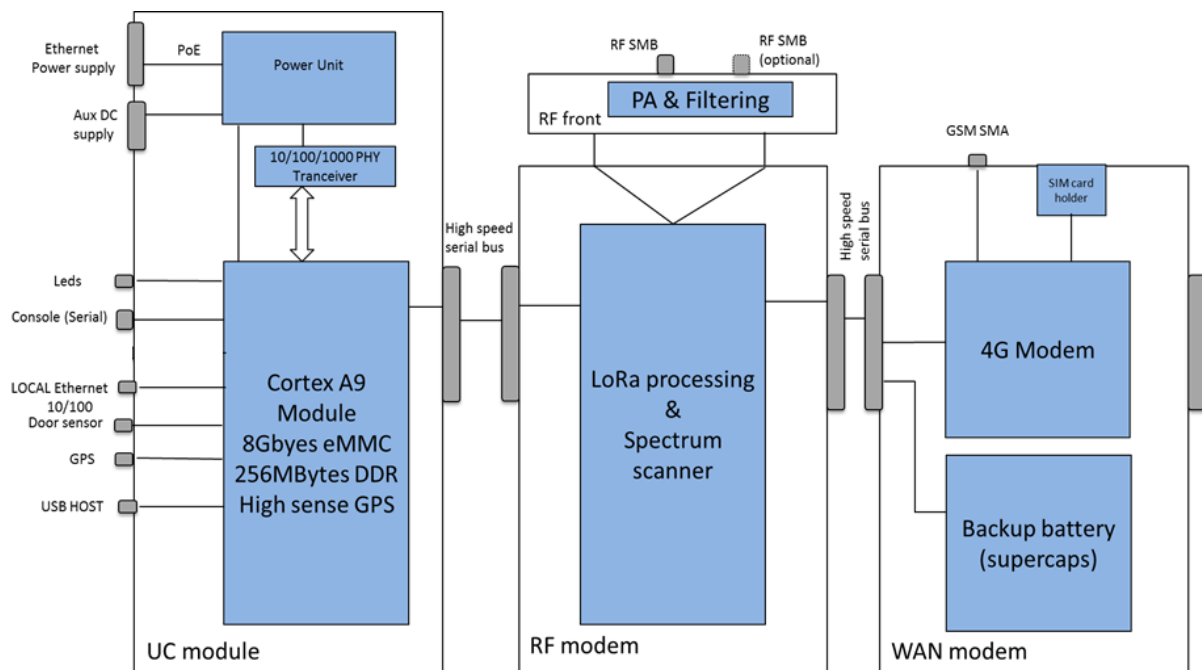


Figure 12: Common Wirnet iBTS block diagram

The Wirnet iBTS is power supplied by a PoE injector through the RJ45 cable.

The RJ45 cable is introduced into the enclosure through the M25 cable gland and connected to the RJ45 connector of the CPU module.

An alternate option of power supply consists in using an auxiliary power supply (11V-55V DC) and connects it to the Euroblock connector of the CPU module.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 33 / 221
Strict confidential		

The CPU Module insures the main followings features:

- Power management unit
- Cortex A9 CPU
- Memories (8GB eMMC and 256Mb DDR)
- GNSS receiver (GPS) with one RF SMA connector to connect the GNSS antenna

The CPU module is connected to the other modules through a back panel board allowing, the management of all the modules inside the Wirnet iBTS.

The “WAN Module” provides the backhaul functionality. It includes:

- Backup battery
- A 4G Mini PCI Express module that can be declined in 3 versions depending on the geographical area:
 - Europe
 - APAC
 - Americas
- The USIM card holder
- A RF SMA connector to connect a LTE antenna
- A 868MHz or 915MHz notch filter to avoid desensitization of the LoRa receivers

The “Dual WAN Module” is an alternative of the “WAN Module”. It provides also the backhaul functionality but includes:

- Backup battery
- Two 4G Mini PCI Express module dedicated to Europe
- Two USIM card holder
- Two RF SMA connectors to connect LTE antennas
- Two 868MHz notch filters to avoid desensitization of the LoRa receivers

The “LoRa modules” can be derived in 4 bands versions to address different countries:

- 868MHz (863-873MHz)
- 915MHz (902-928MHz)
- 915MHz Full-Duplex (902-915MHz uplink, 923-928MHz downlink)
- 923MHz (915-928MHz)

The RF front-end board is configured to support a single antenna (16 channels) or two antennas (2x8 channels).

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 34 / 221
Strict confidential			

1.4.2 Standard version of Wirnet iBTS

The following figure describes the functional architecture for the standard Wirnet iBTS version i.e. including from one to three “LoRa Modules”:

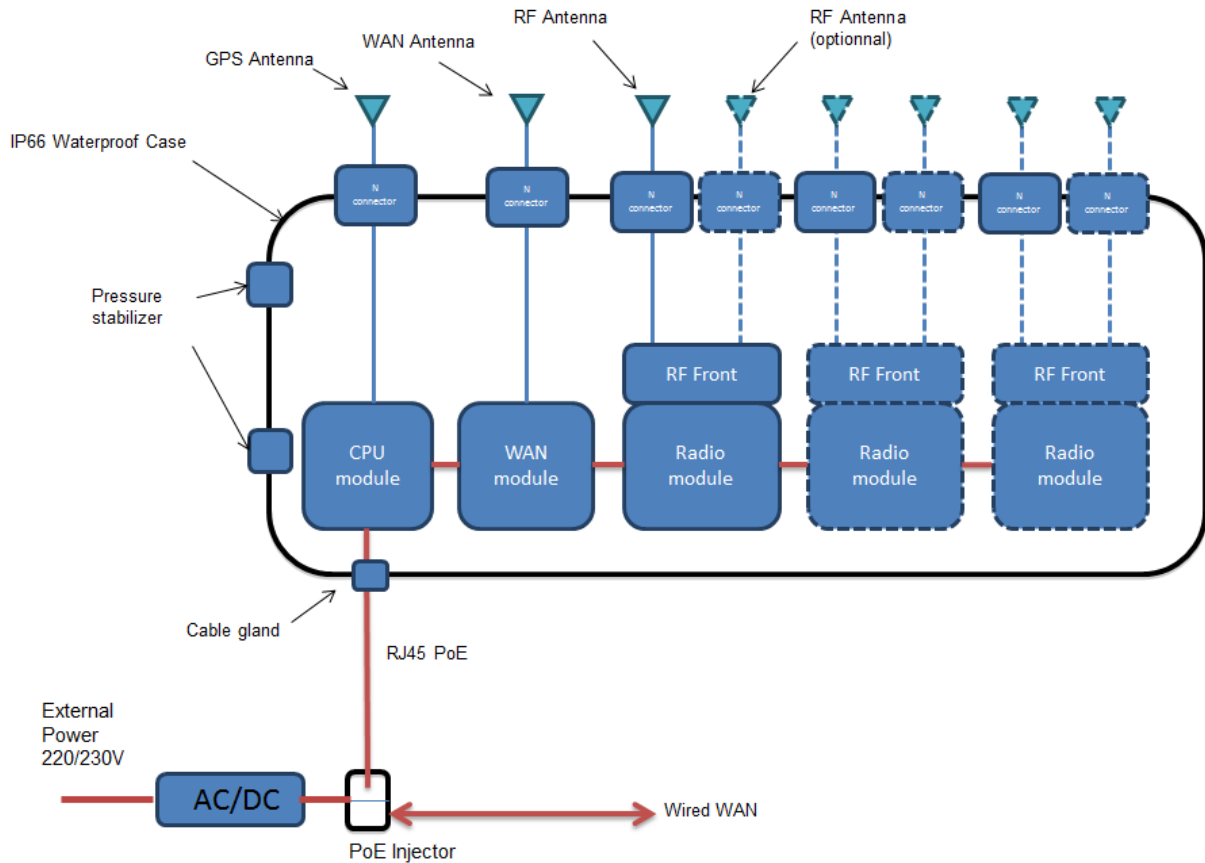


Figure 13: Standard Wirnet iBTS block diagram

The RF front-end board of the “Lora modules” can be derived in 3 bands versions to address different countries:

- 868MHz (863-873MHz)
- 915MHz (902-928MHz)
- 923MHz (915-928MHz)

The RF front-end board is configured to support a single antenna (16 channels) or two antennas (2x8 channels). This could lead then to a “six LoRa antennas” configurations in the maximum use case (tri-sectors, dual polarization antenna for instance).

The GPS (GNSS) connector, the WAN (LTE) connector and LoRa connectors are available on the bottom side of the enclosure. All antennas are external antennas.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 35 / 221
Strict confidential		

1.4.3 “Four LoRa Modules” version of Wirnet iBTS

The following figure describes the functional architecture for a “4 LoRa modules” version, featuring a maximum of 64 channels.

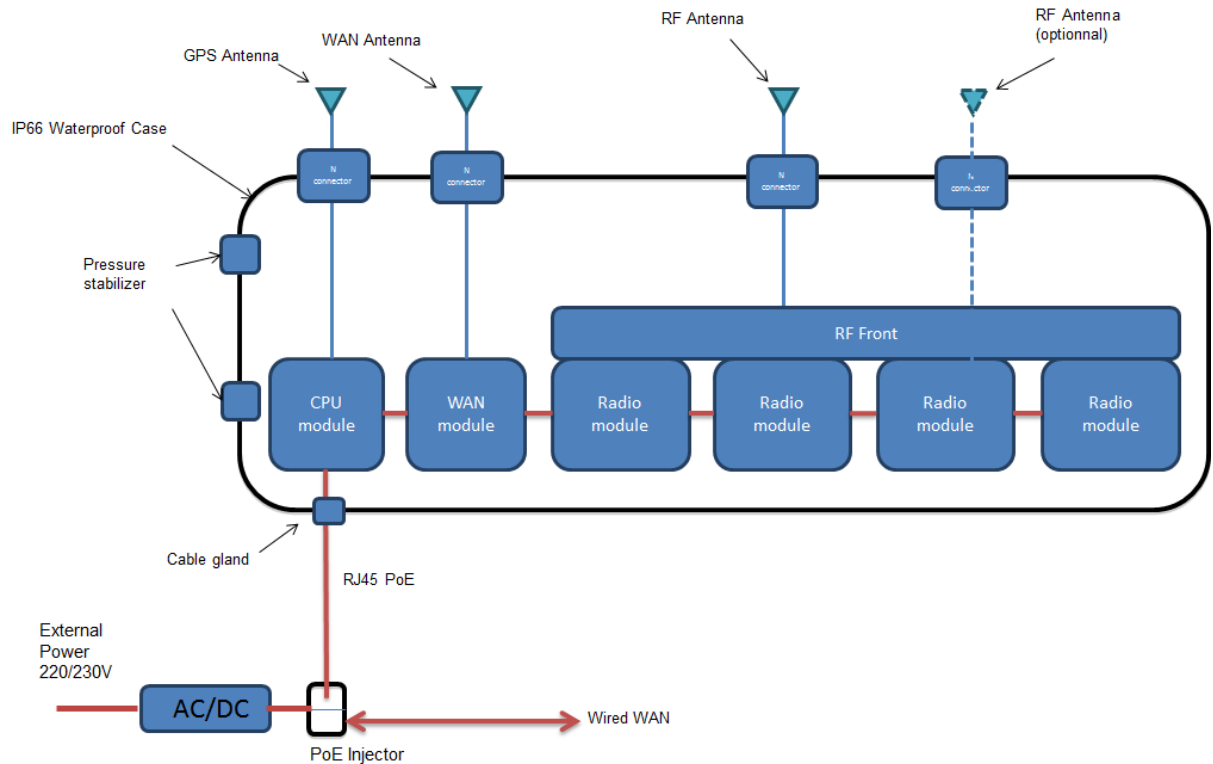


Figure 14: Wirnet iBTS “4 LoRa modules” block diagram

In this particular configuration, the mechanical front-end lids and front-end boards of each individual “LoRa Module” are removed. They are replaced by a bigger RF front end board and front-end lid that combine the 4 LoRa modules together.

This bigger RF front-end board can be derived in 2 bands versions to address different countries:

- 915MHz (902-928MHz)
- 923MHz (915-928MHz)

The 868MHz band is not available in this configuration.

The bigger RF front-end board is configured to support a single antenna (64 channels) or two antennas (2x32 channels).

The GPS (GNSS) connector, the WAN (LTE) connector and LoRa connectors are available on the bottom side of the enclosure. The antennas are all external antennas.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 36 / 221
Strict confidential		

1.4.4 Compact version of Wirnet iBTS

The following figure describes the functional architecture of the Wirnet iBTS Compact:

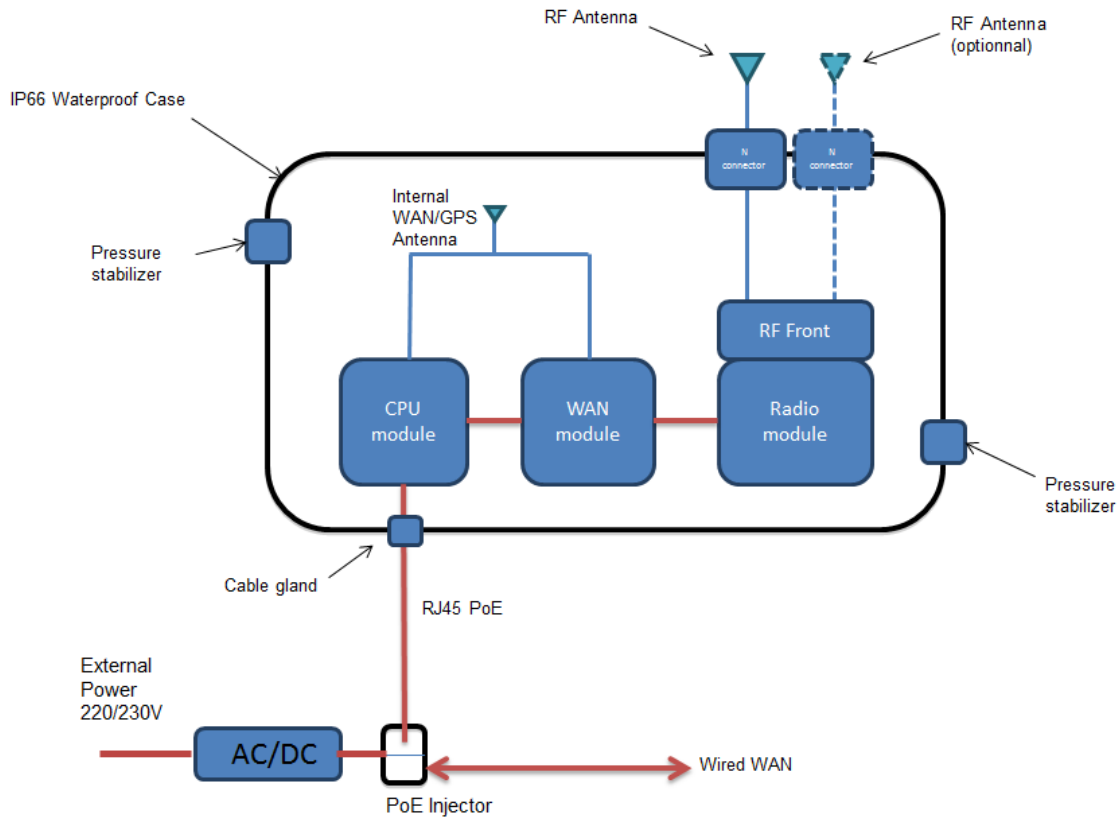


Figure 15: Wirnet iBTS Compact block diagram

The RF front-end board of the “Lora modules” can be derived in 3 bands versions to address different countries:

- 868MHz (863-873MHz)
- 915MHz (902-928MHz)
- 923MHz (915-928MHz)

The RF front-end board is configured to support a single antenna (16 channels) or two antennas (2x8 channels).

The Wirnet iBTS Compact embeds an internal GPS (GNSS) / WAN (LTE) combo antenna compared to external antenna for standard enclosure.

The LoRa connectors are available on the bottom side of the enclosure. The LoRa antennas are external antennas.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 37 / 221
Strict confidential		

1.4.5 Wirnet iBTS FDx

The following figure describes the functional architecture of a full-duplex version, featuring a maximum of 72 Rx channels and 8 Tx channels.

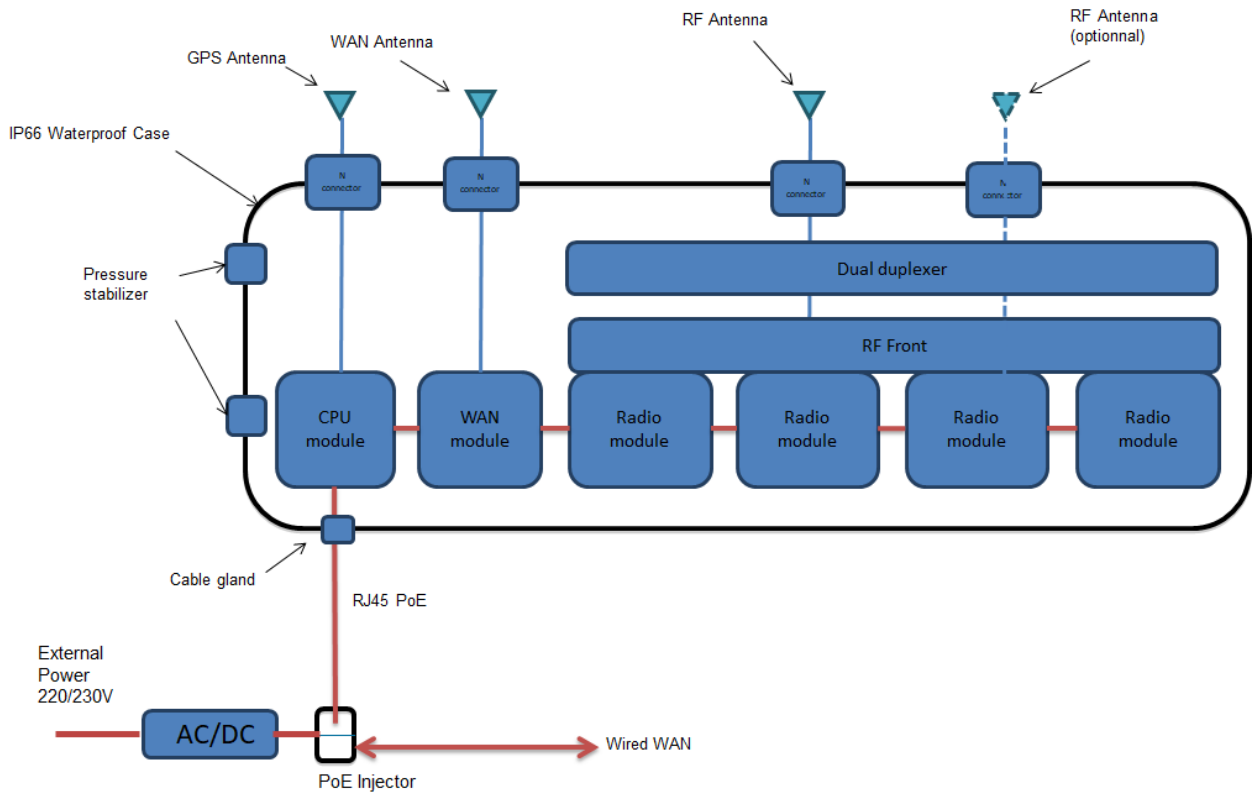


Figure 16: Wirnet iBTS FDx block diagrams

In this particular configuration, the mechanical front-end lids and front-end boards of each individual “LoRa Module” are removed. They are replaced by a bigger RF front end board and front-end lid that combine the 4 LoRa modules together.

The bigger RF front-end board is configured to support a single antenna (72 Rx channels, 4 Tx channels) and two antennas (2x36 Rx channels, 2x4 Tx channels).

A dual cavity duplexer is used for RF filtering and duplexing.

The GPS (GNSS) connector, the WAN (LTE) connector and LoRa connectors are available on the bottom side of the enclosure. The antennas are all external antennas.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 38 / 221
Strict confidential		

1.5 Description of the modules

1.5.1 CPU module

1.5.1.1 Mechanical description

The CPU module is composed of four main mechanical parts:

- A “three-sides” flange including:
 - the connectors and interfaces placement
 - venting of internal boards through many holes
- A rear plate with fixing points for screwing on the blind threaded standoffs
- Two radiators used as right and left side flanges

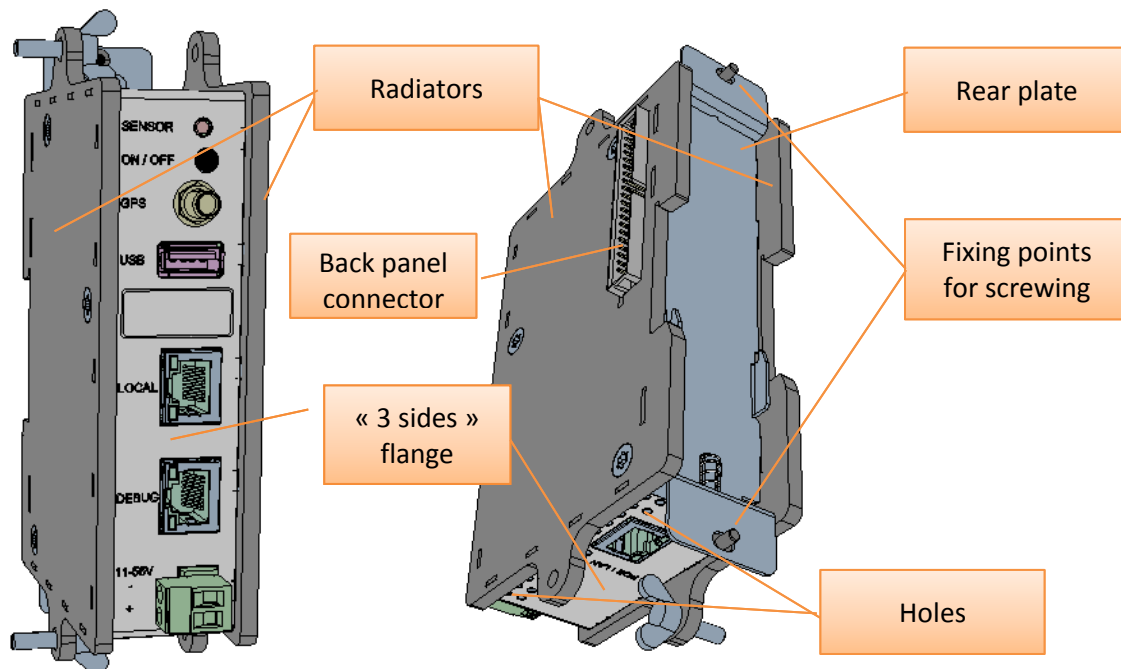


Figure 17: Mechanical description of the CPU module

The main mechanical characteristics of the CPU module are detailed hereafter:

Description	Specification
Radiators material	Aluminum
Other flanges material	Galvanized Steel
Dimensions	156 mm x 88 mm x 38 mm
Weight	500 g

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 39 / 221
Strict confidential		

Ingress protection	IP30
--------------------	------

1.5.1.2 Connectors and user interfaces

The CPU module includes the following user interfaces and connectors:

Module side	Connector / interface	Description
Front side	Sensor	Light sensor to detect aperture of the enclosure
Front side	ON/OFF button	Press this button to power ON and power OFF the CPU module and therefore the Wirnet iBTS
Front side	GPS SMA RF connector	GPS input signal to be connected to the GPS antenna (internal or external)
Front side	USB type A connector	Used for firmware upgrade with a USB stick
Front side	RJ45 Local connector	Local Ethernet connection – interface to portable PC
Front side	RJ45 Debug connector	Serial debug interface – use debug tool described in §1.8.7
Front side	11-56V Euroblock connector	Auxiliary power supply. Polarity indicated on the front panel
Right side	Back panel HE10 40 contacts connector	Distributes the power supplies and high speed serial bus to other modules
Bottom side	RJ45 PoE connector	Ethernet + powers supply coming from PoE injector and introduced in the enclosure through the M25 cable gland

The three RJ45 connectors (PoE, LOCAL and debug) integrates 2 LEDs, one green and one orange. The behavior of the LEDs is detailed hereafter:

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

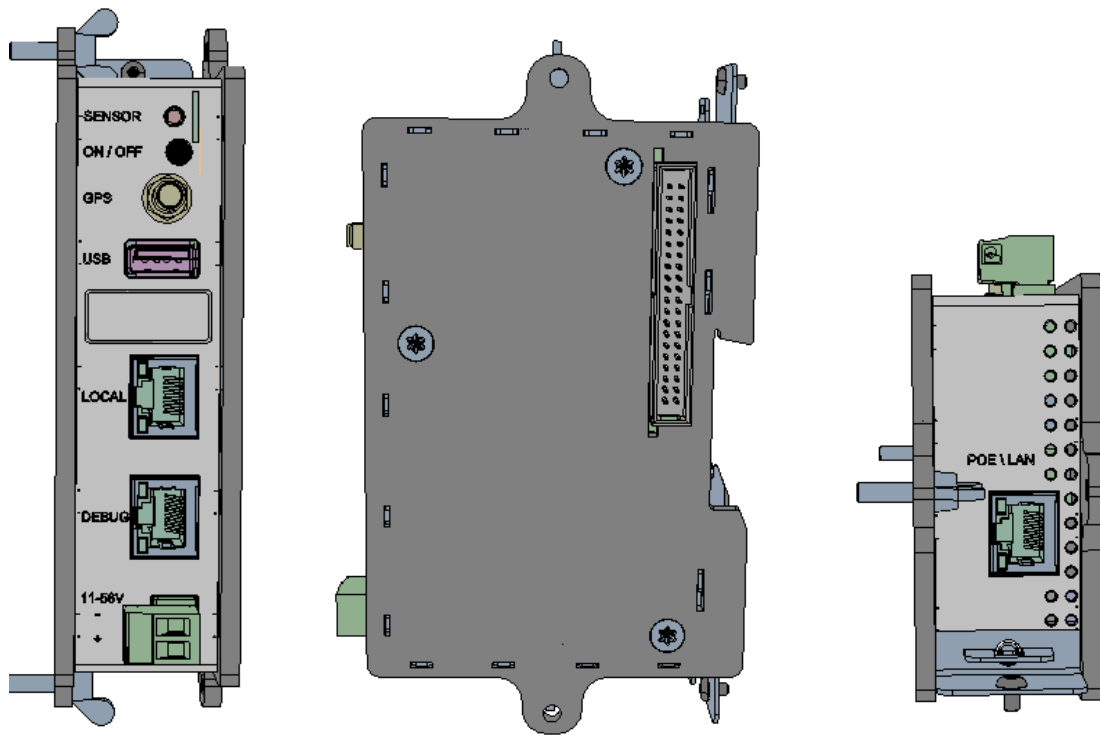


Figure 18: Connectors and user interfaces of the CPU module

Note: The debug interface is intended to be used by authorized and qualified personnel only. Only specific equipment developed by KERLINK must be connected to this interface (see §1.8.7.)

1.5.1.3 CPU module characteristics

The CPU module includes the following features:

Feature	Description
Processor	ARM Cortex A9, 800MHz core
Memories	256MB DDRAM – Volatile memory 8GB eMMC– Non-volatile memory
Watchdog	Hardware type
Security	Secure core Information encryption Secure Boot Secure software download
RTC	RTC clock saved by back-up battery
GPS	Integrated high sensitivity GNSS module GPS L1C/A, GLONASS L1OF, BeiDou B1, QZSS L1C/A, SBAS L1C/A and Galileo E1B/C ready

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 41 / 221
Strict confidential		

	NMEA 0183, version 4.0
	Time pulse (PPS) accuracy < 20ns for LoRa geolocation
Power	PoE controller 48V IEEE 802.3af/at
	LTPoE
	Auxiliary 11-56 VDC
	Backup-battery for RTC saving
	Integrated power management unit in CPU
Ethernet	10/100/1000 Base-T
	PoE IEEE802.3af/at and LTPoE++
	IEEE1588 version 2 time stamping compatible
	Automatic polarity correction
	1 x RJ45 WAN/POE
	1 x RJ45 LOCAL, interface to Portable PC
USB	USB HS type A Slave
DEBUG	UART interface
	Debug tool to be used for UART to USB adaptation
Sensors	Light sensor to detect aperture of the enclose
	Temperature sensor
Auto test	Internal power supplies check
	Interfaces and peripherals check
User interface	LED used for diagnostic (see §1.5.1.2)
	ON/OFF button
Operating temperature range	-20°C to +85°C
Current drain @48V	12mA in Power OFF mode (required to maintain PoE supply)
	35mA @ 20% load CPU + Ethernet Gbits (PoE)
	43mA @ 20% load CPU + Ethernet Gbits (PoE) + Local Ethernet

1.5.2 WAN module

1.5.2.1 Mechanical description

The WAN module is composed of four main mechanical parts:

- A “three-sides” flange including:
 - the connectors and interfaces placement
 - venting of internal boards through many holes
- A rear plate with fixing points for screwing on the blind threaded standoffs
- Two radiators used as right and left side flanges

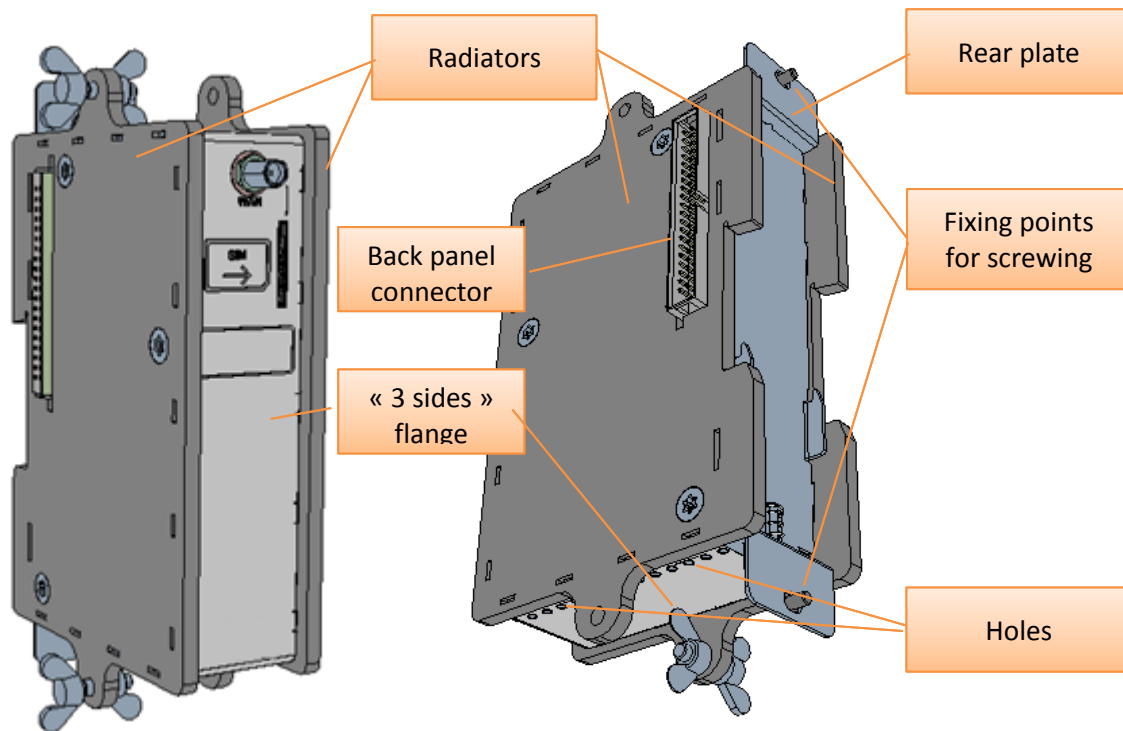


Figure 19: Mechanical description of the WAN module

The main mechanical characteristics of the WAN module are detailed hereafter:

Description	Specification
Radiators material	Aluminum
Other flanges material	Galvanized Steel
Dimensions	156 mm x 88 mm x 38 mm
Weight	500 g
Ingress protection	IP30

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 43 / 221
Strict confidential		

1.5.2.1 Connectors and user interfaces

The WAN module includes the following user interfaces and connectors:

Module side	Connector / interface	Description
Front side	WAN RF connector	WAN 4G RF signal to be connected to the LTE antenna (internal or external)
Front side	USIM connector	Push-push connector Insert USIM according to the besides picture
Right side	Back panel HE10 male 40 contacts connector	Transmit the power supplies and high speed serial bus to the next module
Left side	Back panel HE10 female 40 contacts connector	Receive the power supplies and high speed serial bus from the previous module

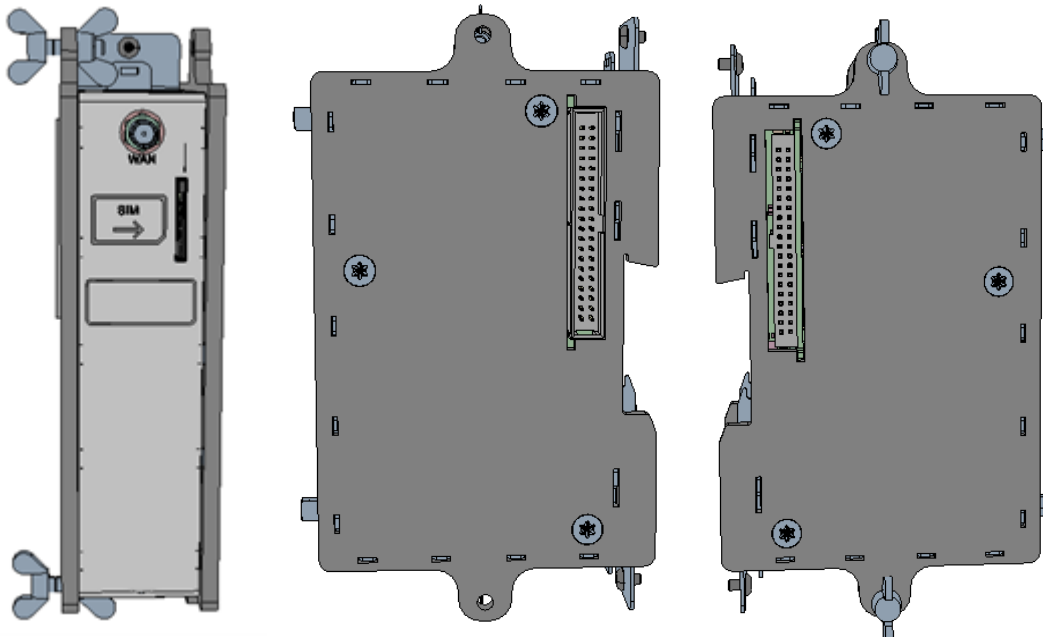


Figure 20: Connectors and user interfaces of the WAN module

Note: UFL to SMA coaxial cables are used to connect the Mini PCI Express card to the antennas.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 44 / 221
Strict confidential		

1.5.2.2 WAN module characteristics

The WAN module supports the following features:

Feature	Description
Mini PCI Express Interface	USB only (no PCI Express interface available) Full Mini Card form factor (F1, F2) 2 versions available (see § 1.5.2.3)
Backup battery	5 x 25F/2.7V supercapacitors 15 minutes charging time Up to one minute capacity to ensure safe power down of the Wirnet iBTS
Operating temperature range	-20°C to +85°C
Current drain @48V	21mA HSPA Rx (attached) 72mA HSPA Tx@Pout max

The WAN module is then based on a Mini PCIe card allowing some flexibility and evolutivity regarding the supported technologies and bands.

Several Mini PCIe cards are currently supported to address different countries. They are detailed in the paragraph 1.5.2.3.

1.5.2.3 Supported mini PCIe cards

The WAN module embeds a Mini PCI express board which is a LTE modem that can be declined in 3 versions:

- One for Europe (and APAC), based on Sierra Wireless MC7304
- One for (Europe and) APAC, based on Sierra Wireless MC7430
- One for Americas, based on Sierra Wireless MC7354

1.5.2.3.1 LTE - Europe and APAC Mini PCI Express card – MC7304

The first 4G Mini PCI Express card is dedicated to the European and APAC markets.

The reference is MC7304.

This module is already GCF approved and meets the Radio Equipment and Telecommunications Terminal Equipment (R&TTE) Directive of the European Union.

The bands and data rate supported by the module are the following:

Technology	Band	Data rate
LTE 3GPP Release 9	Band 1 (2100MHz)	Category 3
	Band 3 (1800MHz)	• Downlink:
	Band 7 (2600MHz)	○ 100Mbps (20MHz BW)
	Band 8 (900MHz)	○ 50Mbps (10MHz BW)
	Band 20 (800MHz)	• Uplink: ○ 50Mbps (20MHz BW)

		○ 25Mbps (10MHz BW)
UMTS	Band 1 (2100MHz)	HSPA+ rates:
HSPA	Band 2 (1900MHz)	• Downlink: up to 42Mbps (category 24)
3GPP Release 8	Band 5 (850MHz) Band 8 (900MHz)	• Uplink: up to 5.76Mbps (category 6)
GSM	GSM 850 (850MHz)	GPRS Multislot class 10
GPRS	EGSM 900 (900MHz)	GPRS Multislot class 12
EDGE	DCS 1800 (1800MHz)	CS1 to CS4
3GPP Release 99	PCS 1900 (1900MHz)	MCS1 to MCS9 EDGE throughput up to 236kbps

Compared to the MC7430 MiniPCIe card, the MC7304 offers one major advantage: GPRS and EDGE modes are supported. This MiniPCIe card is then suitable in rural areas for instance where 4G or 3G coverage is poor.

1.5.2.3.2 LTE - Europe and APAC Mini PCI Express card – MC7430

The first 4G Mini PCI Express card is dedicated to the European and APAC markets. The reference is MC7430.

This module is already GCF approved and meets the Radio Equipment and Telecommunications Terminal Equipment (R&TTE) Directive of the European Union. The module is also already certified in Japan, Brazil, Korea, Taiwan and Korea.

The bands and data rate supported by the module are the following:

Technology	Band	Data rate
LTE	B1 (2100) - FDD	Category 6
3GPP Release 11	B3 (1800+) - FDD	• Downlink:
FDD and TDD	B5 (850) - FDD	○ FDD: 300Mbps
	B7 (2600) - FDD	○ TDD: 222Mbps
	B8 (900) - FDD	• Uplink:
	B18 (800 lower) - FDD	○ FDD: 50Mbps
	B19 (800 upper) - FDD	○ TDD: 26Mbps
	B21 (1500 upper) - FDD	
	B28 (700APT) - FDD	
	B38 (2600) – TDD	
	B39 (1900+) – TDD	
	B40 (2300) – TDD	
	B41 (2500) - TDD	
UMTS	B1 (2100)	HSPA+ rates:
HSPA	B5 (850)	• Downlink: up to 42Mbps (category 24)
3GPP Release 9	B6 (850 UMTS only) B8 (900) B9 (1800)	• Uplink: up to 5.76Mbps (category 6)

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 46 / 221
Strict confidential			

	B19 (800 upper)	
TD-SCDMA	B39 (1900+)	Data rates: <ul style="list-style-type: none"> • Downlink: Up to 2.8 Mbps • Uplink: Up to 2.2 Mbps Spreading rate: <ul style="list-style-type: none"> • Downlink: 1.28 Mcps
GSM	None	N/A
GPRS		
EDGE		
3GPP Release 99		

Compared to the MC7304 MiniPCIe card, the MC7430 supports more 3G and 4G bands. This MiniPCIe card is then suitable in urban areas for instance where 4G or 3G coverage excellent.

1.5.2.3.1 LTE - Americas Mini PCI Express card – MC7354

The next 4G Mini PCI Express card is dedicated to the American market.

The reference is Sierra Wireless MC7354.

This module is already PTCRB and CDG2 approved.

It is also FCC and IC certified:

- FCC ID: N7NMC7355
- IC ID: 2417C-MC7355

The bands and data rate supported by the module are the following:

Technology	Band	Data rate
LTE	Band 2 (1900MHz)	Category 3
3GPP Release 9	Band 4 (1700/2100MHz)	<ul style="list-style-type: none"> • Downlink: <ul style="list-style-type: none"> ○ 100Mbps (20MHz BW) ○ 50Mbps (10MHz BW) • Uplink: <ul style="list-style-type: none"> ○ 50Mbps (20MHz BW) ○ 25Mbps (10MHz BW)
	Band 5 (850MHz)	
	Band 13 (700MHz)	
	Band 17 (700MHz)	
	Band 25 (1900MHz)	
CDMA	BC0 (800MHz)	CDMA IS-856 (1xEV-DO Release A)
EVDO release 0	BC1 (1900MHz)	<ul style="list-style-type: none"> • Up to 3.1 Mbps forward channel • Up to 1.8 Mbps reverse channel
EVDO release A	BC10 (800MHz)	CDMA IS-2000 <ul style="list-style-type: none"> • Up to 153 kbps, simultaneous forward and reverse channel Circuit-switched data bearers up to 14.4 kbps
UMTS	Band 1 (2100MHz)	HSPA+ rates:

HSPA	Band 2 (1900MHz)	<ul style="list-style-type: none"> Downlink: up to 42Mbps (category 24) Uplink: up to 5.76Mbps (category 6)
3GPP Release 8	Band 4 (1700/2100MHz)	
	Band 5 (850MHz)	
	Band 8 (900MHz)	
GSM	GSM 850 (850MHz)	GPRS Multislot class 10
GPRS	EGSM 900 (900MHz)	GPRS Multislot class 12
EDGE	DCS 1800 (1800MHz)	CS1 to CS4
3GPP Release 99	PCS 1900 (1900MHz)	MCS1 to MCS9
		EDGE throughput up to 236kpbs

1.5.3 Dual WAN Module

1.5.3.1 Mechanical description

The Dual WAN module is composed of four main mechanical parts:

- A “three-sides” flange including:
 - the connectors and interfaces placement
 - venting of internal boards through many holes
- A rear plate with fixing points for screwing on the blind threaded standoffs
- Two radiators used as right and left side flanges

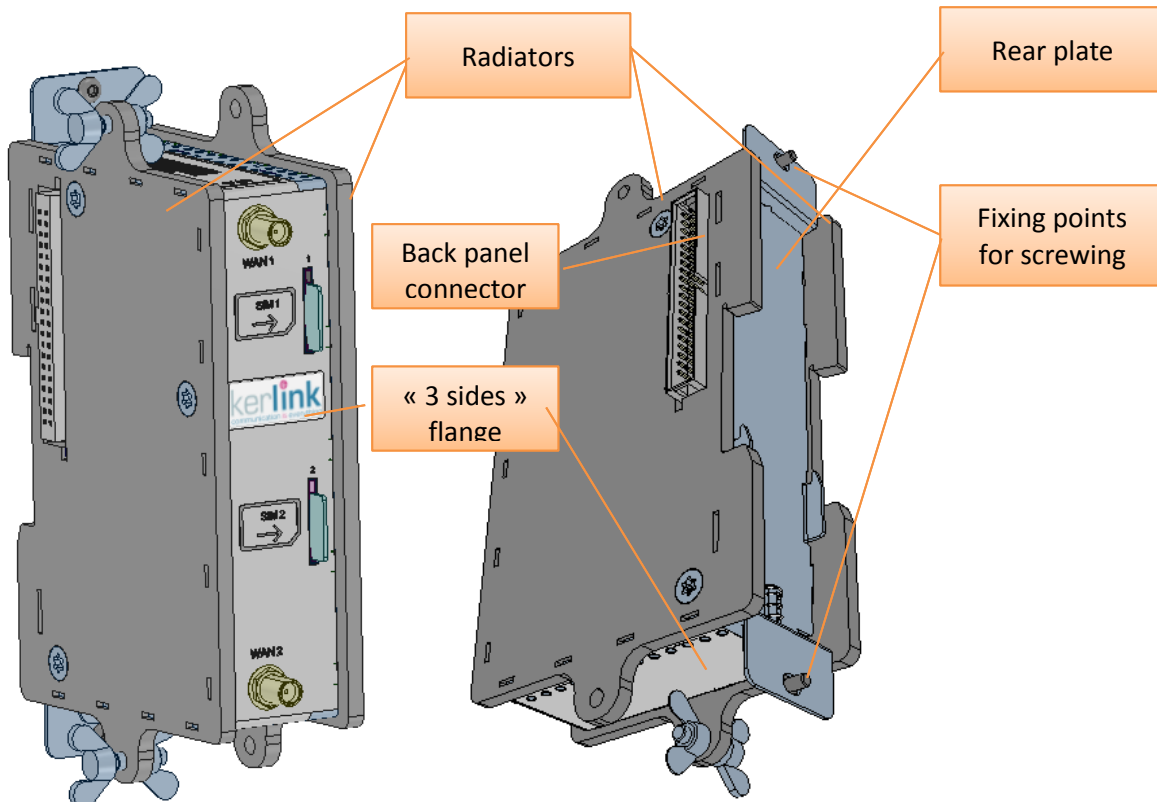


Figure 21: Mechanical description of the Dual WAN module

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 48 / 221
Strict confidential		

The main mechanical characteristics of the Dual WAN module are detailed hereafter:

Description	Specification
Radiators material	Aluminum
Other flanges material	Galvanized Steel
Dimensions	156 mm x 88 mm x 38 mm
Weight	500 g
Ingress protection	IP30

1.5.3.2 Connectors and user interfaces

The Dual WAN module includes the following user interfaces and connectors:

Module side	Connector / interface	Description
Front side	WAN1 RF connector	WAN 4G RF signal to be connected to the LTE antenna (internal or external)
Front side	WAN2 RF connector	WAN 4G RF signal to be connected to the LTE antenna (internal or external)
Front side	USIM1 connector	Push-push connector Insert USIM according to the besides picture
Front side	USIM2 connector	Push-push connector Insert USIM according to the besides picture
Right side	Back panel HE10 male 40 contacts connector	Transmit the power supplies and high speed serial bus to the next module
Left side	Back panel HE10 female 40 contacts connector	Receive the power supplies and high speed serial bus from the previous module

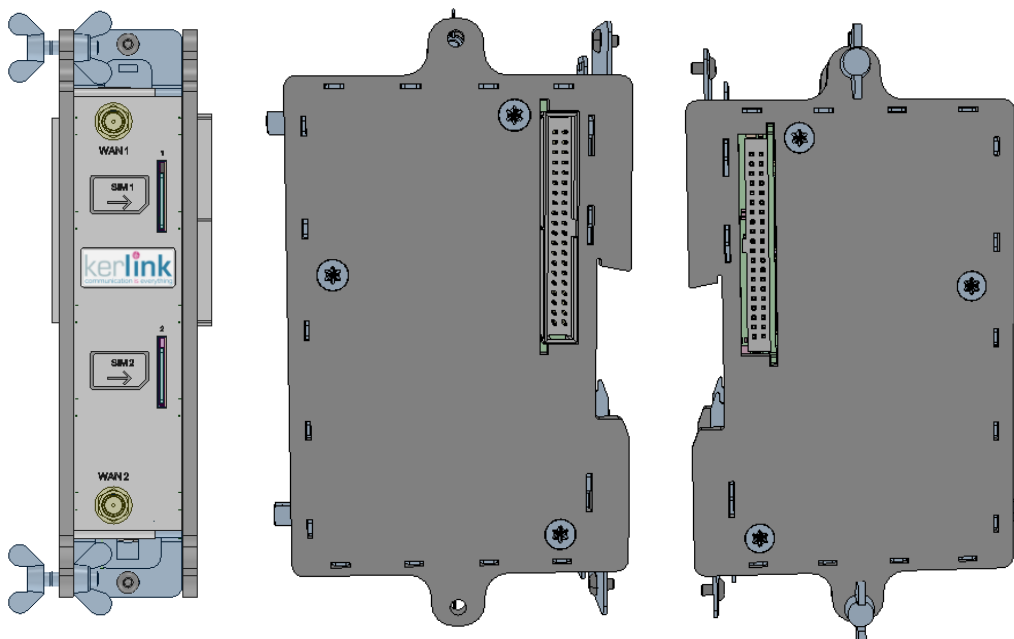


Figure 22: Connectors and user interfaces of the Dual WAN module

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 49 / 221
Strict confidential		

1.5.3.3 Dual WAN module characteristics

The Dual WAN module supports the following features:

Feature	Description
2x Mini PCI Express Interfaces	USB only (no PCI Express interface available) Full Mini Card form factor (F1, F2) Only one frequency bands dependent version is available Both WAN 4G Mini PCI board may be active in parallel, i.e. attached to the network at the same time.
Backup battery	5 x 25F/2.7V supercapacitors 15 minutes charging time Up to one minute capacity to ensure safe power down of the Wirnet iBTS
Operating temperature range	-20°C to +85°C
Current drain @48V / PCI express interface	21mA HSPA Rx (attached) 72mA HSPA Tx@Pout max

1.5.3.4 Supported Mini PCIe cards

The Dual WAN module embeds two Mini PCI express boards.
 So far, only one Mini PCIe board / LTE modem dedicated for Europe and APAC is available: MC7304 from Sierra Wireless. This MiniPCIe card is described in chapter 1.5.2.3.1.
 If other Mini PCI express boards are required, contact KERLINK.

1.5.4 LoRa module – LoRa LOC

1.5.4.1 Mechanical description

1.5.4.1.1 Single “LoRa-LOC” module

The LoRa-LOC module is composed of five main mechanical parts:

- A “three-sides” flange including:
 - the connectors and interfaces placement
 - venting of internal boards through many holes
- A rear plate with fixing points for screwing on the blind threaded standoffs
- Two radiators used as right and left side flanges
- A front-end lid, used as a shield for the front-end board

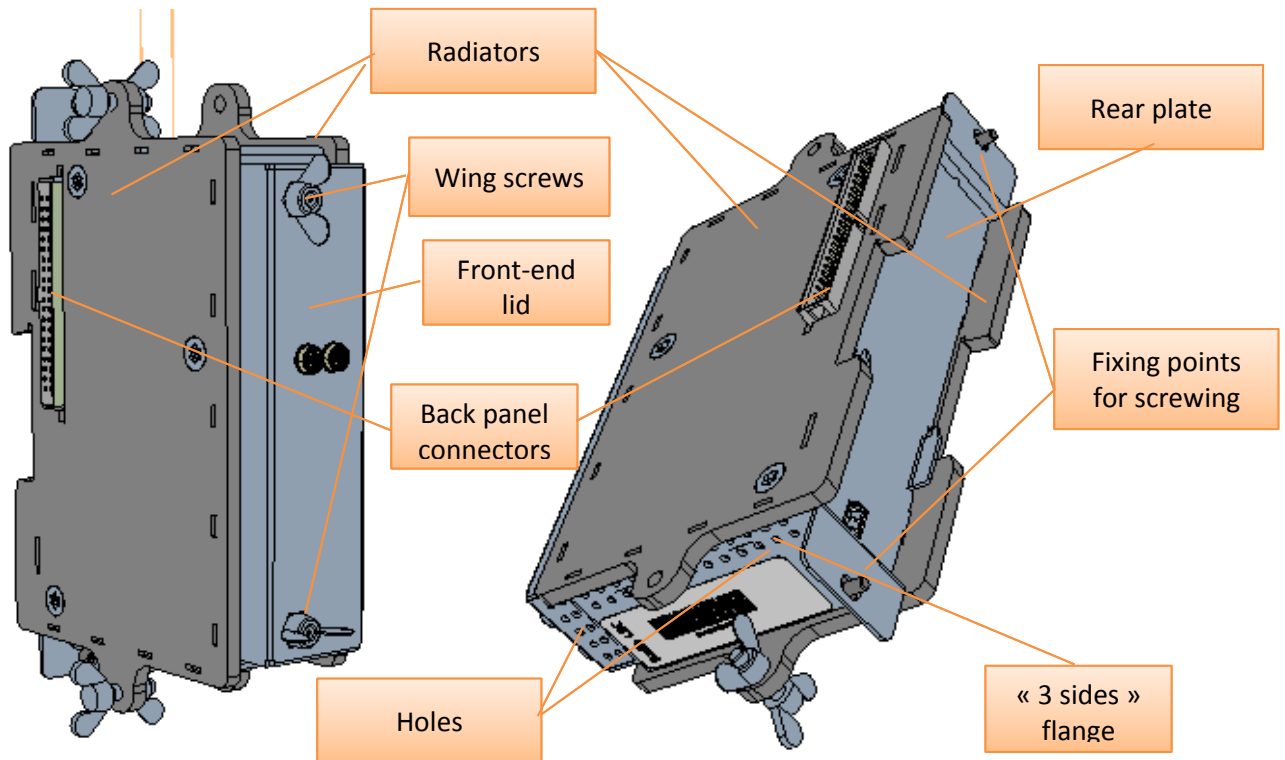


Figure 23: Mechanical description of the LoRa – LOC module

The rear plate and the two radiators side flanges are the same as the one used for the CPU module or the WAN module. The “three-sides” flange is different from the one used for the CPU module or WAN modules due to different interfaces and connectors but dimensions are the same.

The front-end lid is then a particular mechanical part dedicated only for the LoRa modules. The front-end lid is tightened to the other mechanical parts through the wing screws on the front.

The main mechanical characteristics of the Lora module are detailed hereafter:

Description	Specification
Radiators material	Aluminum
Other flanges and lid material	Galvanized Steel
Dimensions	156 mm x 102 mm x 38 mm
Weight	600 g
Ingress protection	IP30

The LoRa-LOC board integrates the LoRa-LOC modem based on the AD936x transceiver (Analog Devices) and SX1301 (Semtech) + DSP as demodulators.

A front-end board embeds the radio transmitters and receivers. Three versions are derived to support the different unlicensed bands:

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 51 / 221
Strict confidential		

- 868MHz (863-873MHz)
- 915MHz (902-928MHz)
- 923MHz (915-928MHz)

1.5.4.1.2 Four “LoRa-LOC” modules

The four “LoRa-LOC” modules version is composed of 4 single LoRa-LOC RF modules. The front-end board and the front-end lid of each individual module are removed and replaced by a single common front-end board and front-end lid, covering and combining the four modules together.

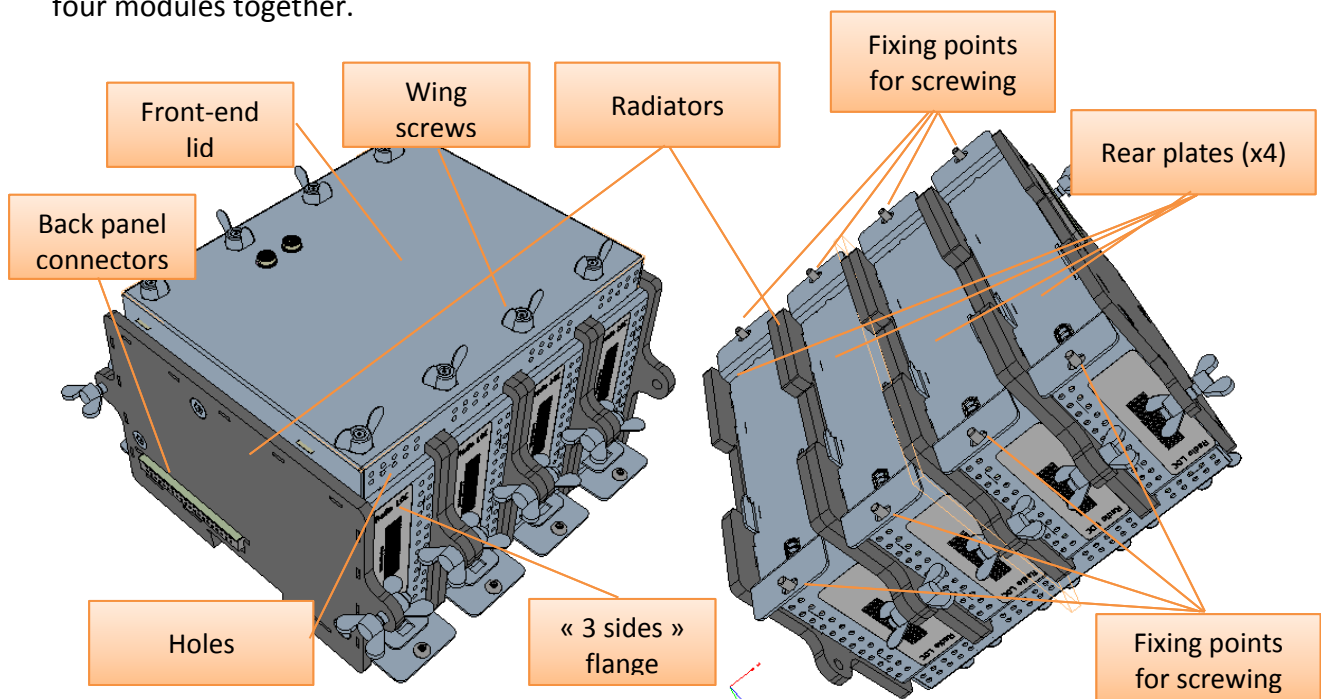


Figure 24: Mechanical description of the four LoRa LOC modules configuration

The rear plates and the two radiators side flanges are still unchanged. The front-end lid is tightened to the other mechanical parts through the wing screws on the front.

The main mechanical characteristics of the Lora module are detailed hereafter:

Description	Specification
Radiators material	Aluminum
Other flanges and lid material	Galvanized Steel
Dimensions	156 mm x 102 mm x 152 mm
Total weight	1700 g
Ingress protection	IP30

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 52 / 221
Strict confidential		

Four Lora LOC boards are used. They integrate the AD936x transceiver and SX1301 + DSP as demodulators, as described previously.

A front-end board embeds the radio transmitters and receivers. Two versions are declined to support the different unlicensed bands:

- 915MHz (902-928MHz)
- 923MHz (915-928MHz)

1.5.4.1.3 Four “LoRa-LOC-FDx” modules

The four “LoRa-LOC-FDx” modules version is composed of 4 single LoRa-LOC RF modules. The front-end board and the front-end lid of each individual module are removed and replaced by a single common front-end board and front-end lid, covering the four modules together.

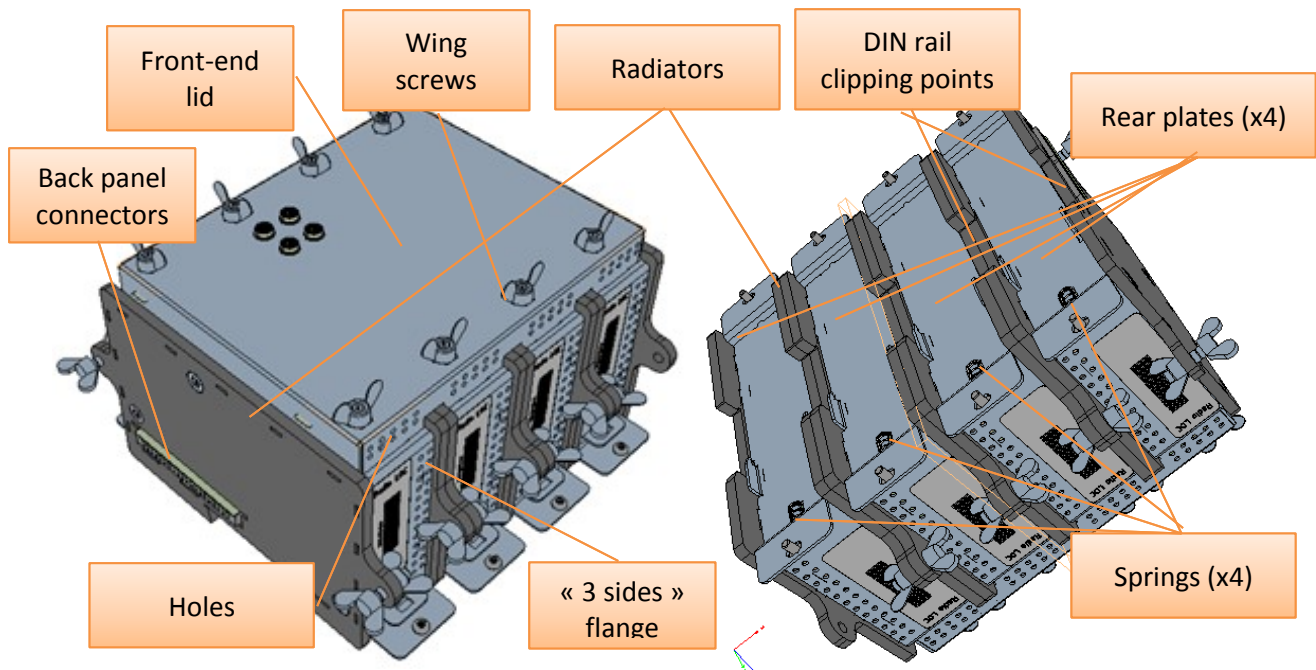


Figure 25: Mechanical description of the four LoRa LOC-FDx modules configuration

The rear plates and the two radiators side flanges are still unchanged. The front-end lid is tightened to the other mechanical parts through the wing screws on the front.

The main mechanical characteristics of the Lora module are detailed hereafter:

Description	Specification
Radiators material	Aluminum
Other flanges and lid material	Galvanized Steel

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 53 / 221
Strict confidential		

Dimensions	156 mm x 102 mm x 152 mm
Total weight	1700 g
Ingress protection	IP30

Inside the mechanical parts, the four “LoRa-LOC-FDx” modules version is composed of 9 boards:

- 4 back panel boards
- 4 LoRa-LOC modem boards
- A single front-end full-duplex radio board

The back panel boards connect the four LoRa modems together and also to the CPU module. This board is the same as the one used in the WAN module and single LoRa module. The board will not be further more detailed.

Four Lora LOC boards are used. They integrate the AD936x transceiver and SX1301 + DSP as demodulators, as described previously.

The front-end board embeds the radio transmitters and receivers to support the ISM915 unlicensed bands (902-928MHz).

The front-end board is connected to the LoRa-LOC modules trough SMB RF connectors and a HE10 14 contacts. The first Lora-LOC board is plugged directly on the front-end board through the SMB connectors. The other LoRa-LOC boards are connected to the front-end board through SMB coaxial cables.

1.5.4.2 Connectors and user interfaces

1.5.4.2.1 Single LoRa-LOC module

The LoRa LOC module includes the following user interfaces and connectors:

Module side	Connector / interface	Description
Front side	LoRa RF SMB connector # RF1	LoRa RF signal to be connected to the LoRa antenna # 1
Front side	LoRa RF SMB connector # RF2	LoRa RF signal to be connected to the LoRa antenna # 2
Right side	Back panel HE10 male 40 contacts connector	Transmit the power supplies and high speed serial bus to the next module
Left side	Back panel HE10 female 40 contacts connector	Receive the power supplies and high speed serial bus from the previous module

The LoRa SMB RF connector’s # RF1 and # RF2 are connected to the SMB/N adapters on the bottom side of the Wirnet iBTS via SMB coaxial cables.

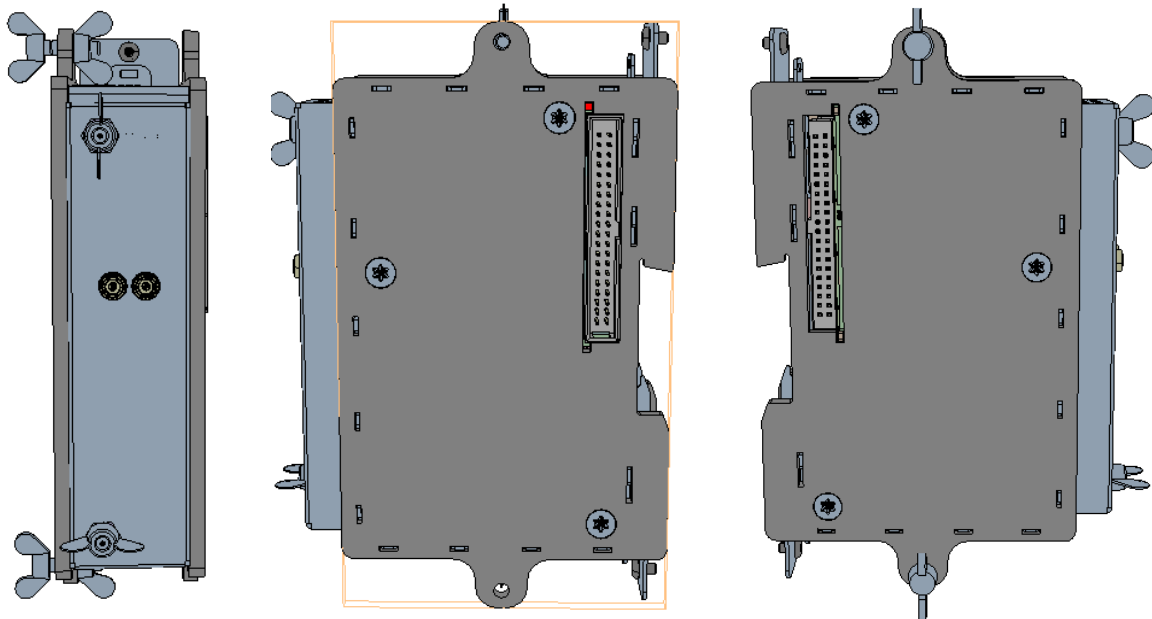


Figure 26: Connectors and user interfaces of the LoRa LOC module

The RF1 connector is on the left side of the front-end lid.

The RF2 connector is on the right side of the front-end lid.

The positions of the RF1 and RF2 connectors are indicated on the sticker on top of the LoRa LOC module as follows:

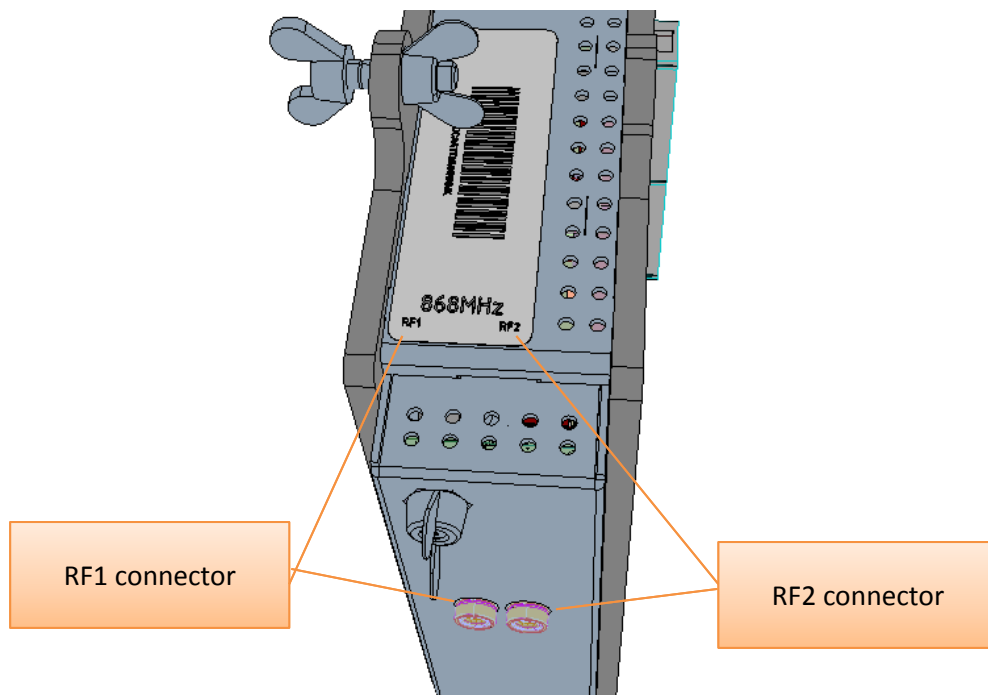


Figure 27: RF1 and RF2 connectors of the LoRa LOC module

Note: RF1 stands for RF path 1, RF2 stands for RF path 2.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 55 / 221
Strict confidential		

1.5.4.2.2 Four LORA-LOC modules

The LoRa LOC “4 modules” configuration includes the following user interfaces and connectors:

Module side	Connector / interface	Description
Front side	LoRa RF SMB connector # RF1	LoRa RF signal to be connected to the LoRa antenna # 1
Front side	LoRa RF SMB connector # RF2	LoRa RF signal to be connected to the LoRa antenna # 2
Right side	Back panel HE10 male 40 contacts connector	Transmit the power supplies and high speed serial bus to the next module
Left side	Back panel HE10 female 40 contacts connector	Receive the power supplies and high speed serial bus from the previous module

The LoRa SMB RF connector’s # RF1 and # RF2 are connected to the SMB/N adapters on the bottom side of the Wirnet iBTS via SMB coaxial cables.

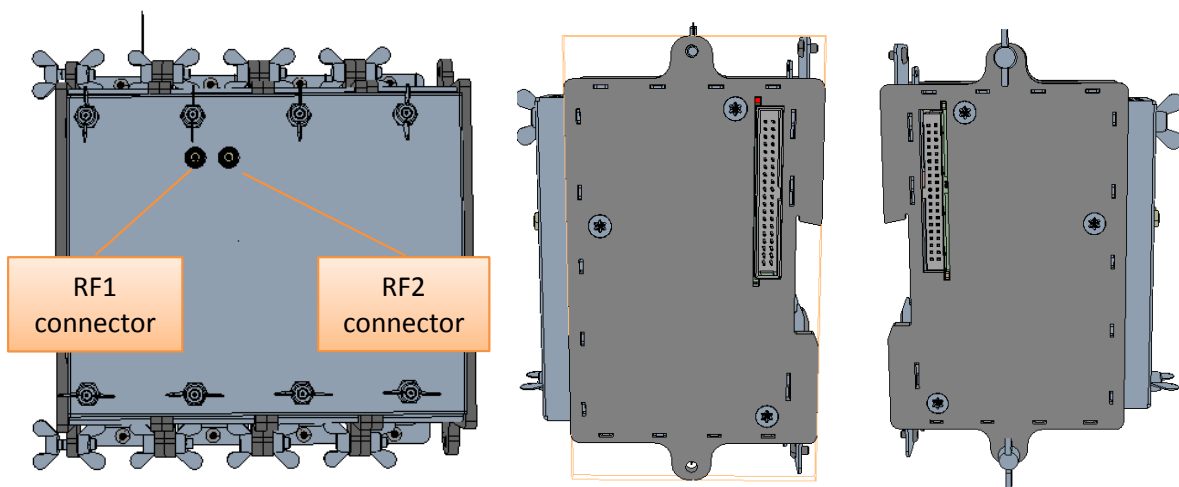


Figure 28: Connectors and user interfaces of the 4 LoRa LOC modules

The RF1 connector is on the left side of the front-end lid.
 The RF2 connector is on the right side of the front-end lid.
 The positions of the RF1 and RF2 connectors are indicated on the sticker on top of the LoRa LOC module (similar to single LoRa LOC module).

Note: RF1 stands for RF path 1, RF2 stands for RF path 2.

1.5.4.2.3 Four “LoRa-LOC-FDx” modules

The LoRa LOC FDx “4 modules” configuration includes the following user interfaces and connectors:

Module side	Connector / interface	Description
Front side	LoRa RF TX SMB connector # RF1	LoRa RF transmit signal to be connected to the duplexer # 1
Front side	LoRa RF TX SMB connector # RF2	LoRa RF transmit signal to be connected to the duplexer # 2
Front side	LoRa RF RX SMB connector # RF1	LoRa RF receive signal to be connected to the duplexer # 1
Front side	LoRa RF RX SMB connector # RF2	LoRa RF receive signal to be connected to the duplexer # 2
Right side	Back panel HE10 male 40 contacts connector	Transmit the power supplies and high speed serial bus to the next module
Left side	Back panel HE10 female 40 contacts connector	Receive the power supplies and high speed serial bus from the previous module

The LoRa SMB TX/RX RF connectors # RF1 and # RF2 are connected to the dual duplexer via SMB/SMA coaxial cables.

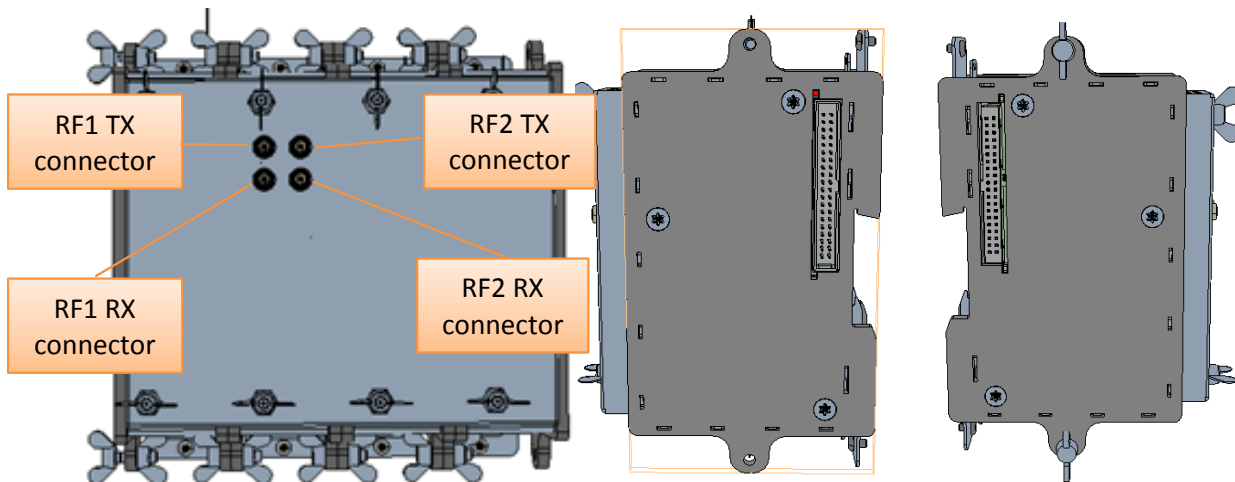


Figure 29: Connectors and user interfaces of the 4 LoRa LOC modules

The RF1 connectors are on the left side of the front-end lid.
The RF2 connectors are on the right side of the front-end lid.
The TX connectors are on the top side and RX connectors on the bottom side.
The positions of the RF1 and RF2 connectors are indicated on the sticker on top of the LoRa LOC module (similar to single LoRa LOC module).

Note: RF1 stands for RF path 1, RF2 stands for RF path 2.

1.5.4.3 LoRa LOC modem characteristics

The mains characteristics of the LoRa-LOC modem are detailed in the following table:

Feature	Description
LoRa demodulator (x2)	Based on SX1301 digital signal processing engine from Semtech True antenna diversity or simultaneous dual-band operation 10 programmable parallel receive paths Emulates 49 x LORA demodulators and 1 x (G)FSK demodulator per SX1301: <ul style="list-style-type: none"> • 8 x LoRa demodulator at dynamic data rate with 125KHz BW • 1 x LoRa demodulator at fixed data rate • 1 x (G) FSK demodulator Dynamic data-rate (DDR) adaptation Detect simultaneously 8 preambles corresponding to all data rates (Spreading Factor) at LoRa 125KHz BW 2 MHz baseband BW FSK or LORA modulator
Geolocalization Ready	Outdoor and indoor environments Synchronization with GPS PPS clock Combines RSSI and TDOA measurements Accuracy < 50m (90% confidence, high density coverage)
Transceiver	Based on Analog Devices AD9361/AD9363 70MHz to 6000MHz / 325MHz to 3800MHz frequency range 200 kHz to 56 MHz / 200 kHz to 20 MHz channel BW Integrated fractional-N synthesizers 2 x 2 transceiver with integrated 12-bit DACs and ADCs <ul style="list-style-type: none"> - Dual transmitters: 4 differential outputs - Dual receivers: 6 differential or 12 single-ended inputs Highly linear broadband transmitter +8dBm typ. output power 90dB output power control range 164dBc/Hz Signal to Noise performance at 90MHz offset Receiver Noise Figure of 2 dB +40dBm IIP2 at max gain -18dBm IIP3 at max gain Independent automatic gain control DC offset correction, quadrature correction and digital filtering Very low LO leakage

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 58 / 221
Strict confidential		

Sniffer (x2)	Based on Semtech SX1239 300MHz to 1020MHz frequency range FSK, GFSK, MSK, GMSK and OOK demodulator FSK Bit rates up to 300 kb/s Digital filtering, demodulation, AGC, AFC, synchronization and packet handling Accurate RSSI measurements through automatic gain calibration 115dB Dynamic Range RSSI +35dBm to +75dBm IIP2 depending on AGC configuration -18dBm to +20dBm IIP3 depending on AGC configuration 66 dB typ. CW interferer rejection at 1 MHz offset 79 dB typ. CW interferer rejection at 10 MHz offset
Auto test	Check of the LoRa LOC module power supplies by MCU
Operating temperature range	-20°C to +85°C
Current drain @48V	130mA in Receive Mode (all demodulators activated) 120mA in Transmit mode@27dBm

1.5.4.4 Front-end boards

1.5.4.4.1 Front-end board - Single module

The following block diagram details the architecture of the front-end board, in a single module configuration:

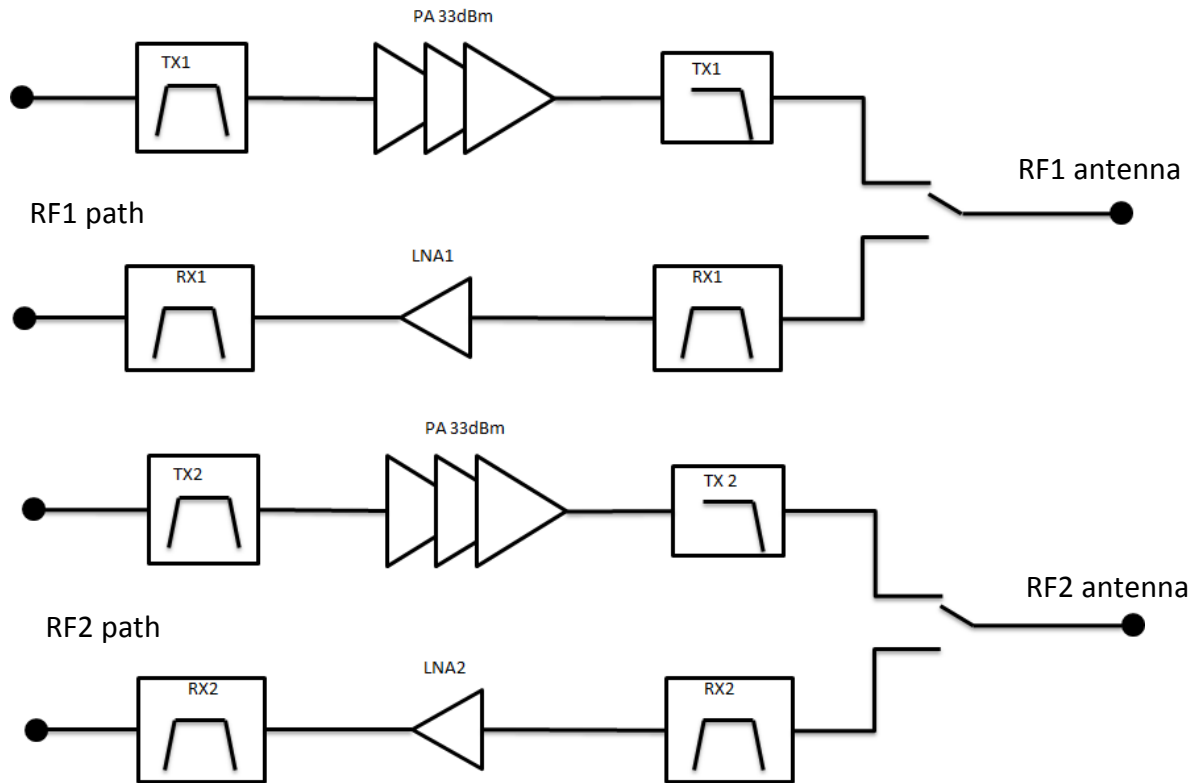


Figure 30: Front-end board block diagram

The front-end board integrates two duplicated TX and Rx paths (RF1 path and RF2 path). Each TX/RX path is connected to one SMB antenna port, referenced as RF1 and RF2. Each path is detailed hereafter:

The front-end board is derived in three different versions to cover the unlicensed bands:

- 868MHz (863-873MHz)
- 915MHz (902-928MHz)
- 923MHz (915-928MHz)

The details of the frequency bands, channelization, out of band rejection are detailed in §1.5.4.6.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 60 / 221
Strict confidential		

1.5.4.4.2 Front-end board - Four modules

The following block diagram details the architecture of the front-end board, in a four modules configuration:

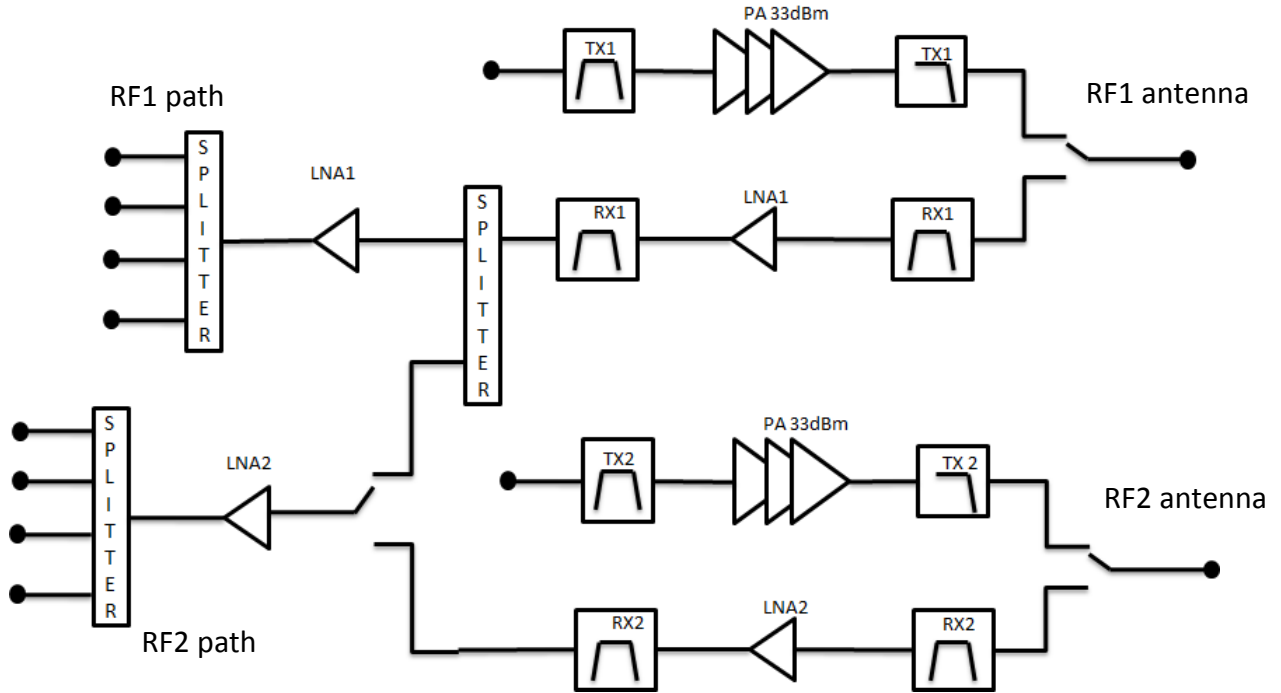


Figure 31: Front-end 4 modules board block diagram

The front-end board integrates two TX and two Rx paths (RF1 path and RF2 path). Each TX/RX path is connected to one SMB antenna port (RF1 and RF2 respectively).

The front-end board is derived in two different versions to cover the unlicensed bands:

- 915MHz (902-928MHz)
- 923MHz (915-928MHz)

The details of the frequency bands, channelization, out of band rejection are detailed in §1.5.4.6.

1.5.4.4.3 Front-end board- Four modules Full-Duplex

The following block diagram details the architecture of the front-end board, in a four modules full-duplex configuration:

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 61 / 221
Strict confidential		

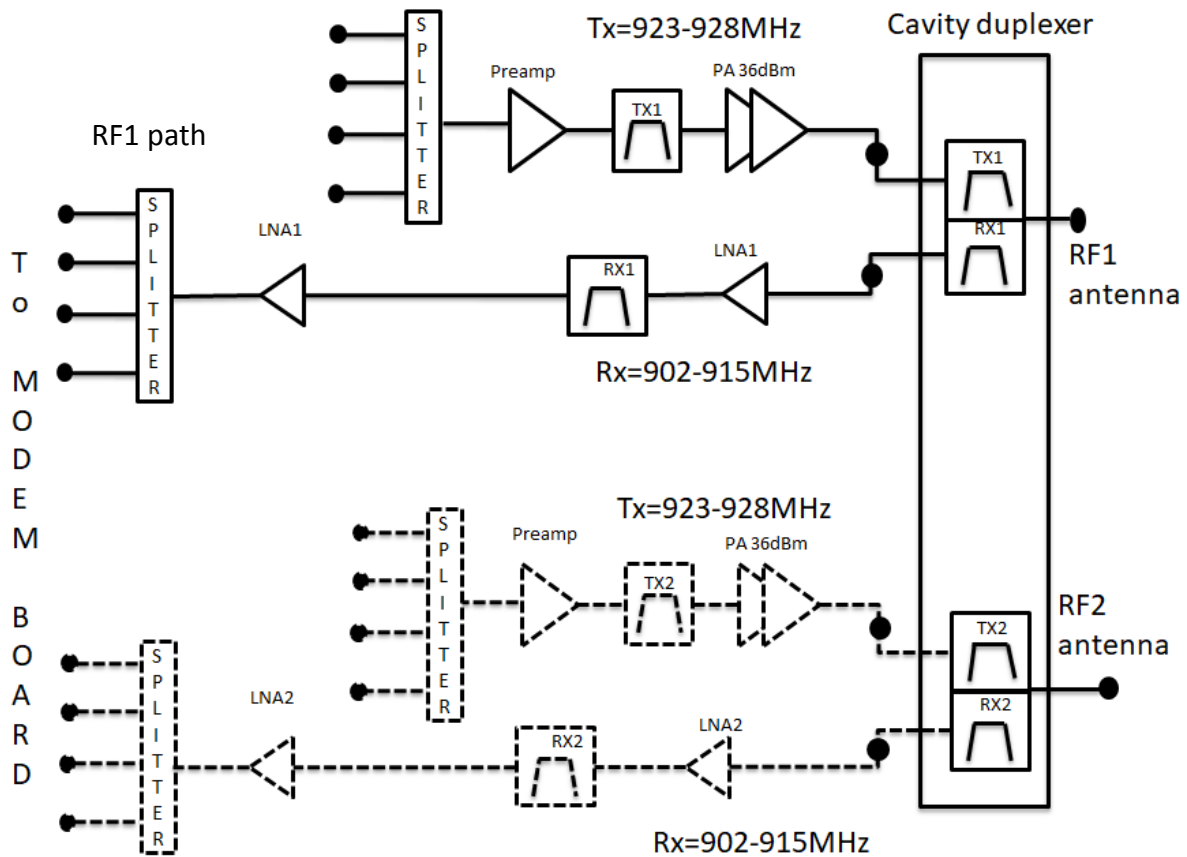


Figure 32: Front-end 4 modules full-duplex board block diagram

The front-end board integrates two TX and two Rx paths (RF1 path and RF2 path). Each TX and RX path is connected to one SMB antenna port.

The two TX paths are similar and are detailed hereafter:

- The TX signal(s), coming from the 4 LoRa LOC board(s), is injected in a pre-amplifier filter via a combiner (splitter). The amplifier has very high linearity to minimize intermodulation.
- The signals are then injected into a RF band-pass filter. The main goal of this RF filter is to reject the harmonics and shape the noise outside the band pass, especially in the WAN bands.
- The TX signal is amplified by a 2W power amplifier. This amplifier has an excellent linearity to minimize intermodulation.

The front-end is then able to transmit 4 RF signals simultaneously per RF antenna port.

The receive paths are also similar.

The Rx path includes:

- A first LNA with a very low noise figure, in order to not degrade the sensitivity of the receiver.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 62 / 221
Strict confidential		

- A band pass filter offers higher attenuation of the out of band blockers.
- The signal is then transmitted to a second LNA used to compensate the insertion losses of the next 4 ways power splitter to not degrade the receiver noise figure.

The details of the frequency bands, channelization, out of band rejection are detailed in §1.5.4.6.

1.5.4.5 Modulations and data rates

The LoRa LOC module supports the following modulation schemes:

SF	BW (KHz)	Data rate (kbps)
7	500	21875
8	500	12500
9	500	7031
10	500	3906
11	500	2148
12	500	1172
7	250	10938
8	250	6250
9	250	3516
10	250	1953
11	250	1074
12	250	586
7	125	5469
8	125	3125
9	125	1758
10	125	977
11	125	537
12	125	293

Note : Payload may have to be adjusted to not overrule 400ms frame length, depending on the local regulations. In this case, SF11/125KHz and SF12/125KHz are not used.

1.5.4.6 Frequency bands and channelization

The frequency bands covered by the Wirnet iBTS depends on the version of the front-end module used (868, 915 or 923).

The downstream frequencies and upstream frequencies are listed in the following table:

Version	Link	Frequency range start/end
868	Upstream (RX Wirnet iBTS)	863MHz / 873MHz
868	Downstream (TX Wirnet iBTS)	863MHz / 873MHz

915	Upstream (RX Wirnet iBTS)	902MHz / 928MHz
915	Downstream (TX Wirnet iBTS)	902MHz / 928MHz
915 FDx	Upstream (RX Wirnet iBTS FDx)	902MHz / 915MHz
915 FDx	Downstream (TX Wirnet iBTS FDx)	923MHz / 928MHz
923	Upstream (RX Wirnet iBTS)	915MHz / 928MHz
923	Downstream (TX Wirnet iBTS)	920MHz / 928MHz

LoRaWAN specification defines a more accurate frequency plan and channelization, although different options could be envisaged.

The channels are summarized in the following table:

Version	Link	Channel frequency	LoRa BW (KHz)	Number of channels	Channel BW (KHz)
915	Upstream (RX Wirnet iBTS)	$902,3+i*0,2\text{MHz}$ (i=0 à 63)	125	64	200
915	Upstream (RX Wirnet iBTS)	$903,0+i*1.6\text{MHz}$ (i=0 à 7)	500	8	600
915	Downstream (TX Wirnet iBTS)	$923,3+i*0.6\text{MHz}$ (i=0 à 7)	500	8	600
915 FDx	Upstream (RX Wirnet iBTS FDx)	$902,3+i*0,2\text{MHz}$ (i=0 à 63)	125	64	200
915 FDx	Upstream (RX Wirnet iBTS FDx)	$903,0+i*1.6\text{MHz}$ (i=0 à 7)	500	8	600
915 FDx	Downstream (TX Wirnet iBTS FDx)	$923,3+i*0.6\text{MHz}$ (i=0 à 7)	500	8	600
923	Upstream (RX Wirnet iBTS)	$915,2+i*0,2\text{MHz}$ (i= 0 à 63)	125	64	200
923	Upstream (RX Wirnet iBTS)	$915,9+i*1.6\text{MHz}$ (i=0 à 7)	500	8	600
923	Downstream (TX Wirnet iBTS)	$919,8+i*0,2\text{MHz}$ (i= 0 à 40)	125	41	200
923	Downstream (TX Wirnet iBTS)	$920,3+i*0.6\text{MHz}$ (i=0 à 12)	500	13	600
868	Upstream (RX Wirnet iBTS)	$863,1+i*0,2\text{MHz}$ (i= 0 à 27)	125	28	200
868	Downstream (TX Wirnet iBTS)	$863,1+i*0,2\text{MHz}$ (i= 0 à 27)	125	28	200
868	Upstream (RX Wirnet iBTS)	$868,9+i*0,2\text{MHz}$ (i= 0 à 1)	125	2	200

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 64 / 221
Strict confidential		

868	Downstream (TX Wirnet iBTS)	868,9+i*0,2MHz (i= 0 à 1)	125	2	200
868	Upstream (RX Wirnet iBTS)	869,525MHz	125	1	250
868	Downstream (TX Wirnet iBTS)	869,525MHz	125	1	250
868	Upstream (RX Wirnet iBTS)	869,850MHz	125	1	300
868	Downstream (TX Wirnet iBTS)	869,850MHz	125	1	300
868	Upstream (RX Wirnet iBTS)	870,1+i*0,2MHz (i= 0 à 14)	125	15	200
868	Downstream (TX Wirnet iBTS)	870,1+i*0,2MHz (i= 0 à 14)	125	15	200

Note : in South Korea, the channels defined for the “923” version must be shifted by 100KHz to meet Korean regulations i.e. 917.1MHz to 923.3MHz with 200KHz steps.

1.5.4.7 Output Power

The conducted output power can be adjusted from 0dBm to +30dBm. This offers a wide range of adjustment to cover all specific countries EIRP requirements. Antenna gain has to be considered to adjust the conducted output power to not overrule the max allowed EIRP.

Description	Specification
Conducted output power range	0dBm to +30dBm
Ripple in the band	+/- 2dB
Variation over temperature range (-20°C to +55°C)	+/- 2dB

For Wirnet iBTS FDx, depending on the number of simultaneous Tx, the power of each carrier must be adjusted to not overrule the max +30dBm total power. The Wirnet iBTS FDx is able to transmit 4 RF signals simultaneously at each RF antenna port.

1.5.4.8 Out of band emissions

Due to the very low noise transmitter, the LoRa LOC module is able to achieve excellent out of band emissions levels in the LTE, UMTS and GSM uplink or downlink bands.

The performances are summarized in the following table:

Version LoRa LOC module	LTE, UMTS or GSM band	Out of band emissions
868	E-GSM900 UL (880-915MHz)	-85dBm/100KHz

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 65 / 221
Strict confidential			

868	R-GSM900 UL (876-915MHz)	-75dBm/100KHz
868	LTE800 (832-862MHz)	-80dBm/100KHz
915	GSM850 DL (869-894MHz)	-85dBm/100KHz
915 FDx	GSM850 DL (869-894MHz)	-125dBm/100KHz
923	GSM900 UL(890-915MHz)	-85dBm/100KHz
923	GSM900 DL(935-960MHz)	-85dBm/100KHz

The performances detailed here are worst case i.e. when transmitting at maximum output power at the edge of the band.

Out of band emissions in other LTE, UMTS or GSM bands are not detailed but are obviously better.

The LORA-LOC module is therefore ideal in co-localization with BTS.

1.5.4.9 Sensitivity

The typical sensitivity performance, depending on the version, at 10% PER, 20 bytes payload is the following:

Mode	868	915	915 FDx	923
SF7/125KHz	-128dBm	-127dBm	-127dBm	-128dBm
SF10/125KHz	-136dBm	-136dBm	-135dBm	-134dBm
SF12/125KHz	-141dBm	-141dBm	-140dBm	-140dBm
SF7/250KHz	-125dBm	-	-	-125dBm
SF12/250KHz	-138dBm	-	-	-135dBm
SF7/500KHz	-121dBm	-121dBm	-121dBm	-122dBm
SF12/500KHz	-135dBm	-134dBm	-134dBm	-134dBm

The sensitivity may vary over the frequency band and over temperature as follows:

Description	Specification
Sensitivity variation over the band	+/- 2dB
Sensitivity variation over temperature range (-20°C to +60°C)	+/- 1dB

1.5.4.10 RSSI and SNR

The Wirnet iBTS is able to receive LoRa frames from -20dBm to -141dBm, depending on the LoRa BW and SF.

The Wirnet iBTS provides for each received frame, the RSSI and the SNR.

The RSSI is the “signal + noise” measurement of the received frame. Due to the wide spreading modulation, the LoRa receiver is able to demodulate signals below the noise floor i.e. with negative SNR.

To estimate the signal strength of the received frame, both SNR and RSSI have to be considered. As a rough estimate:

- If SNR >0, the signal strength = RSSI (dBm)
- If SNR <0, the signal strength = RSSI+SNR (dBm)

RSSI varies from -20dBm to -120dBm. -120dBm is the noise floor measured in a 200KHz BW. SNR is between 10 to 15dB for strong signals. It is close to 0dB when the signal strength approaches -120dBm. It can decrease down to -7dB or -20dB depending on the SF:

Spreading Factor	LoRa demodulator SNR
SF7	-7.5dB
SF8	-10dB
SF9	-12.5dB
SF10	-15dB
SF11	-17.5dB
SF12	-20dB

The following picture is an example of LoRa receiver characterization at SF7 / 125KHz BW. It describes the SNR, RSSI and RSSI+SNR measured vs. the signal strength:

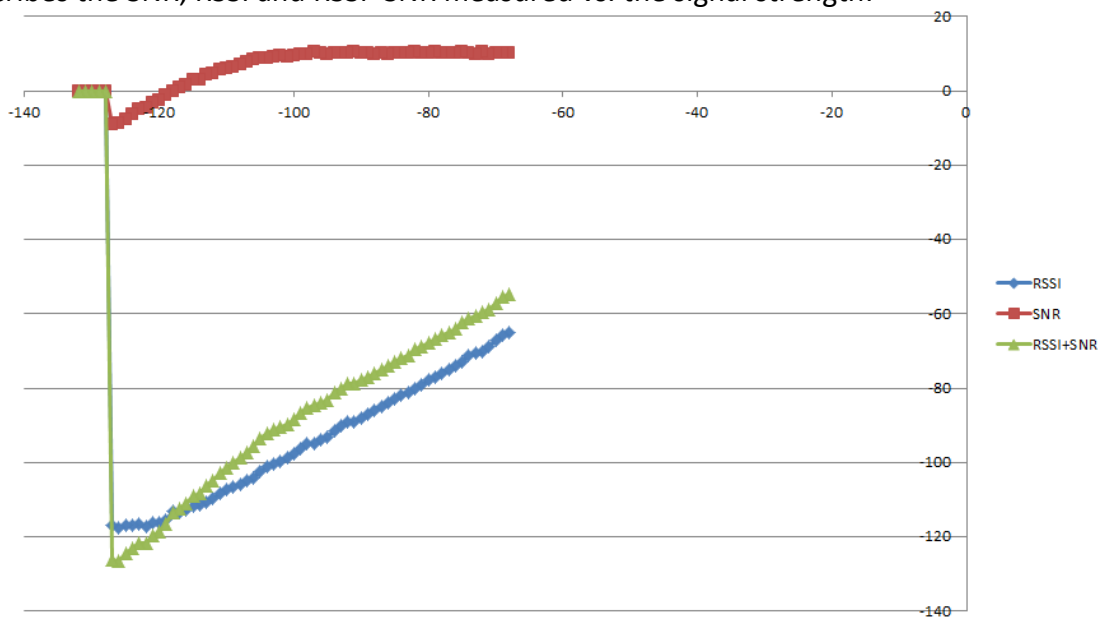


Figure 33: Example of SNR, RSSI and RSSI+SNR plots at 125KHz BW / SF7

1.5.4.11 Out of band blockers rejection

In the following tables, the out of band rejection is measured with a useful signal (LoRa) adjusted 3dB above the sensitivity. The blocker level (CW) is adjusted to reach 10% PER. The level of the blockers is noticed in the table and also the difference (in dB) with the useful LoRa signal.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 67 / 221
Strict confidential		

1.5.4.11.1 868MHz

The useful signal is adjusted at 869.525MHz.

The blockers rejections, at SF12 are the following:

Offset	SF12/125KHz
+/-2MHz	100dB
+/-10MHz	125dB
821MHz	>150dB
880MHz	130dB
935MHz	>150dB
960MHz	>150dB

1.5.4.11.2 915MHz

The useful signal is adjusted at 915MHz.

The blockers rejections, at SF10 are the following:

Offset	SF10/125KHz
+/-2MHz	90dB
+/-10MHz	100dB
850MHz	140dB
894MHz	110dB
935MHz	110dB
960MHz	140dB

1.5.4.11.1 915MHz full-duplex

The useful signal is adjusted at 908.5MHz.

The blockers rejections, at SF10 are the following:

Offset	SF10/125KHz
+/-2MHz	90dB
+/-10MHz	120dB
850MHz	140dB
894MHz	140dB
935MHz	140dB
960MHz	140dB

1.5.4.11.2 923MHz

The useful signal is adjusted at 923MHz.

The blockers rejections, at SF12 are the following:

Offset	SF12/125KHz
+/-2MHz	100dB
+/-10MHz	115dB

850MHz	>150dB
894MHz	140dB
910MHz	120dB
935MHz	130dB
960MHz	>150dB

1.5.5 Dual duplexer

The dual duplexer is used only in the Wirnet iBTS Full-Duplex.

1.5.5.1 Mechanical description

The dual duplexer features two duplexers in the same enclosure.

The main mechanical characteristics of the dual duplexer are detailed hereafter:

Description	Specification
Radiators material	Aluminum
Dimensions	236 mm x 100 mm x 40 mm
Weight	1300 g

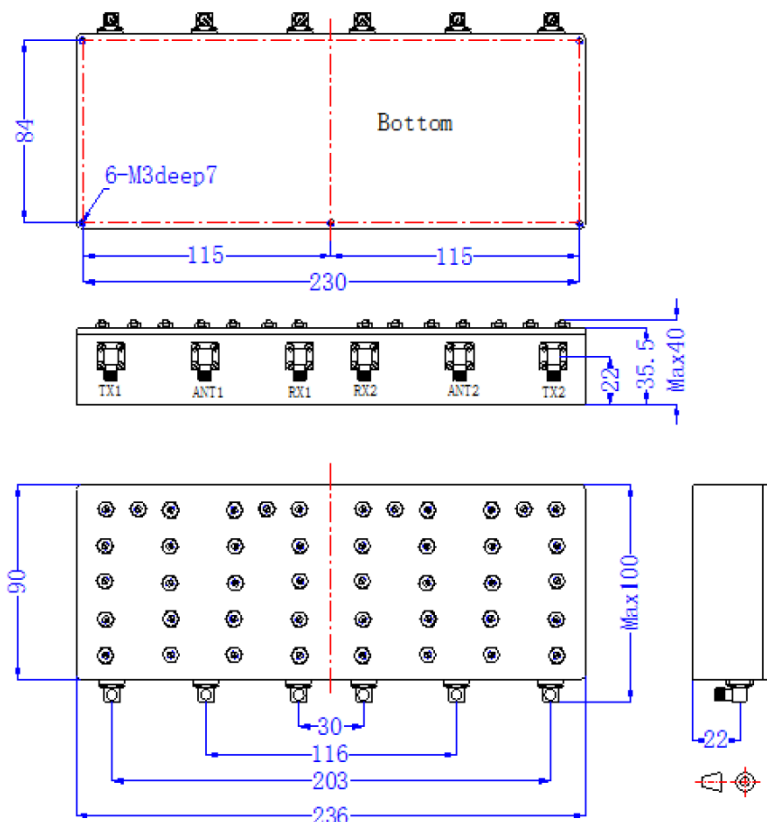


Figure 34: Dimensions of the dual duplexer

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 69 / 221
Strict confidential		

1.5.5.2 Connectors

The dual duplexer includes the following connectors:

Module side	Connector / interface	Description
Top side	ANT1 RF connector (SMA)	LoRa RF signal #1 to be connected to the LoRa antenna # 1
Top side	TX1 RF connector (SMA)	LoRa TX signal #1 to be connected to the front-end RF # 1 TX
Top side	RX1 RF connector (SMA)	LoRa RX signal #1 to be connected to the front-end RF # 1 RX
Top side	ANT2 RF connector (SMA)	LoRa RF signal #2 to be connected to the LoRa antenna # 2
Top side	TX2 RF connector (SMA)	LoRa TX signal #2 to be connected to the front-end RF # 2 TX
Top side	RX2 RF connector (SMA)	LoRa RX signal #2 to be connected to the front-end RF # 2 RX

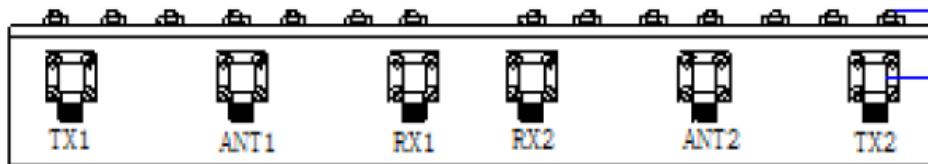


Figure 35: Connectors of the dual duplexer

Note: SMB to SMA coaxial cables are used to connect the duplexer to the antenna connectors.

1.5.5.3 Technical performance

The main RF characteristics of the dual duplexer are detailed hereafter:

Description	Specification RX band	Specification TX band
Band pass frequency range	902-915 MHz	923-928 MHz
Center frequency	908.5 MHz	925.5 MHz
Return Loss	>20dB	>20dB
Ripple	<1.0dB	<0.5dB
Insertion losses	<2.0dB	<2.0dB
Rejection	≥70 dB@923-928 MHz	≥70 dB@902-915 MHz
	≥60 dB@50-850 MHz	≥60 dB@50-850 MHz
	≥50 dB@850-894 MHz	≥60 dB@850-894 MHz
	≥60 dB@935-960 MHz	≥50 dB@935-960 MHz
	≥60 dB@960-2000 MHz	≥60 dB@960-2000 MHz
	≥50 dB@2000-3000 MHz	≥50 dB@2000-3000 MHz

Isolation TX/Rx	>70dB
Connector	SMA F right angle
Power handling	10W CW
Impedance	50 ohms
Operating temperature	-40°C to +85°C

The amplitude / frequency response of the duplexer is presented below:

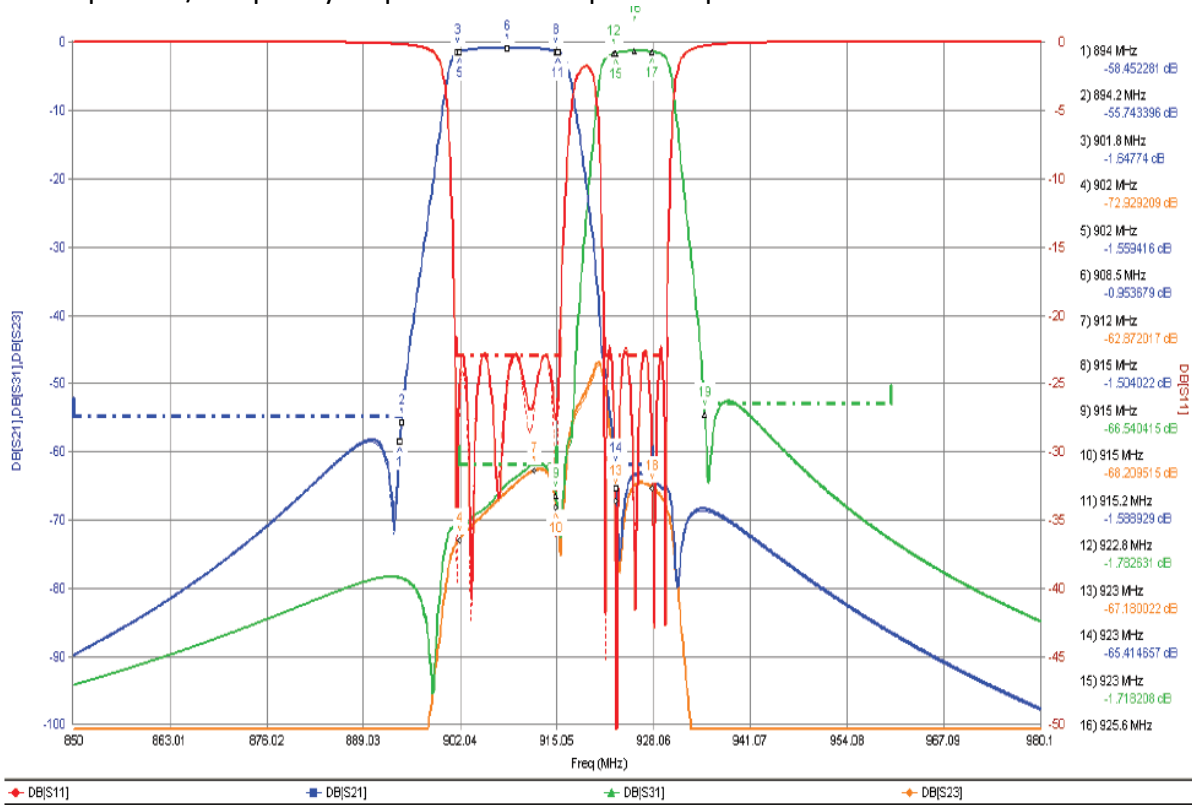


Figure 36: S parameters of the dual duplexer

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 71 / 221
Strict confidential		

1.6 Power supply

1.6.1 PoE injectors

One Midspan PoE injector among the following list is provided with each Wirnet iBTS:

- Indoor AC/DC Midspan PoE injector 30W
- Indoor AC/DC Midspan PoE injector 60W
- Indoor DC/DC Midspan PoE injector 30W
- Indoor DC/DC Midspan PoE injector 60W
- Outdoor AC/DC Midspan PoE injector 30W
- Outdoor AC/DC Midspan PoE injector 60W
- Outdoor DC/DC Midspan PoE injector 60W

Detailed characteristics of those references are done on the following chapters. Customers have to select the good reference during the ordering.

The Midspan PoE injector 30W is dedicated to the Wirnet iBTS Compact.
 The Midspan PoE injector 60W is dedicated to the Wirnet iBTS gateways.
 Both versions can be declined for indoor applications or outdoor applications.

AC/DC vs. DC/DC choice is application dependent.
 In case only 110/220VAC is available, AC/DC solution is preferred.
 In case additional DC backup (type 48V) is available, DC/DC solution may be envisaged.

Note 1: beware of the operating ambient temperature of the Midspan PoE injectors. Output power derating over +40°C has to be carefully considered to insure proper supply of the Wirnet iBTS. If the ambient temperature range cannot be guaranteed below +40°C, the Midspan PoE injector may have to be re-dimensioned. A 60W PoE injector could be then recommended instead of a 30W PoE injector.

Note 2: the power supply of the Wirnet iBTS must be a limited power source. All the PoE injectors listed below must then considered as limited power sources.

1.6.1.1 PoE injectors recommendations

Kerlink recommends using only the validated references of the provided list.

Some POE solutions may not be compatible with the Wirnet iBTS. This is particularly true for specific DC application where the Wirnet iBTS is in power supply colocation with other equipments. In such cases, some equipment may have connection between earthing system and the power supply connection (either “+” or “-” wire) dependent if the application is in +48VDC or -48VDC. As the electrical ground of the Wirnet

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 72 / 221
Strict confidential			

iBTS is directly connected to the earthing system of the installation, dysfunction may occur without POE insulation.

The following drawing shows the insulation importance of the PoE injector.

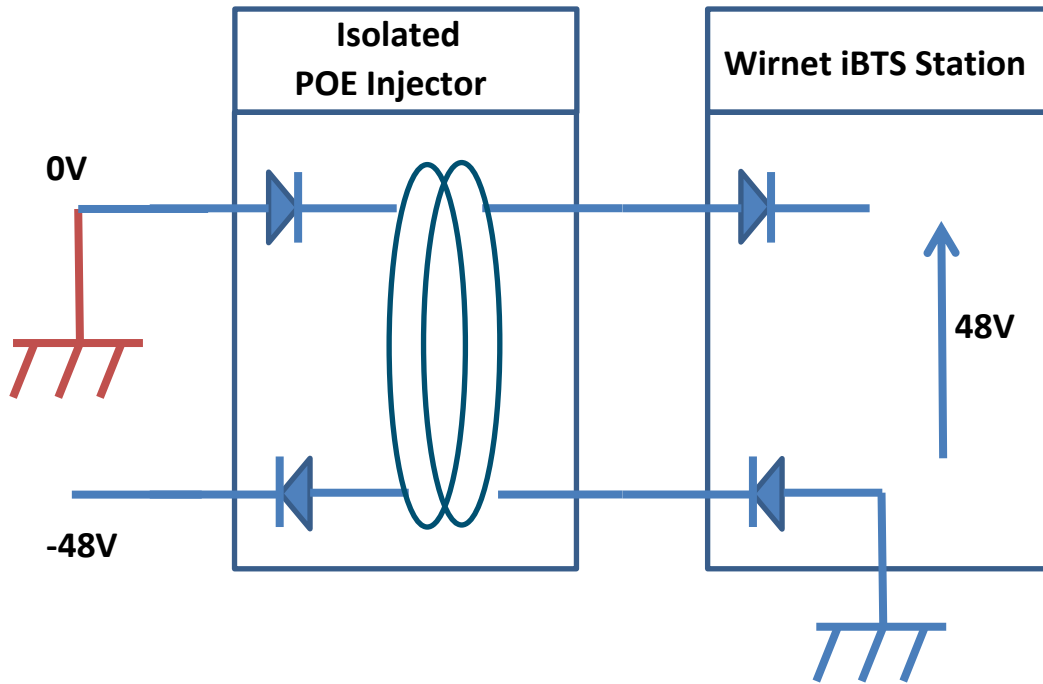


Figure 37 : Required isolation on PoE injector

1.6.1.2 Indoor AC/DC Midspan PoE injector 30W

The indoor AC/DC Midspan PoE injector 30W characteristics are detailed in the following table:

Description	Specification
Ethernet data rates	10/100/1000Base-T
Number of ports	1
PoE compatibility	IEEE 802.3at IEEE 802.3af backward compatible
PoE Output Power	30 Watts (Guaranteed)
PoE Output Voltage	55 VDC
PoE Pin Assignment and Polarity	4/5 (+), 7/8 (-)
Input Power Requirements	AC Input Voltage: 100 to 240 VAC AC Input Current: 0.8A @100-240VAC AC Frequency: 50 to 60 Hz
Dimensions	53 mm (W) x 32.5 mm (H) x 140 mm (L)

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 73 / 221
Strict confidential		

Weight	200g
Connectors	Shielded RJ-45, EIA 568A and 568B
Indicator	AC Power (Yellow) Channel Power (Green)
Operating Ambient Temperature	-20°C to +40°C @ 30W -20°C to +55°C @ 25W
Operating Humidity	Maximum 90%, Non-condensing
Storage Temperature	-20°C to +70°C
Storage Humidity	Maximum 95%, Non-condensing
Regulatory compliance	RoHS WEEE CE
Electromagnetic Emission & Immunity	FCC Part 15, Class B EN 55022 Class B (Emissions) EN 55024 (Immunity) VCCI
Safety Approvals	UL/cUL Per IEC 60950-1 GS Mark Per IEC 60950-1

Note 1: beware of the operating ambient temperature. Output power derating over +40°C has to be carefully considered to insure proper supply of the Wirnet iBTS.

The following figure details the indoor AC/DC Midspan PoE injector 30W:



Figure 38 : indoor 30W AC/DC POE injector

The indoor AC/DC Midspan PoE injector 30W can be provided with E/F type cable (Europe) or B type cable (USA). See §6 to order the required version.

Note 2: this indoor PoE injector must be connected to an industrial electrical installation including lighting protections. It must include a main board with surge protections type 1 and a secondary board with surge protections type 2.

If the electrical installation does not meet those requirements, use an alternate PoE injector featuring better surge protection as detailed in §1.6.1.6.

Note 3: this PoE injector is intended for indoor applications only.

In case the PoE injector cannot be installed indoor, use an alternate PoE injector dedicated to outdoor applications as detailed in §1.6.1.6.

1.6.1.3 Indoor AC/DC Midspan PoE injector 60W

The indoor AC/DC Midspan PoE injector 60W characteristics are detailed in the following table:

Description	Specification
Ethernet data rates	10/100/1000Base-T
Number of ports	1
PoE compatibility	IEEE 802.3at IEEE 802.3af compatible
PoE Output Power	60 Watts over 4 pairs
PoE Output Voltage	55 VDC
PoE Pin Assignment and Polarity	Data Pairs 1/2 (-) and 3/6 (+) Spare Pairs 7/8 (-) and 4/5 (+)
Input Power Requirements	AC Input Voltage: 100 to 240 VAC AC Input Current: 1.2A @100-240VAC AC Frequency: 50 to 60 Hz
Dimensions	62 mm (W) x 38 mm (H) x 151 mm (L)
Weight	320g
Connectors	Shielded RJ-45, EIA 568A and 568B
Indicator	AC Power (Yellow) Channel Power delivered over 4 pairs (Green)
Operating Ambient Temperature	-10°C to +40°C @ 60W -10°C to +55°C @ 30W
Operating Humidity	Maximum 90%, Non-condensing
Storage Temperature	-20°C to +70°C
Storage Humidity	Maximum 95%, Non-condensing
Regulatory compliance	RoHS WEEE CE
Electromagnetic Emission & Immunity	FCC Part 15, Class B EN 55022 Class B (Emissions)

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 75 / 221
Strict confidential		

Safety Approvals

EN 55024 (Immunity)
VCCI
UL/cUL Per IEC 60950-1
GS Mark Per IEC 60950-1

Note 1: beware of the operating ambient temperature. Output power derating over +40°C is critical and has to be carefully considered to insure proper supply of the Wirnet iBTS.

The following figure details the indoor AC/DC Midspan PoE injector 60W:



Figure 39 : indoor 60W AC/DC POE injector

The indoor AC/DC Midspan PoE injector 60W can be provided with E/F type cable (Europe) or B type cable (USA). See §6 to order the required version.

Note 2: this indoor PoE injector must be connected to an industrial electrical installation including lighting protections. It must include a main board with surge protections type 1 and a secondary board with surge protections type 2.

If the electrical installation does not meet those requirements, use an alternate PoE injector featuring better surge protection as detailed in §1.6.1.7.

Note 3: this PoE injector is intended for indoor applications only.

In case the PoE injector cannot be installed indoor, use an alternate PoE injector dedicated to outdoor applications as detailed in §1.6.1.7.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 76 / 221
Strict confidential		

1.6.1.4 Indoor DC/DC Midspan PoE injector 30W

The indoor DC/DC Midspan PoE injector 30W characteristics are detailed in the following table:

Description	Specification
Ethernet data rates	10/100/1000Base-T
Number of ports	1
PoE compatibility	IEEE 802.3at
PoE Output Power	30 Watts over 4 pairs
PoE Output Voltage	55 VDC 54-57 VDC under all conditions
PoE Pin Assignment and Polarity	Data Pairs 1/2 (-) and 3/6 (+) Spare Pairs 7/8 (-) and 4/5 (+)
Input Power Requirements	DC Input Voltage: 36-72VDC DC Input Current: 0.6A
Dimensions	65 mm (W) x 36 mm (H) x 140 mm (L)
Weight	200g
Connectors	Shielded RJ-45, EIA 568A and 568B
Indicator	Green LED 1: Input power "ON" Green LED 2: Valid IEEE8-2.3at load detected and connected "PoE PLUS" Green LED 3: Valid IEEE802.3af load detected and connected
Operating Ambient Temperature	-20°C to +50°C
Operating Humidity	Maximum 90%, Non-condensing
Storage Temperature	-25°C to +85°C
Storage Humidity	Maximum 95%, Non-condensing
Regulatory compliance	RoHS WEEE CE
Electromagnetic Emission	FCC Part 15, Class B EN 55022 Class B (Emissions)
Immunity	ESD: EN61000-4-2. Level 3 RS: EN61000-4-3. Level 3 EFT: EN61000-4-4. Level 2 Surge: EN61000-4-5. Level 3 CS: EN61000-4-6. Level 3

Note 1: beware of the operating ambient temperature. Output power derating over +50°C is critical and has to be carefully considered to insure proper supply of the Wirnet iBTS.

The following figure details the indoor DC/DC Midspan PoE injector 30W:



Figure 40 : indoor 30W DC/DC POE injector

The indoor DC/DC Midspan PoE injector 30W is provided with Euroblock plug.

Note 2: this indoor PoE injector must be connected to an industrial electrical installation including lighting protections. It must include a main board with surge protections type 1 and a secondary board with surge protections type 2.

If the electrical installation does not meet those requirements, use an alternate PoE injector featuring better surge protection as detailed in §1.6.1.7.

Note 3: this PoE injector is intended for indoor applications only.

In case the PoE injector cannot be installed indoor, use an alternate PoE injector dedicated to outdoor applications as detailed in §1.6.1.7.

1.6.1.5 Indoor DC/DC Midspan PoE injector 60W

The indoor DC/DC Midspan PoE injector 60W characteristics are detailed in the following table:

Description	Specification
Ethernet data rates	10/100/1000Base-T
Number of ports	1
PoE compatibility	IEEE 802.3at IEEE 802.3af compatible
PoE Output Power	60 Watts over 4 pairs
PoE Output Voltage	55 VDC
PoE Pin Assignment and Polarity	Data Pairs 1/2 (-) and 3/6 (+) Spare Pairs 7/8 (-) and 4/5 (+)
Input Power Requirements	DC Input Voltage: 36-60VDC DC Input Current: 2A
Dimensions	87 mm (W) x 43 mm (H) x 166 mm (L)

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 78 / 221
Strict confidential		

Weight	450g
Connectors	Shielded RJ-45, EIA 568A and 568B
Indicator	DC Power (Green) Channel Power delivered over 4 pairs (Green)
Operating Ambient Temperature	-20°C to +40°C @ 60W -20°C to +50°C @ 30W
Operating Humidity	Maximum 90%, Non-condensing
Storage Temperature	-20°C to +70°C
Storage Humidity	Maximum 95%, Non-condensing
Regulatory compliance	RoHS WEEE CE
Electromagnetic Emission & Immunity	FCC Part 15, Class B EN 55022 Class B (Emissions) EN 55024 (Immunity) VCCI
Safety Approvals	UL/cUL Per IEC 60950-1 GS Mark Per IEC 60950-1

Note 1: beware of the operating ambient temperature. Output power derating over +40°C is critical and has to be carefully considered to insure proper supply of the Wirnet iBTS.

The following figure details the indoor DC/DC Midspan PoE injector 60W:



Figure 41 : indoor 60W DC/DC POE injector

The indoor DC/DC Midspan PoE injector 60W is provided with Euroblock plug.

Note 2: this indoor PoE injector must be connected to an industrial electrical installation including lighting protections. It must include a main board with surge protections type 1 and a secondary board with surge protections type 2.

If the electrical installation does not meet those requirements, use an alternate PoE injector featuring better surge protection as detailed in §1.6.1.7.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 79 / 221
Strict confidential		

Note 3: this PoE injector is intended for indoor applications only.

In case the PoE injector cannot be installed indoor, use an alternate PoE injector dedicated to outdoor applications as detailed in §1.6.1.7.

1.6.1.6 Outdoor AC/DC Midspan PoE injector 30W

The outdoor AC/DC Midspan PoE injector 30W characteristics are detailed in the following table:

Description	Specification
Ethernet data rates	10/100/1000Base-T
Number of ports	1
PoE compatibility	IEEE 802.3at IEEE 802.3af backward compatible
PoE Output Power	30 Watts (Guaranteed)
PoE Output Voltage	55 VDC
PoE Pin Assignment and Polarity	4/5 (+), 7/8 (-)
Input Power Requirements	AC Input Voltage: 100 to 240 VAC AC Input Current: 1A @100-240VAC AC Frequency: 50 to 60 Hz
Dimensions	170 mm x 140 mm x 60 mm
Weight	1400g
Connectors	Shielded rugged RJ-45 with gasket EIA 568A and 568B
Indicator	None
Operating Ambient Temperature	-40°C to +65°C
Operating Humidity	Maximum 95%, Non-condensing
Storage Temperature	-40°C to +85°C
Storage Humidity	Maximum 95%, Non-condensing
Ingress protection	IP66, NEMA 4X
Corrosion resistance	ASTM B-117
Regulatory compliance	RoHS WEEE CE
Electromagnetic Emission & Immunity	FCC Part 15, Class B EN 55022 Class B (Emissions) EN 55024 (Immunity) EN 61000-4-5 Class 5 (6kV CM) VCCI
Surge protection	GR-1089-CORE Issue 4 ITU-T K.20 6 kV on AC lines
Safety Approvals	UL 60950-1, UL 60950-22 GS Mark

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 80 / 221	
Strict confidential			

Note 1: beware of the operating ambient temperature. Output power derating over +55°C has to be carefully considered to insure proper supply of the Wirnet iBTS.

The following figure details the outdoor AC/DC Midspan PoE injector 30W:



Figure 42 : Outdoor 30W AC/DC POE injector

Note 2: this PoE injector must be connected to an industrial electrical installation including at least a main board with surge protections type 1.

1.6.1.7 Outdoor AC/DC Midspan PoE injector 60W

The outdoor AC/DC Midspan PoE injector 60W characteristics are detailed in the following table:

Description	Specification
Ethernet data rates	10/100/1000Base-T
Number of ports	1
PoE compatibility	IEEE 802.3at IEEE 802.3af compatible
PoE Output Power	60 Watts over 4 pairs
PoE Output Voltage	55 VDC
PoE Pin Assignment and Polarity	Data Pairs 1/2 (-) and 3/6 (+) Spare Pairs 7/8 (-) and 4/5 (+)
Input Power Requirements	AC Input Voltage: 100 to 240 VAC AC Input Current: 2A @100-240VAC AC Frequency: 50 to 60 Hz
Dimensions	170 mm x 140 mm x 60 mm
Weight	1400g

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 81 / 221
Strict confidential		

Connectors	Shielded rugged RJ-45 with gasket EIA 568A and 568B
Indicator	None
Operating Ambient Temperature	-40°C to +65°C
Operating Humidity	Maximum 95%, Non-condensing
Storage Temperature	-40°C to +85°C
Storage Humidity	Maximum 95%, Non-condensing
Ingress protection	IP66, NEMA 4X
Corrosion resistance	ASTM B-117
Regulatory compliance	RoHS WEEE CE
Electromagnetic Emission & Immunity	FCC Part 15, Class B EN 55022 Class B (Emissions) EN 55024 (Immunity) EN61000-4-5 Class 5 (6kV CM) VCCI
Surge protection	GR-1089-CORE Issue 4 ITU-T K.20 6 kV on AC lines
Safety Approvals	UL 60950-1, UL 60950-22 GS Mark

Note 1: beware of the operating ambient temperature. Output power derating over +50°C is critical and has to be carefully considered to insure proper supply of the Wirnet iBTS.

The following figure details the outdoor AC/DC Midspan PoE injector 60W:



Figure 43 : Outdoor 60W AC/DC POE injector

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 82 / 221
Strict confidential		

Note 2: this PoE injector must be connected to an industrial electrical installation including at least a main board with surge protections type 1.

1.6.1.8 Outdoor DC/DC Midspan PoE injector 60W

The outdoor AC/DC Midspan PoE injector 60W characteristics are detailed in the following table:

Description	Specification
Ethernet data rates	10/100/1000Base-T
Number of ports	1
PoE compatibility	IEEE 802.3at IEEE 802.3af compatible
PoE Output Power	60 Watts over 4 pairs
PoE Output Voltage	55 VDC
PoE Pin Assignment and Polarity	Data Pairs 1/2 (-) and 3/6 (+) Spare Pairs 7/8 (-) and 4/5 (+)
Input Power Requirements	DC Input Voltage: 36 to 60 VDC DC Input Current: 2.2A
Dimensions	150 mm (W) x 70 mm (H) x 214 mm (L)
Weight	750g
Connectors	Shielded rugged RJ-45 with gasket EIA 568A and 568B
Indicator	None
Operating Ambient Temperature	-40°C to +50°C @ 60W -40°C to +55°C @ 30W
Operating Humidity	Maximum 95%, Non-condensing
Storage Temperature	-40°C to +85°C
Storage Humidity	Maximum 95%, Non-condensing
Ingress protection	IP66, NEMA 4X
Corrosion resistance	ASTM B-117
Regulatory compliance	RoHS WEEE CE
Electromagnetic Emission & Immunity	FCC Part 15, Class B EN 55022 Class B (Emissions) EN 55024 (Immunity) EN61000-4-5 Class 5 (6kV CM) VCCI
Surge protection	GR-1089-CORE Issue 4
Safety Approvals	UL 60950-1, UL 60950-22 GS Mark

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 83 / 221
Strict confidential		

Note 1: beware of the operating ambient temperature. Output power derating over +50°C is critical and has to be carefully considered to insure proper supply of the Wirnet iBTS.

The following figure details the outdoor DC/DC Midspan PoE injector 60W:



Figure 44 : Outdoor 60W DC/DC POE injector

Note 2: this PoE injector must be connected to an industrial electrical installation including at least a main board with surge protections type 1.

1.6.2 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.

Specific DC applications where the Wirnet iBTS is in power supply colocation with other equipments require precautions. In such cases, some equipment may have connection between earthing system and the power supply connection (either “+” or “-” wire) dependent if the application is in +48VDC or -48VDC. As the electrical ground of the Wirnet

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 84 / 221
Strict confidential		

iBTS is directly connected to the earthing system of the installation, dysfunction may occur without additional insulation. In such casing, Kerlink recommends using additional isolated DC/DC.

The following drawing shows the insulation importance of an additional isolated DC/DC power supply:

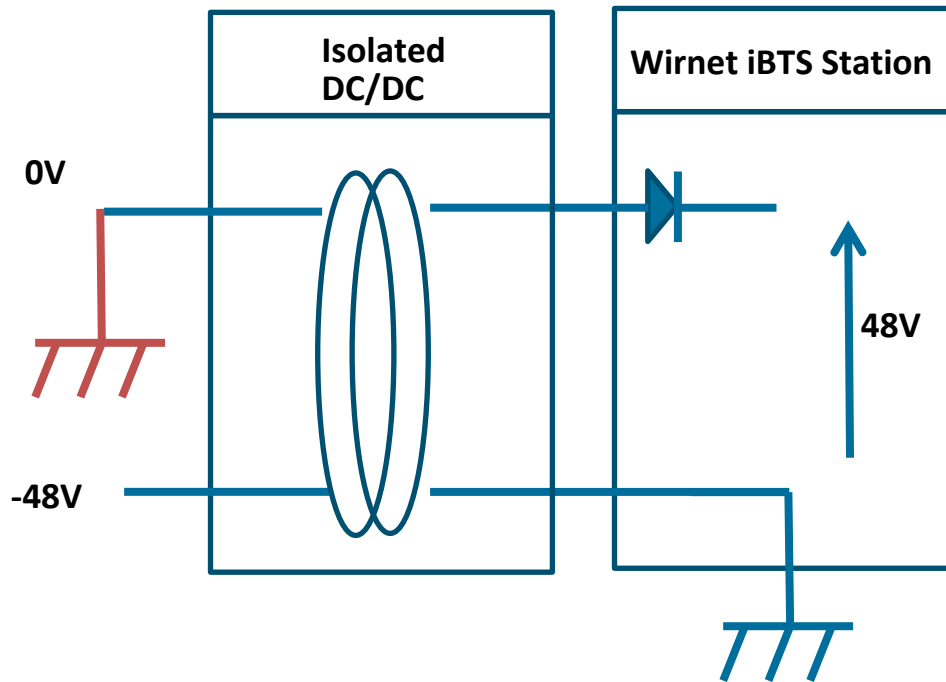


Figure 45 : Required isolation on auxiliary power supply input

An example of 40W isolated DC/DC converter is provided in the chapter 1.6.3

1.6.3 Isolated DC/DC converter 40W

As detailed in paragraph 1.6.2, some specific installation using -48V DC supply require an isolated DC/DC converter.

The characteristics of a 40W isolated DC/DC converter are detailed in the following table:

Description	Specification
Input Voltage	48V DC typ. 18-75V DC range
Input current at full load	0.93A
Undervoltage Lockout	ON at >18V OFF at <16V
Remote On/Off	On: Logic High (3.5-12 V) or open circuit Off: Logic Low (<1.2 V) or short pin 1 to pin 2

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 85 / 221
Strict confidential		

Output Voltage	48 VDC +/- 2%
Output Power	40 Watts > 30W at +60°C
Efficiency	Up to 90%
Maximum capacitive load	150uF
Line Regulation	±0.5 %
Load Regulation	1 % (0 - 10% load)
Ripple and noise	200 mV pk-pk 20MHz BW
Short Circuit Protection	Trip & Restart (hiccup mode), auto recovery
Overload Protection	150 % (Trip & Restart, hiccup mode)
Overvoltage Protection	120 % (Zener diode clamp)
Temperature Coefficient	0.02 %/ °C
Isolation	2500 VDC for 60 s
Isolation Resistance	1000 MΩ at 500 VDC
Dimensions	63.8 mm (W) x 25.6 mm (H) x 112 mm (L)
Weight	162g
Pins connections	1 Remote On/Off 2 -Vin 3 +Vin 4 +Vout 5 No Connection 6 -Vout 7 No Connection\ 8 No Connection
Operating Ambient Temperature	-40°C to +70°C
Operating Humidity	Maximum 95%, Non-condensing
Storage Temperature	-50°C to +125°C
Electromagnetic Emission	EN 55022 Class A (Emissions)
Thermal Impedance	4.25°C/W
Immunity	EN55024 ESD: EN61000-4-2, ±4 kV Contact, ±8 kV Air RS: EN61000-4-3, 10 V/m EFT: EN61000-4-4, Level 3 Surge: EN61000-4-5, Level 3 CS: EN61000-4-6, 10 Vm MF: EN61000-4-8, 30 A/m

Note 1: the 40W isolated DC/DC converter must be used with Wirnet iBTS Compact version. Do not use it with Wirnet iBTS version due to power limitations.

Note 2: beware of the operating ambient temperature. Output power derating over +60°C is critical and has to be carefully considered to insure proper supply of the Wirnet iBTS Compact.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 86 / 221
Strict confidential		

The following figure details the 40W indoor DC/DC converter:



Figure 46 : Isolated 40W DC/DC converter

1.7 Power consumption

The maximum power consumption of each individual module is detailed hereafter:

Module	Power consumption
CPU module (20% load)	1.8W max
WAN module (HSPA, 25% Tx, 75% Rx)	1.7W max
LoRa LOC module (Rx mode)	6.5W max
Four LoRa LOC module (Rx mode)	20W
Four LoRa LOC module (Rx + Tx mode - FDx)	25W

The maximum power consumption per day of the Wirnet iBTS is then the following:

Wirnet iBTS	Power consumption
Wirnet iBTS Compact (1 LoRa LOC Module)	237Wh max
Wirnet iBTS with 2 x LoRa LOC Modules	392Wh max
Wirnet iBTS with 3 x LoRa LOC Modules	547Wh max
Wirnet iBTS with 4 x LoRa LOC Modules	702Wh max
Wirnet iBTS FDx	720Wh max

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

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 87 / 221
Strict confidential		

1.8 Description of the accessories

1.8.1 LoRa antennas

1.8.1.1 Omnidirectional antenna 868MHz 3dBi

The specifications of the omnidirectional 868MHz / 3dBi antenna are the following:

Item	Specification
Frequency range	868MHz +/- 5MHz
Impedance	50 ohms
Technology	Half wave
VSWR	<1.3:1
Max gain	3dBi
Polarization	Vertical
Power handling	50W
DC ground	Yes
Whip material	Fiberglass
Connector	N female
Length	30 cm
Weight	75g
IP rating	IP66K
Shock resistance	IK08
Wind resistance	150MPH
Operating temperature range	-20°C to +60°C
Salt, fog	EN 60068-2-52, severity 1

The radiation patterns are presented here after. They are measured at 870MHz (red), 868MHz (green) and 866MHz (blue):

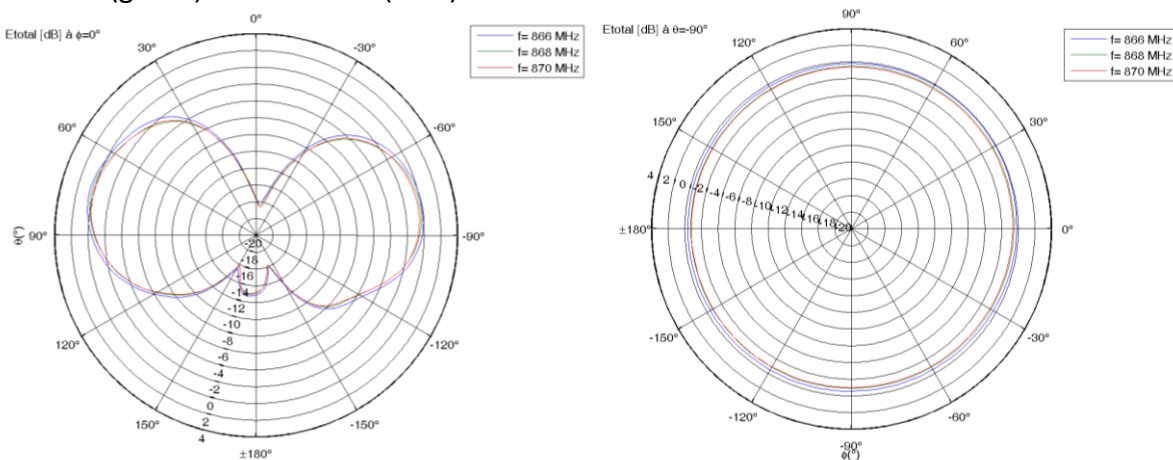


Figure 47 : Radiation pattern of omnidirectional 868MHz/3dBi antenna

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 88 / 221
Strict confidential		

1.8.1.2 Omnidirectional antenna 868MHz 6dBi

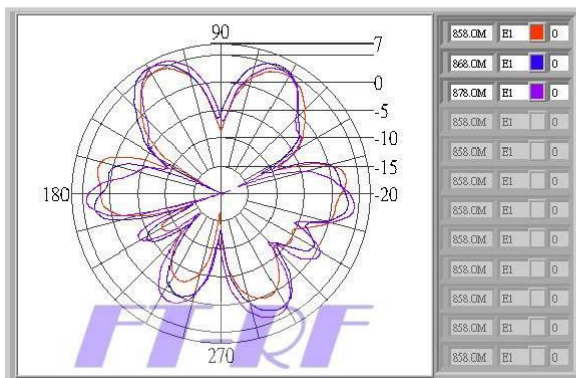
The specifications of the omnidirectional 868MHz / 6dBi antenna are the following:

Item	Specification
Frequency range	865MHz +/- 5MHz
Impedance	50 ohms
Technology	Collinear, dipole array
VSWR	<1.5:1 at 868MHz <2.0:1 at 860-870MHz
Max gain	6dBi
Polarization	Vertical
Vertical Beam width	25°
Power handling	100W
DC ground	Yes
Whip material	Fiberglass
Connector	N female
Length	110 cm
Weight	540g
IP rating	IP66K
Shock resistance	IK08
Wind resistance	150MPH
Operating temperature range	-20°C to +60°C
Salt, fog	EN 60068-2-52, severity 1

The radiation patterns are presented here after. They are measured at 858MHz (red), 868MHz (blue) and 878MHz (purple):

Vertical Pattern

E-plane co-pol ----- -3dB beam-width=25 Deg



Horizontal Pattern

H-plane co-pol ----- -3dB beam-width=360 Deg

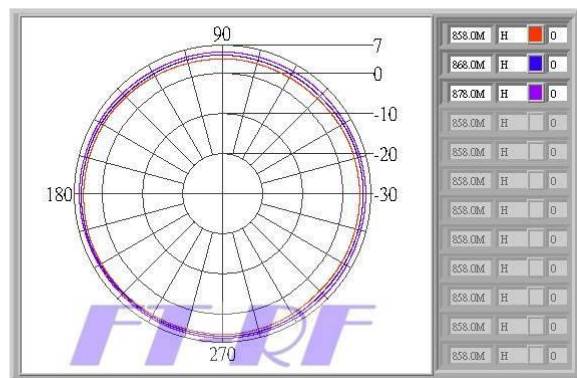


Figure 48 : Radiation pattern of omnidirectional 868MHz/6dBi antenna

Note: this antenna can not be installed on the universal antenna bracket but is provided with its own mounting kit.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 89 / 221
Strict confidential		

1.8.1.3 Omnidirectional antenna 915MHz 3dBi

The specifications of the omnidirectional 915MHz / 3dBi antenna are the following:

Item	Specification
Frequency range	915MHz +/- 15MHz
Impedance	50 ohms
Technology	Half wave
VSWR	<1.3:1
Max gain	3dBi
Polarization	Vertical
Power handling	50W
DC ground	Yes
Whip material	Fiberglass
Connector	N female
Length	30 cm
Weight	75g
IP rating	IP66K
Shock resistance	IK08
Wind resistance	150MPH
Operating temperature range	-20°C to +60°C
Salt, fog	EN 60068-2-52, severity 1

The radiation patterns are presented here after. They are measured at 930MHz (red), 915MHz (green) and 900MHz (blue):

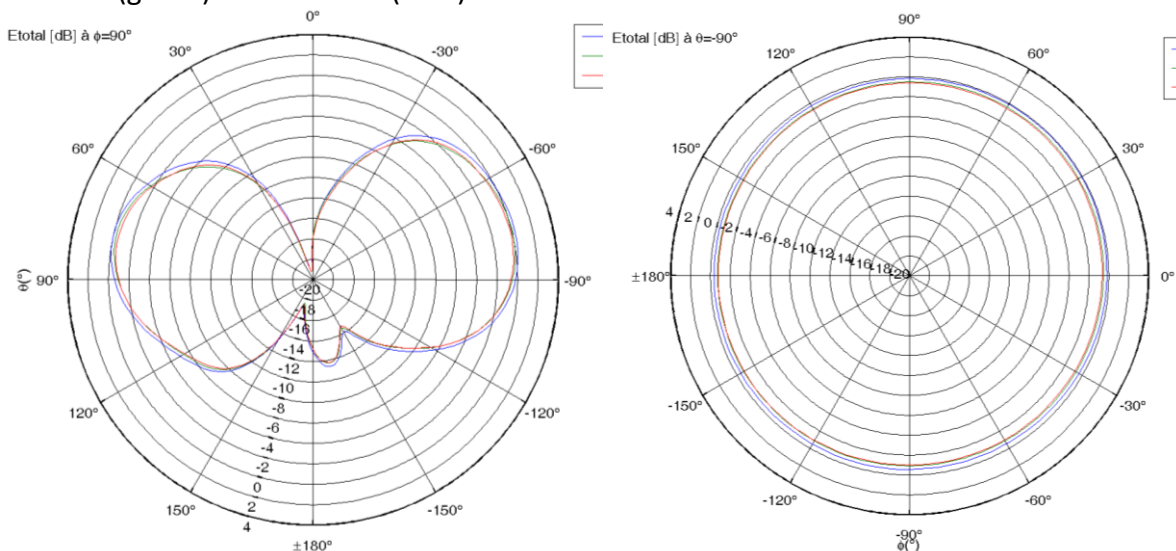


Figure 49 : Radiation pattern of omnidirectional 915MHz/3dBi antenna

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 90 / 221
Strict confidential		

1.8.1.4 Omnidirectional antenna 915MHz 6dBi

The specifications of the omnidirectional 915MHz / 6dBi antenna are the following:

Item	Specification
Frequency range	915MHz +/- 15MHz
Impedance	50 ohms
Technology	Collinear, dipole array
VSWR	<1.2:1
Max gain	6dBi
Polarization	Vertical
Power handling	50W
DC ground	No
Whip material	Fiberglass
Connector	N female
Length	100 cm
Weight	380g
IP rating	IP66K
Shock resistance	IK08
Operating temperature range	-20°C to +60°C
Salt, fog	EN 60068-2-52, severity 1

The radiation patterns are presented here after. They are measured at 900MHz (red), 915MHz (green) and 930MHz (blue):

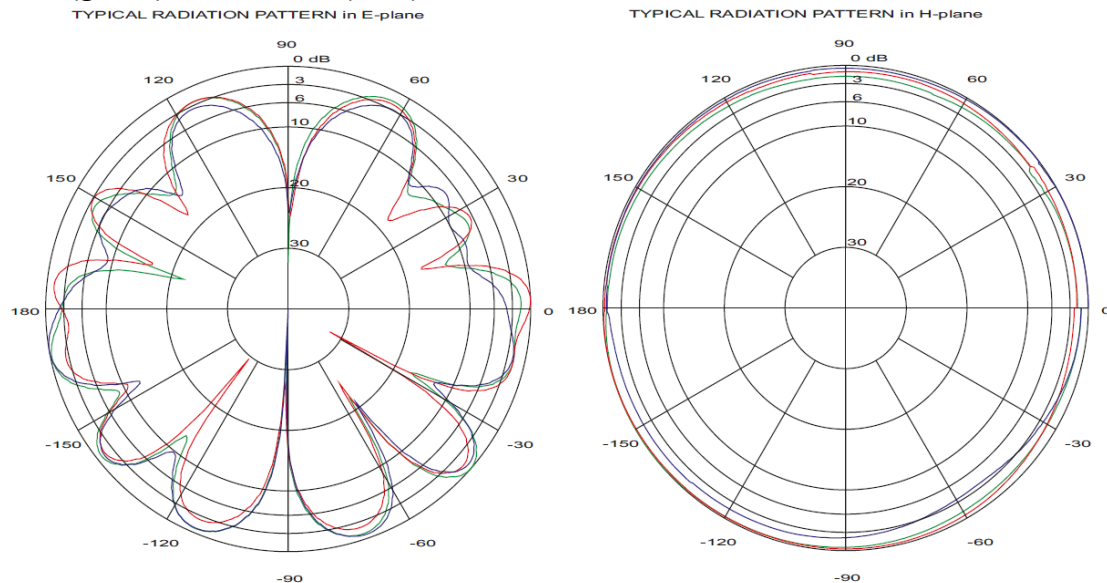


Figure 50 : Radiation pattern of omnidirectional 915MHz/6dBi antenna

KERLINK can provide two distinct references of 915MHz / 6dBi antennas, from two different suppliers. The first one must be installed on the universal antenna bracket whereas the second one has its own mounting kit. The second one cannot be installed on the universal antenna bracket.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 91 / 221
Strict confidential		

1.8.2 GNSS and WAN antennas

1.8.2.1 GNSS antenna

The GNSS antenna is required for the Wirnet iBTS standard casing only, when featuring a “CPU module”.

The Wirnet iBTS Compact embeds a GNSS/LTE internal antenna detailed in §1.8.2.3 and therefore does not require the GNSS antenna.

The GNSS antenna characteristics are detailed in the following table:

Characteristics	Detail	Specification
Frequency range		1572 - 1606 MHz
Antenna peak gain		3dBic
Typical VSWR		<2.0:1
Impedance		50 ohms
Polarization		RHCP
Noise figure		1.5dB typ
Total gain		27dB typ
Out of band rejection		30dB min at +/-100MHz
IIP3		-10dBm
IP1dB		-15dBm
Input voltage		3.0V - 5.5V
Current drain		11mA at 3V
Cable length		5 m
Cable type		RG58
Connector type		N male
Dimensions (DxH)	Diameter and Height	80 mm (D) x 42 mm (H)
Operating temperature		-40°C to +85°C
Wind resistance		> 200 km/h
IP rating		IP66

Note: a dome antenna bracket is provided with the GNSS antenna, allowing wall mounting, pole mounting and metallic strapping. Screws, nuts, U-bolt and metallic strapping are not provided by KERLINK.

1.8.2.2 LTE antenna

The LTE antenna is required for the Wirnet iBTS standard casing only, when featuring a “WAN module”.

The Wirnet iBTS Compact embeds a GNSS/LTE internal antenna detailed in §1.8.2.3 and therefore does not require the LTE antenna.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 92 / 221
Strict confidential			

The LTE antenna characteristics are detailed in the following table:

Characteristics	Detail	Specification
Frequency range	Band 1	698-960 MHz
	Band 2	1700-2700MHz
Peak gain	Band 1	4dBi
	Band 2	2dBi
Typical VSWR	Band 1 & 2	<2.4:1
Impedance		50 ohms
Polarization		Linear, Vertical
Radiation pattern		Omnidirectional
Type		No ground plane required
Power handling		10W min
Cable length		5 m
Cable type		RG58
Connector type		N male
Dimensions (DxH)	Diameter and Height	80 mm (D) x 42 mm (H)
Operating temperature		-40°C to +85°C
Wind resistance		> 200 km/h
IP rating		IP66

Note: a dome antenna bracket is provided with the LTE antenna, allowing wall mounting, pole mounting and metallic strapping. Screws, nuts, U-bolt and metallic strapping are not provided by KERLINK.

1.8.2.3 GNSS/LTE magnetic antenna

The GNSS/LTE magnetic antenna can be used with the Wirnet iBTS Compact casing only. It is not required for the Wirnet iBTS standard casing.

The GNSS/LTE magnetic antenna characteristics are detailed in the following table:

Characteristics	Description	Detail	Specification
LTE antenna	Frequency range	Band 1	698-960 MHz
		Band 2	1700-2700MHz
	Peak gain	Band 1	1dBi
		Band 2	0dBi
	Typical VSWR	Band 1 & 2	<2.0:1
	Impedance		50 ohms
	Polarization		Vertical
	Radiation pattern		Omnidirectional
	Type		No ground plane required

GNSS antenna	Power handling	10W
	Frequency range	1574 - 1606 MHz
	Peak gain	3dBic
	Typical VSWR	<2.0:1
	Impedance	50 ohms
	Polarization	RHCP
	Type	Passive
Mechanical	No ground plane required	
	DC block	Yes
	Mounting type	Magnetic mount
	Cable length (x2)*	15 cm
	Cable type (x2)	RG174
	Connector type (x2)*	SMA male, right angle
	Dimensions (DxH)	63 mm (D) x 16 mm (H)
Operating temperature	-40°C to +85°C	

Note: the antenna must be mounted on the internal GNSS/LTE bracket, a mechanical part provided as standard with the Wirnet iBTS Compact (see §1.3.1 and Figure 10).

1.8.2.4 Internal LTE antenna

The internal LTE antenna is required for the Wirnet iBTS Compact casing only, when featuring a “Dual WAN module”. It is not required for the Wirnet iBTS standard casing.

The internal LTE antenna characteristics are detailed in the following table:

Characteristics	Detail	Specification
Frequency range	Band 1	824-960 MHz
	Band 2	1700-2300MHz
Peak gain	Band 1 & 2	0dBi
Typical VSWR	Band 1 & 2	<2.5:1
Impedance		50 ohms
Polarization		Linear, Vertical
Radiation pattern		Omnidirectional
Type		Monopole
Power handling		10W min
Connector type	Right angle	SMA male
Dimensions		45 mm x 17.4 mm
Operating temperature		-30°C to +75°C

Note: the internal LTE antenna is directly mounted (screwed) on the SMA female connector of the Dual WAN module.

1.8.3 Cavity filters

1.8.3.1 865-867MHz cavity filter

The 865-867MHz cavity filter is typically dedicated to the Indian market. The purpose of this filter is to avoid saturation and desensitization of the LoRa receiver due to co-located LTE850 or CDMA800 base stations.

The 862-867MHz cavity filter characteristics are detailed in the following table:

Characteristics	Specification
Pass band	865-867MHz
Insertion losses	≤4dB
Ripple	≤1.0dB
Return Loss	≥18db
Rejection	≥60dB @ 806-860MHz ≥40dB @ 862MHz ≥50dB @ 869MHz ≥70dB @ 871-960MHz
Impedance	50 ohms
Power Handling	≤10W
Temperature	-30°C to+60°C
Connectors	N-Female / N-Male
Waterproof	IP66
Surface Finish	Black Paint
Dimensions (w/o N connectors)	196 x 104 x 50 mm

The dimensions of the 865-867MHz cavity filter are detailed hereafter:

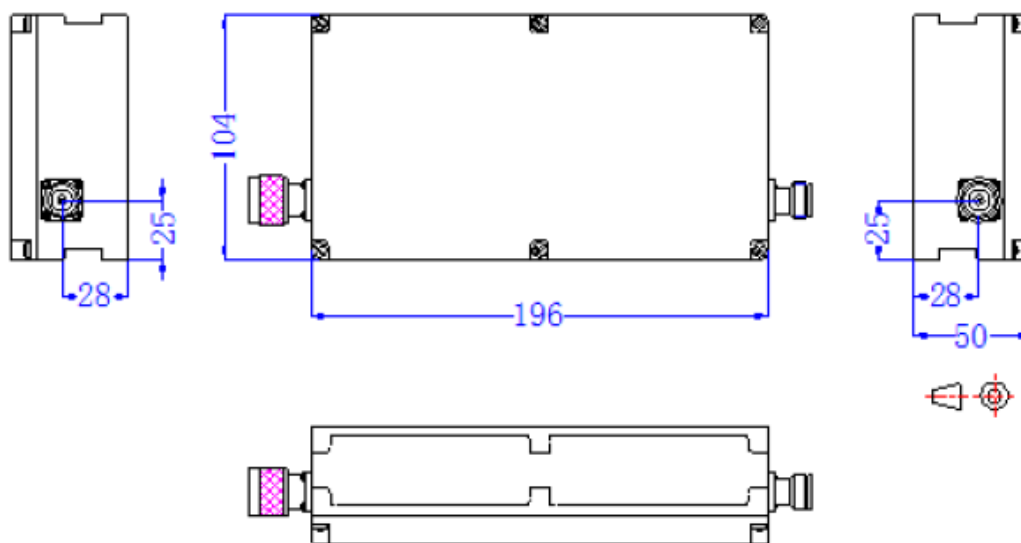


Figure 51 : Dimensions of the 865-867MHz cavity filter

The frequency response of 862-867MHz cavity filter is as follows:

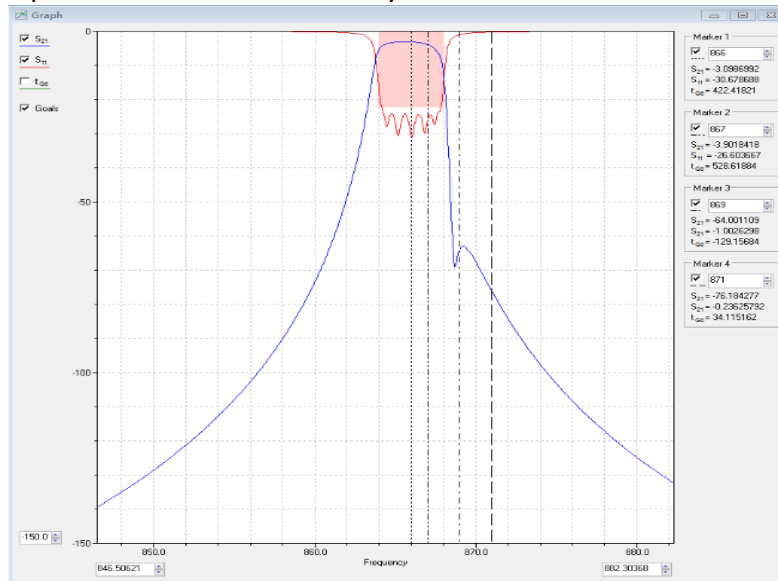


Figure 52 : Frequency response of the 865-870MHz cavity filter

1.8.3.2 865-870MHz cavity filter

The 865-870MHz cavity filter is typically dedicated to the European market. The purpose of this filter is to allow co-located LTE800 base stations, in case of poor isolation between antennas (less than 50dB).

The 865-870MHz cavity filter characteristics are detailed in the following table:

Characteristics	Specification
Center Frequency	867.5 MHz
Pass band	865-870MHz
Insertion losses	≤1dB
Ripple	≤0.5dB
Return Loss	≥20dB
Rejection	≥30dB @ 10-824MHz ≥20dB @ 832-862MHz ≥20dB @ 880-925MHz ≥30dB @ 925-960MHz ≥30dB @ 960-3000MHz
Impedance	50 ohms
Power Handling	≤10W
Temperature	-30°C to+60°C
Connectors	N-Female / N-Male
Waterproof	IP66
Surface Finish	Black Paint
Weight	<650g
Dimensions (w/o N connectors)	100 x 100 x 49 mm

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 96 / 221
Strict confidential		

The dimensions of the 865-870MHz cavity filter are detailed hereafter:

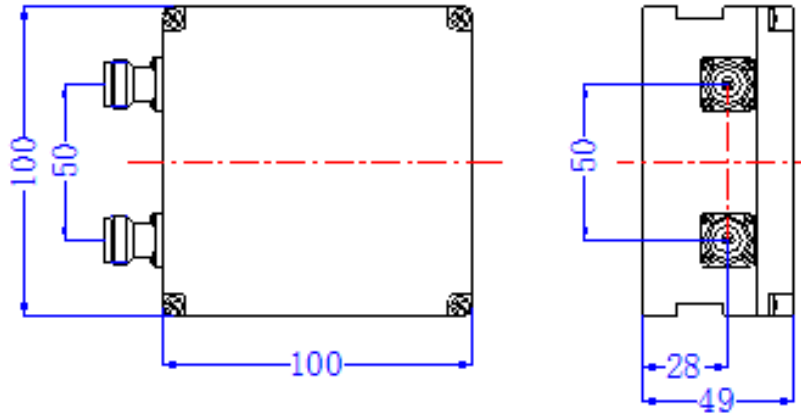


Figure 53 : Dimensions of the 865-870MHz cavity filter

The frequency response of 865-870MHz cavity filter is as follows:

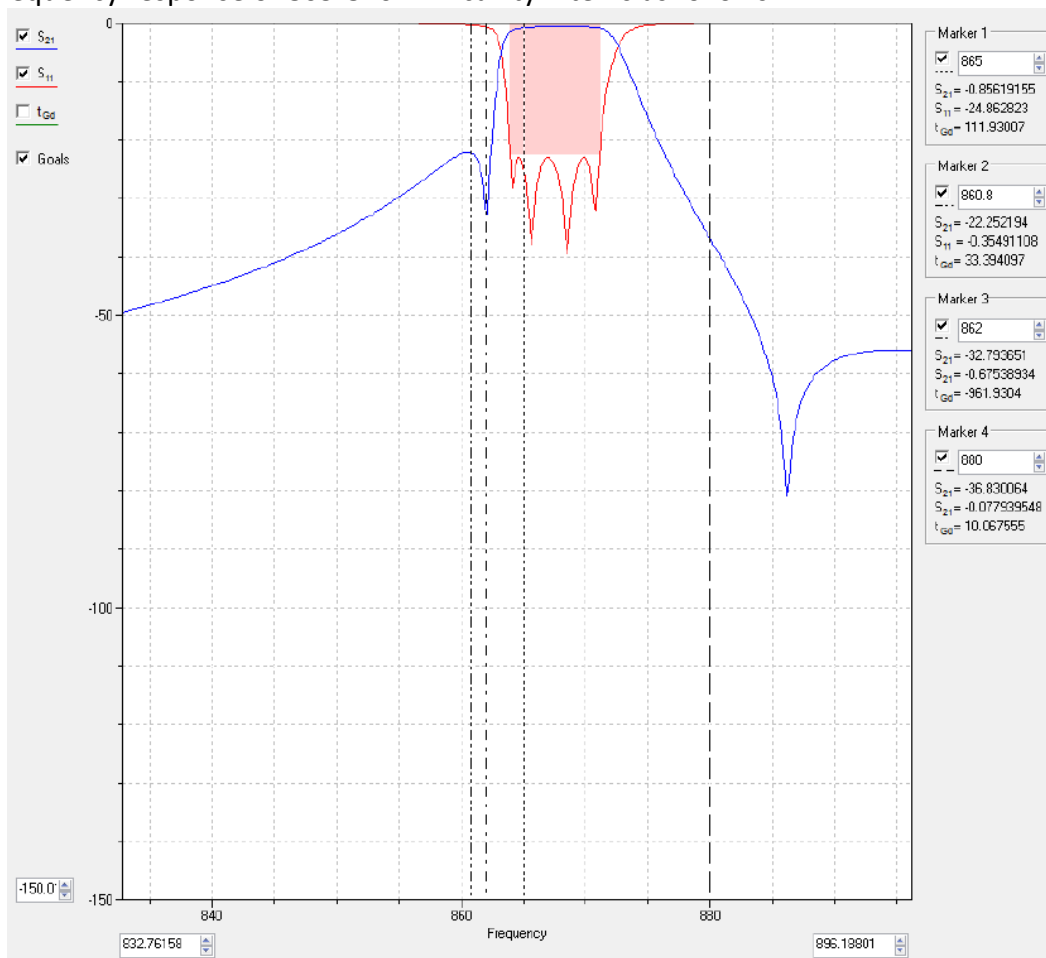


Figure 54 : Frequency response of the 865-870MHz cavity filter

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 97 / 221
Strict confidential		

1.8.3.3 863-873MHz cavity filter

The 863-873MHz cavity filter is typically dedicated to the European market. The purpose of this filter is to allow co-located high power emitters (DVB-T, BTS), in case of poor isolation between antennas (less than 50dB).

The 863-873MHz cavity filter characteristics are detailed in the following table:

Characteristics	Specification
Center Frequency	868 MHz
Pass band	863-873MHz
Insertion losses	≤1dB
Ripple	≤0.5dB
Return Loss	≥20dB
Rejection	≥80dB @ 10-700MHz ≥70dB @ 700-791MHz ≥60dB @ 791-821MHz ≥60dB @ 925-960MHz ≥70dB @ 960-1000MHz ≥80dB @ 1000-2700MHz
Impedance	50 ohms
Power Handling	≤20W
Temperature	-40°C to+85°C
Connectors	N-Female / N-Male
Waterproof	IP66
Surface Finish	Black Paint
Weight	<600g
Dimensions (w/o N connectors)	148 x 46 x 50 mm

The dimensions of the 863-873MHz cavity filter are detailed hereafter:

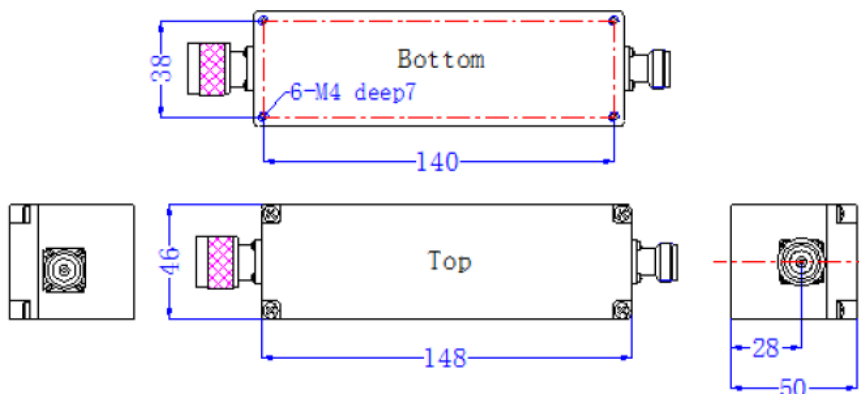


Figure 55 : Dimensions of the 863-873MHz cavity filter

The frequency response of 863-873MHz cavity filter is as follows:

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 98 / 221
Strict confidential		

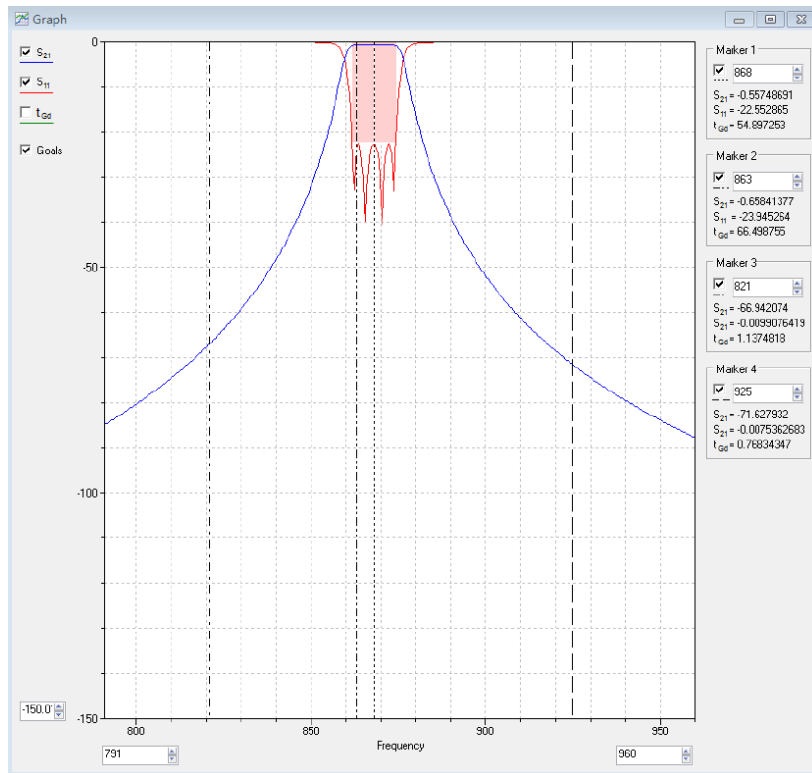


Figure 56 : Frequency response of the 863-873MHz cavity filter

1.8.3.4 915-920MHz cavity filter

The 915-920MHz cavity filter is typically dedicated to the Philippines market. It could be also used in Israel. The purpose of this filter is to avoid saturation and desensitization of the LoRa receiver due to co-located EGSM900 base stations.

The 915-920MHz cavity filter characteristics are detailed in the following table:

Characteristics	Specification
Band pass	915 to 920MHz
Center Frequency (Fc)	917,5MHz
Frequency bandwidth	5MHz
Insertion Loss	<2.8dB @full temp
Band Ripple	<1dB
Out of Band Rejection	>40dB @923MHz >40dB @912MHz >60dB @925MHz >60dB @910MHz
Return Loss	>20dB
Input and Output Impedance	50 Ohm
Max Input Power	10W CW
Temperature range	-30°C / +60°C
Ports	In N male / Out N female

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 99 / 221
Strict confidential		

Positions of the ports	Opposite sides (right / left)
Dimensions	150mm x 80mm x 50 mm
Weight	<1Kg
Waterproof	IP66 min

The dimensions of the 915-920MHz cavity filter are detailed hereafter:

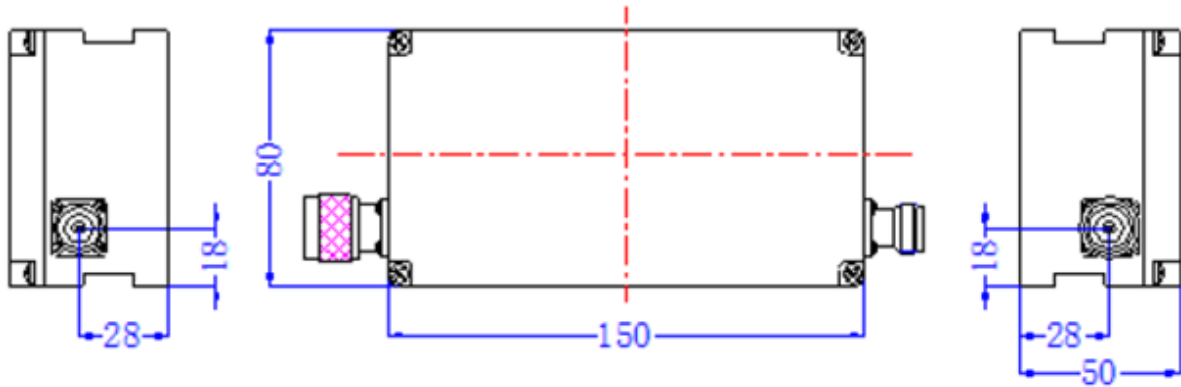


Figure 57 : Dimensions of the 915-920MHz cavity filter

The frequency response of 915-920MHz cavity filter is as follows:

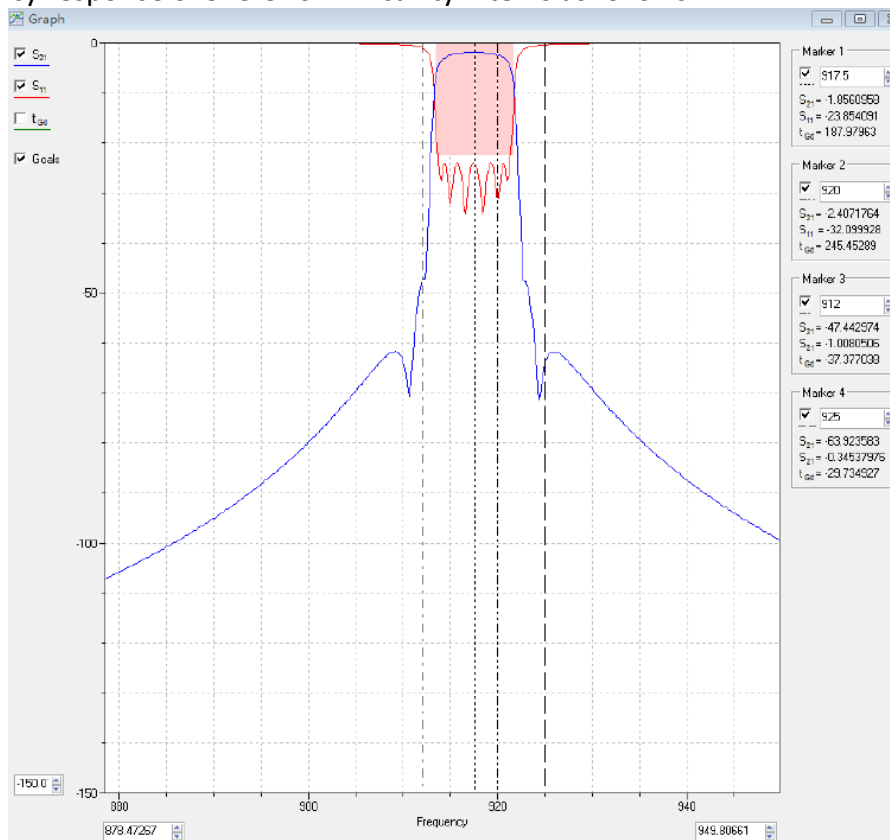


Figure 58 : Frequency response of the 915-920MHz cavity filter

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 100 / 221
Strict confidential		

1.8.3.5 918-923MHz cavity filter

The 918-923MHz cavity filter is typically dedicated to Malaysia market. The purpose of this filter is to avoid saturation and desensitization of the LoRa receiver due to co-located EGSM900 base stations.

The 918-923MHz cavity filter characteristics are detailed in the following table:

Characteristics	Specification
Band pass	918 to 923MHz
Center frequency (Fc)	920,5MHz
Frequency bandwidth	5MHz
Insertion Loss	<3dB @25°C <5.7dB @full temp
Band Ripple	<1.8dB @25°C <3.2dB @full temp
Out of Band Rejection	>40dB @925MHz >40dB @915MHz >70dB @927MHz >70dB @910MHz
Return Loss	>20dB
Input and Output Impedance	50 Ohm
Max Input Power	10W CW
Temperature range	-30°C / +60°C
Ports	In N male / Out N female
Positions of the ports	Opposite sides (right / left)
Dimensions	150mm x 80mm x 50 mm
Weight	<1Kg
Waterproof	IP66 min

The dimensions of the 918-923MHz cavity filter are detailed hereafter:

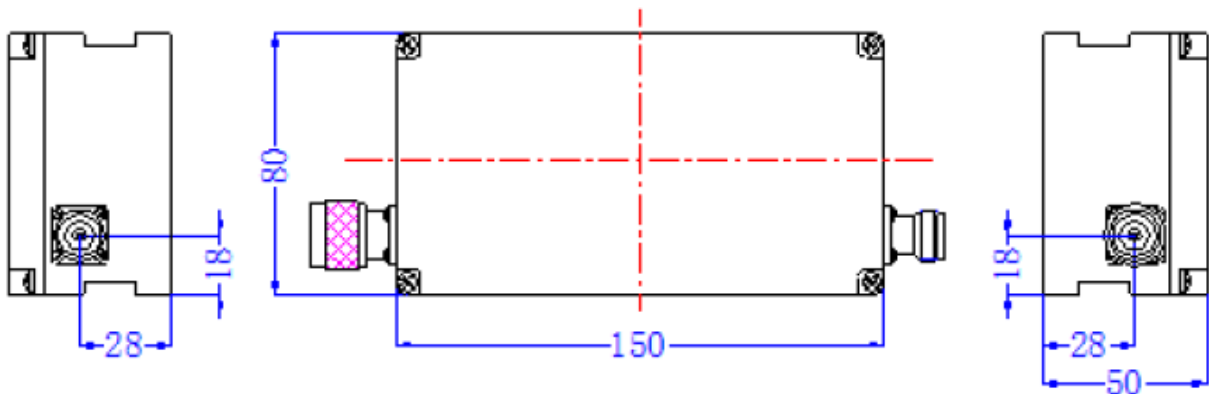


Figure 59 : Dimensions of the 918-923MHz cavity filter

The frequency response of 918-923MHz cavity filter is as follows:

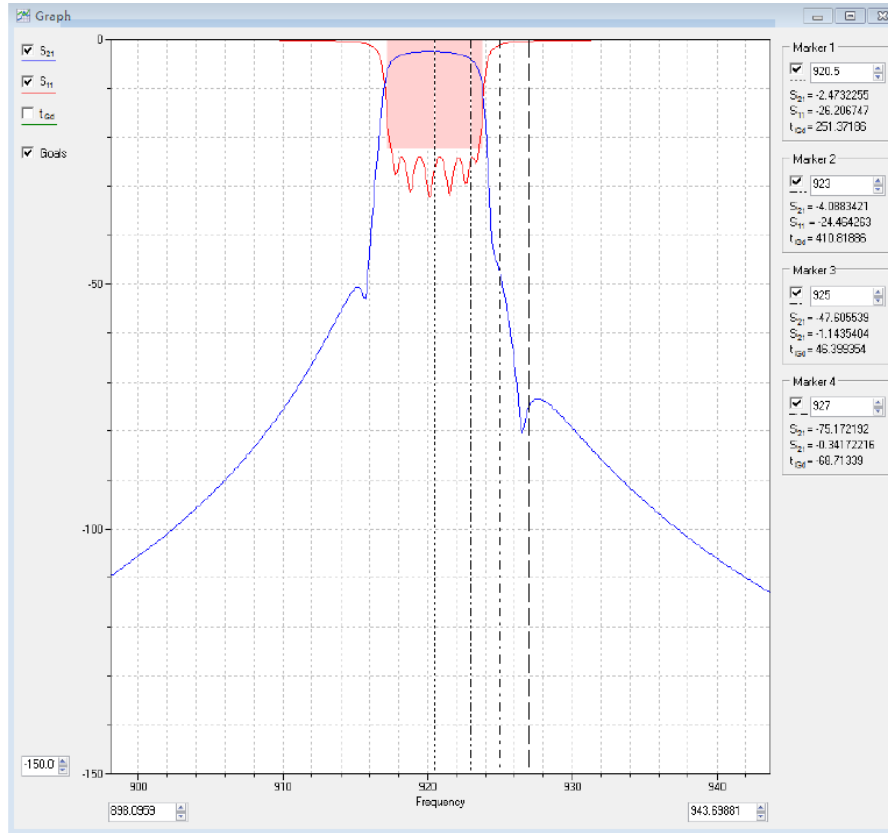


Figure 60 : Frequency response of the 918-923MHz cavity filter

1.8.3.6 920-925MHz cavity filter

The 920-925MHz cavity filter is typically dedicated to the Singapore market. The purpose of this filter is to avoid saturation and desensitization of the LoRa receiver due to co-located EGSM900 base stations.

The 920-925MHz cavity filter characteristics are detailed in the following table:

Characteristics	Specification
Center Frequency	922.5 MHz
Pass band	920-925MHz
Insertion losses	≤3dB
Ripple	≤1.2dB
VSWR	≤1.3:1
Rejection	≥60dB @ 880-915MHz ≥60dB @ 930-960MHz
Impedance	50 ohms
Power Handling	≤10W
Temperature	-30°C to +60°C
Connectors	N-Female / N-Male

Waterproof	IP66
Surface Finish	Black Paint
Dimensions (w/o N connectors)	134 x 80 x 50 mm

The dimensions of the 920-925MHz cavity filter are detailed hereafter:

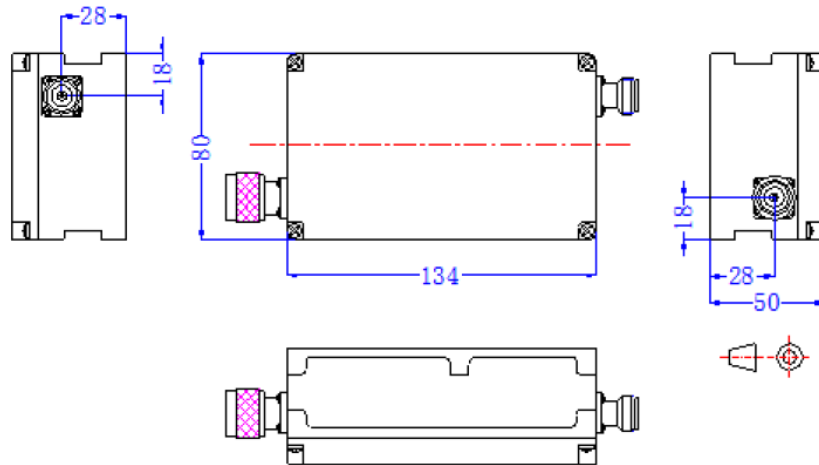


Figure 61 : Dimensions of the 920-925MHz cavity filter

The frequency response of 862-867MHz cavity filter is as follows:

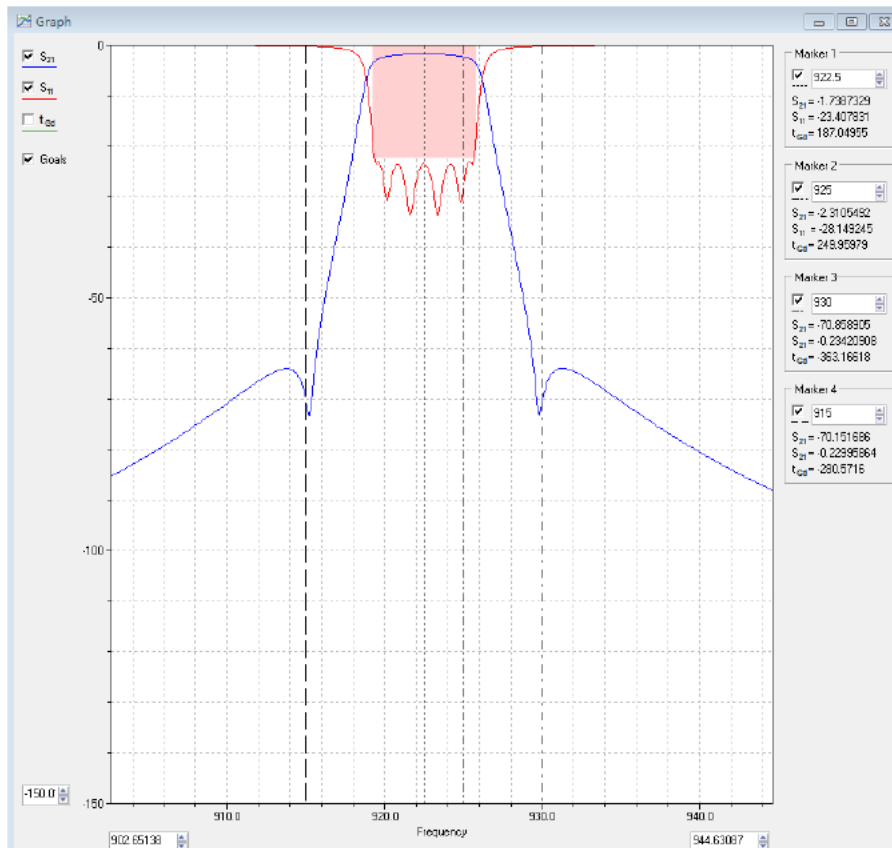


Figure 62 : Frequency response of the 920-925MHz cavity filter

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 103 / 221
Strict confidential		

1.8.3.7 920-928MHz cavity filter

The 920-928MHz cavity filter is typically dedicated to the New-Zealand market. The purpose of this filter is to avoid saturation and desensitization of the LoRa receiver due to co-located GSM900 base stations.

The 920-928MHz cavity filter characteristics are detailed in the following table:

Characteristics	Specification
Band pass	920 to 928MHz
Center frequency (Fc)	924MHz
Frequency bandwidth	8MHz
Insertion Loss	<3dB
Band Ripple	<1dB
Out of Band Rejection	>60dB @935-960MHz >60dB @880-915MHz
Return Loss	>20dB
Input and Output Impedance	50 Ohm
Max Input Power	10W CW
Temperature range	-30°C / +60°C
Ports	In N male / Out N female
Positions of the ports	Opposite sides (right / left)
Dimensions	150mm x 80mm x 50 mm
Weight	<1Kg
Waterproof	IP66 min

The dimensions of the 920-928MHz cavity filter are detailed hereafter:

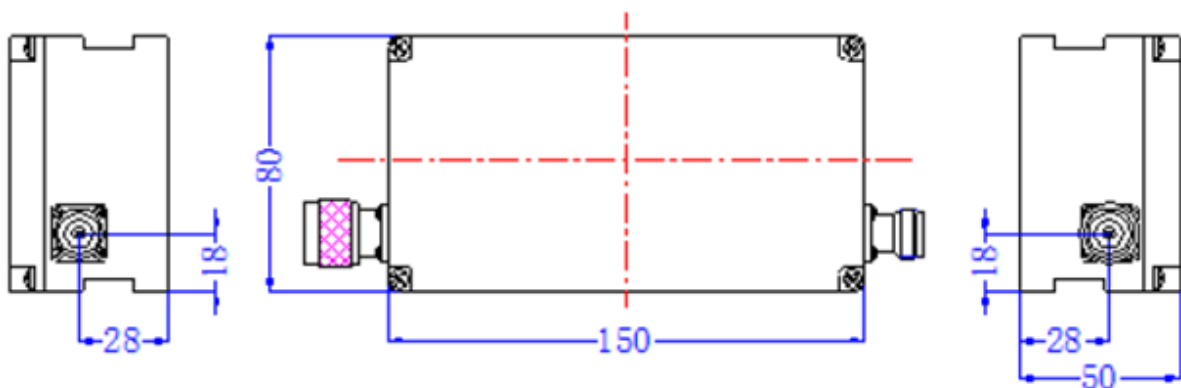


Figure 63 : Dimensions of the 920-928MHz cavity filter

The frequency response of 920-928MHz cavity filter is as follows:

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 104 / 221
Strict confidential		

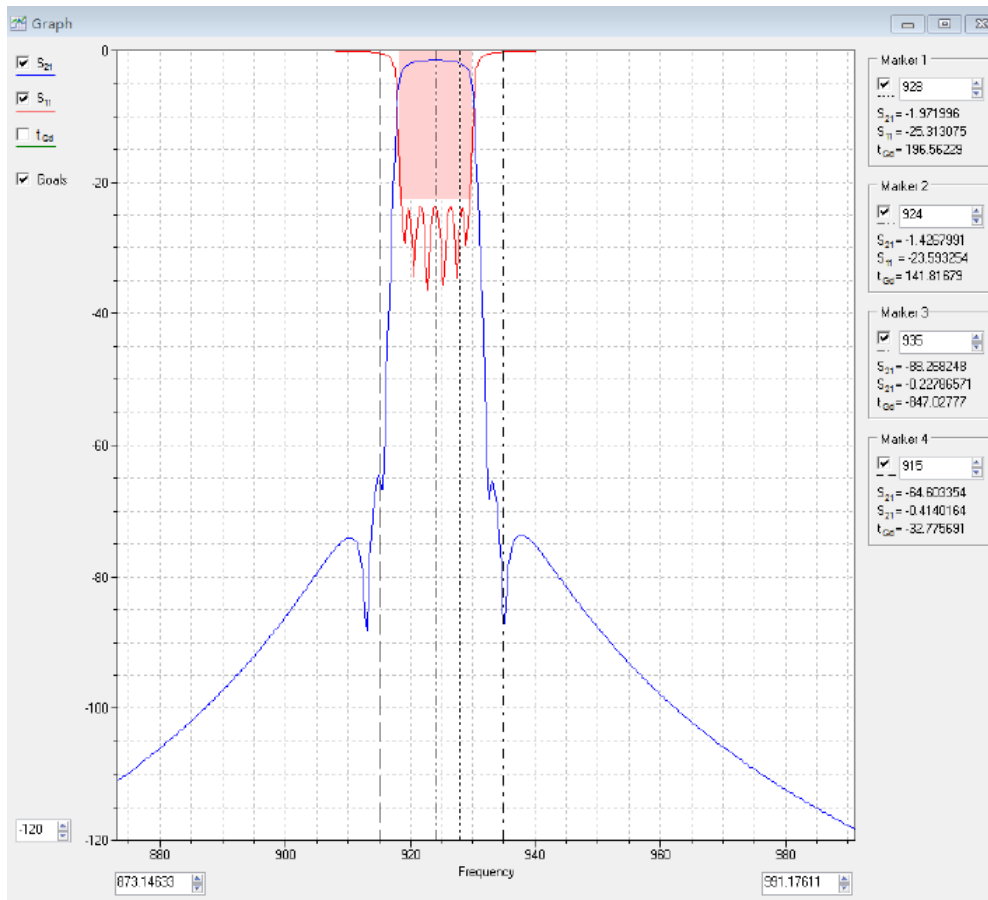


Figure 64 : Frequency response of the 920-928MHz cavity filter

1.8.3.8 902-928MHz cavity filter

The 902-928MHz cavity filter is typically dedicated to the North American market. The purpose of this filter is to allow co-located LTE850 base stations, in case of poor isolation between antennas (less than 50dB).

The 902-928MHz cavity filter characteristics are detailed in the following table:

Characteristics	Specification
Center Frequency	915 MHz
Pass band	902-928MHz
Insertion losses	≤1.5dB
Ripple	≤0.7dB
Return Loss	≥20dB
Rejection	≥45dB @ 850-894MHz ≥45dB @ 935-960MHz
Impedance	50 ohms
Power Handling	≤10W
Temperature	-40°C to+85°C

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 105 / 221
Strict confidential		

Connectors	N-Female / N-Male
Waterproof	IP66
Surface Finish	Black Paint
Weight	<1Kg
Dimensions (w/o N connectors)	150 x 80 x 50 mm

The dimensions of the 902-928MHz cavity filter are detailed hereafter:

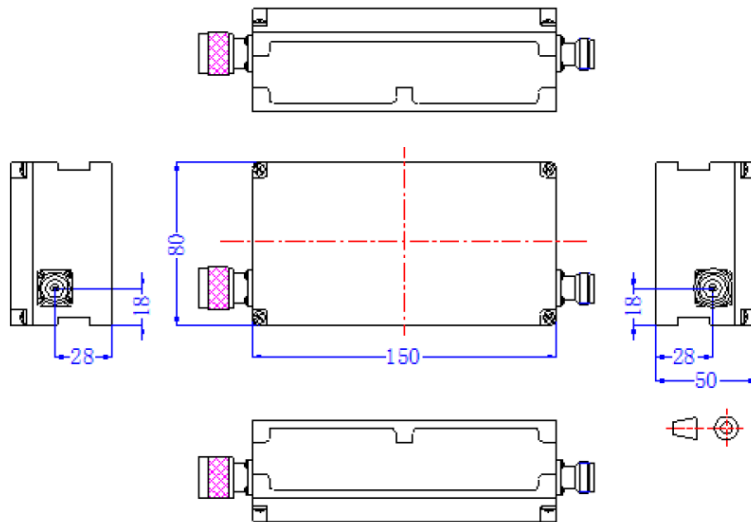


Figure 65 : Dimensions of the 902-928MHz cavity filter

The frequency response of 902-928MHz cavity filter is as follows:

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 106 / 221
Strict confidential		

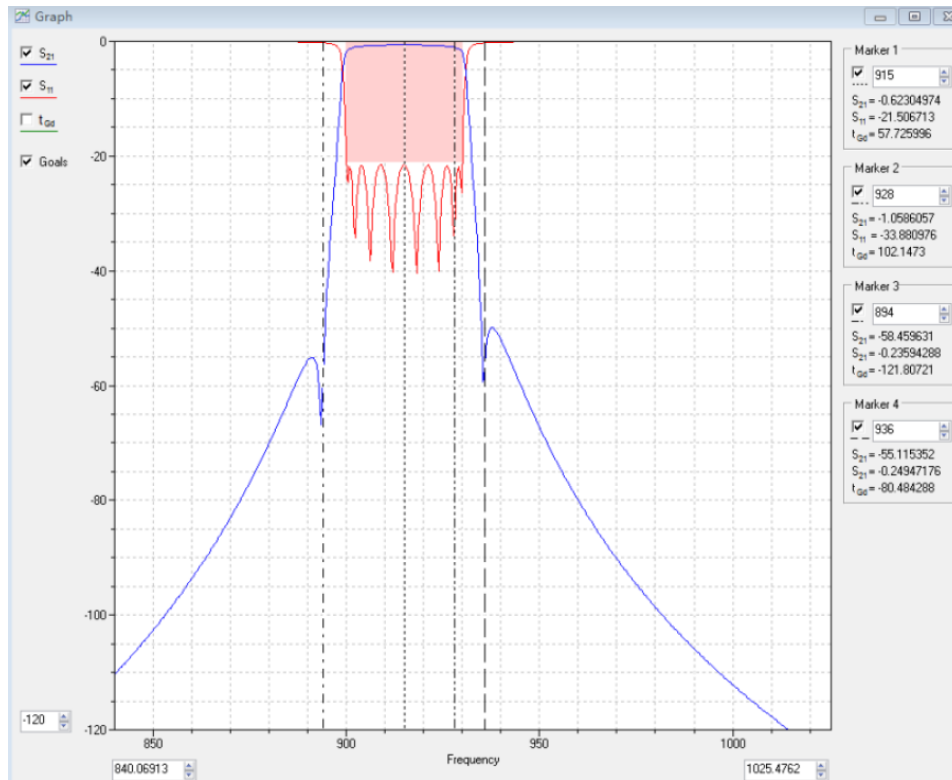


Figure 66 : Frequency response of the 902-928MHz cavity filter

1.8.4 Cables

The Wirnet iBTS are delivered with all required cables to start and operate the gateway, except the power supplies cables:

- RJ45 PoE cable is not provided by KERLINK
- Auxiliary power supply cable is not provided by KERLINK

The LoRa antennas are provided with 1m coaxial cable.

Specific installations may require departing the LoRa antenna further. Extension coaxial cables are not provided by KERLINK.

The GNSS and LTE antennas are provided with 5m coaxial cable.

Specific installations may require departing the GNSS antenna or LTE antenna further.

Departing the GNSS antenna may be required to have a better sky view to optimize the reception of the satellites.

Departing the LTE antenna may be required to optimize the LTE reception or improve isolation with other radio equipment's on the site.

Extension coaxial cables are not provided by KERLINK.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 107 / 221
Strict confidential		

1.8.4.1 RJ45 PoE cable

This cable is not provided with the Wirnet iBTS.
 It neither can be delivered as an accessory.

KERLINK recommends using a PoE cable with the following characteristics:

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

KERLINK recommends the following reference:
 TELEGARTNER AMJ 500 U/FTP 4x2x0.55 LSZH Cat. 6A IEC 600332-1

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

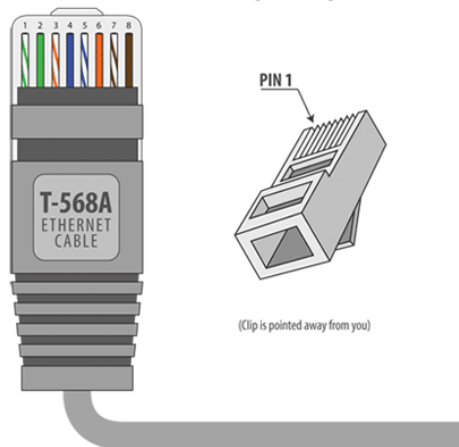


Figure 67 :RJ45 T-568A plug

1.8.4.2 Earthing cables

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

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

Cable description	Technical characteristics
Earthing of the Wirnet iBTS mounting kit	25mm ² , copper
Earthing of the antenna brackets (LoRa antenna, GNSS antenna, LTE antenna)	25mm ² , copper
Earthing of the RF coaxial surge protection	16mm ² , copper

Earthing of the Ethernet surge protection	16mm ² , copper
Earthing of the DC surge protection	16mm ² , copper
Earthing of the outdoor PoE injector	16mm ² , copper

Note: the earthing cables are not provided by KERLINK

1.8.5 Surge protections

In harsh environment, additional protections must be used to improve lightning immunity. The Wirnet iBTS is not warranted by KERLINK in case of deterioration due to lightning. KERLINK recommends adding surge protection, in high keraunic levels areas.

1.8.5.1 RF coaxial surge protection

1.8.5.1.1 GNSS, LTE Links

For the antenna links (GNSS, LTE), KERLINK recommends the P8AX09-6G-N/MF series from CITELE.

Protections must be installed in accordance to its own specifications.

The following picture describes the RF coaxial surge protection:



Figure 68 : P8AX Citel

Note: the RF coaxial surge protector must be connected to the Lightning Protection System down conductor, connecting the lightning rod to the earth. No cables are provided by KERLINK for that purpose.

1.8.5.1.1 LoRa Link

For the LoRa antenna link, KERLINK recommends the PRC822S-N/MF series from CITELE. Protections must be installed in accordance to its own specifications.

The following picture describes the RF coaxial surge protection:

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 109 / 221
Strict confidential		



Figure 69 : PRC822S Citel

Note: the RF coaxial surge protector must be connected to the Lightning Protection System down conductor, connecting the lightning rod to the earth. No cables are provided by KERLINK for that purpose.

1.8.5.2 DC surge protection, 1 pole

Kerlink recommends using the DS71R-48DC reference from CITEL.
A picture of the DS71R-48DC is presented below:



Figure 70 : DC surge protections (1 pole and 2 poles)

The following schematic shows electrical connections of the unipolar DC surge protection to the Wirnet iBTS and the isolated DC/DC converter:

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 110 / 221
Strict confidential		

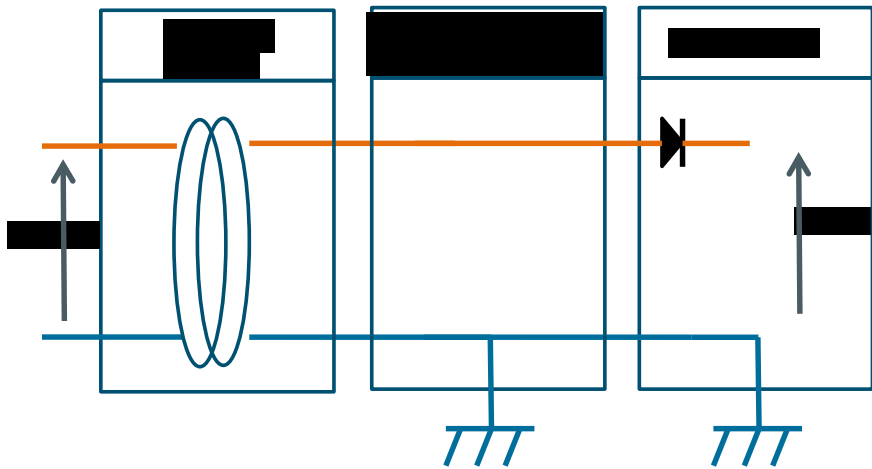


Figure 71 : DC surge protection 1 pole schematic

An example of connections is described below, while the DC surge protection is integrated in the Compact casing :

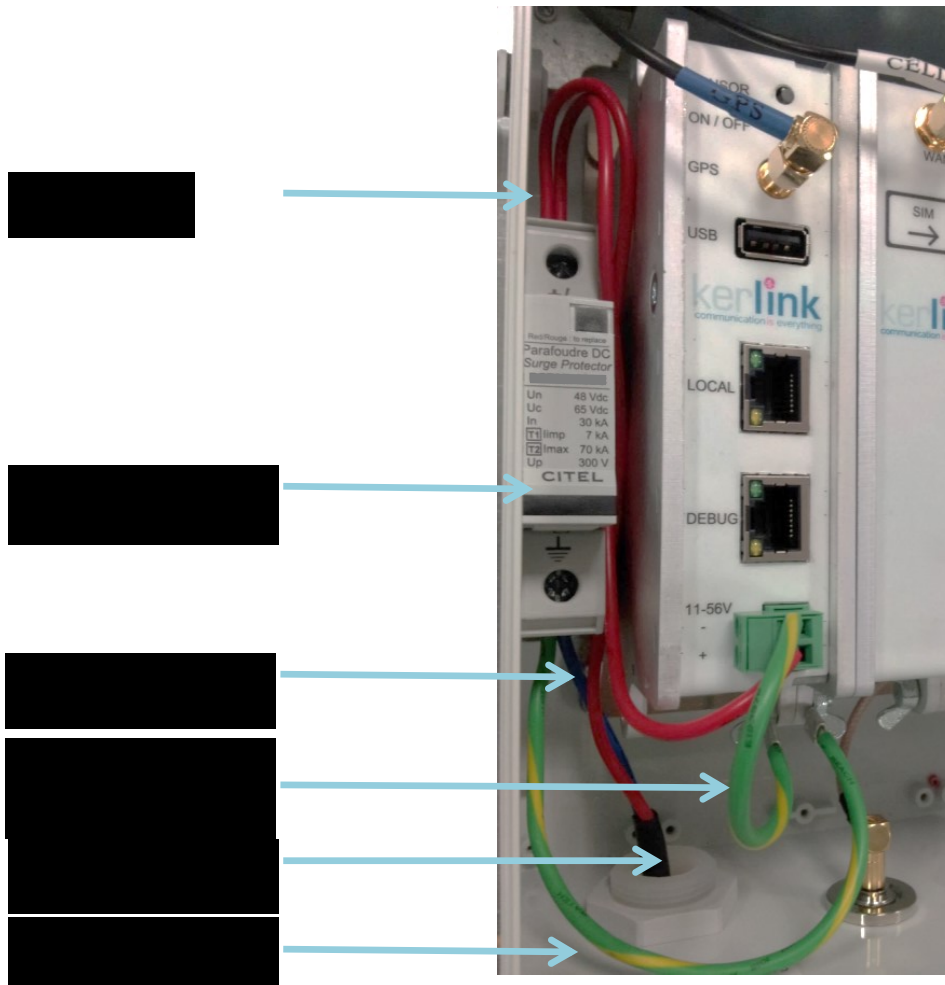


Figure 72 : Example of DC surge protection cabling

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 111 / 221
Strict confidential		

To connect grounding cable to the metal heatsink of the product, Kerlink recommends using tongue terminals. Those terminals must be tightened with wing nuts.

Regarding the DC surge protection integration process inside the Wirnet iBTS enclosure, Kerlink recommends using the following guideline:

1. DS71R-48DC must be inserted on the left side of the UC module.
The mechanical holding must be ensured by using a double face tape.
Note: It is important to avoid any enclosure deformation which may imply ingress protection issue.
2. The M25 cable gland must be used to introduce the power supply cable inside the enclosure. As mentioned on the installation guide of the Wirnet iBTS product, the external cable diameter must be between 5 to 8 mm to insure a good ingress protection.
The power supply cable is a 1.5 sq. mm cable.
3. The positive wire of the power supply cable must be connected to the surge protector and then to the Wirnet iBTS connector.
4. The negative wire of the power supply cable must be connected to the Ground side of the surge protector.
5. A ground connection must be done between the ground side of the surge protector and the metal heatsink of the product. The best solution is to use tongue terminal.
6. A ground connection must be done between the metal heatsink of the product and the Wirnet iBTS connector.



Figure 73 : Tongue terminal

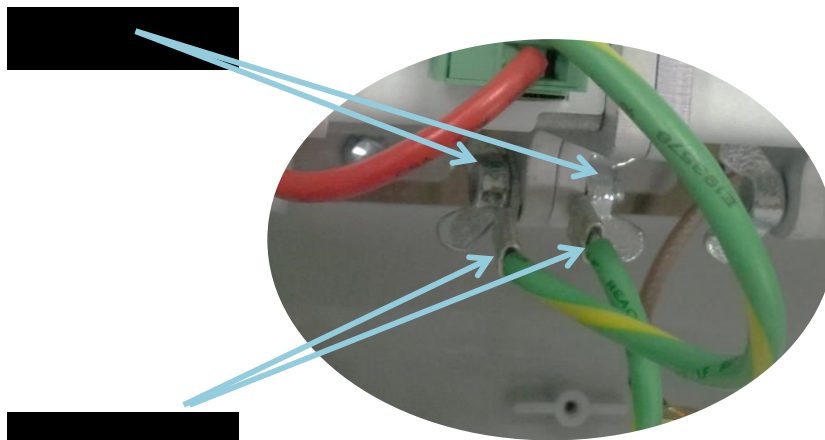


Figure 74 : Tongue terminal assembly

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 112 / 221
Strict confidential		

1.8.5.3 DC surge protection, 2 poles

To avoid any lightning introduction inside the shelter Kerlink recommends using the following bipolar DC surge protection: DS72R-48DC from CITEL.

A picture of DS72R-48DC is presented in Figure 70.

The following schematic shows electrical connections of the bipolar DC surge protection to the Wirnet iBTS and the isolated DC/DC converter:

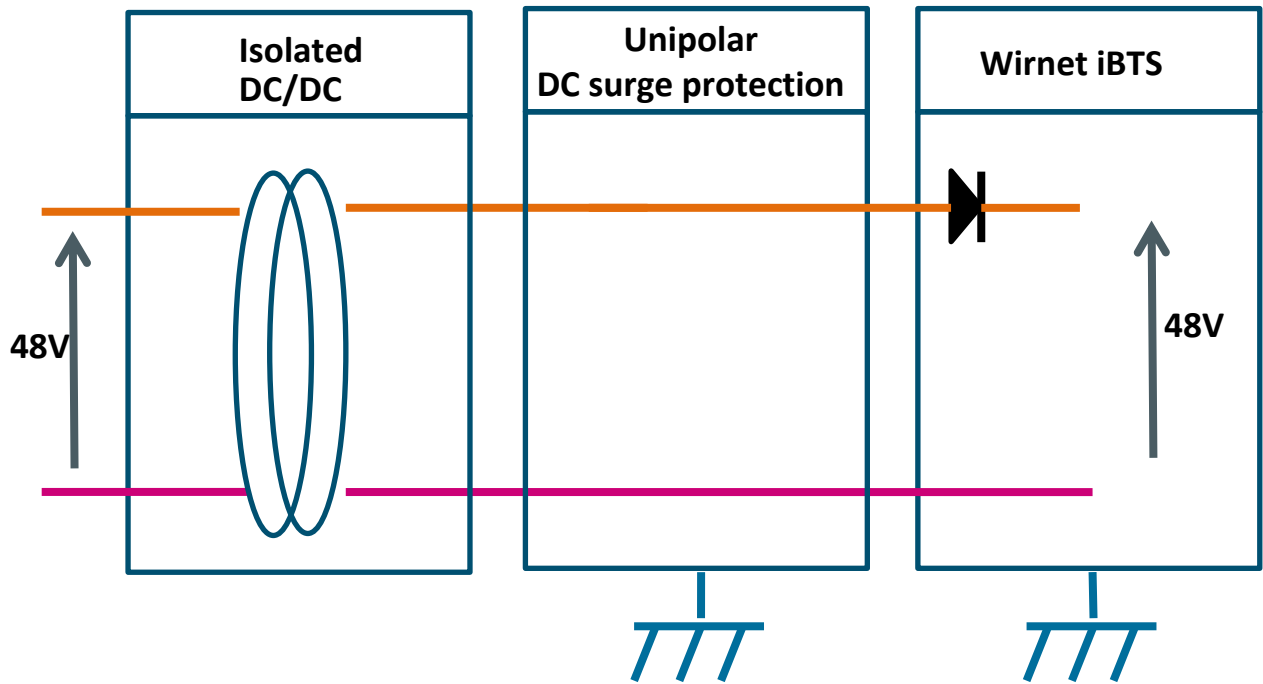


Figure 75 : DC surge protection 2 poles schematic

Kerlink recommends realizing a good direct connection between the Bipolar DC surge protection and the earthing system of the installation. The used earthing cable must be as short as possible (< 50 cm, 4 sq. mm).

The principles of cablig remain identical to those described in §1.8.5.2.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 113 / 221
Strict confidential		

1.8.5.4 Indoor Ethernet surge protection

For the Ethernet link, KERLINK recommends the MJ8-POE-A reference from CITEL. This surge protection must be installed indoor, according to its own specifications.

The following picture describes the PoE surge protection:



Figure 76 : MJ8-POE-A Citel

Note: the PoE surge protector must be connected to the earth. No cables are provided by KERLINK for that purpose. See §1.8.4.2 for additional information.

1.8.5.5 Outdoor Ethernet surge protection

In case the Ethernet surge protection cannot be installed indoor, then KERLINK recommends the PD-OUT/SP11 reference from Microsemi. This surge protection can be installed indoor, according to its own specifications.

The main characteristics of the PoE surge protection are:

Characteristics	Specification
Network	POE and Gigabit Ethernet, High POE (95W)
Technology	Clamping diode
SPD configuration	4 pairs + shielded
Connection to Network	RJ45 shielded connector female input/output
Format	Metallic box with connectors input/output
Mounting	Wall or pole mount
Operating temperature	-40°C to +85°C
Dimensions	30 x 30 x 190 mm
Weight	270g
Protection rating	IP66
Outdoor application	Yes

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 114 / 221
Strict confidential		

Failsafe behavior	Short-circuit
Disconnection indicator	Transmission interrupt
Remote signaling of disconnection	None
Nominal line voltage (Un)	48 Vdc
Max. DC operating voltage (Uc)	60 Vdc
Max. line current (IL)	2A
Protection level (Up)	500V
Nominal discharge voltage 8/20µs	10 kV
Impulse current 2 x 10/350µs Test - D1 Category (Iimp)	100 A
Nominal discharge current 8/20µs Test x 10 - C2 Category (In)	5 kA
Max data rate	1000 Mbps
Certifications	IEC 61643-21 / EN 61643-21 GR1089 ITU-T K.45 UL497B IEEE 802-3ab/3at

The following picture describes the PoE surge protection:

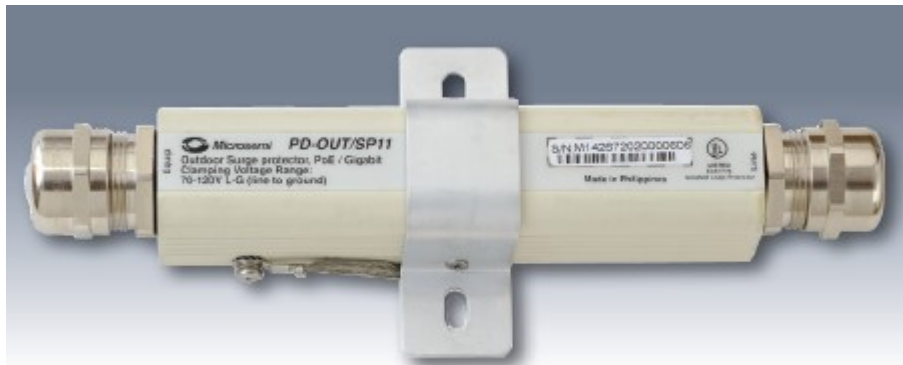


Figure 77 : PD-OUT/SP11 Microsemi

Note: the PoE surge protector must be connected to the earth. No cables are provided by KERLINK for that purpose. See §1.8.4.2 for additional information.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 115 / 221
Strict confidential		

1.8.6 Mounting kits

1.8.6.1 Notched V-shaped pole mounting kit

The notched V-shaped pole mounting kit includes a notched V shaped plate and a U bolt with 2 nuts.

This mounting kit can be used in conjunction with the dome antenna brackets for pole mounting (see §1.8.6.3). The maximum diameter of the pole is 70mm.

The dimensions of the notched V shaped plate part are detailed hereafter:

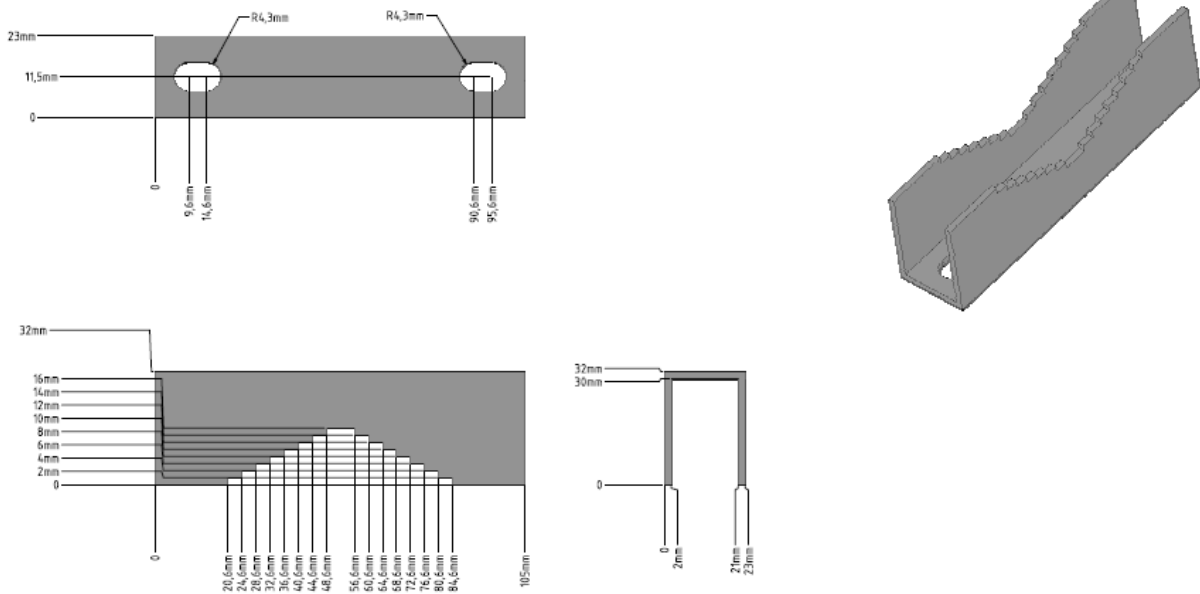


Figure 78 : Dimensions of the notched V shaped plate

1.8.6.2 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 presented hereafter:

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 116 / 221
Strict confidential		

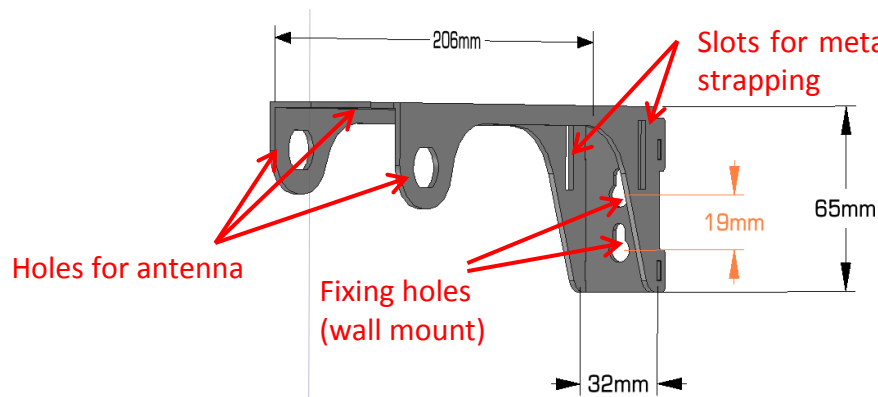


Figure 79 : Universal antenna bracket dimensions

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

The universal antenna bracket can be mounted:

- On a wall: use in this case two M4 screws separated by 19mm.
- On a pole: use metallic strapping through the two 5mm x 25mm slots.
- On the compact casing mounting kit, with 2 x M8 bolts and screws.

1.8.6.3 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)
- GNSS/LTE combo antenna (see §1.8.2.3)

The dome antenna bracket is presented hereafter:

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 117 / 221
Strict confidential		

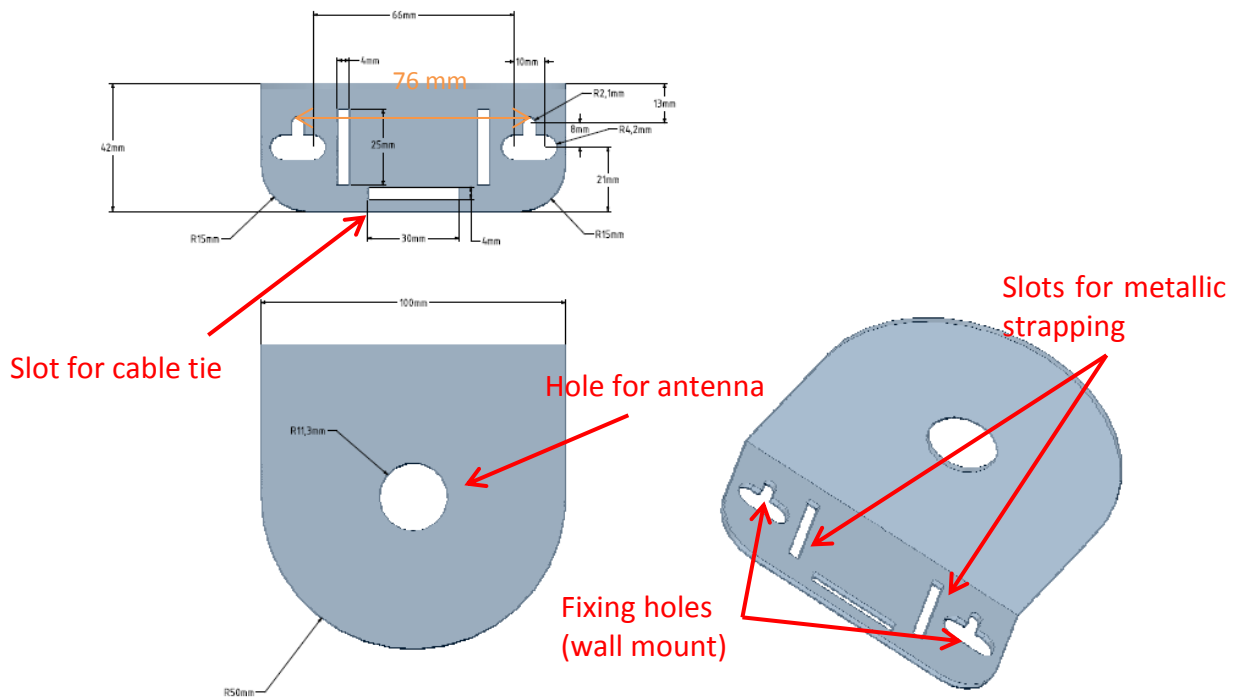


Figure 80 : Dome antenna bracket dimensions

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 (see figure above).
- On a pole: use metallic strapping through the two 4mm x 25mm slots (see figure above).
- 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 two parts are presented on the figure below. 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 §1.8.6.1).

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 118 / 221
Strict confidential		

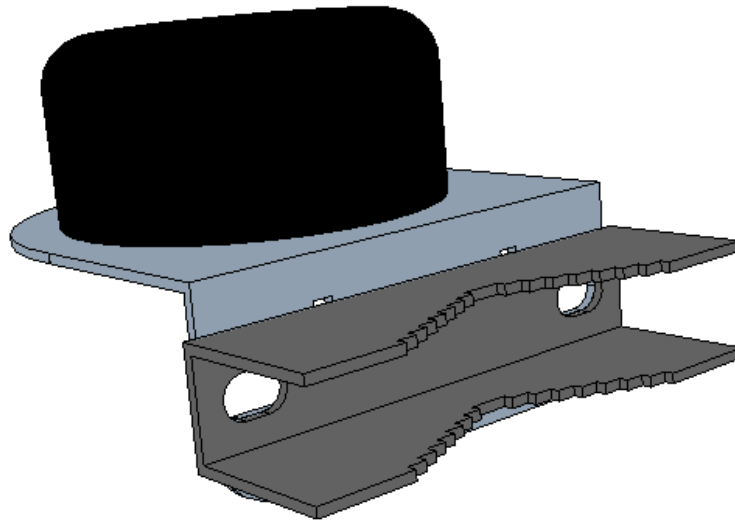


Figure 81 : Dome antenna bracket with notched V shaped bolt

1.8.7 Debug tool

The Wirnet iBTS has a proprietary serial debug interface named DEBUG available on the front panel of the CPU module.

This debug interface is intended to be used by authorized and qualified personnel only.

The WIRMA2 Debug tool is intended to be connected to the debug interface. It is mainly a simple UART to USB converter.

The main characteristics of the Wirma2 debug tool are:

Characteristics	Specification
UART Interface	RJ45 female
	3.3V internal LDO
	Up to 1Mb/s
USB2.0 interface	USB 2.0 A type
	USB Self Bus Powered at 5V
	Full Speed (12Mb/s)
Operating temperature range	0°C to +60°C
Chipset	FT232BL (FTDI)

The debug tool must be used with an Ethernet cable and a USB2.0 type A to type B male cable. They can be provided by KERLINK as options as detailed in §6.

The USB cable must be connected to a computer where must be installed HyperTerminal or Teraterm to visualize the traces.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 119 / 221
Strict confidential		

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

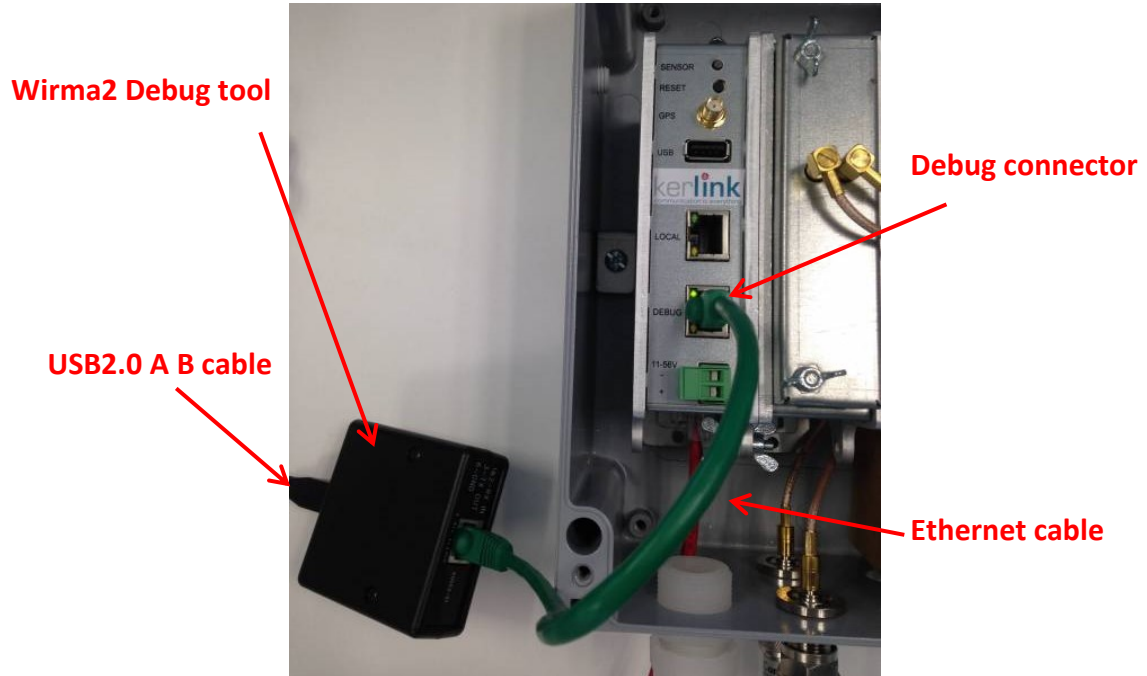


Figure 82 : WIRMA2 Debug Tool connected to the CPU module

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 120 / 221
Strict confidential		

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, Portugal, 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.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 121 / 221
Strict confidential			

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:

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 122 / 221
Strict confidential			

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

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 123 / 221
Strict confidential			

- 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:

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 124 / 221
Strict confidential			

- 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)
 - o FCC Part 15.207 conducted emissions on AC mains in the band 150kHz – 30MHz
 - o FCC Part 15.247 intentional radiated emissions
 - o 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:

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 125 / 221
Strict confidential			

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.*

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 126 / 221
Strict confidential			

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

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 127 / 221
Strict confidential		

-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

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 128 / 221
Strict confidential			

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

Applicable documents:

- CFR 47 FCC Part 15 :
 - o FCC 47 CFR Part 15 : 2014 - Part 15- Radio frequency devices
 - o 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 :
 - o EN 300 220-1, issue 3.3.1
 - o 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

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 129 / 221
Strict confidential			

- 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)

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 132 / 221
Strict confidential			

- 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,

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 133 / 221
Strict confidential		

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:

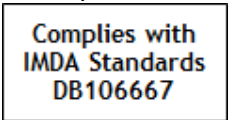
- Frequency plan and channel arrangement similar to Australia, according to the LoRaWAN specification and the regional parameters (AU 915-928MHz) as defined in [1] and [2].
- Frequency plan compliant to the LoRaWAN specification and the regional parameters (AS 923MHz) as defined in [1] and [2].

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

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 135 / 221
Strict confidential			

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 T090800100061 (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

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 136 / 221
Strict confidential			

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:

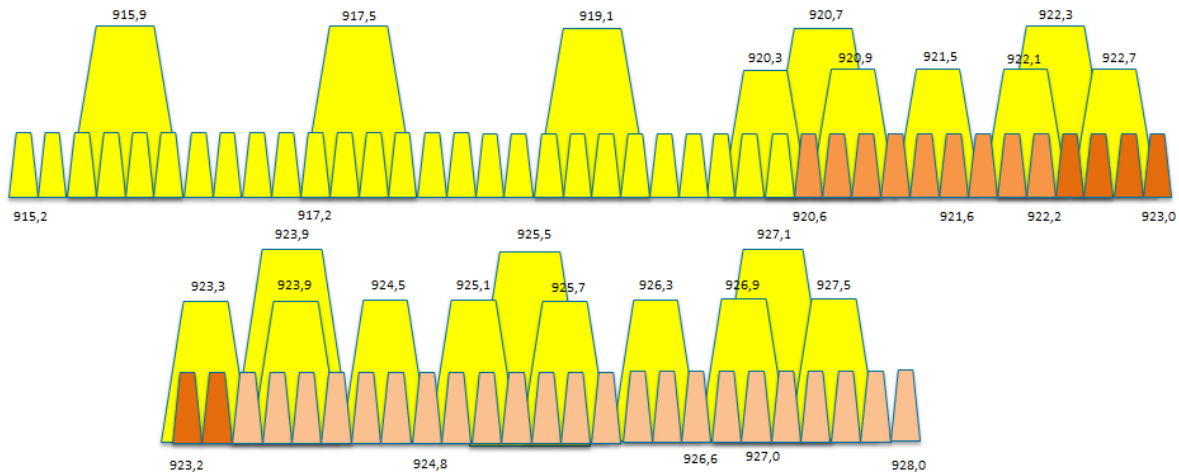


Figure 83 : Channels allocation proposal in Japan

Note:

In the above figure:

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

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 137 / 221
Strict confidential		

- 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 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.
 減少電磁波影響，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。

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 138 / 221
Strict confidential		

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)

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 139 / 221
Strict confidential		

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.

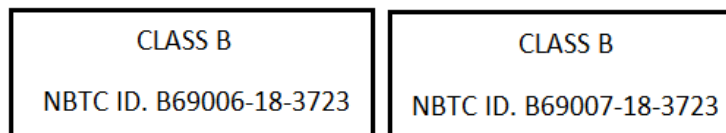
Note: A 918-923MHz cavity filter may be required in Malaysia to avoid saturation and desensitization of the LoRa receiver due to co-located EGSM900 base stations. This cavity filter is described in §1.8.3.5.

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

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 140 / 221
Strict confidential		

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

-ANATEL Certification required-

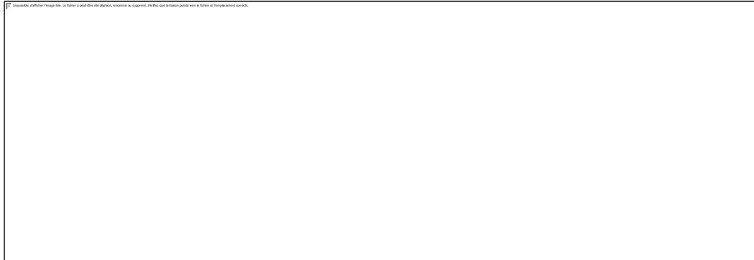
In Brazil, the Wirnet iBTS 923 can be used according to « Resolução nº680 de 27 de junho de 2017– Regulamento Sobre Equipamentos de Radiocomunicação de radiação Restrita.»

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 is also compliant to:

- Resolução nº 477, de 7 de agosto de 2007 - Regulamento do Serviço Móvel Pessoal – SMP.
- Resolução nº 303, de 2 de julho de 2002 - Aprova o Regulamento sobre Limitação da Exposição a Campos Elétricos, Magnéticos e Eletromagnéticos na Faixa de Radiofrequências entre 9 kHz e 300 GHz.
- Resolução nº 442, de 21 de julho de 2006 – Aprova o Regulamento par Certificação de Equipamentos de Telecomunicações quanto aos Aspectos de Compatibilidade Eletromagnética.
- Resolução nº 529, de 3 de junho de 2009 – Aprova o Regulamento par Certificação de Equipamentos de Telecomunicações quanto aos Aspectos de Segurança Elétrica.

Be careful:



Este produto está homologado pela Anatel, de acordo com os procedimentos regulamentados pela Resolução nº 242/2000 e atende aos requisitos técnicos aplicados, incluindo os limites de exposição da Taxa de Absorção Específica referente a campos elétricos, magnéticos e eletromagnéticos de radiofrequência, de acordo com as Resoluções nº 303/2002 e 533/2009.

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 Full-Duplex

2.4.1 USA / FCC

The Wirnet iBTS Full-Duplex 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 Full-Duplex 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)
 - o FCC Part 15.207 conducted emissions on AC mains in the band 150kHz – 30MHz
 - o FCC Part 15.247 intentional radiated emissions
 - o FCC Part 15.215 Additional provisions to the general radiated emissions limitations

The associated FCC identifiers of the Wirnet iBTS Full-Duplex are:

FCC ID : 2AFYS-KLK915FDX
 Model : WIRNET iBTS FDX
 Contains FCCID : N7NMC7355
 Model : MC7355

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 142 / 221
Strict confidential		

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.

2.4.2 Canada / IC

The Wirnet iBTS Full-Duplex 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 Full-Duplex 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 Full-Duplex are:

IC : 20637-KLK915FDX
 Model : WIRNET iBTS FDX
 Contains / Contient IC : 2417C-MC7355
 Model : MC7355

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 143 / 221
Strict confidential			

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 Full-Duplex out of the 40% duty cycle limit.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 144 / 221
Strict confidential		

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 Wanasy 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.

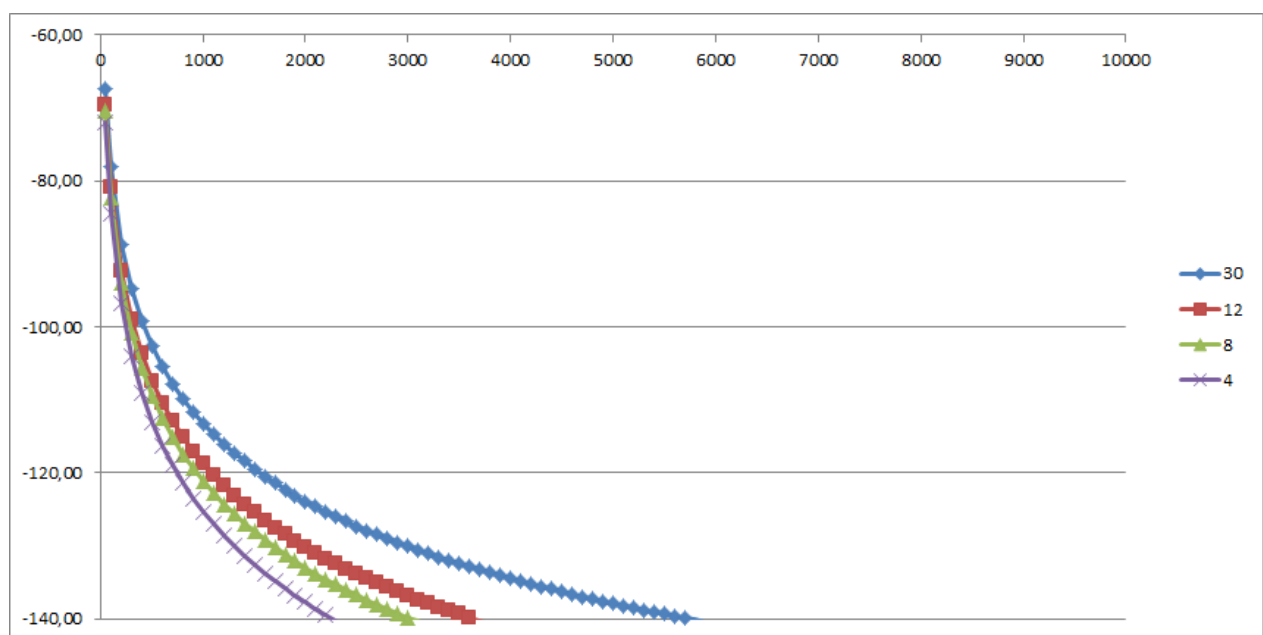


Figure 84 : Urban (small city) Hata propagation model – RSSI (dBm) vs distance (meters) vs height of the antenna

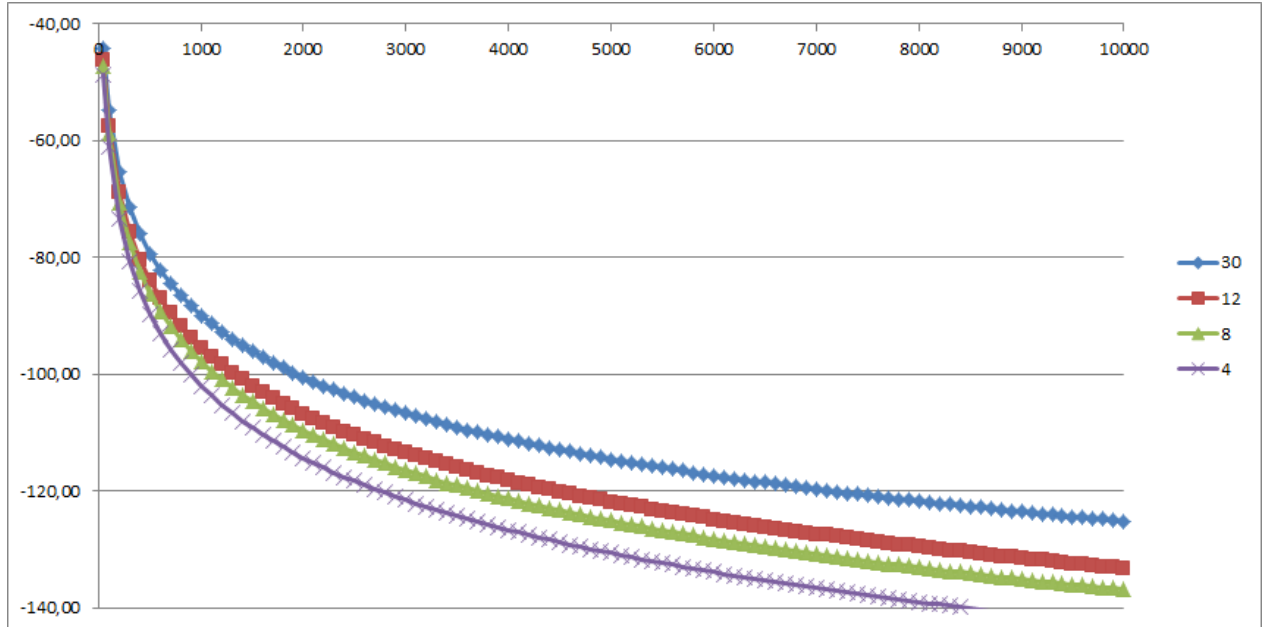


Figure 85 : Rural countryside Hata propagation model - RSSI (dBm) vs distance (meters) vs height of the antenna

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.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 146 / 221
Strict confidential			

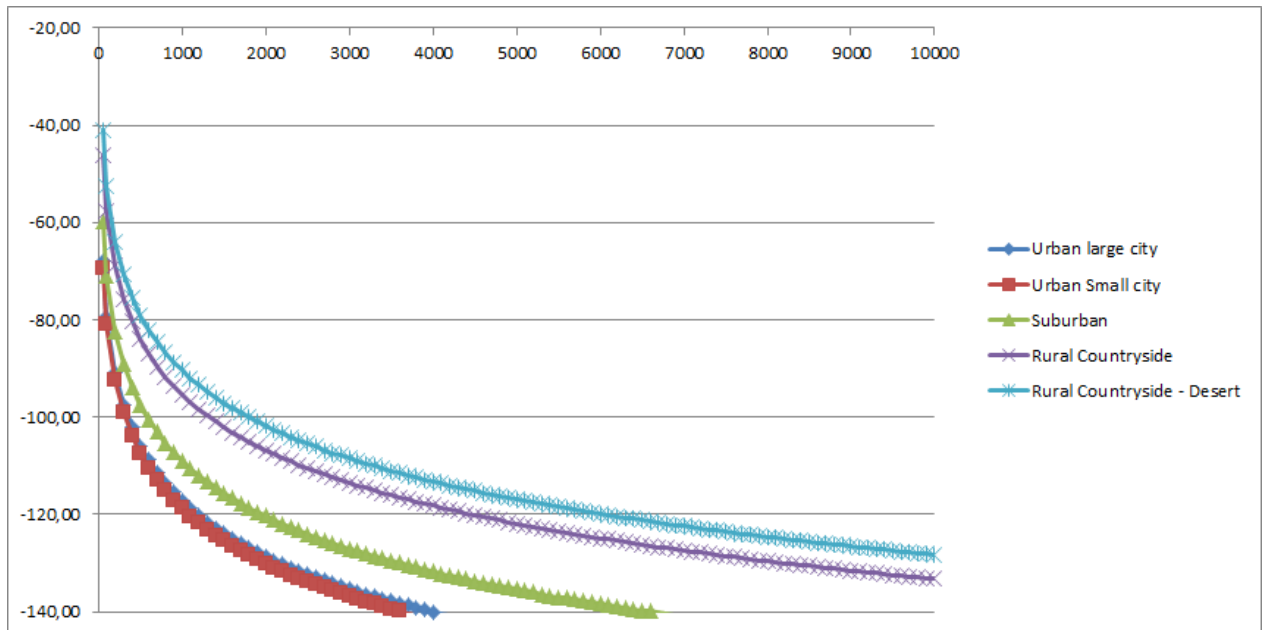


Figure 86 : Hata propagation model vs area configuration (Height = 12m) – RSSI (dBm) vs distance (m)

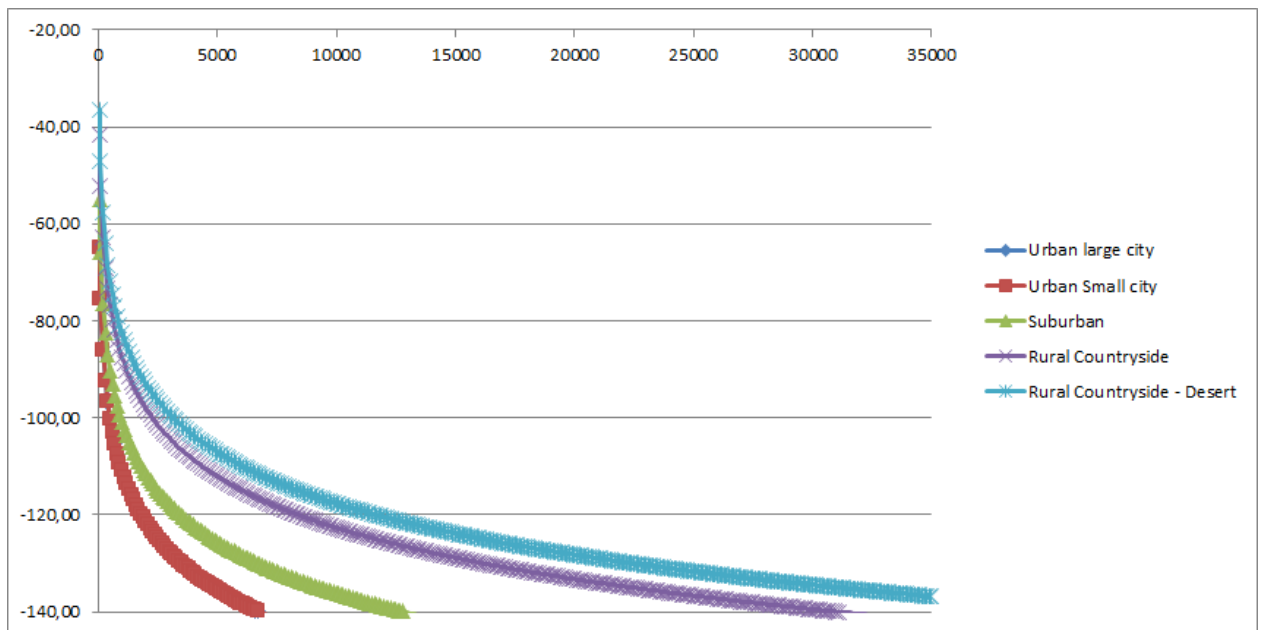


Figure 87 : Hata propagation model vs area configuration (Height = 30m) – RSSI (dBm) vs distance (m)

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).

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 147 / 221
Strict confidential		

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.

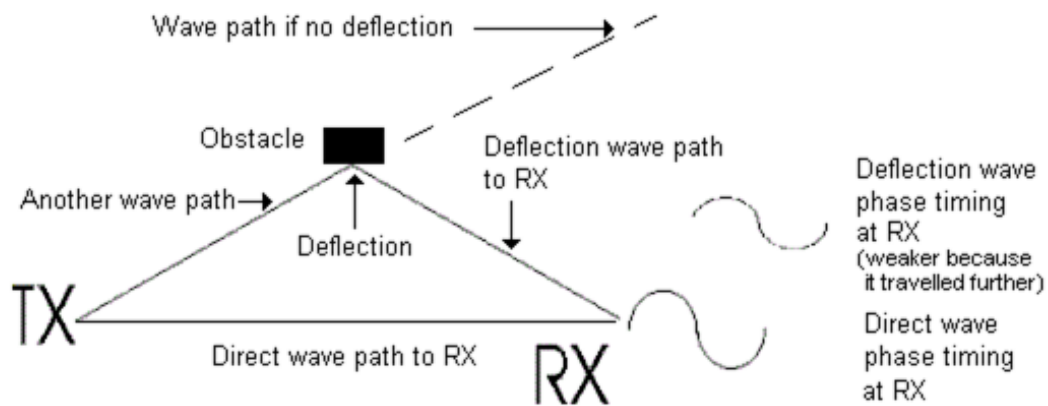


Figure 88 : Fading effects due to obstacles

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:

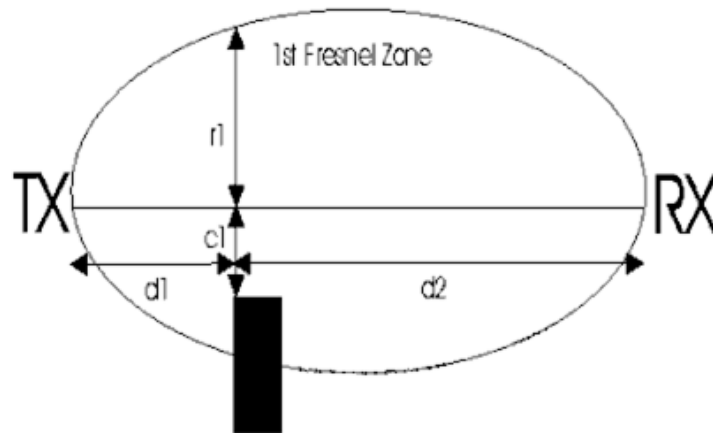
$$r1 = \sqrt{\frac{d1 * d2 * c}{f * (d1 + d2)}}$$

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.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 148 / 221
Strict confidential		



Nasty obstacle must be more than 60% from the center line of TX to RX ($c1 \Rightarrow r1 \times 0.6$)

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.

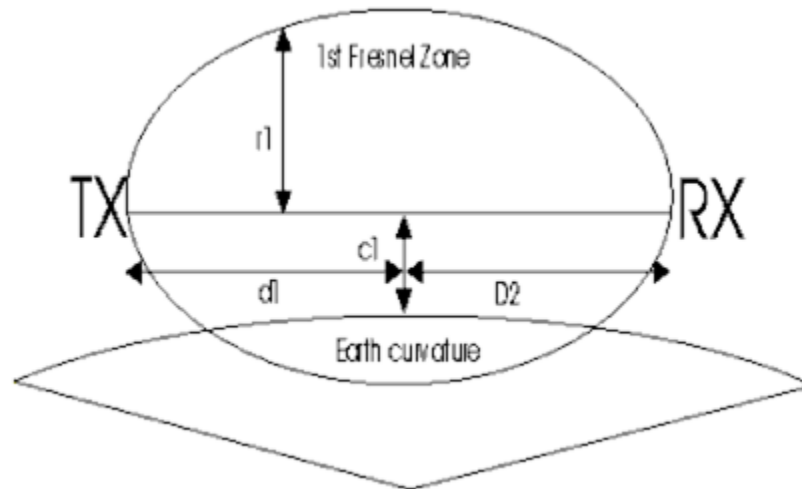


Figure 90 : Fresnel ellipsoid and earth curvature

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.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 149 / 221
Strict confidential		

Then we have:

- $d1 = 15m$
- $d2 = 3600 - 15 = 3585m$
- $f = 868MHz$
- $c = 3E8 \text{ m/s}$

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:

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 150 / 221
Strict confidential			

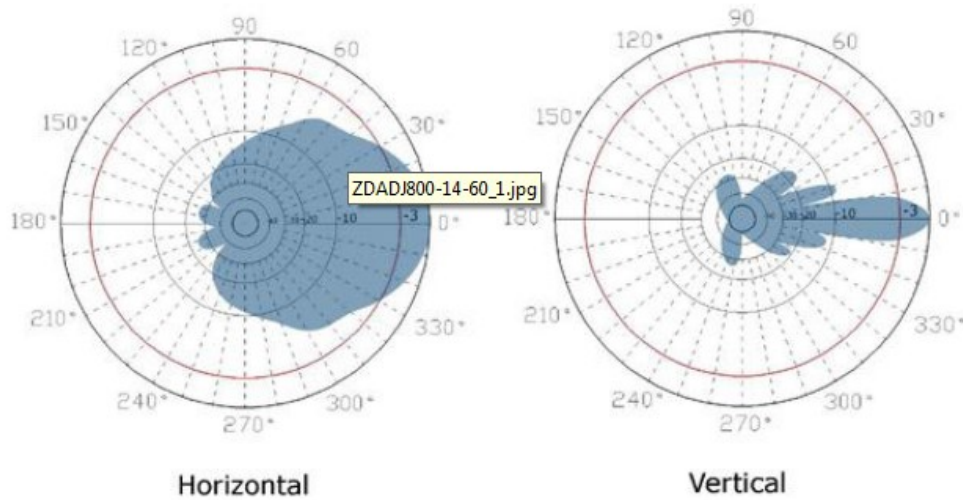


Figure 91 : Typical antenna gain pattern of a GSM BTS

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:

Vertical Pattern

E-plane co-pol ----- 3-dB beam-width=75 Deg

Horizontal Pattern

H-plane co-pol ----- 3-dB beam-width=360 Deg

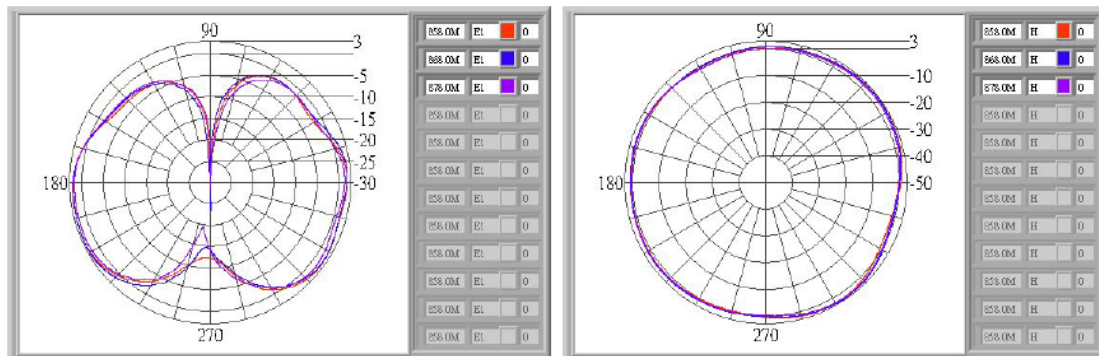


Figure 92 : Typical gain of 3dBi omnidirectional antenna

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:

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 151 / 221
Strict confidential			

Vertical Pattern

E-plane co-pol ----- 3-dB beam-width=50Deg

Horizontal Pattern

H-plane co-pol ----- 3-dB beam-width=55Deg

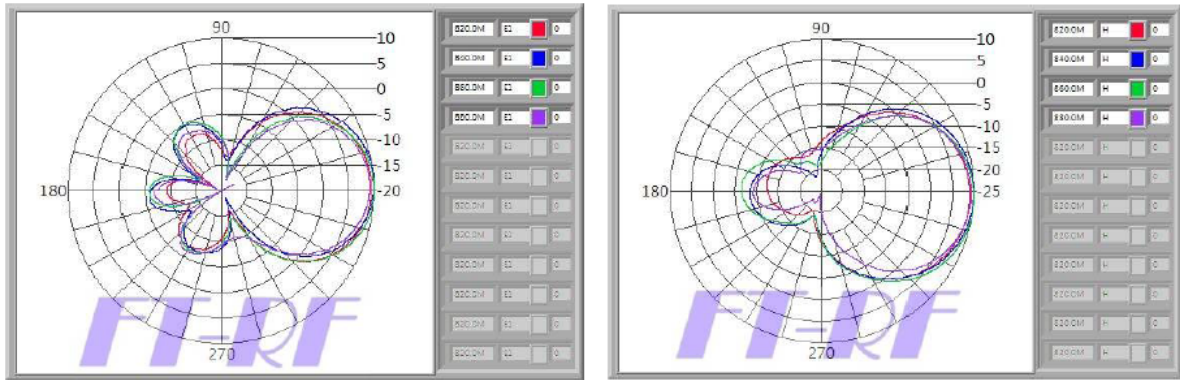


Figure 93 : Typical gain of a sectorial antenna

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.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 152 / 221
Strict confidential		

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 Full-Duplex

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.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 153 / 221
Strict confidential			

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.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 154 / 221
Strict confidential		

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).

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 155 / 221
Strict confidential		



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:

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 156 / 221
Strict confidential		

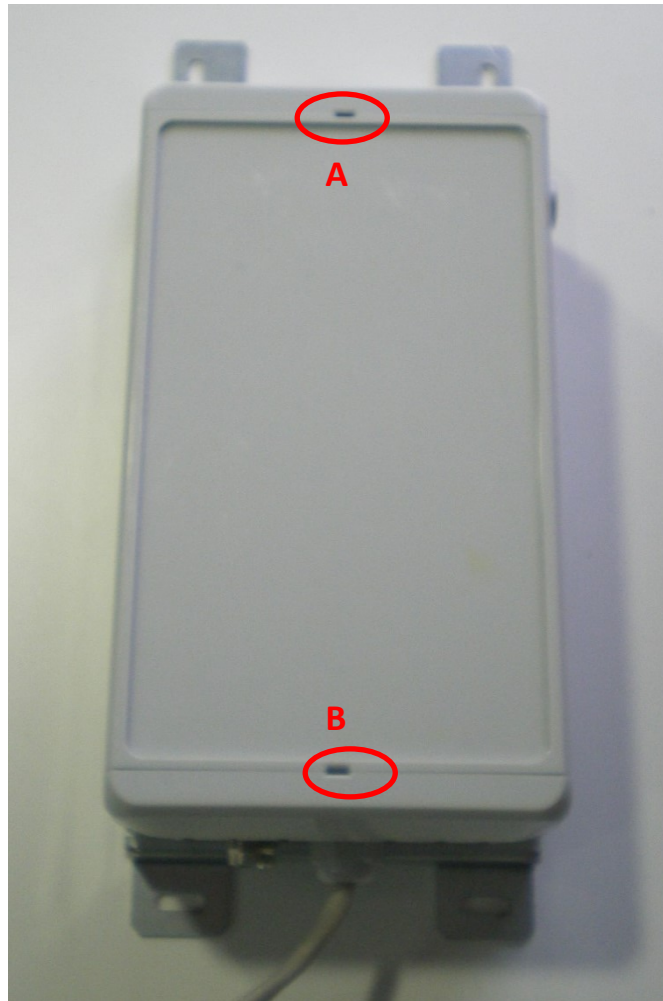


Figure 96 : Open points of the compact enclosure

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.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 157 / 221
Strict confidential		



Figure 97 : Opening of the compact enclosure with screwdriver

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 158 / 221
Strict confidential		

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:

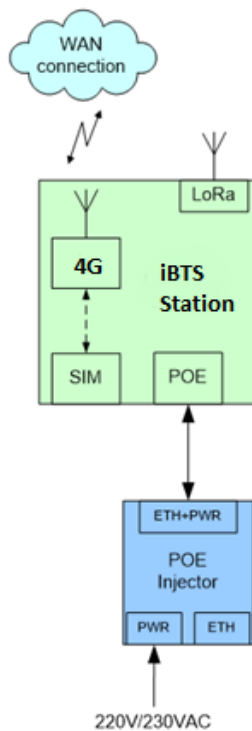


Figure 98 : Single station installation (with USIM)

Without USIM Subscription:

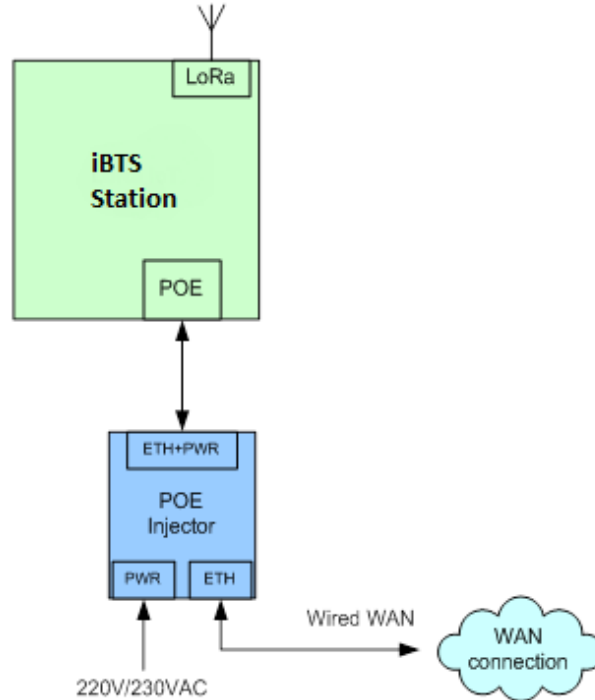


Figure 99 : Single station installation (No USIM)

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 159 / 221
Strict confidential		

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:

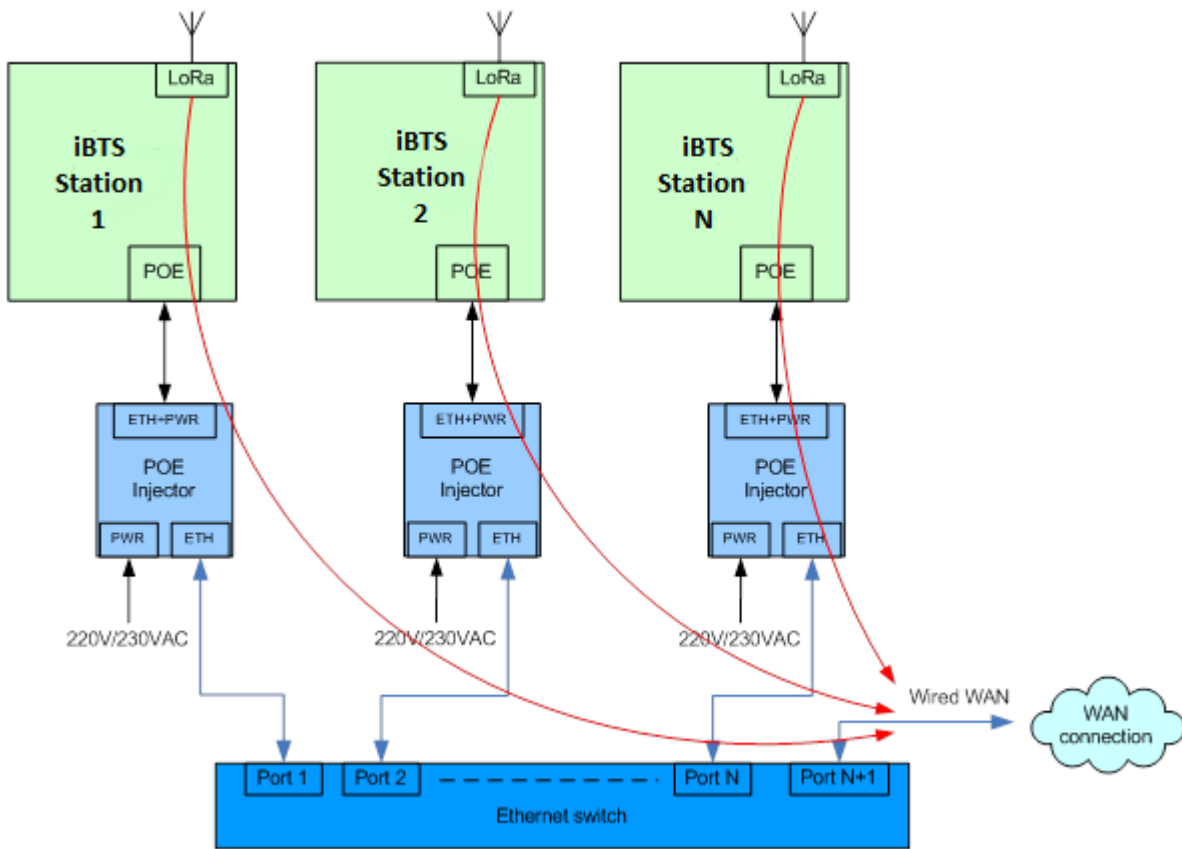


Figure 100 : Multi-station installation (No USIM)

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

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 160 / 221
Strict confidential		

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 lightning 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 lightning. Additional surge protections are recommended in harsh environments.

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

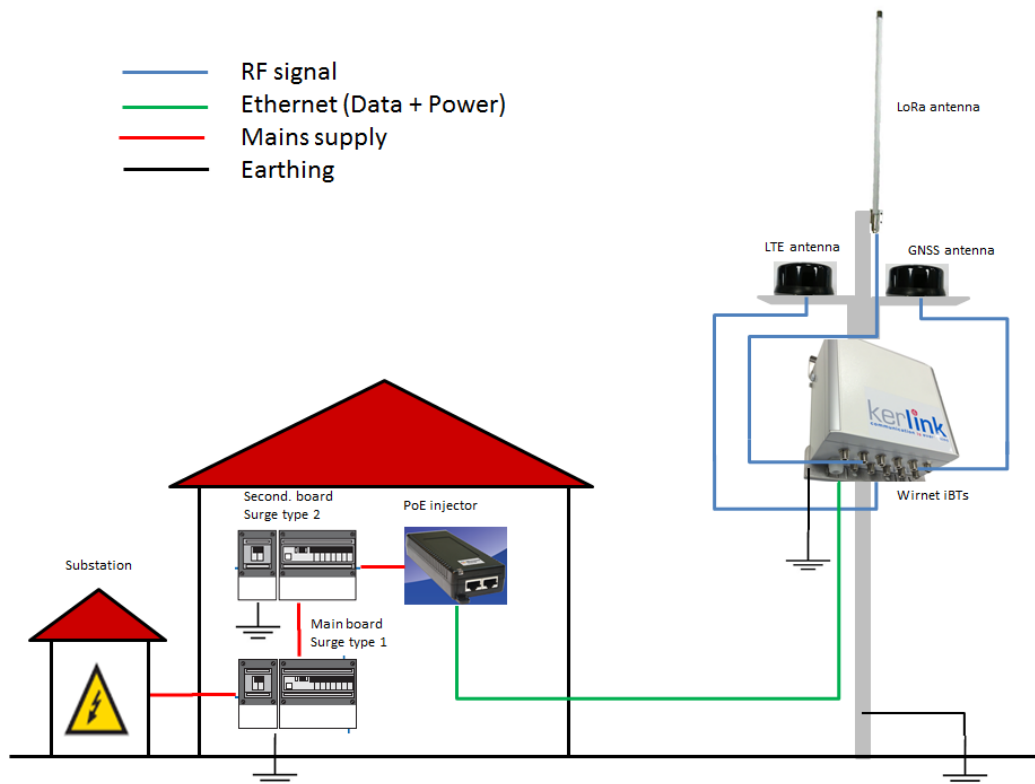


Figure 101 : Power distribution in the installation

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 161 / 221
Strict confidential		

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.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 162 / 221
Strict confidential			

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.

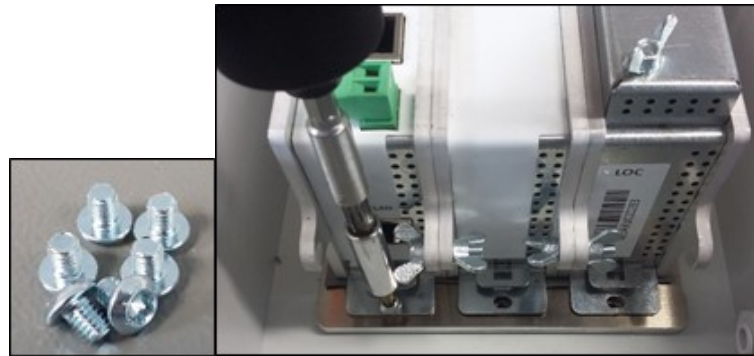


- Insert the LoRa module into the enclosure. Place it close to the available blind threaded standoffs on the back of the enclosure.
- Slide the new LoRa module on the left, close to the previous installed module:
 - Ensure the back panel connector is properly inserted into the previous module
 - Ensure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

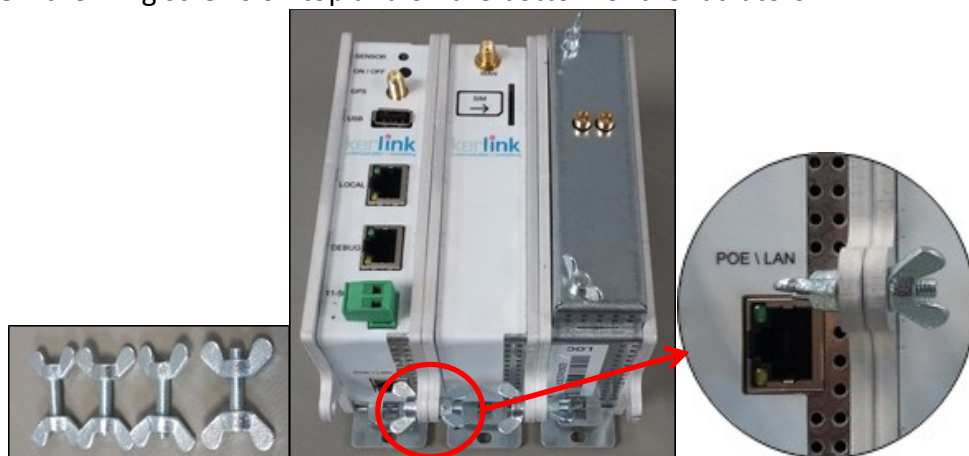


- Screw the module on the blind threaded standoffs with the provided M4 screws

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 163 / 221
Strict confidential		



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



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

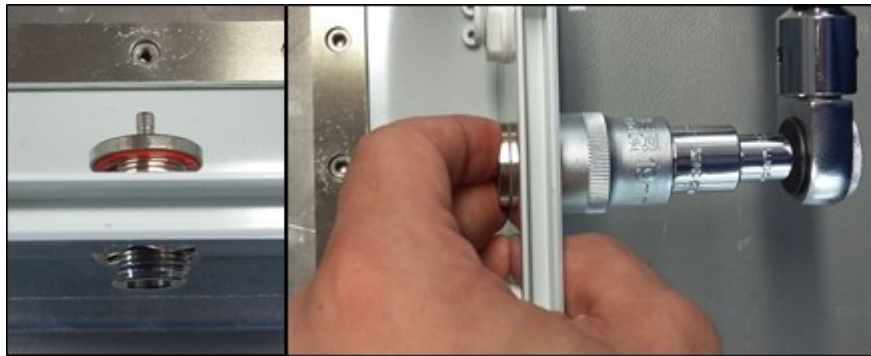
Once the module is properly installed, then one or two N-SMB adapters are required for the antennas connections, depending on the chosen configuration.



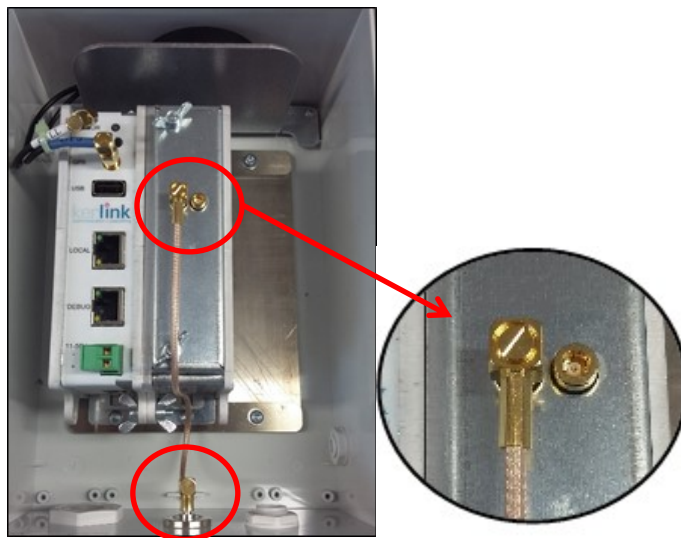
To add a N-SMB adapter, follow the procedure below:

- Unscrew the M16 blind stop
- Screw the N-SMB adapter on the bottom side of the enclosure with M19 wrench (3Nm tightening torque)

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 164 / 221
Strict confidential		



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



Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 165 / 221
Strict confidential		

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 could be used to reach a better position but are not provided by KERLINK. However, beware of the insertion losses!

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 166 / 221
Strict confidential			

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 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.

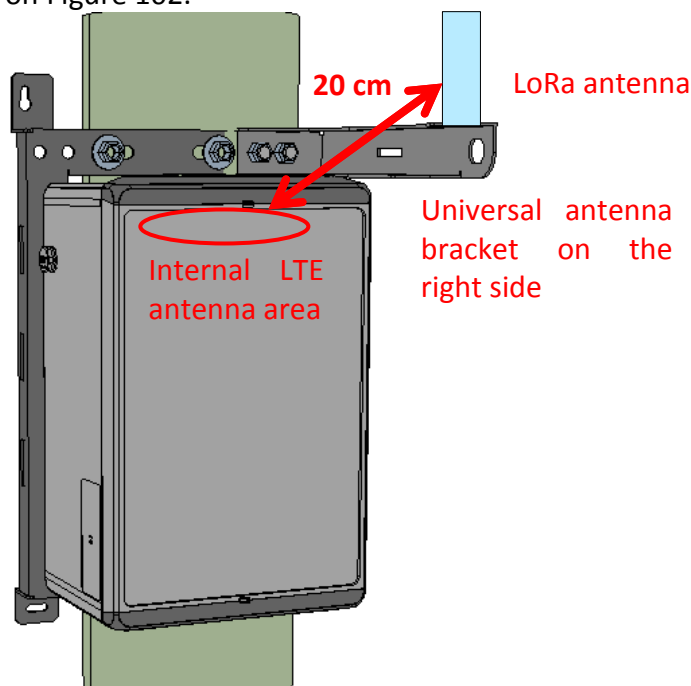


Figure 102 : Position of the universal antenna support when mounted on the compact enclosure support

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 167 / 221
Strict confidential		

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 $13 \cdot \lambda / 8$ between antennas i.e.:
 - 56 cm at 868MHz
 - 53 cm at 915MHz
- The distances can be increased to improve the performance, ideally by steps of a wavelength. The recommended distances are then:
 - 868MHz: 56 cm, 91 cm, 125 cm, 160 cm, etc...
 - 915MHz: 53 cm, 86 cm, 119 cm, 151 cm, etc...

Note 1: the distance between the two universal antenna brackets installed on the 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 $20+20+12=52$ cm 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.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 168 / 221
Strict confidential			

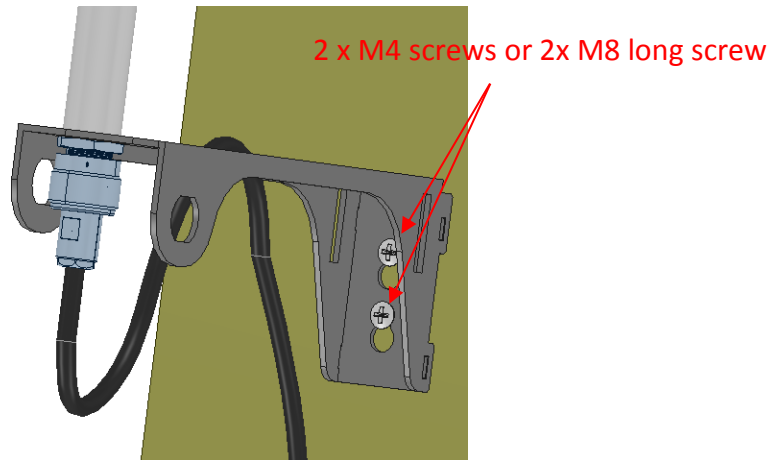


Figure 103 : Wall mount of the universal antenna bracket

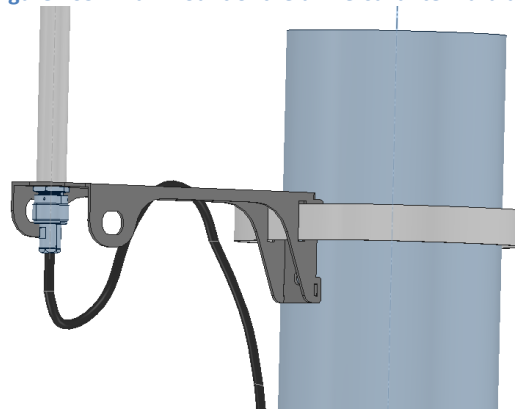


Figure 104 : Pole mounting of the universal antenna bracket using strapping

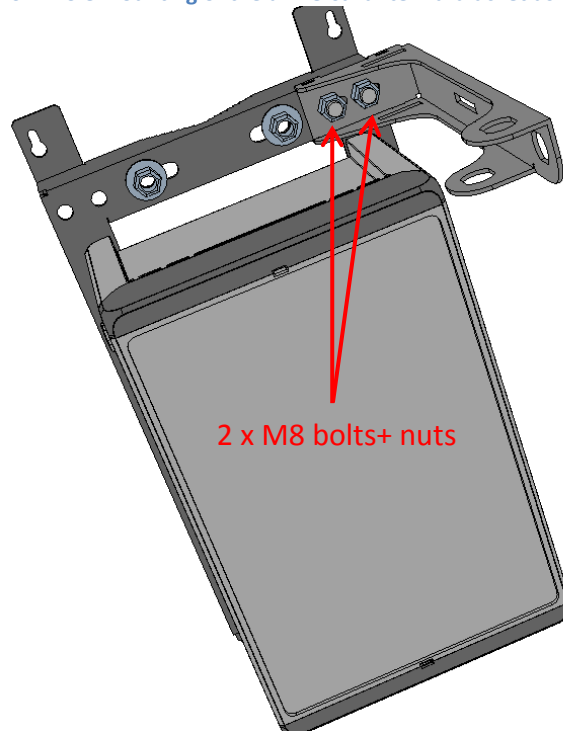


Figure 105 : Universal antenna bracket with compact casing mounting kit

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 169 / 221
Strict confidential		

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

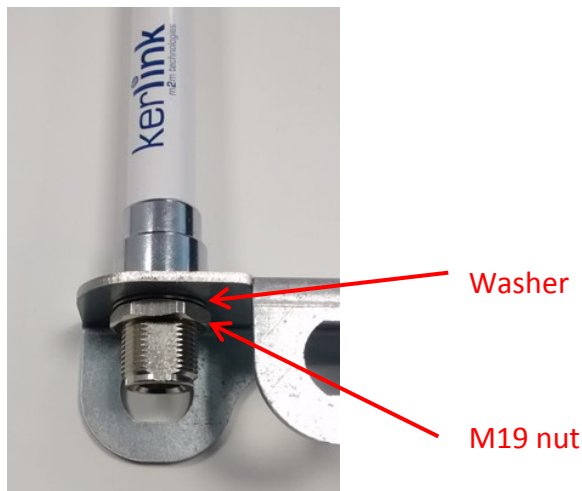


Figure 106 : LoRa antenna mounted on universal antenna bracket

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.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 170 / 221
Strict confidential			

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

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 171 / 221
Strict confidential		

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:

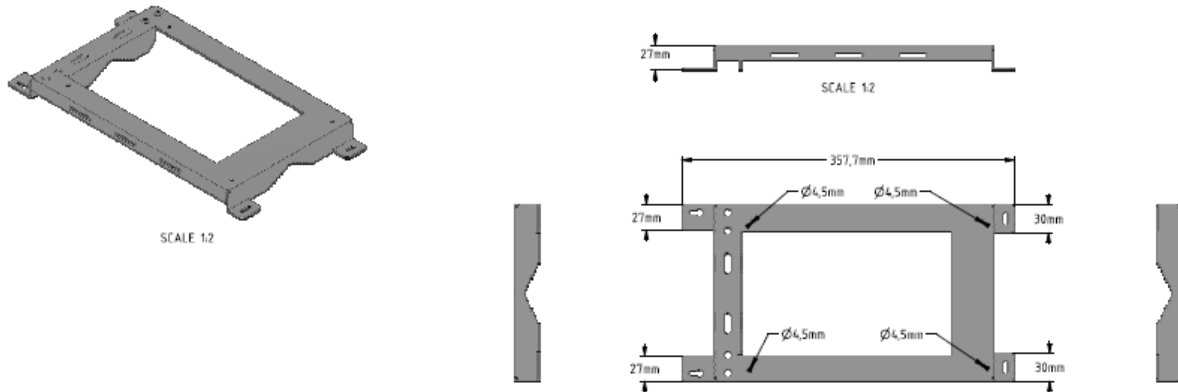


Figure 109 : Compact casing mounting kit dimensions

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.

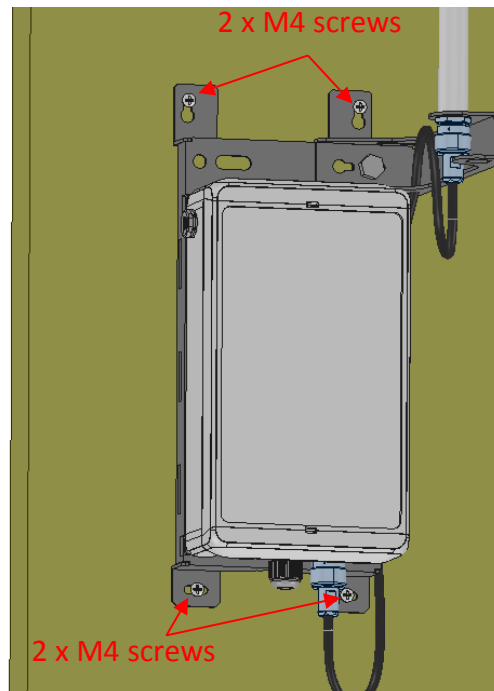


Figure 110 : Compact casing - Wall mount

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 172 / 221
Strict confidential		

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.

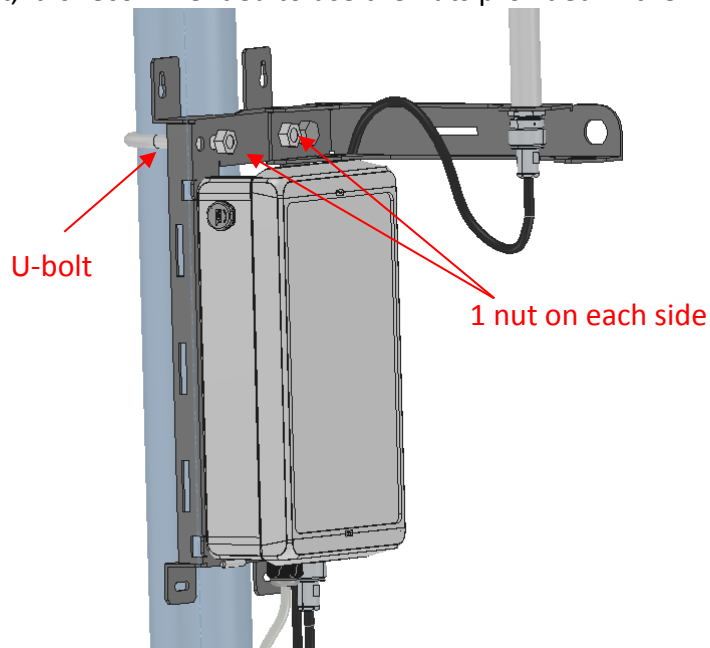


Figure 111 : Compact casing - Pole mount using U-bolt

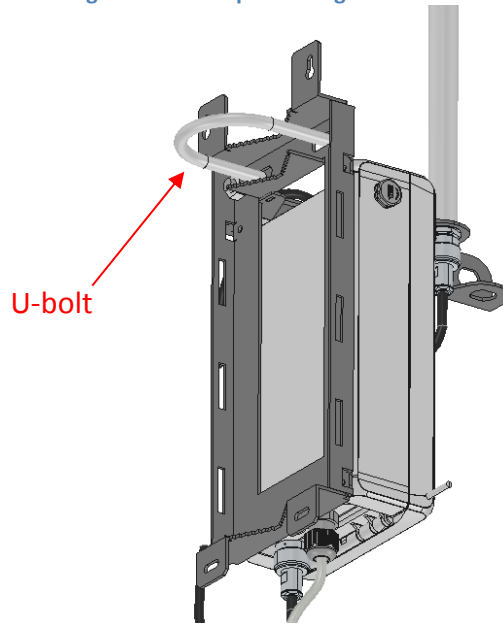


Figure 112 : Compact casing - rear view of the pole mounting using U-bolt (no pole represented)

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 173 / 221
Strict confidential		

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 strapings as described on the figure below:

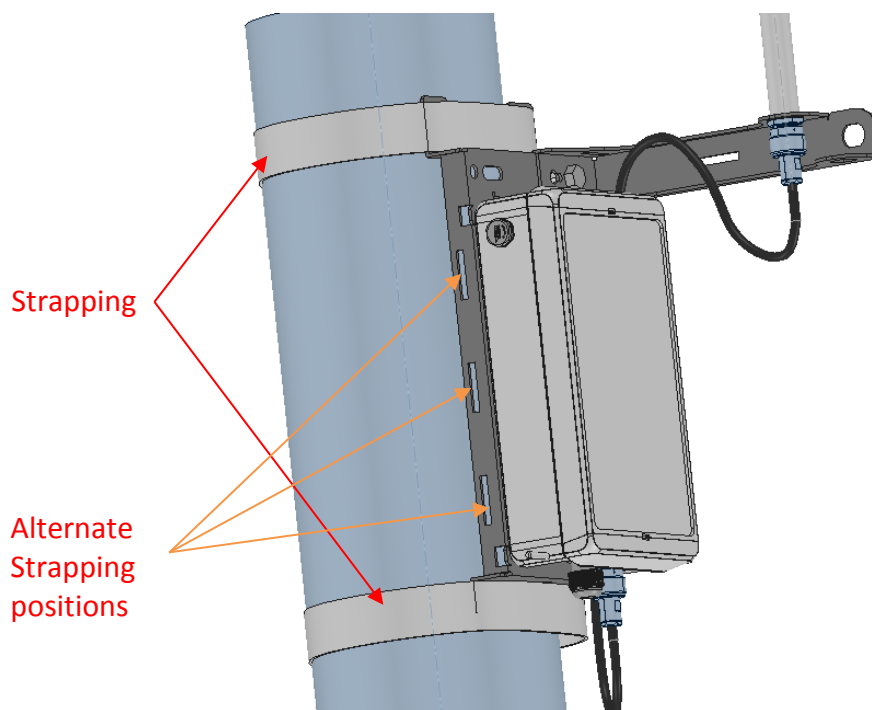


Figure 113 : Compact casing - Pole mount using strapping

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:

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 174 / 221
Strict confidential		

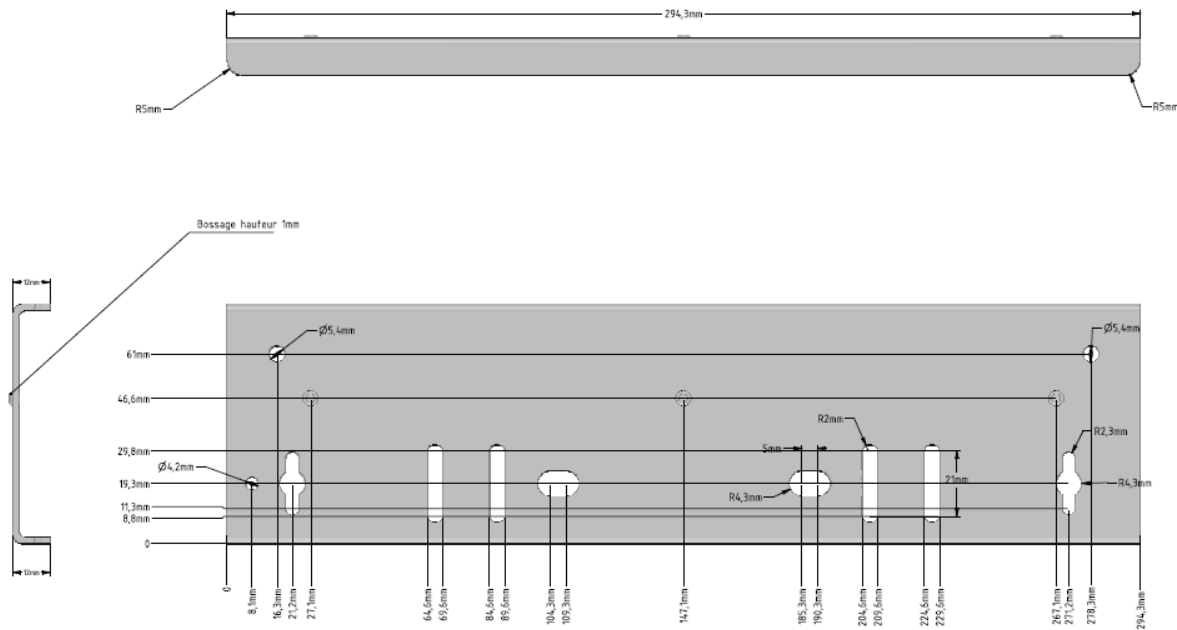


Figure 114 : Standard casing mounting kit dimensions

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:

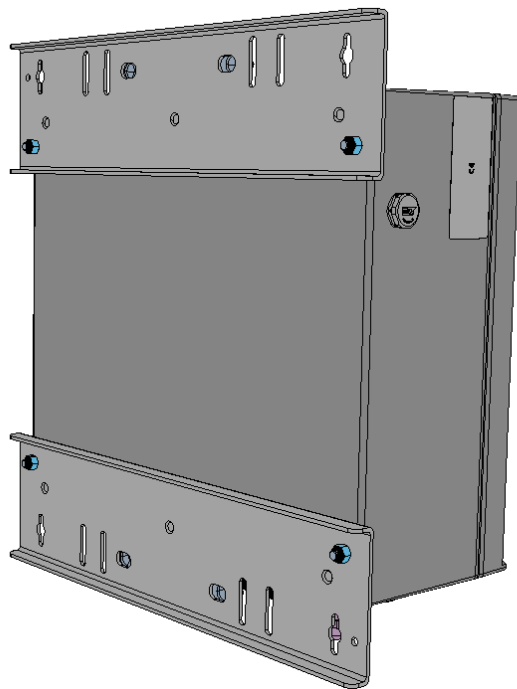


Figure 115 : Rear view of the standard casing with mounting kit

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 175 / 221
Strict confidential			

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.

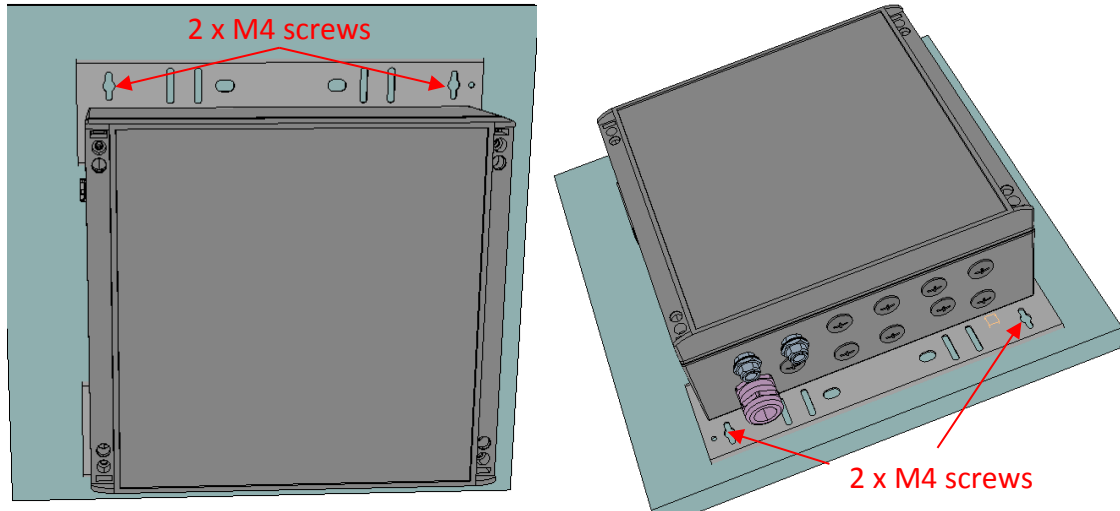


Figure 116 : Compact casing - Wall mount

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.

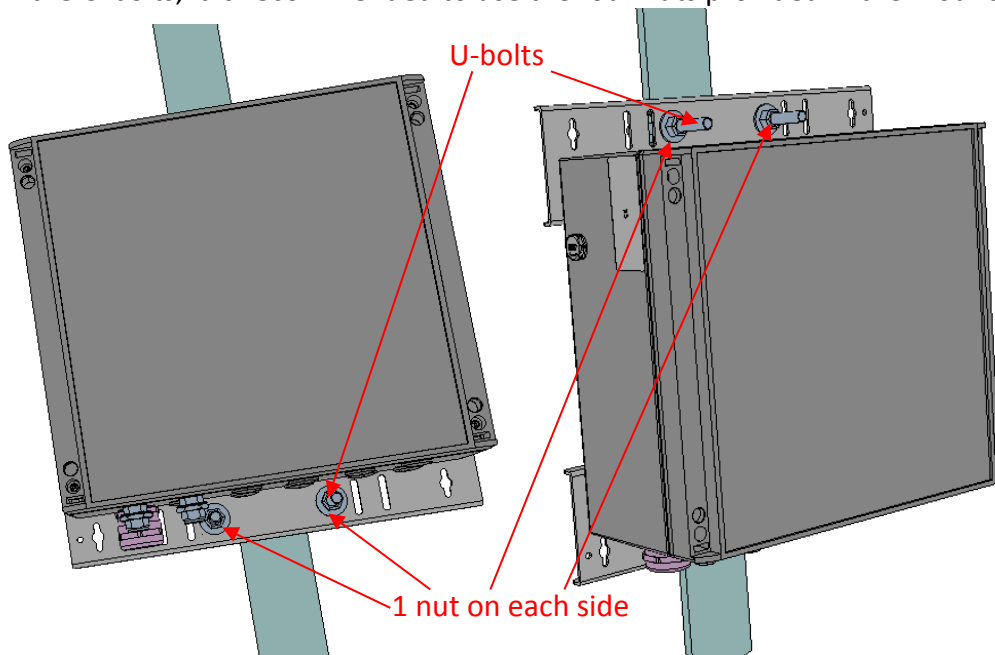


Figure 117 : Standard casing - Pole mount using U-bolts

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 176 / 221
Strict confidential		

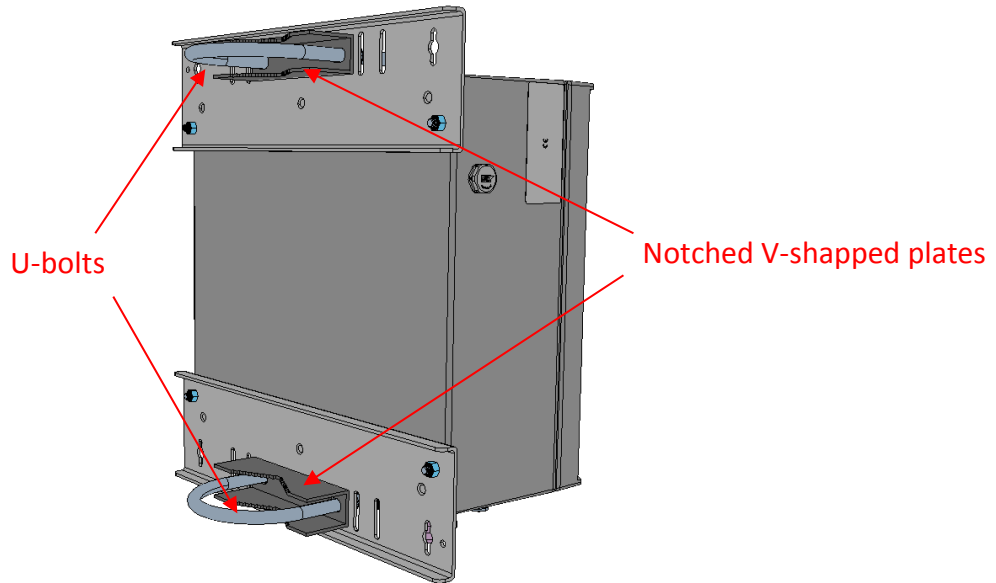


Figure 118 : Compact casing - rear view of the pole mounting using U-bolt (no pole represented)

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:

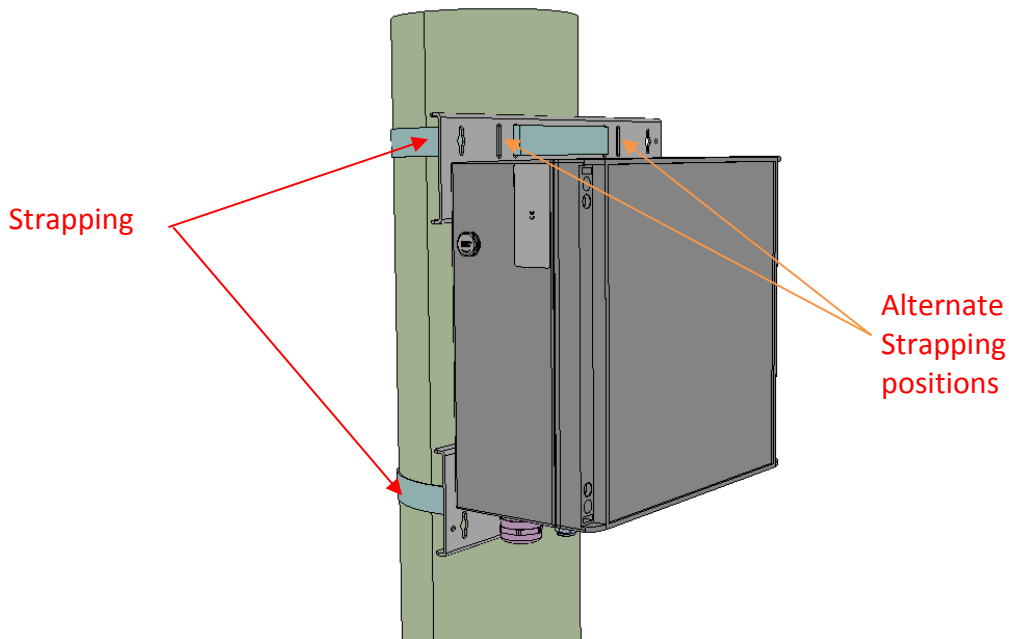


Figure 119 : Standard casing - Pole mount using strapping

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 177 / 221
Strict confidential		

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):

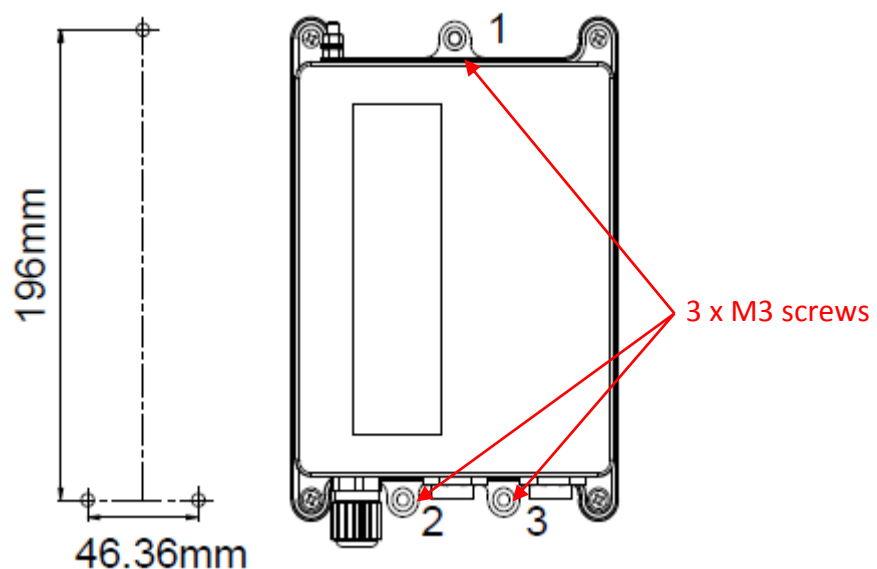


Figure 121 : Screws for outdoor POE injectors mounting

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 178 / 221
Strict confidential		

A mounting bracket kit is also available:

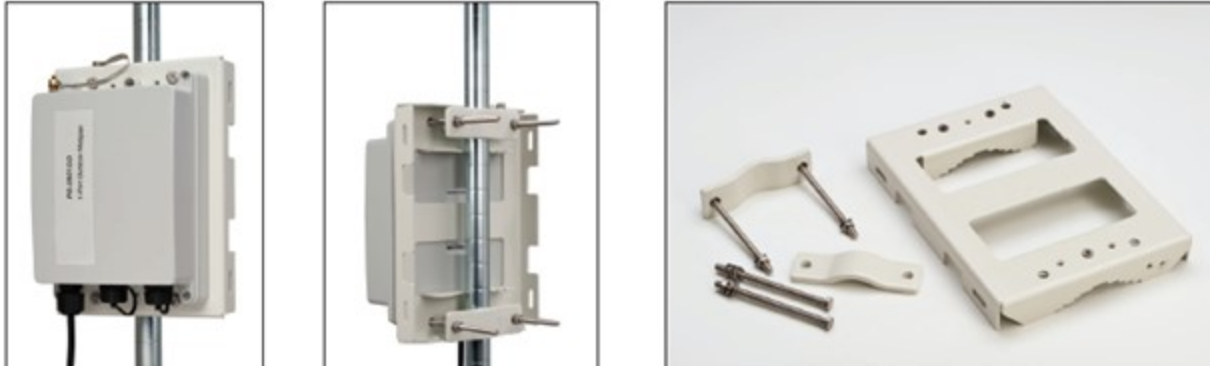


Figure 122 : Mounting bracket for outdoor POE injectors

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:

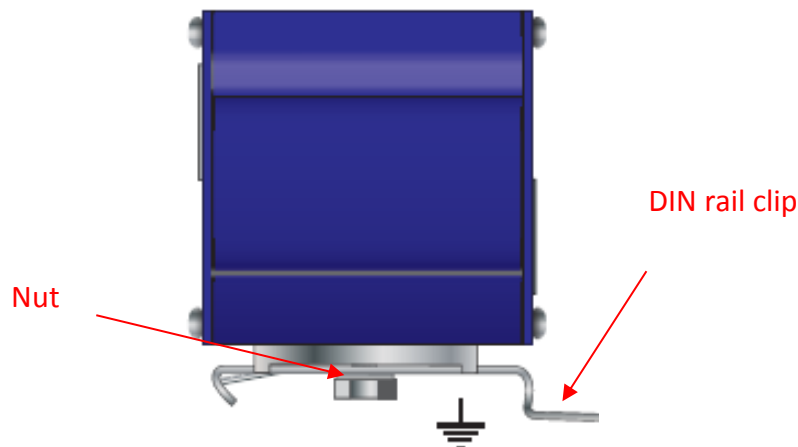


Figure 123 : Indoor Ethernet surge protection – DIN rail clip

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:

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 179 / 221
Strict confidential		

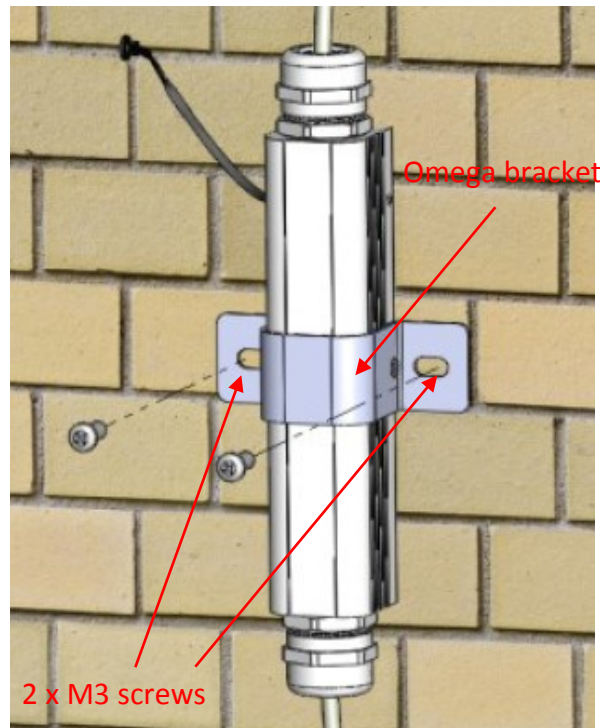


Figure 124 : Outdoor Ethernet Surge protection – wall mounting

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:

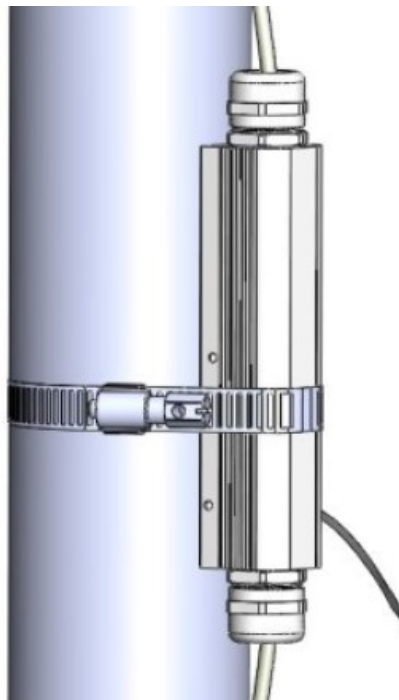


Figure 125 : Outdoor Ethernet Surge protection – pole mounting with strapping

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 180 / 221
Strict confidential		

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.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 181 / 221
Strict confidential		

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:

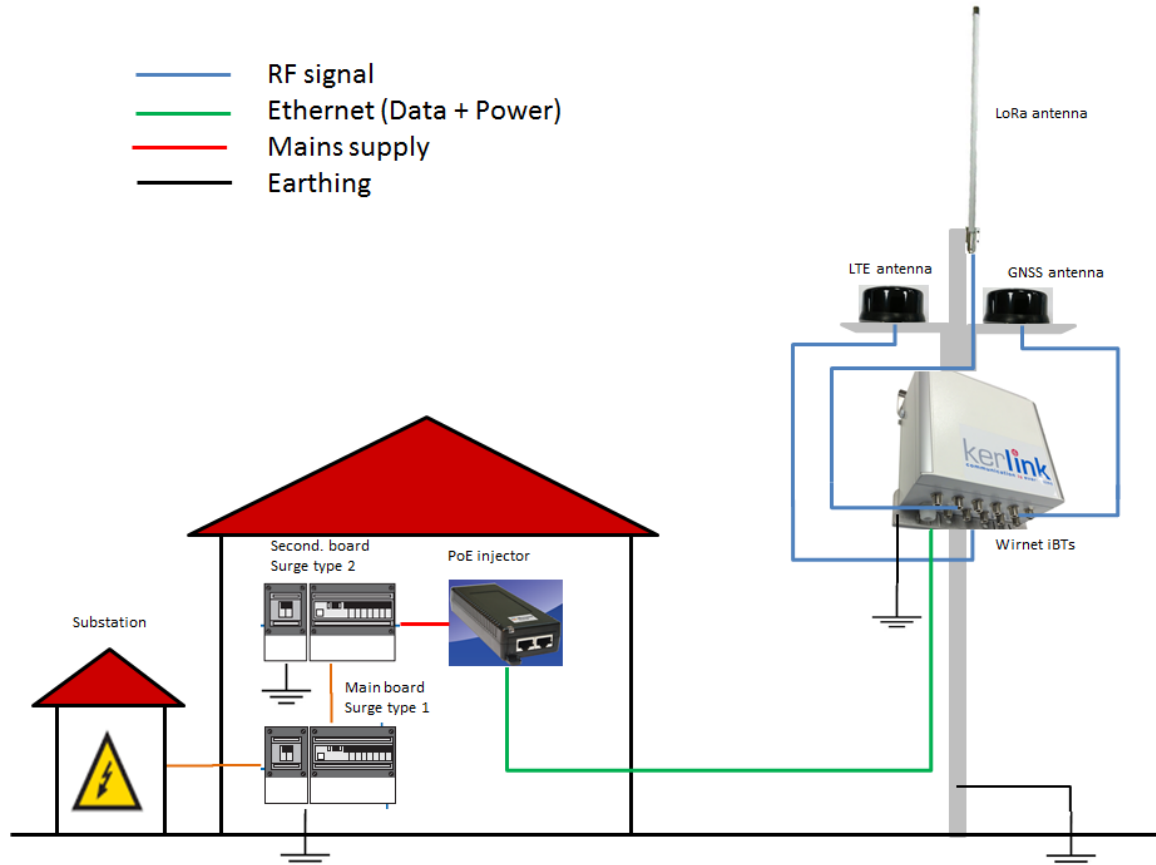


Figure 126 : connection settings of the installation

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 lightning 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.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 182 / 221
Strict confidential		

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 \oplus 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

A M8 bolt and nut is used to connect the ring tongue terminal

The different configurations are presented below:

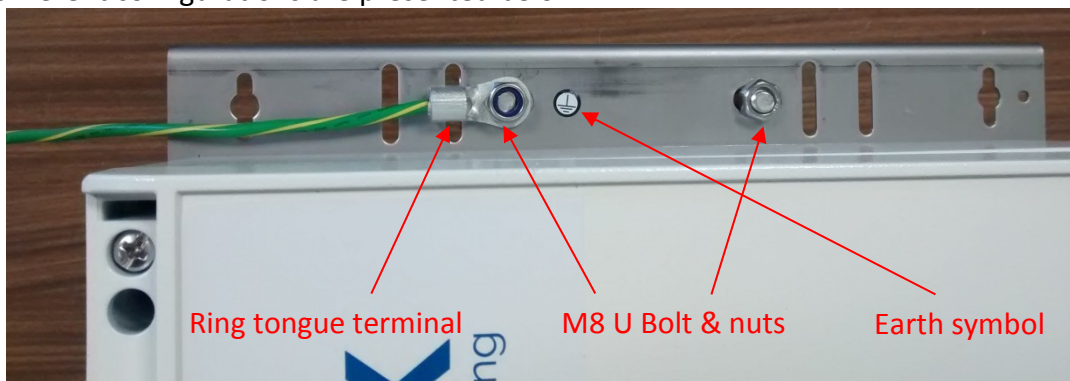


Figure 127 : Standard casing – earthing with U bolt configuration

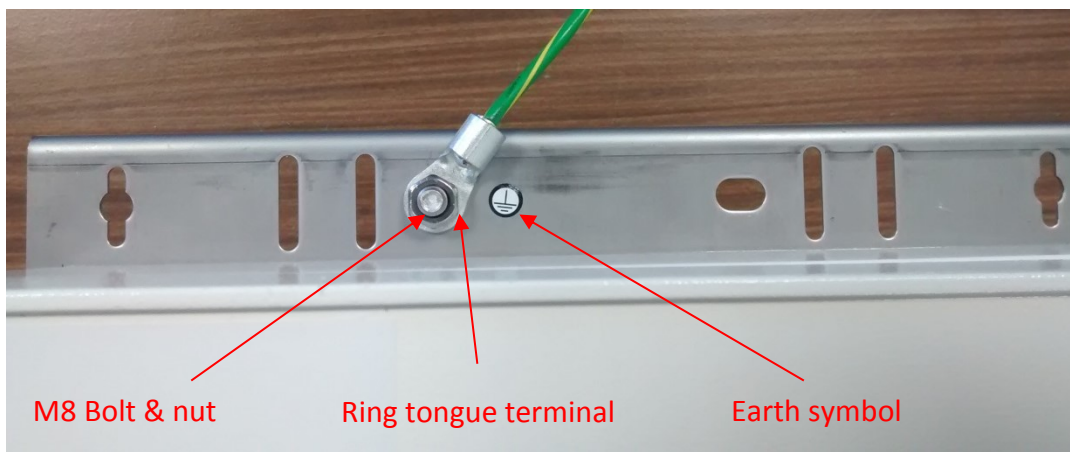


Figure 128 : Standard casing – earthing without U bolt configuration

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 lightning protection system of the of the pole, mast, ... of the installation.

Note 1: the earthing cable is not provided by KERLINK

Note 2: the earthing cable characteristics are detailed in §1.8.4.2.

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

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 183 / 221
Strict confidential		

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 \oplus 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:

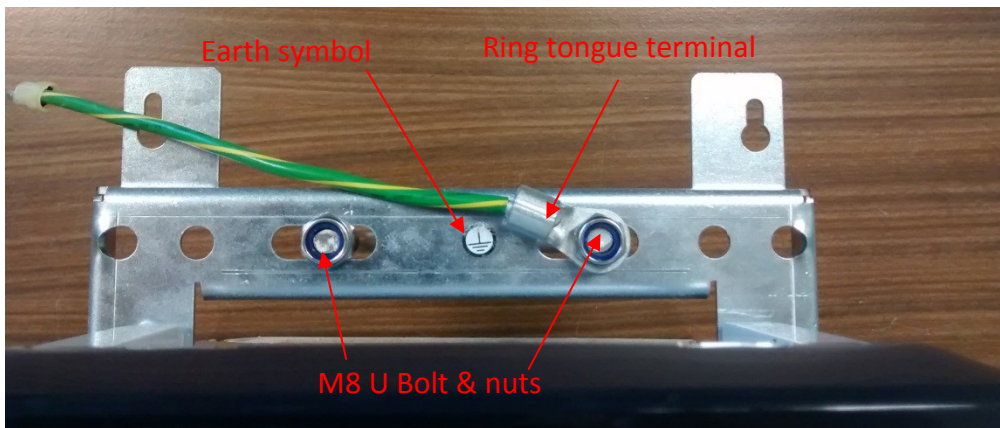


Figure 129 : Compact casing – earthing with U bolt configuration

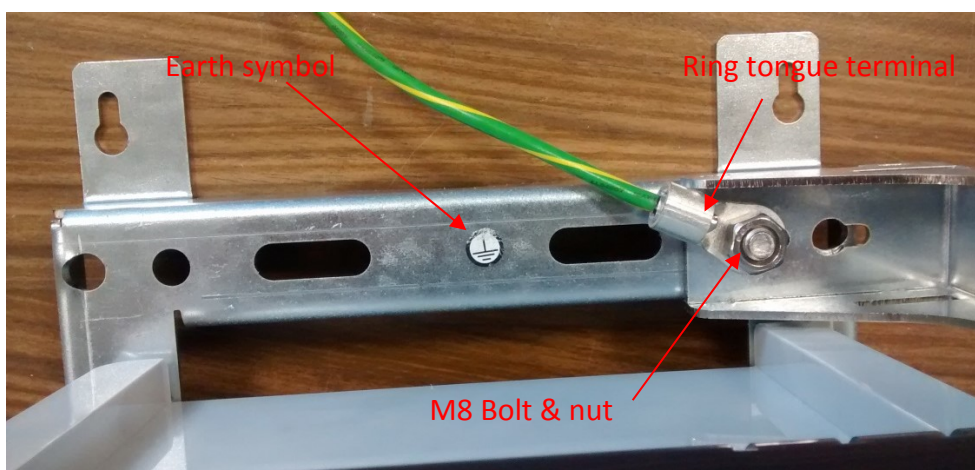


Figure 130 : Compact casing – earthing without U bolt configuration

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.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 184 / 221
Strict confidential		

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.

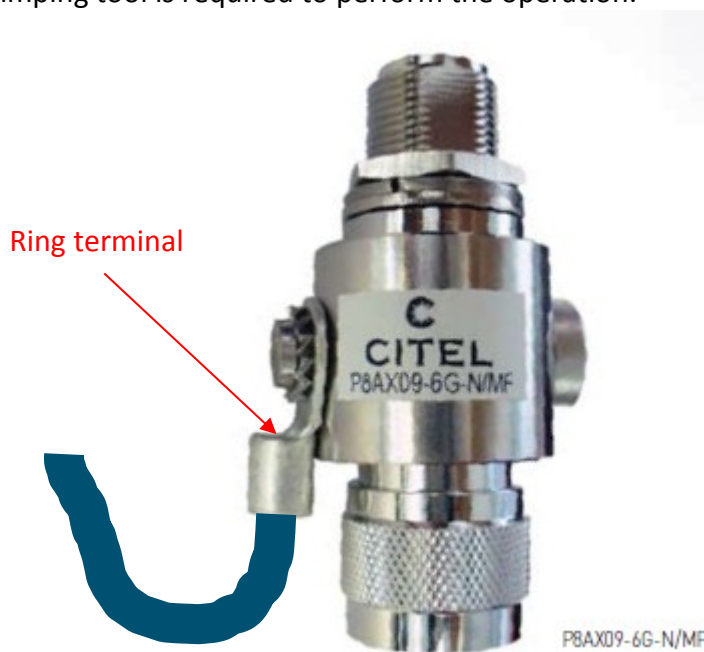


Figure 131 : Earthing of the RF coaxial surge protection

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

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 185 / 221
Strict confidential		

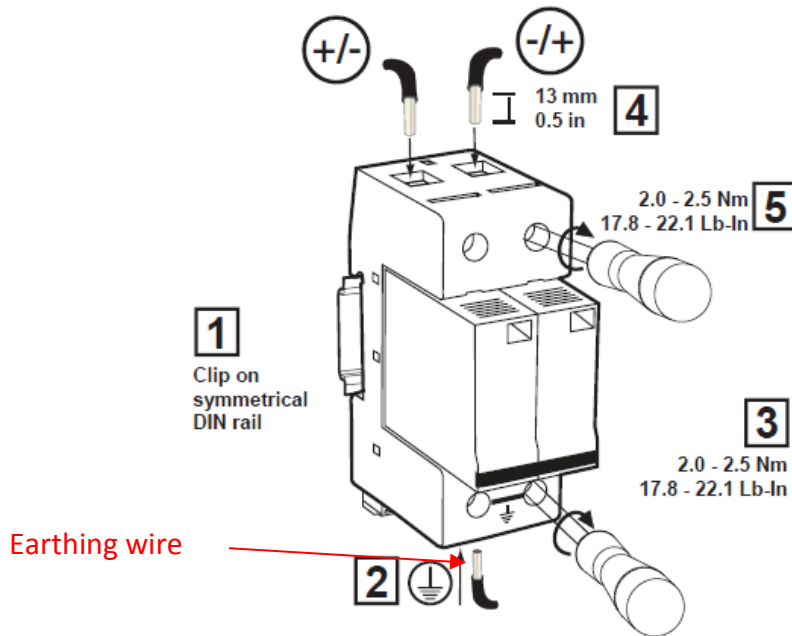


Figure 132 : Earthing of the RF coaxial surge protection

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.

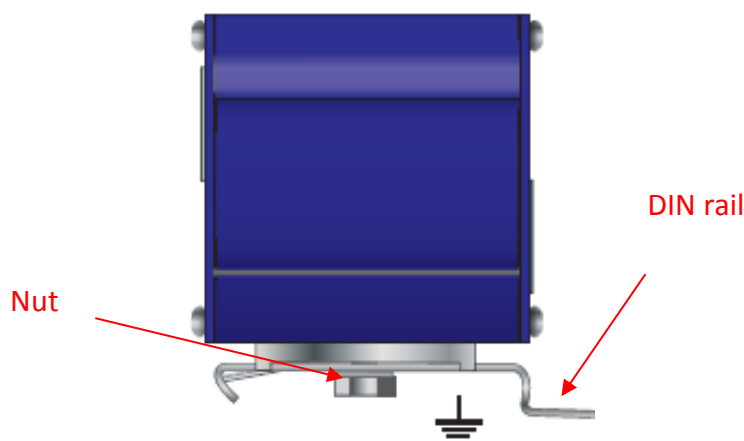


Figure 133 : Earthing of the indoor Ethernet surge protection

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.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 186 / 221
Strict confidential		

A specific crimping tool is required to perform the operation.

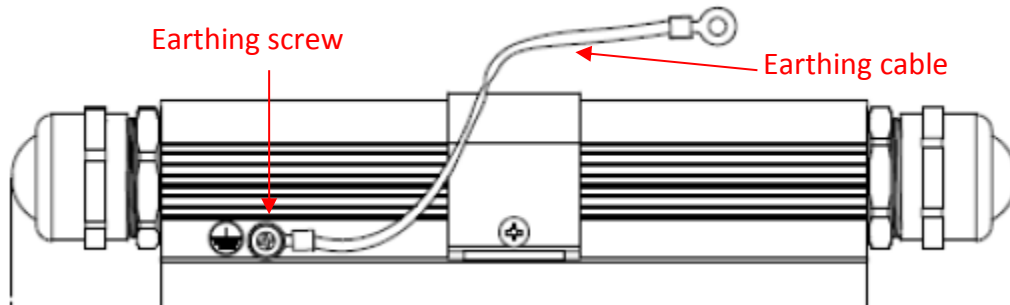


Figure 134 : Earthing of the outdoor Ethernet surge protection

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:

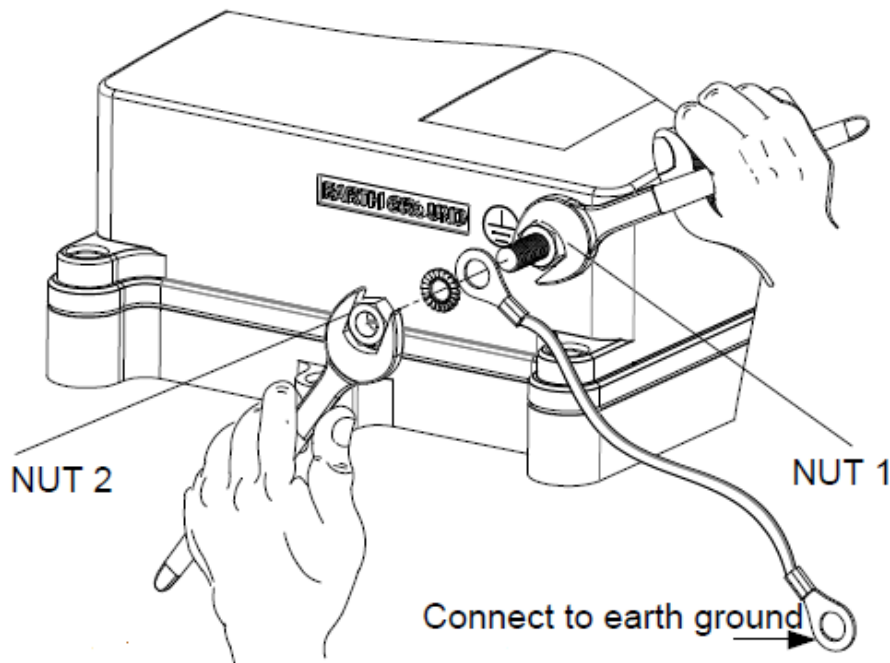


Figure 135 : Earthing of the outdoor PoE injector

Note 1: the earthing cables are not provided by KERLINK

Note 2: the earthing cables characteristics are detailed in §1.8.4.2.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 187 / 221
Strict confidential		

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:

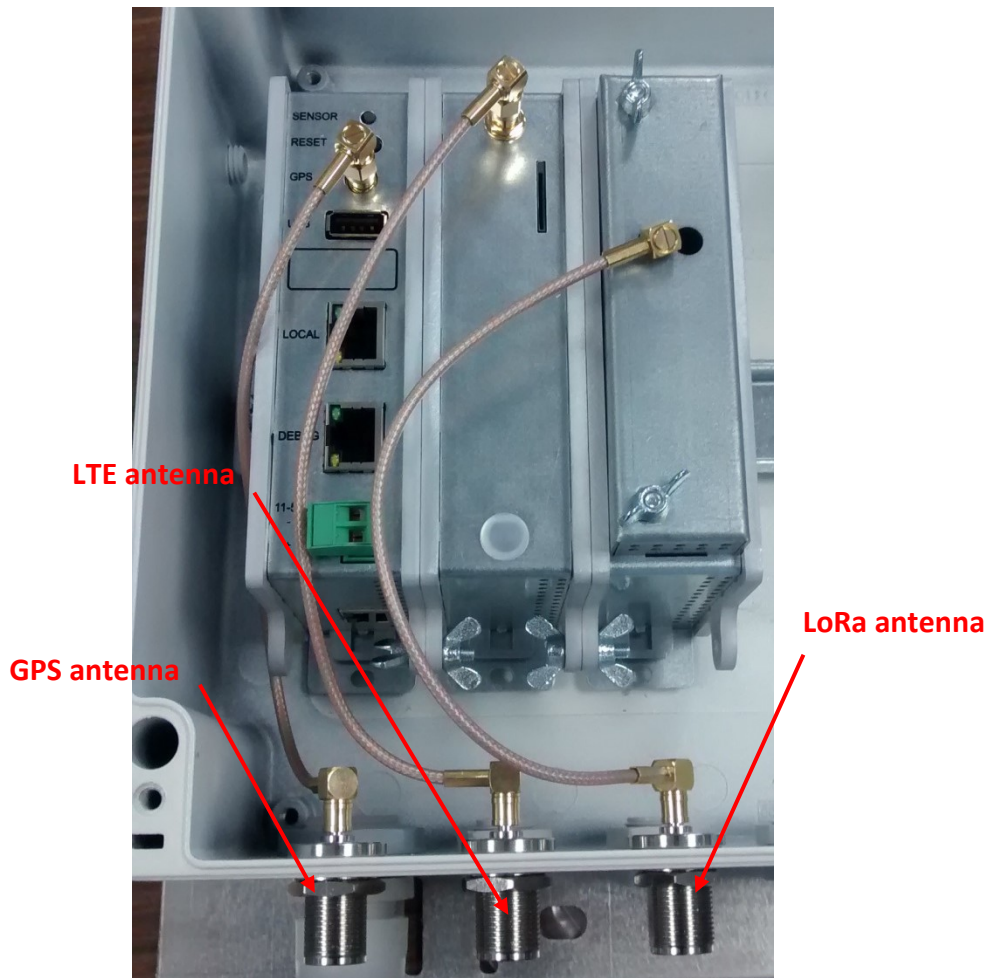


Figure 136 : nominal configuration of N connectors - standard casing

Therefore, in its nominal configuration, only one N connector is available for a single antenna.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 188 / 221
Strict confidential		

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:

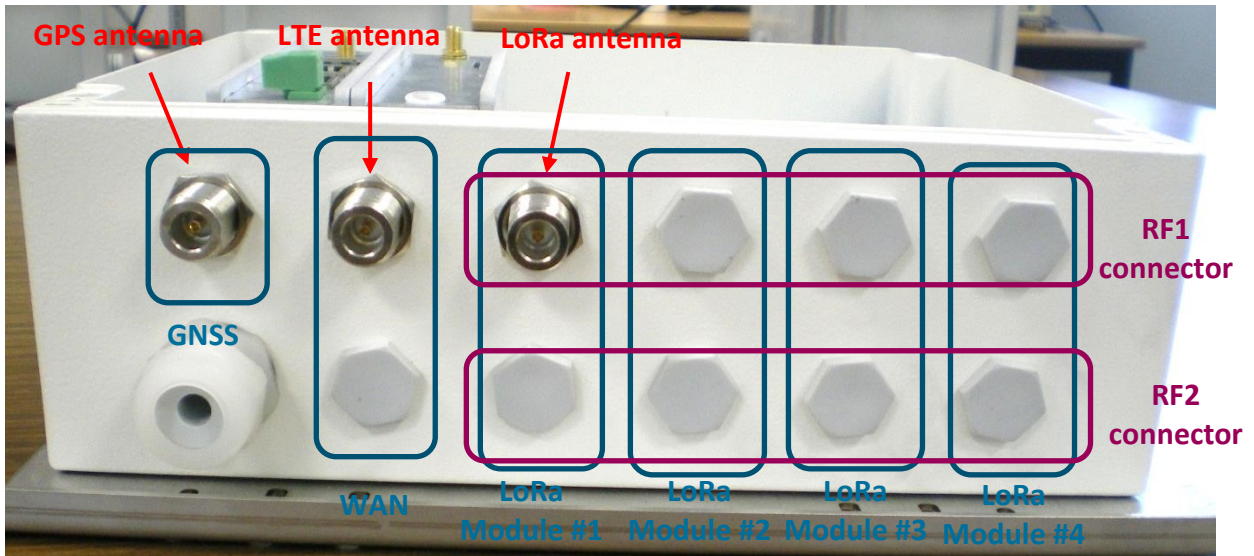


Figure 137 : Recommended allocation of the N connectors – Standard casing

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:

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 189 / 221
Strict confidential		

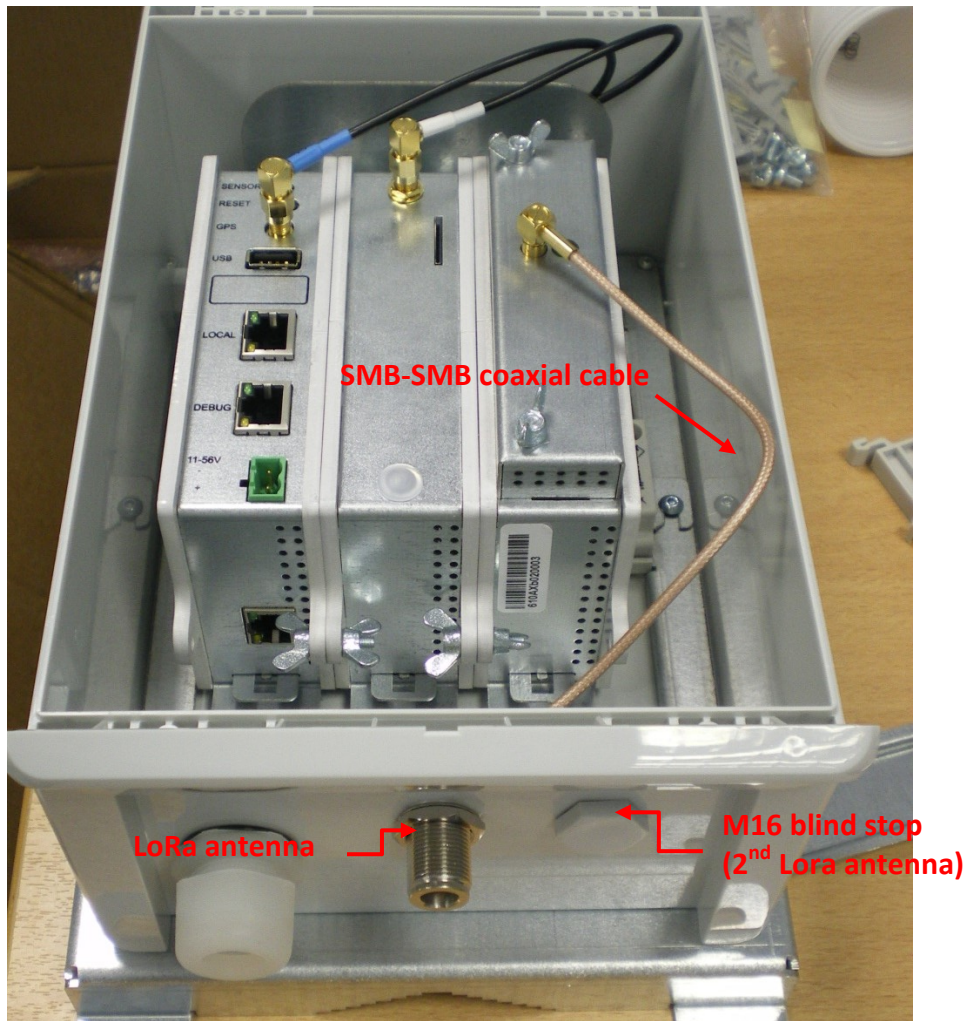


Figure 138 : Nominal configuration of N connectors - compact casing

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.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 190 / 221
Strict confidential		

4.6.2.1 GNSS antenna

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

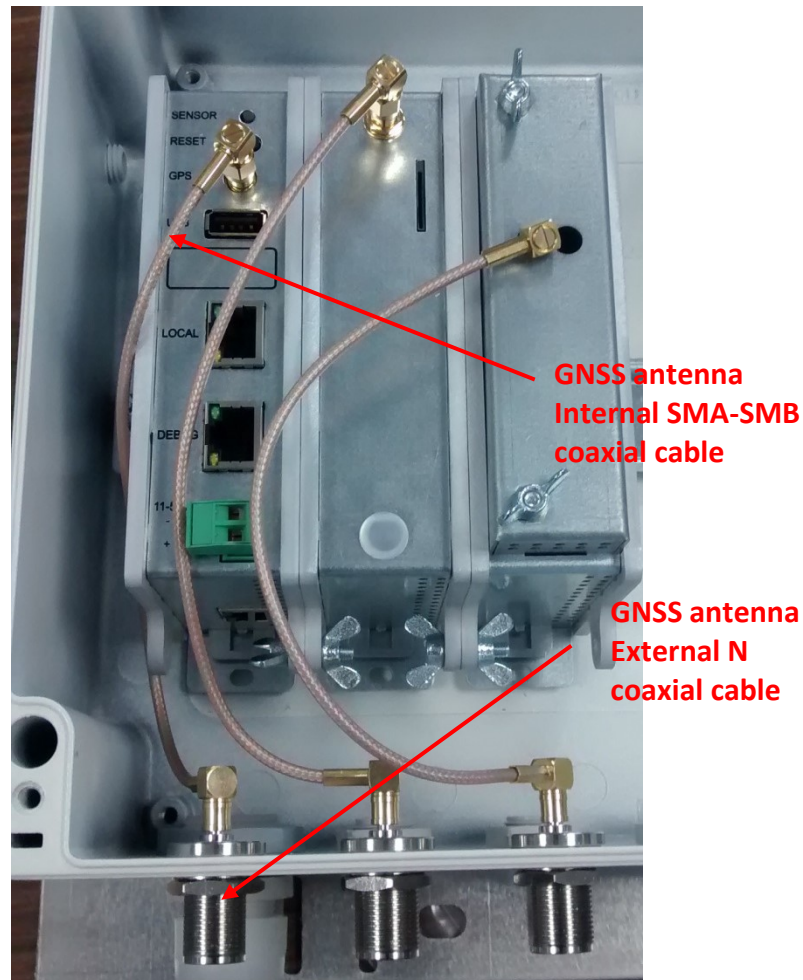


Figure 139 : GNSS antenna cabling, internal and external

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

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 191 / 221
Strict confidential		

4.6.2.2 LTE antenna

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

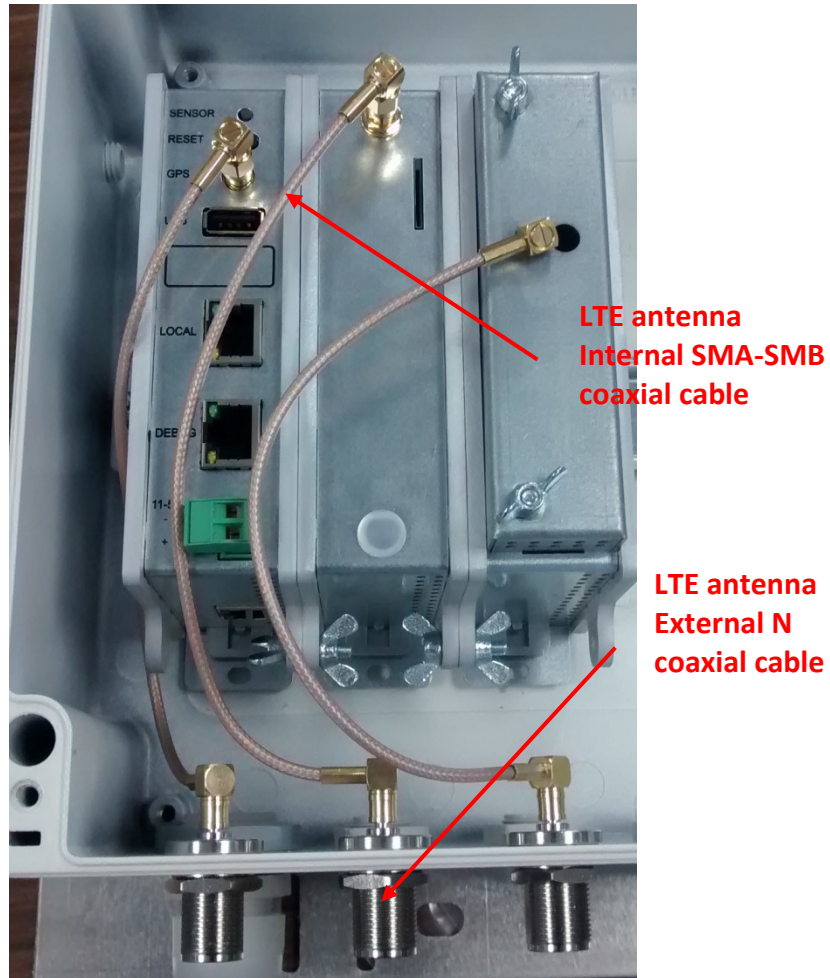


Figure 140 : LTE antenna cabling, internal and external

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:

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 192 / 221
Strict confidential		

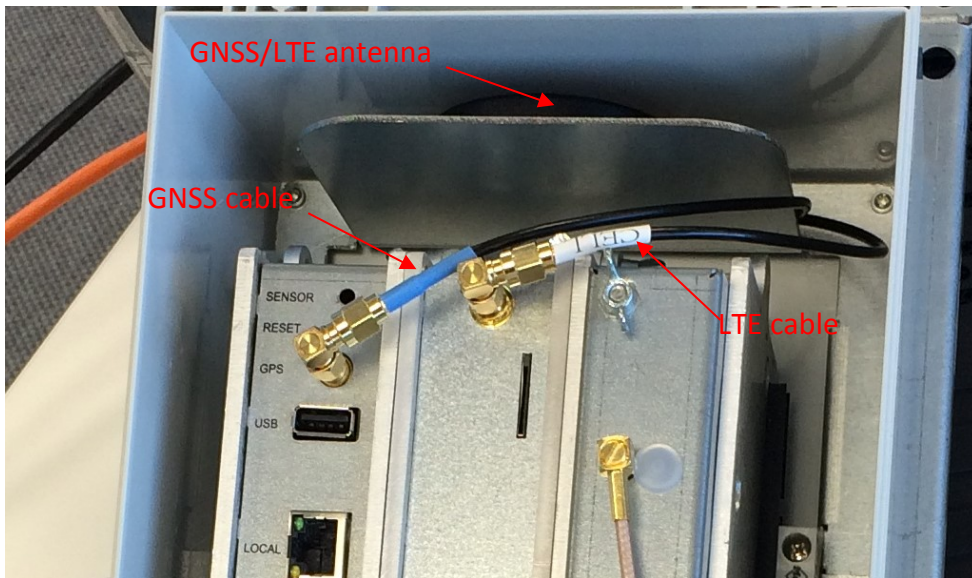


Figure 141 : GPS and LTE cabling within Wirnet iBTS Compact

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

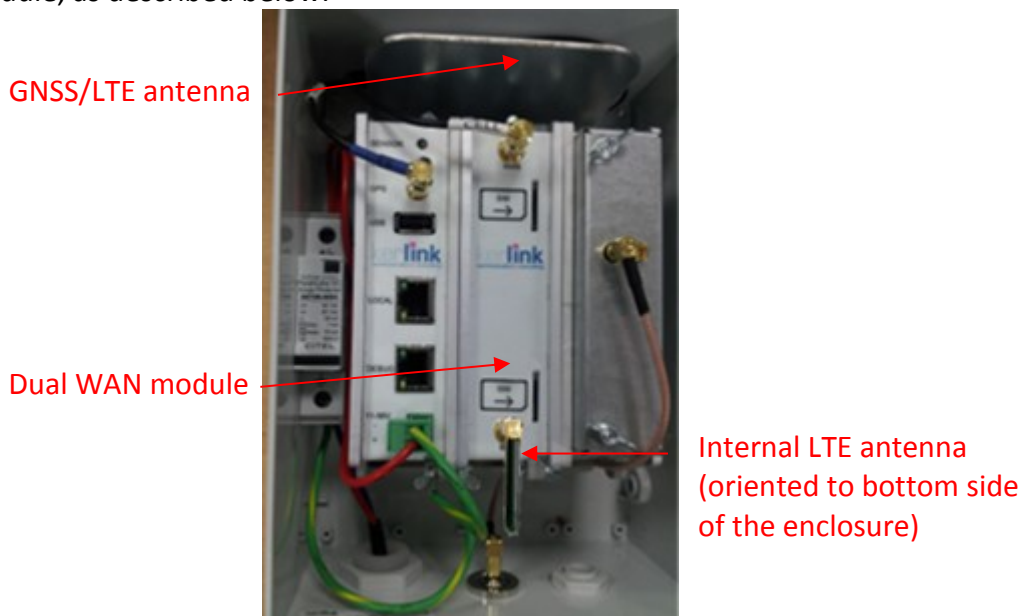


Figure 142 :Internal LTE antenna within Wirnet iBTS Compact

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 193 / 221
Strict confidential		

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:

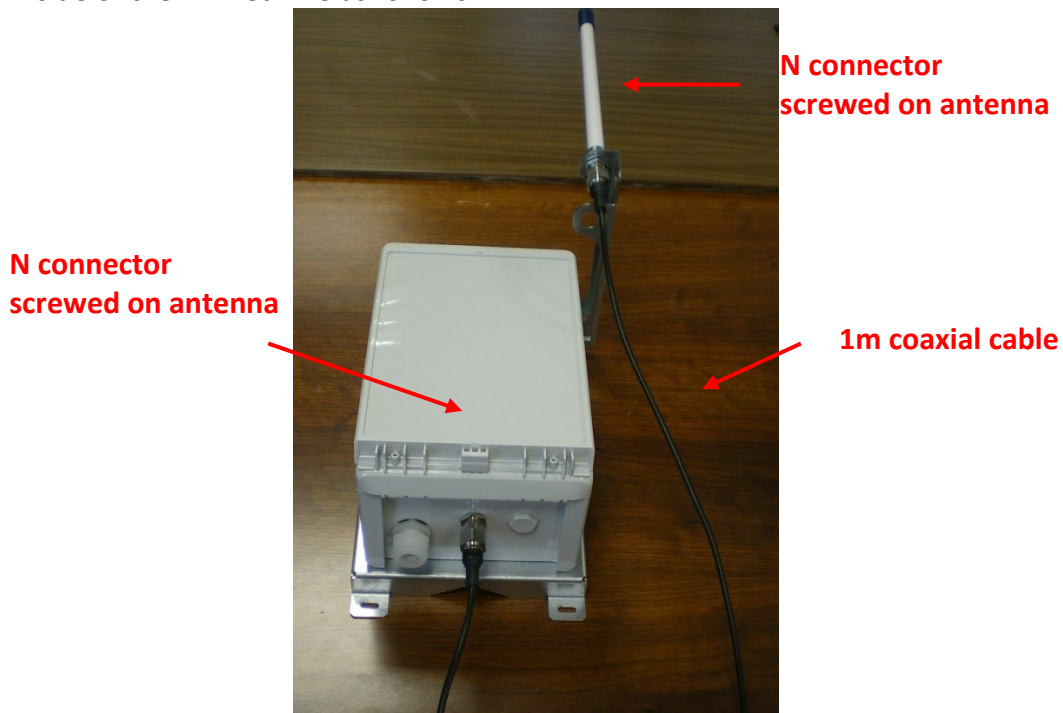


Figure 143 : Connection of the RF coaxial cable

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:

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 194 / 221
Strict confidential		

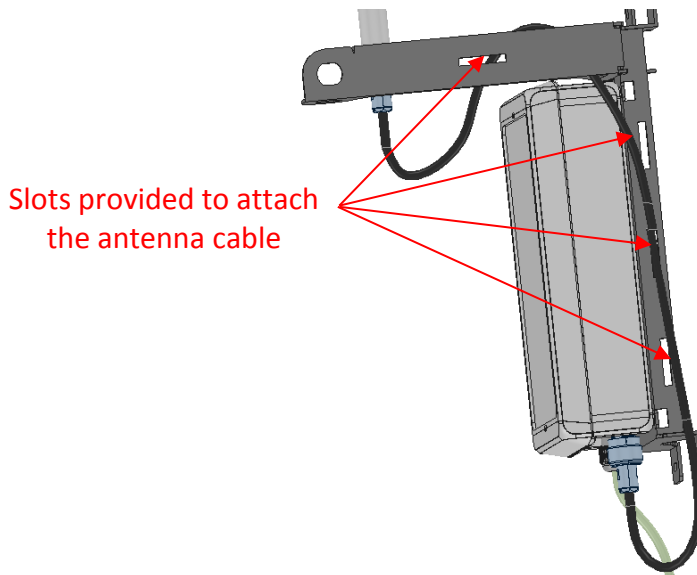


Figure 144 : attachment of the RF antenna coaxial cable

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.

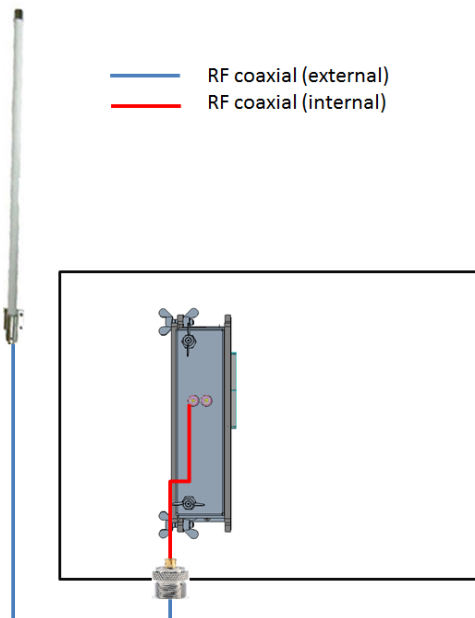


Figure 145 : Single LoRa module / single omnidirectional antenna connections

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 195 / 221
Strict confidential		

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).

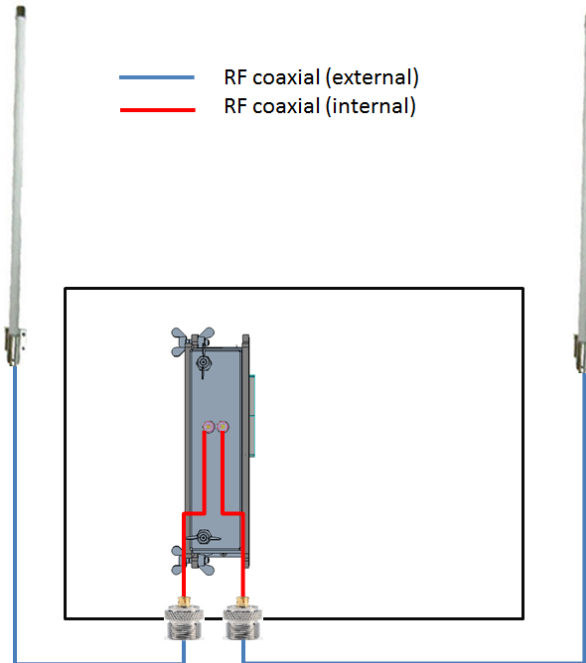


Figure 146 : Single LoRa module / dual omnidirectional antennas connections

4.6.2.5.4 Single LoRa module / single dual polarization antenna

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

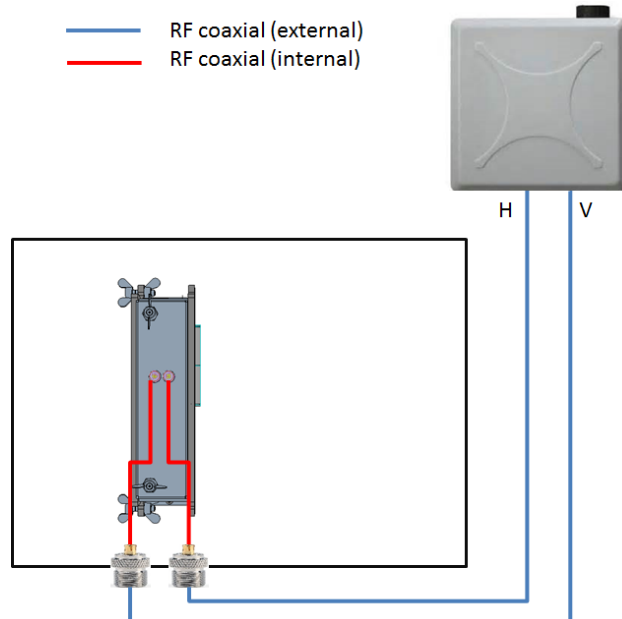


Figure 147 : Single LoRa module / single dual polarization antenna connections

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 196 / 221
Strict confidential		

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).

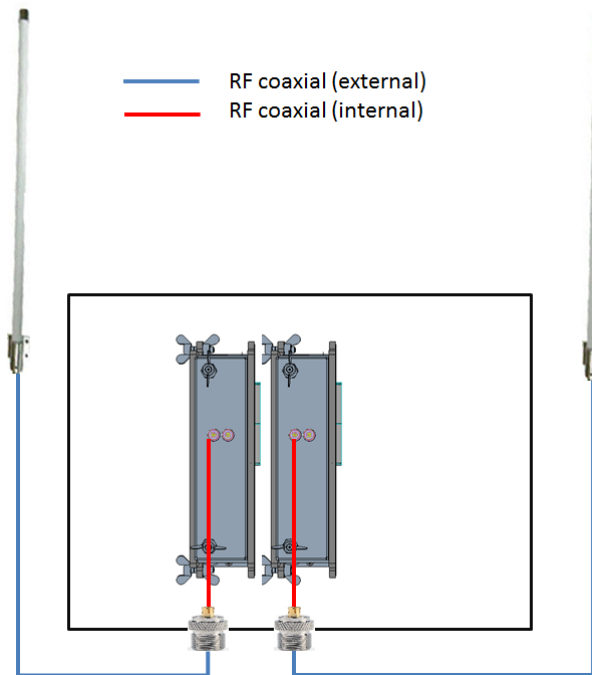


Figure 148 : Two LoRa modules / two omnidirectional antennas / diversity connections

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.

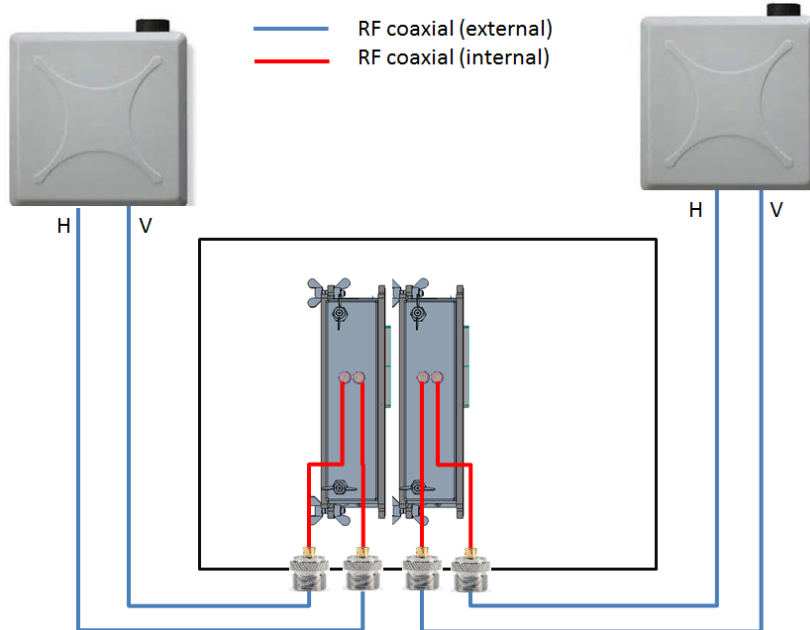


Figure 149 : Two LoRa modules / two dual polarization antennas connections

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 197 / 221
Strict confidential		

4.6.2.5.7 Three LoRa modules / three sectors antennas

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

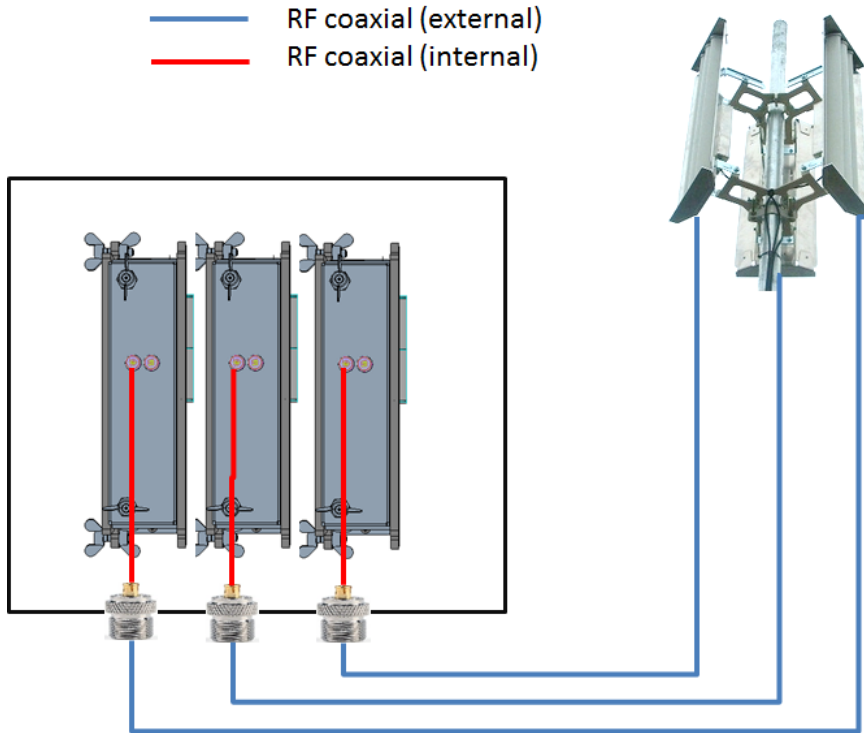


Figure 150 : Three LoRa modules / three sectors antennas connections

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.

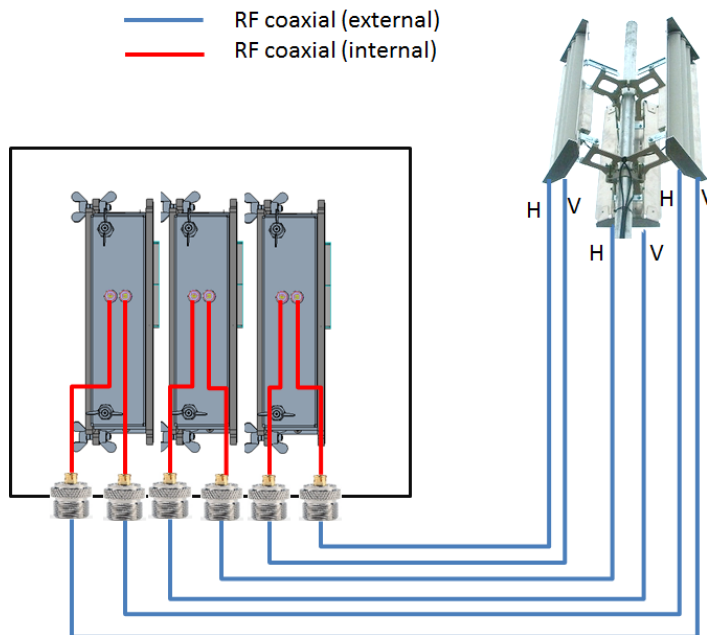


Figure 151 : Three LoRa modules / three sectors antennas / dual polarization connections

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 198 / 221
Strict confidential		

4.6.2.5.9 Four LoRa modules / single omnidirectional antenna

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

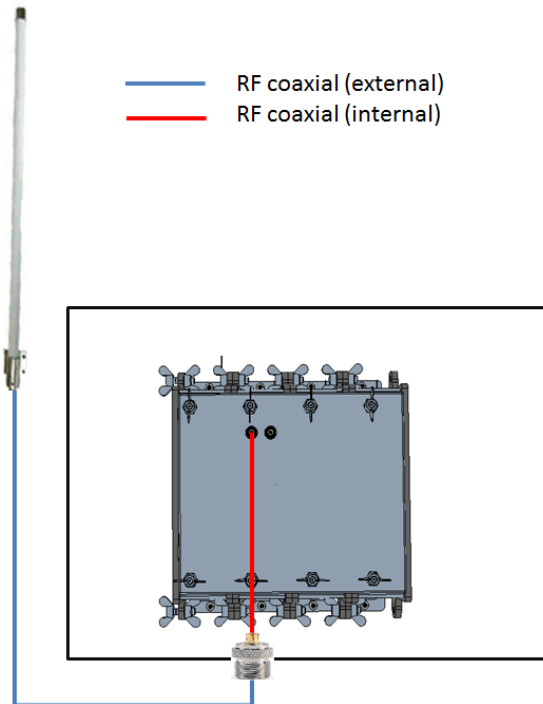


Figure 152 : Four LoRa modules / single omnidirectional antenna connections

4.6.2.5.10 Four LoRa modules / dual omnidirectional antennas / diversity

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

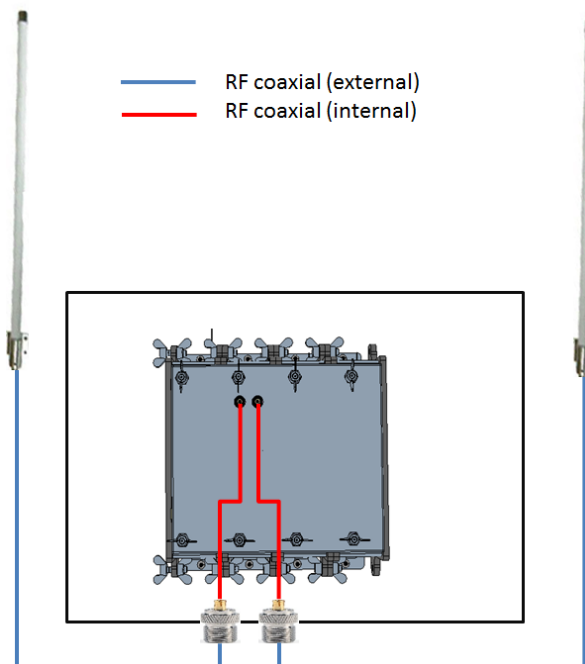


Figure 153 : Four LoRa modules / dual omnidirectional antennas / diversity connections

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 199 / 221
Strict confidential		

4.6.2.5.11 Four LoRa modules / dual polarization antenna

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

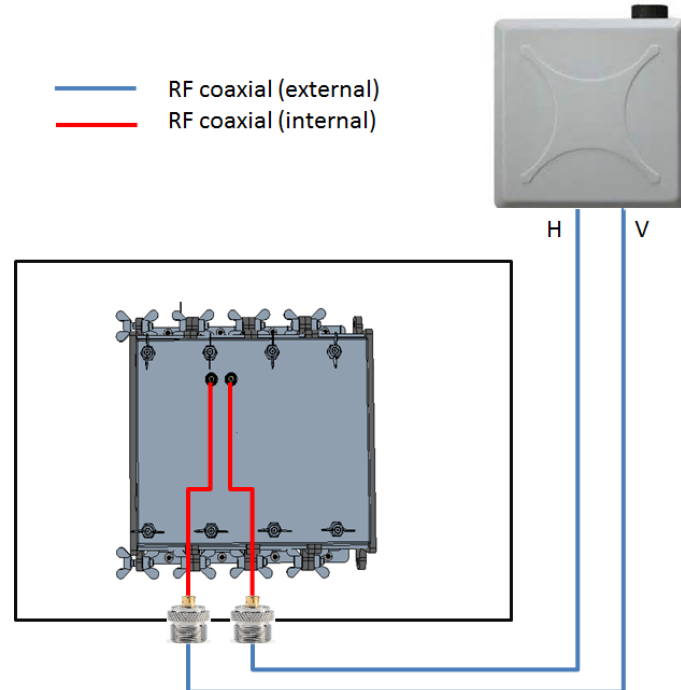


Figure 154 : Four LoRa modules / dual polarization antenna connections

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

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 200 / 221
Strict confidential		

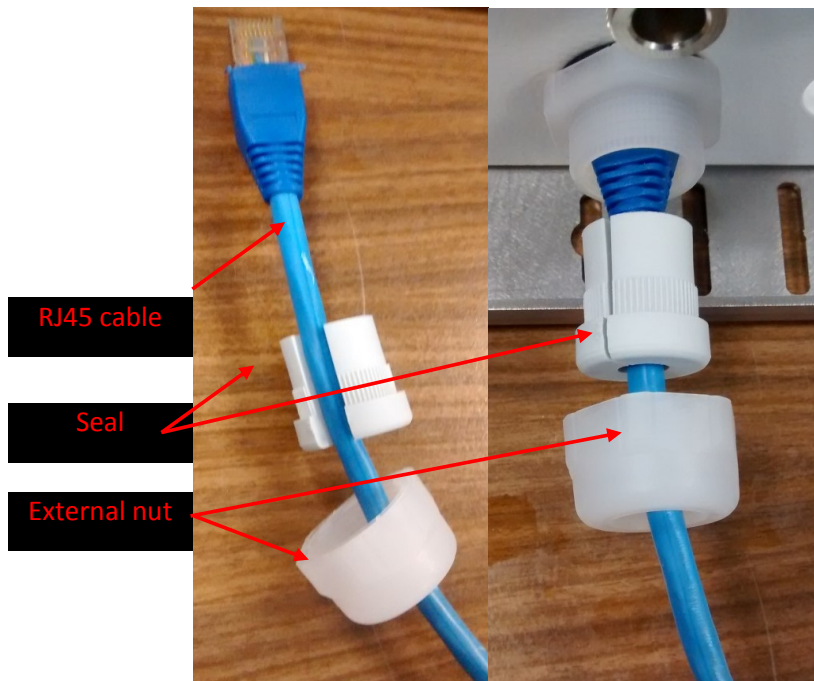


Figure 155 : Ethernet connection on Wirnet iBTS side / cable gland

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:

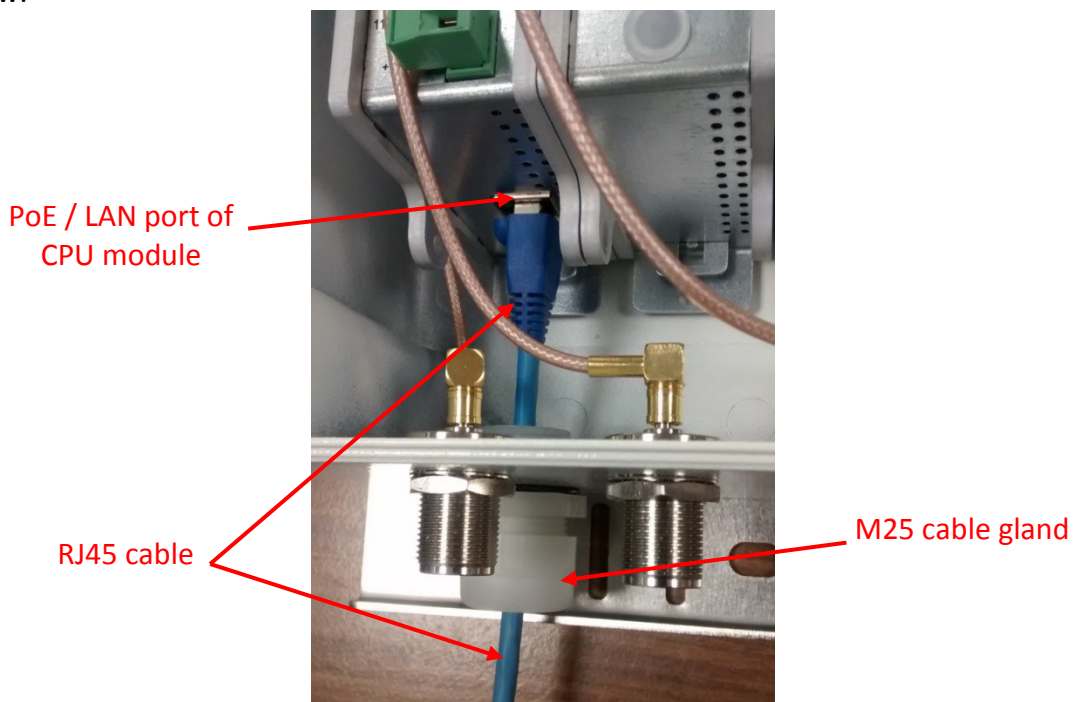


Figure 156 : Ethernet connection on Wirnet iBTS side

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 201 / 221
Strict confidential		

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.

« Data + Power »
port

RJ45 cable



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.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 202 / 221
Strict confidential		

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:

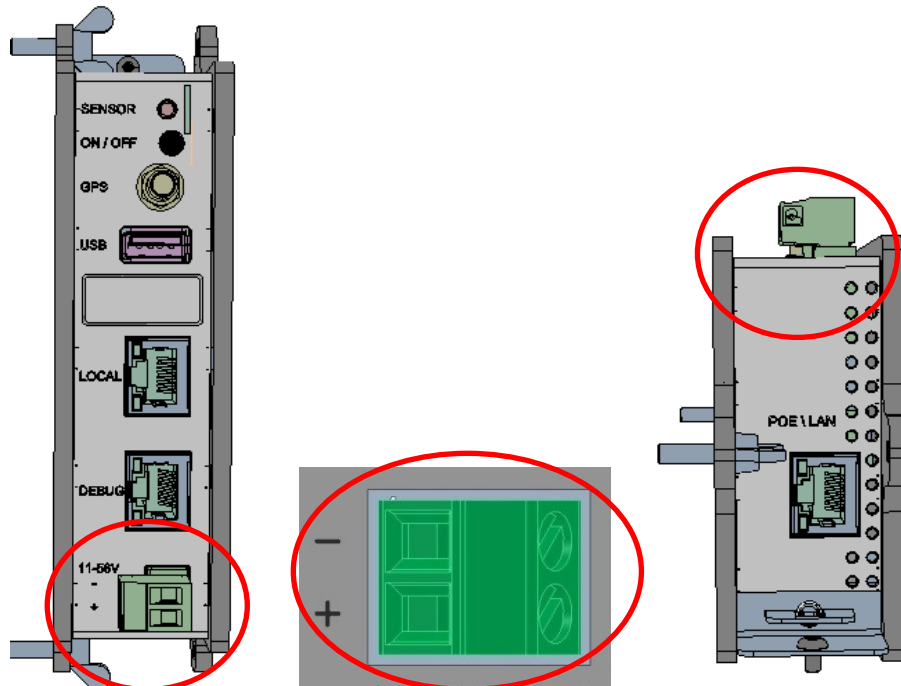


Figure 158 : Auxiliary DC power supply connector

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.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 203 / 221
Strict confidential		

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:

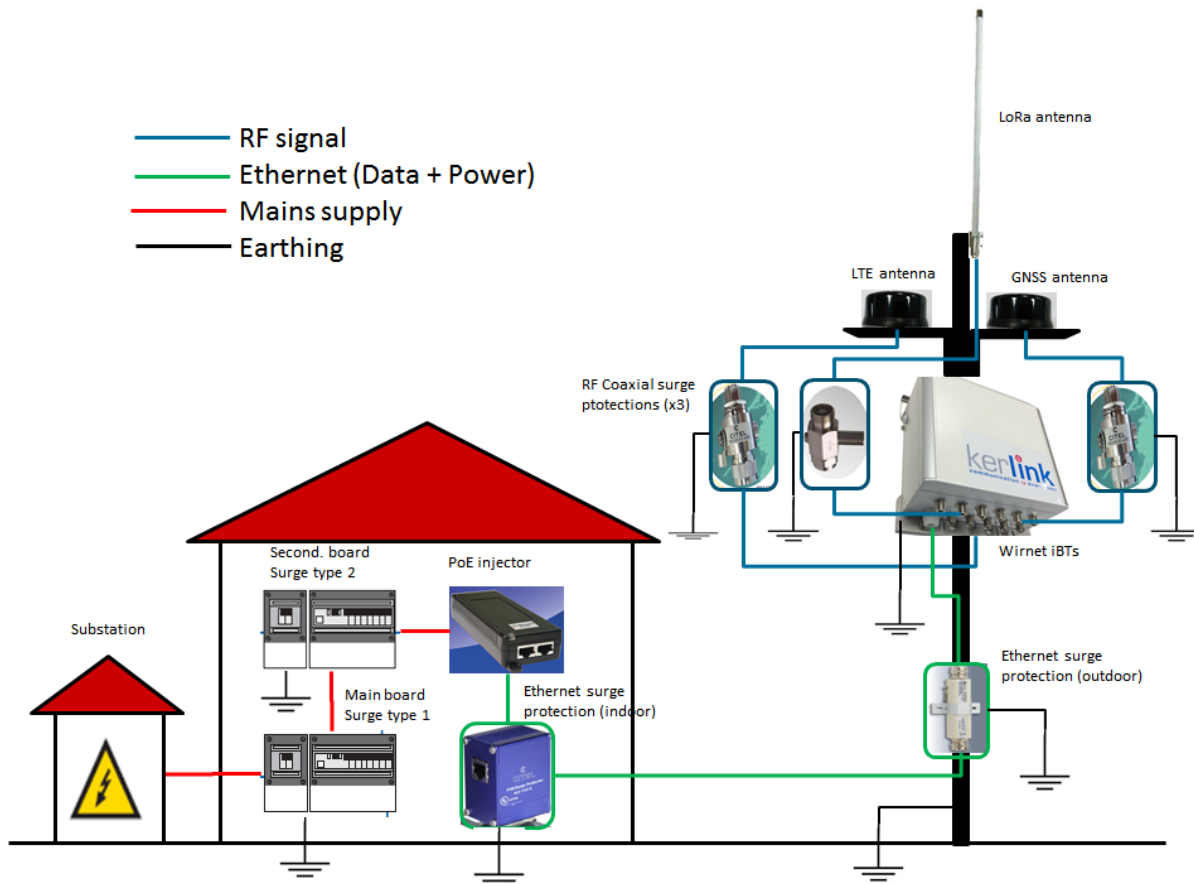


Figure 159 : Installation with recommended lightning protections

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 204 / 221
Strict confidential		

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.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 205 / 221
Strict confidential			

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.

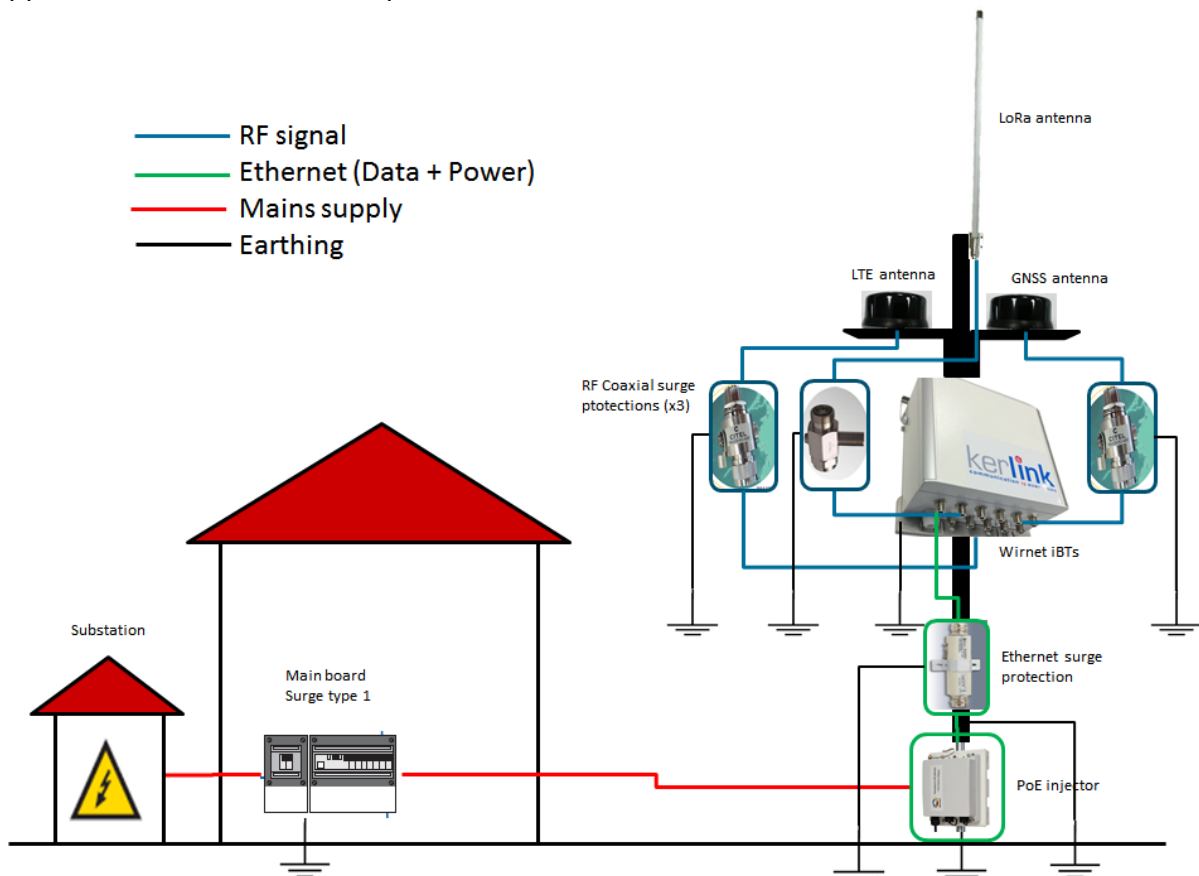


Figure 160 : Installation with recommended lighting protections / Outdoor PoE injector

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 206 / 221
Strict confidential		

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

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 207 / 221
Strict confidential		

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:

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 209 / 221
Strict confidential		

- 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.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 210 / 221
Strict confidential		

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.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 211 / 221
Strict confidential			

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:

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink		
Internal Use	Kerlink m2m technologies reserved rights		
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD		Page 212 / 221
Strict confidential			

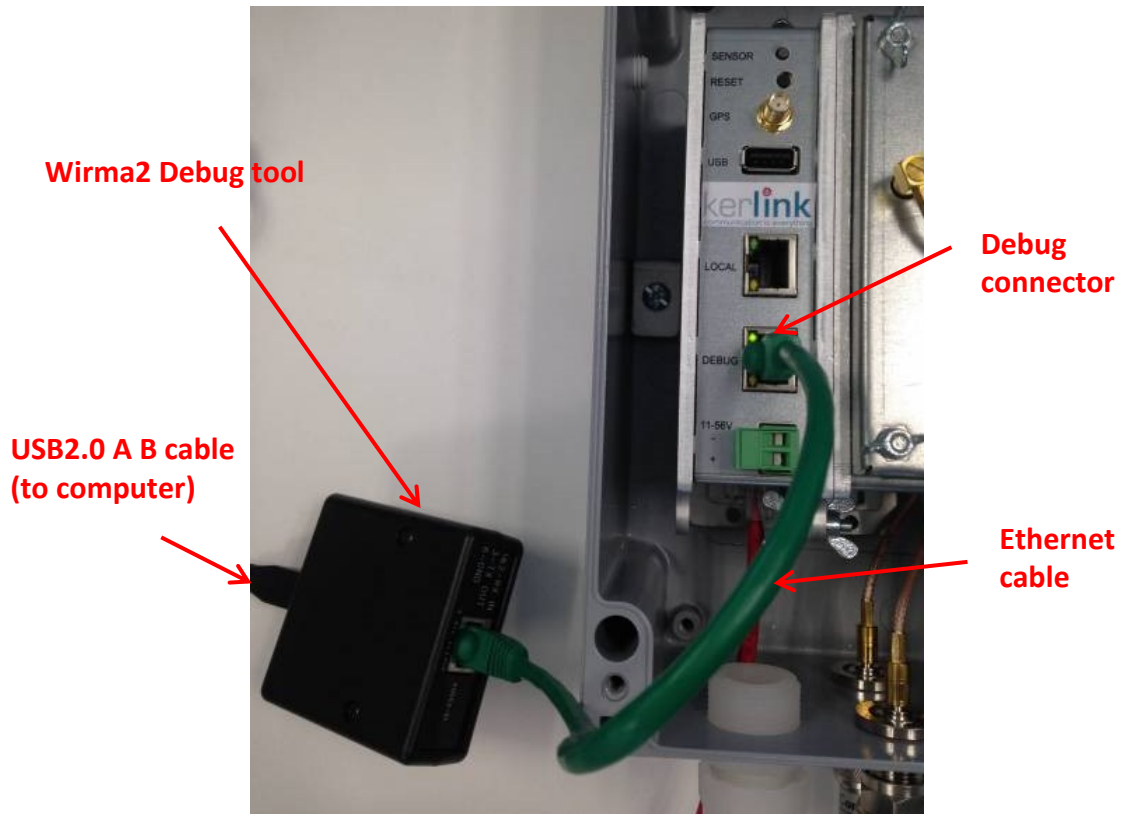


Figure 162 : Wirma2 Debug tool connected to the Wirnet iBTS

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

The serial port must be configured as follows:

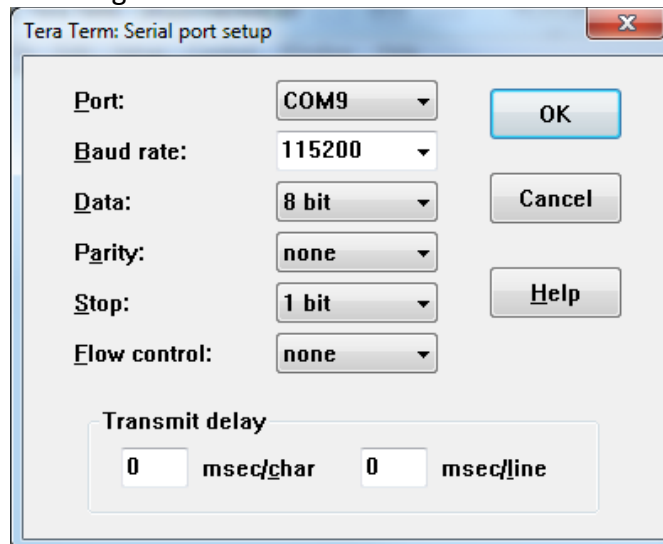


Figure 163 : Serial port configuration

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 213 / 221
Strict confidential		

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:

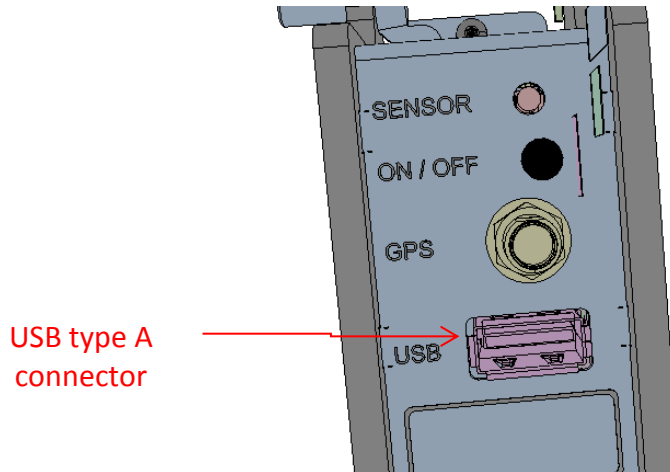


Figure 164 : USB connector of the Wirnet iBTS

5.3.3 ON/OFF button

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

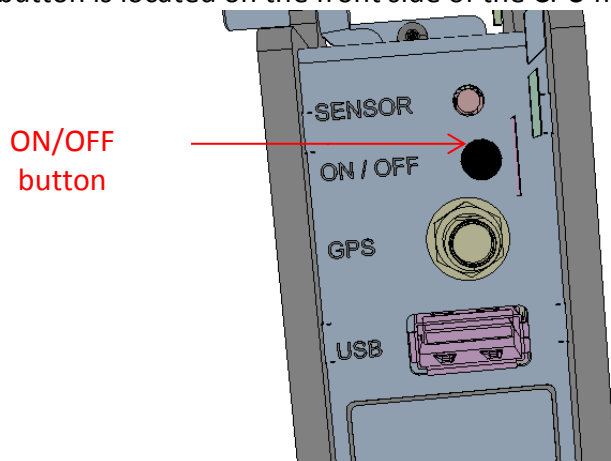


Figure 165 : ON/OFF button of the Wirnet iBTS

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

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 214 / 221
Strict confidential		

- 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 2 minutes.
- 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:

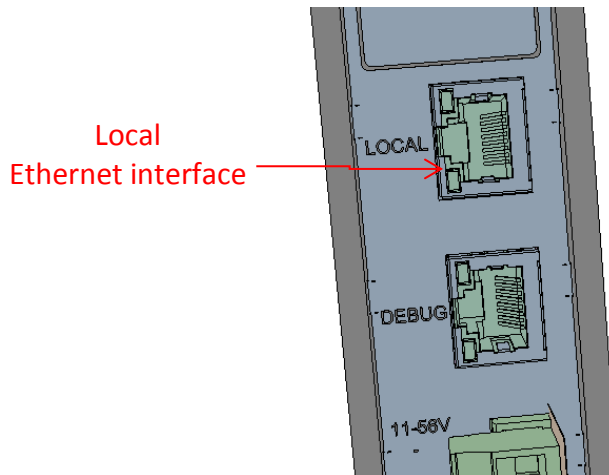


Figure 166 : Local Ethernet interface of the Wirnet iBTS

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.

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 215 / 221
Strict confidential		

6. List of the accessories

Basic configuration:

KERLINK Reference	Designation
KLK-I0144	Wirnet iBTS enclosure, including: <ul style="list-style-type: none"> - 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: <ul style="list-style-type: none"> - 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: <ul style="list-style-type: none"> - 2 X N-SMB adapter - 2 x RF coaxial SMB/SMB cable
KLK-I0164	Single LoRa Module 915 – LoRa LOC, including: <ul style="list-style-type: none"> - 2 X N-SMB adapter - 2 x RF coaxial SMB/SMB cable
KLK-I0153	Quad LoRa Modules 915 – LoRa LOC – 64 channels, including: <ul style="list-style-type: none"> - 2 X N-SMB adapter - 2 x RF coaxial SMB/SMB cable
PDTIOT-ACS03 (KLK-I0183)	Single LoRa Module 923 – LoRa LOC, including: <ul style="list-style-type: none"> - 2 X N-SMB adapter - 2 x RF coaxial SMB/SMB cable
KLK-I0160	Quad LoRa Modules 923 – LoRa LOC – 64 channels, including: <ul style="list-style-type: none"> - 2 X N-SMB adapter - 2 x RF coaxial SMB/SMB cable

UC module:

KERLINK Reference	Designation
KLK-I0177	UC Module, including: <ul style="list-style-type: none"> - 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: <ul style="list-style-type: none"> - 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: <ul style="list-style-type: none"> - 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: <ul style="list-style-type: none"> - 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: <ul style="list-style-type: none"> - 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: <ul style="list-style-type: none"> - 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: <ul style="list-style-type: none"> - 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: <ul style="list-style-type: none"> - 1 X Universal antenna bracket - 1 X 1m coaxial cable
ACCIOT-KAN04 (KLK02648)	Omnidirectional antenna 915MHz 6dBi kit, including: <ul style="list-style-type: none"> - 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: <ul style="list-style-type: none"> - 1 X 5m coaxial cable - 1 X Dome antenna bracket
KLK-I0150	LTE antenna kit, including: <ul style="list-style-type: none"> - 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: <ul style="list-style-type: none"> - 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.

END OF DOCUMENT

Classification	This document is the strict property of Kerlink and shall not be either copied nor sent without express written authorization of Kerlink	
Internal Use	Kerlink m2m technologies reserved rights	
Confidential	Kerlink – 1 rue Jacqueline Auriol – 35235 THORIGNÉ-FOUILLARD	Page 221 / 221
Strict confidential		