

Orthogon Systems

OS Spectra

and then there's
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There's non-line-of-sight...

There's line-of-sight...

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OS-Spectra 58100 System User Manual

February 15th, 2005

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Compliance

General

Changes or modifications not expressly approved by Orthogon Systems could void the user's authority to operate the system.

The frequency band in which the system operates is 'unlicensed' and the system is allowed to be used provided it does not cause interference. Further, it is not guaranteed protection against interference from other products and installations.

The system has basically been shown to comply with the limits for emitted spurious radiation for a Class B digital device¹, pursuant to Part 15 of the FCC Rules in the USA as well as comparable regulations in other countries. These limits have been designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

¹ Class B Digital Device, A digital device that is marketed for use in a residential environment notwithstanding use in commercial, business and industrial environments.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the Outdoor Unit (ODU).
- Increase the separation between the equipment and ODU.
- Connect the equipment into a power outlet on a circuit different from that to which the receiver is connected.

Consult the dealer or an experienced radio/TV technician for help.

Deployment and Operation

The Radio Regulations of various countries limits constrains the operation of radio products generally. In particular, at 5.8GHz, the local regulator may limit the amount of conducted or radiated transmitter power and may require registration of the radio link.

The power transmitted by the OS-Spectra product is controlled by the use of Region-specific Licence Keys.

Contact your supplier/installer to ensure that the product has achieved Type Approval and is set to the correct licence key for your country/region and to ensure that you have fulfilled all local regulatory requirements.

Disclaimer

The parameters quoted in this document must be specifically confirmed in writing before they become applicable to any particular order or contract. The company reserves the right to make alterations or amendments to the detail specification at its discretion. The publication of information in this document does not imply freedom from patent or other rights of Orthogon Systems or others.

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1 Getting Started



1.1 For Your Safety

CAUTION Users and installers should note that the mains power supply is the primary disconnect device.

WARNING Use extreme care when installing antennas near power lines.

WARNING Use extreme care when working at heights.

CAUTION When the system is operational, avoid standing directly in front of the antenna. Strong RF fields are present when the transmitter is on. The Outdoor Unit (ODU) must not be deployed in a location where it is possible for people to stand or walk inadvertently in front of the antenna.

WARNING The OS-Spectra Outdoor unit must be properly grounded to protect against lightning. It is the user's responsibility to install the equipment in accordance with Section 810 of the National Electric Code, ANSI/NFPA No.70-1984 or Section 54 of the Canadian Electrical Code. These codes describe correct installation procedures for grounding the outdoor unit, mast, lead-in wire and discharge unit, size of grounding conductors and connection requirements for grounding electrodes. It is recommended that installation of the outdoor unit be contracted to a professional installer.

CAUTION Safety will be compromised if external quality cables are not used for connections that will be exposed to the weather.

CAUTION Safety will be compromised if a different power supply is used than the one supplied by Orthogon as part of the system.

1.2 Welcome

Congratulations on the purchase of the OS-Spectra systems from Orthogon Systems. The OS-Spectra is the latest innovation in high-speed wireless networking that lets you deploy wireless networks in areas previously unattainable.

1.2.1 About This Guide

This guide covers the installation, commissioning, operation and fault finding of the OS-Spectra system.

1.2.2 Who Should Use This Guide

The guide is for use by the system installer and the end user IT professional. The system installer will require expertise in the following areas:

- Outdoor radio equipment installation
- Network configuration
- Use of web browser for system configuration, monitoring and fault finding

1.2.3 Contact Information

Postal Address:	Orthogon Systems, Unit A1, Linhay Business Park, Eastern Road, Ashburton, Devon. TQ13 7UP United Kingdom
Telephone Enquiries:	+44 (0) 1364 655500
Fax Enquiries:	+44 (0) 1364 654625
Web Site:	http://www.orthogonsystems.com/
Sales Enquires:	mailto:sales@orthogonsystems.com
North American:	mailto:usainfo@orthogonsystems.com
International:	mailto:globalinfo@orthogonsystems.com
Web Support:	http://www.orthogonsystems.com/
Email Support:	mailto:support@orthogonsystems.com

Table 1 - Contact Information

Comments or suggestions concerning this user manual may be emailed to the support team.

1.2.4 Repair and Service

For unit repair or service, contact your service provider or an authorised Orthogon Systems distributor for return material authorisation (RMA) and shipping instructions.

1.3 Product Description

This User Manual is specifically written for the OS-Spectra platform and the 58100 software load.

The OS-Spectra has been developed to provide Point-to-Point data connectivity via a 5.8 GHz wireless Ethernet bridge operating at broadband data rates. The OS-Spectra is aimed at enterprises that have a requirement to connect together the Local Area Network (LAN) of two or more buildings. Figure 1 illustrates such a deployment.

The OS-Spectra offers true non-Line-Of-Sight (NLOS) operation by using a combination of Orthogonal Frequency Division Multiplex (OFDM) modulation and Multi-Beam Space Time Coding (STC) techniques. These technologies enable the OS-Spectra to drive through foliage and around buildings to such an extent that almost universal coverage can be expected at short range.

The OS-Spectra consists of a pair of identical devices that are deployed one at each end of the link. At install time the user sets up one unit as the Master and the other as the Slave. Either unit can be configured as master or slave.

Each end of the link consists of:

- An integrated outdoor transceiver unit containing all the radio and networking electronics hereafter referred to as the Outdoor Unit (ODU).
- An indoor connection box containing a mains power supply and status indicators. Hereafter referred to as the OS-Spectra Power Indoor Unit (SPIDU).
- Units will normally be supplied pre-configured as a link.

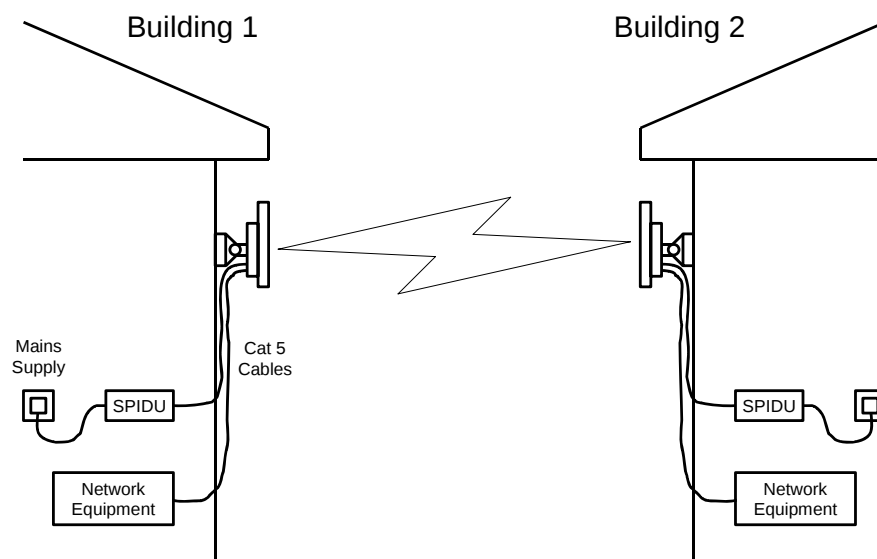


Figure 1 - Typical OS-Spectra Deployment

Power is fed into the SPIDU from the mains via a standard IEC mains plug. Connections between the ODU and SPIDU and between the ODU and Network Equipment are made using standard CAT 5 UV resistant cable.

1.3.1 The Outdoor Unit (ODU)

The ODU (Figure 2) is a self-contained unit. It houses both radio and networking electronics. The current version of OS-Spectra requires two cables; one to supply power and one to connect the unit to the users Network Equipment. The OS-Spectra ODU should only be deployed using the supplied OS-Spectra Power Indoor Unit (SPIDU).



Figure 2 - OS-Spectra Outdoor Unit (ODU)

1.3.2 The OS-Spectra Power Indoor Unit

The OS-Spectra Power Indoor Unit (SPIDU) is used to generate the ODU supply voltage from the mains supply. The SPIDU also houses a status indicator driven from the ODU. The SPIDU is connected to the ODU via a Cat 5 cable using standard RJ45 wiring. The cable conductors are allocated as shown in Table 2 - SPIDU to ODU Power Cable Pin Out.



The pin out used in this version of OS-Spectra is not standard PoE (Power over Ethernet). Care should be taken not to connect equipment other than a OS-Spectra ODU to a SPIDU as equipment damage may occur. The SPIDU is not compatible with and OS-Gemini PIDU.

Pin Number	Conductor Colour	Usage
1	Orange/White	0V
2	Orange	
3	Green/White	
4	Blue	+55V & LED Control
5	Blue/White	
6	Green	0V
7	Brown/White	+55V
8	Brown	

Table 2 - SPIDU to ODU Power Cable Pin Out

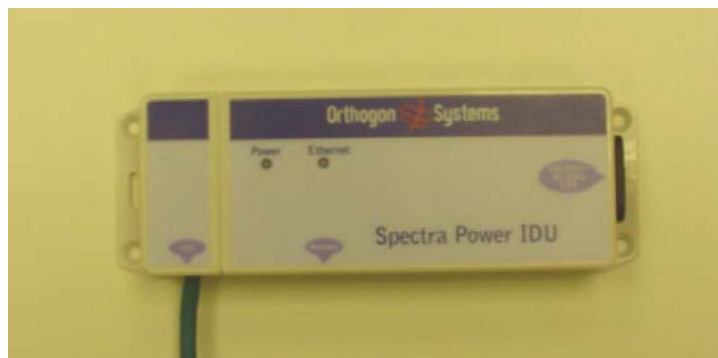


Figure 3 - OS-Spectra Power Indoor Unit (SPIDU)

The front panel contains indicators showing the status of the power and Ethernet connections.

The power indicator is illuminated when the SPIDU is receiving mains power.

The Ethernet indicator normally illuminates when the Ethernet link is working; Flashing when there is Ethernet activity; the fact that it lights also indicates that the ODU is powered. At power up the LED will flash 10 times to indicate that a correct start up sequence has occurred. See Section 6 for further fault finding information.

The bottom of the SPIDU an entry point for SPIDU/ODU cabling and the recovery switch.

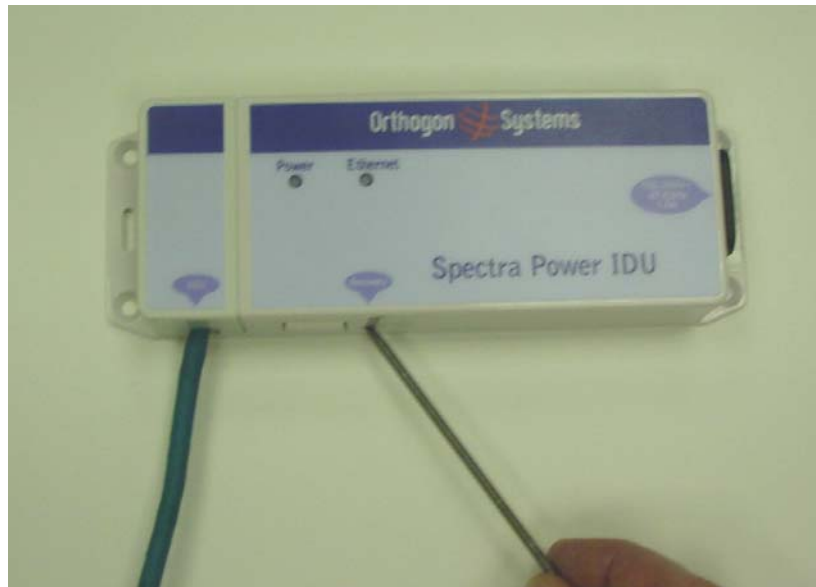


Figure 4 - OS-Spectra Recovery Switch Location

The recovery switch is used to recover the unit from configuration errors or software image corruption. To put an OS-Spectra unit into recovery mode the recovery switch should be depressed then the power applied. The recovery switch should be kept depressed for between 10 to 20 seconds after the power has been applied. Full instruction on the recovery mode can be found in section 7 “Recovery Mode”.

A simple reset can be performed by removing and re-applying the mains power to the SPIDU.

1.3.3 SPIDU Mains Power

The SPIDU incorporates a mains power supply which is converted to supply the non-standard Power Over Ethernet (POE) output by the SPIDU. The input supply range for the powers supply is 90V-264V AC, 47-63Hz.



Figure 5 - OS-Spectra SPIDU Power Input

1.3.4 Cables and Connectors

The cables used to connect the SPIDU to the ODU and the ODU to the users Network Equipment can be any standard CAT 5 type provided that it is suitable for outdoor deployment. Orthogon Systems recommends that cables to the specification below be used.

NEC/CEC: CMR (ETL) C (ETL) 75C SUN RES OIL RES II

Failure to use the recommended (or equivalent) standard of cable may invalidate the system's safety certification.

The SPIDU/ODU cable may be unscreened (UTP) or screened (STP). However, unscreened cables reduce the system's ability to cope with nearby lightning strikes. If lightning activity is common in the area of deployment, the use of screened cable is highly recommended. See Section 10 "Lightning Protection".

The ODU network connection implements automatic MDI/MDI-X sensing and pair swapping allowing connection to another piece of networking equipment or directly to end user equipment.

1.3.5 Surge Arrestor



The SPIDU does not provide lightning or surge suppression. Should lightning or surge suppression be required a separate Ethernet surge suppressor should be used and appropriately earthed. Suitable surge suppressors can be sourced from your Orthogon Systems distributor or reseller. The ODU is protected by built-in surge suppression as standard. See 10 "Lightning Protection".

1.3.6 Mounting Brackets

The OS-Spectra is supplied with a mounting bracket suitable for mounting the ODU to a pole of 25mm to 75mm in diameter. For more details on mounting, see section 5 “Installation”.

The bracket allows for adjustment in both azimuth and elevation. The bracket may be split allowing the pole mount section of the bracket to be mounted to the pole first. This allows the installer to take the weight of the unit and secure it one handed with a single mounting bolt.

The SPIDU can either be desk or wall mounted. The preference is wall mounted with the cables dressed to a cable channel. Wall mounting is achieved by screwing through the mounting lugs on either side of the unit. Remember to leave space for access to the reset button. See section 5.7.9.

1.3.7 Configuration and Management

Configuration and Management of the OS-Spectra is implemented using an inbuilt web server hosting a number of Configuration and Management web pages. This approach allows Configuration and Management to be carried out on any standard web browsing technology. The OS-Spectra can also be managed remotely using the SNMP management protocol. Connection to the OS-Spectra is via the Ethernet connection carrying the bridge network traffic. Connection to the unit is via a preset IP address. This address can be changed via the Network Interface Configuration web page. A full explanation of the available web pages and their use can be found in section 6 “Web Page Reference”.

1.4 Warranty

Orthogon Systems standard hardware warranty is for one (1) year from date of shipment from Orthogon or Distributor. Orthogon warrants that hardware will conform to the current relevant published specifications and will be free from material defects in material and workmanship under normal use and service. Orthogon shall within this time, at its own option, either repair or replace the defective product within thirty (30) days of receipt of the defective product. Repaired or replaced product will be subject to the original warranty period but not less than thirty (30) days.

Orthogon Systems warranty for software is for six (6) months from date of shipment from Orthogon or Distributor. Orthogon warrants that software will perform substantially in accordance with the published specifications for that release level of the software and will be free from material defects in material and workmanship under normal use and service. Orthogon shall within this time correct or replace software to correct significant, demonstrable program or documentation errors.

IN NO EVENT SHALL ORTHOGON SYSTEMS BE LIABLE TO YOU OR ANY OTHER PARTY FOR ANY DIRECT, INDIRECT, GENERAL, SPECIAL, INCIDENTAL, CONSEQUENTIAL, EXEMPLARY OR OTHER DAMAGE ARISING OUT OF THE USE OR INABILITY TO USE THE PRODUCT (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS OF BUSINESS PROFITS, BUSINESS INTERRUPTION, LOSS OF BUSINESS INFORMATION OR ANY OTHER PECUNIARY LOSS, OR FROM ANY BREACH OF WARRANTY, EVEN IF ORTHOGON SYSTEMS HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. (Some States in the USA do not allow the exclusion or limitation of incidental or consequential damages, so the above exclusion or limitation may not apply to you.) IN NO CASE SHALL ORTHOGON SYSTEMS' LIABILITY EXCEED THE AMOUNT YOU PAID FOR THE PRODUCT.

2 Product Architecture

The OS-Spectra consists of an identical pair of units deployed one at each end of the link. The radio link operates on a single frequency channel in each direction using Time Division Duplex (TDD). One unit is deployed as a master and the other as a slave. The master unit takes responsibility for controlling the link in both directions.

The non-Line-of-Sight (NLOS) aspects of the product are provided by multi-beam space time coding, coupled with Orthogonal Frequency Division Multiplex (OFDM) modulation with a dispersion capability of 10 microseconds in both directions.

The OS-Spectra has been developed to operate within license exempt frequency bands, for example the ETSI 5.8 GHz C band (5.725–5.850 GHz) and the USA 5 GHz ISM band (5.725-5.850 GHz). The OS-Spectra has been designed to coexist with other users of the band in an optimal fashion using a combination of Transmit Power Control (TPC), Spectrum Management functionality and Antenna beam shape.

In order to maintain link availability, the product employs adaptive modulation techniques that dynamically reduce the data rate in severe or adverse conditions. To the data network the OS-Spectra is implemented as a learning bridge. A learning bridge builds up a picture of which addresses are connected to which port. This means that it will not bridge a packet if it knows that the destination address is connected to the same port on which the bridge saw the packet. Figure 6 illustrates the OS-Spectra layer diagram.

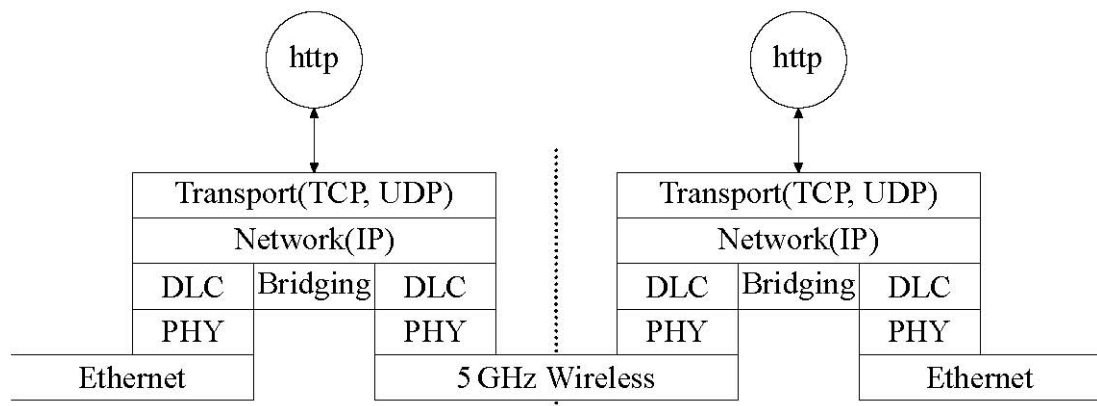


Figure 6 - OS-Spectra Layer Diagram

The OS-Spectra functionality has been extended to encompass the IEEE 802.1q sub specification IEEE 802.1p. IEEE 802.1p allows the Ethernet packets to be extended by 4 bytes to include the IEEE 802.1q VLAN Tag and VLAN Priority. The OS-Spectra will forward all VLAN tagged packets regardless of the VLAN ID value.

Each unit in the link is manageable through an IP connection. Standard IP protocols are utilised for all management functions e.g. HTTP, SNMP, etc.

The OS-Spectra is fully software upgradeable. New software images are first download from the Orthogon Systems website <http://www.orthogonsystems.com> to a convenient computer. The image is then uploaded to the ODU via the web management page described in section 0 “Software Upgrade”. The compressed image is first loaded into RAM and check-summed. If the compressed image transfer has completed successfully the image is decompressed and written to Flash memory. On completion of this process the unit can be rebooted to use the newly uploaded image. Should this process fail the unit will revert to a protected compressed image installed during manufacturing to allow the unit to be recovered.

3 General Considerations

3.1 Frequency Planning

The OS-Spectra operates over the frequency range 5.725 to 5.850 GHz (defined as the USA ISM band and the ETSI 5 GHz C band), utilising a 30 MHz wide channel. Setting of the operating frequency channel is automatic and is carried out by the built in Dynamic Frequency Selection (DFS) functionality.

The user can configure the OS-Spectra to avoid using certain frequencies to prevent interference to other users of the band and prevent operation in parts of the band containing interference. The use of this functionality is described in detail in section 6.3.8 “Spectrum Management”.

3.2 Distance

The OS-Spectra will operate at ranges from 100 m to 200 km, this within 4 modes 0-5km, 0-40km, 0-100km and 0-200km. Operation of the system will depend on obstacles in the path between the units. Operation at 40 km or above will require a near Line-of-Sight path. Operation at 100m could be achieved with one unit totally obscured from the other unit, but with the penalty of transmitting at higher power in a non-optimal direction, thereby increasing interference in the band. This subject is covered in more detail in section 4.1.3 “Path Loss Considerations”.

3.3 Networking Information

The OS-Spectra operates as a transparent Ethernet bridge. Each unit requires an IP address. This IP address is for management purposes only and it plays no part in the operation of the system. IP addresses are assigned during initial configuration as described in section 5.2 “Installation Procedure”.

3.4 Lightning Protection

The amount of lightning protection is dependent on regulatory requirements and the end user requirements. The standard OS-Spectra ODU is fitted with surge limiting circuits and other features to minimize the risk of damage due to nearby lightning strikes. These standard features may require some additional equipment to be configured as part of the system installation to be fully effective. Orthogon Systems recommends the use of screened cable and surge arrestor to protect connected equipment from nearby strikes.

Note: The OS-Spectra is not designed to survive direct lightning strikes. For this reason the unit should not be installed as the highest point in a localised area, unless specific precautions are taken. See section 10 “Lightning Protection”.

3.5 Electrical Requirements

The OS-Spectra is supplied with a variable input voltage (90-264V, 47-63Hz AC) inline power supply unit which is incorporated into the Power Indoor Unit (SPIDU). The OS-Spectra requires one mains supply outlet at each end of the link.

4 Site Planning

4.1 Site Selection Criteria

The following are guidelines for selecting the installation location of the OS-Spectra ODU and SPIDU.

4.1.1 ODU Site Selection

When selecting a site for the ODU the following should be taken into consideration:

- That it is not possible for people to stand or walk inadvertently in front of the antenna.
- Height and location to achieve the best radio path
- Height in relation to other objects with regard to lightning strikes
- Protection from the weather
- Aesthetics and planning permission issues
- Distance from SPIDU and connected equipment (Maximum cable run ODU to connected equipment is 100m)
- Distance from the SPIDU to the ODU (Maximum cable run SPIDU to ODU is 100m)

4.1.2 SPIDU Site Selection

When selecting a site for the SPIDU the following should be taken into consideration:

- Availability of a mains electricity supply
- Accessibility for viewing status indicators and pressing reset switch (See section 1.3.2 “The Power Indoor Unit (SPIDU)” and section 6 “Fault Finding”)
- Distance from ODU and network equipment (Maximum cable run ODU to connected equipment is 100m)
- Distance from the ODU to the SPIDU (Maximum cable run ODU to SPIDU is 100m)

4.1.3 Path Loss Considerations

The path loss is the amount of attenuation the radio signal undergoes between the two ends of the link. The path loss is the sum of the attenuation of the path if there were no obstacles in the way (Free Space Path Loss), the attenuation caused by obstacles (Excess Path Loss) and a margin to allow for possible fading of the radio signal (Fade Margin).

$$L_{free_space} + L_{excess} + L_{fade} + L_{seasonal} < L_{capability}$$

Where

L_{free_space}	Free Space Path Loss (dB)
L_{excess}	Excess Path Loss (dB)
L_{fade}	Fade Margin Required (dB)
$L_{seasonal}$	Seasonal Fading (dB)
$L_{capability}$	Equipment Capability (dB)

Equation 1 - Path Loss

4.1.4 Aggregate Ethernet throughput rate v maximum link loss

The equipment capability is given in Table 3. It gives the Ethernet throughput rate vs link loss for OS-Spectra in both modes. Adaptive modulation will ensure that the highest throughput that can be achieved instantaneously will be obtained taking account of propagation and interference. The calculation of Equation 1 needs to be performed to judge whether a particular link can be installed. When the link has been installed web pages provide information about the link loss currently measured by the equipment both instantaneously and averaged. The averaged value will require maximum seasonal fading to be added and then the radio reliability of the link can be computed.

Aggregate Ethernet Throughput Rate (Mbps) ²				Maximum path budget ³ (dB)
Mode				
0-5km	0-40km	0-100km	0-200km	
12.98	10.16	7.34	5.07	164.0
25.96	20.33	14.69	10.04	160.7
51.90	40.67	29.37	20.08	153.4
103.80	81.35	58.75	40.15	149.3
186.76	146.36	105.71	72.25	139.1
269.9	211.51	152.76	104.43	130.6

Table 3 - Aggregate Ethernet throughput rate v maximum link loss

The full calculation is relatively complicated and thus Orthogon Systems have supplied a link estimator that calculates the radio propagation and reliability of NLOS links using the OS-Spectra equipment.

² Throughput based on 1518 Byte Ethernet Packets on a symmetrical link.

³ Does not include AMOD link margin of 2 dB or 5 dB depending on channel conditions

5 Installation

Orthogon Systems recommends that only qualified personnel undertake the installation of an OS-Spectra system.

5.1 Preparation

Before proceeding with the installation you should:

- Check the contents of all packages against the parts lists shown in the packing list.
- Ensure that you have the correct tools for the job.
- Ensure that you are qualified to undertake the work.
- Ensure that you have taken the correct safety precautions.
- Have completed the site planning as described in section 4 “Site Planning”.

5.2 Installation Procedure

The OS-Spectra installation procedure consists of the following steps:

- Mounting the ODUs, section 5.6
- Connecting up, section 5.6.1
- Mounting the SPIDUs, section 5.7.9
- Powering Up, section 5.7.10
- Aligning the ODUs, section 5.7.11

5.3 Tools Required

The following specific tools are required to install the OS-Spectra in addition to general tools:

- Two 13mm Spanners / Wrenches
- RJ45 Crimp Tool
- IBM Compatible Personal Computer (PC) running Windows 98 or later with 10 or 100baseT Ethernet (Ability to change IP settings easily is recommended)
- Either Internet Explorer version 6 or higher, or Netscape Navigator 7.01 or higher are recommended.
- 2 x short Ethernet patch cables
- 6mm general purpose crimp tool for the grounding lug (optional for lightning Protection)

5.4 Installation Support

Online installation support and contact details for your regional support can be found at <http://www.orthogonsystems.com/>

A Frequently Asked Questions (FAQ) section can be found in section 12.8.

5.5 Legal Disclaimer

IN NO EVENT SHALL ORTHOGON SYSTEMS BE LIABLE FOR ANY INJURY TO ANY PERSONS OR ANY DAMAGE CAUSED DURING THE INSTALLATION OF THE ORTHOGON SYSTEMS OS-Spectra PRODUCT.

5.6 Mounting the ODU_s

The ODU mounting bracket is designed to ease installation by fixing the bracket to a pole and then bringing the ODU into position using a single bolt fixing. The ODU should be mounted using the following steps ensuring that the cable entry is at the bottom.

The ODU mounting bracket is design to work with poles with diameters in the range 1" (25mm) to 3" (75mm). For poles less than 2" in diameter the back of the bracket should be inverted as shown in the following steps.

The enclosure and mounting brackets of the OS-Spectra product range are capable of withstanding wind speeds up to 151mph (242kph). The installer should ensure that the structure the OS-Spectra is fixed to is also capable of withstanding the prevalent wind speeds and loads. See Section 11 "Wind Loading".

5.6.1 Pole Mounting (Pole diameter greater than 2" (50mm))



Step 1: Mount the bracket to the pole.



Step 2: Mate the unit to the bracket together and tighten the nut and bolt.

5.6.2 Pole Mounting (Pole diameter less than 2" (50mm))



Step 1: Mount the bracket to the pole.



Step 2: Mate the unit to the bracket together and tighten the nut and bolt.

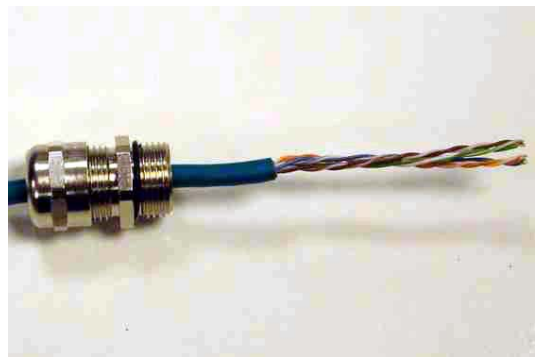
5.7 Connecting Up

5.7.1 Preparing The Cables — RJ45 connections

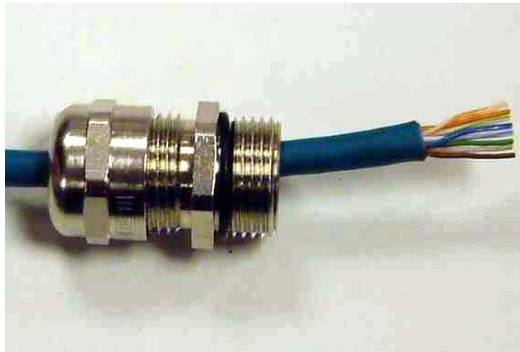
Cables can be purchased from your reseller or distributor in lengths up to 60m. (Note that the maximum length of the power cable between the SPIDU and ODU is 100m and the maximum length of the network cable is 100m from the ODU to the Network equipment.) Those wishing to source their own cables and connectors (see section 1.3.4 “Cables and Connectors” above) should follow the following instructions along with the cable and connector suppliers instructions:



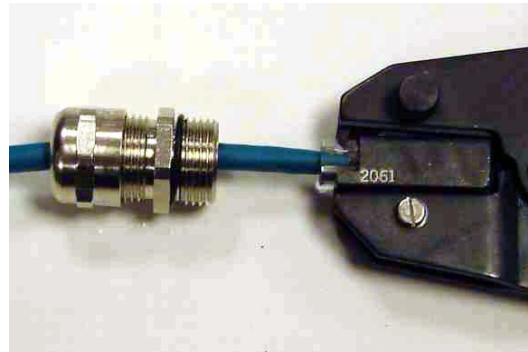
Step 1: Assemble gland Step on cable as shown



Step 2: Strip the outer insulation



Step 3: Arrange conductors as shown in Figure 8 and cut to length



Step 4: Insert conductors and crimp



Figure 7 - Completed ODU connector

Both ends of the ODU cable are terminated in the same way. The above procedure should be repeated for the SPIDU end of the cable when the cable routing process is complete.

Note: The SPIDU end of the cable does not employ a cable gland.

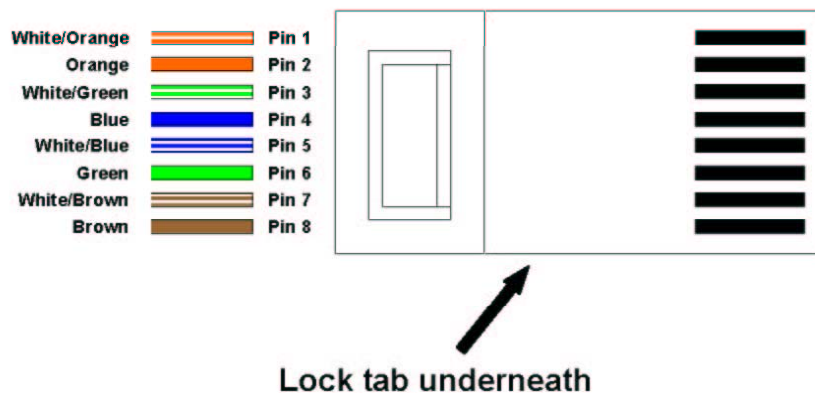


Figure 8 - RJ45 Pin Connection

5.7.2 Making the Connections at the ODU

This initial version of OS-Spectra requires separate power and network connections.



Care must be taken to ensure that the power and network connections are not swapped over or equipment damage may occur.

Looking at the back of the unit with the cable entry at the bottom. The power connection is the second hole from the left and the Network connection the first hole on the right.

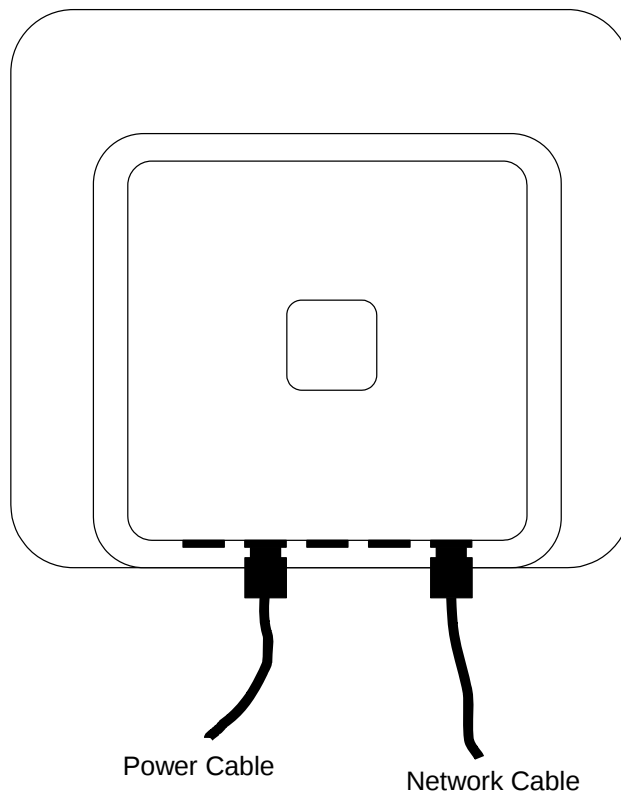


Figure 9 - Power and Network Connections

5.7.3 Making the Power Connection At The ODU

The following procedure describes how connection is made at the ODU. It is often easier to carry out this procedure on the ground or a suitable surface prior to mounting the ODU.

Ensure no power is connected to the SPIDU or present on the cable before connecting the ODU.



Step 1: Assemble the cable as described in 5.7.1 above



Step 2: Insert the RJ45 connector making sure that the locking tab snaps home



Step 3: Screw in the body of the weather proofing gland and tighten



Step 4: Screw on the clamping nut and tighten

Should it be necessary to disconnect the SPIDU to ODU cable at the ODU this can be achieved by removing the weather proofing gland and depressing the RJ45 locking tab with a small screwdriver as shown below:

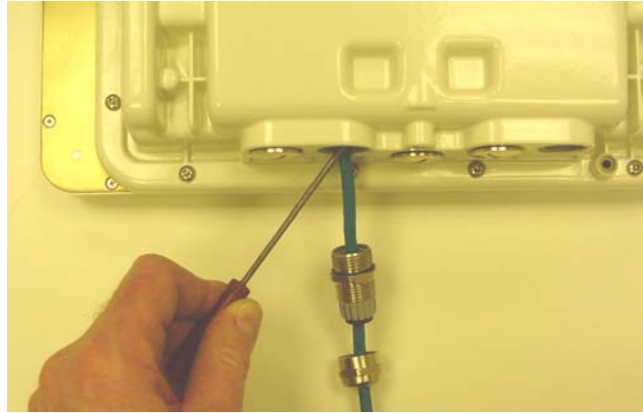


Figure 10 - Disconnecting the ODU



Warning: Ensure that power is removed from the system at the SPIDU to prevent damage to the ODU whilst making or breaking the connection.

5.7.4 Making the Network Connection At The ODU

The same procedure detailed above for the power connection should be followed the Network connection.



Care should be taken to ensure that the power and network connections are not swapped as equipment damage may occur.



Figure 11 - Making the Network Connection

5.7.5 Routing the Cable

After connecting the cable to the ODU it can be routed and secured using standard cable routing and securing techniques. When the cable is in place it can then be cut to the desired length at the SPIDU prior to connection to the SPIDU.

5.7.6 Fitting A Surge Arrestor

If you have opted to fit a Surge Arrestor, this should be installed by following the manufacturers instruction. For recommended types see Section 10 “Lightning Protection”

5.7.7 Grounding The Installation

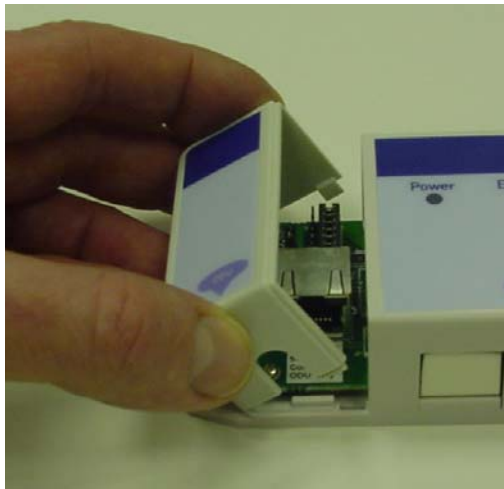
The OS-Spectra Outdoor unit must be properly grounded to protect against power surges. It is the user's responsibility to install the equipment in accordance with Section 810 of the National Electric Code, ANSI/NFPA No.70-1984 or Section 54 of the Canadian Electrical Code or the National Electrical Code in the country of installation. These codes describe correct installation procedures for grounding the outdoor unit, mast, lead-in wire and discharge unit, size of grounding conductors and connection requirements for grounding electrodes. It is recommended that installation of the outdoor unit be contracted to a professional installer. See Section 10 “Lightning Protection” for recommended grounding kits.

5.7.8 Making the Connection At The SPIDU

The ODU is connected to the SPIDU by means of a concealed RJ45 connector. The RJ45 connection has been placed inside the SPIDU removable cover to prevent the user inadvertently plugging other equipment into the ODU RJ45 socket.



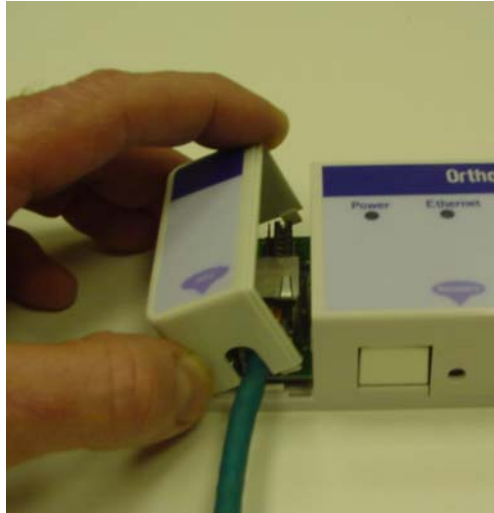
Warning: Plugging other equipment into the ODU RJ45 socket may damage the equipment due to the non-standard Power-over-Ethernet techniques employed. Plugging the ODU into other equipment may damage the ODU and/or the other equipment.



Step 1: Remove the cover by squeezing the sides and rotating away from the SPIDU.



Step 2: Plug in the ODU to SPIDU Cable ensuring that it snaps home



Step 3: Replace the cover ensuring it is firmly latched

5.7.9 Mounting The SPIDU

This step is optional. Orthogon Systems recommends that you mount the SPIDU on a wall or other suitable mounting surface. This prevents the unit from being knocked or kicked and can help maintain link availability. Ensure that the reset switch can be accessed when mounting the unit.



Step 1: Fix the SPIDU to the wall using the lugs provided.



Step 2: Make connections as per Section 5.7.8

5.7.10 Powering Up

The OS-Spectra system is supplied as a pair of matched Master/Slave units. The Master unit to be configured can now be powered up and accessed using the default URL <http://10.10.10.11/>; the Slave unit can be accessed using <http://10.10.10.10/>.

Prior to powering up the OS-Spectra, a computer with web browsing capabilities should be configured with an IP address of 10.10.10.n and subnet mask of 255.0.0.0 where n is any value between 1 and 254 but excluding 10 or 11. If the default address of the unit 10.10.10.10/11 clashes with an address you are already using on your LAN, or you are not sure, you should set up an isolated LAN. As the LAN connection presented at the SPIDU has a default configuration as a hub/switch (and auto-sensing MDI/MDIX cross over is employed) connection can be made directly to the computer using a standard CAT 5 patch cable.

Before physical installation takes place the units to be installed should be set up as described in the section 6.3.5. This process will give the installer the opportunity to set the units IP address to one that is in the desired address range and set each unit up with the MAC address of its peer unit ready to establish a radio link. It is recommended that this procedure be carried out on the bench before physical installation commences. Providing it is safe to do so the installer should take the process to the point where a radio link is established before proceeding to the installation site.

5.7.11 Aligning the ODUs

The following is a description of the steps taken to establish a radio link between the two units forming the bridge and align the units for the best signal strength.

OS-Spectra uses audible tones during installation to assist the installer with alignment. The installer should adjust the alignment of the ODU in both azimuth and elevation until highest pitch tone is achieved⁴. The tones and their meanings are as follows:

State Name	Tone Description	State Description	Pitch Indication (Higher pitch = higher power)
Band Scan	Regular beep	Executing band scan	N/A
Scanning	Slow broken tone	Not demodulating the wanted signal	Rx Power
Synchronised	Fast broken tone	Demodulating the wanted signal	Rx Power
Registered	Solid tone	Both Master and Slave units exchanging Radio layer MAC management messages	Rx Power

Table 4 - Audio indications from the ODU

The term 'wanted signal' refers to that of the peer unit being installed.

In each of the states detailed above the unit should be aligned to give the highest pitch tone. It should be noted that if, when in the Synchronised or Registered state the tone varies wildly, you may be suffering from interference or a fast fading link. Installing in this situation may not give a reliable link. The cause of the problem should be investigated.

For the ease of alignment both Master and Slave units use the install tones in the same way but with some small behavioral differences. This allows the installer to install the Slave unit first and carry out the initial alignment with the Master unit if desired. However due to the Behavioral differences of Master and Slave units it is recommended that the Master unit is installed first and the initial alignment carried out at the Slave unit.

The following behavior should be noted:

When first started up and from time to time the Master unit will carry out a band scan to determine which channels are not in use. During this time, between 10 and 15 seconds, the Master unit will not transmit and as a consequence of this neither will the Slave unit. During

⁴ The pitch of the alignment tone is proportional to the power of the 5.8 GHz wireless signals. The best results are usually achieved by making small incremental movement in angular alignment.

this time the installation tone on the master unit will drop back to the band scan state and the Slave unit will drop back to Scanning state with the pitch of the tone set be the background noise level. Alignment of the unit should cease during this time.

The master unit can take between 10 seconds in 0-5km mode to 60 seconds in 0-130km mode to determine the range of the link being installed⁵. The Master unit will remain in the Scanning state until the range of the link has been established. The Master unit will only move to the Synchronized state when the range of the link has been established.

If at the end of the ranging period the Registered state is not achieved due to interference or other reasons, the Master unit will retry twice more on the same channel before moving to another available channel. Should this occur it might take a number of minutes to establish a link in the Registered state.

The Slave unit does not have a ranging process. The slave unit will change to the Synchronized state as soon as the wanted signal is demodulated.

When the alignment process is complete the installer **MUST REMEMBER TO DISARM BOTH UNITS** in the link as described in section 6.3.5. This is necessary for the following:

- Turn off audible alignment aid.
- Enable Adaptive Modulation
- Fully enable Dynamic Frequency Selection⁶
- Clear unwanted installation information from the various systems statistics
- Store the link range for fast link acquisition on link drop
- Enable Higher Data Rates

⁵ If the unit is operating in region 4 (the UK) the mandatory radar avoidance algorithms may affect the ranging behaviour for the OS-Spectra. The Master has to monitor the initially chosen channel for 60 seconds to make sure it is clear of radar signals before transmitting. If a radar is detected during any of the installation phases a further compulsory 60 seconds channel scan will take place as the master unit attempts to locate a new channel that is free of radar interference.

⁶ Full Dynamic Frequency Selection is not available in region 4 (the UK).

6 Web Page Reference

The web user interface has three main sections. The home page presents to the operator a high level summary of the OS-Spectra wireless link. The status page presents a more detailed set of system parameters describing the performance of the wireless link together with other key system performance metrics. The final section is the system administrator section. This section is password protected and allows the OS-Spectra administrator to perform all the day-to-day administrative procedures, e.g. Software Upgrade and perform configuration changes.

The following subsections give a detailed usage guide for all the web user interfaces. All the web pages are best viewed using a screen resolution of at least 1024 x 768 pixels on a PC using Microsoft Internet Explorer Version 6⁷.

The navigation bar on the left hand side of the web page is used to move between the various management pages. The currently selected page is always highlighted with a dark blue background. The menu is hierarchical selecting any menu item which has associated submenu options will automatically display all sub options. An example webpage with the navigation menu is shown in Figure 12 when the 'Home' Link is highlighted as the current page.

6.1 Home Page

The OS-Spectra home page has been designed to display a high level summary of the status of the wireless link and associated equipment. The home page (Figure 12) normally displays four key system attributes:

Wireless Link Status The Wireless Link Status attribute as the name suggests displays the current status of the OS-Spectra wireless link. A state of 'Up' on a green background indicates that a Point-to-Point link is established. A state of 'Down' on a red background indicates that the wireless link is not established. If the link is down for an unknown reason the system administrator should first consult the status web page for a more detailed summary of up to date system diagnostics.

Link Name The link name attribute is a name and/or handle allocated by the system administrator to aid the identification of the unit, network or building.

⁷ The web pages have also been tested with Netscape Navigator version 7, Mozilla 1.6 and Mozilla Firefox 0.8. Other browsers may function correctly but have not been tested.

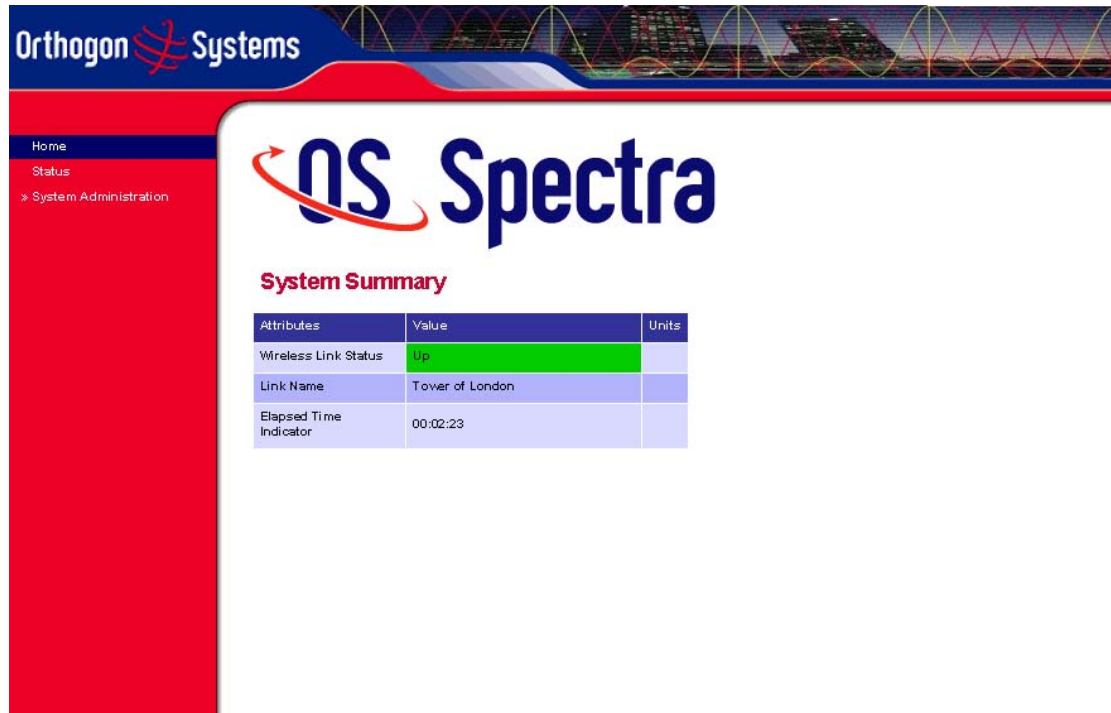


Figure 12 - OS-Spectra Home Page

Elapsed Time Indicator The elapsed time indicator attribute presents the total time in days, hours, minutes and seconds since the last system restart. The system can restart for several reasons, e.g. commanded reboot from the system reboot webpage, or a power cycle of the equipment.

System Clock If the SNTP (Simple Network Time Protocol) (see section 6.3.10.5) is enabled a system clock attribute is displayed giving the date and time of the last page refresh. If SNTP is disabled then the system clock attribute is not displayed on the home page.

6.1.1 Home Page Alarm Display

The home page is also used to display all outstanding major system alarms. Whenever system alarms are asserted a yellow warning triangle is displayed on webpage navigation bar. The warning triangle will be visible from all webpages. Clicking the warning triangle will cause the webpage to jump back to the system homepage. Figure 13 shows an example alarm screen.

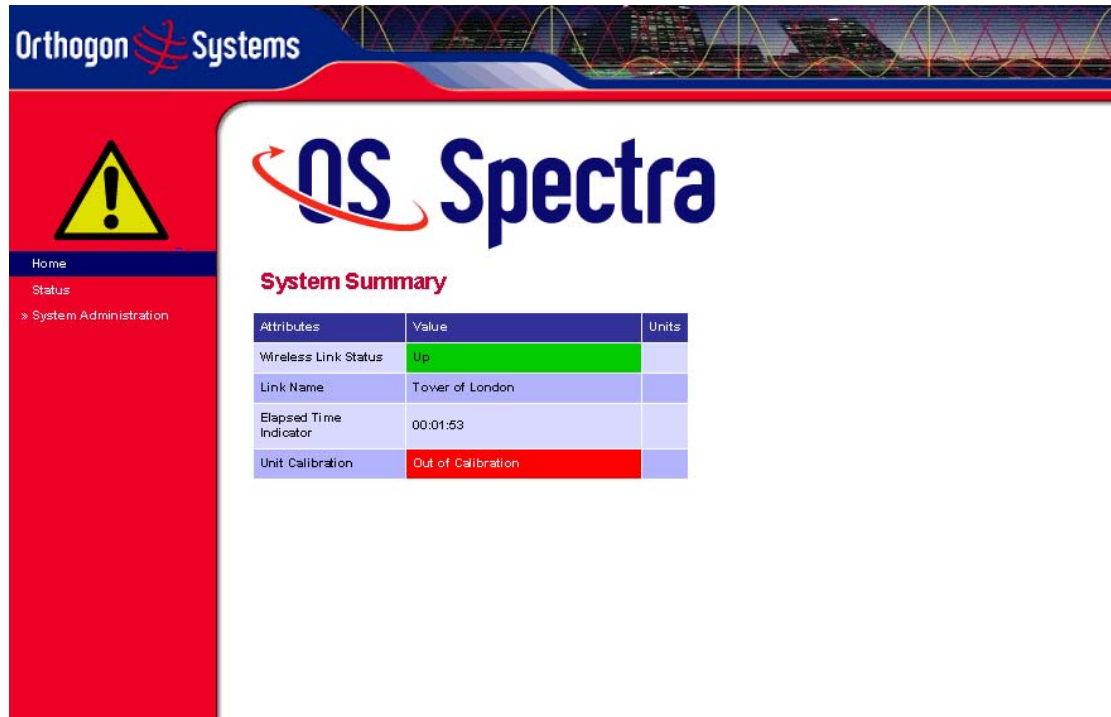


Figure 13 - Alarm Warning Triangle

The following major system alarms are defined:

Install Arm State The Install Arm State alarm is displayed. This alarm warns when a wireless unit is in installation mode. After installation the wireless unit should be disarmed. This will increase the wireless links data carrying capacity and stop the installation tone generator. The wireless link is disarmed from the 'Installation Wizard' see section 6.3.5.

Install Status If any errors are detected during the installation process, the unit will automatically raise an audible alarm. The install status alarm will be raised with an appropriate reason code, e.g. the alarm will be raised if an incorrect target MAC address is specified for the peer OS-Spectra wireless unit.

Encryption Is Not Configured On Both Units Encryption must be enabled on both ends of the Point-to-Point link before the over the air packets can be successfully decrypted. This error message is generated if encryption is not configured on both units.

Ethernet Link Status If there are any problems with the Ethernet interface this alarm will be asserted. This alarm will most likely seen if the unit has not got an Ethernet cable plugged into its Ethernet socket.

Master And Slave Have Incompatible Region Codes The OS-Spectra uses region codes to comply with local regulatory requirements governing the transmission of wireless signals in the 5.8 GHz band. Region codes can only be changed by obtaining a new OS-Spectra

license key. If this alarm is encountered the appropriate license keys from the country of operation should be obtained from your distributor. Applying license keys containing the same region codes to both ends of the link will remove the alarm.

Spectrum Management Channel Warning The alarms warns a user when the intelligent spectrum management feature can't find a suitable wireless channel. This alarm occurs when the signal assessment features of the OS-Spectra can't find a channel to operate on.

6.2 Systems Status Page

The status page has been designed to give the system administrator a detailed view of the operation of the OS-Spectra system from both the wireless and network perspectives.

The page is subdivided into three main categories Equipment, Wireless and Ethernet/Internet. The 'Equipment' section contains all the unit's inventory and identification information. The 'Wireless' section presents all the key wireless metrics displayed as a series of measurements and histograms. The 'Ethernet/Internet' section describes the unit's network identity and connectivity.

The status page can be configured to refresh itself at an operator defined rate (if the user is logged in a system administrator). The refresh period the page field defaults to is 3600 seconds and can easily be changed to refresh at any period between 2 seconds and 3600 seconds. Pressing the 'Update Page Refresh Period' button causes a new page refresh period to be adopted by the system. The page refresh mechanism uses a HTML Meta refresh command. Therefore the refresh is always initiated by the local browser and not by the OS-Spectra system at this interval.

The two OS-Spectra units are arranged in a master and slave relationship. The units role in this relationship is displayed in the page title. The master unit will always have the title '- Master', and the slave will always have the '- Slave' appended to the 'Systems Status' page title.

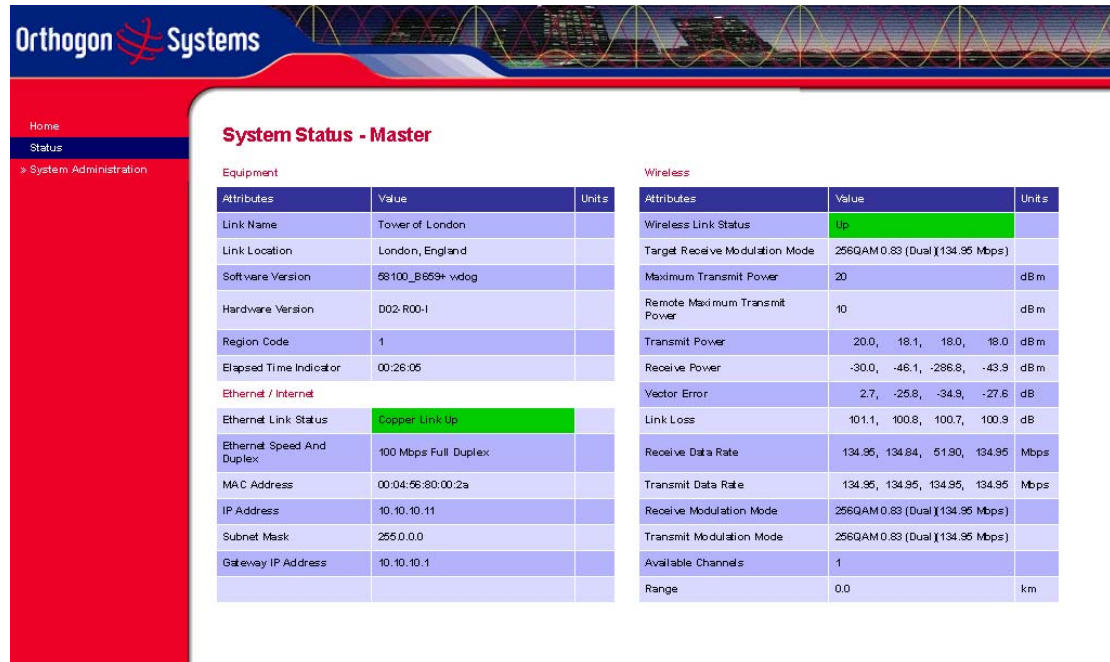


Figure 14 - Status Page

The following section details all the attributes displayed on the status page.:

Link Name The link name is allocated by the system administrator and is used to identify the equipment on the network. The link name attribute is to a maximum size of 63 ASCII characters.

Link Location The link location is allocated by the system administrator and can be used as a generic scratch pad to describe the location of the equipment or any other equipment related notes. The link location attribute is limited to a maximum size of 63 ASCII characters.

Software Version The attribute describes the version of software installed on the equipment. The format of the attributes is *PPPP-XX-YY* where *PPPP* is the product variant, *XX* is the major release version and *YY* is the minor release version.

Hardware Version The hardware version attribute contains all the combined hardware version information. The attribute is formatted as *DXX.-RYY-AZZ* where *DXX* contain the version of the digital card, *RYY* contains the version of the RF (radio frequency) card and *AZZ* describes the antenna type.

Region Code The region code is used by the system to constrain the wireless to operate within the 5.8 GHz regulatory regime of the particular country. The region code is encoded in the product licence key. If the operator wishes to change region code, a new licence key must be obtained from Orthogon Systems or the local distributor / system integrator.

Elapsed Time Indicator The elapsed time indicator attribute presents the total time in years, days, hours, minutes and seconds since the last system restart. The system can restart for several reasons, e.g. commanded reboot from the system reboot webpage, or a power cycle of the equipment.

Ethernet Link Status Current status of the Ethernet link. A state of 'Up' with a green background indicates that an Ethernet link is established. A state of 'Down' with a red background indicates that the Ethernet link is not established.

Ethernet Speed The negotiated speed of the Ethernet interface specified in Mbps.

Ethernet Duplex The negotiated duplex of the Ethernet interface.

Full Duplex Full Duplex data transmission means that data can be transmitted in both directions on a signal carrier at the same time. For example, on a local area network with a technology that has full duplex transmission, one workstation can be sending data on the line while another workstation is receiving data.

Half Duplex Half Duplex data transmission means that data can be transmitted in both directions on a signal carrier, but not at the same time. For example, on a local area network using a technology that has half duplex transmission, one workstation can send data on the line and then immediately receive data on the line from the same direction in which data was just transmitted.

MAC Address The Medium Access Control Layer (MAC) address is used to uniquely identify the equipment on an Ethernet network.

IP Address Internet Protocol (IP) address. This address is used by the family of Internet protocols to uniquely identify the unit on a network

Subnet Mask A subnet allows the flow of network traffic between hosts to be segregated based on a network configuration. By organizing hosts into logical groups, subnetting can improve network security and performance.

Gateway IP Address The IP address of a computer on the current network that acts as a gateway. A gateway acts as an entrance / exit to packets from / to other networks.

Wireless Link Status As the attribute name suggests displays the current status of the OS-Spectra wireless link. A state of 'Up' on a green background indicates that a Point-to-Point link is established. A state of 'Down' on a red background indicates that the wireless link is not established. If the link is down for an unknown reason the system administrator should first consult the status webpage for a more detailed summary of the prevailing system diagnostics.

Target Receive Modulation Mode The target modulation mode is used by the wireless subsystem to control the adaptive modulation algorithm. The mode is used by the OS-Spectra as an upper limit, the system will not move to a high rate modulation mode even if the signal / interference environment will support high rate modes.

Remote Transmit Maximum Power The maximum transmit power the remote wireless unit is permitted to use to sustain a link.

Transmit Power Transmit power histogram is expressed in dBm and presented as: max, mean, min, and latest. The histogram is calculated over a one hour period. If the equipment has been running for less than one hour then the histogram is calculated over the current elapsed time.

The data used to compute the histogram statistics can be downloaded in an ASCII command separated variable (CSV) format via the diagnostics download page, see section 6.3.11.

Receive Power Receive power histogram is expressed in dBm and presented as: max, mean, min, and latest. The histogram is calculated over a one hour period. If the equipment has been running for less than one hour then the histogram is calculated over the current elapsed time.

The data used to compute the histogram statistics can be downloaded in an ASCII command separated variable (CSV) format via the download diagnostics page, see section 6.3.11.

Vector Error The vector error measurement compares the received signal's In phase / Quadrature (IQ) modulation characteristics to an ideal signal to determine the composite error vector magnitude. The results are stored in a histogram and expressed in dB and presented as: max, mean, min and latest. The histogram is calculated over a one hour period. If the equipment has been running for less than one hour then the histogram is calculated over the current elapsed time. The expected range for Vector Error would be approximately 0dB (NLOS link operating at sensitivity limit on BPSK $\frac{1}{2}$) to -29dB (short LOS link running 64QAM $\frac{7}{8}$).

The data used to compute the histogram statistics can be downloaded in an ASCII command separated variable (CSV) format via the download diagnostics page, see section 6.3.11.

Link Loss The link loss is the total attenuation of the wireless signal between the two Point-to-Point units.

The data used to compute the histogram statistics can be downloaded in an ASCII command separated variable (CSV) format via the download diagnostics page, see section 6.3.11. The link loss calculation presented below:

$$P_{ll} = P_{T_x} - P_{R_x} + 2 \cdot (g_{T_x} + g_{R_x})$$

Where

P_{ll}	Link Loss (dB)
P_{T_x}	Transmit power of the remote wireless unit (dBm)
P_{R_x}	Received signal power at the local unit (dBm)
g_{T_x}, g_{R_x}	Antenna gain at the remote and local units respectively (dBi). The antenna gain of the OS-Spectra (23.5 dBi) is used unless one or both of the Gemini units is a Connectorised version. See Section 11.3 for more details

Equation 2 - Link Loss

Receive Data Rate The data rate in the receive direction, expressed in Mbps and presented as: max, mean, min, and latest histogram format.

The histogram is calculated over a one hour period. If the equipment has been running for less than one hour then the histogram is calculated over the current elapsed time.

The data used to compute the histogram statistics can be downloaded in an ASCII command separated variable (CSV) format via the download diagnostics page, see section 6.3.11.

Transmit Data Rate The data rate in the transmit direction, expressed in Mbps and presented as: max, mean, min, and latest histogram format.

The histogram is calculated over a one hour period. If the equipment has been running for less than one hour then the histogram is calculated over the current elapsed time.

The data used to compute the histogram statistics can be downloaded in an ASCII command separated variable (CSV) format via the download diagnostics page, see section 6.3.11.

Receive Modulation Mode The modulation mode currently being used on the receive channel. The number in brackets after the modulation mode and coding rate string is the effective data rate available to all MAC layer protocols.

The data used to compute the histogram statistics can be downloaded in an ASCII command separated variable (CSV) format via the download diagnostics page, see section 6.3.11.

Transmit Modulation Mode The modulation mode currently being used on the transmit channel. The number in brackets after the modulation mode and coding rate string is the effective data rate available to all MAC layer protocols.

The data used to compute the histogram statistics can be downloaded in an ASCII command separated variable (CSV) format via the download diagnostics page, see section 6.3.11.

Available Channels The available channels attribute describes the number of usable channels that have been measured by the Dynamic Frequency Selection (DFS) algorithm.

Range The range⁸ between the peer OS-Spectra units.

Refresh Page Period The Status page refreshes automatically according to the setting entered here (in seconds).

⁸ The OS-Gemini displays range in km by default, if the user would prefer to display range using Miles the 'Distance Units' attribute should be set to imperial, see the "Properties" webpage section 6.3.14

6.3 System Administration Pages

The following menu options are available for the system administrator and can be password protected. Figure 15 shows the system administration login page. By default a system admin password is not set. Simply click the login button to access the system administration features.

Once the password has been set using the 'Change Password' menu item the system administration pages will only be available after the user has entered the correct password.

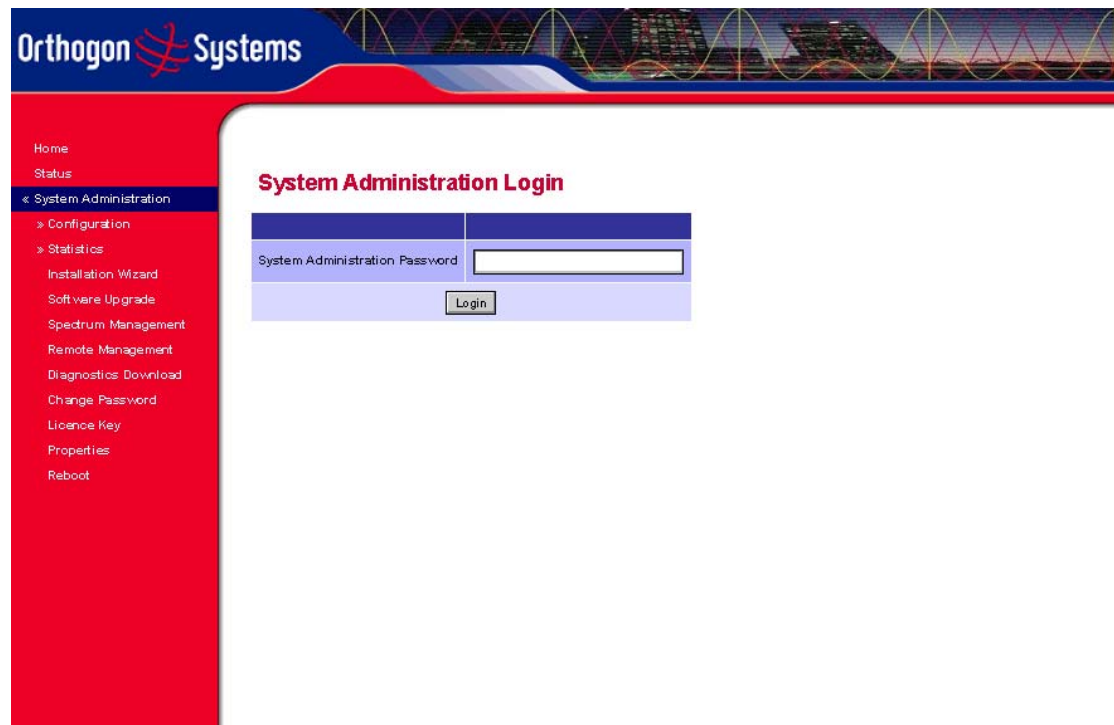


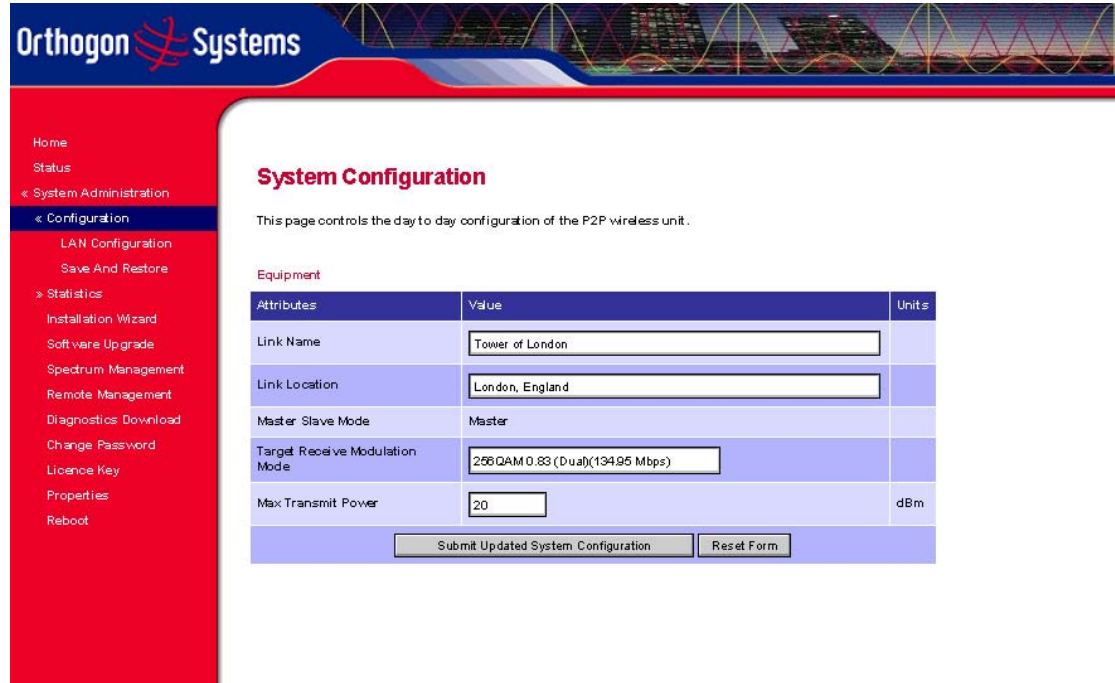
Figure 15 - System Administration Login Page

The features that are only available to the system administrator are:

- Configuration
- Statistics
- The Installation Wizard
- Software Upgrade
- Spectrum Management including DFS
- Remote management
- Downloadable Diagnostics
- Password Management
- Licence Key Management
- Properties
- System Reboot

6.3.1 System Configuration Page

The configuration page (Figure 16) is used by the system administrator to configure the OS-Spectra unit.



Attributes	Value	Units
Link Name	Tower of London	
Link Location	London, England	
Master Slave Mode	Master	
Target Receive Modulation Mode	256QAM 0.83 (Dual)(134.95 Mbps)	
Max Transmit Power	20	dBm

Figure 16 - System Configuration Page

Whilst the majority of the system configuration is entered during installation and should never require changing, this page offers the system administrator the ability to change the basic system parameters for both the wireless and Ethernet components.

Link Name User defined identity for the unit (max 63 characters).

Link Location Can be used as a generic scratch pad to describe the location of the equipment

Target Receive Modulation Mode This is the maximum mode the unit will use as its adaptive modulation. The modulation modes available are:

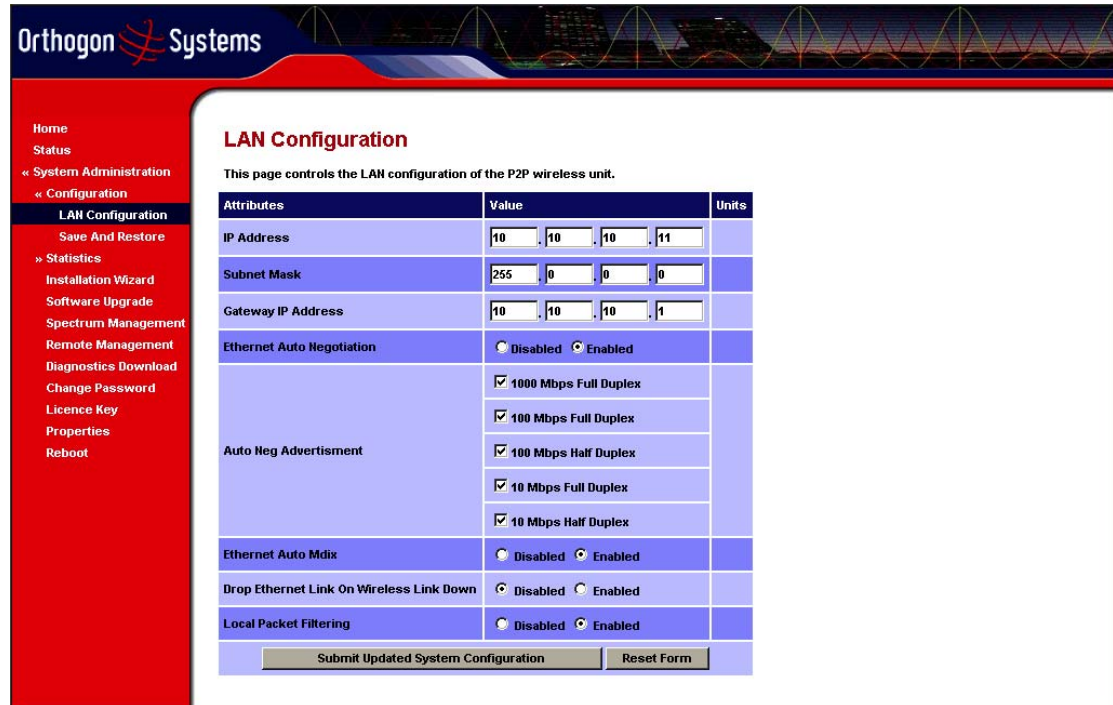
- BPSK 1 / 2
- QPSK 1 / 2
- QPSK 2 / 3
- 16QAM 1 / 2
- 16QAM 3 / 4
- 64QAM 2 / 3
- 64QAM 3 / 4
- 64QAM 7 / 8

By default the Target Receive Modulation Mode is 64QAM 7/8. The value in brackets shows the maximum unidirectional data for the current modulation / ranging mode combination.

Maximum Transmit Power This specifies the maximum transmit power in dBm of the system, it is country dependent and although the user can change this it will be limited to that country's regulations.

6.3.2 LAN Configuration Page

Blah



Attributes	Value	Units
IP Address	10 . 10 . 10 . 11	
Subnet Mask	255 . 0 . 0 . 0	
Gateway IP Address	10 . 10 . 10 . 1	
Ethernet Auto Negotiation	☐ Disabled ☒ Enabled	
Auto Neg Advertisement	☒ 1000 Mbps Full Duplex	
	☒ 100 Mbps Full Duplex	
	☒ 100 Mbps Half Duplex	
	☒ 10 Mbps Full Duplex	
	☒ 10 Mbps Half Duplex	
Ethernet Auto Mdi	☐ Disabled ☒ Enabled	
Drop Ethernet Link On Wireless Link Down	☒ Disabled ☐ Enabled	
Local Packet Filtering	☐ Disabled ☒ Enabled	

Submit Updated System Configuration Reset Form

IP Address Internet protocol (IP) address. This address is used by the family of Internet protocols to uniquely identify this unit on a network.

Subnet Mask A subnet allows the flow of network traffic between hosts to be segregated based on a network configuration. By organizing hosts into logical groups, subnetting can improve network security and performance.

Gateway IP Address The IP address of a computer / router on the current network that acts as a gateway. A gateway acts as an entrance / exit to packets from / to other networks.

Ethernet Configuration This enables the Ethernet configuration to be forced rather than auto negotiated. The configuration should only be forced if you are having problems with auto negotiation. You must ensure that you configure both this unit and the Ethernet port to which it is connected identically. If you force a fixed Ethernet Configuration on the OS-Spectra unit then you MUST also force the same fixed configuration on the equipment to which it is

connected. If you fail to force the configuration of the connected equipment, its automatic configuration mechanisms will normally cause a duplex mismatch, and you will receive greatly reduced throughput!

Ethernet Auto Mdx This enables/disables the Auto Medium Dependent Interface (MDI)/Medium Dependent Interface Crossover (MDIX) capability.

Local Packet Filtering When Local Packet Filtering is Enabled, the bridge learns the source MAC addresses of devices transmitting Ethernet packets on the local Ethernet network, and only bridges packets to the remote unit if the destination MAC address has not been learnt as a 'local' device. When Local Packet Filtering is Disabled the bridge does not learn the source MAC addresses of devices transmitting Ethernet packets on the local Ethernet network, and bridges ALL Ethernet packets received to the remote unit. Local Packet Filtering should only be disabled when external routing hardware is present.

All the above attributes are non-volatile, once set they will be used by the unit even after a power on reboot. A number of attributes, such as IP Address, Subnet Mask and Gateway IP Address will require a reboot before they are used. If any of these attributes are changed a reboot screen appears asking the user to verify the reboot. (see Figure 17)



Figure 17 - Configuration Reboot Page

This will be followed by a pop-up box asking to confirm the action. (see FIGURE ????)

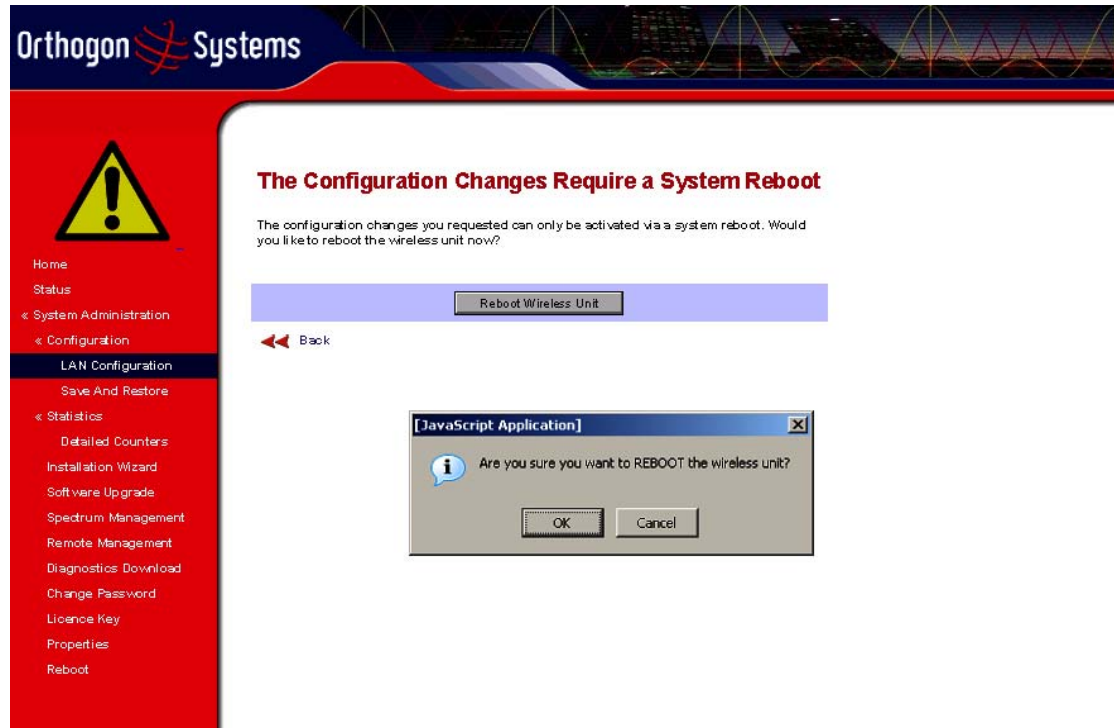


Figure 18 - Reset Confirmation Box

Note: At this point you will lose connection to the unit. If you have just changed the IP Address you now have to reconnect to the unit using the address just set.

6.3.3 Save and Restore

Blah

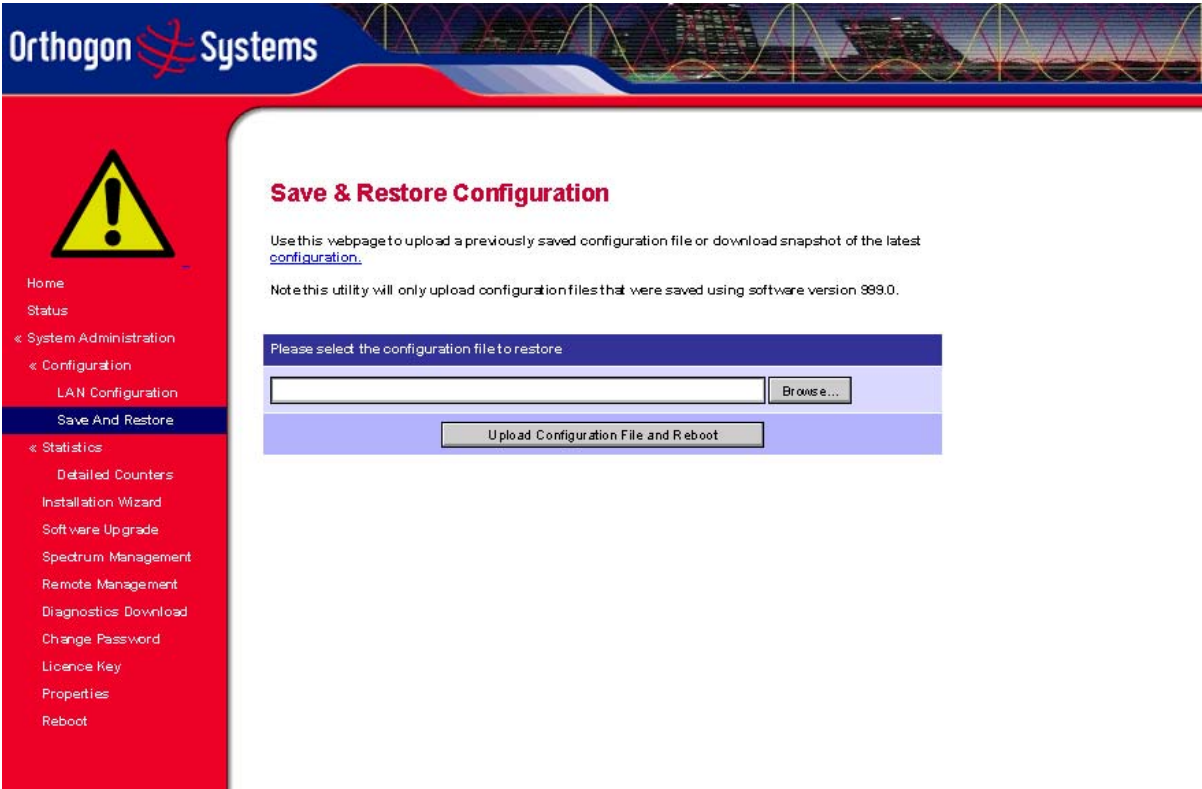


Figure 19 - Save and Restore Configuration Page

Blah

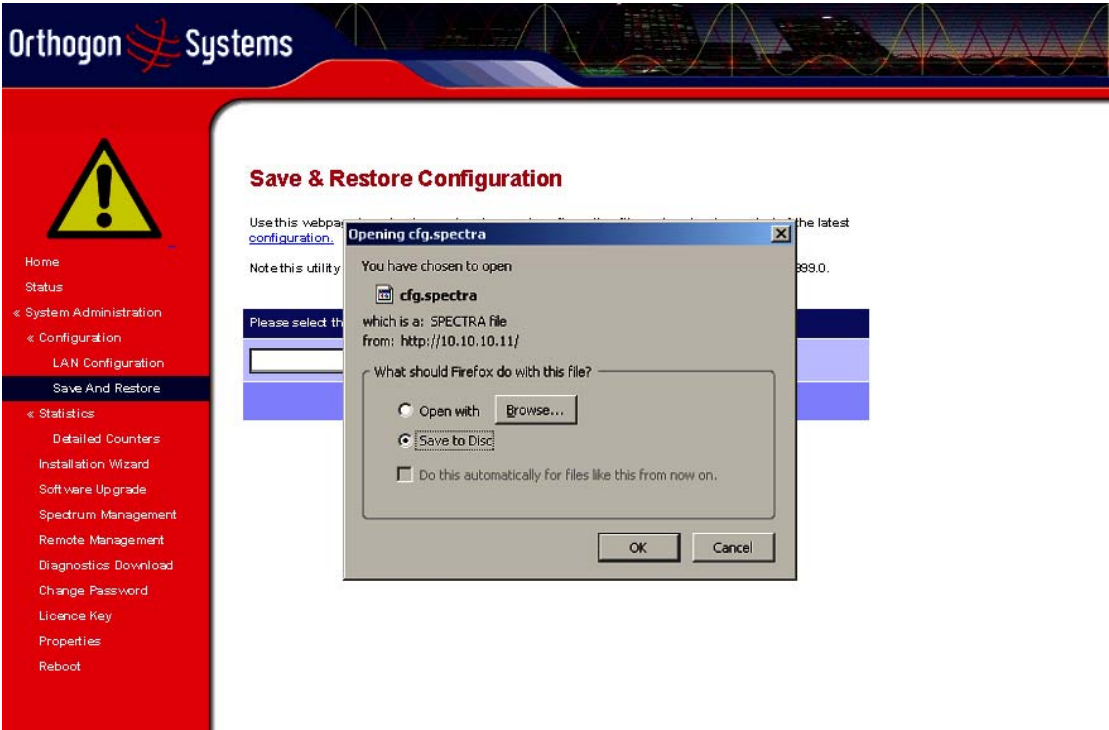


Figure 20 - Save File Confirmation Pop-up

Blah

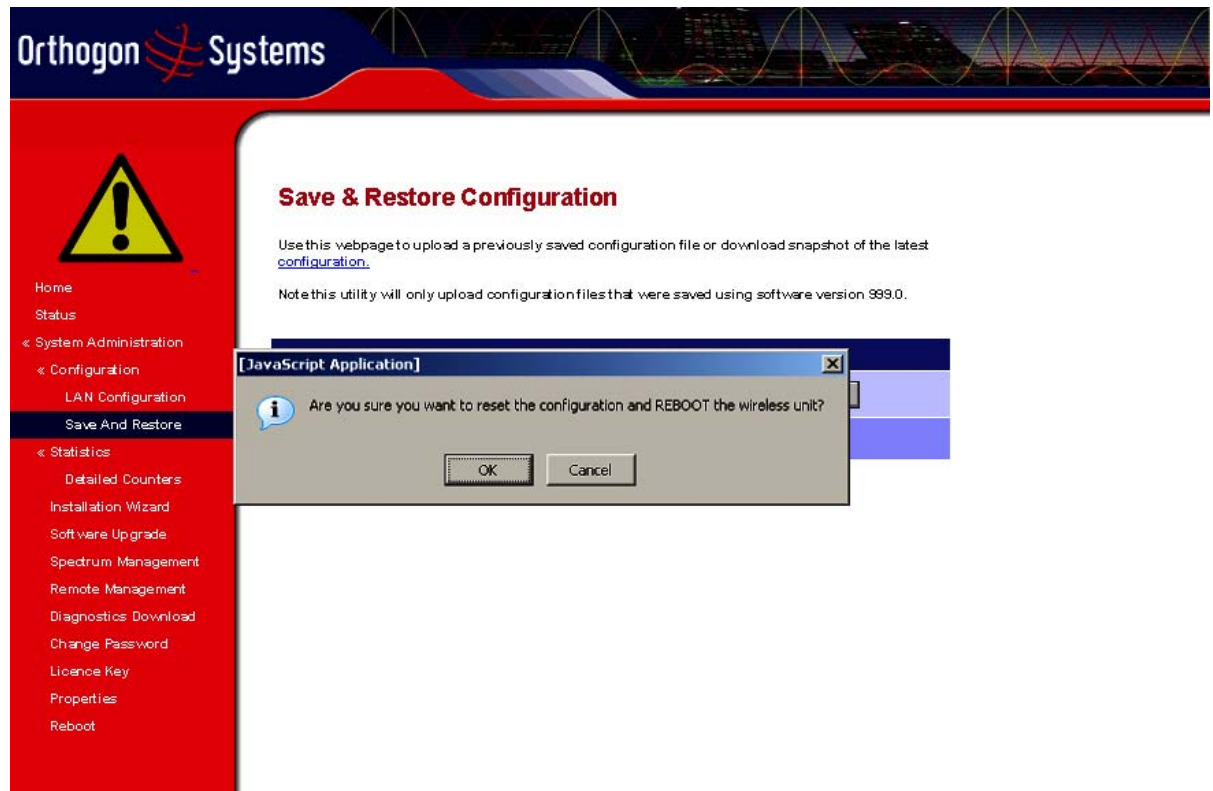


Figure 21 - Reset Configuration and Reboot Confirmation Pop-up

Blah

6.3.4 Statistics Page

The OS-Spectra statistics page is designed to display some key statistics of the Ethernet Bridge and the underlying wireless performance.



Figure 22 - Statistics

Wan Good Tx Packets This displays the total number of good packets the bridge has sent for transmission by the wireless interface. The number in (+nn) displays the number of packets transmitted since the last page refresh.

Wan Dropped Tx Packets This displays the total number of packets that the local unit could not bridge to the remote unit because either the wireless link was down or because Ethernet packets are being received faster than they can be transmitted over the wireless link. The number in (+nn) displays the number of packets dropped since the last page refresh.

Wan Good Rx Packets This displays the total number of good packets the bridge has received from the wireless interface. The number in (+nn) displays the number of packets received since the last page refresh.

Wan Bad Rx Packets This displays the total number of corrupt packets the bridge has received from the wireless interface. The number in (+nn) displays the number of corrupt packets received since the last page refresh.

Lan Tx Packets This displays the total number of good packets the bridge has sent for transmission by the local Ethernet interface. The number in (+nn) displays the number of packets transmitted since the last page refresh.

Lan Rx Packets This displays the total number of good packets the bridge has received from the local Ethernet interface. The number in (+nn) displays the number of packets received since the last page refresh.

Packets To Internal Stack This displays the total number of good packets the bridge has transmitted to the internal stack (e.g. ARP requests, PING requests, HTTP requests). The number in (+nn) displays the number of packets transmitted since the last page refresh.

Packets From Internal Stack This displays the total number of good packets the bridge has received from the internal stack (e.g. ARP responses, PING replies, HTTP responses). The number in (+nn) displays the number of packets received since the last page refresh.

Ethernet Runt Rx Packets Total number of Runt (short) Ethernet packets received from the local Ethernet interface. On a half-duplex link, these packets are the result of collisions and are to be expected. If you have forced the Ethernet configuration to full-duplex and are getting runt packets then you probably have a duplex mismatch (the device you have connected to is running in half-duplex). The number in (+nn) displays the number of Runt packets received since the last page refresh.

L2 Source MAC Address Conflicts The number of times a packet received over the wireless link had the Layer 2 (Ethernet) Source MAC Addresses of a device that had previously been transmitting on the 'local' Ethernet network. This could indicate the presence of a traffic loop or of L2 MAC Address spoofing on the network. The number in (+nn) displays the number of conflicts since the last page refresh.

ARQ Retransmitted Rx Packets Total number of ARQ retransmitted packets that have been received. The number in (+nn) displays the number of packets received since the last page refresh

PHY Code Word Error Counter The wireless link uses error correction techniques to enable reconstruction of packets where there is a certain level of data corruption. This counter displays the total number of packets that were so badly corrupted that they could not be reconstructed. The number in (+nn) displays the number of corrupted packets received since the last page refresh

Receive Data Rate The data rate in the receive direction, expressed in Mbps and presented as: max, mean, min, and latest histogram format.

The histogram is calculated over a one hour period. If the equipment has been running for less than one hour then the histogram is calculated over the current elapsed time.

Transmit Data Rate The data rate in the transmit direction, expressed in Mbps and presented as: max, mean, min, and latest histogram format.

The histogram is calculated over a one hour period. If the equipment has been running for less than one hour then the histogram is calculated over the current elapsed time.

Signal Strength Ratio The Signal Strength Ratio, is the ratio of the power received by the Vertical / Horizontal receivers.

Wireless Link Availability Expresses the link availability as a percentage of time since the first successful registration after a system restart. Expressed as a percentage to four decimal places.

Code Word Error Ratio The ratio of detected codeword errors to the total number of codewords since the last system reboot.

Statistics Page Refresh Period The statistics page refreshes automatically according to the setting entered here (in seconds).

Reset System Counters By pressing this button all counters in the system are reset to zero. This not only affects this page for example the Elapsed Time Indicator is also reset.

Reset System Histograms All histograms are reset, and the calculation period is restarted.

6.3.5 Detailed Counters Page

Blah



Figure 23 - Detailed Counters Page

Blah

6.3.6 Install Pages

These pages are used during system installation. There follows a description of the install pages along with their use during the installation configuration process. The actual installation process is described in section 5.7.11 “Aligning the ODUs”.

All wireless links are shipped as paired units. They are pre-configured at the factory so that they can be installed without the user supplying any configuration. Each wireless link is shipped with a quick start guide. Attached to the quick start guide is a summary of the pre-configured configuration data. Table 5 shows an example link configuration. The values highlighted have been committed to the wireless units non-volatile storage.

<u>Example OS-Spectra Configuration Data</u>	
For your convenience these two units have been pre-configured as a link	
<u>Units:</u>	
ODU serial number	ODU serial number
0167800002BE	0167800002BF
Ethernet MAC address	Ethernet MAC address
00:04:56:00:02:BE	00:04:56:00:02:BF
<u>Configured as:</u>	
Master	Slave
Target MAC address	Target MAC address
00:04:56:00:02:BF	00:04:56:00:02:BE
Licence Key	Licence Key
A471-FE88-428D-E1F3	534F-4F54-D1B0-E2DA
IP Address	IP Address
10.10.10.11	10.10.10.10

Table 5 - OS-Spectra Factory Configuration Values

The factory default configuration is written to the ‘semi-permanent’ configuration bank.



The factory default configuration is limited in range to 40 Km. If you wish to install a wireless link with a range of > 40 Km and < 200 Km you must follow the ‘Manually Configuring The Wireless Units’ in section 6.3.6.1.



The factory default configuration is set to Region 1. Region 1 allows the OS-Spectra a maximum transmit power of 24 dBm. If the local 5.8 GHz regulatory regime limits the maximum transmit power (EIRP) to less than 24 dBm you should obtain a new licence key containing the correct region code from your local distributor or direct from Orthogon

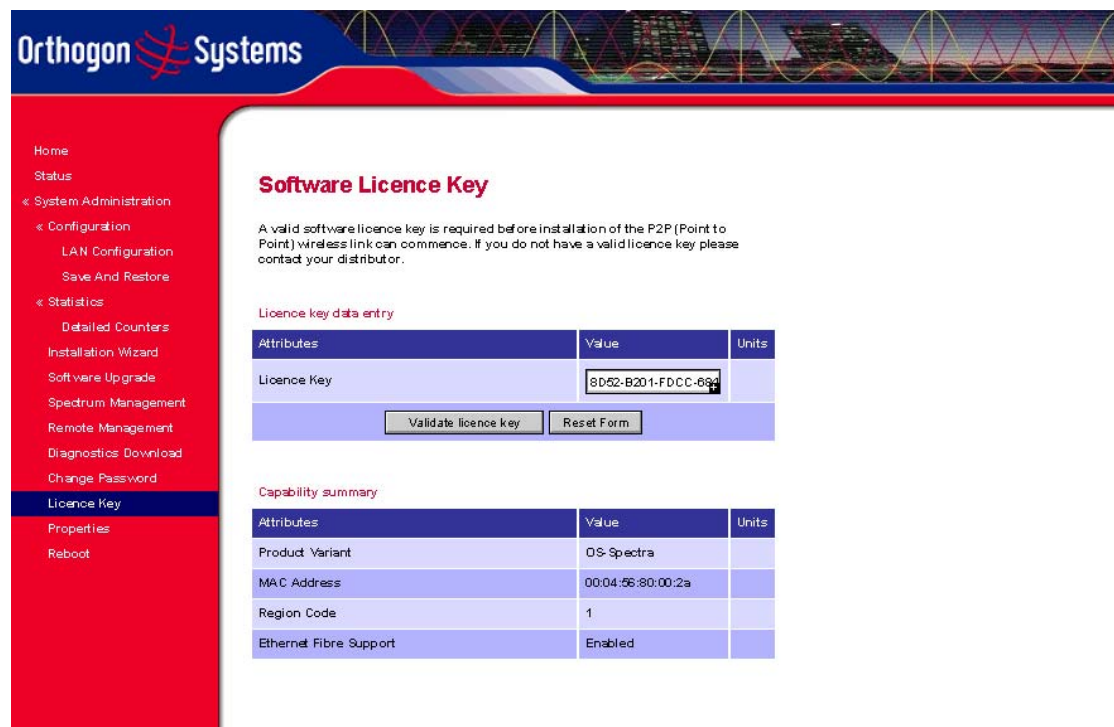
Systems. Alternatively in the short term, you should reduce the maximum transmit power by following the procedures in 'Manually Configuring The Wireless Units' in section 6.3.6.1.

6.3.6.1 Manually Configuring The Wireless Units

If the installer / system administrator wishes, they may modify the default installation configuration. If only the IP addresses are incorrect it is recommended that the values are changed via the configuration menu (Section). If any other parameters require modification then it is recommended that the system administrator use the Installation Wizard.

A detailed description of the Installation Wizard follows:

The OS-Spectra operational software requires a licence key to enable the wireless bridging capability and programs region code specific parameters in to the unit.



Attributes	Value	Units
Licence Key	8D52-B201-FDCC-688	

Attributes	Value	Units
Product Variant	OS-Spectra	
MAC Address	00:04:56:80:00:2a	
Region Code	1	
Ethernet Fibre Support	Enabled	

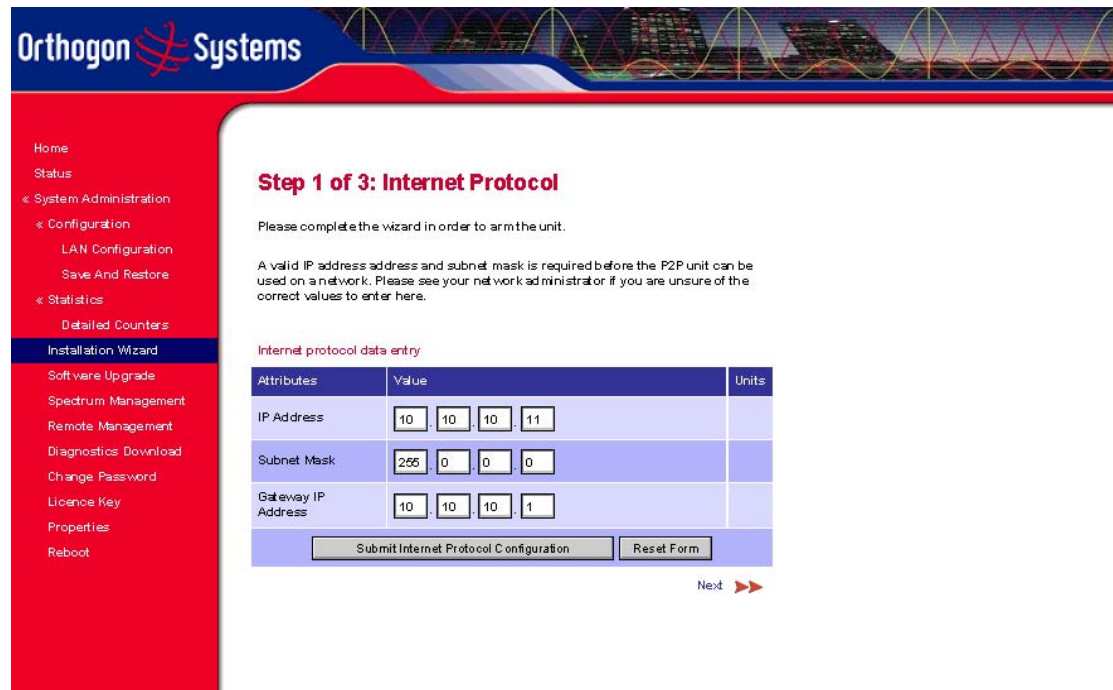
Figure 24 - Licence Key Data Entry

A licence key is programmed into each unit during production and can be found written on the Configuration Data Summary Label which is attached to the Quick Install Guide. If subsequently the licence key has been mislaid, replacement keys can be applied for online. If a valid licence key is not detected in the unit's non-volatile memory then the user is prompted to enter a valid key. It should be noted that OS-Spectra units are shipped as link pairs and as such valid licence keys are entered during the production process. Hence the user should never see the Software Licence Key screen (Figure 24).

To enter a licence key simply type or paste the licence key into the data entry box and click the 'validate licence key' button.

6.3.6.2 Internet Protocol Configuration

Step 1 of the installation wizard requires the installer to enter the Internet Protocol (IP) configuration.



Step 1 of 3: Internet Protocol

Please complete the wizard in order to arm the unit.

A valid IP address and subnet mask is required before the P2P unit can be used on a network. Please see your network administrator if you are unsure of the correct values to enter here.

Internet protocol data entry

Attributes	Value	Units
IP Address	10 . 10 . 10 . 11	
Subnet Mask	255 . 0 . 0 . 0	
Gateway IP Address	10 . 10 . 10 . 1	

Submit Internet Protocol Configuration Reset Form

Next ➡

Figure 25 - Installation Wizard Internet Protocol Configuration.

IP Address Internet protocol (IP) address. This address is used by the family of Internet protocols to uniquely identify this unit on a network.

Subnet Mask A subnet allows the flow of network traffic between hosts to be segregated based on a network configuration. By organizing hosts into logical groups, subnetting can improve network security and performance.

Gateway IP Address The IP address of a computer / router on the current network that acts as a gateway. A gateway acts as an entrance / exit to packets from / to other networks.

Once complete click the 'Submit Internet Protocol Configuration' button or the 'Next' link.

6.3.6.3 Wireless Configuration

Step 2 of the installation wizard requires the installer to enter the wireless configuration parameters.



Step 2 of 3: Wireless Configuration

Please enter the following wireless configuration parameters

Wireless data entry

Attributes	Value	Units
Target MAC Address	00:04:56:80:00:25	
Master/Slave Mode	☒ Master ☐ Slave	
Max Transmit Power	20	dBm
Ranging Mode	☒ Auto 0-5 km ☐ Auto 0-40 km ☐ Auto 0-100 km ☐ Auto 0-200 km ☐ Target Range	
Target Range	0.0	km
Spectrum Management Control	☒ i_DFS ☐ Fixed Channel ☐ WIMAX	
Lower Center Frequency	5742	MHz

Submit Wireless Configuration Reset Form

Back Next

Figure 26 - Installation Wizard Wireless Configuration

Target MAC Address The MAC Address of the peer unit that will be at the other end of the wireless link. This is used by the system to ensure the unit establishes a wireless link to the correct peer.

The MAC Address can be found embedded within the serial number of the unit. The last six characters of the serial number are the last three bytes of the unit's MAC address.

(Note: The OS-Spectra system is shipped as a pair of units with pre-loaded correct MAC addresses. MAC addresses will only need to be entered if an existing unit has to be replaced in the field or the units configuration has been erased).

Master Slave Mode At this point it is necessary to decide which end will be designated a Master. The Master unit is the controlling unit with respect to the Point-to-Point link and its maintenance. The master transmits until the link is made, whilst the Slave listens for its peer and only transmits when the peer has been identified.

Link Symmetry By default Link Symmetry of a Point-to-Point link is 'Symmetrical Data Rate (1:1)' in this configuration the ratio of time the wireless link spends transmitting and receiving is equal. When Link Symmetry is configured to Asymmetric Data Rate (2:1) the wireless link Master will spend twice as long transmitting as receiving. It should be noted that the data rate available to the end users might not follow these ratios exactly. The exact data rates will be dependant on the prevailing modulation. If the direction you want to install the link asymmetry not achievable in the current configuration then the master and slave modes of both OS-Spectra units will need to be reversed.

Link Mode Optimisation By default Link Mode Optimisation of a Point-to-Point link is set to 'IP Traffic'. In this configuration the wireless minimises packet transmission errors by automatically adapting the active modulation mode based on instantaneous vector error measurements and / or the presence of codeword errors. This mode of operation is recommended for connection oriented IP traffic protocols where packet loss is perceived by the protocols as an indication of network congestion. It is recommended that when using this mode of operation that the ARQ state is set to enabled. The 'TDM Traffic' mode of link optimisation is recommended for E1 / T1 applications and non-connection oriented protocols. In this mode the wireless link is optimised for minimum transmission latency and preservation of data throughput by allowing the link to maintain a higher modulation mode in the presence of a limited number of codeword errors. It is recommended that when operating the link in TDM mode that both ARQ state is set to disabled and the Spectrum Management controls are used to fix the wireless link to a single frequency. This can be achieved by using the installation wizard to configure single frequency operation (system reboot will be required) or by using the Spectrum Management channel barring (a system reboot will not be required).

ARQ State Automatic Repeat reQuest (ARQ) is a mechanism where packets lost due to transmission errors over the wireless link are retransmitted rapidly. The retransmission helps to prevent TCP congestion mechanisms from inadvertently interpreting intermittent pack loss as network congestion. ARQ must be enabled on both ends of the Point-to-Point link for it to function.

Max Transmit Power This attribute controls the maximum transmit power the unit is permitted to use when installing and executing the wireless link. The maximum setting for a particular region or country is controlled by the Licence Key.

Ranging Mode During installation the wireless units perform automatic ranging. The ranging mode allows the installer to control the behaviour of the systems automatic ranging

algorithms. The default value is 0 to 40 km⁹. If the installer is required to install a link of greater than 40 km then the ranging mode attribute MUST be configured to '0 to 100km' or '0 to 200km' mode depending on the range of the link. Likewise selecting the 0 to 5 km mode for links under 5 km will give you optimal performance.

Target Range Installers that know the range between the two wireless units to within ± 1 km can use the target range mode. The main advantage of the target range mode is that it reduces the time taken by the units to range. To use the target range mode the installer MUST select Target Range as the ranging mode and enter the approximate range in km in the Target range data entry field at both ends of the link.

Once the installer is satisfied with the wireless configuration options then the 'Submit Wireless Configuration' button or the 'Next' link should be clicked.

⁹ If preferred OS-Gemini range functions can be configured to operate in miles, see the Properties page in section 6.3.14.

Spectrum Management Control Is used to configure the OS-Spectra Spectrum Management features, see section 6.3.8 for more details. **i_DFS** is the abbreviation for intelligent Dynamic Frequency Selection, this feature continually monitors the 5.8 GHz spectrum looking for a the channel with the lowest level of on channel and co-channel interference. Fixed frequency mode allows the installer to fix the transmit and receive frequencies on the units. The frequencies may be configured symmetrically or asymmetrically.

Lower Center Frequency The OS-Spectra software allows a user to optionally adjust the channel center frequencies. The default starting channel center frequency is 5734 MHz. This value can be adjusted to either 5732, or 5736 MHz. Changing the Lower Center Frequency attribute causes all channel center frequencies to be offset. It effectively slides the channelisation up or down 2 MHz.



Warning: The lower center frequency attribute must be configured to the same value for of both the master and slave. Failure to do so will cause the wireless link to fail reestablishment. The only way to recover from this situation is to modify the Lower Center Frequency attribute so that they are identical on both the master and slave unit.

Fixed Transmit Frequency, Fixed Receive Frequency The OS-Spectra software allows a user to optionally fix transmit and receive frequencies for a wireless link. The settings must be compatible at each end of the link. Once configured the spectrum management software will not attempt to move the wireless link to a channel with lower co or adjacent channel interference. Therefore this mode of operation is only recommended for deployments where the installer has a good understanding the prevailing 5.8 GHz interference environment. Figure 27 shows an example fixed frequency configuration. The lower center frequency is set to its default values and the Fixed Transmit Frequency is set to 5740 MHz and the Fixed Receive Frequency is set to 5782 MHz. Care must be taken when configuring the Fixed Transmit and Receive Frequencies to ensure that both frequencies are on the same 6 MHz channel raster as the Lower Center Frequency. For example both the Fixed Transmit and Receive Frequencies must be a multiple of 6 MHz from the Lower Center Frequency ($5740 = 5734 + 6 \text{ MHz}$) and ($5782 = 5734 + 6 \text{ MHz} \times 8$).



- Home
- Status
- System Administration
 - Configuration
 - Statistics
- Installation Wizard
- Software Upgrade
- Spectrum Management
- Remote Management
- Diagnostics Download
- Change Password
- Licence Key
- Properties
- Reboot

Step 2 of 3: Wireless Configuration

Please enter the following wireless configuration parameters:

Wireless data entry

Attributes	Value	Units
Target MAC Address	00:04:56: 80 : 00 : 25	
Master Slave Mode	☒ Master ☐ Slave	
Max Transmit Power	20	dBm
Ranging Mode	☒ Auto 0-5 km ☐ Auto 0-40 km ☐ Auto 0-100 km ☐ Auto 0-200 km ☐ Target Range	
Target Range	0.0	km
Spectrum Management Control	☐ I_DFS ☒ Fixed Channel ☐ WIMAX	
Fixed Transmit Frequency	5742	MHz
Fixed Receive Frequency	5742	MHz

Submit Wireless Configuration
Reset Form

Back
Next

Figure 27 - Fixed Frequency Operation

6.3.6.4 Confirm Configuration

Step 3 of the installation wizard allows the installer to review and confirm the installation information before committing the information to non-volatile memory (Figure 28)



Figure 28 - Installation Wizard Confirm Configuration.

If all the settings are correct and appropriate click the “Confirm Configuration and Reboot Unit” button. All the attributes are committed to non-volatile memory. Immediately following the write to non-volatile memory the unit is reset.

Note: If you have changed the Ethernet parameters you must reconnect using the correct network and address settings.

6.3.6.5 Disarm

Step 5 of the installation wizard is the disarm phase.

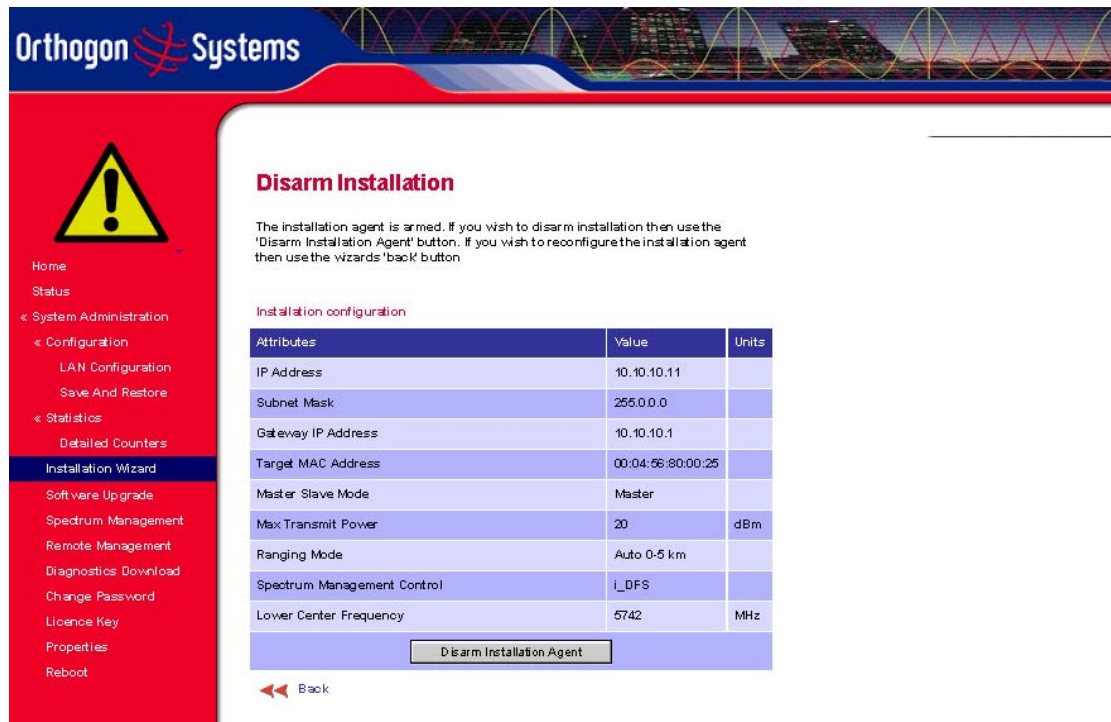


Figure 29 - Disarm Installation.

Once section 5.7.11 “Aligning the ODUs” is complete pressing the “Disarm Installation Agent” button completes the installation process¹⁰ and the audible installation tone will be switched off. If the installer wishes to modify the installation configuration then the ‘Back’ link can be used to access the installation wizard steps described above.

After disarming the wireless link the user is presented with an optional configuration page see Figure 30. The screen presents hyper links to the main configuration and spectrum management pages.

¹⁰ The installation process is completed when both ends of the link are ‘disarmed’.

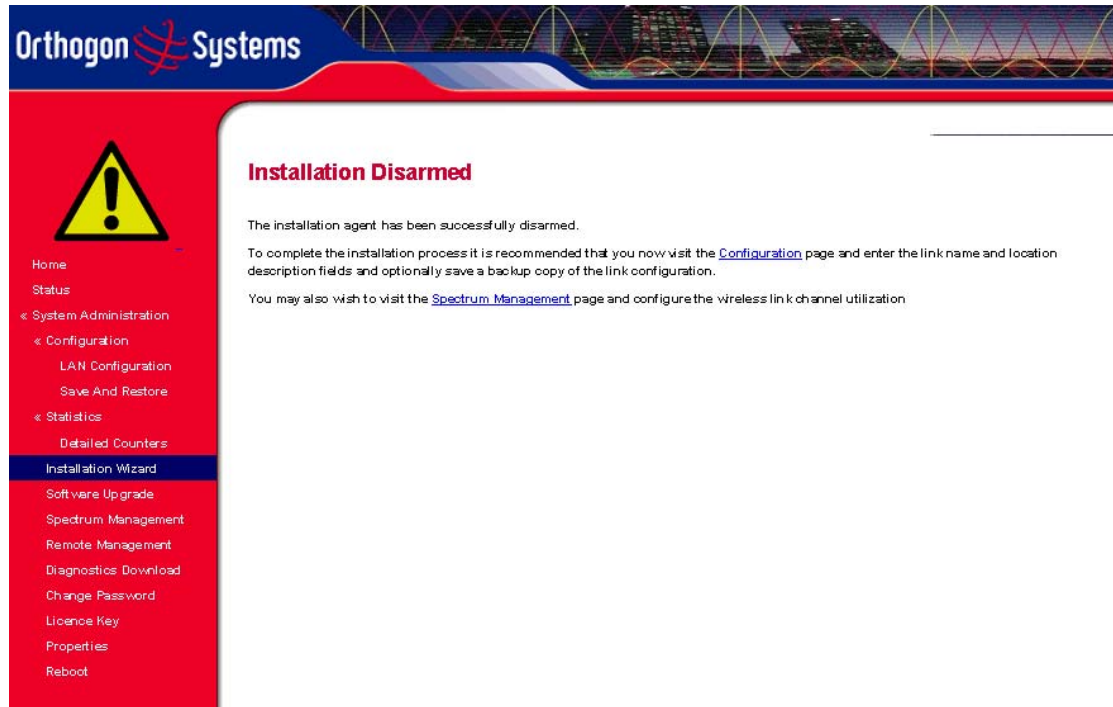


Figure 30 - Optional Post Disarm Configuration 1

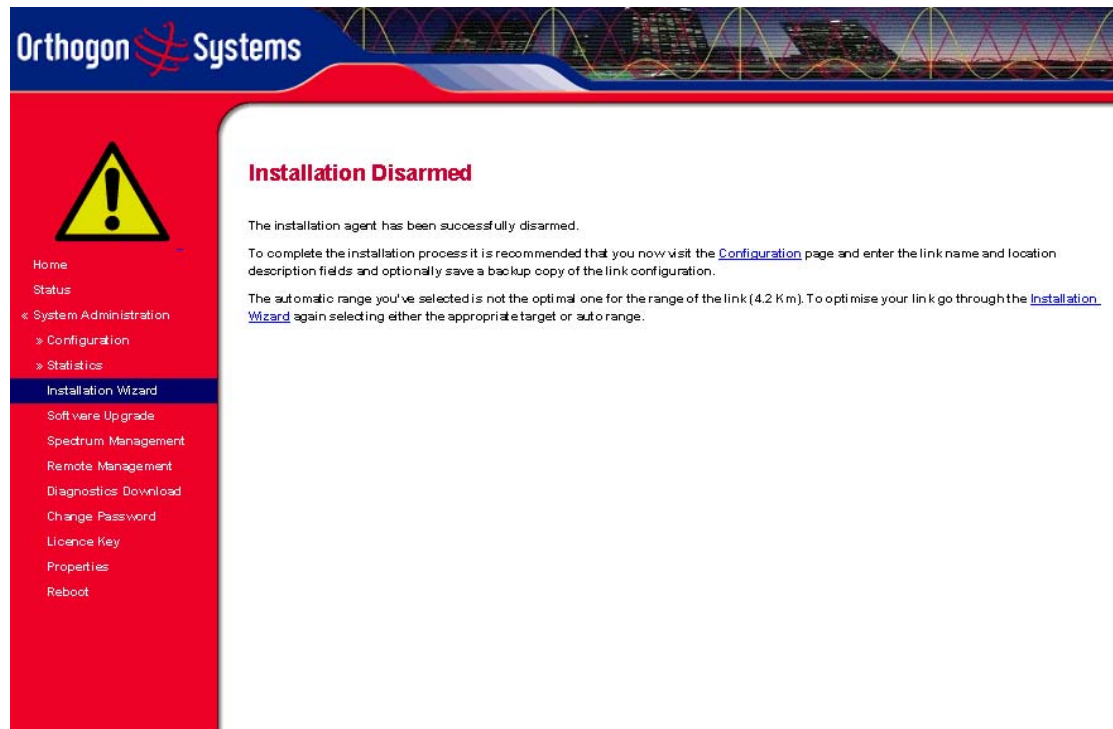


Figure 31 - Optional Post Disarm Configuration 2

6.3.7 Software Upgrade

The OS-Gemini system has two software image banks; one is a fixed image which is stored in protected non-volatile memory and is not modifiable by the user, the second bank is used by the system administrator to upgrade the firmware as and when necessary. Figure 32 shows the main software upgrade webpage.

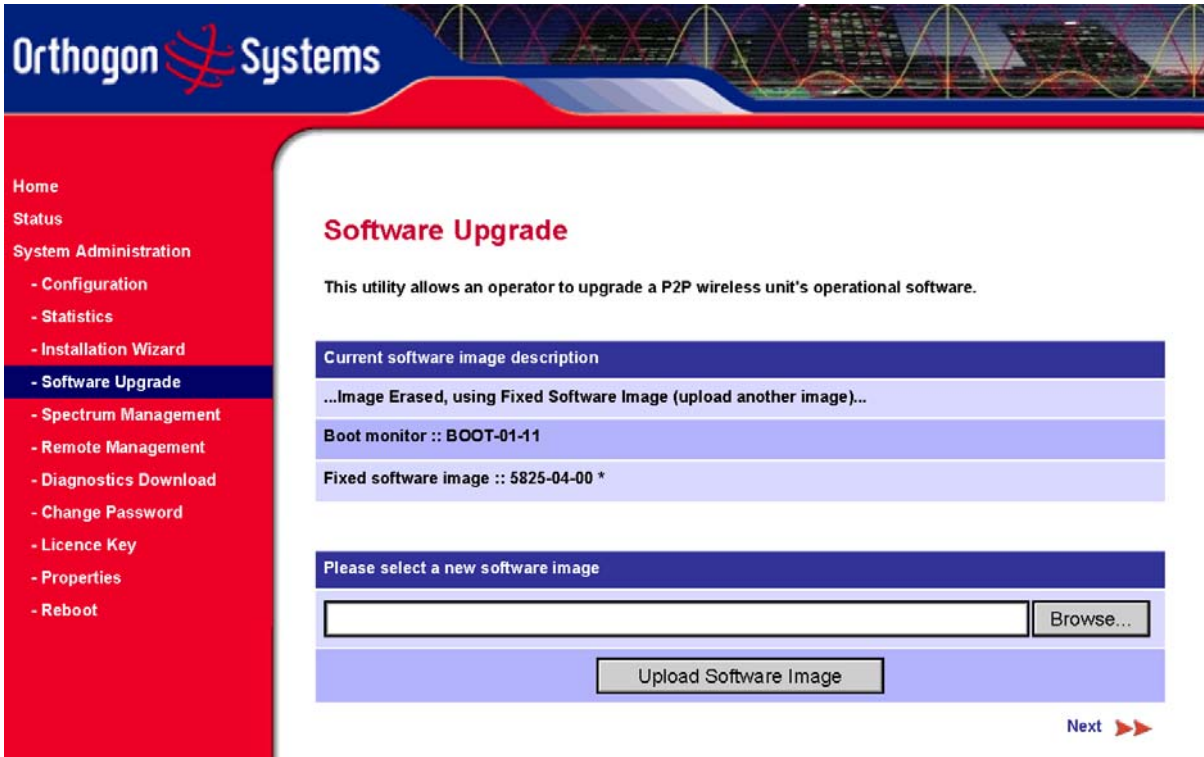


Figure 32 Software Upgrade

The 'Fixed' image is only used if disaster recovery is required, i.e. if an upgrade process is interrupted or the units are reset to their factory defaults.

These pages are used to update a unit's operational software. The software image to be uploaded should be downloaded to local storage from the [Orthogon Systems website](#). The software image is delivered by Orthogon Systems as a compressed zip file. Once the zip file has been downloaded the user should extract the OS-Spectra Software image, identifiable by its '.dld' file extension.

The first step (Figure 32) is to use the "Browse" button to locate the software image previously downloaded to local storage from the [Orthogon Systems website](#). Once the image is located the user should press the "Upload image to wireless unit" button to start the software upgrade process.

The software image will now be uploaded to the unit where it will be stored in SDRAM until it is committed to the unit's non-volatile memory. This upload should only take a few seconds,

once complete the image is verified and validated to ensure that no errors occurred during transfer and the image is valid to run on the current platform. If there are any problems a warning screen will appear.

The unit being upgraded will now display information about the build it currently has stored in the image bank and the one that's just been uploaded. If the image is not the right one the user has the option to go back and reload a new image. (See Figure 32)

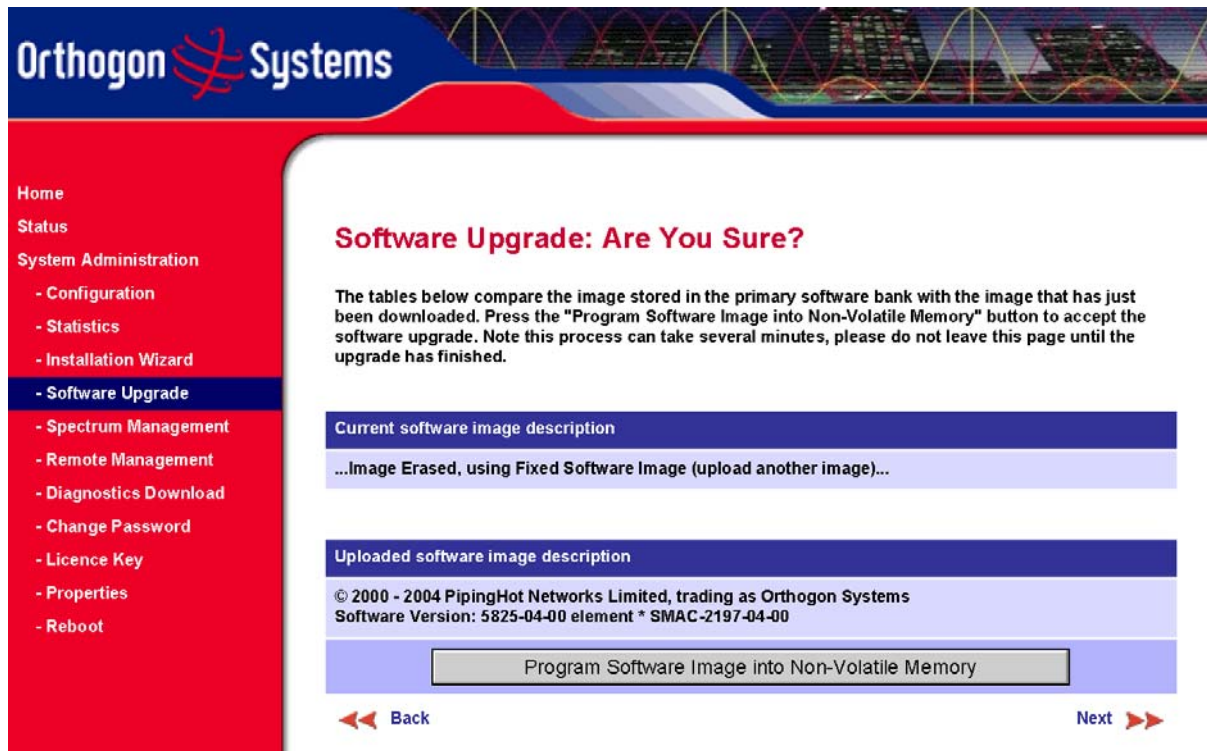


Figure 33 Software Upgrade Image Check

The user should ensure that the correct image is shown before pressing the “Program Software Image into Non-Volatile Memory” button. Once this button has been pressed the image is stored into non-volatile memory, this process can take up to 60 seconds and must not be interrupted.



If the upgrade process is interrupted during the erasure of the image bank or during the reprogramming of the image bank the image bank will be left in a corrupt state. If this occurs the software must be reloaded. All software images that are stored in FLASH memory are protected via the use of 32-bit CRCs. If the software detects a invalid CRC the image bank is marked as ‘corrupt’ and the OS-Spectra boot code will boot the fixed software image. If this occur the user must attempt to reload the correct version of software.

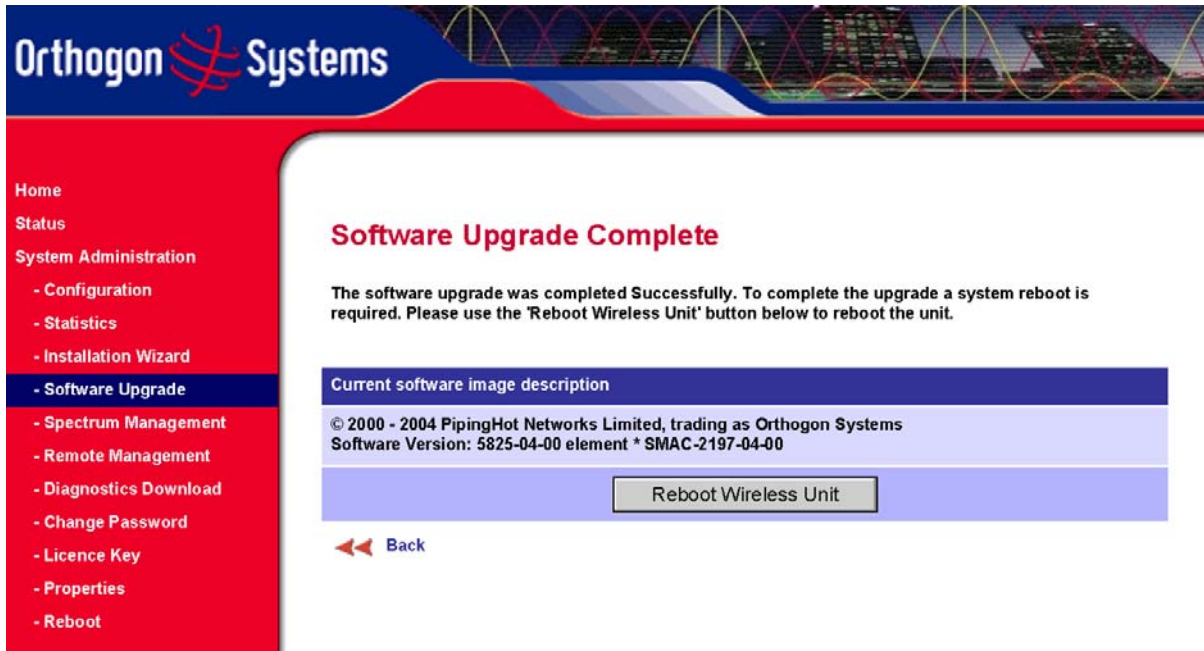


Figure 34 Software Upgrade Complete

When the software image has been written to non-volatile memory Figure 34 will be displayed showing the status of the software upload.

Reboot the unit by clicking the “Reboot Wireless Unit” button. This will reboot the unit within 30 seconds, during this time you will not be able to communicate with the unit. The unit is now fully functional.

If this screen is not displayed after 60 seconds this could indicate a problem with the memory update process.

The user should now power cycle the unit to start using the new software image. The unit's boot software will automatically determine the health of the newly uploaded software image. If any problems were encountered the boot code will revert to a protected fixed software image. After the power cycle the user should check that the required software image is loaded and running by re-entering the Upgrade page where the software bank status will be displayed.

6.3.8 Spectrum Management (Non UK)

Spectrum Management Selection (previously referred to by the acronym DFS) is the OS-Spectra wireless feature that monitors the available wireless spectrum and directs both ends of the wireless link to operate on a channel with the minimum level of co and adjacent levels interference.

6.3.8.1 Wireless Channels

The OS-Spectra wireless operates using a set of predefined overlapping channels. There are 19 predefined channels starting at 5734 MHz and ending at 5842 MHz. Each channel occupies 11 MHz of wireless spectrum and is offset in center frequency from its neighboring channel by 6 MHz. It is important to note that adjacent channels on the Spectrum management display have a 5 MHz overlap to the adjacent channel.

The default channelisation can be modified by varying lower center frequency attribute in the installation wizard - see Wireless Configuration - [Lower Center Frequency](#).

6.3.8.2 Spectrum Management Measurements

The OS-Spectra wireless units perform four Spectrum Management measurements per TDD cycle, per channel. The measurements are subdivided into two signal peak measurements and two mean signal measurements. The peak measurements represent the peak received signal power with a resolution down to 100 nS. The mean measurement represents the mean received signal power for the 40 μ S measurement period.

The Spectrum Management algorithm collects measurements equally from all channels. This process is called the Channel Availability Check (hereafter referred to by the acronym CAC). The CAC uses a round-robin channel select process to collect an equal amount of measurements from each channel. It is important to note that the CAC measurement process is not altered by channel barring process. Measurements are still collected for all channels irrespective of the number of barred channels.

6.3.8.3 Measurement Analysis

Spectrum Management uses statistical analysis to process the received peak and mean measurement. The statistical analysis is based on a fixed, one minute, measurement quantisation period. Spectrum Management collects data for the specified quantisation period and only at the end of the period is the statistical analysis performed. The analysis produces four key metrics for each channel:

- Peak of Peaks
- Peak of Means
- 99.9% Percentile of the Means
- Mean of Means

Peak of Peaks is the largest peak interference measurement encountered during the quantisation period. This metric is useful for detecting large short duration spikes in the interference environment.

Peak of Means is the largest mean interference measurement encountered during the quantisation period. The peak of means is similar to the peak of peaks and is useful for detecting slightly longer duration spikes in the interference environment.

99.9% Percentile of the Means is the value of mean interference measurement for which 99.9% of all mean measurements fall below during the quantisation period. The 99.9% percentile metric is useful for detecting short duration repetitive interference that by its very nature has a minimal effect of the mean of means.

Mean of Means is the arithmetic mean¹¹ of the measured means during a quantisation period. The mean of means is a coarse measure of signal interference and gives an indication of the average interference level measured during the quantisation period. The metric is not very good at predicting intermittent interference and is included to show the spread between the mean of means, the 99.9% percentile and the peak of means.

Important Note. Spectrum Management uses the 99.9% percentile as the prime interference measurement. All subsequent references to interference level refer to this percentile measurement.

The display of statistical measurement on the spectrum management page always shows a statistical summary of all channel measurement. The statistical summary is controlled by the Statistics Window attribute. This attribute defaults to a value of twenty minutes, which means that the mean and percentile values displayed for each channel are calculated over the 20

¹¹ The arithmetic mean is the true power mean and not the mean of the values expressed in dBm.

minute period. All channel decisions are made using the values computed over the statistics window period.

6.3.8.4 The Spectrum Management Master / Slave Relationship

By default Spectrum Management operates in a master / slave relationship. The master is assumed to be the link master configured during installation. All Spectrum Management configuration changes MUST be performed from the master, to enforce this the Spectrum Management webpage has a different appearance depending if you are viewing the data from the master or slave.

All configuration changes are applied at the master only. All configuration changes are messaged from the master to the slave. Any Spectrum Management configuration messages received at the slave are stored in non-volatile memory. This enables both master and slave to keep identical copies of Spectrum Management configuration data in their non-volatile memories. It is therefore possible to swap master and slave roles on an active Point-to-Point link without modifying Spectrum Management configuration.

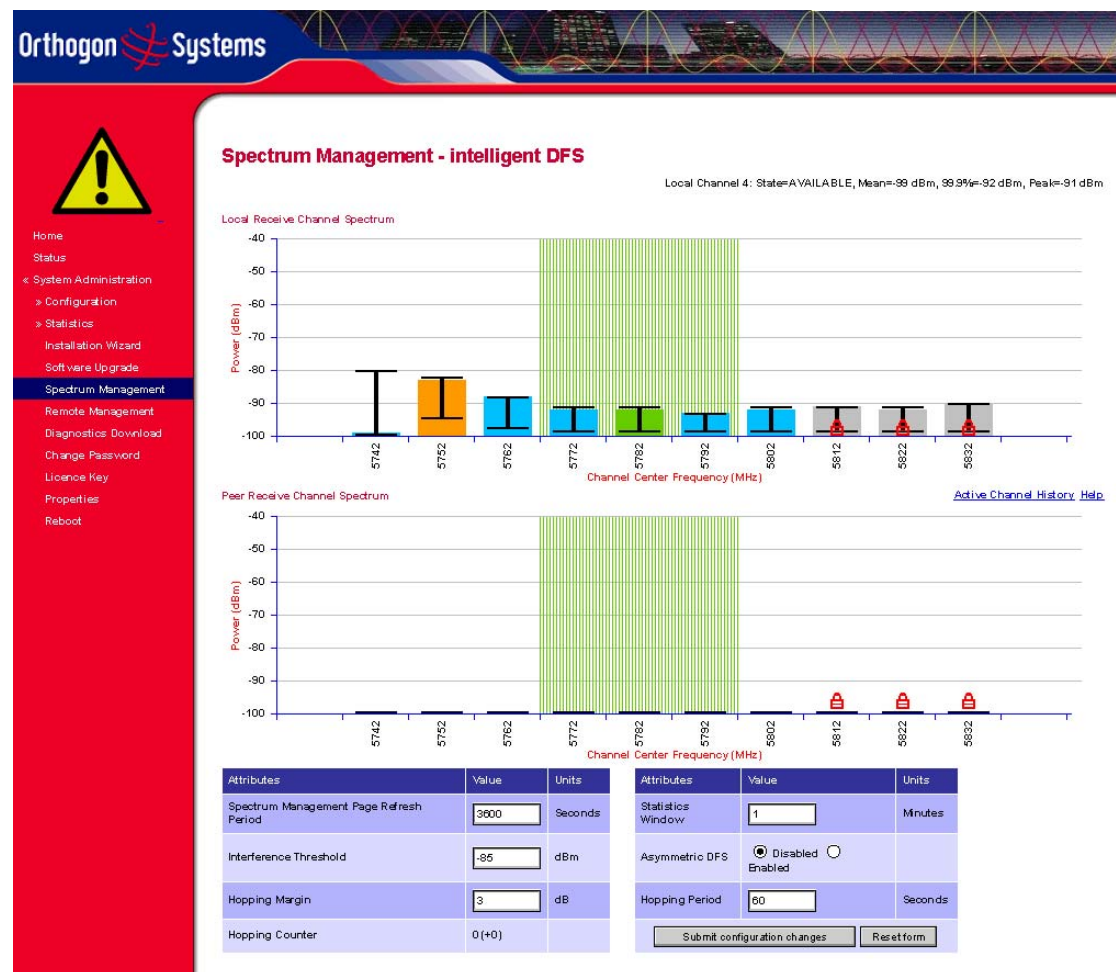


Figure 35 - Spectrum Management as seen from the Master

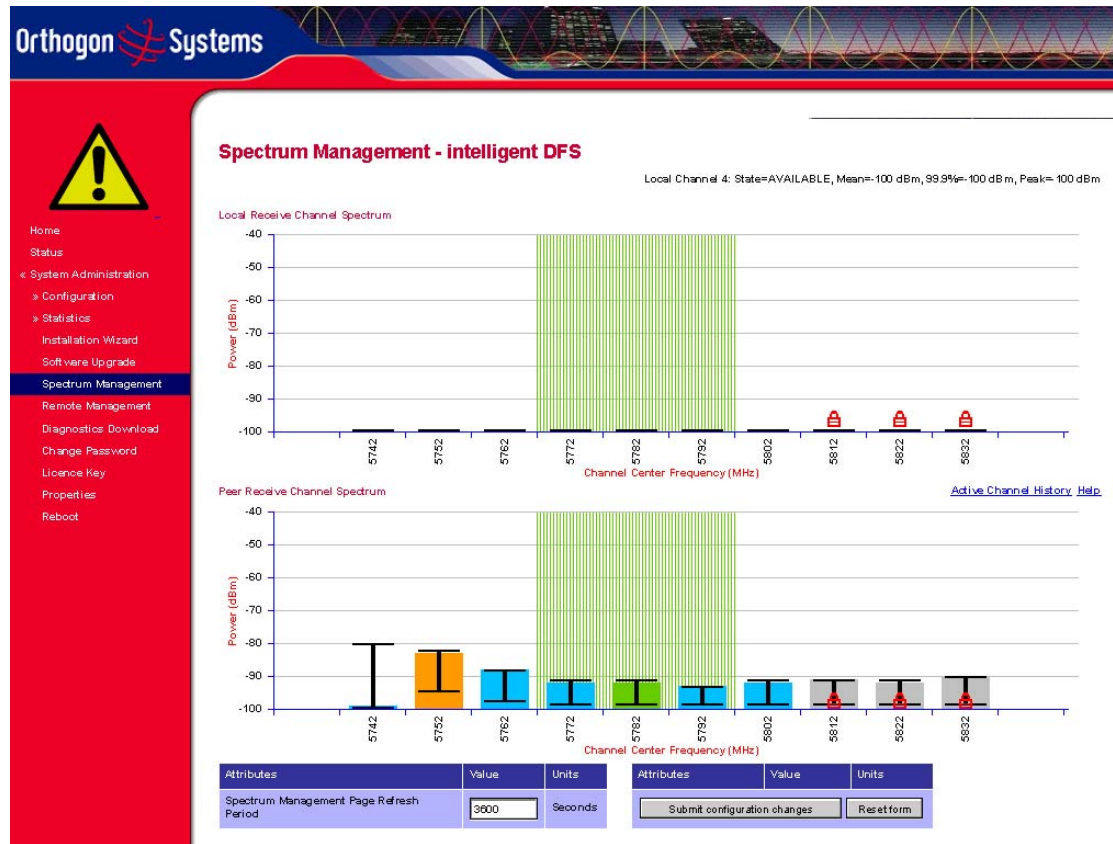


Figure 36 - Spectrum Management as seen from the Slave

Figure 35 shows an example Spectrum Management webpage as seen from the master. Figure 36 shows an example Spectrum Management webpage as seen from the slave. It should be noted that all the key configuration attributes are not available on the slave webpage.

6.3.8.5 Spectrum Management Configuration

The following section describes the user modifiable configuration accessible from the Spectrum Management webpage. It is recommended that the default values are maintained. If the user believes that the performance of the Spectrum Management algorithm requires some modifications this should only be done after consulting your distributor or one of the Orthogon Systems field support engineers.

Refresh Page Period The page refreshes automatically according to the setting entered here (in seconds).

Hopping Period The Spectrum Management algorithm evaluates the metrics every 'Hopping Period' seconds (180 seconds by default) looking for a channel with lower levels of

interference. If a better channel is located then Spectrum Management performs an automated channel hop. If SNMP and or SMTP alerts are enabled an SNMP TRAP and or an email alert is sent warning the system administrator of the channel change.

Hopping Margin Spectrum Management uses this margin when making a channel hop decision. The channel to hop to has to have an interference level 3 dBs (default) better than the current active channel. **Hopping Counter** is used to record the number of channel hops. The number in the “(+)” brackets indicates the number of channel changes since the last screen refresh.

Asymmetric Spectrum Management . The default configuration of symmetric constrains link to operate symmetrically using the same transmit and receive channels. When in symmetric mode the slave unit will always follow the master. If the master moves to a new channel the slave will hop to the same channel. When the Point-to-Point link is configured as an asymmetric link both the master and slave a free to select the best channel from their own set of local interference metrics. (Default Symmetric).

Statistics Window. Spectrum Management uses statistical analysis to process the received peak and mean measurement. The statistical analysis is based around a fixed one minute quantisation period. Spectrum Management collects data for this quantisation period and only at the end of this is the statistical analysis performed. The Statistics Window attribute allows the user to concatenate quantisation periods before making the assessment of the prevailing interference environment. This allows the algorithms to bias away from any channel that has detected interference during the period of the statistics window and slow the channel hopping dynamics down. It also has the effect of biasing away from localized impulsive interference sources. (Default 20 minutes)

Interference Threshold. Spectrum Management uses the interference threshold to perform instantaneous channel hops. If the measured interference on a channel exceeds the specified threshold then DFS will instruct wireless immediately search for a better channel. If a better channel cannot be found then OS-Spectra will continue to use the current active channel. (Default –85 dBm)

6.3.8.6 Barring Channels

Channels can only be barred / unbarred by the system administrator from the master Spectrum Management webpage. The barring / unbarring operations are disabled on the slave webpage. If an attempt to bar / unbar a channel is made at the slave a warning dialog is generated.

Barring / Unbarring of channels is performed by clicking the appropriate channel on the local or peer channel spectrum plots on the master webpage. Each bar / unbar attempt will be

proceeded by a conformation dialog. It should be noted that the channel bar will take effect immediately and is not related to the measurement quantisation period.

6.3.8.7 Local and Peer Channel Spectrum Graphics

Spectrum Management presents its computed statistical measurements in a graphical display on both the master and slave DFS webpage.

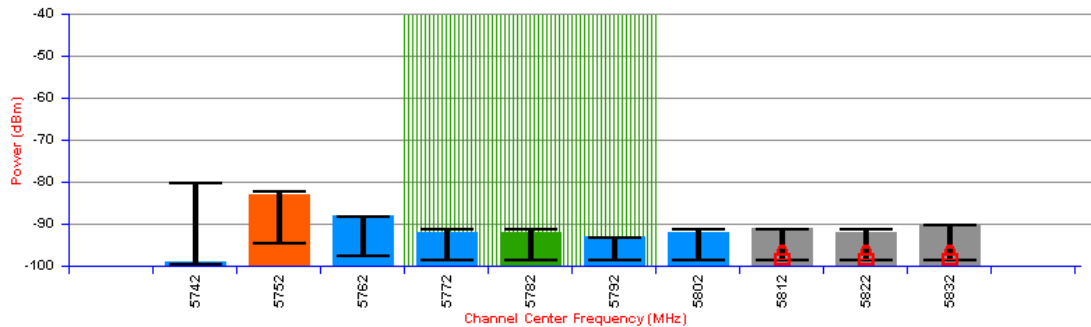


Figure 37 - Example Spectrum Management Graphic

The X-axis shows a stylised view of the 19 selectable wireless channels. It is important to note that adjacent channels on the display have a 5 MHz overlap. The display separates the display of channels to help the clarity of the resultant display. The axis is labeled using the channel center frequencies in MHz.

The Y-axis shows the interference power levels from –100 to –40 dBm.

The active channel (channel 1 in Figure 37) is always marked using hatched green and white lines. The width of the hatching is directly proportional the 11 MHz spectral occupancy of the channel.

The individual channel metrics are displayed using a coloured bar, an ‘I’ bar and a peak symbol.

The coloured bar represents the following channel state:

Green	Active	The channel is currently in use hosting the Point-to-Point wireless link
Orange	Interference	The channel has interference above the interference threshold
Blue	Available	The channel has an interference level below the interference threshold and is considered by the Spectrum Management algorithm suitable for hosting the Point-to-Point link
Grey	Barred	The system administrator has barred this channel from use. Because the low signal levels encountered when a unit is powered up in a laboratory environment prior to installation (which makes the grey of the channel bar difficult to see). An additional red ‘lock’ symbol is used to indicate that a channel is barred.

Table 6 - Spectrum Management (Non UK) change state key

The top of the coloured bar represents the 99.9% percentile metric for specific channel.

The 'I' Bar is used to display the mean of means and peak of means metrics. The lower horizontal bar represents the mean of means and the upper horizontal bar represents the peak of means. The vertical bar is used as a visual cue to highlight the statistical spread between the peak and the mean of the statistical distribution.

The peak symbol (the upper small triangle above each channel 'I' bar) is used to indicate the peak of peaks interference measurement.

6.3.8.8 Active Channel History

The active channel history is a timeseries display of the channels used by the OS-Spectra over the last 25 hours. The active channel history is activated from the main Spectrum Management page using the 'Active Channel History' hyperlink. An example of the active channel history display is shown in Figure 38. Where there are parallel entries on the display this signifies that the wireless link occupied this channel during the measurement period. The measurement periods are one minute from zero to sixty minutes and twenty minutes from 60 minutes to twenty five hours.

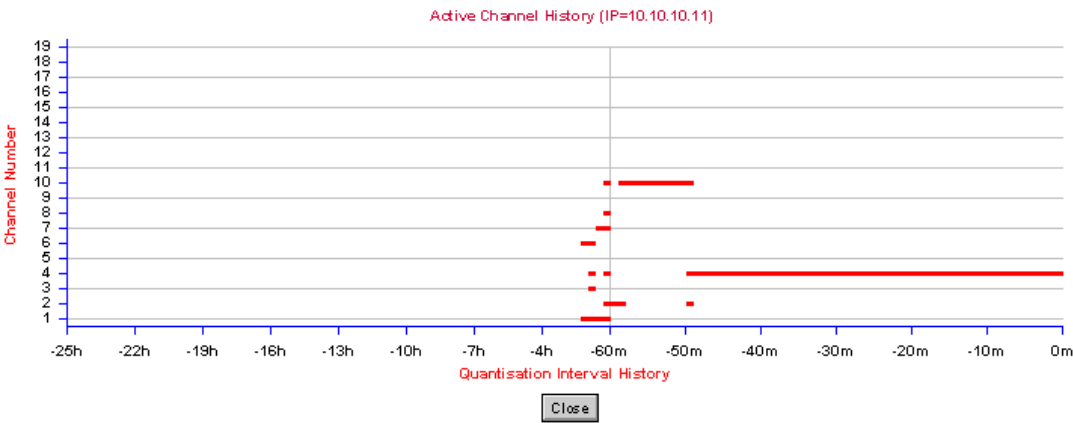


Figure 38 - Active Channel History Screen

6.3.8.9 Viewing Historic Spectrum Management Metrics

Spectrum Management allows the system administrator to view the results of previous measurement quantisation periods. Holding down the shift key and clicking the appropriate channel on the local channel spectrum plots activates this feature. This feature is available on both the master and slave webpage.

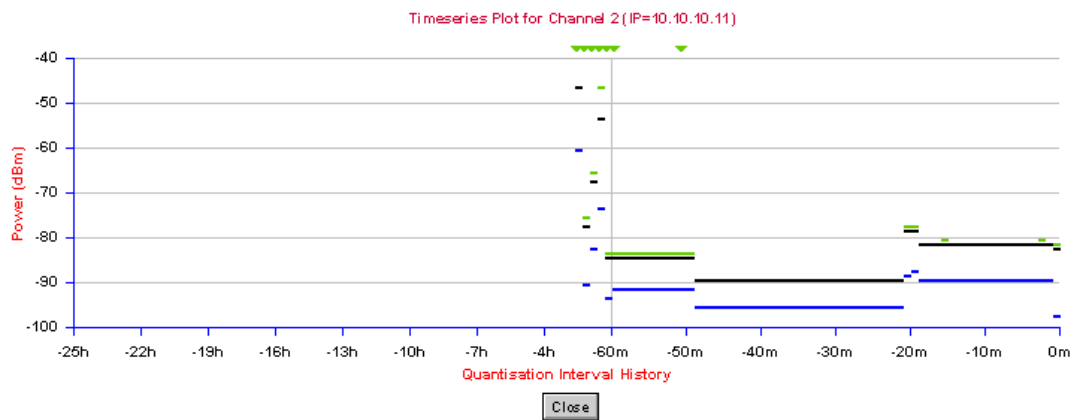


Figure 39 - Spectrum Management Timeseries Plot

Figure 39 shows an example time series plot. A timeseries plot displays the previous 145 measurement quantisation periods. If the OS-Spectra unit has not been running for 145 quantisation periods then only the number of measurement quantisation periods that are available are displayed.

RED	Peak of Peaks interference measurement
GREEN	Peak of Means interference measurement
BLACK	99.9% percentile of means interference measurement
BLUE	Mean of Means interference measurement

Table 7 - Spectrum Management Timeseries Key

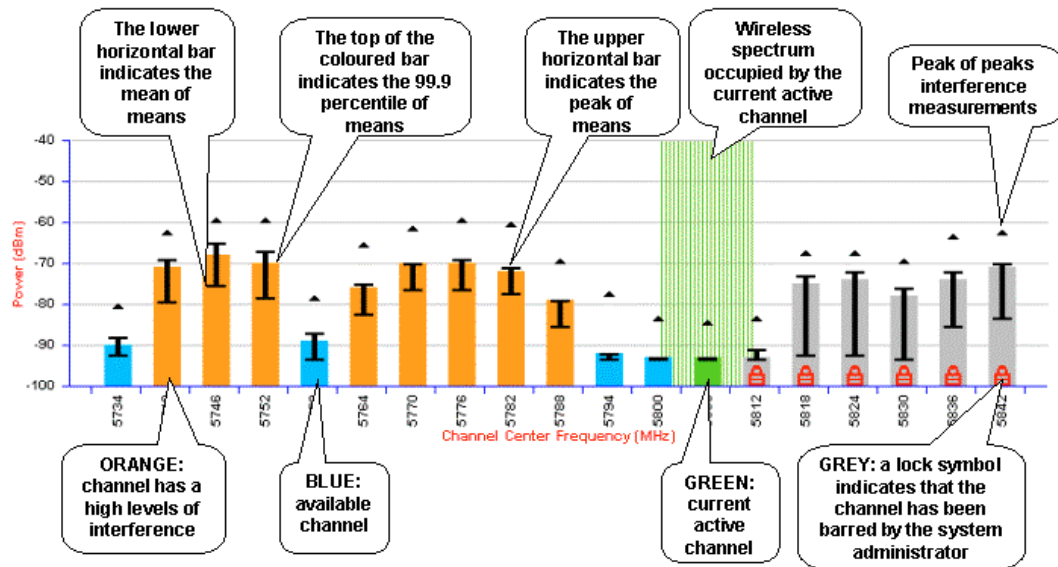
6.3.8.10 Spectrum Management Online Help

Because the Spectrum Management displays contain a large amount of data, symbols and colour references, an online help screen has been provided. This screen is accessible from both the master and slave webpages.

Figure 40 gives a high level overview of the DFS webpage.

Spectrum Management Help Page

Channel barring is achieved by clicking the channel to be barred. Un-barring of channels is achieved by clicking the channel to be un-barrd. Note the channel barring /un-barring will take effect immediately.



Measurements for all channels can be displayed in a 'pop-up' timeseries plot window. This feature is activated by holding the shift key down and clicking the channel of interest.

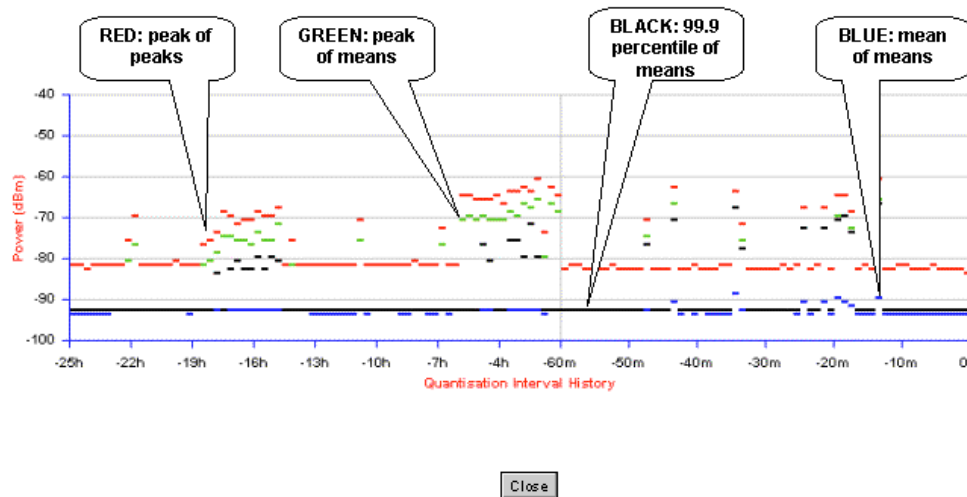


Figure 40 - Spectrum Management Help Page

6.3.9 Spectrum Management (Fixed Frequency)

The OS-Spectra software allows a user to optionally fix transmit and receive frequencies for a wireless link. Once configured the spectrum management software will not attempt to move the wireless link to channel with lower co and adjacent channel interference. Therefore this

mode of operation is only recommended for deployments where the installer has a good understanding the prevailing 5.8 GHz interference environment. (See Wireless Configuration - Fixed Transmit Frequency, Fixed Receive Frequency). Care must also be taken to ensure that the frequency allocations at each end of the link are compatible. To help the user when identifying the mode of operation Spectrum Management uses two visual cues. See Figure 41. The main page title identifies the mode of operation using the '- Fixed Frequency Mode' postfix., and the selected channels are identified by a red capital 'F'.

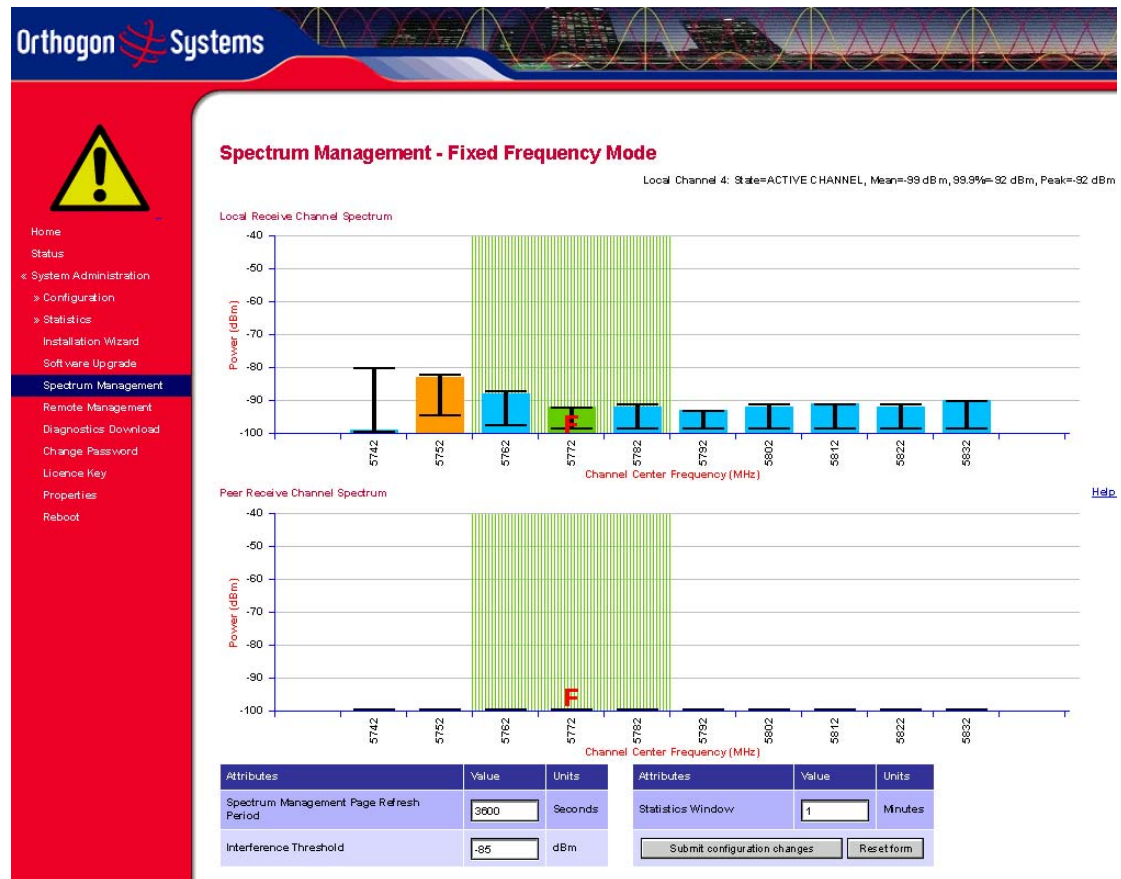


Figure 41 - Spectrum Management Fixed Frequency Screen

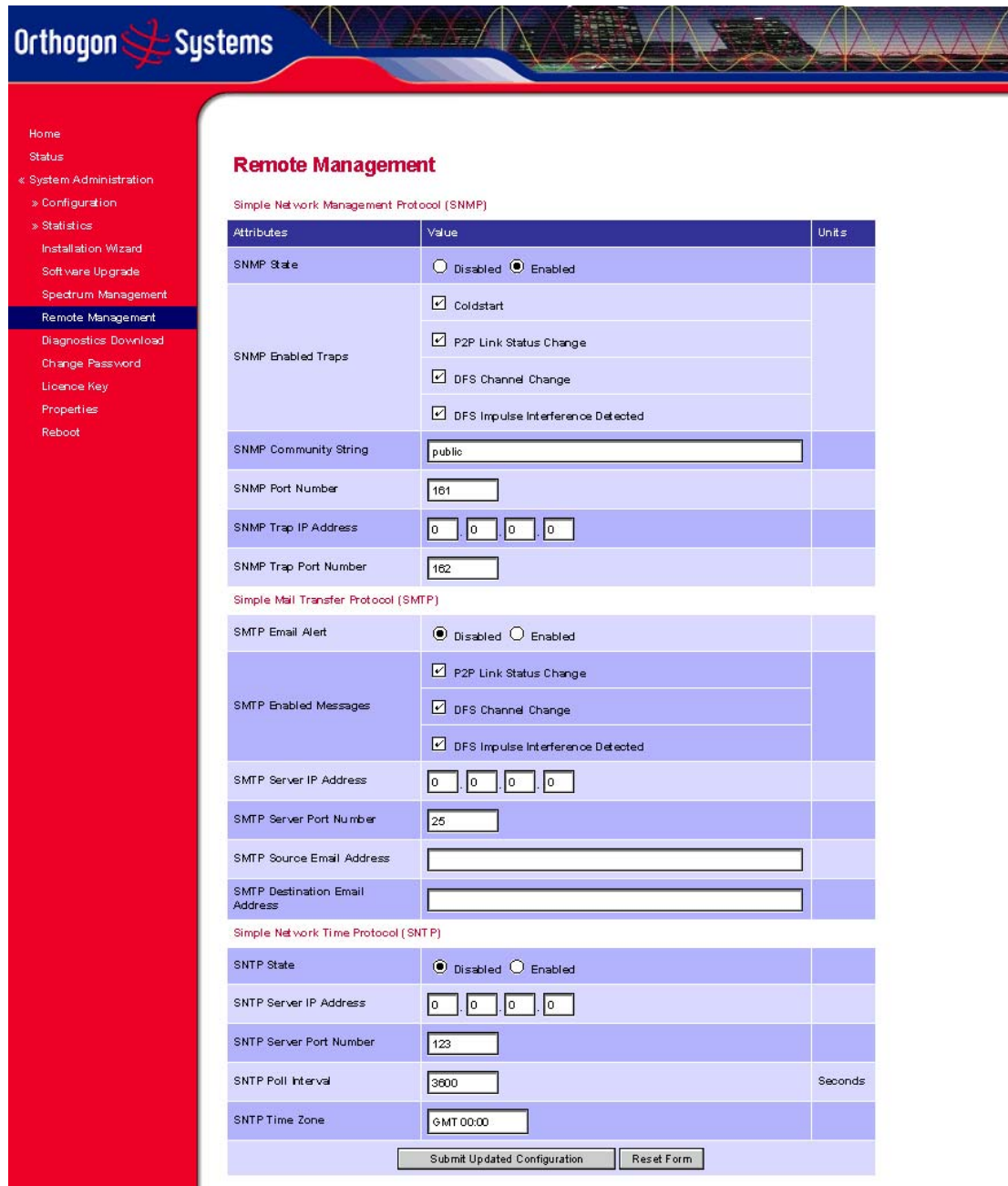
Channel barring is disabled in fixed frequency mode; it is not required as dynamic channel hopping is prohibited in this mode.

The only controls available to the master are the Statistics Window and Interference Threshold attributes. They will have no effect of the operation of the wireless link and will only effect the generation of the channel spectrum graphics.

The active channel history menu is removed in this mode of operation as channel hopping is prohibited.

6.3.10 Remote Management Page

The Remote Management page (Figure 42) allows the system administrator to configure the remote management of the OS-Spectra.



Remote Management

Simple Network Management Protocol (SNMP)

Attributes	Value	Units
SNMP State	☐ Disabled ☒ Enabled	
SNMP Enabled Traps	☒ Coldstart ☒ P2P Link Status Change ☒ DFS Channel Change ☒ DFS Impulse Interference Detected	
SNMP Community String	public	
SNMP Port Number	161	
SNMP Trap IP Address	0 . 0 . 0 . 0	
SNMP Trap Port Number	162	

Simple Mail Transfer Protocol (SMTP)

Attributes	Value	Units
SMTP Email Alert	☒ Disabled ☐ Enabled	
SMTP Enabled Messages	☒ P2P Link Status Change ☒ DFS Channel Change ☒ DFS Impulse Interference Detected	
SMTP Server IP Address	0 . 0 . 0 . 0	
SMTP Server Port Number	25	
SMTP Source Email Address		
SMTP Destination Email Address		

Simple Network Time Protocol (SNTP)

Attributes	Value	Units
SNTP State	☒ Disabled ☐ Enabled	
SNTP Server IP Address	0 . 0 . 0 . 0	
SNTP Server Port Number	123	
SNTP Poll Interval	3600	Seconds
SNTP Time Zone	GMT 00:00	

Submit Updated Configuration Reset Form

Figure 42 - Remote Management

6.3.10.1 SNMP (Simple Network Management Protocol)

The industry standard remote management technique is SNMP (Simple Network Management Protocol). The OS-Spectra supports version 1 and version 2 of the SNMP protocol.

6.3.10.2 Supported Management Information Bases (MIBS)

The industry standard remote management technique is SNMP (Simple Network Management Protocol). The OS-Spectra supports SNMP version 1 and version 2.

The OS-Spectra SNMP stack currently supports three distinct MIBs:

- MIB-II, RFC-1213, The OS-Spectra supports the 'System Group' and 'Interfaces Group'.
- Bridge MIB, RFC-1493, The OS-Spectra supports the 'dot1dBase Group' and the 'dot1dBasePortTable Group'.
- OS-Gemini proprietary MIB

SNMP TRAPs supported:

- Cold Start
- Link Up
- Link Down
- DFS Channel Change
- DFS Impulsive Interference

Orthogon Systems MIB, Proprietary MIB definition

For a copy of the Orthogon Systems proprietary MIB RFC please visit the [Orthogon Systems website](#).

6.3.10.3 SNMP Configuration

SNMP State The SNMP state attribute controls the creation of the SNMP features. Changing the SNMP state attribute requires a mandatory reboot of the unit. Only when the SNMP state is enabled at system start-up will the SNMP processor task be created.

SNMP Enabled Traps The SNMP Enabled Traps attribute controls which SNMP Traps the unit will send.

SNMP Community String The SNMP community string acts like a password between the networks SNMP management entity and the distributed SNMP clients (OS-Spectra units). Only if the community string is configured correctly on all SNMP entities can the flow of management information take place. By convention the default value is set to 'public'. When the community string is changed the system requires a mandatory reboot before the new string or phrase is adopted.

SNMP Trap IP Address Is the address of either the network SNMP manager or Trap receiver. When asynchronous events (Traps in SNMP terminology) are generated the client unicasts these to this IP Address. When the address is changed the system requires a mandatory reboot before the setting is adopted

SNMP Trap Port Number The SNMP Trap Port Number is the port number of either the networked SNMP manager or Trap receiver. By convention the default value for the port number is 162. When the port number is changed the system requires a mandatory reboot before the setting is adopted.

6.3.10.4 SMTP (Simple Mail Transport Protocol)

The SMTP client is an alternative method for the OS-Spectra to alert the outside world when there are or have been system errors

SMTP Email Alert This attribute controls the activation of the SMTP client.

SMTP Enabled Messages The SMTP Enabled Messages attribute controls which email alerts the unit will send.

SMTP IP Address The IP address of the networked SMTP server.

SMTP Port Number The SMTP Port Number is the port number used by the networked SMTP server. By convention the default value for the port number is 25.

SMTP Source Email Address The email address used by the OS-Spectra to log into the SMTP server with. This must be a valid email address that will be accepted by your SMTP Server

SMTP Destination Email Address The email address to which the OS-Spectra will send the alert messages.

6.3.10.5 SNTP (Simple Network Time Protocol)

The SNTP client allows the OS-Spectra to obtain accurate date and time updates from a networked timeserver. The resultant time information is used by the SNMP, webpage and System Reboot tasks.

SNTP State The SNTP state attribute controls the creation of the SNTP features.

SNTP IP Address The IP address of the networked SNTP server.

SNTP Port Number The port number of the networked SNTP server. By convention the default value for the port number is 123.

SNTP Poll Interval The period at which the SNTP client polls the server for time correction updates. Default 1 hour. If for any reason an SNTP poll fails the client will automatically perform 3 retries before waiting for the user defined poll period.

SNTP Time Zone The SNTP time zone is a fixed offset from GMT that is added to the correct time to allow the expression of time in all geographic time zones.

6.3.11 Diagnostics Download

The diagnostics download page allows the system administrator to download snapshots of system diagnostics.



Figure 43 - Diagnostics Download

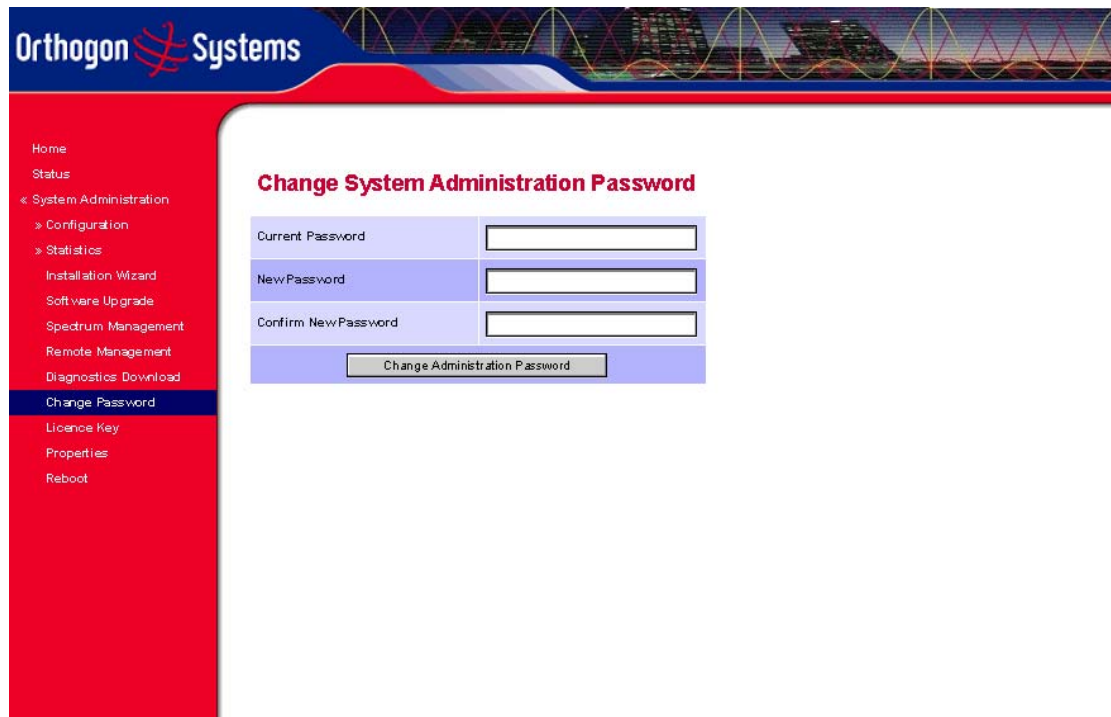
The following diagnostics are available:

- Vector Error Histogram.
- Rx Power
- Rx Gain
- Tx Power
- Signal Strength Ratio V/H
- Link Loss
- Rx Data Rate
- Tx Data Rate

All diagnostics are extracted from the associated status and statistics webpage histograms. They are translated in a CSV file containing at most 3600 entries which equates to one hour's worth of diagnostics. Each entry is a one second average of the number of samples the OS-Spectra makes in a one second period.

6.3.12 Change System Administration Password

This page (Figure 44) is used to change the password for the system administration (The factory default is blank).



The screenshot shows the Orthogon Systems web interface. On the left is a red sidebar with a navigation menu. The main content area is white and titled 'Change System Administration Password'. It contains three input fields for 'Current Password', 'New Password', and 'Confirm New Password', followed by a 'Change Administration Password' button.

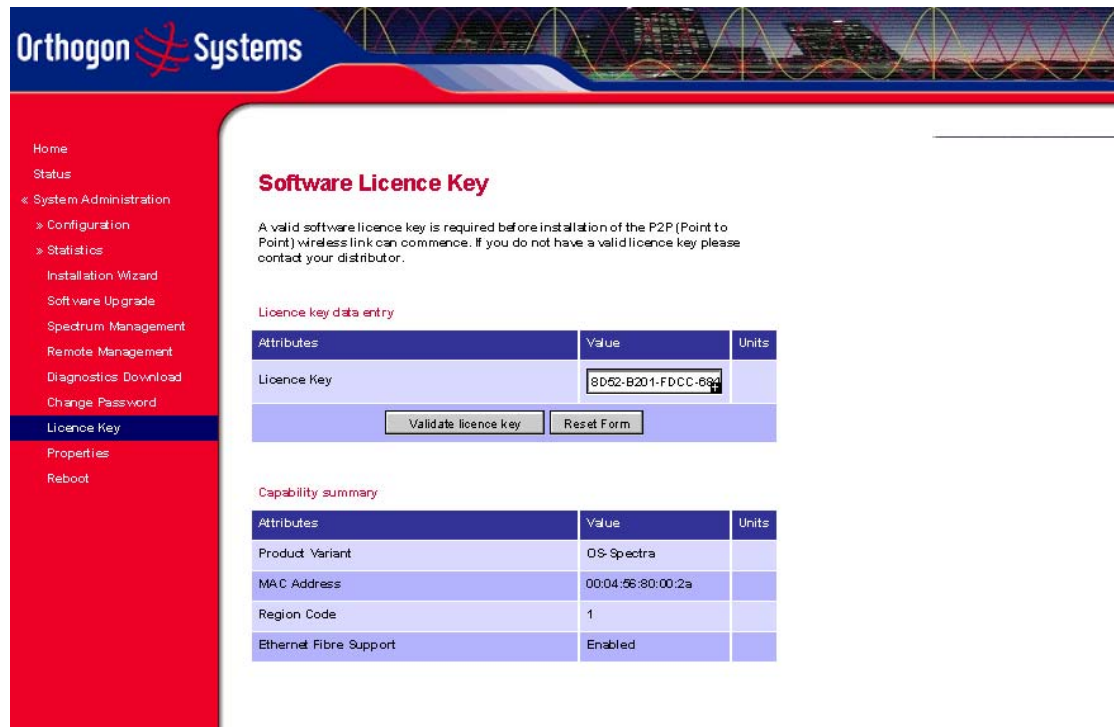
Change System Administration Password	
Current Password	
New Password	
Confirm New Password	
Change Administration Password	

Figure 44 - Password Change

To change the password any combination of alphanumeric characters, up to 31 characters in length, can be used.

6.3.13 Licence Key

The Licence Key data entry page allows the system administrator to update the OS-Spectra licence key. Figure 24 shows an example licence key data entry page.



Software Licence Key

A valid software licence key is required before installation of the P2P (Point to Point) wireless link can commence. If you do not have a valid licence key please contact your distributor.

Licence key data entry

Attributes	Value	Units
Licence Key	8D52-B201-FDCC-680	

Validate licence key Reset Form

Capability summary

Attributes	Value	Units
Product Variant	OS-Spectra	
MAC Address	00:04:56:80:00:2a	
Region Code	1	
Ethernet Fibre Support	Enabled	

Figure 45 - Software Licence Key Data Entry

The user must enter the licence key and click the 'Validate Licence Key' button to check that the key is valid and program it to non-volatile memory.

If a valid licence key is detected then the user will be presented by a system reboot screen, see Figure 46.

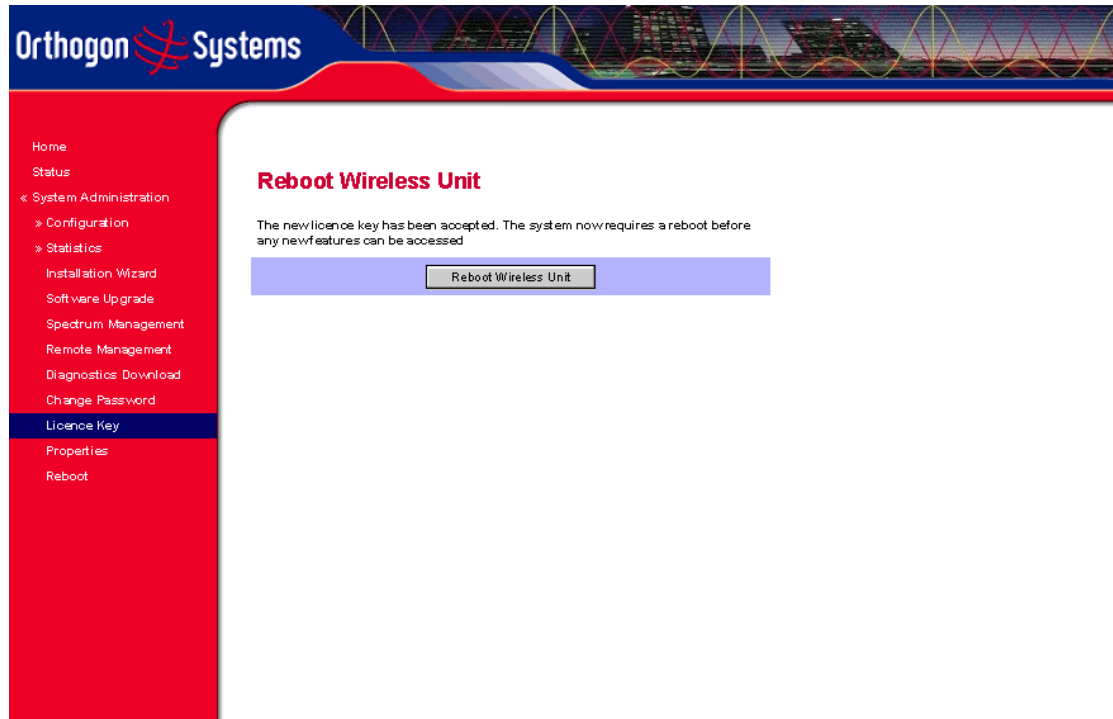


Figure 46 - Licence Key Reboot Screen

6.3.14 Properties

The web page properties screen allows the user to configure the webpage interface.

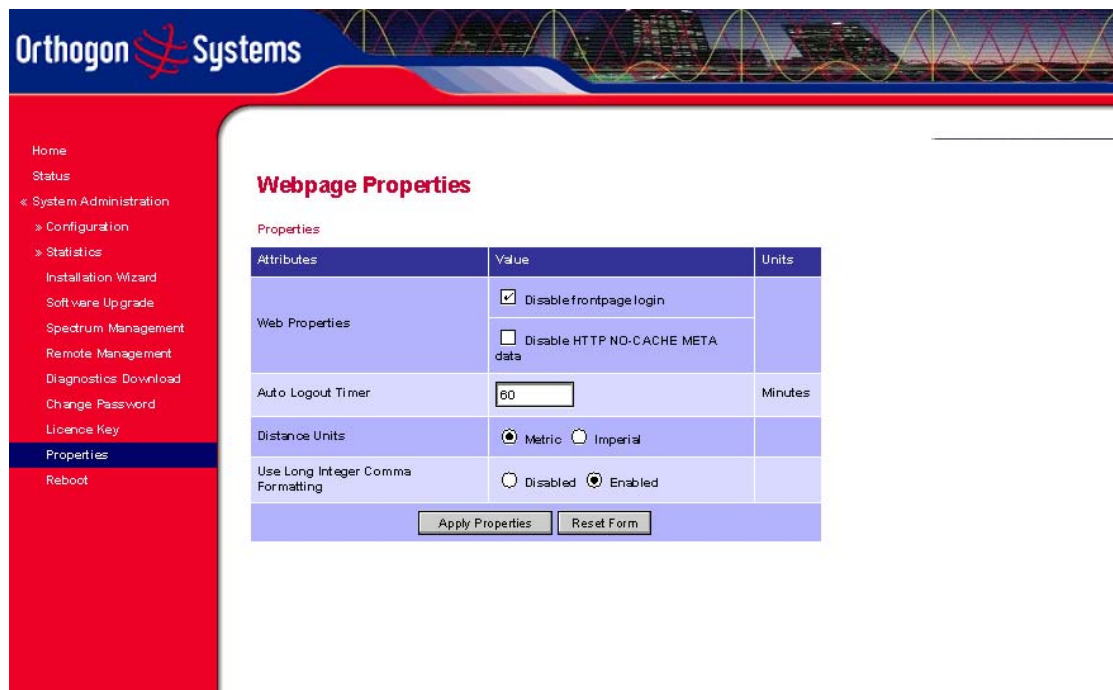


Figure 47 - Properties

WEB Properties: Disable Front Page Animated GIF Replaces the homepage animated OS-Spectra gif with a OS-Spectra static.

WEB Properties: Disable Front Page Login Allow access to homepage and status page webpages without forcing a login as the system administrator.

WEB Properties: Disable HTTP NO-CACHE META data Removes the HTTP NO-CACHE META clause from all dynamically created webpages.

Auto Logout Timer Configures the time in minutes that the system administrator is automatically logged out if no webpage activity is detected.

Distance Units Swaps the default metric display of distance in to imperial units. For example Km into Miles.

6.3.15 Reboot

The reboot page allows the system administrator to perform commanded reboots of the wireless unit. The reboot page also allows the system administrator to view a list of past reboot reasons. The 'reasons for reboot field has been implemented as a drop down selection box, where the latest reason for reboot is located at the top of the list.

If the SNTP service from the remote management section above is active then the command reboot commands will be accompanied by the date and time the reboot was requested.

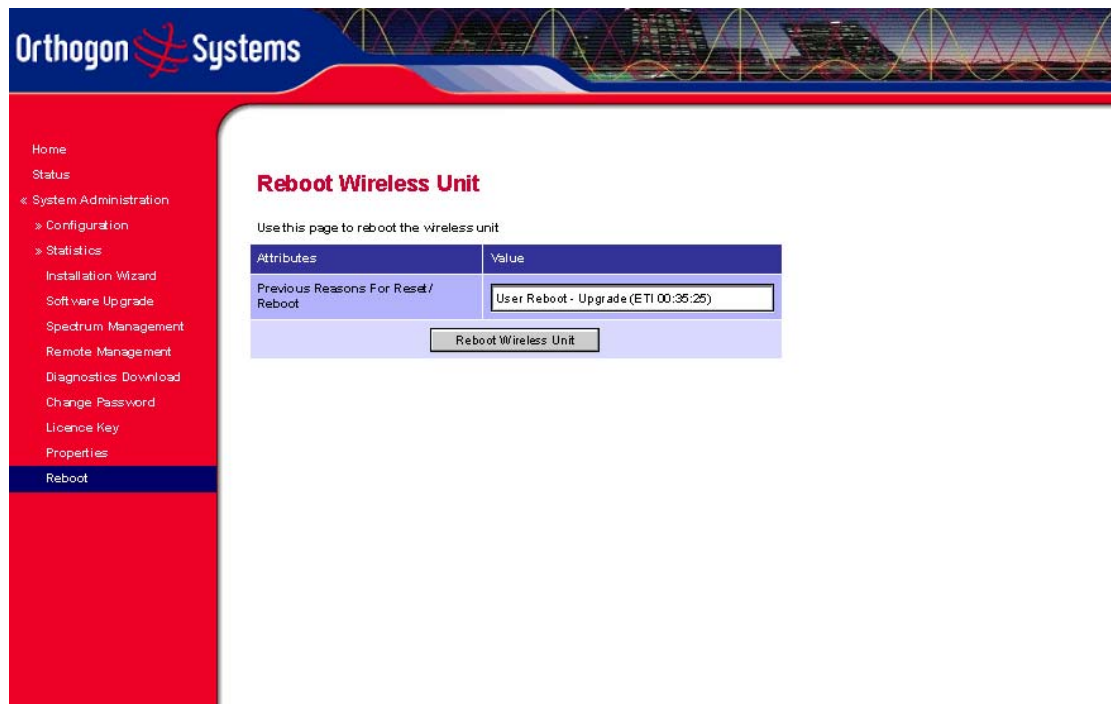


Figure 48 - System Reboot

7 Recovery Mode

The OS-Spectra has a special mode of operation that allows the user to recover a unit from configuration errors or software image corruption.

Recovery mode is entered by depressing the Recovery Switch located on the underside of the SPIDU while applying mains power, as shown in section 1.3.2 “The OS-Spectra Power Indoor Unit”. The Recovery Switch should be held in the depressed state for between 10 and 20 seconds after application of mains power.

When in recovery mode the user will be able to access the unit via the Ethernet interface. The Ethernet interface will have it's IP address set to 10.10.10.10.

8 Fault Finding

If communication has been lost with the unit at the near end of the link then there may be a hardware fault with the wiring, network or hardware. Go to the hardware section below. If communication with the far end of the link is lost then go to the radio section below.

8.1 Hardware

If there are problems suspected with the link hardware the following procedure is recommended.

The following diagram illustrates the main system connections.

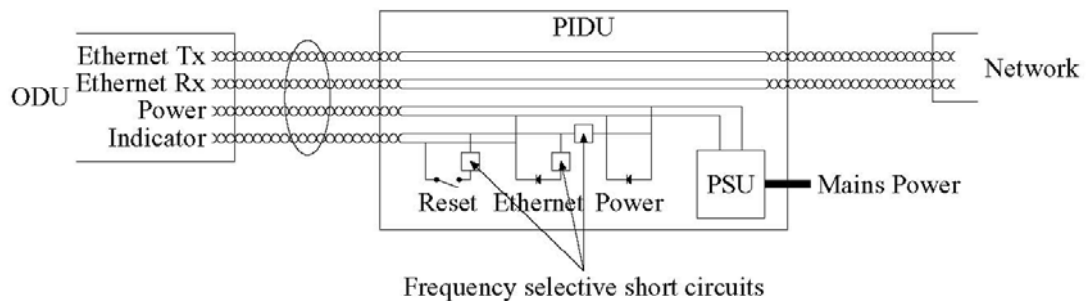


Figure 49 - Main System Connections

8.1.1 Power

Check the power LED at each end of the link. If the power lights are illuminated go to the Ethernet section below. If at either end they are not illuminated then¹² check the Ethernet LED. If neither are illuminated then there is no voltage on the power wires to the ODU.

1. Check that the mains power is connected and switched on.
2. Check that the lamp illuminates if the ODU connector is disconnected at the SPIDU. (Remove the SPIDU cover).
 - a. If it does illuminate then either the ODU is drawing too much current, or the power wiring to the ODU is short circuit or the PSU is supplying insufficient power. The likely fault can be determined by removing the jumper (J906), found inside the removable cover of the SPIDU, and measuring the current taken with an ammeter placed across the 2 jumper pins. This is normally 10mA without the ODU connected and 300mA to 1A when the ODU is connected.
 - b. If it does not illuminate then recheck that power is applied to the SPIDU by measuring the voltage across +55V and 0V pads inside the removable cover in the SPIDU. Check that the SPIDU is not short circuit by measuring the impedance across the Power connector. Is the lamp faulty?

¹² The power indicator LED should be continually illuminated.

8.1.2 Ethernet

The Ethernet LED is driven from the ODU processor and thus is capable of informing you of many conditions using different flash sequences. If the Ethernet indicator does not illuminate at all there are four possible conditions.

1. There is no power reaching the ODU because of a wiring fault
2. The ODU is faulty
3. The SPIDU is faulty
4. The Ethernet network side is faulty

Look at the following table to check the LED response for power up, disconnect the power and reapply and note what happens.

Differentiating between 1--3 and 4 can be achieved by removing the power for 1 second. Watch the Ethernet indicator for 1 minute, if it never flashes then the problem is 1—3. Take the jumper (J906) out of the SPIDU and check the current taken by the ODU. This should be 300mA to 1A when starting through to running normally.

If the Ethernet indicator flashes to begin with but then stops flashing then ODU is powered and software loaded but Ethernet connectivity has been lost between the ODU and the users connected equipment. All Ethernet connections should be rechecked.

Power Indoor Unit LED check chart:

Mode	Green LED	Yellow LED No Ethernet Cable Connected	Yellow LED Ethernet Cable Connected between SPIDU and NIC/Switch/Hub
No Power Applied	Off	Off	Off
Power Applied	On	Will flash once per second regularly approximately 16 seconds after power applied for 10 seconds then will go out and stay out	Will flash once per second regularly approximately 16 seconds after power applied for 10 seconds then operate as Ethernet Link/Activity LED
Valid Ethernet Link and no traffic	On	N/A	Will be on solid for a valid link.
Valid Ethernet Link with traffic	On	N/A	Will be on solid, but will blink randomly as traffic passes through
Whilst Reset Switch Pressed	On	Off	Off

Reset Switch Pressed and released within 10 seconds during normal operation	On	Off	Off whilst switch pressed but returns to LINK/Activity state when released. No reset will take place
Reset Switch Pressed and held for > 20 seconds during normal operation	On	Off whilst switch pressed. One second after release, flashes twice per second regularly for 10 seconds, then erases non-volatile configuration data and resets. The erasure will reset all the unit's configuration apart from the last known wireless link configuration, this ensures that after a reset the wireless link SHOULD re-establish without any user intervention. The IP address will be reset to 10.10.10.10	
Reset Switch Pressed and held for >40 seconds from power on (Reset is pressed whilst power is applied)	On	Off whilst switch pressed. One second after release, flashes twice per second regularly for 10 seconds, then erases non-volatile configuration data & the downloaded image and resets. The erasure will reset all the unit's configuration apart from the last known wireless link configuration, this ensures that after a reset the wireless link SHOULD re-establish without any user intervention. The IP address will be reset to 10.10.10.10 and the unit will boot the fixed software image.	

8.2 Radio

8.2.1 No Activity

If communication over the radio link has been lost and the unit at the other end of the link can be managed on its local network. The following procedure should be adopted:

If there is no wireless activity then the configuration should be checked. It is essential that the following items are correct

- Check that the software at each end of the link is the same version
- Check that the Target Mac address has not been mis-configured at each end of the link.
- Check Range
- Check Tx Power
- Check License key
- Check Master Slave
- Check for Alarm conditions on Home page
- Check that the link has not been further obscured or the ODU misaligned.
- Check the DFS page at each end of the link and establish that there is a common quiet wireless channel to use.

If there are no faults found in the configuration and there is absolutely no wireless signal retry the installation procedure. If this doesn't work then the ODU may be faulty.

8.2.2 Some Activity

If there is some activity but the link is unreliable or doesn't achieve the data rates required then

- Check that the interference has not increased using the DFS measurements
- If a quieter channel is available check that it is not barred
- Check that the path loss is low enough for the communication rates required
- Check that the ODU has not become misaligned

9 Specifications

9.1 System Specifications

Radio Technology	Specification	
RF Band	5.725-5.850GHz	
Channel Selection	By dynamic frequency control and manual intervention Automatic detection on startup and continual adaptation to avoid interference.	
Dynamic Frequency Control	Initial capture 10-15 sec. Out of service on interference 100 ms.	
Channel size	27 MHz	
Tx power @ Antenna ports	Mode	Maximum Power Output (region dependant) ¹³
	BPSK Mode	24 dBm
	QPSK Modes	24 dBm
	16QAM Modes	21 dBm
	64QAM Modes	19 dBm
	256QAM Modes	18 dBm
Transmit Power Control	Loop bandwidth 1 Hz, Range 30dB typical	
Manual Power Control	Maximum power can be controlled lower than the power limits shown above in order to control interference to other users of the band.	
Receiver Noise Figure	Typically 6 dB	

¹³ As specified by FCC Part 15.247

The receive sensitivities and system gains for each mode are as follows:

THIS TABLE IS TO BE CONFIRMED BEFORE PRODUCTION RELEASE

Mode	Threshold (dBm)	Transmit Power (dBm)	Link Budget (dB)
BPSK (Single)	-93.0	24.0	164.0
QPSK (Single)	-89.7	24.0	160.7
16 QAM (Single)	-84.4	22.0	153.4
16 QAM (Dual)	-80.3	22.0	149.3
64 QAM (Dual)	-73.1	19.0	139.1
256QAM (Dual)	-65.6	18.0	130.6

Table 8 - Receive Sensitivity and System Gains

The values quoted here are static sensitivity measurements. When AMOD is in operation, margins are applied to the up and down shifts between modes to ensure seamless changes without loss of data. The margins applied are dynamic and selected dependant on the prevailing link conditions. Link conditions are continually monitored. When multipath is detected a 5dB margin is applied to both up and down mode changes. When no multipath is detected a 2dB margin is applied.

Antenna	
Antenna Type	Integrated flat plate antenna
Antenna Gain	23.5 dBi typical
Antenna Beamwidth	8 Degrees

Wireless PHY	
Max Path Loss	164dB
Duplex Scheme	TDD, Symmetric (1:1)
Range	125 miles (200km) optical Line-of-Sight 6 miles (10km) non-Line-of-Sight
Over-the-Air Encryption	Proprietary scrambling mechanism. Optional AES – via licence update.
Weather Sensitivity	Sensitivity at higher modes may be reduced during high winds through trees due to Adaptive Modulation Threshold changes
Error Correction	FEC and ARQ

Management	
Status Indication	Power status
	Ethernet Link Status
	Data activity
Installation	Web server and browser for setup
	Audio tone feedback during installation
	Web server for confirmation
Radio Performance and Management	Via web server and browser, SNMP
Alarms	Via configurable email alerts, SNMP

Ethernet Bridging	
Protocol	IEEE802.1; IEEE802.1p; IEEE802.3 compatible
Interface	10/100/1000BaseT (RJ-45), Supports MDI/MDIX Auto Crossover
Data Rate 0 – 5 km Mode	BPSK 0.67 (Single) 6.49 Mbps QPSK 0.67 (Single) 12.98 Mbps 16 QAM 0.67 (Single) 25.95 Mbps 16 QAM 0.67 (Dual) 51.90 Mbps 64 QAM 0.78 (Dual) 93.38 Mbps 256 QAM 0.83 (Dual) 134.95 Mbps
Data Rate 0 – 40 km Mode	Reduces by 21.5%
Data Rate 0 – 130 km Mode	Reduces by 43.4%
Data Rate 0 – 200 km Mode	Reduces by 61.2%

Note: Practical Ethernet rates will depend on network configuration, higher layer protocols and platforms used.

Physical	
Dimensions	Width 14.5" (370mm), Height 14.5" (370mm), Depth 3.75" (95mm)
Weight	12.1 lbs (5.5 Kg) including bracket

Power Supply	Separate power supply unit (included)
Power source	90 – 264 VAC, 50 – 60 Hz
Power consumption	45/50 W mean

9.2 Safety Compliance

Region	Specification
USA	UL 60950
Canada	CSA C22.2 No.60950
International	CB certified & certificate to IEC 60950

9.3 EMC Emissions Compliance

Region	Specification
USA	FCC Part 15 Class B
Canada	CSA Std C108.8, 1993 Class B
Europe	Designed to comply with EN55022 CISPR 22

9.4 EMC Immunity Compliance

Top-level Specification ETSI 301-489.

Designed to comply with:

Specification	Comment
EN 55082-1 Generic EMC and EMI requirements for Europe	
EN 61000-4-2: 1995 Electro Static Discharge (ESD), Class 2, 8 kV air, 4 kV contact discharge	Testing will be carried to ensure immunity to 15kV air and 8kV contact
EN 61000-4-3: 1995 ENV50140: 1993 (radiated immunity) 3 V/m	
EN 61000-4-4: 1995 (Bursts/Transients), Class 4, 4 kV level (power lines AC & DC)	Signal lines @ 0.5 kV open circuit voltage.
EN 61000-4-5: 1995, (Surge Immunity)	Requires screened connection to users network
EN 61000-4-6: 1996 (Injected RF), power line, Class 3 @ 10 V/m	Signal lines, Class 3 @ 3 V RMS un-modulated.

9.5 Radio Certifications

Region	Specification (Type Approvals)
USA	FCC Part 15.247

9.6 Environmental Specifications

Category	Specification
Temperature	ODU: -40°F(-40°C) to 140°F (+60°C) SPIDU & PSU: 32°F(0°C) to 104°F(+40°C)
Wind Loading	151mph Max (242kph)
Humidity	100% Condensing
Waterproof	IP65 (ODU), IP53 (SPIDU)
UV Exposure	10 year operational life (UL746C test evidence)

9.7 System Connections

9.7.1 ODU to SPIDU Connection

ODU				SPIDU
Pin 1		0V to ODU (White/Orange)		Pin 1
Pin 2		0V to ODU (Orange)		Pin 2
Pin 3		0V to ODU (White/Green)		Pin 3
Pin 4		+55V/LED to/from ODU (Blue)		Pin 4
Pin 5		+55V/LED to/from ODU (White/Blue)		Pin 5
Pin 6		0V to ODU (Green)		Pin 6
Pin 7		+55V to ODU – (White/Brown)		Pin 7
Pin 8		+55V to ODU – (Brown)		Pin 8

Figure 50 - ODU to SPIDU Connection Diagram

9.7.2 ODU to Network Connections

ODU Ethernet Connector				Network
PIN 1		Data, pair 1 (White and Orange)		PIN 1
PIN 2		Data, pair 1 (Orange)		PIN 2
PIN 3		Data, pair 2 (Green and White)		PIN 3
PIN 4		Data, pair 3 (Blue)		PIN 4
PIN 5		Data, pair 3 (Blue and White)		PIN 5
PIN 6		Data, pair 2 (Green)		PIN 6
PIN 7		Data, pair 4 (Brown and White)		PIN 7
PIN 8		Data, pair 4 (Brown)		PIN 8

Figure 51- ODU to Network Connection Diagram

10 Lightning Protection

10.1 Overview

The idea of lightning protection is to protect structures, equipment and people against lightning by conducting the lightning current to ground via a separate preferential solid path and by reducing the electromagnetic field.

The following should be treated as a guide only, the actual degree of lightning protection required depends on local conditions and weather patterns and applicable local regulations. Full details of lightning protection methods and requirements can be found in the international standards IEC 61024-1 and IEC 61312-1, the U.S. National Electric Code ANSI/NFPA No. 70-1984 or section 54 of the Canadian Electric Code.

The installation of the ODU can be classified into two different lightning protection zones.

Zone A — In this zone a direct hit is possible.

Zone B — In this zone a direct hit is not possible, but the unattenuated electromagnetic field is still present.

The next diagrams (Figure 52 & Figure 53) show this zoning pictorially:

Equipment mounted in Zone A should be capable of carrying the full lightning current. Mounting of the ODU in Zone A is not recommended. Mounting in Zone A should only be carried out observing the rules governing installations in Zone A¹⁴. Failure to do so may put structures, equipment and life at risk.

Equipment mounted in Zone B should be grounded using grounding wire of at least 10 AWG. This grounding wire should be connected to a grounding rod or the building grounding system before entry in to building.

The OS-Spectra ODU grounding point can be found on the bottom of the unit. The OS-Spectra is supplied with an appropriate grounding lug for attachment to the ODU.

10.2 Detailed Installation

The recommended components for an installation protected for nearby strikes are:

- Grounding Kits — Andrew Type 223158 (www.andrew.com)
- Screened Cat 5 Cable
- Line Protection Units — Transtector ALPU-ALVR (www.transtector.com)
- Grounding Stake
- RJ45 screened connectors

¹⁴ Local regulations may also require the fitting of the 10AWG ground wire referred below.

- 10 AWG Grounding Cable

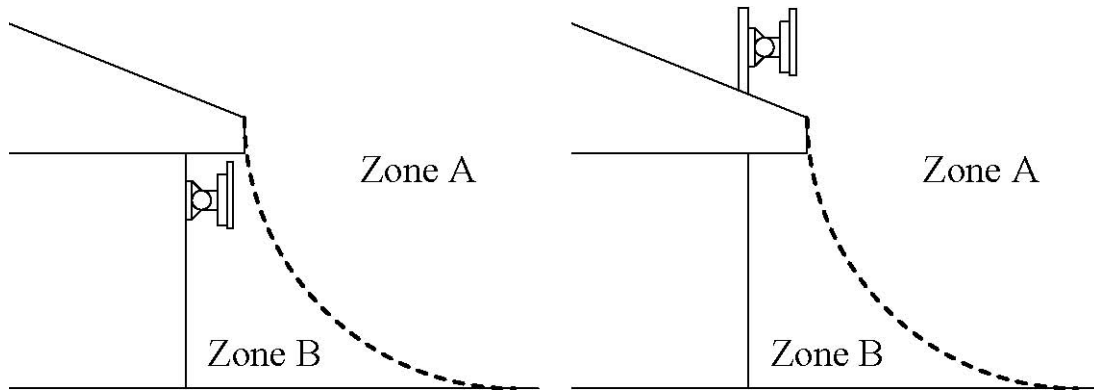


Figure 52 - ODU Mounted in Zone B & ODU Mounted in Zone A

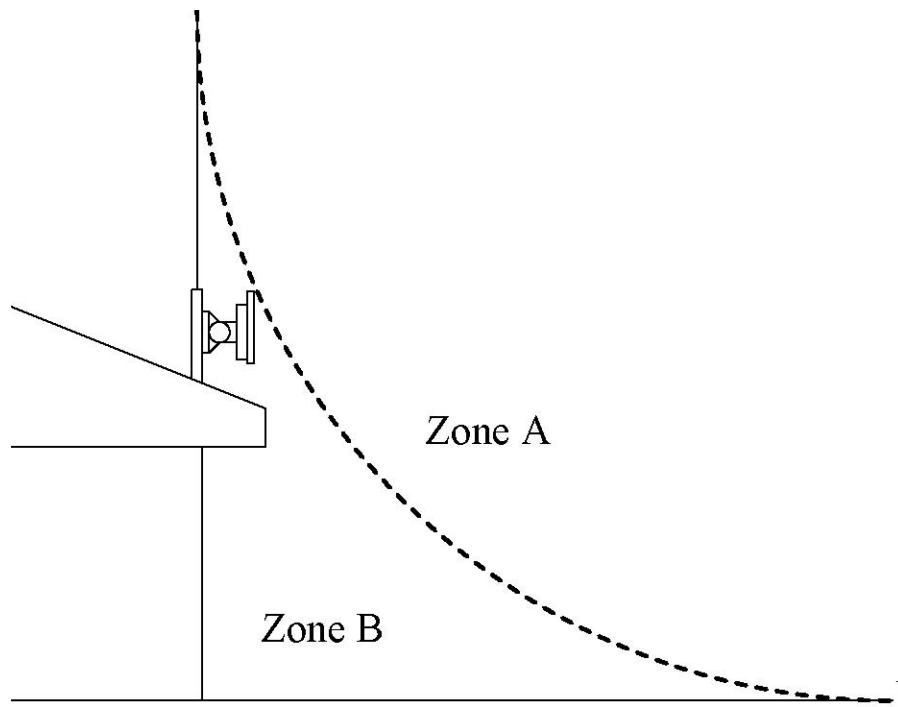


Figure 53 - ODU mounted inside Zone B

	Zone A	Zone B
Earth ODU	Mandatory	Recommended
Screen Cable	Mandatory	Mandatory
Surge Protection Unit at ODU – Transtector	Mandatory	Recommended
Earth Cable at Building Entry	Mandatory	Mandatory
Surge Protection Unit at Building Entry – Transtector	Mandatory	Mandatory

Table 9 - Protection Requirements

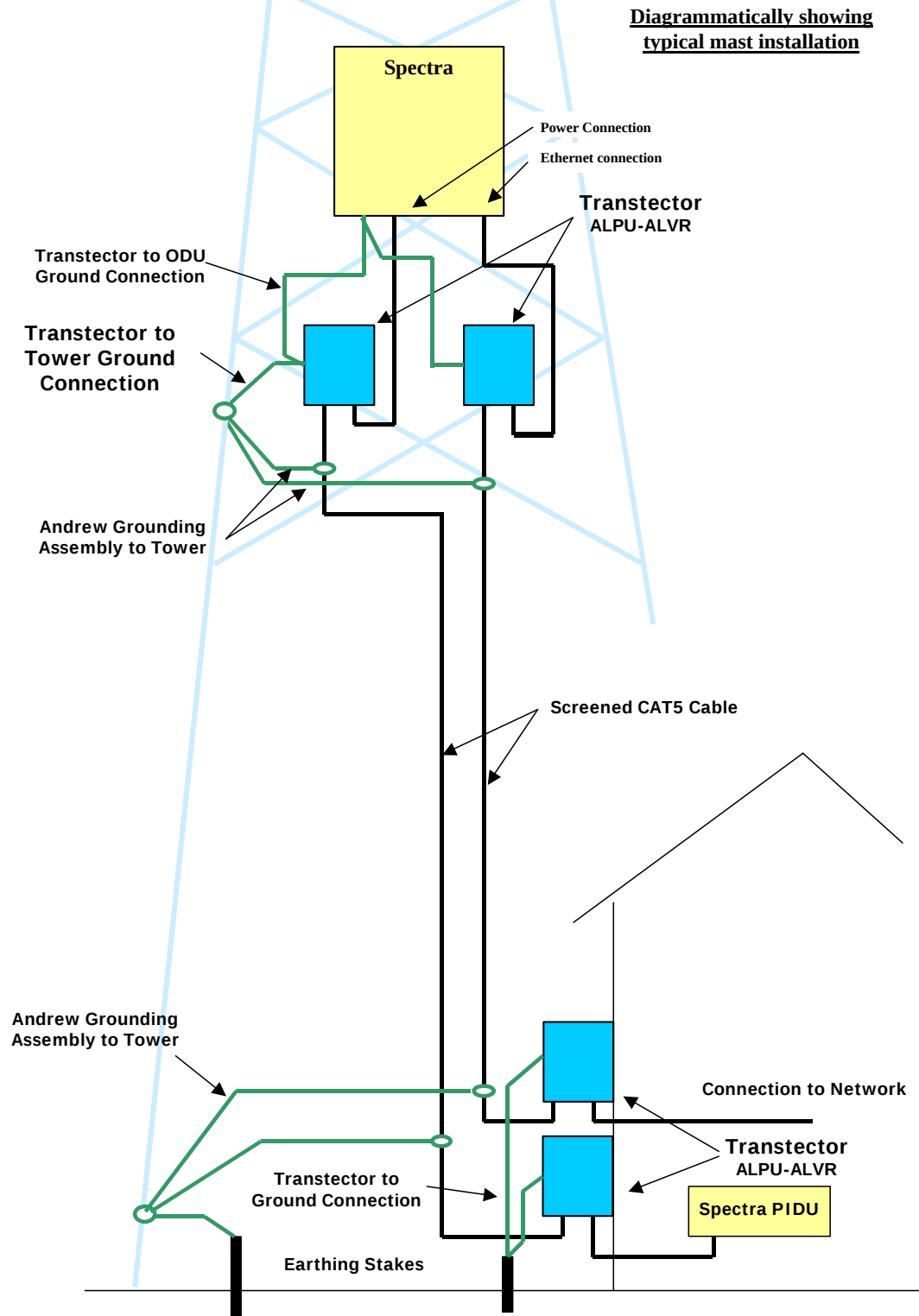


Figure 54 - Diagrammatically Showing Typical Mast Installation

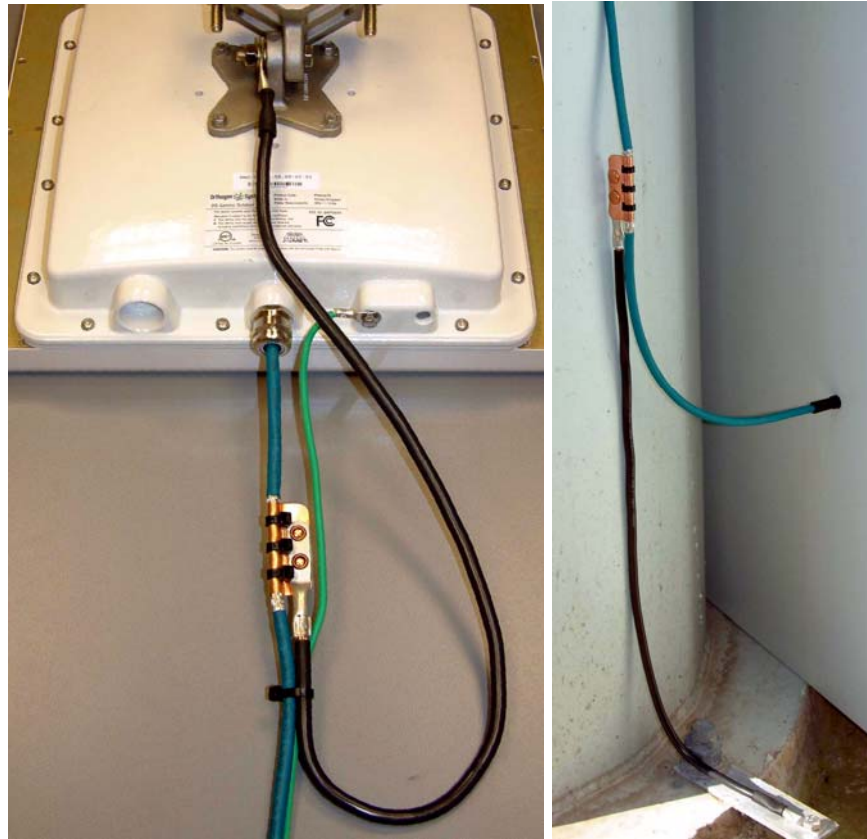


Figure 55 - Upper and Lower Grounding Configurations

The Andrew Grounding Kit at the ODU is optional providing a Surge Protection Unit is located at the ODU and is reliably grounded. However, it may be a regulatory requirement to cross-bond the screened CAT-5 at regular intervals up the mast. Refer to local regulatory requirements for further details.

Surge Protection Units should be mounted at both ends of the external CAT-5 Interface. At the ODU, the Surge Protection Unit should be mounted within 0.5m of the ODU and must be grounded to the ODU. For mast installations, the Surge Protection Unit should be mounted at the same height as the ODU.

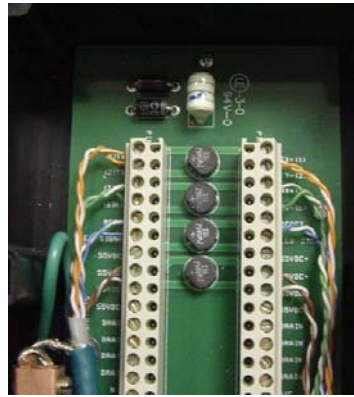
A second Surge Protection Unit should be mounted at the building entry point and must be grounded.

The termination of the CAT-5 Cable into the Surge Protection Unit is illustrated in Figure 56. The screen from the cable must be terminated into the ground terminal within the unit to ensure the continuity of the screen. Earth Sleeving should be used to cover the shield ground connection to prevent internal shorting within the unit.

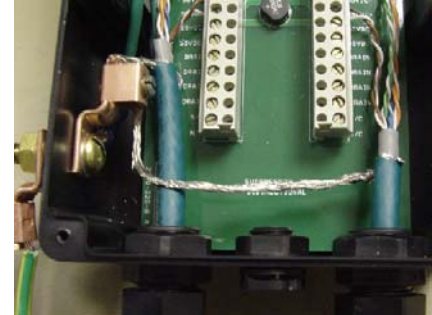


Cable Termination

(Note earth sleeve not shown)



Twisted Pair Termination



Cable Screen Termination

(Note earth sleeve not shown)

Figure 56 - Transtector ALPU-ALVR Connection Illustrations

11 Wind Loading

11.1 General

Antennas and electronic equipment mounted on towers or pole mounted on buildings will subject the mounting structure to lateral forces when there is appreciable wind. Antennas are normally specified by the amount of force (in pounds) for specific wind strengths.

The magnitude of the force depends on both the wind strength and size of the antenna.

11.2 Calculation of Lateral Force

The OS-Spectra unit with or without the integral antenna is essentially a flat structure and so the magnitude of the lateral force can be estimated from:

$$\text{Force (in pounds)} = 0.0042 \cdot A \cdot v^2$$

Where A is the surface area in square feet and v is the wind speed in miles per hour.

The lateral force produced by a single OS-Spectra Unit at different wind speeds is shown below:

Item	Largest Surface Area (sq ft)	Lateral Force (Pound) at windspeed (mph)				
		80	100	120	140	150
Gemini with integrated antenna	1.36	37	57	82	112	129
Connectorised Gemini	1.00	27	42	60	82	95

The equivalent table in metric units is:

Item	Largest Surface Area (sq m)	Lateral Force (kg) at windspeed (m/s)				
		30	40	50	60	70
Gemini with integrated antenna	0.1300	12	22	34	49	66
Connectorised Gemini	0.0930	9	16	24	35	48

Note : When the connectorised version of OS-Spectra is used with external antennas, the figures from the antenna manufacturer for lateral force should be included to calculate to total loading on the mounting structure.

11.3 OS-Spectra Capabilities

The structure and mounting brackets of the OS-Spectra product range is capable of withstanding wind speeds up to 151mph (242kph). The installer should ensure that the structure the OS-Spectra is fixed to is also capable of withstanding the prevalent wind speeds and loads.

11.4 Wind Speed Statistics

Installers are recommended to contact the national meteorological office for the country concerned to identify the likely wind speeds prevalent at the proposed location. This will enable the installer to estimate the total wind loading on the support structures.

Examples of the sort of statistics that are available are:

USA - Reported Fastest Single Wind Velocities for Selected U.S. Cities

(Source: National Weather Service)

City, State	Wind Velocity (mph)
Bismarck, North Dakota	72
Buffalo, New York	91
Chicago, Illinois	87
Hatteras, North Carolina	110
Miami, Florida	132
New York, New York	99
Pensacola, Florida	114

UK Meteorological Office, www.metoffice.gov.uk

Peak windspeed contour maps can be found as Fig 3a/3b at:

<http://www.metoffice.gov.uk/education/historic/1987.html>

12 OS-Spectra-C

12.1 Scope

This Chapter details the changes and additional features relevant to the connectorised variant of the OS-Spectra-C Product, OS 58XXC.

12.2 Product Description

12.2.1 Hardware

The OS-Spectra-C is a variant designed to provide the system integrator and installer with the ability to provide extra capability to cope with very difficult radio links compared to the OS-Spectra Integrated product. The variant allows the use of a variety of externally mounted antennas, either Flat Plate or Dish, which have higher gains than provided by the integrated antenna that is normally used.



Figure 57 - OS-Spectra-C Outdoor Unit

12.2.2 Antenna Choices

The integrated antenna has a gain of 23dBi. External antennas from the list in Table 10 can be used with the OS-Spectra-C. These are approved by the FCC for use with the product and are basically constrained by the following limits:

- Single Polarisation Flat Plate Antennas – up to 28dBi per antenna
- Single/Dual Polarisation Parabolic Dish Antennas – up to 37.7dBi per polarisation or antenna

12.3 Software/Features

The variant operates in the same way as the basic OS-Spectra product and is released initially with the feature set of the OS-Spectra-C product. The areas where the functionality is modified are:

12.3.1 Status Page

The link loss calculation presented on the Status Page on the management interface has to be modified to allow for the increased antenna gains at each end of the link. The manufacturing process of the OS-Spectra-C configures the standard hardware of the unit for use with external antennas. The installer is prompted, as part of the installation process, to enter the gain of the external antenna(s) and cable losses at each end of the link. Peer-2-Peer messaging is used to pass the effective antenna gain to each end of the link so that the link loss calculations can be correctly computed.

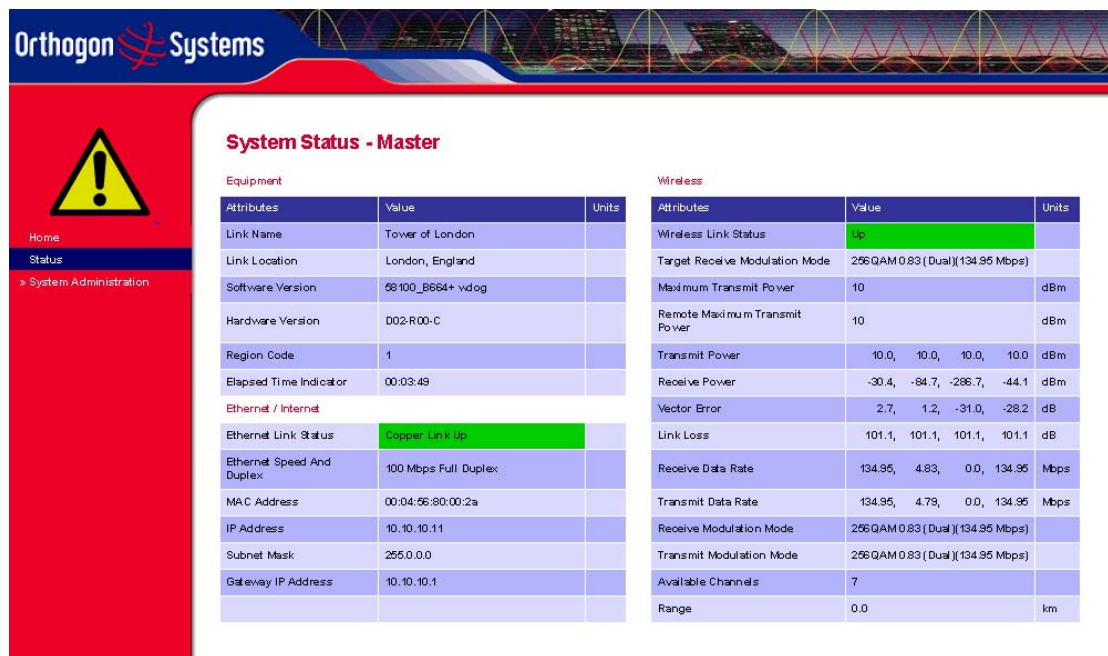
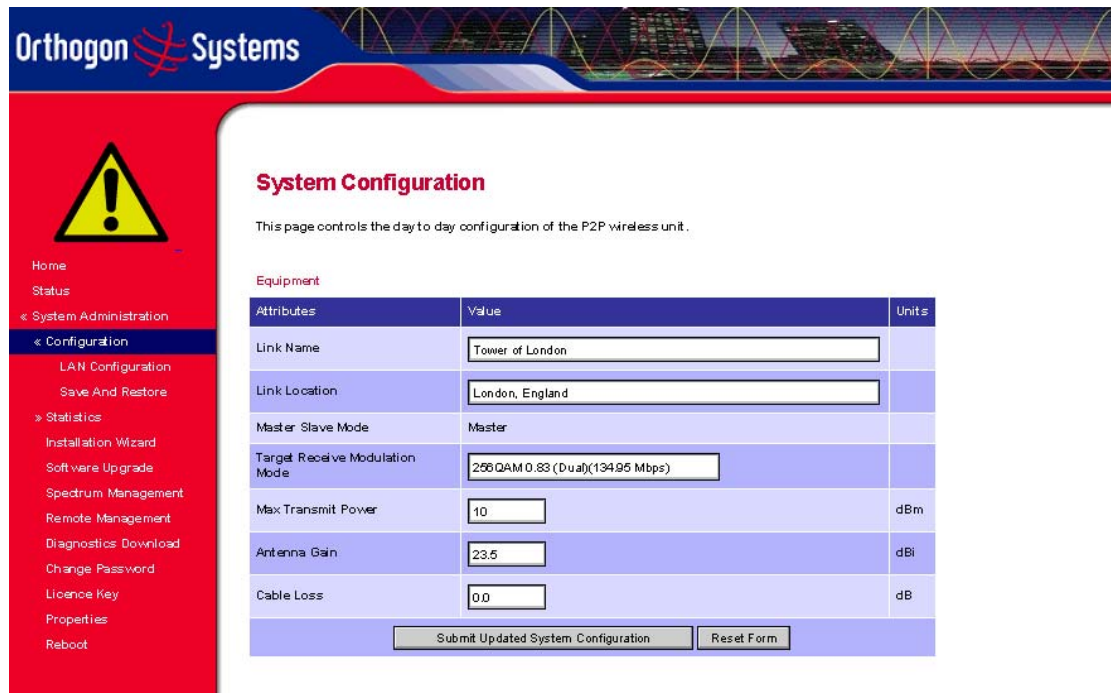


Figure 58 - OS-Spectra-C Status Page

12.3.2 Configuration Pages

The amended Configuration Web page is shown below as Figure 59.



System Configuration

This page controls the day to day configuration of the P2P wireless unit.

Equipment

Attributes	Value	Units
Link Name	Tower of London	
Link Location	London, England	
Master Slave Mode	Master	
Target Receive Modulation Mode	256QAM 0.83 (Dual)(134.95 Mbps)	
Max Transmit Power	10	dBm
Antenna Gain	23.5	dBi
Cable Loss	0.0	dB

Submit Updated System Configuration Reset Form

Figure 59 - OS-Spectra-C 'System Configuration' Page

12.3.3 Installation Pages

The installer is prompted to enter the Antenna Gain and Cable Loss (OS-Spectra-C to antenna) at each end of the link. The Installation Page(s) is shown as Figure 60-Figure 62.



Step 2 of 3: Wireless Configuration

Please enter the following wireless configuration parameters

Wireless data entry

Attributes	Value	Units
Target MAC Address	00:04:56:80:00:25	
Master Slave Mode	☒ Master ☐ Slave	
Max Transmit Power	10	dBm
Ranging Mode	☒ Auto 0-5 km ☐ Auto 0-40 km ☐ Auto 0-100 km ☐ Auto 0-200 km ☐ Target Range	
Target Range	0.0	km
Antenna Gain	23.5	dBi
Cable Loss	0.0	dB
Spectrum Management Control	☒ i_DFS ☐ Fixed Channel ☐ WIMAX	
Lower Center Frequency	5742	MHz

Submit Wireless Configuration Reset Form

Back Next

Figure 60 - OS-Spectra-C 'Installation Wizard' Page

Antenna Gain Gain of the antenna you are connecting to the unit, see Table 12 - Allowed Antennas for Deployment in USA/Canada.

Cable Loss Loss in the cable between the ODU and the antenna. Note: In the event that there is a significant difference in length of the antenna cables for the two antenna ports, then the average value should be entered.

Spectrum Management Control Is used to configure the OS-Spectra Spectrum Management features, see section 6.3.8 for more details. i_DFS is the abbreviation for intelligent Dynamic Frequency Selection, this feature continually monitors the 5.8 GHz spectrum looking for a the channel with the lowest level of on channel and co-channel interference. Fixed frequency mode allows the installer to fix the transmit and receive frequencies on the units. The frequencies may be configured symmetrically or asymmetrically.



- Home
- Status
- System Administration
 - Configuration
 - LAN Configuration
 - Save And Restore
 - Statistics
- Installation Wizard**
- Software Upgrade
- Spectrum Management
- Remote Management
- Diagnostics Download
- Change Password
- Licence Key
- Properties
- Reboot

Step 3 of 3: Confirm Installation Configuration

Please review your entered configuration. If any of the configuration items are incorrect please use the back button to apply the corrections.

Once you're happy with the configuration press the 'Confirm Configuration, Arm Installation Agent and Reboot' button, this will commit the parameters to non-volatile memory and reboot this wireless unit.

Attributes	Value	Units
IP Address	10.10.10.11	
Subnet Mask	255.0.0.0	
Gateway IP Address	10.10.10.1	
Target MAC Address	00:04:56:80:00:25	
Master Slave Mode	Master	
Max Transmit Power	10	dBm
Ranging Mode	Auto 0-5 km	
Antenna Gain	23.5	dBi
Cable Loss	0.0	dB
Spectrum Management Control	i_DFS	
Lower Center Frequency	5742	MHz

Confirm Configuration, Arm Installation Agent and Reboot

Back

Figure 61 - OS-Spectra-C 'Confirm Installation' Page

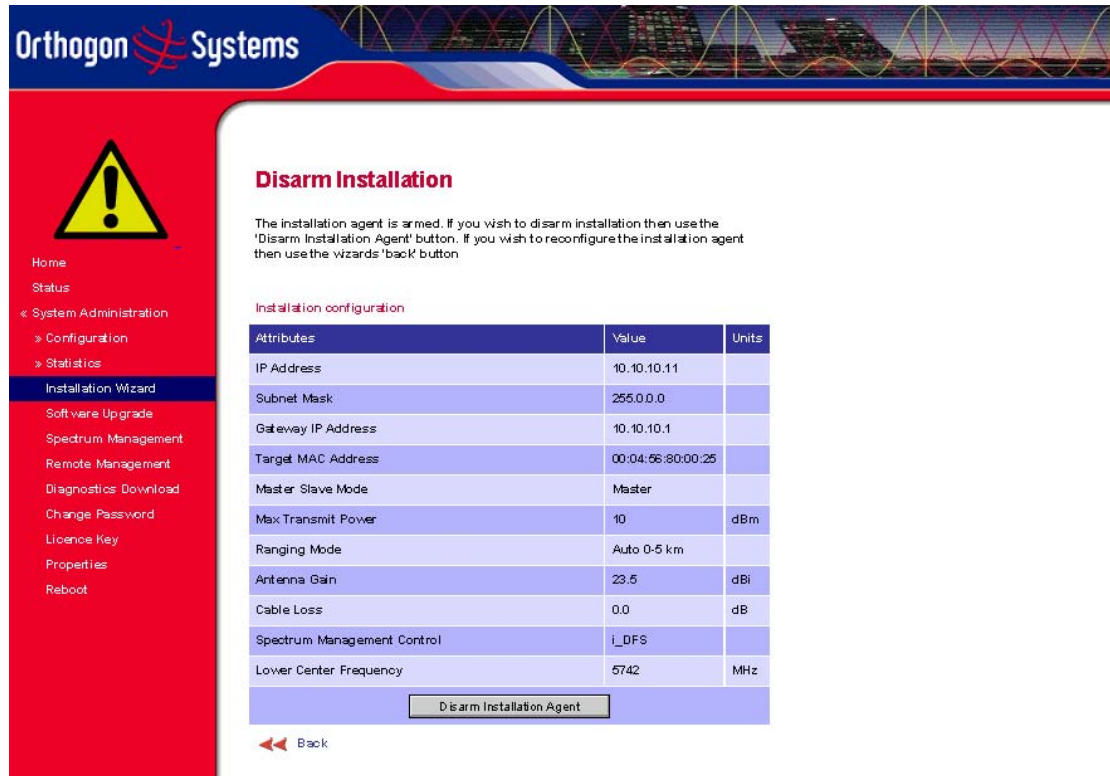


Figure 62 - OS-Spectra-C 'Disarm Installation' Page

12.4 Deployment Considerations

The majority of radio links can be successfully deployed with the OS-Spectra product. It should only be necessary to use external antennas where the Link Budget Calculator indicates marginal performance for a specific link. Examples of this would be where the link is heavily obscured by dense woodland on an NLOS link or extremely long LOS links (>80km) over water.

The external antennas can be either dual-polarisation (as the integrated antenna) or two single polarised antennas can be used in a spatially diverse configuration. It is expected that the dual-polarisation antennas would normally be used to simplify the installation process; spatially diverse antennas may provide additional fade margin on very long LOS links where there is evidence of correlation of the fading characteristics on Vertical and Horizontal polarisations.

Dual polarisation antennas (with a gain greater than the integrated antenna) are currently only available in parabolic dish form.

12.5 Link Budget

This is increased by the additional gain of the external antenna(s) less the cable losses.

Mode	Threshold (dBm)	Static Link Budget (dB)			
		Integrated Antenna	28dBi Flat Plate	4ft Parabolic Dish	6ft Parabolic Dish
BPSK (Single)	-93.0	164.0	170.6	183.4	190.0
QPSK (Single)	-89.7	160.7	167.3	180.1	186.7
16 QAM (Single)	-84.4	153.4	160.0	172.8	179.4
16 QAM (Dual)	-80.3	149.3	155.9	168.7	175.3
64 QAM (Dual)	-73.1	139.1	145.7	158.5	165.1
256 QAM (Dual)	-65.6	130.6	137.2	150.0	156.6
Note: Gains are 23.5/28/34.4/37.7dBi and Cable Loss is 1.2dB for the External Antennas					

Table 10 - Static Link Budget for Various Antenna Options

12.6 Regulatory Issues

In countries where FCC regulations are not relevant, installations should conform to any applicable local regulations for the Equivalent Isotropic Radiated Power (EIRP).

Products deployed in North America or where FCC Part 15 regulations are used for unlicensed radio equipments, the sections 12.6.1 and 12.6.2 apply.

12.6.1 Antenna Choice

The antennas allowed to be deployed with the OS-Spectra-C are shown in Table 12.

12.6.2 Cable Losses

The FCC approval for the product is based on tests with a cable loss between the units of approximately 1.2dB at 5.8GHz. The use of lower cable losses would result in the installation being outside the FCC rules.

As an indication, 1.2dB of cable loss corresponds to the following cable lengths excluding connector losses (source: Times Microwave).

Cable	Length for 1.2dB Cable Loss at 5.8GHz	
	(ft)	(m)
LMR100	1.9	0.6
LMR200	4.6	1.4
LMR300	7.25	2.2
LMR400	11.1	3.4

Table 11 - Cable Losses per Length

12.7 Antennas for USA / Canada

Manufacturer	Antenna Type	Gain(dBi)	Flat Plate	Parabolic Dish
Andrew	Andrew 1-foot Flat Panel, FPA5250D12-N (23.6dBi)	23.6	Y	
Andrew	Andrew 2-foot Flat Panel, FPA5250D24-N (28dBi)	28	Y	
Gabriel	Gabriel 1-foot Flat Panel, DFPD1-52 (23.5dBi)	23.5	Y	
Gabriel	Gabriel 2-foot Flat Panel, DFPD2-52 (28dBi)	28	Y	
MTI	MTI 17 inch Diamond Flat Panel, MT-485009 (23dBi)	23	Y	
MTI	MTI 15 inch Dual-Pol Flat Panel, MT-485025/NVH (23dBi)	23	Y	
MTI	MTI 2 ft Directional Flat Panel, MT-20004 (28dBi)	28	Y	
MTI	MTI 2 ft Flat Panel, MT-486001 (28dBi)	28	Y	
RFS	RFS 1-foot Flat Panel, MA0528-23AN (23dBi)	23	Y	
RFS	RFS 2-foot Flat Panel, MA0528-28AN (28dBi)	28	Y	
Teletronics	Teletronics 2-foot Flat Plate Antenna, ANT-P5828 (28dBi)	28	Y	
Andrew	Andrew 2-foot Parabolic, P2F-52 (29.4dBi)	29.4		Y
Andrew	Andrew 2-foot Dual-Pol Parabolic, PX2F-52 (29.4dBi)	29.4		Y
Andrew	Andrew 3-foot Parabolic, P3F-52 (33.4dBi)	33.4		Y
Andrew	Andrew 3-foot Dual-Pol Parabolic, PX3F-52 (33.4dBi)	33.4		Y
Andrew	Andrew 4-foot Parabolic, P4F-52 (34.9dBi)	34.9		Y
Andrew	Andrew 4-foot Dual-Pol Parabolic, PX4F-52 (34.9dBi)	34.9		Y
Andrew	Andrew 6-foot Parabolic, P6F-52 (37.6dBi)	37.6		Y
Andrew	Andrew 6-foot Dual-Pol Parabolic, PX6F-52 (37.6dBi)	37.6		Y
Gabriel	Gabriel 2-foot High Performance QuickFire Parabolic, HQF2-52-N	28.2		Y
Gabriel	Gabriel 4-foot High Performance QuickFire Parabolic, HQF4-52-N	34.4		Y
Gabriel	Gabriel 6-foot High Performance QuickFire Parabolic, HQF6-52-N	37.4		Y
Gabriel	Gabriel 2-foot High Performance Dual QuickFire Parabolic, HQFD2-52-N	28.1		Y
Gabriel	Gabriel 4-foot High Performance Dual QuickFire Parabolic, HQFD4-52-N	34.3		Y
Gabriel	Gabriel 6-foot High Performance Dual QuickFire Parabolic, HQFD6-52-N	37.3		Y
Gabriel	Gabriel 2-foot Standard QuickFire Parabolic, QF2-52-N	28.5		Y
Gabriel	Gabriel 2-foot Standard QuickFire Parabolic, QF2-52-N-RK	28.5		Y
Gabriel	Gabriel 2.5-foot Standard QuickFire Parabolic, QF2.5-52-N	31.2		Y
Gabriel	Gabriel 4-foot Standard QuickFire Parabolic, QF4-52-N	34.8		Y
Gabriel	Gabriel 4-foot Standard QuickFire Parabolic, QF4-52-N-RK	34.8		Y
Gabriel	Gabriel 6-foot Standard QuickFire Parabolic, QF6-52-N	37.7		Y
Gabriel	Gabriel 2-foot Standard Dual QuickFire Parabolic, QFD2-52-N	28.4		Y
Gabriel	Gabriel 2.5-foot Standard Dual QuickFire Parabolic, QFD2.5-52-N	31.1		Y
Gabriel	Gabriel 2-foot Standard Dual QuickFire Parabolic, QFD2-52-N-RK	28.4		Y
Gabriel	Gabriel 4-foot Standard Dual QuickFire Parabolic, QFD4-52-N	34.7		Y
Gabriel	Gabriel 4-foot Standard Dual QuickFire Parabolic, QFD4-52-N-RK	34.7		Y
Gabriel	Gabriel 6-foot Standard Dual QuickFire Parabolic, QFD6-52-N	37.7		Y
RadioWaves	Radio Waves 2-foot Dual-Pol Parabolic, SPD2-5.2 (28.1dBi)	28.1		Y
RadioWaves	Radio Waves 2-foot Parabolic, SP2-5.2 (29.0dBi)	29		Y
RadioWaves	Radio Waves 3-foot Dual-Pol Parabolic, SPD3-5.2 (31.1dBi)	31.1		Y
RadioWaves	Radio Waves 3-foot Parabolic, SP3-5.2 (31.4dBi)	31.4		Y
RadioWaves	Radio Waves 4-foot Dual-Pol Parabolic, SPD4-5.2 (34.4dBi)	34.4		Y
RadioWaves	Radio Waves 4-foot Parabolic, SP4-5.2 (34.8dBi)	34.8		Y
RadioWaves	Radio Waves 6-foot Dual-Pol Parabolic, SPD6-5.2 (37.5dBi)	37.5		Y
RadioWaves	Radio Waves 6-foot Parabolic, SP6-5.2 (37.7dBi)	37.7		Y
RadioWaves	Radio Waves 2-foot Parabolic, SP2-2/5 (28.3dBi)	28.3		Y
RadioWaves	Radio Waves 3-foot Parabolic, SP3-2/5 (31.4dBi)	31.4		Y
RadioWaves	Radio Waves 4-foot Parabolic, SP4-2/5 (34.6dBi)	34.6		Y
RadioWaves	Radio Waves 6-foot Parabolic, SP6-2/5 (37.7dBi)	37.7		Y
RFS	RFS 2-foot Parabolic, SPF2-52AN or SPFX2-52AN (27.9dBi)	27.9		Y
RFS	RFS 3-foot Parabolic, SPF3-52AN or SPFX3-52AN (31.4dBi)	31.4		Y
RFS	RFS 4-foot Parabolic, SPF4-52AN or SPFX4-52AN (33.9dBi)	33.9		Y
RFS	RFS 6-foot Parabolic, SPF6-52AN or SPFX6-52AN (37.4dBi)	37.4		Y
RFS	RFS 2-foot HP Parabolic, SDF2-52AN or SDFX2-52AN (31.4dBi)	31.4		Y
RFS	RFS 4-foot HP Parabolic, SDF4-52AN or SDFX4-52AN (33.9dBi)	33.9		Y
RFS	RFS 6-foot HP Parabolic, SDF6-52AN or SDFX6-52AN (37.4dBi)	37.4		Y
StellaDoradus	StellaDoradus 45 inch Parabolic Antenna, 58PSD113	33.8		Y

Table 12 - Allowed Antennas for Deployment in USA/Canada

12.8 Installation

The section covers the generic installation instructions for OS-Spectra-C. The actual installation procedure will depend on antenna choice, cable choice, required antenna separation etc.

12.8.1 Antenna Choice

Table 11 shows a wide variety of antennas that can be used with the OS-Spectra-C product. The main selection criteria will be the required antenna gain. The secondary criteria should be the ease of mounting and alignment. For example the Radio Waves Parabolic dishes are supplied with a mount that allows adjustment for alignment independent of the actual antenna mounting. This type of antenna is much easier to align than those that have to be rotated around the mounting pole for alignment.

12.8.2 Cables and Connectors

Cables should be selected using the above criteria. However it should be noted that a cable of a type similar to LMR400 is a lot more difficult to handle and route than a cable of a type similar to LMR100.

Orthogon Systems recommends the use of weatherproof connectors. Preferable ones that come supplied with adhesive lined heat shrink sleeve that is fitted over the cable/connector interface.

The connectors required at the OS-Spectra-C end of the antenna cables are N-Type Male.

The connectors required at the antenna end of the antenna cables is dependant on the antenna type chosen.

12.8.3 Tools

The tools required for mounting a OS-Spectra-C unit are the same as those required for a Spectra-I unit detailed in section 5.3 “Tools Required”. The tools required for mounting the antennas are specific to the antenna chosen. The installer should refer to the antenna manufacturers instructions.

12.8.4 Miscellaneous supplies

The following miscellaneous supplies will be required:

- Cable ties, cable cleats – for securing cables
- Self amalgamating tape – to weatherproof the RF connectors
- PVC tape – for additional protection of the RF connectors and securing cables

12.8.5 Mounting

12.8.5.1 OS-Spectra-C unit

A OS-Spectra-C unit is supplied with the same bracket as supplied with a Spectra-I unit. Details on the use of this bracket can be found in section 1.3.6 “Mounting Brackets”. The OS-Spectra unit should be mounted in a position that gives it maximum protection from the elements but still allows easy access for making off the various connections and applying the recommended weatherproofing.

When using dual polar antennas the OS-Spectra-C unit should be mounted in such a position as to minimize the cable length keeping losses to a minimum (taking into account the minimum cable lengths required by the FCC regulations, see section 12.7 “Antennas for USA / Canada”).

When using separate antennas the OS-Spectra-C unit should be mounted in such a position as to minimize both cable runs between the OS-Spectra-C unit and the antennas. It is not necessary to mount the OS-Spectra-C unit at the mid point between the antennas.

12.8.5.2 Antennas

The Antennas should be mounted according to the manufacturers instructions. Actual antenna position will depend on the available mounting positions and link requirements. It may be necessary to mount the antennas 20m apart or at a certain distance from the ground to get the desired results.

12.8.6 Alignment Process

When aligning antennas deployed with a OS-Spectra-C unit it may not be possible to hear the alignment tone emanating from the OS-Spectra-C unit. In this case it may be necessary for a second installer to assist in the operation. Alternately it may be possible to extend the tube on the supplied stethoscope to give a longer reach.

Tip Fine antenna alignment can sometimes be achieved by tightening and loosening the bolts on either side of the antenna mounting bracket, rather than trying to turn the whole bracket on the mounting pole.

12.8.6.1 Dual Polar Antennas

The process for aligning a dual polar antenna is the same as aligning a Spectra-I unit with an integrated antenna. This procedure is detailed in section 5.7.11 “Aligning the ODUs”.

12.8.6.2 Separate Antennas

When using separate antennas to achieve special diversity it is recommended that one be mounted with Horizontal polarisation and the other with Vertical polarization.

The following steps should be followed:

- Step 1: Mount the Antennas
- Step 2: Mount the OS-Spectra-C unit
- Step 3: Route and make off the ends of the Antenna cables
- Step 4: Connect the antenna cables at the antennas
- Step 5: Connect one of the antenna cables at the OS-Spectra-C unit
- Step 6: Connect the OS-Spectra-C ODU to SPIDU cable and configure the unit as described in section 5.6.1 Connecting up".
- Step 7: Align the connected antenna using the tones as described in section 5.7.11 "Aligning the ODUs".
- Step 8: Connect the other antenna to the OS-Spectra-C unit.
- Step 9: Disconnect the cable to the already aligned antenna.
- Step 10: Align the second antenna using the tones as described in section 5.7.11 "Aligning the ODUs".
- Step 11: Re-connect the second antenna to the OS-Spectra-C (Note: you will notice the tone pitch increase as you re-connect the second antenna due to the additional received signal).
- Step 12: Use the relevant status web pages to check that you are getting the results you expect from your link planning.
- Step 13: Complete the installation as detailed below.

12.8.7 Completing the Installation

The installation should be completed by checking all mounting nuts bolts and screws, securing all cables and weatherproofing the installation.

Warning Finally tightening of the antenna mountings may cause the antenna alignment to be altered due to distortion in the mounting bracket caused by tightening. It is recommended that the installation tone be left turned on (armed) during this process so that any movement can be noticed and counter acted by tightening the other side of the bracket.

12.8.7.1 Antenna Cable Fixing

Cables should be secured in place using cable ties, cleats or PVC tape. Care should be taken to ensure that no undue strain is placed on the connectors on both the OS-Spectra-C unit and the Antennas and also to ensure that the cables do not flap in the wind. Cables flapping in the wind are prone to damage and induce unwanted vibrations in the mast to which the units are attached.

12.8.7.2 Antenna Connection Weatherproofing

Where a cable connects to an antenna or unit from above, a drip loop should be left to ensure that water is not constantly channeled towards the connector.

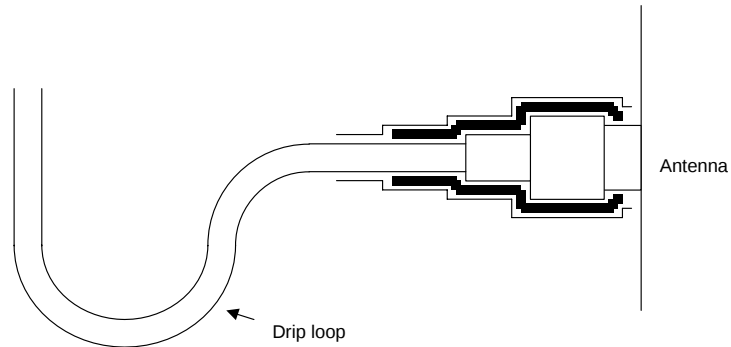


Figure 63 - Forming a Drip Loop

All joints should be weatherproofed using self-amalgamating tape. It is recommended that a layer of PVC tape be placed over the self-amalgamating tape to protect the joint while the self-amalgamating tape cures and give additional protection. Figure 64 shows this diagrammatically for the OS-Spectra unit end of the antenna cables. If the antennas manufacturer has not supplied guidance on this matter the same technique should be employed at the antenna end of the antenna cables.

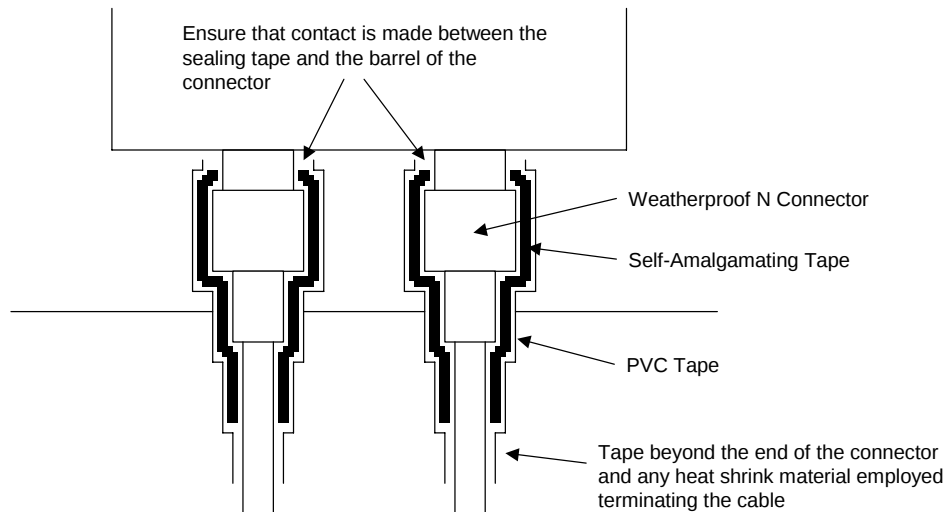


Figure 64 - Weatherproofing the Antenna Connections

13 FAQs

Can I source and use my own PoE adaptor with the OS-Spectra? No. The OS-Spectra uses a non-standard PoE configuration. Failure to use the Orthogon Systems supplied Power Indoor Unit could result in equipment damage and will invalidate the safety certification and may cause a safety hazard.

Who are Orthogon Systems? Orthogon Systems are a specialist wireless manufacturer with a high quality engineering team that is developing advanced radio solutions that allows high capacity building-to-building bridges to be established even in deep non-Line-of-Sight conditions.

Why have Orthogon Systems launched the OS-Spectra? OS-Spectra is the first product in this band to feature Multi-beam Space Time Coding. The OS-Spectra allows wireless connections of up to 200km (125 miles) in near Line-of-Sight conditions and up to 10km (6 miles) in deep non-Line-of-Sight conditions.

What is Multi-beam Space-Time-Coding? The OS-Spectra radiates multiple beams from the antenna - the effect of which is to significantly protect against fading and to radically increase the probability that the receiver will decode a usable signal. When the effects of Space-Time-Coding are combined with those of OFDM techniques and a best in class link budget, there is a significant improvement to the probability of a robust connection over a non-Line-of-Sight path.

What do you mean by “non-Line-of-Sight”? A wireless connection between 2 points without optical Line-of-Sight. i.e. with obstructions in between the antennas but the transmitted signal is still able to reach the receiver and produce a good quality link.

What else is special about the OS-Spectra ? There are many special features built-in to the hardware of the OS-Spectra. The product offers the highest system gain in its class through high sensitivity antennae for improved signal recovery. It also features a Software Defined Radio system that operates on ultra fast digital signal processors but is controlled by firmware giving the ability to download new firmware when enhancements become available. The OS-Spectra has a built-in web server for advanced management capabilities including detailed radio signal diagnosis.

In which frequency band does the OS-Spectra operate? The Orthogon Systems OS-Spectra operates in the unlicensed ISM band at 5.725 - 5.850GHz. This means no license is required to operate the OS-Spectra.

Why does the OS-Spectra operate in the 5.8GHz ISM band? The 5.8GHz band offers the dual benefits of high data throughput and good radio propagation characteristics. The wide

band of spectrum available is subdivided into several channels such that multiple systems can operate in the vicinity without causing interference to one another.

Is the OS-Spectra an 802.11a device? No, although similar, the OS-Spectra uses different encoding and radio transmission systems than 802.11a. In areas where 802.11a systems are operating, the OS-Spectra will detect the 802.11a radio signals and choose a clean channel away from any interference.

How much power does the OS-Spectra transmit? At all times the OS-Spectra operates within country / region specific regulations for radio power emissions. In addition, the OS-Spectra uses a technique known as Transmit Power Control (TPC) to ensure that it only transmits sufficient radio power such that the other antenna can receive a high quality signal. How does the OS-Spectra avoid interference from other devices nearby? At initialisation, the OS-Spectra monitors the available frequency channels to find a channel that is clean from interference. In operation OS-Spectra continuously monitors the spectrum to ensure it is operating on the cleanest channel.

How does the OS-Spectra integrate into my data network? The OS-Spectra acts as a transparent bridge between two segments of your network. In this sense, it can be treated like a virtual wired connection between the two buildings. The OS-Spectra forwards 802.3 Ethernet packets destined for the other part of the network and filters packets it does not need to forward. The system is transparent to higher-level management systems such as VLANs and Spanning Tree.

How does the OS-Spectra provide security for data traffic? The OS-Spectra has a range of security features. At installation time each link must be programmed with the serial ID of its partner. The two ends of the link will only communicate with one another, eliminating any chance of "man in the middle" attacks. Over the air security is achieved through a proprietary scrambling mechanism that cannot be disabled, spoofed or snooped by commercial tools. If further security is required the user is now able to optionally augment the existing high security by encoding the air interface using AES.

How is the Advanced Encryption Standard (AES) enabled? The AES facility is enabled by the user obtaining a licence key from Orthogon Systems. Entering the key will turn on the AES option from which the user will be able to turn on AES. The default setting for AES is off. How do I manage the OS-Spectra? The OS-Spectra has a built-in web server. At installation, the unit is configured with an IP address so that the web server can then be accessed from any browser equipped terminal. For security, access can be password protected, meaning only the network administrator can access the web based management tools. SNMP V1/V2 is also available and the unit can be configured to send traps or email notifications via SMTP.

Can I use Apple Macintosh OS X to control and monitor my OS-Spectra? Yes, but there are some restrictions. Mozilla 1.6 is recommended. There are some issues with Internet Explorer 5.2(IE) and Safari, which could mislead the user.

How will my investment be protected as new features are developed? Future enhancements can be downloaded to the unit, meaning advances in technology or changes in regulations can quickly be applied to the system without any further hardware investment.

14 Glossary

AES	Advanced Encryption Standard	NLOS	non-Line-of-Sight
ARP	Address Resolution Protocol	ODU	Outdoor Unit
ARQ	Automatic Repeat reQuest	OFDM	Orthogonal Frequency Division
BPSK	Binary Phase Shift Keying		Multiplex
DC	Direct Current	PC	IBM Compatible Personal Computer
DFS	Dynamic Frequency Selection	SPIDU	Power Indoor Unit
ETSI	European Telecommunications Standards Institute	PING	Packet INternet Groper
FAQ	Frequently Asked Question	POE	Power over Ethernet
GPS	Global Positioning System	PSU	Power Supply Unit
HTTP	Hypertext Transfer Protocol	PTP	Point-to-Point
ID	Identity	QAM	Quadrature Amplitude Modulation
IEEE	Institute of Electrical and Electronic Engineers	RAM	Random Access Memory
IP	Internet Protocol	STC	Space Time Coding
IQ	In phase / Quadrature	STP	Shielded Twisted Pair
ISM	Industrial Scientific and Medical	TCP	Transmission Control Protocol
ITU	International Telecommunications Union	TPC	Transmit Power Control
LAN	Local Area Network	URL	Universal Resource Location
MAC	Medium Access Control Layer	USA	United States of America
MDI	Medium Dependent Interface	UTP	Unshielded Twisted Pair
MDIX	Medium Dependent Interface Crossover	UV	Ultraviolet
		VLAN	Virtual Local Area Network

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Orthogon Systems, Linhay Business Park, Eastern Road, Ashburton, Devon TQ13 7UP

Telephone: +44 (0)1364 655500 Fax: +44 (0)1364 654625

www.orthogonsystems.com