

6.3.4 Software Upgrade

The OS-Gemini system has two software image banks; one is a fixed image which is stored in protected non-volatile memory, the second bank is used by the system administrator to upgrade the firmware as and when necessary. Figure 21 shows the main software upgrade webpage.

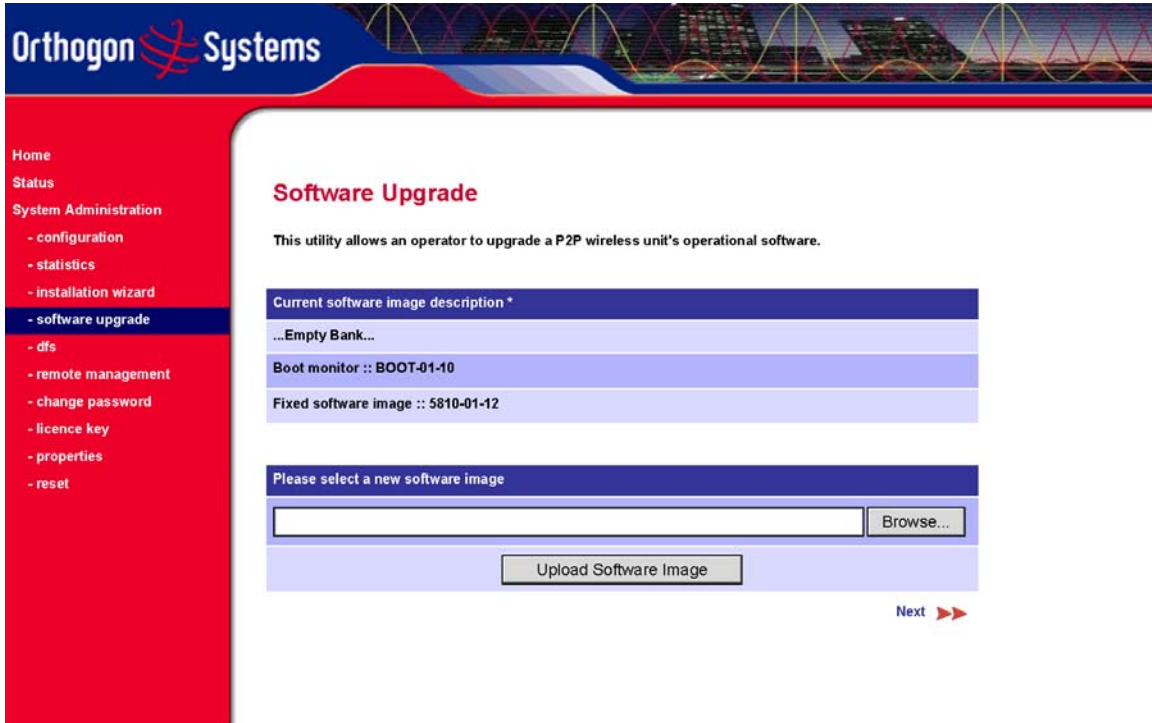


Figure 21 Software Upgrade

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-Gemini Software image. This is easily identifiable by its ‘.dld’ file extension.

The first step (Figure 21) 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 21)

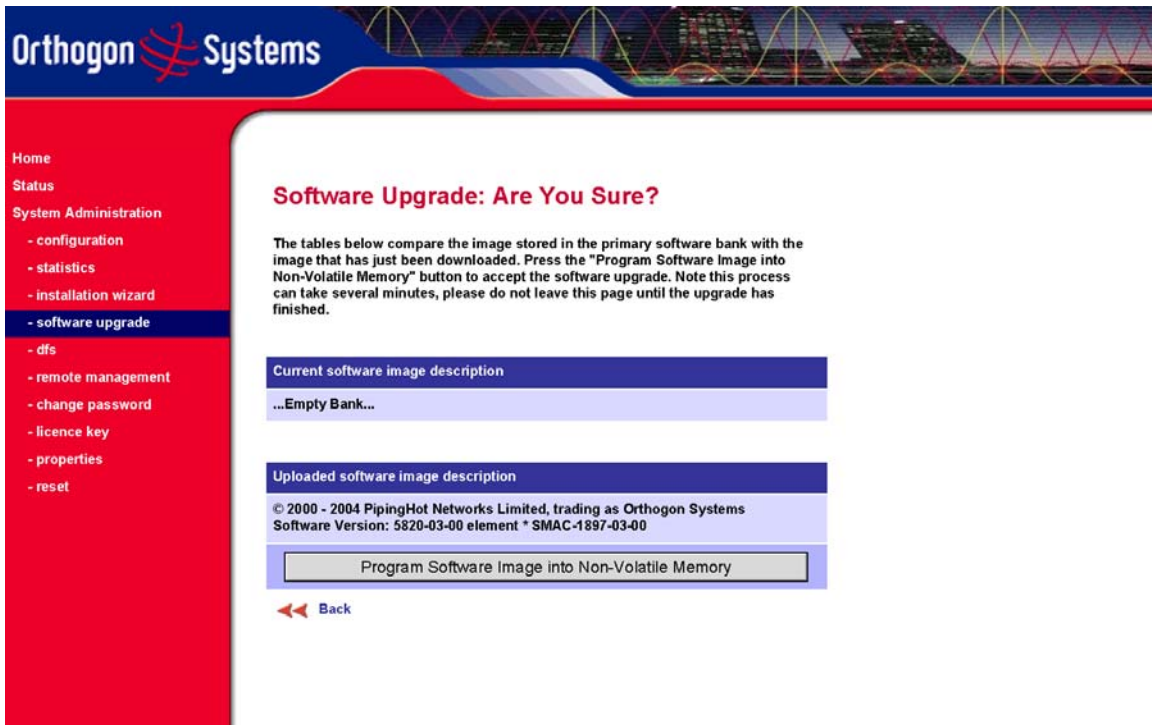


Figure 22 Software Upgrade Image Check

The user should ensure that he is happy to proceed 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.

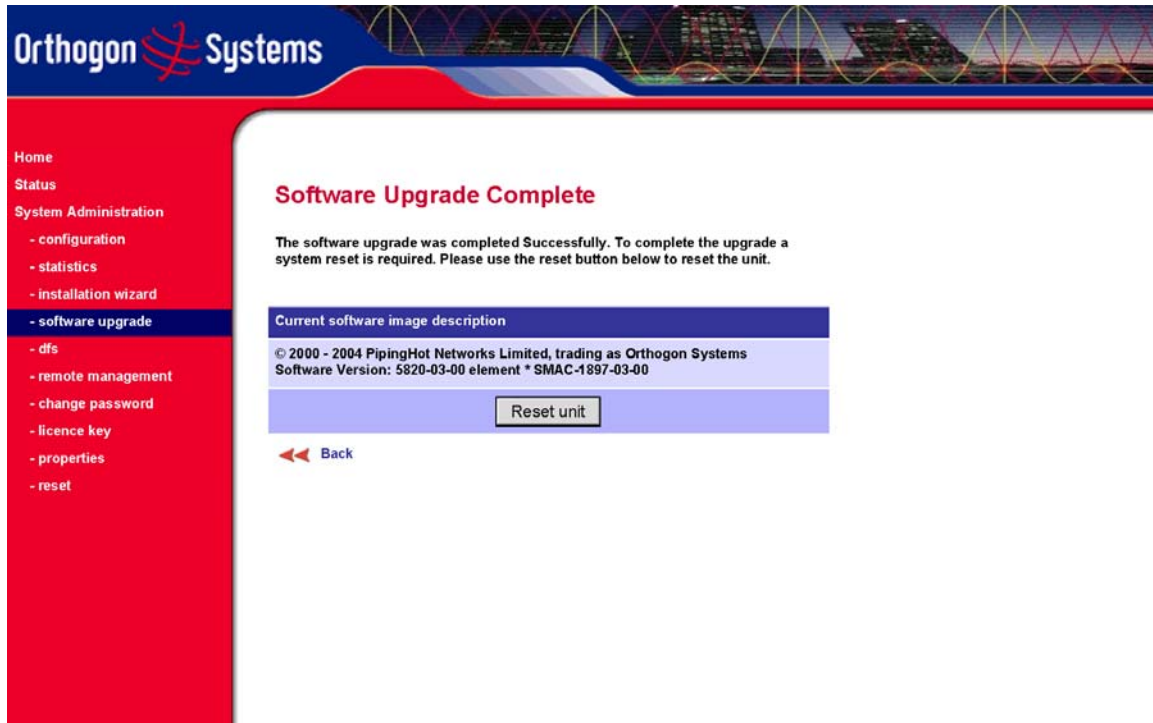


Figure 23 Software Upgrade Complete

When the software image has been written to non-volatile memory Figure 23 will be displayed showing the status of the software upload.

Reset the unit by clicking the Reset Unit button. This will reset 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.

6.3.5 Dynamic Frequency Selection (DFS)

Dynamic Frequency Selection (hereafter referred to by the acronym DFS) is the OS-Gemini 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.

6.3.5.1 Wireless Channels

The OS-Gemini 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 centre frequency from its neighbouring channel by 6 MHz.

It is important to note that adjacent channels on the DFS display have a 5 MHz overlap to the adjacent channel.

6.3.5.2 DFS Measurements

The OS-Gemini wireless units perform four DFS 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 DFS algorithm collects DFS 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 DFS 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.

6.3.5.3 Measurement Analysis

DFS uses statistical analysis to process the received peak and mean measurement. The statistical analysis is based on a fixed measurement quantisation period. The default quantisation period is one minute. DFS 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 mean 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 and 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. This release of DFS uses the 99.9% percentile as the prime interference measurement. All subsequent references to interference level refer to this percentile measurement.

6.3.5.4 The DFS Master / Slave Relationship

By default DFS operates in a master / slave relationship. The master is assumed to be the link master configured during installation. All DFS configuration changes MUST be performed from the master, to enforce this the DFS 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 using the OS-Gemini MAC to MAC management messages. Any DFS configuration messages received at the slave are stored in non-volatile memory. This enables both master and slave to keep identical copies of DFS 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 DFS configuration.

Figure 24 shows an example DFS webpage as seen from the master. Figure 25 shows an example DFS webpage as seen from the slave. It should be noted that all the key DFS configuration attributes are not available on the slave webpage.



Figure 24 DFS as seen from the Master

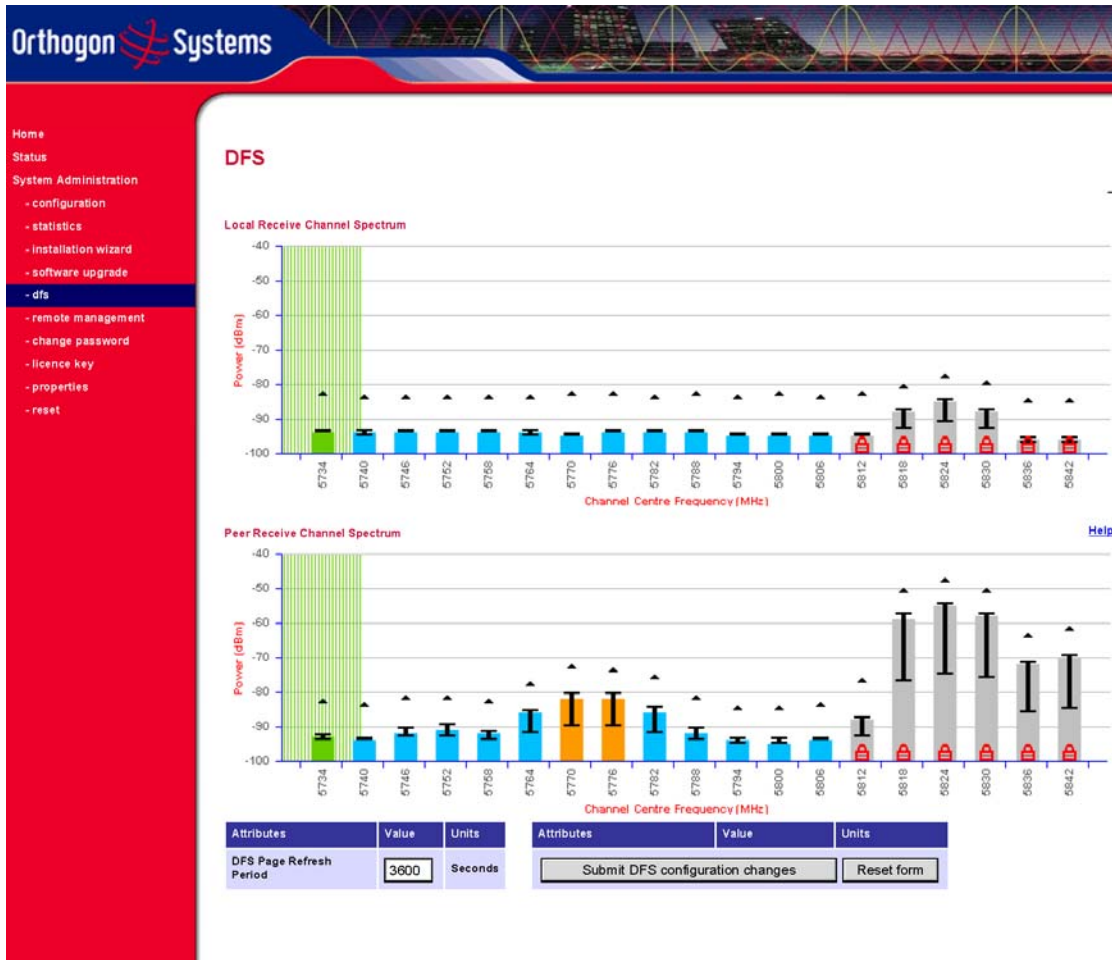


Figure 25 DFS as seen from the Slave

6.3.5.5 DFS Configuration

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

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

Hopping Period The DFS algorithm evaluates the DFS 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 DFS 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 or the channel change. (Default 180 Seconds).

Hopping Margin DFS uses this margin when making a channel hop decision. The channel to hop to has to have an interference level 2 dBs (default) better than the current active channel. (Default 2 dB)

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.

Adjacent Channel Bias To prevent DFS from selecting channels that overlap or are adjacent to channels with high levels of interference the DFS algorithm applies a bias to the channel evaluation algorithm.

The Adjacent channel bias (ACB) is applied as follows:

$$B = (i_{n-4} - 4B_{ACB}) + (i_{n-3} - 3B_{ACB}) + (i_{n-2} - 2B_{ACB}) + (i_{n-1} + 5) + i_{n+1} + 5 + (i_{n+2} - 2B_{ACB}) + (i_{n+3} - 3B_{ACB}) + (i_{n+4} - 4B_{ACB})$$

Where:

i_k	Interference measurement from the k th channel.
B_{ACB}	Adjacent Channel Bias from the DFS configuration webpage (dB).
n	Channel index.
B	Resultant Channel bias used to make channel hop decisions.

Equation 3 Adjacent Channel Bias

The adjacent channel bias calculation is performed on both the master and slave ends of the wireless link. The way in which DFS processes the channel bias information is dependant on the current Asymmetric DFS configuration setting. If the link is in its default Asymmetric configuration setting of ‘Symmetric’ then the master uses the peak of master and slave bias measurements to make the channel hop decision. If DFS is configured as ‘Asymmetric’ then the DFS channel hop algorithm works independently using on the local channel bias measurements and ignores the bias measurements computed by its peer. (Default 10 dB).

DFS State is used to enable and disable operation of the DFS algorithm. When DFS is disabled interference measurements are still processed and displayed but channel hopping is not performed.

Asymmetric DFS. The default configuration of symmetric constrains DFS to operate using the same transmit and receive channel. 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).

Measurement Quantisation. DFS uses statistical analysis to process the received peak and mean measurement. The statistical analysis is based around a fixed measurement quantisation period. The default quantisation period is one minute. DFS collects data for the specified quantisation period and only at the end of that period is the statistical analysis performed. Increasing the measurement quantisation period will reduce the dynamic response time of the algorithm but increase the statistical significance of the metrics. (Default 1 minute)

Interference Threshold. DFS 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-Gemini will continue to use the current active channel. (Default -85 dBm)

6.3.5.6 Barring Channels

Channels can only be barred / unbarred by the system administrator from the master DFS 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.

6.3.5.7 Local and Peer Channel Spectrum Graphics

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

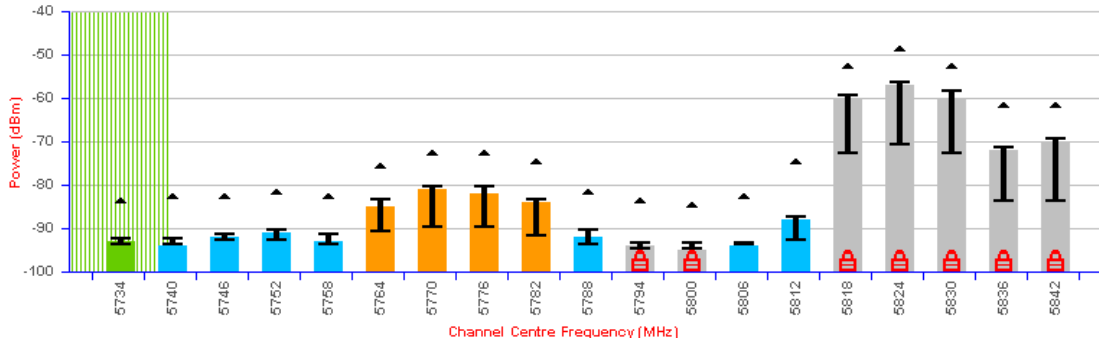


Figure 26 Example DFS Graphic

The X-axis shows a stylised view of the 19 selectable wireless channels. It is important to note that adjacent channels on the DFS display have a 5 MHz overlap. The display separates the display of channels to help the clarity of the resultant display. The axis is labelled using the channel centre frequencies in MHz (5734 to 5842 MHz).

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

The active channel (channel 1 in Figure 26) 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 DFS 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 DFS 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.

6.3.5.8 Viewing Historic DFS Metrics

DFS 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.

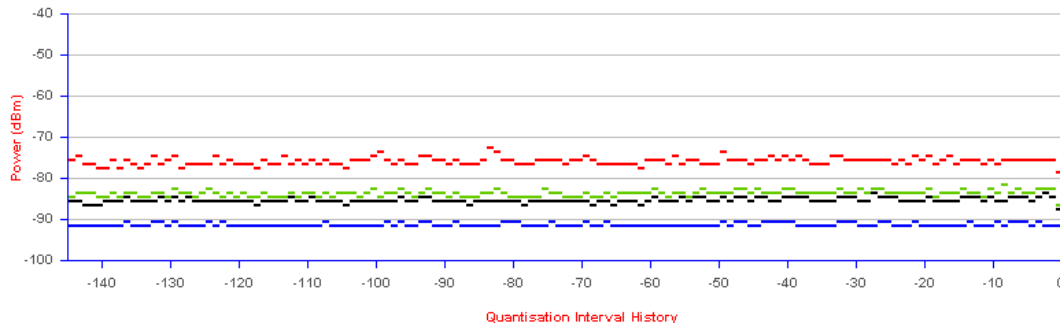


Figure 27 DFS Timeseries Plot

Figure 27 shows an example DFS time series plot. A timeseries plot displays the previous 145 measurement quantisation periods. If the OS-Gemini 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 DFS timeseries key

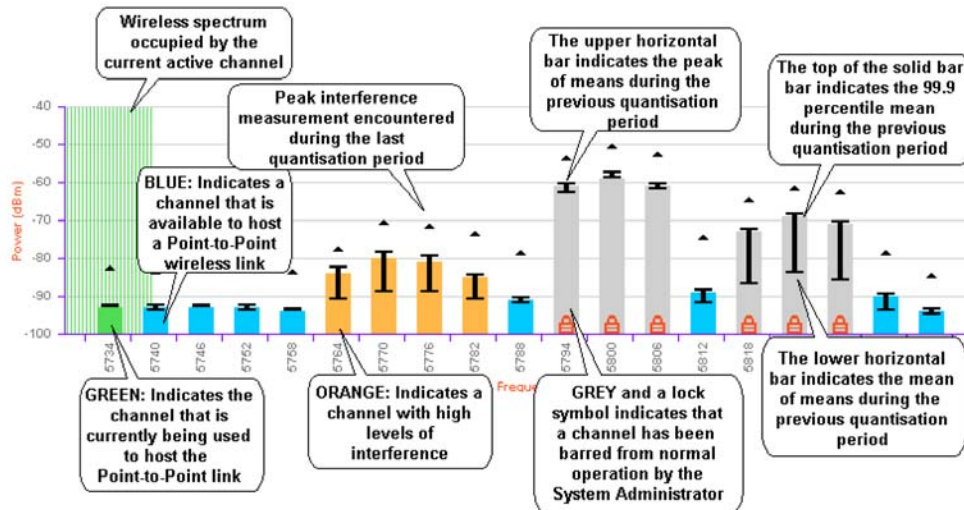
6.3.5.9 DFS Online Help

Because the DFS 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 28 gives a high level overview of the DFS webpage.

DFS 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-bared. Note the channel barring / un-barring will take effect immediately.



DFS 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.

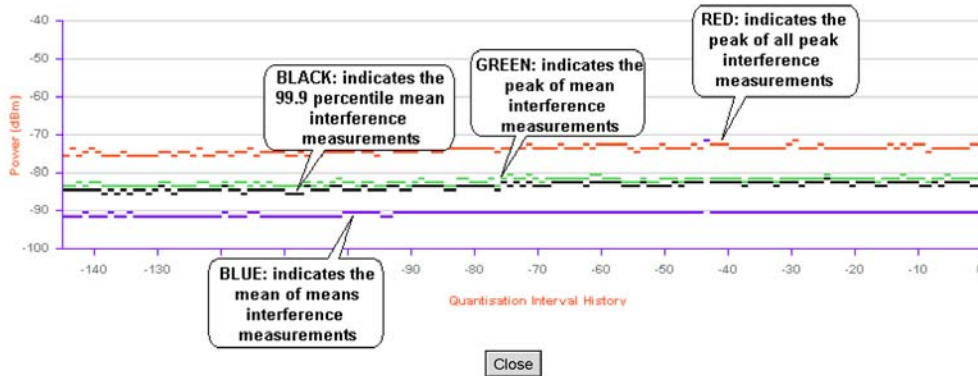
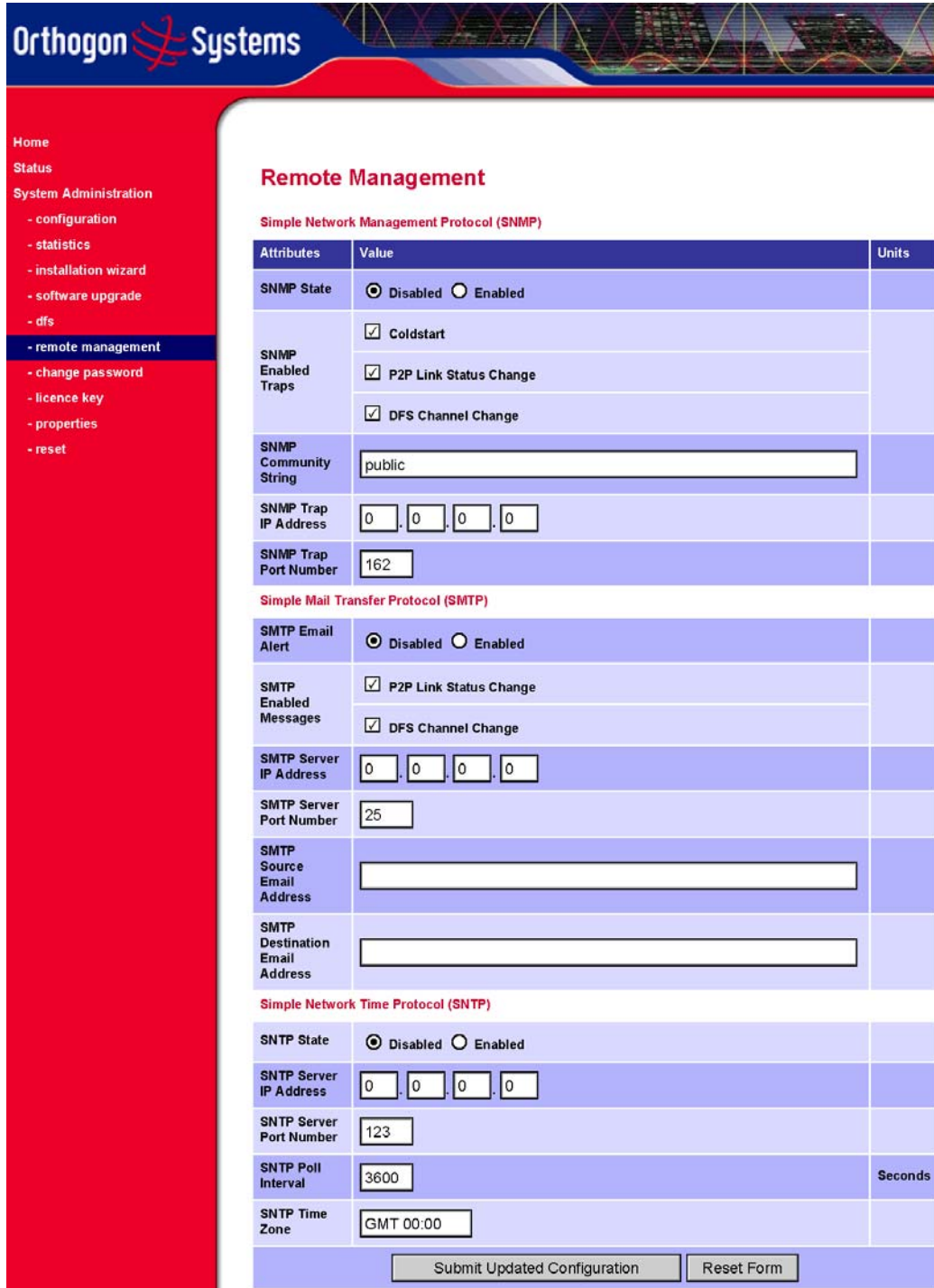


Figure 28 DFS Help Page

6.3.6 Remote Management Page

The Remote Management page (Figure 29) allows the system administrator to configure the remote management of the OS-Gemini.



Home

Status

System Administration

- configuration
- statistics
- installation wizard
- software upgrade
- dfs
- remote management
- change password
- licence key
- properties
- reset

Remote Management

Simple Network Management Protocol (SNMP)

Attributes	Value	Units
SNMP State	<input checked="" type="radio"/> Disabled <input type="radio"/> Enabled	
SNMP Enabled Traps	<input checked="" type="checkbox"/> Coldstart	
	<input checked="" type="checkbox"/> P2P Link Status Change	
	<input checked="" type="checkbox"/> DFS Channel Change	
SNMP Community String	<input type="text" value="public"/>	
SNMP Trap IP Address	<input type="text" value="0"/> . <input type="text" value="0"/> . <input type="text" value="0"/> . <input type="text" value="0"/>	
SNMP Trap Port Number	<input type="text" value="162"/>	

Simple Mail Transfer Protocol (SMTP)

SMTP Email Alert	<input checked="" type="radio"/> Disabled <input type="radio"/> Enabled	
SMTP Enabled Messages	<input checked="" type="checkbox"/> P2P Link Status Change	
	<input checked="" type="checkbox"/> DFS Channel Change	
SMTP Server IP Address	<input type="text" value="0"/> . <input type="text" value="0"/> . <input type="text" value="0"/> . <input type="text" value="0"/>	
SMTP Server Port Number	<input type="text" value="25"/>	
SMTP Source Email Address	<input type="text"/>	
SMTP Destination Email Address	<input type="text"/>	

Simple Network Time Protocol (SNTP)

SNTP State	<input checked="" type="radio"/> Disabled <input type="radio"/> Enabled	
SNTP Server IP Address	<input type="text" value="0"/> . <input type="text" value="0"/> . <input type="text" value="0"/> . <input type="text" value="0"/>	
SNTP Server Port Number	<input type="text" value="123"/>	
SNTP Poll Interval	<input type="text" value="3600"/>	Seconds
SNTP Time Zone	<input type="text" value="GMT 00:00"/>	

Figure 29 Remote Management

6.3.6.1 SNMP (Simple Network Management Protocol)

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

6.3.6.1.1 Supported Management Information Bases (MIBS)

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

The OS-Gemini SNMP stack currently supports three distinct MIBs.

MIB-II, RFC-1213

The OS-Gemini supports the 'System Group' and 'Interfaces Group'.

Bridge MIB, RFC-1493

The OS-Gemini supports the 'dot1dBase Group' and the 'dot1dBasePortTable Group'.

SNMP TRAPs

'Cold Start', 'Link Up', 'Link Down', DFS Channel Change TRAPs are supported.

Orthogon Systems MIB, Proprietary MIB definition

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

6.3.6.1.2 SNMP Configuration

SNMP State The SNMP state attribute controls the creation of the SNMP features. Changing the SNMP state attribute requires a mandatory reset 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-Gemini 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 reset 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 reset 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 reset before the setting is adopted.

6.3.6.2 SMTP (Simple Mail Transport Protocol)

The SMTP client is an alternative method for the OS-Gemini 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-Gemini 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-Gemini will send the alert messages.

6.3.6.3 SNTP (Simple Network Time Protocol)

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

6.3.7 Change System Administration Password

This page (Figure 30) is used to change the password for the system administration (The factory default is blank).



Figure 30 Password Change

To change the password any combination of alphanumeric characters, up to 32 characters in length, can be used.

6.3.8 Reset

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

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



Figure 31 System Reset

7 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.

7.1 Hardware

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

The following diagram illustrates the main system connections.

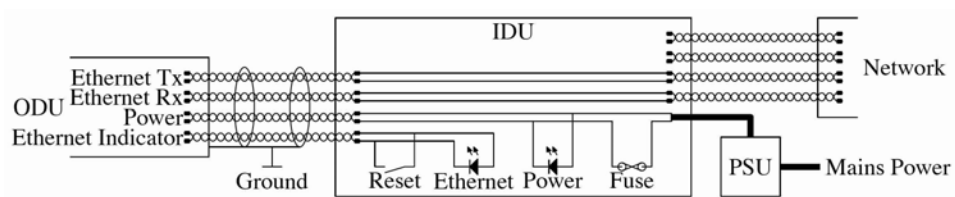


Figure 32 Main System Connections

7.1.1 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 then⁴. 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 IDU. (Remove the IDU 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 fuse and measuring the current taken with an ammeter placed across the fuse. This is normally 10ma without the ODU connected and 300ma to 1amp when the ODU is connected.
 - b. If it does not illuminate then recheck that power is applied to the PSU, that the PSU is plugged in to the IDU. Check that the IDU is not short circuit by measuring the impedance across the Power connector. Is the lamp faulty or the fuse faulty.

⁴ The power indicator LED should be continually illuminated.

7.1.2 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 IDU 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 fuse out of the IDU and check the current taken by the ODU. This should be 300ma to 1amp when starting through to running normally.

If the Ethernet indicator flashes to begin with but then stops flashing then

Mode	Green LED	Yellow LED No Ethernet Cable Connected	Yellow LED Ethernet Cable Connected between IDU and NIC/Switch/Hub
No Power Applied	Off	Off	Off
Power Applied but IDU Fuse Blown	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

<p>Reset Switch Pressed and released within 10 seconds during normal operation</p>	<p>On</p>	<p>Off</p>	<p>Off whilst switch pressed but returns to LINK/Activity state when released. No reset will take place</p>
<p>Reset Switch Pressed and held for > 20 seconds during normal operation</p>	<p>On</p>	<p>Off whilst switch pressed.</p> <p>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.</p> <p>The IP address which will be reset to 10.10.10.10</p>	
<p>Reset Switch Pressed and held for >40 seconds from power on (Reset is pressed whilst power is applied)</p>	<p>On</p>	<p>Off whilst switch pressed.</p> <p>One second after release, flashes twice per second regularly for 10 seconds, then erases non-volatile configuration data & the downloaded image and resets.</p> <p>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.</p> <p>The IP address which will be reset to 10.10.10.10 and the unit will boot the fixed software image.</p>	

7.2 Radio

7.2.1 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
- 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.

7.2.2 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

8 Specifications

8.1 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 adaption to avoid interference.	
Dynamic Frequency Control	Initial capture 10-15 sec. Out of service on interference 100 ms.	
Channel size	11 MHz	
Tx power @ Antenna ports	Mode	Maximum Power Output (region dependant)⁵
	BPSK Mode	24 dBm
	QPSK Modes	23 dBm
	16QAM Modes	21 dBm
	64QAM Modes	19 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	

⁵ As specified by FCC Part 15.247

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

Mode	RX Sensitivity	TX Power	System Gain
BPSK 1/2	-95.5 dBm	24 dBm	166.5 dB
QPSK 1/2	-92.8 dBm	23 dBm	162.8 dB
QPSK 2/3	-90.7 dBm	23 dBm	160.7 dB
16QAM 1/2	-88.1 dBm	21 dBm	156.1 dB
16QAM 3/4	-83.6 dBm	21 dBm	151.6 dB
64QAM 2/3	-80.2 dBm	19 dBm	146.2 dB
64QAM 3/4	-78.3 dBm	19 dBm	144.3 dB
64QAM 7/8	-73.6 dBm	19 dBm	139.6 dB

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.

The margins applied are as follows:

Fading	Mode Up Shift	Mode Down shift
Slow	1.5 dB	1.5 dB
Fast	6 dB	3 dB

For example: In a fast fading environment an up shift from 16QAM $\frac{3}{4}$ to 64QAM $\frac{2}{3}$ will occur at -74.2 dBm (-80.2 dBm + 6 dB) and the down shift from 64QAM $\frac{2}{3}$ to 16QAM $\frac{3}{4}$ will occur at -77.2 dBm (-80.2 dBm + 3 dB).

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

Wireless PHY	
Max Path Loss	167dB
Duplex Scheme	TDD, Symmetric (1:1) and Asymmetric (2:1)
Range	81 miles (130km) 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	10/100BaseT (RJ-45), Supports MDI/MDIX Auto Crossover																
Data Rate ⁶ 0 – 5 km Mode (Single direction – Symmetric TDD (1:1))	<table border="0"> <tr><td>BPSK 1/2</td><td>1.60 Mbps</td></tr> <tr><td>QPSK 1/2</td><td>3.20 Mbps</td></tr> <tr><td>QPSK 2/3</td><td>4.27 Mbps</td></tr> <tr><td>16QAM 1/2</td><td>6.40 Mbps</td></tr> <tr><td>16QAM 3/4</td><td>9.60 Mbps</td></tr> <tr><td>64QAM 2/3</td><td>12.81 Mbps</td></tr> <tr><td>64QAM 3/4</td><td>14.41 Mbps</td></tr> <tr><td>64QAM 7/8</td><td>16.81 Mbps</td></tr> </table>	BPSK 1/2	1.60 Mbps	QPSK 1/2	3.20 Mbps	QPSK 2/3	4.27 Mbps	16QAM 1/2	6.40 Mbps	16QAM 3/4	9.60 Mbps	64QAM 2/3	12.81 Mbps	64QAM 3/4	14.41 Mbps	64QAM 7/8	16.81 Mbps
BPSK 1/2	1.60 Mbps																
QPSK 1/2	3.20 Mbps																
QPSK 2/3	4.27 Mbps																
16QAM 1/2	6.40 Mbps																
16QAM 3/4	9.60 Mbps																
64QAM 2/3	12.81 Mbps																
64QAM 3/4	14.41 Mbps																
64QAM 7/8	16.81 Mbps																
Data Rate 0 – 5 km Mode (Single direction – Asymmetric TDD (2:1))	<table border="0"> <tr><td>BPSK 1/2</td><td>2.07 Mbps</td></tr> <tr><td>QPSK 1/2</td><td>4.13 Mbps</td></tr> <tr><td>QPSK 2/3</td><td>5.51 Mbps</td></tr> <tr><td>16QAM 1/2</td><td>8.26 Mbps</td></tr> <tr><td>16QAM 3/4</td><td>12.39 Mbps</td></tr> <tr><td>64QAM 2/3</td><td>16.53 Mbps</td></tr> <tr><td>64QAM 3/4</td><td>18.59 Mbps</td></tr> <tr><td>64QAM 7/8</td><td>21.69 Mbps</td></tr> </table>	BPSK 1/2	2.07 Mbps	QPSK 1/2	4.13 Mbps	QPSK 2/3	5.51 Mbps	16QAM 1/2	8.26 Mbps	16QAM 3/4	12.39 Mbps	64QAM 2/3	16.53 Mbps	64QAM 3/4	18.59 Mbps	64QAM 7/8	21.69 Mbps
BPSK 1/2	2.07 Mbps																
QPSK 1/2	4.13 Mbps																
QPSK 2/3	5.51 Mbps																
16QAM 1/2	8.26 Mbps																
16QAM 3/4	12.39 Mbps																
64QAM 2/3	16.53 Mbps																
64QAM 3/4	18.59 Mbps																
64QAM 7/8	21.69 Mbps																
Data Rate 0 – 40 km Mode (Single direction – Symmetric TDD (1:1))	Reduces by 6.40%																
Data Rate 0 – 40 km Mode (Single direction – Asymmetric TDD (2:1))	Reduces by 8.11%																
Data Rate 0 – 130 km Mode (Single direction – Symmetric TDD (1:1))	Reduces by 19.63%																
Data Rate 0 – 130 km Mode (Single direction – Asymmetric TDD (2:1))	Reduces by 23.97%																

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

⁶ ARQ disable – (Enabling ARQ drops the rate ~ 0.13%)

Power Supply	Separate power supply unit (included)
Power source	90 – 264 VAC, 50 – 60 Hz
Power consumption	30 W mean (85 BTU/Hr)

8.2 Safety Compliance

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

8.3 EMC Emissions Compliance

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

8.4 EMC Immunity Compliance

Top-level Specification ETSI 301-489.

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	
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 6100045:1995, (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.

8.5 Radio Certifications

Region	Specification (Type Approvals)
USA	FCC Part 15.247

8.6 Environmental Specifications

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

8.7 System Connections

8.7.1 ODU to IDU Connection



Figure 33 ODU to IDU Connection Diagram

8.7.2 Power Connection

The IDU power connection is via a standard 2.5 mm DC power socket.



Figure 34 DC Connector Diagram

The DC connection diagram is shown in Figure 34 for completeness. The OS-Gemini should only be used with the supplied PSU. Failure to do so may invalidate the unit's safety compliance and could lead to a fire.

9 Lightning Protection

9.1 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. Full details of lightning protection methods and requirements can be found in the international standards IEC 61024-1 and IEC 61312-1, the 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 35) 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 A. 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-Gemini ODU grounding point can be found on the bottom of the unit. The OS-Gemini is supplied with an appropriate grounding lug for attachment to the ODU.

9.2 Detailed Installation

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

- 2 Andrew Grounding Kits — Type 223158
- Screened Cat 5 Cable
- Line Protection Unit — Cyclix MTJ-POE 60V
- Grounding Stake
- 2 RJ45 connectors
- 10 AWG Grounding Cable

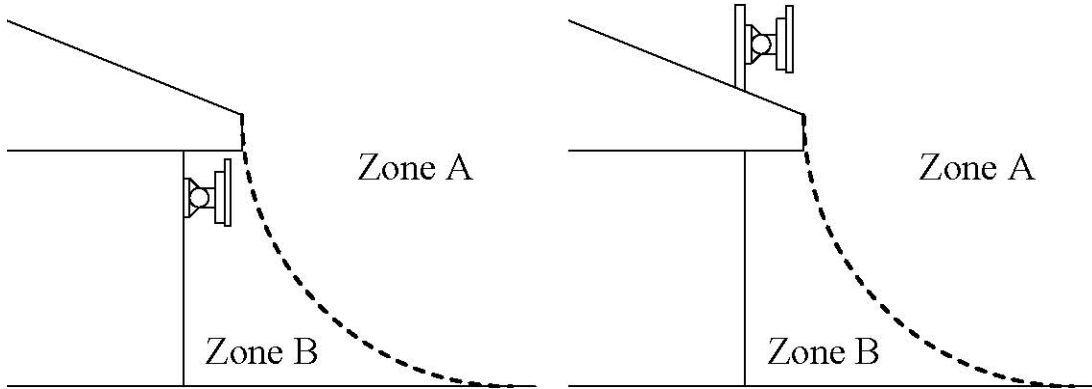


Figure 35 ODU Mounted in Zone B & ODU Mounted in Zone A

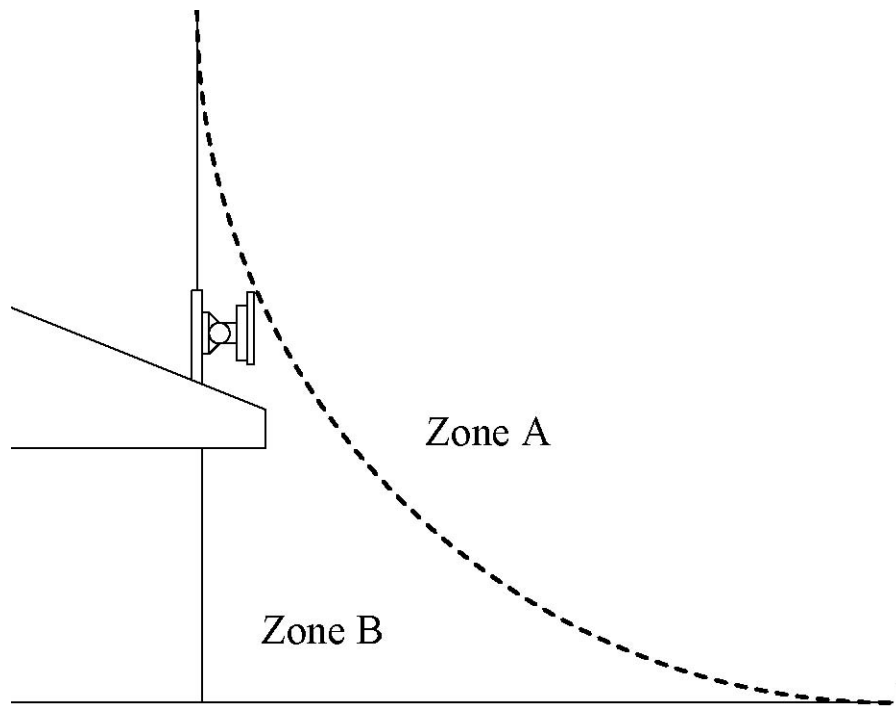


Figure 36 ODU mounted inside Zone B

	Zone A	Zone B
Earth ODU	Mandatory	Recommended
Screen Cable	Mandatory	Recommended
Earth Cable at Building Entry	Mandatory	Recommended
Ethernet Surge Arrestor	Recommended	Recommended

Table 8 Protection Requirements

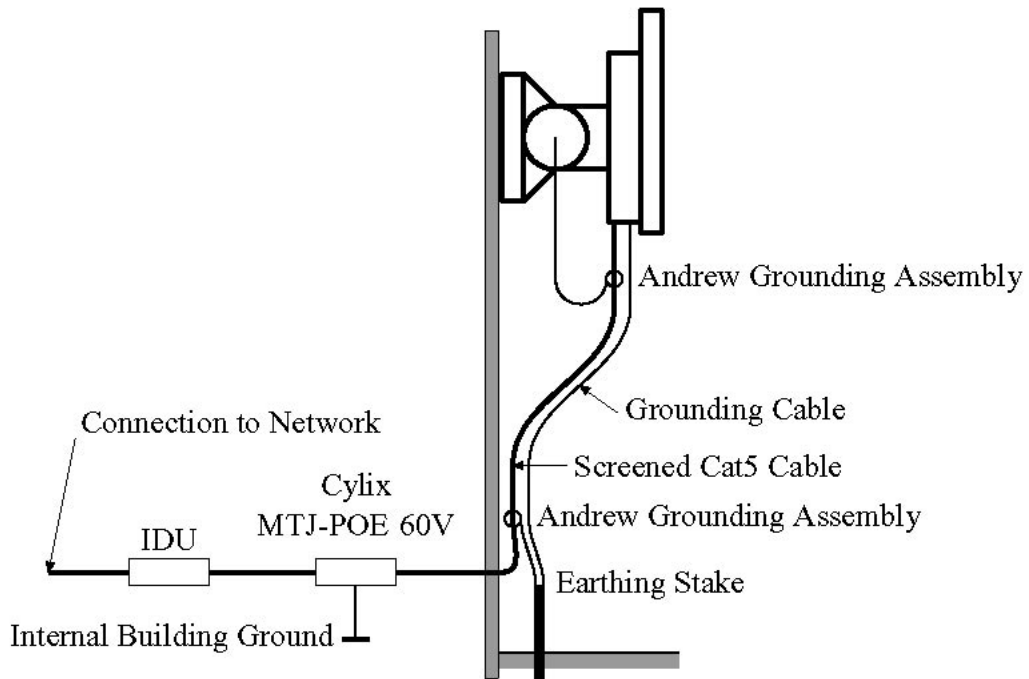


Figure 37 Diagrammatically showing a typical installation

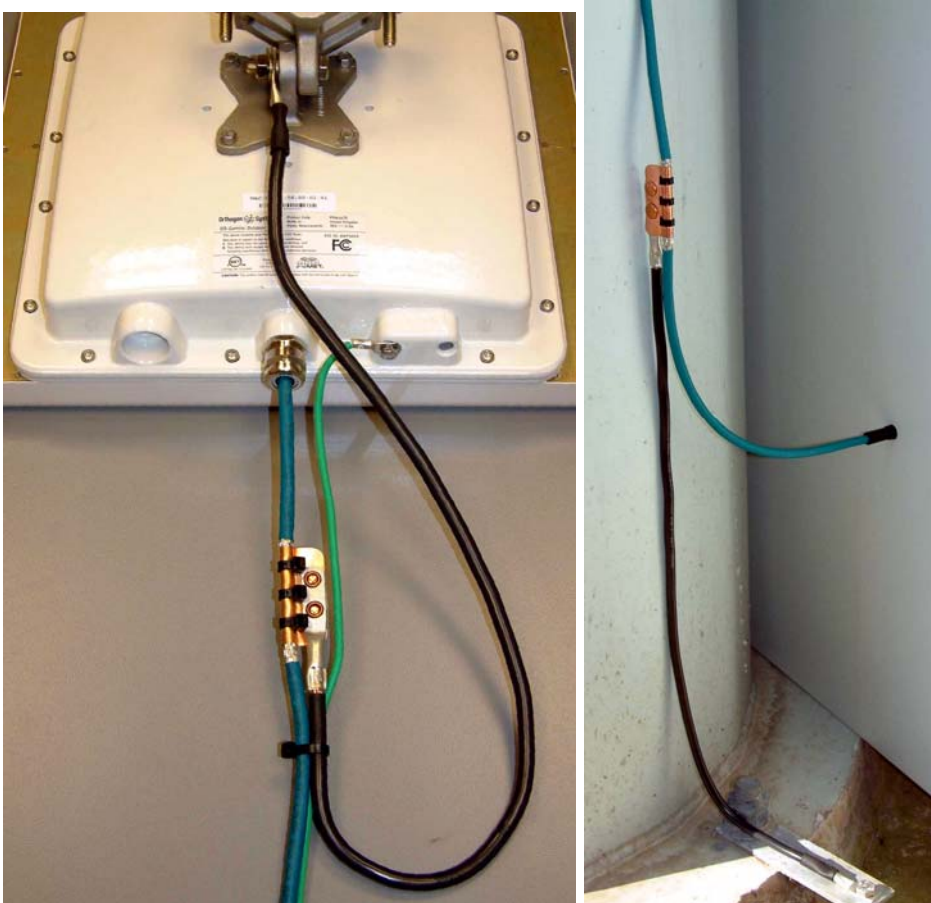


Figure 38 Upper Configuration and Lower Configuration

10 OS-Gemini C

10.1 Scope

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

10.2 Product Description

10.2.1 Hardware

The OS-Gemini 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 basic OS-Gemini 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.

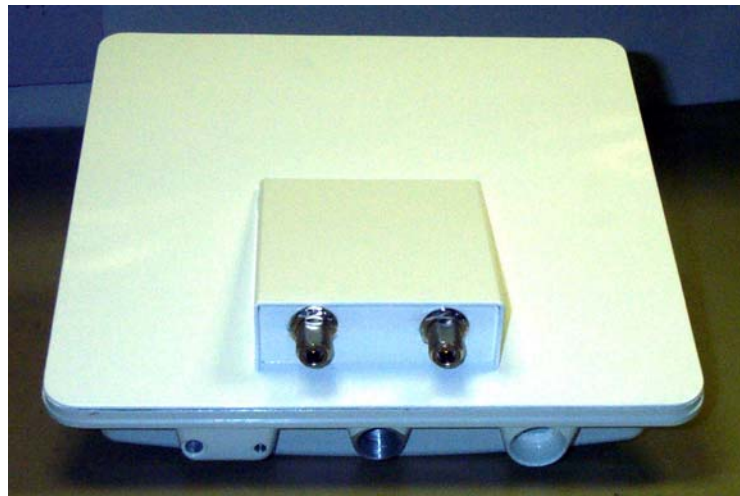


Figure 39 OS-Gemini C Outdoor Unit

10.2.2 Antenna Choices

The integrated antenna has a gain of 23dBi. External antennas from the list in Table 10 can be used with the OS-Gemini 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

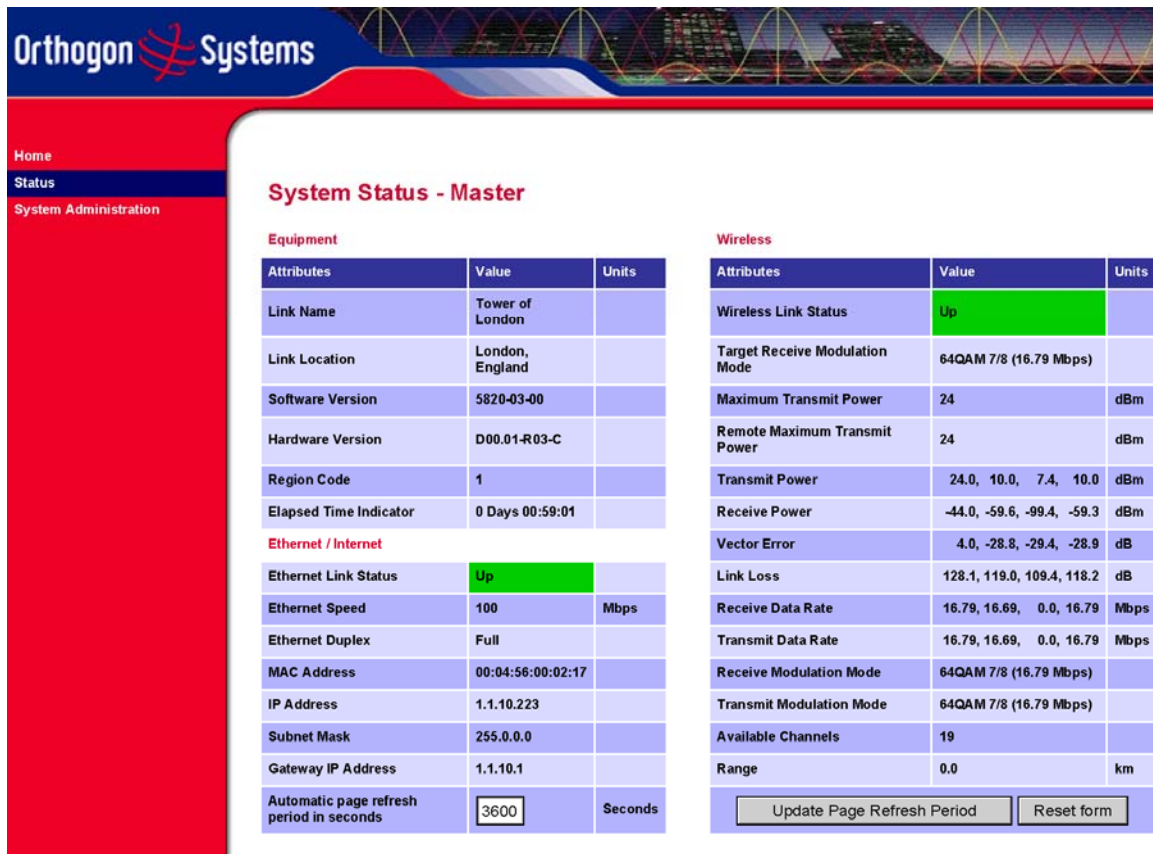
All external antennas – cable loss between OS-Gemini C and the antenna ports must not be less than 1.2dB

10.3 Software/Features

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

10.3.1 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-Gemini 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.



System Status - Master

Equipment

Attributes	Value	Units
Link Name	Tower of London	
Link Location	London, England	
Software Version	5820-03-00	
Hardware Version	D00.01-R03-C	
Region Code	1	
Elapsed Time Indicator	0 Days 00:59:01	

Ethernet / Internet

Attributes	Value	Units
Ethernet Link Status	Up	
Ethernet Speed	100	Mbps
Ethernet Duplex	Full	
MAC Address	00:04:56:00:02:17	
IP Address	1.1.10.223	
Subnet Mask	255.0.0.0	
Gateway IP Address	1.1.10.1	
Automatic page refresh period in seconds	<input type="text" value="3600"/>	Seconds

Wireless

Attributes	Value	Units
Wireless Link Status	Up	
Target Receive Modulation Mode	64QAM 7/8 (16.79 Mbps)	
Maximum Transmit Power	24	dBm
Remote Maximum Transmit Power	24	dBm
Transmit Power	24.0, 10.0, 7.4, 10.0	dBm
Receive Power	-44.0, -59.6, -99.4, -59.3	dBm
Vector Error	4.0, -28.8, -29.4, -28.9	dB
Link Loss	128.1, 119.0, 109.4, 118.2	dB
Receive Data Rate	16.79, 16.69, 0.0, 16.79	Mbps
Transmit Data Rate	16.79, 16.69, 0.0, 16.79	Mbps
Receive Modulation Mode	64QAM 7/8 (16.79 Mbps)	
Transmit Modulation Mode	64QAM 7/8 (16.79 Mbps)	
Available Channels	19	
Range	0.0	km

Update Page Refresh Period Reset form

Figure 40 OS-Gemini C Status Page

10.3.2 Configuration Pages

The amended Configuration Web page is shown below as Figure 41.



System Configuration

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

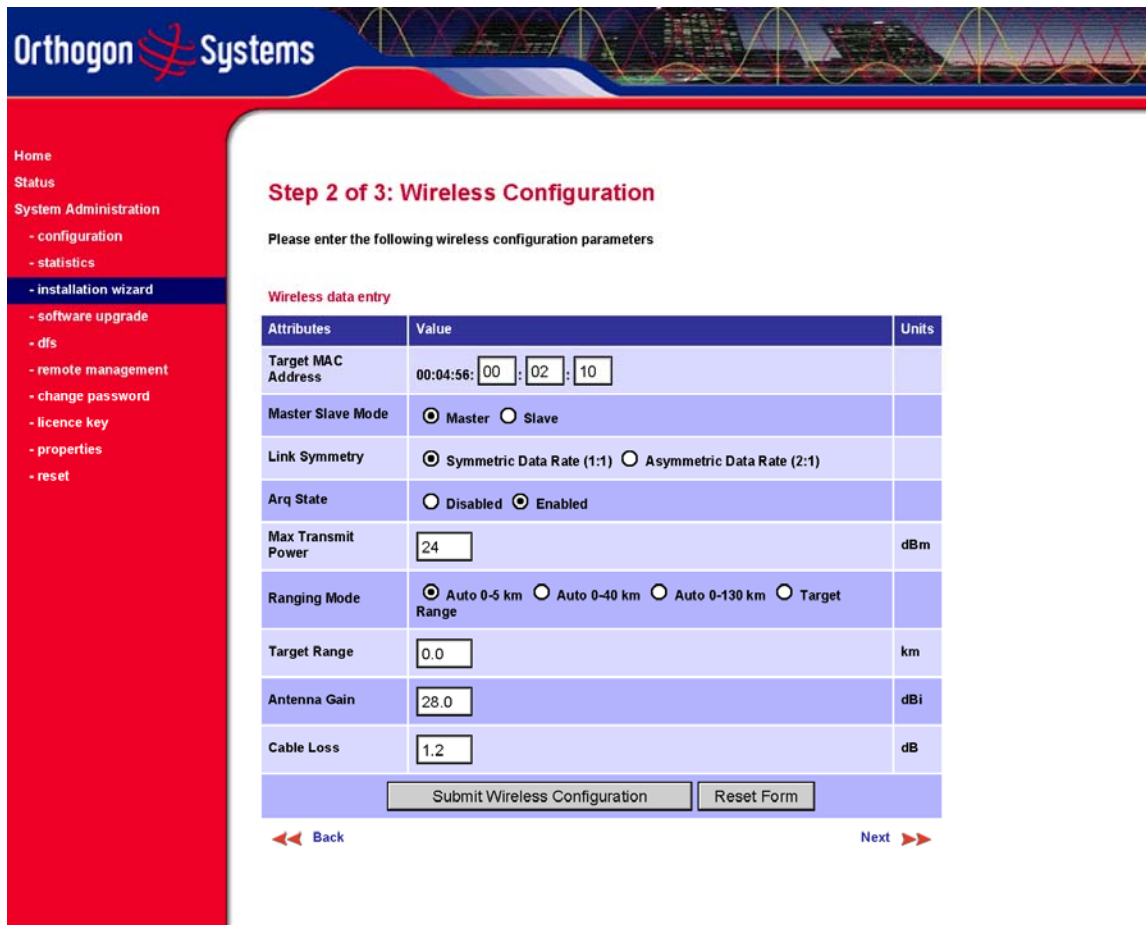
Equipment

Attributes	Value	Units
Link Name	<input type="text" value="Tower of London"/>	
Link Location	<input type="text" value="London, England"/>	
Master Slave Mode	Master	
Link Symmetry	<input checked="" type="radio"/> Symmetric Data Rate (1:1) <input type="radio"/> Asymmetric Data Rate (2:1)	
Target Receive Modulation Mode	<input type="text" value="64QAM 7/8 (16.79 Mbps)"/>	
Max Transmit Power	<input type="text" value="24"/>	dBm
Antenna Gain	<input type="text" value="28.0"/>	dBi
Cable Loss	<input type="text" value="1.2"/>	dB
Arq State	<input type="radio"/> Disabled <input checked="" type="radio"/> Enabled	
Dfs State	<input type="radio"/> Disabled <input checked="" type="radio"/> i_DFS	
IP Address	<input type="text" value="1"/> . <input type="text" value="1"/> . <input type="text" value="10"/> . <input type="text" value="223"/>	
Subnet Mask	<input type="text" value="255"/> . <input type="text" value="0"/> . <input type="text" value="0"/> . <input type="text" value="0"/>	
Gateway IP Address	<input type="text" value="1"/> . <input type="text" value="1"/> . <input type="text" value="10"/> . <input type="text" value="1"/>	
Ethernet Configuration	<input type="text" value="Auto"/>	
Ethernet Auto Mdx	<input type="radio"/> Disabled <input checked="" type="radio"/> Enabled	
Local Packet Filtering	<input type="radio"/> Disabled <input checked="" type="radio"/> Enabled	

Figure 41 OS-Gemini C 'System Configuration' Page

10.3.3 Installation Pages

The installer is prompted to enter the Antenna Gain and Cable Loss (OS-Gemini C to antenna) at each end of the link. The Installation Page(s) is shown as Figure 42-Figure 44.



Step 2 of 3: Wireless Configuration

Please enter the following wireless configuration parameters

Wireless data entry

Attributes	Value	Units
Target MAC Address	00:04:56:00:02:10	
Master Slave Mode	<input checked="" type="radio"/> Master <input type="radio"/> Slave	
Link Symmetry	<input checked="" type="radio"/> Symmetric Data Rate (1:1) <input type="radio"/> Asymmetric Data Rate (2:1)	
Arq State	<input type="radio"/> Disabled <input checked="" type="radio"/> Enabled	
Max Transmit Power	24	dBm
Ranging Mode	<input checked="" type="radio"/> Auto 0-5 km <input type="radio"/> Auto 0-40 km <input type="radio"/> Auto 0-130 km <input type="radio"/> Target Range	
Target Range	0.0	km
Antenna Gain	28.0	dBi
Cable Loss	1.2	dB

Figure 42 OS-Gemini C 'Installation Wizard' Page

Antenna Gain Gain of the antenna you are connecting to the unit, see Table 11 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.

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 and Arm Installation Agent' button, this will commit the parameters to non-volatile memory and reset the system.

Installation configuration

Attributes	Value	Units
IP Address	1.1.10.223	
Subnet Mask	255.0.0.0	
Gateway IP Address	1.1.10.1	
Target MAC Address	00:04:56:00:02:10	
Master Slave Mode	Master	
Link Symmetry	Symmetric Data Rate (1:1)	
Arq State	Enabled	
Max Transmit Power	24	dBm
Ranging Mode	Auto 0-5 km	
Antenna Gain	28.0	dBi
Cable Loss	1.2	dB

Confirm Configuration and Arm Installation Agent

Back

Figure 43 OS-Gemini C 'Confirm Installation' Page

Disarm Installation

The installation agent is armed. If you wish to disarm installation then use the 'Disarm Installation Agent' button. If you wish to reconfigure the installation agent then use the wizards 'back' button

Installation configuration

Attributes	Value	Units
IP Address	1.1.10.223	
Subnet Mask	255.0.0.0	
Gateway IP Address	1.1.10.1	
Target MAC Address	00:04:56:00:02:10	
Master Slave Mode	Master	
Link Symmetry	Symmetric Data Rate (1:1)	
Arq State	Enabled	
Max Transmit Power	24	dBm
Ranging Mode	Auto 0-5 km	
Antenna Gain	28.0	dBi
Cable Loss	1.2	dB

Disarm Installation Agent

Back

Figure 44 OS-Gemini C 'Disarm Installation' Page

10.4 Deployment Considerations

The majority of radio links can be successfully deployed with the OS-Gemini 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.

10.5 Link Budget

This is increased by the additional gain of the external antenna(s) less the cable losses. The improvement in link budget is indicated in for a sample of the antennas when operating in BPSK 1/2 and 64QAM 7/8 modes.

Operating Mode	Static Link Budget (dB)			
	Integrated Antenna	28dBi Flat Plate	4 ft Parabolic Dish	6ft Parabolic Dish
BPSK 1/2	166.5	173.1	185.9	192.5
QPSK 1/2	162.8	169.4	182.2	188.8
QPSK 2/3	160.7	167.3	180.1	186.7
16QAM 1/2	156.1	162.7	175.5	182.1
16QAM 3/4	151.6	158.2	171.0	177.6
64QAM 2/3	146.2	152.8	165.6	172.2
64QAM 3/4	144.3	150.9	163.7	170.3
64QAM 7/8	139.6	146.2	159.0	165.6

Note: Gains are 23.5/28/34.4/37.7dBi and Cable Loss is 1.2dB for the External Antennas

Table 9 Static Link Budget for Various Antenna Options

10.6 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 10.6.1 and 10.6.2 apply.

10.6.1 Antenna Choice

The antennas allowed to be deployed with the OS-Gemini C are shown in Table 11.

10.6.2 Cable Losses

The FCC approval for the product is based on tests with a cable loss between the units of 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 10 Cable Losses per Length

10.7 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-486009 (23dBi)	23	Y	
MTI	MTI 15 inch Dual-Pol Flat Panel, MT-485025/NMH (23dBi)	23	Y	
MTI	MTI 2ft 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, HCF2-52-N	28.2		Y
Gabriel	Gabriel 4-foot High Performance QuickFire Parabolic, HCF4-52-N	34.4		Y
Gabriel	Gabriel 6-foot High Performance QuickFire Parabolic, HCF6-52-N	37.4		Y
Gabriel	Gabriel 2-foot High Performance Dual QuickFire Parabolic, HCFD2-52-N	28.1		Y
Gabriel	Gabriel 4-foot High Performance Dual QuickFire Parabolic, HCFD4-52-N	34.3		Y
Gabriel	Gabriel 6-foot High Performance Dual QuickFire Parabolic, HCFD6-52-N	37.3		Y
Gabriel	Gabriel 2-foot Standard QuickFire Parabolic, CF2-52-N	28.5		Y
Gabriel	Gabriel 2-foot Standard QuickFire Parabolic, CF2-52-N-RK	28.5		Y
Gabriel	Gabriel 2.5-foot Standard QuickFire Parabolic, CF2.5-52-N	31.2		Y
Gabriel	Gabriel 4-foot Standard QuickFire Parabolic, CF4-52-N	34.8		Y
Gabriel	Gabriel 4-foot Standard QuickFire Parabolic, CF4-52-N-RK	34.8		Y
Gabriel	Gabriel 6-foot Standard QuickFire Parabolic, CF6-52-N	37.7		Y
Gabriel	Gabriel 2-foot Standard Dual QuickFire Parabolic, CFD2-52-N	28.4		Y
Gabriel	Gabriel 2.5-foot Standard Dual QuickFire Parabolic, CFD2.5-52-N	31.1		Y
Gabriel	Gabriel 2-foot Standard Dual QuickFire Parabolic, CFD2-52-N-RK	28.4		Y
Gabriel	Gabriel 4-foot Standard Dual QuickFire Parabolic, CFD4-52-N	34.7		Y
Gabriel	Gabriel 4-foot Standard Dual QuickFire Parabolic, CFD4-52-N-RK	34.7		Y
Gabriel	Gabriel 6-foot Standard Dual QuickFire Parabolic, CFD6-52-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 SFFX2-52AN (27.9dBi)	27.9		Y
RFS	RFS 3-foot Parabolic, SPF3-52AN or SFFX3-52AN(31.4dBi)	31.4		Y
RFS	RFS 4-foot Parabolic, SPF4-52AN or SFFX4-52AN(33.9dBi)	33.9		Y
RFS	RFS 6-foot Parabolic, SPF6-52AN or SFFX6-52AN (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 11 Allowed Antennas for Deployment in USA/Canada

11 FAQs

The 100Base-T Ethernet Specification specifies a maximum cable length of 100m. Why am I restricted to 60m of cable between the IDU and ODU? The 60m restriction is a result of the voltage drop experienced using CAT 5 cable. The 100m maximum length still applies between the ODU and connected equipment.

Can I source and use my own PoE adaptor with the OS-Gemini? No. The OS-Gemini uses a non-standard PoE configuration. Failure to use the Orthogon Systems supplied IDU and inline power supply 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-Gemini? The OS-Gemini is the first product in this band to feature Multi-beam Space Time Coding. The OS-Gemini allows wireless connections of up to 130km (81 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-Gemini 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-Gemini? There are many special features built-in to the hardware of the OS-Gemini. 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-Gemini has a built-in web server for advanced management capabilities including detailed radio signal diagnosis.

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

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

How much power does the OS-Gemini transmit? At all times the OS-Gemini operates within country / region specific regulations for radio power emissions. In addition, the OS-Gemini 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-Gemini avoid interference from other devices nearby? At initialisation, the OS-Gemini monitors the available frequency channels to find a channel that is clean from interference. In operation OS-Gemini continuously monitors the spectrum to ensure it is operating on the cleanest channel.

How does the OS-Gemini integrate into my data network? The OS-Gemini 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-Gemini 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-Gemini provide security for data traffic? The OS-Gemini 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 options from which the user will be able to turn on AES. The default setting for AES is off.

How do I manage the OS-Gemini? The OS-Gemini 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-Gemini? 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.

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

13 Index

About This Guide.....	6	Disclaimer.....	2
Aligning the ODUs.....	29	Distance.....	16
Antenna Gain.....	86	Dynamic Frequency Selection.....	40
ARQ Is Not Configured.....	32	Elapsed Time Indicator.....	32, 34
ARQ State.....	40, 48	Electrical Requirements.....	17
Available Channel.....	37	Environmental Specification.....	77
Barring Channels.....	59	Ethernet Auto Mdx.....	41
Cable Loss.....	86	Ethernet Configuration.....	40
Cables and Connectors.....	11	Ethernet Duplex.....	34
Change System Administration Password.....	66	Ethernet Link Status.....	34
Channel Spectrum Graphics.....	59	Ethernet Speed.....	34
Code Word Error Ratio.....	43	FAQs.....	91
Compliance.....	1, 76, 77	Fault Finding.....	68
Configuration and Management.....	12	Fitting A Surge Arrestor.....	26
Configuring The Wireless Units.....	44	For Your Safety.....	6
Confirm Configuration.....	49	Frequency Planning.....	16
Connecting Up.....	23	Full Duplex.....	34
Contact Information.....	7	Gateway IP Address.....	35, 40
Copyright Information.....	1	General Considerations.....	16
Detailed Installation.....	79	Getting Started.....	6
DFS Configuration.....	57	Glossary.....	94
DFS Measurements.....	54	Grounding The Installation.....	26
DFS Online Help.....	62	Half Duplex.....	35
DFS Pages.....	54	Hardware Version.....	34
Disarm.....	50	Historic DFS Metrics.....	61

Home Page.....	31	Mounting the ODUs	22
IDU Site Selection.....	18	Networking Information.....	16
Install Pages	44	ODU Site Selection.....	18
Install Status	32	ODU to IDU Connection	78
Installation.....	21	OS-Gemini C	83
Installation Procedure	21	Overview.....	79
Installation Support.....	21	Packets From Internal Stack	43
Internet Protocol Configuration.....	45	Packets To Internal Stack.....	43
IP Address	35, 40	Path Loss Considerations.....	19
Lan Rx Packets.....	43	PHY Code Word Error Counter	43
Lan Tx Packets	43	Pole Mounting.....	22
Legal Disclaimer	22	Power Connection	78
Lightning Protection.....	16, 79	Powering Up	28
Link Location.....	33, 39	Preparation	21
Link Loss.....	36	Preparing The RJ45	23
Link Name.....	31, 33, 39	Product Architecture	14
Link Symmetry	39, 47	Product Description	7
MAC Address.....	35	Radio Certifications	77
Mains Power Adapter	11	Range	37
Making the Connection At The IDU	26	Ranging Mode	48
Making the Connection At The ODU	24	Receive Data Rate	36, 43
Master Slave Mode.....	47	Receive Modulation Mode.....	37
Max Transmit Power.....	48	Receive Power.....	35
Maximum Transmit Power	40	Refresh Page Period	37, 57, 58, 59
Measurement Analysis	54	Region Code.....	34
Mounting Brackets.....	12	Remote Management Page.....	63
Mounting The IDU.....	27	Remote Transmit Maximum Power	35

Repair and Service	7	Software Version	34
Reset	66	Specifications.....	72
Reset System Counters.....	43	Statistics Page.....	42
Reset System Histograms	43	Statistics Page Refresh Period.....	43
Routing the Cable	26	Subnet Mask.....	35, 40
Site Planning.....	18	Surge Arrestor	12
Site Selection Criteria	18	System Administration Pages.....	38
SMTP (Simple Mail Transport Protocol)	65	System Clock.....	32
SMTP Destination Email Address	65	System Configuration Page.....	38
SMTP Email Alert	65	System Connections.....	78
SMTP IP Address	65	System Specifications	72
SMTP Port Number	65	Systems Status Page	32
SMTP Source Email Address	65	Target MAC Address	47
SNMP (Simple Network Management Protocol).....	64	Target Modulation Mode.....	35
SNMP Community String.....	64	Target Receive Modulation Mode.....	39
SNMP Configuration	64	The DFS Master / Slave Relationship	55
SNMP MIBs	64	The Indoor Unit (IDU)	10
SNMP State	64, 65	The Outdoor Unit (ODU).....	8
SNMP Trap IP Address	65	Tools Required	21
SNMP Trap Port Number	65	Transmit Data Rate	36, 43
SNTP (Simple Network Time Protocol) ..	66	Transmit Modulation Mode.....	37
SNTP IP Address.....	66	Transmit Power.....	35
SNTP Poll Interval	66	Unit Calibration	32
SNTP Port Number.....	66	Vector Error	36
SNTP State.....	66	Wall Mounting.....	22
SNTP Time Zone.....	66	Wan Bad Rx Packets.....	42
Software Upgrade.....	51	Wan Dropped Tx Packets.....	42

Wan Good Rx Packets42

Wan Good Tx Packets.....42

Warranty13

Web Page Reference31

Welcome.....6

Who Should Use This Guide6

Wireless Channels.....54

Wireless Configuration47

Wireless Link Availability43, 54, 55

Wireless Link Status31, 35

Orthogon Systems

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

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

www.orthogonsystems.com