Orthogon Systems

GEMINI

and then there's
Orthogon Systems

There's non-line-of-sight...

There's line-of-sight...

User Manual

Orthogon Systems

Gemini System User Manual

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Copyright Information

Compliance

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

Disclaimer

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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 ODU must not be deployed in a location where it is possible for people to stand or walk inadvertently in front of the antenna.

The Gemini 5810 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. 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 which will be exposed to the weather.

Caution   Safety may be compromised if a different power supply is used than the one supplied as part of the system.

Caution   Safety may be compromised if the screws holding the bracket to the rear of the unit are removed and reassembled more than once.

1.2 Welcome

Congratulations on the purchase of the OS-Gemini systems from Orthogon Systems. The OS-Gemini 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-Gemini 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 Service

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

1.3 Product Description (About the OS-Gemini)

The OS-Gemini has primarily been developed to provide Point-to-Point data connectivity via a 5GHz wireless Ethernet bridge operating at broadband data rates. The OS-Gemini 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. It should be noted that the use of two links requires a router at each end to provide load balancing and redundancy control which are not shown.

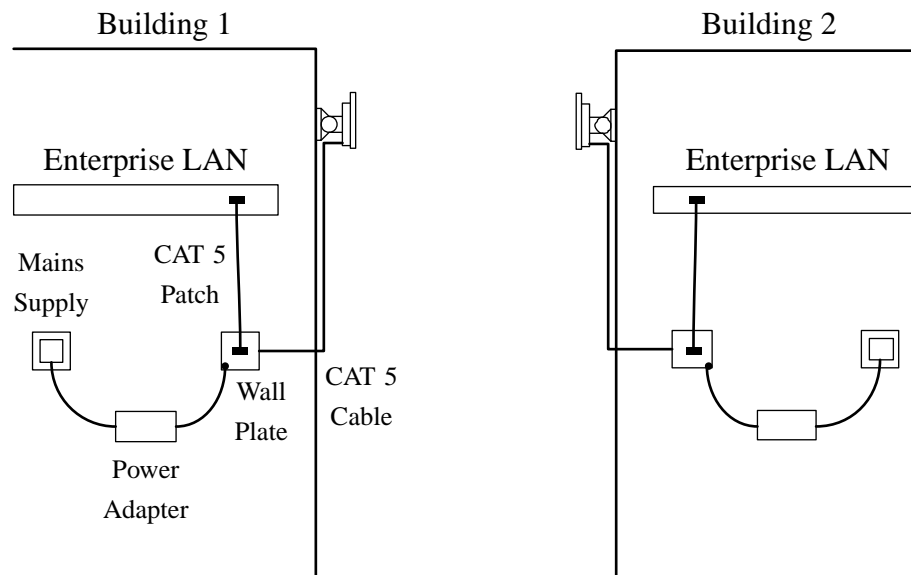**Figure 1**   Typical OS-Gemini Deployment

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

The OS-Gemini 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 is set 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 passive connection box containing status indicators, DC power connection and network connection. Hereafter referred to as the Indoor Unit (IDU).
- A 'mains' power adaptor.

Power is fed into the IDU from the mains power adaptor via a standard low voltage DC connector. The network connection is presented to the user at the IDU via an RJ45 socket. Connection between the ODU and IDU is made using standard CAT 5 UV resistant cable. The spare twisted pairs of the cable are used to feed power from the IDU to the ODU.

1.3.1 The Outdoor Unit (ODU)

The ODU is a self-contained unit. It houses both radio and networking electronics. The unit is fed by a single CAT 5 UTP cable. Power is fed to the unit via the brown/brown-white pair connected to pins 7 and 8 of the RJ45 plugs and sockets employed. It should be noted that this powering arrangement is not standard Power-over-Ethernet (POE). The OS-Gemini ODU should only be deployed using the supplied OS-Gemini Indoor Unit (IDU).

1.3.2 The Indoor Unit (IDU)

The OS-Gemini IDU is a passive device used to inject the DC supply voltage into the cable connecting the IDU to the ODU. The IDU also houses status indicators driven from the ODU over the blue/blue-white pair connected to pins 4 and 5 of the RJ45 plugs and sockets employed.

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

- the power indicator is illuminated when the IDU is receiving 48 volts from the power adaptor.
- the Ethernet indicator illuminates when the ODU is powered; it flashes when there is Ethernet activity.

The bottom of the IDU contains the Ethernet connection via RJ45 socket, the power connection, an entry point for IDU-ODU cabling and the reset button.

The IDU also houses a reset switch. This reset switch is used for various purposes identified in table 1.

reset IP switch

Figure 2 OS-Gemini Outdoor Unit (ODU)

1.3.3 Mains Power Adaptor

The mains power adaptor is an in-line power supply which provides a 48 Volt DC output to supply power to the IDU / ODU

Caution Safety may be compromised if a different power supply is used instead of the one supplied as part of the system.

Figure 3 OS-Gemini Indoor Unit (IDU)

Reset Button Depression	Action
Momentary	This is the same as a power cycle. It simply restarts the unit using the same configuration and software as before.
More than 10 secs	This resets the configuration to factory defaults. All parameters will need to be reentered including the web page which will have returned to 10.10.10.10.
While connecting power for more than 15 secs after power is applied	This resets to factory defaults including to the initial software load.

Table 1 Reset actions

1.3.4 Cables and Connectors

The cable used to connect the IDU to the ODU can be any standard CAT 5 type provided that it is suitable for outdoor deployment. Orthogon Systems recommends that cables to the specification below are used.

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

Figure 4   OS-Gemini Reset Switch

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

The IDU/ODU cable may be unscreened (UTP) or screened (STP). However, unscreened cables reduce the system's ability to cope with nearby lightening strikes. If lightening activity is common in the area of deployment, the use of screened cable is highly recommended.

The connection between the IDU and users equipment can be made using any standard CAT5 UTP patch cable. The RJ45 Ethernet connection is presented as a piece of network equipment. However as automatic MDI/MDI-X sensing and pair swapping is employed a crossed or non-crossed Ethernet patch cable can be used for connection to another piece of networking equipment or directly to end user equipment.

It should be noted that the IDU provides continuity between the screen on the ODU-IDU cable and screen on the IDU-User equipment cable. If continuity of the screening is desired from the ODU to the users equipment, CAT 5 STP cable and connectors should be used for the latter connection.

1.3.5   Surge Arrestor

The IDU 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 re-seller. The ODU is protected through built-in surge suppression as standard.

Figure 5   OS-Gemini power adaptor

1.3.6   Mounting Brackets

The OS-Gemini ODU is supplied with a mounting bracket suitable for mounting the ODU to a pole of 50mm to 75mm in diameter or to a flat surface. For more details on mounting see section 5 "Installation"
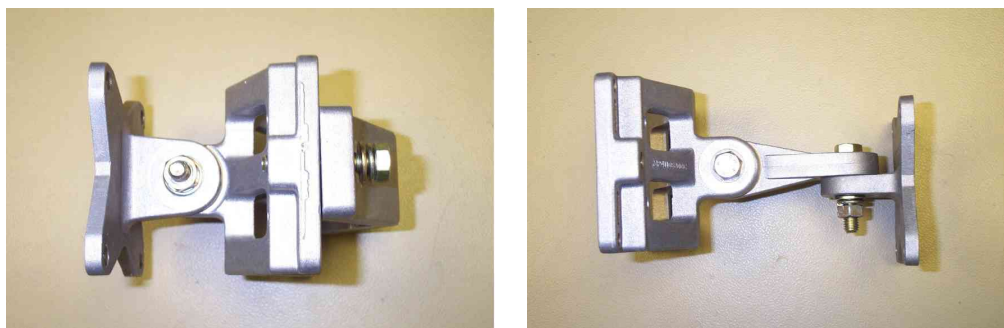
Pole   Wall

Figure 6   ODU Mounting Configurations

The bracket allows for adjustment in both azimuth and elevation. The bracket can be split, allowing one half to mounted to the ODU and the other half to the pole or wall prior to installation. This allows the installer to take the weight of the unit on a single mounting bolt while fitting the retaining nut and washers.

The OS-Gemini IDU can either be desk or wall mounted. The preference is wall mounted with the cables dressed to a skirting board or cable channel. Wall mounting is achieved by screwing through the mounting lugs on either side of the unit.

1.3.7   Configuration and Management

Configuration and Management of the OS-Gemini 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. Connection to the OS-Gemini 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 offers a warranty covering a period of 1 year from the date of purchase by the end customer. If the product is found to be defective during the warranty period, Orthogon Systems Ltd. will repair or replace the product with the same or a similar model, which may be a reconditioned unit, without charge for parts or labour. 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 RISING 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 LTD. HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. (Some states 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 (More Detail About The OS-Gemini)

The OS-Gemini consists of an identical pair of units deployed one at each end of the link. The radio link operates on a single frequency channel 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 OFDMmodulation with a dispersion capability of 10 microseconds in both directions.

The OS-Gemini has been developed to operate in license exempt frequency bands for example the ETSI 5.8 GHz C band (5.725–5.875 GHz) and the USA 5 GHz ISM band (5.725–5.850 GHz). The OS-Gemini has been designed to coexist with other users of the band in an optimal fashion using a combination of Transmit Power Control (TPC), Dynamic Frequency Selection (DFS) and Antenna beam shape.

In order to maintain link availability, the product employs adaptive modulation techniques that reduce the data rate in severe or adverse conditions.

The OS-Gemini operates as a standard IEEE 802.3 Ethernet bridge as defined in IEEE 802.1. The OS-Gemini 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 re-transmit a packet if it knows that the destination address is connected to the same port on which the bridge saw the packet. Figure 7 illustrates the OS-Gemini layer diagram.
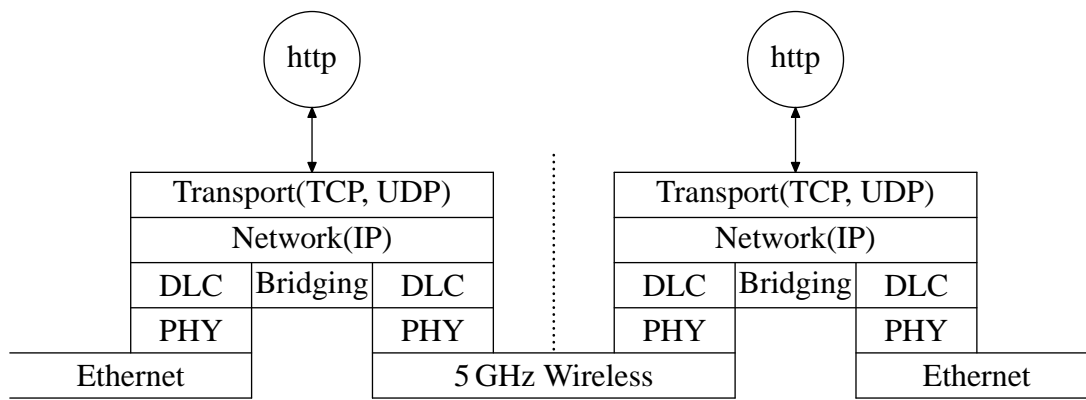
Figure 7 OS-Gemini Layer Diagram

The OS-Gemini 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 8 bytes to include the IEEE 802.1q VLAN Tag and VLAN Priority/ID with VLAN ID set to 0 and the packet priority set to 0-7. The OS-Gemini 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, TFTP, etc. The OS-Gemini is fully software upgradeable. New software images are first downloaded from the Orthogon Systems support web site

(`www.orthogonsystems.com/support/download`) to a convenient platform. The image is then uploaded to the ODU via the web management page described in section 6.3.3 "Software Upgrade Pages". 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 will re-boot using the newly downloaded 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-Gemini is capable of operating in the whole frequency range 5.725 to 5.875 GHz (defined as the ETSI 5 GHz C band) but for the USA is optimised for the ISM band (5.725-5.850 GHz), utilising a 10 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-Gemini 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 6.3.4 "DFS Pages".

3.2 Distance

The OS-Gemini will operate at ranges from 100m to 40 km. Operation of the system will depend on obstacles in the path between the units. Operation at 40km will require a Line of Sight (LoS) 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 4.2 "Path Loss Considerations".

3.3 Networking Information

The OS-Gemini operates as a transparent Ethernet bridge. Each unit requires an IP address. This IP address is for management purposes only; it does not play any part in the operation on 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 dependant on regulatory requirements and the end user requirements. The standard OS-Gemini ODU is fitted with surge limiting circuits and other features to minimise 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-Gemini is not design 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 9 "Lightning Protection".

3.5 Electrical Requirements

The OS-Gemini is supplied with a variable input voltage in-line power supply unit. This unit is supplied with mains cables suitable for the country of sale. The OS-Gemini requires one mains supply outlet at each end of the link.

3.6 Training

Installation training courses can be purchased from Orthogon Systems. Self paced Computer Aided Instruction (CAI) courses can be purchased and downloaded from the Orthogon Systems website. Tailored courses can be supplied at your own premises or at Orthogon Systems HQ. See `http://www.orthogonsystems.com/training` for more details.

4 Site Planning

4.1 Site Selection Criteria

The following are guidelines for selecting the installation location of the OS-Gemini ODU and IDU.

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 elements
- Aesthetics and planning permission issues
- Distance from IDU and connected equipment (Maximum cable run ODU to connected equipment is 100m)
- Distance from the IDU to the ODU (Maximum cable run IDU to ODU is 60m)

4.1.2 IDU Site Selection

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

- Availability of a mains supply
- Accessibility for viewing status indicators (See section 1.3.2 "The Indoor Unit (IDU)" and section 7 "Fault Finding"
- Distance from ODU and connected equipment (Maximum cable run ODU to connected equipment is 100m)
- Distance from the ODU to the IDU (Maximum cable run ODU to IDU is 60m)

4.2 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).

$$L_{\text{Free Space}} + L_{\text{Excess}} + L_{\text{Fade}} < L_{\text{Capability}} \tag{1}$$

where

$L_{\text{Free Space}}$ = Free Space Path Loss   dB
L_{Excess} = Excess Path Loss   dB
L_{Fade} = Fade Margin Required   dB
$L_{\text{Capability}}$ = Equipment Capability   dB

From the above calculation a rough idea of whether the link will work and be reliable can be obtained. This is the best estimate that can be achieved without the use of sophisticated radio planning tools and expensive high-resolution terrain data. The only way to confirm the calculation is to install the units, complete the installation process and monitor the link for a period of time. To ensure that the link is reliable through all environmental changes associated with the changing seasons this monitoring should be continued for a year. In applications where the OS-Gemini forms part of a high availability system monitoring of the radio signals should be built-in as part of the end users day-to-day preventative maintenance schedule.

4.2.1 Free Space Path Loss

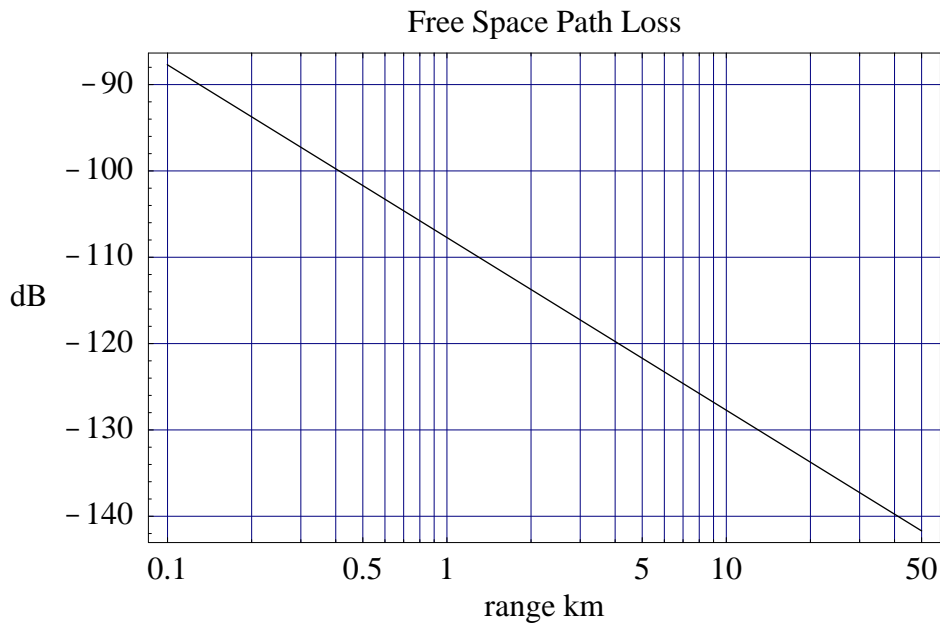The Free Space Path Loss is the loss incurred along a Line of Sight path between the two end point of the radio link.

Figure 8 Free Space Path Loss at $5.8\,\text{GHz}$

4.2.2 Excess Path Loss

The Excess Path Loss is the loss incurred due to obstacles between the two end points of the radio link. The exact attenuation caused by each object is an approximate science. The following figures should be used for guidance only.

- Approximately $20\,\text{dB}$ per Tree
- Approximately $0\text{-}30\,\text{dB}$ per obstruction that would cause the line of sight to bend by $0\text{-}10°$

It should be noted that there is a theoretical area around the line of sight of an antenna, called the Fresnel Zone, which can affect the signal strength. Objects that penetrate the Fresnel Zone can create out of phase reflections that cancel the wanted signal. Objects near the line of sight of the

antenna will add to the excess path loss. Calculations of excess path loss should take this into consideration using values approximately half those used for objects that obstruct the line of site of the antenna. For a thorough understanding of this refer to ITU P526.

4.2.3 Fade Margin

A Fade Margin needs to be applied to link budget to take into account changes in the radio path caused by changes in objects surrounding or in the propagating path. e.g. moving objects such as traffic or the changes in foliage brought on by seasonal change. The fade margin used in the calculation is a function of excess path loss. The fade margin requirement should be taken from figure 9 using the excess path loss calculated above.
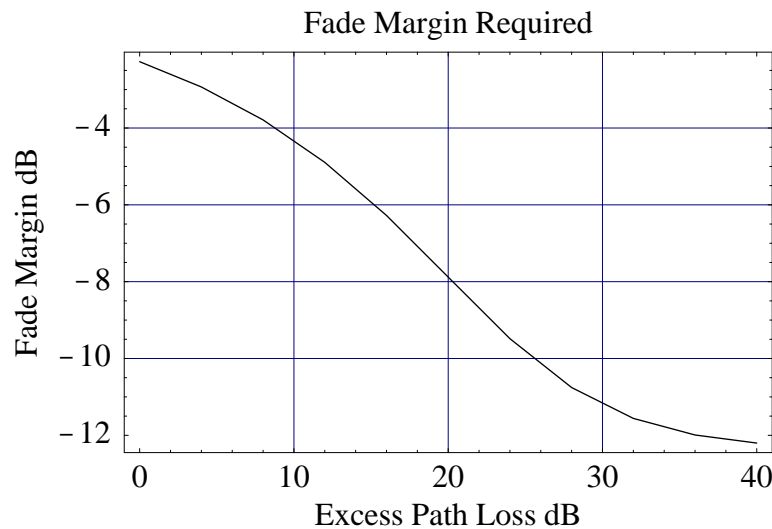

Figure 9 Fade Margin vs Excess Path Loss for 99.99% link availability

The use of MultiBeam Space-Time-Coding allows the OS-Gemini to achieve 99.99% availability even in a totally obscured radio link operating with radio path fading up to 12 dB. This graph should not be used for other products which may need nearly 40 dB fade margin for 30 dB excess path loss

4.2.4 Maximum Path Loss

The Maximum Path Loss is the total path attenuation that the system can withstand and still maintain 99.99% availability. Due to different spectrum licensing conditions in different regions the Maximum Path Loss varies from county to country due to allowable output power differences. In the USA this budget is 164 dB for BPSK and 150 dB for 16QAM.
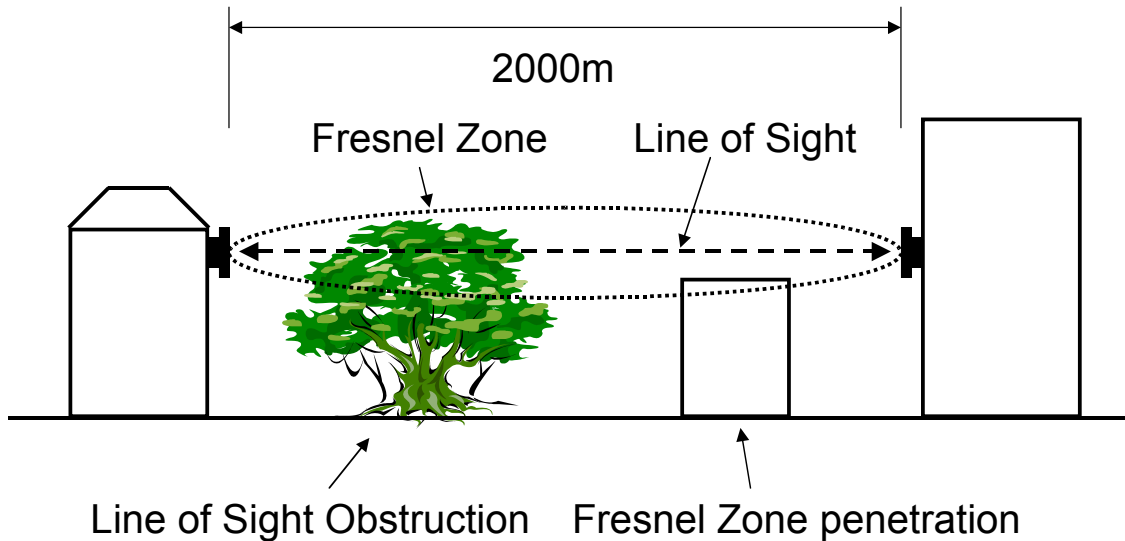
4.2.5 Worked Example 1

Figure 10   Worked Example

This example of figure 10 shows a case where a tree obscures the Line of Sight and the Fresnel Zone has a building intrusion.

In this example:

- Free Space Path Loss = 114 dB
- Excess Path Loss for Line of Sight Obstruction = 20 dB
- Excess Path Loss for Fresnel Zone penetration = 10 dB
- Total Excess Path Loss = 30 dB
- Required Fade Margin from above look up chart = 11 dB

Calculation:

114 dB + 30 dB + 11 dB = 155 dB

The result of this calculation shows that this scenario would work with margin using the allowed US power level (164 dB max path loss). The normal operational mode will be 16QAM but there will be occasional drops to BPSK mode.

4.2.6 Worked Example 2

This example in figure 11 shows a case where the Line of Sight is obstructed by a terrain obstacle.

In this example:

- Free Space Path Loss = 120 dB
- Excess Path Loss for Line of Sight Obstruction = 20 dB
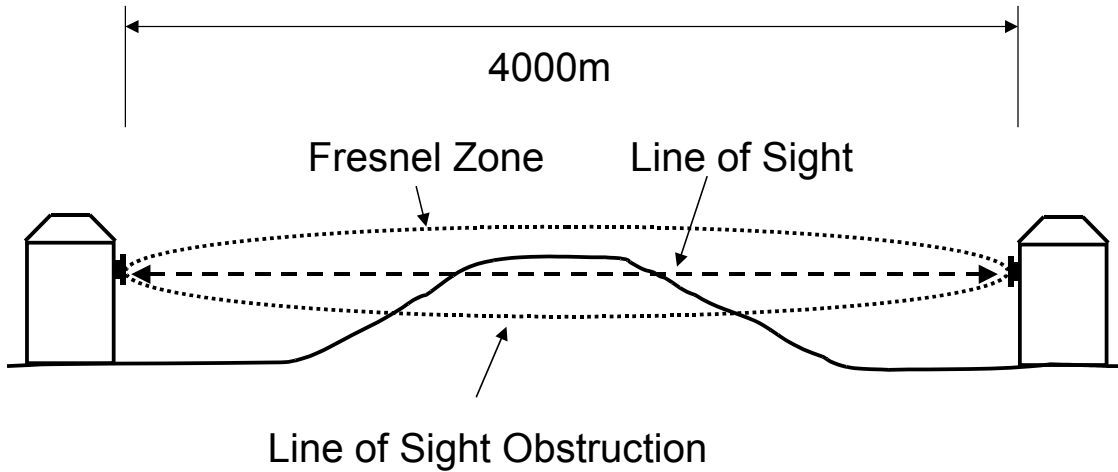- Required Fade Margin from above look up chart = 8 dB

Figure 11   Worked Example over a hill

Calculation:

$120\,\text{dB} + 20\,\text{dB} + 8\,\text{dB} = 148\,\text{dB}$

The result of this calculation shows that this scenario would work continuously at 16QAM.

4.3 Mean Power

A Web Management page for Gemini has an important indicator of mean path loss. This is shown in figure 16. Also on this Web Page is the range. Figure 12 gives the maximum mean path loss vs range for guaranteeing that Gemini is installed in a position that will give 99.99% availability. Note: The web page display is for the previous hour and the full fade cycle may not be traversed for many days depending upon the components causing the fading.
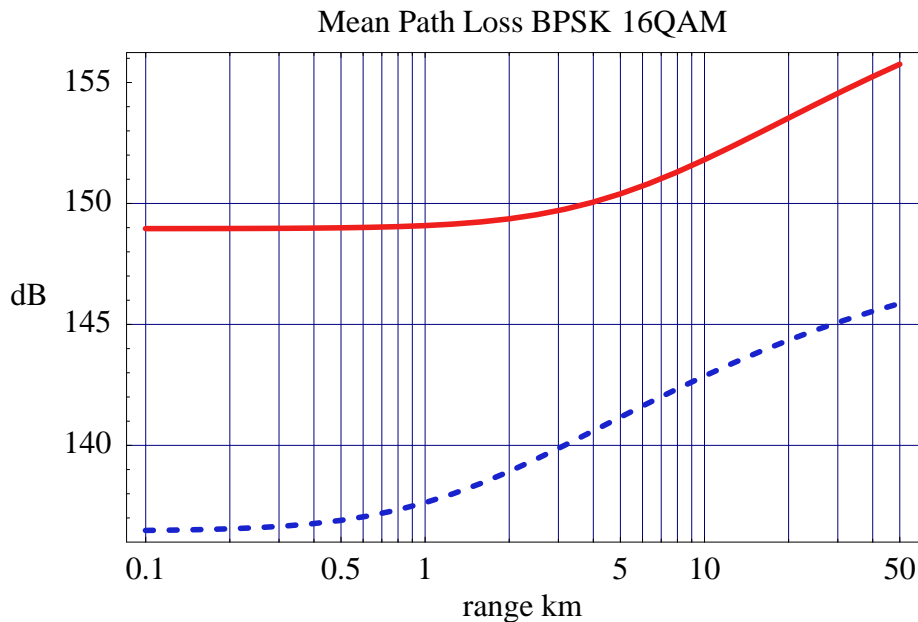

Figure 12   Mean path loss vs range for BPSK and 16QAM

The blue dashed line is for 16QAM and the solid red line of for BPSK.

5 Installation

Orthogon Systems recommends that only qualified personnel undertake the installation of an OS-Gemini 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.
- Completed the site planning as described in section 4 "Site Planning".

5.2 Installation Procedure

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

- Mounting the ODUs
- Connecting up
- Mounting the IDUs
- Powering Up
- Aligning the ODUs

5.3 Tools Required

The following tools are required to install the OS-Gemini

- Two 13mm Spanners
- 4 mm hexagonal key
- Phillips screwdrivers of various sizes
- RJ45 Crimp Tool

5.4 Installation Support

On-line installation support and contact details for your regional support can be found at: `http://www.orthogonsystems.com/support/installation`

A Frequently Asked Questions (FAQs) section can be found in section 10 "FAQs". Further and more up to date FAQs may be found at: `http://www.orthogonsystems.com/support/FAQ`

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-GEMINI PRODUCT.

5.5.1 Mounting the ODUs

The ODU mounting bracket is designed to ease installation by allowing the bracket to be split into two and be brought back together using a single bolt fixing. The ODU mounting bracket is designed for both pole and wall mounting. The ODU should be mounted using the following steps:
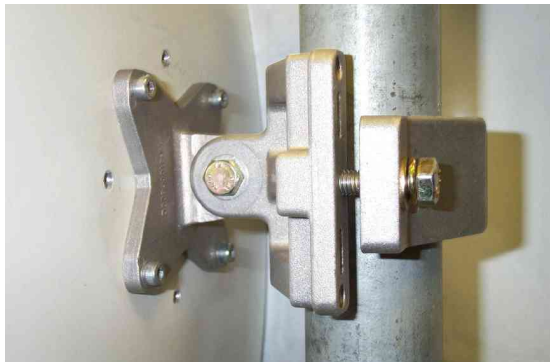
5.5.1.1 Pole Mounting
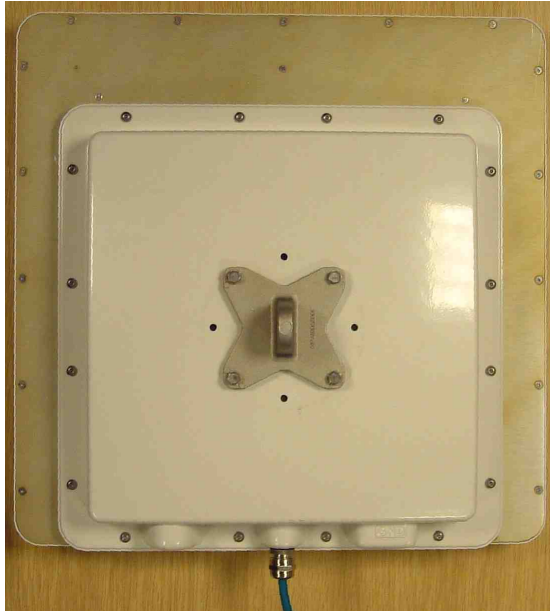
Step 1: Mount the ODU half of the
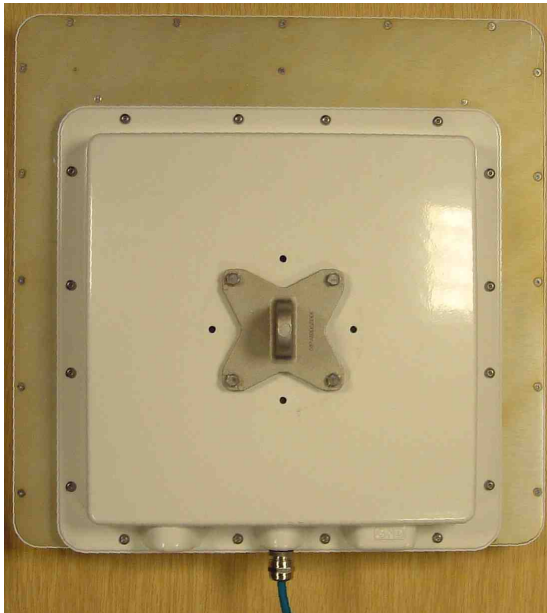bracket to the ODU (Note: orientation)

Step 2: Mount other half
of the bracket to the pole.

Step 3: Mate the two halves
of the bracket together and
tighten the nut and bolt.

5.5.1.2 Wall Mounting

Step 1: Mount the ODU half of the bracket to the ODU (Note: orientation).

Step 2: Mount other half of the bracket to the wall.

Step 3: Mate the two halves of the bracket together and tighten the nut and bolt.

5.5.2 Connecting Up

5.5.2.1 Preparing The Cable — RJ45 connections

Cables with the ODU end already prepared can be purchased from your reseller or distributor in lengths up to 60m. (Note that the maximum length between the IDU and ODU is 60m.) 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
on cable as shown

Step 2: Strip the outer insulation

Step 3: Arrange conductors as
shown in Figure 13 and cut to length

Step 4: Insert conductors and crimp

Figure 11 - Completed ODU connector

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

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

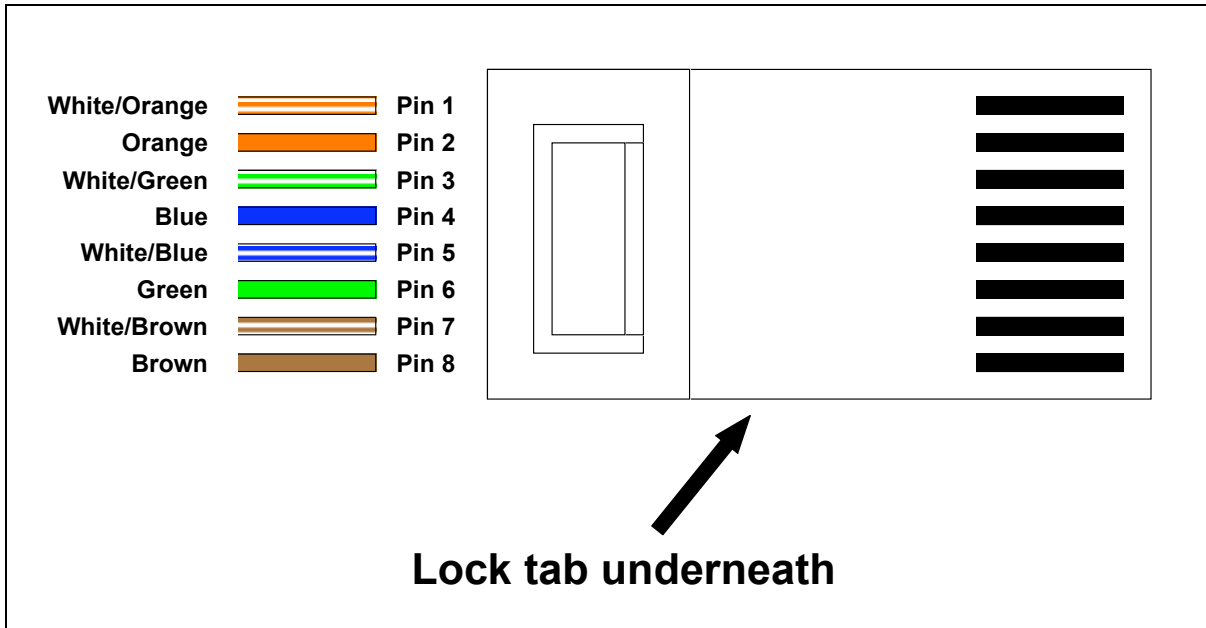|		
White/Orange		Pin 1
Orange		Pin 2
White/Green		Pin 3
Blue		Pin 4
White/Blue		Pin 5
Green		Pin 6
White/Brown		Pin 7
Brown		Pin 8

Lock tab underneath

Figure 13   RJ45 Pin Connections

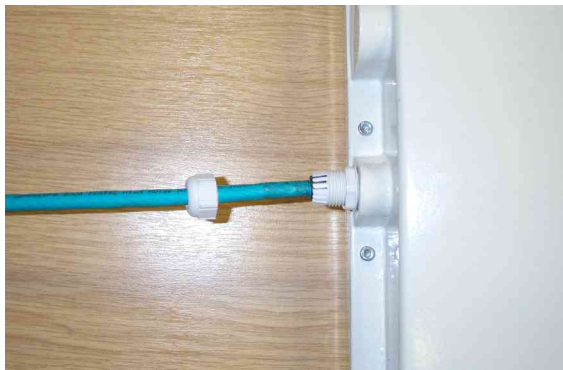### 5.5.2.2   Making the Connection At The ODU

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.

Step 1: Assemble the cable
as described in 5.5.2.1 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 to ?? Nm

Step 4: Screw on the clamping
nut and tighten to ?? Nm

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

Step 1: Disconnecting the ODU

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

5.5.2.3 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 IDU prior to connection to the IDU.

5.5.2.4 Fitting A Surge Arrestor

If you have opted to fit a Surge Arrestor, this should be installed by following the manufacturers instruction.

5.5.2.5 Grounding The Installation

The Gemini 5810 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. 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.

### 5.5.2.6 Making the Connection At The IDU

The ODU is connected to the IDU by means of a concealed RJ45 connector. The RJ45 connection has been placed inside the IDU 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.
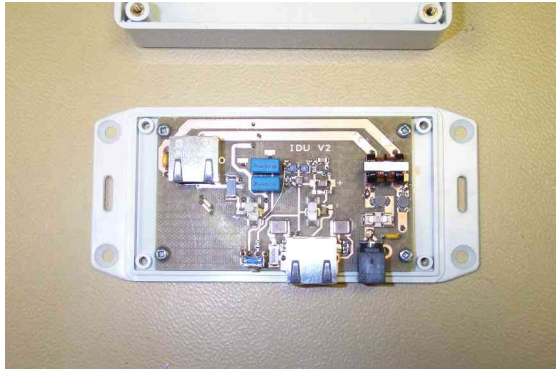
Step 1: Remove the cover by removing the four cover fixing screws.
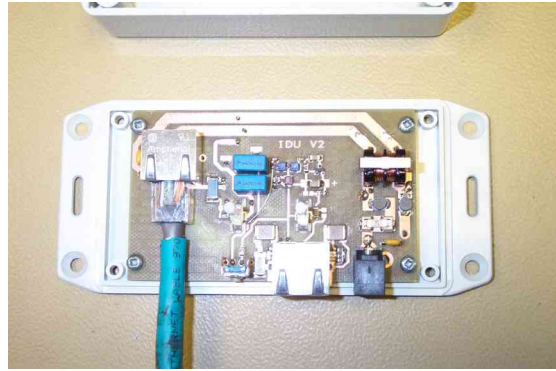
Step 2: Plug in the ODU to IDU cable ensuring that it snaps home.

Step 3: Replace the cover

5.5.3 Mounting The IDU

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

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

Step 2: Connect the DC power and LAN connection

5.5.4 Powering Up

Prior to powering up the OS-Gemini, 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. If the default address of the unit 10.10.10.10 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 IDU has a default configuration as a hub/switch (and auto-sensing MDI/MDI-X cross over is employed).connection can be made directly to the computer using a standard CAT 5 patch cable.

The unit to be configured can now be powered up and accessed using the default URL http://10.10.10.10/. If operating both OS-Gemini units on the same LAN for configuration purposes do not power up both units at the same time as this will result in the use of a duplicate IP address.

Tip: The ping command is sometimes useful to determine connectivity between the unit being configured and the computer.

Each unit can now be configured with an operational IP address within your LANs IP address range using the IP configuration web page described in section 6.3.2 "Install Pages" figure 20.

Tip: Should you lose track of the IP address during this process, the unit can be reset to the factory settings of 10.10.10.10 by following the reset procedure described in section 1.3.2 "The Indoor Unit (IDU)".

5.5.5 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.

Step 1: Mount the first unit in its target location.

Step 2: Power up the unit.

Step 3: Connect to the unit using a web browser.

Step 4: Using the installation web pages described in section 6.3.2 "Install Pages" configure the unit to be the Master.

Step 5: Cycle the power on the Master unit to reset the unit and enable as Master.

Step 6: Point the Master unit in the direction of the other (Slave) units target mounting position.

Step 7: Tighten the units mounting bracket.

Step 8: Mount the second unit in its target location.

Step 9: Power up the unit.

Step 10: Connect to the unit using a web browser.

Step 11: Using the installation web pages described in section 6.3.2 "Install Pages" configure the unit to be the Slave.

Step 12: Cycle the power on the Slave unit to reset the unit and enable it as Slave.

Step 13: Align the Slave unit using the audible tone. (The higher the frequency of the tone, the better the signal).

Step 14: When the best signal strength has been found. Hold the unit steady (preferably lock the unit's mounting bracket) for 10 seconds for the installation process to complete. The completion of the installation process is indicated by the audible tone being turned off.

Step 15: If not already done, tighten the unitÕs mounting bracket without moving the unit from its aligned position.

The following steps are optional depending on the reliability of the link and the confidence of the installer that the link has the desired fade margin to work reliably throughout the year. Interference to other users of the band may also need to be considered when deciding whether to align the other (Master) end of the link. The following is basically a repeat of the above steps with the Master/Slave status of the units swapped.

Step 16: Using the installation web pages described in section 6.3.2 "Install Pages" configure the second unit to be the Master.

Step 17: Cycle the power on the new Master unit.

Step 18: Using the installation web pages described in section 6.3.2 "Install Pages" configure the first unit to be the Slave.

Step 19: Cycle the power on the new Slave unit.

Step 20: Align the new Slave unit using the audible tone. (The higher the tone, the better the signal). When the best signal strength has been found.

Step 21: Hold the unit steady (preferably lock the unit's mounting bracket) for 10 seconds for the installation process to complete. The completion of the installation process is indicated by the audible tone being turned off.

Step 22: If not already done, tighten the unit's mounting bracket without moving the unit from its aligned position.

6 Web Page Reference

This section contains an explanation and usage guide for each of the built-in management web pages. Where the user enters data into a field it is necessary to press the appropriate update button to write the new configuration value to unit's configuration memory.

The small and full menus are shown in figure 14. The full menu is only available to the system administrator after logging in. The login panel is automatically presented when the configuration menu is selected for the first time.
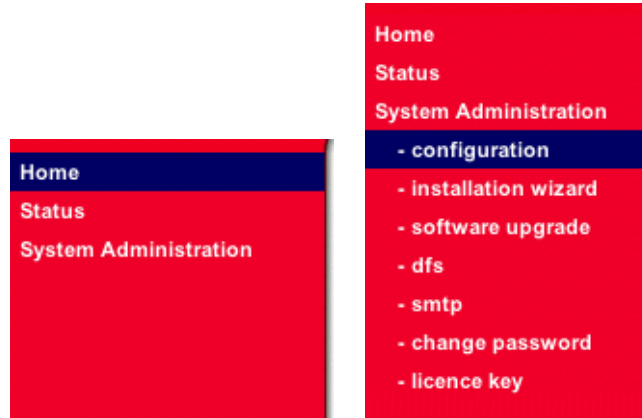

Figure 14   Web page menus

6.1 Home Page

System Summary

Attributes	Value	Units
Wireless Link Status	Down	
Link Name		
Elapsed Time Indicator	0 Days 08:26:40	
Wireless Link Availability	0.0000	%

Figure 15   Home Page

This page is displayed when initial connection is made to the unit. Navigation to all the unit's management functions is via the menu items on the left hand side. This page also displays status items indicating the current link status, link up time and link availability metric.

6.2 Systems Status Page

This page displays the current system status. This page will automatically refresh after a user defined refresh period. A field is provided to enter the required refresh period. Buttons are provided to update the refresh period and reset the displayed counters. Refresh can be forced by using the browsers refresh button.

System Status

Equipment				Wireless		
Attributes	**Value**	**Units**		**Attributes**	**Value**	**Units**
Country Variant	USA			Wireless Link Status	Down	
Link Name	Bench Test			Target Modulation Mode	BPSK	
Link Location	In System Test			Transmit Power Control Mode	Enabled	
Software Version	5810_B200			Maximum Transmit Power	24	dBm
Hardware Version	D00.04-R00.00-A00			Transmit Power	24.0, 24.0, 24.0, 24.0	dBm
Elapsed Time Indicator	0 Days 00:16:22			Receive Power	-162.2, -162.2, -162.2, -162.2	dBm
Ethernet / Internet				Vector Error	16.9, 16.9, 16.9, 16.9	dB
Ethernet Link Status	Up			Link Loss	232.2, 232.2, 232.2, 232.2	dB
Ethernet Speed	100	Mbps		Dfs Status	Acquiring Channels	
Ethernet Duplex	Full			Active Channel	1	
MAC Address	00:04:56:00:02:07			Available Channels	0	
IP Address	1.1.10.207			Range	0.0	km
Subnet Mask	255.0.0.0			Average Bit Rate	0	kbps
SMTP	Disabled			Reset All Counters		
Refresh this page every	3600	Seconds		Update Page Refresh Period		

Figure 16   Status Page

In the section"Equipment" there are various status displayed. The "Country Variant" is dependant upon the software load. The "Link Name" and "Link Location" are attributes which can be set using the "System Administration" page. Software and Hardware version numbers are provided as well as the "Elapsed Time Indicator" providing the run time since the last reset.

In the section "Ethernet / Internet" the status of the Ethernet link is provided. The IP address is that of the web pages and is set on installation or by use of the "System Configuration". The SMTP settings can be adjusted on the SMTP page. The page can be automatically refreshed by the use of the "Refresh this page every..." box and pressing the "Update Page Refresh Period" button.

The section on "Wireless" gives the status of the wireless link. The "Target Modulation Mode", Transmit Power Control and Maximum Transmit Power are controlled on the "System Configuration" Page. Transmit and Receive Power, Vector error and Link Loss are displayed Maximum, Mean and Minimum for the last complete hour. The DFS status is given along with the Active and available channels. Finally the Radio Range is given and the average bit rate.

6.3 System Administration Page

System Administration Login

Administration Password	

Login

Figure 17   System Administration Page

The system administration pages are password protected. On first activation the user will be presented with the above page prompting them to change the system administration home page. Once the password has been set the system administration pages will only be available after the user has entered the correct password. All system configuration pages are accessed via the main, password protected, system administration page.

6.3.1 System Configuration Page

This page is used to enter data about the link. This data is used by the alert and management functionality to identify the link and equipment for status and fault reporting purposes. You may also set the maximum transmit power and IP address and subnet mask for Web Access. Note that the default IP address if not set is 10.10.10.10.

System Configuration

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

Equipment

Attributes	Value	Units
Link Name	Bench Test	
Link Location	In System Test	
Target Modulation Mode	○ Adaptive ● BPSK ○ 16QAM	
Transmit Power Control Mode	○ Disabled ● Enabled	
Maximum Transmit Power	24	dBm
IP Address	1 . 1 . 10 . 207	
Subnet Mask	255 . 0 . 0 . 0	
Gateway IP Address	10 . 10 . 10 . 1	
Ethernet Configuration	● Auto ○ 10Mbps Half Duplex ○ 10Mbps Full Duplex ○ 100Mbps Half Duplex ○ 100Mbps Full Duplex	
Ethernet Auto Mdix	● Enabled ○ Disabled	

Submit Updated System Configuration

Figure 18   Configuration Page

Note: At this point you will loose connection to the unit. You now have to reconnect to the unit using the address just set.

6.3.2 Install Pages

These pages are used during system installation. There follows a description of the install pages along with their use during the installation process. The actual installation process is described in section 5.5.5 "Aligning the ODUs" above. Step 1 figure 19 will automatically invoke on starting the installation wizard if there is no valid license key stored. The OS-Gemini operational software requires a license key to enable the wireless bridging capability. A license key is supplied with each unit and can be found in the envelope marked "License Key" pack along with the units documentation. If subsequently the license key has been mislaid, you can apply for a license key on line at License Application. Your license key should be entered as shown above and the "Submit updated values" button pressed.

Figure 19   Licence key entry

Step 2 figure 20 is used to set the IP addresses.

Figure 20   Installation page 1 — Internet Protocol Settings

Step 3 figure 21 is used to set the MAC Address of the peer unit that will be at the other end of the wireless link. The serial number is the hexadecimal representation of the serial number written into the last 3 bytes of the units MAC address. At this point it is necessary to decide which end will be master. The Master unit is the controlling unit with respect to the radio link and its

maintenance. Master transmits until the link is made, Slave listens for its peer and only transmits when the peer has been identified. figure 21 shows;

- Unit serial number is in Hex. 106 = MAC address 00:04:56:00:01:06
- Unit acting as Master.

Figure 21   Installation page 2 — Wireless Configuration

Step 4 figure 22 is for confirming and committing to non-volatile memory the settings just entered.

Figure 22   Installation page 3 — Confirm Installation

Step 5 figure 23 is used for using the settings previously entered.

If the unit has been configured as the Master, the unit will restart with the transmitter transmitting on a suitable channel having executed a scan for possible "Jamming" signals. The unit will remain in this state until the matching Slave unit has completed its alignment and registration process when the unit will take over control of the radio link and start the DFS functionality.

Step 4 of 4: Configuration Complete

The installation parameters have now been committed to non-volatile memory. A system reset is required before the new configuration can take affect. The system can be reset immediately using the button below, or the reset can be performed by removing and reapplying the units power supply.
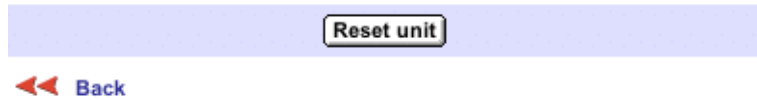
[Reset unit]

◀◀ Back

Figure 23 Installation page
4 — Configuration Complete

If the unit has been configured as the Slave, the unit will restart with the audible installation tone turned on at the ODU. The unit will remain in this state until the signal from the corresponding Master unit has been found, and the alignment and registration stages completed. The alignment stage is taken to be complete when the signal received from the master does not vary for 10 seconds. i.e. the installer is no longer moving the unit. Registration will occur as soon as the alignment stage is complete. Completion of the registration process is marked by the audible installation tone being switch off. The unit will now enter operation as the Slave unit taking its operational parameters and commands from the Master unit.

6.3.3 Software Upgrade Pages

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 support website `www.orthogonsystems.com/support/download` prior to using this utility.

Software Upgrade

This utility allows an operator to upgrade a P2P wireless units' operational software.

Current software image description
...Empty Bank...
Boot monitor :: BOOT_B200
Fixed software image :: 5810_B200
Please select a new software image

[   ] (Browse...)
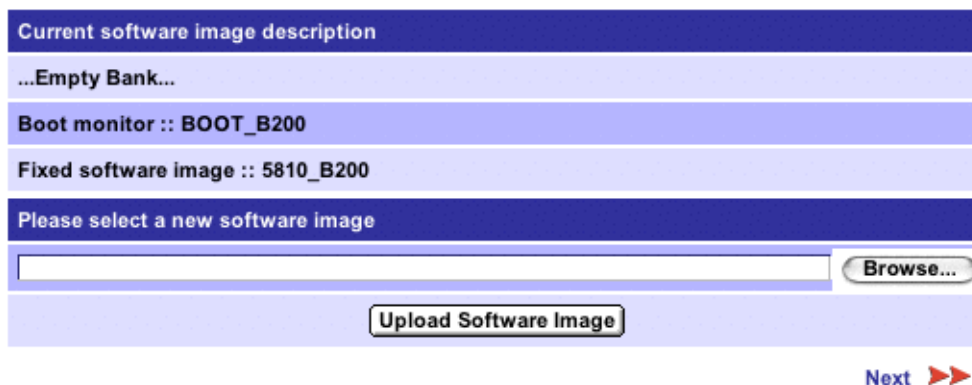
[Upload Software Image]

Next ▶▶

Figure 24 Software upgrade

The first step is to use the "Browse" button to locate the software image previously downloaded to local storage from the Orthogon Systems support 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 downloaded to the unit where it will be stored in RAM until it is committed to the units flash memory. This download should only take a few seconds.

NEW SCREEN SHOT The unit being upgraded will now display its current flash memory status. The user should ensure that he is happy to proceed before pressing the "Continue" button. The user has the option to bail out at this point by pressing the "Abort" button. On pressing the "Continue" button the user should ensure that the power is not cycled, or any other functionality accessed, until the next screen is displayed. This process can take up to 30 seconds.

NEW SCREEN SHOT When the software image has been written to flash memory the above screen will be displayed showing the status of the software download. If this screen is not displayed after 30 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 units boot software will automatically determine the health of the newly downloaded software image. If there are any problems the boot code will revert to a protected operational software image installed during manufacturing.

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.

6.3.4   DFS Pages

This page is used to control and display information about the units DFS functionality. The only user configurable attributes are the page refresh period and channel usage.

The three upper displays show the combined and individual channel status. The colours denote the status of each of the channels according to the following table.

Yellow	Active	The channel is being used for connection
Green	Available	The channel is available for use
Orange	Interference	The channel has interference above the interference threshold
Red	Radar	The channel has a very high level of interference
Black	Barred	The channel has been barred from use

In the "Local Configuration" the interference threshold can be set. A normal value for this is about -80 dBm. When the interference is above this level the display will change to orange. The available channels are those below the interference threshold which are not barred. The active channel number is also displayed as a number.

In the "Peer Configuration" section the configuration of the other end of the link is given.

In the "Spectrum Allocation" section the centre channel frequency range is given and the channel step size.

In the Barred Channel section the ability is given to not allow certain channels to be used. This is for barring the frequency range of the centre frequency of the channel. There are three separate ranges that can be chosen giving many possibilities.

DFS

Figure 25   DFS page

6.3.5 SMTP Configuration Page

This page is used to configure the email alert functionality. The facility can be enabled, the server address and port number entered. The source and destination email addresses can also be entered.

Figure 26   SMTP page

6.3.6 Change System Administration Password

This is the screen to change the password for the system administration.

Figure 27   Password page

6.3.7 Software License Key

This page is for the entry of the Software License Key if necessary.

Figure 28   License page

7 Fault Finding

Before contacting your re-seller/distributor or returning the unit to the manufacturer you should follow the following fault finding guide figure 29:
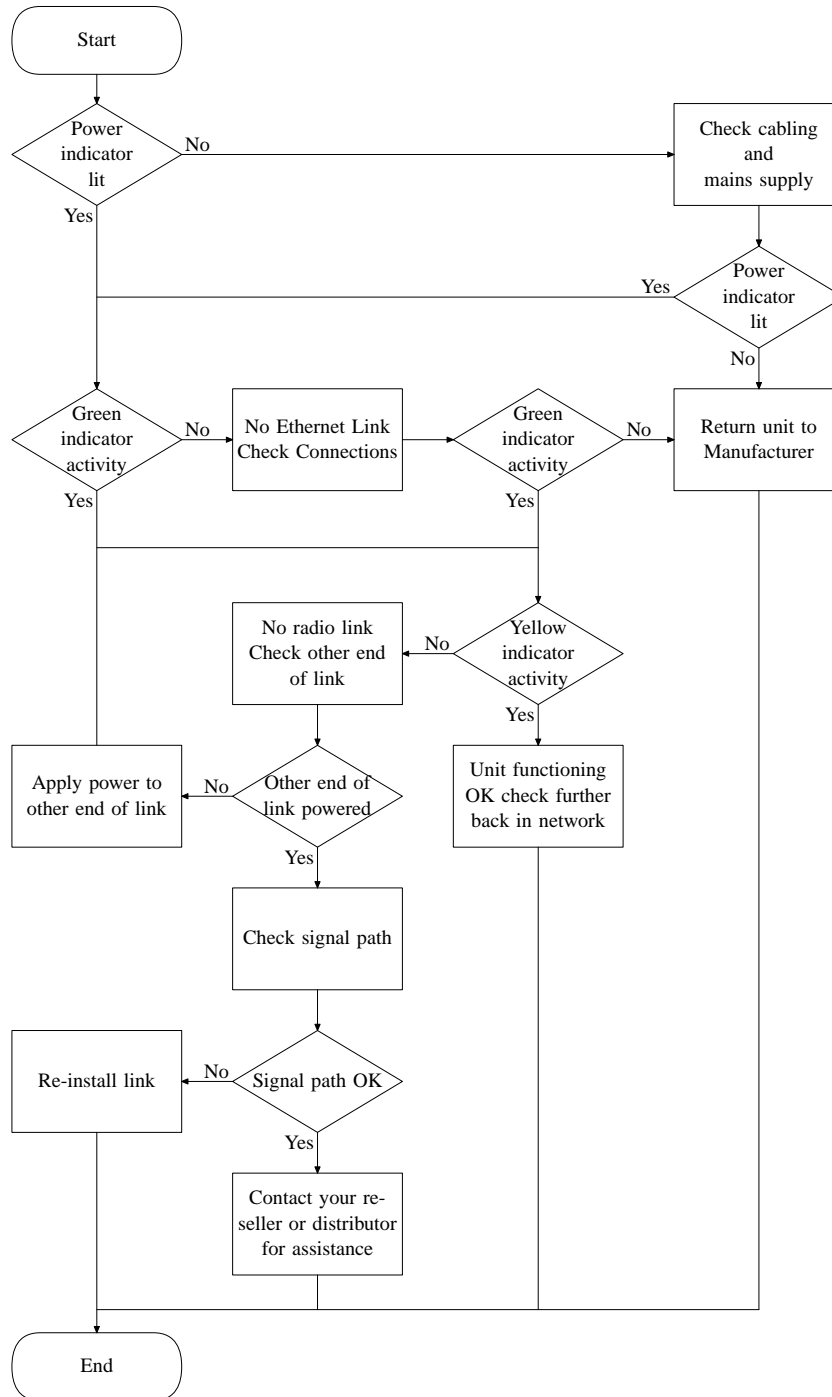
Figure 29   Fault Finding Guide

8 Specifications

8.1 System Specification

Radio Technology	i-OFDM
RF Band	USA 5.725 – 5.850 GHz (ISM)
Channel Selection	By Dynamic Frequency Control
Dynamic Frequency Control	Initial capture 2 sec., Out of service on interference 100 ms.
Channel size	10 MHz
Channel selection	Automatic detection on start-up and continually adapting
Tx power @ Antenna port	Up to 12 dBm/MHz with Transmit Power Control at the antenna port
Transmit Power Control	Loop bandwidth 1 Hz, Range 30dB typical
Rx sensitivity @ Rx input	-93 dBm for BPSK -83 dBm for 16 QAM
Receiver Noise Figure	Typically 6 dB or less
Antenna Type	Integrated dual polar flat plate antenna
Antenna Gain	23dBi per polarisation
Max Path loss	US 164dB
Modulation	Dynamically adapting between 16QAM and BPSK
Duplex Scheme	TDD, Ratio 50:50, Switch Rate 500Hz
Data Rate @ Air Interface	16 Mbps (16QAM) and 4 Mbps (BPSK)
Range	25 miles (40km) optical line-of-sight 6 miles (10km) non-line-of-sight
Over the air encryption	Proprietary scrambling mechanism
Weather sensitivity	None

Ethernet Bridging	
Protocol	IEEE802.1; IEEE802.1p; IEEE802.3 compatible
Interface	10/100BaseT (RJ-45), Supports MDI/MDIX Auto Crossover
Data Rate @ Ethernet	14.2 Mbps (16QAM) and 3.5 Mbps (BPSK)

Management	Embedded web server for direct management
Configuration	DHCP client (default IP address:10.10.10.10)
Status Indicators	Power status Radio Link status Ethernet Link Status Data activity
Alarms	Via configurable email alerts

Physical	Integrated outdoor unit with indoor PSU
Dimensions	Width 15.75" (400mm), Height 15.75" (400mm), Depth 3.94" (100mm)
Weight	12.1 lbs (5.5 Kg) including bracket
Wind loading	75 Mph operating, 111 Mph survival (Class III Hurricane)

Power Supply	Separate power supply unit (included)
Power source	90 – 264 VAC, 50 – 60 Hz
Power consumption	25 W mean (85 BTU/Hr)

Environmental	
Operating temperature	ODU -40°F (-40°C) to 131°F (50°C) IDU 32°F (0°C) to 104°F (40°C)
Protection	IP65

8.2 Safety Compliance

Region	Specification
USA	UL 60950
Canada	CSA C22.2 No. 60950

Table 1 — OS-Gemini Safety Compliance

8.3 EMC Emissions Compliance

Region	Specification
USA	FCC Part 15 Class B

Table 2 — OS-Gemini EMC Emissions Compliance

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 61000-4-6: 1996 (Injected RF), power line, Class 3 @ 10 V/m	Signal lines, Class 3 @ 3 V RMS unmodulated.

Table 3 — OS-Gemini EMC Immunity Compliance

8.5 Radio Certifications (type approvals)

Region	Reference
USA	FCC Part 15 Subpart C (15.247)

Table 4 — OS-Gemini Radio Certification

8.6 Environmental Specifications

General statement in here

Environmental Specifications	
Temperature	-40°C to +50°C plus the effects of solar radiation
Vibration and Shock	ETS 300 019-1-4, Class 4.1 E
Altitude	ETS 300 019-1-4, Class 4.1 E
Wind Loading	ETS 300 019-1-4, Class 4.1 E, In addition, the mounting hardware ensures that in all wind strengths up to 75mph, the alignment of the ODU will be within 2°of the nominal setting. In higher wind strengths up to 111mph, the ODU will survive and return to its original alignment after the exposure.
Humidity	ETS 300 019-1-4, Class 4.1 E
Wind-driven Rain	ETS 300 019-1-4, Class 4.1 E
Biological Conditions	ETS 300 019-1-4, Class 4.1 E
Chemically Active Substances	ETS 300 019-1-4, Class 4.1 E, MIL-STD-810E, Method 509, Proc 1
UV Exposure	10-year operational life (UL746C test evidence)
Transportation	ETS 300 019-1-2
Storage	ETS 300 019-1-1, Class 1.2

Table 5 — OS-Gemini Environmental Specifications

8.7 System Connections

8.7.1 ODU to IDU Connection

Figure 13 - ODU to IDU Connection Diagram

8.7.2 Network Connection

Figure 14 - Network Connection Diagram (Hub/Switch presentation)

8.7.3 Power Connection

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

48V DC

Figure 30 DC
Connection Diagram

The DC connection diagram is shown figure 30 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

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. 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 present.

The next diagrams 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 the appropriate grounding lug for attachment to the ODU.
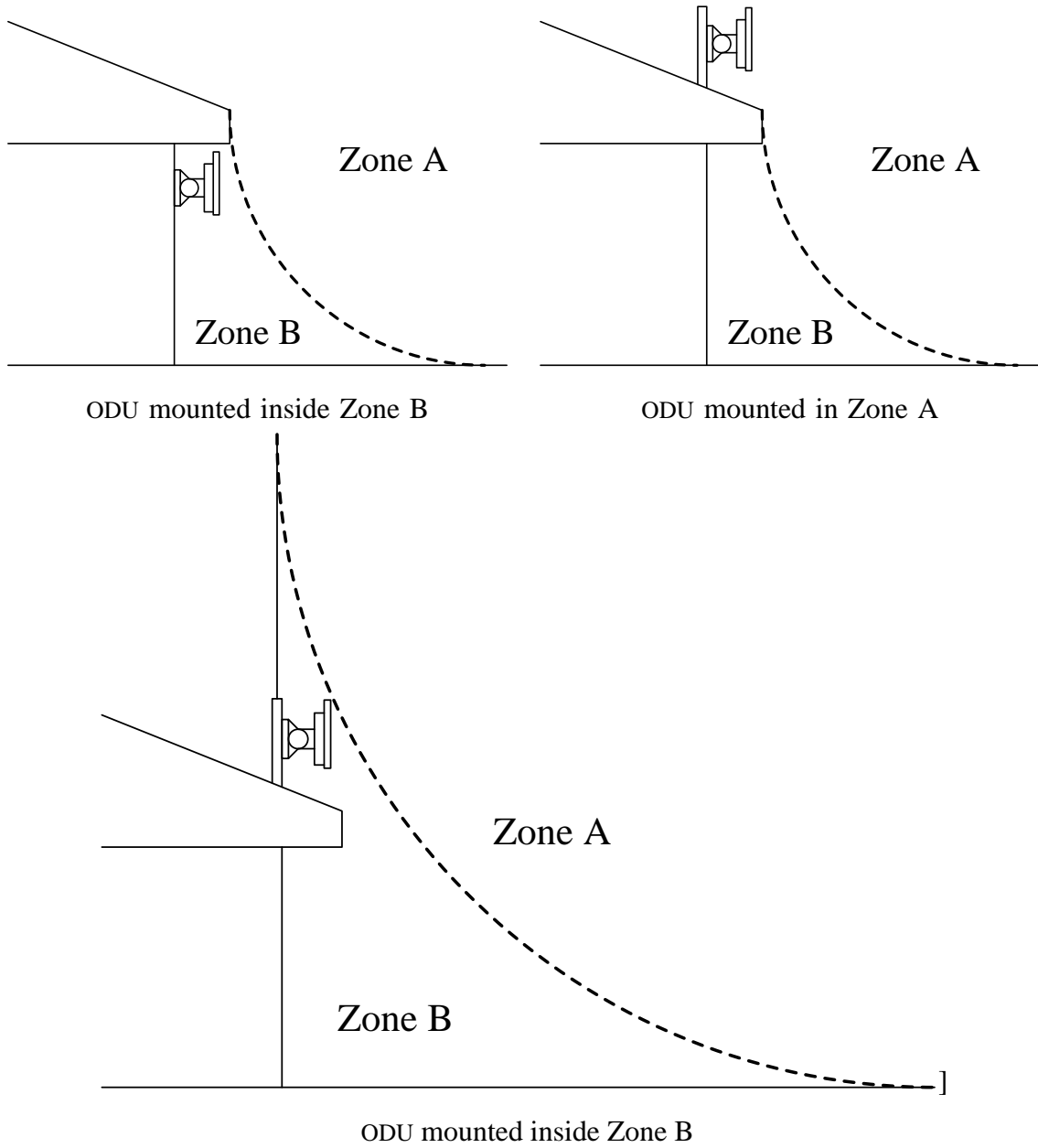
Zone A

Zone B

ODU mounted inside Zone B

Zone A

Zone B

ODU mounted in Zone A

Zone A

Zone B

ODU mounted inside Zone B

Figure 31   ODU Mounting Positions

10 FAQs

This section contains a number of Frequently Asked Questions. This list is not exhaustive. Further and more up to date FAQs may be found in the Orthogon Systems website at: `http://www.orthogonsystems.com/support/FAQ`

Q: The 100BaseT Ethernet specification specifies a maximum length of 100m. Why am I restricted to 60m of cable between the IDU and ODU?

A: The 60m restriction is a result of the voltage drop experience using CAT 5 cable. The 100m maximum length still applies between the ODU and connected equipment.

Q: Can I source and use my own PoE adaptor with the OS-Gemini?

A: No. The OS-Gemini uses a non-standard PoE configuration. Failure to use the Orthogon Systems supplied IDU and in-line power supply could result in equipment damage and present potential safety problems.

Q: ?????

A: ?????

11 Glossary

BPSK	Binary Phase Shift Keying	NLOS	non–Line–of–Sight
CAI	Computer Aided Instruction	ODU	Outdoor Unit
DC	Direct Current	OFDM	Orthogonal Frequency Division Multiplex
DFS	Dynamic Frequency Selection		
ETSI	European Telecommunications Standards Institute	POE	Power-over-Ethernet
		QAM	Quadrature Amplitude Modulation
FAQ	Frequently Asked Question		
HQ	Headquarters	RAM	Random Access Memory
HTTP	Hypertext Transfer Protocol	SMTP	Simple Mail Transfer Protocol
ID	Identity	STC	Space Time Coding
IDU	Indoor Unit	STP	Shielded Twisted Pair
IEEE	Institute of Electrical and Electronic Engineers	TFTP	Trivial File Transfer Protocol
		TPC	Transmit Power Control
IP	Internet Protocol	URL	Universal Resource Location
ISM	Industrial Scientific and Medical	USA	United States of America
ITU	International Telecommunications Union	UTP	Unshielded Twisted Pair
		UV	Ultraviolet
LAN	Local Area Network	VLAN	Virtual Local Area Network
MAC	Medium Access Control Layer		

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Orthogon Systems