



MESHWORKSTM

Customer node installation

Draft copy

Radiant
Networks



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Draft status notice

This is a draft document circulated internally for review and comment.

This manual has been prepared for use by Radiant Networks personnel, licensees and customers.

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Introduction

The Radiant Mesh is built entirely from nodes that interconnect to form a network. This manual gives instructions for the installation of a MESHWORKS customer node.

Radiant Networks also offer a number of further elements that extend and enhance the performance of the Mesh, some of which will be mentioned in this guide. The equipment for customer node installation consists of an Outdoor Unit (ODU), Indoor Unit (IDU) an Uninterruptible Power Supply (UPS) and a Customer Premises Switch (CPS).

The intended audience of this guide is the Installation/Commissioning Engineer. It is assumed that the person reading this (and performing the installation) is familiar with basic telecommunication installation principles and techniques.



No internal setting, adjustment, maintenance and repairs should be performed by you. Such activities may be performed only by skilled service personnel who are aware of the hazards involved. Also, opening the case of a Radiant-supplied component will invalidate your warranty.

This manual includes the following information:

- ❖ Site and equipment requirements;
- ❖ package contents;
- ❖ installation;
- ❖ interfaces and connections;
- ❖ initial set-up and configuration;
- ❖ initial operation and basic checks.

Unpacking the shipment

Note: Before unpacking any of the items, ensure that the correct kits are available for installation.

You should have several items in your shipment:

- ❖ ODU pack;
- ❖ IDU pack;
- ❖ Uninterruptible Power Supply (UPS) pack;
- ❖ mounting pack (applicable to location);
- ❖ Craft Terminal;
- ❖ consumables (cables and connectors);
- ❖ tools;
- ❖ site survey results.

Use the following steps to unpack and inspect the shipment of MESHWORKS equipment. Remove and save all the documentation from components received in shipment. Keep all documentation handy for reference. To prevent damage to the components, carefully unpack everything on a flat, clean surface at the installation site.

Components must remain in their original containers for moving and should only be fully unpacked just before installation.



Retain all packing materials in case you need to return any product to Radiant Networks.

1. Check each package against the order form and packing slip to ensure that all components have been received.
2. Check each package for signs of damage. Open the package and closely inspect all components for obvious signs of damage.
3. You must know exactly where you are going to place this equipment, before removing it from the package.
4. Carefully remove the equipment from the packaging. Save the packing material for future use.
5. Be aware of Electro-Static Discharge (ESD) devices requirements when handling MESHWORKS equipment.



For more information, refer to the Electronic Industries Association (EIA) standard, Requirements for Handling Electrostatic-Discharge-Sensitive Devices (ESDS), EIA-625, as well as local and national standards.

Safety

General safety recommendations and practices

Safety considerations are important while using MESHWORKS Broadband Wireless Access (BWA) equipment. The following information is provided to assist you in establishing appropriate safety practice.



The safety standards discussed in this guide cannot address all safety issues associated with their use or all applicable regulatory requirements. You are responsible for establishing appropriate health and safety practices and to determine the applicability of regulatory limitations before their use. Please refer to the legal disclaimer at the beginning of this document.

It is essential that any personnel working directly on MESHWORKS equipment fulfil the following criteria to ensure their personal safety and to protect the equipment:

- ❖ Installation personnel must be competent, adequately trained and qualified to carry out the tasks required for installation;
- ❖ they must be authorised to carry out the tasks required.

General safety considerations

Ensure that installation personnel are trained in CPR (Cardio Pulmonary Resuscitation) techniques, as well as in local, regional and national safety standards. When working with MESHWORKS equipment, follow these guidelines:

- ❖ Do not work on the system, connect, or disconnect cables during periods of lightning activity.
- ❖ Keep your work site clean and free of clutter.
- ❖ Wear close-fitting clothing rather than loose-fitting clothing.
- ❖ Remove jewellery such as rings, bracelets, or watches.
- ❖ In situations where it is possible to dislodge small pieces of masonry, wear safety goggles.
- ❖ Place equipment or cabinets on stable, level surfaces.

- ❖ Wear a safety belt when climbing a tower and installing equipment on a tower.
- ❖ Work in pairs so that you have someone to help in case of an emergency.
- ❖ Ensure that you have a mobile phone to hand in event of an emergency.

Other safety considerations

In addition to the general precautions, you must also consider the following:

Electrical safety

Locate the main power shut-off switch controlling the equipment on which you are working. This is important in the event of an accident, so you can quickly cut off the power. Disconnect all power when working on power supplies.

In the event of an emergency (electrocution):

1. Shut the power off.
2. Call for emergency medical assistance.
3. If it is necessary to do so, start CPR (Cardio-Pulmonary Resuscitation).

Fibre optic safety

- ❖ Injury or damage may be caused by infrared, ultraviolet, high intensity visible and coherent lights.
- ❖ Optical fibre connectors, when used as part of an optical fibre system, may emit or produce potentially hazardous radiation.
- ❖ Direct viewing of the end of an optical fibre, terminated fibre or optical connector must not be attempted until you have ensured that it is not transmitting energy.
- ❖ Care should be taken when handling small diameter fibre to prevent it puncturing the skin, especially near the eye.
- ❖ Certain chemicals used to prepare and clean optical fibres may be considered hazardous when inhaled, ingested by mouth, or come in contact with the skin.
- ❖ Materials, such as epoxy resins used in the assembly of joints, may cause allergic reactions.

Radio safety

Take the following precautions when working on, or near to, an ODU:



At all times, try to remain below the Outdoor Unit (ODU) while it is switched on. The MESHWORKS ODU is safe with respect to all public regulations examined, provided that 80 cm safe clearance is maintained for general public/uncontrolled access. Note that a warning light on the underside of the ODU is illuminated when it is in transmit mode.

Node overview

Overview of a node

A node in a Radiant Mesh network is built from a number of key elements. These include the following components:

MESHWORKS Outdoor Unit

The MESHWORKS Outdoor Unit (ODU) is the high-volume Mesh radio, used at all the Mesh nodes. It provides the following equipment:

- ❖ The millimetric radios, the steerable antennas and the radome;
- ❖ the baseband modem and the embedded ATM switch;
- ❖ the host processor running the node and link management applications.



The ODU supports four highly directional radio links using a combination of Time Division Multiplexing

(TDMA) and Time Division Duplex (TDD) and four individual antennas.

The antennas are steered using stepper motors. These motors have been developed for automotive applications, and are therefore designed to operate over a very wide range of environmental conditions.



Antennas may rotate without warning when the ODU is powered on.

Of the four links at any node, only a single link is active during any one timeslot, and then only to transmit or receive. The operational frequencies that the ODU uses are determined by the Mesh Planning System, and are remotely programmed into the node by the Mesh Management System. The ODU is able to use frequencies across the selected band.

MESHWORKS Indoor Unit

MESHWORKS Indoor Unit (IDU) is used at nodes where customers require service. The Indoor Unit (IDU) provides the Customer-end adaptation functions. It offers two main services:

- ❖ IP Services (Ethernet or USB);
- ❖ Primary Rate Telephony Services (E1 or T1).

The IDU connects to the ODU using a standard ATM25 connection and provides traffic policing and shaping into the Mesh and traffic shaping out of the Mesh.



MESHWORKS Uninterruptible Power Supply

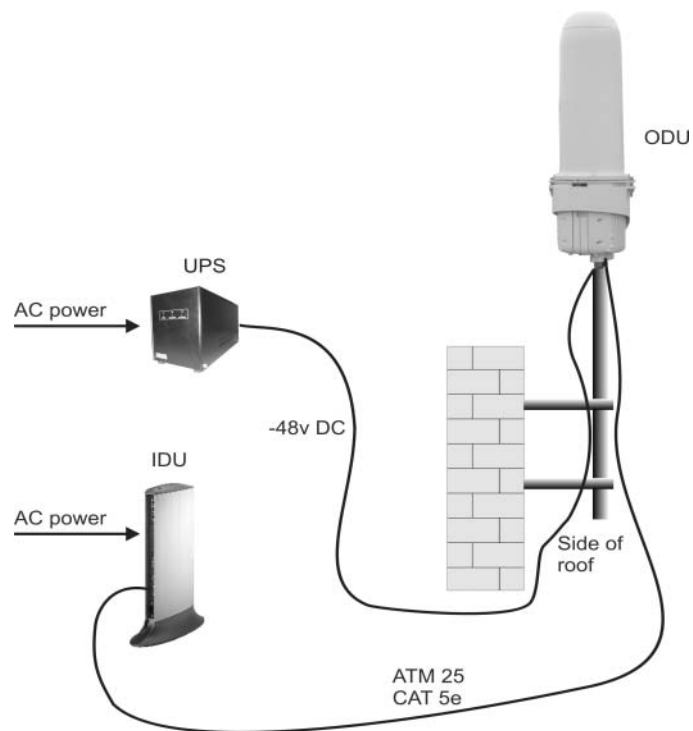
The MESHWORKS Uninterruptible Power Supply (UPS) - this 48V DC uninterruptible power supply provides back-up power even in the event of a mains electricity failure.



The ODU may be carrying traffic for other users, so has an independent power backup facility. The UPS allows the ODU to continue to operate during a short power failure. The UPS does not power the IDU, as it is assumed that the IDU will be powered by the same power management system as the application devices (servers, PABXs and so on). The UPS provides power status alarms and connects directly to the ODU through a separate power cable.

An example of a basic node

The basic customer node configuration is shown below:



Each of the nodes has one or more ODUs and a UPS. The exact configuration of ODUs is determined by the role of that particular node in the network. For example, if the customer requires service - an IDU is added. If the ODU is part of a MIP (where service is not required) or a TNCP - then an IDU is not required.

Installation

Mechanical installation

The following sections will describe the procedures for the mechanical installation of the following MESHWORKS components to the customer's premises:

- ❖ MESHWORKS Outdoor Unit (ODU);
- ❖ MESHWORKS Uninterruptible Power Supply (UPS);
- ❖ MESHWORKS Indoor Unit (IDU).

ODU installation

The Outdoor Unit (ODU) is one of the main building blocks of the Radiant Mesh. The ODU is used at both network and customer locations to provide wireless connectivity. The ODU has an embedded ATM switch, which enables it to route traffic across the Mesh - the only data that passes between the ODU and the IDU being for, or coming from the customer.

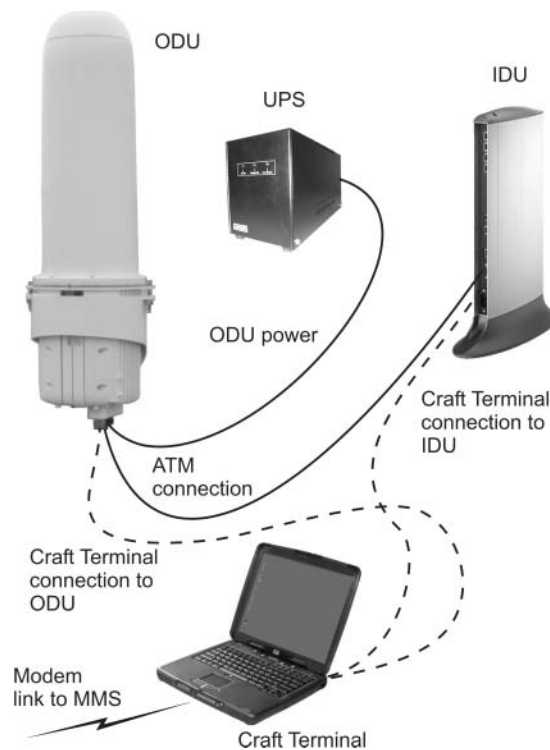
Required tools and equipment

Radiant supplies a MESHWORKS Installation Toolkit (MESHWORKS product code INS1000) that contains a number of the specialised tools required to install a Customer ODU, IDU and UPS. Other equipment that you will need for installation is listed below:

- ❖ Basic telecommunications tool kit;
- ❖ High powered binoculars or monocular with compass. A stabilised version may be particularly useful.
- ❖ ODU alignment tool (see appendices);
- ❖ RJ45 crimp tool;
- ❖ metal detector;
- ❖ RJ45 connectors;
- ❖ Cannon ITT crimp tool;
- ❖ AMP Lightcrimp plus SC style fibre optic termination kit;
- ❖ hammer drill plus appropriately-sized masonry drill bits;
- ❖ marker pen;
- ❖ socket set;
- ❖ a set of appropriately-sized spanners;
- ❖ hammer;
- ❖ spirit level and plumb bob;
- ❖ tape measure;
- ❖ cable ties and cleats.

Use of a Craft Terminal during installation

A laptop PC installed with the MESHWORKS Installation Manager software, known as the Craft Terminal, supports both the installation of new MESHWORKS equipment and the re-installation and repair of existing equipment. The following illustration shows the relationship between the Craft Terminal and the node components:



The Craft Terminal communicates with the Mesh Management System (MMS) via a mobile data modem during the installation process, and provides remote configuration and detailed installation instructions (in other words, it tells you exactly what to do and in what order).

The Craft Terminal is normally connected to each MESHWORKS component via an RS232 connection, or through an Ethernet network.

To start the installation program, use the following procedure:

1. Double-click on the **Installation** program on the desktop.
2. Type in the username and password.
3. Follow the detailed on-screen instructions.

Please read the sections entitled *Commissioning the ODU* and *Commissioning the IDU* to see how the Craft Terminal is used in the commissioning process.

ODU equipment components

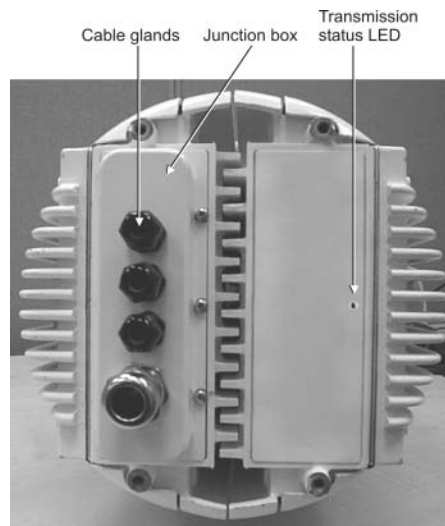
The MESHWORKS ODU (as shown in the following illustration) is shipped as a single sealed unit.

The following pictures show the sides and front of the ODU:

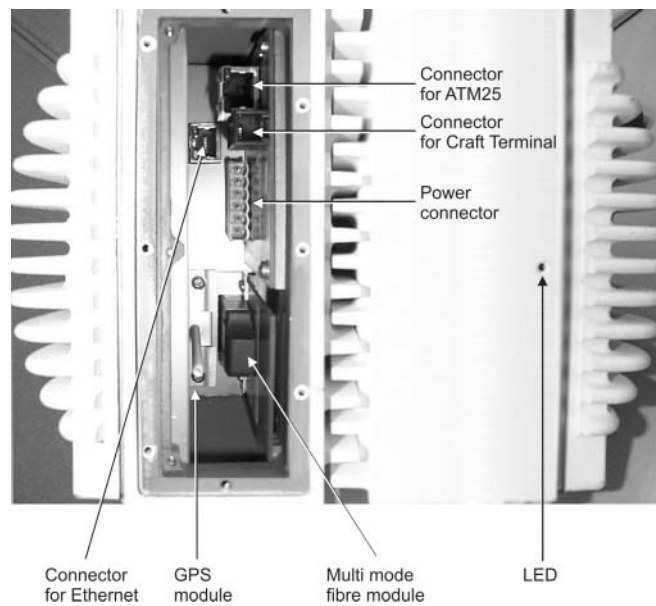


These pictures show the mounting arrangement which holds the ODU in place. They show how the ODU is attached by bolts to a mounting bracket, which is itself bolted to a metal pole. You can see that all the connector cables enter the ODU through a box on the underside of the ODU.

The following picture shows the underside of the ODU:



In this picture, you can clearly see the access plate and box containing the cable connectors and gland nuts. With the access plate removed, you can see the internal connectors:



The cap at the top of the ODU contains the aerial for the GPS unit:



The cap can be removed by unscrewing it. You must take care not to damage the GPS unit when you remove the cap, or when you fit the spike to the top of the cap (the purpose of the spike is to deter birds from landing on the ODU).

ODU weight and dimensions

ODU

The ODU unit is 857 mm high, and 291 mm in width (at its widest point). It weighs 13 kg (28.66 pounds).

ODU bracket assembly

The ODU bracket assembly is 253 mm high, and 247 mm in width. It weighs 4.9 kg (10.80 pounds).

Interfaces and connections

The ODU is designed to connect to the following components:

- ❖ Craft Terminal via RS232 port, using an RJ11 connector;
- ❖ Radiant's Indoor Unit (IDU) - this is connected to the ODU via CAT5e cable carrying ATM25 traffic. This cable connects to the IDU via a standard RJ45 socket.
- ❖ Uninterruptible Power Supply (UPS) - this will usually be installed inside the customer's premises (the loft/attic or in a rack). The UPS is connected to a 110 volt or 240 volt mains supply, and provides -48 volt DC output to the ODU. It is designed (should the mains fail) to provide several hours of battery back-up.
- ❖ A multi-mode fibre module (this is an optional upgrade).

ODU siting

The ODU must be mounted on the customer's premises so that it is within *line of sight* of other ODUs with which it will communicate. To optimise future Mesh formation it would also be preferable for it to be within line of sight of as many other ODUs as possible. The Mesh Planning System (MPS) will be used to assess the merits of possible locations. However, once on site, practical verification of the MPS predictions will be required.



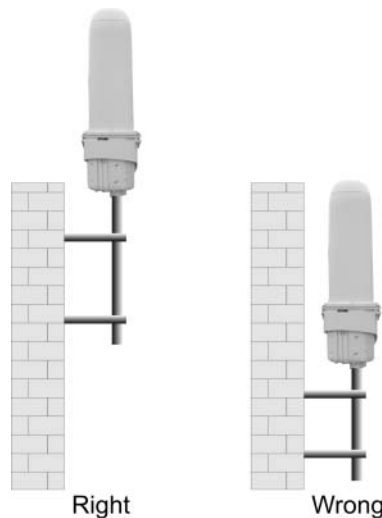
The current FCC compliance rules dictate that the ODU should be no closer than 6 metres to the general public. Please bear this in mind when choosing a location for the ODU.

Accurate positioning of the ODU's alignment must be done with the ODU direction finder (see appendices) - this aligns the ODUs to face North.

Mount the ODU on the least obstructed part of the building. This is normally the roof, but you may find that you will have to locate an ODU on the side of a building. Choose the highest **unobstructed** part of the roof that you can. This can be on a parapet or other structure, or on the peak of the roof. Ensure that any part of the roof structure that you fix the ODU to is strong enough to support the ODU and its bracket, as well as the mounting pole and its fixing brackets. Please note that it must be able to support this weight in strong gusts of wind and stormy weather.

Note that mounting an ODU on the **side** of a building is **not** recommended, except where circumstances demand it. If you do so, you will make it more difficult for the ODU to create successful radio links to other ODUs in the Mesh. The best wall mounting is on the corner of the building.

Also, when mounting an ODU on a wall, it is strongly recommended that you use a mounting pole long enough to bring the top part of the ODU **above** the level of the rooftop:



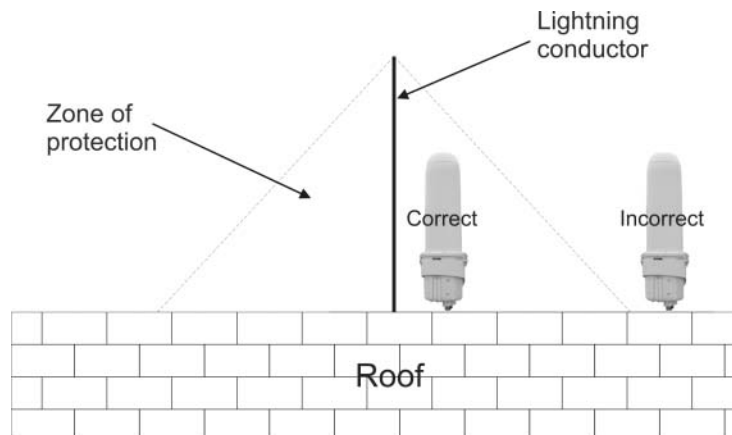
Please also consider the following:

- ❖ Rooftops - are they strong enough to support the weight of an ODU (13 kg or 28.66 pounds) or the weight of an installation engineer? Is there a point on the roof where an ODU can be mounted? Are there any obstructions in the way? Is there a parapet or other structure to which an ODU can be attached?
- ❖ Existing mounting poles and brackets - are they strong enough for mounting an ODU? Are they the correct height? What condition are they in? How far away are they from the location provided by the Mesh Planning System? Are they in the right position for a good line of sight to another node?
- ❖ Electricity supply - is it the correct voltage for Mesh equipment? Can a separate meter be installed, if it is required for separate billing purposes? Where is the closest location of a power supply, near the ODU? Can cabling be extended easily to the ODU or other components?
- ❖ Lightning protection - is any provided? Is it adequate? If not, should the appropriate lightning conductors and earth rods be installed? Who will provide them - the network operator, or the subscriber whose building it is?
- ❖ Planning permission - has planning permission for the siting of an ODU been granted, or can it be obtained?

Lightning protection

If a building is not equipped with lightning protection (this normally applies to low buildings), additional protection is not required for the Radiant ODU. However if a building is equipped with lightning protection (this normally applies to tall buildings), then the Radiant ODU should be:

- ❖ grounded to the existing lightning protection system using a bonding strap;
- ❖ installed within the zone of protection of the existing lightning protection. This is defined within BS 6651 (code of practice for protection of structures against lightning) as within 20 meters of a lightning conductor and within an area shaped like a cone with a 45° side (see illustration).



Mounting specifications

As the construction of buildings will differ, physical installation of the ODU will vary for each customer. However, detailed below is the most likely installation.

Before starting work, ensure that the area chosen is in good repair and free from obvious obstructions. Sweep the areas to be drilled with a metal detector to locate any hidden dangers such as rebar (steel reinforcements in concrete) or pipe work.

The ODU must be mounted onto a 51mm diameter metal pole. This pole must itself be fixed either to a rooftop or wall. The metal pole (such as a length of steel scaffolding pipe) must be capable of supporting a weight of at least 20 Kg (approximately 44 pounds).

When fixing an ODU to a roof, use a metal mounting bracket or existing aerial brackets to mount the pole in place.

When fixing an ODU to a wall, you must fix it to a flat brick or masonry wall using 'T and K' brackets, using a standoff to overcome obstacles such as guttering and eaves. The bracket is attached to a wall by using adjustable heavy duty rawl bolts.

Mounting procedure

To mount the ODU, use the following procedure:

1. Offer up the 'T' section of the bracket to the chosen location on the wall.
2. Using the spirit level, ensure that the bracket is horizontal.
3. Mark the holes to be drilled, and drill them.
4. Insert and tighten the anchor bolts until the sleeve has caught securely.
5. Slacken and remove the bolts, leaving the sleeves in place.
6. Using a tape measure and spirit level, offer up the 'K' bracket 500mm directly below the 'T'.
7. Repeat steps 1 through 6 for the 'K' section of the bracket.
8. When all holes have been drilled, insert the anchor bolts through the mounting holes of the T and K brackets and secure to the wall; **do not tighten the bolts completely**.
9. Slacken the two 'U' bolts and position on the 'T' and 'K' brackets.
10. Slide the mounting pole through the 'U' bolts and tighten again, not fully, but just enough to hold the pole in place. You must now proceed to fine-tune the vertical alignment.

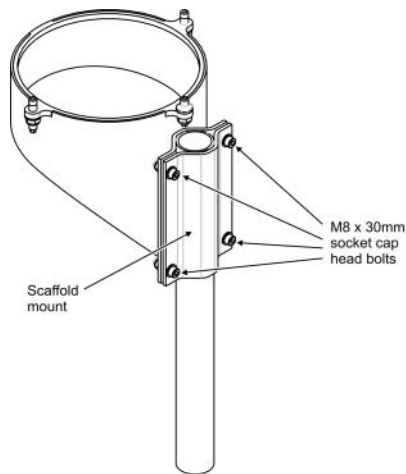
Getting the correct vertical alignment

The ODU **must** be aligned vertically. Use the following instructions to ensure this.

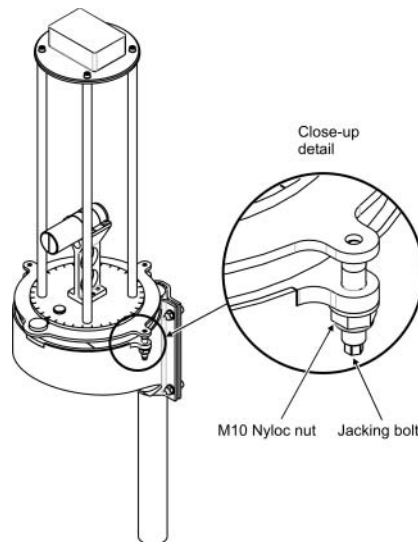


The following steps will require more than one person.

-
11. Use a plumb bob to adjust the vertical alignment of the mounting pole.
 12. Tighten all the anchor bolts securely, and remove the plumb bob.
 13. Position the ODU's mounting bracket on the top of the mounting pole, and lightly bolt on the fastening plate to hold the bracket in place. The following picture shows the ODU's mounting bracket:



- 14.** Move the mounting bracket around on the pole, and partially tighten the bolts on the scaffold mount. The scaffold mount bolts have a nylon thread, and you will need to use an M8 allen key and a spanner (or similar tools).
- 15.** Attach the ODU direction finder to the mounting bracket, and use it to adjust the two jacking bolts. When you have done this, lock the jacking bolts with M10 Nyloc nuts (see following illustration).



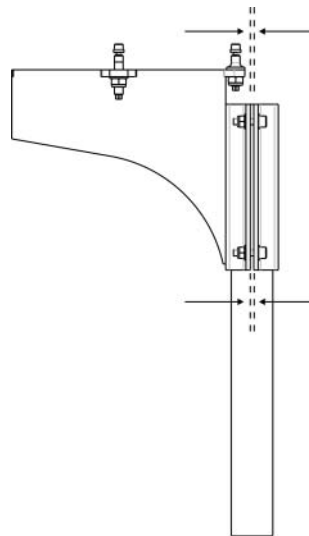
Getting the correct directional alignment

16. Move the bracket around until it faces the direction indicated by the alignment tool. Firmly tighten up all the bolts on the scaffold mount and remove the ODU direction finder. For details of how to use the ODU direction finder, please see the appendices.



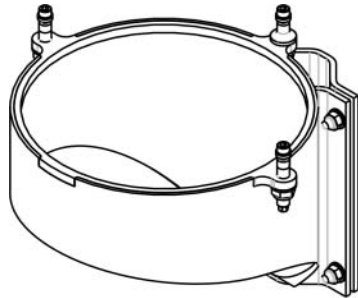
You must take care not to overtighten these bolts - don't strip the thread!

17. Ensure that you tighten these bolts evenly, so that the scaffold mounting plate and the bracket stay parallel (indicated in the next illustration). This ensures a firm, evenly distributed grip on the scaffold pole.

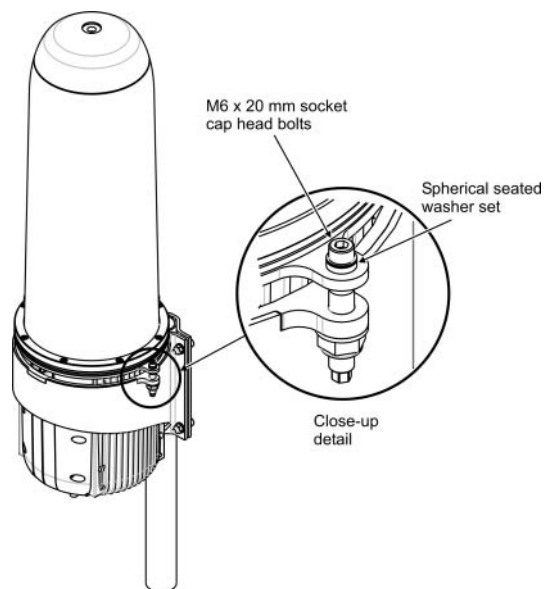


Attaching the ODU to its bracket

18. Position the metallic lower part of the ODU body into the cradle of the mounting bracket. Ensure that the holes on the ODU fit over the 2 jacking bolts and rear mounting bolt on the cradle (shown in the following illustration):



- 19.** Use three M6 x 20mm socket cap head bolts and spherical seated washers to secure the ODU in place (shown in following illustration).



- 20.** The following picture illustrates the rear of the ODU and the bracket fixing arrangements:



The following picture shows the finished ODU mounting, on top of a roof:



Commissioning the ODU

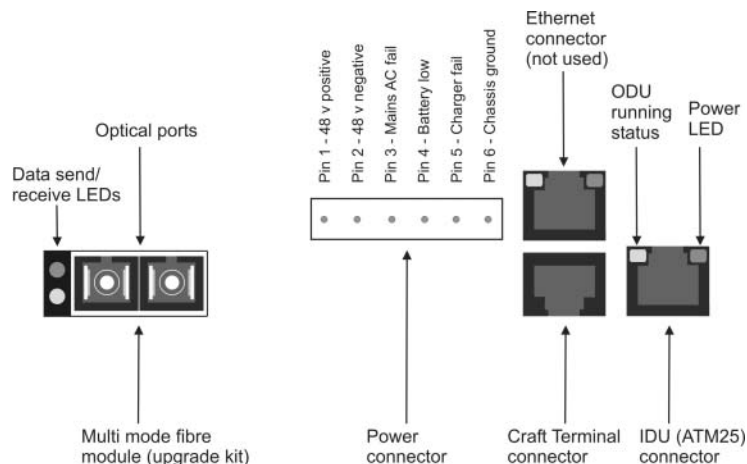
To commission the ODU, use the following procedure:

1. Ensure that the ODU is correctly mounted.
2. Run a length of cable from the ODU and connect it to the UPS. Refer to the UPS installation procedure in this manual for details. The maximum allowable length for the power cable is 100 metres. For greater distances, Radiant Networks must be consulted for technical advice. It is also recommended that the cable is not kept on a reel when powering the ODU.

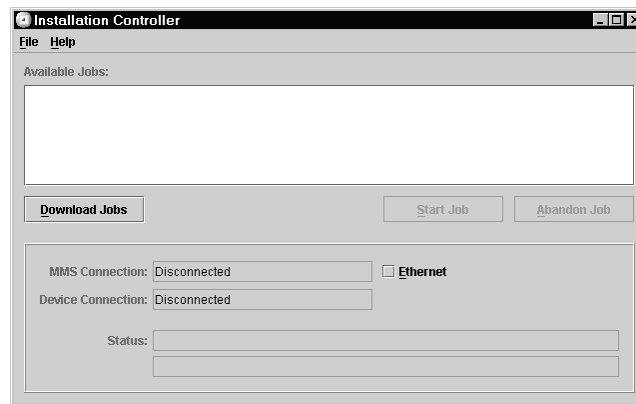


*At this stage, **do not** connect the mains power to the UPS. Install the ODU and complete the wiring of the ODU before you begin the installation of the UPS, to prevent against the possibility of a short circuit or electrocution.*

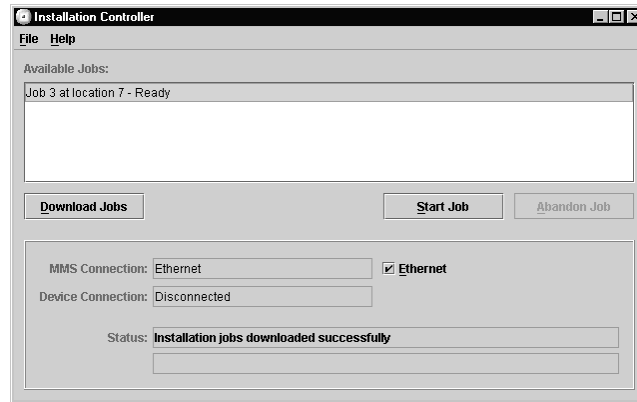
3. Run a CAT5e or fibre cable between the ODU and IDU. The type of cable you decide to use depends on the length of cable required; for example, if you are connecting over a short distance, CAT5e cable should be adequate.
4. Remove the access plate from the underside of the ODU.
5. Connect the power and data cables to the appropriate connectors. The following illustration shows details of the connectors inside the ODU:



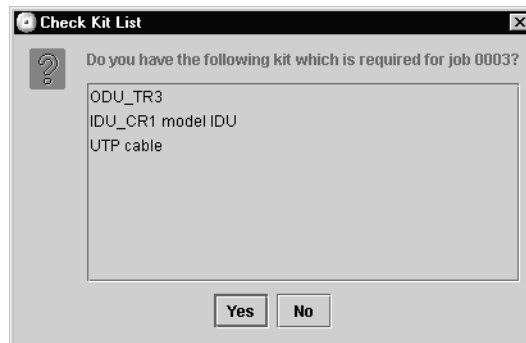
6. Switch on the power to the ODU, using the UPS. Refer to the UPS installation procedure in this manual for further details.
The green LED on the IDU connector should light up to indicate that the power supply is on. The yellow LED on the IDU connector should also light up to indicate that the ODU's running status is OK. Note that this light is normally off whenever the ODU goes through a reset phase. This light should turn on once the ODU's software has started up correctly.
7. Turn on the Craft Terminal.
8. On the Craft Terminal, run the **Installation** program from the **Start** menu, or run the `runInstall.bat` file in the **Craft** directory.
9. The first screen that you will see is shown in the following illustration:



10. To display a list of the assigned jobs, click on the **Download Jobs** button. This starts the dialler and downloads the current jobs.
11. Select your required job by clicking (which will highlight the line) and then click on the **Start Job** button:



12. This opens a dialog box like that shown in the following illustration:



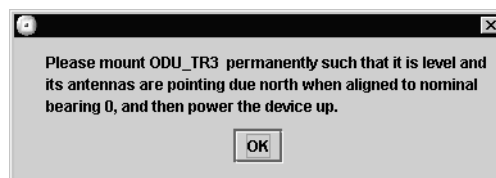
This is a checklist of all the components you will need to construct a customer node. Ensure that you have these items before you proceed. Click on the **Yes** button to proceed.

13. This opens the following action message:



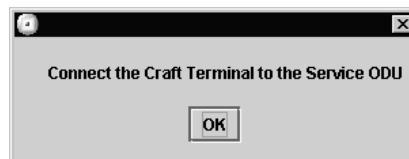
Stick the appropriate label on the ODU, and click on the **OK** button.

- 14.** This opens the following action message:

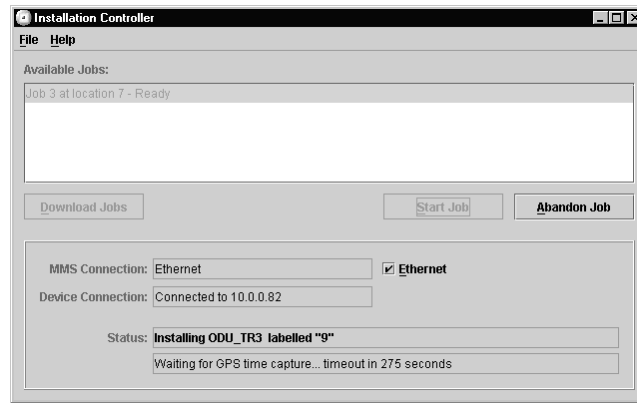


If you have not already done so, mount the ODU in place on the roof and connect it to the UPS. Power up the ODU, and click on the **OK** button to proceed.

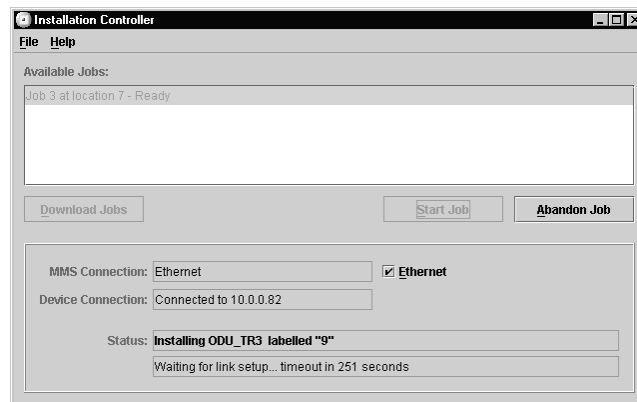
- 15.** This opens the following action message:



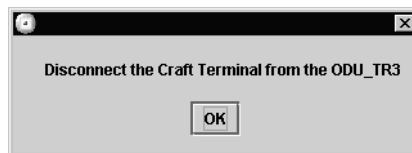
- 16.** Connect the Craft Terminal to the ODU, and click on the **OK** button.
- 17.** The Installation Controller establishes the GPS timing for the ODU:



18. The Installation Controller points the ODU antennas to establish a link:



19. Once the line of sight has been successfully established, you should see the following action message:



- 20.** Disconnect the Craft Terminal from the ODU. Leave the software running for the IDU commissioning process.
- 21.** Replace the ODU's access plates, and use cable ties to tidy away any excess cable.
- 22.** During operation, the LED on the underside of the ODU should light up to indicate that the ODU is in a transmission state.
- 23.** Proceed to the section titled *Commissioning the IDU*. This describes the next stage in the commissioning process.

UPS installation

The 48 volt UPS (Uninterruptible Power Supply) has been designed to provide uninterrupted DC power to an ODU, keeping the ODU running during disruptions to mains power supplies. With an input voltage of 85 - 132 volts / 180 - 265 volts AC, 50-60 Hz, it supplies a nominal -55 volts DC, at 1.3 A. It can supply a constant 70 W over the DC output range of -42 volts to -48 volts for up to 4 hours, during mains electricity outages.

The UPS can either be rack mounted, or mounted on a desk or floor. The following pictures show the front and back of the UPS.

Front (this shows the front panel with status lights):



Back (this shows the junction box and power cable gland):



UPS weight and dimensions

The UPS is 180 mm high, 137 mm in width, and 337 mm in length. It weighs 15 kg (33 pounds).

Required tools and equipment

Radiant Networks supplies an Installation Toolkit (MESHWORKS product code INS1000) that contains a number of the specialised tools required to install a Customer ODU, IDU and UPS.

Other required standard equipment for installation is listed below:

- ❖ A small cross-point screwdriver;
- ❖ a fine-bladed flat screwdriver (electrically insulated screwdriver strongly recommended);
- ❖ cable stripper;
- ❖ clipper or knife for cutting cable ties.

Safety precautions for the UPS

Please observe the following safety precautions when installing a UPS:

- ❖ Do **not** stand anything on top of the UPS, or lean anything against its sides. Leave a clearance of at least 1 cm around the sides of the UPS. This will ensure the free flow of warm air ventilated from the UPS.
- ❖ Place the UPS away from equipment, magnetic media and other items which may be affected by the UPS's magnetic field.
- ❖ Place the UPS away from dust, water or damp objects.
- ❖ Ensure that your mains power supply is correctly earthed before connecting the UPS.
- ❖ The UPS is very heavy. It is recommended that you wear gloves when carrying the UPS to reduce the possibility of getting blisters.



*The UPS is too heavy for sustained one-handed carrying. You **must** carry the UPS with both hands, observing standard safety precautions for lifting heavy objects.*

Installation procedure

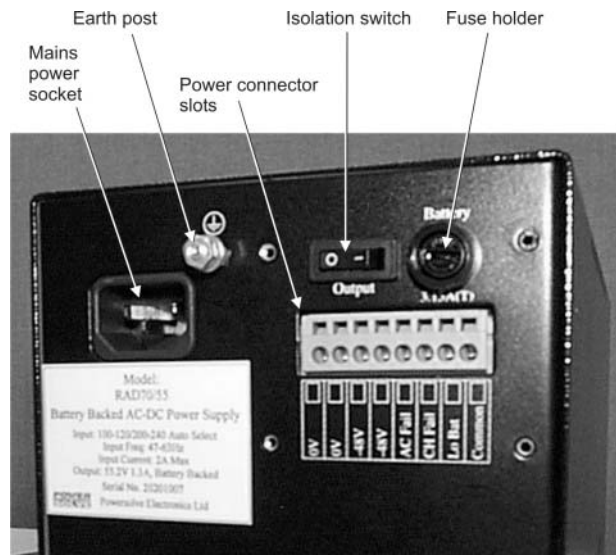
To install the UPS, use the following procedure:

1. Run a length of power cable from the ODU to where you wish to install the UPS. The maximum allowable length for the standard power cable is 100 metres. For greater distances, Radiant Networks must be consulted for technical advice. It is also recommended that the cable is not kept on a reel when powering the ODU.

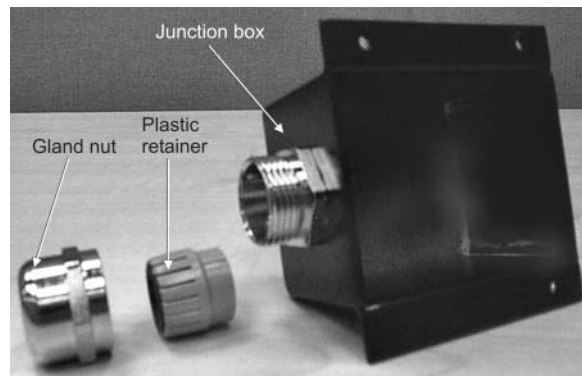


*At this stage, **do not** connect the mains power to the UPS. Install the ODU and complete the wiring of the ODU before you begin the installation of the UPS, to prevent against the possibility of a short circuit or electrocution.*

2. Using the cross-point screwdriver, remove the fixing screws from the junction box at the back of the UPS.
3. Remove the junction box from the UPS. The following picture shows the back of the UPS with the junction box removed:

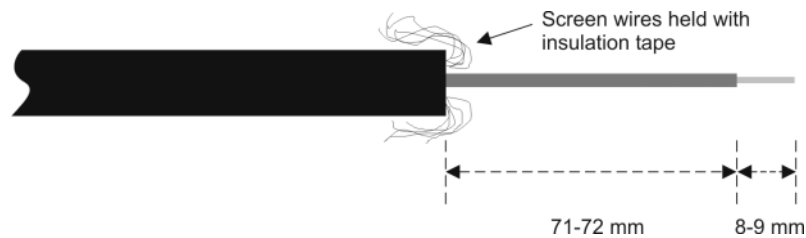


4. Set the isolation switch to 'off'.
5. Use a flat-bladed screwdriver to remove the fuse holder. Put the fuse holder in a safe place.
6. Unscrew the gland nut from the junction box, and take out the plastic retainer. The following picture shows the junction box, the plastic retainer and the gland nut:

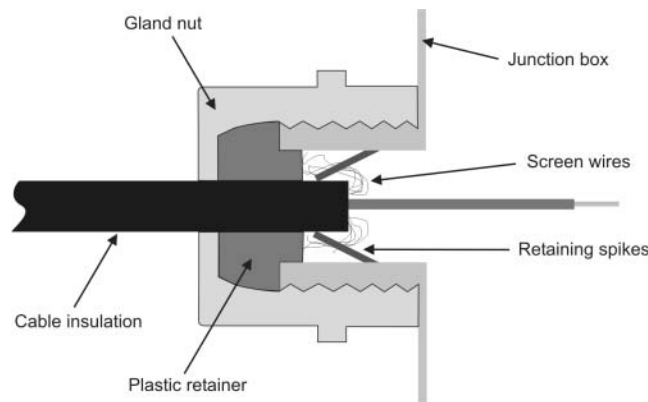


7. Feed the cable through the gland nut and the plastic retainer.

8. Strip a length of insulation from the cable (80 mm is suggested). Peel back the metal screen layer from the core wires.
Strip a length of insulation from the end of each wire (must be 8-9 mm), and twist the ends. Refer to the following illustration:

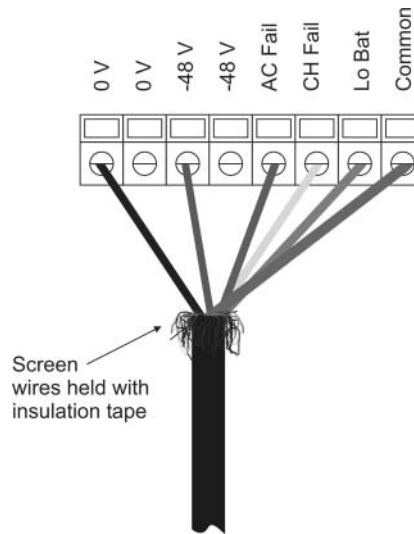


9. Fold back the screen wires around the cable insulation, and trim them down to a manageable length. Use a small piece of insulation tape to secure the screen in place. Feed this end of the cable through the gland nut hole in the box, and pull it through, until the cable's screen is grasped by the retaining spikes inside the gland nut.
10. Push up the plastic retainer and screw on the gland nut to secure the cable in place. See the following cross-section illustration:



11. Pull the wires so they protrude from the box. Use the fine (insulated) screwdriver to hold open the connector holes while you insert the wires. To do this, insert the screwdriver in the rectangular slot above each hole, and twist it a little. To lock each wire in place, remove the screwdriver. The end of the wire will be held by the clamping action of the connector.

See the following illustration for details:



The key to the colour-coding of the wires is as follows (starting from the left):

- The **black** wire should be inserted in the **0 V** connector hole (on the far left).
- The **blue** wire should be inserted in the **-48 V** connector hole (third from left).
- The **red** wire should be inserted in the **AC Fail** connector hole (fifth from left).
- The **white** wire should be inserted in the **CH Fail** connector hole (sixth from left).
- The **brown** wire should be inserted in the **Lo Bat** connector hole (seventh from left).
- The **green** wire should be inserted in the **Common** connector hole (on the far right).



Ensure that no bare wires protrude from the connector. If bare wires are exposed, there may be a danger of shorting to the UPS case.

- 12.** Use a flat-bladed screwdriver to replace the fuse holder.



Do not turn on the power to the UPS until you have completed the wiring of the ODU, to avoid the possibility of a short circuit or electrocution. The wiring at the ODU end **must** be completed before the wiring at the UPS end is done.

-
- 13.** Set the isolation switch to 'on'.



The DC output to the ODU will not be available until mains power is connected.

-
- 14.** Replace the junction box on the back of the UPS, using the screws to secure it in place.
- 15.** On your Craft Terminal, check that the correct stage has been reached. Attach the mains power cable to the UPS and, when ready, switch on the power.
- 16.** Check that all the power indicators on the front panel light up correctly. If the UPS fails this test, contact Radiant Networks for support.

Rack mounting of UPS

If you have more than one UPS on site, you may find it convenient to mount them all together in a rack.

You can mount up to 3 UPS units on each rack shelf. Each rack shelf must be fixed at 4 points, and must be capable of supporting a weight of 47 kilograms.

To allow proper ventilation of warm air, you must maintain a clearance of 1 cm between each UPS.

When using the UPS in a rack, the earth post on the back of the UPS can be used as an earth point for attaching other Radiant Networks equipment. It should be used for electrostatic discharge purposes only.

Replacing the fuse

The UPS fuse is a standard 20 mm anti-surge 3.15 amp type.

If you wish to fit a replacement fuse, use the following procedure:

- 1.** When the Craft Terminal prompts you to do so, switch off the mains power to the UPS.
- 2.** Using the cross-point screwdriver, remove the fixing screws from the junction box at the back of the UPS.
- 3.** Remove the junction box from the UPS.
- 4.** Set the isolation switch to 'off'.
- 5.** Use a flat-bladed screwdriver to remove the fuse holder. Take the fuse out of the holder, and replace it with the new fuse.
- 6.** Screw the fuse holder back in place, and set the isolation switch to 'on'.
- 7.** Replace the junction box on the back of the UPS, using the screws to secure it in place.
- 8.** When the Craft Terminal prompts you to do so, switch the mains power back on.

IDU installation

The MESHWORKS Indoor Unit (IDU) is a device installed inside the customer's premises, usually close to the terminal equipment it will serve. It provides the end-user connectivity and network adaptation functions. The IDU connects to the ODU using a standard ATM connection. It provides traffic policing and shaping into and out of the Mesh.

The IDU enables alternative route selection across the Mesh for path redundancy and seamless network reconfiguration.

The services the IDU provides are:

- ❖ Trunk telephony (either E1 or T1);
- ❖ high speed data connection based on IP (via Ethernet or USB directly from the IDU).

Required tools and equipment

Radiant Networks supplies an Installation Toolkit (MESHWORKS product code INS1000) that contains a number of the specialised tools required to install a Customer ODU, IDU and UPS.

Other required standard equipment for installation is listed below:

Desk or floor mounting

- ❖ Basic telecommunications tool kit;
- ❖ RJ45 crimp tool and connectors;
- ❖ cleating hammer;
- ❖ cable ties;
- ❖ cleats.

Rack mounting

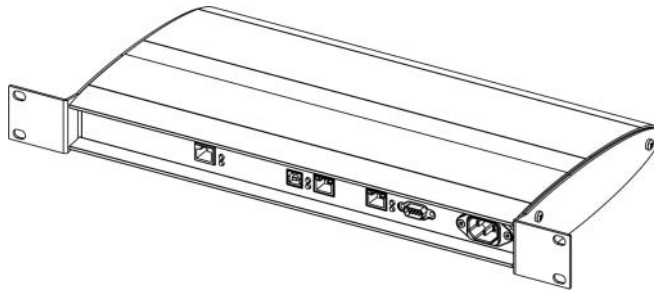
If you wish to rack mount the IDU, you will require a cage nut kit in addition to the items listed above for desk or floor mounting.

Equipment components

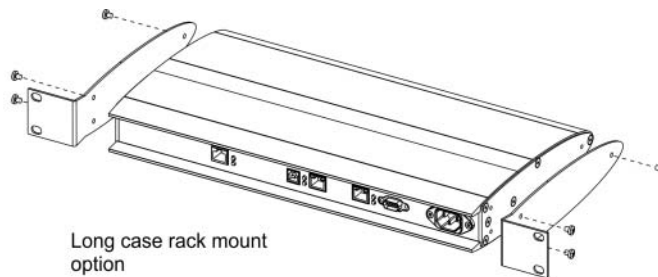
The MESHWORKS IDU is designed to be mounted in a number of different ways:

Horizontal mounting

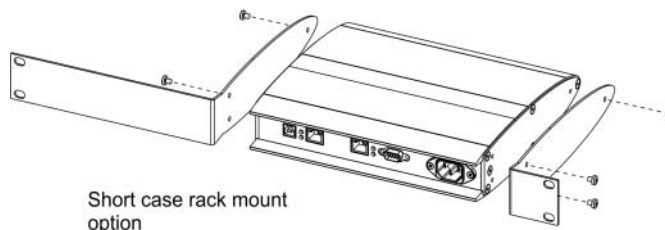
Standard 19" rack mounting option



For this mounting option, you will require two rack mounting end brackets, six screws and four cage nuts and bolts. There are two versions of this mounting option, for both the long and short IDU cases:



Long case rack mount
option

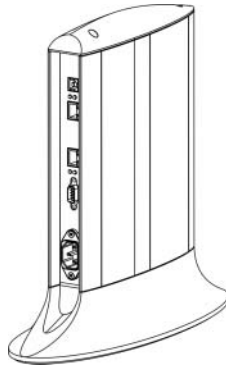


Short case rack mount
option

Vertical mounting

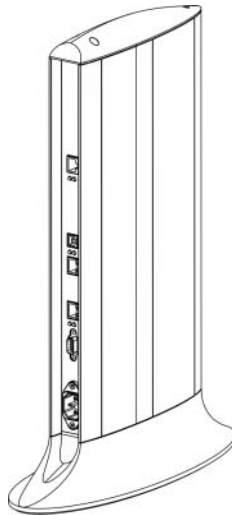
Short floor standing case

For this mounting option, you will require an IDU end cap and a base.



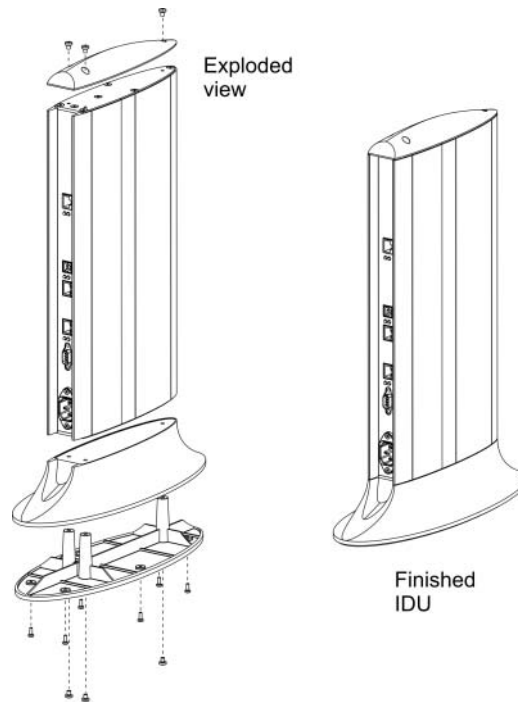
Long floor standing case

For this mounting option, you will require an IDU end cap and a base.



End pieces for IDU

The following illustration shows how the end cap and base are attached to the main body of the IDU:



For the vertical mounting options, you must attach the following parts to the main body of the IDU:

IDU end cap

This is a protective end-piece for the IDU.



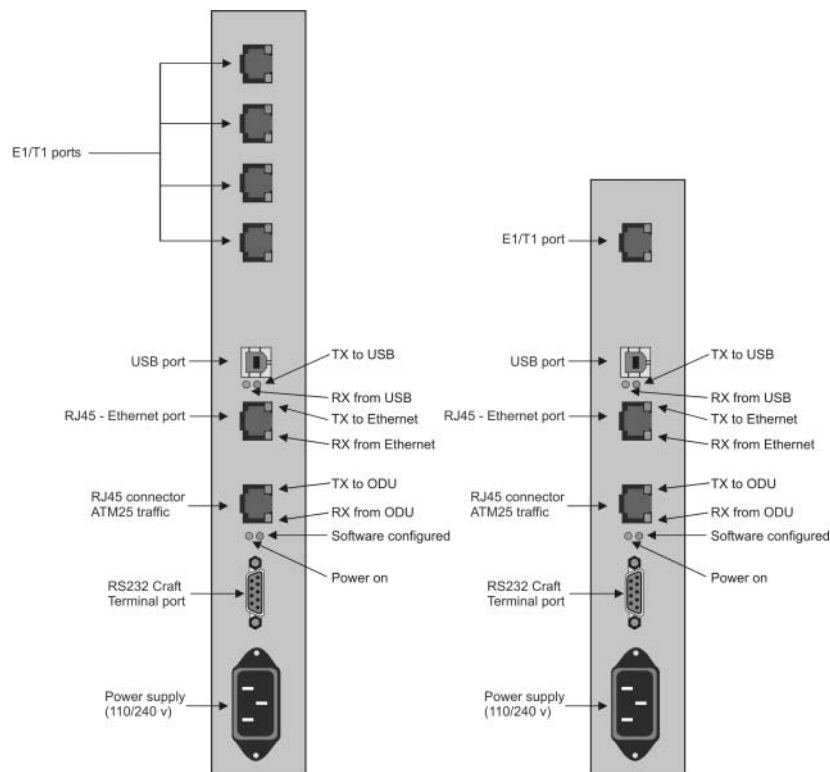
IDU base

This is a heavy base for the IDU, which allows it to stand upright on a desk or on the floor.



Explanation of the IDU's rear panel

The rear panel of the IDU provides all the connectors and the link status lights. The illustration below shows the rear panels of the two versions of the IDU:



The IDU has the following connectors and indicator lights:

Indicator lights

1. Power on (green).
2. Software configured (orange). This indicates that the on-board software has been configured.
3. RX from ODU (green). This indicates that the IDU is receiving data from the ODU.
4. TX to ODU (orange). This indicates that the IDU is transmitting data to the ODU.
5. RX from Ethernet (green). This indicates that the IDU is receiving data from the Ethernet connection.
6. TX to Ethernet (orange). This indicates that the IDU is transmitting data to the Ethernet connection.
7. RX from USB (green). This indicates that the IDU is receiving data from the USB connection.
8. TX to USB (orange). This indicates that the IDU is transmitting data to the USB connection.

Connectors

1. Power Supply 110/240 V AC.
2. RS232 Craft Terminal port.
3. RJ45 connector ATM25 traffic (connects to ODU via CAT5e cable).
4. RJ45 - Ethernet port.
5. Universal Serial Bus (USB) port.
6. E1/T1 port (note that there is only one E1/T1 port in the short version of the IDU).
7. E1/T1 port.
8. E1/T1 port.
9. E1/T1 port.

Connections

The IDU is designed to connect to the following Mesh components and other equipment:

1. MESHWORKS ODU.

2. USB port of customer PC.
3. Ethernet port of customer PC.
4. Trunk telephony supply.

Commissioning the IDU

To get the IDU functioning correctly with the other Mesh components, you must use the following procedure:

1. Assemble and connect all other components (ODU, UPS and so on). Use the Craft Terminal to set up the ODU (as described in the section titled *Commissioning the ODU*), and leave it switched on.
2. Assemble the IDU to the required rack, desk or floor mount option. For vertical floor standing mount - screw on the foot and cap. For rack installation, the MESHWORKS IDU will fit into a standard 19" rack.



At this stage, **do not** connect the IDU to the ODU until instructed to do so by the Craft Terminal.

You **must** commission the ODU before you commission the IDU.

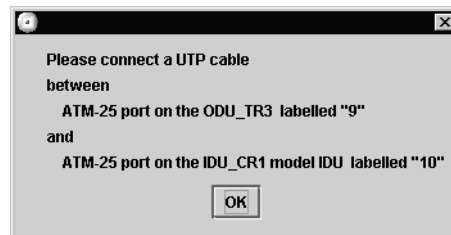
3. Connect the IDU to a mains power supply and switch it on.
4. At this stage in the installation, on your Craft Terminal, a dialog box like the following should be displayed:



5. Stick the appropriate label on the IDU, and click on the **OK** button.
6. An action message like the following should be displayed:



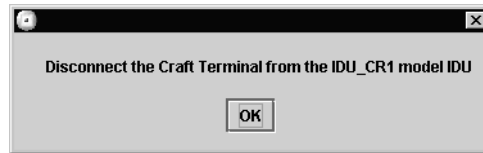
7. Connect the Craft Terminal to the RS232 port of the IDU. Click on the **OK** button to proceed.
8. A message like the following is displayed:



9. Connect the IDU to the ODU by plugging the CAT5e cable into the rear of the IDU. This will allow the newly installed IDU to be visible to the MMS (Mesh Management System), so that it can then continue with the configuration process. When you have done this, click on the **OK** button to proceed.
10. A service test dialog box like the following will be displayed:

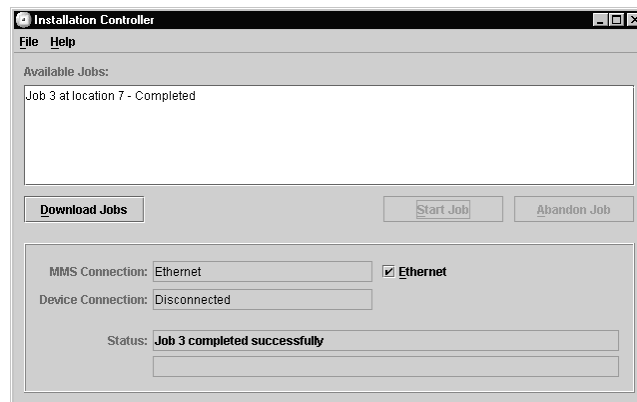


11. Depending on the services required for the customer, connect either USB, Ethernet or telephony into the appropriate ports of the IDU. Test these services to ensure their correct operation. If the connection works OK, click on the **Passed** button.
12. If everything works correctly, you should see a message like the following:



Disconnect the Craft Terminal from the IDU and click on the **OK** button.

- 13.** The Installation Controller should announce that the job has been completed successfully:



Customer Premises Switch

Information not yet available (this hardware is not available).

Appendices

Appendix A - Upgrading software of Mesh components

Periodically, Radiant Networks will issue software upgrades for the Mesh components (ODU, IDU). These will be supplied as data files - contact Radiant for details of these upgrade files. This upgrade process must be used when you wish to upgrade Mesh components before adding them to the Mesh.

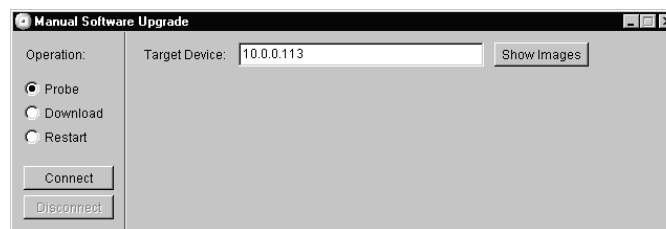
A software upgrade has several separate stages:

- ❖ Probe;
- ❖ download;
- ❖ restart.

Before you start, you should have a list of the IP addresses for all the Mesh components you wish to upgrade.

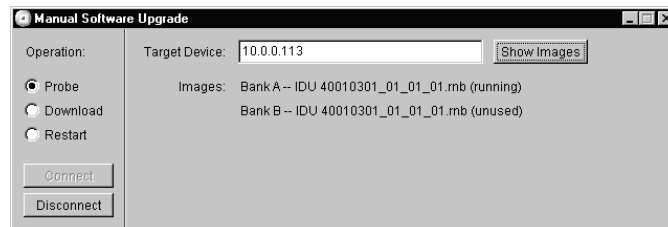
To perform a software upgrade, use the following procedure:

1. Connect the Craft Terminal to the MESHWORKS device with an RS232 cable.
2. Start up the Manual Software Upgrade application. This opens a dialog box like the following:

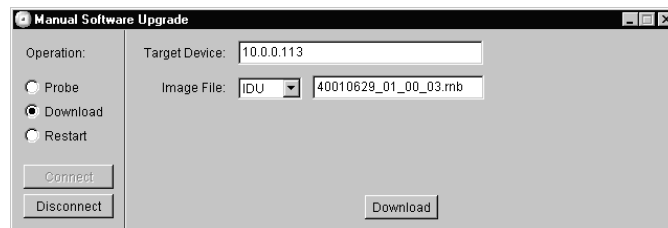


3. To start the upgrade process, you must click on the **Connect** button. As part of the connection process, the device will assign an IP address to the Craft Terminal, which will be used throughout the upgrade process. The IP address of the Craft Terminal will therefore be the device's IP address plus 8 (for example: IDU 10.0.0.113, Craft Terminal 10.0.0.121).
4. You will need to perform a probe of each device to see which version of the software is currently installed. Click on the **Probe** radio button.

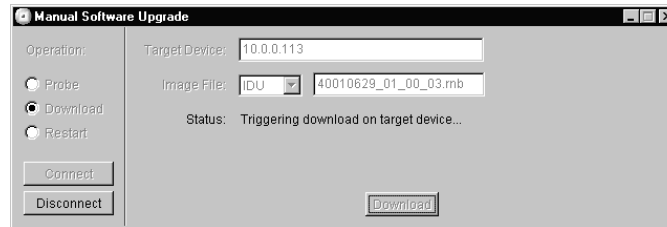
5. In the **Target Device** box, type in the full IP address of the connected device and then click on the **Show Images** button. The dialog box (example in following illustration) will display two banks of software device images, one of which should already be running on the device. It shows you the name and version of the file containing the software:



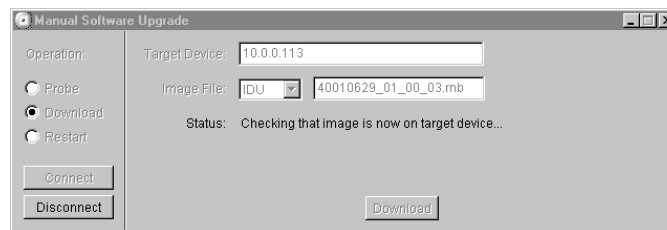
6. Start up the TFTP file transfer application.
7. In the TFTP dialog box, select the IP address assigned to the Craft Terminal by the device.
8. In the Manual Software Upgrade dialog box, click on the **Download** radio button:



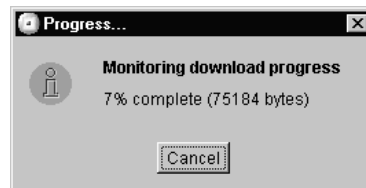
9. In the **Target Device** box, type in the full IP address of the device you wish to upgrade.
10. In the **Image File** drop-down list, select the type of Mesh device you are upgrading, and type the full filename of the upgrade file into the text box (you should have received this file either via FTP, or on a CD). This file should be copied onto the machine which is running the Mesh Monitoring Software.
11. Click on the **Download** button to send the upgrade file to the specified device. The download will invoke the TFTP application:



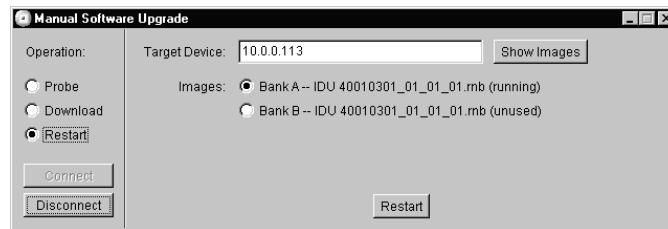
12. During the download process, you should see a progress message similar to the following:



13. You will also see a smaller dialog box (as shown below) which will display the percentage of the download that is complete.



14. Click on the **Restart** radio button to restart the device with the updated software. This displays the following view:



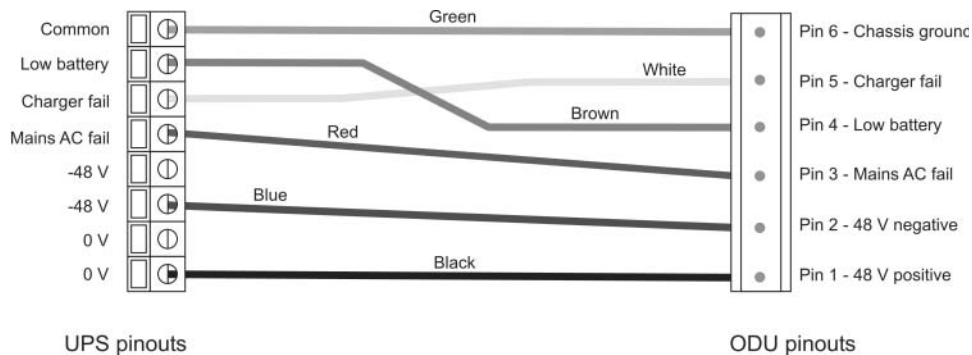
15. You should see that the bank of software which was not running (shown as **unused** in the dialog box) has been upgraded to the latest version of the software. Choose this bank, and proceed to restart the Mesh device.
16. To manually restart the specified Mesh device, click on the **Restart** button. That Mesh component should now reboot, using the software bank you have chosen.

Appendix B - Pinouts for cabling

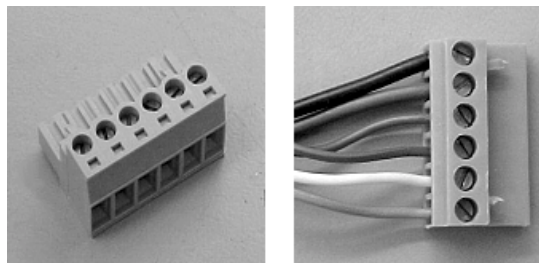
Please contact Radiant Networks technical support if you require further information about pinouts for your MESHWORKS equipment (support@radiantnetworks.co.uk).

Power cable from ODU to UPS

The following diagram illustrates the pinouts for the power cable connections between the ODU and the UPS:



The connector at the ODU end is a right angle 6-way AMP type with friction lock:



Data cable from ODU to IDU

The following diagram illustrates the pinouts for the data cable connections between the ODU and the IDU:



The connectors at both ends are RJ45 type connectors. This uses a straight through, one-to-one wiring.

Data cable from IDU to Craft Terminal

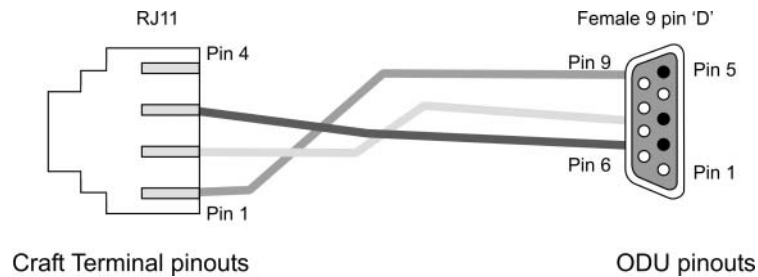
This data cable is a straight-through RS232 serial cable, with one-to-one connections. It has a male 9-pin 'D' connector at the IDU end, and a female 9-pin 'D' connector at the Craft Terminal end.



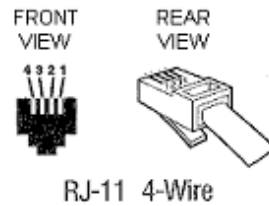
Pins 2, 3 and 5 are the only pins used, although a standard serial cable could be used for the task.

Data cable from ODU to Craft Terminal

This cable uses a 4-pin RJ11 connector at the ODU end, and a female 9-pin 'D' connector at the Craft Terminal end.



Pins 2, 3 and 5 are the only pins used on the 9-pin 'D' connector. The illustration below shows the RJ11 connector:



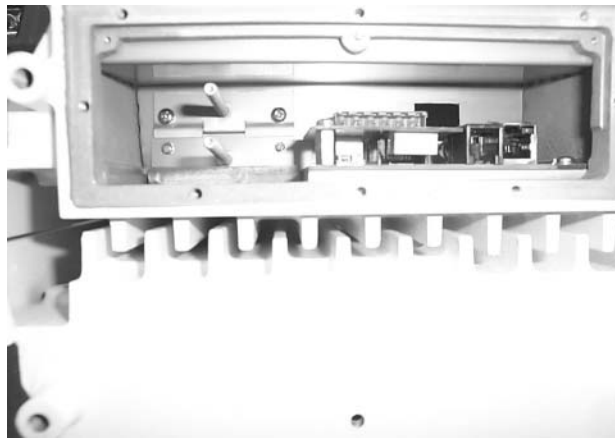
Appendix C - Upgrading an ODU

Multi mode fibre module

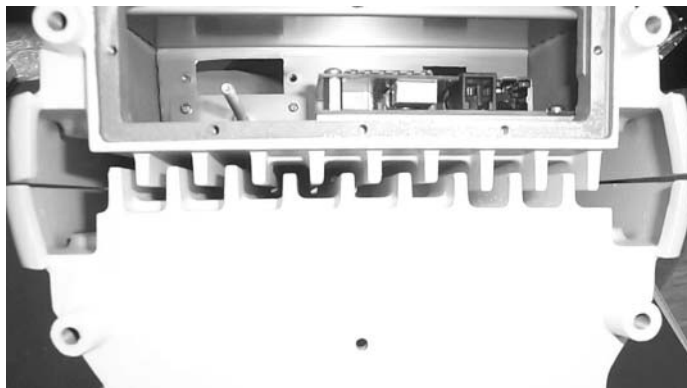
The standard ODU can be upgraded to higher volume capabilities by the installation of a multi mode fibre module.

To install this module, use the following procedure:

1. Ensure that your Network Operations Centre has taken the ODU out of service before you proceed. The Network Operations Centre should change the specification of the node on their Mesh Planning System.
2. Untighten the gland nuts, and remove the access plate from the underside of the ODU.
3. Power down the ODU, by unplugging the power lead. See the section titled *Commissioning the ODU* for details of the internal layout. Unplug the other connectors, so you can gain access to the internal area of the ODU. Inside the ODU, you will see two blanking plates with long metal handles (on the left of this picture):

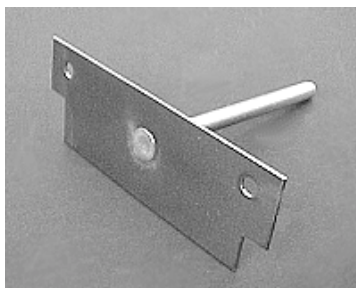


4. The blanking plate on top has the GPS unit attached to it. You must unscrew this unit and pull it out a short distance (it is attached internally with a cable, so it cannot be completely removed). This gives you access to the lower blanking plate.

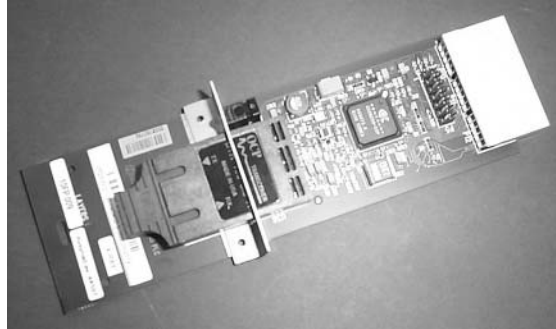


Take care! The screws and washers are small, and can be easily lost.

5. Unscrew and remove the lower blanking plate (shown in the following illustration). No circuitry is attached to this - it can be discarded or returned to Radiant Networks.



6. Open the upgrade kit, and inspect the contents. This should contain the multi mode fibre module, as shown in the following picture:

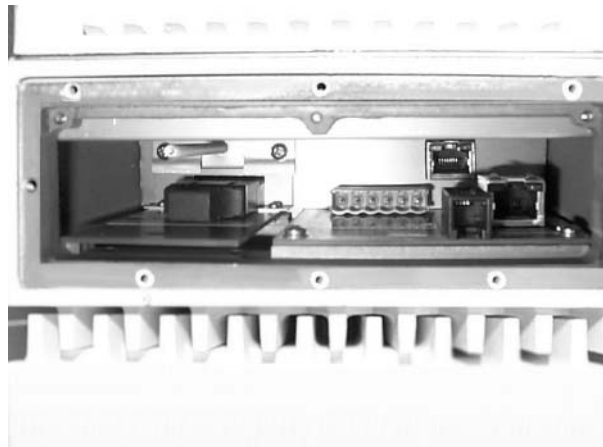


7. Insert the multi mode fibre module in the hole with the circuitry facing upwards, and gently push it home. The metal flange on the top of the module should fit neatly into the hole vacated by the blanking plate. Use the screws to secure the metal flange in place.



Risk of electrostatic discharge - handle the components with care. Take appropriate precautions.

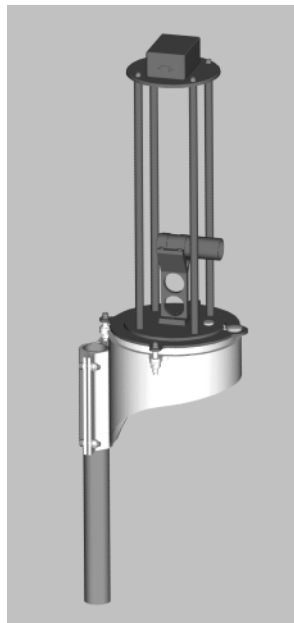
8. Replace the GPS module, and screw it in place. The finished installation is shown below:



- 9.** Remove the rubber bung from the optical ports on the fibre module. Plug in all the appropriate cables, and replace the power lead in its socket.
- 10.** Replace the access plate on the ODU, and secure it in place with screws. Tighten the gland nuts.
- 11.** Contact your Network Operations Centre to put the ODU back in service.

Appendix D - ODU direction finder

The ODU direction finder is a tool that you can use as part of the installation procedure of an ODU. This tool enables you to accurately line up each ODU relative to the others. The direction finder will only be used in circumstances where the Craft Terminal prompts you to use it. Under some circumstances, it may not be required (where a long link to a distant node makes finding the direction less convenient). In such a case, the ODU will search for the link itself.

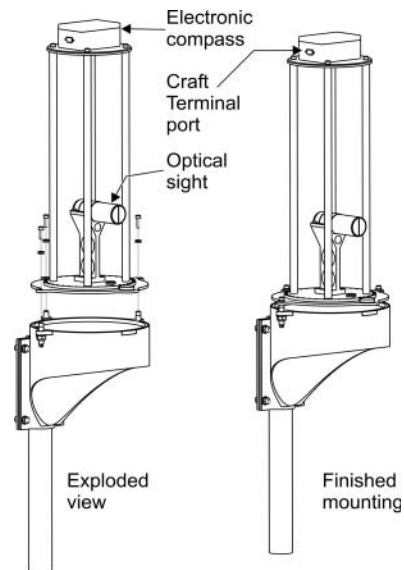


Each ODU direction finder contains both an optical sight and an electronic compass.

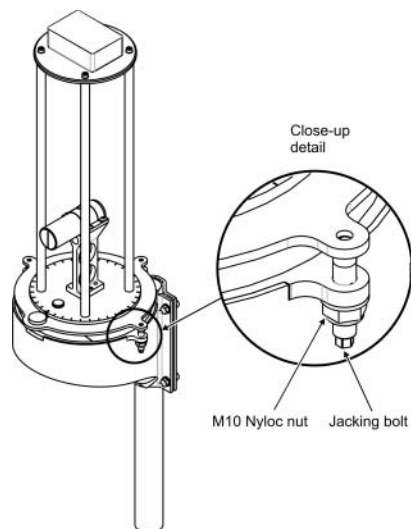
To align an ODU's mounting bracket to North, use the following procedure:

1. Install the mounting pole, and place the bracket on the pole.
2. Move the mounting bracket around on the pole, and partially tighten the bolts on the fastening plate. The fastening plate bolts have a nylon thread, and you will need to use an allen key and a spanner (or similar tools).

3. Attach the ODU direction finder to the mounting bracket, as shown in the following illustration:



4. Use the direction finder to adjust the two jacking bolts. When you've done this, lock the jacking bolts with M10 Nyloc nuts (see following illustration).



5. Secure the direction finder in place with M6 x 20mm socket cap head bolts and spherical seated washers.
6. Using the direction finder to indicate the amount of rotation, move the ODU mounting bracket around until it faces the ODU which is sending out a welcoming signal. The Craft Terminal will give you instructions on the use of the compass or optical sight.
7. Hold the mounting bracket in position, and firmly tighten up all the bolts.



You must take care not to overtighten these bolts - don't strip the thread!

8. Unscrew the M6 x 20mm socket cap head bolts and washers, and remove the ODU direction finder from the bracket.
9. You can continue to install the ODU, as described in the *ODU Installation* section of this manual.

Reference

Glossary of terms

Asynchronous Transfer Mode (ATM)

A broadband communications standard that provides a mechanism of transferring both constant and variable bit rate traffic over a switched network using fixed size packets called cells.

Broadband Wireless Access (BWA)

An access technology that allows a service provider to deliver high bandwidth content over the air to their customers. Typical definitions include radio technologies using spectrum from 2.1 GHz to 44 GHz.

Craft Terminal

A hand-held computer used for site installation and maintenance, that has a communications link to the Mesh Management System.

Electro-Static Discharge (ESD)

The rapid discharge of static electricity from one conductor to another of a different potential. An electrostatic discharge can damage integrated circuits found in computer and communications equipment.

Global Positioning System (GPS)

The GPS (Global Positioning System) is a constellation of 24 well-spaced satellites that orbit the Earth and make it possible for people with ground receivers to pinpoint their geographic location. The location accuracy is anywhere from 100 to 10 meters for most equipment.

GPS

Global Positioning System – used for positioning and for accurate timing.

GSM

GSM (Global System for Mobile communication) is a digital mobile telephone system that is widely used in Europe and other parts of the world. GSM digitises and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. It operates at either the 900 MHz or 1800 MHz frequency band. Since many GSM network operators have roaming agreements with foreign operators, users can often continue to use their mobile phones when they travel to other countries.

IDU

Indoor Unit.

Indoor Unit

This is the unit that provides the user service connection. It connects to an Outdoor Unit at a subscriber node. It is considered to be one edge of the Mesh, and so implements ‘edge-functions’ or ‘edge services’.

Internet Protocol (IP)

The Internet Protocol (IP) is a protocol by which data is sent from one computer to another on the Internet. Each computer (known as a host) on the Internet has at least one IP address that uniquely identifies it from all other computers on the Internet. When you send or receive data (for example, an email note or a web page), the message is divided into packets. IP by itself is something like the postal system. It allows you to address a package and drop it in the system, but there is no direct link between you and the recipient.

Line of Sight

A straight line between two points, normally the ends of links, that is not obstructed, such that one end can ‘see’ the other.

Link

A traffic-carrying RF connection established between two antennas.

Mesh

The interconnection of nodes to create a highly interconnected network, which is both logically and physically a mesh.

Node

The physical element providing Mesh connectivity that may be located at either a subscriber’s or an operator’s site.

ODU

Outdoor Unit.

Outdoor Unit

This is the code radio and switch node used in building the Mesh. The Mesh is actually a mesh of Outdoor Units. Outdoor Units are used in a variety of applications within the Mesh:

- ❖ As seed nodes.
- ❖ At TNCs.
- ❖ At MIPs.
- ❖ At subscriber nodes.

Seed Node

This is a node placed at an operator location which just relays traffic onwards to other nodes. It is not connected to a subscriber, and acts neither as a source nor a sink of traffic.

It may subsequently be converted to a subscriber node, if one is required at that location.

Seed nodes provide early network coverage, where there is not a high enough density of subscribers in a specific area.

Subscriber Node

The equipment at a subscriber's premises, which includes an ODU and an IDU.

TCP

Transmission Control Protocol.

Timeslot

The basic unit of time during which radio data transmissions occur between a pair of nodes. The network uses time division multiplexing based on the division of time into repeated frames, each of which is further divided into timeslots.

TNCP

Trunk Network Connection Point.

Trivial File Transfer Protocol (TFTP)

This is an Internet protocol for transferring files, and is simpler than the File Transfer Protocol (FTP) but less capable. It is used where user authentication and directory visibility are not required. TFTP uses the User Datagram Protocol (UDP) rather than the Transmission Control Protocol (TCP).

Trunk Network

A core broadband network, probably ATM based. Likely to be fibre or cable based.

Trunk Network Connection Point

The point at which traffic passes from a core (trunk) network into the Mesh.

Trunk Telephony

Telephony services delivered over a high capacity circuit from a telecommunications operator to a PBX or multiplexer.

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