MOTOMESH Duo 2.1
Network Setup and Installation Guide

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Chapter 1: System Overview

Motorola's MOTOMESH Duo is a high performance, 802.11 a/b/g meshed Wi-Fi solution designed to meet strict cost per square mile and ROI targets. MOTOMESH Duo is part of the MOTO wi4™ portfolio of broadband wireless access technologies, and delivers a new level of economic flexibility and investment protection to municipalities and service providers. MOTOMESH Duo leverages Motorola's field proven, MeshConnex™ routing engine and One Point Wireless Management™ system to meet the challenges of demanding multi-use networks. Its small size, minimal visual impact and low power consumption increases mounting location flexibility and enables rapid deployment. MOTOMESH Duo devices are available in three different radio configurations:

- 2.4 / 5.4 GHz (single mesh)
- 2.4 / 5.8 GHz (single mesh)
- 2.4 / 4.9 GHz (dual mesh)

MOTOMESH Duo devices can be deployed in a variety of meshing configurations depending on the radio configuration ordered:

- **2.4 GHz client access / 2.4 GHz meshing** – In this configuration the second radio is disabled and the 2.4 GHz radio is used for client access and for inter-nodal meshing.
- **2.4 GHz client access / 5.4 GHz meshing** – In this configuration the 2.4 GHz radio is used for client access and the 5.4 GHz radio is used for inter-nodal meshing.
- **2.4 GHz client access / 5.8 GHz meshing** – In this configuration the 2.4 GHz radio is used for client access and the 5.8 GHz radio is used for inter-nodal meshing.
- **2.4 GHz client access / 2.4 GHz meshing | 4.9 GHz client access / 4.9 GHz meshing** – In this configuration the 2.4 GHz radio is used for client access and inter-nodal meshing. The 4.9 GHz radio is also used for 4.9 GHz client access and inter-nodal meshing. This configuration is referred to as Dual Mesh.

NOTE

MOTOMESH Duo devices can also be ordered in AC and DC versions.

All MOTOMESH Duo 2.1 Infrastructure Devices require professional installation to ensure the installation is performed in accordance with Motorola installation standards and that regulatory requirements are met.

MOTOMESH Duo 2.1 Network Components

A MOTOMESH Duo 2.1 network is comprised of the following components.

- Intelligent Access Points (IAPs)
- Mesh Wireless Routers (MWRs)
- Supporting networking equipment

Intelligent Access Point

A MOTOMESH Duo device can function as an IAP (gateway) or an MWR. All MOTOMESH Duo devices ship from the factory as IAPs. If an IAP does not detect a wired connection it will convert to an MWR thus removing itself as a valid gateway to the wired network. This prevents routing holes from forming in the network. IAPs (functioning as MWRs) will still participate in the mesh and will forward traffic to an alternative IAPs (gateways). A node can also be specifically set as an IAP or an MWR using the One Point Wireless Manager™ application or the device webpage.

Intelligent Access Points:

- Support 802.11 a/b/g Wi-Fi client access.
- Support all 802.11 client security methods (open, WEP, WPA/WPA2 RADIUS, WPA/WPA2 PSK).
- Support 15 Virtual Access Points per radio for client access.
- Support Dynamic Route Selection via the MeshConnex™ routing engine.
- Support Automatic Load Balancing.
- Support 128bit AES encrypted Secure Mesh inter-nodal links.
- Are equipped with two Ethernet interfaces one of which can source standards based 802.3af Power over Ethernet (PoE) (to power an external IP enabled device such as a surveillance camera) or Canopy PoE to power Motorola Canopy subscriber modules.
- Offer fast and easy deployment via a pivot mounting bracket.
- Designed with a rugged NEMA 4 outdoor enclosure.

With the addition of each IAP additional network capacity is added.

Mesh Wireless Router

When a MOTOMESH Duo device operates as a Mesh Wireless Router (MWR), its primary function is to seed and extend the range between IAPs and wireless clients while simultaneously increasing the spectral efficiency of the network.

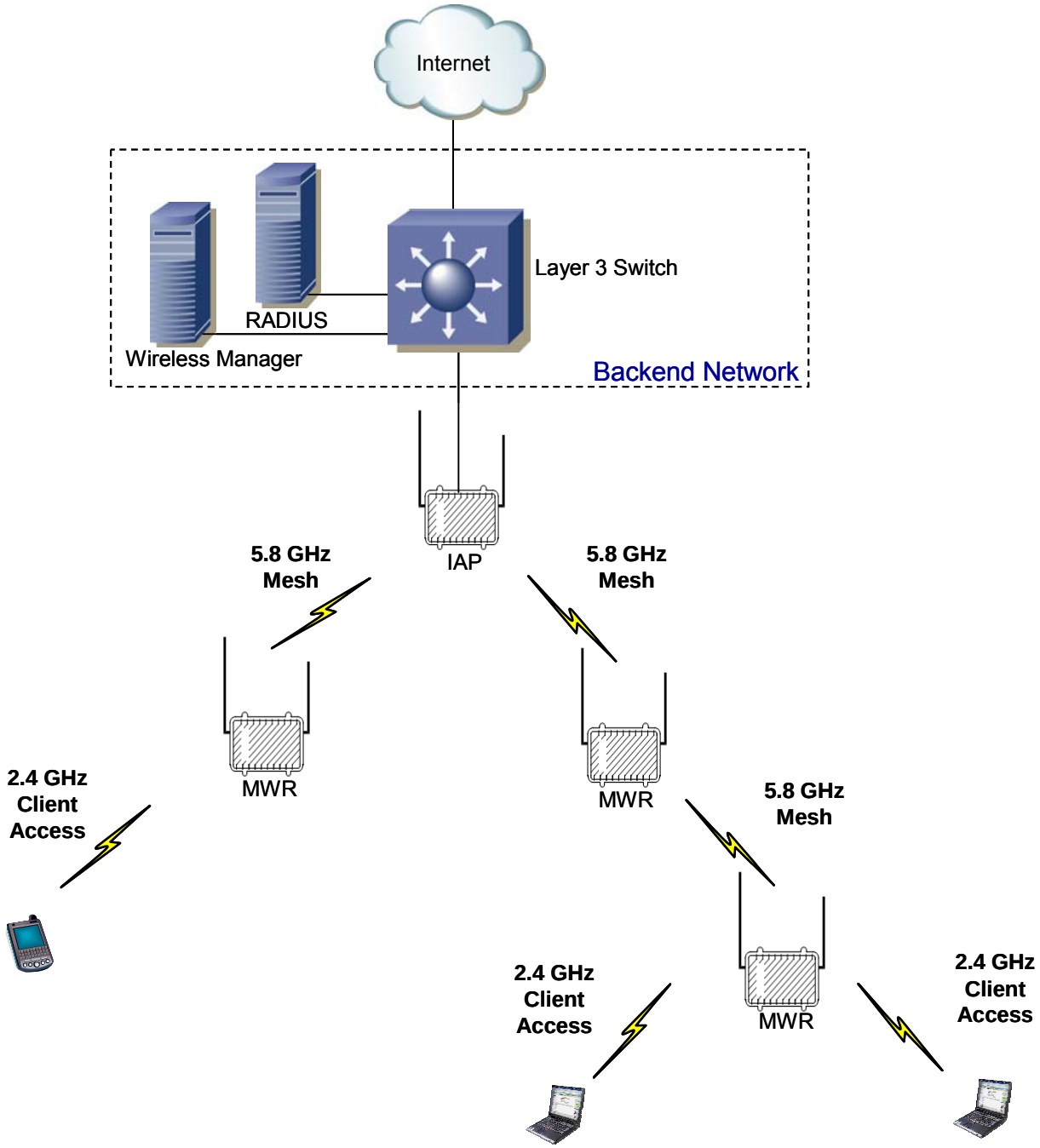
Mesh Wireless Routers:

- Range extension for all other network devices.
- Support 802.11 a/b/g Wi-Fi client access.
- Support all 802.11 client security methods (open, WEP, WPA/WPA2 RADIUS, WPA/WPA2 PSK).
- Support 15 Virtual Access Points per radio for client access.
- Support Dynamic Route Selection via the MeshConnex™ routing engine.
- Support Automatic Load Balancing.
- Support 128bit AES encrypted Secure Mesh inter-nodal links.
- Are equipped with two Ethernet interfaces one of which can source standards based 802.3af Power over Ethernet (PoE) to power external IP enabled devices such a surveillance camera. This allows a network of IP-enabled devices to be directly addressed, accessed and managed over the network.
- Offer fast and easy deployment via a pivot mounting bracket.
- Designed with a rugged NEMA 4 outdoor enclosure.

Supporting Networking Equipment

Additional networking infrastructure is required to support a MotoMesh Duo network. This includes an enterprise grade server to provide network services such as DHCP and DNS, as well as host the MotoMesh Duo management software (One Point Wireless Manager™. A RADIUS server may also be present. Switching and routing network equipment is also required. Our small system reference design utilizes a single Layer 3 switch which provides switching and routing within the same device.

Figure 1-1 2.4 / 5.8 GHz Mesh Network Example



Chapter

2

Chapter 2: Network Setup

Small System Reference Design

This section details a small system reference design. By understanding the small reference design one can apply these details to larger networks. A small system reference design is defined as a network in which the network servers and associated networking hardware are located at a central location. Wireless or wired bridging may be used to provide connectivity between the Intelligent Access Points and the switch / router backend.

Our small system reference design has the following attributes:

- Support for at least 20 IAPs (gateways).
- All IAPs and MWRs will utilize DHCP for network addressing.
- The Network will be configured and managed with the One Point Wireless Manager™ application residing on a RedHat ES 4 Linux server.
- A Windows 2003 RADIUS server will provide authentication for Secure Mesh.
- The standard small network design does not include server or network hardware redundancy.

Network Requirements

Network Servers

There are two network servers used in the small system reference design. The following is the recommended hardware configuration for these two servers. Variations from the recommended hardware configuration may result in inadequate system performance.

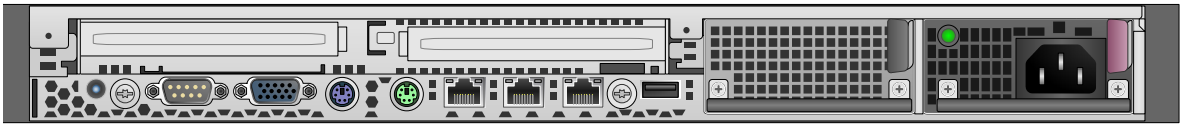
- Enterprise grade server (e.g. Hewlett-Packard ProLiant DL360-G5 3.00GHz Server)
- Minimum 2 GB of RAM
- (2) 36.4 GB 15K RPM SCSI Hard Disk Drives

- Monitor
- Keyboard
- Mouse

NOTE

These requirements are an approximate estimate intended to allow for maximum scalability while supporting rapid system response time. As a minimum, we recommend 2 GB of system memory and redundant hard drives with a hardware RAID controller of server quality.

Figure 2-1 HP DL360 G5 server



One Point Wireless Manager Server

- The One Point Wireless Manager™ server in our reference design server hosts the One Point Wireless Manager™ application. This application provides device configuration and network management. DHCP and DNS will also be configured on this server and are part of the Linux operating system.

RADIUS - (Optional)

- The Windows 2003 server is optional and is used to support EAP-TTLS Secure Mesh. Juniper's Steel Belted Radius application will be configured on the Windows 2003 server since it supports EAP-TTLS based authentication. The Windows 2003 Server also provides certificate services which will be used to generate certificates to support EAP-TTLS. Our RADIUS server could also be used for certificate based 802.11 client authentication and or store 802.11 client usernames and passwords. A RADIUS server for Secure Mesh is not required if PSK Secure Mesh is used instead.

EAP-TTLS Secure Mesh

The MotoMesh 2.1 architecture provides a set of features designed to help network operators secure the mesh network. These security features can help to protect the mesh network from intruders and attackers.

It is important to distinguish between the security provided by the MotoMesh architecture (Secure Mesh) and the security features provided for standard 802.11 clients (e.g. laptops, mobile Wi-Fi devices, etc.). Mesh Security applies between all of the mesh-enabled devices that form the mesh network. 802.11 client security (e.g. WEP, WPA-PSK, etc.) is completely independent of mesh security and is detailed in the WMS Administrator's Guide.

EAP-TTLS Secure Mesh uses Public Key Infrastructure (PKI) certificates to authenticate the network infrastructure, a RADIUS server, and a unique user ID and password to uniquely authenticate each mesh device. EAP mode supports MIC codes and encryption, where available. EAP mode supports centralized control of per-device authentication credentials by the RADIUS server, so a compromised device's credentials can be individually revoked without having to change keys on other devices. Session keys are automatically derived based on the EAP authentication and rolled periodically at a rate controlled by the RADIUS server. EAP mode is recommended for medium- or large-sized networks or any network that requires per-device authentication or centralized control over credentials. EAP mode requires the "R0 Key Holder" (R0KH) service. The R0 Key Holder service acts as a key cache, speeding up key generation for devices that already have a valid session key from the RADIUS server, similar to the R0 Key Holder defined for 802.11r. The R0KH service is included as part of the Linux environment setup.

Secure Mesh can also be configured to use PSK thus eliminating the RADIUS requirement. Please see the WMS Administrator's Guide for detailed steps.

Network Device Ethernet Interconnectivity

This section describes the Ethernet connectivity of the small system reference design. Please note the specific ports used as the software configuration of the equipment assumes the stated interconnectivity.

Figure 2-2 Ethernet connectivity between network servers and 3750 L3 Switch

Port 1	The One Point Wireless Manager server is connected to Port 1 of the L3 Switch.
Port 2	The RADIUS server is connected to Port 2 of the L3 switch.
Ports 3-4	Ports 3 and 4 on the L3 switch can be used to connect to other network devices e.g. gateway router
Ports 5-24	Ports 5-24 will be used for connections to IAPs.

IP Addressing Plan

Table 2-2 shows the network IP plan for our small system reference design. Four VLANs will be utilized in our network design (VLAN 1, 24, 31, and 49) each representing a different IP subnet:

- VLAN 1 (10.1.0.0/16 network)
- VLAN 24 (10.24.0.0/16 network)
- VLAN 31 (172.31.0.0/16 network)
- VLAN 49 (10.49.0.0/16 network)

These VLANs are configured in the Cisco Layer 3 switch. A detailed switch configuration is included in Appendix A.

Table 2-1 Core IP Network Plan

IP Address	Host
172.31.0.2/16	L3 Switch VLAN 31
10.1.0.1/16	L3 Switch VLAN 1
10.24.0.1/16	L3 Switch VLAN 24
10.49.0.1/16	L3 Switch VLAN 49
172.31.0.20	One Point Wireless Manager Server DNS server DHCP server TFTP Server
172.31.0.30 to 172.31.255.254	Reserved for other network services servers (VLAN 31)

The table 2-3 lists the address pools that will be configured to support our network. These address pools are configured on One Point Wireless™ Manager server. A Linux setup script is available from Motorola that will configure the Linux server with these defaults.

Table 2-2 Wireless VLAN /Subnet IP Network Plan

IP Address	Host
DHCP Pool 10.1.0.30 – 10.1.255.254	VLAN 1 (Native) VLAN 1 Address Pool / Untagged devices
DHCP Pool 10.24.0.30 – 10.24.255.254	VLAN 24 (IAP and MWR device addresses) VLAN 24 Address Pool

IP Address	Host
DHCP Pool 10.49.0.30 – 10.49.255.254	VLAN 49 (802.11 clients) VLAN 49 Address Pool

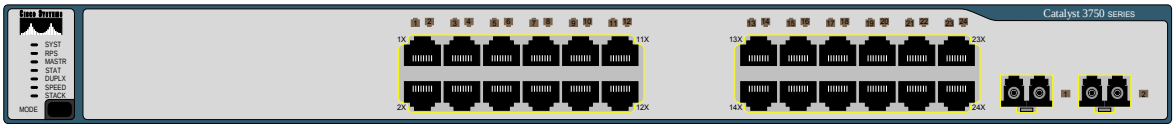
Layer 3 Switch

Overview

The standard small system reference design includes a Cisco 3750 L3 Switch which supports 20 Intelligent Access Points (IAPs). Four switch ports (ports 1-4) are also available for network servers such as the One Point Wireless Manager™ server and RADIUS. IAPs are connected to L3 switch (ports 5-24) via one of three methods:

- Direct Ethernet
- Connection via a wireless bridge (Motorola Canopy™ System)
- Connection via a wireline media converter (e.g. Ethernet over Fiber media converter)

Figure 2-3 Cisco 3750 L3



The Cisco 3750 router provides the following services:

- Routing between the wireless subnets 10.1.0.0 /16, 10.24.0.0/16, 10.49.0.0/16, and the server network 172.31.0.0/16 (e.g. inter VLAN routing between VLANs 1, 24, 31, and 49).
- DHCP relay from the wireless subnets to the DHCP server running on the One Point Wireless server 172.31.0.20.
- 802.1Q VLAN tag recognition enabling the support of a trunked set of VLANs terminating on a single physical interface

IP Directed Broadcasts

By default, the 3750 Switch drops IP directed broadcasts; thus preventing them from being forwarded. The One Point Wireless Manager™ application utilizes SNMP broadcasts for automatic network discovery. We have enabled IP directed broadcasts in the 3750 L3 switch

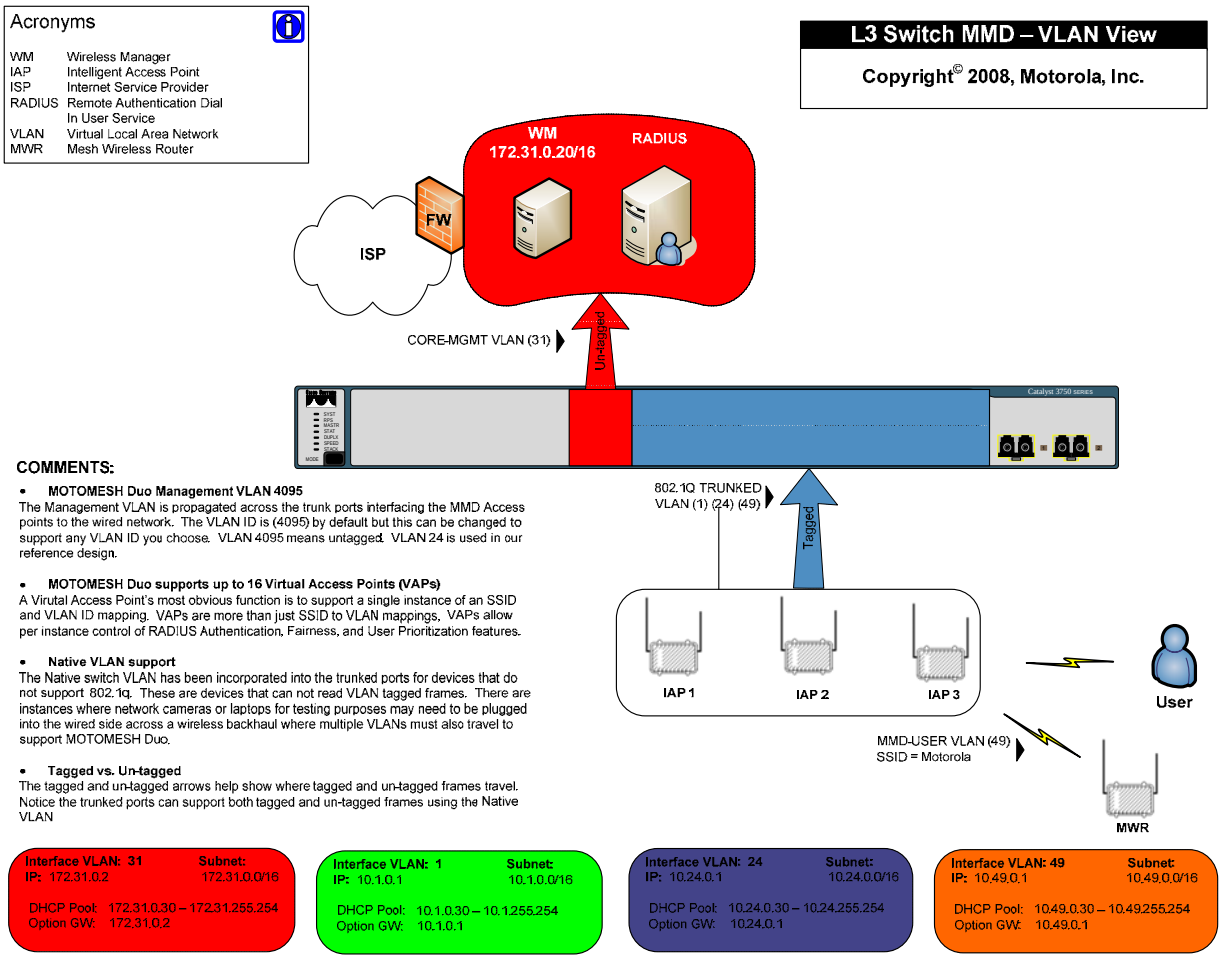
in order to prevent the switch from dropping these discovery packets. See Appendix A for detailed steps on how to configure the IP directed broadcast feature on the 3750 L3 switch.

VLAN Setup

The L3 network switch provides the ability to segment management and user traffic using a combination of VLAN tagging and firewall access control rules, see Figure 2-4. In the small system reference design the L3 switch has been configured with the following 4 VLANs each representing a different IP subnet per our IP plan:

- VLAN 31 is configured on Ports 1-4. Ports 1-4 are access ports only (non-tagged) and are used by network servers such as the One Point Wireless Manager™ server (172.31.0.20/16) and RADIUS. VLAN 31 has the address of 172.31.0.2/16. Note how the second octet of the IP address (31) is aligned with the VLAN number. This has been done to simplify the IP design.
- VLAN 1 is the native VLAN of the L3 switch by default. Ports 5-24 have been configured as trunked ports and have VLAN 1 in their allowed VLAN list. VLAN 1 has the IP address of 10.1.0.1/24. It has been configured to support non VLAN capable devices such as cameras and other IP devices. This VLAN is also configured with an IP helper address of 172.31.0.20 (The address of the Wireless One Point Manager™ server) to service any DHCP requests received on this VLAN.
- VLAN 24 is also included in the allowed VLAN list on ports 5-24. VLAN 24 has the address of 10.24.0.1/16. VLAN 24 has been configured to be used as a management VLAN. The management VLAN is used to communicate management data from the One Point Wireless Manager™ application to IAPs and MWRs. This VLAN is also configured with an IP helper address of 172.31.0.20 (The address of the Wireless One Point Manager™ server) to service any DHCP requests received on this VLAN.
- VLAN 49 is also included in the allowed VLAN list on ports 5-24. VLAN 49 has the address of 10.49.0.1/16. VLAN 49 has been configured to be used by wireless clients. As mentioned previously a MOTOMESH Duo device supports up to 15 Virtual Access Points (VAPs) per radio. Each VAP can be configured to have a unique VLAN. Thus, in this example, VLAN 49 has been created to support a client VAP. Note that this VLAN tag will be stripped off prior to data being sent to client devices (VLAN tag stripping is on by default on client VAPs). Traffic that originates from a client would be tagged with VLAN 49. This VLAN is also configured with an IP helper address of 172.31.0.20 (The address of the Wireless One Point Manager™ server) to service any DHCP requests received on this VLAN.

Figure 2-4 L3 Switch for MOTOMESH Duo 2.1 - VLAN View



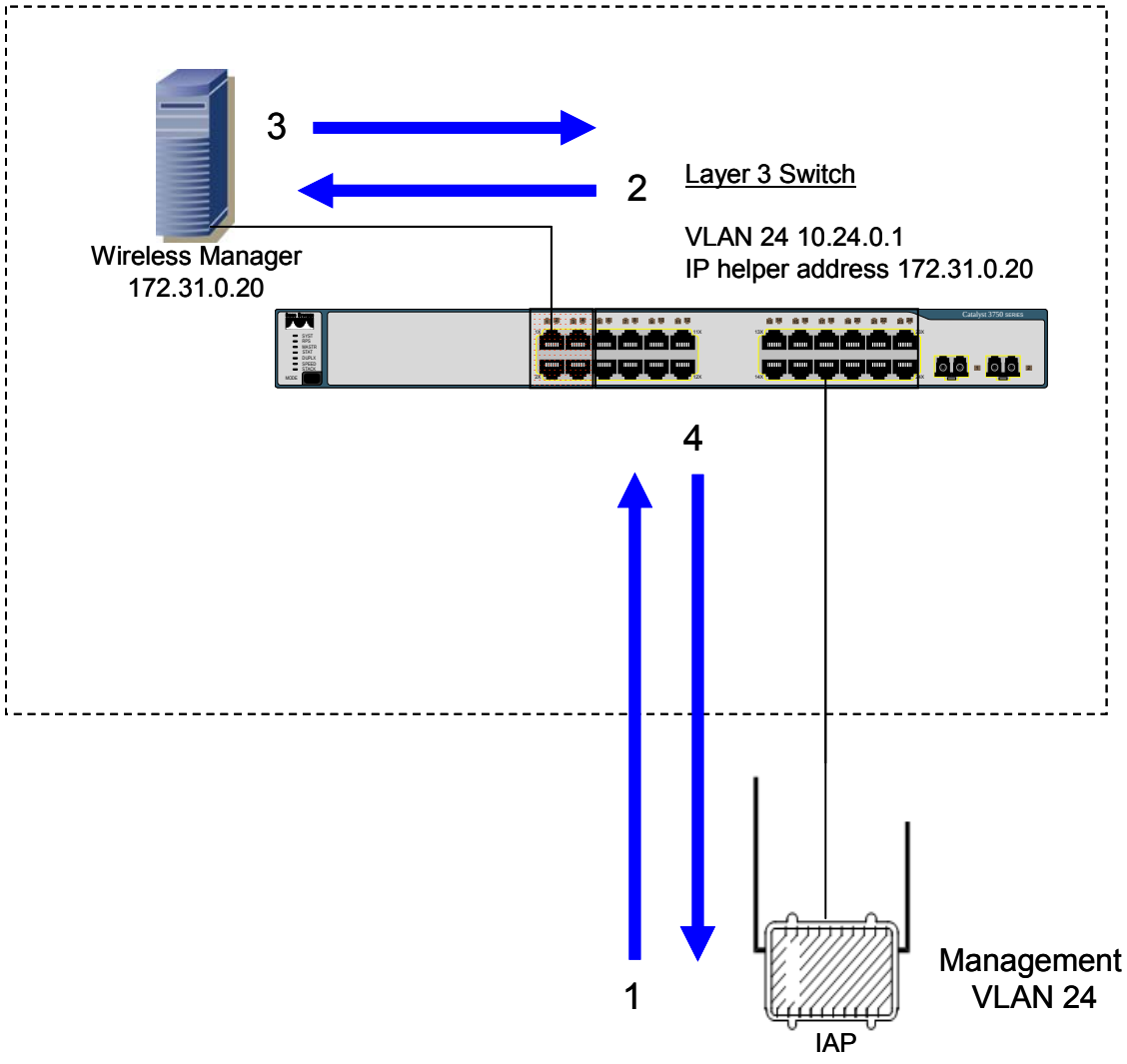
VLAN Examples

In order to better understand how VLANs are used in our small system reference design let's examine how traffic traverses these VLANs. In the example below the One Point Wireless Manager™ server is connected to port 1 and our IAP is connected to port 18. Management VLAN 24 has been configured on our IAP as well as DHCP. When the IAP is powered on it obtains an IP address in the follow steps:

1. The IAP requests an IP address via DHCP. This request is sent over VLAN 24.
2. The 3750 switch receives the DHCP request on Port 18 which is configured to accept packets on VLAN 24. VLAN 24 is configured on the L3 switch to forward DHCP requests to the One Point Wireless Manager™ server via the configured IP helper address 172.31.0.20. Since the One Point Wireless Manager server™ is connected to port 1, and ports 1-4 are a part of untagged VLAN 31, the tag is removed and the DHCP request is forwarded out port 1 to the One Point Wireless Manager™ server.

3. The DHCP server observes that the request originates from the 10.24.0.0/16 network. It answers this request with a 10.24.X.X/16 IP address. Please recall that this DHCP pool has been configured on the DHCP server running on the One Point Wireless Manager™ server.
4. The 3750 switch receives this reply and forwards it out back on VLAN 24 to the IAP.

Figure 2-5 VLAN Example 1

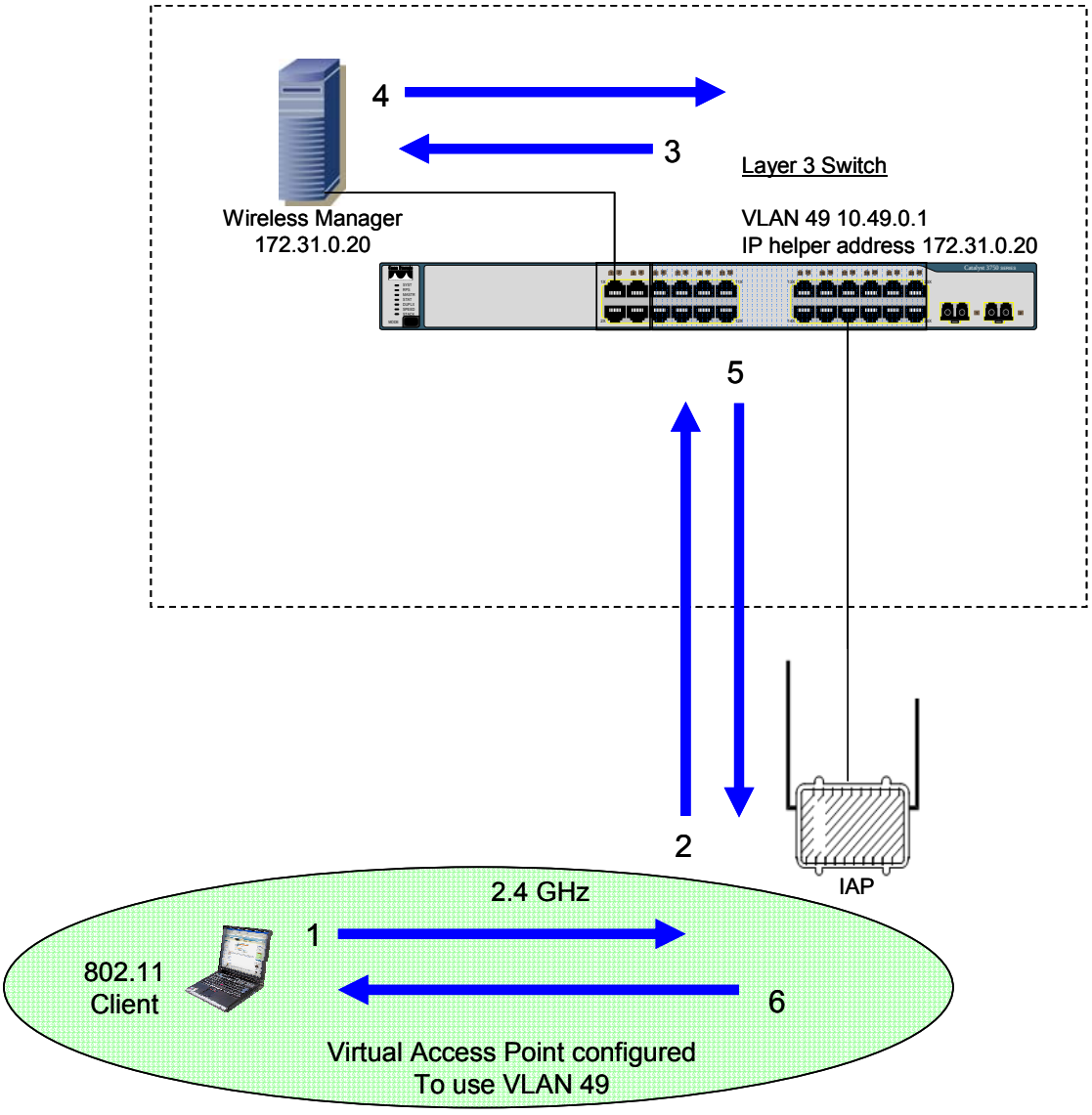


In the next example an 802.11 client has associated to a virtual access point on our IAP. The DHCP exchange is as follows:

1. The client sends a DHCP request.
2. The IAP tags this request with VLAN 49 and forwards it to the 3750 switch.
3. The 3750 switch receives the DHCP request on Port 18 which is also configured to accept packets on VLAN 49. VLAN 49 is configured on the switch to forward DHCP requests to the One Point Wireless Manager™ server via the configured IP helper address 172.31.0.20. Since the One Point Wireless Manager™ server is connected to port 1, and ports 1-4 are a part of untagged VLAN 31, the tag is removed and the DHCP request is forwarded out port 1 to the One Point Wireless Manager™ server.

4. The DHCP server observes that the request originates from the 10.49.0.0/16 network. It answers the request with a 10.49.X.X/16 IP address. Please recall that this DHCP pool has been configured on the DHCP server running on the One Point Wireless Manager™ server.
5. The 3750 switch receives this reply and forwards it out back on VLAN 49 to the IAP.
6. The IAP strips off the VLAN tagged and sends the reply to the client.

Figure 2-6 VLAN Example 2



MOTOMESH Duo Device Defaults

MOTOMESH Duo devices come from the factory with the following default settings:

- All devices are IAPs
- DHCP enabled
- VLAN support enabled
- Management configured as VLAN 4095. A management VLAN of 4095 means untagged. Thus when a MOTOMESH device requests an IP address for the first time the DHCP request will come in as untagged and will be serviced by VLAN 1. Thus the device will receive a 10.1.X.X/16 address (e.g. if the small system reference design defaults are used). The management VLAN can then be changed to another VLAN e.g. VLAN 24 used in the reference design. (The management VLAN would be changed to VLAN 24 and the device rebooted. The device would then get a 10.24.x.x address).
- Backhaul detection on – If a MOTOMESH Duo device does not detect a wired backhaul connection it will convert itself from an IAP to an MWR. The Backhaul detection feature is comprised of active ping and link layer detection. By default, the IAP will ping the gateway address received in the DHCP reply. If an IAP is statically configured then an IP address will need to be entered into the backhaul detection settings (in the One Point Wireless Manager™ application or via the webpage interface) for the Backhaul Detection feature to operate correctly. Improper configuration will lead to the IAPs configuring themselves to operate in degraded mode which is an IAP acting as an MWR.

If an IAP is addressed via DHCP, the gateway address received in the DHCP reply will be used as the logical address the IAP will ping for logical backhaul detection. If the IAP is statically configured a valid "pingable" IP address must be configured in the backhaul detection settings or the IAP will enter degraded status and operate as an MWR.

Preparing the One Point Wireless Manager Server

This section describes the procedure for the installation of Red Hat Enterprise Linux ES Version 4, Update 5 (retail box) in a configuration suitable for use with the One Point Wireless Manager™ application in our small system reference design. While other versions of Red Hat Linux or another Linux distribution may be suitable to use, discussion of support for other versions is outside the scope of this section.

If you choose another version of Red Hat Linux or an alternate distribution, the content of this manual should only be used as general guidelines for the installation process.

Minimum Software Requirements

The following table lists the software versions required to support the One Point Wireless Manager™ application on the Linux platform.

Table 2-3 Software Requirements for One Point Wireless Manager

Device	Software Revision
Red Hat Enterprise Linux ES	4.0 Update 5
Java Runtime Environment	1.6 or higher (included with Wireless Manager application)
MySQL	5.0.40 (included with Wireless Manager application)

Red Hat Linux Installation

Starting the Red Hat Enterprise Linux ES Installation

The MOTOMESH 2.0 One Point Wireless Manager™ application is designed to run on a 32-bit version of the Red Hat operating system. If supported by the BIOS settings, booting with the Red Hat Enterprise Linux ES CD inserted will initialize the installer. If this is not the case, you may have to configure your server BIOS to boot from removable media first. Refer to your server documentation for information on changing BIOS settings. The following section describes how to install RedHat Linux using our reference design defaults.

You must install the 32-bit version of the Red Hat OS.

Installation of Red Hat Enterprise Linux ES

Complete Procedure 2-1 to install the Red Hat Linux ES software.

Procedure 2-1 Red Hat Enterprise Linux ES Installation on HP DL360 G5 Server

1	Insert the first Red Hat Enterprise Linux ES install CD and reboot the server. The system should boot up to the following screen: **[F1-Main] [F2-Options] [F3-General] [F4-Kernel] [F5-Rescue]** **boot:**

2	A Press the **Enter** key to begin the installation in graphical mode. If no key is pressed, the system will auto launch in 60 seconds.  If you are installing from other than the retail boxed set, you may be prompted to perform a media check. While this step is time consuming, it ensures a successful installation.
3	The following prompt will appear: *To begin testing the CD media before installation press OK. Choose Skip to skip the media test and start the installation.* Choose **Skip**.
4	The **Welcome to Red Hat Enterprise Linux** screen will be displayed. Click on the **Next** button.
5	Select the appropriate **Language Selection** setting and click on the **Next** button.
6	Select the appropriate **Keyboard Configuration** setting and click on the **Next** button.
7	Select **Automatically Partition** and click on the **Next** button.
8	Select **Remove all partitions on this system**.  ***This setting will erase any and all existing operating systems and data.***
9	Use the default drive that is highlighted under **Select the drive(s) to use for this installation**. Make sure that **Review** is checked at the bottom of the page. This allows you to view and change the automatic partitioning results. Click on the **Next** button. Click **Yes** in the **Warning** dialog box that appears.
10	It is recommended that the user create a separate */var* partition for storing log files and databases. This ensures that the files to be created will not fill up all available space on the system partitions and will also help prevent fragmentation in the file system.
11	Click on the **New** button. A dialog box will pop up to create a new partition. Enter or verify the following parameters: **Mount Point**: /var **File System Type**: use the default setting **Allowable Drives**: use the default setting **Size (MB)**: 10000 **Additional Options**: Fixed Size
12	Click on the **OK** button. Check the partitions display to ensure that the new */var* partition was created. Click on the **Next** button.
13	The default **Boot Loader Configuration** will already be correct. Click on the **Next** button.

14	When the **Network Configuration** screen is displayed, click on the **Edit** button. Uncheck **Configure using DHCP**. Input the following; **IP Address**: 172.31.0.20 **Netmask**: 255.255.0.0 Click on the **OK** button.
15	Input the remaining network data. **Host Name**: WMS **Gateway**: 172.31.0.2 **Primary DNS**: 172.31.0.20 Click on the **Next** button.
16	It is suggested that you select the ***No Firewall*** option when the **Firewall Configuration** screen is displayed. Click on the **Next** button.  Selecting another option may impact the function of network services, including WMS. On the same page, make sure SE Linux is set to disable.
17	When the **Additional Language Support** screen is displayed, select any additional language options required. Click on the **Next** button.
18	When the **Time Zone Selection** screen is displayed, select the appropriate settings for your geographic location. Click on the **Next** button.
19	When the **Set Root Password** screen is displayed, input your root password. The reference design default is **g0ld11**. Input and confirm the password. Click on the **Next** button.
20	At the **Package Installation Defaults** screen, select *Customize the set of packages to be installed*. Click on the **Next** button.
21	You may now choose the packages to be installed. In addition to the defaults, you **must** choose the following to satisfy prerequisites for the One Point Wireless Manager™ application: - KDE Desktop Environment (To Make KDE your default Desktop Environment unselect "GNOME Desktop Environment" package, or it will be automatically selected) - Editors - Graphical interface – Only Firefox - DNS Name Server - Network Servers You may choose any desired packages as well as a preferred window manager at this time. Click on the **Next** button when you are satisfied with the package selection.
22	The installer is now ready to copy files to the server. Click on the **Next** button to continue. The installer will format and copy files to the hard drive. This process will take several minutes. You will be prompted for additional discs.
23	When the **Congratulations** screen is displayed, the Red Hat Enterprise Linux ES installation is complete. Remove any install media and click on the **Reboot** button.

24	The server should reboot and bring up the **Welcome** screen. Click on the **Next** button to continue.
25	Click on the **Yes** button to accept the **License Agreement** and then click on the **Next** button to continue.
26	Verify the correct date and time for your server and then click the **Next** button to continue.
24	When the **Monitor Configuration** screen is displayed, your monitor should be detected and selected by the installer. If your monitor type is not listed, choose a suitable setting from the **Generic CRT Display** category. Choose the desired color depth and resolution. A recommended minimum is at least 16-bit color and a 1024 X 768 resolution. Click on the **Next** button.
25	When the **Customize Graphics Configuration** screen is displayed, choose the desired color depth and resolution. A recommended minimum is at least 16-bit color and a 1024x768 resolution. Click on the **Next** button.
26	At the **Red Hat Network** screen, make your selection and click on the **Next** button to continue.
27	You can enter the Remote Support User Account at this time. **NOTE** It is highly recommended to add the **meshmgr** user for remote support capabilities. Use the information below to create this account. **Username**: meshmgr **Full Name**: Remote Support **Password**: g0ld10 **Confirm Password**: g0ld10 Click on the **Next** button to continue.
28	At the **Additional CDs** screen, click on the **Next** button if you have no other CDs to install at this time.
29	The **Finish Setup** screen will be displayed. Click on the **Next** button to continue.

IMPORTANT

For optimal screen viewing configure the video adapter display resolution to at least 1024 X 768.

*To prevent the **smartd alarm** from occurring during the server boot process you can execute "**chkconfig --level 345 smartd off**" at a command prompt.*

Running the DHCP and DNS Install Script

Prerequisites

All prerequisite conditions must be observed to ensure proper installation of the additional components required to support the One Point Wireless Manager™ application on a Linux platform.

1. You must be logged on as the *root user* under a KDE Session. At the *Welcome to WMS* screen, select *KDE* under the **>Session** menu at the bottom of the screen. Click the **OK** button to continue.
2. Enter the **Username**: ***root*** and press **Enter.**
3. Enter the Password: ***g0ld11*** and press Enter.

The following steps are required to install the Linux environment setup */opt/motoMeshDuo_setup* as a working directory. This script will set up DHCP and DNS as specified by the small system reference design. It will also install the r0kd daemon which is required if EAP-TTLS Secure Mesh is going to be used.

Procedure 2-2 DHCP and DNS Install Script

1	Insert the CD containing the Linux environment setup archive into the CDROM drive.
2	Right-click on the desktop and select *Open Terminal* to launch a new terminal shell. Execute the following commands: *mkdir /opt/MotoMeshDuo_setup* *cp -f /media/cdrom/Tools/motomesh_duo_linux_setup.tar.gz /opt/MotoMeshDuo _setup* *cd /opt/MotoMeshDuo _setup* *zcat motomesh_duo_linux_setup.tar.gz | tar xf -* *bash ./install*
3	Observe the following prompt: *Do you want to setup Networking? This will overwrite any existing network settings. [yes or no]* Enter **yes**.
4	Observe the following prompt: *Do you want to use this machine as a DHCP server?* Enter **yes**.
5	Observe the following prompt: Do you want to start the DHCPD service? Enter **yes**.

6	Observe the following prompt: *Do you want to use this machine as a DNS server?* Enter **yes**.
7	Observe the following prompt: *Do you want to continue with the installation of bind and associated files?* Enter **yes**.  If this prompt is not displayed, continue to Step 8.
8	Observe the following prompt: *The default DNS domain suffix to be used is* ***meshnetworks.net*** *Do you want to change this? [yes or no]* Enter **no.**
9	Observe the following prompt: *Do you want to start the DNS server?* Enter **yes**.
10	Observe the following prompt: *Do you want to configure this machine to run a TFTP server? [yes or no]* Enter **yes.**
11	Observe the following prompt: *Do you want to configure this machine to run a Time server? [yes or no].* Enter **No**.
12	Observe the following prompt: *Do you want to install the r0k daemon on this machine?* Enter **Yes**. When you enter yes, you will be asked for the location of the r0k config file. The r0k daemon is required when using EAP-TTLS Secure Mesh.
13	Observe the following prompt: *Starting installer for r0k daemon* *./r0kd_install.sh* Enter binary installation directory [/opt/r0kd]: Enter **/opt/MotoMeshDuo _setup/**. It will show the install locations, and then prompt for the install start.

14	Observe the following prompt: *Binary install directory: /opt/MotoMeshDuo _setup/* *Configuration install directory: /etc* *Ready to install. [Y/n]:* Enter **Y** to start the installation of the r0k daemon.
15	You may see the following prompt during the r0k daemon installation: *`/opt/MotoMeshDuo _setup/r0kd' -> `/opt/MotoMeshDuo _setup/r0kd'* *`/opt/MotoMeshDuo _setup/r0k.conf' -> `/etc/r0k.conf'* *r0kd will now be set to startup in runlevels 3-5.* *r0kd doesn't appear to be running, start it? [Y/n]:* If you see this, enter **N.** The daemon will be started later when EAP-TTLS Secure Mesh is configured.
16	Verify that the hardware IP address assignments are correct. It may take several minutes for the IP interfaces to come up after the install script completes. At the command prompt type: **[root@ WMS root]# ip addr** Several lines of text similar to the following will be displayed: **eth0: <BROADCAST,MULTICAST,UP> mtu 1500 qdisc pfifo_fast qlen 1000** **link/ether 00:0c:76:4e:5b:4e brd ff:ff:ff:ff:ff:ff** **inet 172.31.0.20/16 brd 172.31.255.255 scope global eth0**
17	Verify that an entry for WMS has been added to the */etc/hosts* file. Confirm that the remaining entries are correct. At the prompt, type the following: **[root@ WMS root]# cat /etc/hosts** Several lines of text similar to the following will be displayed: **127.0.0.1 localhost** **172.31.0.20 WMS WMS.meshnetworks.net**
18	Try to ping the hostname *WMS* by typing the following at the terminal window prompt: [root@WMS root]**# ping WMS** Several lines of text similar to the following will be displayed: **PING WMS (172.31.0.20) 56(84) bytes of data.** **64 bytes from WMS (172.31.0.20): icmp_seq=0 ttl=0 time=0.047 ms** **64 bytes from WMS (172.31.0.20): icmp_seq=2 ttl=0 time=0.040 ms**
19	Verify that you get a reply from WMS. Press **CTRL-C** to return to the terminal window. Keep the window open for the next step.

20	If the bind and DHCP services were started, it is important to verify that a second machine is able to receive an IP address. Configure a second machine to receive an IP address via DHCP from the MiSC.

Installing the One Point Wireless Manager™ Application

Now that the Linux operating system and DHCP/DNS scripts have been installed on our server, we can now install the One Point Wireless Manager™ Application.

For information about how to install this application, please refer to the WMS Setup and Installation Guide found on the provided product CDs. If you require information about upgrading an existing MOTOMESH Duo system, please refer to the MOTOMESH Duo 2.1 Field Upgrade Procedures documentation, also found on the provided product CDs.

Preparing the Windows 2003 Server and Juniper RADIUS

Installing Windows 2003 Server

As discussed in the section detailing the small system reference design a Windows 2003 server will be configured with RADIUS to support EAP-TTLS Secure Mesh. In this example we will be installing Windows 2003 Server on an HP DL360 G5 server.

The following installation procedure requires valid Windows 2003 R2 Second Edition media and license and the HP Smart Start CD from the HP ProLiant Essentials Foundation Pack.

Procedure 2-3 Windows 2003 Server Installation

1	Insert the **Windows 2003 Server Standard Edition CD** in the CD drive. Reboot the PC and the system should boot from the CD. If the systems does not boot from the CD, use system setup to alter the BIOS device boot order to boot from CD before the hard drive.
2	From the *Windows setup* screen, press **Enter** to start the installation. If an existing installation is detected, the installer will offer the opportunity to repair it. Follow the on-screen instructions to continue with a new installation..
3	At the next screen, press **F8** to agree to the software license.
4	The next screen lists the current disk setup. Use **D** to delete any existing partitions, follow the on-screen instructions to confirm the deletions.
5	The screen should show the entire disk as unpartitioned space. Press **C** to create a partition. The default is to use the entire disk. Press **Enter** to accept this.
6	At the *disk setup* screen, select the new partition and press **Enter** to start the installation process. Use **Enter** again to format the disk with an NTFS files system.

7	Once formatting is complete, the system will copy the installation files to the drive. Upon completion, the system will reboot. On reboot, do not press a key to boot from CD; just allow the system to boot into the Windows 2003 Server Setup to continue with the installation.
8	After a period of time, the *Regional and Language Options* dialog will appear. The default selection of **English (United States)** is correct. Select **Next**.
9	Enter a **Name** and **Organization**, then select **Next**.
10	Depending on the media used for install, the *Product Identification* screen may appear. If it does, enter the *25-digit key* and select **Next**.
11	Select **per Server** for licensing mode unless there is a specific requirement for different licensing according to the deployment. Select **Next**.
12	Enter a **Computer Name**: **radius**, and enter an administrator password **G0ld11** (Windows 2003 Server requires you to use a capital letter in the administrator password). Select **Next** and then select **Yes** at the dialog box to accept the password as is.
13	Set the correct Date and Time, and Time Zone. Select **Next**; the installation will continue.
14	After a period of time this system will reboot. Again, avoid pressing a key to boot from the CD. The system will boot to the login prompt. Login as administrator using the password previously defined.
15	Adjust any necessary settings, such as display size, etc, as needed.
16	Open **Control Panel | System** and select the **Computer Name** tab. Next select the **Change** option and then the **More** button. Set the primary DNS suffix to **meshnetworks.net**. Upon confirmation, the system will request a re-start. Select **Yes**.
17	When the reboot is done, the base Windows 2003 Server Installation is complete.

Driver Installation for HP DL360 G5 Server

Windows 2003 server does not recognize the HP GL360 G5's Ethernet adapter by default and drivers must be loaded. The server comes with a driver CD which can also be obtained online at HP's website.

Procedure 2-4 Ethernet Driver Installation for the HP DL360 G5 Server

1	Insert the HP Smart Start CD.
2	The License and Smart Start GUI will display. Accept the license.
3	Select **Start** menu.
4	Right mouse button, click on **My Computer** and select **Properties** popup menu option.
5	Select **Hardware** tab.
6	Select **Device Manager** button.
7	Select the **Other** devices group.
8	Right-click on one of the two **Ethernet Controllers** and select **Update Driver**.

9	Select the **Install software automatically** radio button from the **Hardware Update Wizard** and click **Next**
10	Be sure the hardware update wizard locates the **HP NC7782 Gigabit Server** driver on the **HP Smart Start CD** follow the wizard prompts to install the driver.
11	After the first driver is installed, repeat steps 8-10 to continue configuring the second Ethernet Controller.  The end result will be two configured network adapters. However, AFTER the Ethernet Controller drivers are configured, the next step is to configure a single LAN network connection (as described in the following steps).
12	Select **Start | Control Panel | Network Connection | Local Area Connection**
13	Select **Properties** button from *Local Area Connection Status* window
14	Highlight the **Internet Protocol (TCP/IP)** line and select **Properties**.
15	In the Internet Protocol (TCP/IP) Properties panel: 1. Select the **Use the following address** radio button 2. Enter an **IP address** of 172.31.0.21. 3. Enter a **Subnet mask** of 255.255.0.0 4. Enter a **Default gateway** of 172.31.0.2 5. Select the **Use the following DNS server** addresses radio button 6. Enter a **Preferred DNS server** address of 172.31.0.20 7. Click the **OK** button

Installing Windows 2003 Support Tools

The following procedure provides installation instructions for Windows 2003 Support Tools.

Procedure 2-5 Windows 2003 Support Tools Installation

16	Re-insert the Windows 2003 Server Installation media.
17	Be sure NOT to trigger a re-install or update of Windows 2003.
18	Select the **Perform Additional Tasks** option.
19	Select **Browse this CD**.
20	Enter the **\Support\Tools** folder.
21	Double-click on **SUPTOOLS.MSI** and follow all on-screen instructions.

Microsoft Certificate Authority Services

The following section details how to set up Windows 2003 Server to provide certificate services. Digital certificates are required in order to exchange and/or validate security credentials in support of **Secure Mesh**.

Procedure 2-6 describes how to install certificate services in a Microsoft Windows 2003 Server.

Procedure 2-6 Installing Certificate Services

1	Add the **Certificate Services** and the **IIS** windows component. Assuming that the permanent hostname and domain registration of the server selected to provide certificate services has already been set, perform the following steps to begin installation: • Open **Settings / Control Panel** and select **Add/Remove Programs**. • Open the **Add/Remove Windows Components** dialog window and add the **Certificate Services** and **Application Server** (IIS) components. Read the note about not being able to change hostname or domain registration and click Yes to confirm.
2	Create a stand-alone root CA. • Click **Next** until the “CA Type” dialog box appears. • Choose **Stand-alone root CA** and click on **Next**.
3	Enter CA information. Enter all of the requested identifying information for the CA. It is highly recommended, but not required, to complete all fields. The default five year certificate validity period specified at the bottom of the dialog is sufficient for most deployments. In our reference design we chose a common name of **radius**.
4	Complete the installation. The default settings are valid on all remaining dialog boxes, simply press **Next** to continue until you are prompted for the Service Pack 1 CD-ROM. Insert the Disk 1 of the Windows 2003 R2 installation media into the CD-ROM and click **OK**.

5	Verify correct installation of CA services. Once installation is complete: • Verify correct installation by opening the Certificates (Local Computer). Click Start | Run | and type MMC.exe. Press enter. • Browse to the certificate store by selecting: **Console / Add/Remove Snap-in / Add… / Certificates / Computer Account**. **Result**: The select PC dialog appears. • Select **Local Computer**. • Ensure that the new CA certificate is stored in the Trusted Root Certification Authorities / Certificates folder. You should see a trusted root certificate called **radius**. **Click on the personal folder and click on certificates. Delete the auto generated certificate called radius. We will re-create this later.**
6	Verify that the certificate services web interface is functional. Using another computer on the network, connect to the certificate server's certificate services interface at URL: **http://172.31.0.21/certsrv**.

Configuring Automatic Certificate Issuing

Procedure 2-7 describes how to configure whether or not an administrator needs to approve certificate requests (manual or automatic issuing).

Procedure 2-7 Configuring Automatic Certificate Issuing

1	Open the **Certification Authority** item by selecting **Control Panel / Administrative Tools**.
2	Right click on the name of your local root CA server in the tree view and select **Properties**.
3	Open the **Policy Module** tab and click the **Properties…** button.
4	Select the radio button labeled **Follow the settings in the certificate template, if applicable. Otherwise, automatically issue the certificate** from the **Request Handling** tab.
5	Restart the Certificate Services to have the changes take effect. • Selecting **Control Panel / Administrative Tools / Services**. • Select and restart the **Certificate Services** service.

Requesting a Server Certificate

The procedure to request a certificate for a network server creates a digital certificate for the RADIUS server to use for EAP-TTLS authentication.

A server certificate signed by our new CA as well as a copy of the trusted root certificate must be installed on the RADIUS server. Procedure 5-6 describes how to generate a server certificate. You must have administrator access on this computer to install the certificates in the local computer store (required).

Procedure 2-8 describes how to install certificates on the authentication server.

Procedure 2-8 Installing Certificates on the Authentication Server

1	Connect to the certificate server web site. From the RADIUS server computer, connect to the certificate server certificate services interface: e.g., **http://**172.31.0.21**/certsrv** If prompted, enter the authentication information of a domain user. You may also need to add this web site to your list of trusted sites if you are using a recent version of Internet Explorer.
3	Select **Request a certificate** from the task selection page.
4	Select **Advanced certificate request**.
5	Select **Create and submit a certificate request to this CA**.
6	Submit the certificate request. This involves filling in any identifying information requested and any other options you require. • Fill in all of the **Identifying Information** fields. The **Name** on the certificate should be that of this server since it will be the server running radius. Enter the name **radius** in the name field. Fill in the rest of the field e.g. email, company, etc. • In the dropdown box change the Intended Purpose field to **Server Authentication Certificate**. • Check the **Mark keys as exportable** and **Store certificate in the local computer certificate store** boxes. • Click **Submit**. **Result**: A confirmation dialog appears informing the user that the website is requesting a certificate on their behalf and if they truly wish to request this certificate now. • Click **Yes**.
8	Since we set up our certificate service to automatically issue certificates you will be immediately be presented with a certificate to install. Click on the certificate to install.
9	Verify the certificate installation. • Once installation is complete, verify correct installation by: • Open the **Certificates (Local Computer) MMC plugin: Start / Run / MMC.exe**. • Browse to the certificate store by selecting: **Console / Add/Remove Snap-in / Add… / Certificates / Computer Account**. **Result**: The select PC dialog appears. • Select **Local Computer**. • Ensure that the new server certificate is stored in the **Personal / Certificates** folder. If you do not find the CA certificate in the computer account / Local Computer certificate store as indicated, it may have been copied to the my user account / Current User certificate store instead.

Authentication Server Configuration

Juniper Steel-Belted RADIUS

This section describes how to configure Juniper Steel Belted Radius server in support of EAP-TTLS Secure Mesh. Any Radius server package can be used as long as it supports EAP-TTLS authentication.

The pre-requisites for the procedure in this section are:

- Windows 2003 server installation complete.
- Installation of our Certificate Authority (CA).
- Creation of a server certificate.
- Steel Belted Radius Enterprise Edition (available from Juniper.net). Download / purchase SBR installer and proceed to install the program by double clicking the installer. We download an evaluation copy of this example. Contact Juniper Networks to purchase a licensed copy.

After the installation SBR is complete we need to add our trusted root and server certificate to our Steel Belted Radius server.

Exporting Certificates

Procedure 2-9 describes how to export existing certificates and install them for use with Steel-Belted RADIUS.

Procedure 2-9 Exporting Certificates

With the installation of our certificate authority in the previous section and the creation of a server certificate we need to add these to Steel Belted Radius.

1	Find the server certificate installed on the authentication server. • Click Start | Run | and type MMC.exe. Press enter. • Browse to the certificate store by selecting: **Console / Add/Remove Snap-in / Add… / Certificates / Computer Account**. **Result**: The select PC dialog appears. • Select **Local Computer**. • Open the **Personal / Certificates** folder in its tree view. • A server certificate was created when we created our Certificate Authority. In our reference design this certificate will be named **radius**.

2	Export the authentication server certificate. • Right click the server certificate, • Choose All Tasks / Export. • Export the cert, including its private key, to a PFX file. You do not need to export all certificates in the path or to enable strong protection. You should not delete the private key if the export is successful. • Select a password used to encrypt and protect the certificate. In our reference design we used g0ld11. • Name the certificate **server** and save it to a folder on the server. It will save it as a .pfx file.
3	Find the valid CA certificate installed on the authentication server. • Run the local computer account **Certificates** MMC snap-in. • Open the **Trusted Root Certificate Authorities / Certificates** folder.
4	Export the CA certificate. • Right click the root CA certificate. • Choose **All Tasks / Export**. • If asked, do not export the private key. Export the root certificate to the **DER encoded binary X.509 (.CER)** format. Save and name the certificate **root** to a folder on the server.  **NOTE** The DER encoded trusted root certificates must have a .der extension but the Microsoft certificate export tool automatically appends a .CER extension to the exported file. You will have to manually rename the file to **root.der** after it has been exported.

Installing Certificates

Procedure 2-10 Installing Certificates

1	Open web browser and navigate to the Steel Belted Radius GUI: http://172.31.0.21:1812 Click the **Launch** button to start Steel Belted Radius

2	Proceed with logging into Steel Belted Radius using the credentials you created when installing the Windows 2003 server. For our reference design we used: username = Administrator password = G0ld11
3	In the dialog box click Permanently trust this server, Then click **Yes** to authenticate to this server
4	On the menu tree on the left expand the **Authentication Policies** Tree. Click on Trusted Root Certificates.
5	Click the **Add** button on top of the menu bar. Navigate to the folder where you exported the **root.der** certificate. Select the file and click open. You should see the root certificate loaded in the main window.
6	On the left tree click on the Certificate branch.
7	Click the Add button. Navigate where you exported the **server.pfx** certificate. Select the file and click **Open**.
8	You will be prompted for the password you configured when the certificate was exported. Type the password you configured when you exported the certificate (in our reference design we used g0ld11) and click **Open**.
9	You should see your server certificate loaded in the main window.

Configuring EAP Settings

We need to now tell Steel Belted Radius to use EAP-TTLS authentication.

Procedure 2-11 Configuring EAP Settings

1	On the menu tree on the left expand the **Authentication Policies** Tree. Click on EAP methods. Select EAP TTLS. Click Apply at the top of the menu bar.
2	Next click on the **Order of Methods** branch. Select EAP-TTLS on the left window pane and click the arrow in the center to move it to the right window pane.
3	Next using the up arrow on the right window pane move **EAP-TTLS** to the top of the list and move **Native User** to the second position.

4	Double click on **Native User**. Select **MS-CHAP-V2** in the left window pane. Click the right arrow in the center and move it to the right window pane. Click **OK**.
5	Click **Apply** on the menu bar at the top.

Configuring a Radius Client

Next we need to configure Steel Belted Radius to accept the r0kd daemon as a radius client. The r0kd daemon runs on the Wireless Manager server.

Procedure 2-12 Configuring A Radius Client

1	On the menu tree on the left click **RADIUS** clients.
2	Click on the **Add** button on the menu bar.
3	Click on the **Any Radius Client** checkbox.
4	Enter a **Radius Shared secret** in the shared secret text box (in our reference design we chose **mesh**)
5	Under the **Make or model** checkbox select **Standard Radius**
6	Click **OK**

Configure RADIUS User

Finally we need to configure the username and password that MOTOMESH Duo nodes will use when authenticating to the RADIUS server when running Secure Mesh. All MOTOMESH Duo devices share a single username and password.

Procedure 2-13 Configuring A Radius User

1	On the menu tree on the left expand the **Users** branch. Click on **Native**.
2	Enter in a **username** (in our reference design we used the username **user**)
3	Enter in a **password** (in our reference design we used the password **password**)
4	Click **OK**

We have now completed the Steel Belted Radius configuration required to support Secure Mesh. The remaining steps are covered in the WMS Administrator's Guide.

Trusted Root Certificate

EAP-TTLS Secure Mesh requires the root certificate be sent to each MOTOMESH Duo device. This process is covered in the WMS Administrator's Guide. The **root.der** certificate created on our Certificate Authority and loaded on our Steel Belted Radius Server needs to be copied to the One Point Wireless Manager™ server. The One Point Wireless Manager™ application will download this root certificate to the MOTOMESH Duo devices when Secure Mesh is configured.

Copy the **root.der** certificate to a folder on the One Point Wireless Management Server. Before EAP-TTLS Secure Mesh can use this certificate it must be converted to pem format. Open up a terminal window on the server, navigate to the folder where you copied the **root.der** certificate and type the following command at the command prompt:

Convert DER (.crt .cer .der) to PEM

openssl x509 –inform der –in **root.der** –out **root.pem**

Now the trusted root certified is in pem format and can be used by the One Point Wireless Manager™ application when Secure Mesh is configured.

Authenticator (R0KH) Configuration

EAP-TTLS Secure Mesh also requires the r0kd daemon to function (which was installed by the Linux environment script). Details on how this is configured are contained in the WMS Administrator's Guide. As part of our network setup we will elect to wait until EAP-TTLS Secure Mesh is configured in the One Point Wireless Manager™ application before we start the r0kd daemon. It is better to wait as the r0kd configuration file (which is located under /etc/r0k.conf) must be updated with values chosen during the Secure Mesh setup in the One Point Wireless Manager™ application.

If you are familiar with configuring EAP-TTLS Secure Mesh and know what values will be chosen in the One Point Wireless Manager™ application then you can edit the r0k.config file and launch the daemon.

The following variables in the configuration file (r0k.conf) have to be set correctly:

- auth_server_addr = <authentication server IP address> (In our reference design this is **172.31.0.21**)

- auth_server_shared_secret= <Radius server shared secret> - must match the shared secret configured in your RADIUS server. (In our reference design this is **mesh**)
- r0k_server_port=<R0k server port> - default 2121 (In our reference design this is kept as **2121**)
- r0k_client_port=<R0k client port> - default 4000 (In our reference design this is kept as **4000**)
- interface=<interface name> - default **eth0** (In our reference design this is kept as **eth0**) e.g., eth0, eth1…etc.
- r0k_md_id= <mobility domain ID in ASCII - 6 bytes> IMPORTANT - must be the ASCII translation of the HEX entered in the One Point Manager™ application. (For example if 123456 was entered in the WM application you must enter **313233343536**)
- r0k_id= <R0 key holder ID in ASCII - 16 bytes> IMPORTANT - must be the ASCII translation of the HEX entered in the One Point Manager™ application. (For example if 1122334455667788 was entered in the WM application you must enter **31313223333334343535363637373838**)

To run the r0kd daemon first navigate to the directory which was chosen when the Linux environment script was executed. (In our reference design the r0kd daemon was installed in /opt/r0kd/.

To run the r0kd daemon as a background processes type the following at the command prompt:

/opt/r0kd/r0kd -B /etc/r0k.conf

Chapter

3

Chapter 3: MOTOMESH Duo Hardware

MOTOMESH Duo Enclosure

MOTOMESH Duo devices are considered fixed **Infrastructure Devices** that have the following attributes:

- Enclosure dimensions are 8.22” x 5.11” x 2.5” inches.
- -30° to +60° Celsius operational temperature range.
- Humidity tolerance from 0 to 100% non-condensing.
- AC versions have an input voltage range of 90-264 VAC, 47-63 Hz single phase power
- DC versions have an input voltage range of 10-18 VDC.
- Weight approximately 5 lbs.
- Cast aluminum weatherproof enclosure – NEMA 4.

Enclosure Side 1

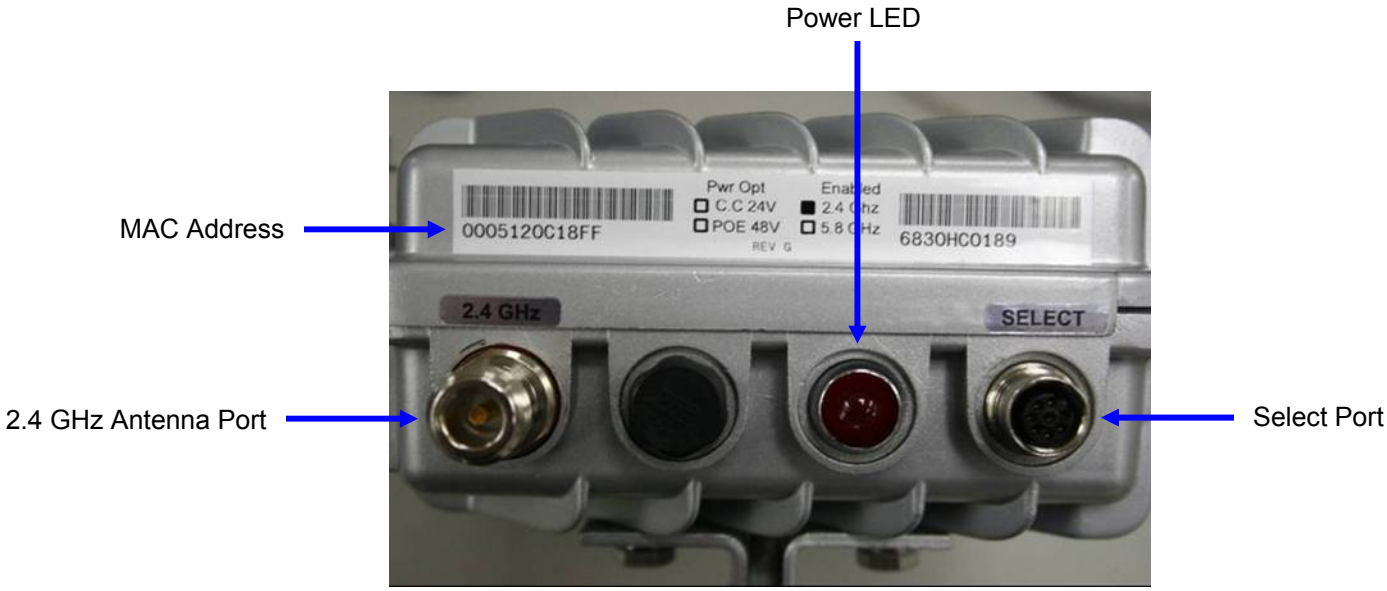
Figure 3-1 details the following ports and connections:

- **Device MAC Address** (Ethernet MAC address)
- **Power LED** (This LED indicates device power only)
- **2.4 GHz Antenna Port** (Female N-Type connector)
- **Vent** (Pressure)
- **Select Port** (When a personality plug is attached standard power over Ethernet (802.3af PoE) or Canopy Connect (PoE) is sourced on the POE OPT Ethernet port (See side 2).

CAUTION

If a personality plug is attached to the select port DC power will be supplied on pins 4, 5 and 7, 8 of the PoE OPT Ethernet port. **[Do not attach a non capable PoE device to this port when using a personality plug as the device could be damaged]**.

Figure 3-1 Enclosure Side 1



Enclosure Side 2

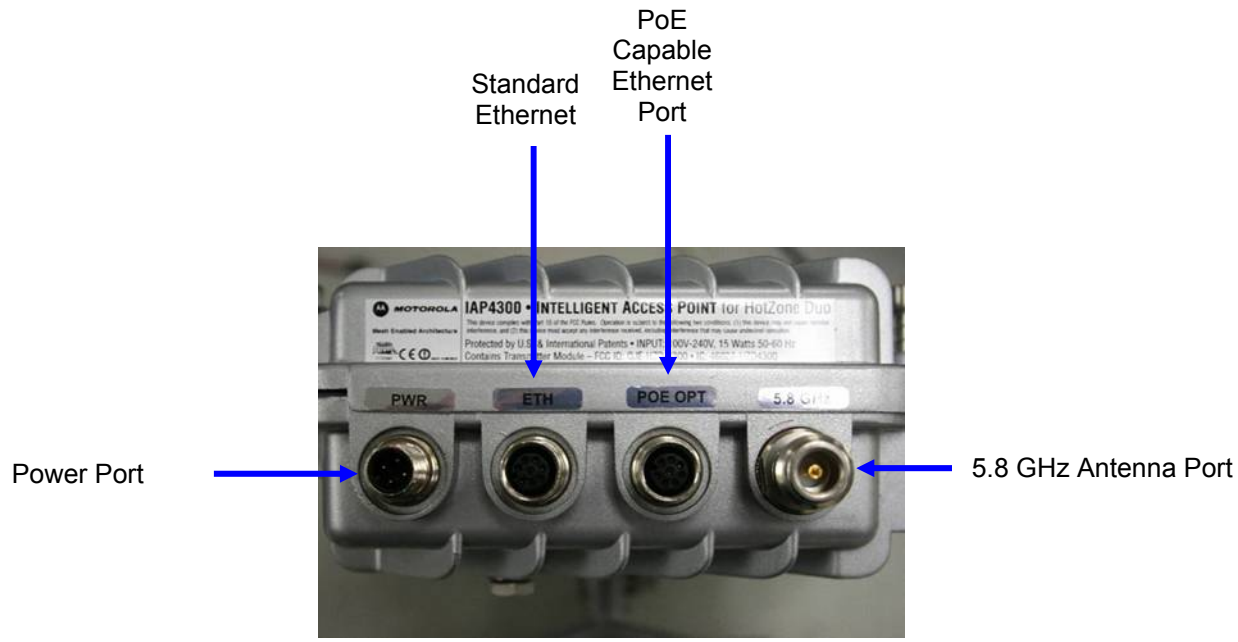
Figure 3-2 details the following ports and connections:

- **PWR** (power port)
- **5.8 GHz Antenna Port** (Female N-Type connector)
- **ETH** (Standard Ethernet port. This port is not capable of sourcing power. This port can be used to connect IP enabled devices that do not require PoE.)
- **POE OPT** (This port is capable of sourcing power over Ethernet (802.3af PoE) or Canopy Connect (PoE) when a personality plug is attached to the Select port.)

IMPORTANT

The POE OPT port is by default the “backhaul port” when a MOTOMESH Duo device is operating as an IAP. The backhaul detection mechanism is configured to look for a physical and logical connection on this port. This detection mechanism can be configured via the webpage or One Point Wireless Manager™ application to use the standard ETH port if desired. Thus, when deploying IAPs the POE OPT port should be used by default to connect to the switch / router supporting network. Note that in this configuration a personality plug will NOT be connected to the Select port and NO power will be sourced on the POE OPT port. If the IAP is being backhauled by a wireless bridge such as a Motorola Canopy™ system then a personality plug may be connected to the Select port and source power on the POE OPT port to power the Canopy backhaul radio.

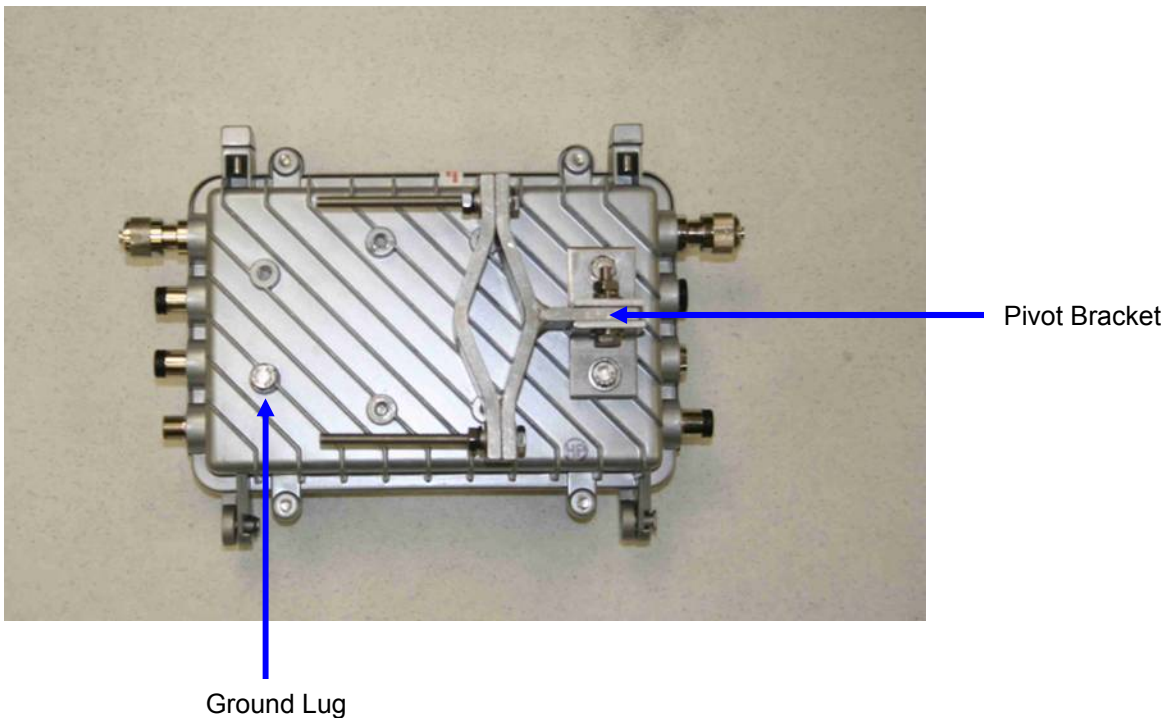
Figure 3-2 Enclosure Side 2



Mounting Bracket

The MOTOMESH Duo device includes a flexible pivot mounting bracket. This bracket can be moved to four different locations on the Duo device to accommodate different mounting scenarios. A 7/16” wrench is required to disassemble and tighten the mounting bracket nuts and bolts. It is also used to adjust the pivot function of the bracket. Also note that one of the bracket screw holes contains a ground lug.

Figure 3-3 Pivot Bracket



Personality Plug

There are three available color coded personality plugs that can be attached to the select port.

- **Canopy Connect Part # 363344B01 (Black)** – If a black plug is attached to the Select port Motorola Canopy based PoE to power Canopy Subscriber Modules will be sourced on the POE OPT port.
- **Standard PoE Part # 286335B01 (White)** - If a white plug is attached to the Select port 802.3af standards based PoE will be sourced on the POE OPT port.
- **Reset Part # 3863343B01 (Red)** – If a red plug is attached to the Select port the MOTOMESH Duo device will be reset to factory defaults.

Figure 3-4 Select Port

Standard / Canopy Connect PoE Plug Usage Information

Procedure 3-1 Personality Plug Usage Information

1	With the MOTOMESH Duo device powered off, connect an external PoE device to the POE OPT port with the Ethernet cable provided.
2	Connect the Canopy Connect or Standards based 802.3af PoE Personality Plug to the Select Port (shown above) AFTER the Ethernet cable has been connected to the desired external device.
3	Apply power to the MOTOMESH Duo device.

Reset Plug Usage Information

An optional Red Hardware Reset Plug is used to reset a MOTOMESH Duo device back to its factory default configuration. See procedure below.

Procedure 3-2 Reset Plug Usage Information

1	Power off the MOTOMESH Duo device.
2	Connect the Reset Plug to the Select port.
3	The Hardware Reset Plug must be inserted for more than 4 seconds, and then removed.
4	Power cycle the MOTOMESH Duo device.

Connecting Power

MOTOMESH Duo devices can be ordered as AC or DC current devices.

- AC Input requirements – 90 to 264 VAC
- DC Input Requirements – 10 to 18 VDC

Before power is attached to a MOTOMESH Duo device make sure that the electrical circuit your are connecting to is not energized. Verify that power has been removed from the correct circuit by using a voltage meter.

If the MOTOMESH Duo device is being installed on a pole or structure that is not properly grounded an external grounding wire must be attached via the ground lug on the MOTOMESH Duo device. This ground wire must be attached to a bonded pipe or ground rod.

Grounding Considerations

In order for a grounding system to be effective, a low impedance path to earth ground must be present. The grounding system must have conductors of sufficient size to withstand the high fault currents that must be shunted along this path. The lower the impedance the grounding system displays, the better its capability to perform its task. The impedance requirement for a communications site is determined by the classification of the site. Sites are broken down into 2 categories: Type A-Light Duty and Type B-Light Industrial/Commercial. Type A-Light Duty sites have impedance requirements of 25 ohms or less to ground whereas Type B- Light Industrial/Commercial sites have impedance requirements of less than 5 ohms to ground. MOTOMESH networks fall into the Type B-Light Industrial/Commercial category, and therefore must be treated with greater considerations as far as grounding requirements are concerned.

Since Type B grounding requirements stipulate 5 ohms or less impedance to earth ground, things such as soil pH, type of grounding rods, size of conductors, and ground enhancing materials must be taken into account to achieve this goal. To verify the impedance requirements are met, a special Earth/Ground Resistance Tester (megohmmeter) may be necessary.

- If the MOTOMESH Duo Device is attached to a light arm and the attachment point meets the Type B grounding requirements, then the grounding stud attachment point is not required to be used.

WARNING

To avoid damage to the equipment, adequate grounding for all MOTOMESH Duo devices is mandatory.

Flying Lead Power Cable

A 12 foot “flying lead” cable is available for AC and DC devices. Different power plug options are available to support different country requirements. See Appendix A for detailed information on wiring.

Wiring detail for US AC installations (AC Flying Lead Cable Part # 3071331H01):

White wire	**Neutral**
Black Wire	**Line**
Green	**Earth Ground**
Red	**Not Used**

Figure 3-5 12ft AC Flying Lead Cable (3071331H01)

Figure 3-6 US Power Plug (5871322H01)

IMPORTANT

Wiring detail for DC installations (DC Flying Lead Cable Part # 30633557B01)

Red Wire	**Positive**
Black Wire	**Negative**
Green	**Ground**

Power Tap Adapter

For power connections to a street light with photoelectric controls a 12 ft power tap adapter is available. Prior to the installation of a power tap adapter it must be verified that the power sourced from the pole is between 90-264 VAC.

WARNING

Do not use a power tap adapter on 480 VAC poles.

Figure 3-7 FP283 Series Power Tap Adapter (5871325H01)

Power Consumption

The power consumption of a MOTOMESH Duo device is dependent on the radio configuration (single vs. dual radio operation) and whether or not PoE is being used.

- 1 radio no PoE = 7.5W
- 1 radio with PoE Canopy = 15W
- 1 radio with PoE Standard = 22.5 W
- 2 radio no PoE = 15 W
- 2 radio with Canopy PoE = 22.5 W
- 2 radio with Standard PoE = 30 W

Ethernet Adapter Cable

To connect an Ethernet cable to a MOTOMESH Duo device the 1ft Ethernet cable is required. This cable provides a standard RJ-45 port.

Figure 3-8 1ft Ethernet adapter cable (3063338B01)

Antenna

Optional Antennas

The antennas listed below are recommended for use.

Table 3-1 Approved MOTOMESH Duo Antennas

Motorola Part No.	Antenna Type
8571327H01	2.4 GHZ OMNI ANTENNA 8 DBI
RAN4054A	2.4 GHZ DOWNTILT ANTENNA 8DBI
8563328B02	2.4GHZ LOW POWER OMNI ANTENNA 6DBI
8563328B03	2.4GHZ LOW POWER OMNI ANTENNA 4DBI
8563339B01	5.8GHZ LOW POWER OMNI ANTENNA 6DBI
8571328H01	5.8 GHZ OMNI ANTENNA 10 DBI
RAN4019A	4.9GHZ OMNI ANTENNA 11DBI
RAN4044A	5.4GHZ OMNI ANTENNA 10DBI

Antenna Support Brackets

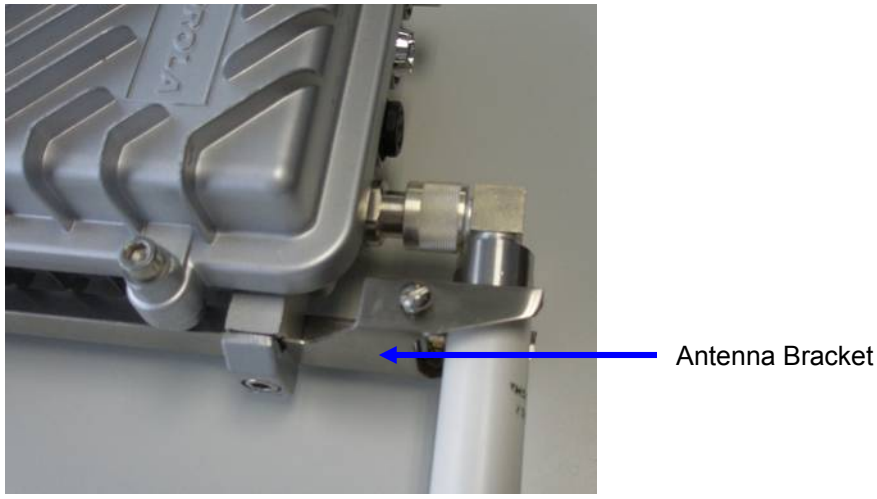
Currently there are two optional brackets. See the list in the table below.

Table 3-2 MOTOMESH Duo Antenna Brackets

Motorola Part No.	Antenna Bracket
0763325A01	ANTENNA SUPPORT BRACKET
0163303A10	CANOPY BRACKET ASSEMBLY

An optional support bracket, Motorola Part Number 0763325A01) can be ordered to stabilize the antennas when a network device is mounted horizontally.

Figure 3-9 Optional Antenna Support Bracket (Part # 0763325A01)



BandPass Filter

The BandPass filter should be used when using a MOTOMESH DUO device together with a Motorola Canopy backhaul radio while operating in the 5.2, 5.4, or 5.8GHz range.

The specific 5.2, 5.4, or 5.8 BandPass filter attaches to the applicable 4.9, 5.4, and 5.8 antenna socket, positioned between the unit and the antenna.

Figure 3-10 BandPass Filter (Part # 9163340B01)

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Chapter

4

Chapter 4: Site Selection and Deployment Guidelines

This chapter will provide information on how to assemble a MOTOMESH Duo device as well as general guidelines to be observed when evaluating a potential deployment location.

Preparation

MOTOMESH Duo devices must be installed by trained professionals familiar with RF planning and regulatory limits defined by the country of installation. All common precautions for grounding and ESD (Electrostatic Discharge) protection should be observed during deployment and installation. MOTOMESH Duo devices are designed to be installed outdoors and must be installed such that no harmful interference results from device operation.

IMPORTANT

All device wiring must follow the National Electric Code (NEC) or wiring requirements in the country of installation. All location building and structure codes must be observed.

WARNING

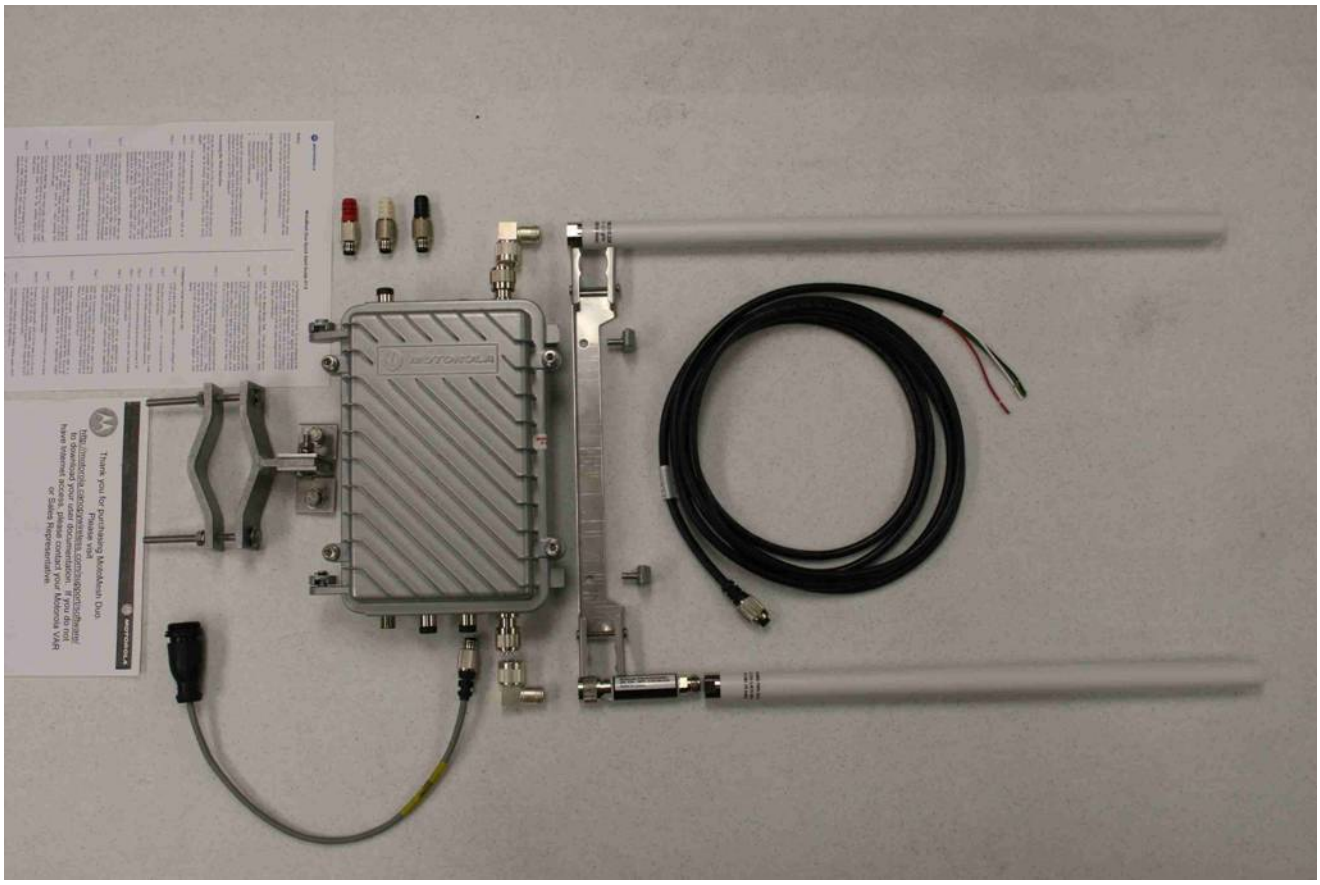
During installation safety precautions must be taken to avoid:

- **Exposure to high voltage sources**
- **Antenna contact with overhead power lines**
- **Falling tools and or equipment**
- **Vehicular traffic in and around mounting locations**

Hardware and Tools

Figure 4-1 details MOTOMESH Duo device and accessories.

Figure 4-1 MOTOMESH Duo device with accessories



Included hardware:

- (1) Pivot packet
- (1) antenna bracket
- (2) right angle antenna connectors
- (2) 7mm hex bolts to secure antenna bracket

The following tools will be required:

- 7/16 wrench
- Adjustable wrench
- 7 mm allen wrench

- Phillips head screwdriver
- Level
- Weatherproofing tape
- Electrical tape

Figure 4-2 Required Tools

WARNING

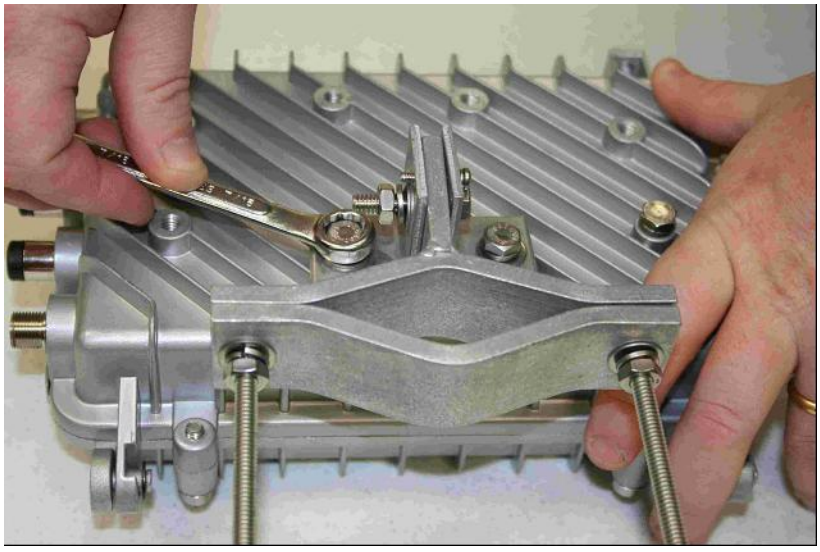
Opening the MOTOMESH Duo device will void the warranty.

Device Assembly

Procedure 4-1 Device assembly

Using the 7/16” wrench position the mounting bracket. There are four possible positions. Figure 4-3 shows the recommended bracket position for mounting the device such that both antennas are facing upward. This is the recommended configuration.

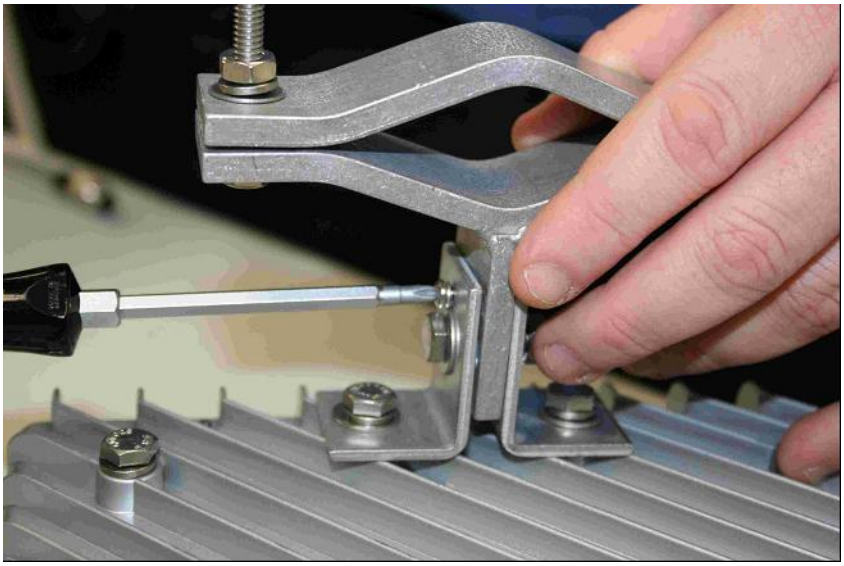
Figure 4-3 Attaching the mounting bracket



Loosen the pivot screw so the bracket is free to rotate.

Figure 4-4 Loosing the pivot screw

=

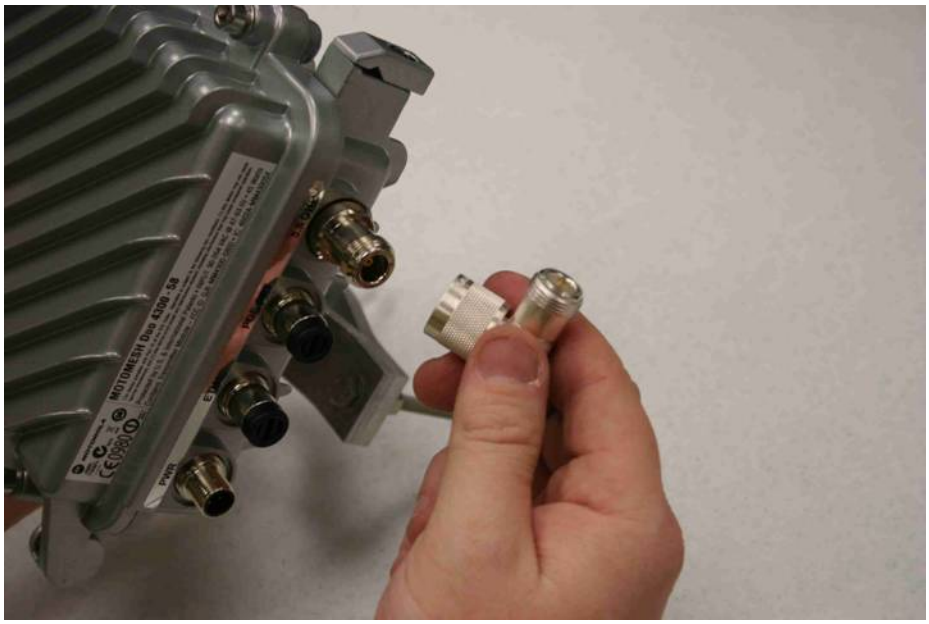


Remove both antenna caps.

Figure 4-5 Remove the antenna caps

Attach the right angle antenna connectors.

Figure 4-6 Attaching the right angle antenna connectors

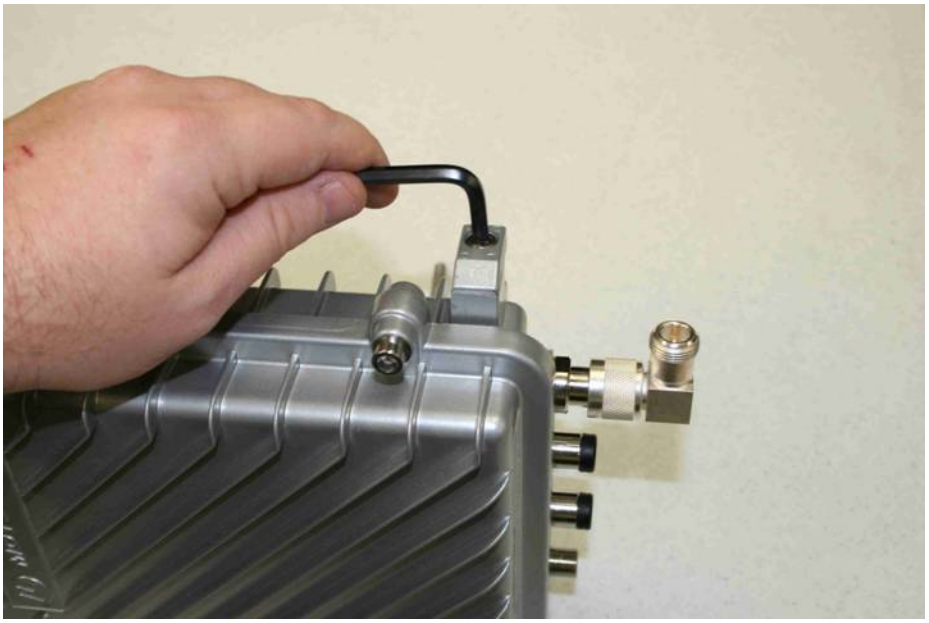


Your MOTOMESH Duo device should now look like this.

Figure 4-7 MOTOMESH Duo device with right angle antenna connectors installed

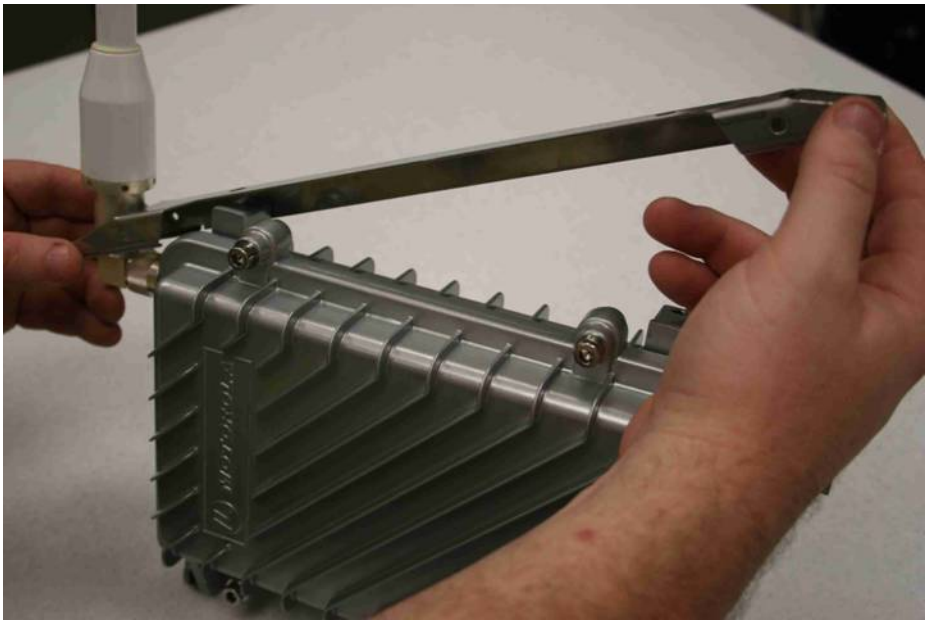
Remove the bracket clamp with the 7mm wrench.

Figure 4-8 Removing the bracket clamp



If using the 2.4 GHz down tilt antenna (which has a larger base) angle the bracket to fit around the base of the antenna.

Figure 4-9 Attaching the bracket

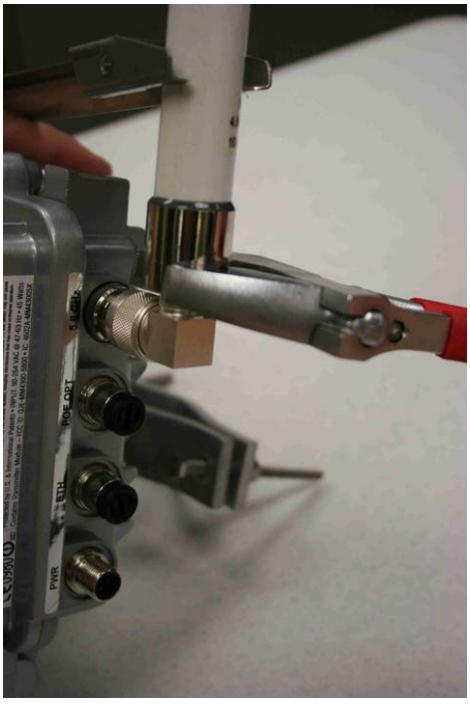


Slide the other antenna through the bracket.

Figure 4-10 Slide the 5.4, 5.8 or 4.9 antenna through the bracket

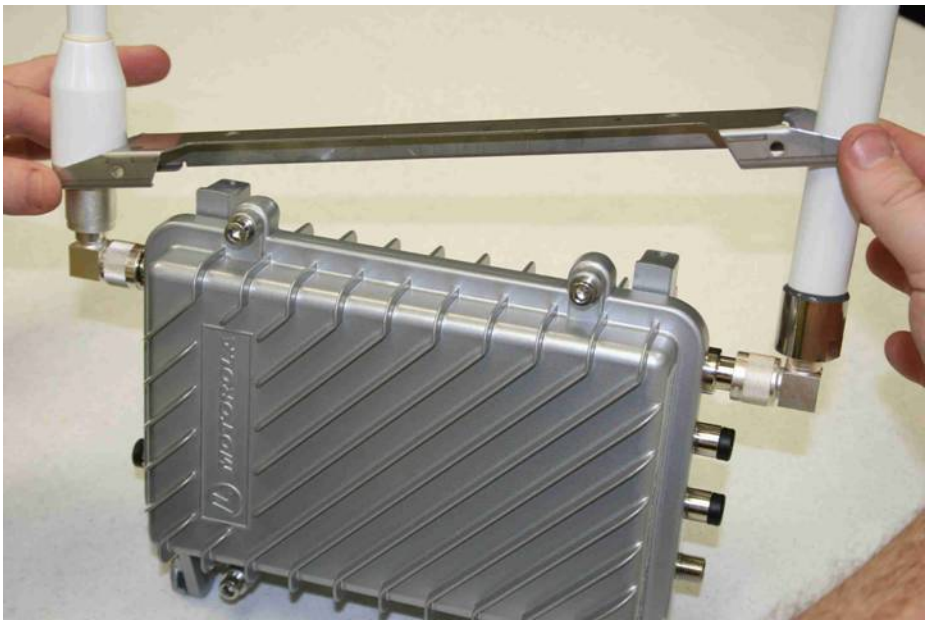
Carefully tighten both antennas. Do not over tighten. Never tighten the antennas by the plastic radome.

Figure 4-11 Tighten the antennas



Slide the bracket up to make additional room to apply the weatherproof tape.

Figure 4-12 Slide the bracket up



Stretch the weatherproof tape around the antenna connector

Figure 4-13 Apply the weatherproof tape

Figure 4-14 Finish wrapping the tape around the antenna base

IMPORTANT

If using an antenna with vent holes above the antenna base (e.g. the 2.4 GHz downtilt antenna) do not tape over the vent holes.

Figure 4-15 Repeat this on the other antenna

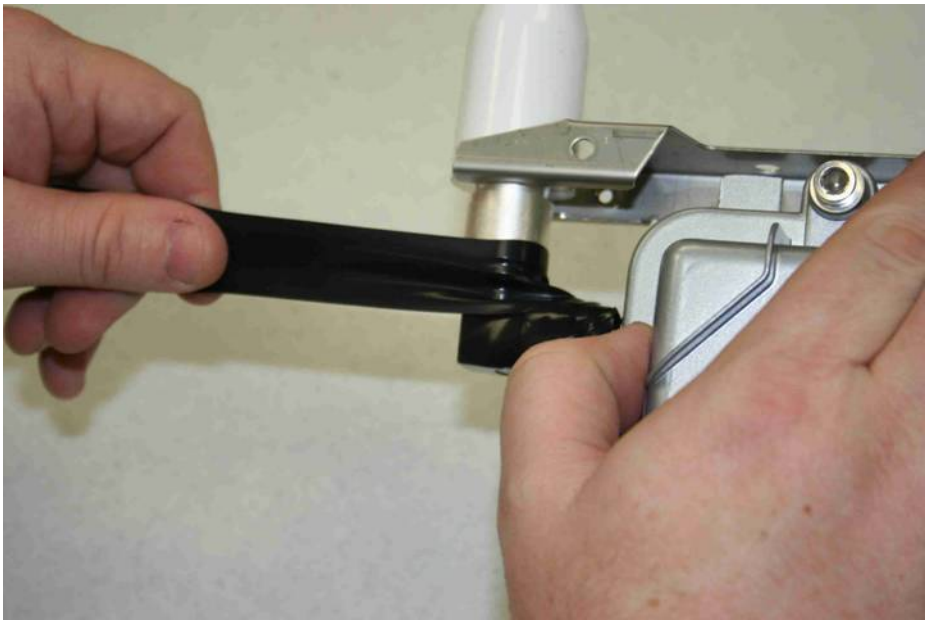


Figure 4-16 Use electrical tape and cover the weatherproof tape

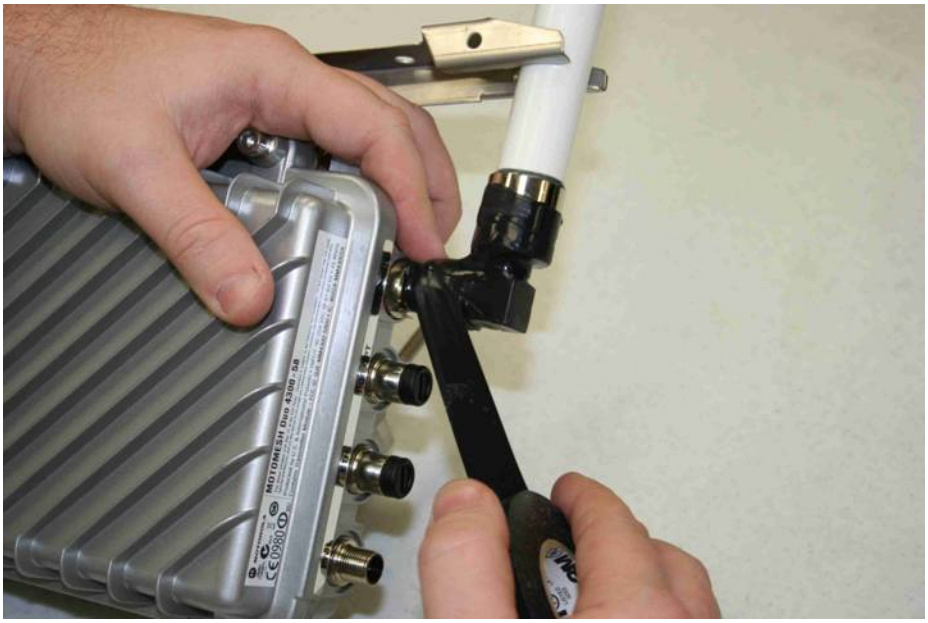
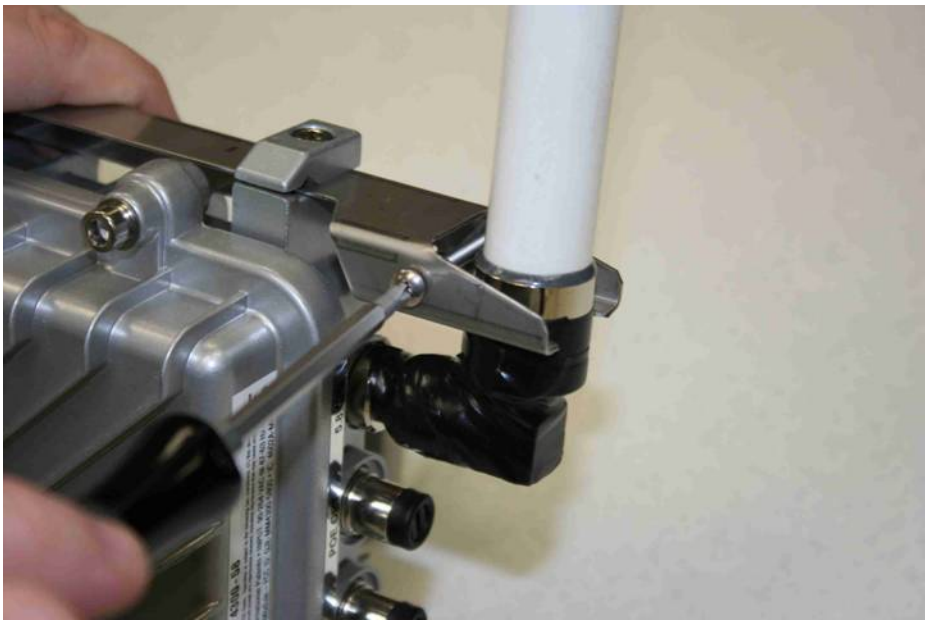


Figure 4-17 Tighten the antenna bracket

Figure 4-18 Tighten the bracket screws



If your MOTOMESH Duo device is going to be used as an IAP remove the protective cap on the POE OPT Ethernet port. The POE OPT port is configured by default to be used as the backhaul port. Note that this port is NOT powered unless a personality plug is attached to the select port. Please see Chapter 3 for more information. Note that the Ethernet cable and port are keyed.

Figure 4-19 Remove the protective cap

Connect the 4 pin power cable to the power port. Note that the cable is keyed.

Figure 4-20 Attach the 8 pin cable Ethernet cable

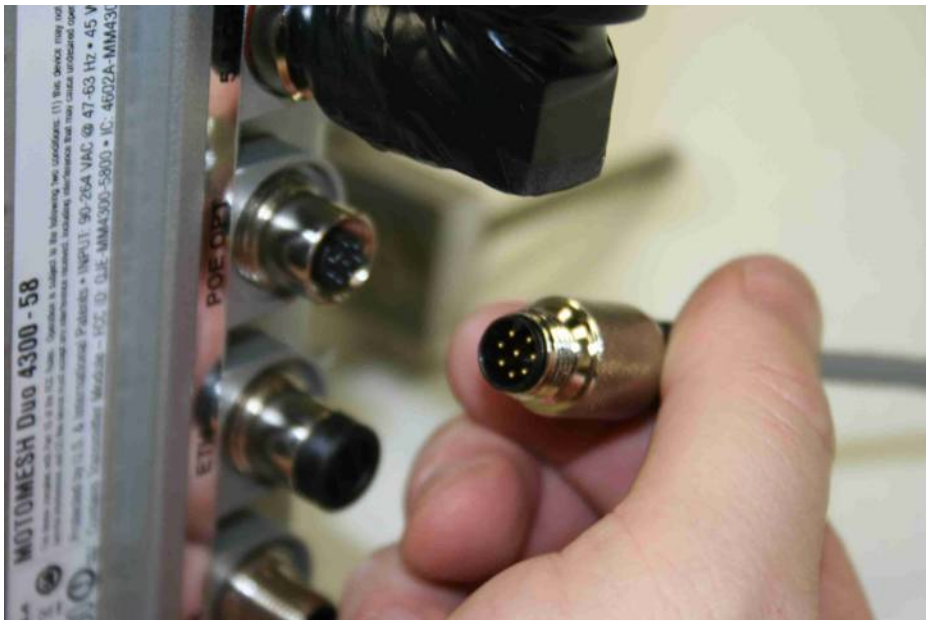


Figure 4-21 Connecting the power cable

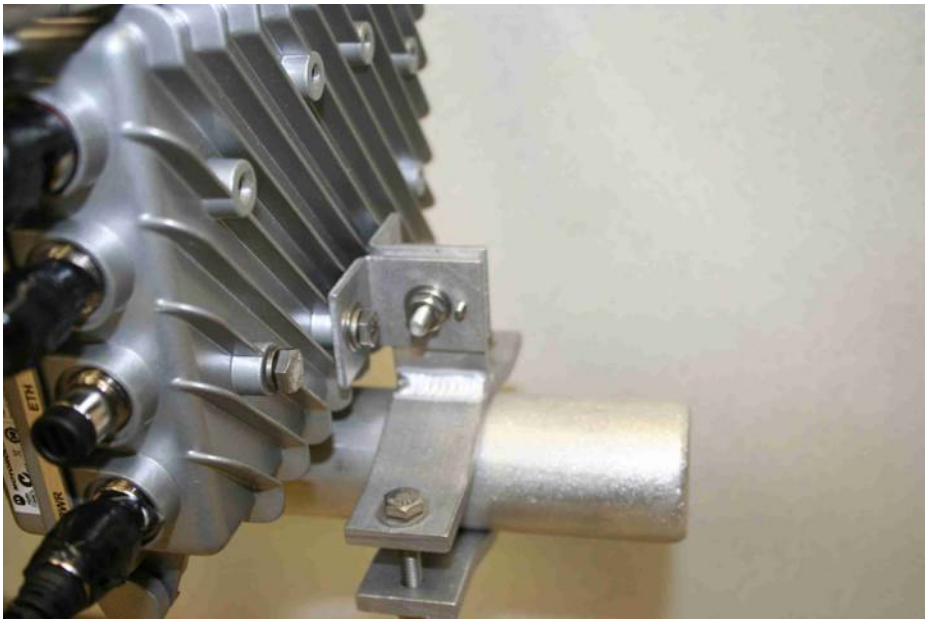
Figure 4-22 Apply weatherproof tape to the Ethernet and power connectors

Figure 4-23 Finished MOTOMESH Duo device

The majority of your MOTOMESH Duo devices will only have a power connection (unless the device is an IAP). If the MWR is going to be used to power a PoE capable device (such as an IP camera) then add the white personality plug to the select port (standards based 802.3af PoE) and connect the Ethernet cable to the POE OPT port.

Figure 4-24 shows a MOTOMESH Duo mounted on a horizontal pole. The mounting bracket is tightened using the 7/16” wrench.

Figure 4-24 Mounted MOTOMESH Duo



Site Selection Guidelines

The following recommendations should be given primary consideration in accessing potential sites for deployment;

1. Device locations should be chosen in areas such that radio signals will not be obstructed by trees, buildings or other structures.
2. Device locations should be chosen away from other in band radio sources. This includes other products operating in the 2.4 GHz, 4.9 GHz, 5.X GHz radio bands, and weather radar sources.
3. Device locations should be chosen such that antennas are at least 30 inches from any nearby metal poles to avoid distortion of the RF pattern. The antenna must also have a separation distance of at least 2 meters from the body of all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.
4. Choose locations that have AC or DC power readily available.
5. Consider the time of year. During the winter months a location may be free of foliage that will return in the warmer months to obstruct the device antennas.
6. When choosing locations consider the proper permits required for mounting on structures that are publicly or privately owned.
7. Choose locations that provide direct line-of-sight conditions such as those along main roadways. Intersections often provide the best mounting options. Nominal 0.25 - 0.35 miles line-of-sight between infrastructure devices.
8. The IAP locations should be determined first since they control the critical function of routing information back to your wired network infrastructure. This may be done via an Ethernet cable if the IAP is located within 100 meters (the max length permitted for standard Ethernet) of each other. If the distance is greater than 100 meters, a mechanism for extending the Ethernet connection will be required, e.g., using fiber, Motorola Canopy backhaul radio.
9. Once the optimal locations for the IAPs have been identified, the location of the MWRs can be determined. Ideally, devices should be distributed such that any subscriber is no more than 3 hops to an IAP.

Site Surveys

It is strongly suggested that an RF site survey be performed during site selection. The uses of tools such as Motorola's MeshPlanner™ or an RF scanner are highly recommended. Consider the following when performing your site survey:

- At each potential mounting location determine the number of access points operating on the non overlapping channels (e.g. 2.4 GHz 1, 6, and 11).
- If possible obtain RF samples at the approximate height in which devices will be located. This can often be safely done with a tripod mounted scanning antenna.

- Consider taking RF sweeps at different times of the day to determine if intermittent interferers exist.

Device Mounting

MOTOMESH Duo can be mounted with two different antenna orientations. The recommended mounting configuration utilizes the antenna bracket (with right angle connectors) with both antennas orientated upward. If the bracket is not used one radio antenna must be pointed upward and the other downward. In either mounting scenario the antennas must be mounted in the vertical plane.

IMPORTANT

Use a level to ensure the antennas are level.

Figure 4-25 Mounting Options

IMPORTANT

If a device is mounted in the configuration without the antenna bracket, and a 2.4 GHz downtilt antenna is used, the 2.4 GHz antenna must be installed facing upward.

Observe the following additional guidelines when deploying fixed Infrastructure Devices:

- Attach the antenna bracket, right angle connectors, and antenna prior to mounting the device.

- MOTOMESH Duo devices may be mounted on a pole having a diameter of 1-3.5 inches, utilizing the pivot mounting bracket.
- Users and installers must be provided with antenna installation and transmitter operating conditions to satisfy RF exposure compliance.
- The IAP MUST have an Ethernet connection to your wired network infrastructure.
- Type A-Light Duty sites have impedance requirements of 25 ohms or less to ground whereas Type B- Light Industrial/Commercial sites have impedance requirements of less than 5 ohms to ground. MOTOMESH Duo 2.1 networks fall into the Type B-Light Industrial/Commercial category, and therefore must be treated with greater considerations as far as grounding requirements are concerned.

Street Lights

If the MOTOMESH Duo device is attached to a light arm and the attachment point meets the Type B grounding requirements, then the grounding stud attachment point is not required to be used. Since Type B grounding requirements stipulate 5 ohms or less impedance to earth ground, things such as soil pH, type of grounding rods, size of conductors, and ground enhancing materials must be taken into account to achieve this goal. To verify the impedance requirements are met, a special Earth/Ground Resistance Tester (megohmmeter) may be necessary.

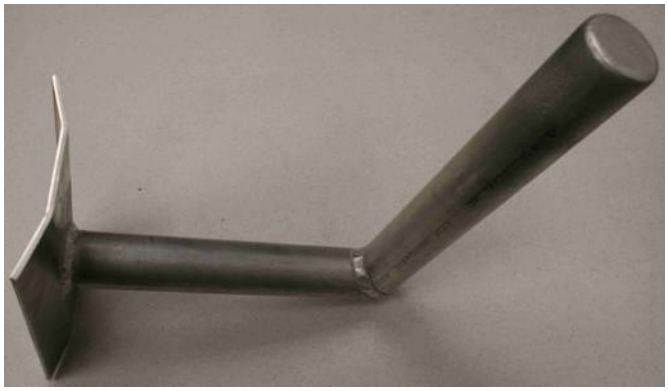
MOTOMESH Duo devices should be mounted on the horizontal arm of the streetlight. If this cannot be accomplished then a stand off bracket should be used to ensure adequate separation from the pole and additional grounding must be supplied.

When using a photocell power cable you must verify that street light power is between 90-264 VAC.

Roof Mount

When mounting on roof tops care must be taken to ensure devices are not significantly higher than surrounding devices. Devices mounted at larger heights are more vulnerable to lightning strikes. They are also more susceptible to interference. When mounting on the side of a building make sure a standoff bracket is used to provide adequate separation between the building surface and the MOTOMESH Duo device. These mounts can be obtained through a variety of distributors.

Figure 4-26 Standoff bracket



Antenna Height

It is important to consider device height. For optimal performance, devices should be mounted at similar heights. Large height mismatches will result in nearby devices not seeing each other. This can produce additional mesh hops which may be undesirable. In Figure 4-27, traffic from Wi-Fi clients connecting to the MWR on pole 1 will have to hop through the MWR on pole 2 to reach the IAP on building A.

Figure 4-27 Antenna Heights

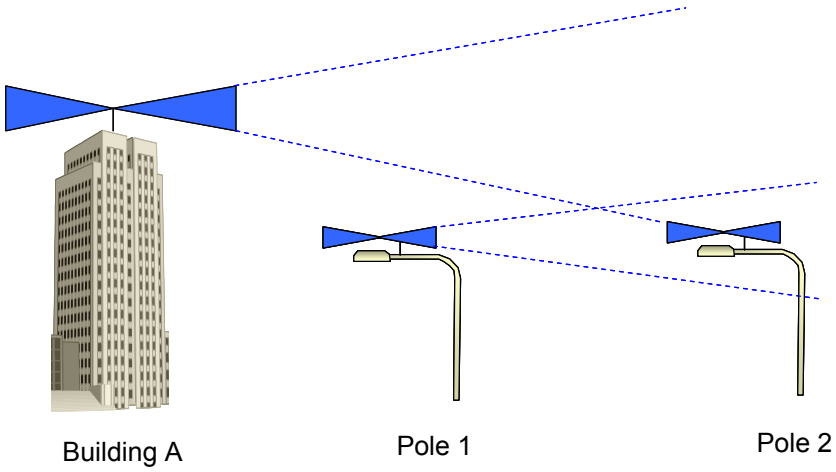
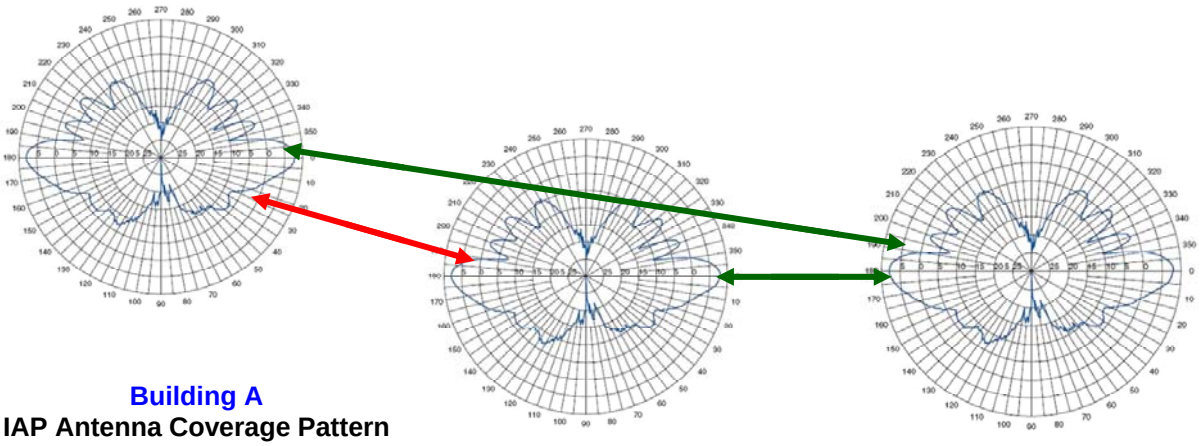


Figure 4-28 Antenna Patterns



Building A
IAP Antenna Coverage Pattern

Pole 1
MWR mounted at different antenna height from IAP.
Weak side lobes align

Pole 2
MWRs mounted at same antenna height.
Strong center lobes align

Mounting Examples

When mounting a MOTOMESH Duo device it is very important to consider the previously discussed location guidelines. The following examples represent poor choices in device location.

Figure 4-29 Poor Install Example 1

Perhaps this location looked ok during the winter months…..

Figure 4-30 Poor Install Example 2

In this example we see the Canopy backhaul radio with its antenna pointing towards the MOTOMESH Duo device. This results in strong interference.

Figure 4-31 Poor Install Example 3

In this example we see the MOTOMESH Duo device mounted with its antenna next to a steel pole. This results in antenna pattern distortion.

Chapter

5

Chapter 5: Customer Information

This chapter provides Customer Service Information and the Motorola Software License Terms and Conditions.

Customer Service Information

If you have read this document and made every effort to resolve installation or operation issues yourself and still require help, please contact your regional Motorola support representatives

USA

Motorola System Support Center (SSC) using the following contact information:

Phone: 800-221-7144

Hours of Operation: 7 days a week, 24 hours

Europe

Phone: +44 (0)1793 564680

Email: 198Hessc@motorola.com

Hours: of Operation: Mon-Fri 09:00 - 17:00 GMT

Calls are logged 24 x 7, cases will be worked Mon-Fri 09:00 - 17:00 GMT

Asia and Pacific Region

Remote Technical Help Desk (Channel Partners)

Phone: +63 28 92 79 93

Email: 199Hwi4Tech@motorola.com

Hours of Operation: Mon - Fri 8 am - 6 pm

Sat 8 am - 12 noon

Obtaining Support

Motorola provides technical support services for your system and recommends that you coordinate warranty and repair activities through the Motorola System Support Center (SSC). When you consult the Motorola SSC, you increase the likelihood that problems are rectified in a timely fashion and that warranty requirements are satisfied. Check your contract for specific warranty and service information.

System Information

To be provided with the best possible opportunity for support, collect the following system information and have it available when obtaining support.

- Location of the system
- Date the system was put into service
- Software or firmware version information for components of your system
- Serial number(s) of the device(s) or component(s) requiring support
- A written description of the symptom or observation of the problem:

  - When did it first appear?

  - Can it be reproduced?

  - What is the step-by-step procedure to cause it?
- Do other circumstances contribute to the problem? For example, changes in weather or other conditions?
- Maintenance action preceding problem:

  - Upgrade of software or equipment

  - Change in the hardware or software configuration

  - Software reload - from backup or from CD-ROM (note the version and date)

Return Material Request

After collecting system information, contact the Motorola System Support Center for assistance or to obtain a Return Material Authorization (RMA) number for faulty Field Replaceable Entities (FREs):

North America: 800-221-7144, Radio Products and Services Division

The Radio Products and Services Division is your source for manuals and replacement parts.

Radio Products and Services Division Telephone Numbers

The telephone numbers for ordering are: (800)-422-4210 (US and Canada orders)

The Fax numbers are: (800)-622–6210 (US and Canada orders)

The number for help identifying an item or part number is (800)-422-4210; select choice “3” from the menu

Returning FREs

Return faulty FREs to Motorola for repair. When you return an assembly for service, follow these best practices:

- Place any assembly containing CMOS devices in a static-proof bag or container for shipment.
- Obtain a return authorization (RA) number from the Motorola System Support Center.
- Include the warranty, model, kit numbers, and serial numbers on the job ticket, as necessary.
- If the warranty is out of date, you must have a purchase order.
- Print the return address clearly, in block letters.
- Provide a phone number where your repair technician can be reached.
- Include the contact person's name for return.
- Pack the assembly tightly and securely, preferably in its original shipping container.

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controversy involves intellectual property, or (iii) interim relief from a court is necessary to prevent serious and irreparable injury to that party or to others.

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Chapter

6

Chapter 6: Certification and Safety Information

This chapter lists the relevant FCC Certification and Product Safety Information for the MOTOMESH Duo 2.1 devices described in this manual.

FCC Regulatory Information

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received; including interference that may cause undesired operation.

The IAP (Intelligent Access Point) is an infrastructure device that is positioned at a fixed location such as a building rooftop.

The MWR (Mesh Wireless Router) is an infrastructure device positioned in a fixed location, such as on a pole, wall, or rooftop. The MWR requires professional installation to ensure the installation is performed in accordance with FCC licensing regulations.

Federal Communications Commission (FCC) Statement

Intelligent Access Point/Mesh Wireless Router

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Safety Information for the MOTOMESH Products

The Federal Communications Commission (FCC) with its action in ET Docket 96-8 has adopted a safety standard for human exposure to radio frequency (RF) electromagnetic energy emitted by FCC certified equipment. Motorola MOTOMESH products meet the uncontrolled environmental limits found in OET-65 and ANSI C95.1, 1991. Proper operation of this radio according to the instructions found in this manual and the hardware and software guides on the MOTOMESH CD will result in user exposure that is substantially below the FCC recommended limits.

- Do not touch or move the antenna(s) while the unit is transmitting or receiving.
- Do not hold any component containing a radio such that the antenna is very close to or touching any exposed parts of the body, especially the face or eyes, while transmitting.
- Do not operate a portable transmitter near unshielded blasting caps or in an explosive environment unless it is a type especially qualified for such use.
- Do not operate the radio or attempt to transmit data unless the antenna is connected; otherwise, the radio may be damaged.

FCC Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20 cm between the radiator and your body.

Safety Certification

Conforms to UL STD ANSI/UL 60950 3rd Edition

- Certified to CAN/CSA C22.2 NO. 60950-00

Equipment shall be suitable for use in Air pressure: 86kPa to106kPa.

Regulatory Requirements and Legal Notices

Regulatory Requirements for CEPT Member States (www.cept.org)

When operated in accordance with the instructions for use, Motorola MOTOMESH Wireless equipment operating in the 2.4 and 5.4 GHz bands is compliant with CEPT Recommendation 70-03 Annex 3 for Wideband Data Transmission and HIPERLANs. For compliant operation in the 2.4 GHz band, the transmit power (EIRP) from the antenna shall be no more than 100mW (20dBm). For compliant operation in the 5.4 GHz band, the transmit power (EIRP) from the antenna shall be no more than 1 W (30 dBm).

The following countries have completely implemented CEPT Recommendation 70-03 Annex 3A (2.4 GHz band):

- EU & EFTA countries**:** Austria, Belgium, Denmark, Spain, Finland, Germany, Greece, Iceland, Italy, Ireland, Liechtenstein, Luxembourg, Netherlands, Norway, Portugal, Switzerland, Sweden, UK
- New EU member states**:** Bulgaria, Czech Republic, Cyprus, Estonia, Hungary, Lithuania, Latvia, Malta, Poland, Slovenia, Slovakia
- Other non-EU & EFTA countries: Bosnia and Herzegovina, Turkey

The following countries have a limited implementation of CEPT Recommendation 70-03 Annex 3A:

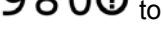
- France **-** Outdoor operation at 100mW is only permitted in the frequency band 2400 to 2454 MHz;

  Any outdoor operation in the band 2454 to 2483.5MHz shall not exceed 10mW (10dBm);

  Indoor operation at 100mW (20dBm) is permitted across the band 2400 to 2483.5 MHz
- French Overseas Territories:

  Guadeloupe, Martinique, St Pierre et Miquelon, Mayotte – 100mW indoor & outdoor is allowed

  Réunion and Guyana – 100mW indoor, no operation outdoor in the band 2400 to 2420MHz
- Italy - If used outside own premises, general authorization required
- Luxembourg **-** General authorization required for public service
- Romania - Individual license required. T/R 22-06 not implemented

Motorola MOTOMESH Radios operating in the 2400 to 2483.5MHz band are categorized as "Class 2" devices within the EU and are marked with the class identifier symbol  , denoting that national restrictions apply (for example, France). The French restriction in the 2.4 GHz band will be removed in 2011. This 2.4 GHz equipment is "CE" marked  to

show compliance with the European Radio & Telecommunications Terminal Equipment (R&TTE) directive 1999/5/EC and that National restrictions apply.

Where necessary, the end user is responsible for obtaining any National licenses required to operate this product and these must be obtained before using the product in any particular country. However, for CEPT member states, 2.4 GHz Wideband Data Transmission equipment has been designated exempt from individual licensing under decision ERC/DEC(01)07. For EU member states, RLAN equipment in both the 2.4 & 5.4GHz bands is exempt from individual licensing under Commission Recommendation 2003/203/EC. Contact the appropriate national administrations for details on the conditions of use for the bands in question and any exceptions that might apply. Also see http://www.ero.dk for further information.

Motorola MOTOMESH dual Radio equipment operating in the 5470 to 5725 MHz band also operates in the 2400 to 2483.5MHz band and is categorized as “Class 2” devices within the EU because of the additional 2.4GHz radio. These devices will become “Class 1” devices after 2011 when the restrictions on the 2.4GHz band are removed but are currently “CE” marked CE0980 to show compliance with the European Radio & Telecommunications Terminal Equipment (R&TTE) directive 1999/5/EC and that National restrictions apply.

Relevant Declarations of Conformity can be found at http://motorola.canopywireless.com/doc.php

European Union Notification

The CE mark is the official marking required by the European Community for all Electric and Electronic equipment that will be sold, or put into service for the first time, anywhere in the European community. It proves to the buyer or user that this product fulfills all essential safety and environmental requirements as they are defined in the European Directives.

CE0980

Motorola Products are covered under the following product certification Europe:

ETSI EN 300 328 V 141 (2003-04)

ETSI EN 301 489-1 (2002-08) and EN 301 489-17

EN 55022:1998 and EN 55024:1998

CENELEC EN 50360 and EN50371 – Specific Absorption Test – SAR

European Union Notification 5.7GHz Product

The 5.7 GHz MOTOMESH is a Class 2 device and uses operating frequencies that are not harmonized throughout the EU member states. The operator is responsible for obtaining any national licenses required to operate this product and these must be obtained before using the product in any particular country. The 5.7GHz MOTOMESH dual radio products also operate in the 2.4GHz band – see other sections of this document for restrictions on operating in the 2.4GHz band.

This equipment is marked CE0980 to show compliance with the European R&TTE directive 1999/5/EC and that National restrictions apply.

The relevant Declaration of Conformity can be found at http://motorola.canopywireless.com/doc.php

Annex 6 – Instructions for use (regulatory content) MOTOMESH 2.4/5.8 GHz Radio

European Union Notification

The CE mark is the official marking required by the European Community for all Electric and Electronic equipment that will be sold, or put into service for the first time, anywhere in the European community. It proves to the buyer or uses that this product fulfills all essential safety and environmental requirements as they are defined in the European Directives.

The 2.4GHz/5.8GHz product range marked with the following CE marks,

CE1321 & CE0980

Carry the alert symbol to denote the product is not suitable for deployment in all EU member states. Products marked with both these CE numbers are **only** suitable for use in the following EU member states: -

- **Ireland**
- **Norway**
- **UK**

The CE mark acknowledges that the product is in compliance with regulations of the European Radio & Telecommunications Terminal Equipment (R&TTE) directive 1999/5/EC and other relevant directives. See section Declaration of Conformity section (found later in this chapter) with the applicable directives.

Note: This product only operates in the following channels (20MHz channel size) in the 5.8GHz band.

Channel Number	Frequency (MHz)
149	5745
153	5765
157	5785
161	5805[1]

[1]For use in the UK, Republic of Ireland, and Norway, the frequency range 5795-5815 MHZ shall not be used and should be notched out to protect RTTT devices. Users must therefore

NOT select channel 161 as an operational channel to conform to National Licensing requirements.

Note: For use in the Republic of Ireland, the maximum transmit power in the 5.8GHz band shall be less than 33dBm EIRP. Therefore to ensure compliance with National licensing requirements users of this equipment must ensure the conducted transmit power is set to no more than 23dBm (10dBi antenna gain).

For the U.K. and Norway this product transmits at a maximum of 34dBm which is less than the maximum allowed in the 5.8GHz band (36dBm).

Equipment Disposal

Waste (Disposal) of Electronic and Electric Equipment

Please do not dispose of Electronic and Electric Equipment or Electronic and Electric Accessories with your household waste. In some countries or regions, collection systems have been set up to handle waste of electrical and electronic equipment. In European Union countries, please contact your local equipment supplier representative or service center for information about the waste collection system in your country.

UK Notification

The 5.7 GHz MOTOMESH product has been notified for operation in the UK, and when operated in accordance with instructions for use it is compliant with UK Interface Requirement IR2007. For UK use, installations must conform to the requirements of IR2007 in terms of EIRP spectral density against elevation profile above the local horizon in order to protect Fixed Satellite Services. The frequency range 5795-5815 MHz is assigned to Road Transport & Traffic Telematics (RTTT) in the U.K. and shall not be used by FWA systems in order to protect RTTT devices. UK licensing specifies that radiolocation services shall be protected by a Dynamic Frequency Selection (DFS) mechanism to prevent co-channel operation in the presence of radar signals.

Belgium Notification

Belgium national restrictions in the 2.4 GHz band include

- EIRP must be lower then 100 mW
- For crossing the public domain over a distance > 300m the user must have the authorization of the BIPT.
- No duplex working

Luxembourg Notification

For the 2.4 GHz band, point-to-point or point-to-multipoint operation is only allowed on campus areas. 5.4GHz products can only be used for mobile services.

Czech Republic Notification

2.4 GHz products can be operated in accordance with the Czech General License No. GL-12/R/2000.

5.4 GHz products can be operated in accordance with the Czech General License No. GL-30/R/2000.

Norway Notification

Use of the frequency bands 5725-5795 / 5815-5850 MHz are authorized with maximum radiated power of 4 W EIRP and maximum spectral power density of 200 mW/MHz. The radio equipment shall implement Dynamic Frequency Selection (DFS) as defined in Annex 1 of ITU-R Recommendation M.1652 / EN 301 893. Directional antennae with a gain up to 23 dBi may be used for fixed point-to-point links. The power flux density at the border between Norway and neighbouring states shall not exceed - 122.5 dBW/m^2 measured with a reference bandwidth of 1 MHz.

MOTOMESH 5.7GHz products have been notified for use in Norway and are compliant when configured to meet the above National requirements. Users shall ensure that DFS functionality is enabled, maximum EIRP respected for a 20 MHz channel, and that channel spacings comply with the allocated frequency band to protect Road Transport and Traffic Telematics services (for example, 5735, 5755, 5775 or 5835 MHz are suitable carrier frequencies).

Greece Notification

The outdoor use of 5470-5725MHz is under license of EETT but is being harmonized according to the CEPT Decision ECC/DEC/(04) 08, of 12th November 2004. End users are advised to contact the EETT to determine the latest position and obtain any appropriate licenses.

DECLARATION OF CONFORMITY

CE0980

Česky [Czech]	Motorola tímto prohlašuje, že tento *Motorola* ***MOTOMESH Duo 4300-54*** *series,* je ve shodě se základními požadavky a dalšími příslušnými ustanoveními směrnice 1999/5/ES.
Dansk [Danish]	Undertegnede Motorola erklærer herved, at følgende udstyr *Motorola* ***MOTOMESH Duo 4300-54*** *series,* overholder de væsentlige krav og øvrige relevante krav i direktiv 1999/5/EF
Deutsch [German]	Hiermit erklärt Motorola, dass sich diese Motorola MOTOMESH Duo 4300-54 series, in Übereinstimmung mit den grundlegenden Anforderungen und den anderen relevanten Vorschriften der Richtlinie 1999/5/EG befindet". (BMWi)
	Hiermit erklärt Motorola die Übereinstimmung des Gerätes Motorola MOTOMESH Duo 4300-54 series, mit den grundlegenden Anforderungen und den anderen relevanten Festlegungen der Richtlinie 1999/5/EG. (Wien)
Nederlands [Dutch]	Hierbij verklaart Motorola dat het toestel *Motorola* ***MOTOMESH Duo 4300-54*** *series,* in overeenstemming is met de essentiële eisen en de andere relevante bepalingen van richtlijn 1999/5/EG
	Bij deze verklaart Motorola dat deze *Motorola* ***MOTOMESH Duo 4300-54*** *series,* voldoet aan de essentiële eisen en aan de overige relevante bepalingen van Richtlijn 1999/5/EC.
English	Hereby, Motorola, declares that this *Motorola* ***MOTOMESH Duo 4300-54*** *series,* is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.
Eesti [Estonian]	Käesolevaga kinnitab Motorola seadme Motorola MOTOMESH Duo 4300-54 series, vastavust direktiivi 1999/5/EÜ põhinõuetele ja nimetatud direktiivist tulenevatele teistele asjakohastele sätetele.
Suomi [Finnish]	Motorola vakuuttaa täten että *Motorola* ***MOTOMESH Duo 4300-54*** *series*, tyyppinen laite on direktiivin 1999/5/EY oleellisten vaatimusten ja sitä koskevien direktiivin muiden ehtojen mukainen.
Français [French]	Par la présente Motorola déclare que l'appareil *Motorola* ***MOTOMESH Duo 4300-54*** *series*, est conforme aux exigences essentielles et aux autres dispositions pertinentes de la directive 1999/5/CE
	Par la présente, Motorola déclare que ce *Motorola* ***MOTOMESH Duo 4300-54*** *series*, est conforme aux exigences essentielles et aux autres dispositions de la directive 1999/5/CE qui lui sont applicables
Ελληνική [Greek]	*ΜΕ ΤΗΝ ΠΑΡΟΥΣΑ* Motorola *ΔΗΛΩΝΕΙ ΟΤΙ Motorola* ***MOTOMESH Duo 4300-54*** *series, ΣΥΜΜΟΡΦΩΝΕΤΑΙ ΠΡΟΣ ΤΙΣ ΟΥΣΙΩΔΕΙΣ ΑΠΑΙΤΗΣΕΙΣ ΚΑΙ ΤΙΣ ΛΟΙΠΕΣ ΣΧΕΤΙΚΕΣ ΔΙΑΤΑΞΕΙΣ ΤΗΣ ΟΔΗΓΙΑΣ 1999/5/ΕΚ*

Magyar [Hungarian]	Alulírott, Motorola nyilatkozom, hogy a *Motorola* ***MOTOMESH Duo 4300-54*** *series,* megfelel a vonatkozó alapvetõ követelményeknek és az 1999/5/EC irányelv egyéb elõírásainak.
Íslenska [Icelandic]	Hér með lýsir Motorola yfir því að *Motorola* ***MOTOMESH Duo 4300-54*** *series,* er í samræmi við grunnkröfur og aðrar kröfur, sem gerðar eru í tilskipun 1999/5/EC.
Italiano [Italian]	Con la presente Motorola dichiara che questo *Motorola* ***MOTOMESH Duo 4300-54*** *series,* è conforme ai requisiti essenziali ed alle altre disposizioni pertinenti stabilite dalla direttiva 1999/5/CE.
Latviski [Latvian]	Ar šo Motorola deklarē, ka *Motorola* ***MOTOMESH Duo 4300-54*** *series,* atbilst Direktīvas 1999/5/EK būtiskajām prasībām un citiem ar to saistītajiem noteikumiem.
Lietuvių [Lithuanian]	Šiuo Motorola deklaruoja, kad šis *Motorola* ***MOTOMESH Duo 4300-54*** *series,* atitinka esminius reikalavimus ir kitas 1999/5/EB Direktyvos nuostatas.
Malti [Maltese]	Hawnhekk, Motorola, jiddikjara li dan *Motorola* ***MOTOMESH Duo 4300-54*** *series,* jikkonforma mal-ħtiġijiet essenzjali u ma provvedimenti oħrajn relevanti li hemm fid-Dirrettiva 1999/5/EC
Norsk [Norwegian]	Motorola erklærer herved at utstyret *Motorola* ***MOTOMESH Duo 4300-54*** *series,* er i samsvar med de grunnleggende krav og øvrige relevante krav i direktiv 1999/5/EF.
Slovensky [Slovak]	Motorola týmto vyhlasuje, že *Motorola* ***MOTOMESH Duo 4300-54*** *series,* spĺňa základné požiadavky a všetky príslušné ustanovenia Smernice 1999/5/ES.
Slovensko [Slovenian]	Motorola izjavlja, da je ta *Motorola Canopy* ***MOTOMESH Duo 4300-54*** *series*, v skladu z bistvenimi zahtevami in ostalimi relevantnimi določili direktive 1999/5/ES.
Svenska Swedish	Härmed intygar Motorola att denna *Motorola* ***MOTOMESH Duo 4300-54*** *series,* står I överensstämmelse med de väsentliga egenskapskrav och övriga relevanta bestämmelser som framgår av direktiv 1999/5/EG.
Español [Spanish]	Por medio de la presente Motorola declara que el *Motorola* ***MOTOMESH Duo 4300-54*** *series,* cumple con los requisitos esenciales y cualesquiera otras disposiciones aplicables o exigibles de la Directiva 1999/5/CE
Polski [Polish]	Niniejszym, firma Motorola oświadcza, że produkt serii *Motorola* ***MOTOMESH Duo 4300-54*** *series*, spełnia zasadnicze wymagania i inne istotne postanowienia Dyrektywy 1999/5/EC.
Português [Portuguese]	Motorola declara que este *Motorola* ***MOTOMESH Duo 4300-54*** *series,* está conforme com os requisitos essenciais e outras disposições da Directiva 1999/5/CE.

EU Declaration of Conformity for RoHS Compliance

Motorola hereby, declares that this *Motorola MOTOMESH **4300-xx** series* is in compliance with the essential requirements and other relevant provisions of Directive 2002/95/EC, Restriction of the use of certain Hazardous Substances (RoHS) in electrical and electronic equipment for the Motorola products listed.

DECLARATION OF CONFORMITY

Motorola declares under it sole responsibility that the products, to which this declaration relates, conform to the applicable essential requirements of the following Directive(s) of the Council of the European Communities:

- 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on the radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (R&TTE Directive).
- 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment
- 2004/108/EC of 20 July 2007 on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Directive).
- 2006/95/EC on the harmonization of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits (LV Directive).
- 1999/519/EC of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz)

Product: Model: Motorola ***MOTOMESH Duo 4300-54 and MOTOMESH Duo 4300-54 DC***

Model Number	Description
HK1599A	Mains (90-264Va.c. 47-63Hz) powered single radio (2.4GHz) assembly comprising: • MLUX4019A – 2.4/5.4GHz radio unit (a.c.) • 8571327H01 – 2.4GHz 8dBi Omni antenna
HK1717A	Mains (90-264Va.c. 47-63Hz) powered dual radio (2.4GHz & 5.4GHz) assembly comprising: • MLUX4019A – 2.4/5.4GHz radio unit (a.c.) • 8571327H01 – 2.4GHz 8dBi Omni antenna • RAN4044A – 5.4GHz 10dBi Omni antenna
HK1598A	D.C. (10.8 – 14 VDC) powered single radio (2.4GHz) assembly comprising: • MLUX4023A – 2.4/5.4GHz radio unit (d.c.) • 8571327H01 – 2.4GHz 8dBi Omni antenna
HK1720A	D.C. (10.8 – 14 VDC) powered dual radio (2.4GHz & 5.4GHz) assembly comprising: • MLUX4023A – 2.4/5.4GHz radio unit (d.c.) • 8571327H01 – 2.4GHz 8dBi Omni antenna • RAN4044A – 5.4GHz 10dBi Omni antenna

Manufacturer: Motorola Inc.
Description: Dual Radio transceiver operating in 2.4/5.4GHz band using Atheros AP30 chipset. 802.11a/b/g

Conformity: **Harmonized standards / Methods used to demonstrate conformity: Annex IV of R&TTE using MET Laboratories Notified Body, CE 0980. Certified to meet:-**

a) Safety – EN 60950-1:2001 + Amendment A11:2004
b) Radio – EN300 328 v1.7.1 & EN301 893 v1.2.3
c) EMC – EN 301 489-1 v1.6.1 & EN 301 489-17 v1.2.1
d) Health – N.B. Statement of Opinion & Test Report 22037 MPE Calculation

Year of first application of CE mark: 2007

Signature:

Name: W. Vann Hasty
Title: Director of Engineering,
Mesh Network Product Group

Name: Laura Phillips
Title: Quality Director

Date: October 29th 2007

CMM Labeling and Disclosure Table

The People's Republic of China require that our products comply with China Management Methods (CMM) environmental regulations. (China Management Methods refers to the regulation *Management Methods for Controlling Pollution by Electronic Information Products* Two items are used to demonstrate compliance; the Label and Disclosure Table.

The label is placed in a customer visible position on the product. The first of the following examples means that the product contains no hazardous substances; the second means that the product contains hazardous substances, and has an Environmental Friendly Use Period (EFUP) of fifty years.

Logo 1 Logo 2

The Environmental Friendly Use Period (EFUP) is the period (in years) during which the Toxic and Hazardous substances (T&HS) contained in the Electronic Information Product (EIP) will not leak or mutate causing environmental pollution, or bodily injury from use of the EIP.

The Disclosure Table, printed in simple Mandarin, is included with each customer order. An example of the Disclosure Table follows, in both Mandarin and English.

部件名称 (Parts)	有毒有害物质或元素 (Hazardous Substance)					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr^{6+})	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
金属部件 (Metal Parts)	×	○	○	×	○	○
电路模块 (Circuit Modules)	×	○	○	×	○	○
电缆及电缆组件 (Cables & Cable Assemblies)	×	○	×	×	○	○
塑料和聚合物部件 (Plastic and Polymeric parts)	○	○	○	○	○	×

○： 表示该有毒有害物质在该部件所有均质材料中的含量均在 SJ/T11363-2006 标准规定的限量要求以下。
Indicates that the concentration of the hazardous substance in all homogeneous materials in the parts is below the relevant threshold of the SJ/T11363-2006 standard.

×： 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T11363-2006标准规定的限量要求。
Indicates that the concentration of the hazardous substance of at least one of all homogeneous materials in the parts is above the relevant threshold of the SJ/T11363-2006 standard.

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Glossary

Chapter 8: Glossary

AAA Server **-** (Authentication Authorization Accounting server) A network server used for access control.

AES– Advanced Encryption Service, a new advanced encryption mechanism using the Counter-Mode/CBC-MAC Protocol (CCMP)

CA – Certificate Authority. When a Certificate Authority is part of a network, its main role is to issue and manage security credentials and public keys to allow for message encryption.

EAP– Extensible Authentication Protocol

EAP-TTLS – Uses TLS to provide a secure channel for traditional authentication methods like CHAP, MS-CHAP, MS-CHAP-v2, and MD5 Challenge. This reduces the certificate requirements and can leverage legacy RADIUS authentication methods.

EIRP - Equivalent Isotropically Radiated Power or, alternatively, Effective Isotropic Radiated Power. Applies to radio communications, specifically to the antenna.

IAP – Intelligent Access Point. An infrastructure device that is a component of the MOTOMESH Duo 2.x system.

MWR – Mesh Wireless Router is an infrastructure device within the MOTOMESH Duo 2.x network.

PoE – Power over the Ethernet (optional feature).

R0KH – R0 Key Handler. Component used in MOTOMESH Duo 2.1 Mesh security.

R0KHID – R0 Key Handler Identification.

RADIUS – (**R**emote **A**uthentication **D**ial-**I**n **U**ser **S**ervice). Considered to be the *de facto* standard protocol for authentication servers (AAA servers).

WM – One Point Wireless Manager™

WPA– Wi-Fi Protected Access, Wi-Fi security launched in October 2003. It also provides a scheme of mutual authentication using either IEEE 802.1X/Extensible

Authentication Protocol (EAP) authentication or pre-shared key (PSK) technology.

WPA2– Wi-Fi Protected Access 2 is the next generation of Wi-Fi security launched in 2004. It supports IEEE 802.1X/EAP authentication or PSK technology and includes AES.

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Appendix

A

Chapter 9: Appendix A:

IP Directed Broadcast Feature

You can enable forwarding of IP-directed broadcasts on an interface where the broadcast becomes a physical (MAC-layer) broadcast. Only those protocols configured by using the **ip forward-protocol** global configuration command are forwarded.

An access list can be specified to control which broadcasts are forwarded. In that scenario, only those IP packets permitted by the access list are eligible to be translated from directed broadcasts to physical broadcasts.

The procedure included in this document will assist you with enabling the IP Directed Broadcast feature, which in turn will be used by the network discovery feature used by the One Point Wireless Manager™ application. This information is also included in the document *Instructions for Enabling the IP Directed Broadcast Feature.pdf* located in the Documentation folder on the WMS deliverable CD.

Enabling the IP Directed Broadcast Feature

The procedure listed below will walk you through enabling the forwarding of IP-directed broadcasts on an interface. It is meant to be followed by beginning it in privileged EXEC mode.

NOTE: All blue text in the table below indicates the configuration that would be needed when using Motorola's default small system reference design configuration.

Procedure 9-1 Enabling IP Directed Broadcast

Command	Purpose

5	**configure terminal**	Enter global configuration mode.
6	**interface vlan 1** [*interface-id*]	Enter interface configuration mode, and specify the interface to configure. **(In this case vlan 1)**
7	**ip directed-broadcast**	Enable directed broadcast-to-physical broadcast translation on the interface. **Note:** The **ip directed-broadcast** interface configuration command can be configured on a VPN routing/forwarding (VRF) interface and is VRF-aware. Directed broadcast traffic is routed only within the VRF.
8	**exit**	Return to global configuration mode.
9	**ip forward-protocol udp snmp**	Specify which protocols and ports the router forwards when forwarding broadcast packets.
10	**end**	Return to privileged EXEC mode.
11	**show ip interface** [*interface-id*] or **show running-config**	Verify the configuration on the interface or all interfaces **(in this case vlan 1).**
12	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

Documentation Credits: Some source information for this procedure was extracted from the Cisco *Catalyst 3750 Software Configuration Guide.*

Cisco 3750 L3 Switch Core Configuration File

The contents of the Cisco 3750 standard production file are shown.

Using 4445 out of 524288 bytes

!

version 12.2

no service pad

service timestamps debug uptime

service timestamps log uptime

no service password-encryption

!

hostname L3-CORE

!

enable secret 5 1Ug./$VMDwCPRbtHyUcMsOq.6u90

```
enable password l00n1e
!
switch 1 provision ws-c3750-24p
ip subnet-zero
ip routing
!
vtp mode transparent
!
spanning-tree mode pvst
no spanning-tree optimize bpdu transmission
spanning-tree extend system-id
!
!
!
!
vlan 24
 name RF-MGMT
!
vlan 31
 name CORE-MGMT
!
vlan 49
 name RF-USER
!
!
interface FastEthernet1/0/1
 switchport access vlan 31
 switchport mode access
!
interface FastEthernet1/0/2
 switchport access vlan 31
 switchport mode access
!
interface FastEthernet1/0/3
```

```
 switchport access vlan 31
 switchport mode access
!
interface FastEthernet1/0/4
 switchport access vlan 31
 switchport mode access
!
interface FastEthernet1/0/5
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 1,24,49
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet1/0/6
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 1,24,49
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet1/0/7
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 1,24,49
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet1/0/8
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 1,24,49
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet1/0/9
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 1,24,49
```

```
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet1/0/10
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 1,24,49
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet1/0/11
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 1,24,49
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet1/0/12
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 1,24,49
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet1/0/13
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 1,24,49
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet1/0/14
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 1,24,49
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet1/0/15
```

```
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 1,24,49
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet1/0/16
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 1,24,49
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet1/0/17
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 1,24,49
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet1/0/18
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 1,24,49
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet1/0/19
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 1,24,49
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet1/0/20
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 1,24,49
 switchport mode trunk
 switchport nonegotiate
```

```
!
interface FastEthernet1/0/21
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 1,24,49
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet1/0/22
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 1,24,49
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet1/0/23
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 1,24,49
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet1/0/24
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 1,24,49
 switchport mode trunk
 switchport nonegotiate
!
interface GigabitEthernet1/0/1
 shutdown
!
interface GigabitEthernet1/0/2
 shutdown
!
interface Vlan1
 ip address 10.1.0.1 255.255.0.0
 ip helper-address 172.31.0.20
```

```
!
interface Vlan24
 ip address 10.24.0.1 255.255.0.0
 ip helper-address 172.31.0.20
!
interface Vlan31
 ip address 172.31.0.2 255.255.0.0
!
interface Vlan49
 ip address 10.49.0.1 255.255.0.0
 ip helper-address 172.31.0.20
!
ip classless
ip http server
!
!
!
control-plane
!
!
line con 0
line vty 0 4
password g0ld10
no login
line vty 5 15
password g0ld10
no login
!
end
```

Equipment Specifications

The specifications listed in the following table apply for all Infrastructure Devices. The specifications listed in the following table apply for all Infrastructure devices.

Table 9-1 MOTOMESH Duo 4300-49 Radio Characteristics

Characteristic	2.4GHz 802.11 b/g	4.9GHz
Output Power	27 dBm	24 dBm
RF Modulation	CCK/OFDM	OFDM
Operating Frequency (GHz)	2.4 - 2.4835	4.94 - 4.99
Maximum Data Rate	54 Mbps	54 Mbps
Antenna Gain	8 dBi	11 dBi
Spectrum Used	20 MHz	10 MHz

Table 9-2 MOTOMESH Duo 4300-58 Radio Characteristics

Characteristic	2.4GHz 802.11 b/g	5.8GHz 802.11a
Output Power	27 dBm	24 dBm
RF Modulation	CCK/OFDM	OFDM
Operating Frequency (GHz)	2.4 - 2.4835	5.725 - 5.825
Maximum Data Rate	54 Mbps	54 Mbps
Antenna Gain	8dBi	10 dBi
Spectrum Used	20 MHz	20 MHz

Table 9-3 MOTOMESH Duo 4300-54 Radio Characteristics

Characteristic	2.4GHz 802.11 b/g	5.4GHz
Output Power	27 dBm	24 dBm
RF Modulation	CCK/OFDM	OFDM
Operating Frequency (GHz)	2.4 - 2.4835	5.47 - 5.725
Maximum Data Rate	54 Mbps	54 Mbps
Antenna Gain	8 dBi	10 dBi
Spectrum Used	20 MHz	20 MHz

Wiring Instructions

The following instructions describe how to assemble an AC power connector to a power cable's flying leads for US, Europe, and Australia.

US Power Connector Wiring Instructions

The following instructions describe how to assemble the US enclosed power connector to the power cable's flying leads.

Part I – Power Connector Parts

1. Initial Power Connector Package contents are shown in the graphic below. Only the items that will actually be used in these instructions are labeled.

Figure 9-1 Initial Power Connector Package Contents

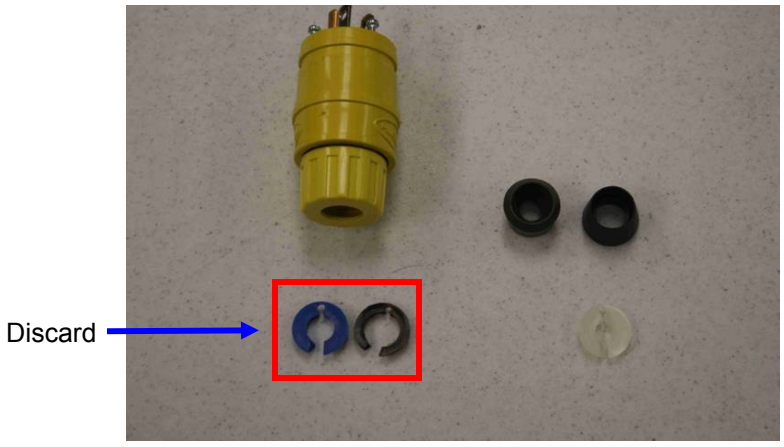


Figure 9-2 Required Items

Part II – Power Cable with Flying Leads

2. The initial Power Cable will have four wires, cut the Red Wire back, as it is not used.

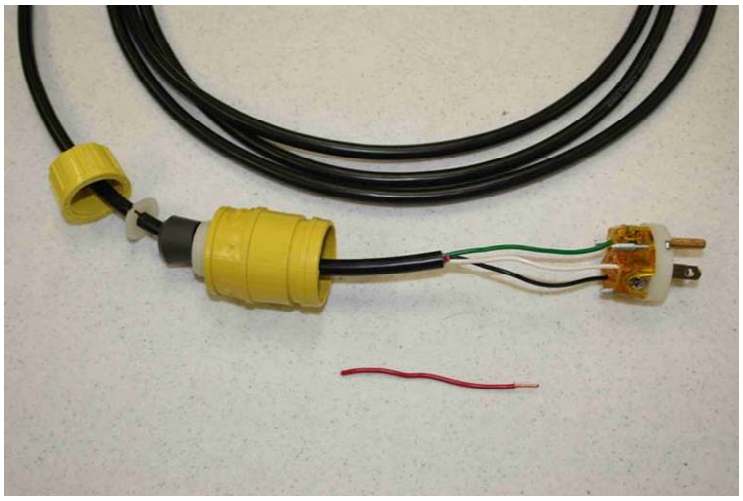
Figure 9-3 Feed flying lead cable through components

NOTE: Be sure to cut the RED WIRE Back as it in not used

Part III – Power Connector and Cable Assembly Instructions

3. Place the Connector parts over the Power Cable as shown below.

Figure 9-4 Attach flying lead cable to the plug



4. Attach the cable wires to the terminal plug in the following way:
    - Cut Back the Red Wire
    - Insert the Green Wire into the green color lug and tighten.
    - Insert the Black Wire into the Bronze color lug and tighten.
    - Insert the White Wire into the Silver color lug and tighten.

Figure 9-5 Assemble plug

5. Insert Plug Terminal into Connector Body and tighten.

Figure 9-6 Arrange the components

Figure 9-7 Tighten plug

6. The finished power connector and cable assembly will look like the image shown below.

Figure 9-8 Finished Power Connector and Cable Assembly

European Power Connector Wiring Instructions

The following instructions describe how to assemble the enclosed power connector to the power cable's flying leads.

Part I – Power Connector Parts

1. The (out-of-the-box) European power connector along with its power assignment is shown in the graphics below.

Figure 9-9 European Power Connector Front View

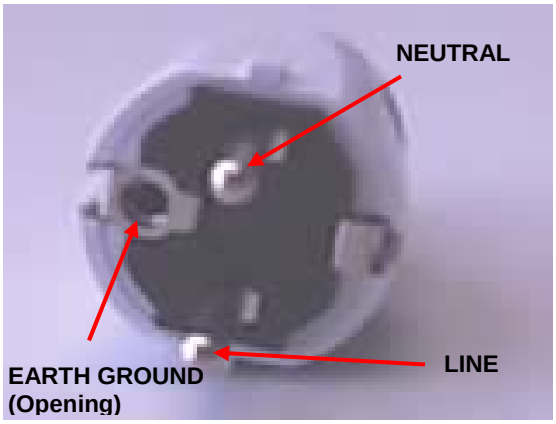
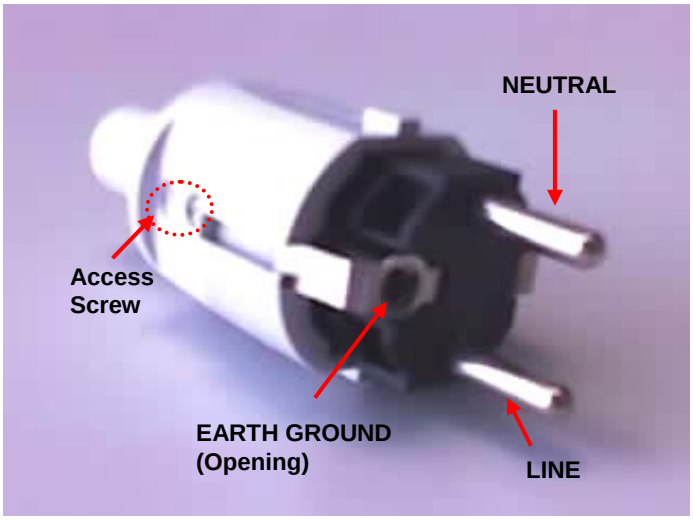
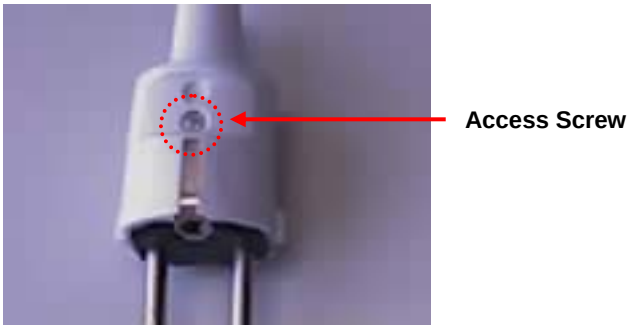


Figure 9-10 European Power Connector Side View



2. Loosen the *Access Screw* on the plug and pull-out the plug contents.

Figure 9-11 Top View of European Power Connector Showing Access Screw



3. After pulling out the *Plug Contents*, place the plug on its side. The *Strain Relief Bar* section of the plug should be facing you, as shown in the graphics below.

Figure 9-12 Side View of Plug Showing Detail of the Stress Relief Bar

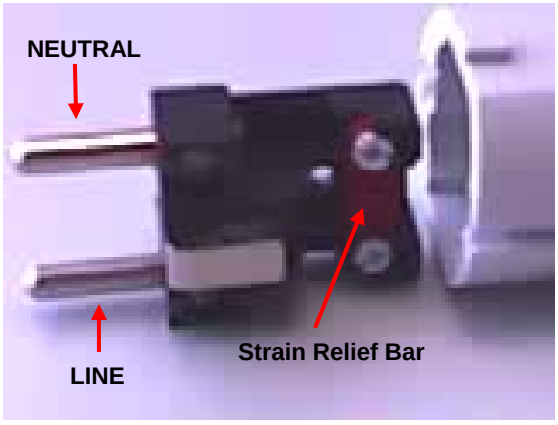
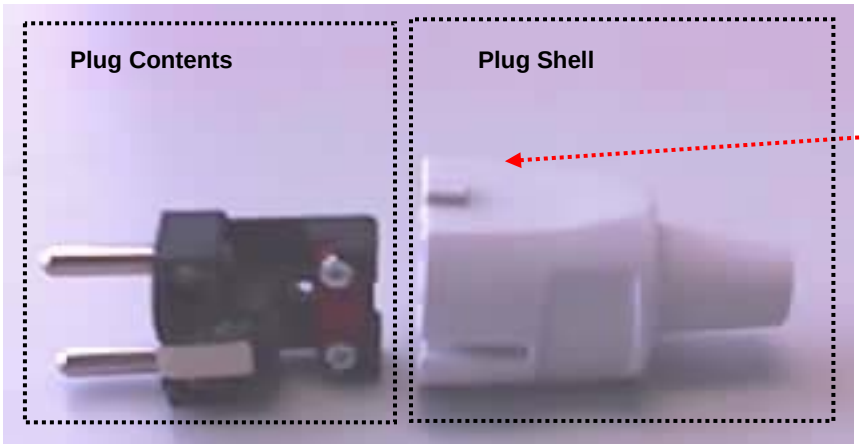


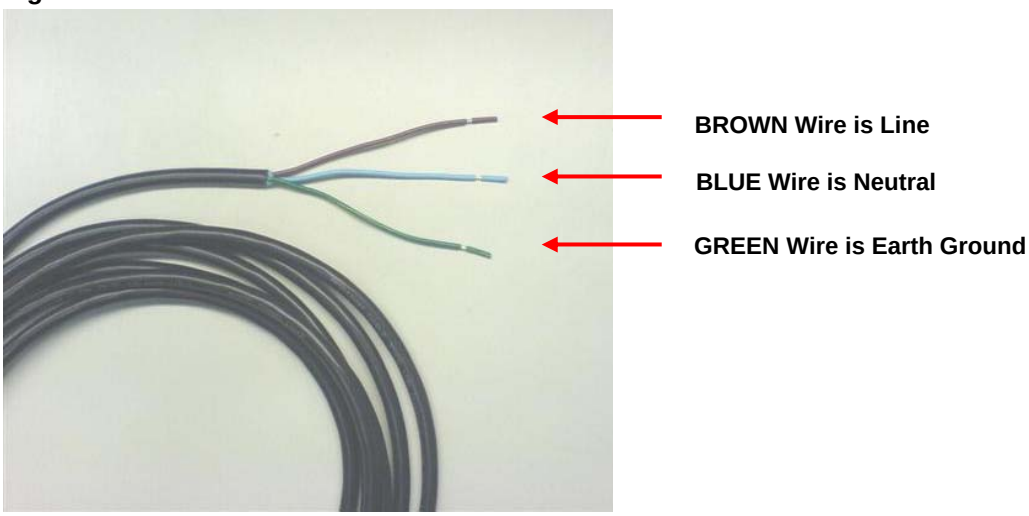
Figure 9-13 Side View of Plug Contents and Plug Shell



Part II – Power Cable with Flying Leads

1. The initial Power Cable will have three wires: Brown (Line), Green (Ground), and Blue (Neutral).

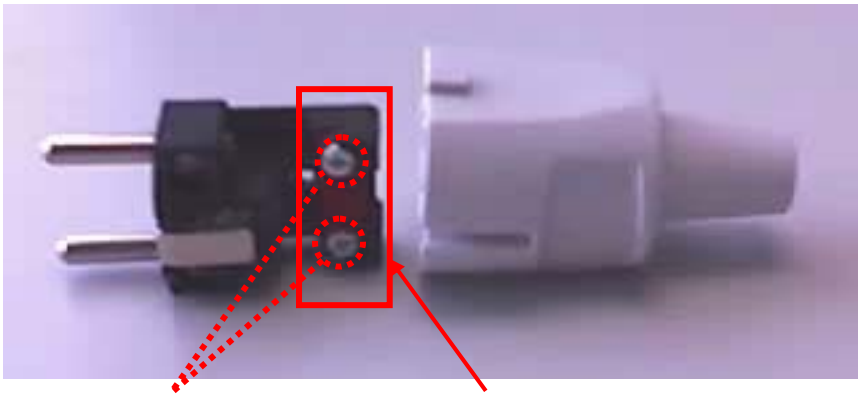
Figure 9-14 Initial Power Cable View



Part III – Power Connector and Cable Assembly Instructions

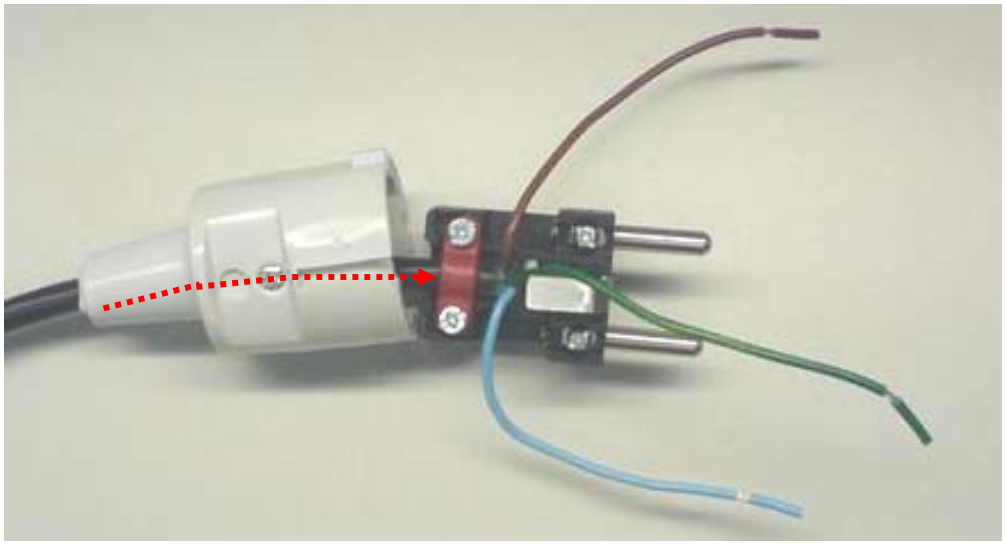
1. Loosen the *Strain Relief Screws* on the plug.

Figure 9-15 Side View of Plug Showing Detail of the Stress Relief Bar and Screws



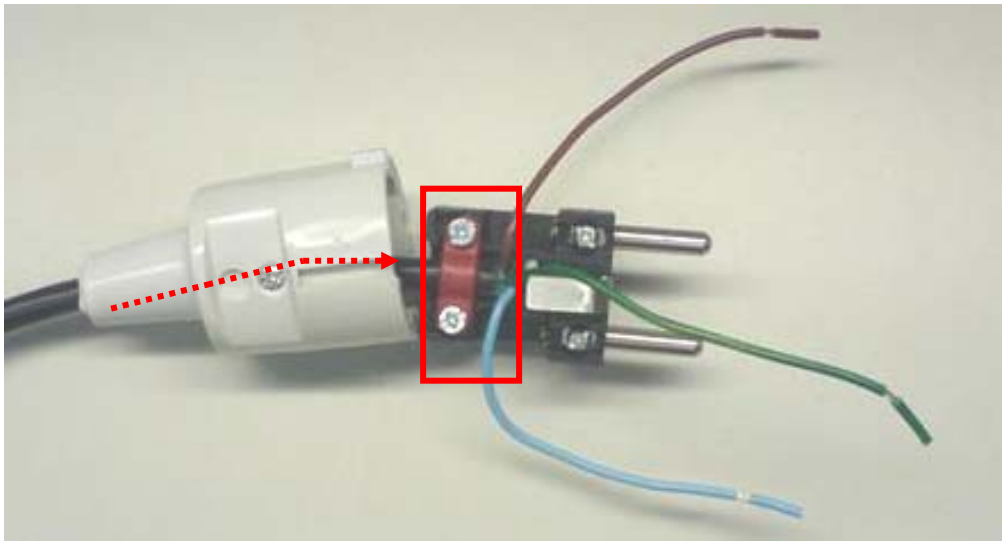
2. Pull the three wires through the rear of the plug until they are visible in front of the plug.

Figure 9-16 Power cable pulled through the Plug Shell and Under the Stress Relief Bar



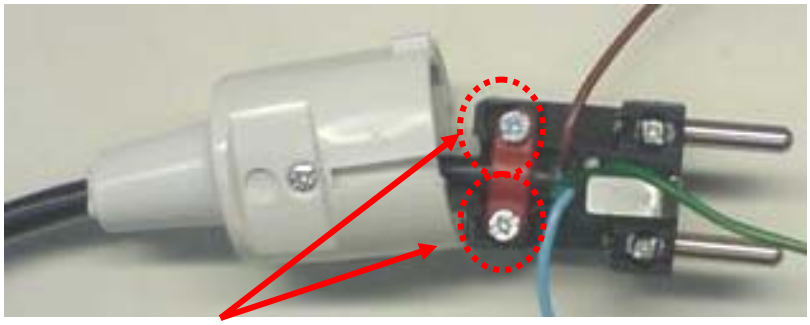
3. Press the wire base *under* the *Strain Relief Bar* so that the main cable is *not* visible on the other side of it.

Figure 9-17 Wire Base is Not Visible on the Right Side of the Stress Relief Bar



4. Tighten the two *Strain Relief Bar Screws* to lock the cable in place.

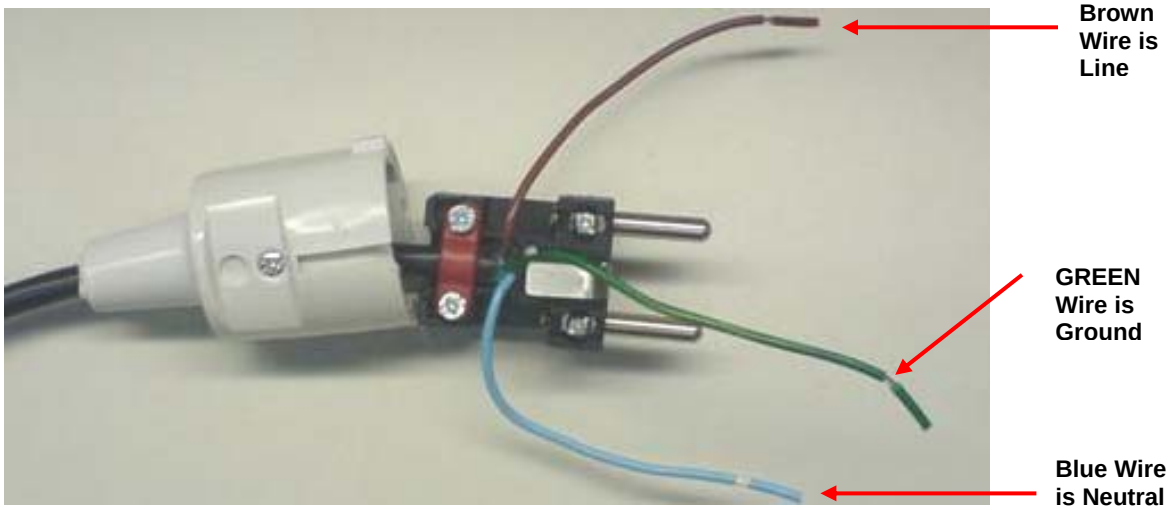
Figure 9-18 Stress Relief Bar Screws



Strain Relief Bar Screws (2)

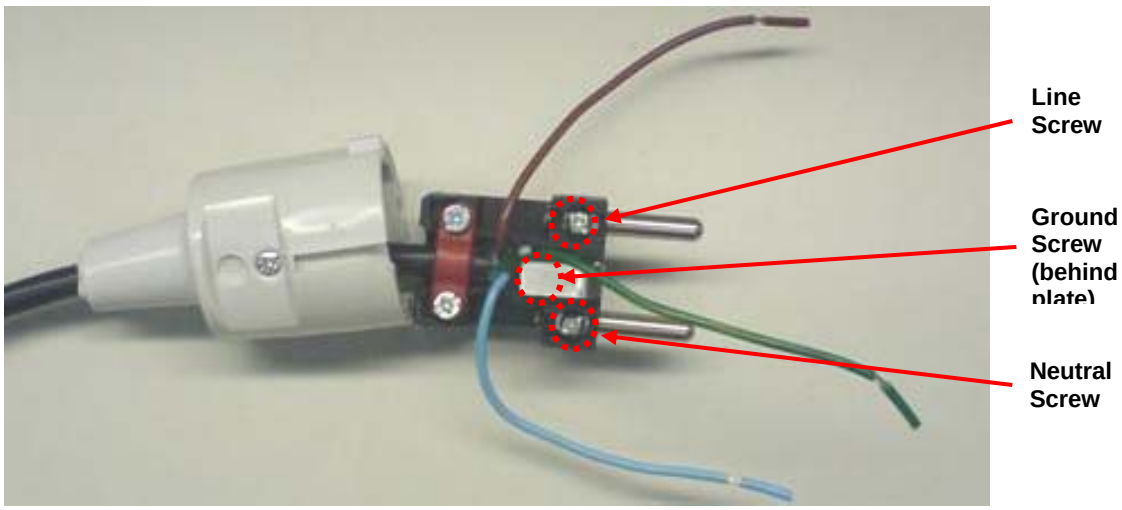
5. Spread out the three wires, so that the **Blue** wire is on the right side, the **Brown** wire is on the left hand side, and the **Green** wire is in the center.

Figure 9-19 Power Cable Designations



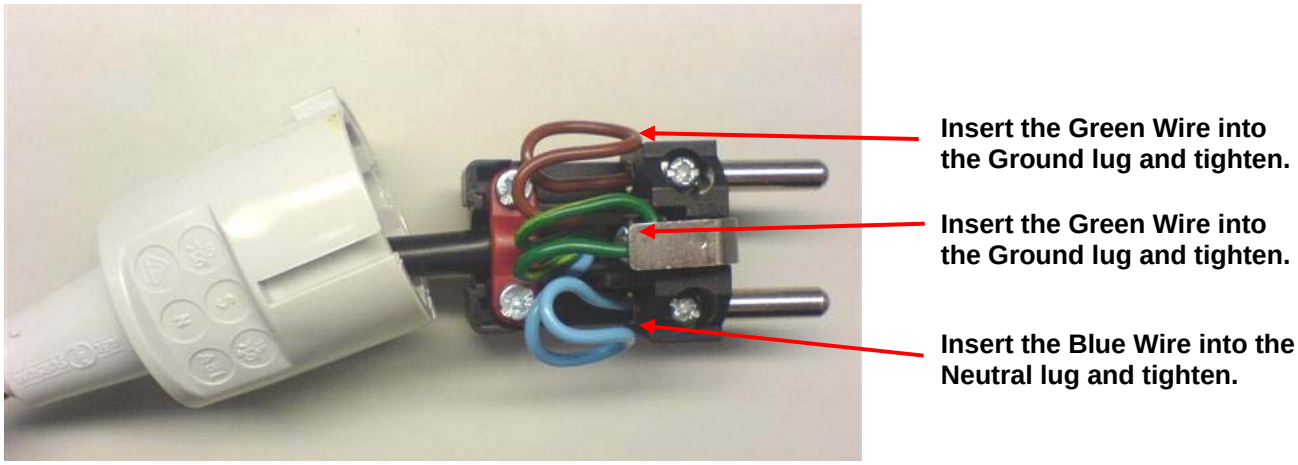
6. Loosen the Neutral, Line, and Earth Ground Screws.

Figure 9-20 Position of the Neutral, Line, and Earth Ground Screws



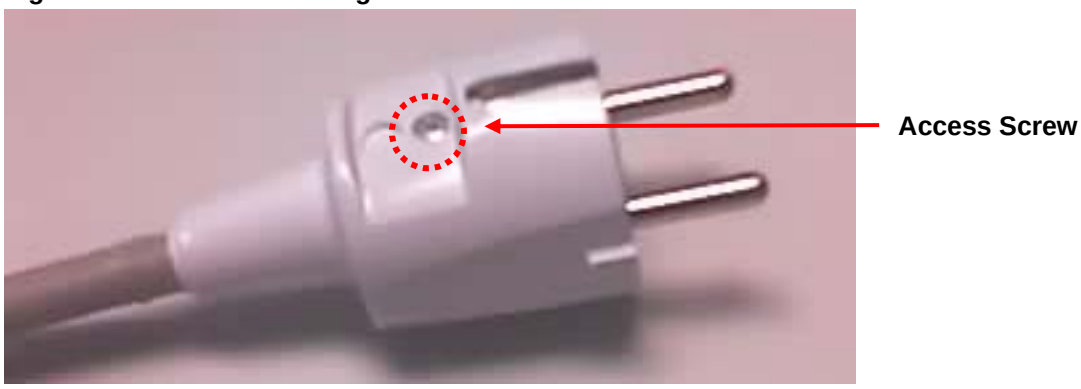
7. Spread out the three wires, so that the **Blue** wire is on the right side, the **Brown** wire is on the left hand side, and the **Green** wire is in the center.
8. Attach the cable wires to the terminal plug in the following way:

Figure 9-21 Correct Position of the Cable Wires Attached to the Plug.



9. Fold the plug back into a closed position and turn the plug to show the access screw. Tighten the *Access Screw* on the plug to lock the plug assembly in place.

Figure 9-22 Finished Plug



Australian Wiring Instructions

The following instructions describe how to assemble the enclosed power connector to the power cable's flying leads.

Part I – Power Connector Parts

1. The (out-of-the-box) Australian power connector plug along with its power assignment is shown in the graphics below.

Figure 9-23 Front View of the Australian Power Connector Plug

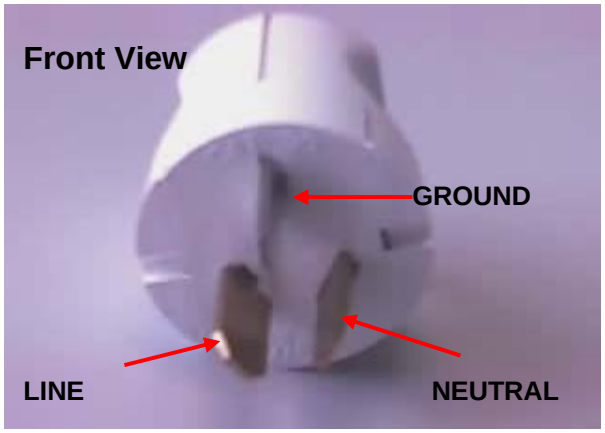
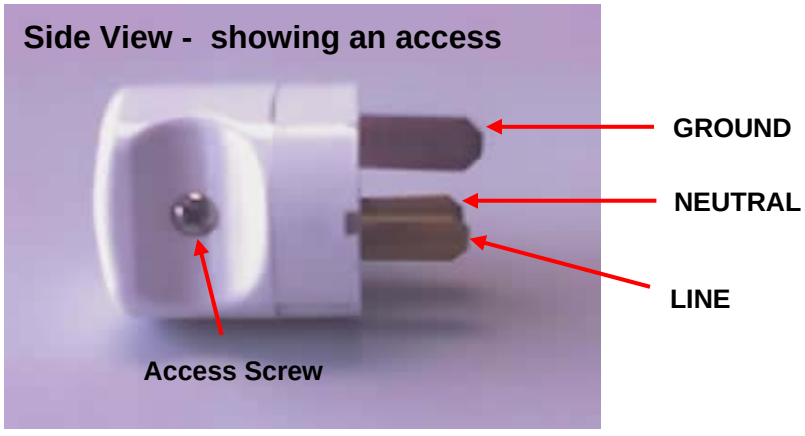


Figure 9-24 Side View of the Australian Power Connector Plug



2. Loosen the *Access Screw* on the plug until its contents are accessible, as shown in the graphics below.

Figure 9-25 Front View of the Australian Power Connector Plug with Opened Sides

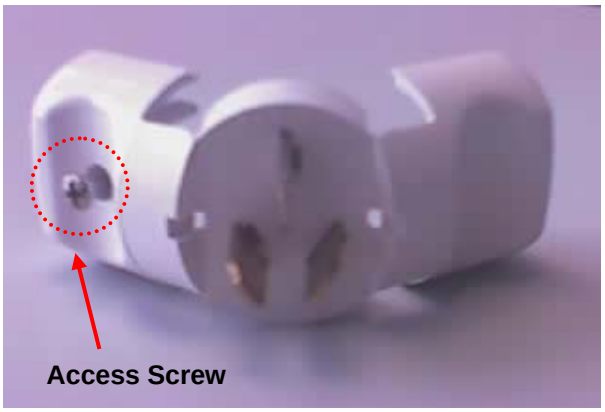
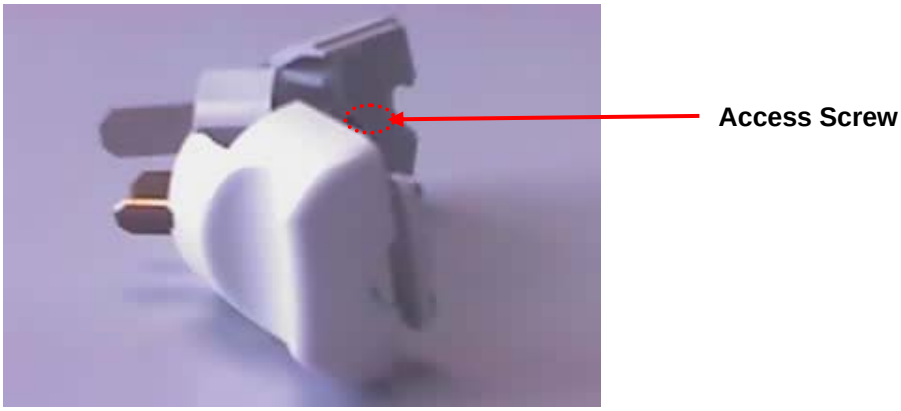
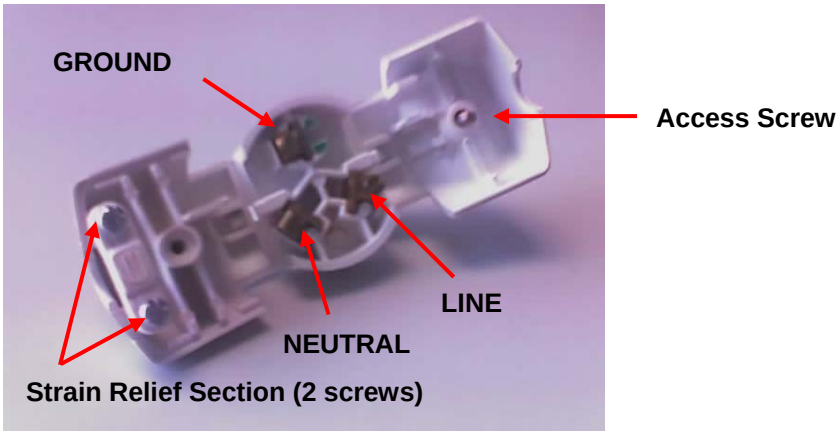


Figure 9-26 Side View of the Australian Power Connector Plug with Opened Sides



3. Place the plug down with its contents open and facing up. The *Strain Relief* section of the plug should be on the left hand side, as shown in the graphic below.

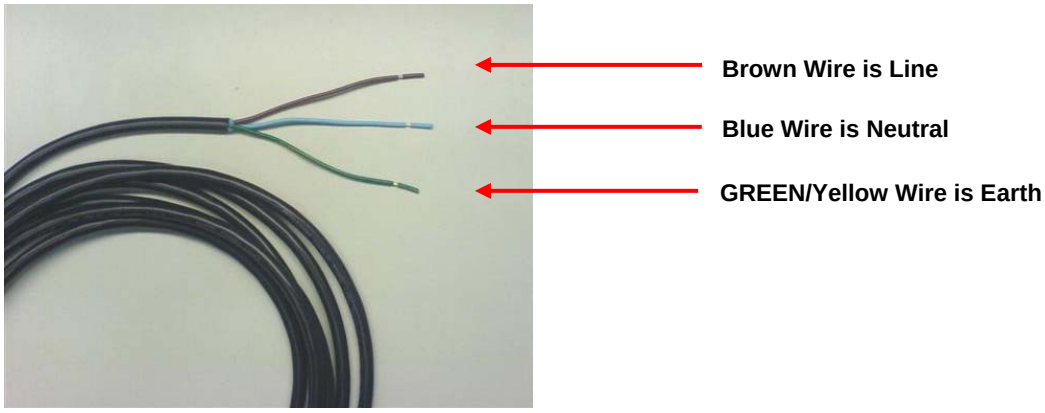
Figure 9-27 Inside View of the Australian Power Connector Plug



Part II – Power Cable with Flying Leads

1. The initial Power Cable will have three wires: Brown (Line), Blue (Neutral), and Green/Yellow (Ground/Earth).

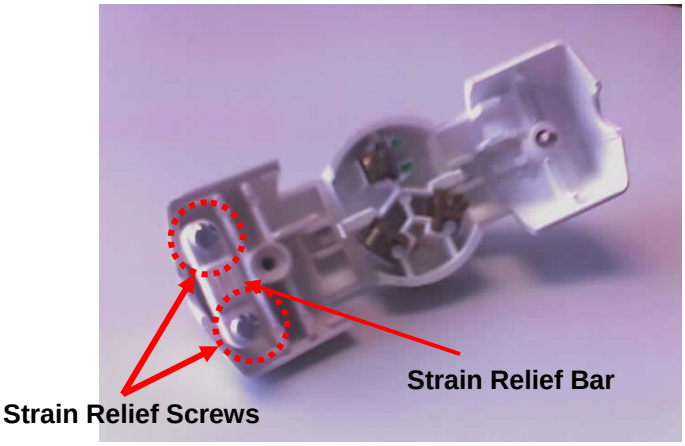
Figure 9-28 Power Cable with Wire Designation



Part III – Power Connector and Cable Assembly Instructions

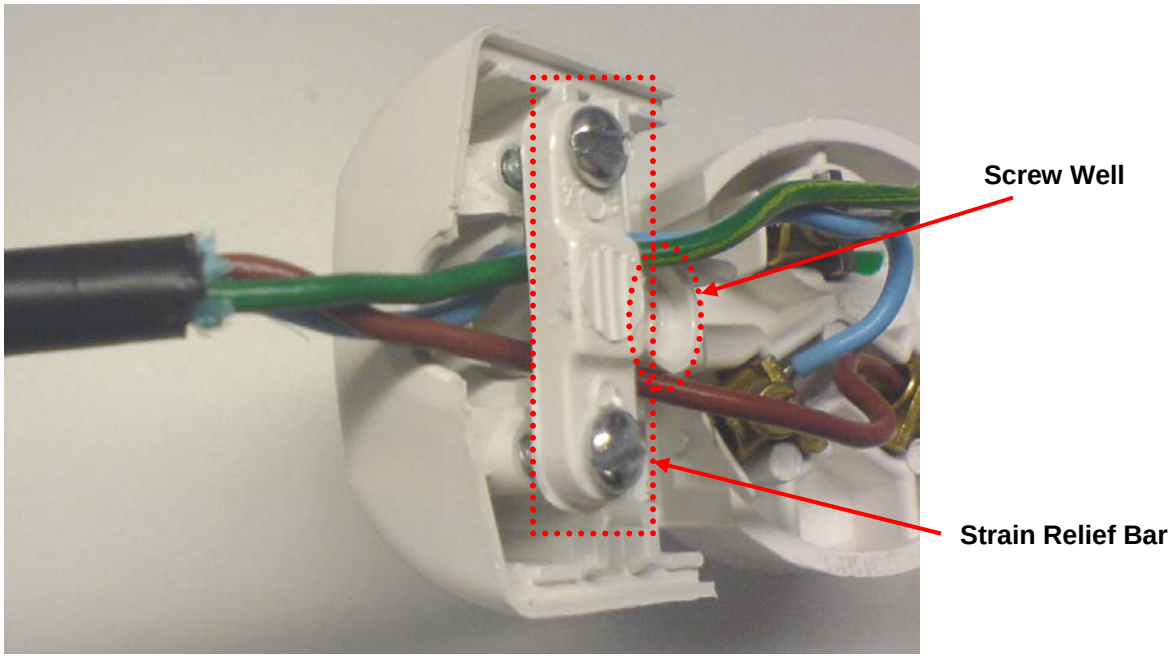
2. Loosen the *Strain Relief Screws* on the plug.

Figure 9-29 Inside View Pointing out Strain Relief Bar and Screws



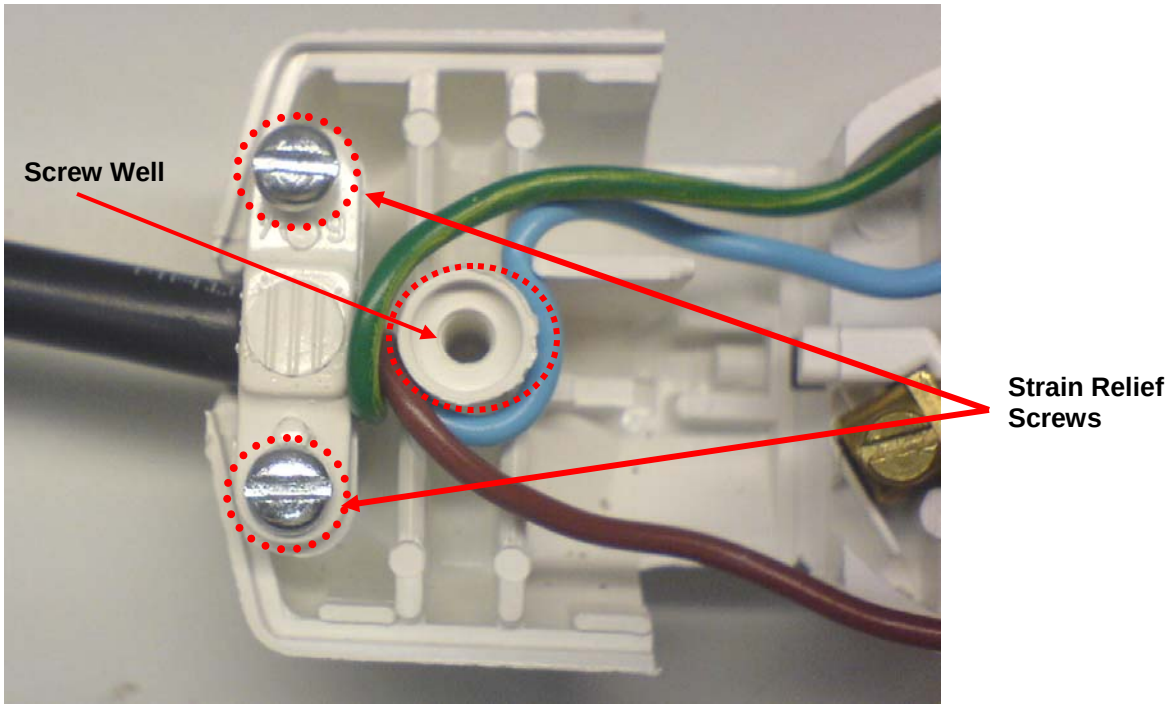
3. Place the three wires **under** the *Strain Relief Bar* and pull through. Allow the **Blue** and **Green Wire** to pull through on the left side of the *Screw Well* and the **Brown** Wire to pull through on the right hand side of the *Screw Well*.

Figure 9-30 Correct Wire Positioning on Either Side of Screw Well



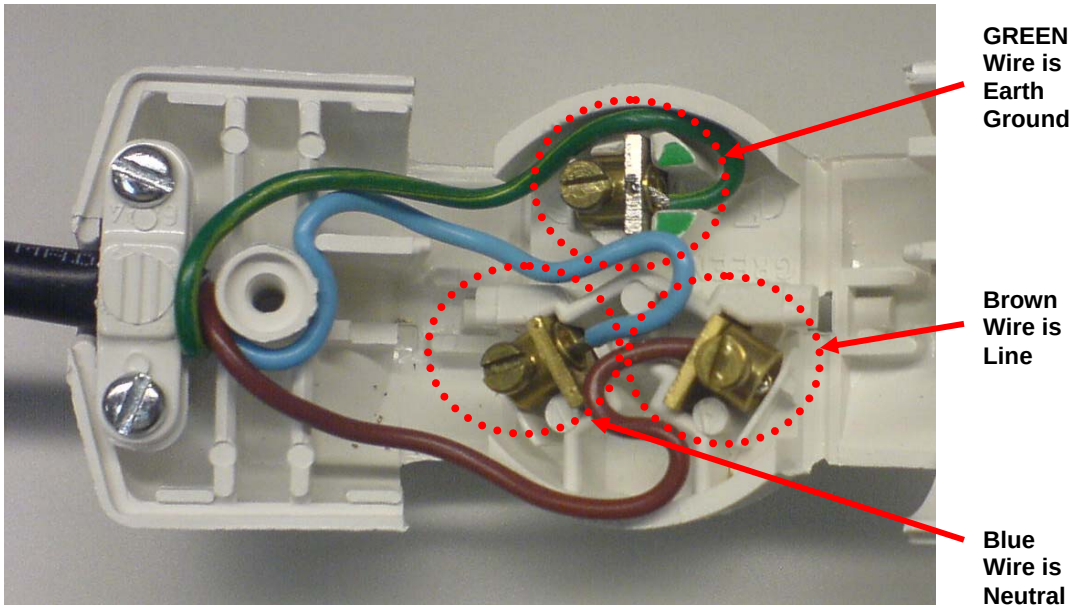
4. Press the wire base against the plug so that the wires are pulled through and the cable fits snugly at the base of the plug. Tighten the two Strain Relief Screws to lock the cable in place. See the graphic below for an example of the desired effect.

Figure 9-31 Correct Position of the Cable Below the Strain Relief Bar



5. Attach the cable wires to the terminal plug in the following way.

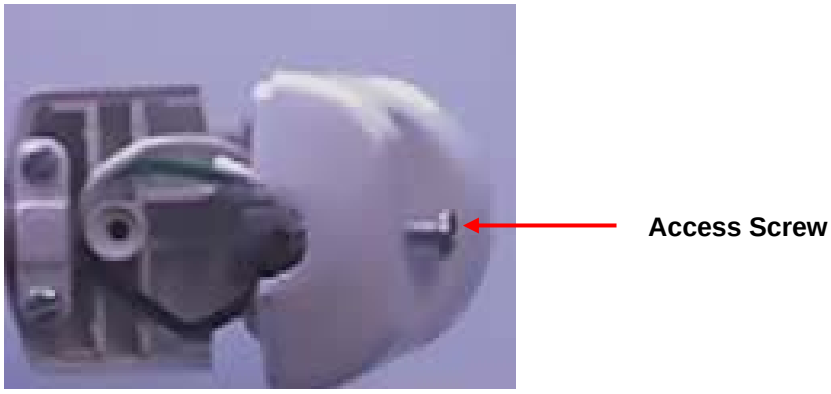
Figure 9-32 Correct Wire Attachment to the Terminal Plug



- Insert the Green Wire into the top (Ground) lug and tighten.
- Insert the Blue Wire into the Bottom Left (Neutral) lug and tighten.
- Insert the Brown Wire into the Bottom Right (Line) lug and tighten.

6. Fold the plug back into a closed position and tighten the *Access Screw* on the plug to lock it.

Figure 9-33 Position of Access Screw When the Plug is folded Half Way



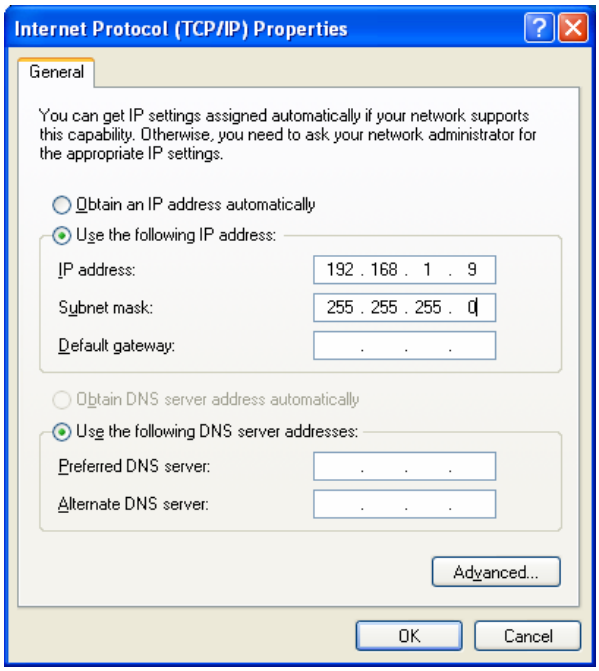
7. The finished power connector and cable assembly will look like the images shown below:

Backdoor Access to a MOTOMESH Duo Device via the Web Interface

The following procedure allows *backdoor* access to a MOTOMESH Duo device after it has been deployed

10. A Duo Device backdoor can only be accessed by a client card across the 2.4 GHz wireless radio. A Duo device's default IP address is 192.168.1.1
11. Configure a wireless client adapter with a static IP address as indicated below

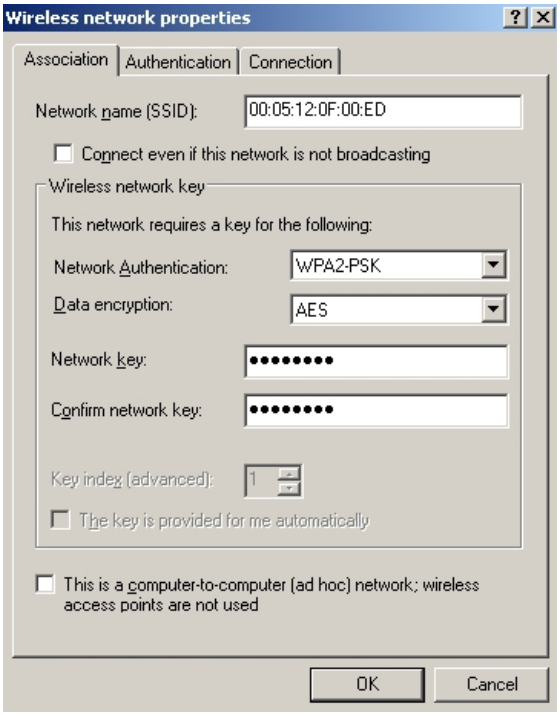
Figure 9-34 Configuring a Wireless Client Adapter with a Static IP Address



12. From a client card utility. Establish a profile as indicated below.

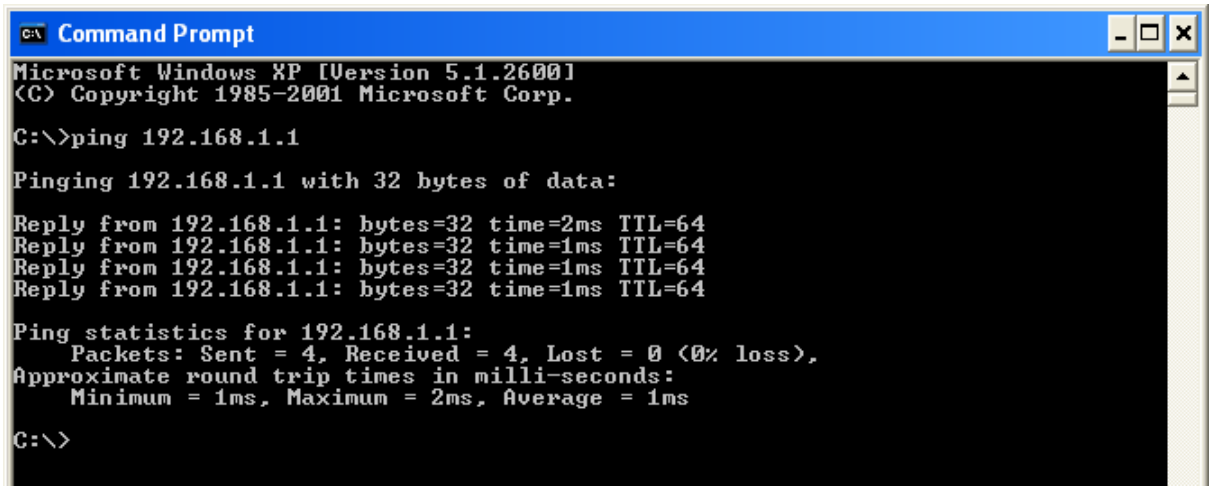
    NOTE: user must specify SSID manually. This is because a Duo device's backdoor access SSID is suppressed. The SSID is the MAC address of the device label in all capital letters separated by colons.

Figure 9-35 Creating a Profile



13. You should now be connected to the backdoor VAP (Virtual Access Point). Verify by attempting to ping the MOTOMESH Duo 2.1 device's default IP.

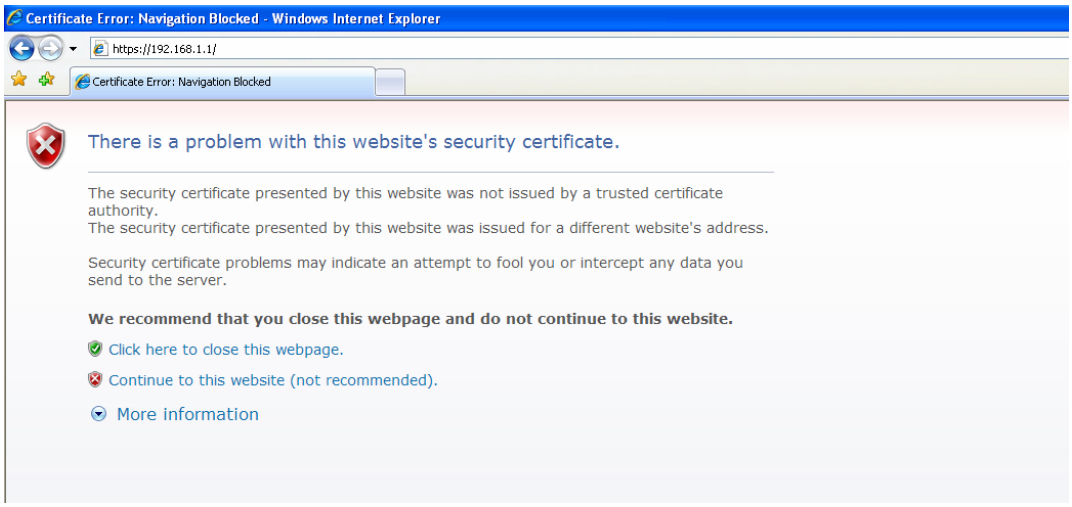
Figure 9-36 Verify Backdoor Access by Performing a Ping



14. Disable all Internet Explorer proxy settings upon your computer

15. Open Internet Explorer. Type **https://192.168.1.1**
16. Click Continue to website

Figure 9-37 Select "Continue to Website" in Internet Explorer

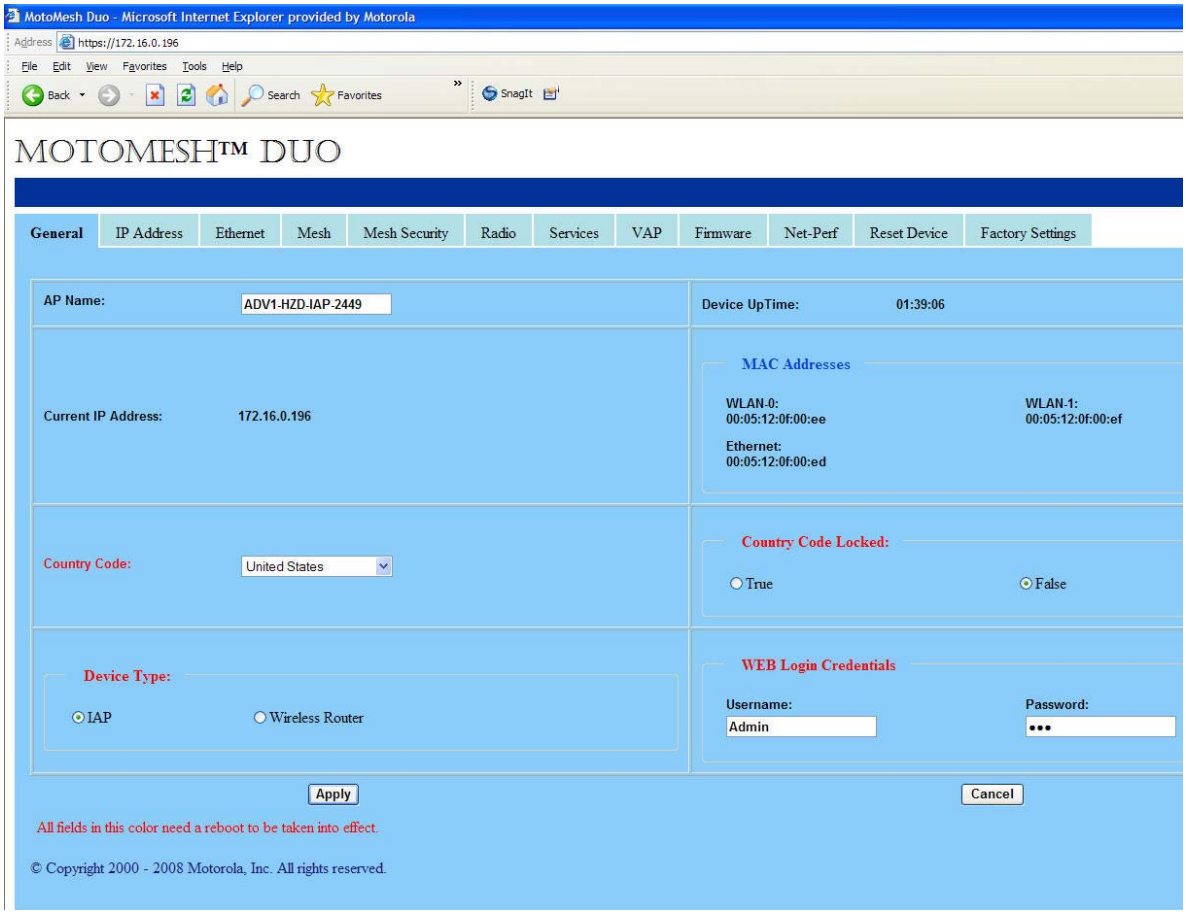


17. Enter Username and Password Information

Figure 9-38 Login to the MOTOMESH Duo 2.1 Backdoor

18. You should now see the General Settings section of the web-interface

Figure 9-39 General Settings Tab in the Web User Interface



MOTOMESH Duo Infrastructure Device Labels

The following are samples of device product labels.

Figure 9-40 MOTOMESH DUO 4300 - 49 AC and DC Device Product Labels (Samples)

Figure 9-41 MOTOMESH DUO 4300 - 58 AC and DC Device Product Labels (Samples)

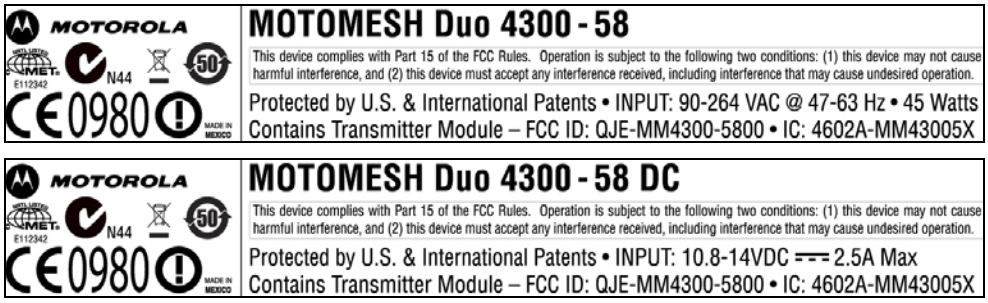


Figure 9-42 MOTOMESH DUO 4300 - 54 AC and DC Device Product Label

(Samples for European Use only)

Dynamic Frequency Selection

The following section details notes and questions concerning the 2.4 / 5.4 GHz MOTOMESH Duo and dynamic frequency selection in the presence or radar triggers and interference. First it is important to detail the auto channel selection feature and the specific behaviors with respect to radar and interference will be discussed.

Auto-Channel Selection

Auto-channel selection is a feature that attempts to choose the best operating channel for one of the transceivers in a Duo access point at the time it is initiated. Auto-channel selection can be enabled / disabled independently on both the 2.4 GHz and 5.4 GHz transceivers in the Duo product.

Preferred Channel List

Each access point has a list of preferred channels that are configured by the operator. The list contains all of the channels that a Duo device is allowed to operate in for a given transceiver. There is a separate preferred channels list for the 2.4 GHz and the 5.4 GHz transceiver. When a scan is performed only the channels in this preferred channel list are considered.

Scan Triggers

An auto channel selection scan is triggered by five stimuli:

1. Reboot – Upon reboot the Duo transceivers will auto channel select on each of the transceiver that it is enabled on.
2. Very high route metric – The Duo node will automatically establish a route to the best IAP in its current operating channel. This IAP route is selected based on the lowest routing metric to an IAP and is constantly updated. If adverse channel conditions are encountered the route metric will become higher than channels that are not impaired. If the auto-channel selection feature is enabled, and the current best IAP has a route exceeding a high threshold for 10 minutes then the device will initiate an auto channel scan to find an operating channel where a route to new route to an IAP can be established with a lower (better) route metric. If the result of the scan indicates that the original channel is still the best operating channel, the Duo will return to the original channel.
3. Extremely high noise floor – When a noise floor is detected that would prohibit successful communication with other devices the Duo will reboot and initiate the channel scan detailed in 1.
4. DFS radar detection – When radar is detected and the auto-channel scan is enabled, the radar detection will trigger and auto-channel scan.
5. One Point Wireless Manager has the ability to initiate a channel rescan, either as a periodically scheduled or one-time event.

The Scan

Once a scan is triggered on a transceiver that has auto-channel scan enabled the Duo will switch to the next channel in the preferred channel list and listen passively for a few hundred milliseconds. While it is listening, it records all of the beacons that are present in the channel. Duo then moves to the next channel in the list until all of the channels have been sampled. If the trigger that caused the scan was a DFS trigger that channel is marked unavailable for 30 minutes and it is not scanned. Once the scan is complete an algorithm inspects the list of beacons in all of the available channels and picks a channel that has the best route metric and channel conditions to an IAP. It then retunes to that channel. Under

DFS regulations, this node is required to listen passively for radar for 60 seconds after retuning to the channel before transmitting. After 60 seconds has expired with no radar present the transceiver resumes normal operation.

Our recommended configuration is to select two to three channels in the preferred channel list based on a channel plan developed during the installation/field findings.

Question #1:

Radar signal on the 5.4 GHz
How does the system react to a detected radar signal?

The MOTOMESH Duo Platform supports the DFS Regulations as outlined by ETSI EN 301 893 version 1.2.3. In this version the IAPs and MWRs will adhere to the regulations by avoiding or leaving channels that where radar is detected. If the auto-channel scan feature is enabled it will begin when a radar signal is detected. If the feature is disabled the radio will cease transmissions for 30 minutes. It should be noted that channel interference can come from many sources is often an isolated one-time or intermittent event. Our Duo nodes are designed to ignore these and maintain the network channel plan unless severe, sustained interference is sensed. At the same time, features in Wireless Manager allow the network operator to monitor changes in channel characteristics and investigate further if intermittent interference impacts performance.

Impact of Radar Avoidance on a Mesh Network: Radar detection by a node will not necessarily disrupt the entire network. If a node detects radar, it is possible that other nodes will not detect the same radar. Some nodes might be in geographically different areas where the radar may not be seen. For example, a node might be on a hill where other will be in a valley and not detect a radar pulse.

If the node detecting the radar is an IAP and a channel scan is initiated, the IAP will establish operations on the channel identified in the scan process after 60 seconds has expired. All of the associated MWRs will loose their associations with the IAP since it has changed channels. They will first attempt to use the next best IAP in their current operating channel. If a satisfactory route to an IAP is not discovered in the current operating channel, after 2 minutes they will initiate a scan to find the best IAP in one of the operating channels in their preferred channel list. During the second scan, the MWR would normally sense the new channel that the IAP had selected and re-associate, completing the reconfiguration of the network.

The operator can use Wireless Manager's Conflicted Channels Analyzer to view the conflicted channels list which shows the channels that have been abandoned due to radar signal

Question #2:

Co channel interference in 2.4 and 5.4 GHz.

a. *How does the system deal with an interference source?*
b. *How can a network operator react to such situation?*

We will outline the behaviors related to interference on the 2.4 or 5.4GHz radios and include how the MOTOMESH Duo product reacts to different levels of interference on these radios as well as how the operator can react to these scenarios.

Auto Channel Scan on the 2.4GHz radio:

- The Duo will scan all channels or a specified list of channels on the 2.4GHz radio of an IAP or a 2.4GHz radio that is dedicated to client access (i.e. is not being used for backhaul)
- The Auto Channel scan will look for AP traffic on all channels or the preferred list of channels, specifically WiFi standard beacons.

- When the scan concludes, the decision on how a channel is chosen is based on the strength and number of beacons on each channel. Also, non-overlapping channels are weighted as highly preferred channels.
- This scan can occur through three different methods:
    - Upon the Boot-up
    - Through a manual channel rescan command via Wireless Manager
    - Through a scheduled channel rescan command via Wireless Manager

High Interference and channel scan on the 2.4GHz radio

- High interference can be defined as the Duo node being incapable of receiving or transmitting due to an extremely high noise floor.
- In this case, the Duo node will initiate a reboot if it is in this state for an extended amount of time.
- The reboot will force the node to execute an Auto Channel Rescan where it is expected to select a channel that is cleaner.
- If this still exists, the Duo node will keep rebooting until it finds a cleaner channel.
- An operator of the network has the ability to monitor this behavior through Wireless Manager. If a Duo node is rebooting due to extreme interference, a threshold alarm can be set that will indicate a frequent node that is rebooting. Through this threshold alarm, a network operator will be notified that a node has had a high number of reboots which would highlight further investigation of that node.

High Interference and channel scan on the 5.4GHz radio

- High interference can be defined as the Duo node being incapable of receiving or transmitting due to an extremely high noise floor.
- The behavior for the 5.4GHz radio is similar to the behavior of the 2.4GHz radio during high interference. However, the channel scan on a 5.4GHz radio is different. It is also different between IAP's an MWRs.
- When an MWR initiates a channel rescan, it will look for an IAP.
- If there are multiple IAP's that are within range, it will choose the IAP based on the best link metric.
- When an IAP disappears, the MWR will prefer to stay on the current channel rather than rescan on other channels.
- It will scan the current channel for other IAP's and once again choose the IAP that has the best link metric.
- If it does not find an IAP on that channel, it will trigger a channel rescan.
- After this channel rescan concludes, it will have chosen a new channel and a new IAP on that channel.

Impact of Interference Avoidance on the Network:

The impact of interference avoidance in the network is similar to the impact of radar avoidance. The exception is that the channel in which the interference is detected is not blacklisted for 30 minutes when a scan is initiated.