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NETNode Operations Guide

IP Mesh Systems

Tactical Communications and Surveillance

Commercial in Confidence

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0. Preface

0.1 About this Publication

This publication contains details required for the Operation and Administration of the equipment or system.

Since the available functions are licensed and rely on the actual installation, not all the functions and or applications contained in this document can be related or applicable to the system you will be working with.

Actual screen presentation can be different from those in this document because of software changes or your browser configuration.

0.2 Who Must Read this Publication

This publication is meant for anyone interested in how the system can best be used, but it is of most benefit to:

- **Operators** who are in charge of the daily operation of the equipment.
- **Installers** who are responsible for the pre-installation, on-site installation and configuration of the system in the end-user environment.
- **Maintainers** who are responsible for maintaining the equipment or system.

0.3 Your Knowledge

In this publication we think you have a full knowledge of:

- Basic Personal Computer Operations.
- Basic Radio Frequency (RF) Principles.

0.4 Notice about Specifications

While Cobham tries to keep the precision of the information contained in its material guides, the information can change without notice. Performance specifications included in this publication are included for customer guidance and to help system installation. Actual operating performance can change.

0.5 Notice about this Guide

The material described in this publication has continuous development and improvement. All applicable details of the material and its functions (with the information and applicable details in this guide) are given by Cobham in good faith. But, it is acknowledged that there can be errors or omissions in this guide.

0.6 Typographic Conventions

This publication uses these typographic conventions to identify text that has a special meaning:

Typographic Convention	Example
TEXT in small capitals represents a key push on the console **keyboard** or hardware **panel**.	ESC, F1, SHIFT
The + sign means "hold down the first key while pushing the second key".	Push CTRL+C to abort
<Text> Serves as a placeholder for text that you will replace as applicable to its context.	Use the filename <systemname>.sys for…
Text in **bold** emphasises a new word or term of significance.	We name this a **protocol** and its function is…
[-a] Text in these brackets shows an optional component that can be left out.	Ls [-a]
NN This shows a value entered on a **numeric keypad**.	45 on the numeric keypad
Successive menu selections are shown with **arrows** to show a sub-menu. In this example this means: Select the **Insert** menu, then select **picture**, then select **from file**.	**Insert** > **picture** > **from file**

0.7 Symbols

This publication uses these symbols to highlight important information:

WARNING: A written notice given to a reader when a situation might cause personal injury or loss of life.

CAUTION: A written notice given when a situation might cause damage to or destruction of equipment or systems.

Note: A written notice given to tell you something or to supply more information.

0.8 Trademarks

All trademarks or registered trademarks in this publication are the property of their related owners.

0.9 Related Publications

It can also be necessary to read:

Publication	Source
NETNode User Guide	Cobham Tactical Communications and Surveillance
IP Concept Guide	Cobham Tactical Communications and Surveillance

0.10 Revision History

This publication was written and produced by the Cobham Technical Publications Team.

This is a change controlled publication. Each page of this publication shows a revision number at the bottom left corner.

Changes to a page will increase the revision status of the full publication.

Revision	Date	Authors	Summary of Changes
Draft 1	2012-11-19	R Cogswell	Initial draft document for review.
Revision 1.0	2012-11-19	R Cogswell	First formal release.
Revision 1.1		C Baudouin	Updates to manual.
Revision 1.2	2012-12-11	R Cogswell	Formatting review.
Revision 1.3	2010-12-14	C Baudouin	Added V4.2 features.
Revision 1.4	2013-11-03	C Baudouin	Added V5.0 features.
Revision 1.5	2013-12-13	C Baudouin	Added V5.2 roaming.

Revision	Date	Authors	Summary of Changes
Revision 1.6	2014-07-17	C Baudouin	Added V5.4 interlink updates.
Revision 1.7	2014-09-30	R Cogswell	Fixed limit to Mesh ID. STE-100 Compliant.
Revision 1.8	2015-08-03	I Reilly	Added AES key Apply, how to License and Upgrade

Contents

1. Basic Operation

1.1 General

This chapter covers day to day operations of a **fully configured** NETNode system.

When installed and configured the NETNode is easy to operate. These guidelines will help you do basic operations on your NETNode.

Note: If you are working with a new system or it is necessary to change a configuration, look at the **Advanced Operation** and **Advanced Setup** in this guide.

1.2 Starting and Stopping the NETNode

NETNode units don't have power switches – you simply apply power to them and they will start up.

Before you start

This is necessary:

- A NETNode
- A source of power.

Step 1: Powering Up

1. Energize the NETNode with one of the procedures in *Setting up your NETNode*.
2. On the front panel, the Indicator LED will show stable red. You can see the Indicator LED change to stable green depending on the condition of the network.

Step 2: Stopping

It is important to stop the system carefully. This makes sure that all procedures are stopped correctly and no data or settings are forgotten.

1. Disconnect the power cable from the NETNode.
2. On the front Panel, the LED will go out.
3. The system is shutdown safely.

Next Steps

Working with the IP Interface.

1.3 Working with the IP Interface

When working with NETNodes you'll be connecting with an IP interface and a web browser.

Step 1: Connect the NETNode to your Computer

1. Use the notes in *Setting up your NETNode*, to connect your PC to the NETNode.

Step 2: Start the Control Session

1. Power up the NETNode.
2. Click **Start** → **Internet** on the PC.
3. Your **browser window** will open.
4. Type the **IP address** of the NETNode you wish to configure like this example: **http://192.168.2.1/**
5. Click the **Refresh** button.
6. The web browser opens the **Status** →**Overview** page of the NETNode.

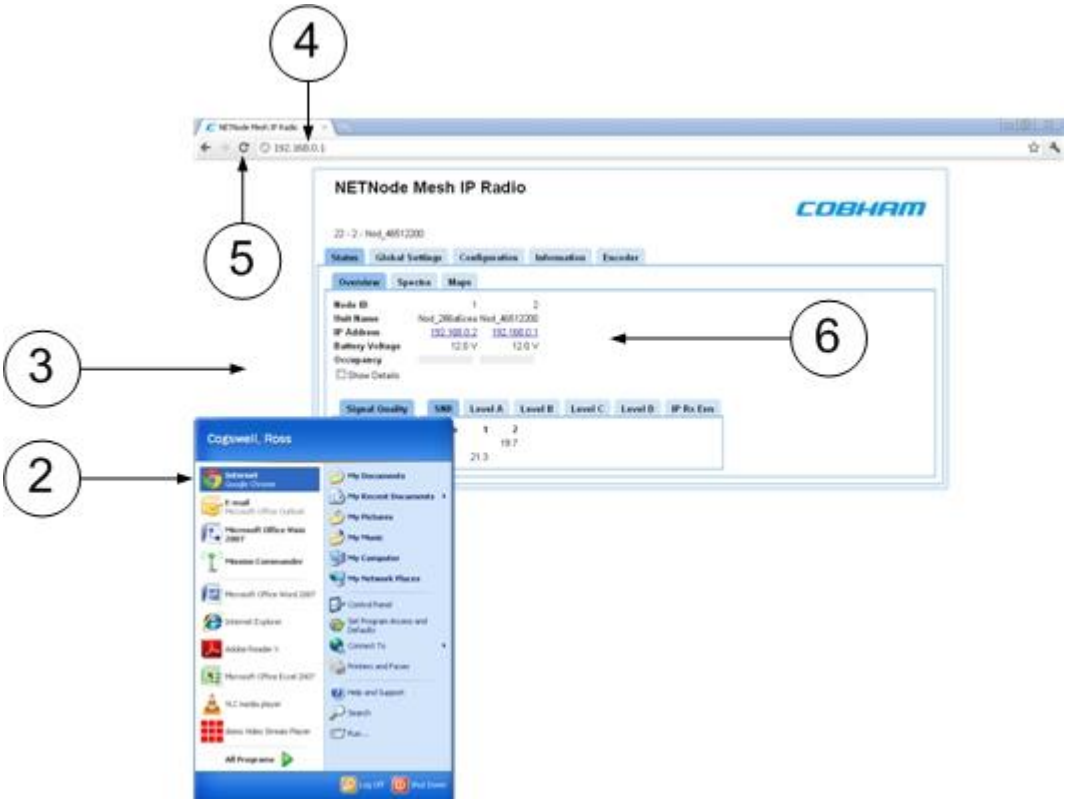


Figure 1-1 Starting a control session

Step 3: Log in to the Control Application

7. The **Authentication Required** dialog opens.
8. By default, the **User Name** is not required.
9. By default the **password** is meshweb.
10. Click the **Log In** button.

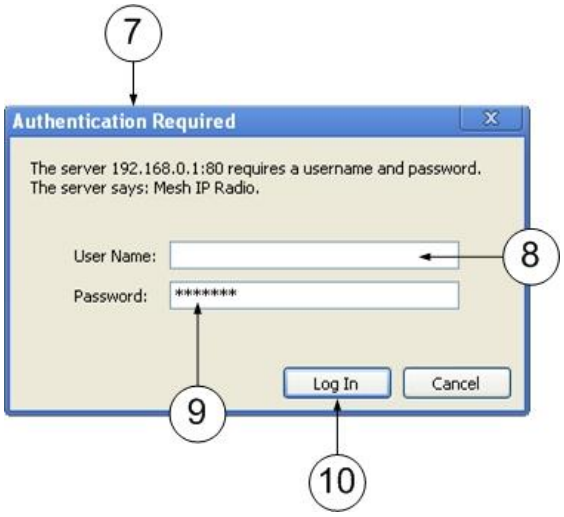


Figure 1-2 NETNode Authentication Dialog

At this time, you are logged in to the NETNode and can start configuring it to suit your operation. All the details of working with the Control System are located in *Advanced Setup*.

Note: If you are simply trying to get some NETNodes configured to operate together as a mesh network then jump to *Configuring the Basic Settings*.

1.4 Working with IP Cameras - Panasonic BB-HCM735

You will wish to operate with IP cameras across your mesh network. IP cameras are manufactured by many different companies and they each have different features. We'll use the example of a **Panasonic IP Camera** as it demonstrates many of the techniques that will be necessary on many manufacturers' IP cameras.

Before you start

This is necessary:

Like most IP cameras, the Panasonic BB-HCM735 comes with:

- Camera head with integrated microphone and PTZ mounting
- Power supply
- Software for the PC that will monitor and control the camera.

Step 1: Rig the Camera

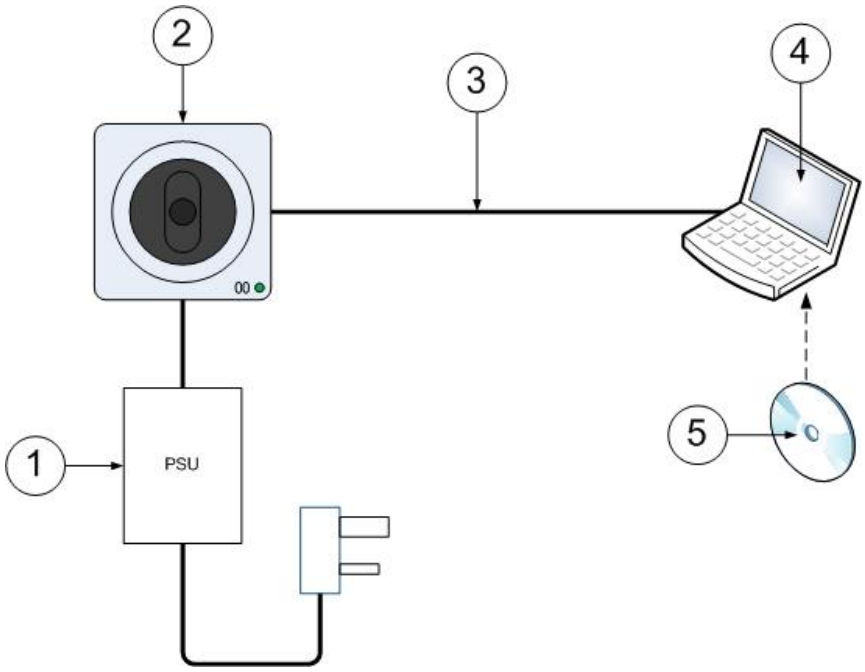


Figure 1-3 Rigging an IP Camera

Serial	Part	Description
1	Panasonic AC Adaptor, BB-HCA3	Converts 100-240VAC 50-60Hz to 12VDC 0.75A for the camera head.
2	Panasonic BB-HCM735 Camera Head	Has integrated camera, microphone and PTZ systems.
3	Ethernet Cable	The cable is used for the initial configuration. This will be replaced by the mesh network after setup.
4	Personal Computer	Needs to support video from the camera.
5	Panasonic Network Camera Software	The CD contains configuration setup and Network camera viewer software.

Table 1-1 – Rigging an IP Camera

Step 2: Configure the Camera for the first time

It is necessary to have all the parts in the diagram rigged as above.

1. Put the **Panasonic Network Camera Software disk** into your PC – it auto starts.
2. The **Network Camera** software starts.
3. Click the **Search for Cameras** button.
4. The **Easy Setup** dialog opens.
5. **Highlight** the camera you wish to operate with.
6. Click the **Network Settings** button.
7. The **Save Settings to Camera** dialog opens.
8. Set up a **fixed IP address** for the camera.
9. Click the **Save** button.

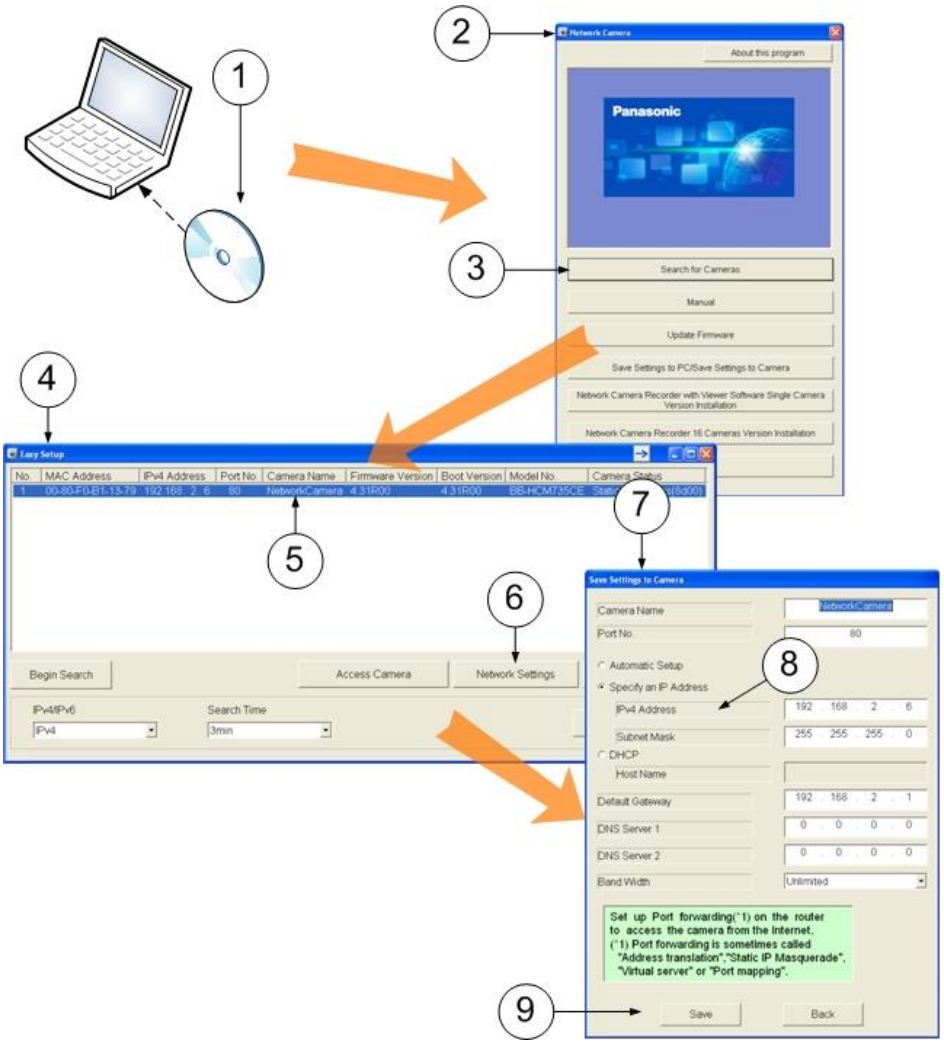


Figure 1-4 Panasonic BB-HCM735 setup

Step 3: Rig the Camera across the Mesh

It will be necessary to have two or more fully configured NETNodes, A configured Panasonic BB-HCM735 Network Camera and a PC with the Panasonic software loaded and configured.

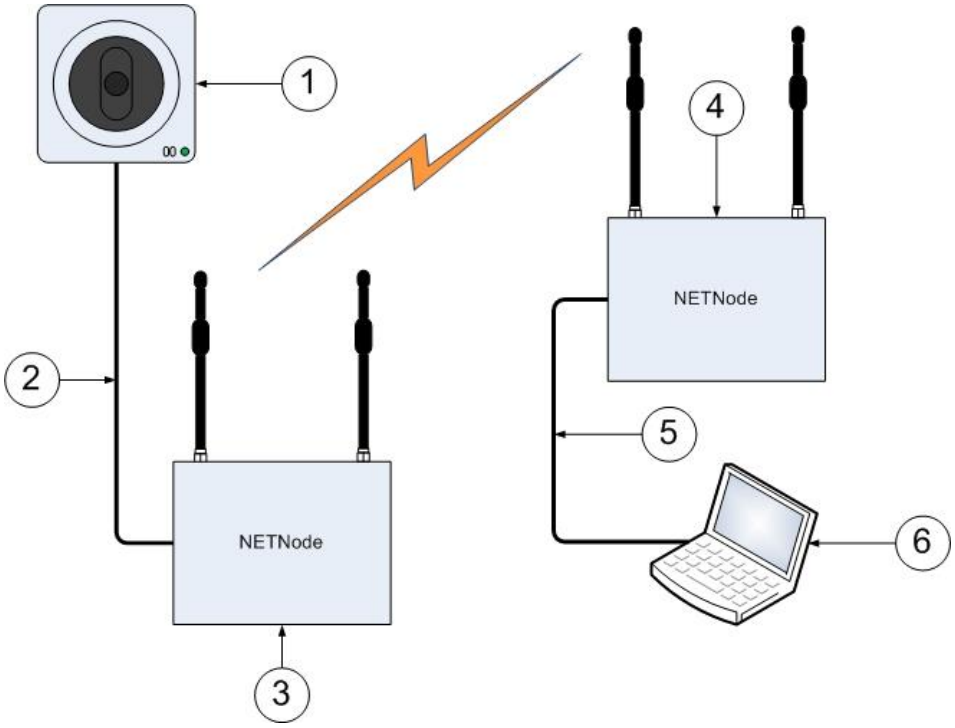


Figure 1-5 Sending IP video across Mesh

Serial	Part	Description
1	Panasonic BB-HCM735 Camera Head	Has integrated camera, microphone and PTZ systems.
2	Ethernet	You'll connect the camera to one of the two Ethernet ports available on the NETNode.
3	First NETNode	Located near the target.
4	Second NETNode	Located at the safe location.
5	Ethernet	You'll connect the PC to one of the two Ethernet ports available on the NETNode.
6	PC	The PC has Panasonic software pre-configured to monitor the output of the camera.

Table 1-2 – Sending IP video over Mesh

Step 4: Monitor the Camera across the Mesh

1. On the PC, click **Start →Internet** to open your web browser.
2. Type the **camera IP address** into the browser address bar.
3. Click **Refresh** button.
4. The **Connect to** dialog box opens.
5. Type in the **User name** and **password** for the camera.
6. Click the **OK** button.
7. The **Panasonic Viewing software** starts in your browser.
8. Click **Single** Tab.
9. The **Network Camera Control Page** opens.

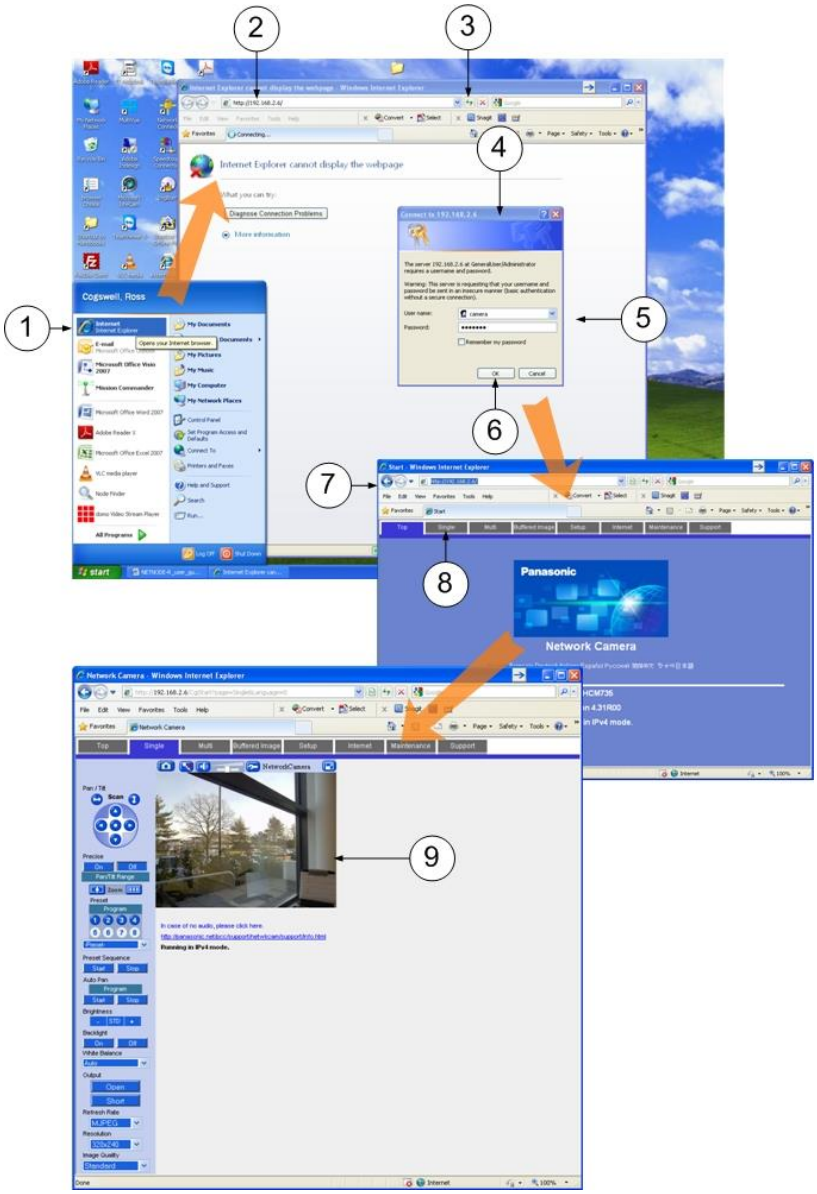


Figure 1-6 Connecting to IP camera across a Mesh network

With the Panasonic BB-HCM735 Network camera connected in this manner you can use the software to:

- Monitor the camera output
- Pan
- Tilt
- Zoom
- Move to Preset positions
- Scan in pan and tilt

Panasonic systems also support multi-camera display and some recording facilities.

You'll find many features in the software to let you to configure the camera:

- White balance
- Resolution
- Brightness
- Image quality
- IP Settings

Note: There are many types of IP camera that you could operate on a mesh system. They will all have different features. Study the documentation that comes with your chosen camera.

Note: You will monitor or listen to *most* assets in the same way depending on the device being used. Each IP device will have its own control software but is usually accessed by a web browser.

1.5 Working with Composite Cameras

Sometimes it will be necessary to use **composite cameras** across your mesh network. If the MESH node has an AVI option fitted then it will accept standard composite video (NTSC or PAL) and it will encode and stream the video across the Network. An Encoder Tab appears on the Web-browser if an internal video encoder is fitted.

Step 1: Check if your NETNode has the AVI board

The AVI board is a factory fitted option. Look at the device label which will have the letters AVI if the board is fitted.

You can also check by logging on to the NETNode and checking if the Encoder tab is displayed on the Control Pages. The encoder tab is only there when the board is fitted and the **Global Settings →Main →Auxiliary Address** is set to **1**.

Note: The Mini Mesh cannot be fitted with an AVI board.

Step 2: Connect a Composite Camera

It will be necessary to have a fully configured NETNode with AVI option fitted, a composite camera source and a PC to monitor the images.

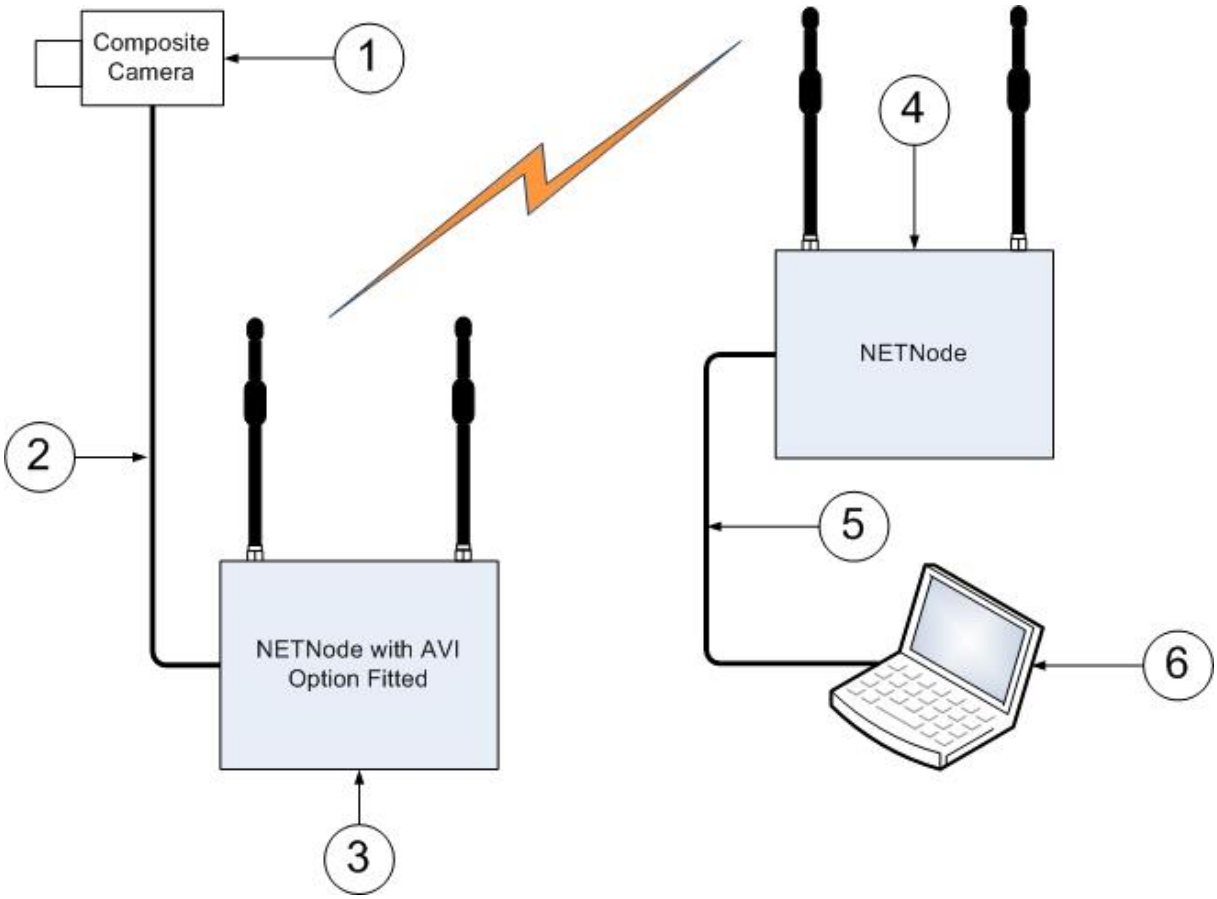


Figure 1-7 Sending composite video across Mesh network

Serial	Part	Description
1	Composite Camera	Connect the video output of the camera to the BNC 2-way plug (sockets) on the CA0477 A/V cable. Connect the audio output (if available) to the Phono 2-way plugs (pins) on the CA0477 A/V cable.
2	CA0477 A/V Cable Assembly	Connect the Amphenol 19-way plug (pins) to the Amphenol 19-way receptacle (sockets) on the NETNode. **Note**: Microphone power is on the audio connectors at approximately 3V (applicable for Electret microphones).
3	First NETNode with AVI option fitted	Located near the target. Remember, the Auxiliary address must be set at 1 to see the Encoder tab.
4	Second NETNode	Located at the safe location.

Serial	Part	Description
5	Ethernet	You'll connect the PC to one of the two Ethernet ports available on the NETNode.
6	PC	Has Cobham Stream player software or VLC software loaded and configured.

Table 1-3 – Sending composite video across Mesh network

Step 3: Configure the NETNode with the AVI Option Fitted

1. Connect your PC to the NETNode and **log on.**
2. Navigate to the **Encoder** tab.
3. Check that the **Video Lock** indicator is showing **green.**
4. Set the **Encoder Preset** drop-down box to **Medium rate (900kbps).**
5. Set the **Audio Enable** checkbox to **Checked** if you have an audio source connected.
6. Set the **Scrambling** drop-down box to **off.**
7. Click **Apply** button.
8. The **Encoder Configured Successfully** dialog opens.
9. Click **OK** button.

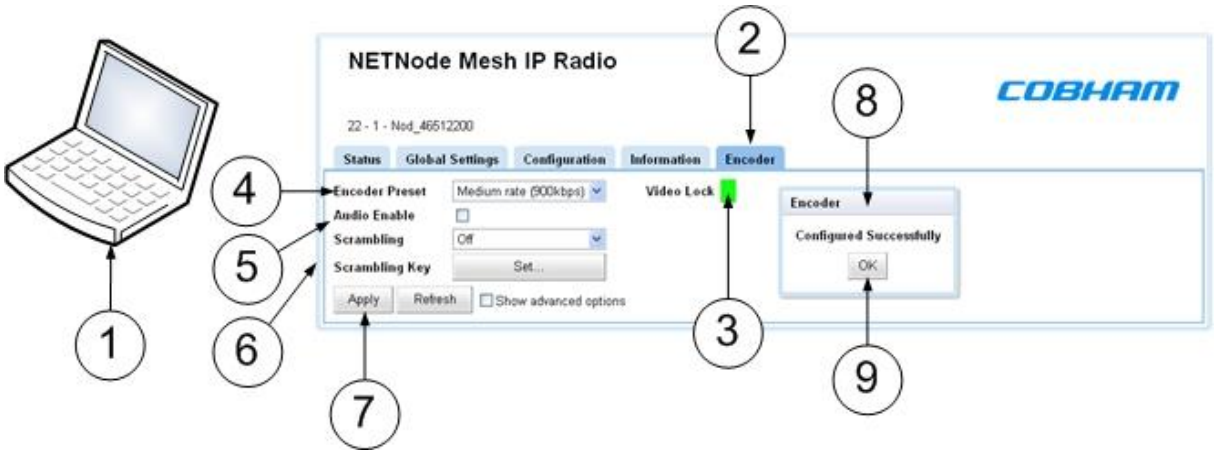


Figure 1-8 Encoder configuration

10. Navigate to the **Global Settings** tab.
11. In the **Main** pane, set **Streaming Protocol** to **UDP Multicast.**

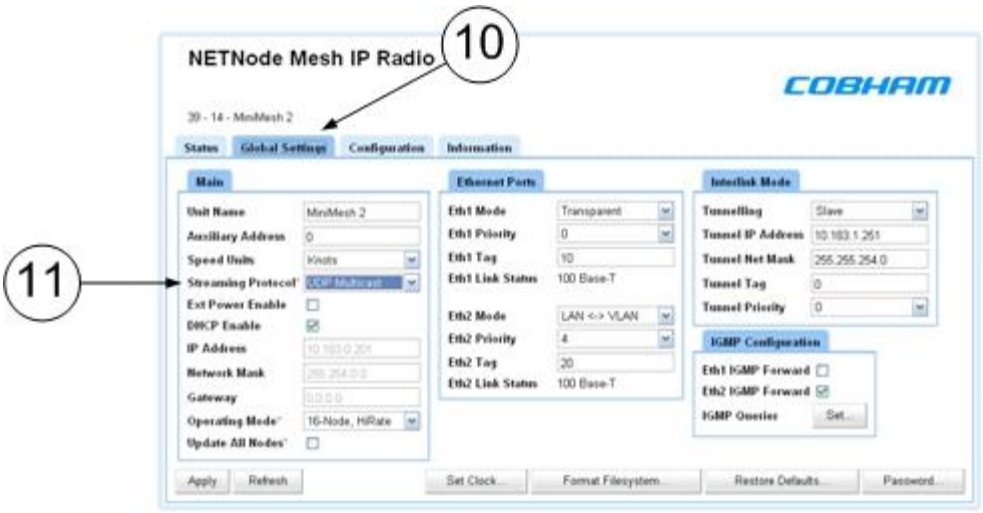


Figure 1-9 Global Settings, Streaming Protocol

12. Navigate to the **Configuration** tab.
13. In the **Streamer** pane, click **Stream Enable** tick box.

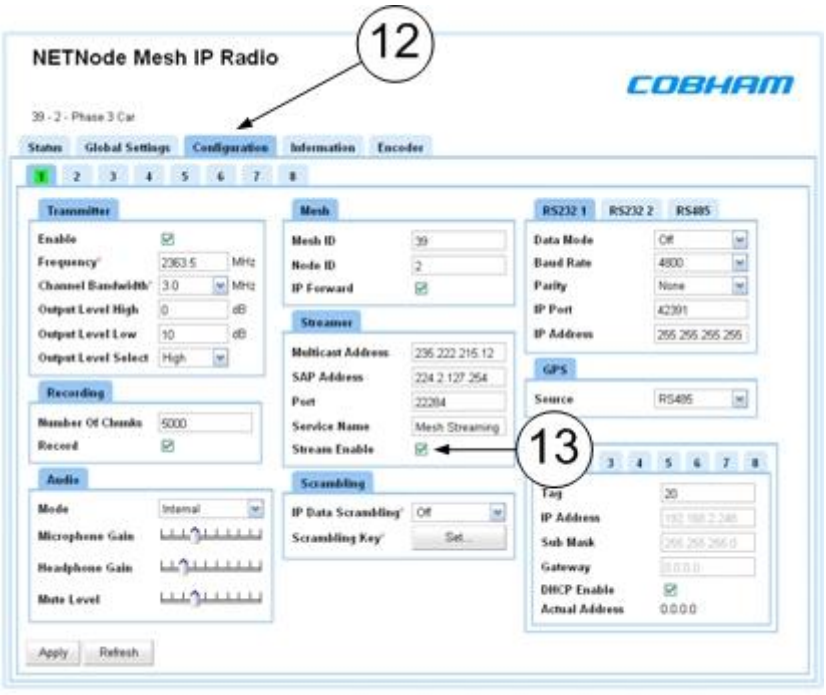


Figure 1-10 Configuration, Stream Enable

Step 4: Stream the Images on the PC Connected NETNode

At this time, look to the other NETNode that has the PC connected. At this part of the link we will use a technique called **streaming** to monitor the pictures. While you can download many types of free streaming software, we will use **Cobham Stream Player.**

1. Double-click **Stream Player** icon.
2. The **Multiple Local Addresses** dialog opens.
3. **Highlight** the **IP address** of your PC.
4. Click **OK.**
5. **Video Stream Player** dialog opens.
6. Cascade **Mesh Streaming** menu and **double-click** the **stream** you wish to play.
7. The **video** will start to play in a **new window.**

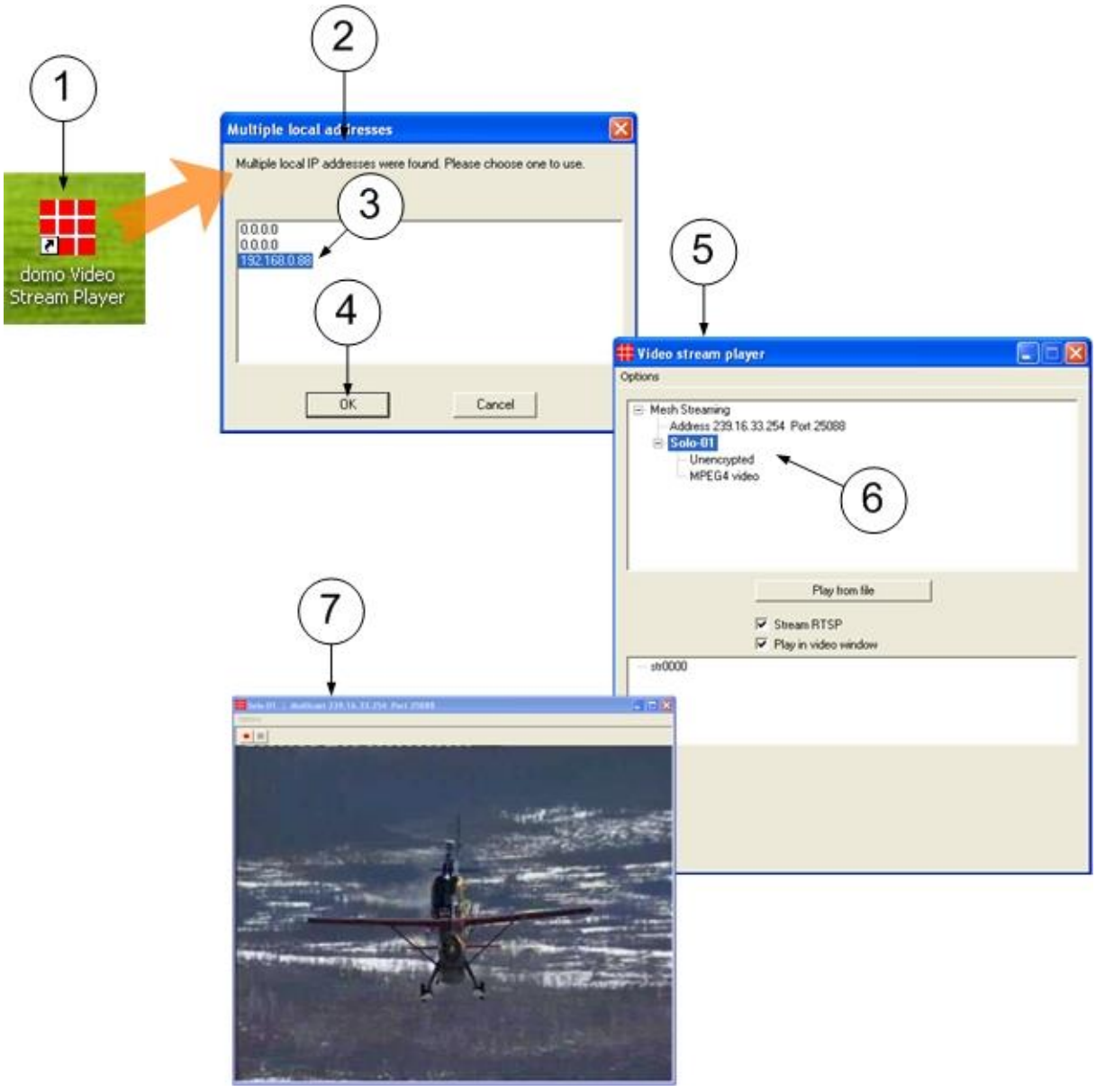


Figure 1-11 Setting up Cobham Stream Player

1.6 About AVI H264 Coding

Phase three units with the AVI option can be upgraded to give H264 video (improved quality/lower bitrates) and MP3 audio (MPEG1 and half rate MPEG2). The software to upgrade these units can be found on the **Information** Tab together with upgrade instructions.

2. Advanced Operation

2.1 Configuring your NETNode for the very first time

Usually, you'll connect to your NETNodes with an IP connection. There are some times when it will be necessary to connect to the NETNode with a **serial connection**:

- The first time you get it out of the box from the factory
- If you have forgotten the IP address
- If you have lost the password
- The unit has been left in DHCP mode and it is necessary to apply a fixed IP address

In these cases you'll connect your NETNode to your PC with the **Serial cable** and operate **Node Finder**.

The most important thing to do when you first get a NETNode is to connect serially and **switch off DHCP**. Then apply a **fixed IP address**. At this time you can operate with the NETNode quickly with simple IP connections.

Step 1: Connect to your Personal Computer with Serial (RS232)

It will be necessary to have a fully powered **NETNode**, a personal computer operating the **Mesh Serial Configuration Tool** and the correct data cable supplied with the unit.

- NETNode-3-Robust – **CA0406**
- NETNode-3-Plain – **CA0474**
- NETNode-Mini Plain – **CA0474**

1. Connect the Control Cable Assembly to the control receptacle on the NETNode.
2. At this time, connect the D-Type 9-way plug (sockets) marked RS232 on the control cable to the D-Type 9-way receptacle (pins) on your personal computer.

CAUTION: There are **two** D-Type 9-way plugs on each control cable – make sure you select the RS232 version by checking the label attached to the cable near the plug. The other is RS485.

Note: Some PCs do not have D-Type 9-way receptacles. In this case, it will be necessary to get a USB plug (pins) to D-Type 9-way plug (pins) adapter cable. These are easy to get from computer stores.

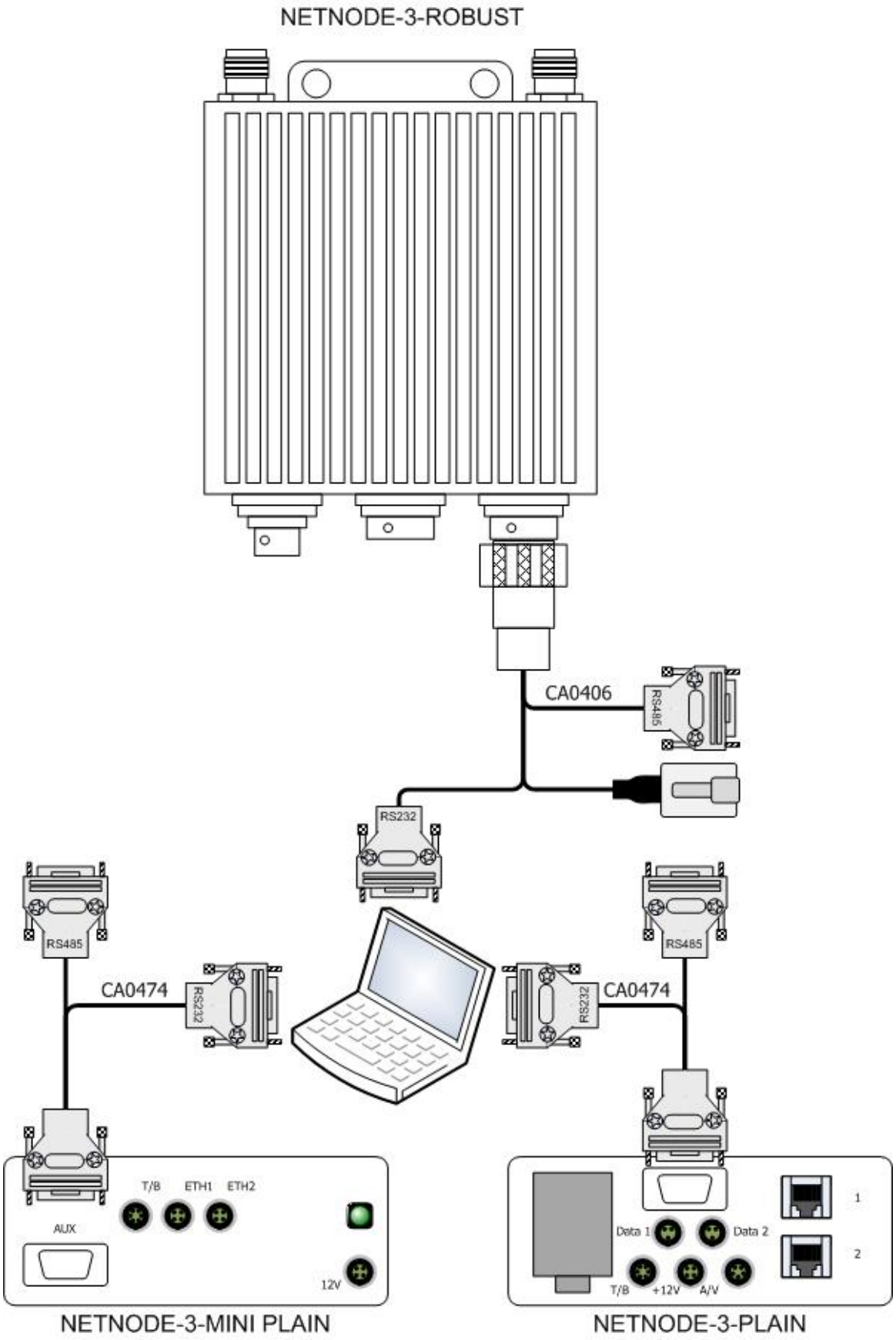


Figure 2-1 Connecting to the NETNode through serial port

2.2 Configuring your NETNode with Node Finder

Step 1: Setup the Serial Connection between NETNode and PC

Connect your NETNode to your computer with the control cable. See *Configuring your NETNode for the very first time* earlier in this section.

Step 2: Start Node Finder

1. Double-click the **Node Finder** icon on the computer desktop.
2. The **Node Finder** application opens.
3. Click **Tools →Network Settings (via serial port)...**
4. The **Select Serial Port** dialog opens.
5. Select the **Serial port** for your NETNode.
6. Click **Next>** button.
7. The **Configure Network** dialog opens.
8. Set up the network.
9. Click **Apply** button.
10. Click **Finish** button.

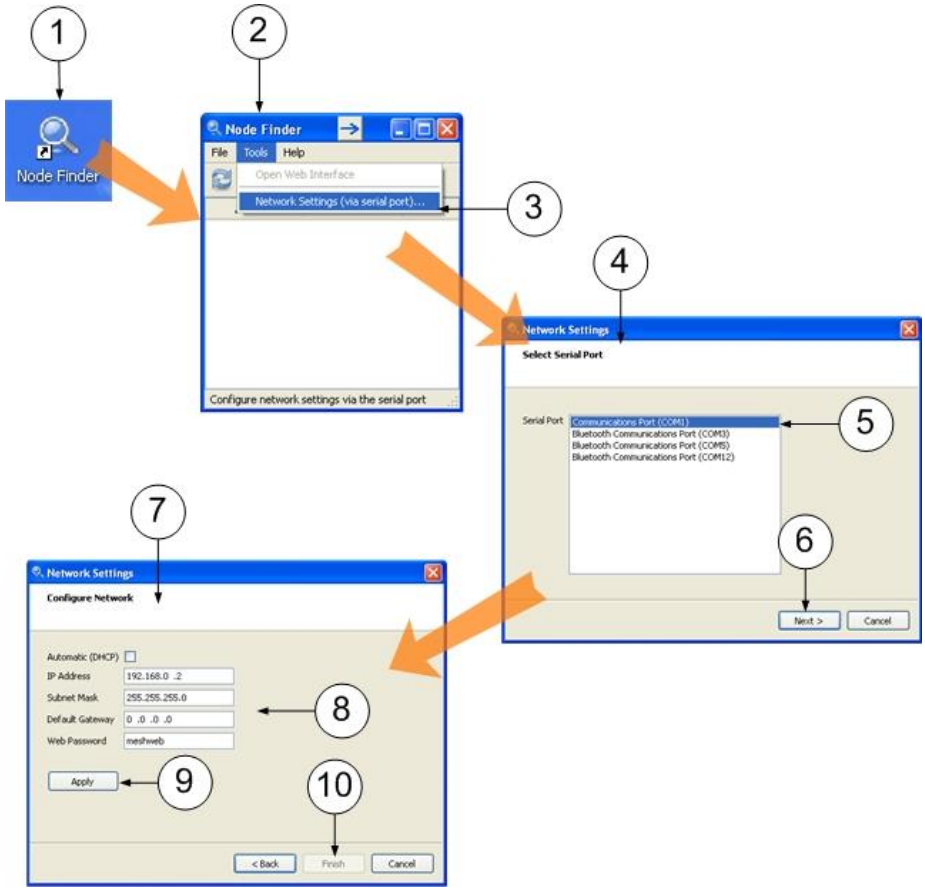


Figure 2-2 Using Node Finder

2.3 Working with Talkback

When you have established a mesh network it is possible to attach headsets to NETNodes in the network. These headsets let you to listen and talk to a different operator on the network ('party line').

Step 1: Rig the Headsets

It will be necessary to have at least two fully configured NETNodes, at least two headsets and the correct Microphone/Headphone External Cable Assembly

- NETNode-3-Robust – **CA0589**
- NETNode-3-Plain – **CA0588**
- NETNode-Mini Plain – **CA0588**

Here's an example using the NETNode-3-R (Robust):

1. With the Microphone/headphone cable, connect to the Audio receptacle on the NETNode marked **T/B** (NETNode-3-Plain & NETNode-3-Mini Plain) or **CTRL/DATA** (NETNode-3-Robust).
2. Connect the microphone plug of the headset to the inline plug marked IN on the CA0589 cable.
3. Connect the headphone plug of the headset to the inline plug marked OUT on the CA0589 Cable.
4. Do the same for other NETNodes with headsets.

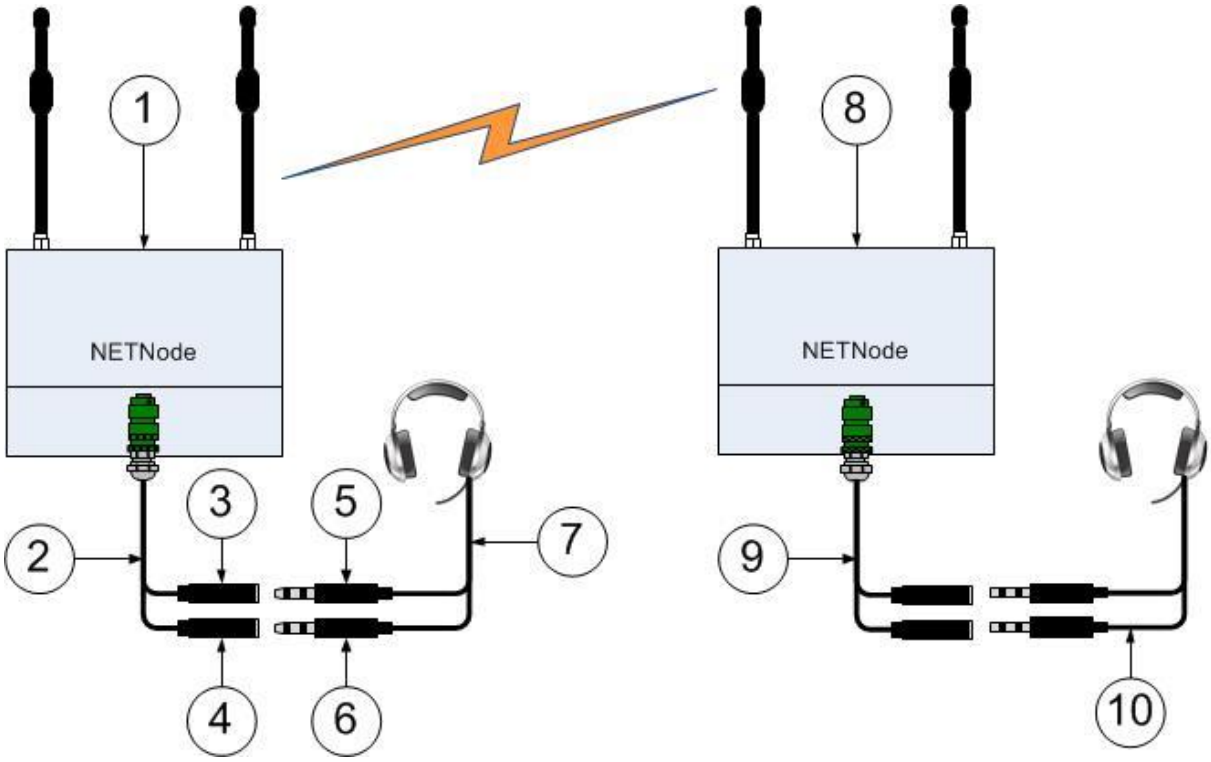


Figure 2-3 Using Talkback across NETNode-3-Robust RF link

Serial	Part	Description
1	First NETNode	Configured to operate with headset.
2	CA0589 Headset cable	Amphenol 22-way plug (pins) to 3.5mm plug 3 Pole (socket) audio in and 3.5mm plug 3 Pole (socket) audio out.
3	Inline TRS Plug Marked IN	This is where you connect your headset microphone plug. **Note**: Microphone power is on the audio connectors at approximately 3V (applicable for Electret microphones)
4	Inline TRS Plug Marked OUT	This is where you connect your headphone plug.
5	Microphone Plug	Usually pink in colour.
6	Headphone Plug	Usually green in colour.
7	Domestic Headset	As used with domestic computer applications like Skype.
8	Second NETNode	Configured to operate with headset.
9	CA0589 Headset cable	Amphenol 22-way plug (pins) to 3.5mm plug 3 Pole (socket) audio in and 3.5mm plug 3 Pole (socket) audio out.
10	Domestic Headset	As used with domestic computer applications like Skype. Connect the same as the first NETNode.

Table 2-1 – Using Talkback

Step 2: Configure the NETNode to operate with Talkback

1. **Connect** your PC to the NETNode and **log on**
2. Navigate to the **Configuration** tab
3. In the **Audio** pane, set the **Mode** drop-down box to **Internal**
4. Adjust the **Microphone Gain**, **Headphone Gain** and **Mute** level to suit your environment. The mute level must be set at a high enough level so that only speech (and not ambient noise) is allowed through.
5. Click the **Apply** button.
6. **Repeat** on each NETNode that has a headset attached.

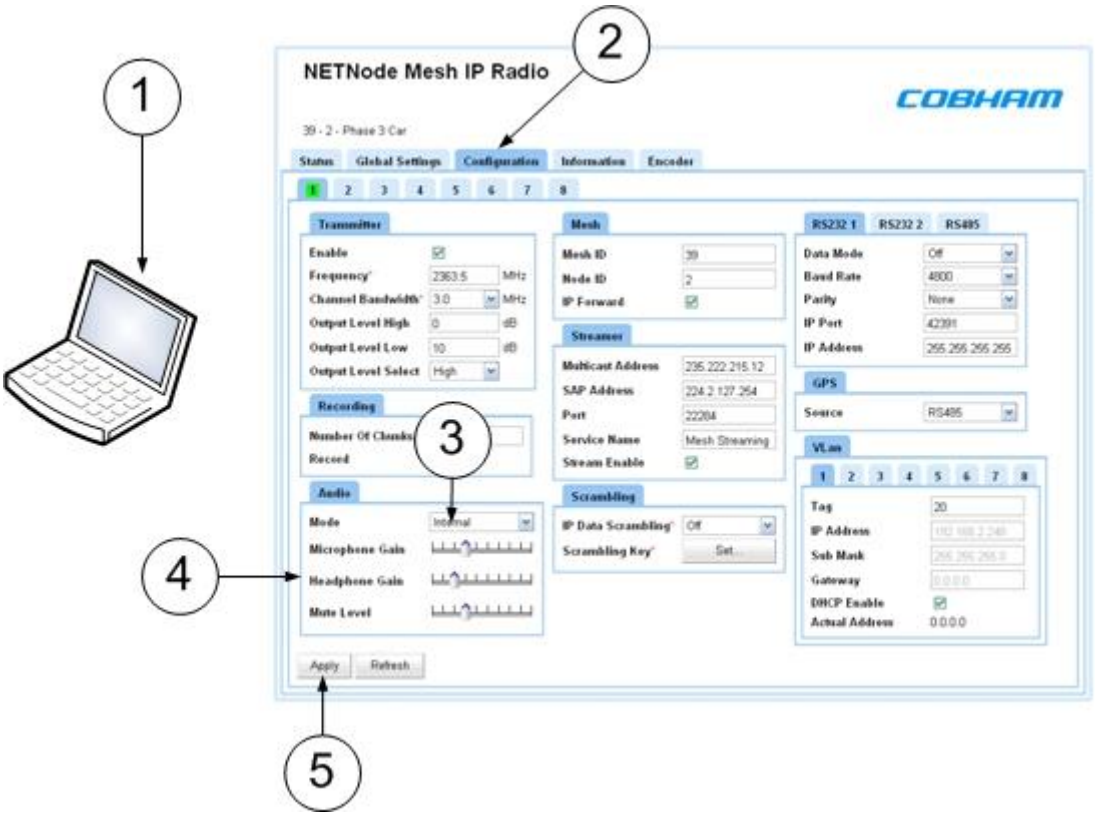


Figure 2-4 Talkback Configuration

Step 3: Test the Talkback

When you listen on the headset and nobody is talking, you'll hear a **tone** each ten seconds to show that the audio circuit is operating.

Note: This is **open talkback**. Everyone on the network can hear you at all times. A **Push to Talk** switch can be installed with the microphone to stop this.

Step 4: Explore the Remote Setting

You'll see that in **Configuration →Audio →Mode** there is a setting called **Remote**. If you are using headsets on each NETNode they will continue to operate as described above.

Internal mode only distributes the talkback audio **within the local mesh network**.

But, **Remote** mode allows the onward distribution of this audio on an external IP network with RTSP protocols.

This enables you to connect a PC to a second NETNode and hear what is being said across the network with streaming software like VLC and the URL:

rtsp://ip_address_of_unit/audio.sdp

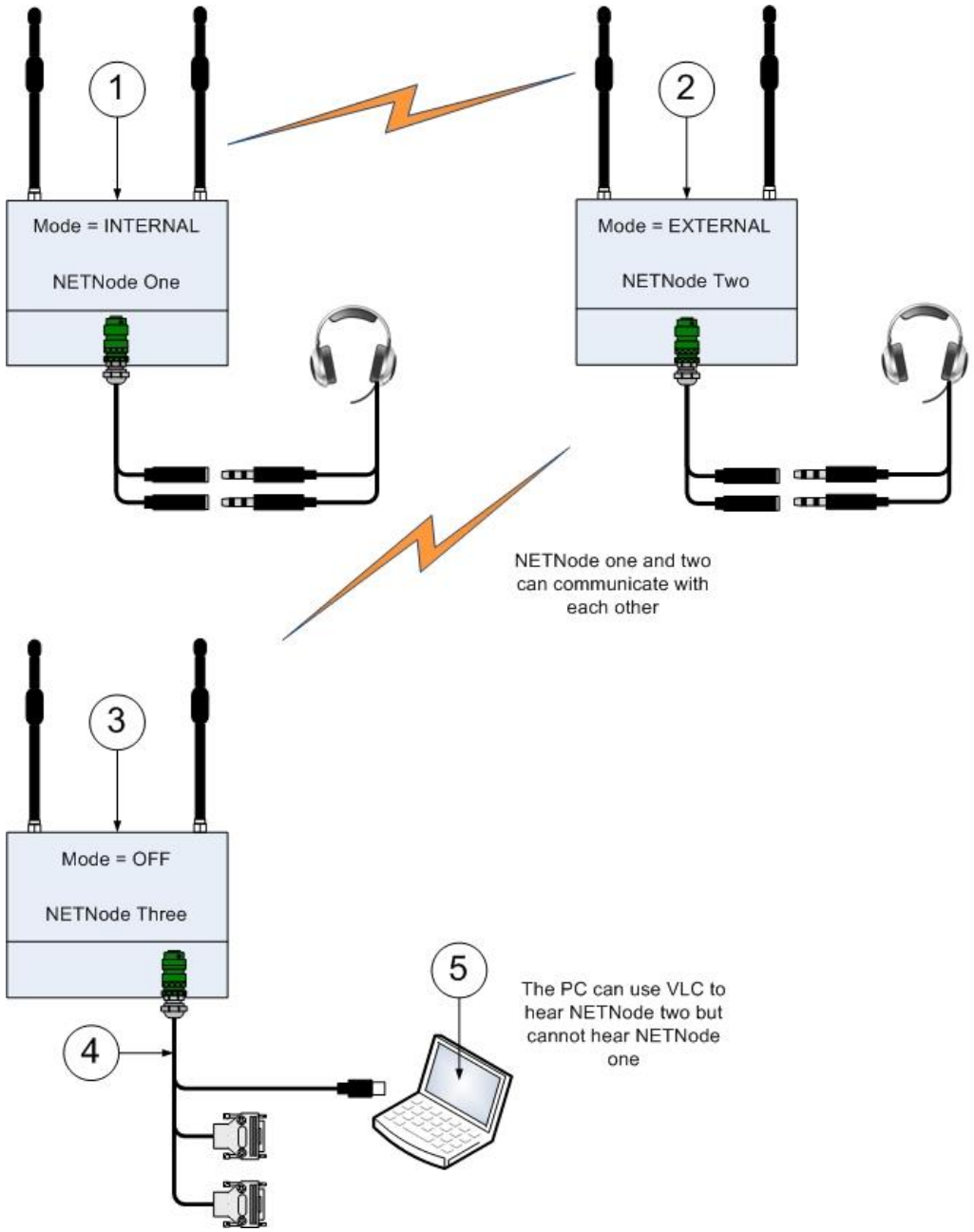


Figure 2-5 Remote Setting

Serial	Part	Description
1	First NETNode	Configured to operate with headset with INTERNAL mode set.
2	Second NETNode	Configured to operate with headset with REMOTE mode set.

Serial	Part	Description
3	Third NETNode	You can connect your PC to this NETNode with the Ethernet connection cable and use VLC software to hear the **second NETNode** headset which is in REMOTE mode. **Note**: You will **not** hear the **first NETNode** as that is in INTERNAL mode.
4	Ethernet Cable	■ NETNode-3-Robust – CA0406 ■ NETNode-3-Plain – AP000465 (Optional) ■ NETNode-Mini Plain – CA0505
5	PC	Personal Computer operating VLC software. You can stream the output of the second NETNode.

Table 2-2 – Talkback Configuration

Step 5: Use VLC to stream from a **Remote** Enabled NETNode

1. **Connect** your PC to **NETNode three.**
2. Double-click the **VLC icon** on your desktop.
3. **VLC media player** window opens.
4. Select **Media →Open Network Stream** from the drop-down menu.
5. The **Open Media** window opens.
6. Type the **Network URL** like this example: rtsp://192.168.1.2/audio.sdp
7. Click the **Play** button.

Note: The IP address for VLC is the NETNode that has the headset to which you wish to listen. It can be necessary to turn the mute level down to zero to stop VLC from stopping when there is no stream.

Note: You can get VLC free from the internet at: *www.videolan.org/**vlc**/*

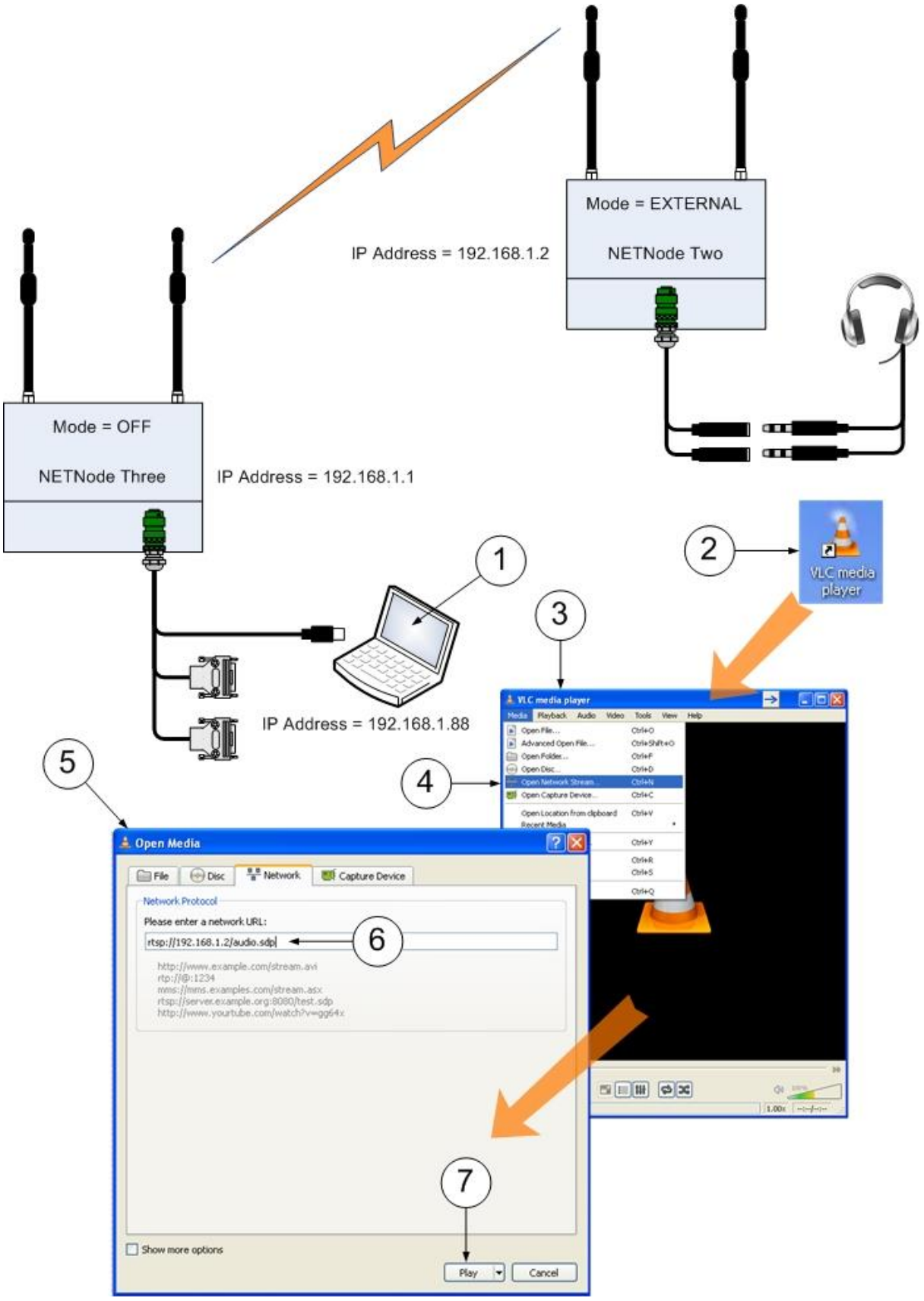


Figure 2-6 Streaming Audio with VLC player

2.4 Configuring your NETNode for GPS

If you attach a applicable GPS receiver to a NETNode you can use GPS location data on your system. It can be very useful to show the location of NETNodes on a digital mapping screen for example.

The NETNode system uses the **NMEA 0183** GPS protocol to send GPS data.

We'll use the example of operating with a **Garmin GPS 17X** Receiver.

Step 1: Connect the GPS Receiver to the NETNode

It will be necessary to have a Garmin GPS 17X Receiver, a Garmin cable a fully powered and configured NETNode, a Data Cable Assembly and a PC with a web browser.

- NETNode-3-Robust – **CA0406**
- NETNode-3-Plain – **CA0474**
- NETNode-Mini Plain – **CA0474**

1. Connect the Data Cable to the receptacle on the NETNode:

- NETNode-3-Robust – Amphenol 19-way receptacle (Sockets) Marked **AV/PTZ**
- NETNode-3-Plain – LEMO 3-way receptacle (Sockets) Marked **AUX**
- NETNode-Mini Plain – D-Type 15-way receptacle (Sockets) Marked **AUX**

2. Connect your GPS 17X cable to the RS485 D-Type 9-way plug (sockets) on your data cable assembly.

Step 2: Configure NETNode for operation with the Garmin GPS 17X

1. **Connect** your PC to the NETNode and **log on.**
2. Navigate to the **Configuration** tab.
3. In the **RS485** pane, set: **Data Mode** to **Off, Baud Rate** to **4800, Parity** to **None** (the other settings are unimportant).
4. In the **GPS** pane set the drop-down box to **RS485**.
5. Click the **Apply** button.
6. On phase 3 units it will be necessary to enable external DC power on the **Global Settings > Main** panel tab.
7. The **Configured Successfully** message appears, click **OK.**

Note: It is necessary for the Garmin cable to be adapted for use with NETNodes.

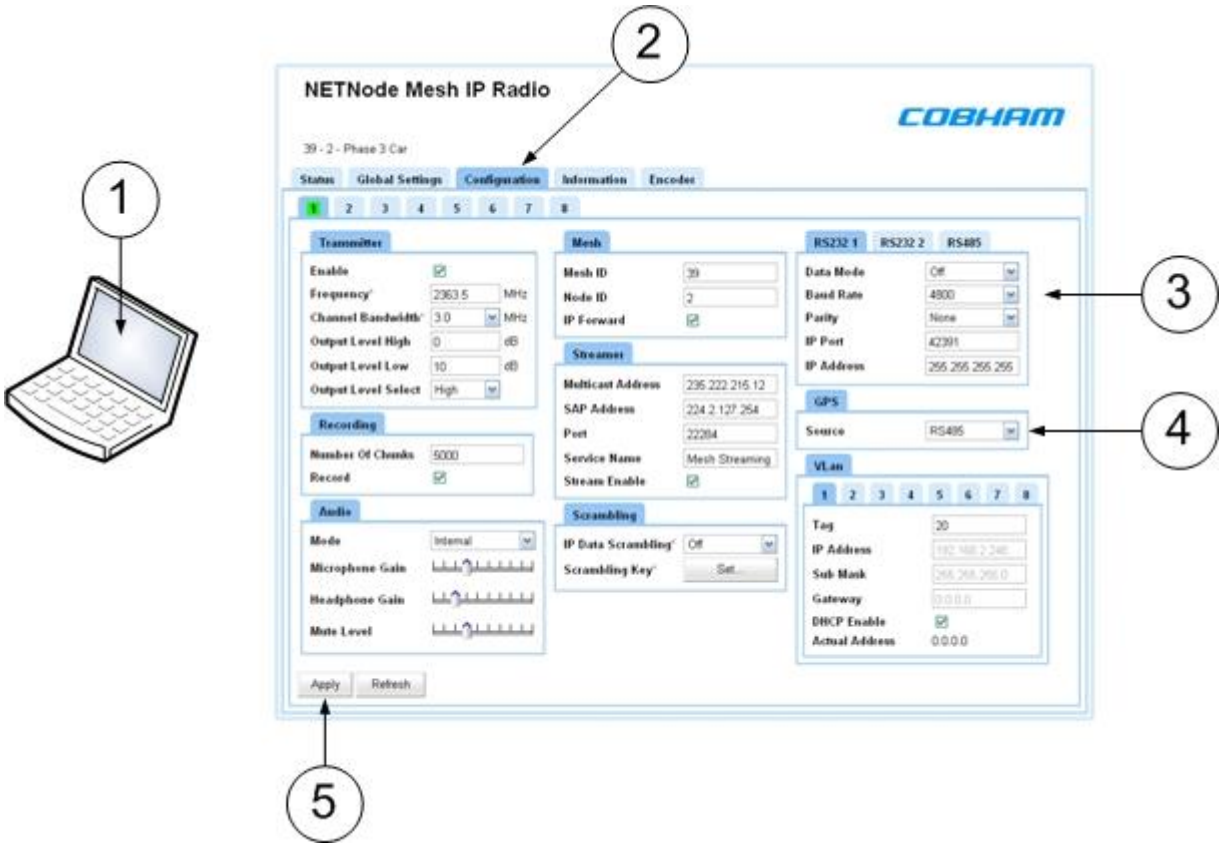


Figure 2-7 GPS Configuration

Step 3: Test the Garmin GPS 17X with the NETNode

You have connected and configured your Garmin GPS 17X. Here is how we can test it.

1. **Connect** your PC to the NETNode and **log on.**
2. Navigate to the **Status →Maps** tab.
3. Make sure the Option Buttons are set to **Network.**
4. **Click** the local NETNode with the **GPS connected**.
5. The **GPS data** will show.

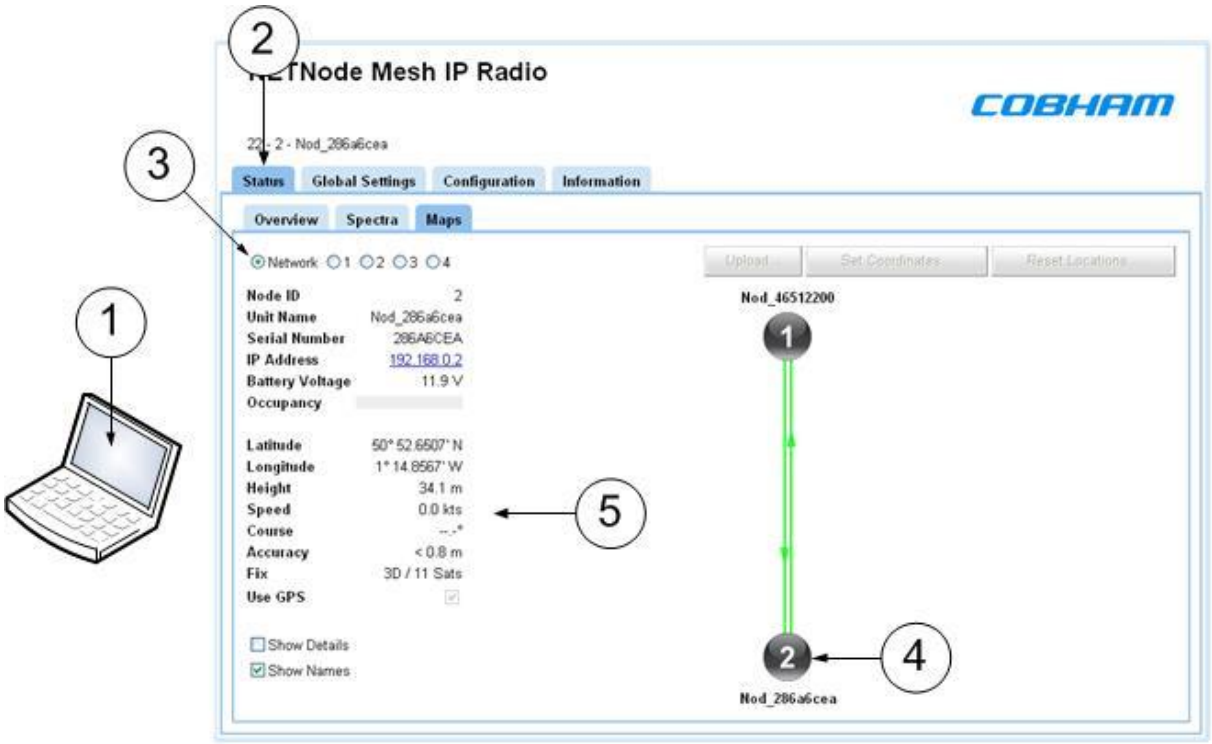


Figure 2-8 GPS Data Displayed in the Maps Sub-tab

Step 4: Display the GPS Location on a Map

1. **Connect** your PC to the NETNode and **login**
2. Navigate to the **Status →Maps** tab
3. Make sure the **Option Buttons** are set to **a map (1,2,3 or 4)**
4. **Click** the local NETNode with the **GPS connected**
5. **Check** the **Use GPS** checkbox
6. The NETNode with the GPS will jump to the correct location on the map.

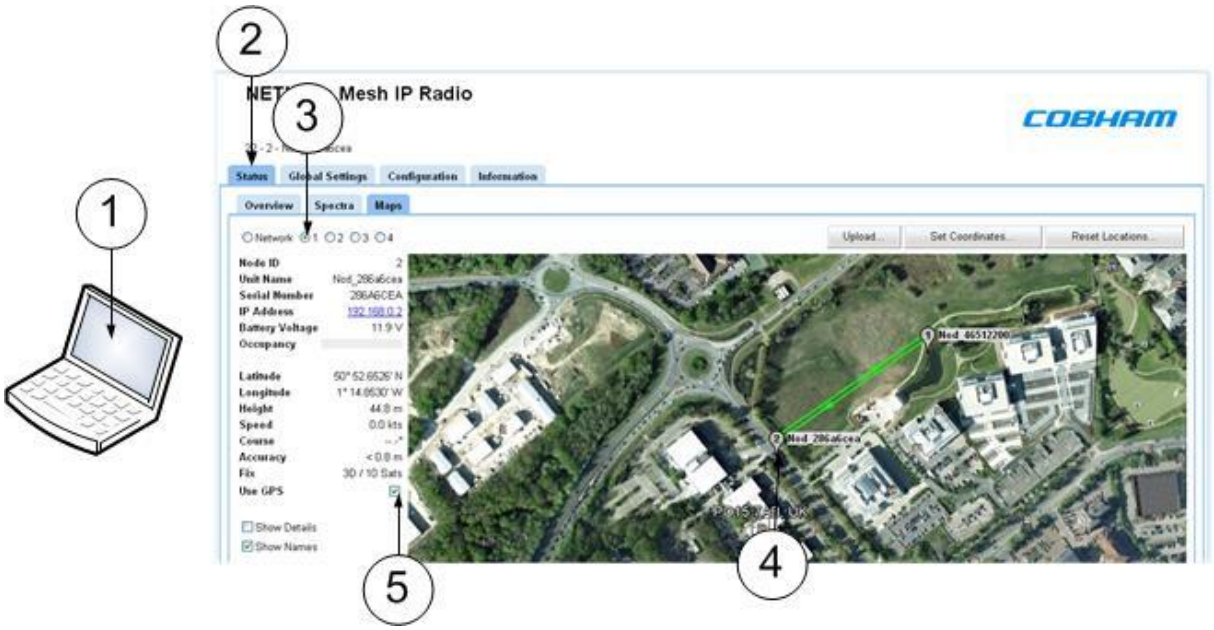


Figure 2-9 GPS NETNode located on a map

Note: You must have a map loaded on the GPS and have loaded the coordinates of the corners of the map. Only then will the GPS show the location of the NETNode.

You can find out how to **upload maps** and **set coordinates** in the *Advanced Setup* chapter.

2.5 About NETNode IP Functionally

Each NETNode behaves as a Switched Hub. This hub contains two real ports ('eth0' and 'eth1'), a virtual port to each remote NETNode across the radio interface ('msh0' – 'msh15' (where number=node)), and a local virtual port ('loc') for control and local streaming. The HUB contains additional packet filtering to prevent unnecessary packets from being passed across the network.

The packet filtering rules are as follows:

- Only packets of type ARP and IP are passed all other packet types are blocked
- Scanning Tree Protocol is forwarded (and a metric added if passed across the radio) if enabled
- The maximum MTU is 1514 or 1518 for VLAN single tagged packets
- VLAN packets are supported if enabled on a tag by tag basis
- Only packets from the local subnet are passed by default
- Packets for other subnets are allowed if Static Routes are manually entered or Routing Information Protocol is enabled and received
- Broadcast packets on IP address 255.255.255.255 or within the same subnet are passed to all ports
- Multicast packets 224.0.0.1 – 224.0.0.255 are passed to all ports

- Other multicast packets are supported by IGMP control and only forwarded to ports which are members of that group
- Unicast packets are forwarded only to the correct port

Each NETNode keeps an ARP table. This contains the IP, MAC and additionally a port (real and virtual) of each unicast IP address on the system for the main subnet. The table is built up by recording the source addresses for both ARP and IP packets entering the NETNode. There is a separate list for each VLAN on the system.

When a unicast packet arrives on the local subnet, the destination IP address is searched for in the table, and the packet sent to this port in the table. If no entry is found then this results in the unit generating an ARP request (who is ...?). Destination IP addresses which are not on the local subnet are checked against the static and RIP routes and forwarded to the correct gateway. If this fails then the default gateway address is used.

NETNodes will also send out gratuitous ARP's when they join the network. This aids network cohesion.

NETNodes support to following protocols on the local port ('loc'):

- ARP (LAN and VLAN)
- ICMP ping (LAN and VLAN)
- IGMP (LAN and VLAN)
- RIP v2 (LAN and VLAN)
- DHCP (LAN and VLAN)
- HTTP control (TCP port 80 and 50080)
- TFTP (for upgrades)
- RTSP/RTP (TCP port 520 for streaming)
- TELNET (RS232 over IP)

In addition NETNodes also include a number of Domo/Cobham proprietary protocols for control and network discovery. These tend to be UDP over specific port numbers.

2.6 Multicast Packet Processing

IP multicast is a technique for one-to-many communication over an IP infrastructure in a network. It is often used for streaming of services such as audio and video. These can take up large bandwidths in a network. In order to manage this in the MESH system, each NETNode functions as a multicast router allowing the flow of packets only when required. IP multicast is often used for communication between routers/gateways.

The Internet Group Management Protocol (IGMP) is a communications protocol used by hosts and adjacent routers on IP networks to establish multicast group memberships. In order to perform multicast routing each NETNode acts an IGMP snooper/router.

NETNodes from v4.1 onwards support IGMP (v2) protocol. Separate multicast routing tables are maintained for the main LAN and for each VLAN in the system.

2.6.1 Detailed Multicast Forwarding rules for NETNodes

To send multicast packets across the MESH a set of rules are applied:

1. IP packets with destination address 224.0.0.0 are blocked; these are used internally within the MESH.
2. IP packets with destination addresses 224.0.0.1 to 224.0.0.255 and 239.255.255.250 (SSDP) are flooded to all nodes and interfaces regardless of being members of the group or not.
3. All other multicast packets are forwarded only to nodes and interfaces which are members of the group.

Although non-registered groups should be forwarded to all destinations, this is *prevented* in the MESH to control bandwidth.

There are two types of interface as far as IGMP is concerned:

1. Multicast-router interfaces – these interfaces lead towards multicast routers or IGMP queriers
2. Group-member interfaces – these interfaces lead towards hosts

2.6.2 IGMP Querier

A querier is required on the network to ensure proper functionality of the IGMP protocol. A querier periodically sends out a IGMP general query which causes each host to send out a membership report for each of its' group. This in turn refreshes the multicast routing tables in the routers. Without this, the table entries would eventually timeout and become void.

There is usually only one querier on the network. This is the multicast router with lowest IP address, and any routers with higher addresses fall silent.

NETNodes act as multicast routers. By default, a NETNode will become a querier at start up, and will continue to send queries if it has the lowest IP address of all the NETNodes and multicast routers.

2.6.3 Connecting a NETNode to a Multicast Router

To let IGMP function correctly between MESH and an external multicast router, the ports connected between the multicast-router and the NETNode must be set to forward IGMP membership reports. For the NETNode the Eth1 or Eth2 check boxes must be ticked (depending on which port the router is connected to), and a similar procedure repeated on the multicast-router. This will forward IGMP reports for both LAN and all VLANs.

Alternatively, if the external multicast-router management interface is not accessible, and the multicast router has a *lower IP* address than all MESH nodes, then it is necessary to start up a second querier on a NETNode using the IGMP Force Query popup panel. This will cause the external multicast router to continue to forward IGMP membership reports to the MESH.

A querier can be setup for each VLAN. The presence of a forced querier will automatically prevent any other (non-forced) queriers starting up on the local (but not on a remote) MESH network.

Note: To prevent excess network traffic only one forced querier per VLAN should be set on the MESH network.

1. **Connect** your PC to the NETNode and **log on.**
2. Navigate to the **Global Settings** tab.

3. On the IGMP **Configuration Pane** you can select IGMP forwarding for each port.
4. You can select a forced IGMP Querier by hitting the **IGMP Querier** Set button.
5. This will produce a **Force IGMP Querier** popup box.
6. You can select to place an IGMP Querier on the local LAN and/or any of the VLANs.
7. Click **OK.**
8. You must hit **Apply** on the **Configuration Pane** for the changes to take effect.

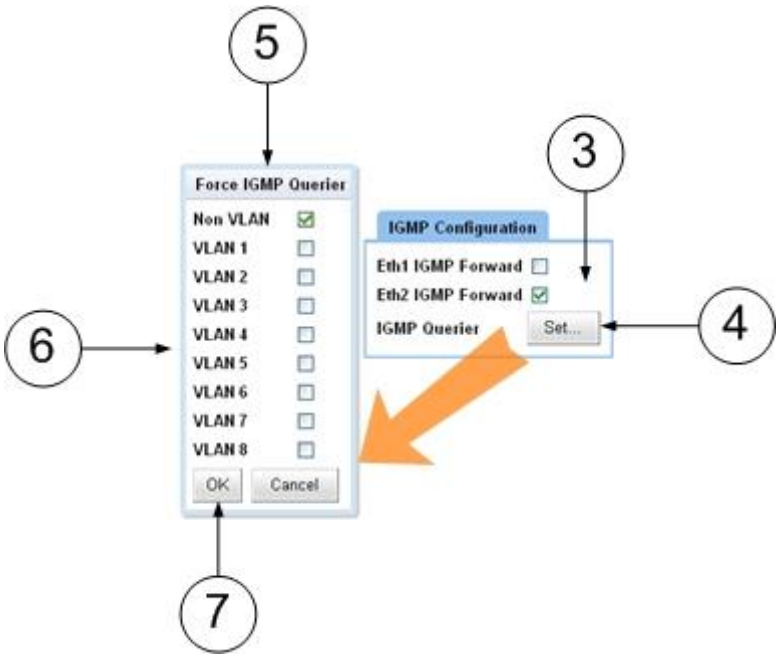


Figure 2-10 IGMP Configuration

Protocols such as PIM (Protocol Independent Multicast) designed for router to router interfaces but NETNodes do not process this type of packet.

Forcing a querier on the MESH network can be useful when no external querier is present, and the user wishes to override the default behaviour of the MESH selecting the NETNode with the lowest IP address. This may have poor RF connectivity. Instead the user can choose the NETNode which has good RF connectivity.

Note: NETNode Multicast and RTSP streaming (Multicast and Uniicast) depend on IGMP functionality.

2.6.4 IGMP Reference Material

For a more detailed understanding of multicasting and IGMP some reference material is available to read.

http://tools.ietf.org/html/rfc2236 IGMP-v2

http://tools.ietf.org/html/rfc4541 Considerations for IGMP Snooping Switches

http://www.juniper.net/techpubs/en_US/junos11.3/topics/concept/igmp-snooping-multicast-forwarding.html

2.7 Understanding Streaming Over IP

Streaming is the transmission of digital audio or video or the listening and viewing of such data without first storing it.

This section is relevant only to customers that have the **NETNode-AVI-UP** option fitted into their NETNode unit.

The NETNode supports:

- Raw Multicast streaming
- RTSP/RTP streaming.

2.8 Configuring Multicast Streaming

For multicast streaming the transport stream video data is transmitted over the Ethernet network by means of **multicasting** i.e. continuous real-time streaming of packets accessible to any PC connected to the network.

It is thus possible for more than one connected PC to view the streamed data simultaneously.

Two types of multicast IP packets are streamed:

- Packets carrying video, audio and data as received by the unit.
- Packets known as Session Announcement Protocol and Sessions Description Protocol data (SAP and SDP), which contain information regarding the nature and location of the stream itself.

Step 1: Open the **Configuration** Tab → **Streamer** Pane

When you have got a Video or Audio product into the NETNode, you can wish to stream that information down a fixed IP link. The **Configuration** →**Streamer** pane enables you to configure this facility easily.

In Cobham systems we have the ability to carry streams using multicast protocols and these streams can come from external or internal sources. This is controlled by the **Source Mask**.

To make sure we don't overload the bandwidth we wish to be able to choose which nodes get to receive the stream. This is controlled by the **Destination Mask.**

Step 2: Setup the **Service Name**

Textual information naming the multicast stream as delivered in the SAP/SDP packets from the unit. The default setting is **Mesh Streaming**

Step 3: Stream Enable

This function enables the streaming of Video that originates from the internal encoder (if it is fitted). This must be set to **On** for UDP multicast, RTSP multicast streaming or RTSP unicast streaming.

Step 5: Check the Multicast Address

This text box enables you to change the multicast address used by the unit. Different NETNodes (even if they are on separate MESHs) should have different multicast addresses to

make sure that IGMP packets only open up the stream from that source. This is a change from previous versions of software.

Note: Having two NETNodes set to the same multicast address will cause both to stream (even if RTSP modes are selected) which is wasteful of bandwidth.

Step 6: Check the SAP Address

This text box enables you to change the value of SAP/ SDP multicast address used by the unit.

The default value is 224.2.127.254 and the port used is 9875.

These are standard multicast values for such parameters, and it is recommended they are not changed unless specifically required due to routing restrictions.

Step 7: Check the Port

A good rule is to use numbers above 10,000 to avoid conflict with existing services.

When you set up a port number on several computers on a network they will all listen for packets directed to that port.

Step 8: Configure the Service Name

This text box lets you name the multicast stream as delivered in the SAP/SDP packets from the unit. Default is **MPEG Stream.**

2.9 About RTSP Streaming

Real Time Streaming Protocol (RTSP) allows automatic control of the routing through the mesh system. To use this feature the streaming protocol box must be set to the same RSTP multicast or Unicast modes for all nodes in the system (this will happen if the **Update all nodes** checkbox is checked).

The streaming protocol is selected on the **Global Settings** tab – see Chapter 10-5 *Working with the Global Settings Tab* for details.

To access a stream on an AVI unit the URL is as follows:

rtsp://<ip_address_of_AVI_unit>/stream.sdp

This will automatically set the internal destination masks of the AVI node and the endpoint node (the node where the data emerges from the Ethernet) to the correct values. The destination values displayed in the destination mask on the Configuration Tab no longer have any effect in this mode of operation.

If necessary the endpoint node will convert the multicast RTP packets to unicast (and remap the port numbers) if the Software player does not support multicast streaming. Unicast can also be forced by setting the mode to RTSP Unicast. The Mesh always uses multicast packets internally as this is more bandwidth efficient when reaching multiple destinations.

Note: the player must be able to support transport stream packets (MP2T – suitable players include VLC media player). Ports on different AVI NETNodes should be set to different unique values (use even addresses for RTSP/RTP).

The source mask, internal multicast address, service name and port number are still used in this mode.

It is possible to stream just the video elementary stream rather than the complete transport stream. This is performed by:

rtsp://<ip_address_of_AVI_unit>/video1.sdp

This can be useful for players which don't accept MP2T streams.

2.10 Working with Stream Recording and Playback

The NETNode Robust allows recording of the video from the AVI unit onto a micro SD card.

Files are recorded in 30 second lengths called **chunks**, and are stored in a compressed transport stream format. They can subsequently be downloaded through the web browser from the file system, or alternatively the card can be inserted into an external computer. Files are stored in FAT16 format and thus are easily read. The date and time is always stored in UTC format regardless of the time-zone setting.

Step 1: Insert an SD Card

To use this facility first put a 2GB micro SD card into the slot on the NETNode.

This will cause the green LED on the SD card slot to come on. The card must only be removed when the LED is green to prevent corruption of the data on the card.

Step 2: Format the SD Card

The SD card must be formatted in FAT16 format. If not, the flash can be formatted using **Global setting →Format file system** button.

Step 3: Observe the File Length

This is the maximum number of files stored on the card and the oldest will be removed first. This must be set so that the number of files does not become bigger than the capacity of the SD card.

Step 4: Start Recording

To set the recording mode make sure the AVI unit's video encoder is set up correctly (See Chapter 8 Section 8 *Working with the Encoder Tab*) and the video feed connected from the camera.

1. **Connect** your PC to the NETNode and **login.**
2. Make sure the **Encoder** tab has been set up correctly.
3. Navigate to the **Configuration** tab.
4. In the **Recording** pane, select the **Record** checkbox.
5. Click the **Apply** button to accept the changes.

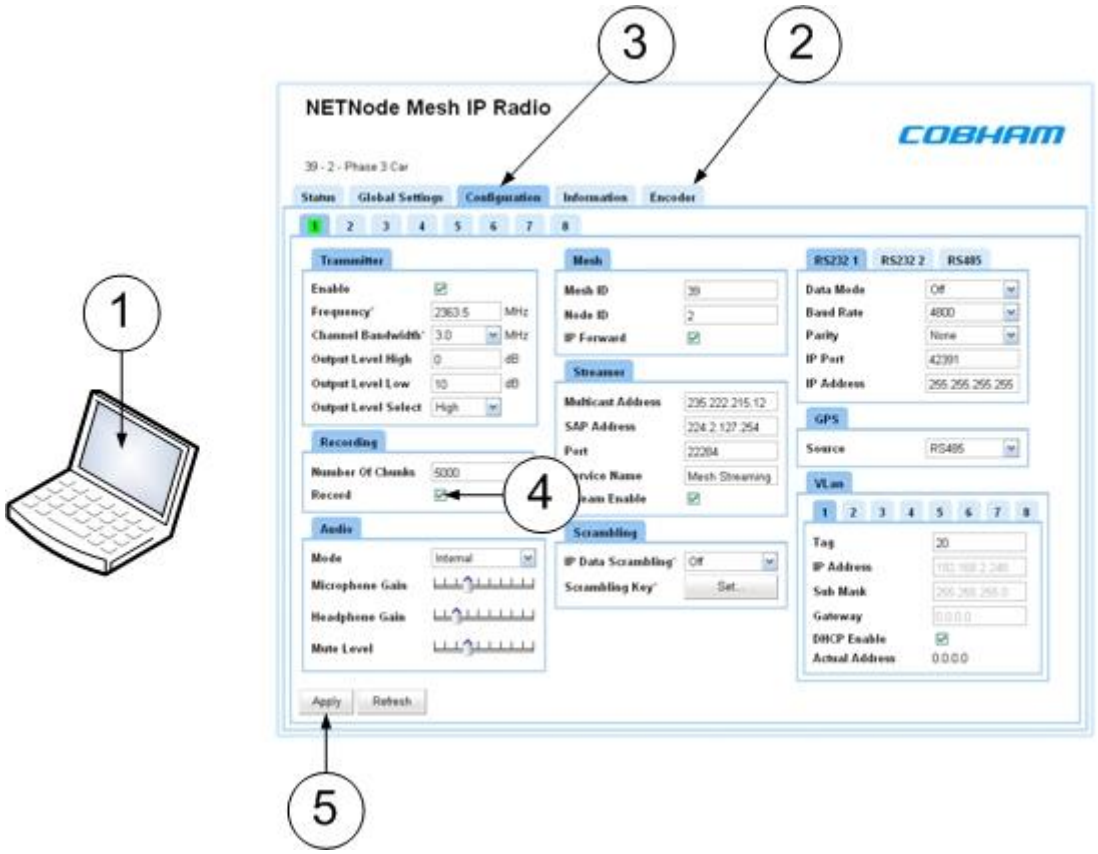


Figure 2-11 Setting up recording

The data is recorded onto the SD card in 30 second chunks. Thus the dimension of each chunk is the encoded bit-rate (in bits/s) * 30 / 8. Set the maximum number of chunks to be less than the capacity of the card over the chunk size, to prevent the data from exceeding SD card capacity.

Step 5: Check Recording is Taking Place

1. **Connect** your PC to the NETNode and **login.**
2. Navigate to the **Information** tab.
3. Click **File System.**
4. The File System window opens.
5. Click **Flash Card.**
6. The **Directory** window opens.
7. Click **Stream.**
8. The **file window** opens with all your recordings.

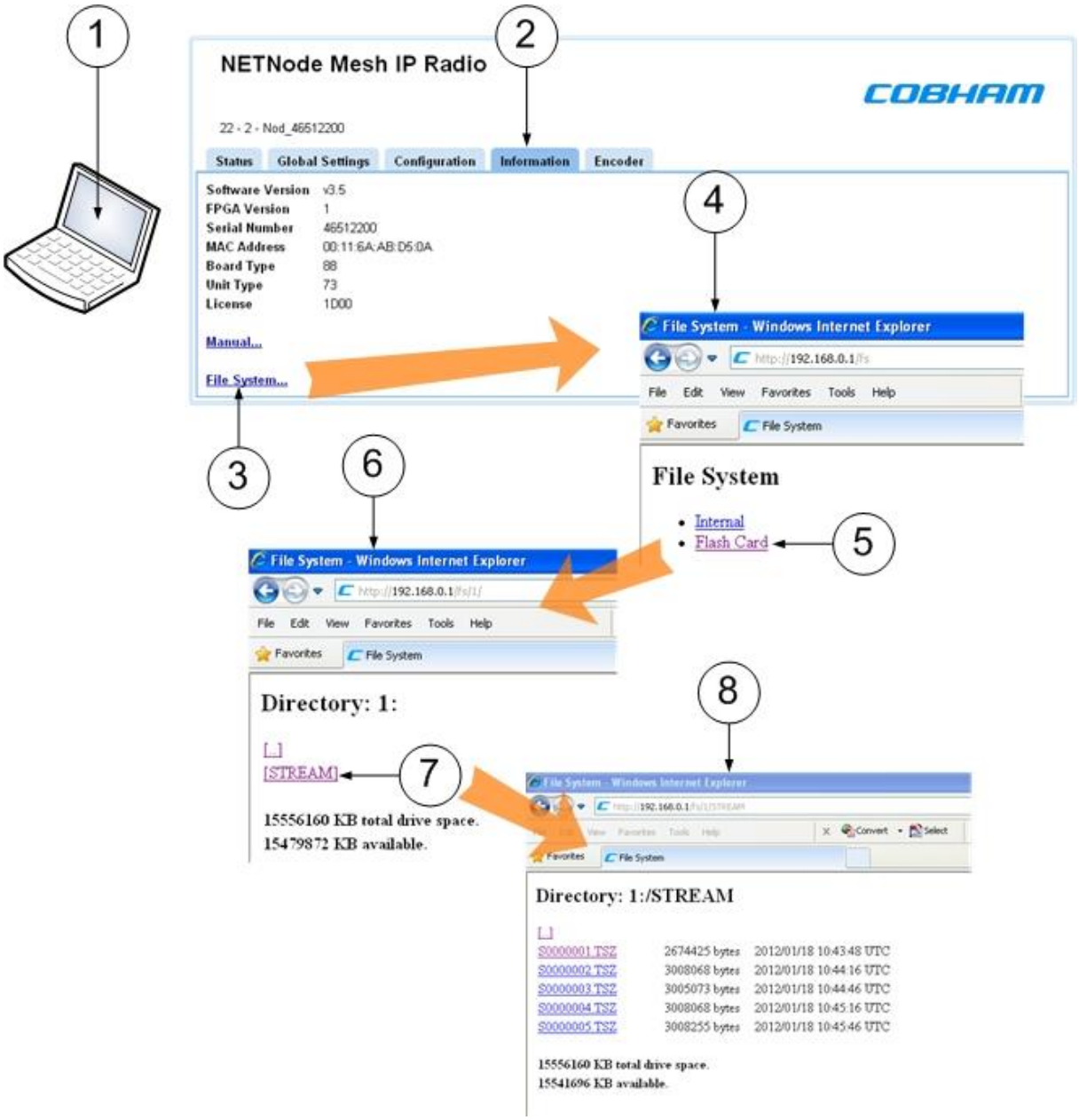


Figure 2-12 Recorded video file system

Each file is one chunk representing 30 seconds of data. When the number of chunks is reached, the oldest file is deleted and recording continues providing the SD capacity is not exceeded.

For example to set a continuous recording of the last five minutes of encoded video you would set the number of chunks to 10 and this would continuously record and overwrite the last five minutes of video.

With a 1Mb/s video stream and a 2GB SD card a user can record just over four hours of video data.

1Mb/s is equivalent to 125kBytes/second of data. A 2GByte SD card can store 16,000 seconds of video before it hits capacity or 533 30 second chunks.

To keep a safe margin a 500 chunk limit must be used giving just over four hours of recording if recording a 1Mb/s video stream.

Step 6: Playing back the Recorded Data

The recorded data can be viewed directly with a player such as VLC media player:

1. **Connect** your PC to **NETNode** with the SD card installed.
2. Double-click the **VLC icon** on your desktop.
3. **VLC media player** window opens.
4. Select **Media →Open Network Stream** from the drop-down menu.
5. The **Open Media** window opens.
6. Type the **Network URL** like this example: rtsp://192.168.1.2/record.sdp.
7. Click the **Play** button.
8. VLC media player window opens with your **playback.**

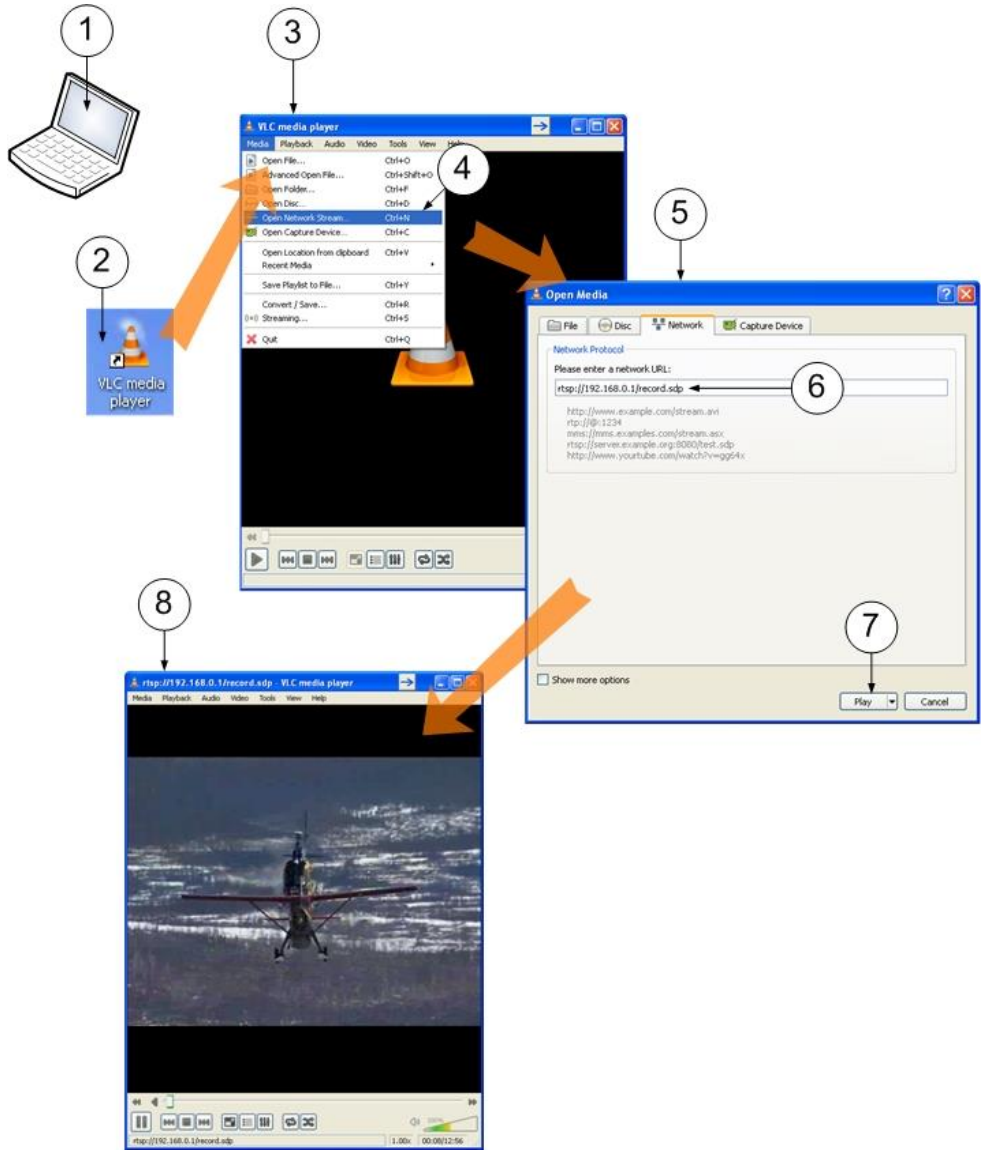


Figure 2-13 Setting up VLC player

In this mode of operation the slider bar on VLC can be moved to navigate to different parts of the recording.

Note: Playback will always start on the next 30 second chunk. The Network Time Protocol (NTP) timestamps in the data contain the time the recording was transferred to SD card.

Step 7: Transferring the Files

Individual recorded files can be transferred to the PC using the Web interface to download the files. To do this operation, simply right click on the file.

The SD card can also be removed and inserted into a card slot on the PC to read the files. The SD card format is FAT16 with the date stored in UTC format.

2.11 Video Flow Control

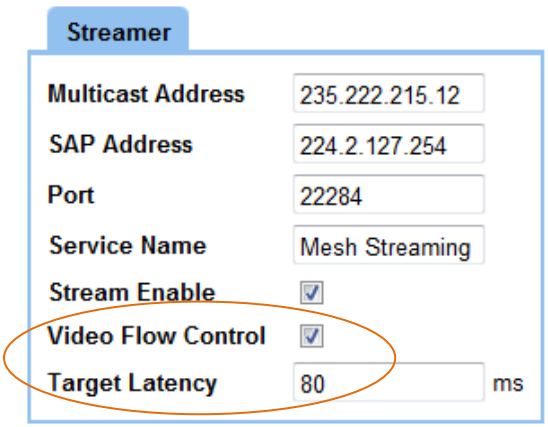
Video flow control allows the video bitrate to be varied depending on the MESH bandwidth available. This prevents corruption of the video when MESH bandwidth drops, and allows the picture quality to adapt accordingly.

The VFC operates by monitoring the latency from the video encoder to the MESH endpoint or endpoints (this is where the video emerges from the MESH network). At the endpoint a special acknowledgement packet (RACK) is sent back to the source. The system tries to maintain the round trip to the target latency.

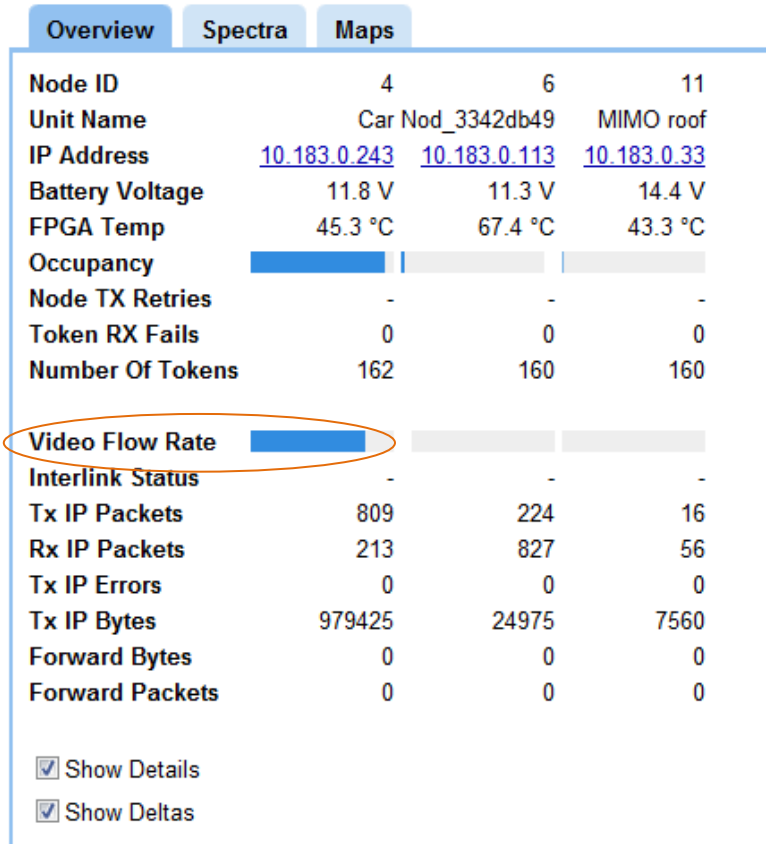
Video flow control requires the internal encoder to be upgraded to version 1.4 or greater. See the H264 encoder upgrade instructions to see how to do this.

To setup the video flow control, first check that the streaming protocol on the global settings plane is set to RTSP unicast or multicast. On the configuration plane set the video bitrate on the encoder tab to the lower of maximum value that the link will support, and what is required to give the required picture quality. This value will not be exceeded. Setting this value too high will degrade performance.

At this time, go to the streamer plane, and enable Video Flow Control. It can be necessary to adjust the Target Latency depending on the network. Too low a value will drop the actual bitrate, too high a value will increase latency and cause overflow in the internal FIFOs, which will corrupt the video. The value must be chosen so it is just big enough to give full capacity. In most cases the default value of 80ms will operate well. It is possible to reduce the value a little to give spare capacity for other services.



It is possible to see how much capacity is in use on the **Status** > **Overview** page by clicking show details and looking at the **Video Flow Rate**. This is a percentage of the maximum video bitrate (in this example, about 85%).



The encoder does not change transport stream rate, but video bitrate. This affects the number of null packets in the stream. The NetNode compresses the transport stream packets by removing the null and replacing with a marker byte before being sent across the radio interface. This is reinserted by the NetNode the far end. Although the transport stream rate does not change, the quantity of data send across the air interface does. The rate can vary between 25% and 100% of the encoder specified bit rate.

Note: The H264 encoder will switch into low delay mode when VFC is enabled.

Note: VFC will also affect the recording quality on the SD card.

2.12 Working with VLAN

A Virtual LAN (VLAN) enables a number of networks to share the same physical resources such as routers and cabling while remaining fully independent of each other.

The use of VLAN makes it possible to have completely separate networks running over a common NETNode mesh system without sharing data between the networks.

VLANs are created to provide the segmentation services traditionally provided by routers in LAN configurations. VLAN addresses issues such as scalability, security, and network management.

Routers in VLAN topologies provide broadcast filtering, security, address summarization, and traffic flow management. By definition, switches may not bridge IP traffic between VLANs as it would violate the integrity of the VLAN broadcast domain.

Step 1: Configure the NETNode to operate with VLAN

By default the standard mesh network does not allow passage of VLAN packets. To let VLAN packets through the system each NETNode must be programmed with:

- The VLAN tag
- A correct IP address
- Subnet mask
- Gateway

Version 4.0 software onwards supports DHCP auto-configuration of each VLAN.

The VLAN tag is a number between 1- 4095 and is unique to each VLAN in the system. It identifies each VLAN.

The setting of the IP address and subnet mask allows additional filtering of the IP packets as they enter the NETNode. Setting the gateway address allows packets not on the local subnet to be forward to this address. It also allows the generation of ARP and ICMP reply packets which aids internal switching and testing of the VLAN network.

The NETNode mesh network supports up to eight separate VLANS. Each VLAN is maintained by a separate ARP table within each NETNode.

1. **Connect** your PC to the NETNode and **log on.**
2. Navigate to the **Configuration** tab.
3. In the **VLAN** pane, select a VLAN sub-tab.
4. Set the **Tag, IP Address**, **Sub Mask** and **Gateway** (if applicable) for each VLAN.
5. Alternatively, set **DHCP Enable** if there is a DHCP server operating on this VLAN, and auto-configuration of the IP address is required.
6. Click **Apply** button.

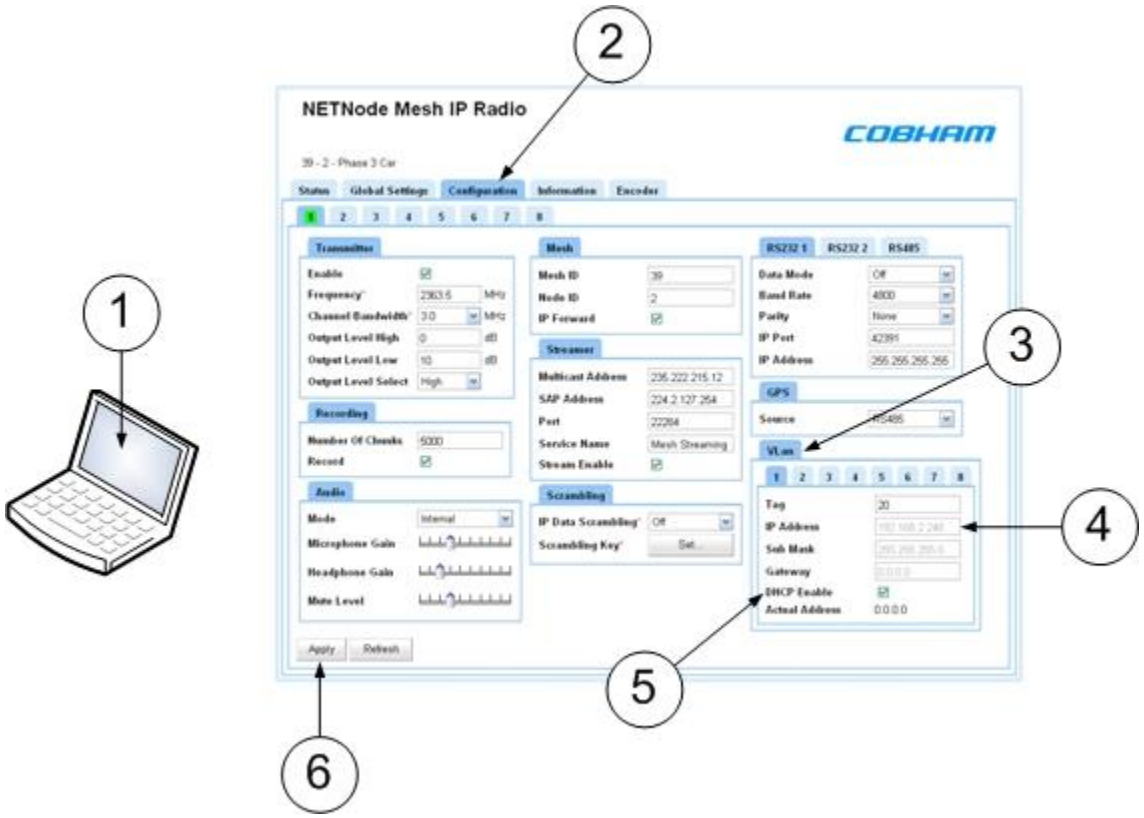


Figure 2-14 VLAN Configuration

In the example above the NETNode is set up to support a VOIP (Voice over IP) system operating using a VLAN through the mesh system. The IP Address supports ICMP ping and can be used for debugging.

Optional Step 2: Configure VLAN Tagging and Stripping on Ethernet Ports

The NETNode allows VLAN tagging and stripping on the two external Ethernet ports.

Note: Changing the Mode of the Ethernet port which you are currently using to control a NETNode will cause loss of control of the unit. The user may only be able to regain control using the other Ethernet port or the RS232 interface.

1. Connect your PC to the NETNode and **login.**
2. Navigate to the **Global Settings** tab.
3. In the **Ethernet Ports** pane, set **Eth2 Mode** to **LAN<->VLAN.**
4. Set **Eth2 Priority** to **4.**
5. Set **Eth2 Tag** to **1531.**
6. Click **Apply** button.

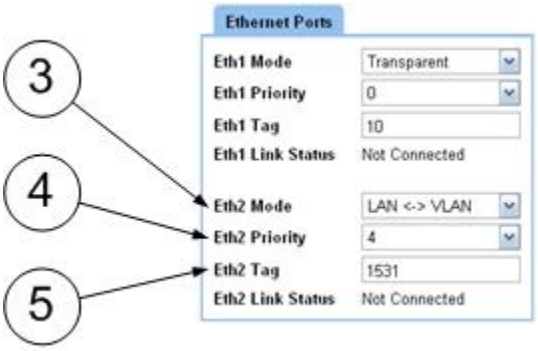


Figure 2-15 VLAN Tagging and Stripping

In the example above Ethernet Port 1 is acting as a typical Ethernet port enabling you to web browse as normal into the radio and send data across the radio network on the same IP address range as the radio IP addresses.

Ethernet Port 2 is configured to support a VLAN with a Tag of 1531.

2.12.1 About the VLAN Tagging

VLAN tagging adds the VLAN tag as the packet enters the NETNode port and removes it again when a VLAN packet of the correct tag exits. Only VLAN packets with the correct tag will exit the port.

This is selected by **Global Settings →Ethn Mode →LAN<->VLAN**.

The tag number and priority must also be specified.

2.12.2 Using VLAN Tagging

Suppose the system administrator wishes a camera to be connected to each NETNode, but each on a separate network so that individual users cannot snoop onto other cameras, or change the configuration of the Mesh system.

Connecting the camera to each NETNode and setting the Ethernet port using different VLAN tags for each NETNode would enable this.

The endpoint node could pass the VLAN tags unaltered by setting:

Global Settings →Ethn Mode →Transparent, and programming all eight VLAN addresses and tags in this node.

The endpoint node could then be connected to an external intelligent router which puts out the separate LAN networks out on separate ports. In this example the endpoint would typically be at the HQ building.

2.12.3 About VLAN Stripping

VLAN stripping removes the VLAN tag as the packet enters the port and adds it again when the packet exits. This is selected by:

Global Settings →Ethn Mode →VLAN<->LAN.

The tag number and priority must also be specified.

Note: Stripping will block non VLAN traffic on that port. Priority is required but currently is not implemented in the mesh system.

2.12.4 Using VLAN Stripping

VLAN stripping allows a NETNode to pass its data over an IP backbone without interference to other traffic on the network. It also has the potential to let multiple NETNodes on the same mesh network to connect to the same IP infrastructure.

CAUTION: Changing the Mode of an Ethernet port to VLAN can cause temporary collapse to the IP network the NETNode is connected to, if done incorrectly. A good understanding of the network topology is required before implementing VLAN on a mesh system.

Note: Some units may have Ethernet port numbers reversed. Check which port is connected by looking at the **Ethn Link Status**. If control of unit is lost, connect to other port and wait 30 seconds or repower unit.

2.12.5 LAN traffic only

This is selected by **Global Settings →Ethn Mode →LAN traffic only**.

This allows LAN traffic (and the management interface) through, and blocks any VLAN traffic from the port. This mode is useful for isolation.

2.12.6 VLAN traffic only

This is selected by **Global Settings →Ethn Mode →VLAN traffic only**.

This allows all VLAN traffic through, and blocks any LAN traffic from the port. No tags are added or removed. This mode is useful for isolation.

2.12.7 Tagged VLAN only

This is selected by **Global Settings →Ethn Mode →Tagged VLAN only**.

This allows VLAN traffic with the tag set by the **Ethn** through, and blocks any other traffic (LAN and VLAN) from that port. No tags are added or removed. This mode is useful for isolation.

2.12.8 About Disable Mode

This disables the external port and is useful for security.

2.13 Port Blocking (V5.4 onwards)

To prevent IP loops forming in the Mesh network, each NETNode performs a port blocking function. Every 2 seconds a broadcast port probe packet (UDP port 29837) is sent out from each physical port. Each Ethernet interface uses a separate MAC address which is different to the units' main MAC address so as not to confuse switched hubs or routers. The UDP

packet contains a list of serial numbers of the nodes which are linked across the radio network.

If a NETNode detects this packet arriving at a physical port with the same serial number as itself then the port is blocked unless this is the lowest IP address (if the interlink IP address is set), then lowest serial number and then the lowest port number in the system. The port will remain blocked for an additional 30s after the condition is removed. Port probe packets continue to be sent while the port is blocked.

This prevents IP loops forming by shutting off the physical port of the NETNode to and from the units' main MAC address and VLAN addresses. This may be used to an advantage – for example multiple NETNodes or a single NETNode (using both ports) can be connected to the same IP backbone providing redundancy if unit or one connection fails.

Note: Port blocking is only effective over a single MESH network. For multiple networks which contain a loop, routers with Spanning Tree Protocol may be used.

2.13.1 MAC Address Blocking

NETNodes also provide a secondary method of blocking loops.

If a packet which has the same source MAC address arrives via multiple ports (including the radio interface), then any packet with this source MAC address is blocked for 5s and until the condition is cleared.

2.14 Interlink Mode

Usually, IP networks do not allow multiple routes from an IP source to an IP destination address. This precludes multiple nodes to be connected to the same IP backbone network.

For example in a city it is often advantageous to have multiple high points on the same mesh all connected to the same IP backbone. In this example connection of two NETNodes onto the same IP backbone would cause a loop to be created in the network.

In practice each NETNode identifies this network loop occurrence (same MAC address appearing on multiple ports) and blacklists the entry for 30 seconds, to prevent this happening.

But, it can be extremely useful to be able to connect multiple NETNodes to the same backbone. For example, a city Mesh system may have two nodes on two different buildings.

In this example it may be that a mobile node is only served by the one of the two nodes (for example Mesh #1 in the diagram below), and if this not the node connected to the backbone then IP forwarding over the radio link would have to take place. This reduces the overall network capacity; as the hop means information has to be sent twice over the radio network.

Step 1: Understanding Interlink Operation

Interlink mode replaces the radio links between the mesh nodes on the backbone with an IP tunnelling protocol over the IP backbone. To make this IP tunnelling possible one of the NETNodes acts as a master allowing both tunnelling data and the main IP data through the Ethernet interfaces while the other nodes act only as slaves just allowing IP tunnelling data to and from that node.

To isolate the IP layers each NETNode contains a second IP address (and MAC address) which is used for the tunnelling. This IP address only supports ARP, ICMP (ping) and the UDP tunnelling packets.

When this Interlink mode is activated, each node also sends out a broadcast packet on the second IP interface which advertises it's presence on the IP backbone. This allows each node to know what other nodes are connected to the backbone, and thus whether the interlink data can be sent across the IP network. The nodes also check that there is one and only one master on the network and correct this if necessary. This is useful if, for example, the master is lost from the network.

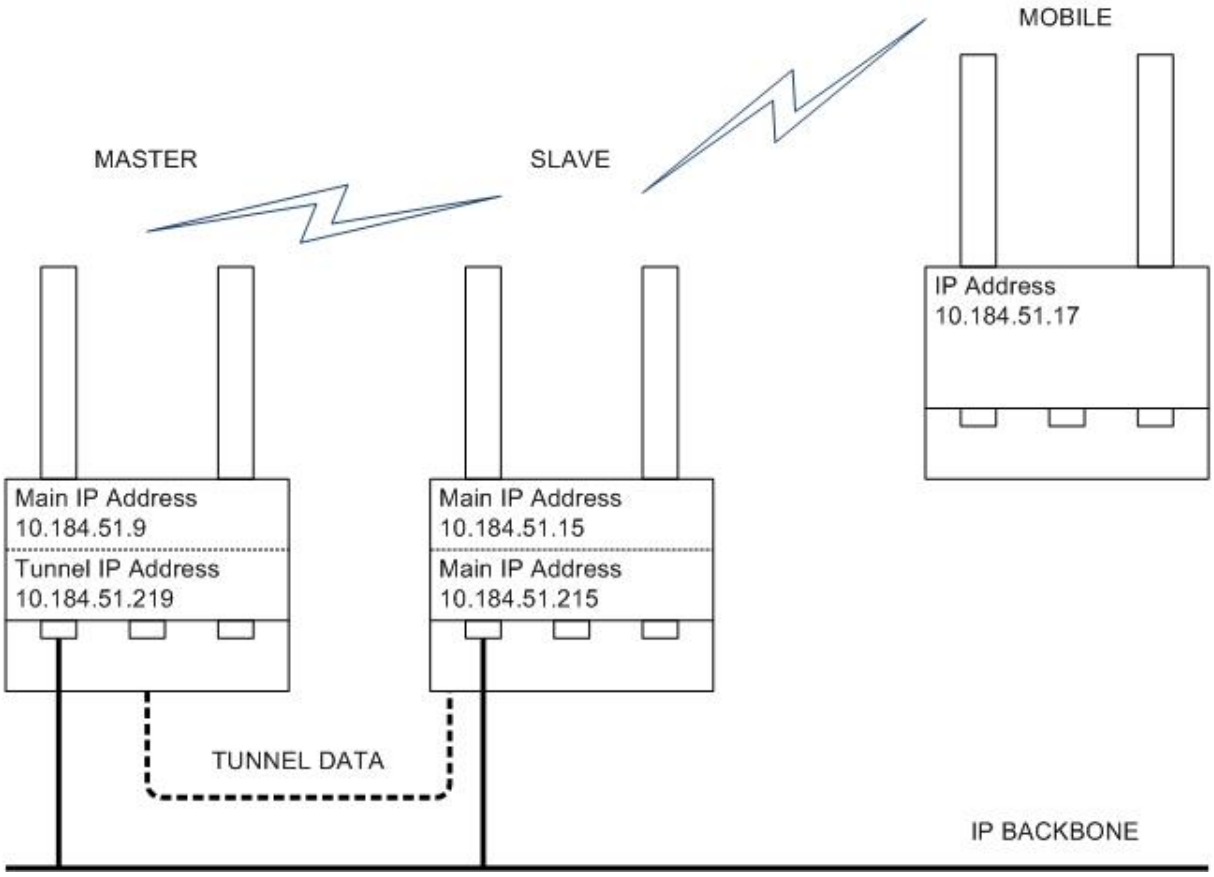


Figure 2-16 Interlink RF operation

Step 2: Configure the NETNode to operate with Interlink Mode

If there are multiple mesh networks on different frequencies anywhere on the same network they must have different Mesh IDs before starting. This can be checked with Node finder.

To enable the interlink mode, select the interlink mode tab and provide an IP address for each active port connected to the IP backbone. The IP address must be on the same subnet as the NetNode. Both ports can be used (for redundancy) but in this case, both ports must have different IP addresses and share the same NETNodes on the backbone. (That is, a unit cannot act as a switched hub for the tunnelling data).

2.14.1 Interlink Mode across a VLAN Network (v3.6 onwards)

It is possible to send the interlink data across a separate network. To configure this mode, a Tunnel VLAN tag and priority must be set to a nonzero value. The Tunnel IP address and Tunnel Network mask must be set appropriately. This causes a VLAN tag to be added to the tunnel IP data.

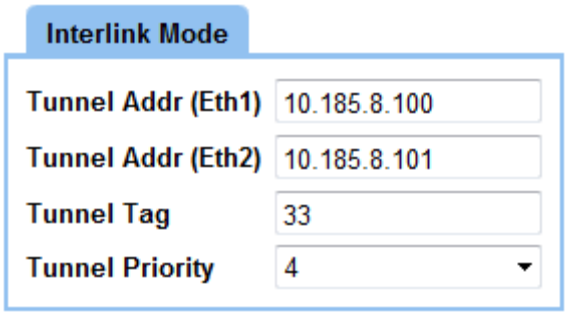


Figure 2-17 Tunnelling settings

The VLAN tag may be removed by an external router, or the NETNode may be configured so that one Ethernet port has VLAN tagging enabled with the same tag (and priority) as the tunnel tag. This can then be directly connected to the tunnelling network.

Interlink mode uses UDP ports 29836 (Unicast) and 29837 (network broadcast), which it can be necessary to unblock on some firewalls.

Note: All separate Mesh networks connected to the IP network (no matter where) must have different Mesh IDs. Failure to do this will result in loss of functionality.

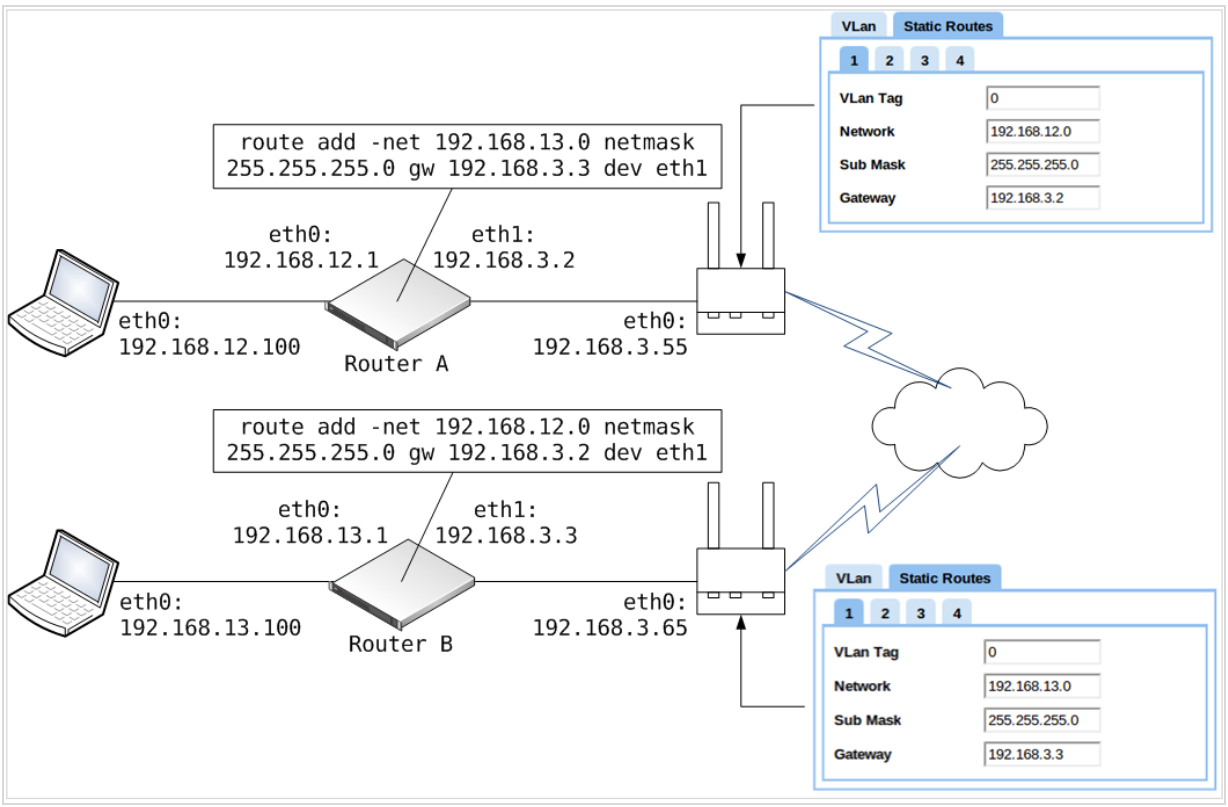
Note: The Interlink NETNodes must always be linked via the radio interface, as well as the IP backbone to operate correctly. This ensures the system remains as a single Mesh Network.

2.15 Adding Static Routes

V5.0 onwards of the software lets the user add static routes for subnets which are not part of the MESH subnet. Static routes are supported for both LAN and VLAN. Any packet which matches the subnet specified will be forwarded to that gateway rather than the default gateway.

To add a static route to the system, browse to the node which is physically connected to the router for that gateway/subnet. On the configuration -> static routes page select one of the four entries which is not in use (i.e. Network = 0.0.0.0). Add in the network, subnet mask and the gateway (which must be on the local subnet). Optionally add the VLAN tag or 0 if on the main LAN.

Each node distributes its' own static routes round to all nodes within the MESH network. The diagram below illustrates a particular example of this:



Note: If a static route is added to a VLAN then a VLAN entry must also exist for that tag.

Note: Do not add the same static route to different nodes in the system. Because all static routes are distributed within the MESH network this will cause much confusion.

Note: It is best to add the static route to the node physically connected to that gateway/subnet, i.e. not across the radio link. As well as minimising confusion, this ensures that if the node goes down it only affects its' own static routes.

Up to four static routes can be added per node.

2.16 Routing Information Protocol

V5.0 of the software now supports snooping of RIP v2 packets to allow the automatic identification of gateways to different subnets. To enable this feature the RIP v2 enable checkbox must be selected in **Global Settings** > **IGMP/RIP Snooping** dialog box.

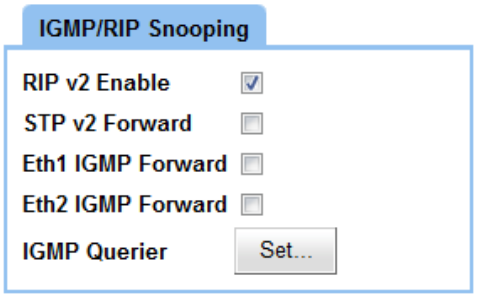


Figure 2-18 Routing Information Protocol

NETNodes can also send out an initial RIP v2 general query packet to aid starting up of the network.

Note: NETNodes do not currently snoop on OSPF packets.

2.17 Spanning Tree Protocol

V5.0 of the software now allows STP/RSTP packets to pass through the system. This allows external routers to check for IP loops in the network.

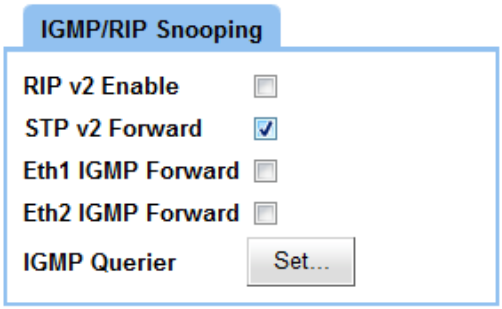


Figure 2-19 Spanning Tree Protocol

A packet entering a port of the MESH network is forwarded on to all other ports on the MESH in the same way as a broadcast packet. A fixed value of 5000000 is added to the current route path cost for STP/RSTP packets which go across the radio interface. This allows a router to favour non MESH radio routes when a direct Ethernet path is available.

CAUTION: It is recommended to disable STP in interlink mode. During a master-slave switch it is possible for an STP packet originating from a particular router port to be sent back to the same port. This may cause the port to shut down.

2.18 Roaming

Roaming allows a NETNode to move between one MESH network and another. This is very useful, for example, in city networks where there can be a large number of nodes or sufficient bandwidth to support the use of multiple frequencies. Another example might be an airborne environment where an aircraft may be required to join different city MESH's located across the country.

Each separate MESH Network is called a 'zone'. A zone can consist of a single NetNode base station or a large existing MESH network with multiple connected high point 'base-station' nodes.

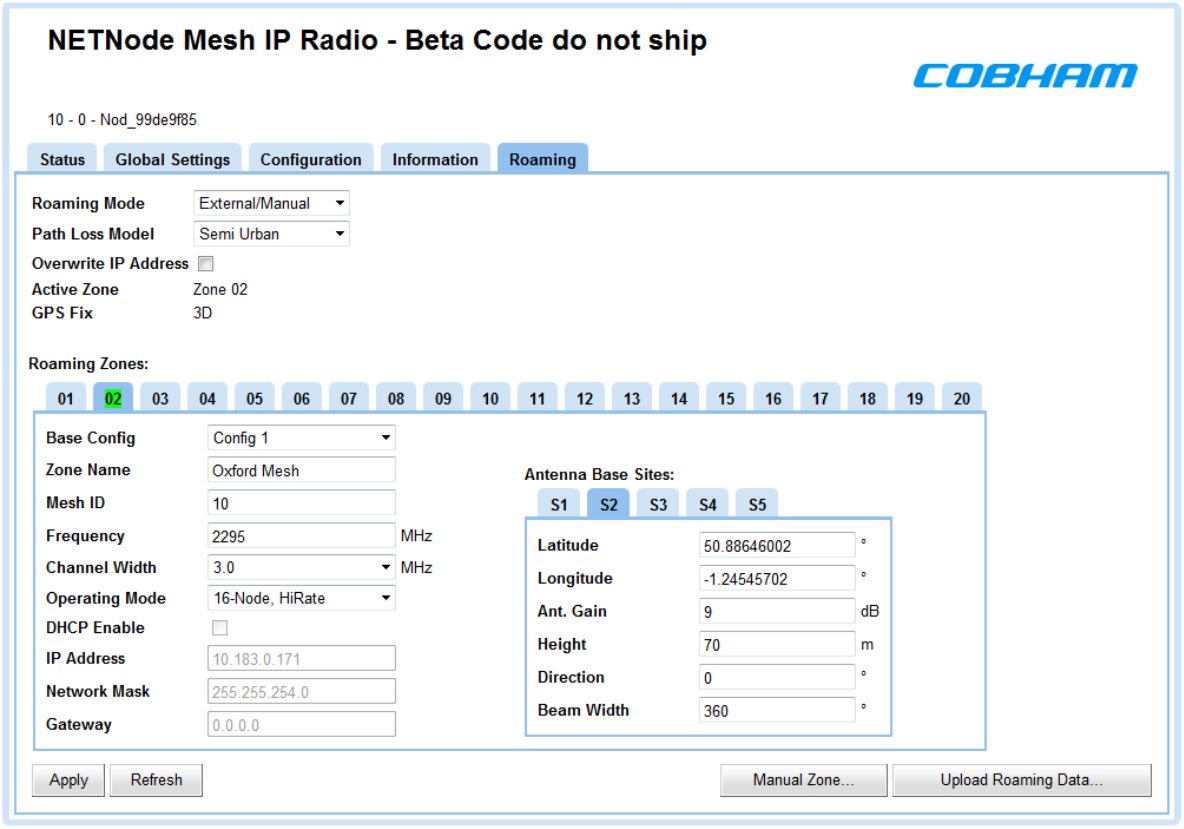
Roaming currently supports four modes of operation: 'Off', 'Round Robin', 'GPS Location' and 'External/Manual'. Round Robin hops sequentially between networks; while GPS location uses a simple path loss model to pick the best network to join. There are advantages and disadvantages in each method. The External/Manual mode allows control of the zones through a remote command or by the manual zone button. This allows applications such as

Mission Commander (which can contain topographic data) to select the zone the unit operates in. The manual zone button is useful for testing the zone functions correctly.

Each zone uses a base configuration. This is the configuration stored in the Configuration tab panel. The base configuration is then overlaid and overwritten with the local parameters from the Zone tab such as frequency, mesh ID etc. If the Overwrite IP Address box is selected then DHCP Enable, IP Address, Subnet Mask and Gateway on the **Global Setting** > **main** tab will also be overwritten with the local values from the Zone tab. The **Zone Name** is not used but is useful for identification.

Using the same configuration for multiple zones allows, for example, the scrambling keys and VLAN addresses to be reused.

Setting the base configuration to **off** disables the zone.



Note: When roaming is enabled, some of the parameters on the global settings and configuration panels will be overwritten with the zone information. The update all nodes checkbox will also be cleared.

The active zone box together with the green highlighted roaming zone indicates which zone is currently active.

2.18.1 Round Robin Mode

Round Robin mode simply looks for 10s at each active zone at a time and if a signal is found joins that Network. If no signal is found or the current signal is lost then Round Robin moves onto the next zone. Obviously with large numbers of zones this becomes very slow. The other disadvantage with this mode of operation is that the NETNode will not leave the network until the signal is lost even when alternate Networks may be available at higher signal strengths. But it is simpler to configure than GPS location mode.

2.18.2 GPS Location Mode

For GPS Roaming, each zone contains a list of primary antenna (fixed) sites. For each site the GPS location, height, and the antenna parameters are entered into the antenna base sites panel.

For this mode to operate a GPS receiver must be connected to the roaming NETNode. Please see section 2.4 on how to perform this task. The presence of a working GPS is indicated by the 3D fix in the GPS Fix status box.

For each zone a path loss is calculated between the Roaming NETNode and each of the individual sites. A number of path loss models are supported – the urban mode increases the path loss at a quicker rate than the free space model and takes into amount antenna heights (Egli's model). The semi-urban model is a halfway house between the urban and free space models. The loss also includes an over the horizon model (the aircraft applications). The lowest loss from all sites and zones is calculated and then compared with the lowest loss of all sites on the current zone. The NETNode will switch to the new zone if difference exceeds a small threshold to allow for some hysteresis.

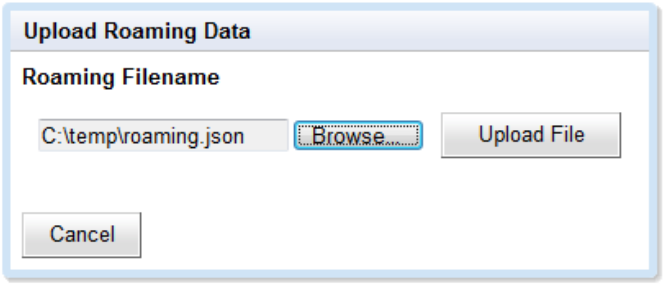
Up to five sites are supported per zone. For more than five fixed sites it is suggested entering the principle sites around the periphery of the area. Latitude and Longitude data can be readily acquired from the WEB using tools such as Google maps. The beam width box allows for sector antennas to be specified. Setting the beam width to 360 assures an Omni antenna. Setting the beam width to zero indicates that site is not in use.

GPS location may not work well in cluttered environments where the path loss and actual signal strength do not correlate well. It is very suited to airborne applications.

Note: The GPS panel and data rate must be set correctly for all configurations which roaming is used. If this is not done then the GPS will become disabled when the unit changes configuration.

2.18.3 Downloading and Uploading Zone Data

Zone data may be downloaded and uploaded in to different units. To download the zone data, on the browser manually type in the URL: http://ip_address_of_unit/roaming.json. The resulting file can be saved to disk. This file is in **JSON**, or **JavaScript Object Notation** format and can be easily edited in a text editor if required. The file can be uploaded back into any unit by clicking the Roaming Upload Button, and entering the file name in the dialog box.


Upload Roaming Data
Roaming Filename
C:\temp\roaming.json
Browse...
Upload File
Cancel

3. Advanced Setup

3.1 About Advanced Setup

To get the most from your radio system you must customise the programming for your operations and area.

CAUTION: Before you start programming your radio make sure the batteries are new and fully charged. If not, you could operate an AC adapter to power your radio.

If the radio loses power while you program it, its memory might be corrupted and it will be necessary to reset defaults. All information programmed in the radio might be lost.

The **Control Application** or **Control Pages** let you control the communications system, to keep it operating in a correct and stable mode. It lets you to change many of the settings of the unit like frequency or bandwidth.

The control system can be a **Control Application** that operates on your PC connected to the device with Serial communications.

If not, it can be Control **Pages** that are viewed on your PC browser when connected to the device with IP communications.

3.2 Connecting your PC to your Radio

The NETNode uses **Control Pages** accessed from your web browser which enables you to do many configuration tasks quickly and easily.

This section tells you how to connect your PC to the NETNode and then configure the unit with the control pages.

Step 1: Install the Control Application

You install a **browser** (Internet Explorer, Firefox or Chrome for example) onto your Personal Computer (PC).

At this time you can start the browser and connect to the Control Pages and start configuring your NETNode.

Step 2: Make an IP Connection between Radio and PC

It will be necessary to have a fully powered **NETNode**, the correct Ethernet cable for your variant and a personal computer operating a web browser. The Ethernet cables are:

- NETNode-3-Robust – **CA0403** or **CA0406**
- NETNode-3-Plain – **AP000465** (Standard RJ45-RJ45 Ethernet cable – Available separately)
- NETNode-Mini Plain – **CA0505**

1. Connect the Ethernet cable to the NETNode Ethernet receptacle.
2. Connect the **RJ45 8-way plug** (pins) to the **RJ45 8-way receptacle** (sockets) on your Personal Computer.

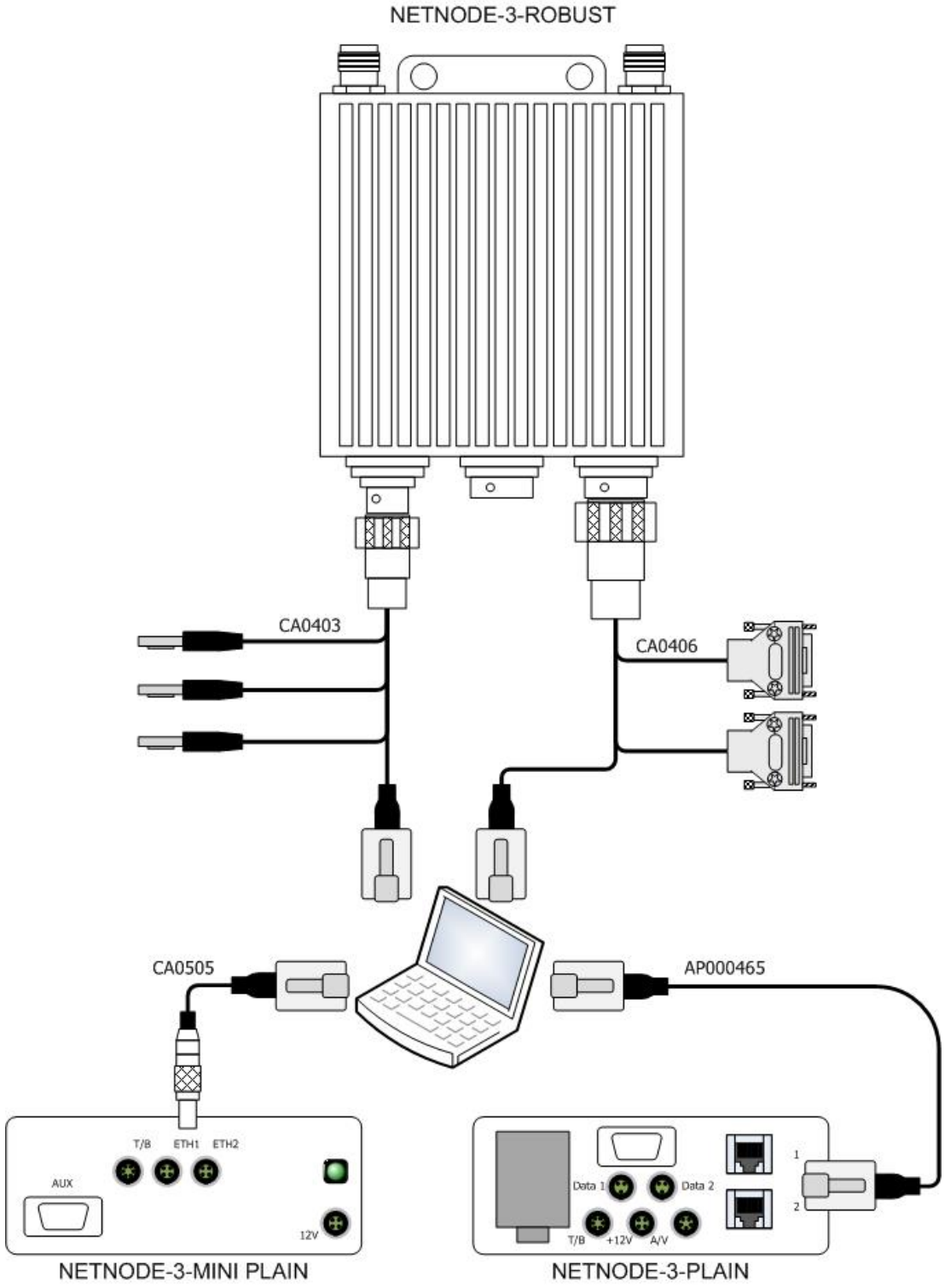


Figure 3-1 NETNode IP Connections

Step 3: Start the Control Pages

1. Power up the NETNode.
2. Click **Start** → **Internet** on the PC.
3. Your **browser window** will open.
4. Type the **IP address** of the NETNode you wish to configure like this example: **http://192.168.0.1/**
5. Click the **Refresh** button.
6. The web browser opens the **Status** →**Overview** page of the NETNode.

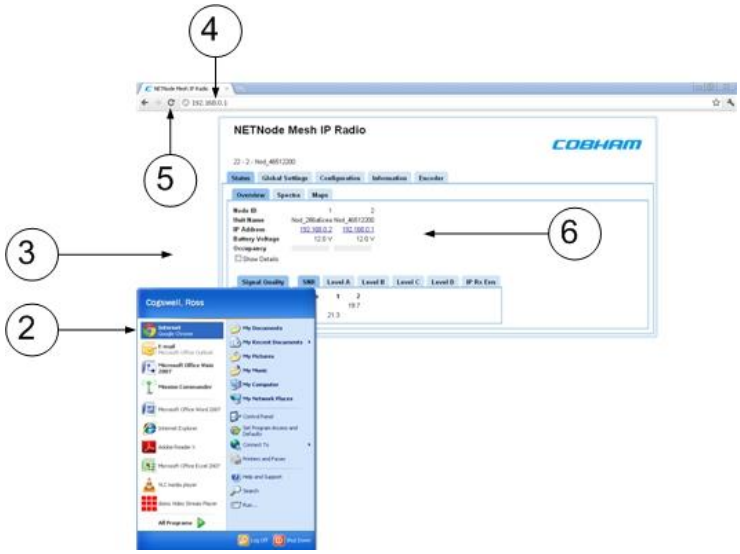


Figure 3-2 Starting the Control Session

Step 4: Log on to the Control Pages

7. The **Authentication Required** dialog opens
8. By default, the **User Name** is not required
9. By default the password is **meshweb**.
10. Click **Log In** button.

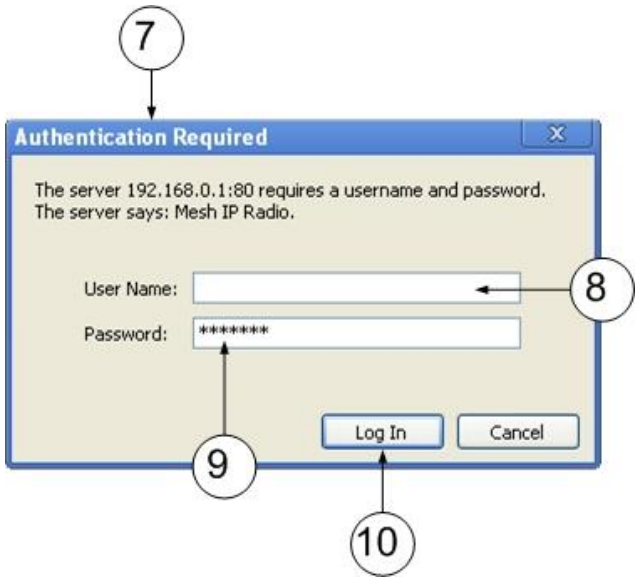


Figure 3-3 Logging In

Step 5: Look at the Primary Window

Each Windows based application must have a **Primary window** as its entry point. For the NETNode this is the **Web Browser** showing the first of the **Control Pages**.

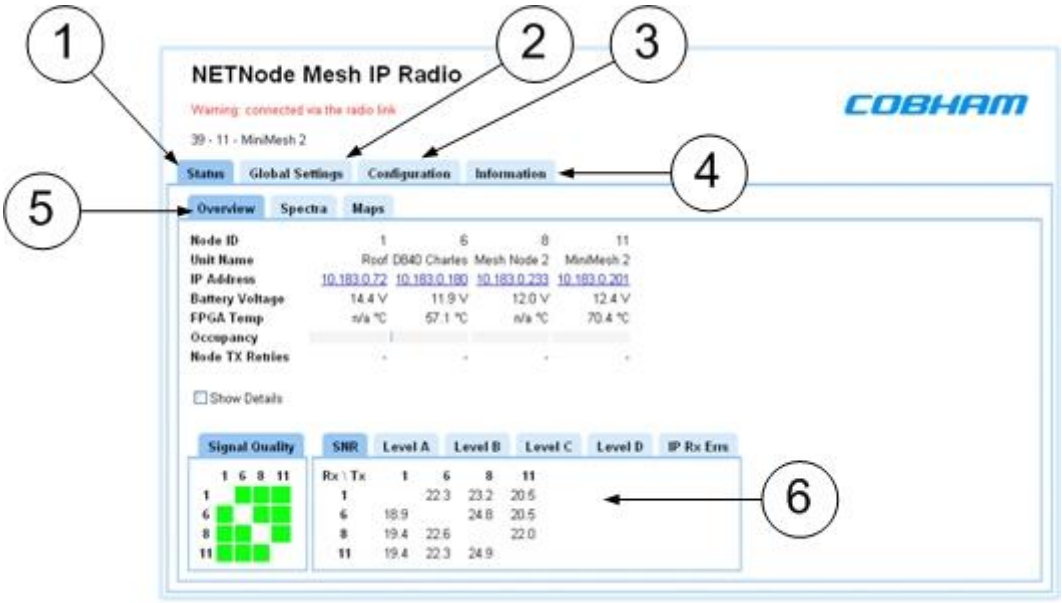


Figure 3-4 NETNode Status/Overview Control Page

No.	Property / Description
1	**Status** tab. Divided into Overview, Spectra and Maps sub-tabs. This displays detailed status information of received signal quality, battery and mapping information.
2	**Global Settings** tab. Divided into Main, Ethernet Ports and Interlink Mode panes. You'll find the Set Clock, Format File system, Restore Defaults and Password buttons here too.
3	**Configuration** tab. Divided into Transmitter, Recording, Audio, Mesh, Streamer, RS232, GPS, Scrambling and VLAN panes. The Configuration tab contains the list of 8 presets. For each preset the user can specify demodulation parameters, decoding modes, and descrambling configuration.
4	**Information** tab. Contains information including software versions and unit specific data. You'll need this information during a support call for example.
5	**Sub-Tabs.** Simply enables you to break down information from a tab.
6	**SNR Pane.** The tabs and sub-tabs are broken down into panes of information. This particular one is all about Signal to Noise ratios for example.

Table 3-1 – The Primary Window

3.3 Configuring the Basic Settings

You will wish to configure a device to start to explore what you can do with a mesh network.

Step 1: Configure the Big Seven

It will be necessary to have some powered NETNodes for which you know the IP address and a PC with a web browser.

There are only **seven things** you have to configure on **each** NETNode to make them form a mesh network.

1. **Connect** you PC to the first NETNode and with your browser, log on to the control pages.
2. Select **Global Settings** tab.
3. Set the **Operating Mode** on all units to the same type. For best performance set **16-Node, Hi-Rate**. Others modes give compatibly with earlier software versions.
4. Click **Apply.**

Note: If you select **16-Node, Hi-Rate** as your operating mode, you can only select between **1 to 63** for your **Mesh ID**.

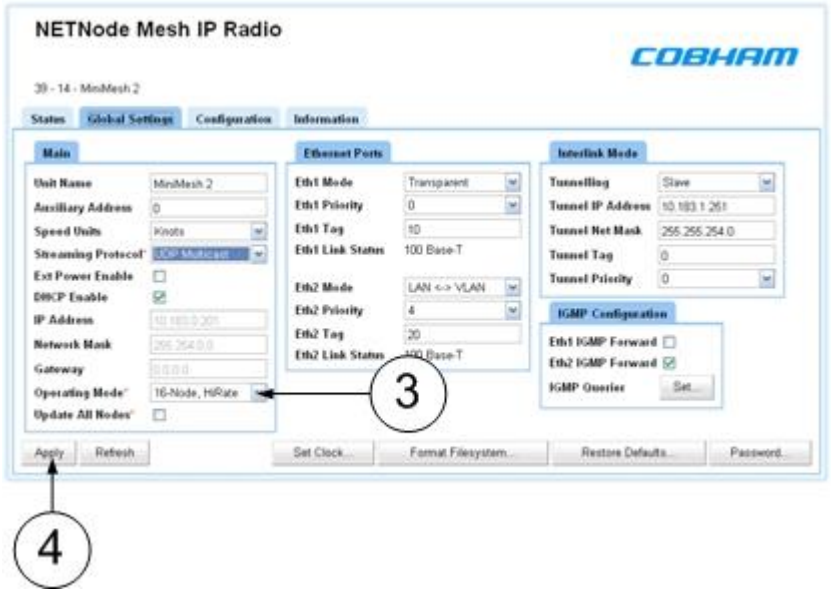


Figure 3-5 Configuring the Big Seven – Global Settings Tab

5. Navigate to the **Configuration Settings** tab.

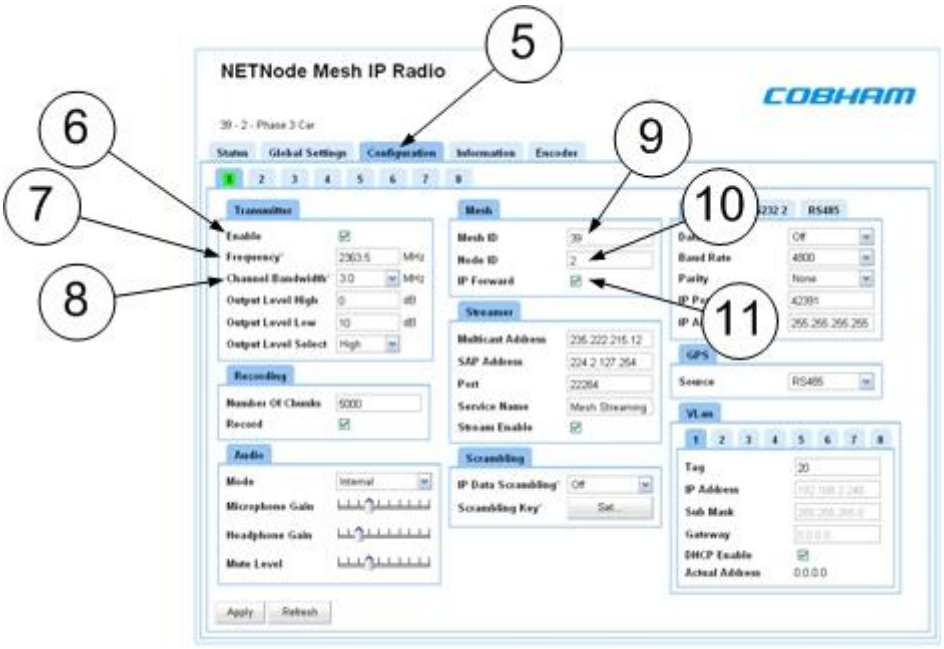


Figure 3-6 Configuring the Big Seven- Configuration Tab

At this time there are six more **basic setup** fields that let you quickly setup the unit without getting into details. (We'll discuss those later).

There are basic things to setup:

No.	Basic Setting	What you can do…
6	Enable	Select this checkbox to switch the transmitter on.
7	Frequency	Type in the frequency you wish to use for your mesh. This must be the same on all units.
8	Channel Bandwidth	Select the bandwidth you wish to use for your mesh from the drop-down list. This must be the same on all units.
9	Mesh ID	Type in a mesh ID you wish use for your mesh. This must be the same on all units in the mesh network. The mesh ID tells the unit which mesh it belongs to. All NETNodes on Mesh ID 60 for example will communicate with each other. 1 to 255 (8 and 12 Node systems) 1 to 63 (16 Node, Hi-Rate) **Note**: If you select **16-Node, Hi-Rate** as your operating mode, you can only select between **1 to 63** for your **Mesh ID**.
10	Node ID	Type in a Node ID for each node in the mesh. The node ID must be unique and can only be 0 to 11 for a twelve node mesh system. **Note**: A node can automatically reassign its Node ID at power up if it finds a conflict with an existing node.
11	IP Forward	Select this checkbox to switch IP forwarding on.

Table 3-2 – Quick Setup

Note: Remember to click the **Apply** button. This is important to saving all your settings.

That's it! Do the same procedure on each NETNode that you require in your mesh network.

When you power these configured NETNodes they will make a mesh network ready for you to use.

All the other fields in the control pages are simply tools for you to use with your working network.

CAUTION: If you select to use **encryption**, the encryption **type** and **keys** must align.

3.4 Working with the Status /Overview Sub-Tab

This displays detailed status information of received signal quality and enables navigation between nodes.

The Status tab is divided into **three** sub-tabs:

- Overview

- Spectra
- Maps

Step 1: Open the **Overview** Sub-Tab

1. Click **Status → Overview.**
2. The **Status** tab opens focussed on the **Overview** sub-tab.

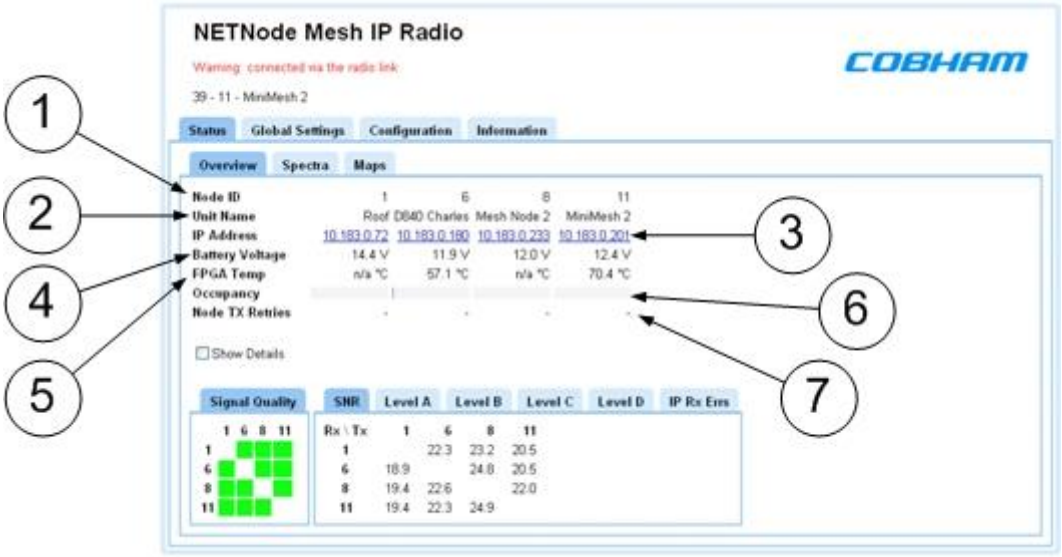


Figure 3-7 The Status / Overview Tab

Step 2: Interpret the Basic Details

No	Property	Range	Description
1	Node ID	0 to 7 or 0 to 11 or 0 to 15 depending on operating mode.	We are showing **two** NETNodes with **Node IDs** of 1 and 2. There could be up to **sixteen** NETNodes in a mesh with Node IDs numbered 0 to 15. The Node ID can be shown in different colours when a NETNode experiences traffic congestion.
2	Unit Name	You can use up to 12 alphanumeric characters for the Unit name.	The unit name is a friendly name to make it easier for you to know which NETNode we are talking about. This name is assigned in the **Global Settings** Tab.
3	IP Address	192.168.9.99 for example.	This shows the **IP address** of the unit that we set up in our initial configuration. Notice that it is shown as a **hyperlink**. If you click on one of these hyperlinks the browser will switch to that NETNode.

No	Property	Range	Description
4	Battery Voltage	11 to 16V.	This returns the battery voltage of the NETNode. Not exciting when we are on mains in the lab but important when you are looking at a node located on a high building some miles away which is operating on batteries.
5	FPGA Temperature	Temperature in Degrees Celsius (phase 3 units only).	This is the internal temperature of the FPGA. The box will become **yellow** or **red** if the unit is too hot. The unit must be allowed to cool and placed in better airflow if the temperature reaches the red zone. **CAUTION:** Operating the unit at high temperatures will lower the life of the internal components and the RF PA.
6	Occupancy	Blue and Orange bars.	The **blue** bar gives a visual indication of the volume of data generated by **this NETNode**. An **orange** bar gives a visual indication of the volume of data being **forwarded** by the NETNode from other Nodes.
7	Node TX Retries	Number of Node retries each 2 seconds.	This must be **zero** ('-') with occasional ones. Higher values will have an unwanted effect the throughput of the system. If problems occur check for interference and that there is no other MESH system operating on the same or adjacent frequency.

Table 3-3 – Basic Details

Step 3: Select the **Show Details** Checkbox

If you select this box you'll see a lot of data about TX IP Packets etc. This can give you important information about the operating of the network.

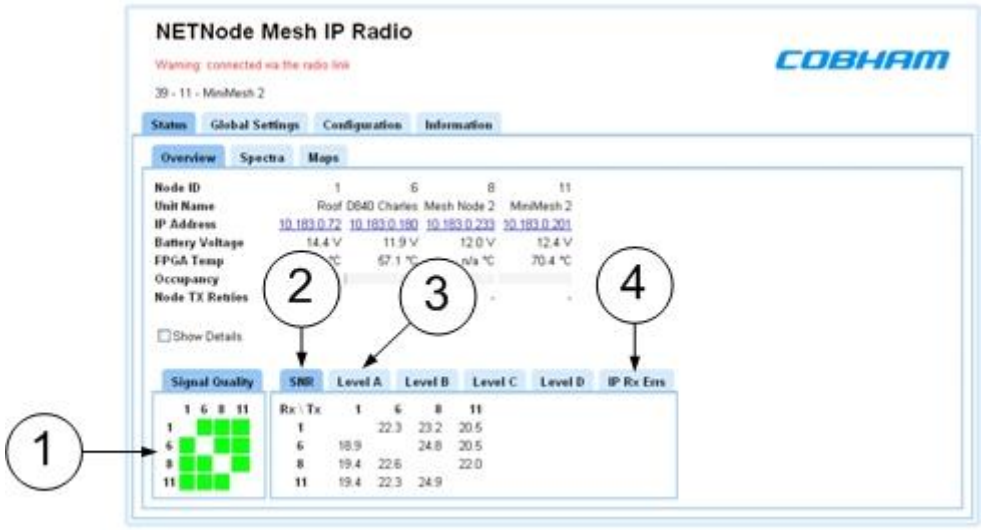


Figure 3-8 The Status / Overview Tab showing Details

Step 4: Interpret the **Signal Quality** Pane (1)

This gives you a simple picture of the signal quality around the mesh system. Ideally, we'd like to see stable green boxes for all links. Naturally, mobile units will go out of range or interference will cause a unit to degrade for a while. The good thing is the mesh will find a new routing and heal itself when it can, keeping your network on air.

The column position corresponds to the transmit node, and the row position to the receive node.

What the colours mean:

Colour	**Means…**
Green	Reliable path for 16QAM modulation.
Yellow	Reliable path for QPSK modulation.
Red	**Unreliable path. Avoid passing data across this path.**
White	No Link.

Table 3-4 – Signal Quality Display (8 and 12-Node operating mode)

Colour	Means…
Green	Reliable path for 16QAM 2/3 rate modulation.
Lime	Reliable path for 16QAM 1/2 rate modulation.
Yellow	Reliable path for QPSK 2/3 modulation.
Orange	Reliable path for QPSK 1/2 modulation.

Colour	Means...
Red	**Unreliable path. Avoid passing data across this path.** BPSK 2/3 modulation only.
White	No Link.

Table 3-5 – Signal Quality Display (16-Node Hi-Rate operating mode)

Step 5: Read the SNR Pane (2)

This pane shows the Signal to Noise Ratios for each of the NETNodes.

The columns correspond to the transmit node and the rows to the receive node.

Step 6: Read the **Level A** Pane (3)

This pane shows the dBm value for antenna A on the NETNode unit. There are equivalent panes for antennas B, C and D.

The columns correspond to the transmit node and the rows to the receive node.

The diagonal entries show interference levels. These can be shown in a yellow or red colour if interference is bad. It can be necessary to install inline filters on the antennas in some situations. Please speak to Cobham for more details.

Non diagonal entries can be heighted yellow when the signal level reaching that input is significantly lower than then other inputs. A full row of highlighted entries can show a faulty antenna or cable, and is worth investigating.

Step 7: Read the **IP Rx Errs** Pane (4)

This pane shows the number of IP receive errors for each NETNode.

3.5 Working with the Status /Spectra Sub-Tab

Step 1: Open the **Spectra** Sub-Tab

1. Click **Status** → **Spectra.**
2. The **Status** tab opens focussed on the **Spectra** sub-tab.

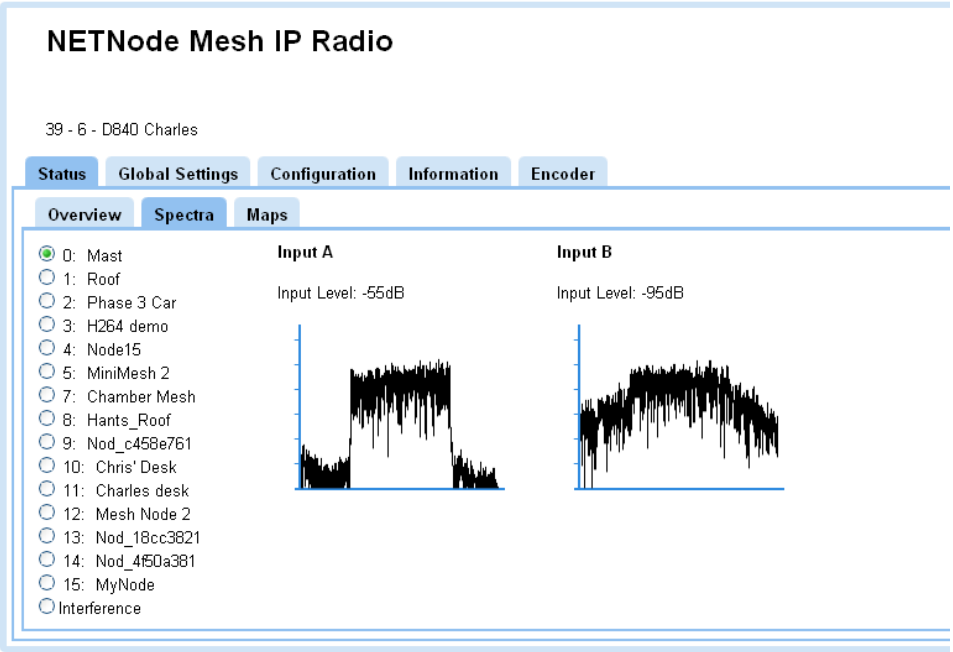


Figure 3-9 The Status / Spectra Tab

Step 2: Interpret the Spectra Displays

There are up to **four** displays labelled A, B, (C & D for quad unit) which shows the spectra being **received** on the two (or four) diversity antennas of the NETNode you are attached to.

But, there could be **several** NETNodes transmitting on the mesh thus it is necessary to define **which** unit we are looking at.

This is done with the option buttons on the left side of the spectra display. In our example, the option button for **Mast** is selected. This means the two displays are showing spectra for that **NETNode's** transmissions as received on our node's two antennas.

Step 3: Interpret the Interference Display

The last option button is called **Interference**. When you select this, the displays show the spectra when none of the NETNodes in the mesh are transmitting. This enables us to look for interference on the frequency we are planning to use for our mesh.

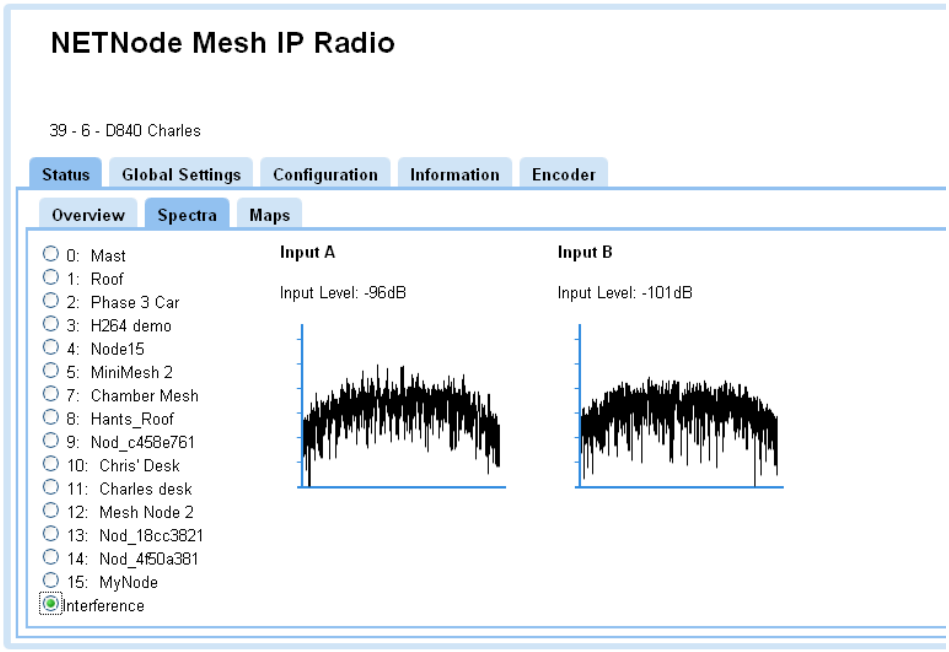


Figure 3-10 The Status / Spectra Tab, Interference Display

3.6 Working with the Status / Maps Sub-Tab

Step 1: Open the **Maps** Sub-Tab

1. Click **Status** → **Maps.**
2. The **Status** tab opens focussed on the **Maps** sub-tab.

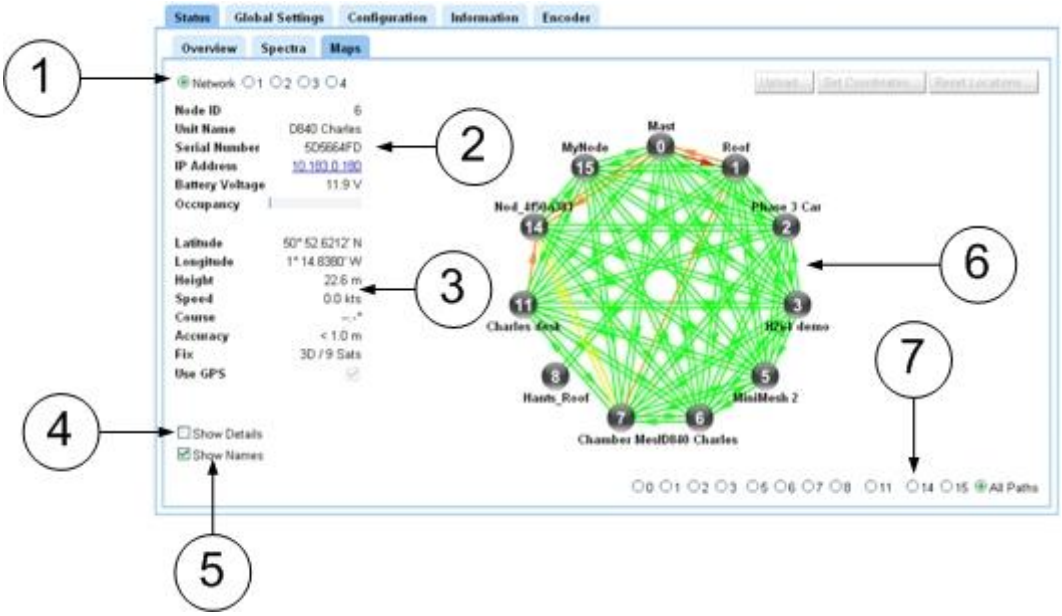


Figure 3-11 The Status/Maps Tab, Network Map Display

Step 2: Set the Option Button (1)

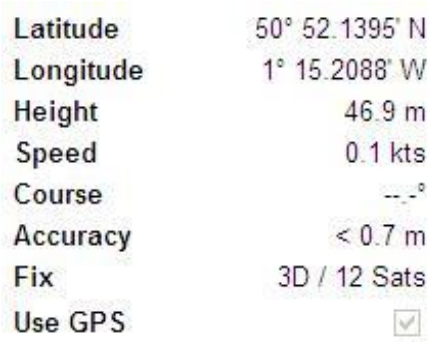
The option buttons let you select between **Network** and one of **four** map displays for the mesh. Select **Network** at this time.

Note: When you are in Network mode the **Upload**, **Set Coordinates** and **Reset** Locations buttons are greyed out.

Step 3: Read the Node Information (2)

Looking at the option buttons you'll see some node information about the NETNode you are currently attached to. We talked about this information in the Overview Pane above.

Step 4: Read the GPS Information (3)



If the NETNode we select has a GPS receiver connected and the **Use GPS** checkbox is selected, the NETNode can broadcast accurate information about its location to other nodes or fixed assets on the mesh.

Step 5: Select the **Show Details** Checkbox (4)

When the **Show Details** checkbox is selected the node information shown above is expanded to show things like **TX IP Packets** which are useful when diagnosing network problems.

Step 6: Select the **Show Names** Checkbox (5)

When the **Show Names** checkbox is selected the friendly names for the nodes is shown on the network map display.

Step 7: Interpret the Display Pane when in Network Display (6)

In the example above you can see the network display is selected. This gives a simple graphical image of the NETNodes in the mesh and the links between them.

Each NETNode is shown as a circle with a white number. (If the number turns red, then the node is temporarily congested).

If you have the **Show Names** checkbox selected, you'll also see the node **name** displayed.

The links between the nodes are shown as **coloured lines**. As each NETNode supports bidirectional operation there are usually **two** lines for each link.

Step 7: Simplify the Display Pane when in Network Display (7)

You can simply select to examine paths to and from a single node when there are a large number of nodes available. To do this click the applicable **option button** for that node. To return to the full display, select the option button, **All Paths**.

Note: The buttons above the display are greyed out as they have no function when the Network option button is selected.

What the colours mean:

Colour	Means…
Green	Reliable path for 16QAM modulation.
Yellow	Reliable path for QPSK modulation.
Red	**Unreliable path. Avoid passing data across this path.**
White	No Link.

Table 3-6 – Signal Quality Display (8 and 12-Node operating mode)

Colour	Means…
Green	Reliable path for 16QAM 2/3 rate modulation.
Lime	Reliable path for 16QAM 1/2 rate modulation.
Yellow	Reliable path for QPSK 2/3 modulation.
Orange	Reliable path for QPSK 1/2 modulation.
Red	**Unreliable path. Avoid passing data across this path.** BPSK 2/3 modulation only.
White	No Link.

Table 3-7 – Signal Quality Display (16-Node Hi-Rate operating mode)

In the example above you are seeing static lines but when you are connected to a live system, you will see these lines changing status and the RF environment changes or NETNodes move about.

3.7 Working with the Map Display

Step 1: Switch to Map Display

Select one of the **numbered option buttons**. This changes the display to the **map display**. There are **four** possible map displays each selected by an option button.

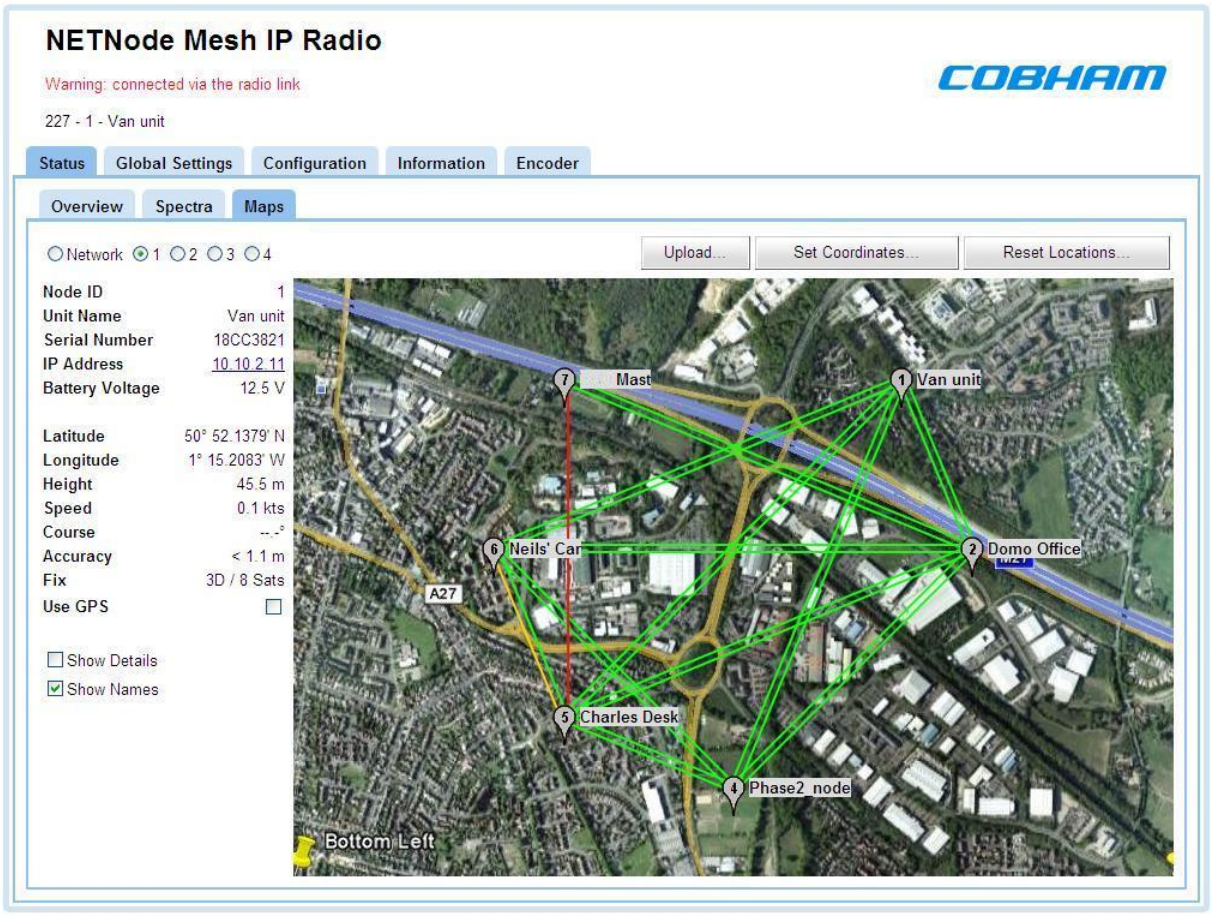


Figure 3-12 The Status / Maps Tab, Map 1 Display

You'll see the mesh network diagram overlaid onto a map of the area showing the nodes and the links between them.

There are **two** ways you can put the nodes onto the map:

- Manual Placement
- GPS Placement

Step 2: Manually put a Node on the Map

Put the mouse pointer on the node symbol. The pointer will change to a four-headed arrow. Left click and drag the node to the location on the map where the node must be displayed.

Note: You can drag a node symbol to **anywhere** on the map. Usually, you put the symbol where the node is actually located, but there is nothing to stop you simply randomly placing the symbol in Portsmouth when the physical NETNode is in Southampton for example.

Step 3: Monitor the GPS put a Node on the Map

If a NETNode has a GPS unit connected it can report its location which can then be displayed on the map.

1. Make sure you are connected to a NETNode with **GPS attached**.
2. Make sure the **Use GPS** checkbox is selected.
3. The symbol for that node will jump to the correct location on the map where the actual NETNode is currently located. If it moves, it will move on the map, showing heading speed and height.

3.8 Uploading Map Data

Each of the **four** map option buttons can contain a different map. It is necessary for these maps to be uploaded before you can use them.

Step 1: Upload a Map Image File

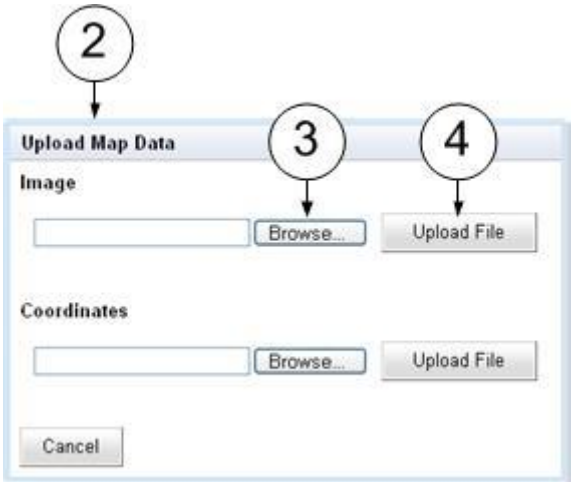
To upload a map it is necessary to have an internal drive which has been formatted. (See *Information Tab*).

It is also necessary to have an image file containing the map for the area you are interested in. The system supports four file types for maps:

- .JPG
- .PNG
- .GIF
- .BMP

We recommend operating with JPEGs as they are good quality but small files. Bitmaps on the other hand are excellent quality but very large. There is a small quantity of memory available in each NETNode for maps.

1. Click the **Upload...** button.
2. The **Upload Map Data** dialog opens.



3. Click the **Browse** button and navigate to your image file.
4. Click the **Upload File** button to put the image in the NETNode flash memory.

Step 2: Set the Coordinates

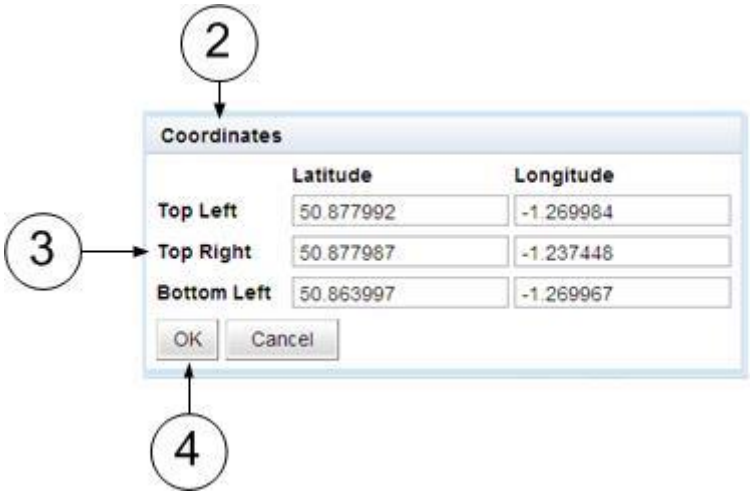
When you have loaded your map, it will be necessary to find out the **coordinates** of **three** of the corners of the map image to let the GPS operate.

It is necessary to know the **Top Left**, **Top Right** and **Bottom Left** coordinates of your image.

These coordinates must be in **decimal** format and accurate to six places. (You probably know Latitude and Longitude as being expressed in degrees, minutes and seconds).

You can get the coordinates from your map data source for example.

1. Click the **Set Coordinates** button.
2. The **Coordinates** dialog box opens.

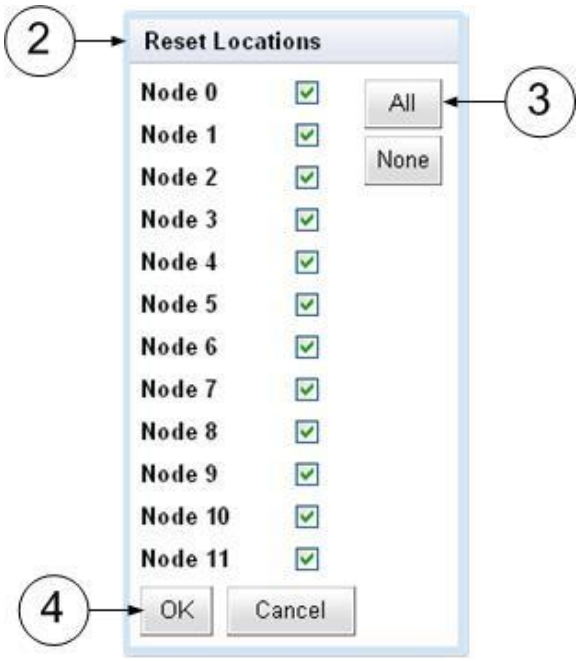


3. Type in the **coordinates** of each of the corners of the image.
4. Click **OK.**

Step 3: Test the **Reset Locations** Button

When you have loaded a new map or you have been moving nodes on an existing map it can be necessary to reset their locations. This can be useful if you lose nodes off the edge of the map.

You can make the system reset the locations of **all the nodes** or **a combination** of them.



5. Click the **Reset Locations**... button.
6. The **Reset Locations** dialog opens.
7. Click the **All** button or select the nodes you wish to reset.
8. Click the **OK** button.
9. The system resets the locations and switches off the GPS tracking function.

3.9 Working with the Global Settings Tab

This tab enables you to make configuration changes which apply to the full unit.

Step 1: Open the Global Settings Tab

1. Click the **Global** tab.
2. The Global tab opens.

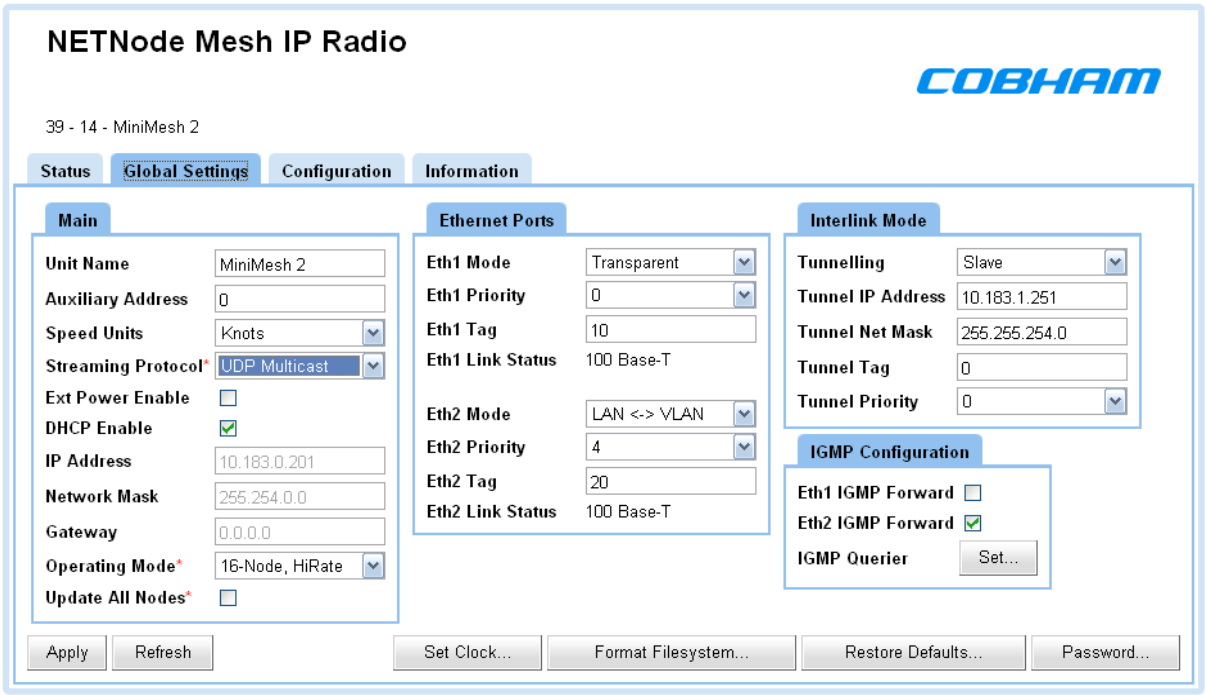


Figure 3-13 The Global Settings Tab

Step 2: Interpret the Fields in the Main Pane

The **Main** pane is concerned with basic settings that it is necessary to apply globally across the network. Here are the fields you can operate with:

Property	Range	Description
Unit Name	You can use up to 12 alphanumeric characters for the Unit name.	The unit name is a **friendly** name to make it easier for you to know which NETNode we are talking about.
Auxiliary Address	0 or 1.	Usually, the NETNode will be operating with IP devices like cameras microphones or GPS units and the Auxiliary address is left as 0. Some NETNodes (Robust and Plain with AVI option) can use composite cameras. To do this they have a second board installed called a D550. To make sure the NETNode recognises the D550 we have to set the auxiliary address to 1. At this time, your composite camera can be used with the system.
Speed Units	Knots, MPH or KPH.	If you have a GPS connected to a NETNode it can supply speed data. You can select the units you wish to use for speed in this combo box.
Streaming Protocol	UDP Multicast. RTSP Multicast. RTSP Unicast.	If your NETNode is licensed for streaming, you'll have three possible streaming protocols to select from.
External Power Enable Checkbox	Select or Clear.	There is an external power output which can be used to give 12VDC (1A) to an external device. This could be a camera, GPS antenna or other device. See pin outs in Part D of this document set. It is necessary to have a custom cable for this operation.
DHCP Enable Checkbox	Select or Clear.	In some situations having DCHP enabled can be applicable for advanced users of the system but in most cases it's better if each NETNode has its own fixed address. If selected, then the NETNode will try to get its IP address from a DHCP server on the network – this DHCP server can be located through a second NETNode across the radio interface.

Property	Range	Description
IP Address	Example: 192.168.2.120	If the radio is not automatically acquiring its IP address through a DHCP server then a fixed IP address needs to be assigned to the unit Type an **IP address** for this NETNode in the IP address text box. It can be a class of network of your choosing.
Network Mask	Example: 255.255.255.0	The network mask lets a network administrator divide a network into smaller more efficient subnets to stop large numbers of IP packets being routed through the network. This is usually defined by the network administrator. Type a **subnet mask** in the Network mask text box.
Gateway	Example: 192.168.2.120	A default gateway is used by a host when an IP packet's destination address belongs to someplace outside the local subnet. The default gateway address is usually an interface belonging to the LAN's border router. We recommend you keep the gateway at the same setting as the IP Address.
Operating Mode	8-Node System 12-Node System 16-Node, Hi-Rate	Select 16 Node Hi-Rate across all MESH NETNodes for best performance. Other modes are there for backward compatibility with earlier versions of software.
Update All Nodes	Select or Clear	When you make changes to global setting they are usually applied to the NETNode you are currently attached to. Sometimes it's really convenient to update all the NETNodes in the mesh, for example when you wish to change the frequency of all units at the same time. Select the **Update All Nodes** checkbox to enable these global updates on all nodes. Parameters which are **globally updated** are marked with '*'. Examples of things you can update like this are: ■ Frequency ■ Bandwidth

Table 3-8 – Interpreting the Main Pane

Step 3: Interpret the Ethernet Ports Pane

Property	Range	Description
Eth 1 Mode	Transparent LAN<->VLAN VLAN<->LAN LAN traffic only VLAN traffic only Eth1 tagged VLAN	See *Working with VLAN* for details.
Eth 1 Priority	0,1,2,3,4,5,6,7	Typically use 4.
Eth 1 Tag	1 - 4095	The VLAN tag on which this operates.
Eth 1 Link Status	Not Connected 10 Base-T 100 Base-T	Indicates the link status.

Table 3-9 – Ethernet Ports Pane

Step 4: Interpret the Interlink Mode Pane

Property	Range	Description
Tunnelling	Off Master Slave	Default is Off. There will only be one master. See *Interlink Mode* for details.
Tunnel IP Address	IP Address	The IP Address the NETNode will use to pass tunnelled data. This address responds to ICMP ping for debugging purposes.
Tunnel Network Mask	Network Mask IP Address	Subnet Mask. Example 255.255.255.0
Tunnel Tag	0 - 4095	The tag used for the VLAN tunnel operation. If set to zero the LAN is used.
Tunnel Priority	0,1,2,3,4,5,6,7	Typically use 4.

Table 3-10 – Interlink Mode Pane

Step 5: Interpret the IGMP Configuration Pane

Property	Range	Description
Eth1 IGMP Forwarding	Select or Clear	Default is Off. Allows forwarding of IGMP membership reports on this interface.
Eth2 IGMP Forwarding	Select or Clear	Default is Off. Allows forwarding of IGMP membership reports on this interface.
IGMP Querier	Popup box	Allows a forced IGMP querier to be added for the LAN and each VLAN on the system.

Step 6: Use the Apply Button Consistently

Each time you change a parameter on the Control Application it is **very important** to click the **Apply** button and wait for a moment for the changes to be sent to the device.

It is very important to hit apply after ticking/un-ticking **Update All Nodes** before altering other parameters.

Personnel change a parameter and then wonder why the device has not changed behaviour. **Always** click the **Apply** button.

Step 7: Test the Refresh Button

The browser software will poll the device regularly which lets it update the Control Pages with the latest changes.

To force a refresh of the control pages it is necessary to click the **Refresh Button.**

Step 8: Set the Clock

1. Click the **Set Clock** Button.
2. The **Set Clock** dialog opens.
3. Set the **Date** field.
4. Change the **time.**
5. Select a **Time Zone** from the drop-down list.
6. Select a **Daylight Saving** offset from the drop-down list.
7. Choose an Auto Set Time mode.
8. Click the **Set** button.

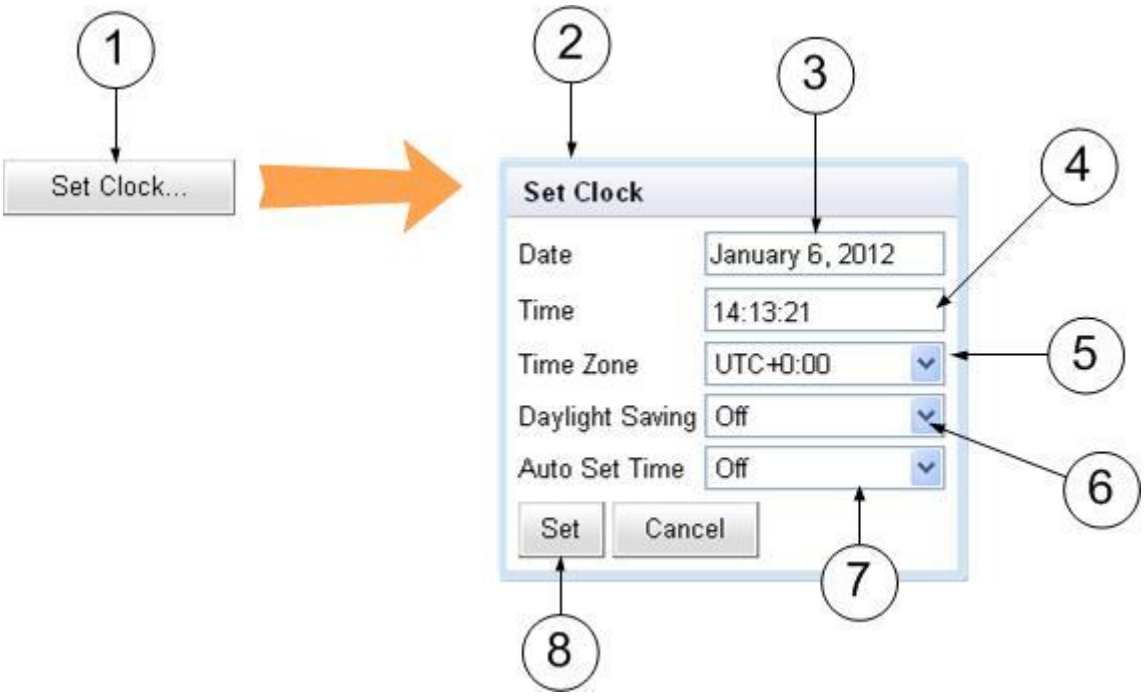


Figure 3-14 Set Clock dialogue box

Note: To set the clock automatically, set the **Auto Set Time** field to **GPS**. At this time, the NETNode will set its internal clock based on signals from an attached GPS unit.

Step 9: Format the File System (ONLY do this if needed)

There are two flash drives built into each NETNode.

Flash	Use
Internal Flash	Holds the maps and coordinates files.
External Memory Card	Used to record video material.

1. Click the **Format File System**... button.
2. The **Format Flash File system** dialog opens.
3. Click **Format Internal Flash** button.
4. The **Format Flash** warning message is displayed.
5. Click the **OK** button. Your internal Flash drive will be formatted.

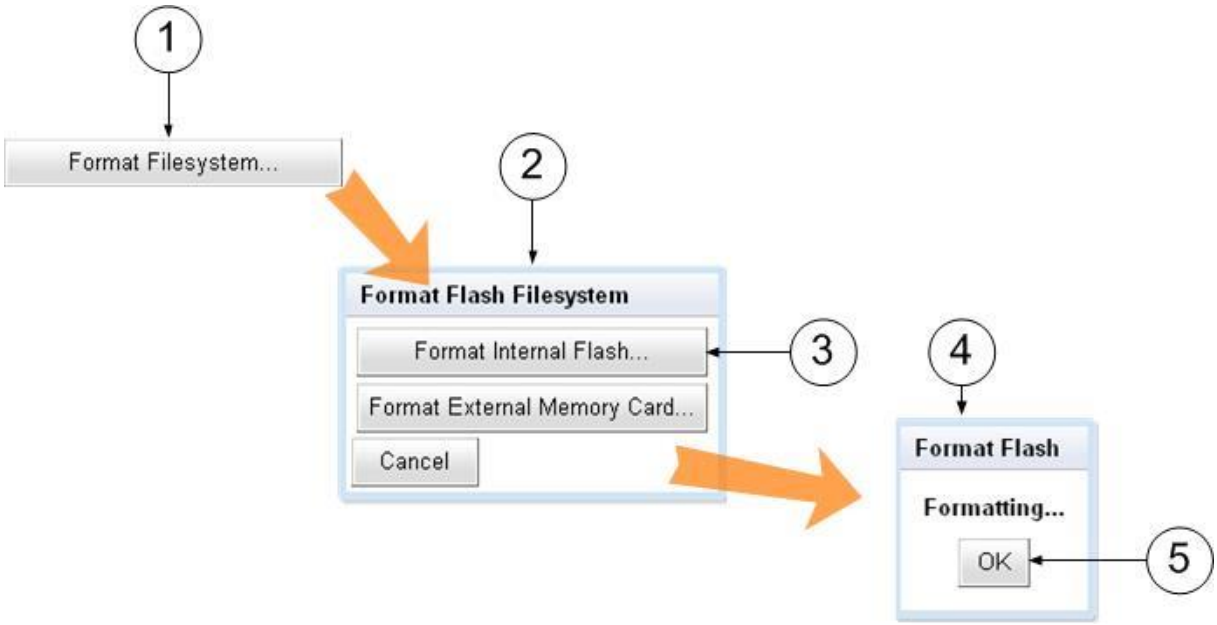


Figure 3-15 File Formatting System

Note: If you wish to format the External Memory Card, click the **Format External Memory Card** button at step 3 above.

Step 10: Restore Defaults (ONLY do this if really required)

To restore a default condition to the full unit:

1. Click the **Restore Defaults** button.
2. The **Restore Defaults** dialog opens.
3. Click the **OK** button.

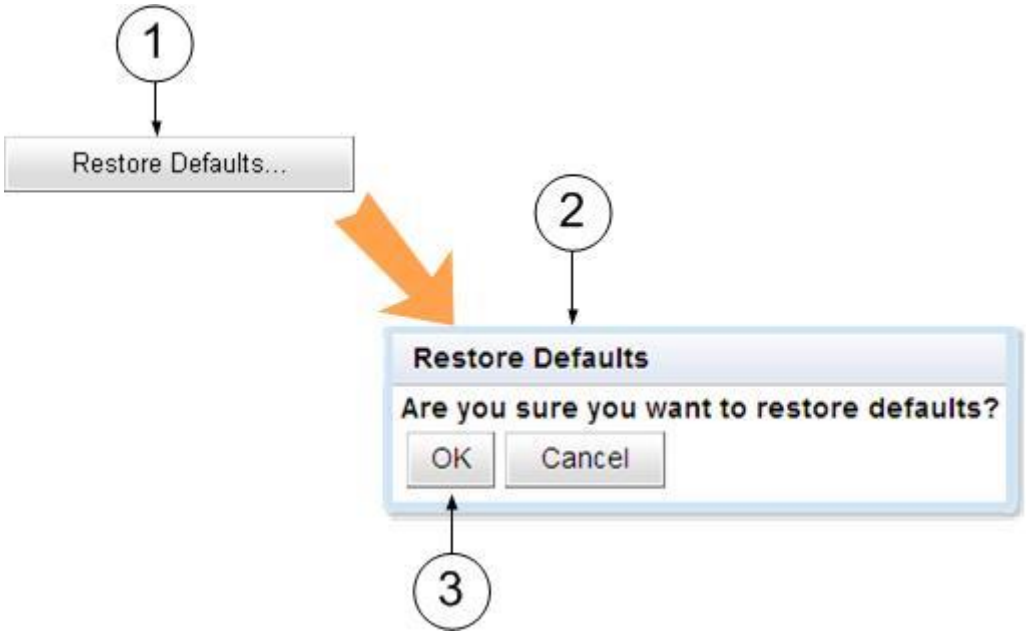


Figure 3-16 Restore defaults options

Step 11: Change Password (ONLY do this if really required)

1. Click the **Password...** button.
2. The **Change Password** dialog opens.
3. Type in the **Old Password.**
4. Type in the New Password in the **New Password** text box.
5. Type in the New Password in the **Confirm New Password** text box.
6. Click the **OK** button.

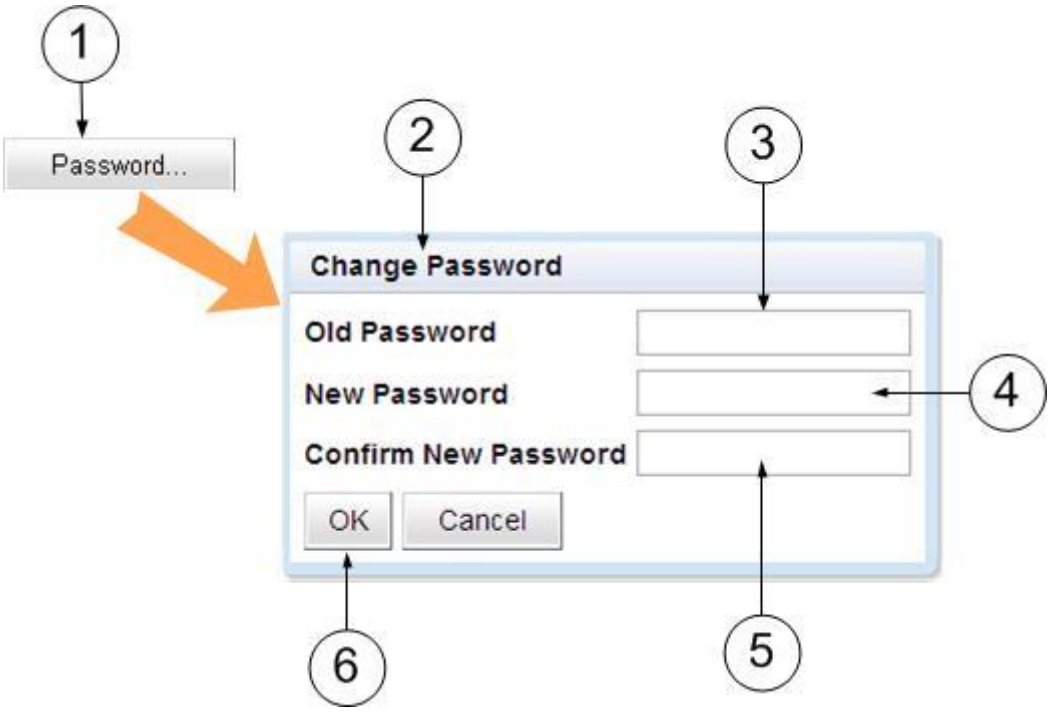


Figure 3-17 Changing your password

3.10 Working with the Configuration Tab

This tab enables you to make configuration changes which apply to this NETNode.

Step 1: Open the Configuration Tab

1. Click the **Configuration** tab.
2. The Configuration tab opens.

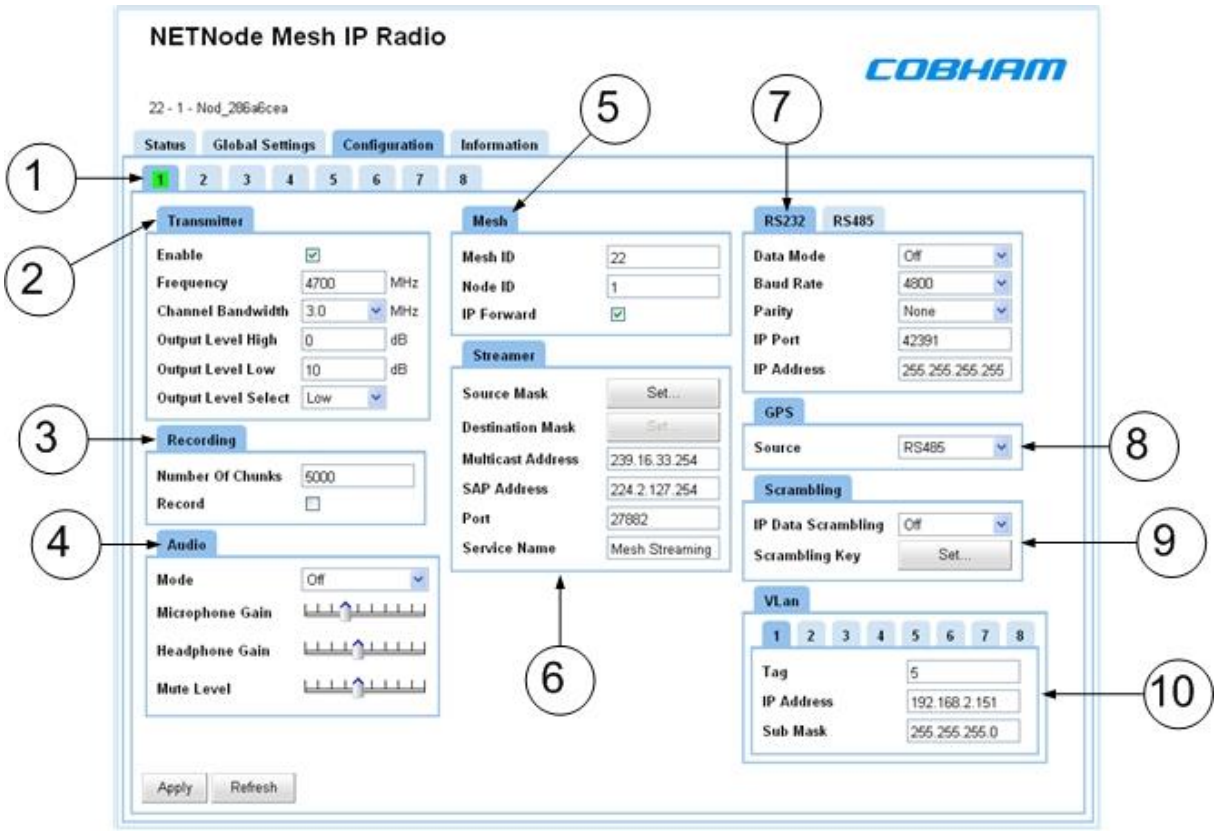


Figure 3-18 Configuration Tab

Step 2: Find which Preset Tab is Active (1)

The **darker blue** tab shows the preset you are currently **editing**.

The **green box** shows which preset is currently **active** in the receiver.

In the example above, preset **one** is **active** and preset **one** is also available for **editing**.

Step 3: Configure the Transmitter Settings Pane (2)

Property	Range	Description
Enable Checkbox	Select or Clear	This simply turns on the transmitter when selected. Remember that the transmitter only sends when it has data ready to move. All NETNodes in a mesh must have their transmitters enabled.
Input frequency (MHz)	L, S and C Bands	The frequency in megahertz (MHz) that you wish to use for this preset. If you try to input a frequency that is out of range, the radio will tune the lowest available frequency automatically.

Property	Range	Description
Channel Bandwidth	2.5MHz 3.0MHz 3.5MHz 5.0MHz 6.0MHz	You can configure the channel bandwidth with this drop-down box. If you use a lower bandwidth range will increase. If you use a higher bandwidth range must decrease.
Output Level High	0 to 30dB	The level of attenuation in dB that will be applied to the high output level. This could be useful if your transmitter is swamping a second unit nearby.
Output Level Low	0 to 30dB	The level of attenuation in dB that will be applied to the low output level. This could be useful if your transmitter is swamping a second unit nearby.
Output Level Select	Low or High	You can select high or low output level to suit the RF environment you are working in. When you select high or low here it applies attenuation you have set in the output level setting discussed above.

Table 3-11 – Transmitter Settings Pane

Step 4: Configure the Recording Settings Pane (3)

If the NETNode has the AVI option fitted, it can make short recordings on an SD card which is inserted into the front panel of the unit.

Property	Range	Description
Number of Chunks	0 to 5000	A chunk is about thirty seconds of video. This is the maximum number of chunks stored on the card and the oldest will be removed first. This must be set so that the number of files does not get more than the capacity of the SD card.
Record Checkbox	Select or Clear	When you select this box, the video will be recorded to the built in SD card. To playback, use Mission Commander or VLC and the command: rtsp://<ipaddress>/record.sdp

Table 3-12 – Recording Settings Pane

Step 5: Configure the Audio Settings Pane (4)

Unit Parameter	Options	Notes
Mode	Off Internal Remote	**Off** simply disables the headset. **Internal** mode only distributes the talk back audio in the local mesh network. **Remote** mode allows the onward distribution of this audio on an external IP network using RTSP protocols. The remote mode also allows external 'eavesdropping' of the audio using the URL: rtsp://ip_address_of_unit/audio.sdp Audio can also be sent to that unit using the same port as the RTP packet. The audio format must be G726-32 with a payload size of 512 bytes.
Microphone Gain	Variable Slider	When a talkback headset is attached to the unit, this slider controls the microphone gain.
Headphone Gain	Variable Slider	When a talkback headset is attached to the unit, this slider controls the headphone gain.
Mute Level	Variable Slider	When a talkback headset is attached to the unit, this slider controls the mute level. This control is very much like the squelch control found on communication radios. Sets the level at which is microphone is enabled. Below this level no packets are sent. An external push to talk switch can be connected with the microphone to do the same task if required. All NETNode units give a low level bleep tone when no talkback is received and the unit is connected onto the mesh network.

Table 3-13 – Audio Settings Pane

Step 6: Configure the Mesh Settings Pane (5)

Unit Parameter	Options	Notes
Mesh ID	1 to 255 (8 and 12 Node systems) 1 to 63 (16 Node, Hi-Rate)	The **Mesh ID** tells the unit which **group** it belongs to. All NETNodes on Mesh ID 60 for example will communicate with each other. **Note**: If you select **16-Node, Hi-Rate** as your operating mode, you can only select between **1 to 63** for your **Mesh ID**.
Node ID	0 to Max Number of Nodes - 1	The **Node ID** gives the unit a **unique** ID within the mesh. Each must have a unique Node ID. The maximum number of nodes is determined by **operating mode** set in the **global settings tab**.
IP Forward	Select or Clear	If this node is connected to an IP source selecting the **IP Forward** check box will make sure this data is passed around the mesh for access on other units.

Table 3-14 – Mesh Settings Pane

Step 7: Configure the Streamer Settings Pane (6)

When you have got the asset to the NETNode, you may wish to stream that information down a fixed IP link. The streamer pane enables you to configure this easily.

Streaming is the transmission of digital audio or video or the listening and viewing of such data without first storing it.

In Cobham systems we can carry streams using multicast protocols and these streams can come from external or internal sources. The internal source (an optional encoder) is enabled with **Stream Enable**.

Property	Range	Description
Multicast Address	Use different values for each NETNode	This text box enables you to change the multicast address used by the unit for internal streaming. The default value is random to make sure different NETNodes have different multicast addresses.

Property	Range	Description
SAP Address	The default value is 224.2.127.254 and the port used is 9875.	This text box enables you to change the value of SAP/ SDP multicast address used by the unit. The default value is 224.2.127.254 and the port used is 9875. These are standard multicast values for such parameters, and it is recommended they are not changed unless specially required due to routing restrictions.
Port	10000 or above	Protocols like TCP or UDP use port numbers in the header to direct traffic around the network. Low port numbers are used by computer systems for predefined tasks. For example SMPT (for your email service) uses port 25. A good rule is to use numbers above 10,000 to avoid conflict with existing services. When you set up a port number on several computers on a network they will all listen for packets directed to that port. The default value is random.
Service Name	Mesh Streaming	This text box lets you name the multicast stream as delivered in the SAP/SDP packets from the unit. Default is **Mesh Streaming.**
Stream Enable	Select or Clear	This enables the streaming of Video that originates from the internal encoder (if it is fitted). This must be **selected** for UDP multicast, RTSP multicast streaming or RTSP unicast streaming.

Table 3-15 – Streamer Settings Pane

Step 8a: Configure the Scrambling Settings Pane (7)

It can be very important to scramble received assets before they are passed across networks.

The system offers DES, AES128 and AES 256 and this encrypts all user data exchanged across the network.

The DES+, AES128+ and AES256+ settings make sure that the network will only process encrypted data. Any data sent in the clear by any nodes will not be presented or accepted by a NETNode if the DES+ or AES+ is set on the unit.

This drop-down box enables you to select the scrambling scheme you wish to use. You can select: AES128, AES128+, AES256, AES256+, DES, DES+. Only licensed features will be shown in the drop-down box.

Note: AES and DES scrambling is a licensable item. Speak to Cobham for details.

Step 8b: Set the Scrambling Key (7)

When you select a scrambling scheme it is necessary to specify a key that it will use.

Here's how:

1. Click the Scrambling Key **Set...** button.
2. The **Scrambling Key** dialog opens.
3. Select the Key type from the **Key Type** combo box.
4. **Type your key** in the xxx bit key combo box.
5. Click **OK.**
6. Once the key has been set it is essential to click **Apply**.

Note: If you make a mistake when typing the key, use the **Clear** button.

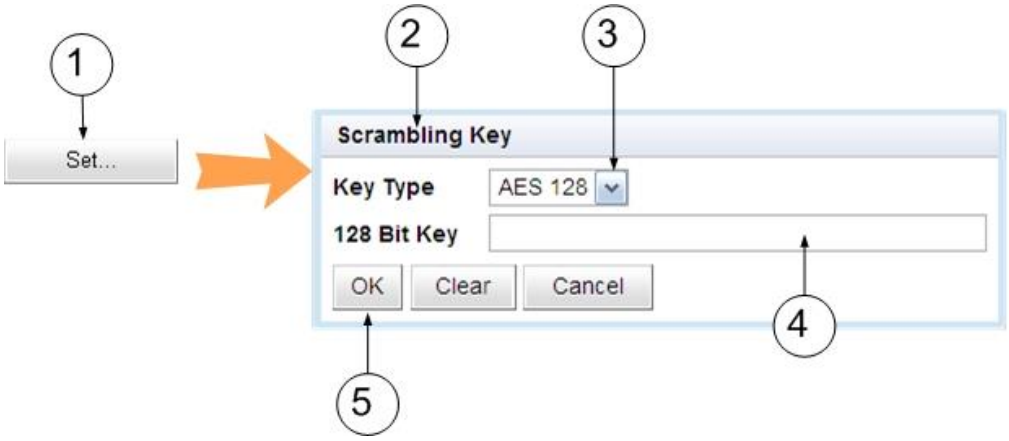


Figure 3-19 Setting up encryption

Step 9: Configure the RS232/RS485 Data Settings Pane (8)

The NETNode can send and receive data through its RS232/1, RS232/2 or its RS485 serial port. See *Controls, Connections and Indicators* to find out which port you are using.

Property	Range	Description
Data Mode	Off UDP TCP Server TCP Client	Off – Data transfer is switched off. UDP - UDP (User Datagram Protocol) is used to move data about the network. The packets are sent out and the system does not expect a reply. There is no way that the sending device can tell if the data arrived at the destination. TCP - TCP (Transmission Control Protocol) is used to move data about the network. The packets are sent out and the system will expect a reply. Each message is acknowledged by the destination device. Setting **TCP server** allows applications such as telnet to connect to the port. Setting one NETNode to **TCP server** and one to **TCP client** allows data pipes to be formed. Default is OFF.
Baud Rate	Speeds available are: None, Illegal, 1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200.	This is where you set the speed at which data will be transferred across the network. **Note**: The data is assumed to be eight bits. Default is 4800.
Parity	None Even Odd	A **parity bit** is a bit that is added to make sure that the number of bits with the value one in a set of bits is even or odd. Parity bits are used as the simplest form of error detecting code. There are two variants of parity bits: **even parity bit** and **odd parity bit**. When using even parity, the parity bit is set to 1 if the number of ones in a given set of bits (including the parity bit) is even. When using odd parity, the parity bit is set to 1 if the number of ones in a given set of bits (including the parity bit) is odd. In other words, an even parity bit will be set to "1" if the number of 1's + 1 is even, and an odd parity bit will be set to "1" if the number of 1's +1 is odd. Default is None.

Property	Range	Description
IP Port	42391	These set an IP address and Port to and from which the data will transferred. The user can connect to the data port through telnet by setting the mode to TCP and the port number to 23. The user can connect two data ports on different units together through setting UDP mode and using the aligning port numbers. Default is 42391.
IP Address	255.255.255.255	The IP address of the destination computer which wishes to connect or all 255's for any host.

Table 3-16 – RS232/RS485 Data Settings Pane

Step 10: Configure the GPS Settings Pane (9)

It is possible to connect a GPS receiver to a NETNode. This switch enables you to select the source for the GPS. There are three choices:

Property	Range	Description
Source	Off RS232 RS485 Encoder	Off - simply turns off the GPS. RS232 or RS485 is set when the GPS has been connected to the Data port on the NETNode and this is where the system will look for GPS data. Encoder is set when the GPS has been connected to the Encoder port (AV) and this is where the system will look for GPS data. This is only possible with the AVI variant of the NETNode.

Table 3-17 – GPS Settings Pane

Step 11: Configure the VLAN Settings Pane (10)

It can be valuable to make Virtual LANs within the physical LAN of the mesh network. These virtual LANs are configured in the VLAN Settings pane. See *Working with VLAN* for details.

3.11 Working with the Information Tab

This tab enables you to find information about the system. It can be necessary to have this information when you make a support call to Cobham for example.

Step 1: Open the Information Tab

1. Click the **Information** tab
2. The Information tab opens

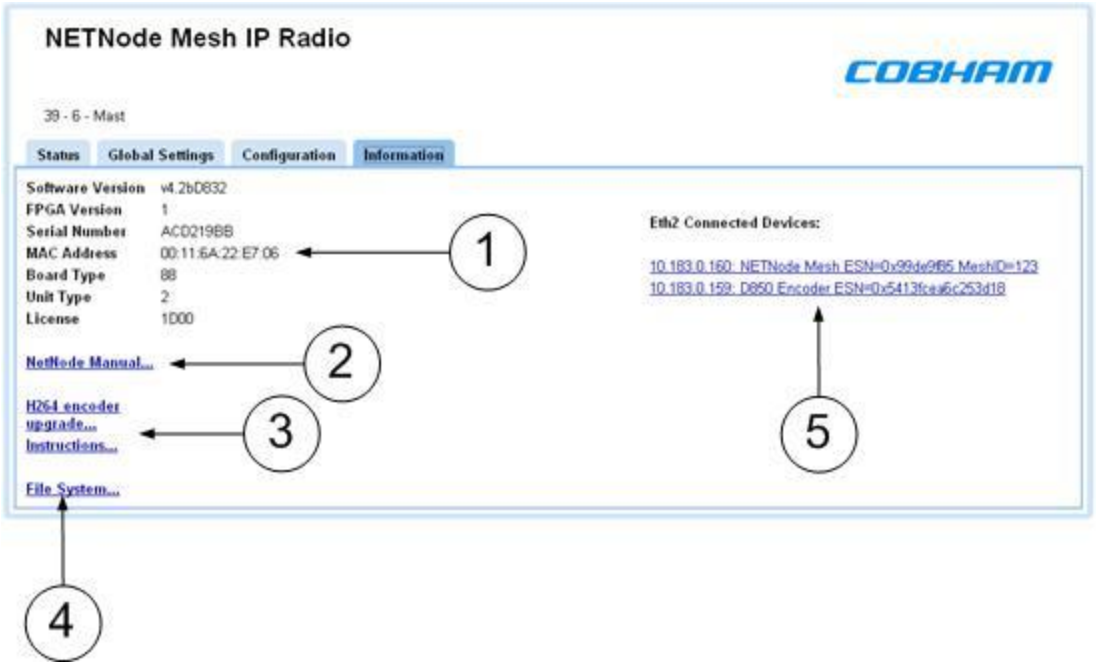


Figure 3-20 The Information Tab

Step 2: Interpret the Information Pane (1)

The information tab gives you some details about the hardware and software loaded into your NETNode unit. This could be very valuable during a support call for our engineers to help you.

Unit Parameter	Options	Notes
Software Version	V4.2	The current version of firmware operating on the NETNode.
FPGA Version	1	The current version of FPGA located in the NETNode.
Serial Number	46512200	Unique identifier for your unit.
MAC Address	00:11:6A:AB:D5:0A	Unique identifier for the network card.
Board Type	88	Cobham board identity.
Unit Type	73	Cobham board identity.
License	1D00	Current license type installed.

Table 3-18 – Interpreting the Information Pane

Step 3: Look at the Manual (2)

Click on this hyperlink to open a version of the on-board manual for the NETNode.

Step 4: About the H264 Encoder Upgrade (3)

If your NETNode has an AVI board fitted, this dialog enables you to load the encoder with a Codec to support H.264 operations.

Note: If the AVI option is upgraded to support H.264 then MPEG-2 and MPEG-4 ASP encoding are no longer supported.

Step 5: Look at the File System (4)

Click on this hyperlink to open the file system of the NETNode. This is where all your map and configuration files are stored. You can share these files with other NETNodes to save time.

Step 6: Check the Connected Devices List (5)

When you connect a second Cobham device to your NETNode, providing it has the Identifying Protocol available, it will show up in the **Connected Devices** list.

If the NETNode has an internal Dual H.264 and H.264HD Audio Video Interface option fitted, (NETNode-AVI-HDUP3P or NETNode-AVI-HDUP3R), then the **IP address** of the Internal AVI encoder will show in this list.

At this time, you can click on an item in the list to jump directly to it, rather like you can jump between NETNodes on the Status / Overview tab.

Today, NETNodes and D850 IP Encoders have the Identifying Protocol to show in the list but other products will have this feature in the future.

3.12 Working with the Encoder Tab

If your unit has a **video encoder card** installed there will be an **Encoder** tab shown.

Note: The video encoder card is available as a factory fit option with both the NETNode-3-Robust and the NETNode-3-Plain, this option cannot be fitted to the NETNode-Mini Plain.

This tab enables you to configure the **Encoder**. It is necessary to have the optional encoder fitted to your NETNode before the Encoder tab appears. It is also necessary to make sure that **Global Settings** → **Auxiliary Address** has the numeral **1** in the field to switch on the encoder tab.

Note: If you use the **Restore Defaults** button on the Control Application, the Auxiliary address is always returned to 0. You must **reset** the Auxiliary address to 1 before you can use the encoder tab again.

Step 1: Open the Encoder Tab

1. Click the **Encoder** tab.
2. The Encoder tab opens.

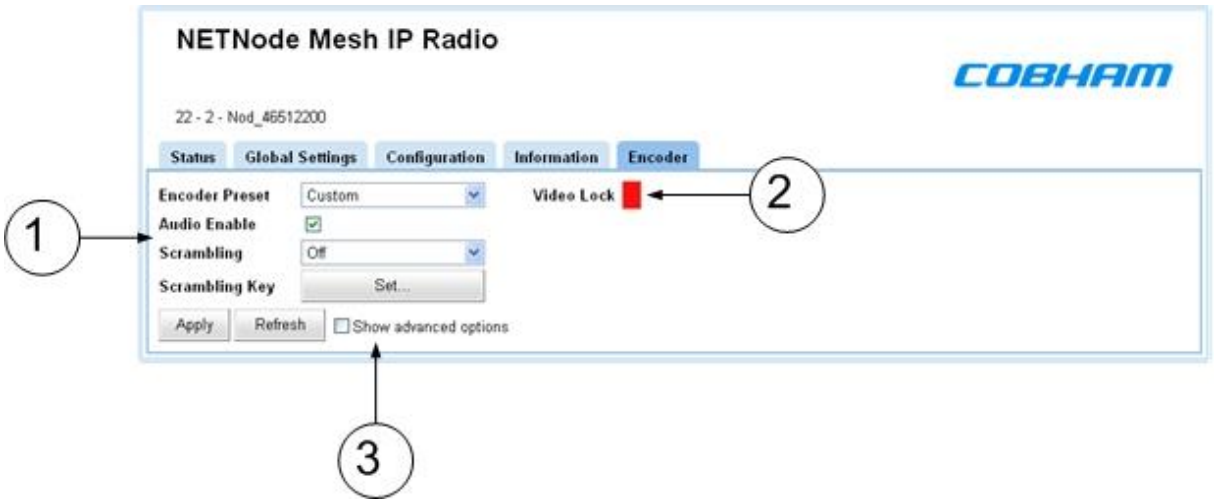


Figure 3-21 The Encoder Tab

Step 2: Configure the Encoder Settings Pane (1)

This is where you configure your encoder to suit the Composite camera source you're operating. It also helps you to make best use of the available bandwidth on the mesh network.

Property	Options	Notes
Encoder Preset	Low rate (500kbps) Medium rate (900kbps) High rate (1.8Mbps)	
Video Lock	Red Green	Red means no video lock. Green means video is locked.
Audio Enable Checkbox	Select or Clear	Select the **Audio Enable** checkbox to switch on the audio. Audio will take some of the available bandwidth. For some applications you may wish to turn off audio to let all the bandwidth to be used by video.

Property	Options	Notes
Scrambling	Off AES128 AES256 DES	It can be very important to scramble received composite assets before they are passed across networks. The system offers DES, AES128 and AES 256 and this encrypts all composite assets exchanged across the network. This combo box enables you to select the scrambling scheme you wish to use. You can select: DES, AES128 or AES256. Default is OFF

Table 3-19 – Encoder Settings Pane

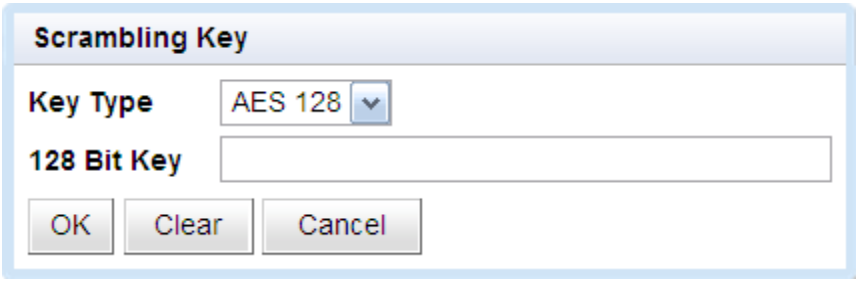
Note: This scrambling of the **composite signal** is independent of the **Main IP Scrambling** on the node. This composite scrambling is **nested** in the Main IP scrambling. This means you can scramble the Composite signal and then scramble the full IP data again.

Step 3: Configure the Scrambling Key

When you select a scrambling scheme it is necessary to specify a key that it will use.

Here's how:

1. Click the Scrambling Key **Set...** button.
2. The **Scrambling Key** dialog opens.



3. Select the **Key type** from the **Key Type** combo box.
4. Type your key in the **xxx bit key** combo box.
5. Click the **OK** button.
6. Once the key has been set it is essential to click **Apply**.

Note: If you make a mistake when typing the key, use the **Clear** button.

Step 4: Select the **Show Advanced Options** Checkbox

If you select the **Show Advanced Options** checkbox, the dialog will expand like this:

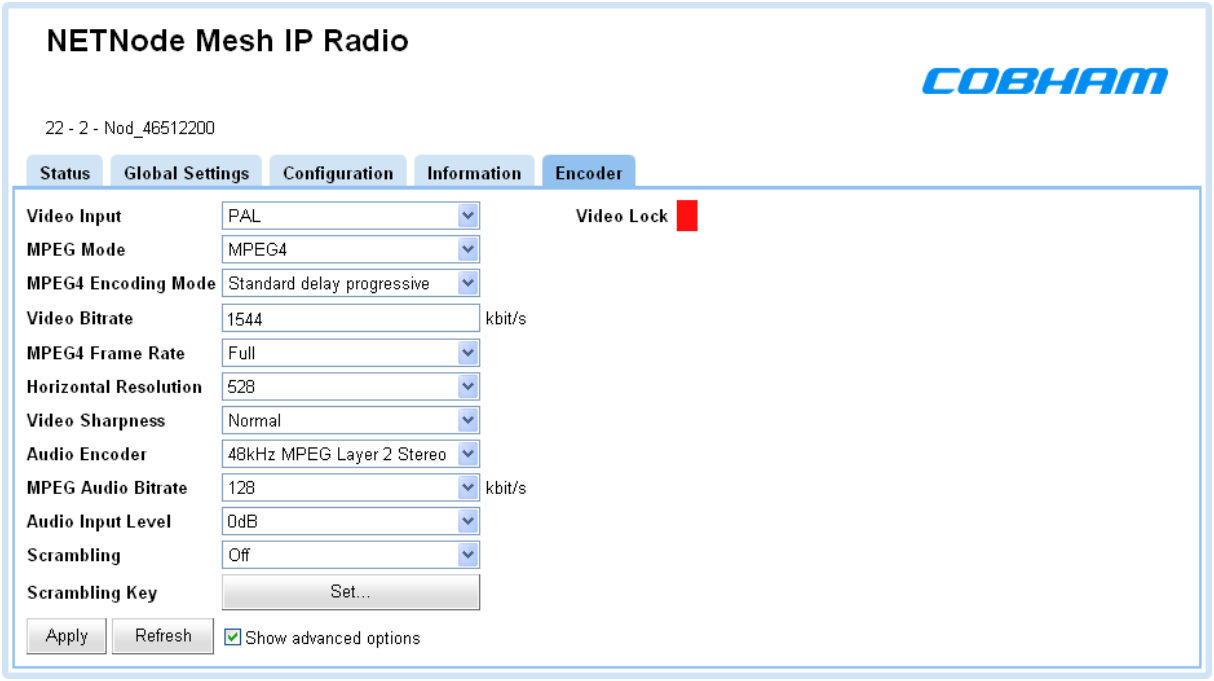


Figure 3-22 The Encoder Tab, Advanced Options Display

Property	Range	Description
Video Input	Off PAL NTSC NTSC no ped S-Video PAL S-Video NTSC S-Video NTSC no ped SDI PAL SDI NTSC	You can select the video to be off or an available setting to suit the camera source you have.
MPEG Mode	MPEG2 MPEG4 H264	Select between MPEG2 and MPEG4. For H264 the video card must be upgraded. Details for this are on the **information pane**.

Property	Range	Description
MPEG4 /H264 Encoding Mode	Low Delay Interlaced Standard Delay Interlaced Low Delay Progressive Standard Delay Progressive SIF QSIF	Default is Low Delay Interlaced. If you have selected MPEG4 mode then these settings apply.
Video Bit rate	A number	You can type in a bit rate you wish the encoder to use. If you set more than the capacity of the encoder it simply won't operate. This item is for advanced users only.
MPEG4/H264 Frame rate	Full 1/2 1/4 1/8 1/24	If full frame rate is giving unsatisfactory quality, you can step this down until you get a satisfactory picture. Only applies to MPEG4. Use when unit is operating at low bitrates.
Horizontal Resolution	704, 528, 480 and 352	The number of pixels across each line of the screen. Changing the horizontal resolution to lower values will make the coded picture softer. Try to align horizontal resolution to the resolution of the camera for best image results.
Video Sharpness	Normal Sharp	You can increase the sharpness of the video but you will reduce the bandwidth.

Property	Range	Description
Audio Encoder	Off 32kHz 12bit Stereo 32kHz 12bit Mono 32kHz 8bit Stereo 32kHz 8bit Mono 16kHz 8bit Stereo 16kHz 8bit Mono 8kHz 8bit Stereo 8kHz 8bit Mono 32kHz MPEG Layer 1 Stereo 32kHz MPEG Layer 1 Mono 48kHz MPEG Layer 1 Stereo 48kHz MPEG Layer 1 Mono 32kHz MPEG Layer 2 Stereo 32kHz MPEG Layer 2 Mono 48kHz MPEG Layer 2 Stereo 48kHz MPEG Layer 2 Mono 32kHz MPEG Layer 3 Stereo 32kHz MPEG Layer 3 Mono 44.1kHz MPEG Layer 3 Stereo 44.1kHz MPEG Layer 3 Mono 48kHz MPEG Layer 3 Stereo 48kHz MPEG Layer 3 Mono 16kHz MPEG Layer 3 Stereo 16kHz MPEG Layer 3 Mono 24kHz MPEG Layer 3 Stereo 24kHz MPEG Layer 3 Mono	Default is audio Off. You can select one of many modes to suit operating and bandwidth requirements. As you select each of these audio modes and apply them, monitor the Video bitrates parameter and see it change. The higher the audio quality used the less the video bandwidth available MP3 modes are only available with H264.
MPEG Audio Bit rate	8 to 384kbit/s	This is the MPEG audio sampling rate. Usually the higher the number the better the quality.
Audio Input Level	0, 12, 24, 36 and 48dB	Used to set the audio gain applied to the audio input signal. 0db is no gain which is the default setting. If you have low level audio sources you may wish to apply more gain.

Table 3-20 – Encoder Tab, Advanced Options Display

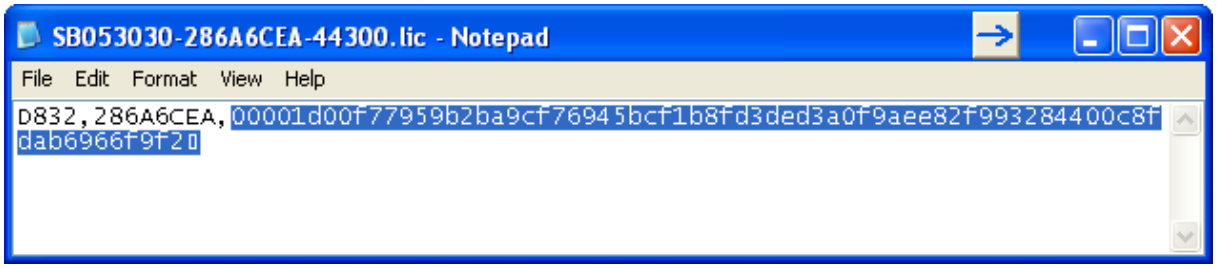
3.13 Licensing the NETNode

Feature availability in NETNodes is controlled by license. If you require a new feature, contact your Cobham representative who can arrange for a license to be produced for you.

The license generated is in the form of a *.lic file. This file will contain a 72 digit license code.

Step 1: Prepare for the License Upgrade

1. Open the license file provided by Cobham using Notepad or similar text editor.
2. Highlight and copy only the 72 digit numbers highlighted below:



3. Open the Web Browser application

Step 2: Insert the License Code

1. Holding down the **Ctrl** key on your keyboard, right-click the **COBHAM** logo on the web browser.
2. The **Engineering** dialogue box opens.
3. Select **Main** to write commands to the D84x PCB.
4. Type **wglco;<paste code here>;** (paste in the 72 digit code copied in Step 1).
5. Click the **Send** button.
6. You'll see a **Reply** code.
7. Click **Done** to complete the process.

Note: If the reply code is **Failed**, then the license code has not gone into the NETNode. This may be caused by incorrect syntax, for example check the punctuation is semi-colons either side of the license code.

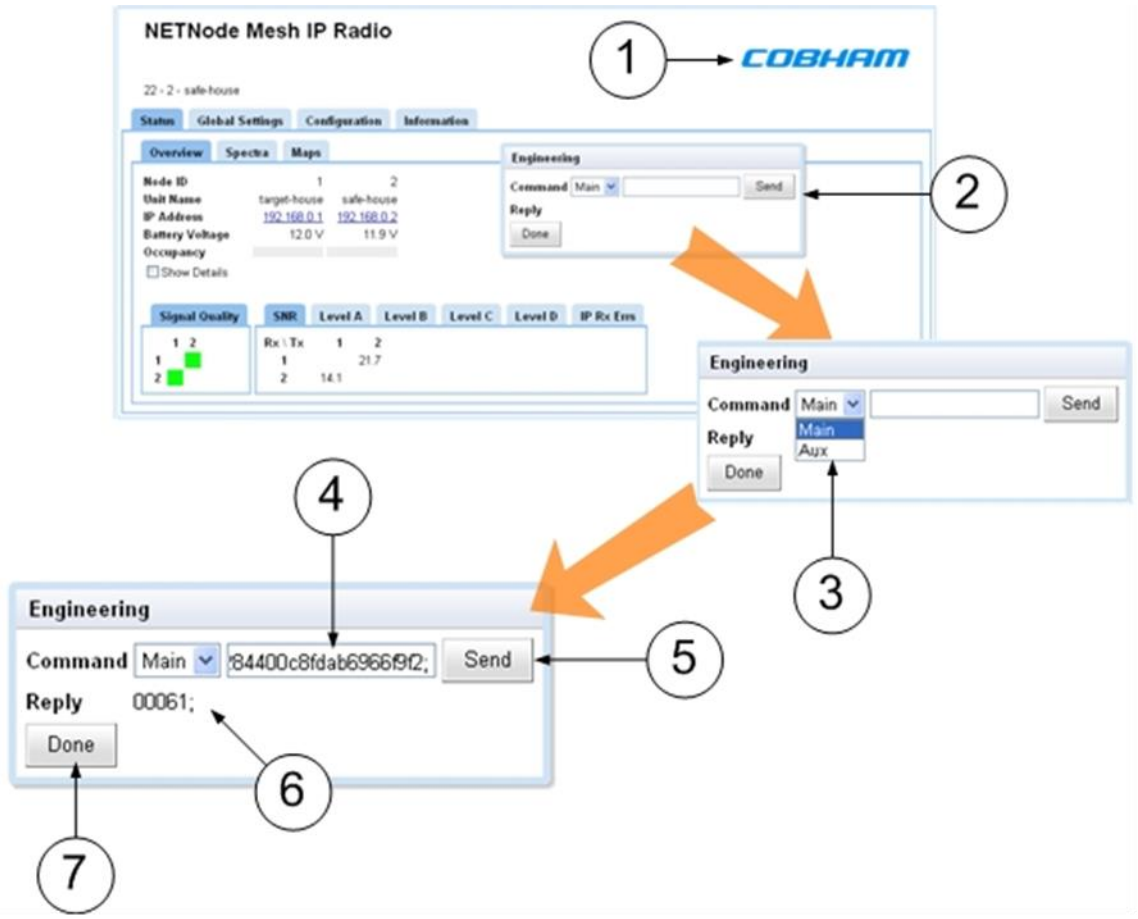


Figure 3-23 Inserting your new license code

3.14 Upgrading the Firmware

Step 1: Enable TFTP in Windows 7/Vista on your PC

Your PC will need to be enabled as a TFTP client to perform a TFTP upgrade. In Windows 7 and Vista this may need to be activated.

1. On your PC click **Start→Control Panel→Programs**.
2. Select **Programs and Features**.
3. Click **Turn Windows features on or off** at the top left of the dialogue box.
4. Check the **TFTP Client** checkbox.
5. Click the **OK** button.

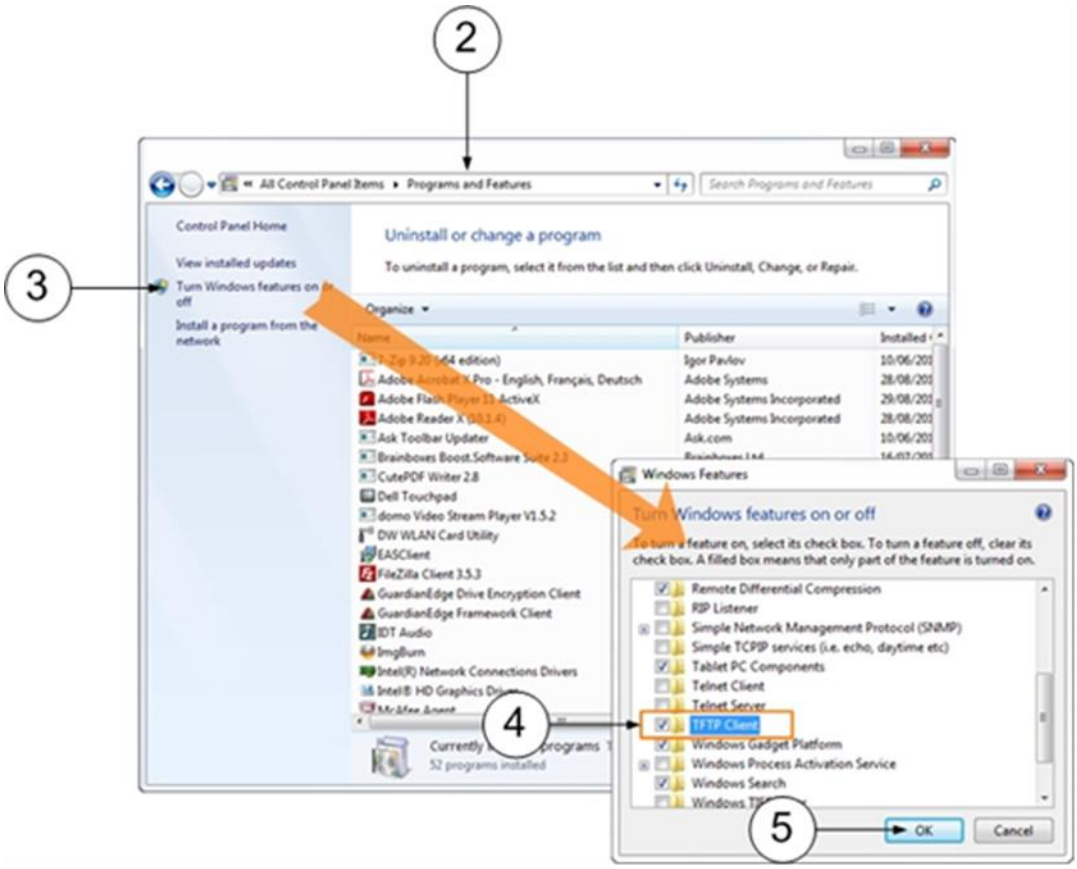


Figure 3-24 Enabling TFTP

Step 2: Prepare for the Upgrade

1. Establish the IP address of the NETNode you wish to upgrade.
2. Place the latest version of the firmware in the **root** of you C: drive.

Step 3: Perform the Upgrade

1. On the PC click **Start→Run**.
2. The **Run** dialogue box opens.
3. Type **cmd** and click the **OK** button (depending on the Operating System of your PC, this can also be done clicking the **Start** button and enter **cmd** in the ***Search programs and files*** box).
4. The **Command Prompt** window opens.
5. Type **ping <*IP address*> -t** and press enter (insert the IP address of the unit you wish to upgrade.
6. You'll see the NETNode being continuously pinged which confirms you are connected and that you are OK to proceed. Leave it pinging!
7. Open a second command prompt and type **cd..** and press enter.
8. This will change directory to the root of **C:** (where you placed the upgrade file earlier).
9. At the command prompt, type **tftp <*IP address*> put d840_mesh_download.exo** (insert the IP address of the unit you wish to upgrade) and press **enter**.

Note: The file names have to be exact and are case sensitive. The transfer will take a few seconds if connected locally and much longer if connected across the Mesh network.

10. **ONLY** when the **pings** start to display **Requested timed out** in the first command window, can you cycle the power on the NETNode to complete the process.
11. You'll see the **pings** start to reply again.

CAUTION: If the unit is power cycled to early, the flash data will be lost and the Node will need to be returned to Cobham for repair.

12. Close both Command Windows.
13. Browse to the NETNode and navigate to the **Information** tab.
14. Confirm the new software version is displayed.

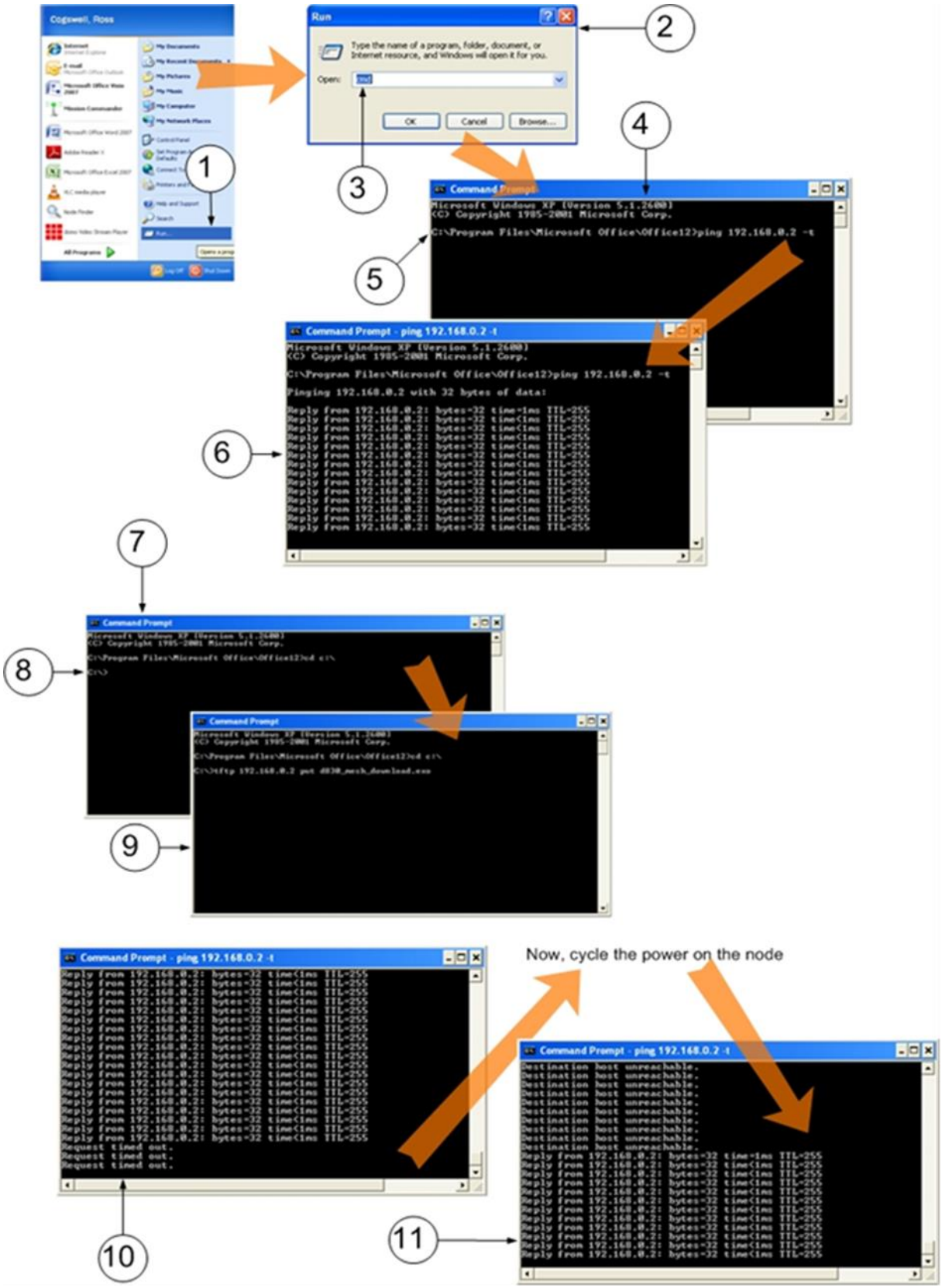


Figure 3-25 Performing the firmware upgrade

4. Appendix A – Cautions and Warnings

4.1 Cautions and Warnings

Serial	Area	Note
1	Enclosures	Do not remove factory installed screws or fastenings. Damage to the units can be caused and void warranties. Only approved personnel must open the device. There are no operations that required the user to access the device internally. There are no user serviceable parts internally.
2	Maintenance	Other than cleaning, no scheduled maintenance is required to make sure of the correct operation of the unit.
3	Environment	The equipment must not be used in dangerous or atmospheres that can cause corrosion. Users are reminded of the necessity of complying with restrictions regarding the operation of radio devices in refuel depots, chemical plants and locations where explosives are kept and/or used.
4	Power Supply	Make sure that the power supply arrangements are sufficient to align with the requirements of each device. Obey all electrical safety precautions.
5	Electro Static Discharge (ESD) Precautions	ESD guidelines must be followed for this electrostatic sensitive device.
6	Lightning Hit	There is a risk of lightning hits to antennas. The equipment must not be assembled in an area during lightning. Antennas must be adequately protected from lightning hits.
7	Working at Height	You must be careful when locating the device at height, for example on a mast. Make sure the unit is correctly attached to stop it falling and injuring personnel.
8	Risk of Eye Injury	You must be careful to stop your eye touching the antennas.
9	Cables	Connecting cables must not be put where they can become damaged or where they can be dangerous by personnel tripping on them.

Serial	Area	Note
10	Thermal Control System	Energized devices always become hot during operation. If you operate this device in a closed area you must make sure it has sufficient airflow to keep it at a low temperature. Also, if worn near the body, you must be careful to give protection the operator from large temperatures.
11	RF Emission System	When operating this device please make sure a distance of 20cm is kept between your device and your body while the device is transmitting.
12	Aircraft Safety	Operating this equipment on board aircraft is not permitted. Operating radio transmitter equipment in an aircraft can be dangerous to navigation and other systems.

Table 4-1 – Cautions and Warnings

4.2 EMC / Safety and Radio Approvals

The equipment has been designed to align with, and has been tested against these harmonized EMC and safety standards:

4.3 CE Marking

The CE mark is attached to all products, and the CE Declaration of Conformity, as well as the technical file is available on request.

5. Appendix B - Precautions and Maintenance

5.1 Caring for your Equipment

- Do not apply physical abuse to the unit, too much shock or vibration.
- Do not let it fall.
- Do not shake or throw the unit.
- Do not carry the unit by the antenna.
- Prevent exposure to too much moisture or liquids.
- Do not submerse the unit unless it is designed to be submersible.
- Do not let the unit touch corrosives, solvents, cleaners or mineral spirits.
- Prevent exposure to too much cold or hot.
- Prevent too long exposure to direct sunlight.
- Do not put or keep units on surfaces that are not stable.
- Always turn the unit off before installing optional accessories.
- Only use accessories intended for the specified make and model of your unit, especially batteries, chargers and power adapters.

5.2 Charging

- Use approved batteries, chargers and adapters designed specially for your make and model unit.
- Do not try to charge a wet unit or battery pack.
- Do not charge the unit or battery pack near anything flammable.
- Let the battery pack become stable at room temperature (72 degrees F) before charging.
- Do not charge units and / or battery packs on surfaces that are wet or not stable.
- Do not keep units and / or batteries in chargers for too long.

5.3 Working with Lithium Batteries

- Charge only with the approved charging cable.
- Batteries are to be used only for the specified function. Incorrect operation will invalidate the warranty and can make the battery become dangerous.
- Charge in a clean, dry environment, ideally at 10 degrees Celsius. (0 to 45 degrees Celsius is permitted).
- Do not keep or operate in direct sunlight for extended periods. Battery can be damaged by becoming too hot, for example if put on the rear parcel shelf of a vehicle.
- Keep in a cool and dry environment. Being kept too hot can cause permanent loss of capacity.

- For short term (fewer than six months), keep in a fully charged condition.
- For extended periods (more than one year) charge before keeping and charge at intervals of six to nine months.
- Always fully charge the battery after a period of more than one month before operation.
- Do not keep the battery with the charge low as this can cause the battery to become unserviceable and invalidate the warranty.
- Do not short circuit.
- Do not put in water.
- Do not burn. Cells are likely to explode if put in a fire.
- Dispose of batteries in accordance with the regulations for the Country of operation. Batteries are usually thought of as 'isolated waste' and must not be in the usual waste stream. Send to the seller, or send to an approved re-cycling company.

5.4 Cleaning

- Turn off the unit and remove batteries (if applicable) before maintenance.
- Use a clean, soft, moist cloth to clean the unit. A microfiber cloth is recommended.
- Do not use alcohol or cleaning solutions to clean the unit.
- Do not put the unit in water to clean it.
- If the unit becomes wet, immediately dry it with a microfiber or other lint-free cloth.

5.5 Storage

- Turn off the unit and remove batteries before storage
- Keep units and battery packs in a cool, dry area at room temperature (72 degrees F).
- Do not keep units and / or batteries in chargers which are on.

5.6 Repairs

Do not try to repair the unit. The unit contains no user serviceable parts. Speak to the Cobham Customer Servicing Centre or send it to an approved repair technician.

5.7 Getting Technical Support

Step 1: Speak to Client Services

Technical support enquiries must be sent to the Client Services team.

Post: The Cobham Centre-Solent, Fusion 2, 1100 Parkway, Solent Business Park, Whiteley, Hampshire, PO15 7AB, England.

Phone: +44 1489 566 750 then push 1 for support. Office hours: 0900-1700 UK time not including holidays.

Email: tcs.whiteley.support@cobham.com (no restricted content).

For technical support we plan to give a first response to you in less than one working day and a progress update at intervals of two weeks at least.

5.8 Operate with the Cobham RMA Service

If you have a problem and all troubleshooting steps have not worked, you must speak to Cobham for Return Material Authorisation (RMA) Service.

Step 1: Email Cobham

To send something to Solent please Email tcs.whiteley.rma@cobham.com. We will then send you an RMA request form to complete and send to us. We'll then send you an RMA number and shipping instructions.

Step 2: Keep your Personal Kit

Remove all personal kit or media from the device.

Step 3: Put the Unit into the Box

Use the initial shipping container and packing materials if possible.

If the initial packing materials are not available, put the equipment in soft material (e.g. PU/PE foam) then put the wrapped equipment into a hard cardboard shipping box.

Step 4: Prepare an Information Sheet

Include a sheet with these items of information:

- Name
- Address
- Unit Serial Number
- Date of Purchase or the initial invoice number
- Date of problem
- A detailed description of the problems you have encountered
- A record of the hardware / software configuration if applicable

Note: Please keep a copy of this sheet for your records.

Step 5: Put the RMA Number on the Box

Clearly identify the outer surface of the shipping box with the RMA number. If an RMA number is not on the shipping box, receiving cannot identify it and it might be sent to you again.

Step 6: Send the Box to Cobham

Send the box with your usual shipping procedure.

6. Appendix C-Glossary

6.1 Glossary

0-9	Means...
16QAM	16-state Quadrature Amplitude Modulation.
64QAM	64-state Quadrature Amplitude Modulation.

A	Means...
AC	**Alternating Current.** Current that is continually changing in magnitude and at intervals in direction from a zero reference level.
A/V	Audio/Video.
AES	In cryptography, the **Advanced Encryption Standard** (**AES**) is an encryption standard adopted by the U.S. government. The standard comprises three block ciphers, AES-128, AES-192 and AES-256, adopted from a larger collection originally published as **Rijndael.** Each AES cipher has a 128-bit block, with keys of 128, 192 and 256 bits, respectively.
ASI	**Asynchronous Serial Interface**. A streaming data interface which often carries an MPEG Transport Stream. An ASI signal can carry one or multiple SD, HD or audio programs that are already compressed, not like an uncompressed SD-SDI (270Mbs) or HD-SDI (1.45Gbs). An ASI signal can carry differing quantities of data but is always padded to operate at a fixed line rate of 270 Mb/s.
Amplification	Increasing the strength (current, voltage or power) of a signal.
Amplitude	The level of an audio or other signal in voltage or current. The magnitude of variation in a changing quantity from its zero value.
Amplitude Modulation	Modulation in which the amplitude of the carrier wave is varied above and below its usual value in accordance with the intelligence of the signal being transmitted. Also called AM.
Analogue	**Analog transmission** is a transmission method of conveying voice, data, image, signal or video information with a continuous signal which varies in amplitude, phase, or some other property in proportion to that of a variable.

A	Means…
Antenna	An **antenna** (or **aerial**) is a transducer designed to radiate or receive electromagnetic energy (generally RF).
Antenna Bandwidth	The frequency range over which a given antenna will accept signals.
Antenna Gain	The effectiveness of a directional antenna as compared to a standard non-directional antenna. It is usually expressed as the ratio in decibels of standard antenna input power to directional antenna input power that will make the same field strength in the wanted direction. For a receiving antenna, the ratio of signal power values produced at the receiver input terminals is used. The more directional an antenna is, the higher is its gain.
Attenuation	Power loss resulting from conductor resistance and dielectric loss in the insulating material used to isolate the conductors.

B	Means…
BNC	**Bayonet Neill-Concelman –** A very well-known **type** of RF connector used for terminating coaxial cable.
Bandwidth	The width of a band of frequencies used for a function.

C	Means…
COFDM	**Coded Orthogonal Frequency Division Multiplexing** is a frequency-division multiplexing (FDM) scheme utilized as a digital multi-carrier modulation method. A large number of closely-spaced orthogonal sub-carriers are used to carry data.

D	Means…
D/C	Downconverter. A device which changes microwave frequencies to UHF frequencies for operation in Cobham receivers.
Digital	A **digital signal** is a discontinuous signal that changes from one condition to one more condition in discrete steps.
Decibel	The standard unit used to express transmission gain or loss and relative power levels. Also written as dB.
Decoder	Processor in a video receiver that changes digital video data to analogue signals for replay on analogue monitors; or in some cases a software decoder, a program that decodes digital data for replay on the PC (decompression etc.).

D	Means...
Demodulate	To collect the information originally impressed on the radio wave.

E	Means...
Electromagnetic field	The field of force that an electrical current produces around the conductor through which it flows.
Electromagnetic Waves	A wave propagating as a periodic disturbance of the electrical and magnetic fields and having frequency in the electromagnetic spectrum; the means by which energy is transmitted from one area to one more area.
Elementary Stream (ES)	Elementary streams: These streams contain only one MPEG-2 video channel and no audio. Elementary streams are required if you intend to operate **Milestone** or a player that cannot operate with Transport streams. You must be in RTSP mode to operate Elementary streams.
Encoder	A processor in a video transmitter which changes analogue video from a camera to digital data.

F	Means...
FEC	**Forward Error Correction** is a system of error control for data transmission, whereby the sender adds redundant data to its messages, also known as an **error-correction code**. This lets the receiver find and correct errors (inside some bound) without the need to ask the sender for additional data. The advantage of forward error correction is that a back-channel is not required, or that retransmission of data can often be prevented, at the cost of higher bandwidth requirements on average. FEC is thus applied in situations where retransmissions are relatively costly or impossible.
Firmware	Software which is installed directly on a device and is intended specially for that device and is used to control it.
FOV	**Field of View -** The field of view (also field of vision) is the angular quantity of the observable world that is seen at a given moment.
Fading	A periodic decrease in the received signal strength.

F	Means...
Frequency	The rate at which a procedure repeats itself. In radio communications, frequency is expressed in cycles for each second. Signals also have a property called wavelength, which is inversely in proportion to the frequency.
Frequency Modulation	Changing the frequency of a carrier wave, usually with an audio frequency, to send intelligence. Also called **FM**.
FPGA	**Field-Programmable Gate Array -** an integrated circuit designed to be configured by the customer or designer after manufacturing, hence "field-programmable".

G	Means...
GUI	**Graphical User Interface.**
GHz	**Gigahertz** - One gigahertz is equal to 1,000 megahertz (MHz) or 1,000,000,000 Hz.
Gain	The increase in signal strength that is produced by an amplifier.

H	Means...
Hertz	One cycle for every second.

I	Means...
IP Address	**Internet Protocol Address** – A unique numeric ID for a device in a network.
IR	**Infra-Red** - Infrared (IR) radiation is electromagnetic radiation whose wavelength is longer than that of visible light.
Impedance	The total opposition offered by a circuit or component to the flow of alternating current.

L	Means...

L	Means...
LOS and NLOS	**Line-of-sight** propagation refers to electro-magnetic radiation including light emissions moving in a straight line. The rays or waves are diffracted, refracted, reflected, or absorbed by atmosphere and obstructions with material and usually cannot move above the horizon or behind obstacles. NLOS is Non Line-of-sight.
Load	A device that consumes electrical power.
Lux	The **lux** (symbol: **lx**) is the SI unit of illuminance and luminous emittance. It is used in photometry as a measure of the *apparent* intensity of light hitting or passing through a surface.

M	Means...
MHz	**Megahertz** is the same as 1,000,000 Hz
mW	**Milliwatt** - The milliwatt (symbol: mW) is equal to one thousandth (10^{-3}) of a watt.
MPEG	Moving Pictures Experts Group.
Modulation	To change the output of a transmitter in amplitude, phase or frequency in accordance with the information to be transmitted. Data is superimposed on a carrier current or wave by means of a procedure called modulation. Signal modulation can be done in one of two ways: analogue and digital. In recent years, digital modulation has been getting more usual, while analogue modulation methods have been used less. There continues to be plenty of analogue signals around, but, and they will probably not become totally extinct.
Multicast	Multicasting is sending data from a sender to multiple receivers where each receiver signals that they *want* to receive the data.

N	Means...
nm	A **nanometre** (American spelling: **nanometer**; symbol **nm**) is a unit of length in the metric system, equal to one billionth of a metre (i.e., 10^{-9} m or one millionth of a millimetre).

N	Means…
NMEA 0183	**NMEA 0183** is a combined electrical and data specification for communication between marine electronic devices such as echo sounder, sonar, anemometer, gyrocompass, autopilot, GPS receivers and many other types of instruments. It has been specified by, and is controlled by, the U.S.-based National Marine Electronics Association.
NTSC	National Television Systems Committee.
Noise	Random pulses of electromagnetic energy generated by lightening or electrical equipment.

O	Means…
Omni directional antenna	An antenna radiation pattern that shows the same radiation in all horizontal directions.
Oscillation	A periodic, repetitive movement or set of values (voltage, current, velocity).

P	Means…
PAL	Phase Alternate Line.
PIR	**Passive Infra-Red** sensor (PIR sensor) is an electronic device that measures infrared (IR) light radiating from objects in its field of view.
PTZ	**Pan, Tilt and Zoom** – PTZ is a usual description of controllable cameras.
Propagation	A phenomenon by which a wave moves from one point to a second point; the movement of electromagnetic waves through space or along a transmission line.

Q	Means…
QPSK	Quadrature Phase Shift Keying.

R	Means…
RF	**Radio Frequency.**

R	Means...
RTSP	**Real Time Streaming Protocol** (RTSP) is a network control protocol designed for operation in entertainment and communications systems to control streaming media servers. The protocol is used for establishing and controlling media sessions between end points. Clients of media servers issue VCR-like commands, such as play and pause, to let real-time control of playback of media files from the server.
Rx	**Receiver**, an electronic device that changes a radio signal from a transmitter into useful information.
Radiate	To transmit RF energy.
Radio Frequency	Frequency of electrical energy capable of propagation into space (usually above 20kHz). Also called RF.

S	Means...
SNR	**Signal to Noise Ratio** is an electrical engineering measurement specified as the ratio of a signal power to the noise power corrupting the signal. Signal-to-noise ratio compares the level of a desired signal (such as music) to the level of background noise. The higher the ratio, the less obtrusive the background noise is.
Shannon Limit	The **Shannon limit** or **Shannon capacity** of a communications channel is the theoretical maximum information transfer rate of the channel, for a noise level.
Signal	In electronics, a signal is an electrical current or electromagnetic field used to send data from one area to a second area. The simplest type of signal is a direct current (DC) that is switched on and off; this is the principle by which the earliest telegraph worked. More complex signals consist of an alternating-current (AC) or electromagnetic carrier that contains one or more data streams.
Streaming	**Streaming** is the transmission of digital audio or video or the listening and viewing of such data without first storing it.

T	Means...
Tx	A **transmitter** is an electronic device which, usually with the aid of an antenna, propagates an electromagnetic signal such as radio, television, or other telecommunications.

T	Means...
TNC	The **TNC (threaded Neill-Concelman) connector** is a threaded version of the BNC connector. The connector has a 50 Ω impedance and operates best in the 0–11 GHz frequency spectrum.
Transport Stream (TS)	Transport streams: These streams can contain some MPEG-2 content channels and related audio. All the channels are multiplexed together, letting the receiver select which to play back.

U	Means...
UDP	**User Datagram Protocol** (UDP) Sometimes called fire and forget because there is no dialog between the sender and receiver. If the receiver does not receive a packet, the sender will not know. But, UDP is very satisfactory when there is a small risk of errors (like in your LAN), or when TCP can give "too late" delivery.
USB	Universal Serial Bus.
UVMS	**Universal Video Management System**, a network video recorder storage solution from BAE Systems. Gives full archiving coupled with live and retrospective viewing.
Unicast	Unicast is simply sending packets from one source to one destination. For example, from one web server to one (or each) person viewing a page on a web browser.

V	Means...
VHF	**Very High Frequency** – 30 MHz to 300 MHz
V	Volt.
Viterbi Decoder	A Viterbi decoder uses the Viterbi algorithm for decoding a bit stream that has been encoded using forward error correction based on a Convolutional code.

W	Means…
Watt	The **watt** (symbol: **W**) is a derived unit of power in the International System of Units (SI). It measures rate of energy conversion. One watt is equivalent to 1 joule (J) of energy per second.
Waveform	Signal shape.
Waveguide	A specially formed hollow metal tube, usually rectangular in shape in cross section, used to connect a High Power amplifier to the antenna.