Document Number DS000034

User Manual

NETNode

Phase 1 and 2 Units (software versions >V2.1)

Cobham Surveillance

Unclassified

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0. Preface

0.1. About this Document

This manual describes the operation of **domo** IP radio MESH systems. The manual is divided into three main sections.

- **Getting started and basic operation**

This section describes to users how to deploy and use a domo IP Radio MESH system with its associated NETNode units in typical operational scenarios.

- **Advanced operation**

This section describes the operation of the system in more detail, concentrating particularly on secondary functions such as importing mapping information and working with configurations.

- **Technical reference**

This section provides technical specification and control protocol data and will be of interest to those integrating the MESH system into larger systems.

0.2. Who Should Read this Book

This document 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 systems and infrastructure.

0.3. Assumed Knowledge

Throughout this book it is assumed that the reader has a thorough knowledge of:

- Web Navigation and Browsers
- TCP/IP Network configuration

0.4. Typographic Conventions

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

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

0.5. Symbols

This document uses these symbols to highlight important information:

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

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

NOTE: A written notice given to draw the reader's attention to something or to supply additional information.

0.6. Trademarks

All trademarks or registered trademarks that appear in this document are the property of their respective owners.

0.7. Related Documents

You may also need to read:

Document	Source
None	

0.8. Document History

This document was written and produced by Cobham Technical Communications Team.

This is a change controlled document. Each main page of this document displays a file name at the bottom left corner of the page. This is followed by a release number ('V1.0' is the original). The revision date is also indicated in the table below.

Changes to any page will raise the revision status of the whole document.

Revision	Date	Authors	Summary of Changes
V1.4	2009-12-18	NMcS / RC	New format
V1.5	2009-12-24	CB	Add new features
V1.8	2010-10-18	CB	Updates for V2.1 release
V1.9	2010-10-00	CB	Updates
V2.0	2011-05-23	RDPC	Address, FCC compliance
V2.1	2011-09-30	RDPC	More Compliance statements
V2.2	2011-10-18	SD	Intrinsic Safety inclusion.
V2.3	2011-12-12	SD	FCC 15.19 Statement.

Contents

1. Introduction

Cobham Surveillance domo has been supplying point to point high data rate digital video links for many years to security users. These links exhibit exceptional performance, enabling users to reliably exchange video data in extremely difficult RF transmission environments such as mobile links and links in dense urban areas. More recently domo has seen an increasing requirement to use the rugged transmission capabilities of COFDM to carry general purpose IP traffic.

There is now also a growing demand from domo customers to incorporate bi-directional capability in its solution, and also a MESH capability.

The traditional two frequency approach (Frequency Division Duplex or FDD) to enable bi-directionality is not convenient or appropriate in many applications; the use of separate frequencies makes frequency management difficult. Also FDD adds complexity, cost and weight with additional antennas, amps and circuitry.

The solution to this problem is a single frequency approach (Time Division Duplex or TDD) where all communicating nodes share the same frequency. This simplifies frequency management and circuitry implementation.

1.1. MESH Applications

- Rapid deployment temporary surveillance
- Mini and Micro UAV communications.
- Radios to connect surveillance team vehicles.
- Special Forces data radios.
- Military vehicle radios.
- True real time surveillance / pursuit where an ad-hoc network is used relay imagery in a fluid environment. This would apply equally to manned surveillance as to vehicle pursuit.
- Next generation Unmanned Ground Vehicles (UGVs) where vehicles operate co-operatively.
- FIST battlefield communication applications.
- Perimeter security applications.

Each MESH NETNode has two Ethernet interfaces to allow flexibility of connection. This, in conjunction with the radio link, provides the same functionality as a switched Ethernet hub.

The radio technology is based on the fundamentals of the acclaimed **domo** Solo4 rugged, robust and reliable transmission system giving an extremely secure and easily deployable bi-directional communication system.

AES BCRYPT1 encryption/decryption (AES128 & 256) is also supported on both forward and reverse paths of the MESH system. AES support is an optional software feature and may require an export license.

1.2. domo MESH Features

- Single frequency IP MESH Network
  - Reduces antennas, amplifiers, filters in a bi-directional unit
- No central Node (genuine Mesh)
  - No single point of failure
  - Makes a very adaptable
- Rapid connection and disconnection
  - Nodes are able to connect into the network within 2 seconds without user intervention
- 8 Nodes Maximum
  - 8 nodes provides a good balance between capacity and latency
- Very rugged RF link
  - Proven to be 5 to 10 times better than Wi-Fi per link

IMPORTANT NOTE:

The MESH IP Radio product range has been specifically designed for government security and law enforcement users, the equipment will tune across frequencies that are only available to licensed government users. Non-government users should employ the equipment restricted to the license exempt bands only typically 1.389 to 1.399GHz, 2.400 to 2.483GHz and 5.725 to 5.875GHz.

2. Getting Started and Basic Operation

2.1. Which Model do I Have?

Each unit in the **domo** product range is marked with two panels.

- Product Code Panel. Give product code and manufacturers information.
- CE and Serial Number Panel. Gives CE mark and product serial number.

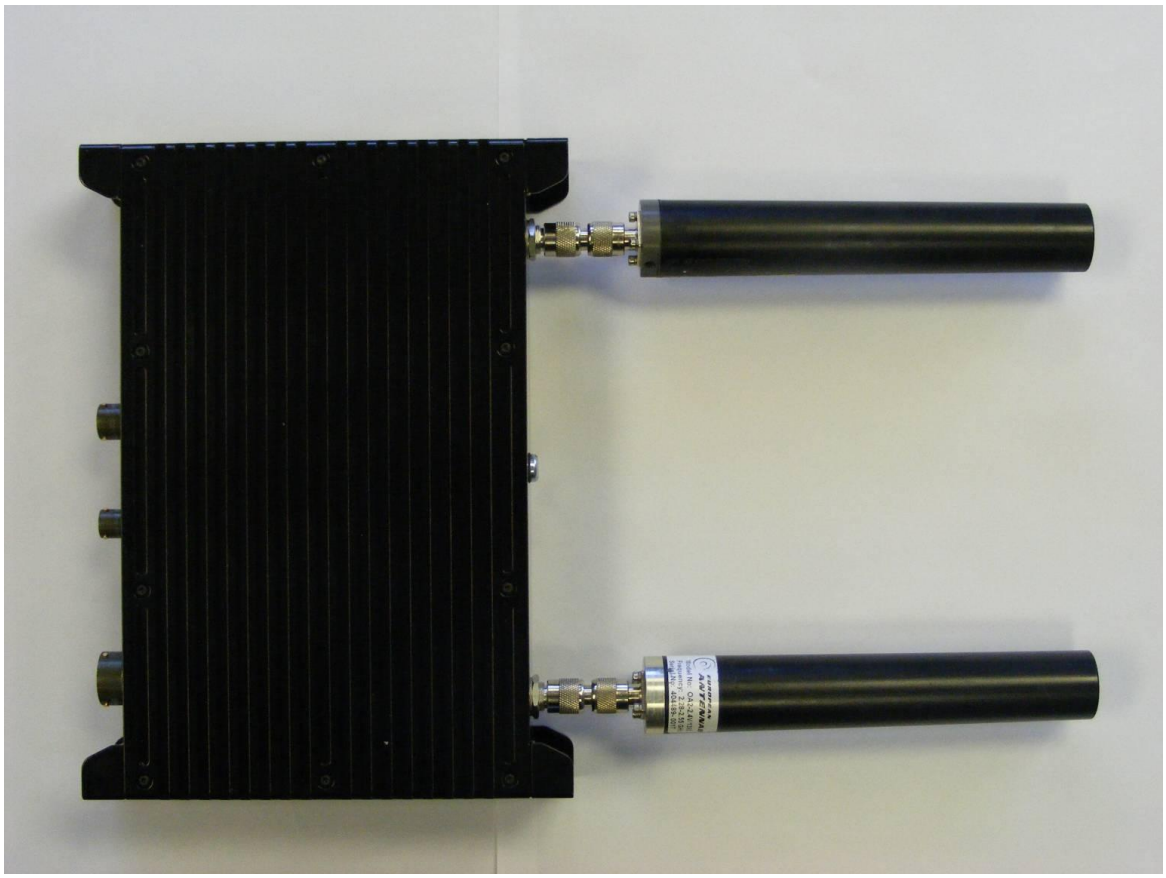
domo
NETNode1W-217250
Made in the UK

Mesh systems are available in 3 different product enclosures. These enclosures are targeted to different user applications.

Phase 1 units are sold in waterproof milled aluminium boxes suitable for outdoor mounting.

Phase 2 units supersede the Phase 1 units. These are made in two variants; a plain box variant and a waterproof robust box variant. The plain box variant uses standard cable and connectors where possible. The robust variant is a milled aluminium enclosure and uses Amphenol connectors and bespoke Amphenol cables. These bespoke cables are supplied with the unit.

2.2. Phase 1 Unit



The domo product code can be referenced in the table below.

Product Code	Product	Accompanying items
NETNode1W-217250 (2.17 to 2.50GHz)	1W RF output MESH link (1 node)	Cables: 1-off Control 2m (CA288) 1-off DC Power 5m (CA285) 1-off Ethernet 5m (CA284) CD with operating software and manual
NETNode1W-550600 (5.5 to 6.0GHz)	1W RF output MESH link (1 node)	Cables: 1-off Control 2m (CA288) 1-off DC Power 5m (CA285) 1-off Ethernet 5m (CA284) CD with operating software and manual
NETNode-AVI-UP	Audio/Video Input option Fitted inside the	Cables: 1-off A/V cable 2m (CA286)

	NETNode	

Note: Antennas are not included with this product.

2.3. Phase 2 Products

2.3.1. Plain Box Variant

The **domo** product code can be referenced in the table below.

Product Code	Product	Accompanying items
NETNode-P-217250 (2.17 to 2.50GHz)	1W RF output MESH link (1 node)	Cables: 1-off Control 2m (CA0001) 1-off DC Power brick (CA0023) 1-off Auxiliary cable(CA0474)
NETNode-P-115140	1W RF output	Cables:

(1.15 to 1.40GHz)	MESH link (1 node)	As NetNode-P-217250
NETNode-P-034047 (340 to 470MHz)	1W RF output MESH link (1 node)	Cables: As NetNode-P-217250
NETNode-P-440500 (4.40 to 5.00GHz)	1W RF output MESH link (1 node)	Cables: As NetNode-P-217250
NETNode-AVI-UP2	Audio/Video Input option for Phase 2 Fitted inside the NETNode	Cables: 1-off A/V cable 2m (CA0122)

Note: Antennas are not included with this product.

2.3.2. Robust Product

The **domo** product code can be referenced in the table below.

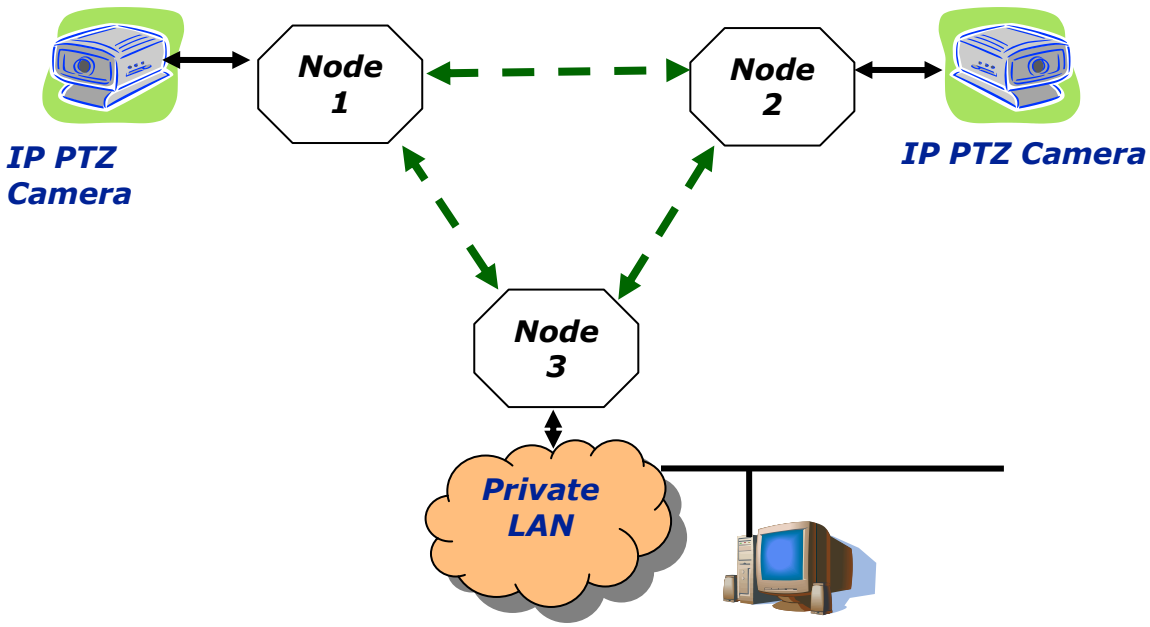
Product Code	Product	Accompanying items
NETNode-R-217250 (2.17 to 2.50GHz)	1W RF output MESH link (1 node)	Cables: 1-off Control/Data 2m (CA406) 1-off DC/Ethernet 5m (CA403)

NETNode-R-115140 (1.15 to 1.40GHz)	1W RF output MESH link (1 node)	Cables: As NetNode-R-217250
NETNode-R-034047 (340 to 470MHz)	1W RF output MESH link (1 node)	Cables: As NetNode-R-217250
NETNode-R-440500 (4.40 to 5.00GHz)	1W RF output MESH link (1 node)	Cables: As NetNode-R-217250
NETNode-AVI-UP2	Audio/Video Input option for Phase 2 Fitted inside the NETNode	Cables: 1-off A/V cable 2m (CA0477)

Note: Antennas are not included with this product.

2.4. Basic Operating Principles

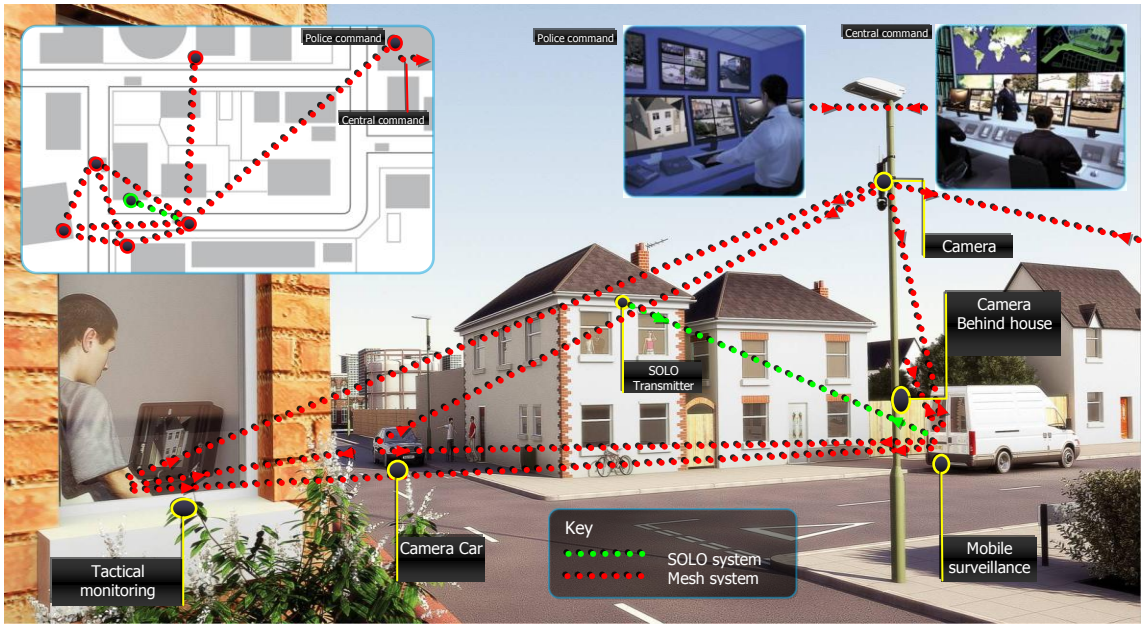
As an example a basic system is illustrated with two IP cameras contributing into a Private LAN using the MESH system. Each MESH NETNode behaves as a switched hub providing two physical Ethernet ports, and a connection onto the mesh radio link.



All NETNode units are connected to each other as a wireless IP network. The Mesh system arbitrates which node transmits at any given time avoiding any conflict.

The nodes are able to seamlessly connect into the network without user intervention. The only key parameters that need to be preloaded into the units are the encryption keys and the frequency.

Mesh could also be used to quickly deploy a multiple node surveillance system around an area of interest. The NETNode units could be used to contribute Video or IP data such as stills photography or sensor data.



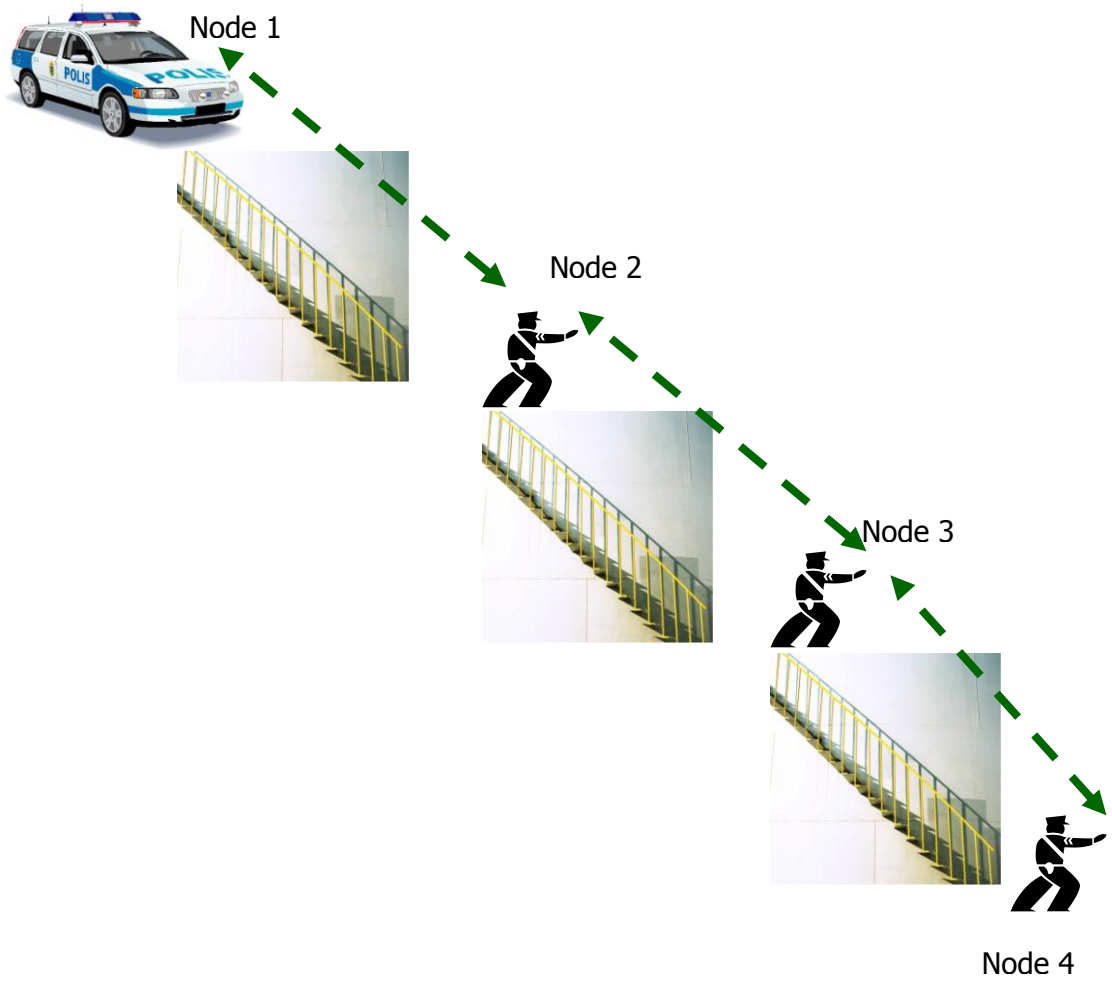
The NETNode can accept video from a standard composite (PAL/NTSC) camera or an IP camera can be connected through the MESH Network. To connect a standard composite video signal into a MESH NETNode the NETNode-AVI-UP option must be fitted into the NETNode.

The MESH is able to support 3 or 4 full quality video links through the one frequency – if 3 nodes were to contribute video simultaneously then the bit-rate for each link would have to be adjusted to roughly 700kbps per video service. Full frame rate video can be supported at 700kbps but at reduced resolution – typically ½ resolution or SIF resolution would be selected. Higher resolutions could also be supported – even up to full resolution but typically not at full frame rate.

A 4 or 5 Node Mesh network (when configured to operate in 3.5MHz bandwidth mode) can have up to 3Mbps of data capacity available for transmission of information between the Nodes IF every Node can see every other Node and the link quality between all the nodes is good. Note that if information needs to be transmitted through a chain of Nodes or if the link quality is not good then the useful information rate available in the Mesh reduces.

NOTE: Some Phase 2 Mesh Nodes (4.4 to 5GHz) units and post Sep 2010 delivery (2.17 to 2.50GHz) Mesh NETNodes can support a 5MHz bandwidth that allows up to 5.5Mbps of useable data in the Mesh Network. To discover if your unit supports 5MHz bandwidth you can look at the Board Type in the Information Pane of the web browser interface. See Section 4.12 Information Tab for details on how to discover the Board Type.

The MESH can also be used to facilitate range extension. Nodes can communicate through a chain.



In this example the MESH system is used to provide a video link back through a chain to a command vehicle. Using either the Talkback feature (Phase 2 NETNodes) or an external VOIP codec all the operatives could also be listening and communicating over the network.

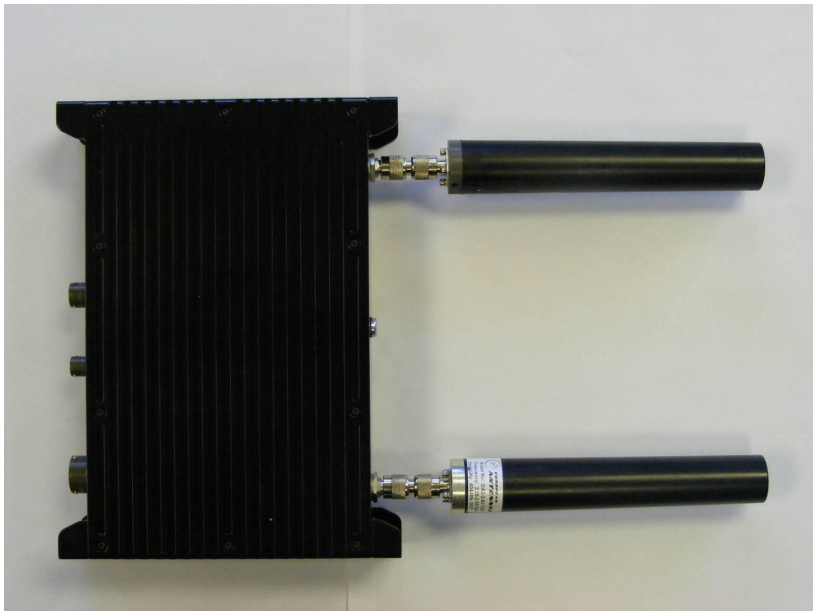
2.5. Getting Started on the Bench (Phase 1 Unit)

2.5.1. Cables and Connections

This section describes how to connect the following **domo** model numbers.

- NETNodeIP1W-217250 (2.17 to 2.50GHz)
- NETNode-AVI-UP (option)

The pictures below show the Phase1 **domo** NETNode product.



A **domo** MESH Phase 1 NETNode and a Phase 2 Plain box NETNode is supplied with the following cables:

- IP via Ethernet x 1
- Control 2m x1
- DC Power 5m x1
- AV 2m x1 (if the NET-AVI-UP option is ordered)

A **domo** MESH Phase 2 Weatherproof NETNode is supplied with the following cables:

- IP via Ethernet x 1 and DC Power is combined Part Number CA0403
- Control 2m x1 Part Number CA0406
- AV 2m x1 (if the NET-AVI-UP2R option is ordered) Part Number CA0477

A **domo** MESH Phase 2 Plain NETNode is supplied with the following cables:

- Standard 12V Power Block Part Number CA0023
- Control cable 2m x1 Part Number CA0001
- Special Control / Data Cable Part number CA0474
- AV 2m x1 (if the NET-AVI-UP2P option is ordered) Part Number CA0122

Before deploying **domo** MESH NETNode units in the field it is strongly advised to test the products in a bench environment in order to gain familiarity with the product.

BEFORE SWITCHING ON THE UNIT PLEASE NOTE:

The DC power supply must be set to 12.5V and assume up to 2.5A of current draw.

2.6. Establishing Connection to a Node

Once a user has connected to a unit and established a NETNode on their network operating the system is easy.

The procedure to establish communication with a node varies depending on whether the User wishes to connect the MESH to a network running DHCP or whether the user wishes to run with static IP addresses.

If your network has no DHCP server you will need to assign a fixed IP address for the NETNode using a serial RS232 interface. If you have a DHCP server the NETNode will automatically acquire an IP address and you can connect straight via IP. You may still wish to change the DHCP IP address to a fixed IP address using the browser.

2.6.1. Connecting the NETNode to your Computer using Serial (RS232)

The first time you set up a NETNode with no DHCP you'll be connecting using a serial RS232 interface.

You'll only have to do this once – every other time you'll hook up to the NETNode using an IP interface using a web browser.

On a Phase 1 Unit

1. Connect the Amphenol 19-way plug (m) from CA0288-5 cable to the Amphenol 19-way jack (f) on the NETNode labelled CTRL/DATA.

2. Now, connect the RS232 D-Type 9-way plug (f) to your computer's RS232 9-way jack (m).

Caution: There are two D-Type 9-way plugs on the CA0288-5 cable – ensure you select the RS232 version by checking the label attached to the shell of the plug. The other is RS485.

On a Phase 2 Robust Unit

3. Connect the Amphenol plug (m) from CA0406 cable to the Amphenol jack (f) on the NETNode labelled CTRL/DATA.
4. Now, connect the RS232 D-Type 9-way plug (f) to your computer's RS232 9-way jack (m).
5.

Caution: There are two D-Type 9-way plugs on the CA0406 cable – ensure you select the RS232 version by checking the label attached to the shell of the plug. The other is RS485.

On a Phase 2 Plain box Unit

6. Connect the 15-way HD D-Type plug (m) from CA0474 cable to the 15-way D-Type jack (f) on the NETNode labelled AUX.
7. Now, connect the RS232 D-Type 9-way plug (f) to your computer's RS232 9-way jack (m).
8.

Caution: There are two D-Type 9-way plugs on the CA0474 cable – ensure you select the RS232 version by checking the label attached to the shell of the plug. The other is RS485.

2.6.2. Starting the Control Software

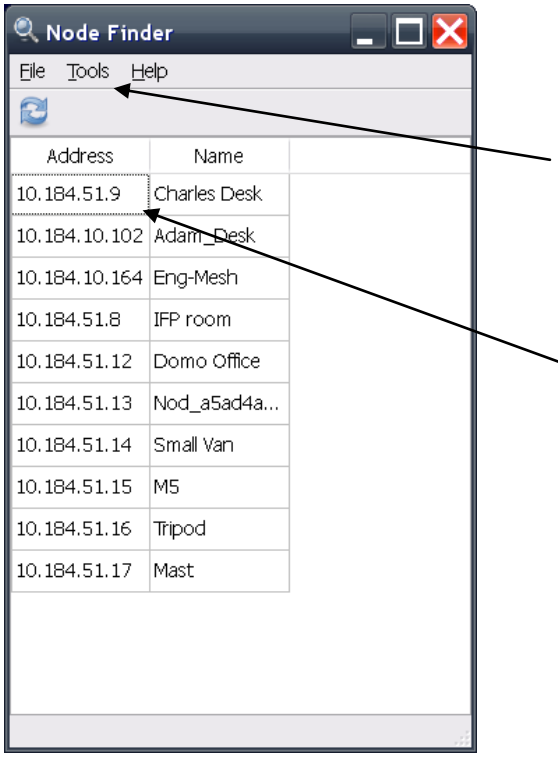
The procedure to establish communication with a node varies depending on whether the network is running a DHCP server or whether the user wishes to run with static IP addresses.

If the network is running DHCP and the NETNode unit is set to defaults, the unit will acquire an address via DHCP. To find out the IP address a PC running the Node Finder PC application must be connected to the same network as the Mesh NETNode.

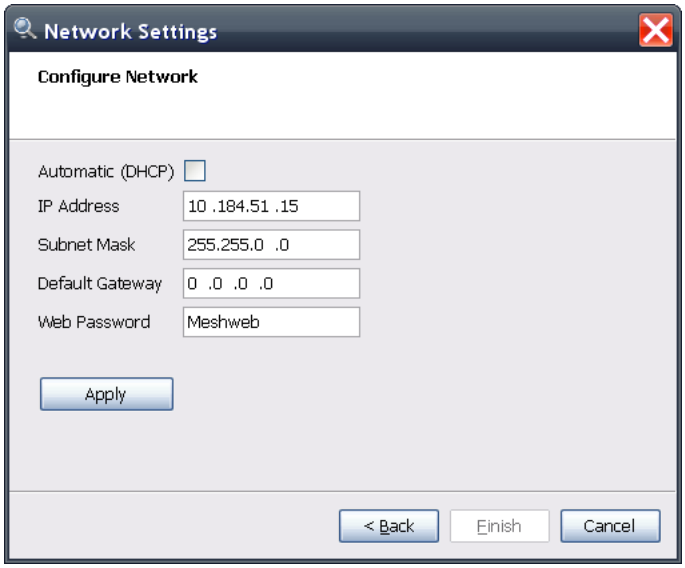
Starting the Nodefinder application will identify the IP address of any and all mesh nodes on the Network. To find out which unit this is unplug the IP connection to the unit and refresh Node Finder (F5). The entry that disappears is the node in question.

If the User's Network does not support DHCP or the unit has the wrong fixed IP address, then a PC running the Node Finder PC application must be connected via RS232 using the data cable (CA288 (Phase1) or CA0406 (Phase 2 Robust) between the port on the PC and the Control port on the MESH node.

On a Phase2 Plain box Mesh connect the PC to the AUX port using the CA0474 cable. The RS232 control 9-way D-type must be used.



To set the IP address via RS232 select the correct PC RS232 port from the tools->network setting menu.



If the NETNode unit is connected to a network that supports DHCP then leave the DHCP option box checked. If the network does not support DHCP then a valid static IP address must be entered and the DHCP box unchecked.

Note: Click 'Apply' after changing any configuration setting

Once a valid IP address is set it may also be changed in the WEB browser.

Now that the IP address is established the web-server should be used to configure frequency and output power. Once the node is on the User network any Web-browser can be used to browse to the Mesh NETNode to configure and control the node or to browse network status. The unit can be browsed by entering the relevant IP address in the web-browser.

2.6.3. Connecting the NETNode to your Computer using IP

For the rest of the set up of the NETNode you'll be connecting using an IP interface and a web browser.

On a Phase 1 Unit

9. Connect the Amphenol 19-way plug (m) from CA0288-5 cable to the Amphenol 19-way jack (f) on the NETNode labelled **CTRL/DATA**.
10. Now, connect the RJ45 8-way plug (m) to your computer's RJ45 8-way jack (f).

On a Phase 2 Robust unit

11. Connect the Amphenol plug (m) from CA0403cable to the Amphenol jack (f) on the NETNode labelled **Power/IP. (**This cable also includes the DC power banana plugs.)
12. Now connect the RJ45 8-way plug (m) to your laptop's RJ45 8-way jack (f).
13. Ensure you know the IP address of the computer you have attached.

On a Phase 2 Plain box unit

On a Phase 2 Plain box unit simply connect to one of the RJ45 panel mount sockets labelled **1** or **2** on the NETNode unit. It does not matter which socket you use.

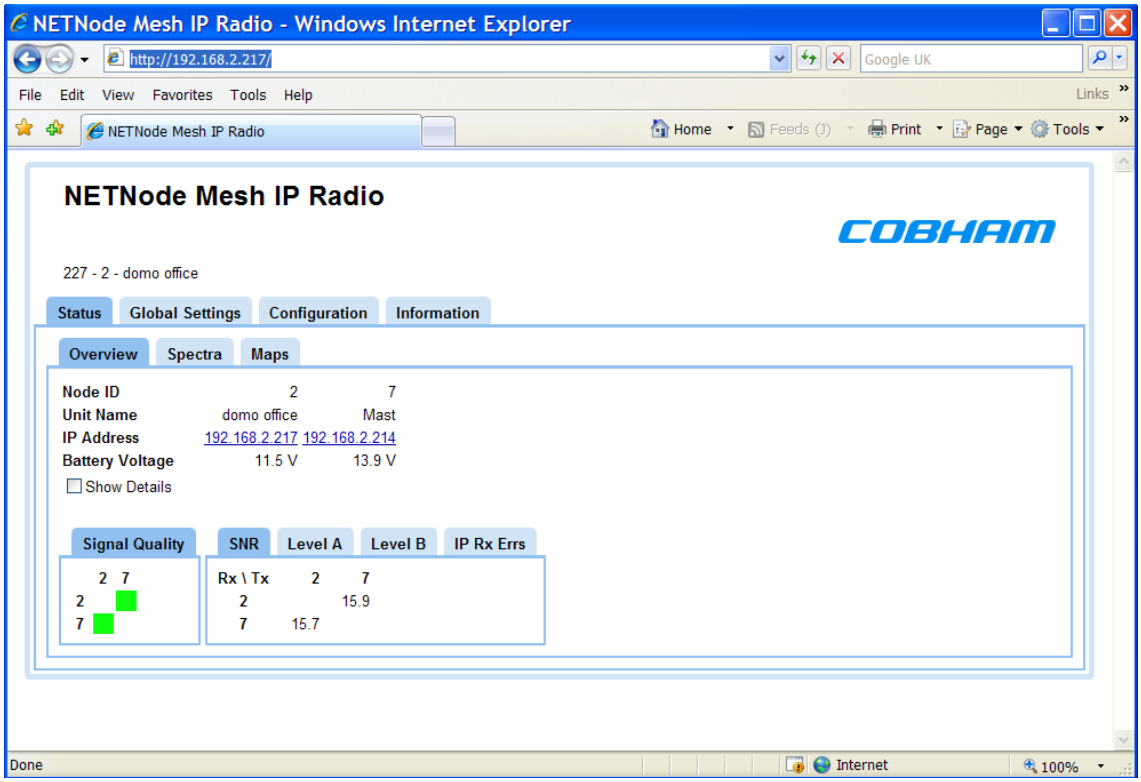
2.7. Web-browser Username and Password

The web-browser will prompt for a Username and Password on the first connection.

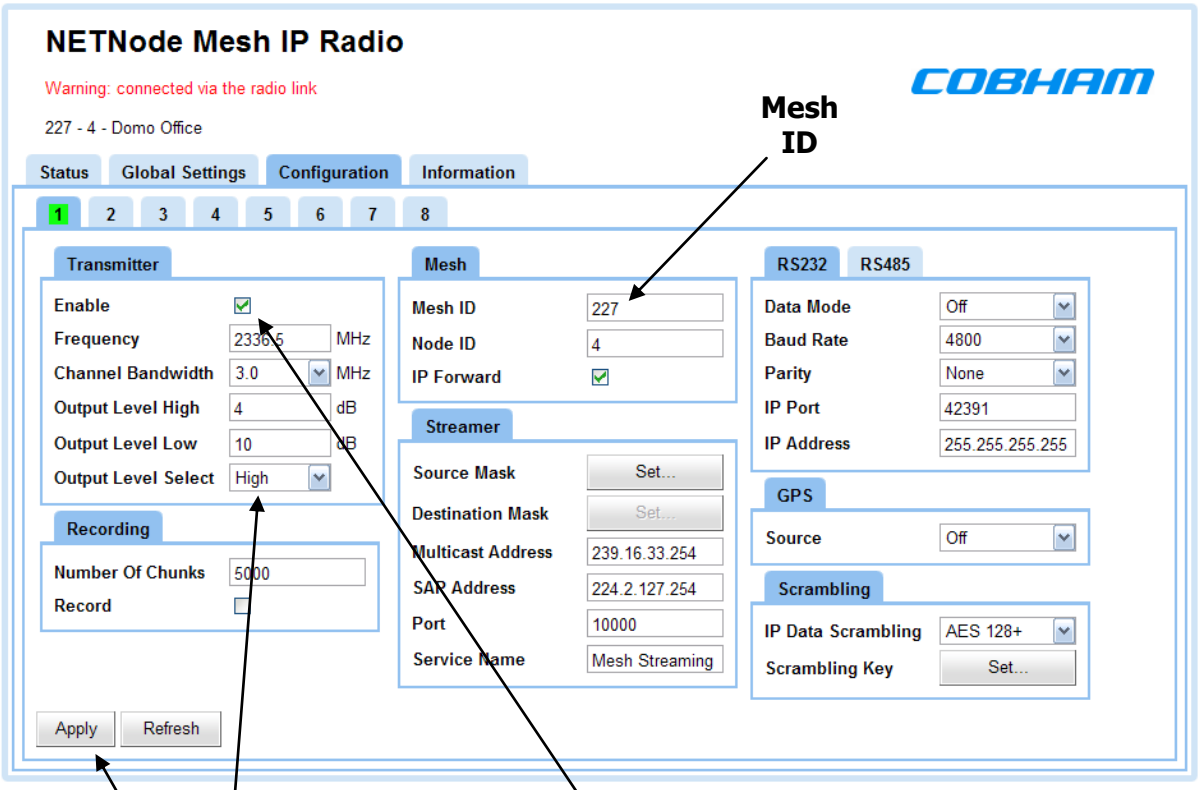
Username should be left blank

The default password is 'meshweb'

The status page will be displayed upon successfully entering the Username and Password.



Navigate to the Configuration page by clicking the Configuration Tab.



Set **Output level select** to 'Low' and set **Enable** 'ON' by 'ticking' the check box.

Note: Click 'Apply' after changing any configuration setting

Check that the Frequency is valid for the operation of the unit – specific country regulations will determine the frequencies available for operation. Note that 2400 to 2480MHz is licence exempt in most of the world.

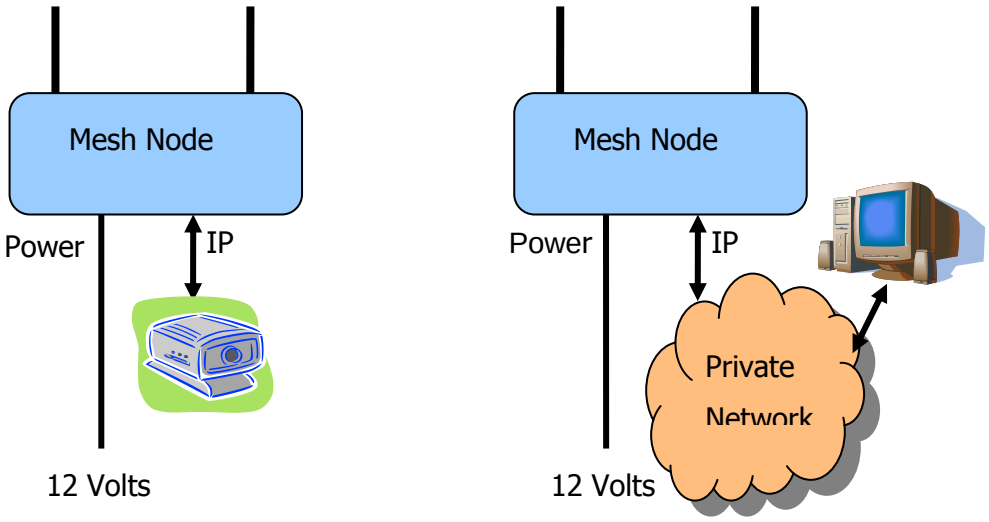
For the units to function in a single network the following must be set correctly:

1. *All units must be set to the same frequency*
2. *All units must have the same channel bandwidth set*
3. *All units must have their Transmit enabled*
4. *All units must have the same mesh ID*
5. *Each unit should be assigned a different node ID (0-7).*
6. *If encryption is enabled then the encryption type and keys must match.*

Power down the Unit.

Repeat the procedure for a second node – making sure that the frequency is always set to be identical.

Domo suggests configuring the system on the bench as outlined below.



BEFORE SWITCHING ON THE WHOLE SYSTEM PLEASE NOTE:

The DC power must be set to 12.5V and assume up to 2.5A current draw.

Don't connect the Ethernet ports of both units simultaneously to your network when they are both operating as you will create a loop in and out of your IP network. This may affect your network performance and prevent access to either node for about 1 minute.

Connect one MESH node unit to your network and the other MESH node to an IP camera or a standalone PC. The IP Camera or the standalone PC will then be connected to your network through the MESH network.

2.8. DC Power

The NETNode can be powered from a nominal 12V DC supply or an AC to DC adapted supply.

Locate, push and twist to lock the Amphenol connector on the Power cable into the socket labelled POWER, taking care to align the connectors. Connect the banana connectors on the other end of the cable to a suitable DC source.

The 12V DC input has the following characteristics.

- Input Voltage Range – 12V to 15V, **not** reverse voltage protected on Phase 1 Units
- Current draw – 1.2A to 2A at 12V (capacity dependant), the power draw is very dynamic and you should use at least a 2.5A rated supply.

CAUTION: Early units were **NOT** reverse voltage protected. Take extreme care when connecting power to this unit. DO NOT OVER VOLTAGE THE UNIT (Use 15V absolute MAX)

2.9. Ethernet

Locate, push and twist to lock the Amphenol connector into the socket labelled 'IP', taking care to align the connectors. When using a plain box Mesh Node simply insert a RJ45 network cable into one of the 2 RJ45 Ethernet sockets.

2.10. Talkback audio (Phase 2 units only)

Connect headset to T/B 6-way Lemo.

Microphone power is provided on the audio connectors at approximately 3V (suitable for Electret microphones)

2.11. Video and Audio Input (if Option is Present)

Locate, push and twist to lock the Amphenol connector into the socket labelled 'AV', taking care to align the connectors. If using a plain box Mesh unit simply push fit the Lemo connector. Connect the video and audio sources.

Connector	Signal
Video BNC	75 ohm composite video source, PAL or NTSC software selectable
Audio Plugs	Line / Microphone level audio, switchable. Line level -2dBu clip level low impedance source (< 600 ohm) Microphone level 12, 24, 36 and 48dB preamp stages software switchable

Microphone power is provided on the audio connectors at approximately 3V (suitable for Electret microphones)

Typically the video source should be a small colour or black and white CCD camera.

Typically the audio source should be an Electret microphone.

2.12. Antennas

Note: It is important only to power up the NETNode unit with the Antennas fitted.

Both antennas must be connected for normal operation. The units are supplied with different types of panel mounted connectors. The phase 1 units are supplied with panel mounted TNC connectors which carries the RF input and output. The antenna should be connected by screwing it onto the TNC, but care should be taken to not over tighten the connector.

The phase 2 plain box mesh units are supplied with panel mounted SMA connectors which carry the RF input and output. The antenna should be connected by screwing it onto the TNC, but care should be taken to not over tighten the connector.

The phase 2 robust box mesh units are supplied with panel mounted N-Type connectors which carry the RF input and output. The antenna should be connected by screwing it onto the TNC, but care should be taken to not over tighten the connector.

The units have the following RF output characteristics.

RF Spec	Model Number ending - 034047	Model Number ending - 115140	Model Number ending - 217250	Model Number ending - 440500	Model Number ending - 550600
Output Frequency			2.170 to 2.50GHz	4.40 to 5.0GHz	5.6 to 5.9GHz
Output Bandwidth	2.5/3/3.5MHz	2.5/3/3.5MHz (5MHz)*	2.5/3/3.5MHz (5MHz)*	2.5/3/3.5/5MHz	2.5/3/3.5MHz
Output Power	1W (nominal)	1W (nominal)	1W (nominal)	0.5W (nominal)	1W (nominal)
Output Impedance	50 ohm	50 ohm	50 ohm	50 ohm	50 ohm

* Some later Phase 2 NETNode units at these frequencies can support 5MHz. Units supplied after November 2010.

Note: It is recommended that the antennas be connected directly to the transmitter unit. The use of RF cables at this point will degrade the performance of the system.

The optimum choice of antenna will vary according to application. The following table gives some suggestions for suitable transmit antennas with the associated **domo** part number.

Application	Antenna model number
Mobile body worn application	1.00 to 1.40GHz - ANTBCL 2.28 to 2.50GHz - ANTBCS
Mobile vehicle application	1.00 to 1.40GHz – ANT4L 2.20 to 2.50GHz - ANT4S 5.60 to 5.90GHz – ANT4-560590
Long range point to point link	1.00 to 1.40GHz – ANT12L 2.28 to 2.50GHz – ANT12S 5.60 to 5.90GHz – ANT14-560590

Other antennas for more specialist applications, such as aircraft use or covert surveillance use are available on request from domo.

Some of the antennas will require connector adaptors (Inter series RF adaptors) to connect the antennas directly to the product.

2.13. Deploying the System

All external connection to the MESH products should be made, as described in the previous sections, before proceeding to power on the system.

2.13.1. Installation Notes

This section gives guidelines for how to install the MESH node in the following applications.

2.13.2. Fixed position Applications

The Phase 1 and Phase 2 robust NETNode units are designed to be waterproof allowing them to be installed outdoors.

2.13.3. Vehicle Applications

Interconnection between the unit and any antenna should be kept as short as possible, but where this is not possible, special attention should be taken to use only low loss cables. An appropriate cable might be RG213C/U. It is essential to minimise the distance between the unit and the antenna. Mounting holes are provided.

Power conversion will be required for 24V vehicles.

The video input can be connected across long video cable lengths so remotely mounted cameras should pose no problem.

The unit is self-cooling; however it should be mounted in a ventilated environment. Forced air cooling is not required.

2.13.4. Diversity and Antenna Positioning

The **domo** MESH NETNode product uses an advanced diversity technique called maximum ratio combining to construct a good spectrum from two potentially damaged received signals. This requires a small separation of the antennas.

Sometimes better results can be achieved by separating the antennas further. The optimum antenna placement depends on the environment in which the equipment is used and the signal path, and is often limited by physical factors (accessibility for example) as well as cable loss.

Note: Any cable run between the Node and the antenna **MUST** be **LOW LOSS** cable.

Contact domo for details of suitable cable. Note that a cable suitable for use at 400MHz will not necessarily also be suitable for use at 5GHz.

2.14. Battery / DC Power Considerations

The Phase 1 MESH NETNode units can consume over 2A of current at 12V. Phase 2 NETNodes typically do not exceed 1.5Amps of current consumption at 12V nominal supply voltage.

They are designed to trip off at 10.5V and reset on at 11.5V. The DC cable supplied as standard with the MESH node is 5m long to allow a customer to mount the NetNode on a mast. This suffers about 0.5V drop through the cable.

Therefore 1W MESH nodes need to be connected to a large capacity battery which in nominally 12V or to a 12V power supply. AC to 12V power supplies are not supplied as standard with the product.

Users can order a suitable universal AC to 12V power supply from domo as a cost option.

Note: Product code SOL4CLC-PSU is used for the Phase 1 unit

Phase 2 Plain Box Mesh units are supplied with an AC to 12V power block as standard

3. Operation

This chapter covers normal day to day operations of a fully configured NETNode system. If you are working with a new system or you need to change any of the configurations, look at the Advanced Procedures later in this guide.

3.1. Connecting Up the NETNode

3.1.1. Connecting the Antennas

You'll need a NETNode and two antennas.

1. Connect **both** antennas to the RF connectors on the rear of the unit.

Caution: Antennas should be connected **directly** to the unit. If you have to use cables (in a mobile application for example) keep them short.

Note: There are many types of antenna that can be fitted to the NETNode unit. Your antennas may look different from those in this guide.

3.1.2. Connecting to AC Supply

You'll need a NETNode and an AC Adaptor.

2. Connect the Amphenol 2-way plug (m) from the AC adaptor to the Amphenol 2-way jack (f) on the Robust NETNode. On the plain box unit the connector is a 4-way Lemo.
3. Now connect the IEC mains cable to your local AC supply and switch on.
4. On the front panel, the Power LED will show solid green.

3.1.3. Connection to DC Supply – Mesh Phase 1 & Phase 2 Robust Unit

You'll need a NETNode and the CA0285 cable assembly.

1. On a Phase 1 unit connect the Amphenol 2-way plug (m) from CA0285 cable to the Amphenol 2-way jack (f) on the NETNode.
2. On a Phase 2 Robust unit the CA0403 provides both the DC supply cable and an Ethernet connection cable. This 5m long cable is designed to allow a user to mount the unit on a tripod or small mast and run the power and Ethernet into a command or control point.
3. Connect the banana plugs to a suitable 12VDC supply
4. On the front panel, the Power LED will show solid green.

3.2. Starting Up and Shutting Down the NETNodes

3.2.1. Powering up the NETNodes

You'll need at least **two** fully configured NETNodes. (If they are not, then see advanced procedures).

1. Connect the live power cable to the NETNodes.
2. On the front panel, the Power LED will show solid green.
3. Do Nothing! - Leave the system to form a mesh automatically.
4. After about 5s on the front panel, the RF Connected LED will show solid green on each NETNode. This indicates that the Mesh units are connected. If this does not happen recheck the configuration of each unit individually.
5. The mesh system is now ready for operation.

3.2.2. Shutting Down the NETNodes

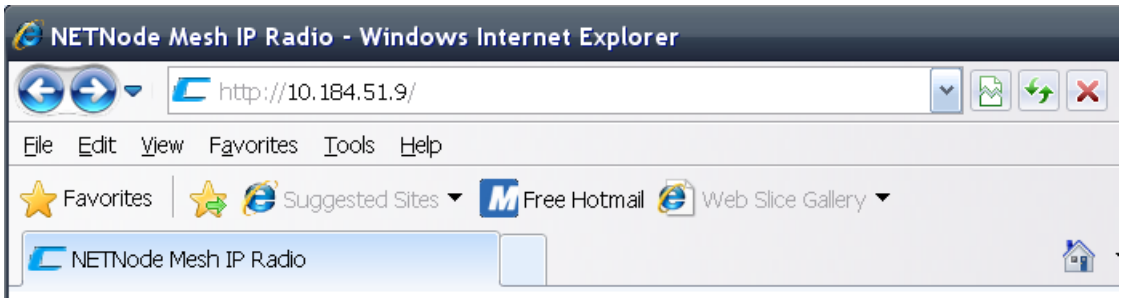
Disconnect the power cable from each of the NETNodes.

3.3. Basic Operation

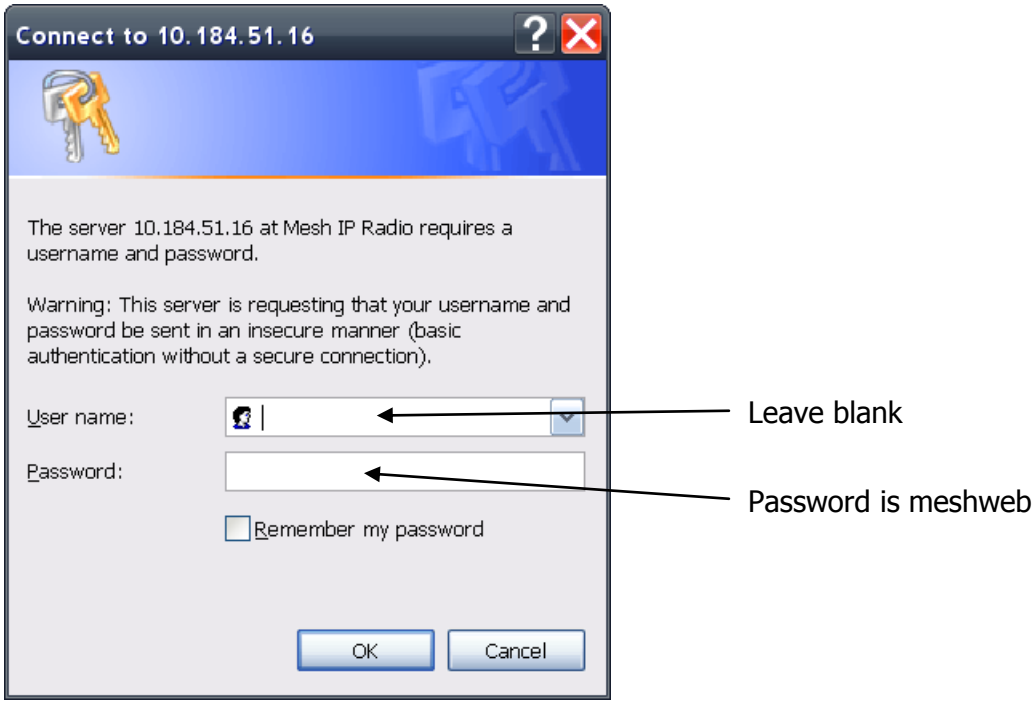
1. Start your **web browser** (normally: **start → internet**).

Note: You can use many different types of web browser with our products like Firefox for example. These web browsers start in slightly different ways.

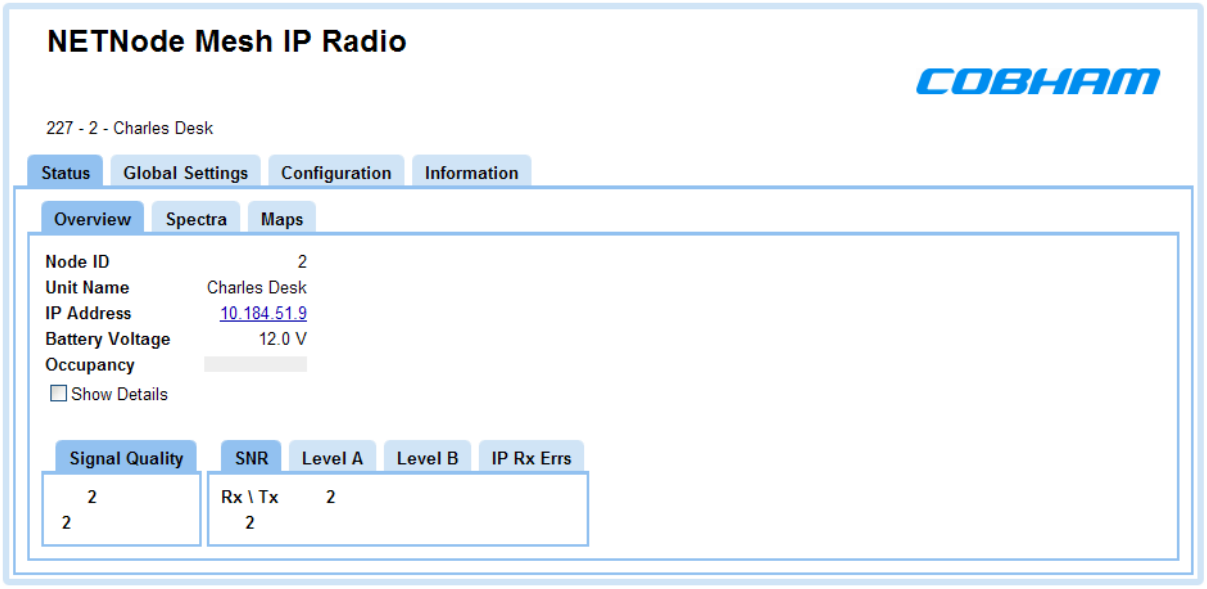
2. Type the **IP address** of the NETNode you are connected to in the **address bar**.



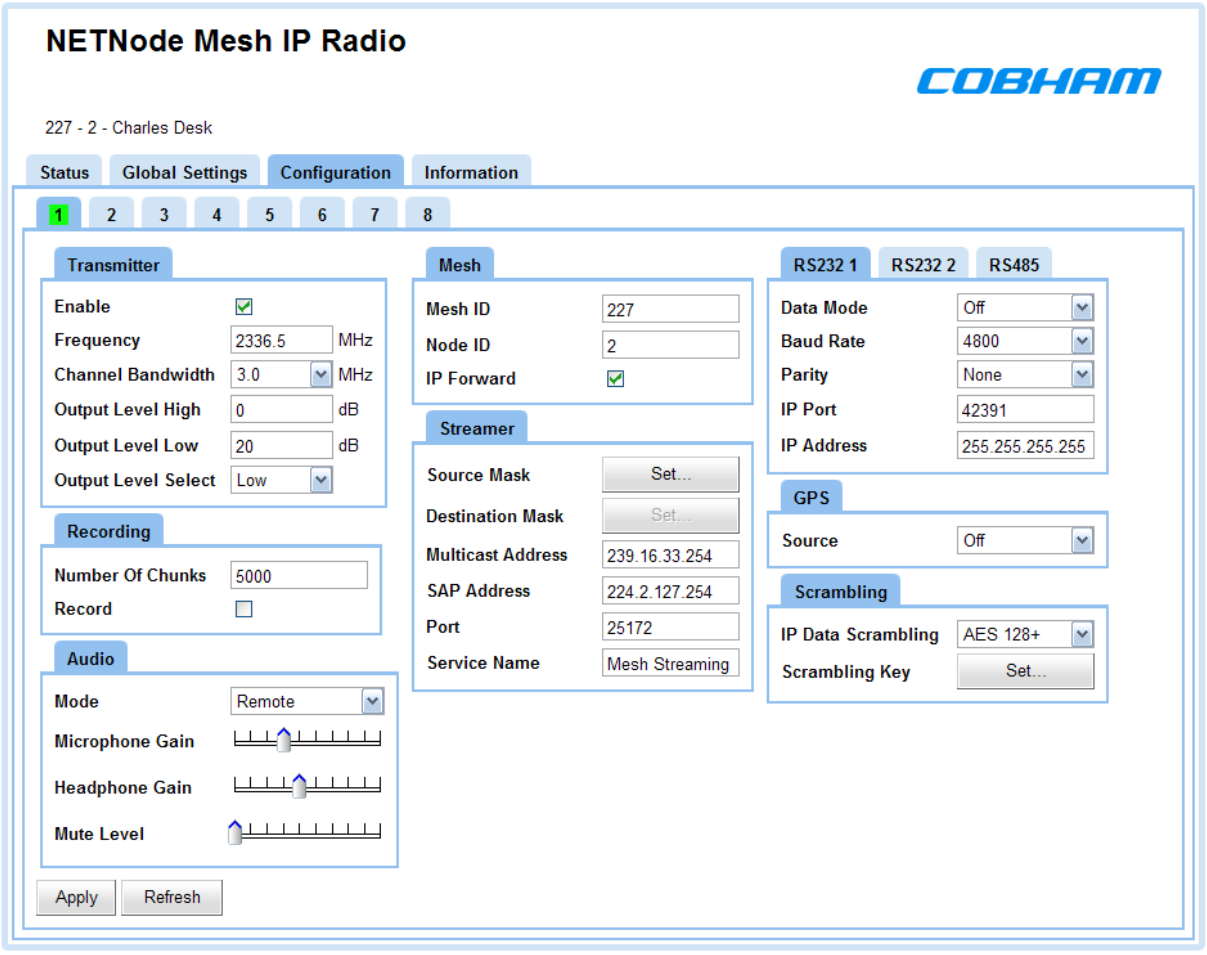
3. Press **ENTER** on your keyboard
4. The **Connect to** dialog will open



5. Do **not** type a **User Name**
6. In the **Password** text box type **meshweb**
7. The web browser window will open and the **Status** tab is displayed



8. Click on the **Configuration** tab
9. Click on configuration **1** (it will show **green** when selected, like below)



10. In the **Transmitter** pane check the **Enable** check box.
11. In the **Transmitter** pane type in the **frequency** you want.
12. In the **Mesh** pane type in a **Mesh ID** (the number must be between 001 and 255)

13. In the **Mesh** Pane type the **Node ID** (0 to 11)

14. Click the **Apply** button.

You'll see the **Configuration** dialog appear. The NETNode is now configured and ready to form a part of a mesh.

3.3.1. About Enable Check Box

This simply turns on the transmitter when checked. The transmitter only sends when it has data ready to move. For a unit to function in a mesh the transmitter must be enabled.

3.3.2. About Frequency

All the units in a mesh must be on the same frequency. Check that the Frequency is valid for the operation of the unit – specific country regulations will determine the frequencies available for operation.

3.3.3. About Channel Bandwidth

All units in a mesh must have the same bandwidth set. The options are 2.5, 3 and 3.5MHz. As the bandwidth increases the bit-rate available in the Mesh increases in proportion to the bandwidth. November 2010 units may have an additional 5MHz bandwidth mode.

3.3.4. About Mesh ID

The **Mesh ID** tells the unit which **mesh** it belongs to. All NETNodes on Mesh ID 122 for example will communicate with each other.

This means you could set up **another mesh** with Mesh ID 125 for example on the **same frequency** which would run independently of Mesh 122. However the Meshes will only work reliably if the separation is sufficient to avoid NO interference. Operation of two mesh systems on the same frequency should be avoided.

You can choose any numbers from **001 to 255** for your **Mesh ID**.

3.3.5. About Node ID

The **Node ID** gives the unit a **unique** ID within the mesh. You can have up to **twelve** NETNodes in a mesh and they each must carry a unique Node ID.

You can choose any numbers from **0 to 11** for your **Node ID**.

A node may automatically reassign its' Node ID at power up if it finds a conflict with an existing node.

3.4. Connecting an IP Device to a NETNode

Now you can attach an IP device to any of the NETNodes. There are many types of IP device you can attach:

- Computers
- IP Cameras

Let's take the example of attaching a laptop computer to a NETNode. You might use this as an observation post to look at all the assets you have deployed on other NETNodes like cameras and microphones.

You'll need a fully powered mesh system which has completed forming a mesh automatically and is showing a solid green RF Connected LED on each NETNode.

You'll also need a Laptop computer with an RJ45 Jack and a CA0284-5 cable.

On a Phase 1 unit

1. Connect the Amphenol 4-way plug (m) from CA0284-5 cable to the Amphenol 4-way jack (f) on the NETNode labelled **IP.**
2. Now connect the RJ45 8-way plug (m) to your laptop's RJ45 8-way jack (f).
3. Ensure you know the IP address of the computer you have attached.

Note: Attach all the IP devices you need on each NETNode of your mesh network in the same way.

On a Phase 2 Robust unit

1. Connect the Amphenol plug (m) from CA0403cable to the Amphenol jack (f) on the NETNode labelled **Power/IP. (**This cable also includes the DC power banana plugs.)
2. Now connect the RJ45 8-way plug (m) to your laptop's RJ45 8-way jack (f).
3. Ensure you know the IP address of the computer you have attached.

On a Phase 2 Plain box unit simply connect to one of the RJ45 panel mount sockets labelled **1** or **2** on the NETNode unit. It does not matter which socket you use.

Note: Attach all the IP devices you need on each NETNode of your mesh network in the same way.

NETNodes will also allow the IP addresses of any IP devices to be configured with DHCP from a central server if preferred. If you are using static IP address the Net mask MUST be correctly configured to allow information transfer.

Note: the IP transmit and receive are not auto detecting on NetNode units. The user may need to provide a hub to connect to for earlier types of PC.

3.5. Connecting a Second IP Device to a NETNode

We have seen how to connect IP devices to the NETNodes using the Amphenol 4-way jack on the NETNodes labelled IP.

In fact, you can connect a second IP interface to the same NETNode at the same time.

Here's how!

On a Phase 1 Unit

You'll also need for the second IP device (an IP camera for example) a CA0288-5 cable.

1. Connect the Amphenol 19-way plug (m) from CA0288-5 cable to the Amphenol 19-way jack (f) on the NETNode labelled **CTRL/DATA.**
2. Now connect the RJ45 8-way plug (m) to your IP device's RJ45 8-way jack (f).
3. Ensure you know the IP address of the IP device you have attached.

On a Phase 2 Robust Unit

You'll also need for the second IP device (an IP camera for example) a CA0406 cable.

1. Connect the Amphenol plug (m) from CA0406 cable to the Amphenol jack (f) on the NETNode labelled **CTRL/DATA.**
2. Now connect the RJ45 8-way plug (m) to your IP device's RJ45 8-way jack (f).
3. Ensure you know the IP address of the IP device you have attached.

On a Phase 2 Plain box Unit

On a Phase 2 Plain box unit simply connect to one of the RJ45 panel mount sockets labelled **1** or **2** on the NETNode unit. It does not matter which socket you use.

3.6. Viewing a Network Camera

As an example of using an asset, let's try viewing a Network Camera attached to the mesh.

You'll need a fully powered mesh system which has completed forming a mesh automatically and is showing a solid green RF Connected LED on each NETNode.

You'll also need an IP network camera attached to one of the NETNodes and a computer attached to another NETNode. You need to know the IP address of the network camera you want to view.

The network camera will come with setup software to configure the camera before first operation. Ensure you have configured you camera.

1. On the computer open your web browser
2. Type in the IP address of the camera in the address bar. (http://10.10.10.30/ for example).
3. You may be prompted for a username and password, depending on the features of the connected camera.
4. An image from the camera will be displayed.
5. If your network camera has PTZ capability, you'll be able to control it using the software on the computer.

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

3.7. Connecting a Composite Camera to a NETNode

If you have an **AVI version** of the NETNode you can attach a **composite** camera to the unit. The composite camera can be **PAL** or **NTSC**.

You'll need a fully powered mesh system which has completed forming a mesh automatically and is showing a solid green RF Connected LED on each NETNode.

The NETNode must be configured for composite camera operation. Check that **Global Settings** → **Auxiliary Address** is set to 1.

On a Phase 1 Unit

You'll also need for the composite camera with a BNC Jack a CA0286-3 cable.

1. Connect the Amphenol 10-way plug (m) from CA0286-3 cable to the Amphenol 10-way jack (f) on the NETNode labelled **AV**.
2. Now connect the BNC 2-way plug (m) to your camera's BNC 2-way jack (f).

On a Phase 2 Robust Unit

You'll also need for the composite camera with a BNC Jack a CA0477 cable.

1. Connect the Amphenol plug (m) from CA0477 cable to the Amphenol jack (f) on the NETNode labelled **AV**.
2. Now connect the BNC 2-way plug (m) to your camera's BNC 2-way jack (f).
3. The CA0477 cable also provides a DB-9 socket that carries RS232 data from the NETNode that can be used to control a Pan Tilt Zoom (PTZ) camera PTZ control is required.

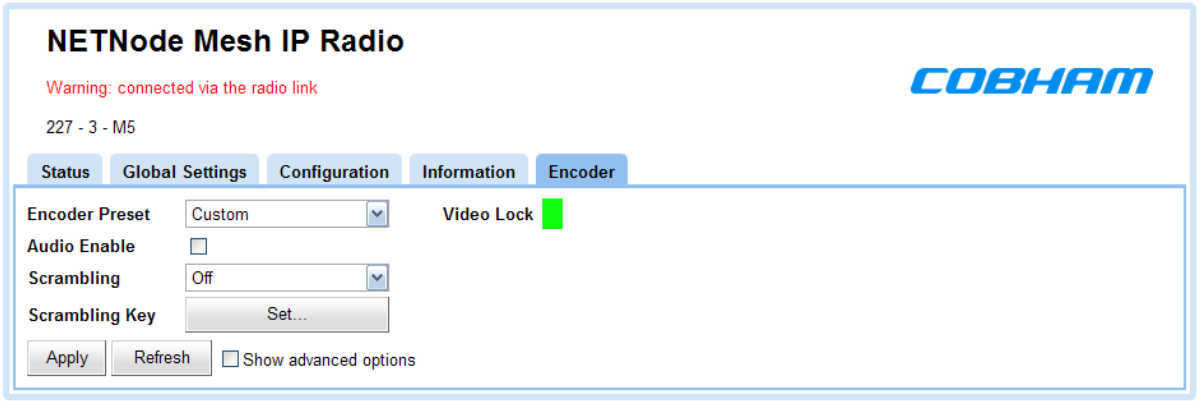
On a Phase 2 Plain box Unit

You'll also need a composite camera with a BNC Jack and a CA0122 cable.

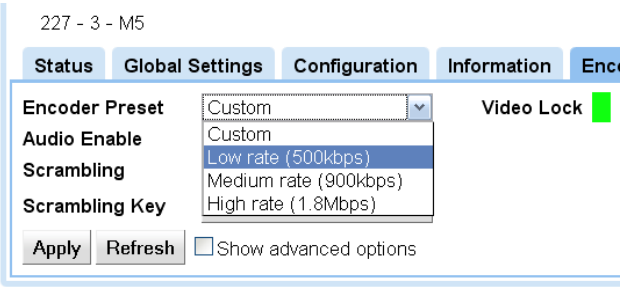
1. Connect the 5-pin Lemo plug (m) from CA0122 cable to the Lemo 5-way jack (f) on the NETNode labelled **A/V**.
2. Now connect the BNC 2-way plug (m) to your camera's BNC 2-way jack (f).
3. The **AUX** connector can provide RS232 or RS485 data to control PTZ functions, if required.

3.7.1. Integrated Video Encoding AVI option fitted (Composite Input)

The user must enable the video transmission. 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 over the Network. An Encoder Tab appears on the Web-browser if an internal video encoder is fitted.



The user can select from a number of preset Encoder options



Using the advanced options the user can more precisely customise the encoder settings.

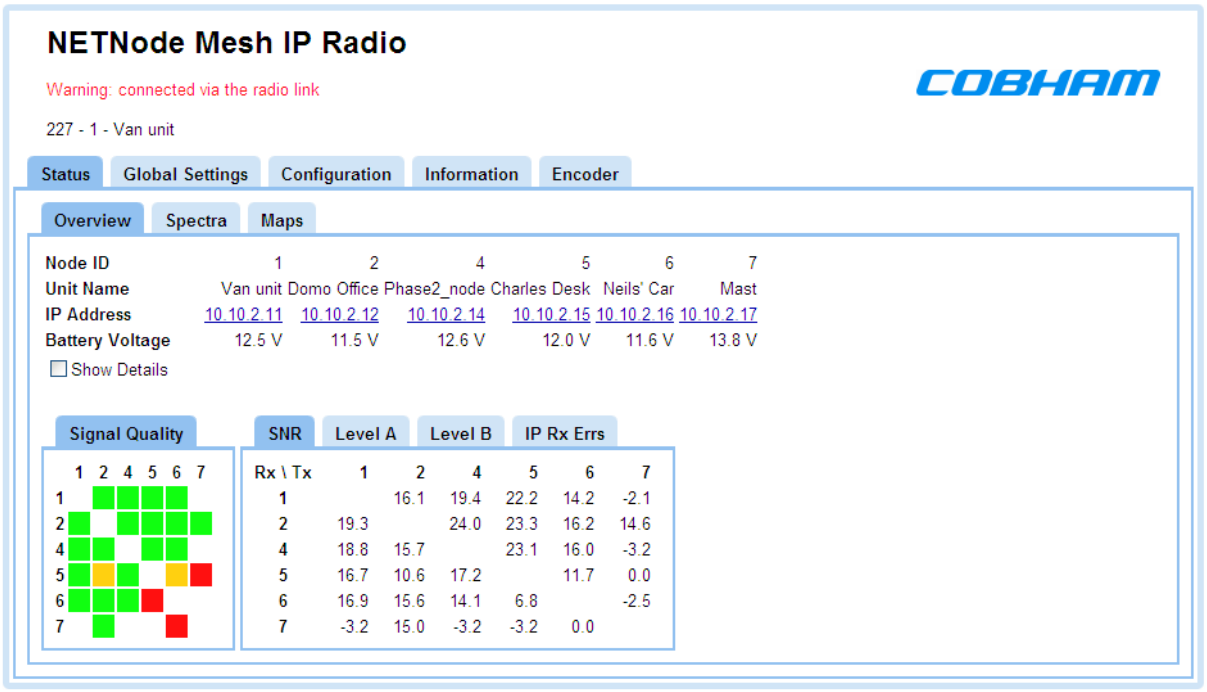
Please refer to chapter 5 Streaming over IP for details on how to configure the NETNode to stream this encoded video and audio data to a destination on the network.

Note: Click 'Apply' after changing any configuration setting

4. Advanced Procedures

4.1. Status Tab – Overview Pane

Now you have got the NETNodes configured, let's take a look at the rest of the configuration possibilities. We'll begin with the Status tab.



Here is the **Status tab** with the focus on the **Overview** pane.

4.1.1. Node ID

We are showing **six** NETNodes with **Node IDs** of 1, 2, 4, 5, 6 and 7. There could be up to twelve NETNodes in a mesh with Node IDs numbered 0 to 11.

4.1.2. 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.

4.1.3. IP Address

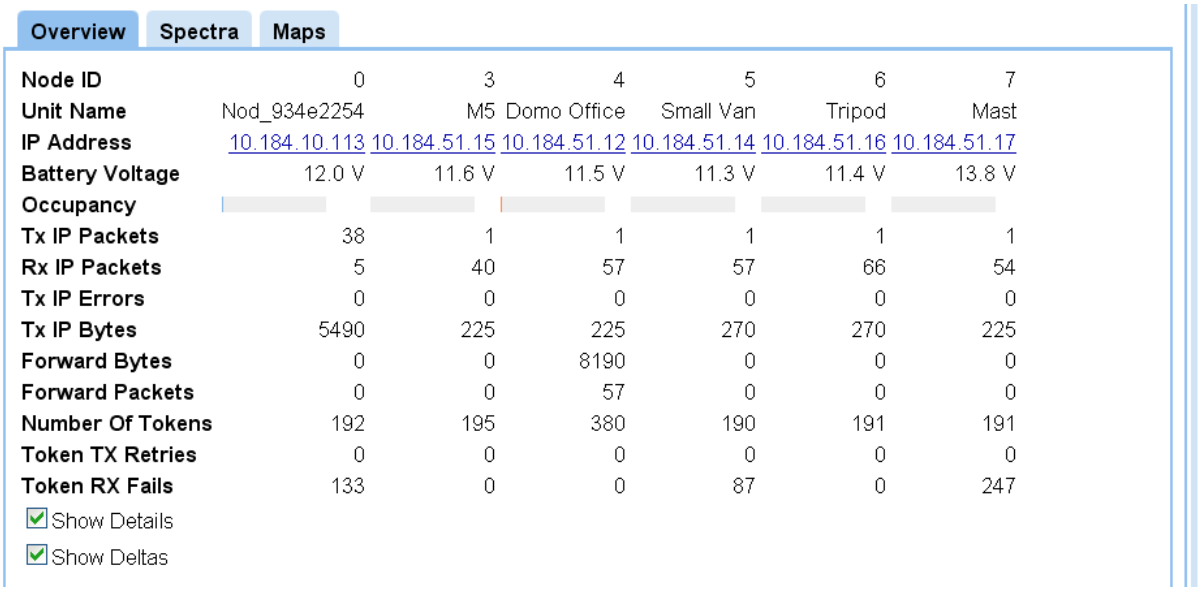
This shows the IP address of the unit that we set up in our initial configuration. Notice that it is shown as a hyperlink. If you click on one of these hyperlinks the browser will switch to that NETNode.

4.1.4. Battery Voltage

This returns the current battery voltage of the NETNode. Not so exciting when we are on mains in the lab but vital when you are looking at a node located on a high building several miles away which is running on batteries.

4.1.5. Show Details Check Box

If you check this box you'll see a whole bunch of data about Tx IP Packets etc. This can give you vital information about the running of the network.



4.1.5.1. Tx IP Errors

Zero unless the node in question has too much data to send.

4.1.5.2. Number of tokens

This is the number of token passes in a 2 second interval that the node performs. This higher this number the more data that node can transmit.

4.1.5.3. Number of TX retries

Number of times a token needs to be retransmitted from the node in question. This should all be zero for a working system.

> *A non zero number indicates a problem with that node (such as antenna position or interference), and should be corrected as it will drastically reduce system throughput.*

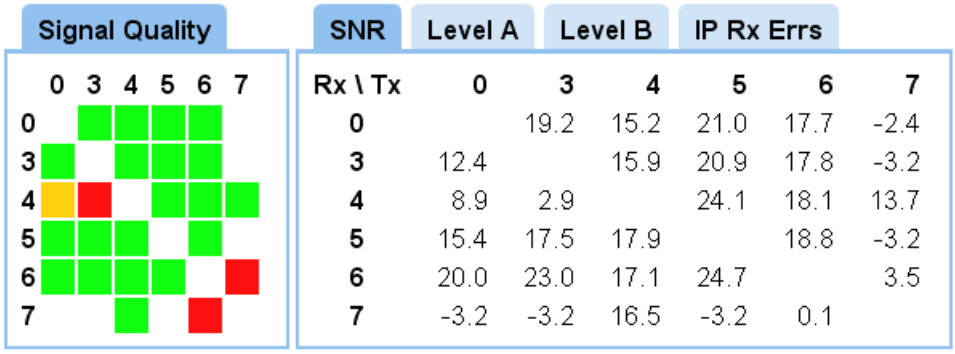
4.1.5.4. Number of RX fails

Number of times the node does not receive a decode-able transmission. This can be non zero if a node does not see another node properly in the system. This may be indicated by red signal strength. Forwarding allows data to be passed between nodes that have a poor link using other nodes in the system.

4.1.5.5. Show deltas

When ticked all numbers show the parameter over a 2s internal. When not ticked the numbers are accumulative and updated every 2s.

4.1.6. Signal Quality



This gives you a simple picture of the signal quality around the mesh system. Ideally, we'd like to see steady green boxes for all links. Naturally, mobile units will go out of range or interference will cause a unit to degrade for a while. One of the clever things about the mesh is its ability to find a new routing and heal itself thus keeping your network on air.

Here's what the colours mean:

Colour	Means...
Green	16 QAM mode – most robust
Amber	QPSK mode – less robust
Red	Basic link only – lowest data rate passing between nodes
White	Link broken or not configured

Note that a Red link will not guarantee IP data between nodes.

For example the link between node 0(TX) and node 4(RX) is currently Amber.

4.1.7. SNR

This pane shows the Signal to Noise Ratios for each of the NETNodes. For good quality links this should be in excess of 17dB.

4.1.8. Level A

This pane shows the dBm value for antenna A on the NETNode unit.

4.1.9. Level B

This pane shows the dBm value for antenna B on the NETNode unit.

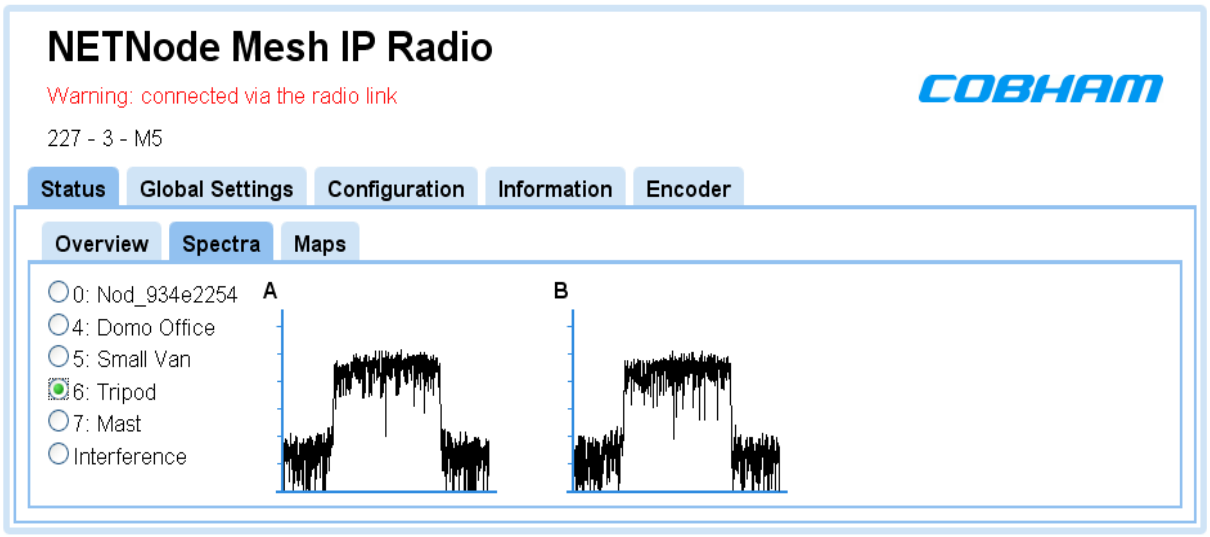
It is worth checking that the received signal levels on both antennas are similar. Very different readings from the inputs can indicate a faulty antenna which should be replaced.

4.1.10. IP Rx Errs

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

4.2. Status Tab – Spectra Pane

Now let's look at the **Status tab** with the focus on the **Spectra** pane.



4.2.1. About the Spectra Displays

There are **two** displays labelled A and B which show the spectra being **received** on the two diversity antennas of the NETNode you are attached to.

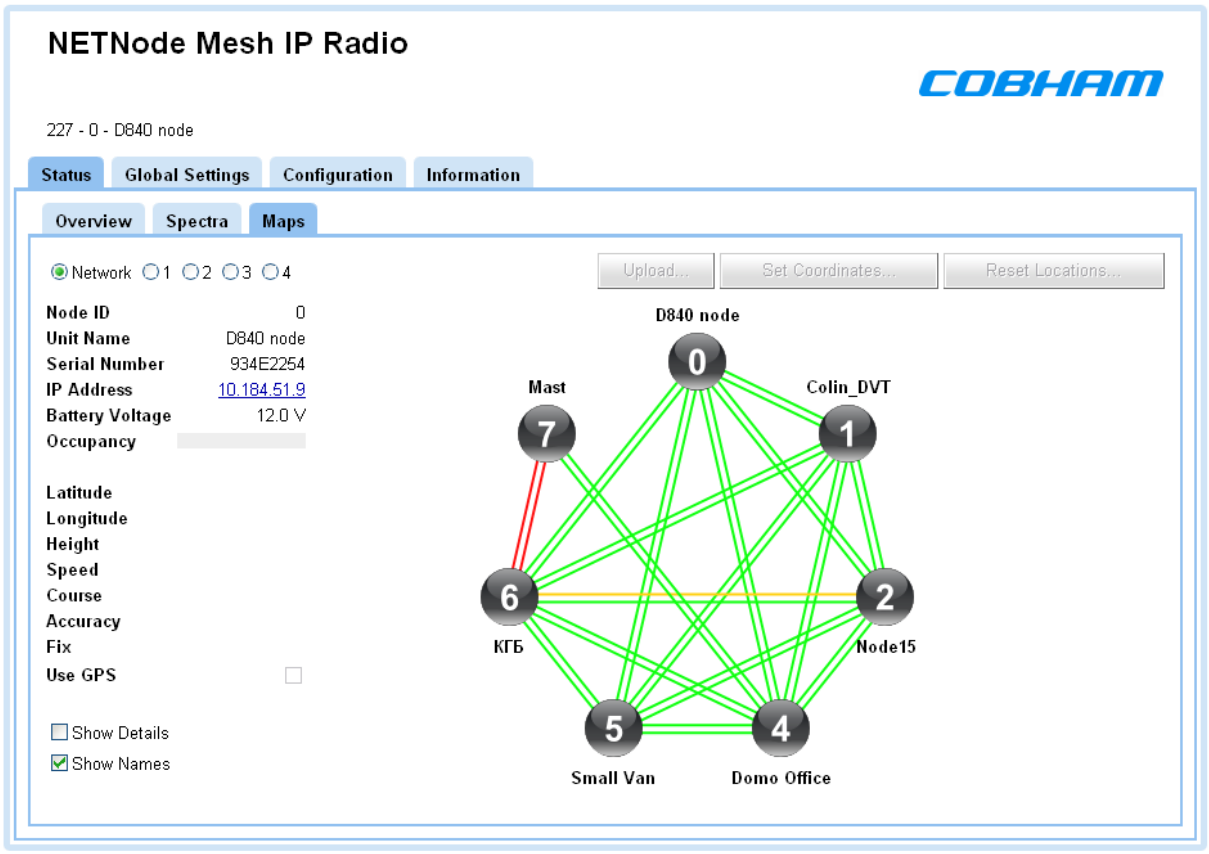
But, there could be **several** NETNodes transmitting on the mesh so we need to define **which** unit we are looking at.

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

4.2.2. Interference

The last radio 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.

4.3. Status Tab – Maps Pane



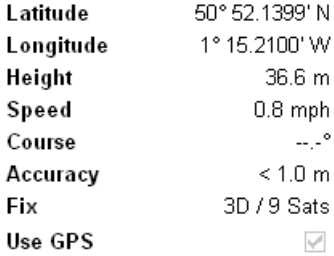
4.3.1. Radio Buttons

The radio buttons enable you to choose between **Network** and one of **four** map displays for the mesh. Leave it on Network for now.

4.3.2. Node Information

Under the radio 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.

4.3.3. GPS Information



The NETNode we have selected has a GPS unit connected and the Use GPS check box is checked. This means that the NETNode can broadcast precise information about its location to other nodes or fixed assets on the mesh (assuming that the GPS is locked to the GPS satellite transmissions).

4.3.4. Show Details Check Box

When the **Show Details** check box is checked the node information shown above is expanded to show the information listed in the 4.1.5 Show Details Check Box section of this manual. Only the details for the selected Node are displayed.

4.3.5. Network Display

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

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

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** check box checked, you'll also see the node **name** displayed.

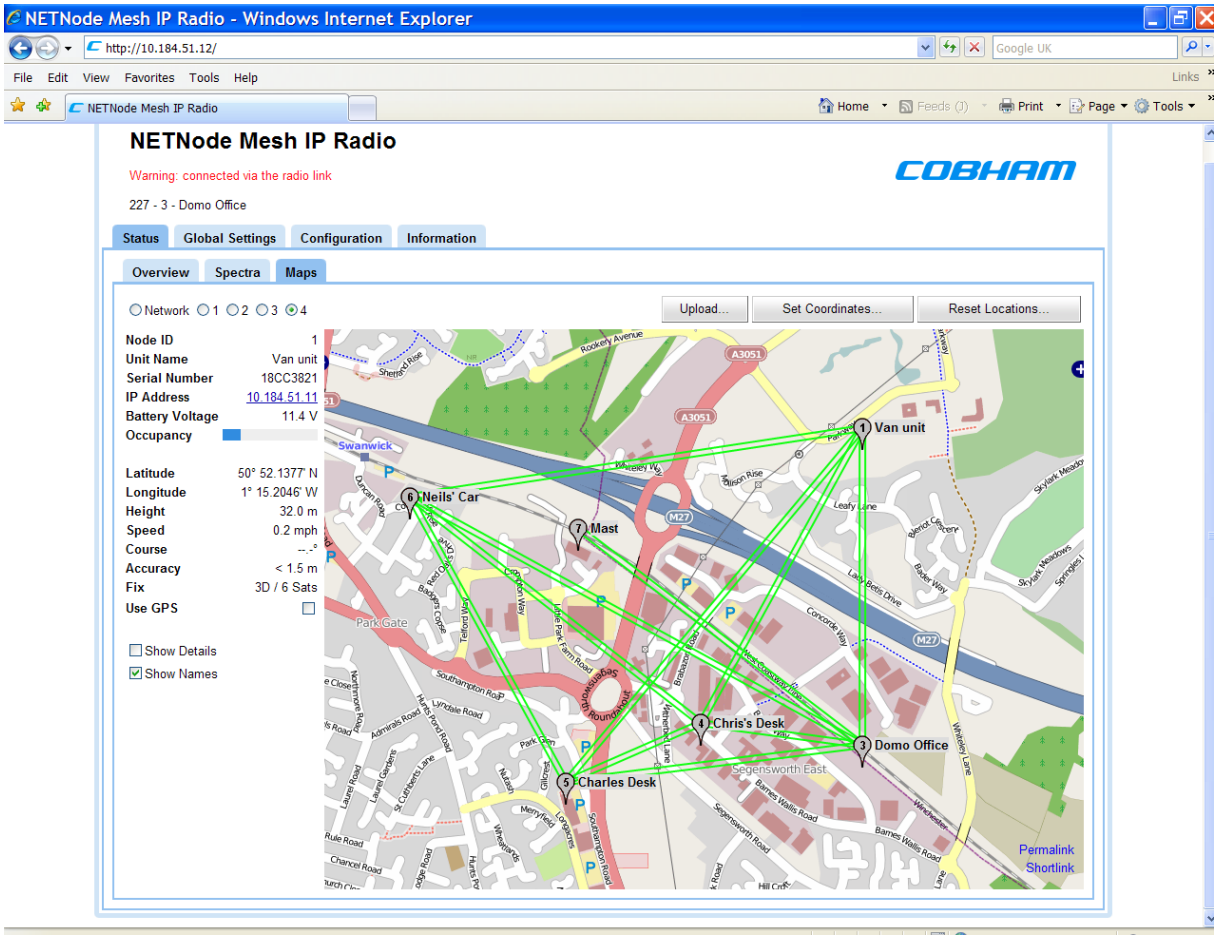
The links between the nodes are shown as **coloured lines**. As each NETNode supports bidirectional operation there are normally **two** lines for each link.

Colour	Means…
Green	16 QAM mode – most robust
Amber	QPSK mode – less robust
Red	Basic link only – lowest amount of data passing
White	Link broken or not configured

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

4.3.6. Map Display

Now select one of the **numbered radio buttons**. This changes the display to the **map display**. There are **four** possible map displays each selected by a radio button. Refer to section 4.3.9 Upload Map Data to learn how to put maps into the units prior to use.



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 place the nodes onto the map:

- Manual Placement
- GPS Placement

4.3.7. Manual Placement

Position the mouse pointer over the node symbol. The pointer will change to a four-headed arrow. Left click and drag the node to the position on the map where the node should be displayed.

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

4.3.8. GPS Placement

If a NETNode has a GPS unit connected it can report its position which can then be displayed on the map. Section 6.3 Configuring NETNode for GPS details how to connect GPS to a Mesh.

1. Ensure you are connected to a NETNode with **GPS attached**.
2. Ensure the **Use GPS** check box is checked.
3. The symbol for that node will now snap 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.

4.3.9. Upload Map Data

Each of the four map radio buttons can contain a different map. These maps need to be uploaded before you can use them.

4.3.9.1. Upload Map Image File

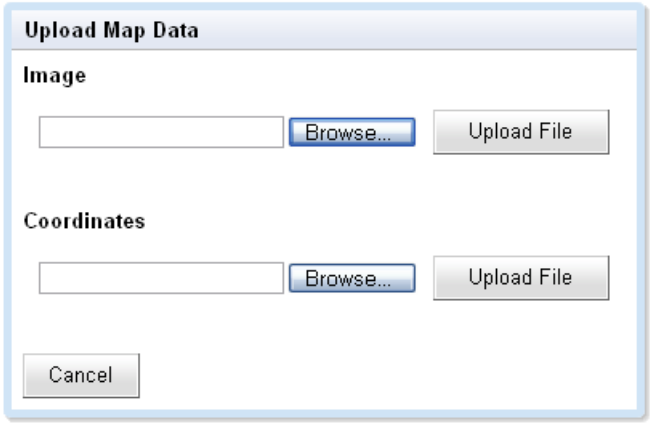
To upload a map you'll need an internal drive which has been formatted. (Information Tab).

You'll also need 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 using JPEG or PNG as they are good quality but small files. Bitmaps on the other hand are excellent quality but very large. There is a limited amount 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 place the image in the NETNode's flash memory.

4.3.9.2. Set Coordinates

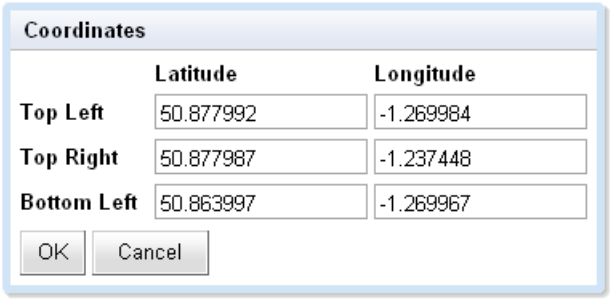
When you have loaded your map, you'll need to find out the **coordinates** of **three** of the corners of the map image to enable the GPS feature to work.

You'll need to know the Top Left, Top Right and Bottom Left coordinates of your image.

These coordinates must be in **decimal** form and accurate to six places. (You may be more familiar with Latitude and Longitude being expressed in hours 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.



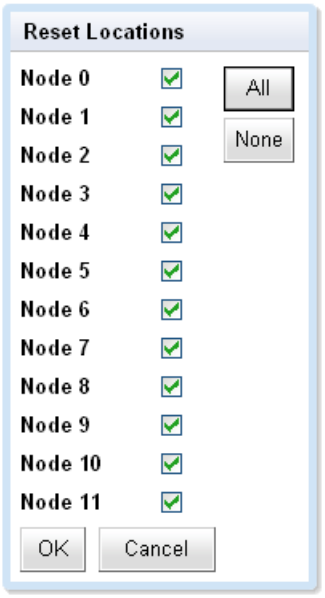
3. Type in the coordinates of each of the corners of the image.
4. Click **OK.**

4.3.9.3. Reset Locations…

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

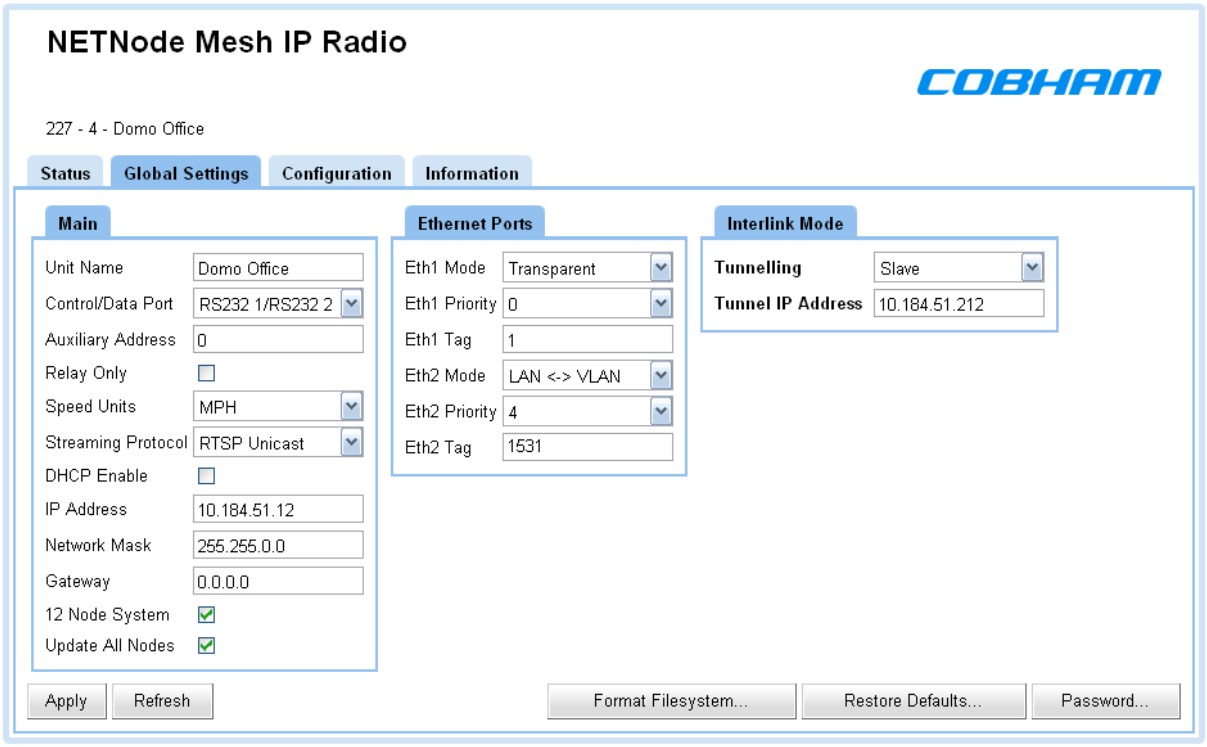
You can force the system to reset the locations of **all the nodes** or **any combination** of them.

1. Click the **Reset Locations…** button
2. The **Reset Locations** dialog opens



3. Click the **All** button or check the nodes you want to reset
4. Click **OK**
5. The system resets the locations and switches off the GPS tracking function.

4.4. Global Settings Tab



4.4.1. Unit Name

The NETNodes are uniquely identified by the **Node ID** parameter which is a number between 0 and 11.

This is not a very useful name for normal operations so this text box allows you to enter a better description for the node which will appear on network diagrams and maps within the software.

1. Type in a meaningful name for the NETNode.
2. This name will be used in all maps and network diagrams for this node

Note: You can use up to 12 alphanumeric characters for the Unit name

4.4.2. Control/Data Port

On a Phase 1 NETNode unit the Control/Data port uses the CA0288-5 cable which has an Amphenol 19-way plug (m) on one end and two D-Type 9-way plugs (f) on the other end labelled RS232 and RS485. On a Phase 2 Plain box NETNode the Control/Data port is labelled AUX and uses the CA0474 cable which has two D-Type 9-way plugs (f) on the other end labelled RS232 and RS485. On a Phase 2 Robust unit the Control/Data port uses CA0406 which has an Amphenol plug (m) on one end and two D-Type 9-way plugs (f) on the other end labelled RS232 and RS485.

Normally we use RS232 for Control.

There may be times when you want to change this and so this combo box enables you select other setting for the plugs on this cable.

You can select from the Control/Data Port box:

On both Phase1 and Phase2 Mesh nodes up to and including Software release V1.4 there is only one data channel and one serial control channel. If the Data channel is set to the RS232 port then the control channel is forced to the RS485 port and vice versa.

Setting	Means...
RS232/RS485	Control is RS232 plug, Data Port is RS485 plug (normal)
RS485/RS232	Control is RS485 plug, Data Port is RS232 plug
RS232/RS232	Special mode, only used for engineering.

4.4.2.1. Control/Data Port - Software Version 2.1

Software version 2.1 allows for the use of two separate data channels RS232 and RS485. The RS485 is now a dedicated port on the unit. The RS485 can no longer be configured to be a Unit Control channel – it is now a dedicated data channel.

The RS232 data channel shares with the control port. So the RS232 serial port can be set to be a second data channel.

A second RS232 port is available on units without the AVI option fitted and this second channel can also be configured to be a data channel or a control port. If the AVI option is fitted then the second serial port is used to control the AVI encoder.

Setting	Means...
RS232 1/RS232 2	Data is on RS232 plug
RS232 2/RS232 1	Control is on RS232 plug

Caution: D830 – Do not set the control data port to 'Data is on RS232 plug' if you are controlling the unit via this port, and the unit cannot be controlled via IP.

4.4.3. Auxiliary Address

Normally, the NETNode will be operating with IP devices like cameras microphones or GPS units and the Auxiliary address is left as 0.

Some NETNodes (the AVI variant) are able to use composite cameras. To do this they have an extra Video / Audio and data encoder board fitted inside the unit.

To ensure the NETNode recognises and uses the internal encoder card we have to set the auxiliary address to 1. Now your composite camera can be used with the system.

Caution: If you ever reset defaults on the NETNode it will reset the Auxiliary Address to zero. You must reset this to 1 for your composite camera to work.

4.4.4. Relay Only

Normally each NETNode will have at least one source of sensor data attached to it, for example, a camera or a microphone.

However, occasionally the NETNode only needs to act as a relay, for example, when you are setting up a chain network for range extension or working with a helicopter relay.

In this case you would check the **Relay Only** check box.

Note: When the Relay Only check box is checked it simply disables any Ethernet connectivity to the NETNode.

4.4.5. Speed Units

If you have a GPS connected to a NETNode it can supply speed data. You can choose the units you want to use for speed in this combo box. The possible choices are:

- Knots
- MPH
- KPH

4.4.6. Streaming Protocol

This allows either multicast (raw UDP) or RTSP streaming (RTP multicast/unicast) of the internal video encoder. See Section 5 on Streaming as this explains the intricacies of Video streaming over IP in more detail.

4.4.7. DHCP Enable

In some situations having DCHP enabled may be appropriate for advanced users of the system but in most cases it's better if each NETNode has its own fixed address. Fixed IP address allocation is better when a system is in a dynamically changing environment as operation is such an environment means that connection to the DHCP server can not always be guaranteed.

If checked, then the NETNode will try to acquire its IP address from a DHCP server on the network – this DHCP server can be located through another NETNode over the radio interface.

4.4.8. IP Address

If the NETNode is not automatically acquiring its IP address via a DHCP server then a fixed IP address needs to be assigned to the unit. This address is typically obtained from a

network administrator to avoid a clash of IP addresses on any network. The unit is expecting an IPv4 address.

Enter an **IP address** for this NETNode in the IP address text box. It can be any class of network you choose.

4.4.9. Network Mask

The network mask allows a network administrator to break a network into smaller more efficient subnets to prevent excessive numbers of IP packets being routed through the network. This is normally defined by the network administrator

Enter a **subnet mask** in the Network mask text box.

4.4.10. Gateway

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 leave the gateway at 0.0.0.0

4.4.11. 12 Node System

This box should be ticked for support for up to 12 nodes. It should be unticked if backwards compatibily with V2.x (8 Node) software.

Note: All nodes on the Mesh must have the same mode set. To change all the nodes from an 8 Node (compatible) to the new 12 Node system use the update all nodes tickbox.

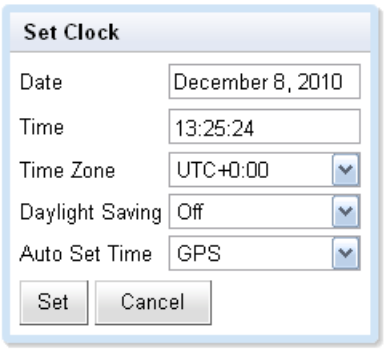
4.4.12. Update All Nodes

When you make changes to any setting they are normally applied only 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 want to change the frequency of all units at the same time.

Check the **Update All Nodes** checkbox to enable these global updates on all nodes. Not all parameters are updated globally on the Mesh:- just Frequency, Bandwidth, Encryption, RTSP streaming, 12 Node system mode parameters.

CAUTION: All nodes in a Mesh must be in range and connected for a 'Update all Nodes' command to work across the whole Mesh. If the command is issued and while a node has dropped out of the Mesh as it is out of range then it will not receive the command and may not reconnect to the Mesh when it returns into coverage. If this happens changing the parameters back to the original values may restore operation.

4.4.13. Setting the clock (Phase 2 units only)



The real time clock is used to timestamp the recordings on the external memory card. The clock may either be set manually or synchronised to a GPS unit connected to any node of the system. The clock internally runs in UTC time and the user may set the time-zone offset and daylight saving time. Note the units do not automatically adjust for daylight savings.

4.4.14. Format File System…

There are two flash drives built into each NETNode.

- Internal Flash
- External Memory Card

Note: The External memory card is only available on Phase 2 units

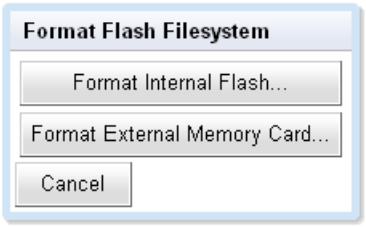
Note: The External memory card slot ONLY support basic 2GB or 4GB SD cards

Flash	Use
Internal Flash	Holds the maps and coordinate files.
External Memory Card	Use for video recording on Phase 2 units

Here's how you format these drives:

1. Click the **Format File System**… button

The **Format Flash File system** dialog opens



2. Click **Format Internal Flash** button
3. Your internal Flash drive will be formatted.

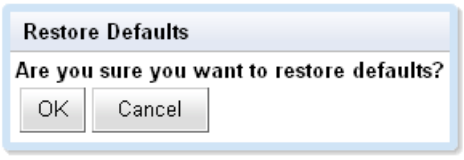
Caution: When you press the **Format Internal Flash** button the system does not ask you to confirm your actions – it just formats the drive. Be very sure you want to do this.

Note: If you want to format the External Memory Card, click the **Format External Memory Card** button at step 2 above.

4.4.15. Restore Defaults…

To restore a default condition to the whole unit:

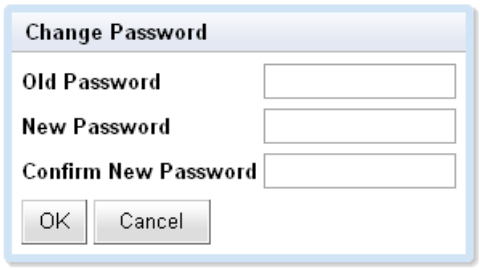
1. Click the **Restore Defaults** button
2. The **Restore Defaults** dialog opens



3. Click the **OK** button

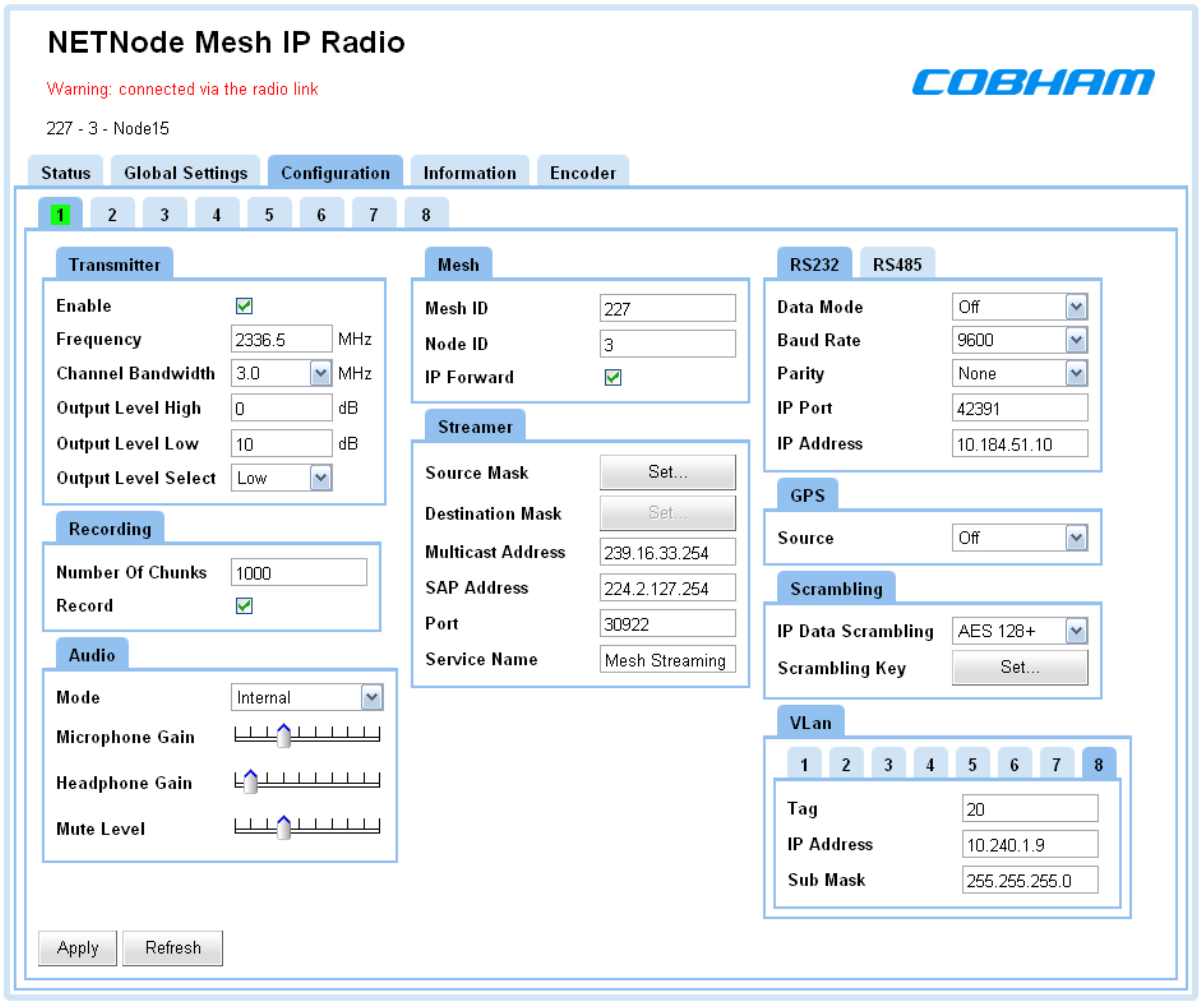
4.4.16. Change Password…

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

4.5. Configuration Tab – Transmitter Pane



Note that there are eight configuration tabs enabling you to have eight completely different setups stored in the NETNode. We are going to look at just tab one – they are all identical. In the example above, the green square on tab 1 shows we are working on configuration number one.

The transmitter pane enables you to change the frequency of a NETNode, set the transmission bandwidth and adjust the output power level of the NETNode.

4.5.1. Preview and Active Configuration

A configuration can be Active or Previewed. This can be determined by looking at the Configuration numbers. The active configuration is darker blue than the inactive configurations. To preview a configuration the user can click the configuration number and the previewed configuration is then highlighted in Green. A user is able to preview configurations without activating the configuration. To activate a previewed configuration the user needs to click the 'Apply' button.

Note: All configuration parameter changes need to be confirmed by clicking the 'Apply' button before the changes are activated

4.5.2. Enable Transmitter Check Box

This simply turns on the transmitter when checked. All NETNodes in a mesh must have their transmitters enabled.

4.5.3. Frequency

Input the frequency in MHz that you want to use for this NETNode.

4.5.4. Channel Bandwidth

You can configure the channel bandwidth with this combo box. There are three choices:

2.5 MHz

3.0 MHz

3.5 MHz

5.0 MHz (V2.1 software and unit types 68 upwards only)

See Section 4.12 Information Tab to discover the Board type and the Software version.

4.5.5. Output Level High and Output Level Low

These two text boxes allow you to set the level of attenuation in dB that will be applied to the low and high output levels. This could be useful if your transmitter is swamping another unit in close proximity. You can set anything between 0 to 30 dB.

4.5.6. Output Level Select

You can choose high or low output level to suit the RF environment you are working in. When you select high or low here it applies any attenuation you have set in the output level setting discussed above.

4.6. Configuration Tab – Mesh Pane

4.6.1. Mesh ID

The **Mesh ID** tells the unit which **group** it belongs to. All NETNodes on Mesh ID 122 for example will communicate with each other.

This means you could set up **another mesh** with Mesh ID 125 for example on the **same frequency** which would run independently of Mesh 122 (though you *would* have to be careful about interference and run the units in separate areas).

You can choose any numbers from **001 to 255** for your **Mesh ID**. Different Mesh systems should not be allowed to co-exist on the same frequency.

4.6.2. Node ID

The **Node ID** gives the unit a **unique** ID within the mesh. You can have up to **twelve** NETNodes in a mesh and they each must carry a unique Node ID.

You can choose any numbers from **0 to 11** for your **Node ID**.

A node may choose to automatically reassign its' node ID on power if it conflicts with an existing node on the network.

4.6.3. IP Forward

If this NETNode is connected to an IP source then checking the IP Forward check box will ensure this data is passed around the mesh for access on other units. A node will forward IP data when it finds that the data cannot get from the source node to the destination node in a single hop. Leave this box checked for normal operation.

4.7. Configuration Tab – Streamer Pane

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

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 have the ability to carry streams using Multicast, Unicast and RTSP protocols. The protocol selection is performed within the Global settings tab (see Section 4.4.6 Streaming Protocol).The Streamer pane within the configuration tab is purely associated with Multicast streams. These streams can come from external or internal sources. This is controlled by the **Source Mask**.

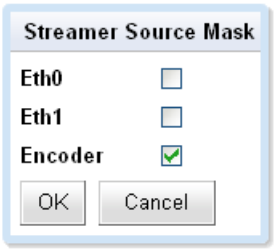
To ensure we don't overload the bandwidth we want to be able to choose which nodes get to receive the stream. This is controlled by the **Destination Mask.**

4.7.1. Source Mask

The Source Mask enables the streaming of Video that originates from a network connected to either one of the two NETNode Ethernet ports or from the internal encoder (if it is fitted).

Here's how to configure it:

1. Click the Source Mask **Set...** button
2. The **Streamer Source Mask** dialog will open



3. Place a check mark in the check box that is the source to stream down the link.
4. Click **OK**

In our example we are planning to stream from the composite camera connected to the internal AVI encoder.

Here are all the possible connections involved:

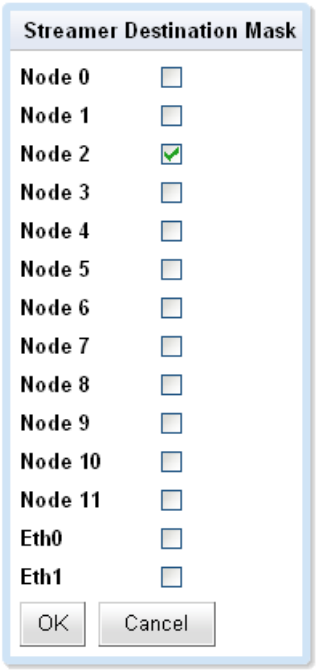
Source	Front Panel Label	Connector (Robust Units)	Connector (Plain Box)
Eth0	IP	Amphenol	RJ45 (f)
Eth1	CTRL/DATA	Amphenol	RJ45 (f)
Encoder	Internal (if fitted)	Internal (if fitted)	Internal (if fitted)

Eth0 and **Eth1** will be from a **network** connected to the NETNode. **Encoder** will ONLY be valid if the NETNode has the AVI-UP option (internal AV Encoder) fitted.

4.7.2. Destination Mask

You can choose which NETNodes will receive the stream. Your NETNode could have up to eight NETNodes attached to it via the mesh. Multicast streaming to all nodes is an inefficient use of mesh capacity and so you need to be able to restrict the multicast to specific nodes.

1. Click the Destination Mask **Set...** button
2. The **Streamer Destination Mask** dialog will open



3. Check the node check boxes for the NETNodes that you want to receive the stream.
4. Click **OK**

When RTSP streaming is enabled this box will be greyed out and the destination mask selected automatically as defined by the RTSP connection.

Note: The **Eth0** and **Eth1** are ticked by **default**. These ports will be used as the exit point from the mesh at the node(s) you have specified.

4.7.3. Multicast Address

This text box enables you to change the multicast address used by the unit. The default value is 239.16.33.254.

4.7.4. 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.

4.7.5. Port

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.

4.7.6. 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.**

4.8. Configuration Tabs – Data RS232/RS485 Pane

The NETNode can send and receive data through either of its RS232 serial port, and its RS485 serial port (V2.1 onwards). Configuration of the RS232 port is found under the **Global Settings** tab (see Section 4.4.2 Control/Data Port).

It is possible to configure the system to send data from one NETNode serial port to another NETNode serial port or from a NETNode to a PC connected on the same IP network.

4.8.1. Data Mode

The Data Port can be configured in three ways:

- Off
- UDP
- TCP server
- TCP client (V2.1 onwards)

4.8.1.1. Off

Data transfer is switched off.

4.8.1.2. 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.

To send data between two nodes the data IP address of each node should point at the other and the ports must match.

4.8.1.3. TCP Server

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.

4.8.1.4. TCP Client

This mode allows the NETNode data port to connect to another NETNode in server mode using a robust TCP link.

To send data between two nodes one node should be set to server, one to client, the IP address of each node should point at the other and the ports must match.

4.8.2. Baud Rate

This is where you set the speed at which data will be transferred across the network. Speeds available are: None, 1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200.

Note: The data is assumed to be 8 bits.

4.8.3. Parity

A **parity bit** is a bit that is added to ensure 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**.

This combo box allows you to set: **None**, **Even** and **Odd**.

4.8.4. IP Port and IP Address

These set an IP address and Port to and from which the data will transferred.

The user can connect to the data port via telnet by setting the mode to TCP server and the port number to 23.

The user can connect two data ports on different units together via setting UDP mode and using the matching port numbers.

4.8.5. GPS Source

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: **None**, **RS232 Port, RS485 port** and **Encoder**. None simply turns off the GPS facility.

4.8.5.1. Encoder (V2.1 upwards)

From V2.1 software onwards it is possible to connect the GPS to the Encoder data input port (if AVI is fitted). This is only possible with the AVI variant of the NETNode. The encoder encryption must be disabled for this to work.

4.8.6. IP Data Scrambling

It can be important to scramble sensitive data before they are passed across radio networks.

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

The AES128+ and AES256+ settings ensure that the NETNode will **only** receive encrypted data. Any data sent in the clear by any nodes will not be accepted by a NETNode if the AES+ is set on the unit.

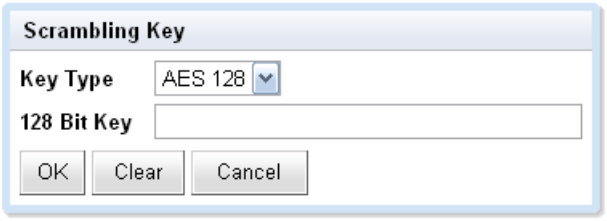
This combo box enables you to select the scrambling scheme you want to use. You can select: AES128, AES128+, AES256 and AES256+.

4.8.7. Scrambling Key

When you choose to use a scrambling scheme you need to specify a key that it will use.

Here's how:

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



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

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

4.9. Configuration Tab – Record Pane

The NetNode unit (Phase 2 only) allows recording of the video from the AVI unit unto a SD card.

Files are recorded in 30 second lengths, referred to as a 'chunk', and stored in a compressed transport stream format. They can be subsequently downloaded either through the WEB browser from the file system tab, or alternatively the card may be inserted into an external computer. Files are stored in FAT16 format and so can easily be read. The date and time is always stored in UTC format regardless of the time-zone setting.

The card should only be removed when the SD card LED is green and not red. This always occurs at the end of the 30s transfer when record is enabled. Failure to do this may result in a damaged file system on the card.

The unit currently supports micro SD cards only.

4.9.1. File length

This is the maximum number of files stored on the card the oldest will be removed first. This should be set so that the number of files does not exceed the capacity of the SD card.

4.9.2. Record

Tick box to start recording. Untick the box to stop.

4.10. Configuration Tab – Audio Pane

NETNode phase 2 contains an audio talkback feature which allows operatives to communicate over the mesh using their own headset. The system allows each user to talk to all other users. To use this feature, a headset with microphone needs to be connected to the unit. The NETNode unit provides a small amount of power to the microphone capsule.

The pin-outs for the talkback audio connectors can be referenced in Section 12.6 T/B - 6-pin 0B LEMO socket (G-key) for the Plain box unit and Section 13.3 Misc Connector Amphenol 38999 Series 3 13-35 22 way chassis socket for the Robust variant.

Note: Phase 1 units do not support Audio Talkback

4.10.1. Mode

To enable this feature the 'Mode' drop down box must be set to 'local' or 'remote'.

Local mode only distributes the talk back audio within the local Mesh. 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 may 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.

4.10.2. Microphone Gain

This sets the microphone gain.

4.10.3. Headphone Gain

This sets the headphone volume.

4.10.4. Mute Level

Set 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 serve the same purpose if required.

All NetNode units provide a low level bleep tone when no talkback is received and the unit is connected onto the mesh network.

4.11. Configuation Tab – VLAN Pane 1-8

Upto 8 VLANs may be programmed for each NetNode.

4.11.1. Tag

VLAN Tag number.

4.11.2. IP address

IP address of unit for this VLAN.

4.11.3. Sub Mask

Subnet mask for this VLAN.

4.12. Information Tab

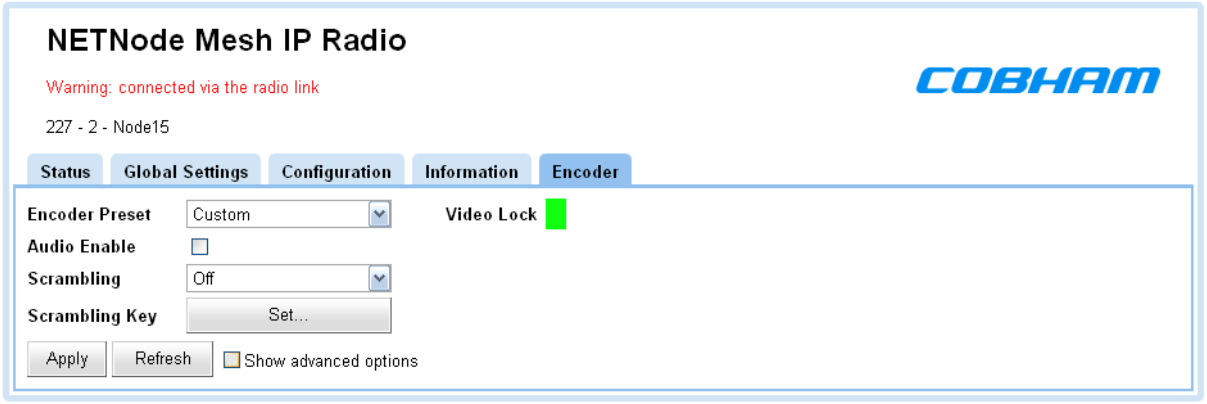
The information tab gives you some details about the hardware and software loaded into your NETNode unit. This could be very valuable during a support call to help our engineers to assist you.

We discussed how to load maps and coordinates in an earlier section of this guide. By clicking on the **File System...** hyperlink on this page you can get access to the files. Here you'll find all your maps and configuration files which you may want to share with other units.

4.13. Encoder Tab

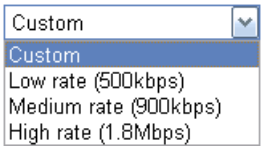
If you have a NETNode which has the AVI option installed you will be able to use a **composite** camera (PAL or NTSC) connected to the AV jack on the front panel of the unit.

When you are using a NETNode with a video encoder, you'll see an extra tab on the control software called **Encoder**. This is where you configure the encoder features.



4.13.1. Encoder Preset

You can choose from a number of encoder options.



4.13.2. Video Lock

This block will show Red when there is no video lock. It shows Green when video is locked.

4.13.3. Audio Enable

Check the Audio Enable check box to turn on the audio. Audio will now take some of the available bandwidth. For some applications you may wish to turn off audio to allow all the bandwidth to be used by video.

4.13.4. Scrambling

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

The system offers AES128 and AES 256 and this encrypts all composite assets exchanged over the network.

This combo box enables you to select the scrambling scheme you want to use. You can select: AES128 or AES256.

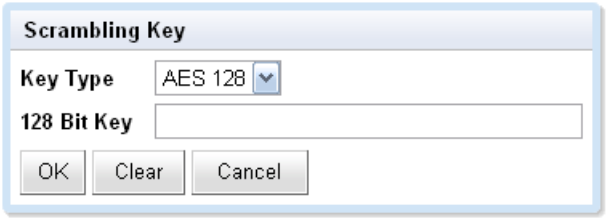
Note: This scrambling of the **composite signal** is independent of the **main IP Scrambling** on the node. This composite scrambling is **nested** under the main IP scrambling. This means you can scramble the Composite signal and then scramble the whole IP data again.

4.13.5. Scrambling Key

When you choose to use a scrambling scheme you need to specify a key that it will use.

Here's how:

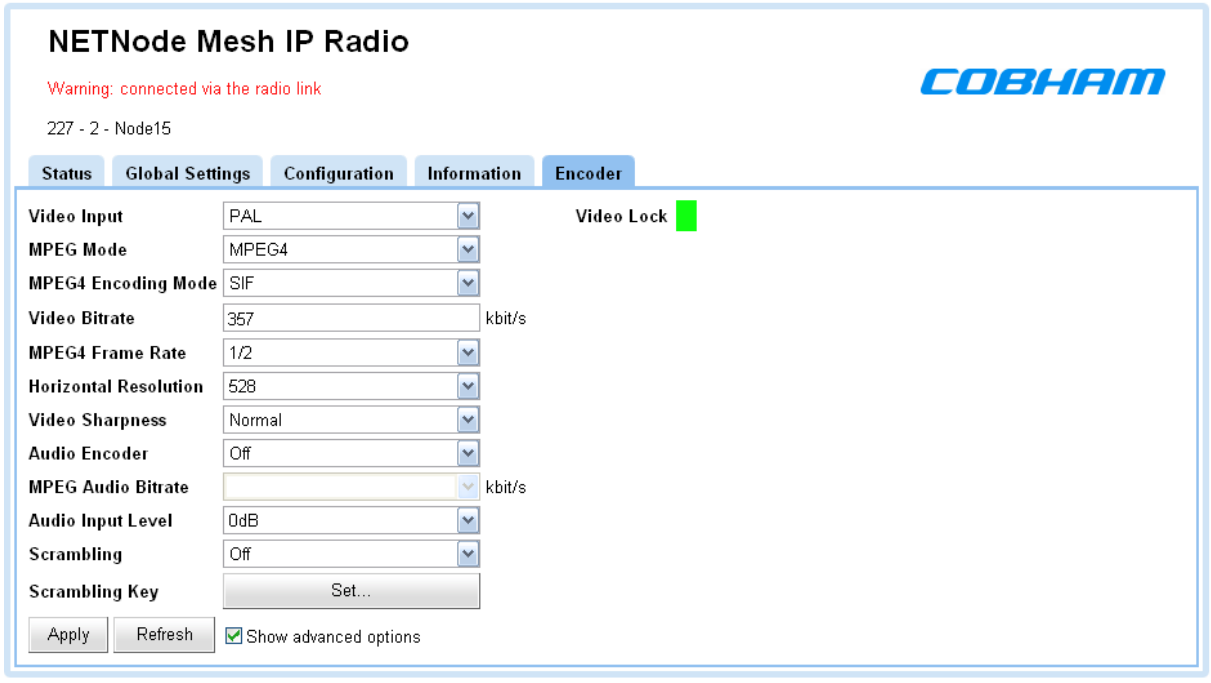
1. Click the Scrambling Key **Set...** button
2. The Scrambling Key dialog open



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**

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

If you check the **Show Advanced Options** check box, the dialog will expand like this:



5. Streaming over IP

5.1. General Info

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

5.2. Multicast Streaming

The NetNode supports both raw multicast streaming and RTSP/RTP streaming.

5.2.1. Streamer Operation

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 therefore possible for more than once 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.

5.2.2. Configuration Tab – Streamer Pane (Multicast Mode)

When you have got a Video or Audio product into the NETNode, you may want to stream that information down a fixed IP link. The streamer pane enables you to configure this facility 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 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 ensure we don't overload the bandwidth we want to be able to choose which nodes get to receive the stream. This is controlled by the **Destination Mask.**

5.2.2.1. Service Name

Textual information naming the multicast stream as delivered in the SAP/SDP packets from the unit. Default is "Mesh Streaming"

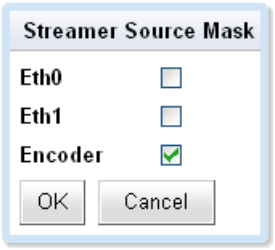
5.2.2.2. Source Mask

The Source Mask enables the streaming of Video that originates from a network connected to either one of the two NETNode Ethernet ports or from the internal encoder (if it is fitted).

This pop-up box enables the streaming of Video from either one of the two external Ethernet ports or from the internal encoder (if it is fitted). Enabling one of the two Ethernet ports allows a stream on an external network connected to the NETNode Ethernet ports to pass into the Mesh network. Enabling the Encoder tick box allows the internal MPEG encoder (if fitted in the NETNode as option NETNode-AVI-UP) to stream over the Mesh network.

Here's how to configure it:

1. Click the Source Mask **Set...** button
2. The **Streamer Source Mask** dialog will open



3. Place a check mark in the check box that is the source to stream down the link.
4. Click **OK**

In our example we are planning to stream from the composite camera connected to the encoder.

Here are all the possible connections involved:

Source	Front Panel Label	Connector (Robust Units)	Connector (Plain Box)
Eth0	IP	Amphenol	RJ45 (f)
Eth1	CTRL/DATA	Amphenol	RJ45 (f)
Encoder	Internal (if fitted)	Internal (if fitted)	Internal (if fitted)

Eth0 and **Eth1** will be from a **network** connected to the NETNode. **Encoder** is ONLY valid IF the NETNode has the AVI-UP Option (internal AV Encoder) fitted.

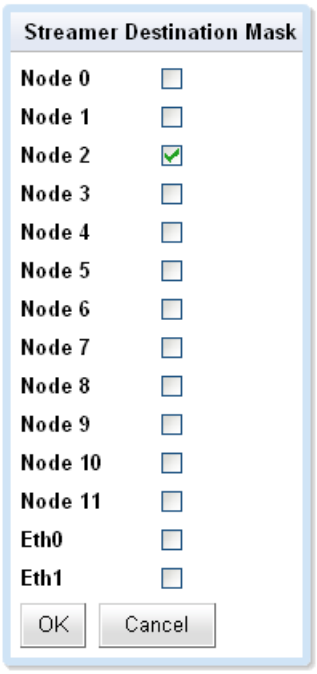
5.2.2.3. Destination Mask

You can choose which NETNodes will receive the stream. Your NETNode could have up to eight NETNodes attached to it via the mesh. Streaming to all nodes is an inefficient use of mesh capacity and so you need to be able to restrict the multicast to specific nodes.

This pop up box allows the user to specify precisely which nodes need to receive the stream. Streaming to all nodes may be an inefficient use of MESH IP capacity and so the user may wish to restrict the multicast to specific nodes.

Note: Please note after hitting the OK box on the source or destination mask, the main Apply Bottom must be pressed to action the command.

1. Click the Destination Mask **Set...** button
2. The **Streamer Destination Mask** dialog will open



3. Check the node check boxes for the NETNodes that you want to receive the stream.
4. Click **OK**

Note: The **Eth0** and **Eth1** are ticked by **default**. These ports will be used as the exit point from the mesh at the node(s) you have specified.

5.2.2.4. Multicast Address

This text box enables you to change the multicast address used by the unit. The default value is 239.16.33.254.

5.2.2.5. 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.

5.2.2.6. 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.

5.2.2.7. 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.**

5.3. RTSP Streaming

Real Time Streaming Protocol allows automatic control of the routing through the Mesh system. To use this feature the streaming protocol box should 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 ticked). The streaming protocol is selected on the Global Settings tab – see Section 4.4.6 Streaming Protocol 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 may 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.

5.4. Stream Recording and playback (v2.1)

The AVI enabled NETNode allows recoding of video streams onto a SD card (phase 2) onwards. To use this facility first insert and 2GB SD card into the slot.

SD card slot behind cap

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

5.4.1. Formatting

The SD card should be formatted in FAT16 format. If not, the flash can be formatted using global setting->format file system box.

5.4.2. Recording

The set the recording mode make sure the AVI unit's video encoder is set up correctly and the video feed connected from the camera. On the configuration tab->recoding pane enable the record tick box.

The data is recorded onto the SD card in 30s chunks. Therefore the size 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 chuck size, to prevent the data from exceeding SD card capacity.

To check recording is taking place move to information->file system->flash card->stream directory.

Directory: 1:/STREAM

[..]

S0002003.TSZ	1567196 bytes	2010/10/22 07:35:26 UTC
S0002004.TSZ	1568701 bytes	2010/10/22 07:35:56 UTC
S0002005.TSZ	1567386 bytes	2010/10/22 07:36:26 UTC
S0002006.TSZ	1567196 bytes	2010/10/22 07:36:56 UTC
S0002007.TSZ	1568890 bytes	2010/10/22 07:37:26 UTC
S0002008.TSZ	1567008 bytes	2010/10/22 07:37:56 UTC
S0002009.TSZ	1568327 bytes	2010/10/22 07:38:26 UTC
S0002010.TSZ	1566819 bytes	2010/10/22 07:38:56 UTC
S0002011.TSZ	1569078 bytes	2010/10/22 07:39:26 UTC
S0002012.TSZ	1567384 bytes	2010/10/22 07:39:56 UTC
S0002013.TSZ	1568326 bytes	2010/10/22 07:40:26 UTC
S0002014.TSZ	1567007 bytes	2010/10/22 07:40:56 UTC
S0002015.TSZ	1568703 bytes	2010/10/22 07:41:26 UTC
S0002016.TSZ	1567572 bytes	2010/10/22 07:41:56 UTC
S0002017.TSZ	1567761 bytes	2010/10/22 07:42:26 UTC
S0002018.TSZ	1567761 bytes	2010/10/22 07:42:56 UTC
S0002019.TSZ	1567573 bytes	2010/10/22 07:43:26 UTC

1931072 KB total drive space.
1729472 KB available.

Each file is one chuck representing 30s of data. Once the number of chucks 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 5 minutes of encoded video the user would set the number of chunks to 10 and this would continuously record and overwrite the last 10 minutes of video.

With a 1Mbps video stream and a 2GB SD card a user should be able to record just over 4 hours of video data.

1Mbitps 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 leave a safe margin a 500 chunk limit should be used giving just over 4 hours of recording if recording a 1Mbps video stream.

5.4.3. Playing back the recorded data

The record data may be viewed directly with a player such as VLC media player using the following RTSP url:

rtsp://<ip_address_of_AVI_unit>/record.sdp

In this mode of operation the slider bar on VLC may be moved to navigate to different parts of the recording. Note play will always commence on the next 30 second chunk. The NTP timestamps in the data contain the time the recording was transferred to SD card.

5.4.4. Transferring the files

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

The SD card may 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.

6. Configuring your NETNode for GPS

6.1. General Information

This section is relevant only to customers that want to use GPS with the NETNode unit. This chapter will explain how to enable GPS position data on your system.

It can be very useful to show the position of all the nodes on a digital mapping screen.

Sometimes these nodes will be in a fixed position on top of buildings for example. In other situations the nodes may be constantly moving in a vehicle or aircraft for example.

You can enable GPS position data using a suitable GPS receiver on as many nodes within the mesh as you wish.

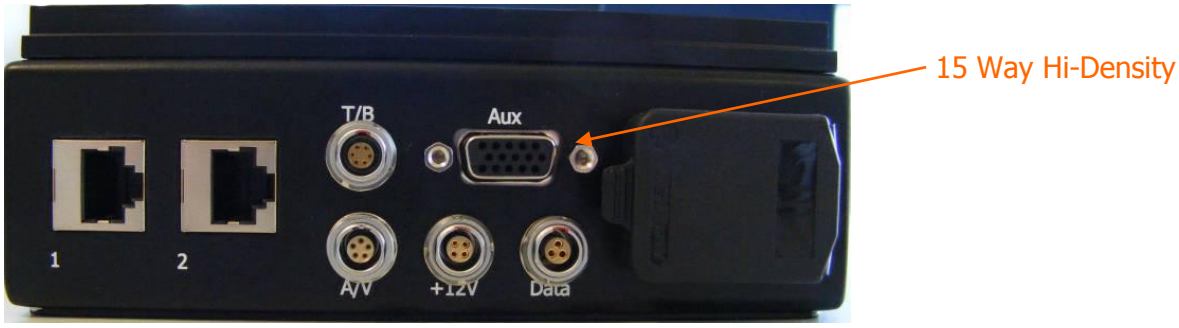
For GPS position data to be used to move nodes on the map you must place a checkmark in the **Use GPS** checkbox.

Now the GPS position data will be automatically used to position the nodes on the digital mapping you have loaded into the mesh system.

The mesh system uses the **NMEA 0183** GPS protocol to passing data.

6.2. Connecting the GPS unit to the NETNode

The connections you use for the GPS will depend on the GPS receiver being used and the type of NETNode you have. We'll take the example of connecting a **Phase 2 Plain Box NETNode** and a **Garmin 17X GPS** receiver.



Take the 15-way High Density D-Type plug (Male) and connect it to the 15-way High Density D-Type jack (female) labelled AUX on the Phase 2 Plain Box NETNode.

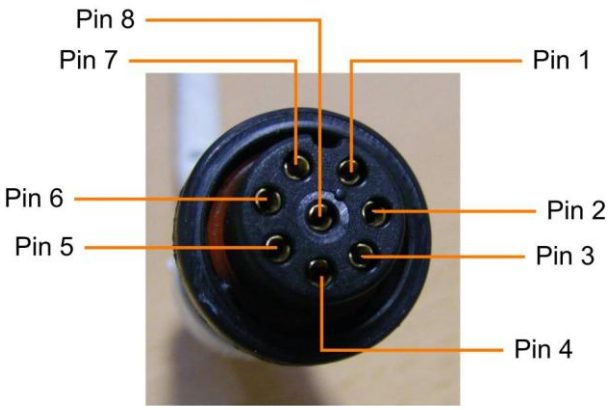
Now, take the 8-way Garmin plug (female) and connect it to the 8-way Garmin jack (male) on the Garmin17X GPS receiver.

The wiring is as follows:

Function	Garmin Pin	AUX pin
Power	3	6
Ground	2	3
RS485 A (+)	6	4
RS485 B (-)	5	5
Accessory On	4	15 or 3

This connects the RS485 data NMEA data out of the Garmin into the RS485 port on the NETNode and connects the power out of the NETNode to the Garmin device.

6.2.1. 8-Way Garmin Plug (female) Pin Out



Pin No	Function	Wire Colour
3	Power	Red
2	Ground	Black
4	Accessory On	Orange
6	Tx A (+)	Grey
5	Tx B (-)	White/Red
1	Rx A (+)	White
7	Rx B (-)	White/Orange
8	Pulse per Second (PPS)	Purple

6.2.2. 15-Way High Density D-Type Plug (male) Pin Out

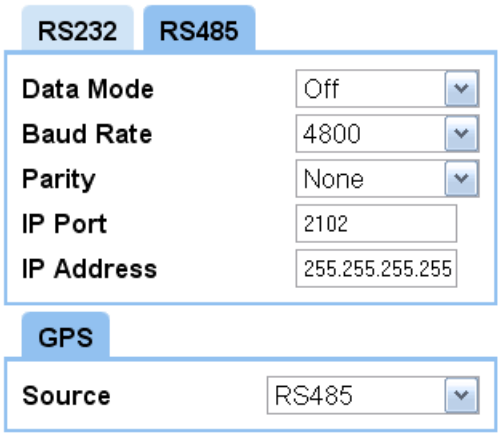
Pin No	Function
1	RS485 TX+
2	RS485 TX-
3	GND
4	RS485 RX+
5	RS485 RX-
6	+12V
7	RS232 TX1
8	RS232 RX1
9	RS232 GND
10	RS232 TX2
11	RS232 RX2
12	RS232 GND
13	RC trainer +
14	RC trainer -
15	GND

6.3. Configuring NETNode for GPS

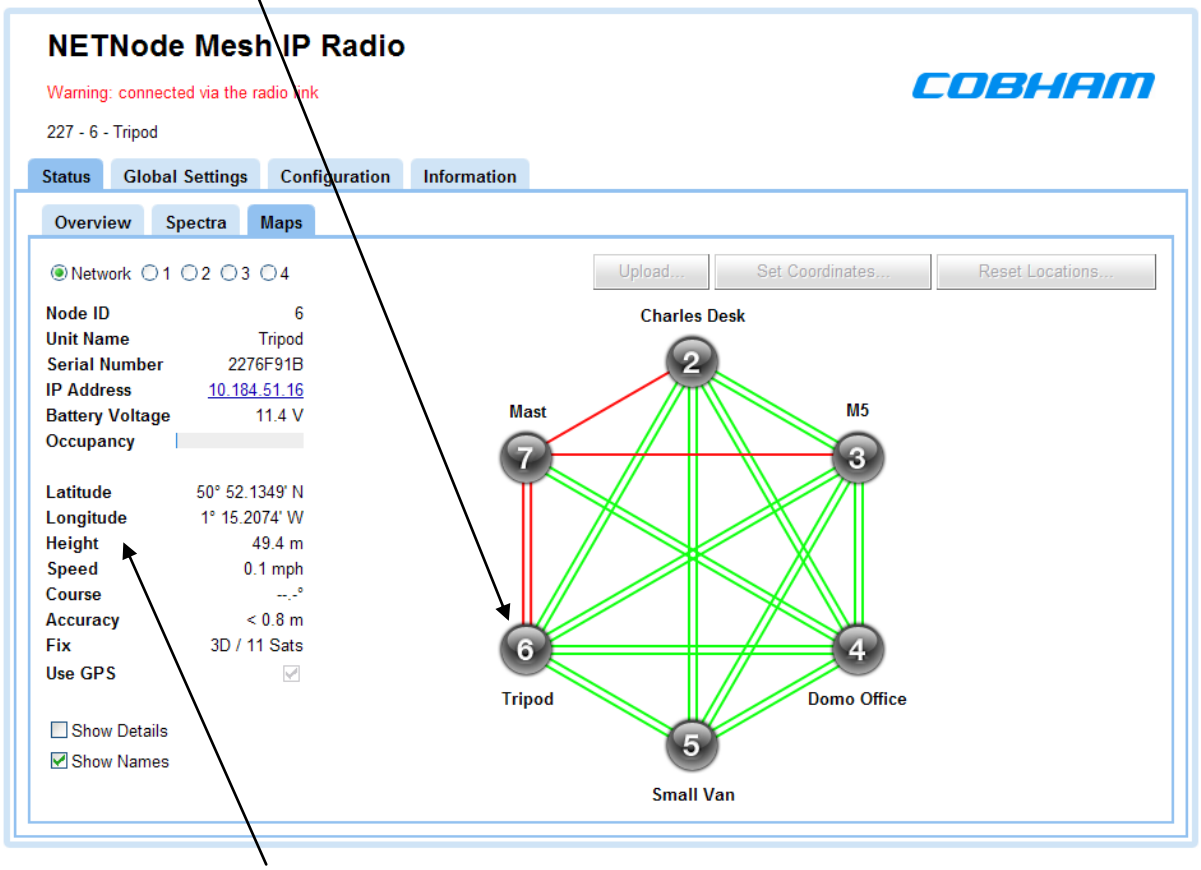
To configure the NETNode to receive GPS data set the configuration pane->RS485 as follows:

Baud Rate = 4800, Parity = None,

configuration pane->GPS: Source = RS485.



To check the GPS is functioning correctly move to the status->maps pane. Click on the local node with the GPS connected.

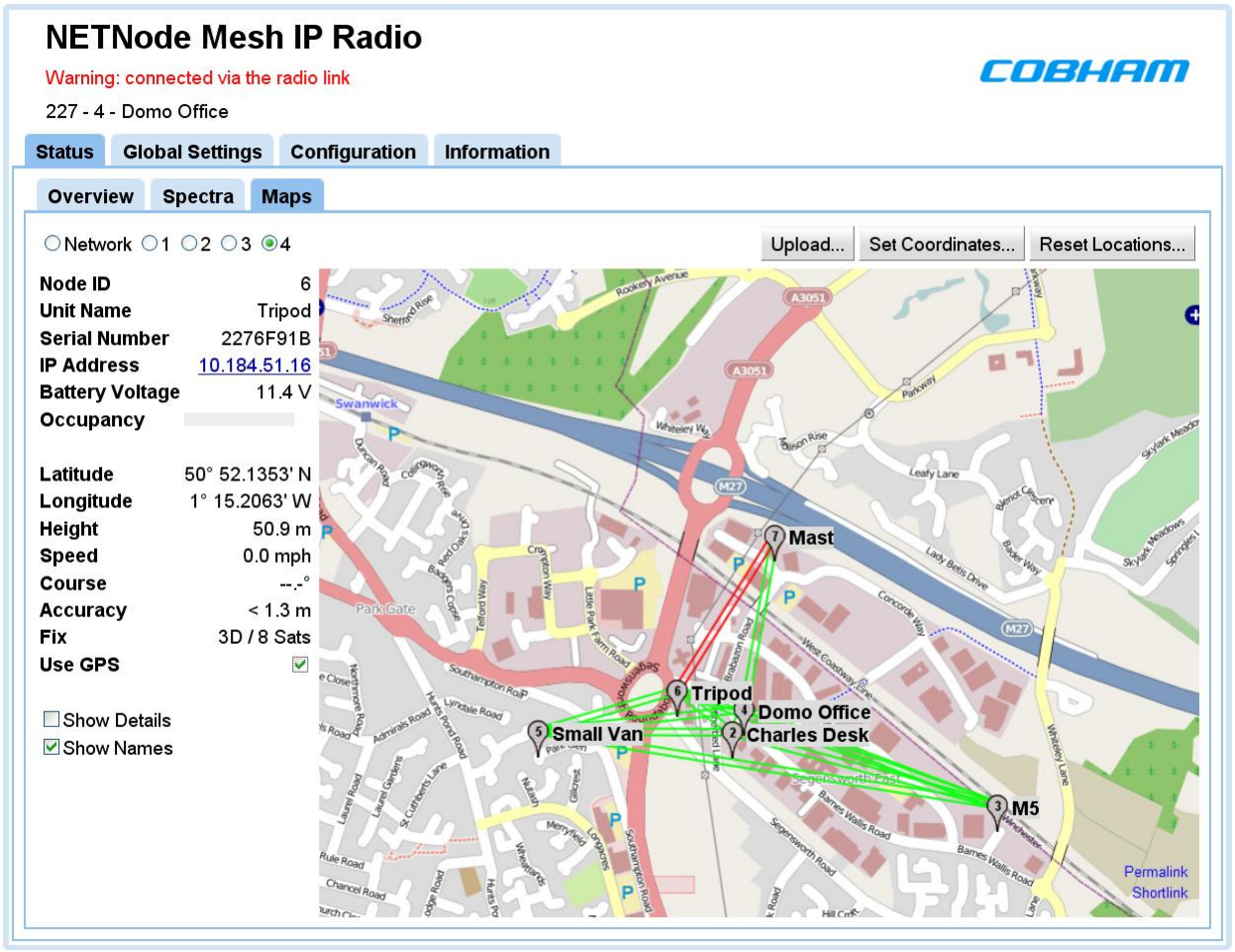


The GPS position should appear here.

6.3.1. Displaying GPS location on map

On the **Status →Maps** tab you can either:

- Place a node in a **fixed** location by dragging and dropping.
- Let the node **position itself** using GPS data



7. VLAN Support (v2.4)

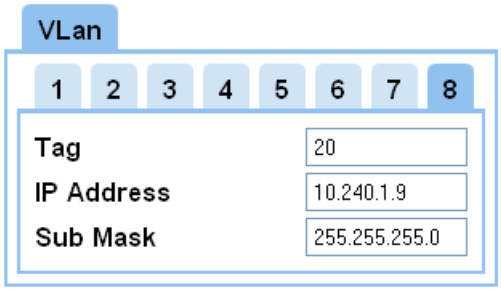
A **virtual LAN**, commonly known as a **VLAN**, allows a number of networks to share the same physical resource such as the mesh network or more typically shared IP bandwidth over a satellite link. The use of VLAN makes it possible to have completely separate networks running over a common NetNode mesh system without sharing data between the networks.

VLANs are created to provide the segmentation services traditionally provided by routers in LAN configurations. VLANs address 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.

7.1. Configuring VLAN

By default the standard mesh network does not allow passage of VLAN packets. In order to allow VLAN packets through the system each NetNode must be programmed with the VLAN tag, subnet mask and a valid IP address for each VLAN. The setting of the IP address and subnet mask allows additional filtering of the IP packets as they enter the NetNode. It also allows the generation of ARP and ICMP reply packets which aids internal routing and testing of the VLAN network.

The NetNode mesh network supports up to 8 separate VLANS. Each VLAN is maintained by a separate routing table within each NetNode.

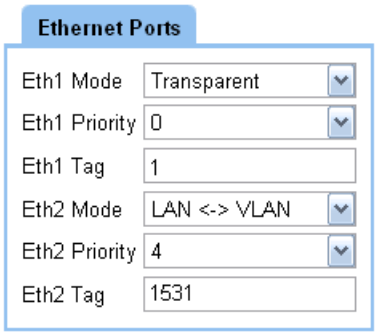


In the example above the NetNode is set up to support a VOIP (Voice Over IP) system operating using a VLAN through the mesh system. If the user does not want the node to respond to its own VLAN IP address the IP Address should be set to 10.240.1.255. The combination of IP Address 'Or-ed' with the Sub net mask must be 255.255.255.255 to ensure that the Netnode itself will not respond to Ping requests on the network

7.2. Setting VLAN tagging and stripping on External ports

The netnode allows VLAN tagging and stripping on the two external Ethernet ports. In the example below Port 1 is acting as a normal Ethernet port allowing a user to web browse as

normal into the radio and indeed send data over the radio network on the same IP address range as the radio IP addresses. Port 2 is configured to support a VLAN with a Tag of 1531.



7.2.1. VLAN tagging

VLAN tagging adds the VLAN tag as the packet enters Netnode the 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 GlobalSettings->Ethx Mode->LAN<->VLAN. The tag number and priority must also be specified.

7.2.1.1. Use of 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 allow this. The endpoint node could pass the VLAN tags unaltered by setting GlobalSettings->Ethx Mode->Normal, and programming all 8 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 (the command and control centre.)

7.2.2. VLAN stripping

VLAN striping removes the VLAN tag as the packet enters the port and adds it again when the packet exits. This is selected by GlobalSettings->Ethx 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.

7.2.2.1. Use of VLAN stripping

VLAN strpping allows a NetNode to pass its data over a IP backbone without interference to other traffic on the network. It also has the potential to allow multiple NetNodes on the same mesh network to connect to the same IP infrastructure.

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.

!Warning: 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.

7.2.3. Mode Off

This disables the external port and is useful for security.

8. Interlink Mode

Normally 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.

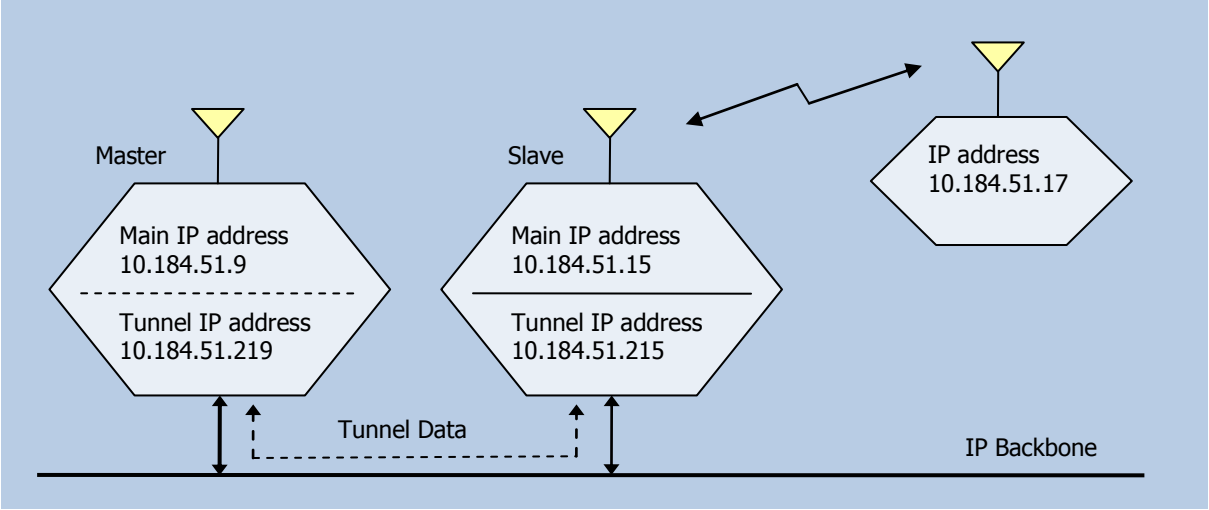
However, it can be extremely useful to be able to connect multiple NetNodes to the same backbone. For example, a city Mesh system may have two nodes on two different buildings. In this example it may be that a mobile node is only served by the one of the two nodes (for example Mesh #1 in the diagram 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.

8.1. 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.

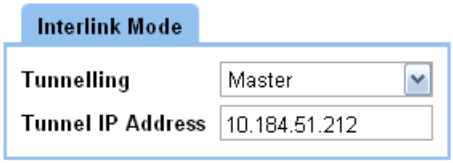
When this Interlink mode is activated, each node also sends out a broadcast packet on the second IP interface which advertises it's presence on the IP backbone. This allows each node to know what other nodes are connected to the backbone, and therefore whether the interlink data can be sent over the 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.



8.2. Configuring Interlink Mode

If there are multiple mesh networks on different frequencies anywhere on the same network they must have different Mesh ID's before starting. This can be checked with Nodefinder.

To enable the interlink mode first make sure only one NetNode is connected to the IP backbone, and all other nodes to be connected are currently accessable on the Mesh Network. Set the tunnelling IP address and the Tunnel Mode to 'Master'.



This should leave the unit connected to the network. You should now be able to ping the tunnel IP Address as well as the unit's main IP address.

Without changing the Mesh topology, connect to each node in turn on the IP backbone. Set the tunnel IP address and the tunnel Mode to 'Slave'. You will only be able to ping the tunnel IP address when the unit is connected via the backbone. Leave the Tunnel Mode of the nodes not connected to the backbone to Off.

When all nodes have been configured they can all be connected to the common backbone. You may need to wait unit 1min before the Mesh is accessible.

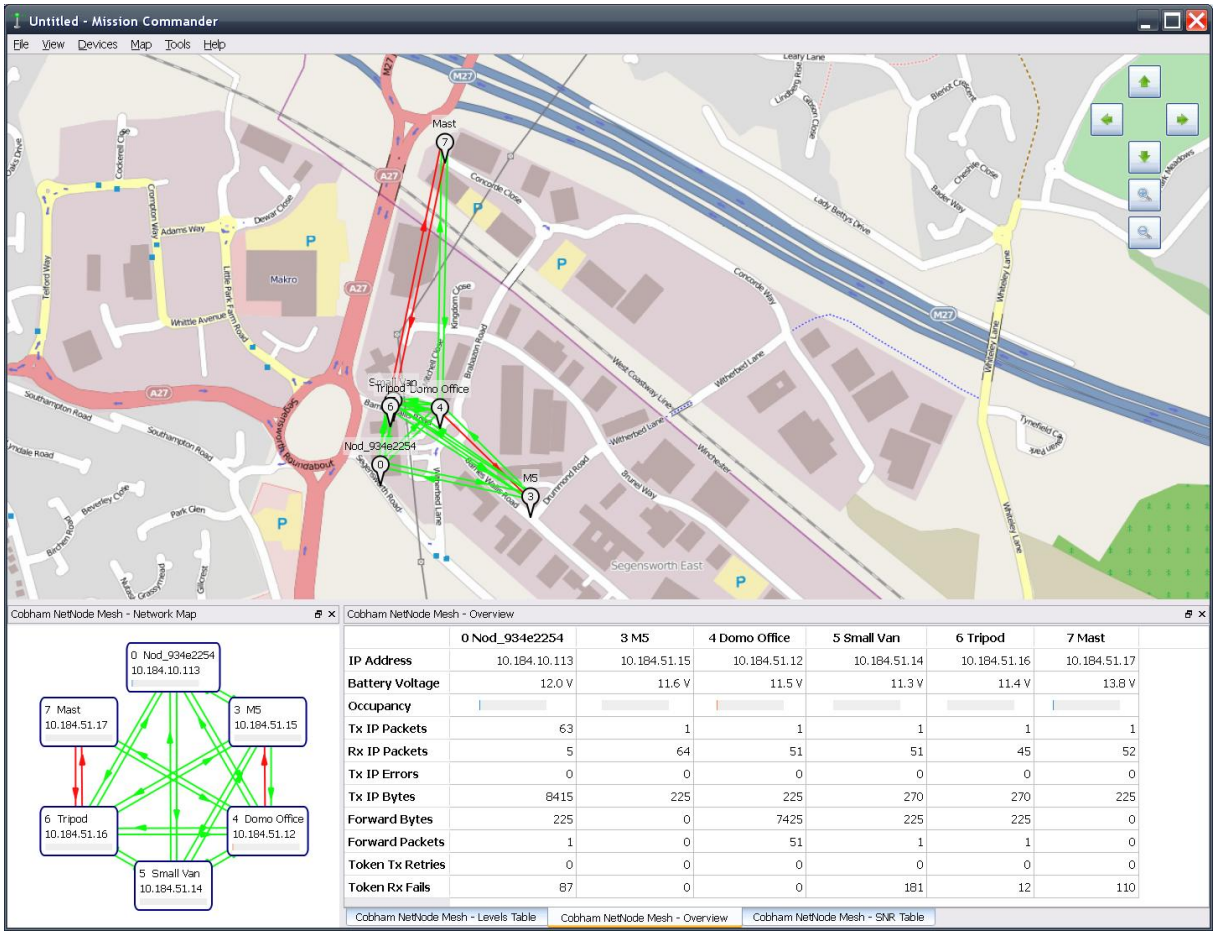
Note: All separate Mesh networks connected to the IP network (no matter where) must have different Mesh ID's. Failure to do this will result in loss of functionality.

Note: Do not connect a unit on the same Radio Network to the same IP backbone with its Tunnel Mode set to Off. This will result in loss of functionality. First set the mode to master or slave and then connect.

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.

9. Mission Commander

Mission Commander is a multi-platform application which allows user to view the status of the entire Mesh Network and other connected devices on a map based platform. An example of its use is shown below.



	0 Nod_934e2254	3 M5	4 Domo Office	5 Small Van	6 Tripod	7 Mast
IP Address	10.184.10.113	10.184.51.15	10.184.51.12	10.184.51.14	10.184.51.16	10.184.51.17
Battery Voltage	12.0 V	11.6 V	11.5 V	11.3 V	11.4 V	13.8 V
Occupancy						
Tx IP Packets	63	1	1	1	1	1
Rx IP Packets	5	64	51	51	45	52
Tx IP Errors	0	0	0	0	0	0
Tx IP Bytes	8415	225	225	270	270	225
Forward Bytes	225	0	7425	225	225	0
Forward Packets	1	0	51	1	1	0
Token Tx Retries	0	0	0	0	0	0
Token Rx Fails	87	0	0	181	12	110

The detailed description and features are outside of this document. Mission Commander is available as a separate software product.

10. LED Indicators

10.1. NETNode Phase 1 Unit

10.1.1. Top Led

This lights green if power is applied to the unit.

10.1.2. Bottom Led

This lights green if the unit is successfully connected to other NETNode units in a Mesh.

10.2. NETNode Phase 2 Robust Unit

The LEDS are mounted behind a plastic 'flip' cover. The position and function is identical to the Phase 1 unit.

10.3. NETNode Phase 2 Plain Box Unit

The LEDS are mounted behind a plastic 'flip' cover. The position and function is identical to the Phase 1 unit.

The slot beside the LED allows a user to insert a SD card.

11. Connector Pin Outs (Phase 1)

11.1. POWER – 2-way Female Amphenol Male Size 10

Pin No	Function
A	12 V
B	Ground

11.2. CTRL / DATA 19-way Female Amphenol Size 14

Pin No	Function
A	RS485 Tx+
B	RS485 Tx-
C	GND
D	RS485 Rx+
E	RS485 Rx-
F	GND
G	Engineering Use Only
H	Engineering Use Only
J	GND
K	RS232 Control TX
L	RS232 Control RX
M	GND
N	Radio Controller Trainer +
P	Radio Controller Trainer -
R	GND
S	Secondary Ethernet OP
T	Secondary Ethernet ON
U	Secondary Ethernet IP
V	Secondary Ethernet IN

11.3. IP 4-way Female Amphenol Size 08

Pin No	Function
A	Ethernet OP
B	Ethernet ON
C	Ethernet IP
D	Ethernet IN

11.4. AV 10-way Female Amphenol Size 12

Pin No	Function
A	Audio Left
B	Ground Audio Left
C	Audio Right
D	Ground Audio Right
E	Ground
F	Composite / S-Video Luma
G	Video Ground
H	S-Video Chroma
J	Ground Chroma
K	Ground

12. Connector Pin Outs (Phase 2 Plain Box)

12.1. AV - 4-pin 0B LEMO Socket (TX and RX)

Pin No	Function
1	12 V
2	12 V
3	GND
4	GND

12.2. Data - 3-pin 0B LEMO Socket

Pin No	Function
1	TX
2	RX
3	GND

12.3. Aux 15-way Female High Density D-Type

Pin No	Function
1	RS485 TX+
2	RS485 TX-
3	GND
4	RS485 RX+
5	RS485 RX-
6	+12V
7	RS232 TX1
8	RS232 RX1
9	RS232 GND
10	RS232 TX2
11	RS232 RX2
12	RS232 GND
13	RC trainer +
14	RC trainer -
15	GND

12.4. RJ45 1 and 2

Standard RJ45 female 10/100 Base-T Connector

12.5. A/V Input - 5-pin 0B LEMO socket (Only with A/V option)

Pin No	Function
1	Audio Right In
2	Audio Left In
3	GND
4	Composite In
5	GND

12.6. T/B - 6-pin 0B LEMO socket (G-key)

Pin No	Function
1	Spare Talkback Audio In
2	Mic Talkback Audio In
3	Talkback Audio in GND
4	Talkback Audio Out 1
5	Talkback Audio Out 2
6	Talkback Audio Out GND

12.7. RF Connectors

1 SMA (f) Receive only

1 SMA (f) Transmit and Receive

13. Phase 2 Robust Unit

13.1. Power Amphenol 38999 Series 3 11-98 6 way chassis plug

Pin No	Function
A	+12V Power Input
B	Ground
C	ETH_OP
D	ETH_ON
E	ETH_IP
F	ETH_IN

13.2. Camera Connector Amphenol 38999 Series 3 15-19 19 way chassis socket

Pin No	Function
A	+12V
B	GND
C	RS485 TX+
D	RS485 TX-
E	RS485 RX+
F	RS485 RX-
G	EthTX+2
H	EthTX-2
J	EthRX+2
K	EthRX-2
L	RS232 TX1
M	RS232 RX1
N	RS232 GND
P	Video 1
R	Video 2
S	Video 1 & 2 GND
T	Audio in 1
U	Audio in 2
V	Audio in GND

13.3. Misc Connector Amphenol 38999 Series 3 13-35 22 way chassis socket

Pin No	Function
1	+12V
2	GND
3	RS232 TX1
4	RS232 RX1
5	RS232 GND
6	RS232 TX2
7	RS232 RX2
8	RS232 GND
9	GPIO
10	GPIO
11	GPIO GND
12	RS232 TX data
13	RS232 RX
14	RS232 GND
15	Spare
16	Spare
17	Spare Talkback Audio In 1
18	Mic Talkback Audio In 2
19	Talkback Audio in GND
20	Talkback Audio Out 1
21	Talkback Audio Out 2
22	Talkback Audio Out GND

13.4. RF Connectors

1 N-Type (f) Receive only

1 N-Type (f) Transmit and Receive

14. Control Protocols

The control protocols for the NETNode are available upon request from Technical Support.

The unit can be controlled via RS232 command, RS485 command or Ethernet.

15. Default Configurations

This section tabulates the default configuration settings for the **domo** NETNode product.

Item	NETNode1W-217250
RF Output	OFF
Frequency	2405MHz
Mode	2.5MHz
Power mode	Low
MESH ID	0
Node ID	0
GPS Source	None
Data Mode	OFF
Scrambling	OFF
AES Key	None
AVI-UP Option	
Video Input	PAL (if AVI-UUP fitted)
Audio	OFF
Horizontal Resolution	528

15.1. Default IP Address

DHCP

16. NETNode Specification

RF	Frequency Bands Power Power Control Tuning Steps	2170 to 2500MHz 1W 30dB 125kHz
Modulation	Bandwidth FEC Modulation Forward Link Sensitivity	2.5 or 3 or 3.5 MHz (selectable) 5MHz on unit types 66 and above 1/2 QPSK/16QAM Adaptive -92 to -98dBm (mode)
Ethernet	Physical Data Rate Protocols	100 BaseT Network Toplogy dependent (Up to 2.2Mbps capacity in a 2.5MHz system. Up to 3Mbps capacity in a 3.5MHz system.) Internal packet compression will increase the data rate capacity for some types of packet considerably. ARP, UDP control, Ping, TFTP upgrade IP and ICMP protocols between the radios MPEG over IP Encapsulation (UDP multicast + SAP) HTTP and RTSP
Audio Talkback	Input Output Protocol Gain	Microphone with internal power Headphone G726-32 8KHz over RTP Mic, Headphone and mute level selectable
Video In (AVI option)	Line Standard Resolution Coding Mode	PAL/NTSC 704, 528, 480, 352 MPEG2 or MPEG4

	Delay Frame Rate	60ms to 0.5 sec depending on mode Full / Half / Quarter / Eigth (optional)
Audio In (option)	Input Sample Rate Bits per Sample	Line Level or Microphone 32KHz, 16KHz, 8KHz switchable 12 or 8bit switchable
Data Interface	RS485 Data I/O	1K2 to 115K6 baud switchable
Encryption	Format	AES128 / 256 Selectable (optional)
Control	RS232 Local Control Remote Control Ethernet	9K6 Control Port Ethernet control with comprehensive diagnostic capability
Power	D.C input Power Consumption	11 to 14V only (No reverse power protection) 14W to 24W (Unit and mode dependant)

	Phase 1 Box	**Phase 2 Robust Box**	**Phase 2 Plain Box**
Weight	2.5kg	1.75kg	1.25kg
Dimensions	260 x 194 x 57mm	180 x 180 x 70mm	185 x 155 x 55mm
Temperature Spec	-10 to +50°C	-10 to +50°C	-5 to +45°C
Sealing	Waterproof	Waterproof	Indoor use only

17. Warranty and Support

17.1. Warranty Cover

domo offers a 12 month standard product warranty. During this period, should the customer encounter a fault with the equipment we recommend the following course of action:

- Check the support section of the website for information on that product and any software/firmware upgrades. If fault persists;
- Call our support line and report the fault. If fault persists and you are informed to return the product please obtain an RMA number from the domo support department, and ship the equipment with the RMA number displayed and a description of the fault. Please email the support section the airway bill/consignment number for tracking purposes.
- If you have extended warranty provisions then **domo** will send an immediate advance replacement to you. Under most circumstances this must be returned once the fault item is repaired.

Depending on the nature of the fault **domo** endeavour to repair the equipment and return it to the customer within 14 days of the item arriving at our workshops.

Obviously it is impossible to cater for all types of faults and to manage 100% replacement part availability, and delays are sometimes inevitable. This is why **domo** recommends that its customers take out an extended warranty (which includes advanced replacement of faulty items), and/or hold a basic level of spare parts, which can be held by **domo** on the customer's behalf.

Please contact **domo** for details of packages that can be tailored to meet your individual needs, whether they are service availability, technical training, local geographic support or dedicated spares holdings.

18. Safety, Compliance and Approvals

18.1. Safe Operating Procedures

- Ensure that the power supply arrangements are adequate to meet the stated requirements of each MESH NETNode enclosure.
- Operate within the environmental limits specified for the product.
- Do not subject the indoor equipment to splashing or dripping liquids.
- Only authorized, trained personnel should open the product. There are no functions that required the User to gain access to the interior of the product.

18.2. EMC / Safety and Radio Approvals

The equipment has been designed to meet and has been tested against the following harmonized EMC and safety standards:

- EN 301 489-1 & EN 301 489-5
- EN 61000-3-2:2000
- EN 61000-3-3:1995
- EN 55022:1998, Class B for Weatherproof Units
- EN 55022:1998, Class A for Plain box Units
- EN 61000-4-2:1995
- EN 61000-4-3:1996
- EN 61000-4-4:1995
- EN 61000-4-5:1995
- EN 61000-4-6:1996
- EN 61000-4-11:1994
- EN 60950:2000

18.3. CE marking

The CE mark is affixed to all SOLO4 and SOLO2 products, and the CE Declaration of Conformity, as well as the technical file is available on request.

18.4. FCC

18.4.1. FCC Subpart 15A Rule Section 15.21

CAUTION: The user of an intentional or unintentional radiator shall be aware that changes or modifications not expressly approved by Cobham could void the user's authority to operate the equipment.

18.4.2. FCC Subpart 15B Rule section 15.105

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

18.4.3. FCC Subpart 15A Rule section 15.19(a)(3)

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules.

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

18.4.4. RF Exposure Guidance

The unit must be operated at least 20cm away from the body for RF exposure compliance purposes.

18.4.5. Intrinsically Safe Units – Conditions of Use

If you are using the intrinsically safe variant as identified by the following label:-

the following conditions of use shall apply.

1. **"Special Condition of Safe Use**: The equipment shall only be powered by an ATEX approved power supply with Ui ≤ 10.25V and Ii ≤ 2A. For e.g. ATEX approved barrier."
2. The equipment shall only be used in operation within the steel enclosure tightly locked in place to avoid an ignition hazard due to impact or friction.
3. It is at the users' discretion to determine the length of the cables as per requirements that may be used for the connections however it shall be limited by the bulk capacitance and inductance of the internal circuitry.

The above product is compliant to ATEX/IEC standards [EN 60079-0:2006/IEC 60079-0:2004, modified and EN 60079-11:2007/IEC 60079-11:2006]