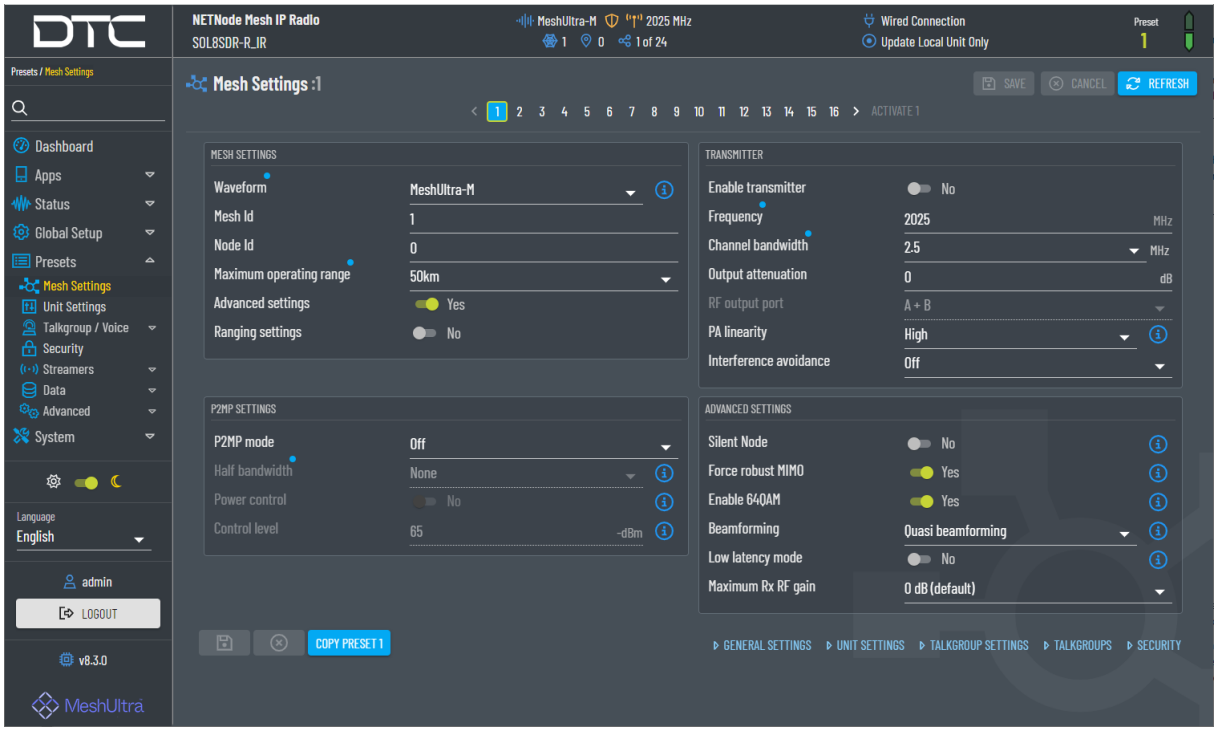
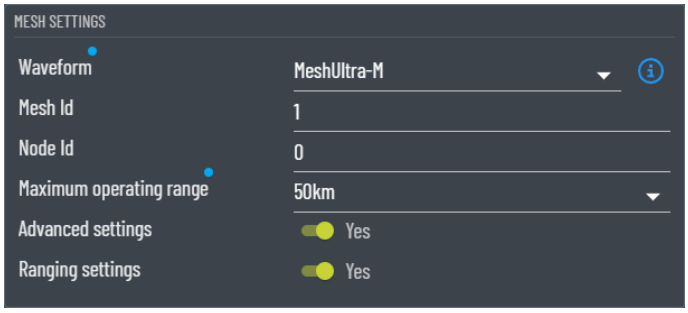
8.2 Mesh Settings

Settings marked with a dot must match for all units in a Mesh network. When the dot is green, they will be updated automatically, when the dot is blue, they must be made manually. See *Section 7.2.2* for full explanation.



8.2.1 Mesh Settings

Note: It is recommended that software for all devices in a Mesh network should be at the same version to avoid potential compatibility issues. See *Table 9-1* for software compatibility.



Property	Description
Waveform	**MeshUltra-M**, **MeshUltra-80** and **MeshUltra-X** are MIMO modes which are dedicated to the Mesh network. **Single Mesh** and **MIMO Mesh** are legacy modes to support products with built-in H.264 video encoding. MIMO Mesh will double the data rate over Single Mesh. For data rates, please read *Section 12.5*. **Note**: Please see *Waveform Comparison* below.
Mesh Id	The Mesh ID must be the same for all units in a network. It tells the unit which Mesh network it belongs to. • 1 to 63 (Single Mesh, MIMO Mesh, MeshUltra-M) • 1 to 255 (MeshUltra-80, MeshUltra-X)
Node Id	The Node ID must be unique for each unit in a network. **Note**: Node ID conflicts will resolve automatically once at least two nodes have been formed into a Mesh network. Node ID conflicts for nodes which are currently in a Mesh network will require the RF power to be disabled then re-enabled to re-allocate the Node ID. • 0 to 15 (Single Mesh) • 0 to 19 (MIMO Mesh) • 0 to 23 (MeshUltra-M) • 0 to 79 (MeshUltra-80) • 0 to 143 (MeshUltra-X)
Maximum operating range	A larger range allows the Mesh network to operate over a bigger distance at the expense of bitrate.
Advanced settings	Select **Yes** to open the Advanced Settings pane, see *Section 8.2.4*.
Ranging settings	Ranging is a licensed feature. Select **Yes** to open the Ranging Settings pane, see *Section 8.2.5*.

Mixed MIMO System Note

Mixed MIMO allows nodes with two antennas (such as SDR-Mesh) to function properly with NETNodes. The lack of spatial diversity for a 2MI2MO is overcome by adding time diversity to the system.

A node with two antennas informs the remaining nodes that it is not fully MIMO capable. This halves the bit rate on this path but adds over 3dB of robustness over a non-MIMO system as both transmit paths are on and the time diversity is employed.

The OFDM packet and pilot structure allows MIMO IP packets to mix within the same OFDM data burst. Forwarding data rules take both MIMO modes into account. The token is always sent in reduced MIMO mode. To give a correct SNR measurement, the token SNR is measured in both MIMO modes and the appropriate value used in the signal quality table.

In addition, nodes may be forced into **robust MIMO** mode, see *Section 8.2.4*. This is useful with a system that contains vertically polarised antennas. Although the same throughput as a non-MIMO system, both antennas transmit giving double the output power, increasing range.

Waveform Comparison

Function/Capability	Single Mesh	MIMO Mesh	MeshUltra-M	MeshUltra-80	MeshUltra-X
Maximum nodes	16	20	24	80	144
Max bandwidth	10MHz	10MHz	20MHz	20MHz	5MHz
Approx. max. data (TBC)	17Mbps	32Mbps	90Mbps	75Mbps	25Mbps
SDI video encoder	Yes	Yes	No	No	No
USB cameras	Yes	Yes	UVC v1.1 H.264	UVC v1.1 H.264	UVC v1.1 H.264
IP cameras	Yes	Yes	Yes	Yes	Yes
Backward compatible with Phase 3/4 Mesh	Yes	No	No	No	No
64QAM capable	No	No	Yes	Yes	Yes
RF transmit port	A, B or A+B	A+B	A+B	A+B	A+B
Robust MIMO	No	Yes: NETNode No: SDR	Yes	Yes	Yes
Quasi beamforming	No	Yes	Yes	Yes	Yes

8.2.2 Transmitter

Property	Description
Enable transmitter	If set to **Yes**, the RF power is enabled.
Frequency	The centre frequency of operation. This must be the same for all units in the Mesh network and within the bandwidth of the product variant. Some Mesh products offer enhanced sub-band filtering within the operating bandwidth, offering improved blocking performance in noisy or high traffic environments. See *Table 8-1* for details of which internal PCBs this applies to.
Channel bandwidth	The bandwidth for the COFDM waveform. Lower bandwidths provide greater range at the expense of data throughput.
Output attenuation	The level of attenuation that can be applied to reduce the RF transmit power. Refer to *Section 12.9* for a dBm to watts conversion table and example calculation. **Note**: For SDR variants with USB power delivery configured as a sink with a low power contract, this will indicate **-3dB**.
RF output port	In Single Mesh mode, the transmit port is selectable. In MIMO and MeshUltra modes, this will always be set to A+B. **Note**: In a four port product, Port A corresponds to the physical port B and Port B corresponds to the physical port D.
PA linearity	**High** or **Ultra high** linearity will optimise the COFDM waveform for improved adjacent channel performance and is the recommended method of operation. The **Low** linearity option is for power critical applications. For some variants, the output attenuation cannot be set below 3dB.

Property	Description
Interference avoidance	DTC's Interference Avoidance Scheme is a licensed feature which ensures the network switches frequency automatically when interference is experienced to the channel with the cleanest interference levels. **Note**: See *Section 11.7* for advanced IAS setup. One node is set as a **Leader**, all other nodes are **Followers**. **Forced off**: allows the node to join the network on the active frequency but will not enter the IAS system. **Local leader**: the frequency setting is replaced by a frequency list. Up to eight frequencies can be entered which are followed by all other nodes in the network. Follower nodes will have these values greyed out but viewable. **External leader**: presets are controlled through an external platform such as Mission Commander. **Distributed mode**: applicable for MeshUltra modes. Distributed mode is a self-managed system which uses the lowest Node ID to activate the scheme.
Roaming modes	Mobile nodes can be set up to connect to an alternative Mesh frequency (roam) when the RF link fails. The Mesh ID must match for all nodes in this scheme. **Roam mobile follower**: the frequency setting is replaced by a frequency list. Up to eight roam frequencies can be entered. **Roam fixed leader**: a single fixed-point frequency which allows roaming.

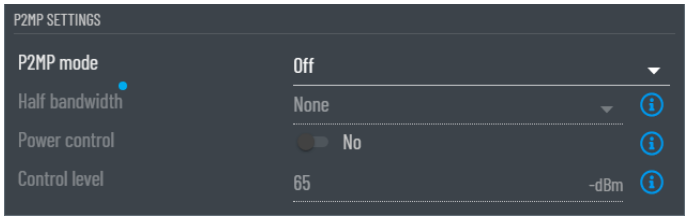
Mesh Enhanced Filtering

IMPORTANT: Enhanced filtering only applies to products with the following internal PCBs. The board type and frequency range can be discovered in the **System>Info** page.

Board Type (Frequency)	Band 1	Band 2	Band 3
D1740/D1744 (320-470MHz)	446.5-449.5MHz	N/A	N/A
D1740/D1747 rev <4.0 (1200-1700MHz)	1410-1460MHz	N/A	N/A
D1740/D1747 rev ≥4.0 (1200-1700MHz)	1350-1440MHz	N/A	N/A
D1740/D1748 (1650-2400MHz)	2200-2300MHz	N/A	N/A
D1740/D1741 (1980-2550MHz)	2200-2300MHz	N/A	N/A
D1986 (1780-2290MHz)	1780-1850MHz	1990-2110MHz	2200-2290MHz
D1987 (1980-2700MHz)	2200-2290MHz	2300-2390MHz	2400-2480MHz

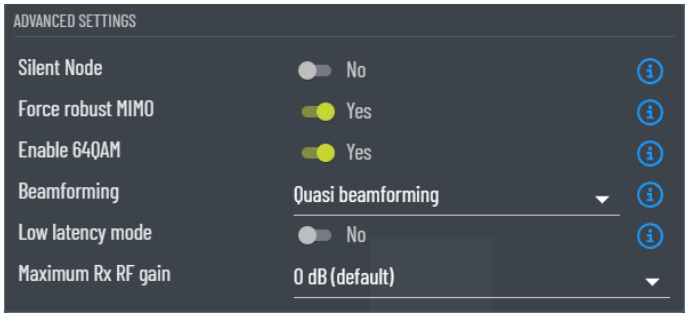
Table 8-1: Enhanced Noise Filtering Bands

8.2.3 P2MP Settings



Property	Description
P2MP mode	P2MP mode configures the network to act as a point-to-multipoint system. The **Downlink** is the central receive node and an **Uplink** is a mobile node. When P2MP mode is enabled, the transmitter frequency will split to an uplink frequency and downlink frequency. See *Section 11.6* for detailed P2MP setup.
Half bandwidth	This will half the bandwidth for data traffic in the selected direction. This may be particularly useful for downlink data which may not need full bandwidth.
Power control	If set to **Yes**, this will reduce transmit power for an uplink node when the received signal strength exceeds the control level (below).
Control level	Used in conjunction with power control, this will set the receive signal strength level at which the transmit power will reduce.

8.2.4 Advanced Settings



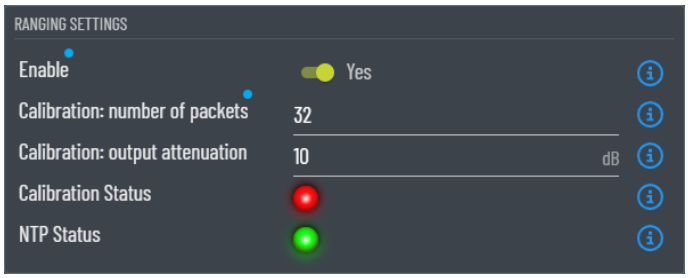
Note: Some settings will not be applicable depending on the waveform selected.

Property	Description
Silent Node	If set to **Yes**, this node will not transmit until invited to join a network by a non-silent node, or another silent node which is already in a Mesh network. At least one node must have silent mode disabled for a network to form.
Force robust MIMO	Set this to **Yes** if the antennas are in a non-MIMO configuration. Please read *Mixed MIMO System Note* above.
Enable 64QAM	If set to **Yes**, this will allow the node sending data to use 64QAM modulation. For 64QAM to operate successfully, PA linearity will be set to high or ultra high. **Note**: 64-QAM may reduce the robustness of the RF link but will increase the data throughput.
Beamforming	**Quasi beamforming** will allow a Mesh node to operate when only one antenna is serviceable or fitted. **Note**: For D1740 based products, **Robust MIMO** must also be set. This will be at the expense of bitrate if one antenna operation is not required. **Adaptive beamforming** is available for MeshUltra-M and MeshUltra-80 modes. The Mesh network will automatically select the best beam pattern for improved SNRs and reliability; particularly beneficial in smaller networks.
Low latency mode	If set to **Yes**, this reduces latency for smaller networks by minimising the delay between transmissions. **Note**: Low latency mode will increase power consumption.
Maximum Rx RF gain	This parameter allows the Maximum Rx RF gain to be reduced in 3dB steps from 0dB (max) to -21dB (min). This can be beneficial if the radio SNRs are degraded due to proximity to an out of band high power RF transmitter. Reducing the gain can prevent the out of band signal from overloading the receiver, thus improving the SNR. **Note**: Reducing the gain may affect the radio's sensitivity.

8.2.5 Ranging Settings

Ranging is a licensed feature which enables the node to measure the distance between radios in a network when operating in MeshUltra-M mode. Distances can be combined for multiple different applications including geolocation.

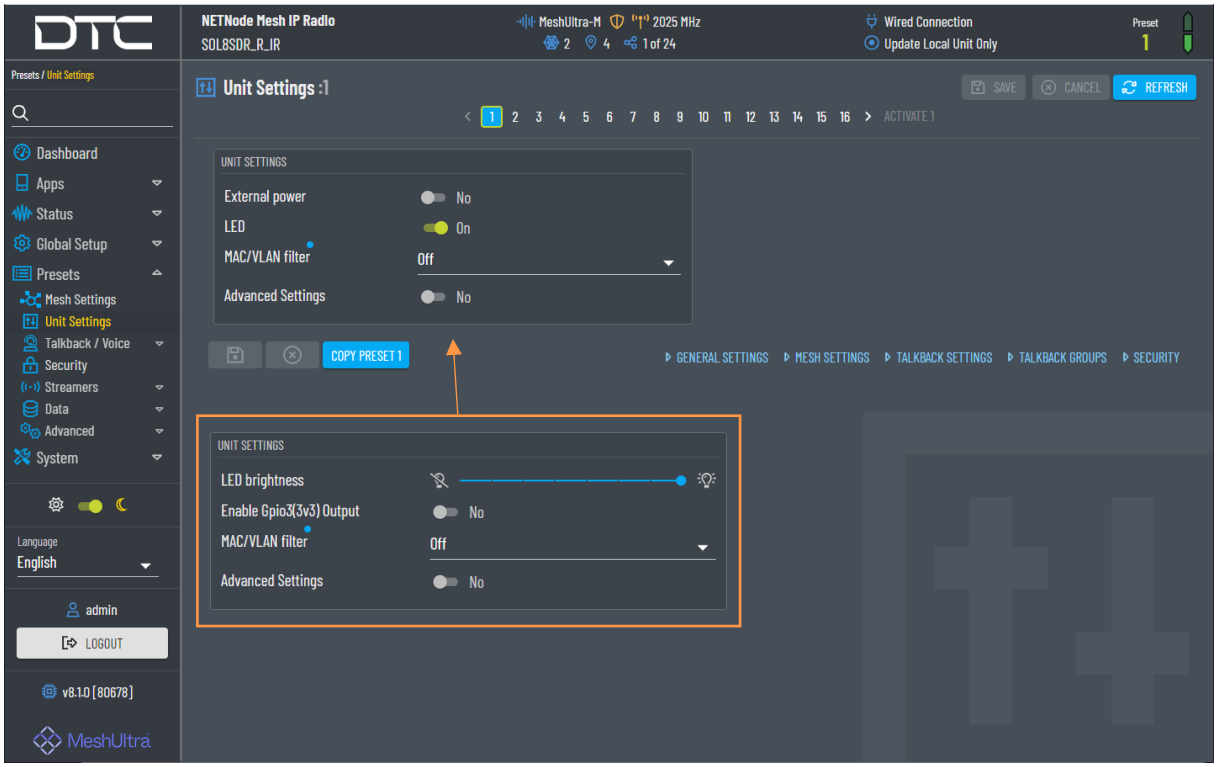
Note: Ranging data is returned in JSON format, please refer to the *IP Mesh Radio JSON Guide*.



Note: Update all parameters are indicated by a dot, please see *Section 7.2.2* for an explanation.

Property	Description
Enable ranging	When ranging is enabled, *ranging.json* data can be accessed and needs to be enabled for all radios which will perform ranging measurements.
Calibration: number of packets	This is the number of packets to be sent for self-calibration. The unit will send packets to itself and measure its own internal delay which used to remove the processing delay. The more packets which are sent, the longer the calibration process will take. The self-calibration process, with 256 packets selected, will cause a delay of 130ms when using 20MHz bandwidth, and 500ms when using a 5MHz bandwidth.
Calibration: output attenuation	The output attenuation sets the power at which the packets are sent. The power amplifier is switched off during self-calibration, therefore, the output attenuation will be relative to the output power of the transceiver chip. Typically, this will be set to 10-20dB except for NETNodes (4-channel systems) which require 0dB attenuation.
Calibration Status	An indication of successful calibration. Green is success. If it is red, then try reducing the output attenuation value.
NTP Status	An indication of time synchronisation. Green is success for all nodes except for the primary which will be yellow. NTP allows the ranging algorithm to synchronise its averaging process across the Mesh network. See **Global Setup>Region & Time** page, *Section 7.4.3* for NTP configuration. NTP status can be viewed in the **Status>Node Table** page, see *Section 6.2.6*.

8.3 Unit Settings



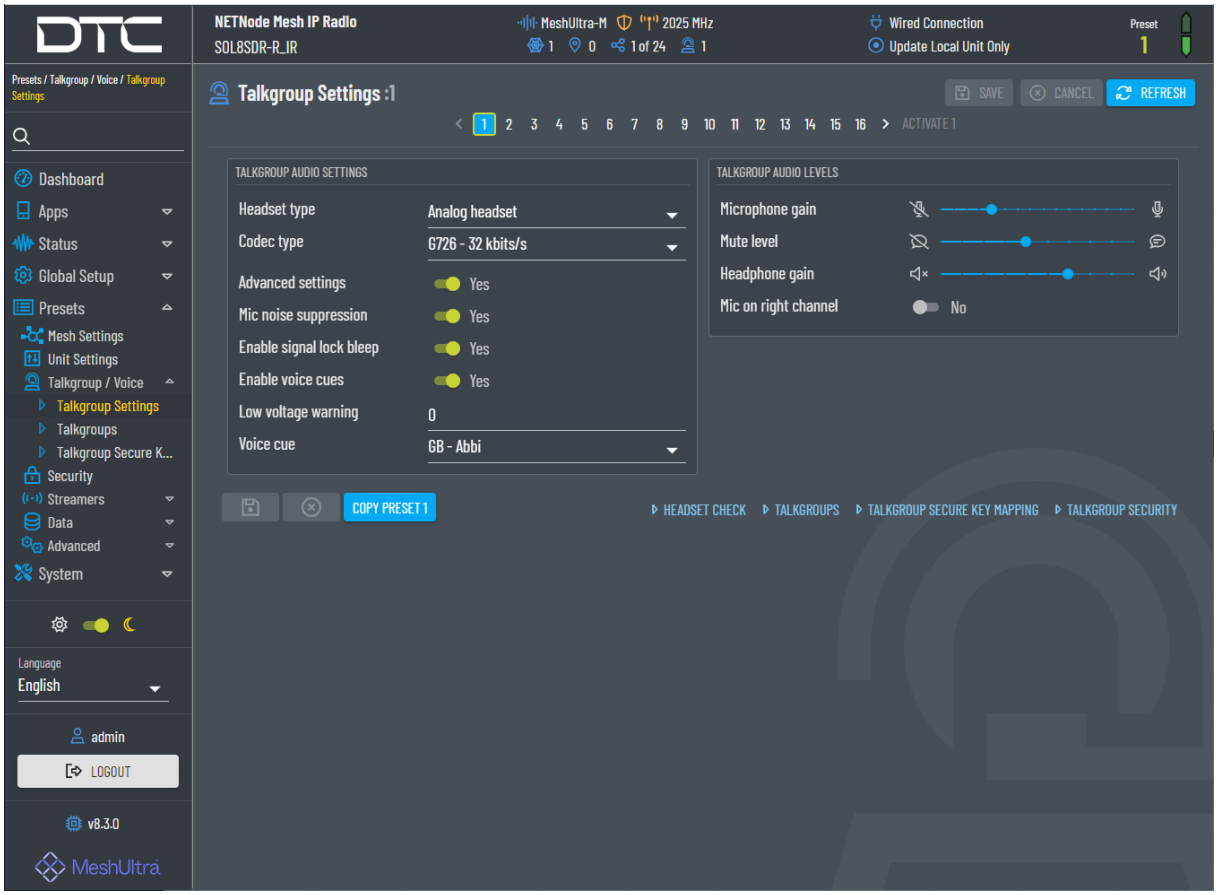
Note: Unit settings in the **orange border** above are for products with a GPIO port.

Property	Description
External power	Products that have an external power pin can be used to provide power to a camera, GPS antenna or other device. See the *Hardware Guide* for pinout and power specification.
Enable Gpio3(3v3) Output (see **orange border** above)	Products with GPIO signals can enable a 3V3 output on GPIO3.
LED LED Brightness	For products which are fitted with an LED indicator, the brightness setting will allow the LED to be switched on or off. Some products will have a slider which will allow varying brightness.
MAC/VLAN filter	The MAC/VLAN filter allows packets with certain source MAC addresses or VLAN to be prioritised (level 1 is the lowest). This may be useful to control the amount of data entering the Mesh network when congestion could occur. The filters are applied to packets entering via the Ethernet interfaces or local network, not via the radio interfaces. To be applied in relation to the **Streamer Level** setting in the **MAC/VLAN Filtering** page, see *Section 7.10*.
Advanced Settings	If you set this to **Yes**, the TCP Spoof Settings pane will open. This will allow TCP port settings on up to eight ports.

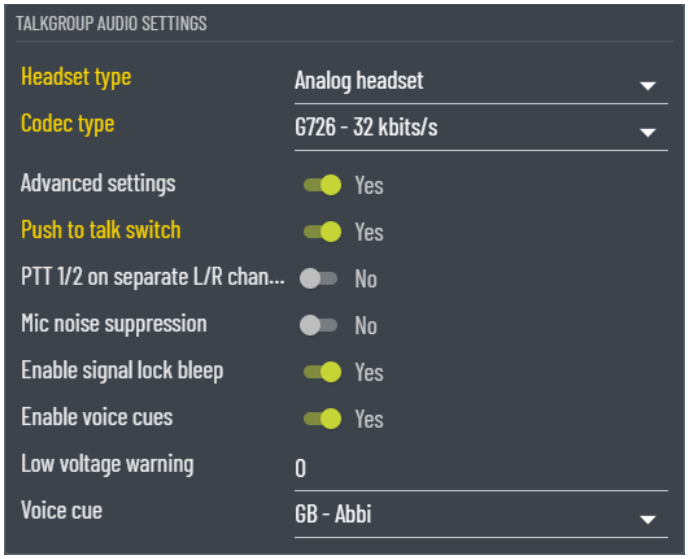
8.4 Talkgroup/Voice>Talkgroup Settings

Audio headsets can be attached for live talkgroup communications between nodes.

Note: Headset function can be tested in the **Apps>Headset Check** page, see *Section 5.3*.



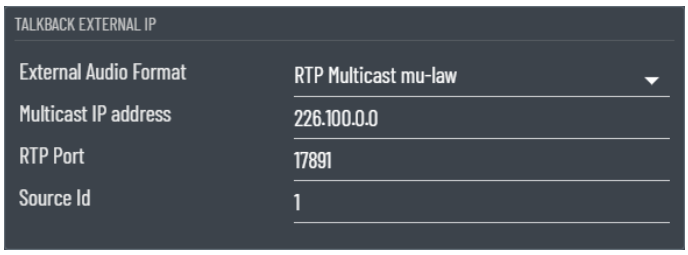
8.4.1 Talkgroup Audio Settings



Property	Description
Headset type	Select the physical headset connection to the device. When analogue headset or USB headset are selected, the radio will direct talkgroup audio packets to and from a connected headset. Talkgroup packets are received/decoded or encoded/sent. See *Section 8.4.2* if using an **IP headset**.
Codec type	Codecs are used to compress digital audio files making better use of available bitrate.
Advanced settings	Select **Yes** to open additional audio settings.
Push to talk switch	Applicable for SOL8SDR-H2 devices. When set to **Yes**, this allows an attached push-to-talk switch to operate.
PTT1/2 on separate L/R channel	Applicable when the above setting is enabled. When set to **Yes**, allows the left and right channels to be enabled by the PTT device.
Mic noise suppression	If set to **Yes**, this will help prevent background noise from the system.
Enable signal lock bleep	Set this to **Yes** to enable a low-level signal bleep in the headphones.
Enable voice cues	Set this to **Yes** to receive information voice cues in the headphones.
Low voltage warning	This sets the battery voltage level at which an audio message will be given.
Voice cue	Select the style you would like to hear for voice cues.

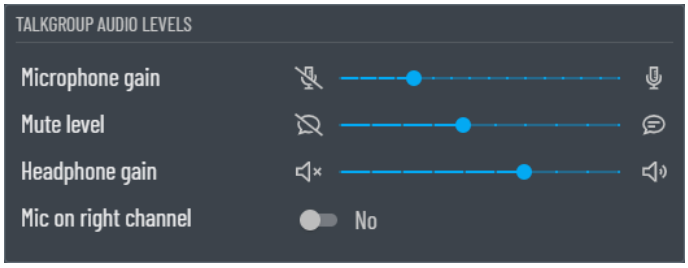
8.4.2 Talkgroup External IP

These settings will open for IP headsets, see *Section 11.12* for advanced details.



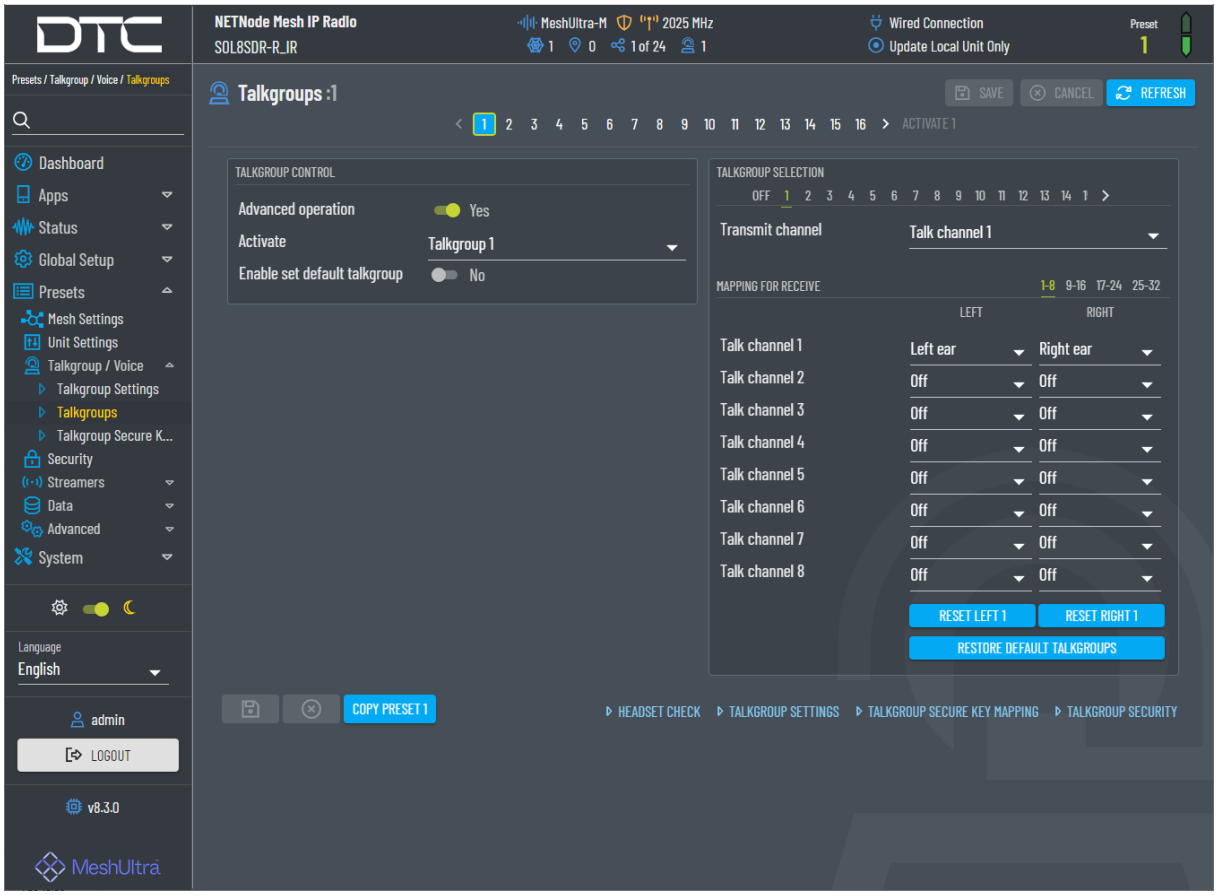
Property	Description
External Audio Format	Select G.711 **mu-law** for USA/Japan or **a-law** for Europe. The G711 encoded audio will be encapsulated in an RTP packet.
Multicast IP address	RTP packets will be sent and received on this multicast address.
RTP Port	RTP packets will be sent and received on this port.
Source Id	This identifier will be applied to RTP packets output by the radio.

8.4.3 Talkgroup Audio Levels

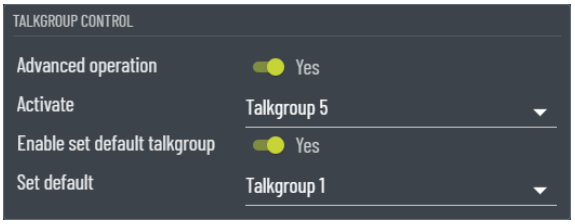


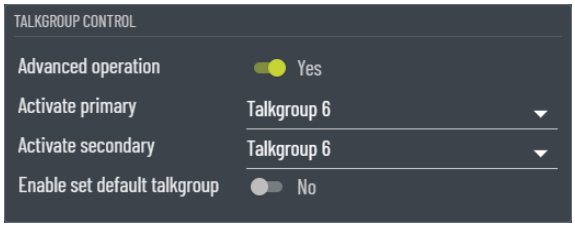
Property	Description
Microphone gain	Slide to the right to increase the microphone volume.
Mute level	This slider controls the mute level at which the microphone is enabled. Below this level no audio packets are sent.
Headphone gain	Slide to the right to increase the headphone volume.
Mic on right channel (advanced setting)	Mono microphone audio is commonly wired to the left audio channel. If set to **Yes**, this will switch microphone audio signals to the right channel.

8.5 Talkgroup/Voice>Talkgroups



8.5.1 Talkgroup Control

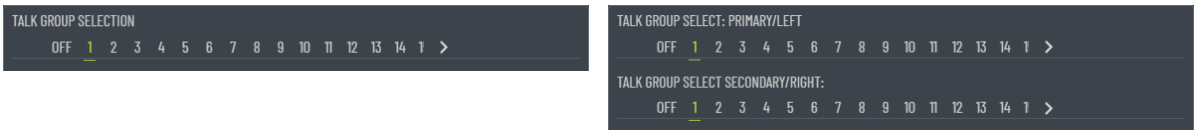




A talkgroup is a sub-configuration. Up to 32 talkgroups can be configured, see *Section 8.5.2* below.

Property	Description
Advanced operation	Set this to **Yes** to allow talkgroup configuration. If set to **No**, talkgroup will be fixed to the default basic configuration.
Activate	Select a talkgroup for control and click **Save** to activate. SOL8SDR-H2 devices allow primary and secondary settings for left and right audio.
Enable set default talkgroup	This setting enables the radio to return to a known talkgroup on reboot or by resetting the preset selection.

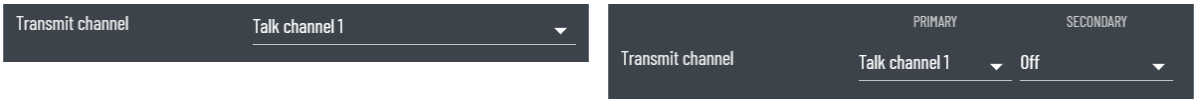
8.5.2 Talkgroup Selection



Select from up to 32 talkgroups to configure the channel mapping. Click **Save** to retain the settings but this will **not** make the talkgroup active.

SOL8SDR-H2 talkgroup select is shown on the right side. **Primary** will configure the primary/left settings and **Secondary** will configure the secondary/right settings.

8.5.3 Transmit Channel



Up to 32 talk channels can be configured as the transmit channel. Click **Save** to retain the settings but this will **not** make the talkgroup active.

SOL8SDR-H2 transmit channel select is shown on the right side.

8.5.4 Mapping for Receive

Up to 32 talk channels can be configured for headphone left/right receive. Click **Save** to retain the settings but this will **not** make the talkgroup active.

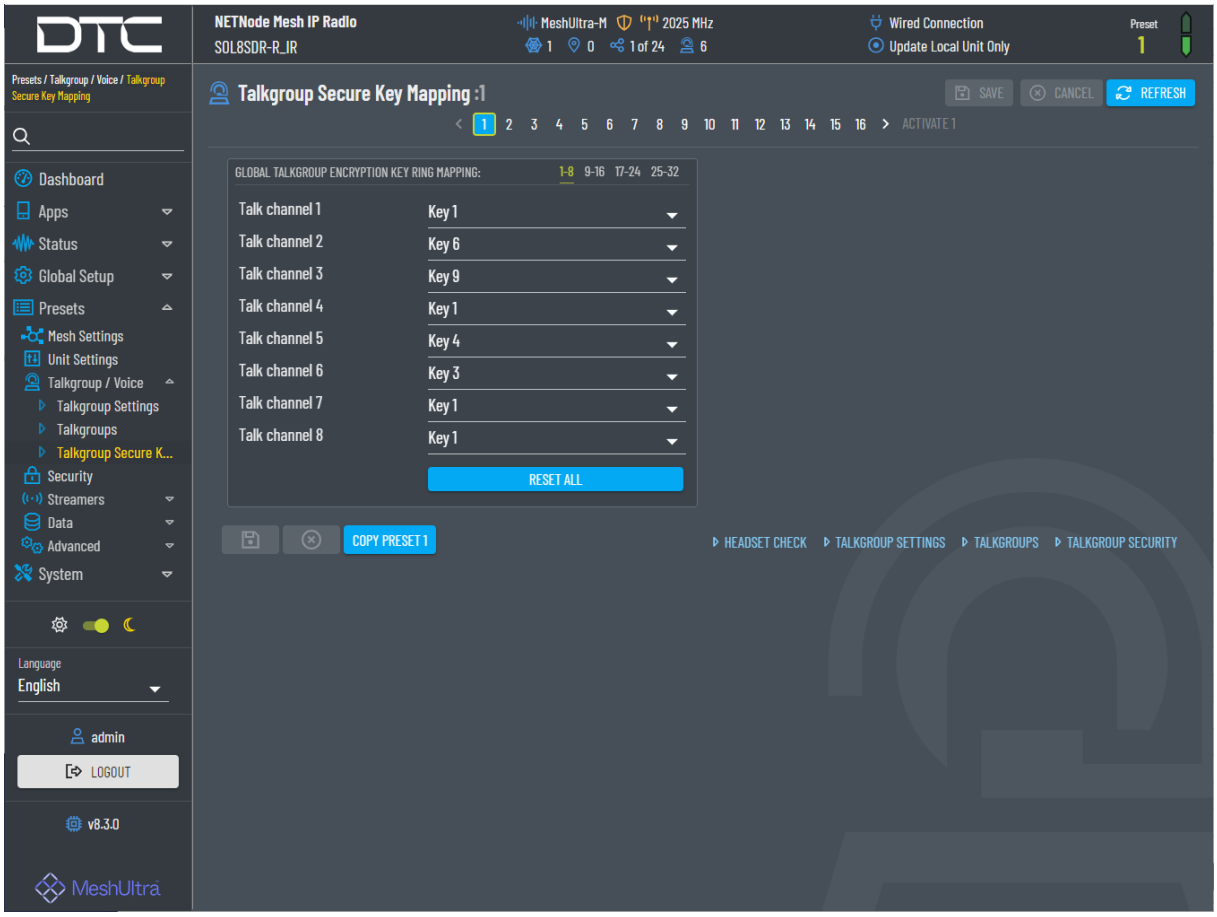
The **Reset** buttons will restore the Left or Right channel mappings to their default settings.

The **Restore Default Talkgroups** button will restore the Left and Right channel mappings for all talkgroups to their default settings.

8.6 Talkgroup Secure Key Mapping

If encryption is required in the system, set an encryption key for the talk channel.

Encryption key rings are configured in the **Global Settings>Advanced>Talkgroup Security** page, see *Section 7.12*.



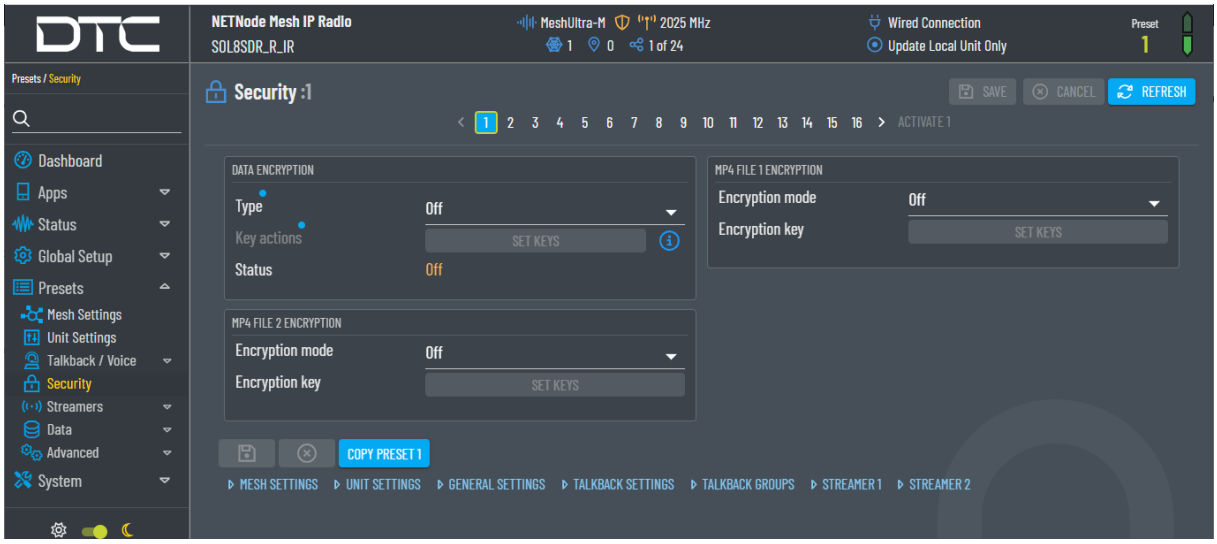
8.7 Security

Encryption can be applied to Mesh **Data**, **Streamer** for nodes with on-board encoding in Single Mesh mode, or **MP4 File** recordings when in MeshUltra modes.

Note: Further information on encryption in DTC Mesh products, including details of FIPS accreditation, is provided in *Section 12.8*.

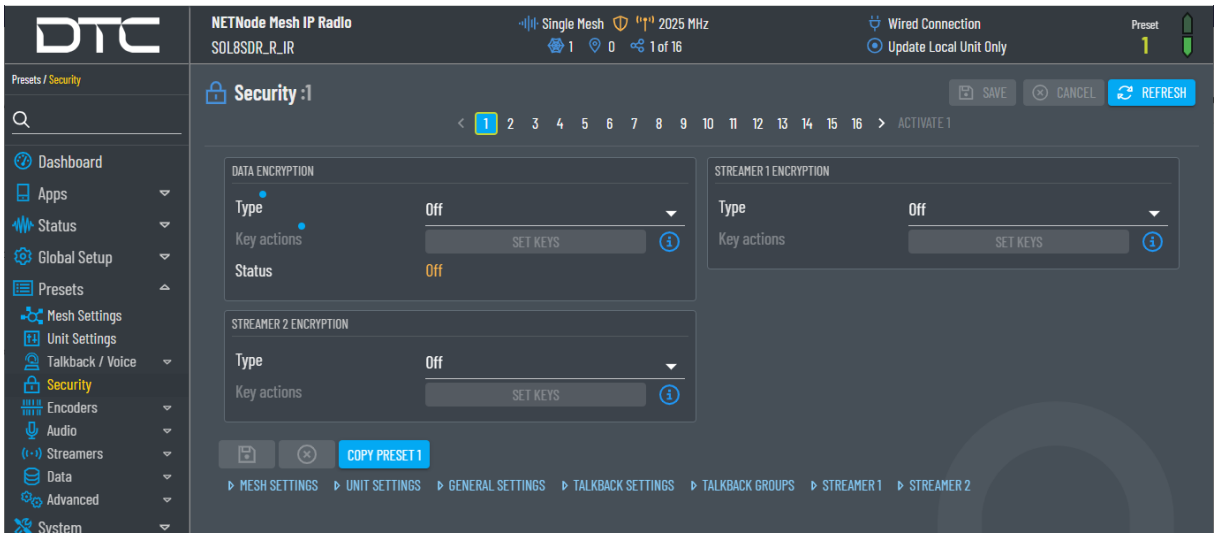
Security: MeshUltra

Domo Video Download Tool can be used to decrypt MP4 file recordings.



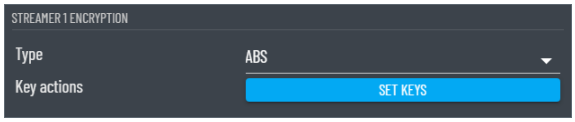
Security: Single Mesh (H.264 Encoding)

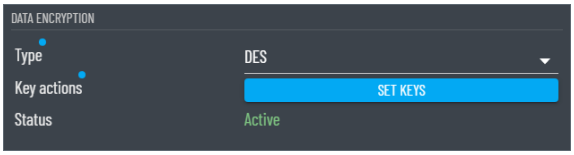
Domo Video Player can be used to play encrypted streams. Domo Video Download Tool can be used to decrypt recordings.



Note: Settings marked with a dot must match for all units in a Mesh network. When the dot is green, they will be updated automatically, when the dot is blue, they must be made manually. See *Section 7.2.2* for full explanation. **Data encryption** must be applied to all nodes in the Mesh network.

Settings

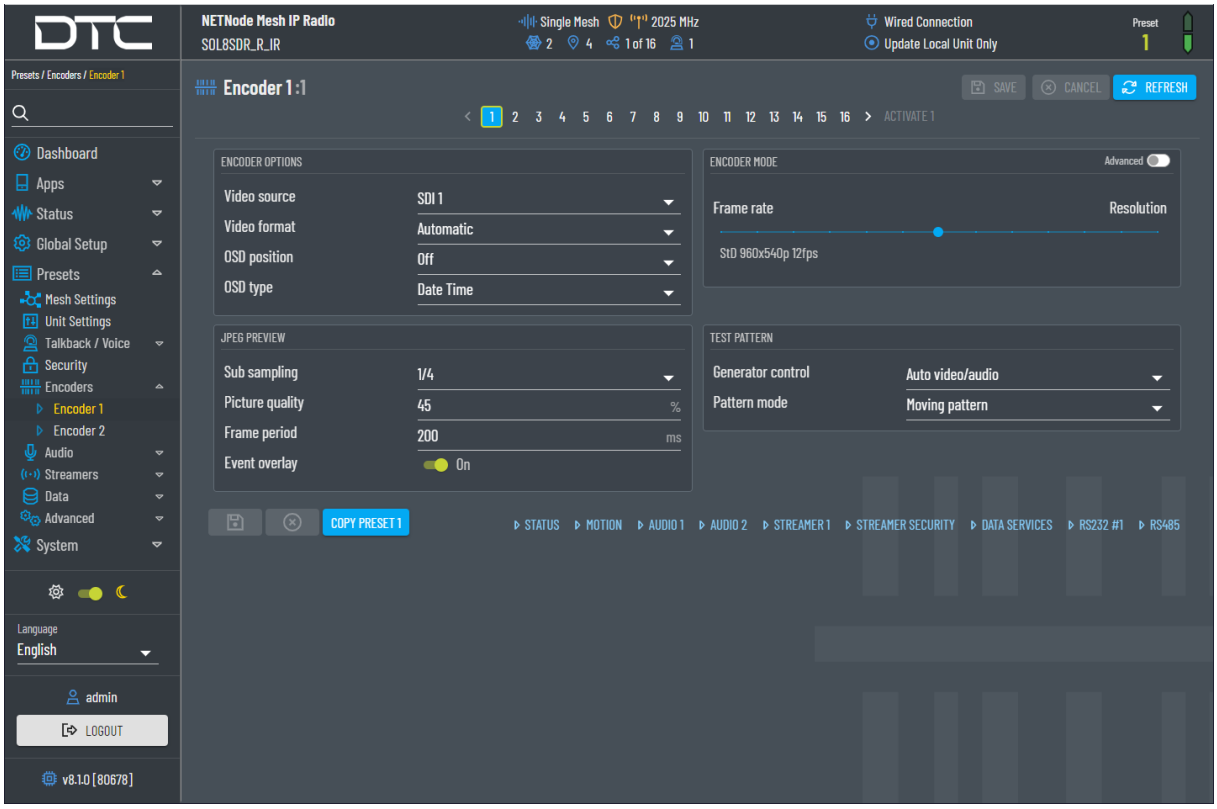




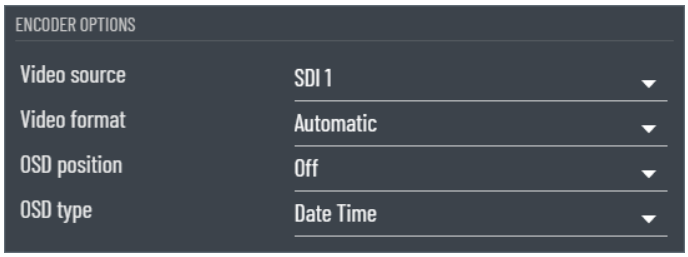
Property	Description
Encryption mode/Type	Select the encryption type from the dropdown menu. DES or ABS encryption comes as standard but AES128 and AES256 are licensed features.
Key actions	If you click **Set Keys**, the **Encryption Key Entry** dialogue box will open.

8.8 Encoders>Encoder

Encoder settings are applicable for products with built-in H.264 video encoding configured in Single Mesh or MIMO Mesh modes.



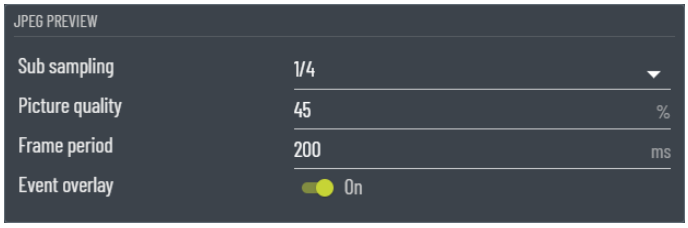
8.8.1 Encoder Options



Property	Description
Video source	Select the video input source. **SDI (powered)** sends +5VDC across the video cable. This can be used to power a SOL8SDI or cameras that require power. **CAUTION**: Do not hot plug devices when SDI (powered) is enabled. Do not select if you do not have a camera that needs power, damage may occur to the camera or SDR device.
Video format	Select the **Video Format** that aligns with the camera you are operating. The **Automatic** setting allows the encoder to discover the signal automatically. Power-up standard in Automatic mode defaults to PAL.
OSD position	Sets the position of the on-screen display (OSD) which will appear on your screen when you play video.

Property	Description
OSD type	This will let you select what details appear on the OSD. Heartbeat adds a pulsing symbol to the video output. This may be helpful in images with no discernible movement. **Note**: When working with motion detection or JPEG capture, the OSD is masked automatically, see *Section 5.6.2*.

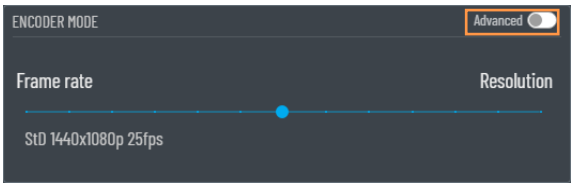
8.8.2 JPEG Preview

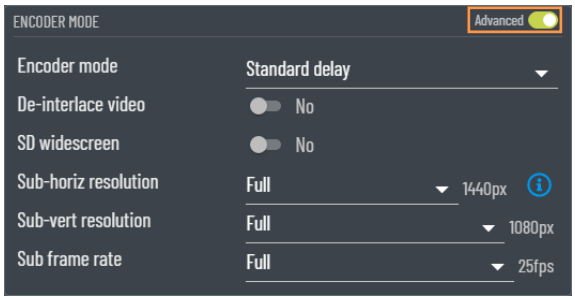


MJPEG video is displayed in the **Status>Streamers** page, **Streamer** view. See *Section 6.7*.

Property	Description
Sub sampling	If full frame rate is giving unsatisfactory quality, you can step this down until you get a satisfactory picture. **Note**: Using a sub sampling rate will set the **Encoder mode** to **Standard delay**.
Picture quality	Picture quality is a percentage of the compression level of the JPEG, e.g., 100% has no loss. When you increase picture quality and the bitrate available is limited, the frame period could be reduced to keep the stream running.
Frame period	The frame refresh period for the MJPEG video used for monitoring, for example in motion detection or streamer status. When using the JPEG capture feature, it is recommended to reduce this value to 500ms to reduce processor load.
Event overlay	If set to **On**, this produces a momentary green overlay on the MJPEG image when an event occurs.

8.8.3 Encoder Mode



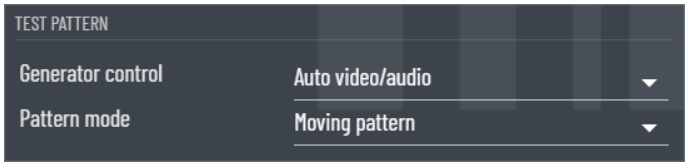


Note: Please refer to *Section 12.3* for guidance on manual video settings.

Property	Description
Advanced setting	When set off, a **Frame rate/Resolution** slider will set the video settings automatically. When set to on, the advanced settings will let you manually set the video settings.
Frame rate/Resolution slider (Advanced off)	As the slider is moved towards **Frame rate**, more resource is assigned to frame rate at the expense of resolution. Therefore, moving the slider towards **Resolution** will favour resolution at the expense of frame rate.
Encoder mode	**Standard** delay provides higher picture quality at the expense of delay. Must be used with long range modulation parameters. **Ultra Low Delay** provides very low delay at the expense of picture quality. Three criteria are essential: • HD video source • One encoder • Full frame rate **Note**: Encoder mode, resolution and frame rate settings will adjust automatically to ensure throughput limits are not exceeded.
De-interlace video	If set to **Yes**, this converts interlaced fields to a progressive frame. This improves picture quality on PC monitor type devices. Progressive images are also easier to encode which will reduce bit rate.
SD widescreen	If set to **Yes**, this changes the display aspect ratio to wide screen.
Sub-horiz resolution	This is the fraction of the horizontal resolution that will be displayed. If you select **Full** then you will see all horizontal pixels, if you select **1/2** you will see a down-sampled picture which requires much less bitrate to encode.
Sub-vert resolution	This is the fraction of the vertical resolution that will be displayed. If you select **Full** then you will see all vertical lines, if you select **1/2** you will see a down-sampled picture which requires much less bitrate to encode. **Note**: Depending on the type of video content, when using a sub-vertical resolution, you may wish to enable the de-interlace option too.

Property	Description
Sub frame rate	If full frame rate is giving unsatisfactory quality, you can step this down until you get a satisfactory picture. **Note**: Using a sub-frame rate will set the **Encoder Mode** to **Standard**.

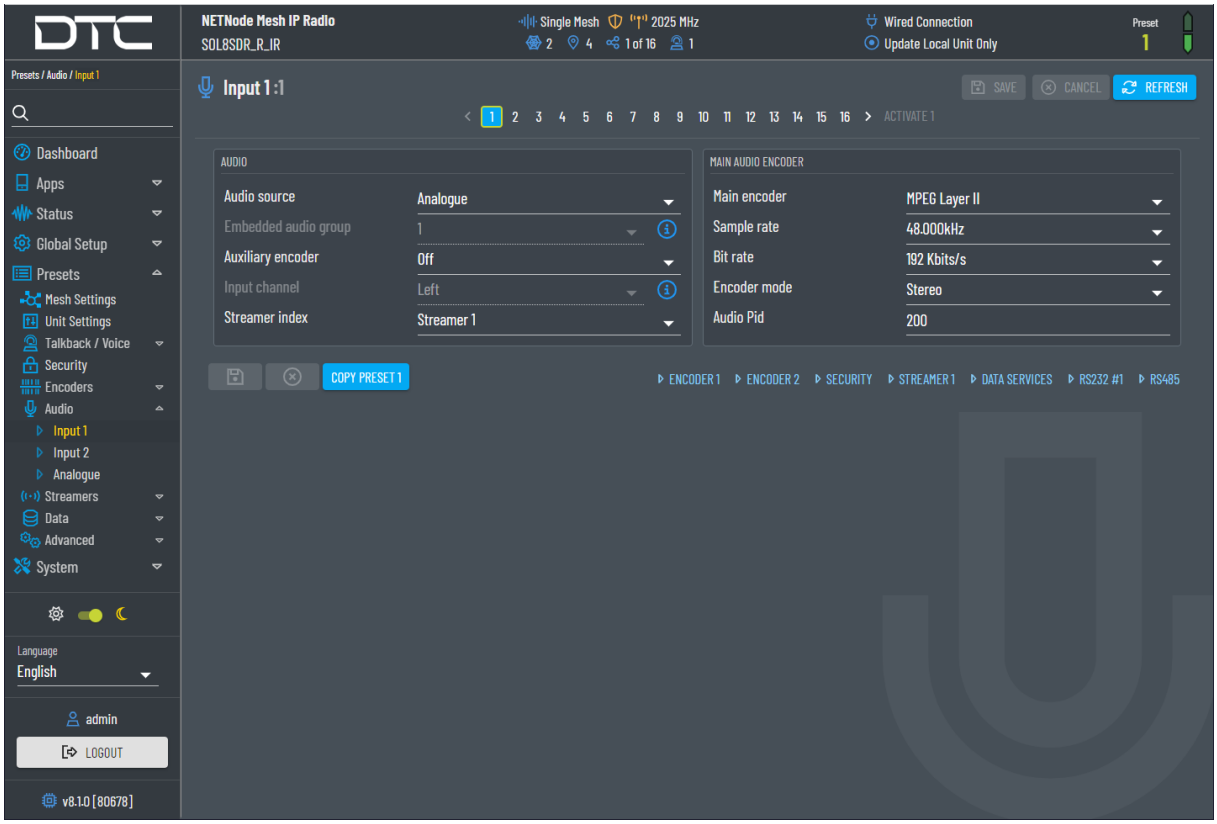
8.8.4 Test Pattern



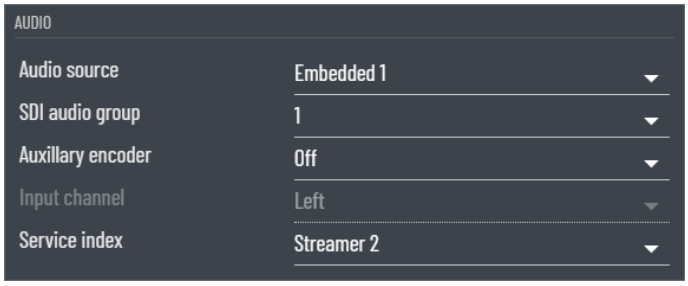
Property	Description
Generator control	**Disabled**: off **Force on**: overrides the video input and the pattern becomes the video output **Auto video/audio**: displays the pattern or emits a tone if video or audio is missing **Auto video**: displays the pattern if video is missing **Auto audio**: emits a tone if audio is missing **AV sync**: displays an AV sync pulse only
Pattern mode	This is what will appear on the screen in the event of no video input or if generator control is set to **Force on**.

8.9 Audio>Input

Audio settings are applicable for products with built-in encoding configured in Single Mesh or MIMO Mesh modes.



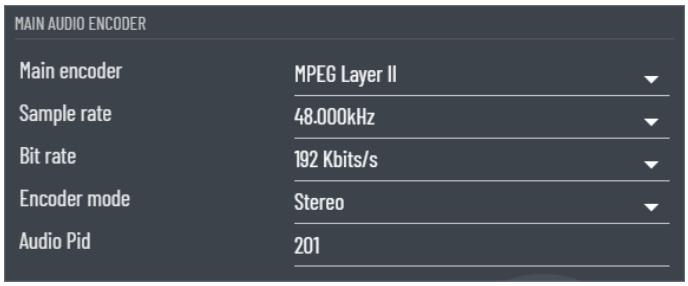
8.9.1 Audio



Property	Description
Audio source	**Analogue** audio is sourced from the device audio input. The audio encoder mode can be set for mono left, mono right, or stereo pair. Also see the Analogue page, see *Section 8.10*. **Embedded** audio is encapsulated in the SDI video signal. **USB** audio can use channel 1/2 or 3/4.
SDI audio group	SDI provides 16 channels of embedded audio in four groups of four channels. This should be left at default unless an advanced user.
Auxiliary encoder	These formats will provide an audio elementary stream only for onward processing when the streaming mode is set to RTSP. **Note**: If using the auxiliary encoder, the main encoder should be set to off.

Property	Description
Input channel	Select which audio input channel is used.
Service index	This links the audio channel to the streamer service.

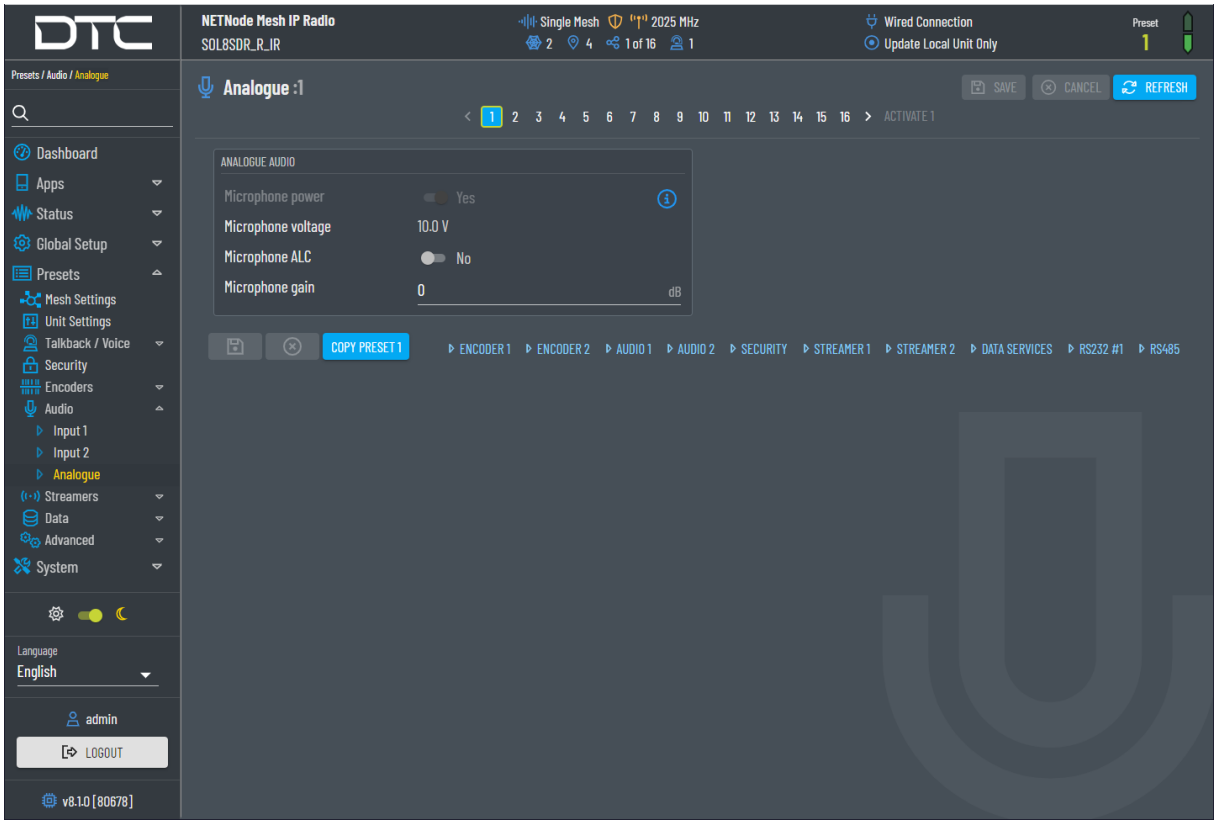
8.9.2 Main Audio Encoder



Property	Description
Main encoder	The audio encoding format for the transport stream. The higher the audio quality used the less the video bandwidth available. AAC-LC will provide an audio elementary stream when the streaming mode is set to RTSP. **Note**: If using the main encoder, the auxiliary encoder should be set to off.
Sample rate	Usually, the higher the sample rate the better the quality.
Bit rate	The range is dependent on encoder selection. Usually, the higher the bit rate the better the quality.
Encoder mode	The encoding mode may depend on the audio source.
Audio Pid	This sets the PID for the audio content in the Program. The Audio PID is listed in the PMT, see *Section 8.11.3*. These can be edited but should be left to default unless an advanced user.

8.10 Audio>Analogue

Analogue audio settings are applicable when the audio source is set to Analogue in **Presets>Audio>Input** page.

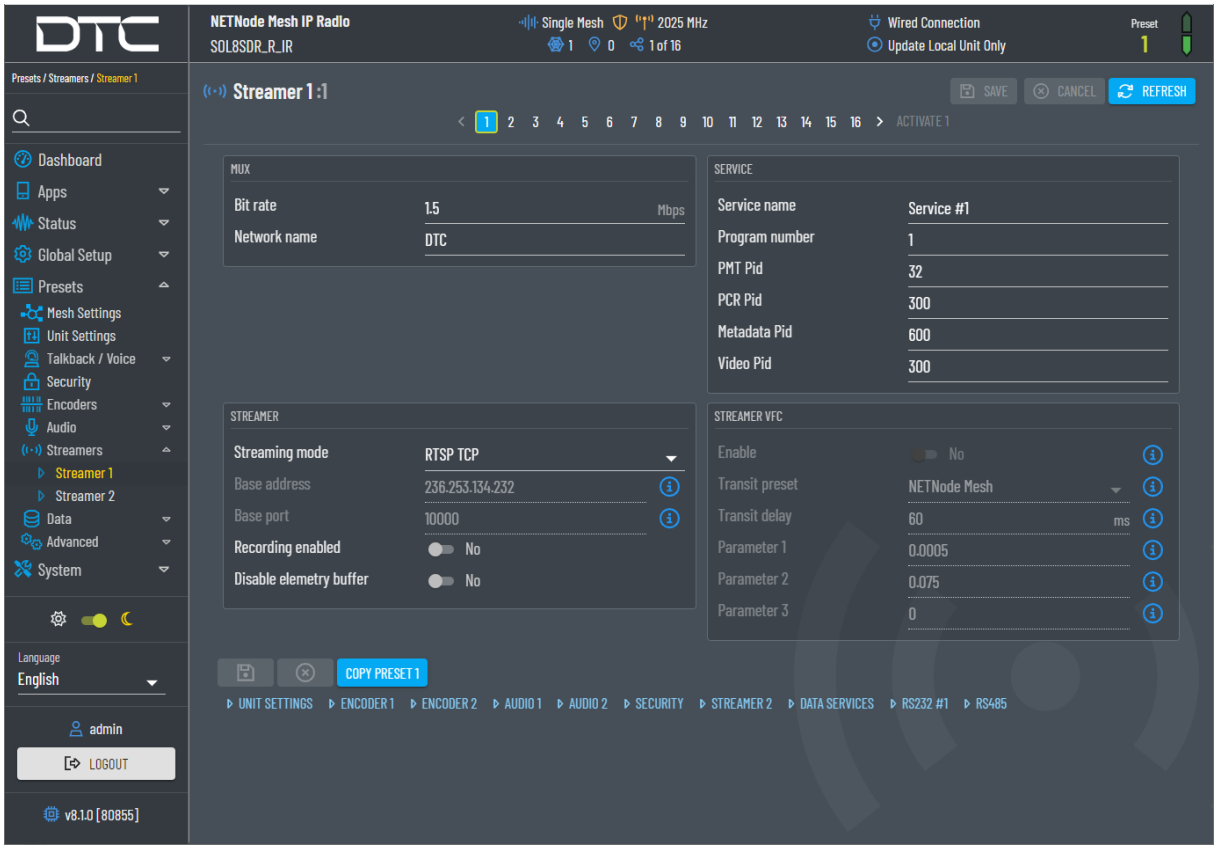


Property	Description
Microphone power	If set to **Yes**, this will enable power to the microphone input (applicable for Electret microphones), please see the *Hardware Guide* for pinout. **Note**: D1800 based products have a dedicated power pin and will always be set to **Yes**.
Microphone voltage	Indication only. The applied voltage will differ depending on the internal board type, see the **System>Information** page: • D1740: 2.4V approx. • D1800: 10V approx. • D1987: 1.9V approx.
Microphone ALC	Automatic Level Control (ALC) controls power to the microphone, preventing overload.
Microphone gain	Used to set the audio gain applied to the audio input signal. 0dB is no gain which is the default setting. If you have low level audio sources, you may need more gain.

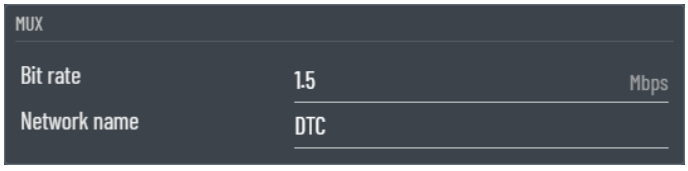
8.11 Streamers (Encoders)

The Streamer settings in this section apply to products with built-in encoding configured in Single Mesh or MIMO Mesh modes.

Note: For Streamer settings in **MeshUltra** modes, and for products that do not have on-board encoding, see *Section 8.12*.



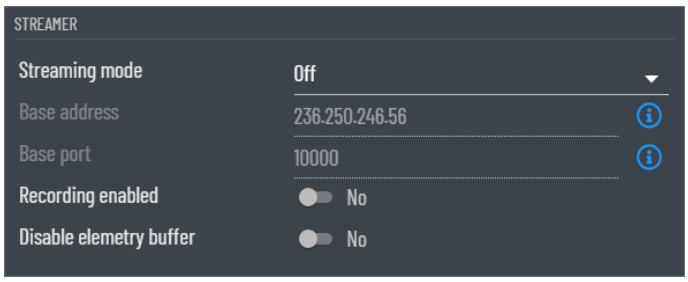
8.11.1 Mux



Property	Description
Bit rate	The bitrate for the streamer service. If it is set too low, video and audio packets will be affected.
Network name	A name to identify the multiplexed service. It will appear as the publisher in VLC.
ASI remux	When set to Stream, the re-multiplexed ASI input will appear on the streamer output.

8.11.2 Streamer

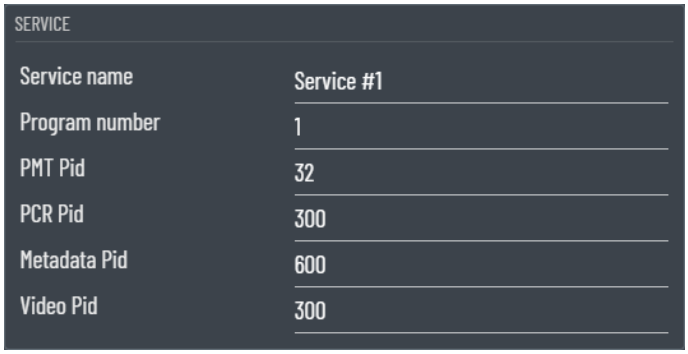
When streaming is configured, the URL can be found in the **Status>Streamers** page.



Property	Description
Streaming mode	**RTSP TCP** and **RTSP UDP** are both unicast. **RTSP TCP** streaming does not have issues with firewall blocking making it more user friendly for VMS customers. **RTP-Z** is DTC's compressed RTP. You will need Domo Video Player to run streams using this protocol. If you select RTP-Z, Streamer VFC settings will become available.
Base address	This is the address used by the unit for UDP/RTP streaming. If multicasting, the default value is random to make sure nodes have different multicast addresses.
Base port	Multicast streaming modes will require a port number. Port numbers in the header are used to direct traffic around the network.
Recording enabled	When set to **Yes**, the video will be recorded to the built in SD card. Recordings are made in 30 second chunks, therefore, a minimum 30s is required. **Domo Video Download Tool** can be used for downloading and merging of recorded files, please refer to *Section 12.1*. **Note**: When the SD card is full, the oldest recordings will be overwritten. Please ensure recordings are downloaded to avoid loss. To playback **RTSP** recordings to a media player without downloading, use the format: rtsp://<*ip_address*>/play1.sdp (streamer 1) rtsp://<*ip_address*>/play2.sdp (streamer 2)
Disable elementary buffer	Elementary streams are encoded data that is carried within the transport stream. The elementary data will vary depending on the content. When set to **No**, the elementary stream bitrate is kept constant within the transport stream. This can prevent a network becoming overloaded with data. When set to **Yes**, this will disable elementary stream buffering but will ensure correct timing of video frames within the transport stream. This may be useful when playing elementary streams into media players which can struggle with fluctuating bitrate.

8.11.3 Service

Note: Each table or elementary stream in a transport stream is identified by packet ID (PID). These can be edited but should be left to default unless an advanced user.



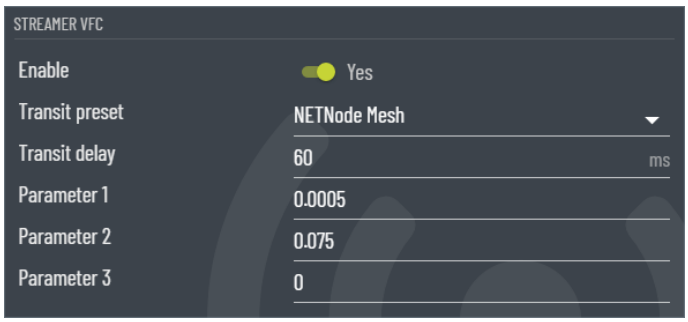
Property	Description
Service name	An identifier for the service in the transport stream (TS). The receiver must align with this name for the service to be decoded.
Program number	A number to identify the program. Must be > 1 (0 = no service).
PMT Pid PCR Pid Metadata Pid Video Pid	Each table or elementary stream within a transport stream is identified by packet ID (PID). For each program, there is one Program Map Table (PMT). PIDs identify the content in a PMT. PIDs can be edited but should be left to default unless an advanced user.

8.11.4 Streamer VFC

Video Flow Control (VFC) is applicable for RTP-Z streaming.

VFC allows the video bitrate to be varied depending on the bandwidth available. This prevents corruption of the video when bandwidth drops and allows the picture quality to adapt accordingly.

VFC is a PID Controller. VFC Parameters 1, 2 and 3 correspond with the Proportional, Integral and Derivative terms of the control loop.



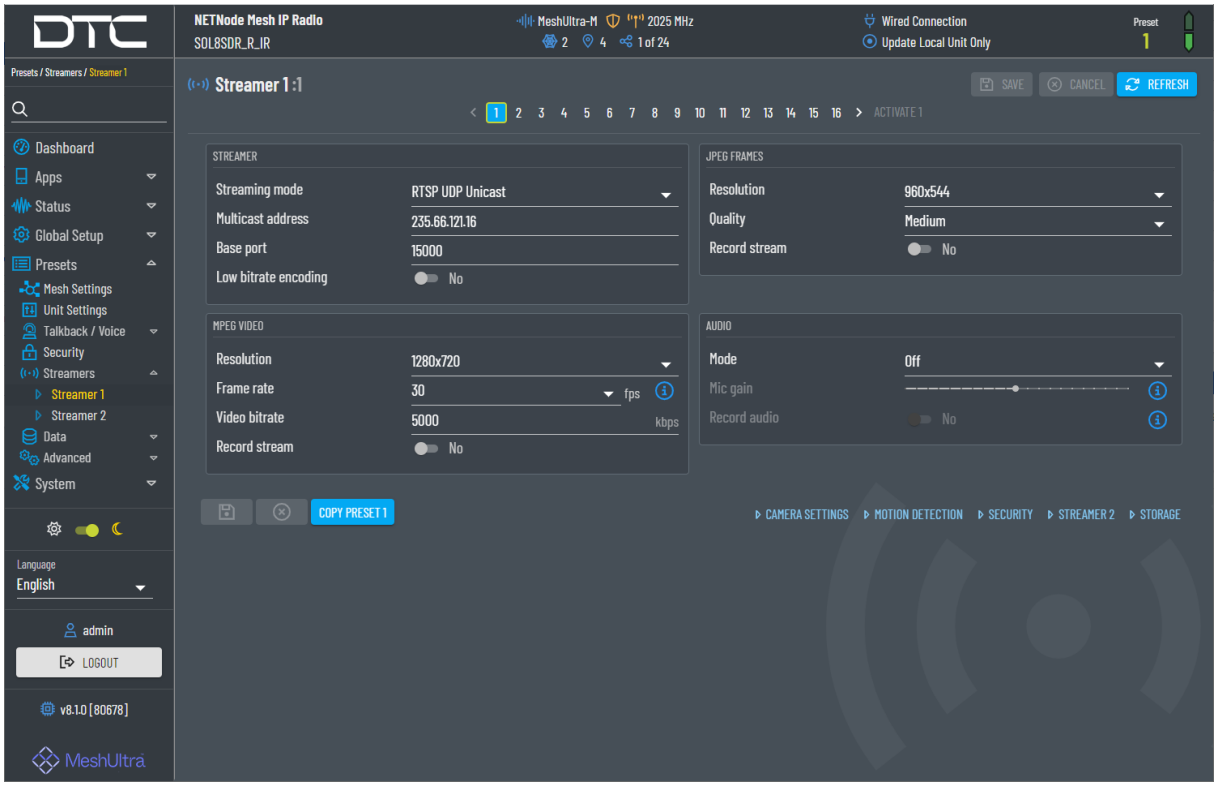
Property	Description
Enable	If set to **Yes**, this enables Video Flow Control (VFC) when streaming in **RTP-Z** only. VFC allows the video bitrate to vary depending on the Mesh bandwidth available. This prevents corruption of the video when bandwidth drops and enables the picture quality to adapt accordingly.
Transit preset	If you choose **Custom**, you can manually select the remaining values.
Transit delay	VFC monitors the latency from the video encoder to the Mesh endpoint. The system tries to maintain the round trip of the transit delay. Too low a value will drop the bitrate; too high a value will increase latency and corrupt the video. In most cases the default value will operate well.
Parameter 1	Can be up to six decimal places. This corresponds with the VFC proportional term.
Parameter 2	Can be up to six decimal places. This corresponds with the VFC integral term.
Parameter 3	Can be up to six decimal places. This corresponds with the VFC derivative term.

8.12 Streamers (No Encoding)

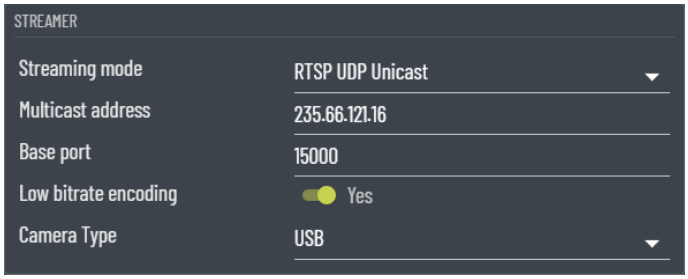
The Streamer settings in this section apply to **MeshUltra** modes, and for products that do not have on-board encoding but will allow **USB cameras**.

USB cameras must be H.264 encoded, unless using **Low Bitrate Encoding**.

Note: For Streamer settings for products with built-in encoding configured in Single Mesh or MIMO Mesh modes, see *Section 8.11*.

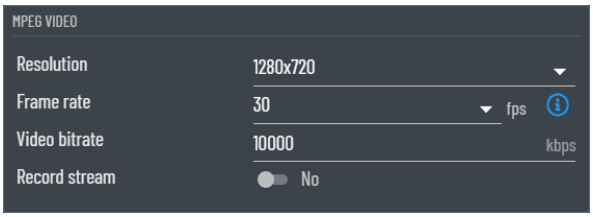


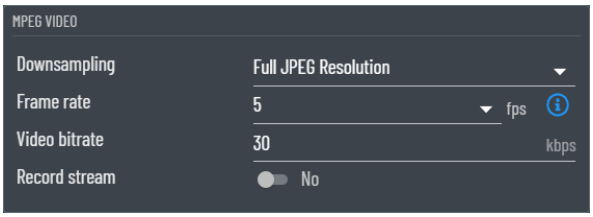
8.12.1 Streamer



Property	Description
Streaming mode	**RTSP TCP** and **RTSP UDP** are both unicast. **RTSP TCP** streaming does not have issues with firewall blocking making it more user friendly for VMS customers. The stream URL can be found in the **Apps>USB Cameras>Camera** page.
Multicast address	The address used by the unit for multicast streaming. The default value is random to make sure nodes have different multicast addresses.
Base port	Multicast streaming modes will require a port number. Port numbers in the header are used to direct traffic around the network.
Low bitrate encoding (licensed feature)	Set this to **Yes** to achieve low bitrate video encoding. See example in *Section 11.2*.
Camera type	Low bitrate encoding is possible for cameras which support JPEG frames. Supported IP cameras will need configuration, *Section 8.12.3*.

8.12.2 MPEG Video



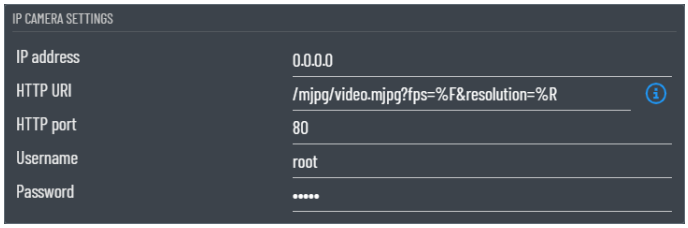


Property	Description
	When low bitrate encoding is set to **Yes**, the **Resolution** setting will change to **Downsampling**.
Resolution	Resolution is the number of pixels displayed vertically and horizontally.
Downsampling	Relates to the JPEG frame resolution (*Section 8.12.4*) to provide downsampled video.
Frame rate	Frame rate is the number of pictures that are displayed in one second of video. High frame rates produce smoother video but increase the bitrate.
Video bitrate	Set the bitrate for the stream. Higher quality video will need a higher bitrate. When in low bitrate mode, video bitrate can be set as low as 30kbps.
Record stream	When set to **Yes**, the video will be recorded to the built in SD card. Recordings are made in 1 minute chunks. Recording is applicable for USB cameras. IP cameras which are **low bitrate encoded** can also be recorded. Recordings are signed for validity and saved to the internal SD card. They can be downloaded from the **Apps>Storage Manager** page. **Note**: When the SD card is full, the oldest recordings will be overwritten. Please ensure recordings are downloaded to avoid loss.

8.12.3 IP Camera Settings

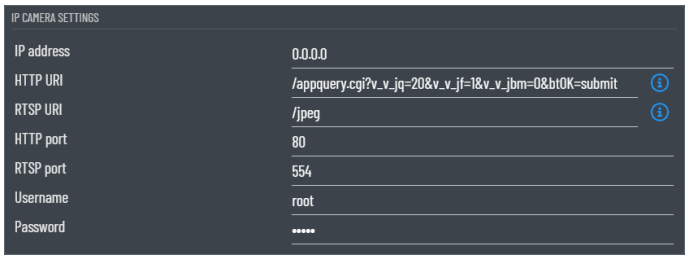
Low bitrate encoding currently supports two IP cameras: **AXIS (IP HTTP)** or **MOHOC (IP RTSP)**. For each selection, parameters specific to the camera must be entered.

AXIS (IP HTTP)

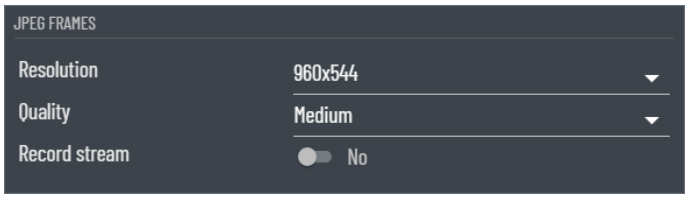


In the **HTTP URI** setting, replace the %F value with the frame rate and the %R with the resolution.

MOHOC (IP RTSP)

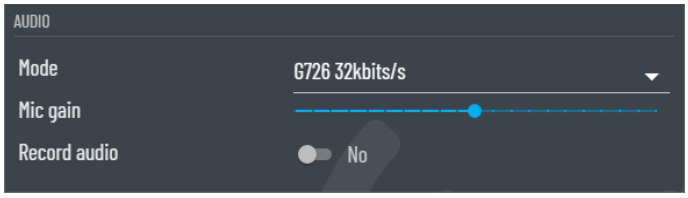


8.12.4 JPEG Frames



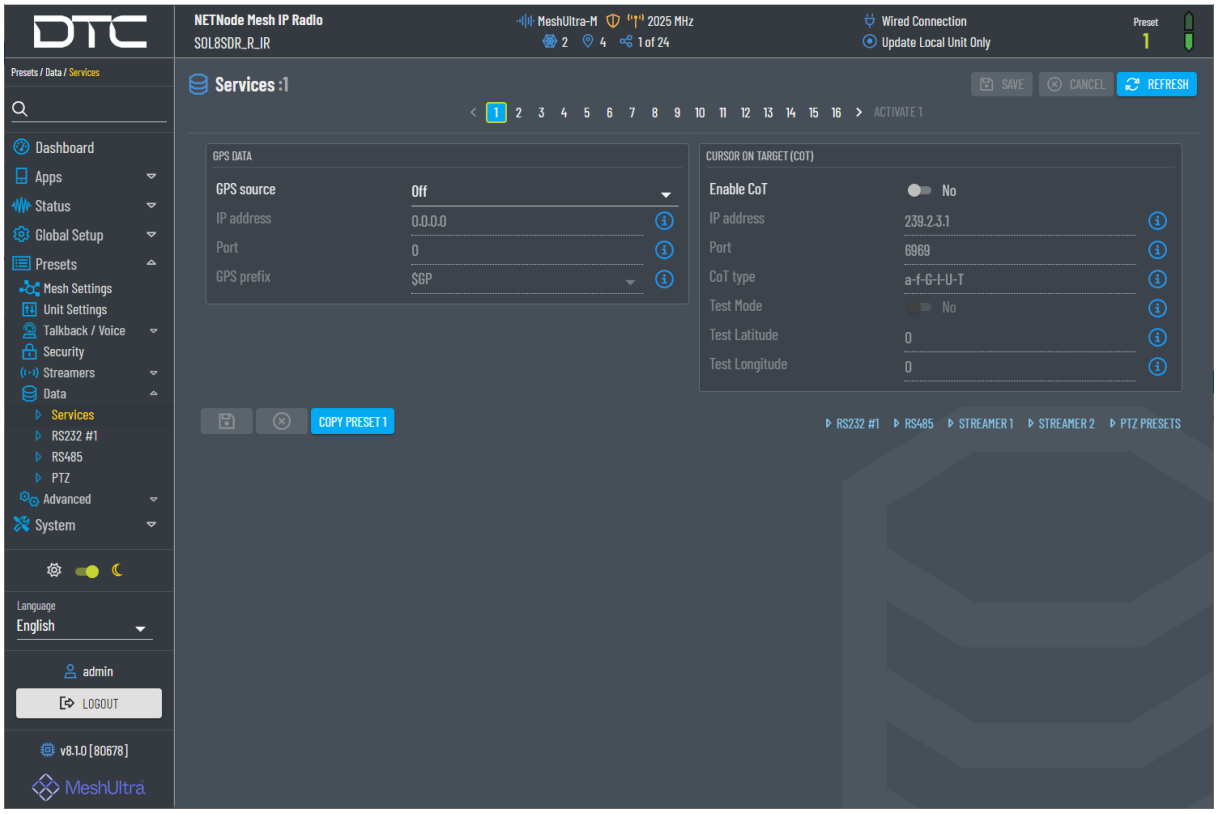
Property	Description
Resolution	Resolution is the number of pixels displayed vertically and horizontally.
Quality	The picture quality will affect bitrate.
Record stream	If set to **Yes**, the JPEG frames will be recorded to the built in SD card. Set to **No** to stop recording. Recording is applicable for USB cameras. IP cameras which are **low bitrate encoded** can also be recorded. Recordings are signed for validity and saved to the internal SD card. They can be downloaded from the **Apps>Storage Manager** page. **Note**: When the SD card is full, the oldest recordings will be overwritten. Please ensure recordings are downloaded to avoid loss.

8.12.5 Audio

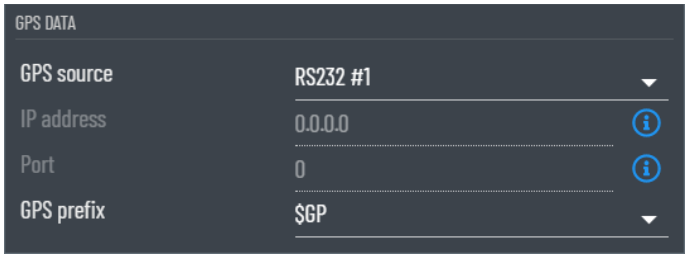


Property	Description
Mode	Select an audio stream format for onward processing.
Mic gain	The slider is used to adjust the gain applied to the audio input signal. If you have low level audio sources, you may need more gain.
Record audio	If set to **Yes**, the audio will be recorded to the built in SD card. Set to **No** to stop recording. Audio recordings are added to the video and saved to the internal SD card. They can be downloaded from the **Apps>Storage Manager** page. **Note**: When the SD card is full, the oldest recordings will be overwritten. Please ensure recordings are downloaded to avoid loss.

8.13 Data>Services



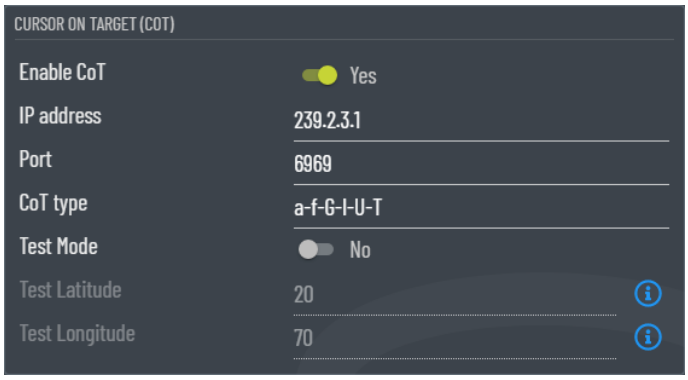
8.13.1 GPS Data



Property	Description
GPS source	**Note**: Baud rate settings can be configured in the relevant data page. Source options will depend on the device hardware. **IP/UDP** will allow GPS data over a UDP IP stream. In this mode, set the IP address and port. **IntGPS** is for devices with an in-built GPS receiver. **USB** is for when a USB GPS source is attached. **GPIO RS232** is for products with a GPIO port which will allow low voltage serial data.
IP address	Valid when IP/UDP is selected as the GPS source. The IP address can either be: • Unicast address of a unit sending GPS NMEA data • 255.255.255.255 will accept NMEA from any address on that port • A multicast address used to send data
Port	Valid when IP/UDP is selected as the GPS source. This is IP port from which GPS data will be transferred.
GPS prefix	This identifies the talker ID of the transmitting unit. • $GP: Global Positioning System • $GN: Mixed GPS and GLONASS and other • $BD: BeiDou Navigation Satellite Systems

8.13.2 Cursor on Target (COT)

Cursor on Target is an exchange standard that is used to share information using XML. UDP CoTs messages are updated every 2s.



Property	Description
Enable Cot	If set to Yes, Cursor on Target is enabled.
IP address	Enter the destination UDP IP address.
Port	Enter the destination UDP port number.
CoT type	The CoT type field identifies a specific node. The type definitions are based on the MIL-STD-2525B specification.
Test mode	Test mode will provide test CoT data in the absence of a GPS fix.
Test Latitude Test Longitude	Enter a latitude and longitude to place the CoT test data.

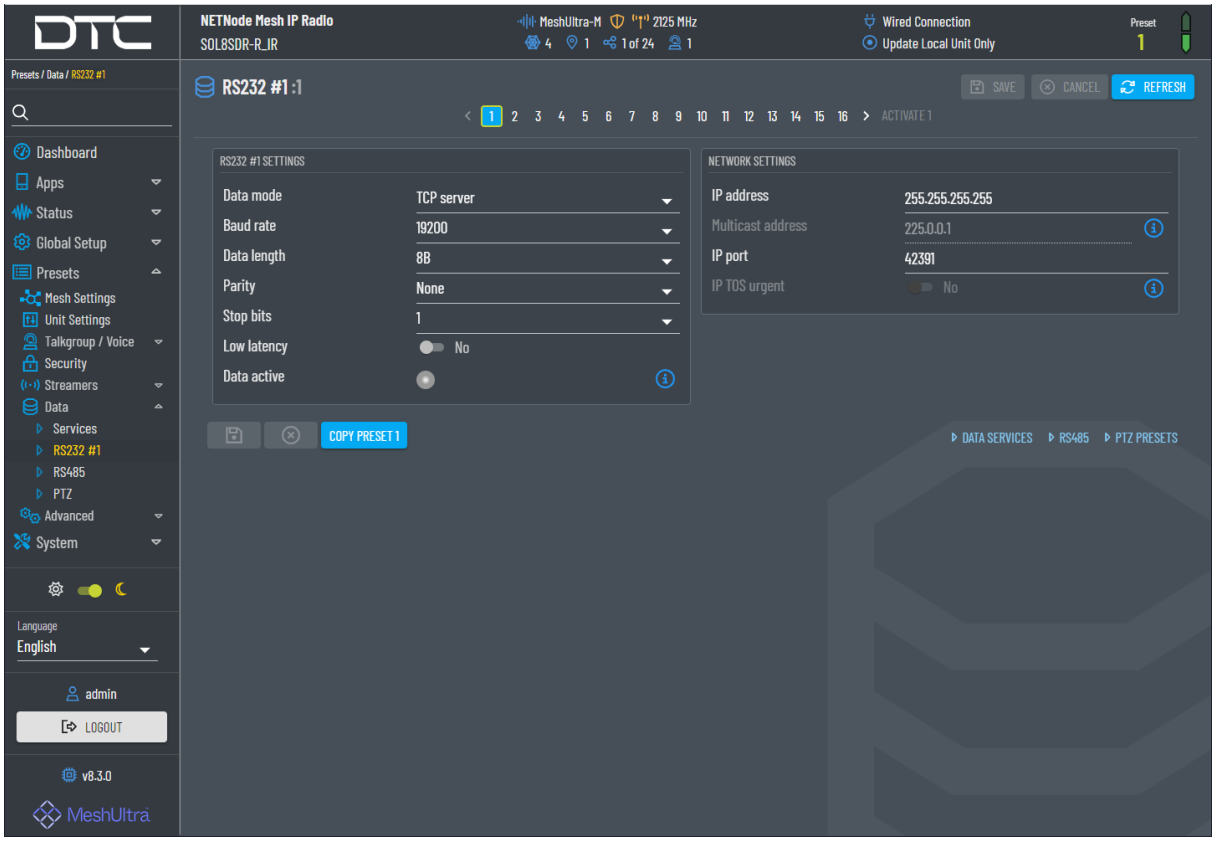
8.14 Data>RS232 / RS485 / Internal GPS / USB / GPIO RS232

The **Internal GPS** page will show for devices fitted with an internal GPS receiver and the **USB** page will show when a USB to serial adaptor is connected to the USB port.

Note: Up to three USB ports can be supported via a hub. The USB mode must be set as **Host** in the **Global Setup>General Settings** page.

The **GPIO RS232** page will show for products with a GPIO port which will allow low voltage serial data transfer when a **Data Mode** is enabled.

Serial or Telnet communications can be used to send/receive data packets over TCP or UDP. See examples in *Section 11.3*.



Data Note

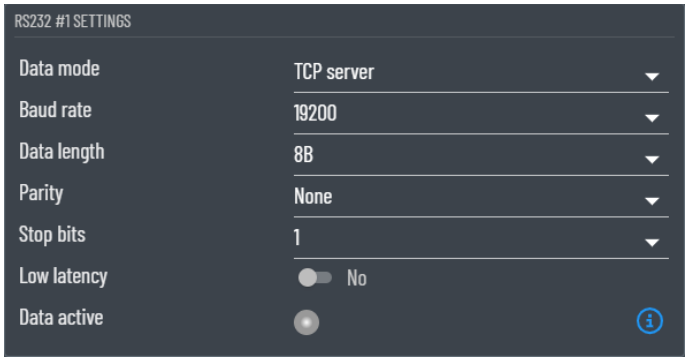
The data process is an interrupt-based system, so if there is data in the unit's buffers to send, it will be given to the Mesh algorithm to send.

In a large system it may take a small amount of time for the Mesh network to establish, so data sent to the unit's buffers at that point may not be guaranteed to be sent. If there is a small delay in transmitting data, this could be due to a large network establishing links.

Furthermore, it is possible that in a Mesh network with poor RF connections, the system will need to perform multiple hops. If nodes are dropping in and out constantly this is not ideal to ensure the delivery of data from point A to B.

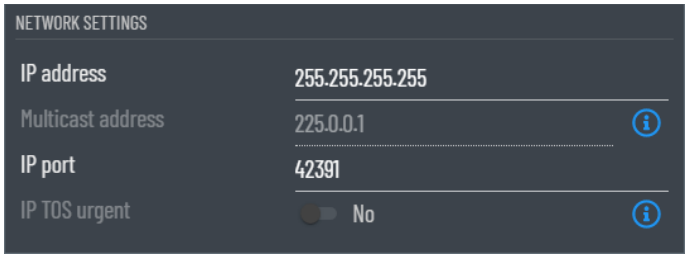
It is recommended to design a system with good RF connections between nodes to ensure reliable data communications.

8.14.1 Data Settings



Property	Description
Data mode	**UDP**: UDP packets are sent out and the system does not expect a reply. There is no way that the sending device can tell if the data arrived at the destination. **TCP**: TCP packets are sent out and the system will expect a reply. Each message is acknowledged by the destination device. **Note**: Setting one node to **TCP Server** and one to **TCP Client** allows data pipes to form. The **Multicast** data modes allow a single node to send data to multiple nodes in the system. It also creates a unicast data return channel. This may be useful in a UAV application to send GPS data to all receivers. **Control**: This will allow four letter control commands to be sent to the node, see *JSON Integration Guide*. **UDP/Control**: where only one serial port is available, it can be switched between **UDP** and **Control** mode. Open a terminal session and send the command **wcmd+++;**. The reply will indicate the mode: • *rcmd+++:0;* UDP mode (default) • *rcmd+++:6;* Control mode
Baud rate	Baud rate is the speed at which data will be transferred across the network.
Data length	Select the data length from 7 or 8 data bits.
Parity	A parity bit is a simple form of error correcting which ensures that the number of bits with the value 1 in a set of bits, is even or odd.
Stop bits	Stop bits are sent at the end of every character. Most devices will only need one stop bit.
Low latency	In normal operation, the frame will be sent when buffer is filled or 100ms timeout. In low latency, the timeout is 20ms which is less prone to bursts.
Data active	A visual indication of data output. • Grey: no data in buffers • Green: data in transmit buffer • Yellow: data in receive buffer • Lime green: data in transmit and receive buffers

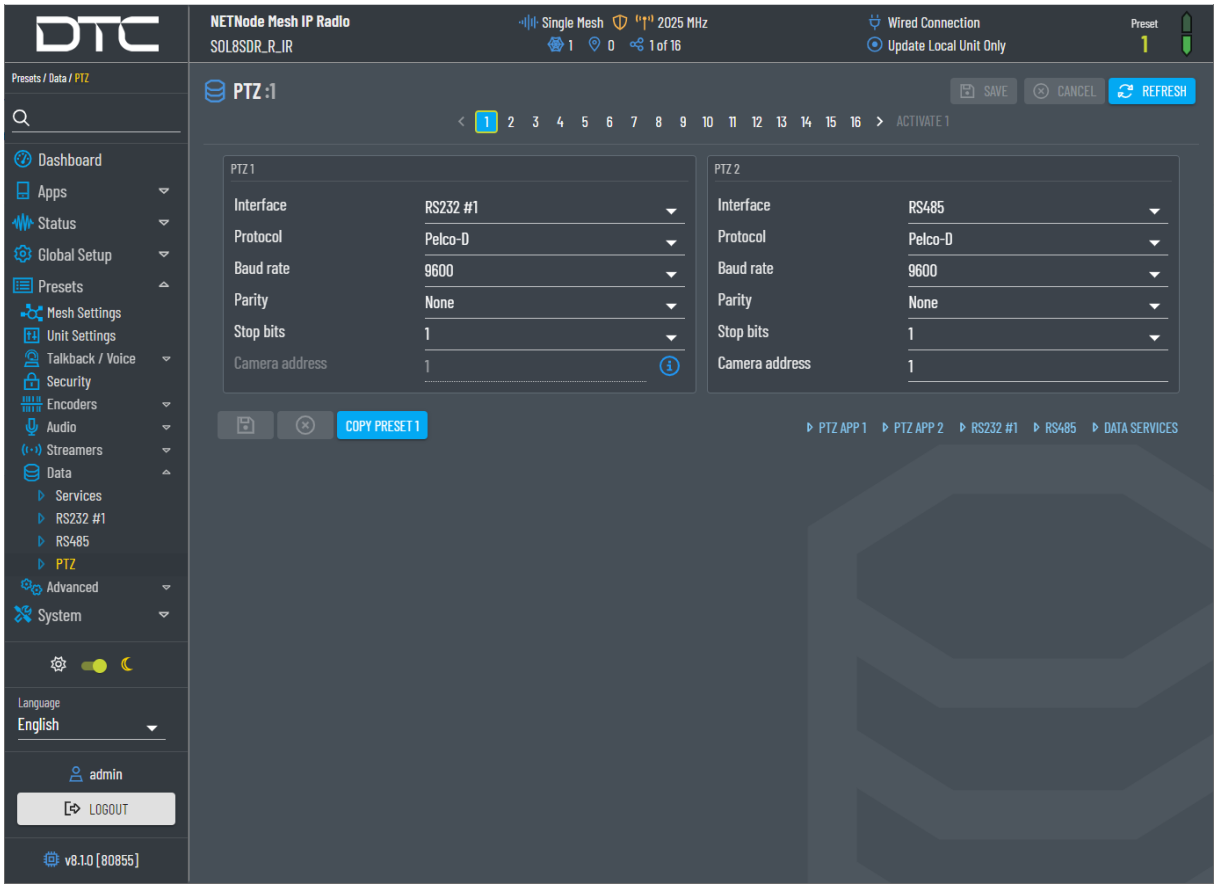
8.14.2 Network Settings



Property	Description
IP address	This sets an IP address to and from which the data will transferred. The IP address of the destination computer which wishes to connect or all 255's for any host (except UDP unicast).
Multicast address	Set the multicast address for source and sink to the same value. The address must be different from any multicast streaming and data channels.
IP port	The IP port which data will be transferred to and from. The port is reserved for data traffic while the data link is connected.
IP TOS urgent	If set to **Yes**, this will set the priority for IP packets to data (default priority is talkgroup audio). **Note**: TOS = type of service

8.15 Data>PTZ

The PTZ page allows you to configure the data settings for attached PTZ cameras. This will need to be configured to allow the PTZ App to operate, see *Section 5.4*.

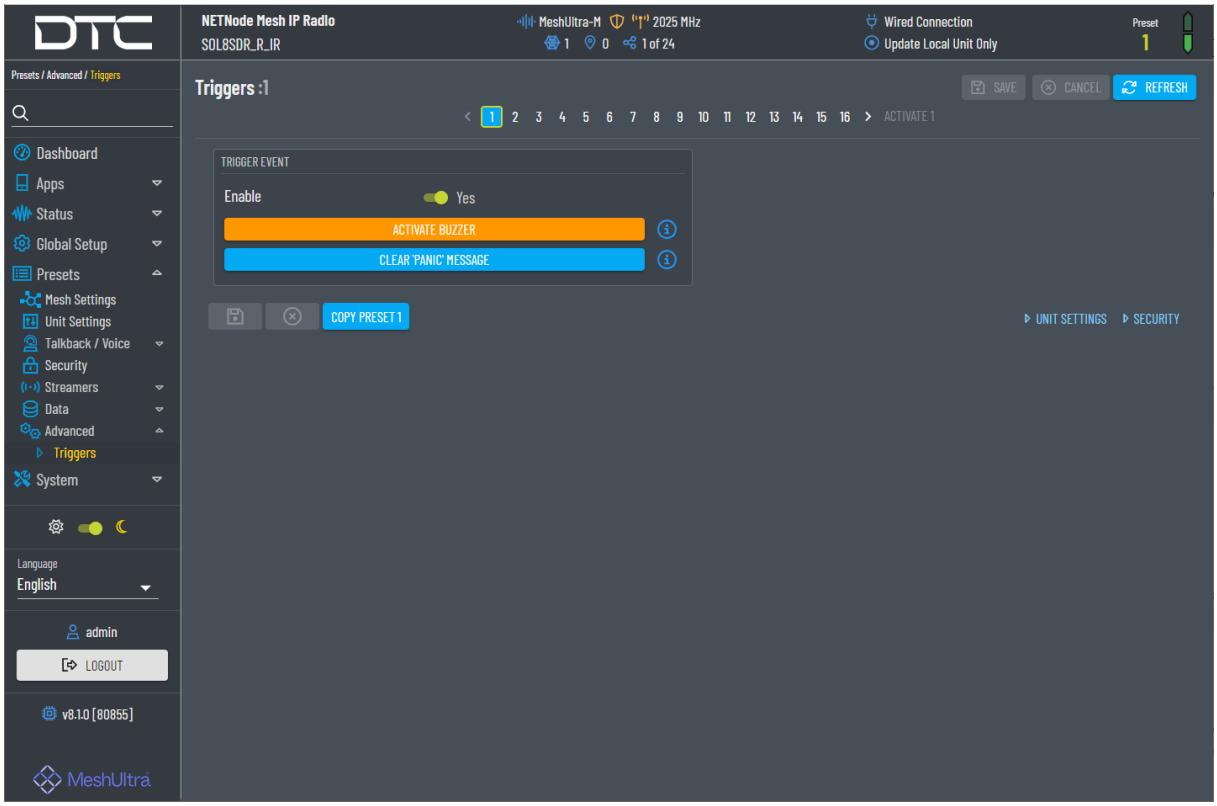


Property	Description
Interface	The serial interface for the transfer of PTZ data between your camera and the unit. Interface options will depend on the device hardware. **GPIO RS232** is for products with a GPIO port which will allow low voltage serial data.
Protocol	Supported PTZ control protocols.
Baud rate	The baud rate of the output.
Format	The data and parity bit.
Camera Address	In the range 1-255. The attached camera must be given a unique address which the unit must match. **Note**: The interface must be RS485 to apply this setting.

8.16 Advanced>Triggers

Products with a GPIO port may be fitted with a panic buzzer/panic button on the GPIO connector. See example setup in *Section 11.8*.

Note: The buzzer can be activated, and alarms can be cleared, from the WUI by any node variant.



Set Enable to **Yes**, to allow the trigger events to become live. If set to **No**, you will not be able to activate buzzer alarms or see panic messages.

When you click **Activate Buzzer**, an alarm will be invoked on products with a GPIO port which are fitted with a buzzer device. The buzzer will operate for 4 seconds.

Products with a GPIO port can be fitted with a panic button device which when activated will invoke an alarm message to all nodes in the network. The alarm will show node and time details in a real time status banner which can be viewed from any page in the WUI.

Click **Clear Panic Message** to clear the alarm.

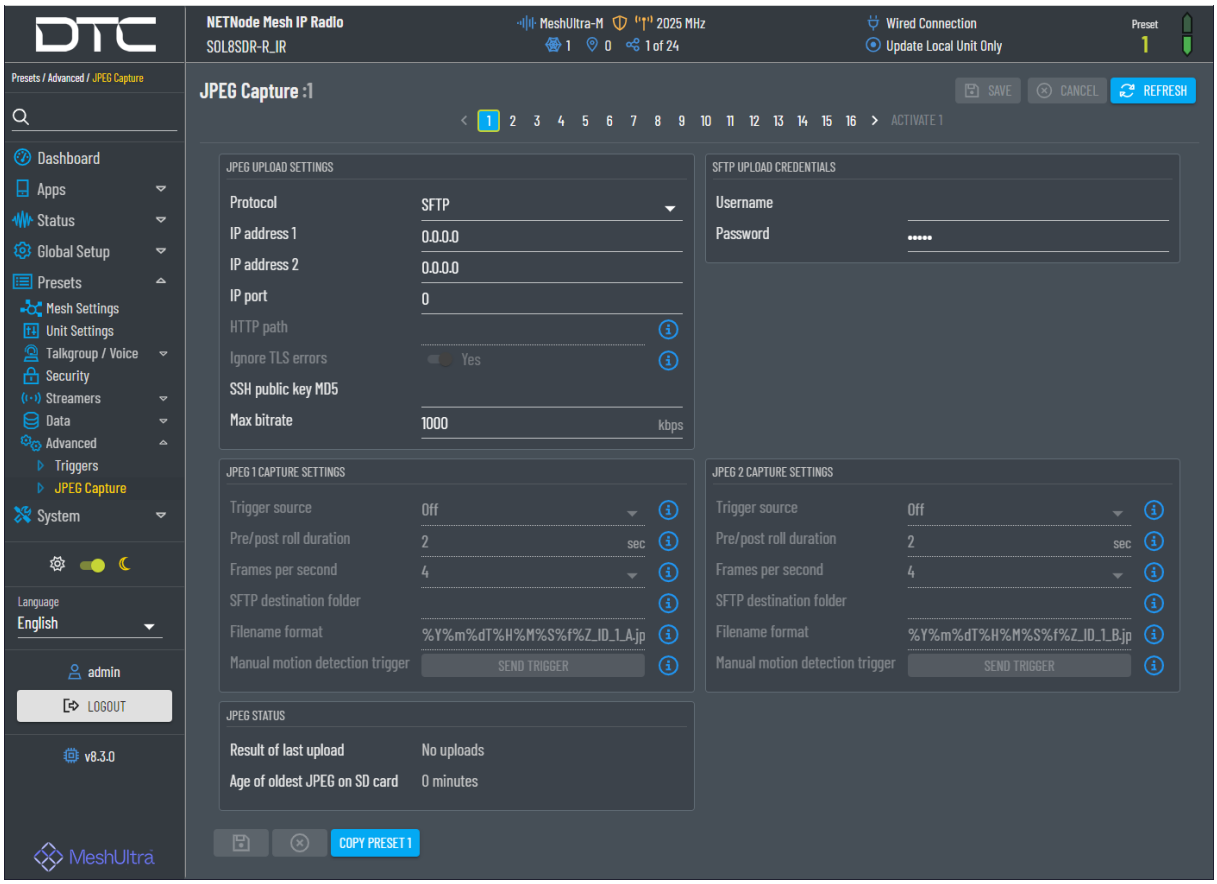
8.17 Advanced>JPEG Capture

8.17.1 Introduction

JPEG capture is a licensed feature that is used in combination with motion detection (see *Section 5.6*); images will be recorded at the moment of trigger along with both pre-trigger and post-trigger images for a set duration.

The device is configured to send the captured JPEG files onwards to servers for storage and further processing using a range of industry standard file transfer protocols.

Note: The SD card is used as a transfer buffer for images; when files are transferred, they will be deleted from the SD card.



8.17.2 Audit Logs

If there are errors in the JPEG upload process, it may be useful to view the audit logs. To access the current log file, enter:

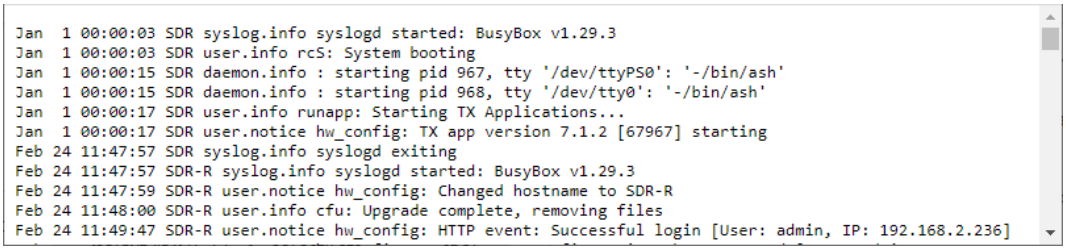
http://<*ip_address*>/audit_log.txt

The maximum size of each audit log is 500kB. When the current audit log reaches this size, it gets rotated, and a new file takes its place. There is a maximum of three rotated log files plus the current file for a total of 2MB. To access rotated log files, enter:

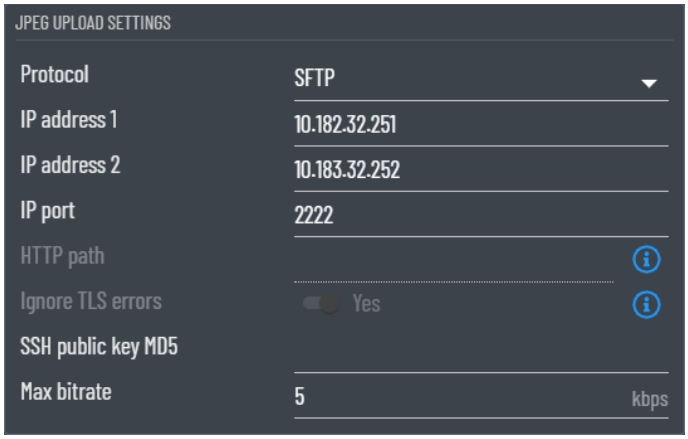
- http://<*ip_address*>/audit_log.txt?i=1
- http://<*ip_address*>/audit_log.txt?i=2
- http://<*ip_address*>/audit_log.txt?i=3

A page error will occur if there are no logs to show.

After each power cycle, the log will begin with a boot sequence for the SDR application dated Jan 1, but once booted will return the current date logs.

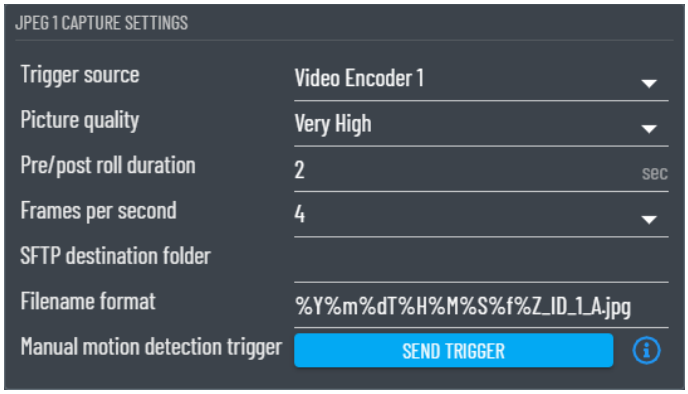


8.17.3 JPEG Upload Settings



Property	Notes
Protocol	Select the file transfer protocol from **SFTP**, **HTTP** or **HTTPS**. This must be compatible with the back-end server used to store the captured JPEG files. To allow HTTPS secure web communications, a CA certificate must be loaded on the device, see *Section 9.3.5*.
IP address 1 IP address 2	The IP address of the server used to save images. Two IP addresses are provided for load balancing of the saved images. The images will be saved alternately between each server. If IP address 2 is set to 0.0.0.0, images will not be saved to this address.
IP port	The IP port that the server will use for JPEG capture.
HTTP path	The HTTP path extends the URL with a user-specified setting. The complete path is: http://<*ip_address*>:<*ip_port*>/<*HTTP path*> e.g., http://10.182.32.251:2222/upload.cgi
Ignore TLS errors	When HTTPS is selected as the transfer protocol, set this to **Yes** to disregard Transport Layer Security (TLS) errors which will be generated when a CA certificate has not been loaded. **CAUTION**: Web communications will not be fully secure.
SSH public key MD5	The checksum key used by the **SFTP** client to identify the server. The checksum will be provided by the IT administrator. If the key is not entered, the device will not authenticate the target SFTP server.
Max bitrate	The bitrate for transfer of JPEG images. Large JPEG files will take longer to upload with low bitrates. If set to 0 (zero), this will allow unlimited bitrate for file transfer. See **Picture Quality** below.

8.17.4 JPEG Capture Settings



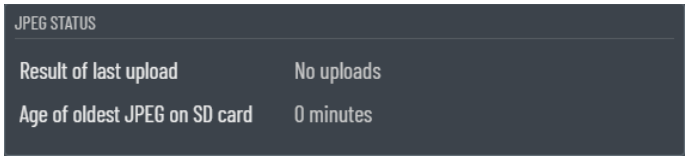
Property	Notes
Trigger source	Select the trigger source for the JPEG capture. **Note**: Ensure video encoding has been enabled. It may be necessary to reduce the JPEG frame period, see *Section 8.8.2*.
Picture quality	Select a value to increase or reduce picture quality. Higher quality images create larger files which will take longer to transfer if Max Bitrate is set too low or use more bitrate if the Max Bitrate setting is not constrained.
Pre/post roll duration	Sets the time duration for capture of pre/post-trigger images. If this is set to 0 (zero) only the trigger image will be uploaded.
Frames per second	Sets the number of pre/post-trigger images that will be uploaded per second. Used in relation with **pre/post roll duration**, this will determine how many images are uploaded for each event plus the event image. For example, with pre/post roll duration set to 2 sec and frames per second set to 4, a total of 17 images will be uploaded (i.e., 1 event frame + 8 pre-frames + 8 post-frames).
SFTP Destination folder	The user's destination folder in the SFTP server that images will be uploaded to. This will need to match a valid folder in the server. For LINUX based SFTP servers, the use of a tilde (~) will cause files to be sent to the user's home directory. Alternatively, the full path can be entered, e.g., **/home/sftp**. If this is left blank the files will be posted to the root directory which the user may not have permissions to write to.
Filename format	The format used to convert date and time objects to their string representation (see https://strftime.org/). Text can be edited or added for identification. For an explanation of the default format, see *Table 8-2*.
Manual Motion Detection Trigger	Click **Send Trigger** to activate a trigger. Manual triggering will be useful in system testing.

The default filename format for camera A is %Y%m%dT%H%M%S%f%Z_ID_1_A.jpg and an example filename might be 20201225T09050150UTC_ID_1_A.jpg. This can be explained in the table below.

Format Code	Description	Example
%Y	Year with century as a decimal number	2020
%m	Month as a zero padded decimal number	12
%d	Day of the month as a zero padded decimal number	25
T	“T” character inserted for clarity between date and time	T
%H	Hour (24-hour clock) as zero padded decimal number	09
%M	Minute as a zero padded decimal number	05
%S	Second as a zero padded decimal number	01
%f	Hundredths of a second as a zero padded number	50
%Z	Time zone abbreviation	UTC
_	Underscore character inserted for clarity	_
ID	Text can be edited to suit filename conventions	ID
_	Underscore character inserted for clarity	_
1	Text can be edited to suit filename conventions	1
_	Underscore character inserted for clarity	_
A	Text can be edited to suit filename conventions. A or B has been used to differentiate between each encoder.	A
.jpg	JPEG file type format	.jpg

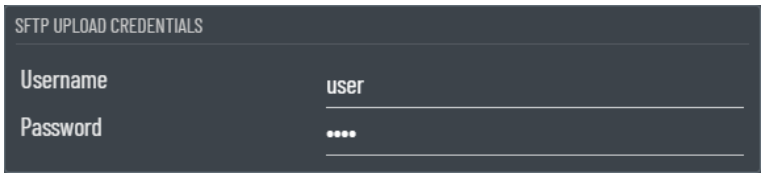
Table 8-2 Default Filename Explained

8.17.5 JPEG Status



Property	Notes
Result of last upload	This will display a **Success** or **Fail** value to indicate if files are being uploaded to the remote server correctly.
Age of oldest JPEG on SD card	The SD card is used as a transfer buffer for images; when files are transferred, they will be deleted from the SD card. If the most recent trigger occurs within 10 seconds of the oldest trigger, the most recent JPEGs will be sent first. Otherwise, the oldest JPEG images will be sent first and then sequentially. The age of the oldest JPEG on the SD card is updated every 10s. **CAUTION**: If the age of JPEGs on the SD card reaches 24 hours, the oldest files will be lost first. If this time exceeds 12 hours, it is recommended to investigate the transfer rate of images, for example by increasing the Max Bitrate, reducing the quantity of images or the sensitivity of the trigger.

8.17.6 SFTP Upload Credentials



The Username and Password credentials in the server must be entered to allow the JPEG images to be uploaded.

9. System Pages

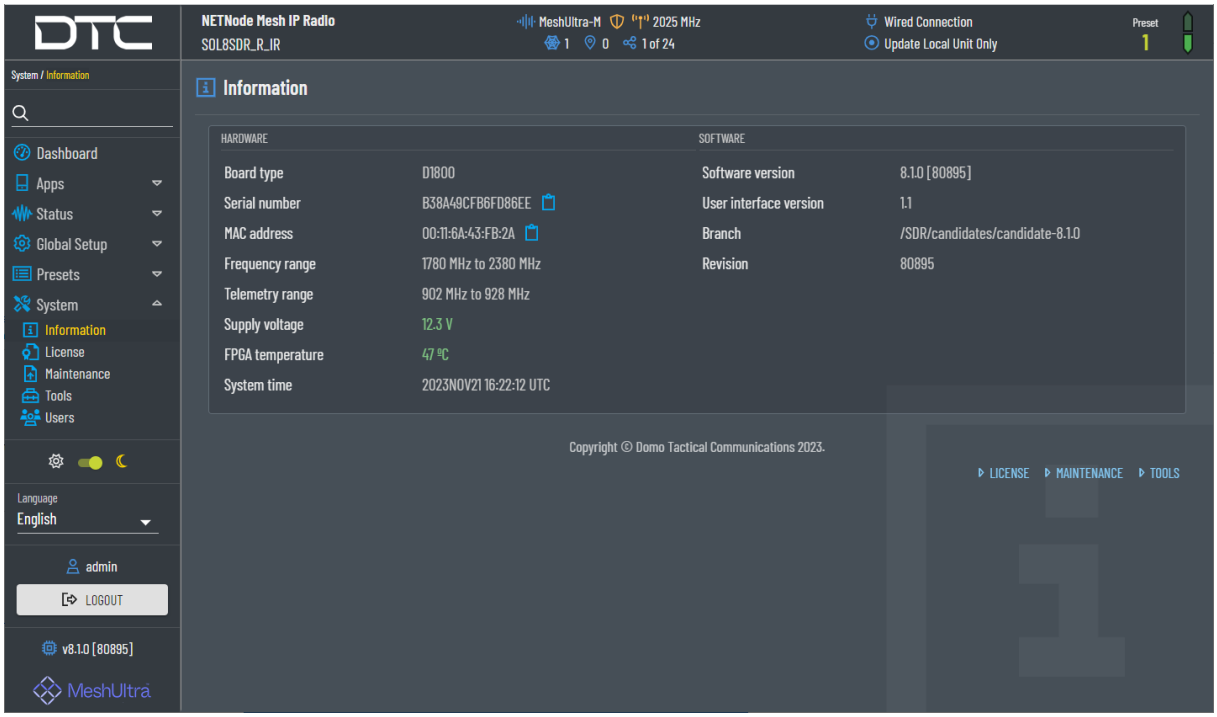
9.1 Information

The information page provides details that may be useful during a service call.

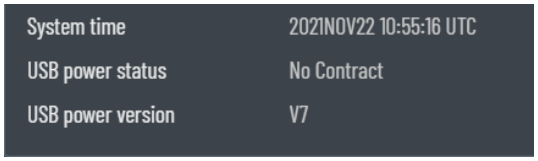
The internal PCB hardware revision will be appended for D196x and D198x/D1990 and D1800 (>v6.0). The hardware revision is not currently supported for D1740 based nodes.

The system time is displayed in UTC time. To set the time go to the **Global Setup>Region & Time** page, see *Section 7.4*.

Colour-coded FPGA temperature can also be viewed on the **Dashboard**, see *Chapter 4*.



Variants that have USB power delivery will show the power status and firmware version.



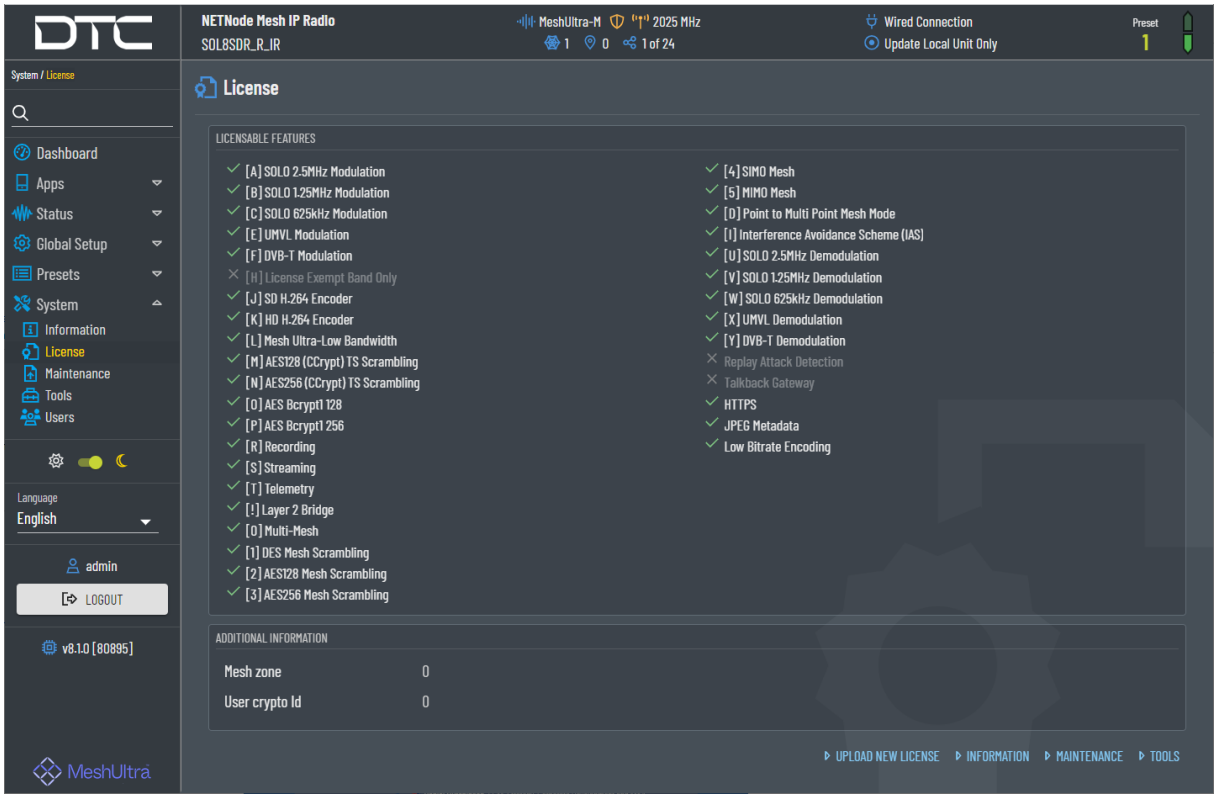
USB power status can have one of the following values:

USB PD Status	Description
No Contract	PD chip OK, but no contract negotiated.
Limited Power	Power supply is offering a low power contract that limits or disables RF output.
9.00V@3.00A 15.00V@2.00A	A contract was negotiated that allows full RF power.
Error 1-6 Error 7 Error 8	Internal error in power delivery chip. I2C error. Power delivery firmware failed to boot.

9.2 License

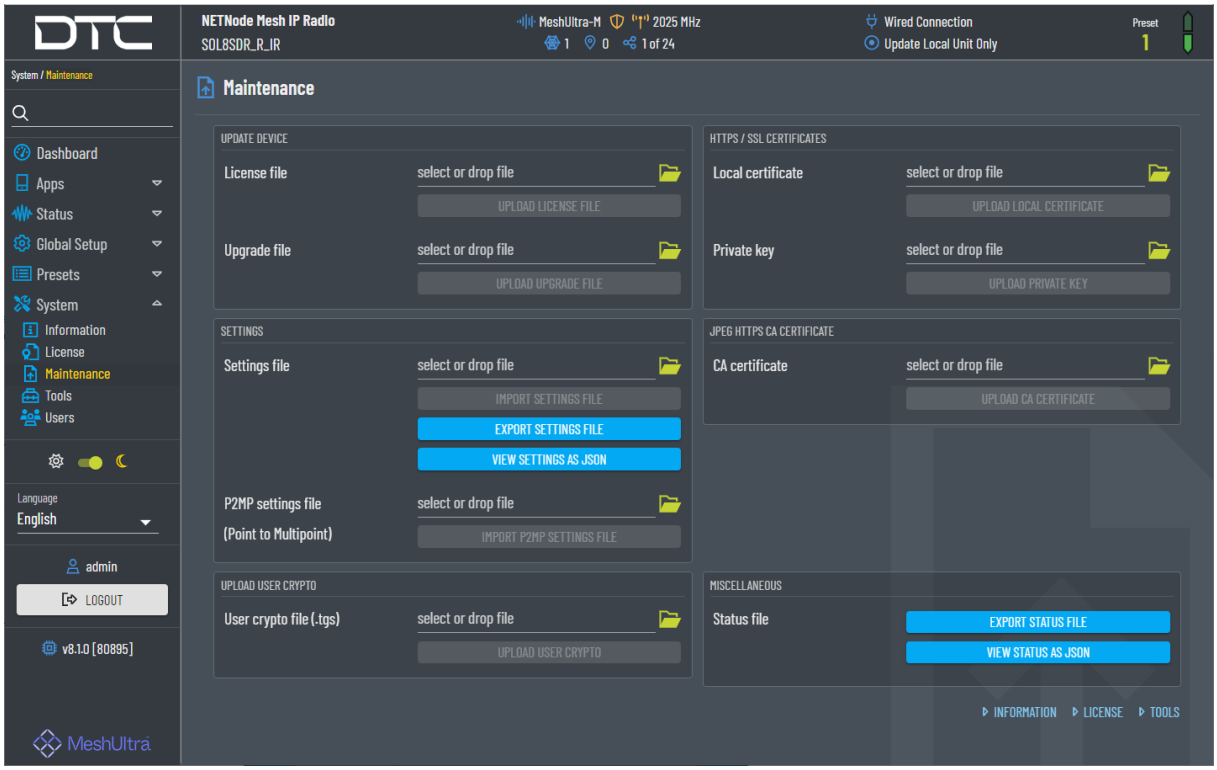
The License page shows a list of features which will provide functionality.

The enabled licenses are highlighted and marked with a tick. New licenses can be uploaded from the **System>Maintenance** page.



9.3 Maintenance

The Maintenance page is used to upload or download files to and from the node.



9.3.1 Update Device

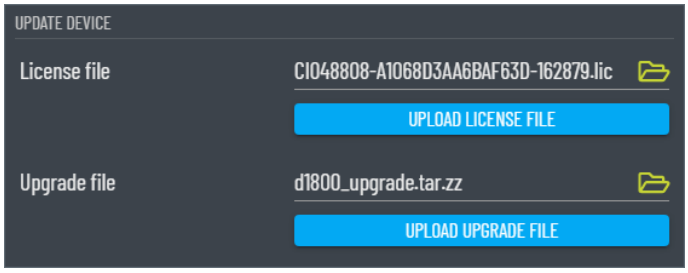
Update Device provides the recommended method to upgrade software and licenses to a single node.

Note: If multiple nodes on a Mesh network require software upgrade, an efficient tool for doing this is DTC's **Domo Upgrade Tool** which can be downloaded from WatchDox, see *Section 13.1*.

Note: Multiple upgrades may be performed quicker if all nodes are at the highest bandwidth setting, however, the maximum bandwidth capability (20MHz or 10MHz) should not be exceeded.

The software upgrade file will depend on the internal PCB which can be found in the **System>Information** page.

CAUTION: It is recommended that software for all devices in a Mesh network should be at the same version to avoid potential compatibility issues. See *Table 9-1* for software compatibility.



Browse for files by clicking the file icon or alternatively, files can be loaded by drag and drop. Initialise the upgrade by clicking the **Upload License File** or **Upload Upgrade File** button.

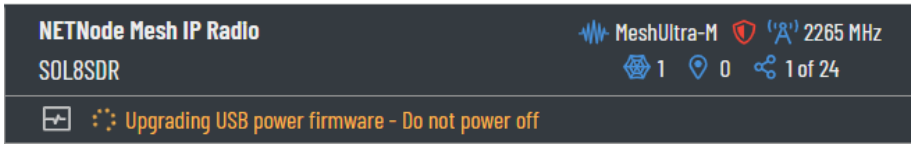
Update progress will be displayed throughout the process. When the upgrade is complete, refresh the browser to enable new software features.

Note: If the device loses power during a software upgrade, the upgrade will start again when the unit is repowered.

USB Power Delivery

Where SDR devices carry a USB PD chip, the upgrade file will also carry the latest PD chip firmware. When the software is upgraded, the PD chip will also upgrade, if needed.

A banner will be displayed showing the upgrade is being processed and the progress can be viewed in the **System>Information** page.

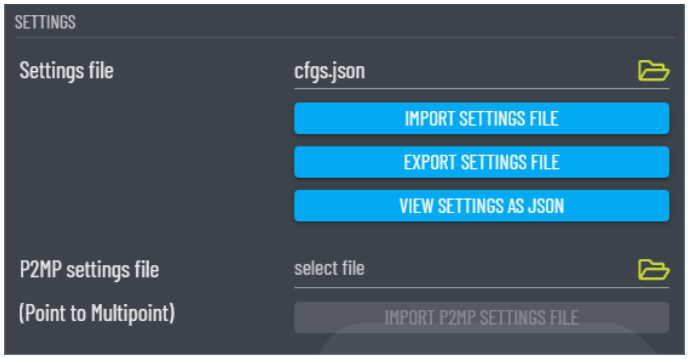


Software Compatibility

Software Version Waveform	< 5.1.0	v5.1.0-5.3.0	v6.0.0-6.4.0	v7.0.4-7.2.4	≥ v8.1.0
< v5.1.0 Single Mesh	✓	✓	✓	✓	✗
< v5.1.0 MIMO	✓	✗	✗	✗	✗
< v5.1.0 MeshUltra	✓	✗	✗	✗	✗
v5.1.0-v5.3.0 Single Mesh	✓	✓	✓	✓	✗
v5.1.0-v5.3.0 MIMO	✗	✓	✓	✓	✗
v5.1.0-v5.3.0 MeshUltra	✗	✓	✗	✗	✗
v6.0.0-6.4.0 Single Mesh	✓	✓	✓	✓	✗
v6.0.0-6.4.0 MIMO Mesh	✗	✓	✓	✓	✗
v6.0.0-6.4.0 MeshUltra	✗	✗	✓	✓	✗
v7.0.4-7.2.4 Single Mesh	✓	✓	✓	✓	✗
v7.0.4-7.2.4 MIMO	✗	✓	✓	✓	✗
v7.0.4-7.2.4 MeshUltra	✗	✗	✓	✓	✗
v7.0.4-7.2.4 MeshUltra-X	N/A	N/A	N/A	✓	✗
≥ v8.1.0 All modes	✗	✗	✗	✗	✓

Table 9-1 Software Compatibility

9.3.2 Settings

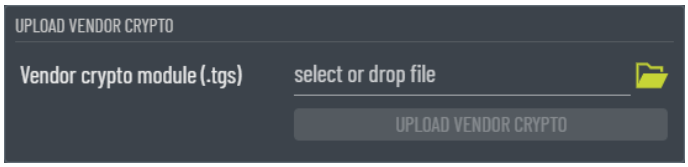


The Settings pane provides an easy way to import, export or view JSON configuration files.

Note: Full details on working with JSON data can be found in DTC's *JSON Integration Guides*.

The P2MP settings file is loaded in conjunction with Mission Commander setup.

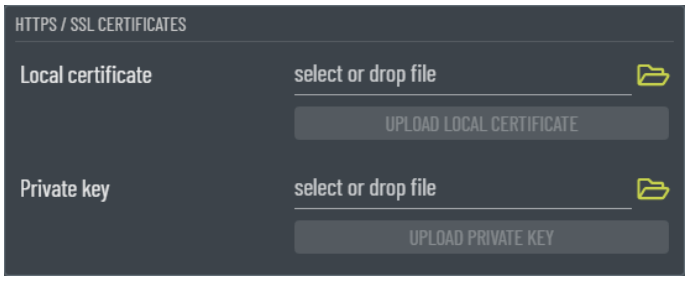
9.3.3 Upload Vendor Crypto



Users may wish to upload cryptographic algorithms specific for their region or operational need. The vendor software is supplied to DTC as a shared object which is combined to form a bundle to be uploaded. Please contact DTC if this licensed feature is a requirement, see *Section 13.2*.

The cryptographic file can be removed from the **System>Tools** page, see *Section 9.4.2*.

9.3.4 HTTPS / SSL Certificates

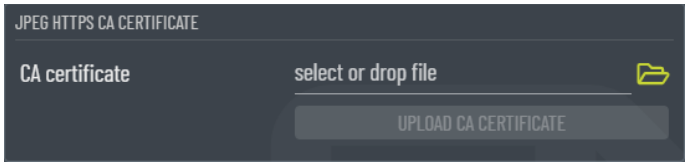


Please refer to the *Hardware Guide* for details.

Hypertext Transfer Protocol Secure (HTTPS) is used for secure communication over a computer network between a web browser and server.

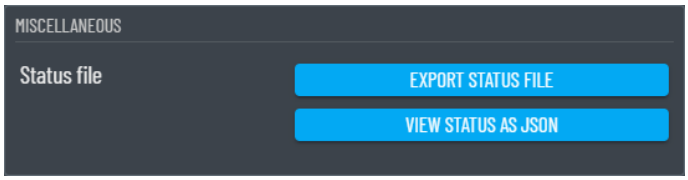
DTC are now able to offer HTTPS web communications on products which are *licensed*, to ensure security of passwords, encryption keys and other sensitive information passed over the network.

9.3.5 JPEG HTTPS CA Certificate



When HTTPS is selected as the file transfer protocol in JPEG Capture (see *Section 8.17.3*), a valid HTTPS CA certificate must be loaded to ensure fully secure web communications. In this scenario, the node will be acting as an HTTPS client device.

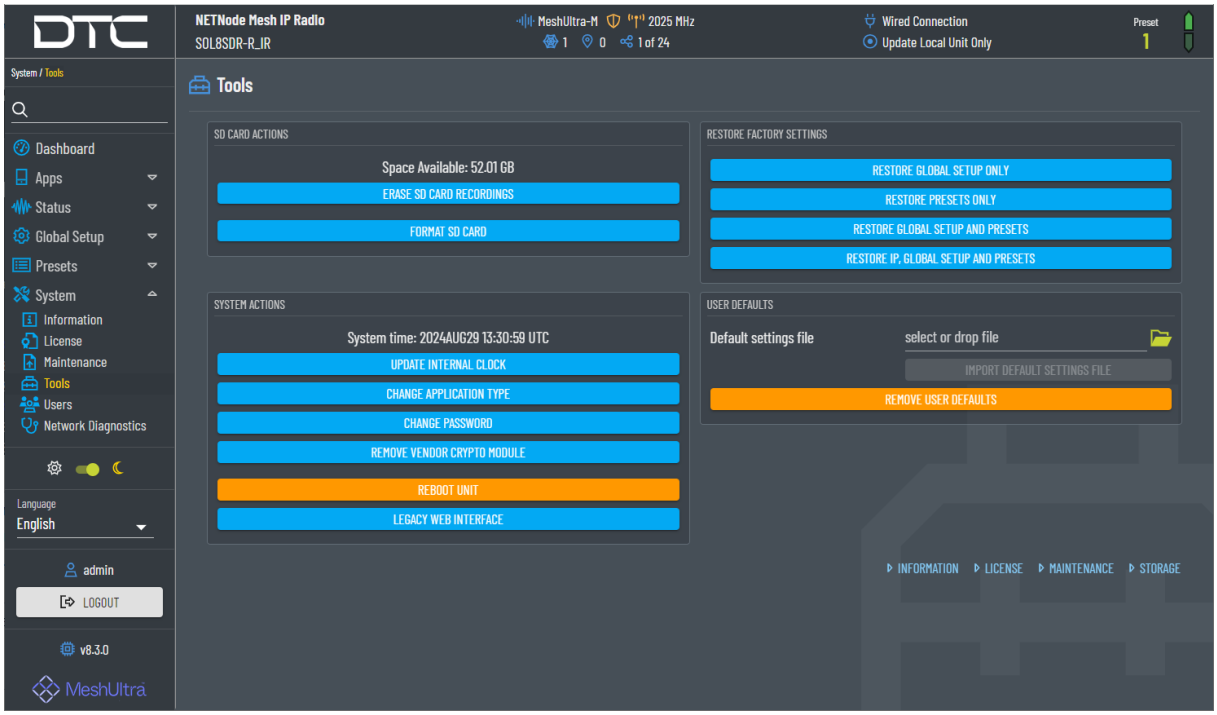
9.3.6 Miscellaneous



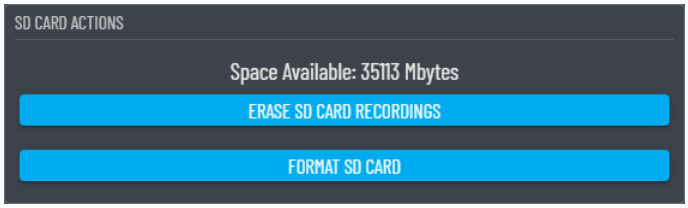
The Miscellaneous pane provides an easy way to export or view JSON status files.

Note: Full details on working with JSON data can be found in DTC's *JSON Integration Guides*.

9.4 Tools



9.4.1 SD Card Actions

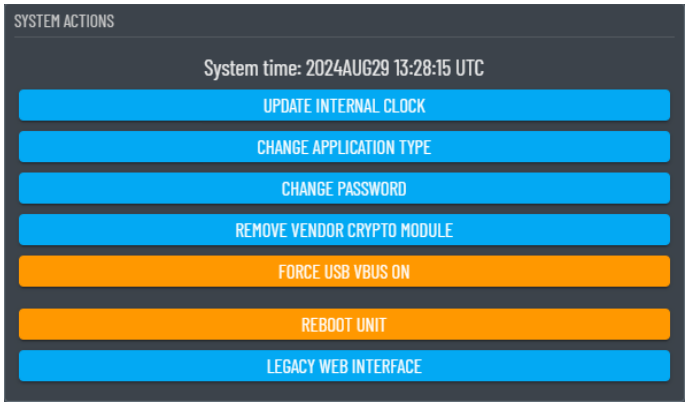


An internal SD card is used to store recordings and for receiving upgrade files.

Format SD Card will format the SD card and erase all data or **Erase SD Card Recordings** only.

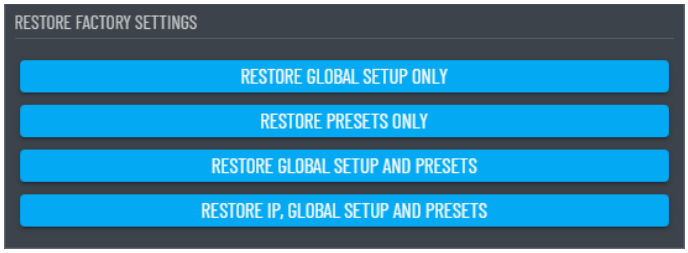
Available storage space can also be monitored.

9.4.2 System Actions



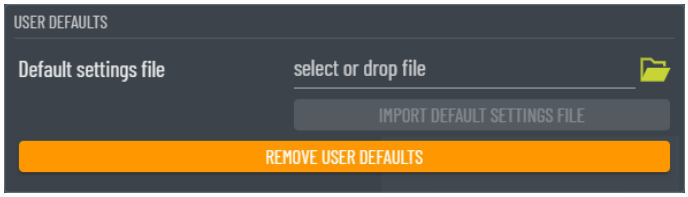
Property	Description
Update Internal Clock	Sets the internal clock to the PC system time.
Change Application Type	The SDR application can be changed to SOL-TX or SOL-RX if the required licenses have been applied.
Change Password	The login password can be changed from the default **Eastwood**. If the password is changed and then forgotten, there is a password reset process detailed in the *Hardware Guide*.
Remove Vendor Crypto Module	Crypto modules can be removed by clicking this button. For more detail see *Section 9.3.3*.
Force USB VBUS On	In USB device mode, the VBUS line is normally set off. This button will override this behaviour and force VBUS on. **WARNING**: This special use case requires cabling to prevent damage to hardware. Please contact DTC if unsure if this setting should be applied.
Reboot Unit	This selection will force a reboot of the device.
Legacy Web Interface	This button will revert the WUI to the legacy version.

9.4.3 Restore Factory Settings



Property	Description
Restore Global Setup Only	Restores the Global Setup to factory default conditions. The IP settings and unit name will be retained.
Restore Presets Only	Restores the 16 Preset configurations to factory default conditions. The IP settings and unit name will be retained.
Restore Global Setup and Presets	Restores Global Setup and 16 Preset configurations to factory default conditions. The IP settings and unit name will be retained.
Restore IP, Global Setup and Presets	Restores **all** settings to factory default settings, including IP settings and unit name.

9.4.4 User Defaults

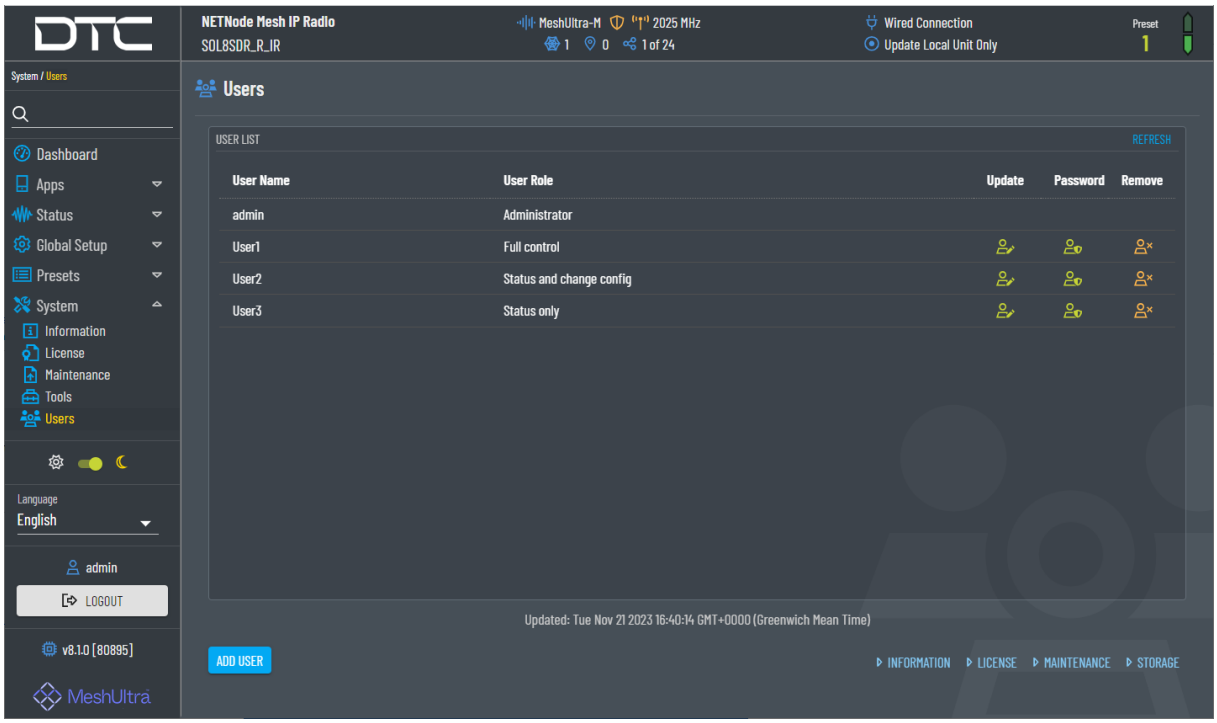


This feature allows the user to upload a saved JSON settings file (see Section 9.3.2) to configure the unit to user defined settings when a restore to defaults is performed.

9.5 Users

Web users can have four levels of access:

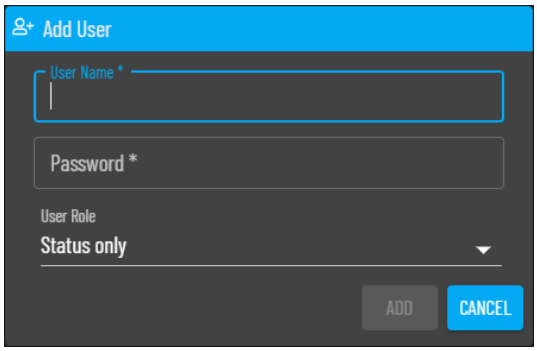
Administrator, **Full Control**, **Status and Change Config**, **Status Only**.



The Administrator uses the default login password, **Eastwood**. The Administrator can add up to 31 user accounts and manage their permissions.

Click the **Add User** button to enter user login credentials.

Note: User names and passwords are case sensitive.

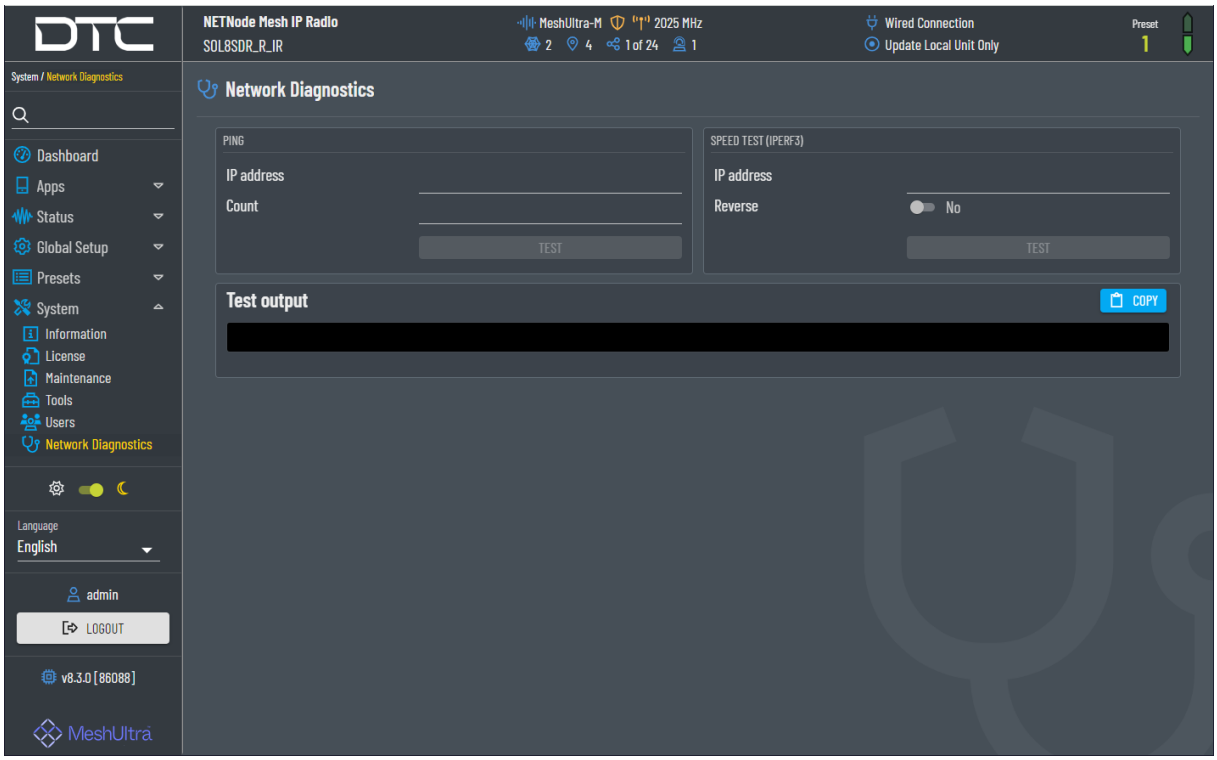


User Roles:

- **Full control** allows most administrator permissions but will not allow user management or restore factory settings.
- **Status and change config** allows the user to change the preset configuration and view settings and status. There is limited access to **System** information and can change password.
- **Status only** allows the user to view status but does not allow visibility of the settings. There is limited access to **System** information to change password.

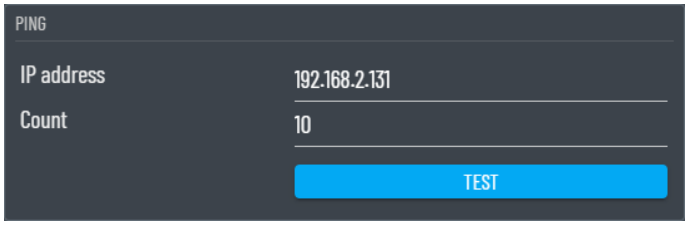
9.6 Network Diagnostics

The network diagnostics page provides a convenient way to activate common network tests.



9.6.1 Ping

A ping is used to test the reachability of an IP address on the network.

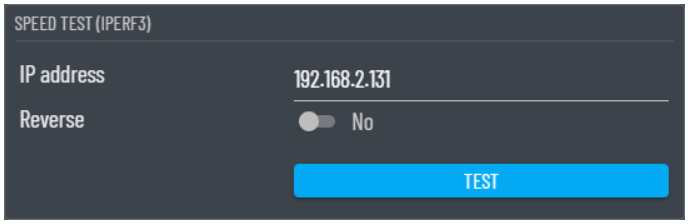


Enter the destination **IP address** and the ping **Count** required. Click **Test** to generate the ping. The results will be displayed on the Test Output pane and can be copied to the clipboard.

9.6.2 Speed Test (Iperf3)

Iperf is a network performance test.

Note: It is necessary for the user to have (or have access to) a running iperf server to perform the test. Mesh nodes from s/w v6.4.0 onwards have an iperf server running on them.



Enter the iperf server **IP address** and set **Reverse** to **No** or **Yes** to determine the direction of the test. Click **Test** to generate the iperf. The results will be displayed on the Test Output pane and can be copied to the clipboard.

Note: Iperf should only be used as a testing format as it will have an effect on overall throughput of the system.

10. Interlink Operation

10.1 Interlink Basics

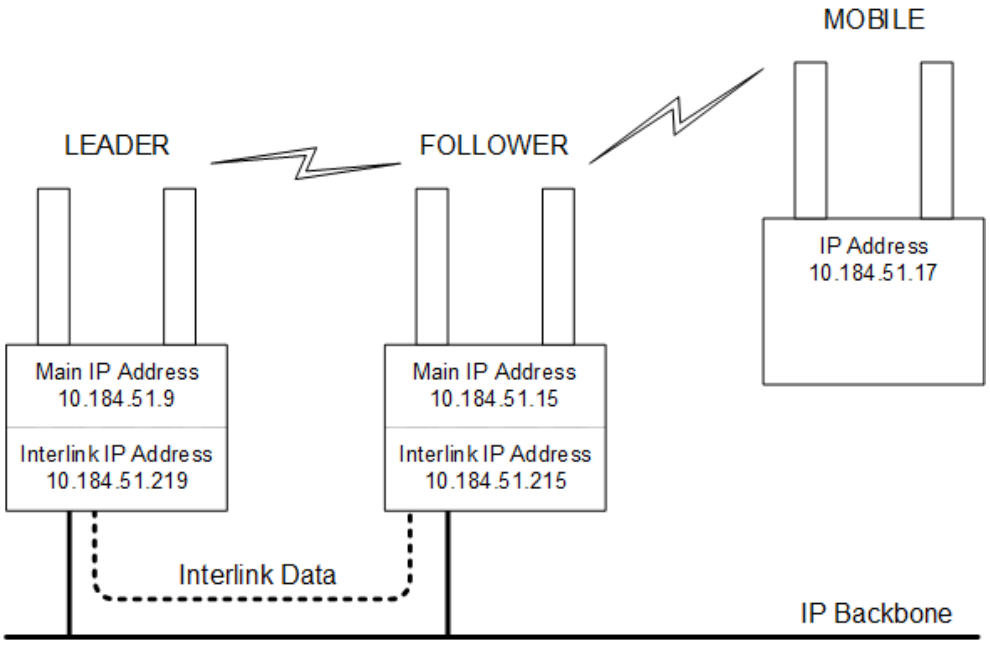
10.1.1 Interlink Introduction

Normally IP networks do not allow multiple routes from an IP source to an IP destination address. 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.

Interlink mode allows nodes to forward IP data through a backbone network as if this were an additional radio link. This allows data to forward via the backbone rather than the RF link, increasing capacity. The backbone is treated as an additional radio link having very good quality.

10.1.2 Principle of Operation

To prevent loops forming in the IP network, when two or more nodes are connected to the same backbone, one of the nodes becomes leader and the rest are followers, the leader remains connected to the network. Each node has a secondary IP address (Interlink), data which would have been sent over the RF link is now encapsulated with the secondary IP address and passed as Interlink data between nodes. The diagram below illustrates this:



In this case, the follower's main IP address is no longer connected to the IP backbone directly but passes as Interlink data over to the leader. Data from the mobile node is now forwarded over the backbone rather than the follower acting as an RF relay, improving network bandwidth.

10.1.3 Simple Configuration

To enable Interlink mode, go to the **Global Setup>Advanced>Networking** page and select the **Eth(*x*)** port which is physically connected for Interlink.

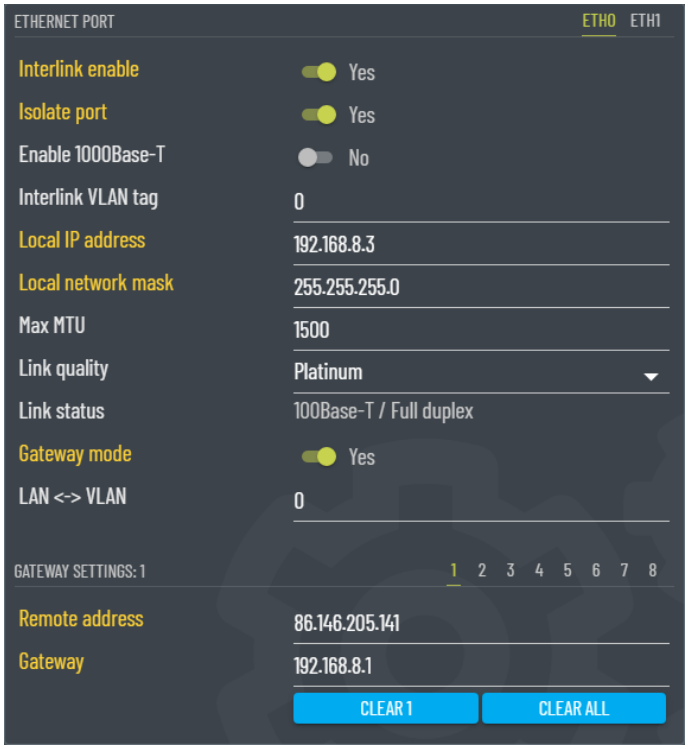
Set **Interlink enable** to Yes and enter a **Local IP address** and **Local network mask** for each node. This must be different between all nodes and from the main IP address of the unit. Interlink can use both physical ports of the unit for redundancy over multiple backbones. In this case the IP address of the two ports must also be different. The local IP addresses of all nodes sharing the same backbone should be on the same physical subnet but can be different from the main subnet of the nodes.

The **Max MTU** should be set to the same value as the network supports. For normal LAN this would be 1500. Please read description in *Section 7.6.2* for guidance.

Setting **Isolate Port** to Yes removes all incoming and outgoing traffic from the unit except the Interlink data which acts as a firewall preventing access to the unit. This should be used when connecting through an external router to the Internet. Care should be taken not to block both ports and have no radio link, as the unit will not be controllable. However, Node Finder can be used to manually unblock ports if this does occur.

Interlink mode will also allow data to be sent over a separate VLAN by specifying non-zero **Interlink VLAN tags**, see example in *Section 10.3*.

10.1.4 Gateway Mode



Gateway mode is used when Interlink is used over a firewall or Layer 3 network such as an ADSL router over the Internet. Layer 3 networks are sometimes deployed at remote sites with private ADSL connections.

The IP address must be specified for each remote node, up to eight remote addresses can be specified. The gateway of the remote router must be provided when the remote IP address is not on the same subnet as the local Interlink address.

10.1.5 Interlink Only Links

Nodes in Interlink Mode do not need to have an RF path between them. This may be useful when a node is located remotely back at base, simply to decode the Interlink data and present a layer 2 network. Different groups of nodes can be allocated different frequencies.

Links which have an Interlink only link (no RF link) appear in grey in the **Apps>Tactical Display** map view, *Section 5.2*. Links which have both Interlink and RF link between the same two nodes appear as greyed versions of the original RF signal quality colour, so a good quality RF link with Interlink would appear grey/green in the signal quality table.

To allow Interlink packets to pass over the router port, UDP/37682 may need to be specified in the port forwarding rules.

10.2 Interlink over 4G

10.2.1 Overview

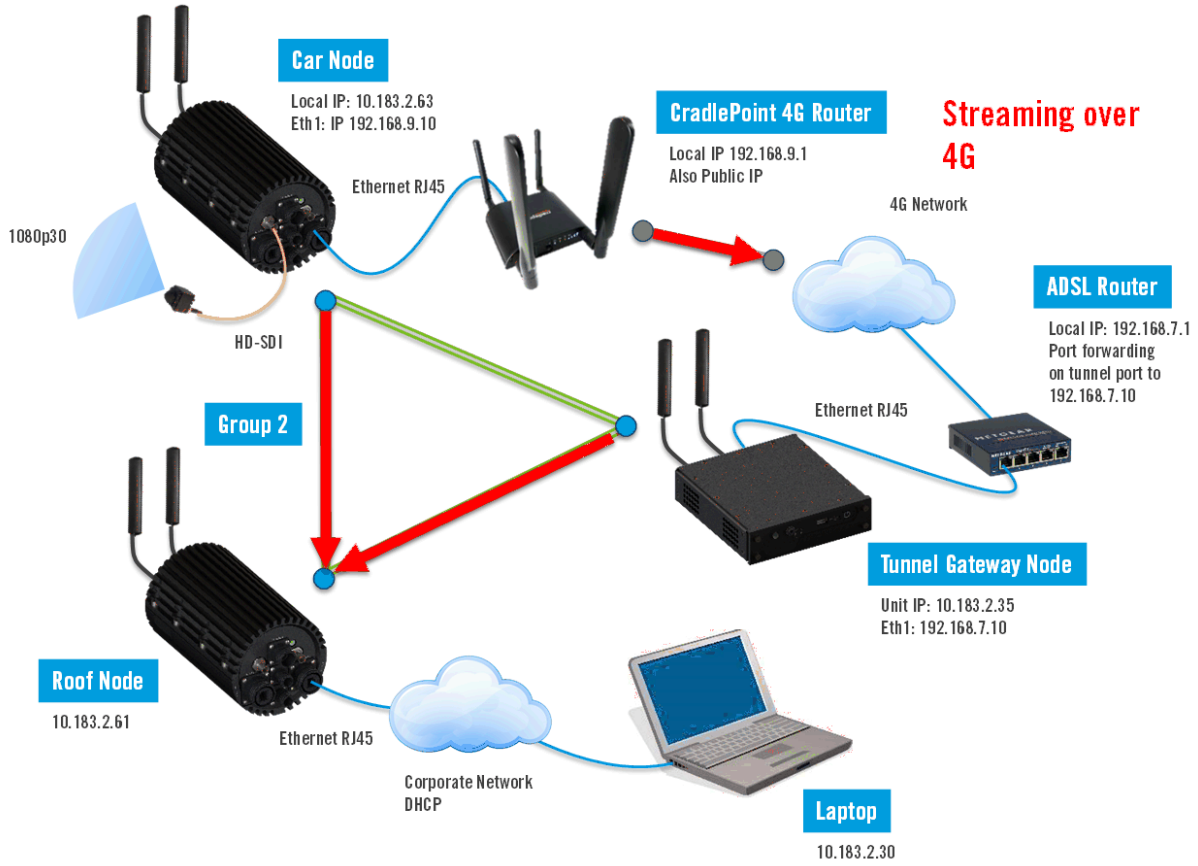


Figure 10-1 Operation with 4G Router

Interlink can be configured to function over 3G/4G networks.

For a non-static IP address, the client end (3G/4G end) will not accept incoming connections. The client end must specify the IP address of the remote ADSL router together with the local gateway of the Cradlepoint LP3 router. The server end (ADSL end) should be set to manual config but have non-entries for the remote address and gateway. Often Network Address Translation (NAT) and Port Address Translation (PAT) are employed across this sort of network so the client end cannot be reached directly. Instead, the server end will detect the arrival of the Interlink 'hello' packets and automatically know what IP address and port to send back the reply.

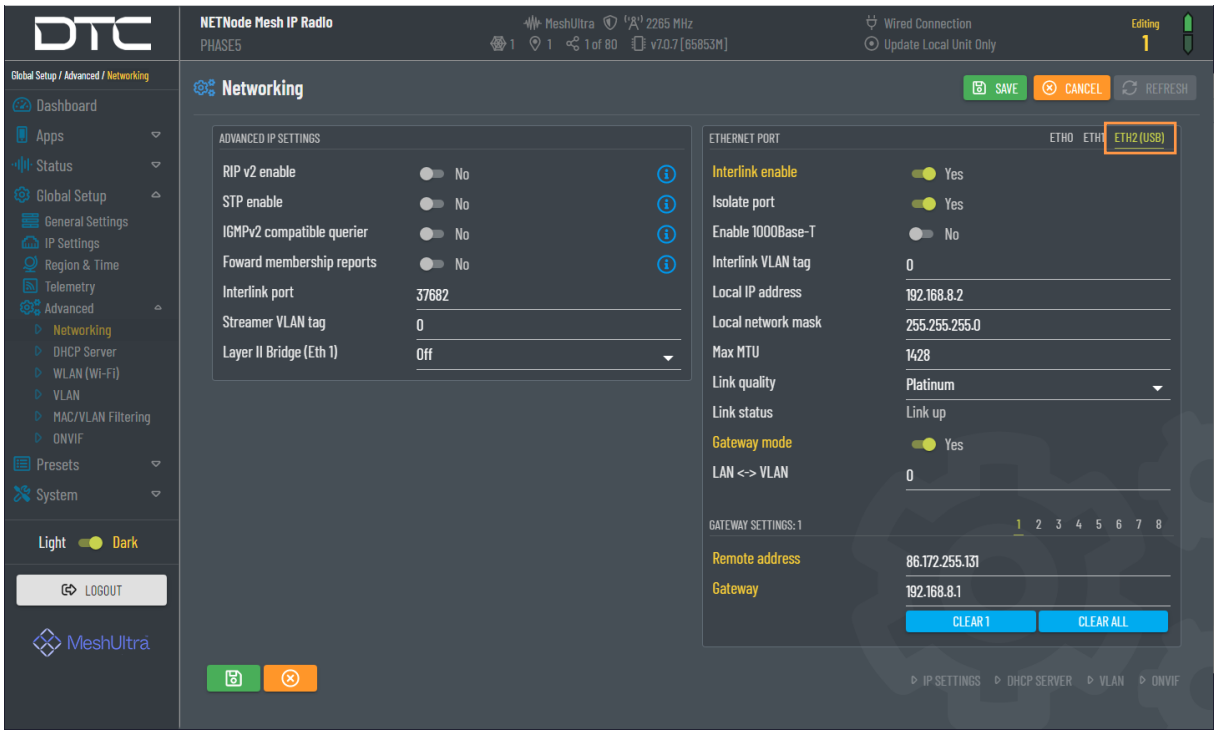
Mesh nodes support the use of a 4G dongle via the USB connection. The setup would be the same as in *Figure 10-1* but replace the router with a dongle plugged into the USB port.

DATA CAUTION: Please be aware of data usage when using a mobile network USB dongle or router. It is highly recommended to add a data use limit. **Failure to do so could incur roaming fees from your network provider**.

10.2.2 4G Dongle Example

Ensure the USB mode is set to Host in the **Global Setup>General Settings** page and attach a 4G dongle to the USB interface.

Eth (USB) settings will appear in the **Global Setup>Advanced>Networking** page.



In the **Eth (USB)** settings, set **Interlink enable** and **Isolate port** to Yes.

Set **Gateway mode** to **Yes** which allows you to setup an independent local area connection with the USB LTE device. In this case the 4G dongle has an IP address of 192.168.8.1 which is set as the **Gateway**. The **Local IP address** of the interface is then set to a compatible but different IP address to the gateway.

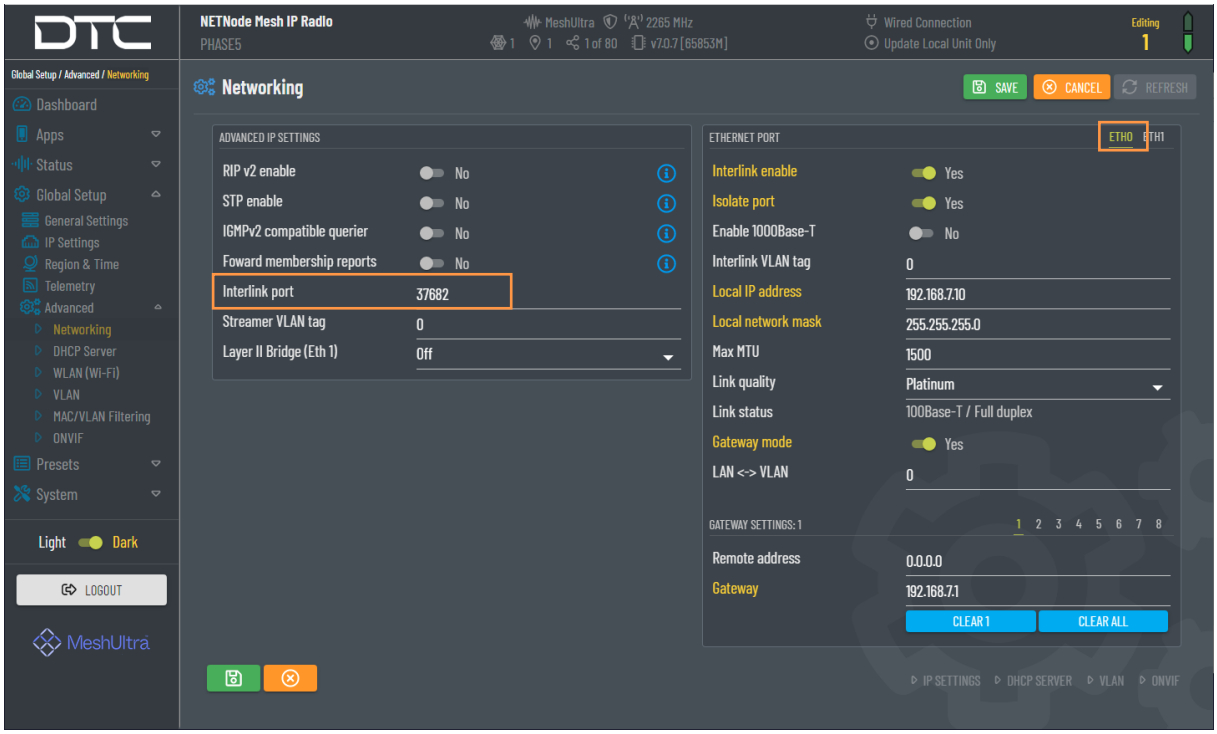
The **Remote address** is the publicly accessible IP address behind which the Interlink end point node is located e.g., 86.172.255.131.

The **Link Quality** is the fall over condition at which the 4G link will be enabled. Platinum is a permanent 4G link, but all other settings are the RF link quality based on the signal quality colours defined in *Section 6.3*.

Click **Save** to make the changes active.

The Interlink end point node is configured in much the same way. There is a local ADSL router sitting on the Eth0 interface with a local IP address of 192.168.7.1 (which we then use as the **Gateway** address). Please note no remote address is required to be set.

The ADSL router needs to be configured to port forward data on the **Interlink port**, in this case 37682, to the IP address of the radio on the Eth0 interface (192.168.7.10 in this instance).



When correctly configured, the **Apps>Tactical Display** map view will show a grey link between the two nodes connected by the Interlink connection. If an RF link also exists, the grey link is blended with the green RF link.

10.3 Interlink with One Ethernet Port

10.3.1 Introduction

There may be instances where only one port is available for Interlink, such as when using an SDR.

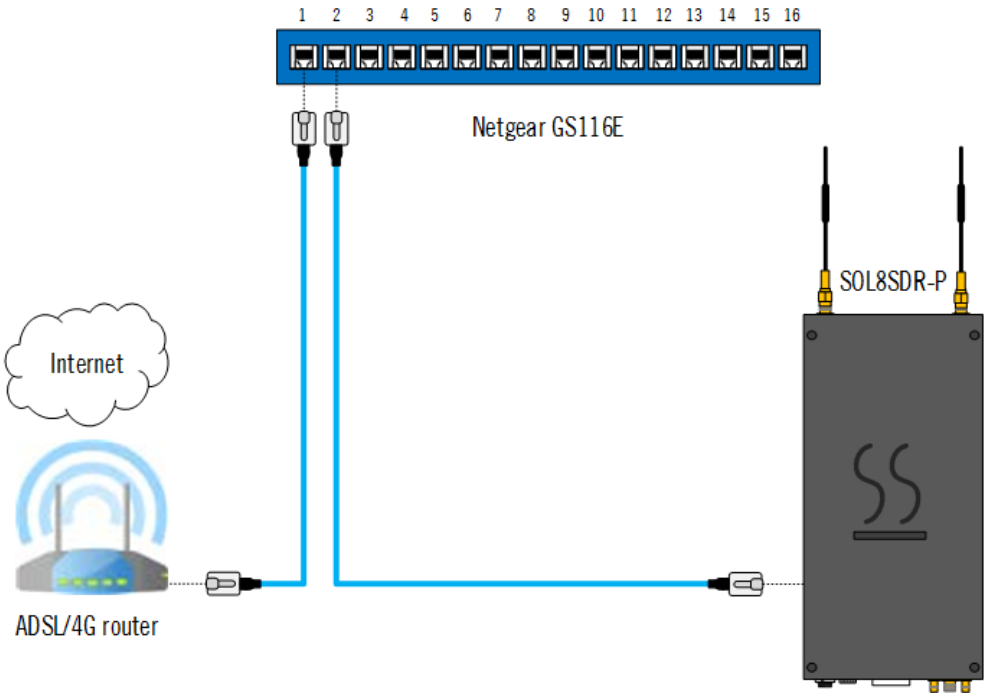
If you only have one Ethernet port but want access to the unit and operate Interlink mode, then you need to move the Interlink data onto a separate VLAN using the **Interlink VLAN tag** setting. Without this the Mesh network will have direct access to the Internet and therefore is untrusted.

Note: The Interlink VLAN tag for all nodes sharing the same backbone should have the same value. In this mode of operation each node sends a broadcast 'hello' packet (e.g., 192.168.8.255) to establish connections with other nodes on the backbone. The Interlink address selected can be also checked with ping (ICMP).

10.3.2 Setup

This example shows how to setup an SDR Mesh with a Netgear GS116E switch.

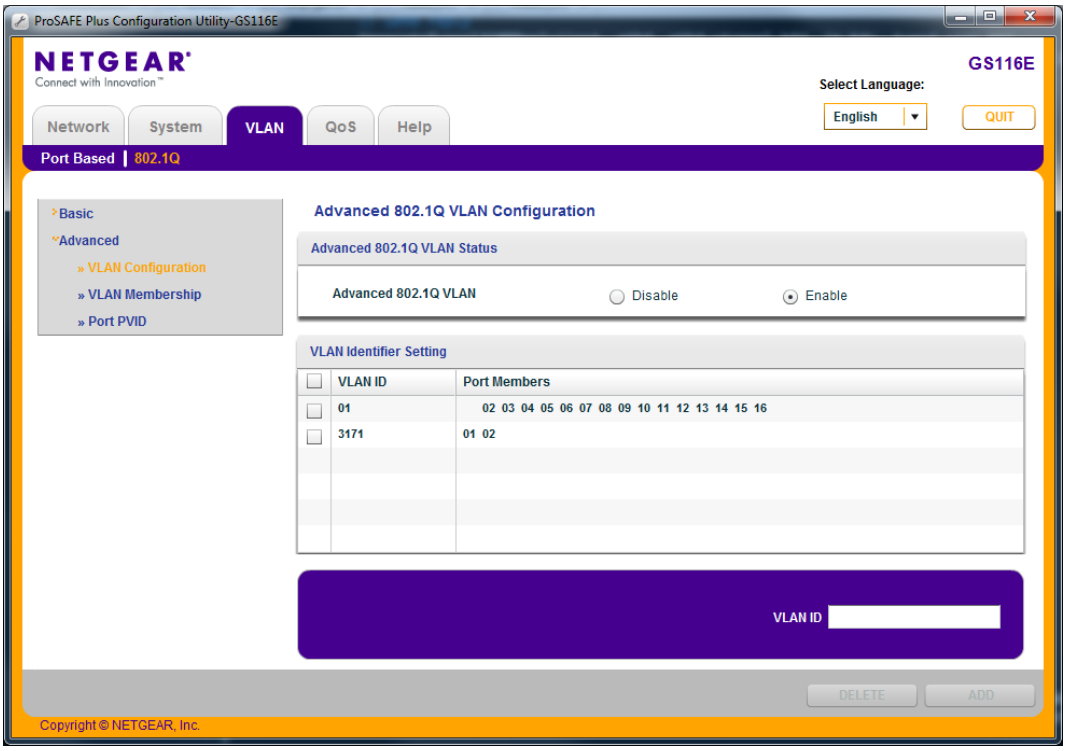
Port 1 of the switch is connected to an ADSL or 4G router and Port 2 to the SDR. All remaining ports are for the private Mesh network only.



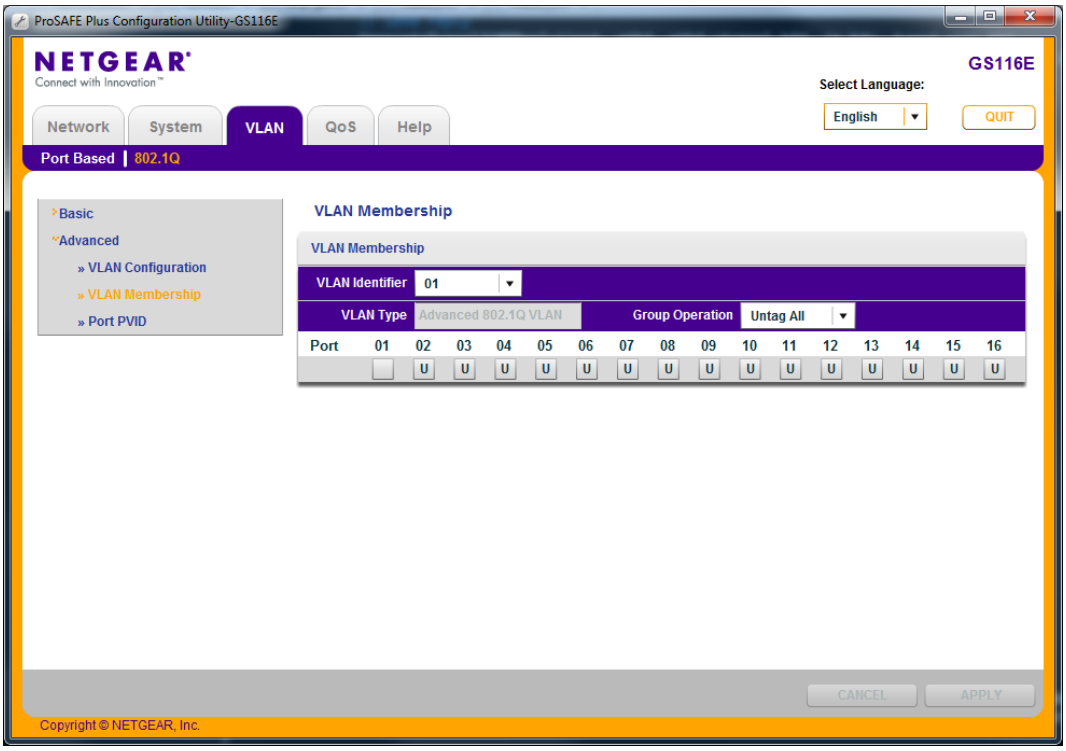
10.3.3 Switch Configuration

The screenshots below show the GS116E VLAN configurations.

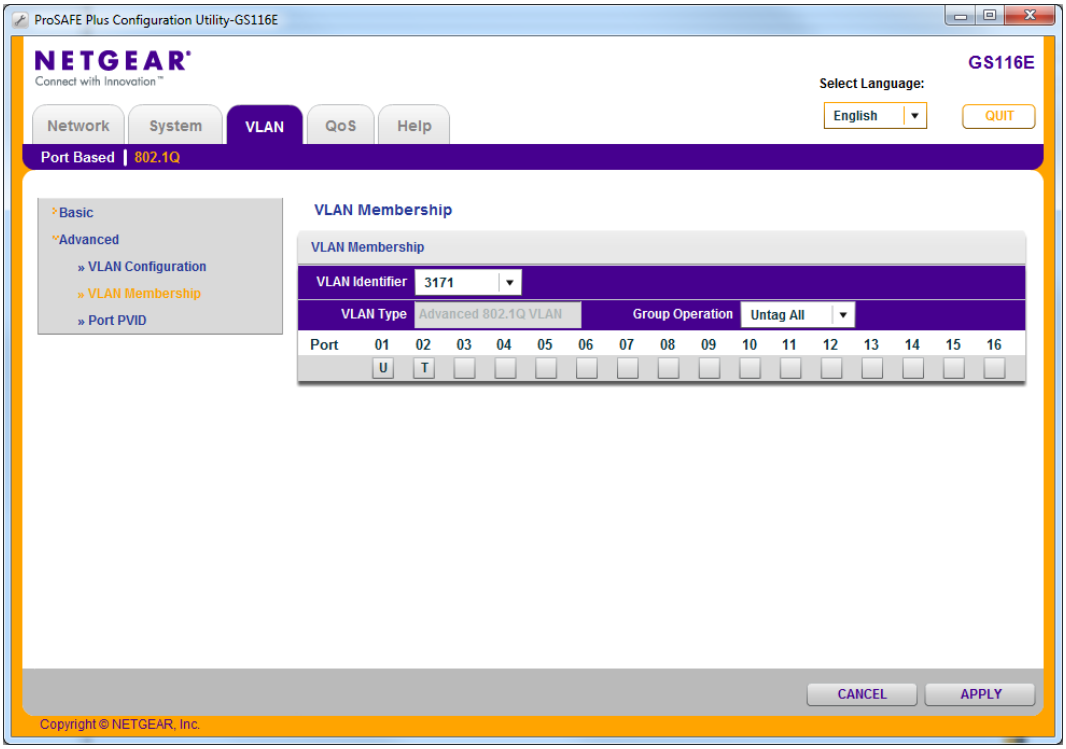
VLAN 01 includes all ports allocated to the private Mesh network. VLAN 3171 includes the 4G/ADSL router port (01) and the SDR Mesh port (02).



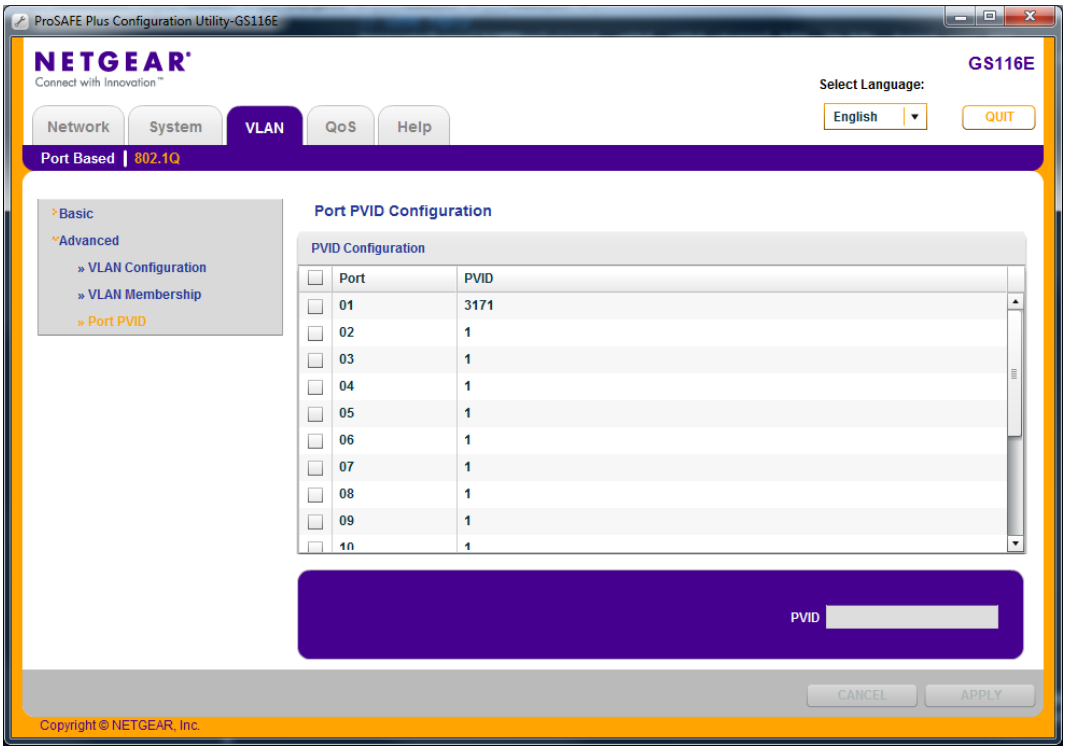
The private Mesh network ports on VLAN 01 are set to untagged (U) as they are client ports.



The SDR (Interlink) port on VLAN 3171 is set to tagged (T) as it will need to switch between VLANs, and the 4G/ADSL port is untagged (U).

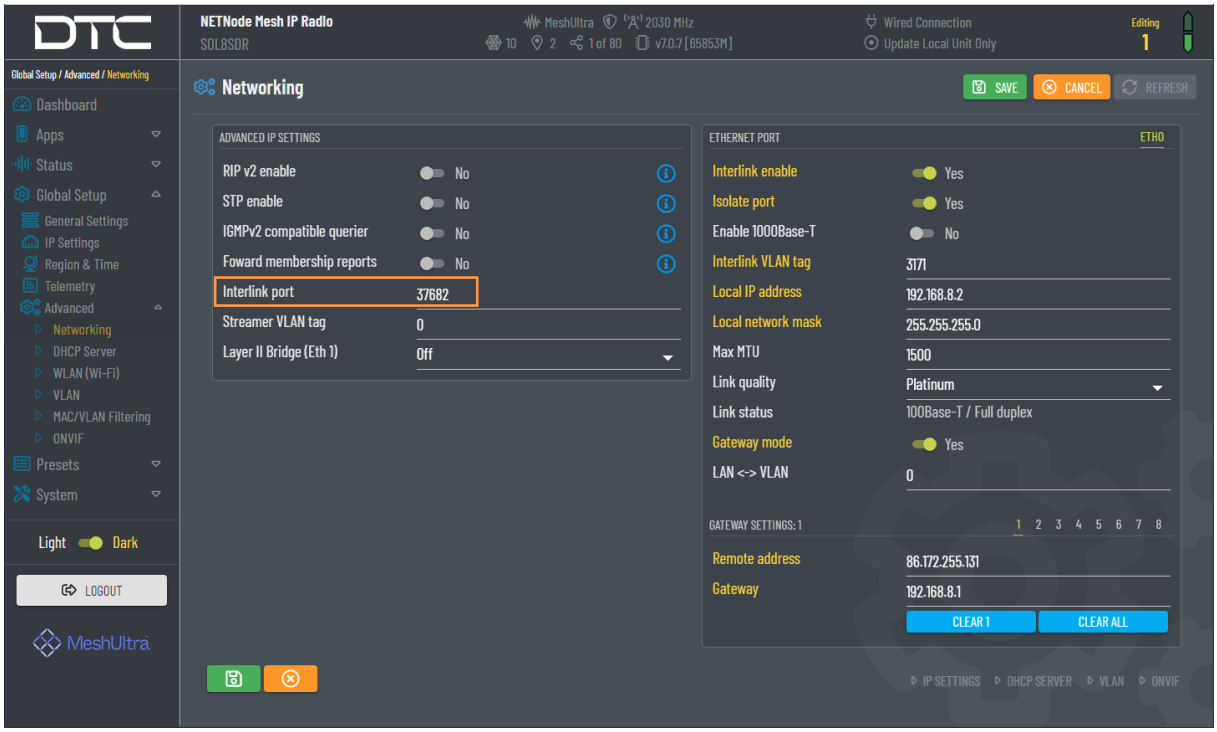


For the untagged ports, set the PVID to the VLAN ID it was set up for.



10.3.4 SDR Configuration

Go to the **Global Setup>Advanced>Networking** page in the WUI.



In the **Ethernet Port** settings, set **Interlink enable** and **Isolate port** to Yes.

Set the **VLAN tag** to 3171 to match the VLAN for the switch for Interlink data.

Set **Gateway mode** to Yes which allows you to setup an independent local area connection with the 4G/ADSL router. In this case the router has a local IP address of 192.168.8.1 which is set as the **Gateway**. The **Local IP address** of the interface is then set to a compatible but different IP address to the gateway.

The **Remote address** is the publicly accessible IP address behind which the Interlink end point node is located e.g., 86.172.255.131.

The **Link Quality** is the fall over condition at which the Interlink will be enabled. Platinum is a permanent link, but all other settings are the RF link quality based on the signal quality colours defined in *Section 6.3*.

In the **Advanced IP Settings**, ensure the **Interlink port** has been entered to match the port forwarding for your network.

Click **Save** to make the changes active.

11. Advanced Setup and User Examples

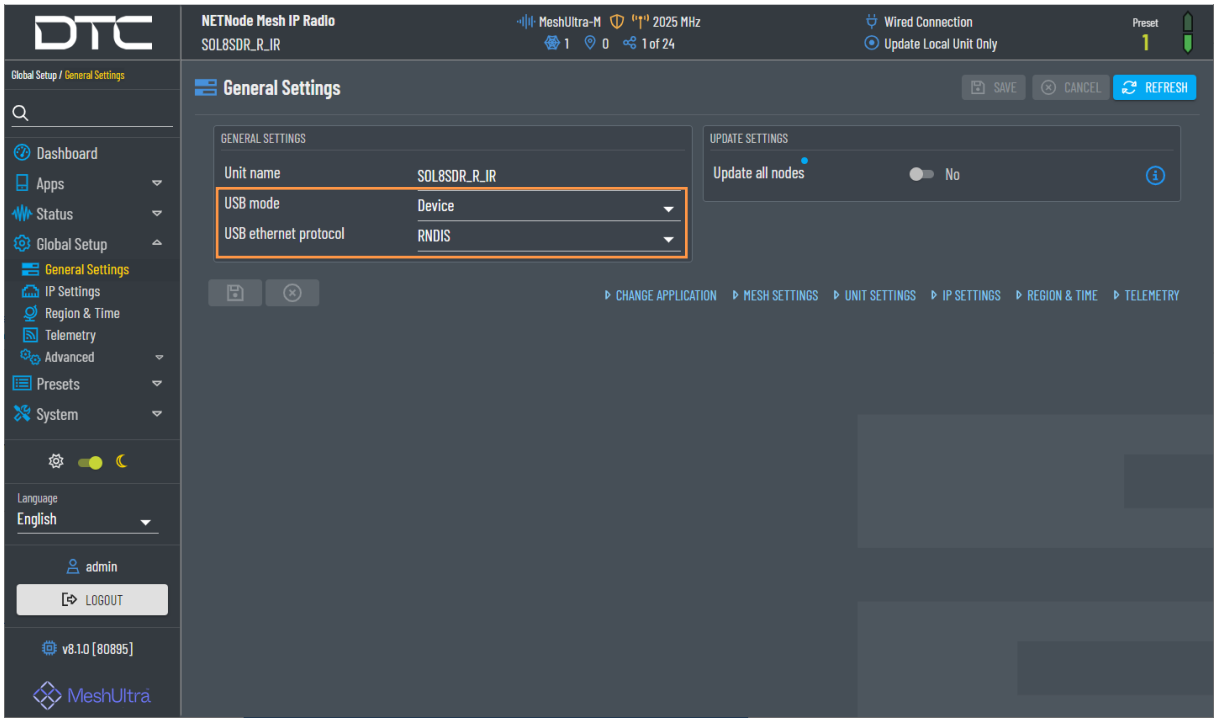
11.1 RNDIS Driver Installation

Remote Network Driver Interface Specification (RNDIS) is a Microsoft protocol which can be used to create a virtual Ethernet connection over USB when connected to a compatible device.

When this is a requirement, drivers will need to be loaded the first time the node is connected as a USB device to the PC or laptop.

11.1.1 USB Mode

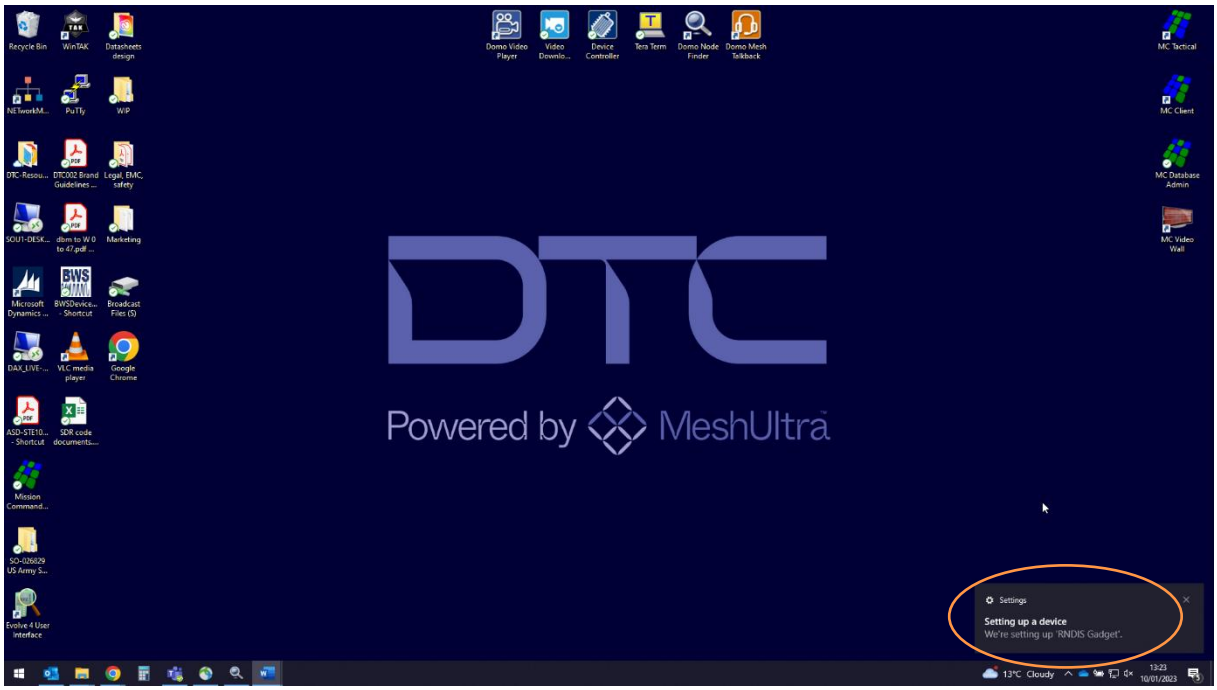
Go to the **Global Setup>General Settings** page and configure the USB mode as a **Device** and the USB Ethernet Protocol to **RNDIS**.



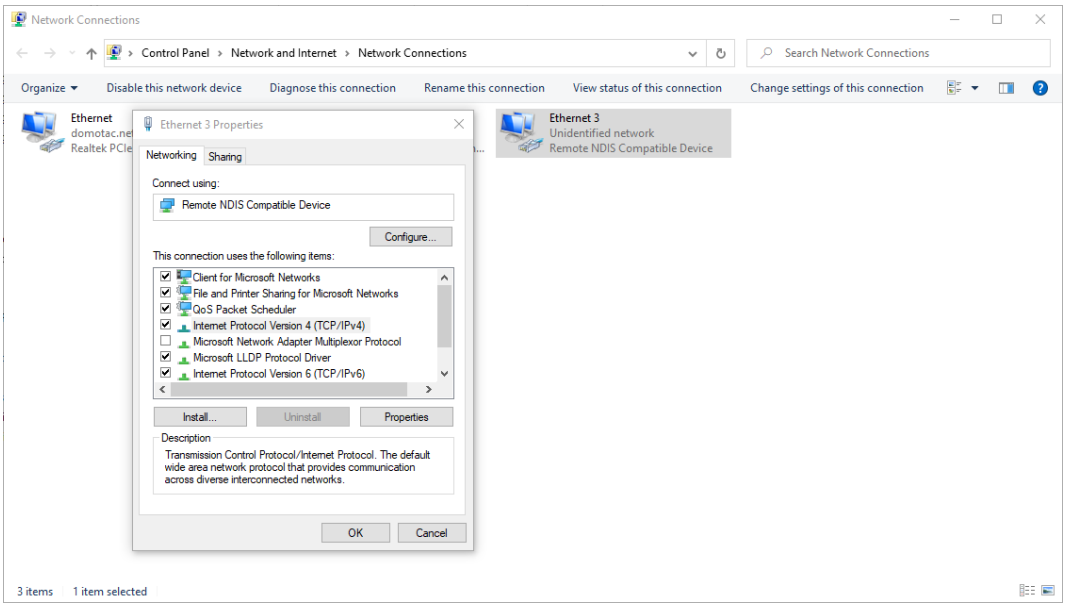
11.1.2 Automatic Driver Installation

Attach a cable from the USB port to a USB port on the PC.

RNDIS drivers will load automatically for Windows operating systems from SDR software v6.0.0 onwards. Progress is displayed in the bottom-right corner of the screen.

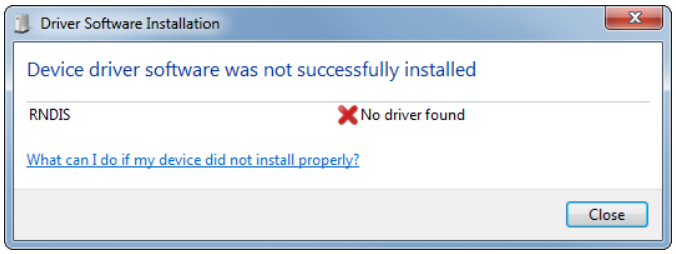


Once installed, the Ethernet adaptor can be re-named, and IP settings changed to suit the network. Right-click on the Ethernet port to open properties.

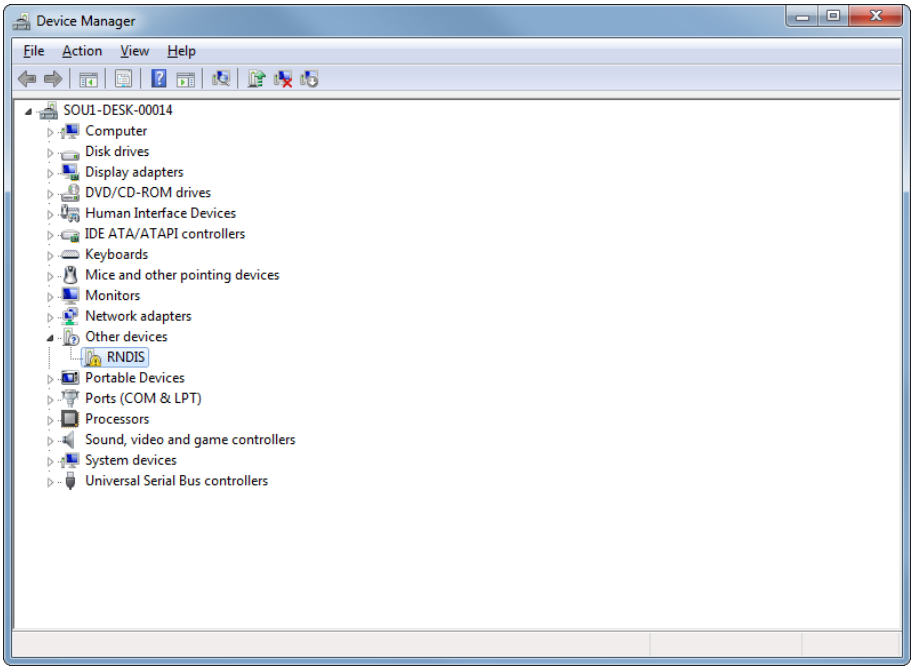


11.1.3 Manual Driver Installation

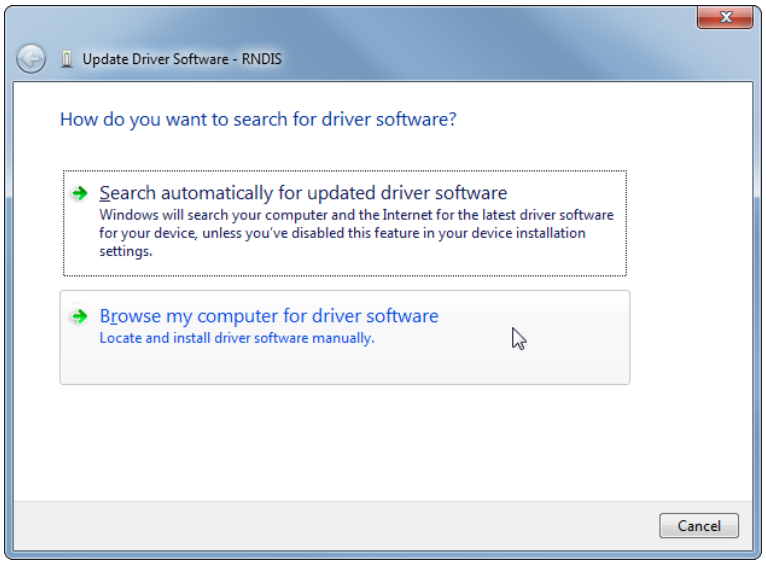
The following driver installation instructions are for a Wndows7 operating system which can be used as a guide if the drivers fail to load. This screenshot will be displayed.



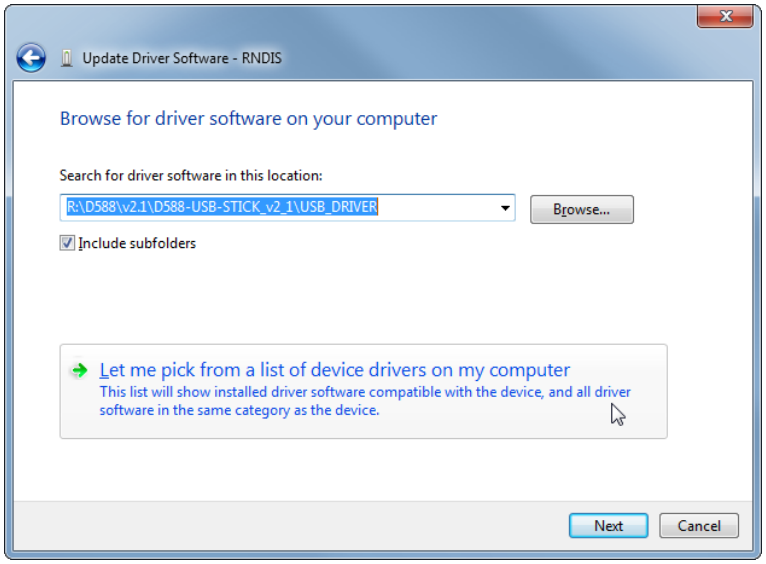
Open **Device Manager** on the PC. The RNDIS connection will show a caution symbol.



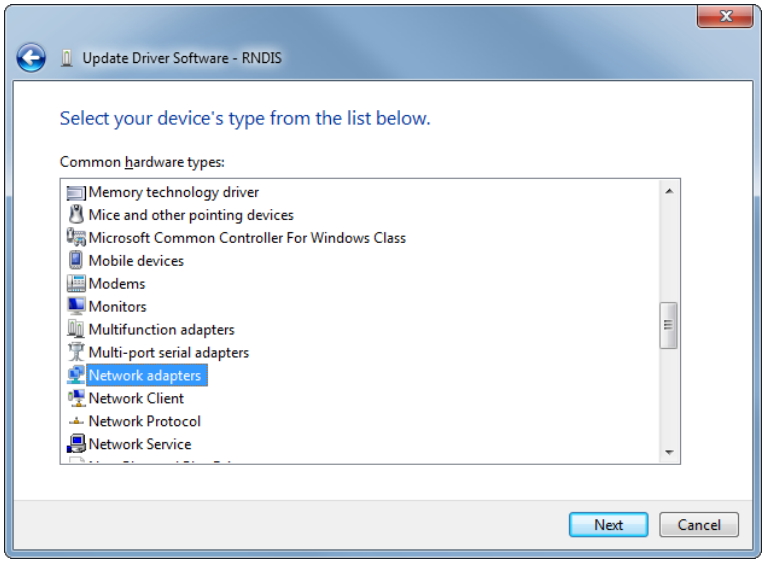
Right-click on the RNDIS connection and select **Update Driver Software**. The **Update Driver Software** window will open, click **Browse my computer for driver software**.



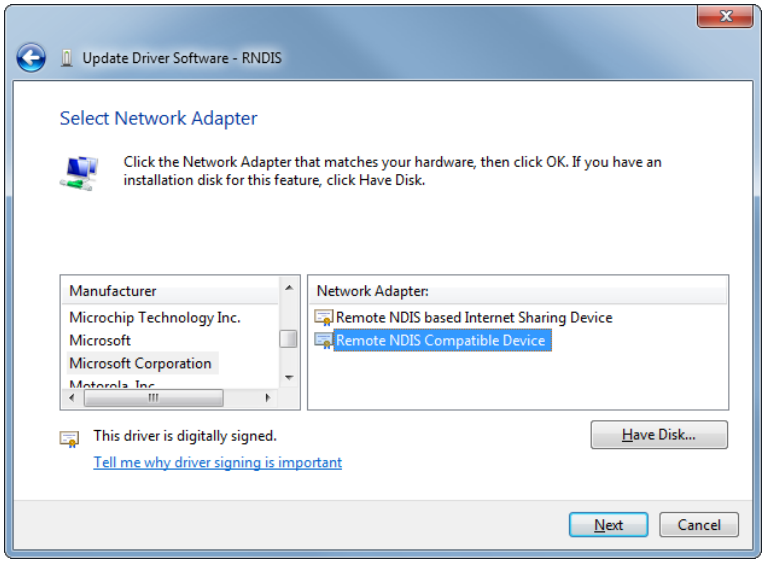
Select Let me pick from a list of device drivers on my computer, then click Next.



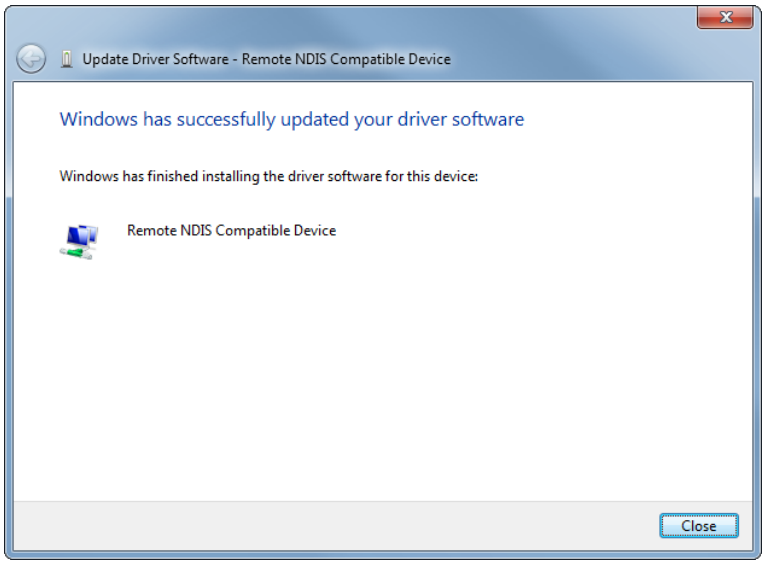
Select Network adaptors, then click Next.



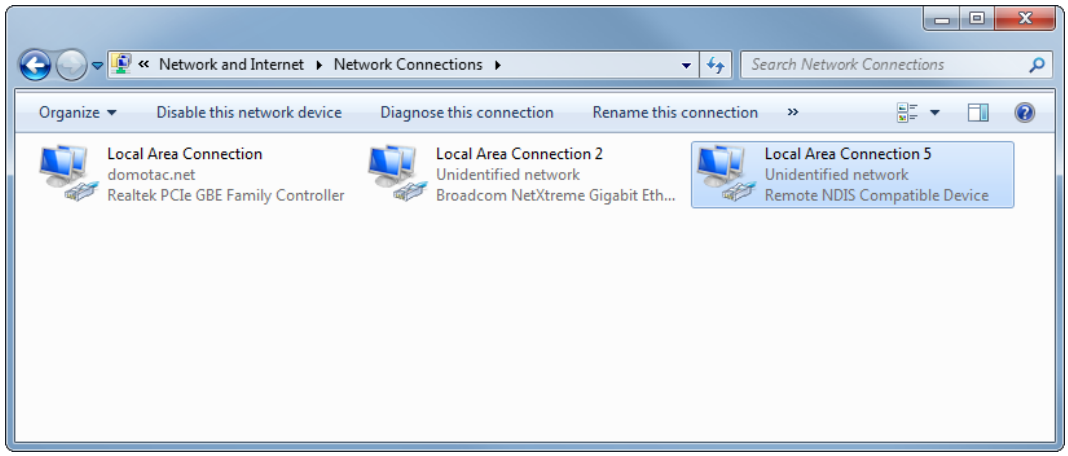
From the Manufacturer list select **Microsoft Corporation**, and from the Network Adaptors select **Remote NDIS Compatible Device**, then click **Next**.



The driver will successfully update. Click **Close** to complete.



You will now see the network connection for the RNDIS port.



11.2 Low Bitrate Video Encoding

11.2.1 Introduction

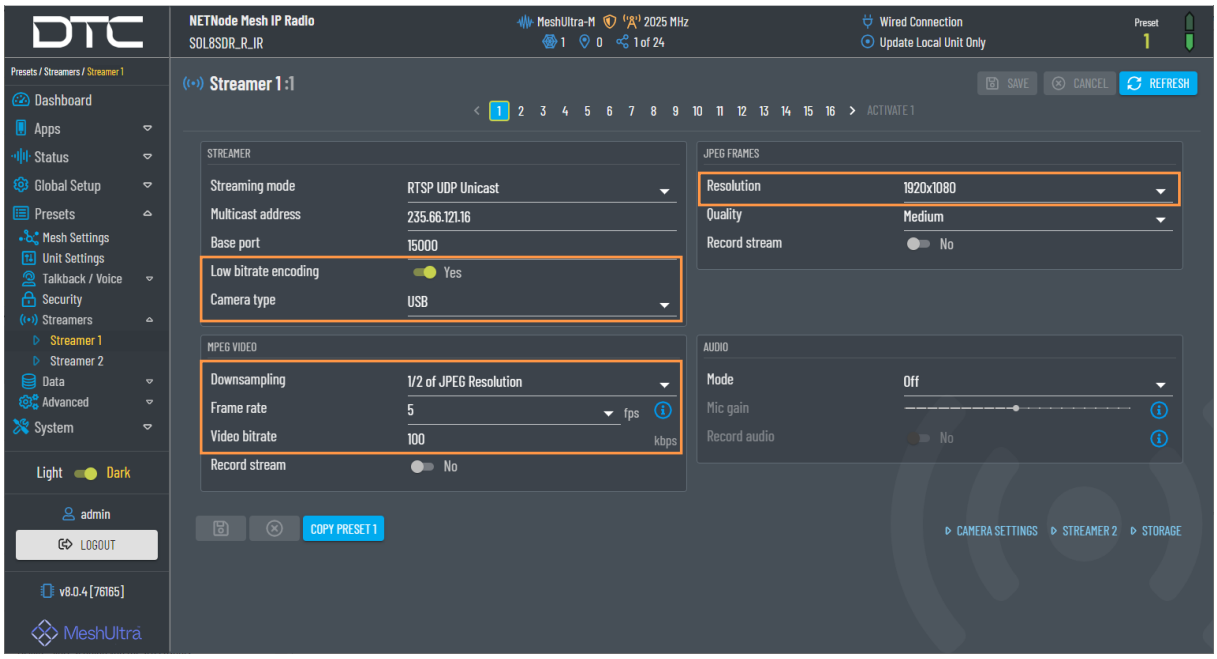
Low bitrate video encoding is a licensed feature, please contact DTC if this is a requirement.

High video stream throughput can have an impact on how much data can be transmitted or stored within a system, which will come at a cost. The low bitrate encoding feature for Mesh nodes, enables USB and IP cameras which support JPEG frames to stream at bit rates as low as 30kbps with adjustable video resolution and frame rate, whilst still maintaining acceptable video quality.

For typical optimum video bitrates, see *Figure 11-1*.

11.2.2 USB Camera

Go to the **Presets>Streamers** page and set **Low bitrate encoding** to **Yes** and the **Camera type** to **USB**.



Select the wanted JPEG **Resolution**, **Downsampling** and **Frame rate**, see *Table 11-1*. Set the desired **Video bitrate**; in the example above, this has been se to 100kbps.

A wide range of video resolutions and frame rates are supported; however, some trade-off is required.

JPEG Resolution	Downsampling	Frame Rate (fps)
1920x1080	3/8 or 1/4	5
1280x720	1/2 or 3/8 or 1/4	5
960x544	3/4 1/2	5 or 7.5 5 or 7.5 or 15
800x600	Full 3/4 1/2	5 5 or 7.5 5 or 7.5 or 15
640x480	Full or 3/4 1/2	5 or 7.5 5 or 7.5 or 15

JPEG Resolution	Downsampling	Frame Rate (fps)
640x360	Full 3/4 or 1/2	5 or 7.5 5 or 7.5 or 15
352x288	Full or 3/4 or 1/2	5 or 7.5 or 15
320x240	Full or 3/4 or 1/2	5 or 7.5 or 15
320x180	Full or 3/4 or 1/2	5 or 7.5 or 15

Table 11-1: Low Bitrate Resolution Options for USB Cameras

Typical video rates with no visible artefacts that have been tested at DTC are:

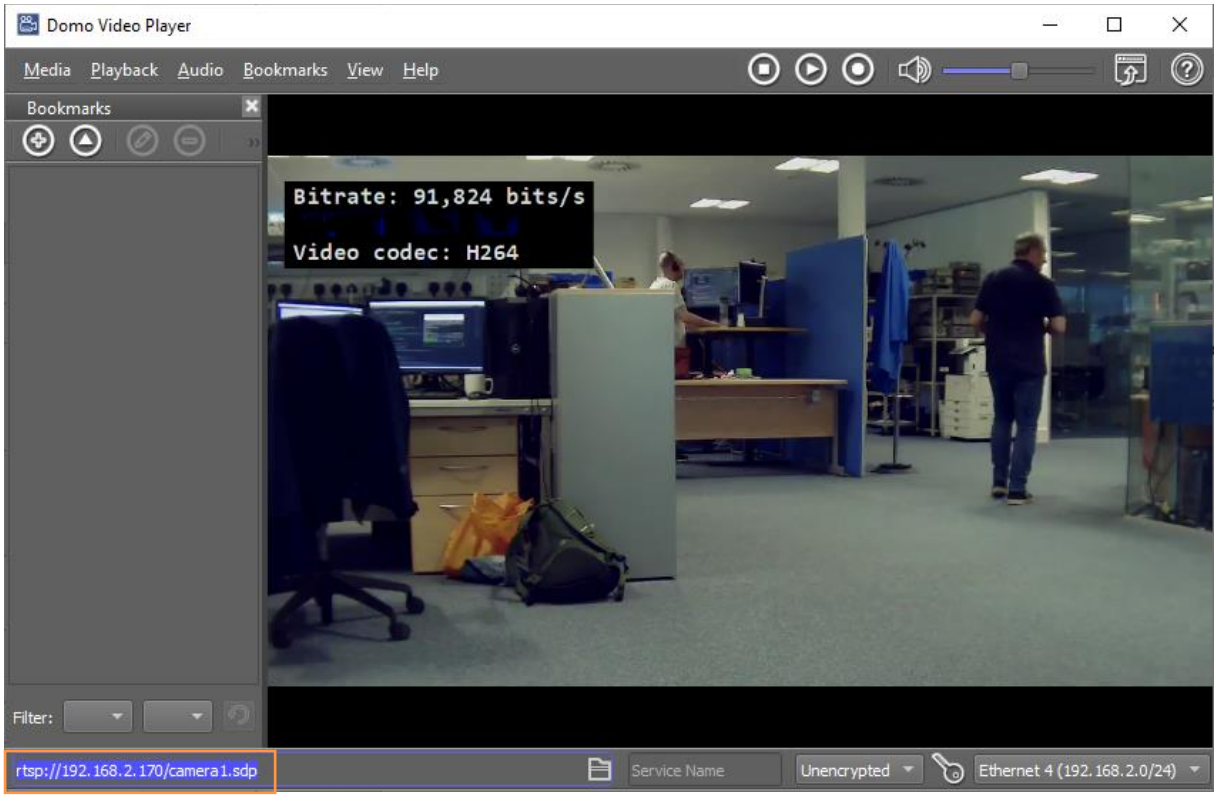
JPEG Resolution	Downsampling	Frame Rate (fps)	Video Bitrate
800x600	Full	5	240kbps
800x600	3/4	7.5	180kbps
800x600	1/2	15	120kbps

Figure 11-1: Typical Video Rates

Note: Video bitrates that are set above these rates will provide no discernible improvement. Lower rates can still achieve acceptable video.

11.2.3 Play the Stream

Open a video media player and enter the stream URL copied from the **Apps>USB Cameras** page.



11.3 Data Examples

Nodes in a Mesh network can be configured to send/receive data packets. TCP or UDP data connections can be used for serial or Telnet communications. GPS data can be configured to multicast.

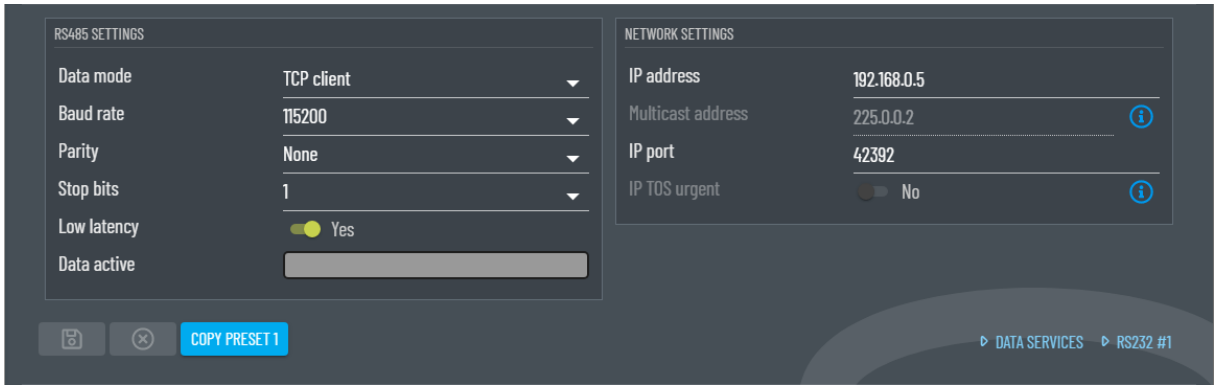
11.3.1 TCP Data

The following illustrates settings for TCP data packets.

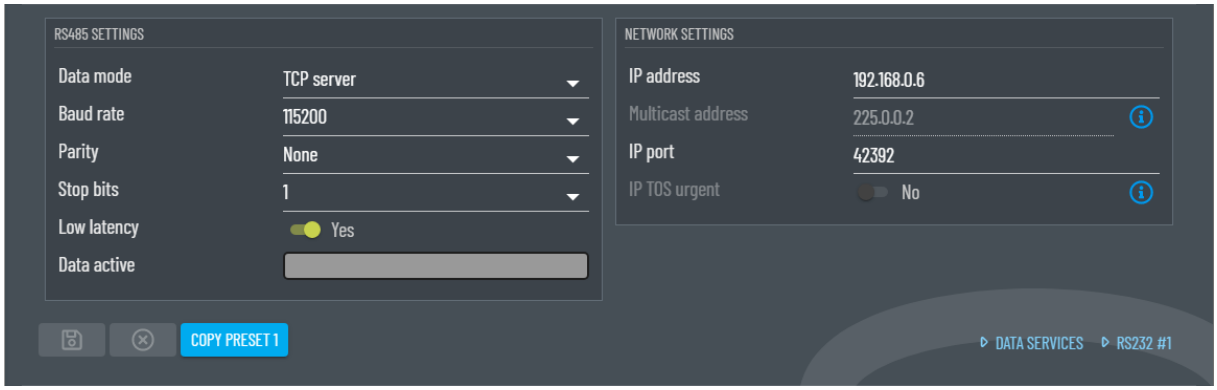
Go to the **Presets>Data** pages for the connection and make the following data settings.

One node needs to set up as the **Client** and one node as the **Server**. The **IP Address** setting is pointing to the address of the receiving device.

Client



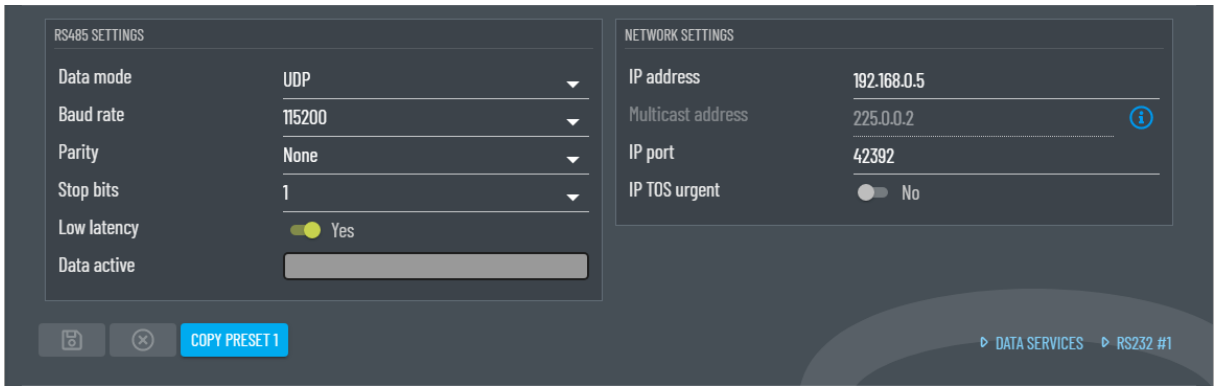
Server

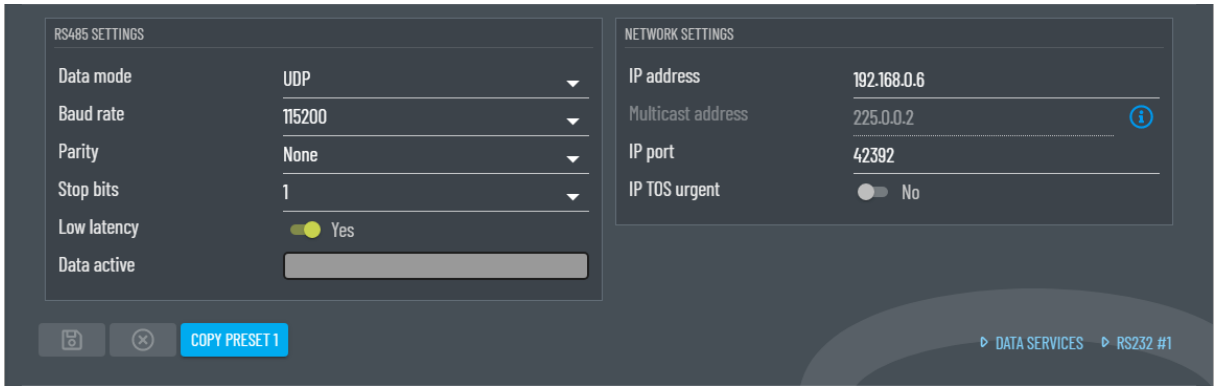


11.3.2 UDP Data

The following illustrates settings for UDP data packets.

Go to the **Presets>Data** pages for the connection and make the following data settings. The **IP Address** settings apply as in the TCP example.





11.3.3 Multicast Data

This example will configure a UAV application to send GPS data to all receivers. Ensure the GPS source is configured to receive GPS data in the **Presets>Data>Services** page.

Go to the **Presets>Data** page for the connection and set the UAV node data mode as a multicast source and all other nodes as multicast sinks.

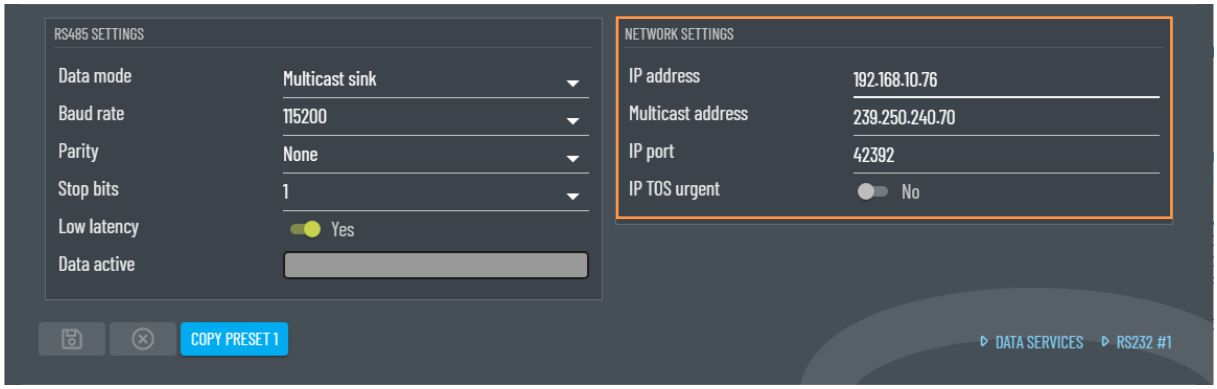
Set the **IP port** to the same value and the **Multicast address** to the same value, avoiding the 244.0.0.X address range. The address must be different from any multicast streaming and data channels.

Multicast Source

Set the **IP address** of the **Multicast source** to 255.255.255.255 to send the data to all receivers.

Multicast Sink

If a UDP return channel is required, set the **IP address** of the **Multicast sink** to the IP address of the Multicast Source node, or if the return channel is not required, set the IP address of all the sink nodes to 255.255.255.255.



11.4 Working with VLAN

11.4.1 Overview

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

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

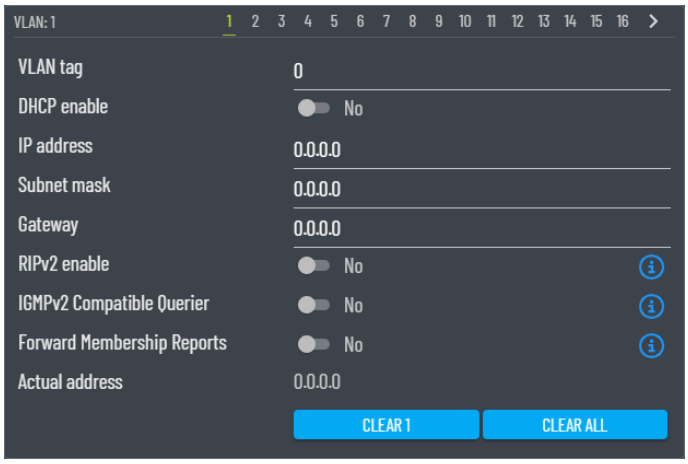
VLANs are created to provide the segmentation services traditionally provided by routers in LAN configurations. VLANs address issues such as scalability, security, and network management.

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

An example could be a setup using a VLAN through the Mesh system to support a VOIP (Voice over IP) system. The IP address supports ICMP ping and can be used for debugging.

11.4.2 VLAN Configuration

VLAN settings can be found in the **Global Setup>Advanced>VLAN** page, see *Section 7.9.1*.



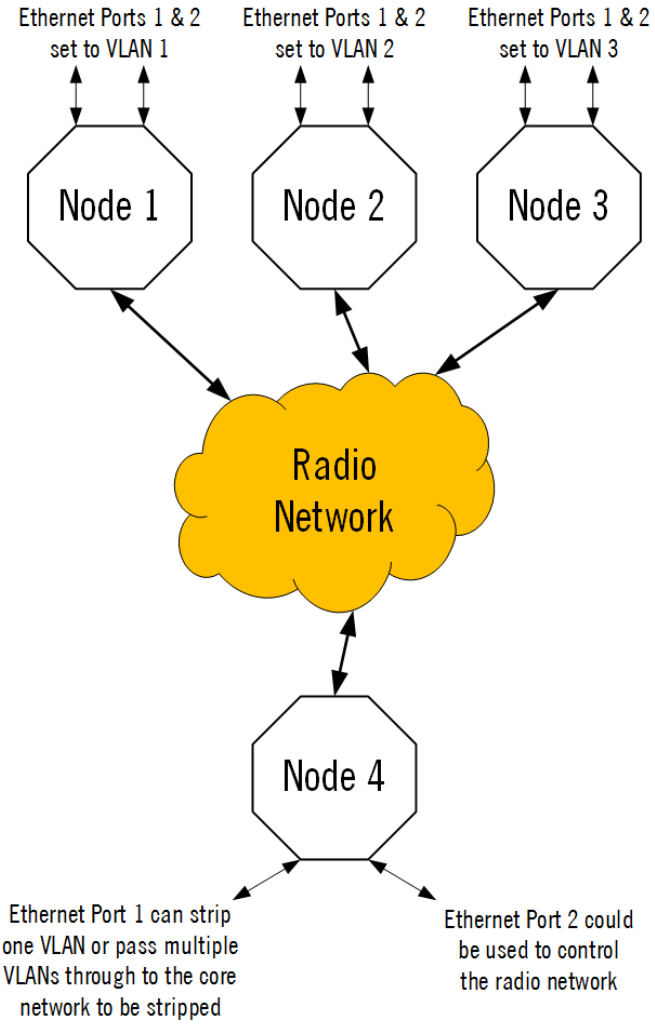
By default, the standard Mesh network does not allow VLAN packets to pass. To allow VLAN packets through the system, each node must be programmed.

The **IP address** and **Subnet mask** allows additional filtering of the IP packets as they enter the node. It also allows the generation of ARP and ICMP reply packets which aids internal routing and testing of the VLAN network.

The Mesh network supports up to 32 separate VLANs. Each VLAN is maintained by a separate routing table within each node. DHCP is supported on the Mesh VLANs.

11.4.3 Example VLAN Operation

In this example four node network, Nodes 1 to 3 are deployed remotely, and Node 4 is the gateway to the wider network. It is possible to run VLAN out of Node 4, not stripping the VLAN tags and using a router in core network to strip the tags. This means that IP devices connected to Nodes 1, 2 and 3 will not be able to see any data from the other nodes in the network. Nodes 1, 2 and 3 can be connected to IP sensors, IP cameras or just to laptops.

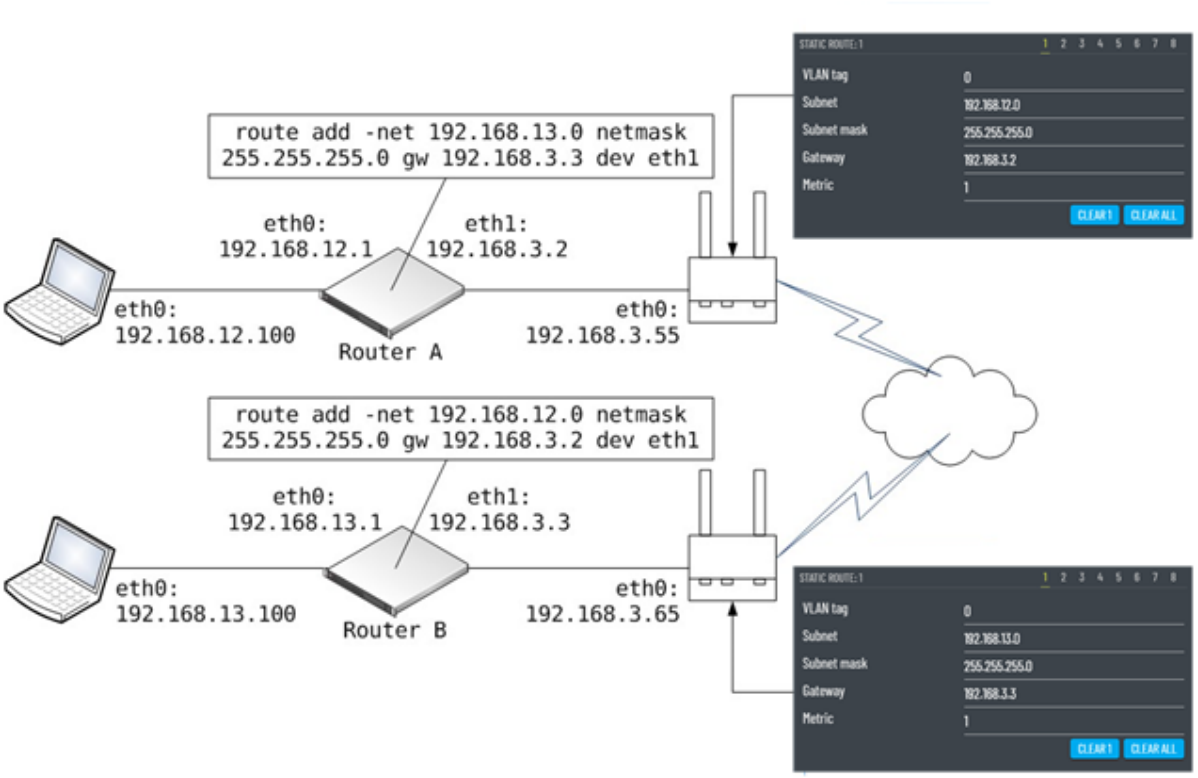


In this example it would be preferable for Node 4 to be in a secure location as Ethernet port 2 is used to control the radio network.

11.5 Static Routes

The user can add static routes for subnets which are not part of the Mesh subnet. Static routes are supported for both LAN and VLAN. Any packet which matches the subnet specified will be forwarded to that gateway rather than the default gateway. Up to 32 static routes can be added per node.

Each node distributes its own static routes round to all nodes within the Mesh network. The diagram below illustrates an example of this:



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

Note: Do not add the same static route to different nodes in the system. All static routes are distributed within the Mesh network; therefore, this will cause confusion.

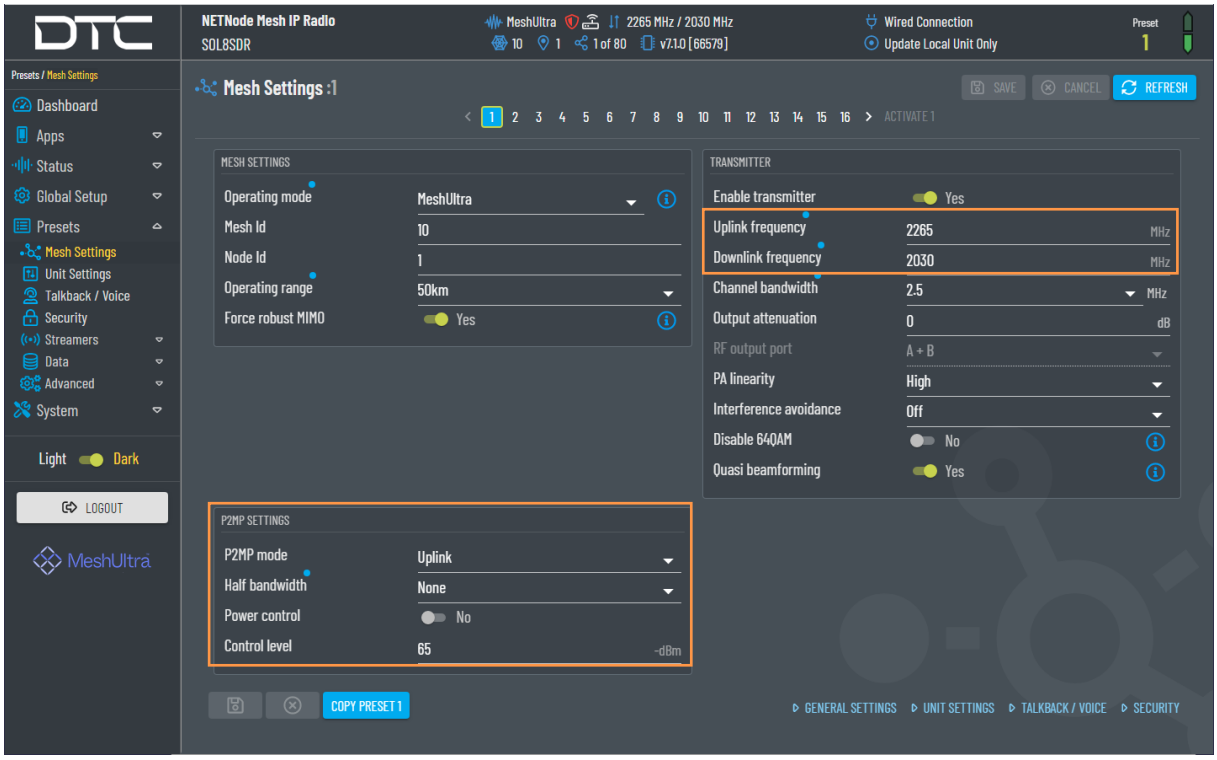
Note: It is advisable to add the static route to the node physically connected to that gateway/subnet, i.e., not across the radio link. As well as minimising confusion, this ensures that if the node goes down it only affects its own static routes.

11.6 P2MP Mode

P2MP (point-to-multipoint) is a network system where access points on the ground communicate with a base station on a high point, e.g., a tower. The access points will only communicate with the base station.

Note: Interference Avoidance can also be applied to an P2MP network, see *Section 11.7.2*.

Go to the **Presets>Mesh Settings** page, refer to *Section 8.2* for a description.



Set **P2MP Mode** to either an **Uplink** (Access Point) or **Downlink** (Section Base Station).

All Access Point data traffic is delivered on the **Uplink frequency**. The Section Base Station transmits data back to the Access Points on the **Downlink frequency**.

Note: There are optimum small frequency offsets that improve the performance of the system by reducing the chance of adjacent frequencies triggering false burst detection on the wanted frequency; the optimum offsets can be calculated from frequency delta and bandwidth figures. Please contact DTC Technical Support (*Section 13.2*) for help in selecting offsets, if required.

The P2MP setup can be viewed in the **Apps>Tactical Display** page. In the example below of a simple network, Node ID 1 is the base station, and all other nodes are access points.